ENGLISH TRANSLATION

OPERATIONAL GUIDELINES FOR DIGITAL TERRESTRIAL TELEVISION BROADCASTING

ARIB TECHNICAL REPORT

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Association of Radio Industries and Businesses

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http://www.arib.or.jp/english/index.html

Preface

The ARIB (Association of Radio Industries and Businesses) establishes the "ARIB Standards" and “ARIB Technical Reports” for the basic technical conditions such as standard specifications for a variety of radio communication equipment and broadcast transmission and reception equipment with the participation of broadcasting companies, broadcast equipment manufacturers, telecommunications carriers, radio communication equipment manufacturers and users.

This technical report encompasses materials related to “ARIB standards” which combine governmental technical standards and optional private sector standards.

This technical report stipulates provisions for general operations at broadcasting stations for digital terrestrial television broadcasting and functional specifications for digital terrestrial television receiver units.

We hope that this technical report will be put to practical use by broadcasting companies, broadcast equipment manufacturers, telecommunications carriers, radio equipment manufacturers and users.

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Vol. 5

DIGITAL TERRESTRIAL TELEVISION BROADCASTING

Provisions for Conditional Access System (CAS) Operations and Specifications on Receiver Units

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1 Introduction

1.1 Foreword

Descriptions regarding the Conditional Access Method for digital terrestrial television broadcasting receiver units are stipulated in Part 1 of the Control Method on Reception (Conditional Access Method) for the “Access Control Method on Digital Broadcasting” in the Association of Radio Industries and Businesses Standard (hereinafter Part 1 of ARIB STD-B25).

This volume stipulates the transmission operation provisions on the operation and requirement specifications for receiver units based on Part 1 of ARIB STD-B25 to supplement Part 1 of ARIB STD-B25. Please refer to the Part 1 of ARIB STD-B25 for the details of items not described in this volume.

For the Conditional Access Method of terrestrial digital television broadcasting, this volume was written based on the idea that some specifications will be limited by the Conditional Access Method of BS digital broadcasting for items that were not planned at the scheduled start of the broadcasting. In particular, it is regarded that the PPV function necessary for phone lines should be operated with additional provisions in the future due to the idea that a collection method for viewing records should also be appropriately stipulated for operation. Therefore, note we would like these provisions to be quickly revised and maintained in coordination with the actual operation plan of the broadcasting service.

For use as a scramble method for the purpose of contents protection of free programs, at the start of broadcasting, the Conditional Access Method following Part 1 of ARIB STD-B25 should be used. In the future, operations for multiple Conditional Access Methods will also be mentioned in advance so as not to cause receiver units at the start of broadcasting malfunction when multiple Conditional Access Methods are operated such as the introduction of scramble methods for the purpose of contents protection by different methods and the introduction of new Conditional Access Methods in new services.

1.2 Purpose

This volume is written based on Part 1 of ARIB STD-B25 regarding operation information and requirement specifications for receiver units which should be considered when installing CAS functions in terrestrial digital television broadcasting receiver units.

1.3 Scope

These written standards apply to transmission operation provisions in the Conditional Access System (CAS) method following Part 1 of ARIB STD-B25 for terrestrial digital television broadcasting and specifications for receiver units.

2 References

(1) Telecommunication Technology Council Advisory Report No. 17
(2) Telecommunication Technology Council Advisory Report No. 74
(3) 2003 Ministry of Internal Affairs and Communications Ordinance No.26
(4) 2003 Ministry of Internal Affairs and Communications Notification No.36
(5) 2003 Ministry of Internal Affairs and Communications Notification No.37
(6) 2003 Ministry of Internal Affairs and Communications Notification No.40
(7) “Service Information for Digital Broadcasting System” ARIB STD-B10
(8) “Receiver for Digital Broadcasting” ARIB STD-B21
(9) “Access Control Method of Digital Broadcasting” ARIB STD-B25 Part 1
(10) “Operational Guidelines for BS/Wide-area CS Digital Broadcasting” ARIB TR-B15

3 Definitions

The terms used in these regulations are defined as below.

ARIB	Association of Radio Industries and Business: An organization which standardizes technology related to the domestic use of radio waves with participation by broadcasters, telecommunication operators, equipment manufacturers (makers).
CA system	Conditional Access System: A system that controls the reception of services (channels) and events (programs).
CAT	CAT, an abbreviation of the Conditional Access Table, is used to specify the packet ID of the TS packet that carries individual information from among relevant information comprising chargeable broadcasting.
component	Components are defined as each element that makes up an event (program) such as video, audio, text and other data.
descriptor	The descriptor is defined as the description area placed in the table to list various information.
ECM	ECM, an abbreviation of the Entitlement Control Message, is defined as the common information that includes program information (program related information and descrambling keys,etc) and control information.
EIT	EIT, an abbreviation of the Event Information Table, is defined as the program related information such as program names, air dates and times and brief program descriptions. Digital terrestrial television broadcasting uses the H-EIT for display on fixed receiver units, M-EIT for display on mobile receiver units and L-EIT for display on partial receiver units.
EMM	Entitlement Management Message:Individual information which includes information on each subscriber’s contract, work keys to decode common information.
EMM Message	Individual and common message transmitted in EMM.
ES	ES, an abbreviation of the Elementary Stream, is defined as the coded video, audio and independent data in PES packets. One ES is carried in a sequence of PES packets with the same stream ID.
event	The event (or program) is defined as a collection of streams with a preset starting and ending time within the same service (channel) such as news and dramas.
PID	PID, an abbreviation of the Packet Identifier, is defined as the 13-bit stream identifier information, which shows the attributes of individual streams of the packet.
PMT	PMT, an abbreviation of the Program Map Table, is used to specify the ID of the TS packet that carries coded signals for each program and the ID of the TS packet that carries common information from among chargeable broadcasting related information.
PPV	PPV, an abbreviation of the Pay Per View, is the system for chargeable broadcasting, in which viewers pay for individual program or program groups according to their viewing style.

SDT	SDT, an abbreviation of the Service Description Table, is defined as the table that lists channel related information such as channel names and broadcasting company names.
CA alternative service	CA alternative service is a service that directs viewers to “Information channels” operated by broadcasting companies when scrambled channels are selected and the viewer is not a subscriber to the service.
Protected free program	Protected free program is defined as free program that are protected by copyright. Without viewer management, the contents are carried by broadcast waves.
Free program with right management	Free program with right management that controls copies with a Digital Copy Control Descriptor and a Contents Availability Descriptor without encrypting broadcast waves for the purpose of protecting the rights of the contents in the partial reception layer.
Mail	Mail is defined as a message that is stored in a receiver unit and that can be arbitrarily called through an operation by the user among EMM messages that are sent to each IC card.
Conditional access broadcasting	Broadcasting using the Conditional Access Descriptor. In conditional access broadcasting, there are pay programs, broadcasts using EMM messages and protected free program.
Automatic display of message	Among EMM messages that are sent to each IC card, messages stored in IC cards (including the case of playing signals received by receiver units with storage and receiving functions) and messages are displayed at the same time programs are received.
Product planning	Receiver functions or actions which depend on the hardware design, the software design of the receiver planed by each manufacturer.
Bound Recording	Bound Recording is defined as the recording function to enable recorded content to reproduce only on the equipment that has recorded the content.
Free program	A program which is not chargeable and. is described as free_CA_mode=0 in SDT and EIT.
Pay program	A program which is chargeable and is described free_CA_mode=1 in SDT and EIT.
Content protection system	The contents protection system is defined as the technique that uses, for example, encryption, to prevent the illegal modification and copying of contents, for the purpose of protecting the rights on contents.

4 Carrier Operation Provisions

4.1 Conditional Access Broadcasting

- Broadcasting that uses the Conditional Access Descriptor.
- In conditional access broadcasting, there are paid programs, broadcasts using EMM messages, and protected free program.

4.2 Charged Units(Chargeable ES)

- The charged unit is each available ECM.

- In terrestrial digital television broadcasting, only one ECM is located in the first loop of the PMT. More specifically, the charge shall not be per each ES (component).

4.3 Non-scramble/Scramble

4.3.1 Outline

- Refer to the transport_scrambling_control field in the TS packet header for the decision on the scramble mode for the receiver side component. In terrestrial digital television broadcasting, for the free_CA_mode, the purpose is to only make a paid or free decision. Do not use the scramble, non-scramble decision to decide whether or not the program is paid or free.
- Even if the component is chargeable, it is not always scrambled.
  The case which a non-scramble insertion for operation is necessary is described in chapter 4.10.4 ECM Application Changes.

4.3.2 Use of Closed Caption and Teletext

- If the valid ECM_PID is described in the first loop of the PMT for the default ES group, in other words, under normally scrambled condition, when the closed caption or teletext components are scrambled, be sure the ECM _PID is the same as the default ES group.
- Even if the default ES group is scrambled, the closed caption or teletext components can be operated without being scrambled. In this case, ensure the invalid ECM_PID = 0x1FFF in the second loop of the PMT is described for the relevant non-scrambled component.
- When the default ES group is not scrambled, both the closed caption and teletext components operate without being scrambled.

4.4 Free Programs, Pay Programs

4.4.1 Free Programs/ Pay Programs

4.4.1.1 Definitions

- Free programs are programs in which the default ES group that composes these programs is non-chargeable and pay programs are chargeable programs.
- The default ES group is defined in each service type.

Example: For digital TV services,
the default ES group = default image ES and default audio ES.

Table 4 1 Default ES Group

service_type	Contents	Default ES Group
0x01	Digital TV Service	Images, audio
0xC0	Data Service	Data(Entry Component)
0xA1	Temporary image service	Images, audio
0xA3	Temporary Data Service	Data (Entry Component)
0xA4	Engineering Service	Not provided.*1

0xAA	Bookmark List Data Service	Data (Entry Component)

* 1 :The engineering service is not provided as a default ES group as the conditional access system because it is not a service selected for viewing.

4.4.1.2 Use

(1) Free Programs

- All ES are non-chargeable.
- They are operated with free_CA_mode = 0 in the SDT and EIT.

(2) Pay Programs

- For the valid ECM, only one is placed in the first loop of the PMT and the charge shall not be per each ES (component).
- They are used with the free_CA_mode = 1 in the SDT and EIT.
- If the operation is conducted non-scramble in the ES except for default ES, ECM_PID = 0x1FFF is placed in the second loop of the PMT.
- Even when non-chargeable programs are broadcast temporarily or by program unit by pay broadcasters for the subscribers, they are operated as pay programs by setting the free_CA_mode to 1.
- When the component tag value operates the audio ES of 0x85 non-scrambling in the partial reception layer, pay programs operated in layers other than in the partial reception layer are not operated as a default audio ES.

4.4.2 Protected Free Programs

4.4.2.1 Definitions

- For the purpose of contents protection, they are scrambled programs without charge because they safely transmit contents in the broadcast waves.
- “The scrambled free program function” for ARIB STD-B25 Part 1 compliant conditional access system is used.
- In protected free program, the broadcaster identifier regulated by 4.4.2.2 is used as it is recognized that they are protected free program with receiver units according to the broadcaster identifier described in the non-encrypted part of the ECM.
- In the partial reception layer, they are used without being scrambled for free programs with copy control, and in order to distinguish them from protected free program that are scrambled outside the partial reception layer they are called free program with right management.

4.4.2.2 Use

- An ECM is always transmitted. Additionally, depending on the copyright-protection common broadcaster identifier prescribed in Vol. 8, only 1 PID indicating a valid ECM is placed in the first loop of the PMT. Refer to Vol. 8 of this manual for a description of this relationship.
- It is not necessary for the CA Contract Info Descriptor to be placed in Protected free program.
- Transmission of an EMM for key opening following a scramble broadcast is basically not necessary in protected free program; however an EMM can be transmitted for updating Kw.
- To use EMM messages refer to Chapter 4.11 EMM in this volume.
- In protected free program, a common value for the broadcaster identifier will be used in the operation of corresponding programs. And EMM messages and power distribution control, etc are managed by each broadcaster identifier with the receiver units. Therefore, in the transmission of EMM's the operation should be conducted carefully after obtaining mutual agreement with all operators to avoid problems.
- When non-scramble is used in an ES other than the default ES group, ECM_PID set to 0x1FFF is placed in the second loop of the PMT. However, in programs (excluding the partial reception layer) that use audio ES with a component tag value of 0x85 as the default audio ES, ECM_PID = 0x1FFF for the corresponding ES is placed in the second loop of the PMT because the corresponding ES is non-scrambled.
- Pay broadcasters may use protected free program temporarily or in program units.
- \- In free program wiyh right management in the partial reception layer, ECM's are not transmitted. However, for conditional access services other than free program with right management, this is not always applied.

4.4.3 Operational Combinations of Pay Programs, Free Programs, and Protected Free Programs

- Table 4-2 is a list of conditions for the operation of pay programs, free programs and protected free programs. Additionally, Table 4-3 is the default ES group and non-default ES group combinations that can use non-scramble/scramble.

Table 4.2 Use of Pay Programs, Free Programs, and Protected Free Programs and Free Programs with Right Management

No		1	2	3	4
Program Type		Free Programs	Protected Free Programs (Excluding the Partial Reception Layer)	Pay Programs	Free Programs with Right Management (Partial Reception Layer only)
Free/Pay Program Division		Free	Free	Paid	Free
Pay Added ES		×	×	×	×
Free_CA_mode		0	0	1	0
Contents Protection	Default ES Group	No Protection	Protection Available	Protection Available	Protection Available
	Excluding Default ES	No Protection	Protection Available	Protection Available	Protection Available
TS Packet Header *4	Default ES Group	00	10,11 *1	10,11	00
	Excluding Default ES	00	10,11 *2	10,11 *2	00
Chargeable	Default ES Group	Non-chargeable	Non-chargeable	Chargeable	Non-Chargeable
	Excluding Default ES	Non-chargeable	Non-chargeable	Chargeable	Non-Chargeable
ECM Transmission		Unnecessary	Necessary	Necessary	Unnecessary
EMM Transmission		Possible (EMM Message)	Possible *3	Necessary	Unnecessary
Broadcaster identifier used	Default ES Group	-	Contents Protection Common ID	Unique Broadcaster ID	-
	Excluding Default ES	-	Valid ECM placement in the first loop of the PMT only	Valid ECM placement in the first loop of the PMT only	-

*1: In protected free program, even in a default ES group, for ES with 0x85 component tag value, non-scramble is used and an invalid ECM_PID = 0x1FFF is placed in the second loop of the PMT.

*2 : Closed caption with a component tag value of 0x30-0x3F, ES of teletext, data components of 0x40-0x7F excluding the default ES group, and component tag values of 0x84, 0x86 AAC audio ES if non-scramble use is carried out excluding the default ES group in protected free program and pay programs.
Additionally, an invalid ECM_PID = 0x1FFF is placed in the second loop of the PMT at this time.

*3 :EMM messages may be transmitted in protected free program. Additionally, an EMM can be transmitted for Kw updates, etc.

*4 :Transport_scrambling_control field within the TS packet header.

Table 4.3 Possible Combinations Used for Non-scramble/Scramble

		Default ES Group			
		Free Programs	Protected Free Programs *2 (Excluding the Partial Reception Layer)	Pay Programs	Free Programs with Right Management (Partial Reception Layer only)
Excluding default ES group	Non-scramble *1	○ 1st:None 2nd:None	○ 1st: Contents Protection Common 2nd:PID=0x1FFF	○ 1st:Unique Broadcaster 2nd:PID=0x1FFF	○ 1st:None 2nd:None
	Scrambling for Contents Protection	×	○ 1st:Contents Protection Common 2nd:None	×	×
	Scrambling for Pay Programs	×	×	○ 1st:Unique Broadcaster 2nd:None	×
	Absent (No 2nd loop.)	○ 1st:None	○ 1st:Contents Protection Common	○ 1st:Unique Broadcaster	○ 1st:None

*1:Possible use of non-scramble excluding the default ES group is limited to closed captions with a component tag of 0x30-0x3F, ES of teletext, 0x40-0x7F and component tag values of 0x84, 0x86 AAC audio ES components.

*2: In protected free program, even in a default ES group, for ES with 0x85 component tag value, non-scramble is used and an invalid ECM_PID = 0x1FFF is placed in the second loop of the PMT.

– - Explanation of Phrases in Table 4-3

・○: Applicable, ×: Prohibited use (limited operation)

・Contents for the Conditional Access Descriptor placed in the first loop (1st) and second loop (2nd) of the PMT are shown.

1) None: A Conditional Access Descriptor is not placed.

2) PID=0x1FFF:A Conditional Access Descriptor is placed, and an invalid ECM is pointed out.

There is no ECM stream.

3) Contents Protection Sharing: A Conditional Access Descriptor is placed, and an ECM for the contents protection sharing broadcaster identifier is pointed out.

4) Unique Broadcaster: A Conditional Access Descriptor is placed, and an ECM for the pay subscriber unique broadcaster identifier is pointed out.

4.5 Use of the Conditional Access Service during Hierarchical Transmission

4.5.1 Transmission of the Transmission Layer and Related Information for the Conditional Access Reception Service

- - CAT is transmitted by a high protection layer.
- - ECM's are transmitted by the same layer as the one which describes the PMT
- or a higher protection layer.

Table 4-4 Transmission of Information Related to the Conditional Access Services During Transmission in the Partial Reception Layer

Pattern	Layer	No. of segments	Information Related to CAS		
			CAT	EMM	ECM
(1)	A	13	○	○	○
(2)	A	13	○	○	○
(3)	A	1(Partial reception)	○	Δ	Δ
	B	12	×	○	○
(4)	A	8~2	○	○	○
	B	5~11	×	×	○
(5)	A	1(Partial reception)	○	Δ	Δ
	B	12	×	○	○
(6)	A	1(Partial reception)	○	Δ	Δ
	B	7~1	×	○	○
	C	5~11	×	×	○

Table symbols, ○: Transmission possible, ×: Does not transmit, Δ: Transmission possible for pay broadcasting.

- The pattern in Table 4-4 has the same meaning of that in Table 2 in Outline of this manual.

4.5.2 Conditional Access Service in the Partial Reception Layer

- Scramble broadcasting for contents protection is not conducted in the partial reception layer.
- There is a possibility of pay broadcasting with the conditional access system in the future. In this case, the Conditional Access Descriptor will be specified in the PMT. (Related matters are written in A.9.)
- The pay broadcasting operation in the partial reception layer is the one provided again at the beginning, and is not necessarily operated by the conditional access system for conforming methods in Part 1 of ARIB STD-B25 specified by this volume.

4.6 Setting Parental Rates

- Parental control cannot be used.

4.7 PPV Use

- PPV is not used in terrestrial digital television broadcasting at the start of broadcasting.
- When PPV use begins, the CA Contract Info Descriptor is placed correctly in the EIT or SDT together with revisions in the provisions of this manual. In receiver units, when a program is reserved, whether or not it is a PPV service is recognized by the IC card response of this descriptor. In other words, it is regarded that whether or not the corresponding program is PPV or not is recognized by the IC card response, and the processing of non-compliant messages etc. is carried out in receiver units for non-PPV correspondence at the start of the broadcasting.

4.8 Conditional Access Descriptor

4.8.1 Functions

- \- The TS packet ID that transmits EMM's is specified when it is described in the CAT.
- \- Multiple conditional access system descriptors may be described in the CAT.
- \- The TS packet ID that transmits ECM's is specified when it is described in the PMT.
- \- Multiple conditional access system descriptors may be described in the PMT.

4.8.2 Use

- \- When the same CA_system_id is used for the Conditional Access Descriptor in the CAT, it is described only one time.
- \- The number of Conditional Access Descriptors for CA_system_id to transmit EMM's in the relevant TS is described in the CAT.
- \- The number of Conditional Access Descriptors for CA_system_id used by relevant programs is described in the PMT.
- \- When the scramble ES and non-scramble ES are mixed in the program components, the placement of the Conditional Access Descriptor in the PMT is set as follows.
  1) When the Conditional Access Descriptor is placed in the first loop of the PMT, the relevant ECM is used for all components in the program.
  2) The Conditional Access Descriptor is not placed in the second loop of the PMT (During limited PPV use).
     However, the invalid ECM_PID set to 0x1FFF may be placed only when non-scramble excluding the default ES group is used.

3) When multiple Conditional Access Descriptors are described, the number of Conditional Access Descriptors described in the first and second loops and the described CA_system_id are the same. In this case also, the ECM PID of the Conditional Access Descriptor described in the second loop is an invalid value which means the relevant ES is non-scramble.

- - When the Conditional Access Descriptor is described in the PMT, for the data described in the private_data_byte area, the first 1 byte is ignored in the receiver unit. This is to take the adjustment for the operation of the parental rate in BS digital broadcasting. (The second byte or later will not be used in the present.)
- - When the Conditional Access Descriptors are described in the CAT, the EMM transmission identification is described in the first byte of private_data_byte area. Refer to 4.11.1.1 in this manual for details.
- - Even if multiple conditional access systems are used in the same TS, the EMM transmission method is transmitted by only one system. In other words, it is not used for different EMM transmission identification in the TS.

4.9 CAT Transmission

4.9.1 TS PID of CAT

- - As shown in the separate paragraph No. 1 "Allocation of PID" in Supplemental Table No. 7 of 2003 Notification No. 37 of the Ministry of Internal Affairs and Communications.(0x0001)

4.9.2 Data Structure

- - As shown in the Supplemental Table No.10 "CAT Composition" of 2003 Notification No. 37 of the Ministry of Internal Affairs and Communications.

4.9.3 Descriptor and Composition

- - The descriptor transmitted in the CAT is a conditional access system descriptor and a CA service descriptor, and the composition of the conditional access system descriptor is as shown in the separate paragraph No. 1 "Composition of the Conditional Access System Descriptor" in the Supplemental Table No. 12 of 2003 Notification No. 37 of the Ministry of Internal Affairs and Communications. Refer to Vol. 4 of this manual for the composition of the CA service descriptor.
- - Refer to Vol. 7 of this volume for the CA_system_id.

4.9.4 Repetition rate

- \- The transmission frequency for the CAT is in Vol. 4.

4.9.5 Update Rate

- \- When the PID that transmits EMM's are changed or when the automatic display message service is changed, the CAT is also updated. When the automatic display message service is changed here, it means the automatic display message service itself is conducted or not conducted.
- \- During normal use, the update rate is less than once a day.

4.10 ECM

4.10.1 ECM identification

- \- The ECM's transmitted TS packet PID is specified when the conditional access method descriptor is described in the first loop of the PMT.
- \- The relevant ECM will not be transmitted only when the conditional access PID of the conditional access system descriptor is 0x1FFF.

4.10.2 ECM Data Structure

4.10.2.1 Section Format

- \- It is transmitted by the extended section format described in the Supplemental Table No.1 and No. 3 in the 2003 Notification No. 37 of the Ministry of Internal Affairs and Communications and the value of the table identifier uses 0x82 only , 0x83 is not used. Additionally, the "Table Identifier Extension" is not used.

4.10.2.2 ECM Main Body

- \- For the data structure of the ECM main body in the ECM section, refer to 3.2.3 ECM in Part 1 of ARIB STD-B25.

4.10.3 ECM Applications

- \- If the Conditional Access Descriptor is described in the first loop of the PMT, relevant ECM's are applied to all ES's that transmit broadcasting program elements. Originally, if the Conditional Access Descriptor is described in the second loop of the PMT, only relevant ES' are applied. But, in terrestrial digital television broadcasting, ECM PID's which are only valid in the first loop of the PMT are described in order to limit PPV use at present.

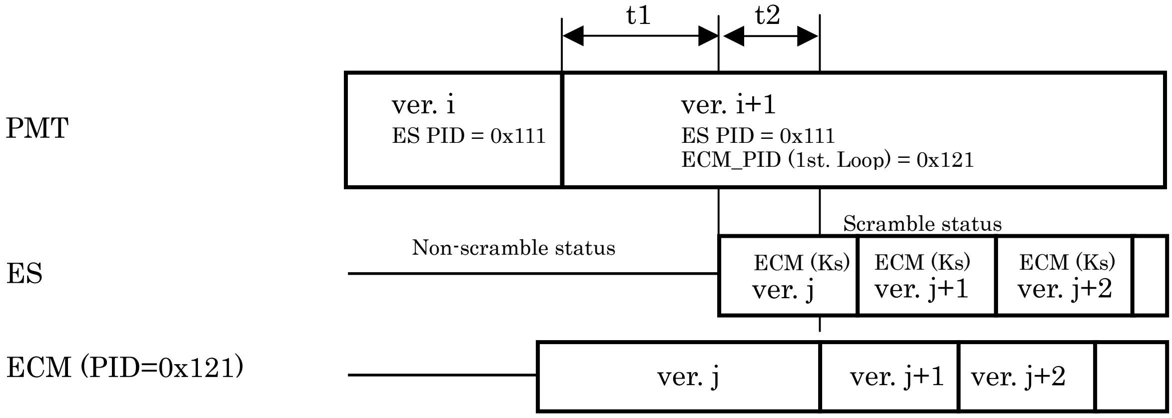
－ - When 0x1FFF is used as the ECM_PID (conditional access PID), it means that the scramble for the relevant ES has not been scrambled, and ECM's with PID set to 0x1FFF are actually not transmitted.

4.10.4 Changes of ECM Application

The related information is described in A.4.3 of this volume.

4.10.4.1 Start of Scrambling

－ - The change in the broadcasting signal when non-scramble broadcasting (or the ES that transmits broadcasting program elements) switches to scramble broadcasting (or the ES that transmits broadcasting program elements) is as follows.



1) An ECM is transmitted with the relevant ES that has been transmitted in a non-scramble status.
2) After the ECM is transmitted, the relationship between the ECM and relevant ES (group) is described and transmitted in the first loop of the PMT. (PMT update)
3) t1 seconds After the PMT update, scrambling begins in the relevant ES (group).
4) t2 seconds After scrambling begins, the first ECM update is begined.
   t1= 2, 0<t2

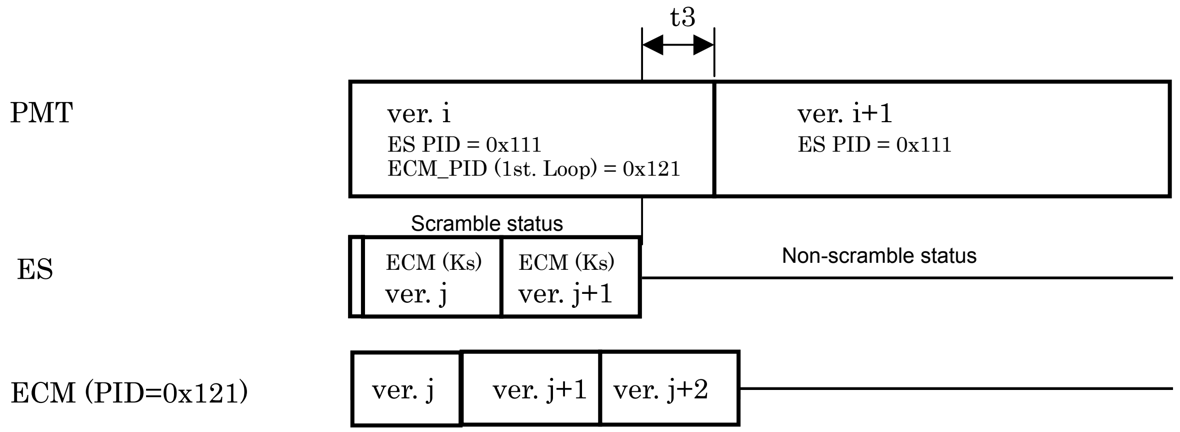
Update of ECM complies with

4.10.5.2 Update/Repetition rate

4.10.5.3 ECM Updates and Scramble Key Change

4.10.4.2 End of Scrambling

– - The change in the broadcasting signal when scramble broadcasting (or the ES that transmits broadcasting program elements) switches over to non-scramble broadcasting (or the ES that transmits broadcasting program elements) is shown as follows.

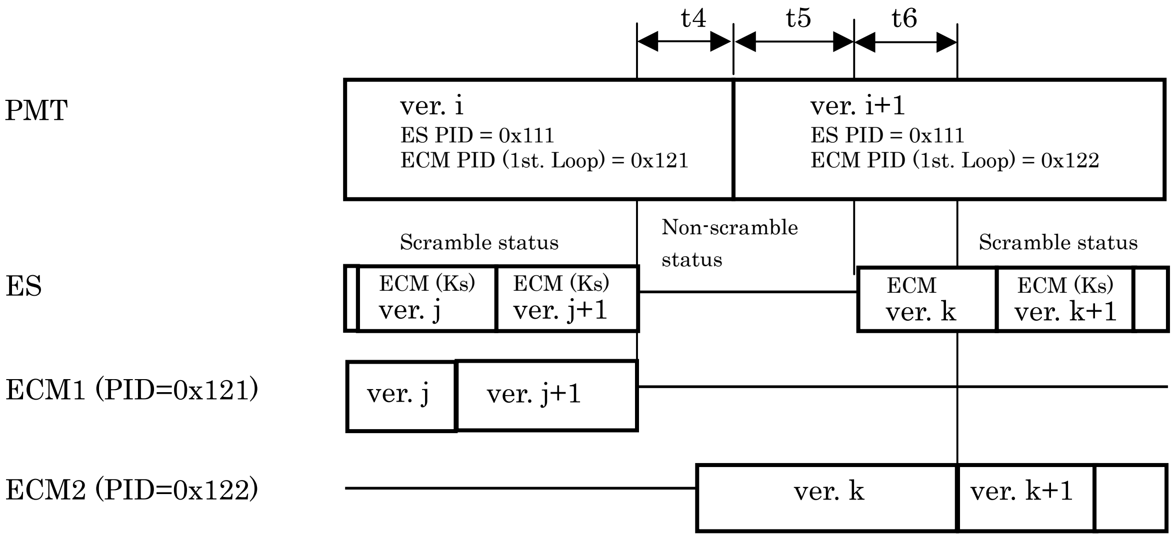


1) Scrambling in the relevant ES (group) ends.
2) After t3 seconds, the relationship between ECM and the relevant ES (group) is deleted in the first loop of the PMT and is transmitted. (PMT update)
   t3=1

4.10.4.3 Change in the Relationship Between ES and ECM that Transmit Broadcast Program Elements

(1) Case in which a change of the ECM_PID is required

– - When the Conditional Access Descriptor is described in the first loop of the PMT and the relationship between the ES that transmits the broadcasting program elements and the ECM_PID that has been described by PMT is changed with changing ECM_PID, a transition procedure from scramble to non-scramble shown below is necessary.



1) All ES' are transmitted as non-scrambled.

2) New ECM's are transmitted.

3) After t4 seconds from 1), the PMT is updated.

4) After t5 seconds from PMT update, scrambling begins in the ES.

5) After t6 seconds from the start of scrambling in the ES, the initial ECM update is carried out.

t4=1, t5= 2, 0<t6

Update of the ECM complies with

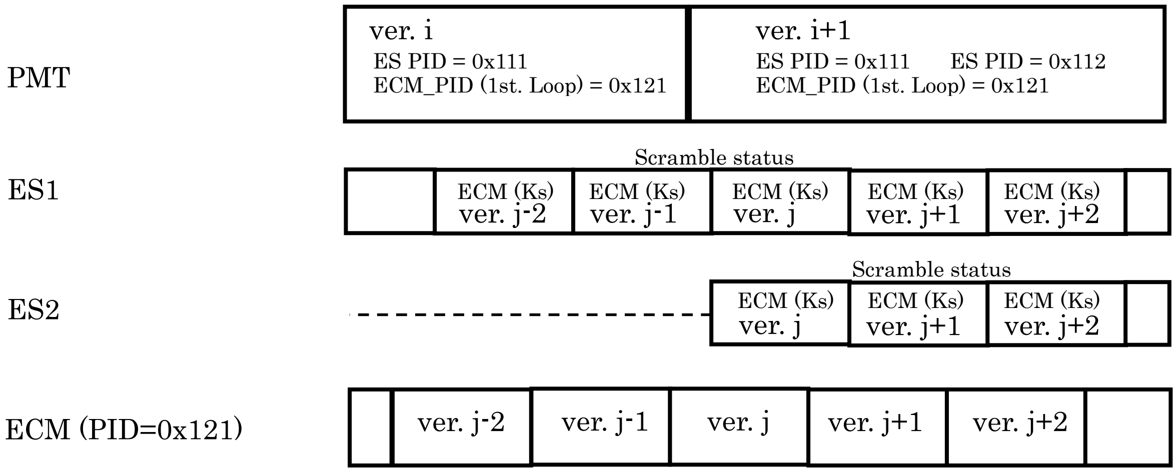
4.10.5.2 Updates/Repetition Rate

4.10.5.3 Updates and Scramble Key Change

in this volume.

(2) When ECM_PID is not required

- - When the Conditional Access Descriptor is described in the first loop of the PMT and the relationship between the ES that transmits the broadcasting program elements and ECM_PID that has been described by PMT is changed without changing ECM_PID, a special transmission procedure such as the transition from scramble to non-scramble, etc. is unnecessary.
- - The change in the broadcasting signal when a new ES is added is shown below as an example.



4.10.5 ECM Updates/Repetition

- - When the scramble key of the ES is changed, the ECM applied to the ES is updated before the change of the scramble key. The ECM update is notified by a change in the version number of the extended section format.

4.10.5.1 Scramble Key Change

- - The update of the scramble key(Ks) is indicated as a transport scramble control flag in the relevant ES header. The transport scramble control flag is always changed when the scramble key changes. It is changed in order from odd number key to even number key, and from even number key to odd number key, and the same key is not continuously changed.

4.10.5.2 Update/Repetition Rate

- - Refer to the Appendix 4 of Reference 2 in Part 1 of ARIB STD-B25.

－ - The recommended value for the ECM update/repetetion rate is as follows. The related information is described in A.4 of this volume.

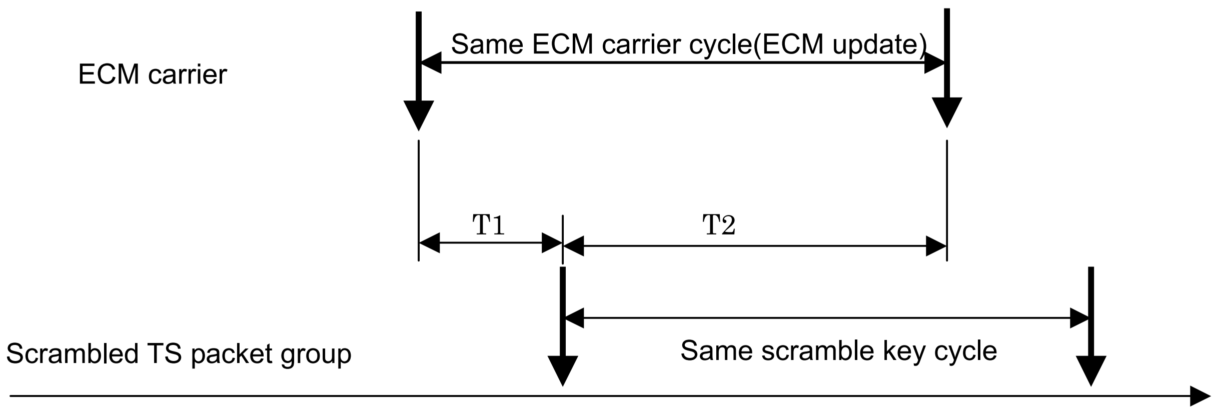
Table 4-5 Recommended values for the ECM update cycle and re-sending cycle

	Excluding the partial reception layer	Partial reception layer
ECM Update Rate	2s	TBD
ECM Repetition Rate	100ms	TBD

－

4.10.5.3 ECM Updates and Scramble Key Change

－ - The diagram below shows ECM updates and scramble key changes when a single ECM is used.



1600ms<T1, 0<T2, T１+T2>2000ms

－ - When an ECM is used in multiple TS packets, the minimum is applied to both T1 and T2 for each packet.

4.10.6 Others

4.10.6.1 ECM and Scramble

－ - When the Conditional Access Descriptor has not been specified in the 1st and 2nd loop of the PMT, it means that all ES groups that transmit the broadcasting program elements are not scrambled.

－ - Contrary, even if the conditional access system descriptor has been specified in the 1st and 2nd loop of the PMT, the operations in which all components which compose services are not scrambled are also conducted. (Consideration of transition etc. from scramble broadcasting to non-scramble broadcasting.)

– - However, ES linked to ECM_PID set to 0x1FFF is never scrambled .

4.10.6.2 ECM Suspension

(1) Detection of ECM Suspension

In the case that ECM is described in the PMT, receiver units may detect the suspension of ECM when the ECM does not arrive in regulation time or less. (within 2 seconds)

(2) Receiver Unit Operation when ECM's are blocked.

The receiver units that detect ECM suspension when a program is selected will carry out an operation that refers to the transport scramble control flag for TS packet header which composes broadcast programs with or without an IC card.

4.11 EMM

4.11.1 EMM Transmission Specifications

4.11.1.1 EMM Stream Specification Method

2 types of EMM transmission method are defined.

(1) Identification measures with the transmission format

Type A and Type B of transmission formats are described in the first place byte of the private_data_byte area for the conditional access method descriptor in the CAT.

Table 4-6 The first place byte of private_data_byte for the conditional access system descriptor in the CAT.

Value	Meaning
0x00	Undefined
0x01	Type A
0x02	Type B
0x03~FF	Reserved for future use

The identification information for EMM transmission format shallbe described in the first place byte of private_data_byte of the conditional access method descriptor in the CAT.

When the identification information value for a valid EMM transmission format is not described in the first byte of private_data_byte for the conditional access method descriptor in the CAT, the EMM acquisition in the receiver unit is not guaranteed and it may not be acquired at all due to the exceptional process.

The related information is described in A.3.5 of the commentary.

_

4.11.1.2 EMM Transmission Specifications Excluding the Partial Reception Layer

(1) Type A Transmission Specifications

Type A shall be described in the first place byte of the private_data_byte area of the conditional access system descriptor in the CAT.

The composition of EMM section header is based on Notification No.37 by the Ministry of Internal Affairs and Communications in 2000.

The formation of EMM main unit in the EMM section shall be refered to 3.2.4 EMM in Chapter 3 of ARIB STD-B25 Part 1.

EMM section shall not be transmitted in multiple sections.

EMM transmission interval is as follows:

The transmission interval is defined in conjunction with EMM section and EMM individual message section. The transmission interval shall comply with 4.11.3 EMM Transmission Interval in this document.

The receiver units shall not refer to EMM section version number.

EMM transmission order shall comply with 4.11.4 EMM Transmission Order of this document.

(2) Type B Transmission Specifications

Type B shall be described in the first place byte of the private_data_byte area of the conditional access system descriptor in the CAT.

Only 1 EMM main body is allowed in the 1EMM section. in other words, individual information is based on 1 Card ID only. 1 section header, 1 EMM unit and section CRC are included in the section.

1TS packet is available to configurate multiple combination with EMM sections.

The information for EMM filtering (Total of 14 byte, 8 bytes of Section header and 6 bytes of card ID) shall not extend over multiple TS packets.

In the case of multiple section transmission, The maximum number of sections embedded in 1TS packet shall be 10 in accordance with Vol. 4 (multi section transmission) of this document.

EMM transmission for the own card ID shall be maintain one or more seconds intervals . In other words, even if multiple EMM's exist in 1TS packet, EMM is guaranteed at least one with a card ID.

Use of the group ID and global ID shall not allowed.

4.11.1.3 EMM Transmission Specifications in the Partial Reception Layer (T.B.D.)

4.11.2 EMM Message Transmission Specifications

(1) Type A Transmission Specifications

The format of EMM individual message main body in the EMM message section shall be refered to Chapter 3, 3.2.5.2 EMM Individual Messages in Part 1 of ARIB STD-B25 .

The format of EMM common message main body in the EMM message section shall refer to Part 1 of ARIB STD-B25.

EMM messages shall not be transmitted in multiple sections.

The transmission interval for EMM individual messages is shown in 4.11.3 EMM Transmission Interval in the this document.

The transmission interval of EMM common messages is shown in 4.11.3 EMM Transmission Interval in the this document.

When the main message body area of EMM common message is 0 bytes and when the automatic display deletion indication is "0x02", message and the frame for the message shall not be displayed. (In this case of message “Emergency response”, it shall not be displayed.)

The receiver units shall refer to version number of the appropriate EMM message section and prepare for the update of EMM common message contents or the deletion of the display while the message is on the screen.

The receiver units shall not refer to the version number in the individual message section of the EMM.

The transmission order for EMM individual messages is described in 4.11.4 EMM Transmission Order in the document.

EMM messages shall not be transmitted in the partial reception layer.

(2) Type B Transmission Specifications

EMM individual message main body in 1 EMM individual message section shall be only one, in other words, the information is on 1 card ID uniquely. The section shall contain only header,1 EMM individual message main body and section CRC.

Multiple EMM individual message sections shall be able to be set in 1TS packet.

Appropriate information (Total of 14 bytes, Section header 8 bytes and card ID 6 bytes) for filtering EMM individual message shall not extend over multiple TS packets.

In the case of multi sections, the maximum number of sections embedded in 1TS packet shall be 10 in accordance with Vol. 4 (Multi Section Transmission) of the this document.

The transmission interval of EMM individual message section transmitted in the same card ID shall maintain more than one seconds. In other words, even if multiple EMM individual messages sections exist in 1TS packet, appropriate EMM individual message section shall be guaranteed at most one.

The group ID and global ID shall be avoided .

4.11.3 EMM Transmission Interval

4.11.3.1 EMM Transmission Interval except for the Partial Reception Layer

(a) Transmission interval of EMM section and EMM individual message section

(1) Type A

EMM shall be sent with TS for programs in the case of terrestrial digital broadcasting, and shall not be sent with TS for exclusive use. Related information is described in A.3 of the document.

Transmission interval of TS packet level of the EMM section and EMM individual message section shall be defined in accordance with Vol.4 fundamentally.(This means EMM transmission interval is not defined with the intervals of each EMM section but the transmission density of the EMM section in accordance with the operation rules of PSI/SI.)

When EMM section and EMM message section are transmitted, TS packet for appropriate PID shall be transmitted within 32ms in the range of 1.28kB±100%. TS packet of EMM section and EMM message section shall not be transmitted more than 320 kbits within a random second with same PID.
(In the above 320 kbits, the data amount for 1 EMM section and EMM message section shall be deemed to be 4kB.)

(2) TypeB

When EMM section and EMM individual message section are transmitted, regardless of TS for program and TS for exclusive use (specific transponder), TS packet for the appropriate PID shall be transmitted within 32ms in the range of 8.0kB±100%. TS packet that transmits EMM section and EMM message section shall not be transmitted more than 2.0 M bits within random 1 second with same PID. (In the above 2.0 Mbits, the data amount for 1 EMM section and EMM individual message section shall be deem to be 4kB.)

(b) Transmission interval of EMM common message section

− The transmission interval of the EMM common message section with a specific fixed message number (Table ID Extension) in Type A and Type B shall be at most one section within 200ms.

4.11.3.2 EMM Transmission Interval in the Partial Reception Layer (T.B. D)

4.11.4 EMM Transmission Order

(1) Type A

EMM and EMM individual messages shall be loaded with plurality of information in one section.

In order to facilitate the filtering process with the receiver units, the following operation shall be constrained EMM placement order loaded in the same section. EMM individual messages is as same as EMM.

1) The first place of EMM shall be EMM with the minimum vale of card ID included in the section.
2) The second place of EMM shall be EMM with the maximal value of card ID included in the section.
3) The third place and more of EMM shall be allocated remaining EMM's with sorting in order of card ID (ascending order).

If there are n piece of EMM's in one section, and theas EMM's are in order of the smallest card ID such as EMM_1, EMM_2, …, EMM_n, they shall be arranged in the following order.

EMM_1	EMM_n	EMM_2	EMM_3	EMM_n-1
Head	2nd	3rd	4th	Rear

← Within the same section →

The receiver units can determine the possibility of the presence or absence of EMM to the receiver itself is included in this section by means of examining the first 2 EMM's. In addition, even when there is a possibility it will be included, by examining in order, at the time when it turn out that the EMM is larger than its own ID, it can determine the absence of EMM to the receiver itself in the section . The entire section can be rejected and comparison measurement up to the last

EMM in the section is not necessary when it turned out that EMM to the receiver itself is not included in its' own EMM.

(2) Type B

EMM and EMM individual message to be transmitted to one IC card shall be allowed only 1 piece per a section.

4.12 Message Codes for EMM Messages

4.12.1 Format Number

- \- The format number is defined as 0x01. The following section defines the format of the message code in format number 0x01.
- \- When format numbers other than the format defined by ARIB or this document are received, the receiver units shall delete the message code and ignore the reception itself.

4.12.2 Message Code Main Body Format of EMM Common Messages in Format Number 0x01

- \- When the message code main body exists, the first place of 1 byte shall be the "Recommended display position" (Refer to 4.12.6 Recommended Display Position for the Automatic Display Message in this document). The "Recommended display position" shall be defined as the display position in the automatic display message (IC card retention message). This shall be void in the case of mail (IRD retention message) and the receiver unit shall ignore it.
- The meaning of the recommended display position are described more in 4.12.6 Recommended Display Position for the Automatic Display Message in this document.
- \- From the second place of byte and more, the characters until before NULL shall be the main body. (NULL cannot be placed in the main body.)
- \- Inserter 0x1A is described at the point that inserts the byte sequence specified by the differential data.
- \- Although plurality of inserter 0x1A in a common message may be good, the results of the merge with the message code of an individual message should not exceed 800 bytes for mail and 400 bytes for automatic display messages.
- \- The message code of an EMM common message with a fixed form statement number that is pointed out by the EMM individual message shall be the same character code as the message code of the EMM individual message.

4.12.3 Differential Data Format for EMM Individual Messages in the Difference Format Number 0x01

- Specify the character string to be inserted as differential data.
- The main body shall be characters from the first place of byte until before NULL. (NULL cannot be specified as differential data.)

4.12.4 Example of Using the Differential Data

An example of format number 0x01 is shown below.

1) Main body of the message (EMM Common Message)

: Thank you for your subscription. From today client 0x1A will be able to view a terrestrial special package.

2) Differential Data (EMM Individual Message)

:Tanaka

3) Generated message

: Thank you for your subscription. From today Mr. /Ms. Tanaka will be able to view a special terrestrial package.

4.12.5 Character Codes

- The character and control codes that can be used by format number 0x01 shall be allowed as follows:
  1) Character code and control code in accordance with the encoded character string 4. in Part 1 of Vol. 4
  2) Inserter 0x1A

4.12.6 Recommended Display Position for the Automatic Display Message

- - The guidelines for display position and image frames, etc. of the automatic display message are shown as follows:

The first place of 1 byte for the main body of the message code in the EMM common message section shall be the "Recommended display position "Recommended display position" shall be dined as follows:

The upper four bytes (0100:Left, 0010:Middle, 0001:Right) are the recommended horizontal display position and the lower four bytes (0100:Top, 0010:Middle, 0001:Bottom)are the recommended vertical display position. The message shall be local dialogue with the receiver units, and the above bytes shall be recommended values. The display pixel quality is not required.

- - The following operation is desired for the image frame.

1) For the receiver side, 18 characters (full-size) × image frame with maximum of 8 lines equivalent is used.

2) For data creation side, the entire layout is maximum of 18×8 lines with inserted line breaks/SPACES. Therefore, the display character data of full-size 144 characters or more in the message code that merged a common message with an individual message must not be included.

3) For the receiver side, optimize the image frame of the automatic display message with the number of line breaks and the maximum number of characters per line.

4) When the image frame is optimized according to the number of characters and the number of lines, the recommended display positions (0100:Left ,0010:Middle ,0001:Right),(0100:Top, 0010:Middle, 0001:Bottom)in this document are shown as follows:

Left: In the screen, the image frame of the automatic display message is aligned by left justification.

Right: In the screen, the image frame of the automatic display message is aligned by right justification.

Top: In the screen, the image frame of the automatic display message is aligned by top justification.

Bottom: In the screen, the image frame of the automatic display message is aligned by bottom justification.

Middle: In the screen, the image frame of the automatic display message is aligned in the center.

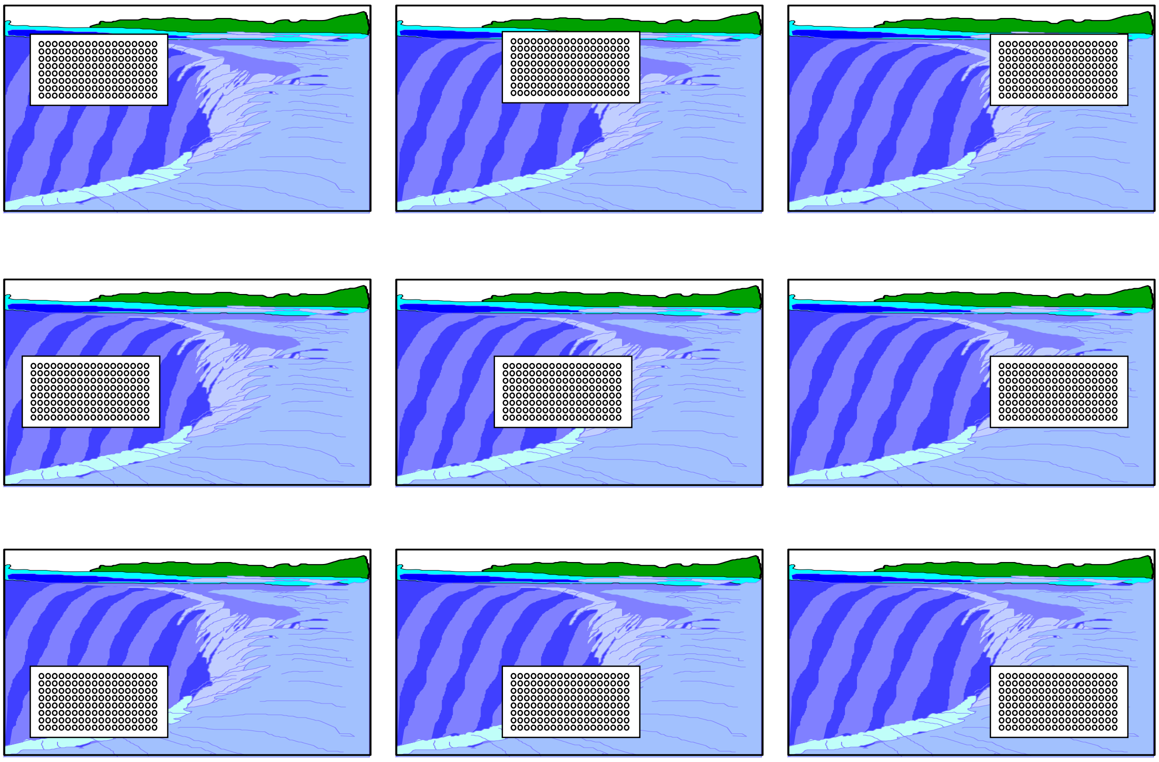
5) Line breaks are not used after the final character on the transmission side.

6) The blank spaces at the top, bottom, left, and right of the image frame and the design, etc. are left up to the receiver units.

7) For the receiver side, the page turn over display of the sent message is not displayed.

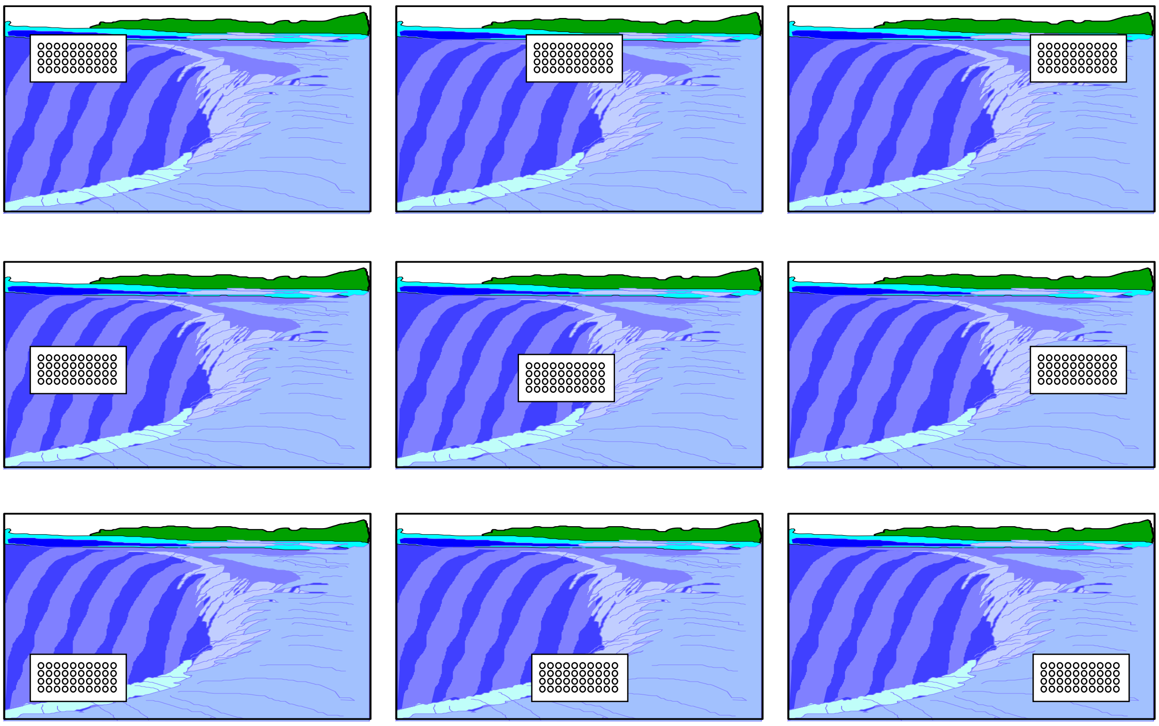
●Displaying images

[Example of maximum (18 characters per line, 8 lines) image frame]



[Example when the image frame is optimized]

[Example of optimized image frame]



4.13 CA Contract Info Descriptor

– - Refer to Vol. 4 of the document to use the CA Contract Info Descriptor.

– - Since there were limits on PPV at the start of terrestrial digital television broadcasting, the "fee_name" of the CA Contract Info Descriptor is ignored by the receiver units.

– - When PPV use begins, correctly arrange the CA Contract Info Descriptor in the SDT or EIT after the revision of these use provisions. Receiver units recognize that the relevant program is PPV by the card response of the CA Contract Info Descriptor.

– - Do not use the "fee_name" for the CA Contract Info Descriptor used in flat/tier, etc. contract programs.

4.14 Message ID

4.14.1 Use

– - Provide for the recycling of a message ID.

– - Messages that broadcasters can transmit at the same time (number of mails) N mails
*

Message ID recycling period of the broadcaster M days or more

1 message transmission period of the broadcaster L days or less

*It is assumed that the message (mail) ends the transmission sequentially from messages with old transmission start times (mail) one by one at the receiver side.

N=7, M=30, L=14

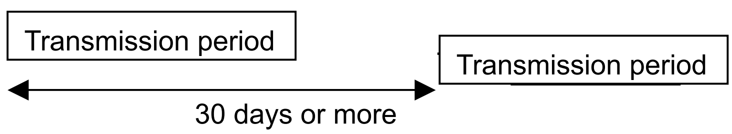
4.14.2 Transmission Operation Example

– A typical transmission example is shown below.

(1) Transmission example 1 (same message ID)

Message ID [104]

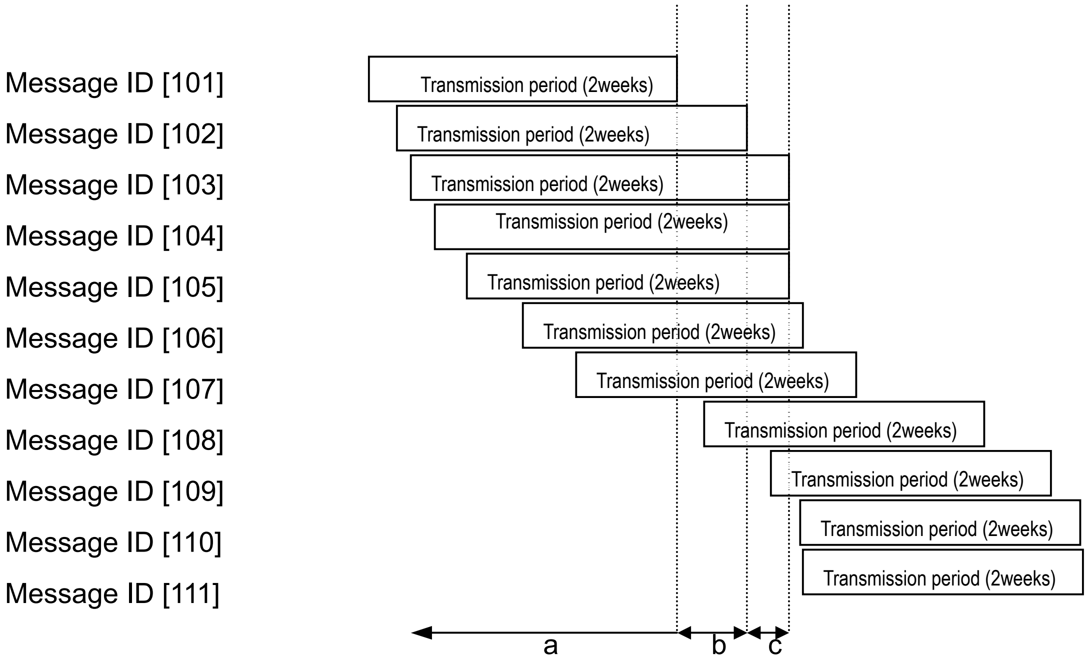
Message ID [104]



..

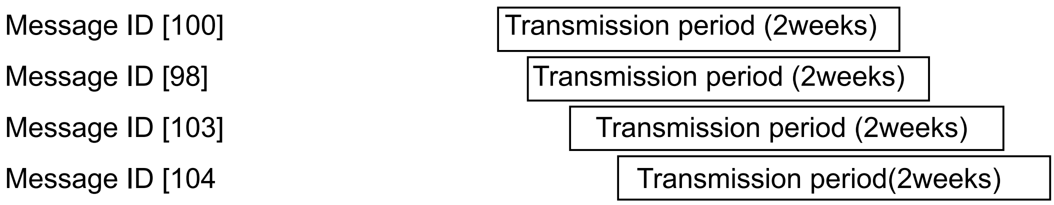
.

(2) Transmission example 2(Most general example)



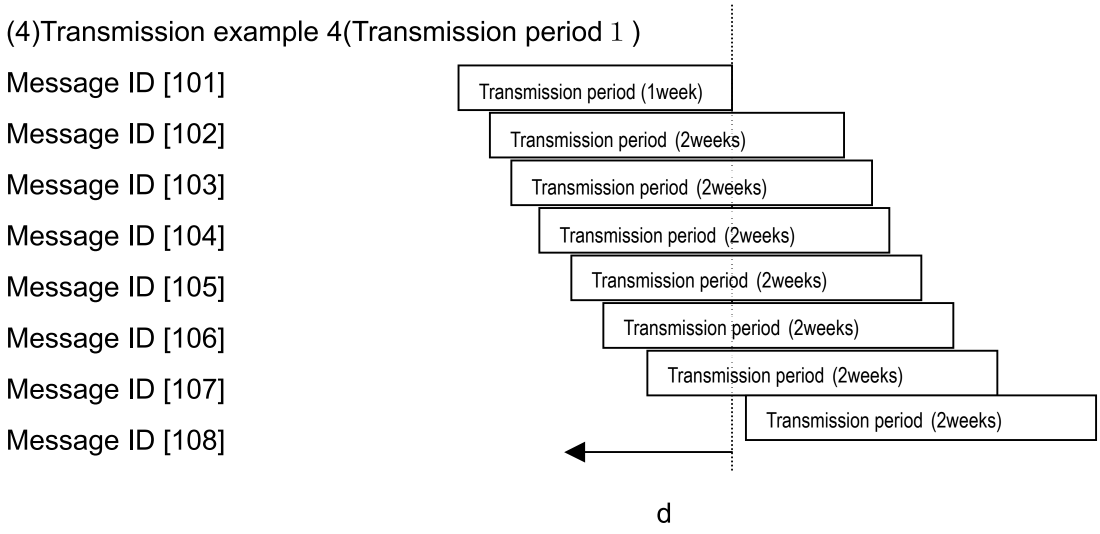
The outgoing message (mail) which can be sent in any area of a, b, and c is seven or less.

(3) Transmission example 3(Possible increase of Message ID's)



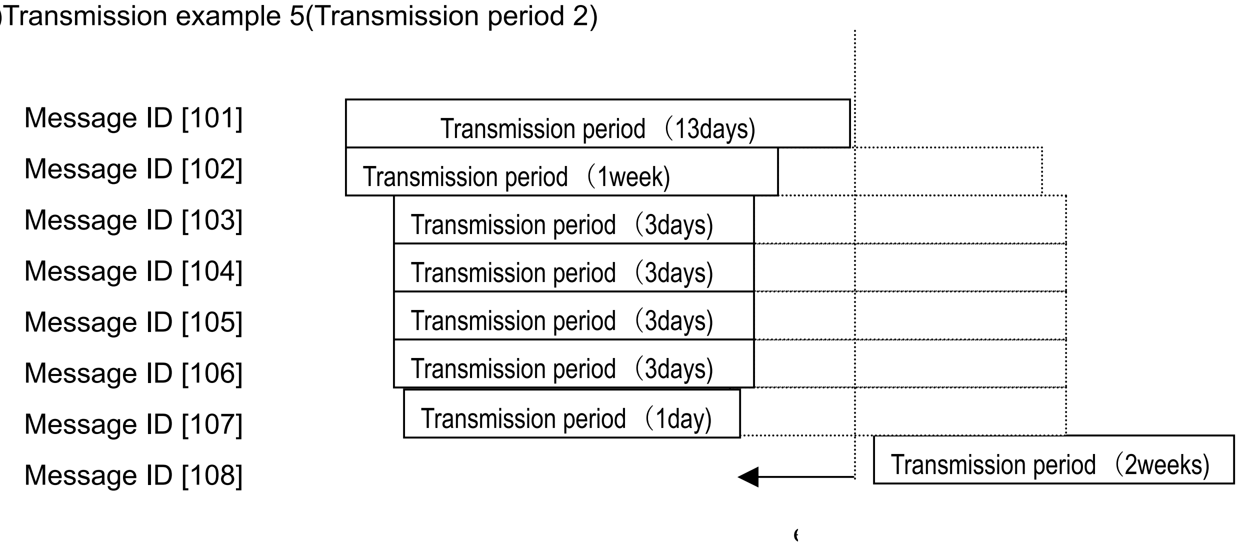
When the message (mail) is sent by simultaneous use of the group ID and card ID, a possible increase in the message ID only is not ensured. (Old and new messages (mail) cannot be accessed by the message ID.)

(4)Transmission example 4(Transmission period １)



For example, Message ID [101] is used with a transmission period of one week. Naturally, Message ID [108] (the eighth message/ mail) cannot be transmitted in the d time segment. (The rule for transmitting mail at the same time limits it to seven.)

(5)Transmission example 5(Transmission period 2)



–

– - For Message ID [102], [103], [104], [105], [106], and [107], it is possible to end transmission within the Message ID [101] transmission period. However, since the end of transmission cannot be accessed at the receiver unit side, Message ID [108] cannot be transmitted in the e time segment. (It is an assumed rule at the receiver side that transmission for messages (mail) ends sequentially from the transmission start time's old message (mail).)

4.15 Recording Control Response of IC Cards

- \- The copy control for pay broadcasting is described in 5.9 Copy Control in Pay Broadcasting in this volume. Since there were limits on PPV operations at the start of terrestrial digital television broadcasting, the receiver units ignore information related to recording control from IC cards. Specifications concerning copy control from IC cards are the purchase operation of PPV recording. Therefore, the copy control information of the IC card response becomes valid from the correspondence of the PPV program that has been operated after these provisions have been revised at the start of PPV operations.

4.16 CA Substitute Service

4.16.1 Operation Unit

- \- Use of the CA substitute service is carried out by the service unit. The CA substitute service is not used in each component.
- \- The link service that was the target for the CA substitute service is the scramble broadcast service (pay service and protected free program).

4.16.2 Link Service

- \- Since the programs have to be able to be viewed by the link service, the link service must be operated without scramble regardless of whether there is a contract or not with pay broadcasters.
- \- The arrangement of the data component in the link service is indispensable when the CA substitute service linked with data broadcasting is carried out, and the data contents for the CA substitute service are always transmitted. However, the link service may be a video or audio service without a data component.
- \- The link service is operated in the same TS and for only 1 service.

4.16.3 Link Descriptor Transmission Operation

- \- When the CA substitute service is used, the Linkage Descriptor is placed in the SDT and transmitted. Link service information (original_network_id, transport_stream_id, service_id, etc.) is described in the Linkage Descriptor.
- \- The Linkage Descriptor can be placed in the SDT of services which are used with non-scramble (In broadcasting where non-scramble/scramble exists, for operation of a fixed Linkage Descriptor). In this case, the link operation is not generated because viewing is possible by non-scramble broadcasting.
- \- Operations that place the CA substitute service Linkage Descriptor in the link service again are prohibited. (Since there is a possibility that the link operation loops.)

- - The first 8 bytes of private_data_byte for the Linkage Descriptor is the message number. The main body of the message is described in the second byte and later.
- - The number of characters and bytes that can be described in the mobile confirmation message is 80 characters and 160 bytes or less (8-bit message number not included).
- - For the display frames by the receiver units, in addition to the above the maximum number of characters per line is up to 24 full-size characters and the number of display lines is six lines or less (including line break only lines).
- - The character and control codes that can be used for mobile confirmation messages are the character and control codes defined by Vol. 4 Encoding of Character Strings in the document.
- - When the same message number is used for multiple service_id's in the same TS, private_data_byte is able to skip transmission of the message contents with an 8-bit message number only.
- - The main message body of the message number that has been described in the same TS must always be transmitted in the TS.
- - The type of mobile confirmation message that is sent at the same time is 20 kinds or less in terrestrial digital television broadcasting, and the message number for the CA substitute is 41-60 (0x29-0x3C).
- - When the message embedded in the receiver units is displayed, nothing is described in the private_data_byte area.
- - Refer to Vol. 4 of the document for the details of use of the Linkage Descriptor.

4.17 Use of the CA_EMM_TS Descriptor

- - In terrestrial digital television broadcasting, the CA_EMM_TS Descriptor is not used.

4.18 CA Service Descriptor

4.18.1 Use

- - Shows the organization channel of broadcasters that use the Automatic display of message, and describe the display control information of the relevant message.
- - Multiple CA Service Descriptors may be described in the CAT. This is when multiple conditional access systems are used in the relevant TS, and the Automatic display of message is used with CA_system_id that is specified by the CA Service Descriptor. Additionally, when the Automatic display of message is used, one CA Service Descriptor is arranged in each broadcaster. Therefore, when multiple conditional access systems are used, the number of CA Service Descriptors that can be described in the CAT is the

number of combinations of the CA_system_id which carried out the Automatic display of message and broadcaster identifier.

4.18.2 Use of the Delay time

- \- Show the Delay time period until the Automatic display of message previously embedded in the IC card is displayed. However, 0xFF means the Delay time has not been transmitted. (suspension of the Delay time)
- \- The start date is the Current date of the " Automatic Display Message Display Information Acquire Command " described in Part 1 of ARIB STD- B25.
- \- In order to work the Automatic display of message in the received and accumulated program in the receiver units that have the storage function, the lowest bit of the Delay time is used as 0.

  \- In order not to work the Automatic display of message in the received and accumulated program in the receiver units that have the storage function, the lowest bit of the Delay time is used as 1.

5 Required Specifications to the Receiver Unit

5.1 Receiver Unit Configuration

Figure 5-1 shows the hardware configuration related to the CAS. This is a configuration model to explain the specifications, and actual configuration depends on the design of the receiver units.

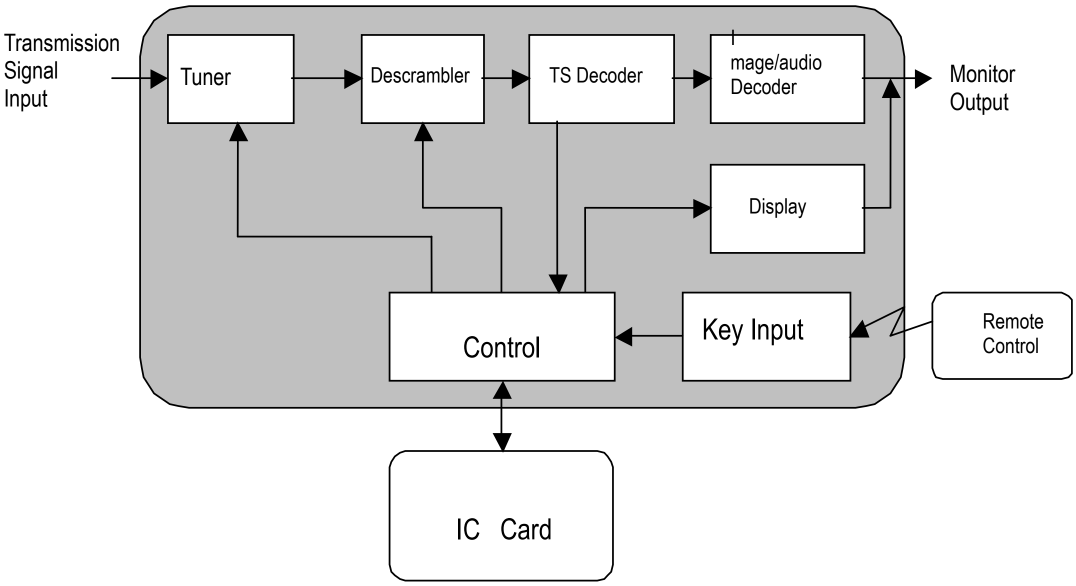


Figure 5.1 Basic configuraiton of receiver units

(1) Tuner

－ - The reception and selection of the broadcasting signals are controlled from the control unit, and packet processing of the transmission signal and error correction processing are carried out.

(2) De-scrambler

－ - Descrambling of specific packets by the MULTI2 method is controlled from the control unit.

－ - Refer to Part 1 of ARIB STD-B25 below.

Chapter 2	2.2.2.4	Descrambler
Chapter 4	4.8	Assessment of the existence of scrambling
Appendix 2	3.4	Descrambler

(3) TS Decoder Unit

－ - Separates necessary packets from TS multiplexed signals, selects broadcasting program signals, and separates various multiplex data (various SI data, ECM, and EMM, etc.).

(4) Video Audio Decoder Unit

- Outputs decoded video and audio to a monitor.

(5) Display Unit

- User interfaces such as screen display measures to display menus, lists, IC card information, automatic display messages, mail, IC card tests, and IC card response errors, etc, to the users are installed here.

(6) Key Input Unit

- Key input processing is carried out from a remote controller.

(7) Control Unit

－ -Carries out control of the entire receiver unit. In particular, it carries out communication with IC cards, processing of various data that has been separated from broadcasting signals, descrambler control, time count, display processing control, and key input processing for the CAS.

(8) IC Card, Low Speed CA Interface

－ -They are installed in receiver units, and they communicate with the control unit of the receiver units. Decoding of received encryption EMM's, contract data management, decoding of encrypted ECM's, view control processing of pay programs, and decoding of encrypted EMM messages are carried out as core processing in the CAS of the receiver units.

－ -The receiver units must not issue unnecessary commands in program viewing other than the ECM reception command, contract confirmation command and card request command while issuing commands for which transmission orders have been decided such as the issuing of commands which require multiple receptions, transmission of commands/responses (ones that use the PDU number) and communication related commands.

－ -The receiver units, in accordance with this document, must not issue the "Prepayment balance confirmation command" because they do not use pre-paid cards during operation. Revision of related standards in the time period that corresponds to the pre-paid card operation for the pre-paid card.

－ -Install the low-speed CA interface described in the following of Part 1 of ARIB STD-B25.

Chapter 4	4.3	CA Interface
Appendix 2	3.5	IC card communication control

- -The description concerning inquiries on IC cards is in appendix B.2.

5.2 User Interface

-Details on the user interface depend on product planning.

Therefore, the display screen that is shown in [the procedure] described in Chapter 4 "Technical Specifications Related to Receiver Units" of Part 1 of ARIB STD-B25 is one example for promoting greater understanding.

- -The Automatic display of message is superimposed on the display.

5.3 Memory

- -The necessary NVRAM related to the conditional access service is as below.

1) 5.6kB or more for mail reception. The breakdown is the size required to memorize seven e-mails or more with 800 bytes for one mail.
2) For message ID recycling, memory for 13 message IDs and the time of receipt per broadcaster is necessary, and the number of broadcasters is 32 or more.
3) For power distribution control management and message ID recycling of each broadcaster (32 records at the maximum), additional memory may be necessary depending on the design of the receiver units, however the size and implementation measures are at the discretion of the receiver units.

- -Set up a delete function for private information related to conditional access maintained in the NVRAM in order to transfer and dispose of the terrestrial digital television receiver units.

  Specifically, set up a function that can delete all the saved areas of EMM mail memorized by the receiver units. Related matters are described in 6.2.5.7 of Vol. 2 of the document.

5.4 Saving Power

- -In the terrestrial digital television broadcasting Conditional Access System, a power distribution control method is adopted to save power when updating EMM. In case of EMM power distribution control, when a membership application is first made, a corresponding EMM is received while receiving the subscribed service. After that, the receiver knows the next period to receive EMM by the IC card response, therefore a design for saving energy until the next period becomes possible.
- -A timer function (calendar function) that counts absolute time is necessary for the receiver units for the above operation. Refer below for details.

Part 1 of ARIB STD-B25

Appendix 2	3.1	Saving Power
Appendix 2	3.2	Timer

5.5 Power Distribution Control

5.5.1 Normal Power Distribution Control by IC Card Response, etc.

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– -This function is used to control circuit power distribution for minimum EMM reception when the power distribution control period specified by the EMM is on standby with the sub-power off (not with the AC off but with the power turned off by the remote control), and is a function to receive EMM's at the specified time by the specified network and transport stream.

– -When power distribution control is set to each broadcaster (maximum 32 records), and each respective power distribution control period overlaps, the power distribution control carries out reception control for all broadcasters sequentially. Additionally, even if the power distribution control is interrupted, schedule control for all broadcasters is regularly carried out so that reception control does not concentrate each time in a specific broadcaster.

– -It is preferable that the acquisition of EMM message as well as EMM’s is carried out in the power distribution control period.

– -It is necessary to specify by which TS the subscriber is receiving, in order to specify the TS that carries out power distribution control when the broadcaster generates EMM's for the enrolment period of pay broadcasting. Therefore, it must be equipped with a function to display a 10 character TS name for the service for current viewing that can specify the received TS in the receiver units. However, it is also permissible to share display functions such as EPG and program details information, etc.

– -For operation priorities during standby in the power distribution period for EMM reception specified by the power distribution control information request command/response, refer to Chapter 5.5.4 Priority of Operations in Standby in this volume.

– -Power distribution control is managed by each CA_system_id. In the receiver units, a valid IC card is inserted, and if the card has a different ID from the CA_system_id in the IC card that had been previously inserted, resetting of the power distribution control data of the previous CA_system_id is acceptable.

5.5.2 Power Distribution Control According to the CA_EMM_TS Descriptor

– In terrestrial digital television broadcasting, the CA_EMM_TS descriptor is not used.

5.5.3 Related Standards

- Refer to Part 1 of ARIB STD-B25 below.

Appendix 1	4.	Power distribution control use example
Appendix 2	3.12	Power distribution control

5.5.4 Priority of Operations in Standby

- When various operations on standby overlap the priority is as follows.
  1) Various reserved operations (program reservations, etc.) by the user have the highest priority.
  2) The priority of the EMM reception control and downloading is at the discretion of the receiver units. Additionally, if data to be downloaded is common for all receiver units, the EMM reception control has priority.
- -In particular, for the acquisition of download contents, when it is expected that it has become the start time for the reservation operation (reservation recording, etc.) during acquisition, do not acquire the contents.
- -At the completion of reservation operation (reservation recording, etc.), there is a power distribution period for EMM acquisition or when a download delivery schedule exists, execute an acquisition operation for EMM's or download the contents.

5.6 Effective Conditional Access System for Reception (Consistency Confirmation of the CA_system_id in IC Cards and Broadcast Waves)

- -Multiple Conditional Access Systems may be used but they are distinguished by the CA_system_id.
- -A valid Conditional Access System is a system that regards valid if the CA_system_id acquired by the default setting command/response with the IC card when the power is on or when the IC card is inserted does not correspond with a CA_system_id sent by PSI/SI.
- -Even when multiple CA_system_id's are described in the CAT and PMT, if the values do not correspond with the CA_system_id acquired by the command/response with the IC card, the receiver units set down by this manual are processed.
- -In the Conditional Access Descriptor in the PMT and the CA Contract Information Descriptor in the SDT/EIT, pay much attention to any service or event which does not correspond with the CA_system_id acquired by a command/response with the IC card not to cause a malfunction and display error indication provided in Chapter 5.15 Error Notification Display. However, in the SDT/EIT, for Protected Free Program, etc., there is no description of the CA Contract Information Descriptor or it is used with free_CA_mode set to 0. Therefore, it is not necessary to display an error when it is judged that reservation is

possible even though CA_system_id does not correspond between the broadcast wave and IC card.

5.7 View Control of Pay Programs

5.7.1 View Processing

- -The basic operation selects the transport stream of the selected program based on the PSI/SI, and selects the components that comprise the program.
- -The scramble control flag and the adaptation field control of the TS packet header are referred to along with the ECM received in sequence given to the IC card, and viewing is controlled by this response.
- -Even when the service is chargeable, scramble broadcasting is not always carried out. This kind of non-scramble broadcasting displays programs according to judgement of the scramble flag.
- -Only ECM's are specified in the relevant service and are described in the first loop of the PMT. It is assumed that PPV use has started after the documents are revised and in the receiver units, when the PID's ECM described in second loop of the PMT is different from the ECM_PID described in the first loop of the PMT, it is regarded that another charge for each ES is operated and provide display function, etc. that the relevant ES cannot be switched.
- -Since PPV use is not carried out at the start of terrestrial digital television broadcasting, the PPV function should not be implemented by the receiver units. When PPV is used, the operation will be introduced after the documents are revised. Therefore, in receiver units not installed with an initial PPV function at the start of the broadcasting, pay attention not to cause a malfunction even if the return code related to PPV returns by the IC card response.
- -At the start of terrestrial digital television broadcasting, the charging operation in each component (ES) is defined not to be used at this point but in consideration of cases where these standards will be revised and used in the future, when the ES that has been placed in the Conditional Access Descriptor described by the valid ECM_PID in the second loop of the PMT is placed, a non-compliant message similar to PPV and pay attention not to cause a malfunction must be displayed.

5.7.2 Related Standards

- Refer to Part 1 of ARIB STD-B25 below.

Volume 4	4.2.3	Program Viewing
Appendix 1	6.	Judgment of Scrambling

Appendix 2 3.5 IC Card Communication Control

Appendix 2 3.10 ECM Reception and Descrambler Control

Appendix 2 3.15 Program Viewing

- Vol.4 Provisions for Transmission Operations in this volume.

5.8 Protected Free Programs and Scheduling of Pay Programs

5.8.1 Function Outline

- -Scheduling of programs shall be treated without distinguishing between pay programs and free programs, and when the receiver unit is equipped with a program scheduling function it is preferable that pay broadcasting be included within this scope.
- -Determination of whether the scheduled pay program can be viewed or not uses the CA Contract Information Descriptor from the SDT or EIT, and the viewing availability, viewing format are obtained by the contract confirmation command/response in the IC card. The viewing format can be judged by the return code.
- -Use of PPV is not carried out at the start of terrestrial digital television broadcasting. (Related matters are described in A.1 of this volume.) However, it is assumed at the start of use, when the non-compliant conditional access service (PPV and different CA_system_id service) is judged by the card response of the CA Contract Information Descriptor described in the EIT or SDT, a message for non-compliant must be displayed.
- -When a program is scheduled, it is considered that it is possible to schedule it unconditionally when free_CA_mode is set to 0 in the EIT. (Free program/protected free program) However, for protected free program, the CA Contract Information Descriptor is not placed but since installation of a valid IC card is necessary for viewing programs, even during scheduling, the presence of an installed IC card is detected. For uninstalled or invalid IC cards, it is preferable to display a message, etc. prompting the installation of a valid IC card.
- -When there is no CA Contract Information Descriptor and the free_CA_mode is 1, scheduling is not possible.
- -The CA Contract Information Descriptor defines the Contract Confirmation Information for the entire service in the SDT and on each program in the EIT. When this descriptor is defined in both the SDT and EIT, the definition in the EIT is given priority.
- -When the response from the IC card by the relevant CA Contract Information Descriptor in a scheduled program is a non-contract, and even when the Linkage Descriptor targeted by the CA substitute service of the service concerned is described in the SDT, do not start the CA substitute service.

5.8.2 Related Standards

- Refer to Part 1 of ARIB STD-B25 below.

  Chapter 4.2.4 Program Reservation

  Appendix 2 3.16 Reservation of Programs

5.9 Copy Control in Pay Broadcasting

- -Refer to Vol. 8 of the document for the copy control method.
- -Refer to Vol. 4 and Vol. 8 for Copy Control Information in PSI/SI.
- -At the start of terrestrial digital television broadcasting, since PPV operation is not conducted, regardless of the response from the IC card, as a conditional access service, conduct a predetermined copy control according to the control information related to the copy control specified with the PSI/SI. The PPV recording purchase operation will be introduced after the document is revised prior to operation.

5.10 Automatic display of message

5.10.1 Basic Use

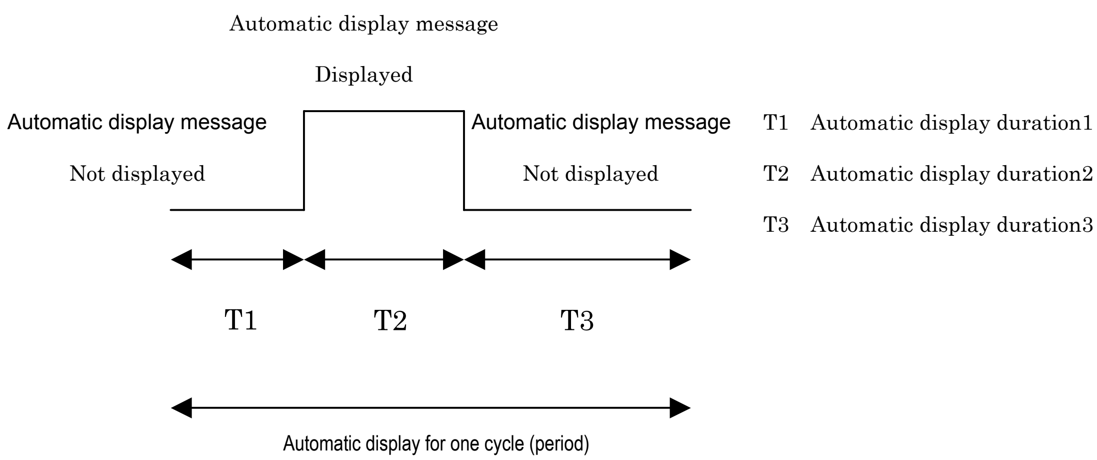
- - The automatic display message is acquired from EMM individual messages transmitted to each receiver (IC card stored messages) and EMM common messages transmitted to all common receiver units. EMM individual messages are memorized in the IC card, and EMM common messages are basically received at the time of display execution.(However, when a stored program that is received by receiver units with a storage reception function is played, information included in the played signal or information transmitted by the broadcast waves of the relevant broadcaster at the time of play, is acquired.)
- -This function operates when, in the CA service descriptor described in the CAT, the CA_system_id acquired by the IC card response matches the CA_system_id described in the CA service descriptor, and when the selected service_id is described.
- -The distinction of mail or automatic display messages in EMM messages is done by referring to the message control for the non-encryption header in the main body of the message in the EMM individual message section. When “IC card storage (0x01)" is there, it is a message that corresponds to the automatic display message.
- -The EMM individual message for the automatic display message is always encrypted. Decryption is carried out by the IC card and is memorized in the IC card. The receiver units use the EMM individual message reception command/response in the installed IC card to send the message code area and to acquire the response message code. The message

code storage length is shorter than the message division length acquired by the initial default setting command and is sent to the IC card in 1 command without being broken up.

- -For automatic display messages, stuffing may exist in the final part of the response message code area. The receiver units ignore the stuffing part.
- -The response message code area is as follows.

Item in the message code area	Description	No. of bits
alternation_detector	Falsification check	16
limit_date	Expiration date	16
fixed_message_ID	Message fixed format number	16
extra_ message_format_version	Differential format number	8
extra_message_length	Differential data length	16
extra_message_code	differential data	N
stuffing	Stuffing	M

- -When the program channel is selected, the receiver units acquire EMM individual message information memorized in the IC card with the automatic display message information acquisition command/response of the IC card.
- -The receiver units must generate one automatic display message information acquisition command from one CA service descriptor.
- -The receiver units first acquire the message fixed format number from information in the EMM individual message acquired from the IC card, and receive a corresponding EMM common message. Next, the differential data in the EMM individual information message information is added to this EMM common message information and is displayed on the screen.(It is possible there is no differential data.)
- -When the automatic display message is displayed, the receiver units display the following according to automatic display durations 1, 2, and 3 described in the main body of the EMM common message.



- -The receiver units repeat the on/off control written above according to how often the automatic display is described in the main body of an EMM common message.
- -After the predetermined frequency displaying cycle is repeated, the display is deleted. The receiver units execute the above control again if the channel is re-selected.
- -The receiver unit operations for the three kinds of automatic display deletion status types described in the EMM common message section are as follows.
  (1)0x00:Deletion possible. The message can be deleted by the viewer during the display period which includes the previous message on/off.
  (2)0x01:Deletion not possible. The message cannot be deleted during the message display period by the viewer.
  (3)0x02:Display deletion. The automatic display message is not displayed.
  If updated to "Display deletion" during the display of the automatic display message, discontinue the automatic display of message along with the message frame.
- -The steps for deletion by the viewer depend on product planning.
- -The period until the display of the automatic display message begins is controlled by transmitting the renewal period sent by the CA service descriptor to the IC card. In this case, because schedule control is carried out in the IC card, the receiver units only have to follow the automatic display message information acquisition command/response with the IC card since schedule control for this renewal period is not necessary.
- -For the automatic display message, the same EMM individual message retransmission check carries out a check on the same message retransmission by using the broadcaster identifier with the message ID described in the EMM individual message section. The installation of a mechanism in the receiver units, which memorizes the message ID and broadcaster identifier of the latest received mail, etc. to prevent the same message from being received again, is recommended.
- -The version monitoring period of EMM common messages carries out the display period of EMM common messages during use (period when the frequency displaying cycle of the automatic display was multiplied by the sum of automatic display periods 1-3). However, when the automatic display message type deletion status is 0x02 (display deletion), the version is always monitored.
- -When the main body of the message code is updated, it is immediately reflected and displayed. Additionally, for the count of the display period of the update, even if it is newly counted from the time of the update (reload), (Depending on the channel switch, etc.) or

counted from the next display period, both are acceptable, however the latter is recommended.

- -The items that are changed when the version number of the EMM common message is updated are the main body of the message code (including the recommended display position information), the automatic display deletion type, the automatic display duration 1-3, and the frequency displaying cycle of the automatic display.

5.10.2 Related Standards

Refer to the following for details.

- Part 1 of ARIB STD-B25

Chapter 3	3.2.5	Message Information(EMM/ECM)
Chapter 4	4.2.6	Automatic Display Message
Chapter 4	4.3.3	Command/Response
Chapter 4	4.6	EMM Message Display (1) automatic display of message
Chapter 4	4.7.3	EMM Message Reception
Reference 2	3.11	EMM, EMM Message Reception

However, Part 1 of Reference 2 3.11.2 EMM, EMM Message Reception Format supports reception by power distribution control.

- -Refer to the following in this manual.

4.11.2	EMM Message Transmission Specifications
4.12	Message Codes in EMM Messages

- Volume 4 CA Service Descriptors

5.10.3 About Displaying

- -The automatic display of message function during regular program viewing is necessary mandatory.
- -The message display for when program images and blend are temporarily displayed by the user operating EPG and the menu, etc. depends on product planning. In this case, it is acceptable to move the automatic display of message in order to make the EPG, etc. display easier to see but when returning to regular viewing, obtain the automatic display of message and return to the predetermined display operation.
- -When program images and blend display are not carried out by the menu, etc., the automatic display message does not need to be displayed.
- -For the color of characters in the automatic display message, although it depends on product planning, bright colors should be avoided as much as possible, and black and white colors are recommended.

- -The message image frame similarly depends on product planning. The message characters should be easy to read and transparent processing, etc. which does not interfere with program viewing is recommended.
- -When SD is output, the standard character size should be in the 18×18 -20×20 dots range. A similar size that is easy to see should also be used to display HD output on the screen. However, in receiver units, etc., with small screens, since visibility is impaired by the small size of characters in comparison with other error messages, etc. displayed by EPG and the receiver units, enlarging the character size to the minimum level in order to guarantee visibility is recommended.
- -When the character size is enlarged for the above reason, ensure that the message characters become easier to read and the program images are visible.
- -In common receiver units used for BS digital, coordinating the message display specifications in BS digital to the display specifications of automatic display messages (character size, etc.) is recommended.(Specification of the priority level of display specifications)
- -When other errors occur during use of automatic display messages, in order to avoid displaying multiple messages which are difficult to see by the viewer, it is recommended that automatic display messages be displayed with the default ES group correctly decoded. For example, when the default ES group is scrambled in content-protected freeRight Management and Protection program and when contents cannot be decoded because automatic display messages are also being used without an installed IC card, it is recommended that when a card is not installed in the receiver unit, an error should be displayed and an automatic display message should be displayed according to the provisions of this manual to show that the contents have been correctly descrambled after the insertion of a valid IC card.

5.10.4 Displaying Automatic Display Messages When Playing Stored Programs in Receiver units with the Bound Recording built-in storage functions

- -The definitions of built-in storage functions here refer to receiver units with a playable record and play function with recorded devices only. Refer to Vol. 8 for details on the Storage Function in this manual.
- -When viewing programs operated by broadcasters which operate automatic display messages, display the automatic display message. This includes playing and viewing programs stored in the receiver units with the built-in storage function. At this time, control of the display of the automatic display message in each receiver unit is based on

information (when the program is played) that has been recorded in the IC card installed in this same receiver unit.

- -When programs stored in receiver units with the built-in storage function are played, the stored signals correspond to the CA_system_id acquired by the IC card response and the CA_system_id described in the CA service descriptor that has been described in the CAT regardless of the service type. When it is a relevant service, they carry out control related to the display of the automatic display message.
- -In order to execute the above function, broadcasters that use the automatic display message are confirmed by the CA service descriptor in the CAT of the received signal and when the broadcaster's program records, it includes the EMM common message included in the same CAT and TS, and records. In this case the table ID is 0x85, and although filtering is recommended with table_id_extension≠0x0000(Common message), regardless of the table_id_extension, it does not matter if filtering is done with table ID:0x85 (EMM message) only.
- -There are functions provided on the broadcasting station side that can control whether or not to display the automatic display message when viewing the programs of broadcasters who use automatic display messages in real time, and when the stored programs are played and viewed in the receiver units with the built-in storage function.
- -When playing and viewing recorded programs, the CAT is extracted from the TS of the play signal. When the CA service descriptor is included, the lowest bit of the renewal period is referred to and is judged on whether it has been specified as in the display of the automatic display message even when it is played. When it has been specified as display (lowest bit =0), the "automatic display of message information acquisition command" is issued to the IC card, and based on this response, the message fixed format number is acquired and the EMM common message in the play signal corresponding to this fixed format number is acquired and displayed. When it is specified as not displayed (lowest bit =1), the "automatic display of message information acquisition command" is not issued to the IC card and the message is not displayed.
- -For the displayed message sentence, when the recorded program plays, as stated above, it is standard to display the EMM common message sentence that has been recorded when the data broadcasting signal was recorded. However the most recent message sentence in receiver units with a real-time reception function can also be displayed.
- -When the EMM and EMM individual message are included in the play signal, they are ignored.

5.11 Mail Display

5.11.1 Basic Use

- -As is the case with automatic display message, mail is comprised of EMM individual messages (IRD storage messages) and EMM common message.
- -Mail, unlike automatic display messages, is messages memorized in the receiver unit and not in the IC card.
- -EMM Individual messages may be encrypted or not encrypted. When EMM individual messages are encrypted, decoding is done with the IC card and is eventually memorized in the receiver units.
- -The distinction of mail or automatic display messages in EMM messages is done by referring to the message control for the non-encryption header in the main body of the message in the EMM individual message section. When "IRD storage (0x02)" is there, it is the message that corresponds in the mail.
- -When EMM individual messages are encrypted, the receiver unit sends the message code area by using the EMM individual message reception command/response in the installed IC card, and acquires the response message code. When the message code area length is longer than the message partition length acquired by the default setting command, it is sent in sequence to the IC card while dividing the message partition length. The remaining amount is sent by the final command.

- The contents of the response message code area are as follows.

Items in the message code area	Description	No. of Bits
Reserved	Backup	16
Reserved	Backup	16
standardfixed_message_ID	Message fixed format number	16
extra_ message_format_version	Differential format number	8
extra_message_length	Differential data length	16
extra_message_code	Differential data	N
stuffing	Stuffing	M*

*:Stuffing is not sent for the IRD storage message (0 bytes).

The acquired response message code is connected and used when it is divided and sent. The valid differential data is up to length shown by the differential data length.

- -In regards to mails, they may have fixed sentences or may not have fixed sentences. (Message fixed format number =0). When they have standard sentences, the receiver unit first receives an EMM common message corresponding to the message fixed format number. Next, the differential data for the received EMM common message information and EMM individual message is combined, and the mail text is synthesized and memorized.

- -A minimum of seven mails is memorized in the receiver unit. NVRAM is used as the storage location. In order to store 1 mail with a maximum of 800 bytes, it is necessary to secure a minimum of 5.6kB of memory for the mail. When the amount of received mail exceeds the memory capacity, it is permissible to delete mail in order from the oldest reception date.
- -One mail should have less than 400 full charactersJapanese-Zenkaku-Charactors and be 800 bytes or less. The display method depends on product planning (number of characters per line and displays, etc. that use page breaks).
- -In receiver units, the installation of a display function is recommended to explain the meaning of “Mail reception" to users. “Mail reception" is for storing unread mail.
- -In receiver units, mail is composed of EMM individual messages and EMM common messages, and mail reception is viewed as complete when it is memorized. Users are notified by the above notification method.
- -Even if an IC card with a different card ID from when the mail was memorized is installed, the receiver units will not delete the memorized mail. Additionally, even if an IC card with a different CA_system_id from when the mail was memorized is installed, the receiver units will similarly not delete the memorized mail.(The most recent 7 or more mails are memorized on the receiver unit side.)
- -When an IC card with a different card ID from when the mail was memorized is installed, the display processing of this mail depends on product planning. Processing is envisioned as follows, etc.

  Example 1: Mail with different card ID's are not displayed.

  Example 2: Mail with different card ID's are not displayed, but when mail with different card ID's are accumulated, the users are informed accordingly.

  Example 3: Regardless of installed card ID, all mails that have been accumulated are displayed.
- -Whether or not to delete already read mail by the user, etc. depends on product planning.
- -For mail, the re-sending check of the same mail is done by using the broadcaster identifier with the message ID described in the EMM individual message section. In the receiver units, the identification ID of the deleted mail after the contents are confirmed (message ID and broadcaster identifier) is memorized and the installation of a mechanism that prevents the same mail from being received again etc. is recommended in order to

prevent deleted mail from being acquired again. When IC cards with different CA_system_id from previously installed IC cards are installed, the receiver units may reset the message ID management data such as the identification ID of the memorized mail (message ID and broadcaster identifier).

- -Use the first ten characters or more when using received mail as titles.
- -Although mail display depends on product planning, it is advisable to display mail in the center of the screen with a size that can be easily read by the user.
- -The related information is described in Appendix B B.1 in this manual.

5.11.2 Related Standards

- Refer to Part 1 of ARIB STD-B25 below.

Chapter 4	4.2.9	Mail Display
Chapter 4	4.6	EMM Message Display (2) Mail Display
Reference 2	3.11	EMM, EMM Message Reception

However, in Reference 2 3.11.2 EMM , EMM Message Reception Format of Part 1, reception is supported by power distribution control.

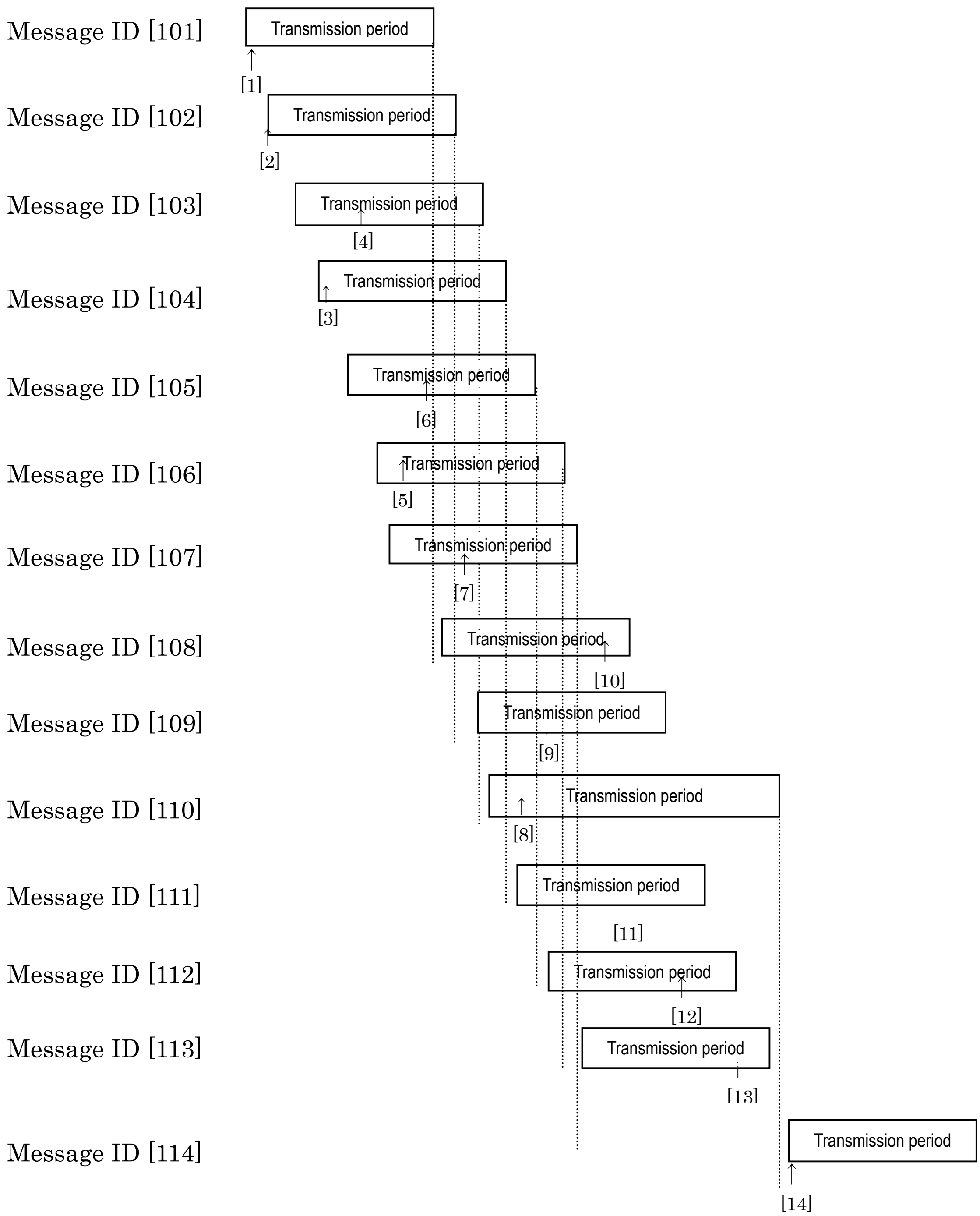
5.11.3 Message ID Processing

- -The receiver units prepare 13 areas where the message ID and reception time are stored by each broadcaster.

(13 areas are allocated storage of 2N-1. N: Number of messages that broadcasters can transmit at the same time)

- -For areas in which 14 days have passed since the time of reception, delete the contents as the transmission period ends.
- -When information in all 13 areas is fulfilled and the 14th new message (mail) is received, the message ID and the reception time are overwritten in the area with the oldest time.

An example of the transmission period and operation of the receiver units is shown as follows.


Message ID [101]
Transmission period
[1]
Message ID [102]
Transmission period
[2]
Message ID [103]
Transmission period
[4]
Message ID [104]
Transmission period
[3]
Message ID [105]
Transmission period
[6]
Message ID [106]
Transmission period
[5]
Message ID [107]
Transmission period
[7]
Message ID [108]
Transmission period
[10]
Message ID [109]
Transmission period
[9]
Message ID [110]
Transmission period
[8]
Message ID [111]
Transmission period
[11]
Message ID [112]
Transmission period
[12]
Message ID [113]
Transmission period
[13]
Message ID [114]
Transmission period
[14]

Receiver unit operation

- Time[1]

Message ID 101 Received at Time [1], Message ID 101 and reception time [1] are stored in the first message ID 101 reception area.

- Time[2]

Message ID 102 Received at Time [2], Message ID 102 and reception time [2] are stored in the second message ID 102 reception area.

- Time[3]

Message ID 104 Received at Time [3], Message ID 104 and reception time [3] are stored in the third message ID 104 reception area.

- Time[4]

Message ID 103 Received at Time [4], Message ID 103 and reception time [4] are stored in the fourth message ID 103 reception area.

- Time[5]

Message ID 106 Received at Time [5], Message ID 106 and reception time [5] are stored in the fifth message ID 106 reception area.

- Time[6]

Message ID 105 Received at Time [6], Message ID 105 and reception time [6] are stored in the sixth message ID 105 reception area.

- Time[7]

Message ID 107 Received at Time [7], Message ID 107 and reception time [7] are stored in the seventh message ID 107 reception area.

- Time[8]

Message ID 110 Received at Time [8], Message ID 110 and reception time [8] are stored in the eighth message ID 110 reception area.

- Time[9]

Message ID 109 Received at Time [9], Message ID 109 and reception time [9] are stored in the ninth message ID 109 reception area.

- Time[10]

Message ID 108 Received at Time [10], Message ID 108 and reception time [10] are stored in the tenth message ID 108 reception area.

- Time[11]

Message ID 111 Received at Time [11], Message ID 111 and reception time [11] are stored in the eleventh message ID 111 reception area.

- Time[12]

Message ID 112 Received at Time [12], Message ID 112 and reception time [12] are stored in the twelfth message ID 112 reception area.

- Time[13]

Message ID 113 Received at Time [13], Message ID 113 and reception time [13] are stored in the thirteenth message ID 113 reception area.

- Time[14]

Message ID 114 Received at Time [14], Message ID 114 and reception time [14] are stored in the first message ID 114 reception area.

(Time [1] is the oldest reception time. The elapsed time from time [1] until time [14] is for operations within 14 days.)

5.12 Parental Control (Viewer Age Limit)

The parental control function is not used in terrestrial digital television broadcasting.

5.13 Regarding Valid/Invalid/Unavailable IC Cards

5.13.1 Valid IC Cards

- -Valid IC cards must meet all the following requirements.
- 1) Obtain a normal response (normal termination) for the default initial setting command in Part 1 of ARIB STD-B25.
- 2) Include a system_management_id of 0x0301 or 0x0201 in the default setting command/response.
- 3) A card type of 0x01 for default setting command/response.

5.13.2 Invalid IC Cards

- -Invalid IC cards do not meet the requirements for valid IC cards described in 5.13.1 in this volume.
- -If the program which is being received is scrambled and the IC card is invalid, display the error messages described in 5.15 Error Notification Display in this volume.
- -When the service_id being selected has been described in the CA service descriptor described in the CAT and the program being received is non-scrambled, and when the IC card is invalid, carry out the operation described in 5.16 Operation When Valid IC Cards are Not Inserted of this manual.

5.13.3 Unavailable Cards

- -Unavailable IC cards are cards which have become unavailable due to a malfunction, etc. even though these cards are valid IC cards. These cards are defined as unavailable cards in order to distinguish them from invalid cards. Unavailable IC cards are valid IC cards provided by 5.13.1 of this volume with a return code of A1FF or A102.

- -When the programs being received are scramble broadcasts, and if the IC card is an unavailable card, display the error message described in 5.15 Error Notification Display of this manual.
- -When the service_id being selected has been described in the CA service descriptor described in the CAT and the program being received is non-scrambled, and when the IC card is unavailable, display the error message described in 5.15 Error Notification Display of this manual.

5.14 IC Card Information Display

5.14.1 Function Outline

- -This function displays IC card information according to how a user operates the menu, etc. when contacting the customer center, etc. about membership applications and various Conditional Access services.
- -The card identification, card ID, and group ID are displayed according to operations by the user.
- -Each standardized name is also a card identification, card ID and group ID. Although the user interface depends on product planning, consider making correspondence with each display number and standardized name clear.
- -When there are multiple group ID's, they are described in order of smallest numerical value of ID identification. There are a maximum of 7 group ID's.
- -The IC card information display relationship is described in A.8 of this manual.

5.14.2 Related Standards

Refer to Chapter 4　4.2.10 Card Information Display in Part 1 of ARIB STD-B25.

5.15 Error Notification Display

5.15.1 Function Outline

- -The types of error notification in relation to CAS are shown in the following table.

If SW1/SW2 is described in the corresponding return code in the table, describe the return code from the card or SW1/SW2 in hexadecimal display in error messages such as "Code :****" . (**** stand for return codes from IC card or SW1/SW2.)

- -Error messages basically depend on product planning but refer to the following examples for judgement by the customer center, etc. and following display examples are recommended. Additionally, there are cases when separate error message display examples from the customer center are notified. The blank columns inside the table in the display example depend on product planning.

No	Error classification	Corresponding return code	SW1/SW2	Display example
1	Password disagreement			
2	IC card not installed			Ex.1[Note1]
3	Unavailable IC card installed notification	A1FF, A102		Ex.2
4	Non-contract (no Kw)	A103		Ex.3
5	Non-contract (outside the contract)	8901,8501,8301		Ex.4
6	Non-contract (expired)	8902,8502,8302		Ex.5
7	Non-contract (limited viewing)	8903,8503,8303		Ex.6
8	Outside the Purchase Period/ Purchase Not Possible Notification Display	8108		Ex.7
9	Data Full/ Purchase Not Possible Notification Display	8109		Ex.8
10	Communication failure notification	9103,9104,9105,9106		
11	IC card exchange		6400,6581	Ex.9
12	Other errors	A104,A105, A106,A107		Ex.10
13	Invalid IC card installed notification			Ex.11
14	Non-conforming CA_system_id			Ex.12

Note 1: For displaying error messages when the IC card is not installed, refer to the procedure for Operation When Valid IC cards are Not Inserted in 5.16 of this manual.

Note 2: For handling error codes that do not appear in this table,
The following error codes that do not appear in this table are errors due to problems with the broadcasting station and or the receiver units, and codes generated by normal operation (ones that should not be handled as errors). As these are irrelevant to the operation of the viewers, the error codes/error messages are not displayed to the viewers.

(1) Errors considered to be in violation of protocols due to problems with the receiver units
(Code)SW1/SW2=6700, 6800, 6A86, 6D00, 6E00(all non-standard commands)
(Response of the receiver units)Does not display error codes/error messages.

(2) Errors from PPV automatic purchasing by reservation
(Code)8141PPV program number disagreement(Viewing not possible.)
4040PPV program number disagreement(Viewing possible)
(Error reason) When PPV is automatically purchased by reservation, programs purchased by reservation and programs that are actually broadcast do not match due to the reason that the previous program has been extended etc.
Whether viewing is possible or not means the program which is being broadcast can be viewed or not.
(Response of the receiver units)
The receiver units issue and retry the PPV program purchase command until the return of a "Purchase Complete: Pay Later PPV" response is acquired within the

reservation purchase time limit by the contract confirmation command. Even if the reservation purchase time limit is over, retry is discontinued and it becomes a PPV automatic purchase failure when this code returns.
Error message display while retrying is unnecessary. When the automatic purchase operation finally fails, some sort of display is required but the method depends on product planning.

(3) Errors that show there is no relevant data

(Code)A101 no corresponding relevant data

(Error reason) The relevant data that should respond to the automatic display of message information acquisition command, the call date request command and the power distribution control information request command, does not exist in the card. Whether the information exists or not is different according to the operation of broadcaster or the contract of each user. Therefore, even if the information does not exist they are not errors.

(Response of the receiver units)
Does not display error codes/error messages.

(4)Other errors

(Code)A1FE Other errors

(Error reason) Errors caused by rule violations, etc. due to problems with the broadcasting station and receiver units.

(Response of the receiver units)
Does not display error codes/error messages. However, in cases where the relevant error code is caused by a command that sends Ks back from the IC card such as the ECM reception command and the PPV program purchase command, etc, are excluded.
Additionally, when the relevant error occurs by the command that sends Ks back from the IC card, it becomes a descramble error. Errors indicated in this case are a matter of product planning, however a reference example is shown below.

[Error Display Example]

Errors occur in information in order to cancel scrambling descrambling the program.
Please contact the customer center of the channel being viewed.

Code: A1FE

(5) Call not possible

(Code)11FF Call not possible

(Error reason) The "User call request command" is given in the IC card from the receiver unit side without receiving the IC card instruction "Retry over notification".

(Response of the receiver units)
Does not display error codes/error messages.

Ex. 1: IC card not installed (During scramble broadcast reception)

Please install the IC card correctly.

Ex.2: Unavailable IC card installed

(For valid/invalid/unavailable IC cards, refer to 5.13 Regarding Valid/Invalid/Unavailable IC Cards of this manual.)

This IC card cannot be used.

Please contact the customer center of the channel being viewed.

Code:****

Ex.3:Non-contract(No Kw)

- Case 1: The IC card response is A103, and CA_system_id described in the Conditional Access system descriptor of the program being selected and broadcaster identifier described in ECM are different than the broadcaster identifier used by protected free programs described in Vol. 8 in this manual.

(For pay programs)

This channel has not been contracted.

Please contact the customer center of the channel being viewed.

Code:****

- Case 2: The IC card response is A103, and CA_system_id described in the Conditional Access system descriptor of the program being selected and broadcaster identifier described in ECM are the values used by protected free programs described in Vol. 8.

There is no required information in this IC card.

Please contact the customer center of the channel being viewed.

Code:****

Ex.4:Non-contract(outside the contract)

This channel cannot be viewed.

Please contact the customer center of the channel being viewed.

Code:****

Ex.5:Non-contract(expired)

The contract period has expired.

Please contact the customer center of the channel being viewed.

Code:****

Ex.6:Non-contract(limited viewing)

According to the conditions for viewing, this channel cannot be viewed.

Please contact the customer center of the channel being viewed.

Code:****

Ex.7:Outside the Purchase Period/Purchase Not Possible Screen

Since the application period has been ended, this channel cannot be purchased.

Code:****

Ex.8:Data Full/Purchase Not Possible Screen

After connecting the telephone line, please contact the customer center to view this channel.

Code:****

Ex.9:IC card exchange

IC card exchange is necessary.

Please contact the customer center of the channel being viewed.

Code:****

Ex.10:Other errors

This IC card cannot be used.

Please contact the customer center of the channel being viewed.

Code:****

Ex.11:Invalid IC card(for scramble broadcasting reception)

(For valid/invalid/unavailable IC cards, refer to 5.13 Regarding Valid/Invalid/Unavailable IC Cards of this manual.)

This IC card cannot be used.

Please install a proper valid IC card.

Code: EC01

(The code in example 11 displays the above error code and not a card return code.)

Ex.12: Non-conforming CA_system_id

(Refer to 5.6 of this manual for accessing the conformity of CA_system_id.)

This IC card cannot be used for viewing.

Please contact the customer center of the channel being viewed.

Code: EC02

(The code in example 12 displays the above error code and not a card return code.)

5.15.2 Related Standards

- Refer to Chapter 4　4.2.5 Error Notification Display of Part 1 of ARIB STD-B25.
- Refer to Vol. 2 for integrated error messages.

5.16 Operation When Valid IC Cards are Not Inserted

5.16.1 Error Message Display Method When Valid IC Cards are Not Inserted

- -When the selected program is scrambled and the receiver units detect that a card is not installed, display a message to prompt the installation of a card. Refer to 5.15 Error Notification Display of this manual to display this message.
- -The followings are the explanations for error messages required to be displayed if the IC card is not installed or if the installed IC card is invalid when the selected program is not scrambled.
- -In this case the error message uses the automatic display of message method as follows.

5.16.1.1 Conditions for Displaying Error Messages

- -For when the IC card is not installed or when the installed IC card is an invalid IC card.
- -When the service_id for the channel being selected has been described in the CA service descriptor described in the CAT.
- -Display when the power is on and when the channel is being changed.

5.16.1.2 Display Method

- -For acquisition of the EMM common message, when an IC card has not been installed, acquire the corresponding EMM message by using the CA_system_id for the default message code described below.
- -The default message is defined by a corresponding EMM individual message in the relevant service. More specifically, an EMM individual message reception command is issued to the IC card for the CA service descriptor's broadcaster identifier, and the receiver unit processes the following message code acquired from the IC card.
- -The default message codes are as follows.

  Expiration date: 0xFFFF

    Message fixed format number: Upper byte is the relevant broadcaster identifier, lower byte is 0x01

  Difference format number: 0x01

  Differential data:0x00(No information)

  CA_system_id: Refer to Vol. 7 of this manual.
- -As in the case of 5.10 automatic display of message of this manual, when attaching colors for characters and frames, consider not using bright colors more than is required so as to not interfere with program viewing.

- -The display of the on/off control and other display points are similar to displaying messages in 5.10 automatic display of message of this manual.
- -When it is possible to show program images in non-scramble broadcasting, display this error message by superimposing it on the viewing screen.

5.16.2 Conditions for Fixed Formats when IC Cards are Not Inserted on the Sending Side

- Standard sentence number: Upper byte is the relevant broadcaster identifier, lower byte is 0x01

5.16.3 Others

- -Refer to Chapter 4　4.2.2 Power On of Part 1 of ARIB STD-B25.
- -Whether or not to display this message is not provided in the output image to analog VTR.

5.17 System Test

5.17.1 IC Card Test

- -The receiver must have a user interface for testing the IC card.
- -This function notifies the results of the IC card test.
- -The success of the IC card test is, at the very least, successful completion by the default setting command.

5.18 CA Substitute Service

5.18.1 Function Outline

- -When the viewer selects the scramble broadcast service (Pay channels and protected free program. Hereinafter, link source service), there is a function that prompts the user to select a channel (hereinafter, link source service) managed by the relevant broadcaster when either of the following conditions apply.

(1) A contract with the pay broadcaster has not been concluded.

(2) The user has a contract with the pay broadcaster controlling the selected channel but the selected channel is not a contracted channel.

- -Channels using the CA substitute service are identified by the presence of the "linkage_type set to 0x03 " link descriptor placed in the SDT. Only when the link descriptor has been described, does the CA substitute service start.

- -When the CA substitute service starts, ask the viewer for confirmation on whether or not to transfer to the link source service. If the viewer agrees, transfer to the link source service.
- -The link source service is a "Channel Guide" used for promotion, and online contracts, etc. that use data broadcasting.
- -The function-name for describing this function to users with a manual, etc. is the "Channel Guide Switch Function".

5.18.2 Basic Use

－ The CA substitute service processing flow for when the link source service uses supplemental data broadcasting is shown below. The flow ([6] [7] [8]) after transferring to the link service is one example.

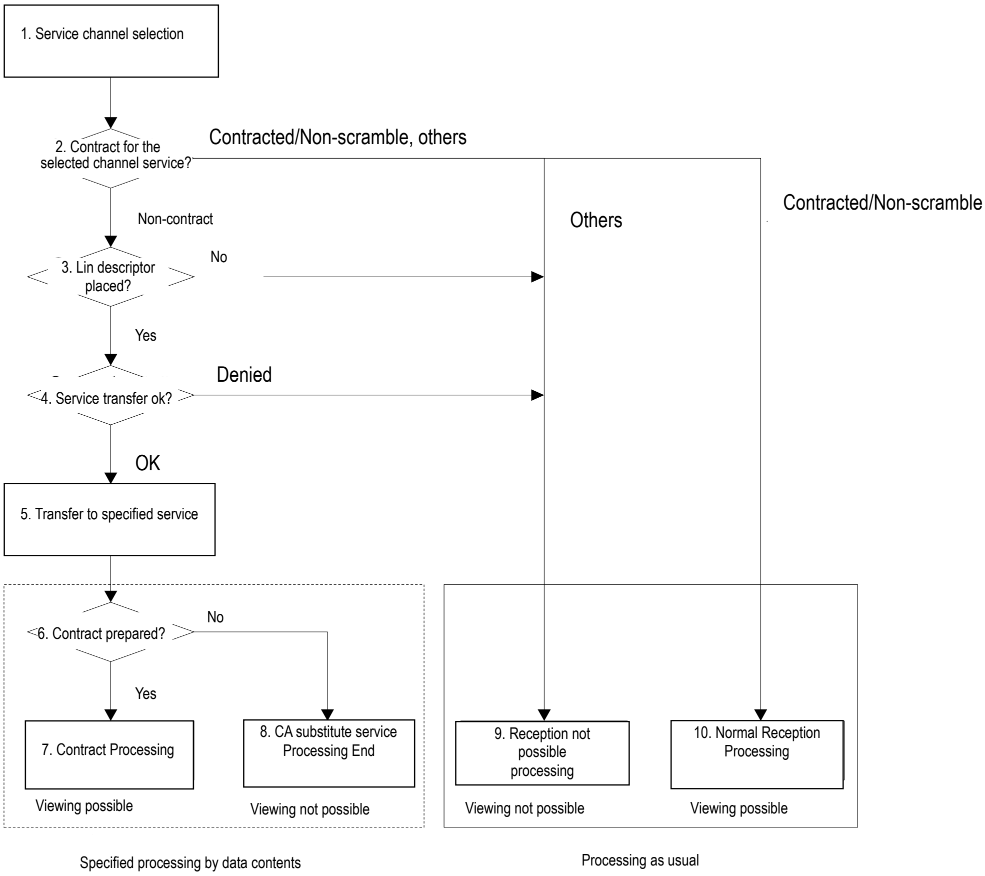


Figure 5-2 CA substitute service processing flow example

[1]Viewer selects the relevant channel (service).

[2]Confirm the contract by the ECM in the same way as normal channel selection.

1) In case there is no contract, CA substitute service processing ([3]～)

A non-contract is a received program in scramble broadcasting and when the return code from the IC card for the ECM reception command is applied to the next table.

Table 5-1 Return code for non-contracts

Return code	Details
A103	Non-contractual(No Kw)
8901	Non-contractual(Outside the contract; tier)
8902	Non-contractual(Expired; tier)
8301	Non-contractual(Outside the contract; Deferred

	payment PPV)
8302	Non-contractual(Expired; Deferred payment PPV)
8501	Non-contractual(Outside the contract; Pre-paid PPV)
8502	Non-contractual(Expired; Pre-paid PPV)

When an IC card is not inserted and an invalid/unavailable card has been inserted instead or when the CA_system_id acquired by the response from the CA_system_id and IC card described in the PMT of the relevant program does not correspond, regular error processing is carried out without being accessed as the non-contract.

2) For expired contracts/scrambling and other cases, normal reception processing ([10]) and reception not possible processing([9]).

[3] The presence of the SDT link descriptor placement is confirmed.

1) When the link descriptor is placed, service transfer confirmation processing([4]).

2) When the link descriptor has not been placed, regular reception processing is not possible([9]).

Note: The linkage_type = 0x03 link descriptor displays the CA substitute service.

[4] Display a unique transfer confirmation message (hereinafter, transfer confirmation message) for the broadcaster described in the link descriptor or the message built-in the receiver units, and confirm the permission and the intent of the viewer to transfer to the link source service with the viewer. The transfer confirmation message is described in private_data_byte of the link descriptor. When there is no description in private_data_byte of the link descriptor for the CA substitute service, the message ("A contract and registration are necessary to view this program. Details are introduced in the channel guide.") built in the receiver units is displayed.

1) When the viewer permits the transfer to the link source service, transfer processing ([5]) of the service is carried out.

2) When the viewer denies transfer to the link source service, regular reception processing cannot be carried out ([9]).

Note:
-When other options (transfer denied) to move to the relevant screen are provided, they are carried out with normal non-contract processing.
-It is also possible to remain on the screen, when there are no other options (transfer denied) to move to the relevant screen.(Depending on selections made by the viewer for the relevant screen.)

3) When multiple transfer confirmation message numbers (hereinafter, message number) are used in the SDT of the TS being received by the specifications on the transmission side of the CA substitute service, one or more main bodies of the message is sent in that TS, but it is also possible to abbreviate the main body of the same message. In that case, display by referring to the display for the main body of

same message number. When the main body of the message is not defined in the same TS as exception handling, the message built-in the receiver unit is displayed.

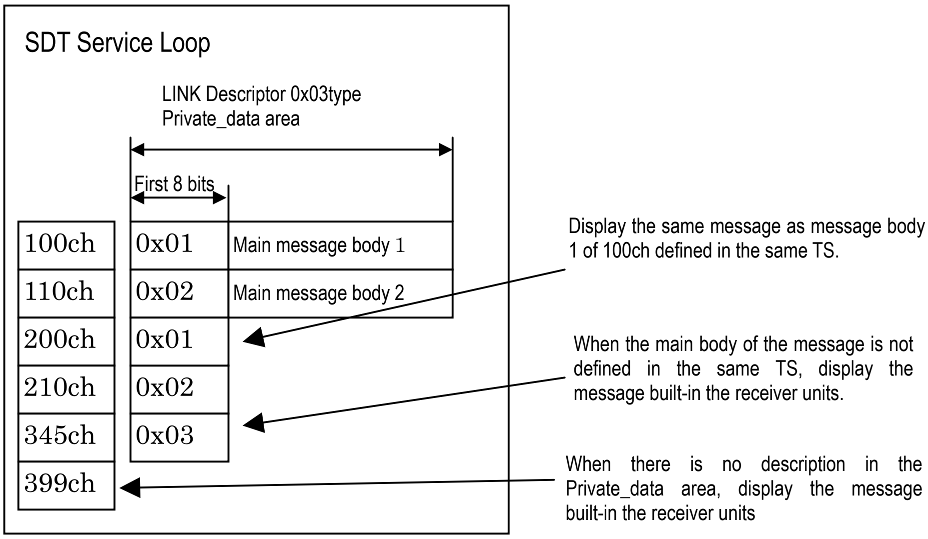
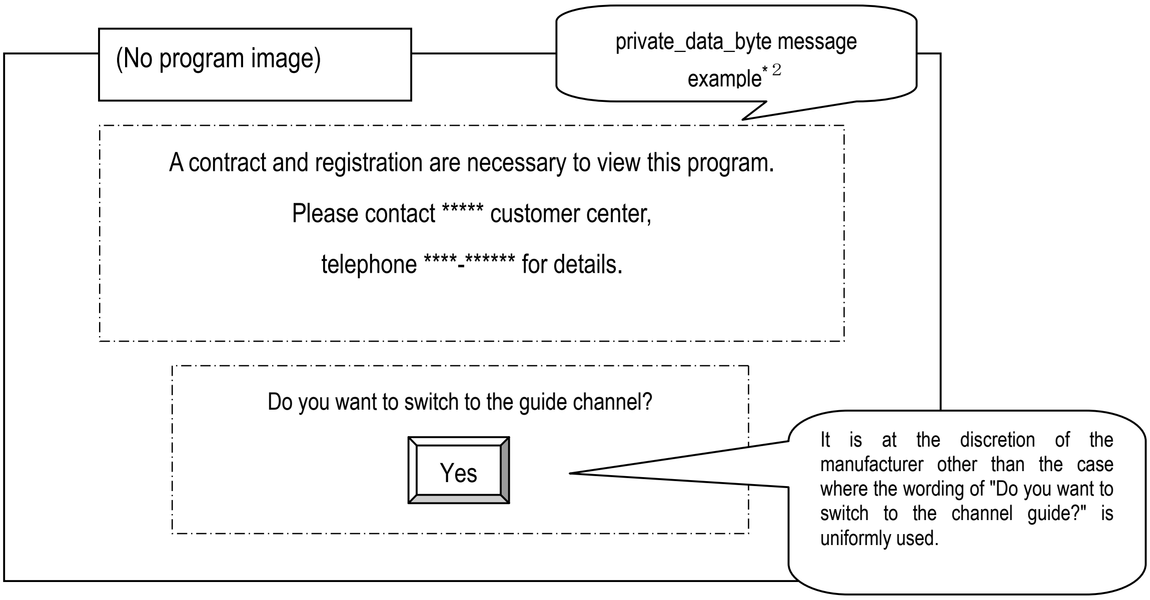


Figure 5-3 Use of the CA substitute service and receiver unit processing example

4) The transfer confirmation messages are 80 characters and 160 bytes or less. Additionally, assume a maximum of 24 characters per line and 6 lines or less (including line breaks) for the number of display lines as display specifications.

5) When the link descriptor is placed, display the transfer confirmation screen as in the example below in addition to the message (or, the message built in the receiver units) described in the private_data area of the link descriptor. The text displayed here is built into the receiver units beforehand, and the contents are, "Do you want to switch to the guide channel?" The method for displaying the display frame, etc. depends on product planning.

An example of the transfer confirmation screen is shown below.



(Note[*1]) When the CA substitute service function is described to the user with the manual, etc. , the " Guide Channel Switch Function" is used.

(Note[*2]) When there is no description in private_data_byte, display the "Contract and registration are necessary to view this program. Details are introduced in the guide channel," message built-in the receiver unit.

Figure 5-4 CA substitute service[*1] Transfer confirmation screen example

[5] Link source service information is acquired from the link descriptor of the SDT, and the service is transferred.

Transfer to the link source service in accordance with the original_network_id/ transport_stream_id/ service_id for the link descriptor.

<Examples [6][7][8] for specification processing by data contents>

[6] The intention of the contract is confirmed in the program of the link source service. The intention confirmation method differs according to the pay broadcaster.

1) When there is an intention of making a contract, the contract is processed([7]).

2) When there is no intention of making a contract, the CA substitute service processing ends([8]).

[7] Contract processing with the viewers is carried out. Contract processing is different in each pay broadcaster such as on-line processing using data broadcasting, etc. and off-line processing for sending contracts, etc. Do not return to the previous link service after processing ends.

[8] Termination of the CA substitute service is carried out. Do not return to the previous link service after processing ends.

<Processing [9][10] as usual>

[9] Processing for services which cannot be received as well as normal reception that cannot be carried out.

[10] Reception processing of the selected service is carried out as well as normal reception operations.

- -The receiver unit displays the transfer confirmation screen by starting the CA substitute service when the viewer selects a non-contract service directly or with EPG or the up and down keys. However, the CA substitute service will not start when the following conditions apply.

1) The viewer is already signed on the contract.(In cases other than the non-contract displayed [2] above.)

2) The service that the viewer selects is operated by non-scramble.

3) When service_type of the link source service does not compatible with the receiver unit.

4) When the link which is not the object for selection by the receiver units is specified (ie. service in the network which is not the object of reception, etc.).

- -When a non-contract pay broadcast service is reserved, do not start the CA substitute service for the service when the reservation is being set.
- -Since the transmission cycle is longer for the SDT in comparison to the PMT, it is expected that it will take some time before the SDT is received, the presence of the link descriptor is confirmed, and the transfer confirmation screen is displayed. For this reason, after the relevant service is selected, it is also conceivable that the non-contract message built into the receiver units switches to the transfer confirmation screen after being momentarily displayed. In order to prevent this behavior from occurring each time a selection is made, it is recommended that the receiver units cache the SDT to RAM and immediately display the transfer confirmation screen after the selection of the relevant service.
- -There are 20 types of CA alternate messages sent at the same time with CA alternate message numbers between 41-60 (0x29-0x3C) for Terrestrial Digital Television Broadcasting. When numbers for the CA alternate message number other than this message number are sent, the receiver units consider these messages invalid and will display the message built in the receiver units.

- -After final processing following the transfer to the link source service by the CA substitute service ([7] and [8] above), the link source service remains as is without returning to the previous link service. Additionally, even when the link source service is a video service or audio service without a data component, the link source service remains as is without returning to the previous link service. Transfer to another service depends on the viewer.
- -After the display status of the transfer confirmation screen is established and displayed once, it is not necessary to delete it until the user confirms it. Even when the display status changes to a failure while being displayed, automatic deletion is not required, and it is fine leave the display as is. However, in this case, the link conditions must be live, and if the user gives permission to transfer to the link source, transfer to the link source.
- -When the link source service is a service with supplemental data, the acquisition of the previous link service by the link descriptor and the acquisition of the link type when linked by the link descriptor are possible on the data contents. Refer to ARIB STD-B24 for the DOMAPI related to these BML documents.

5.18.3 Related Standards

- Refer to ARIB STD-B10 below.

Part 2	6.1	Identification and Placement of Identifiers
	6.2.8	Link Descriptors

- Refer to ARIB STD-B24 below.

Vol. 2	Chapter 7	Procedure Description Language

- Refer to Part 1 of ARIB STD-B25 below.

Chapter 2	2.2.2.15	Selection of Viewing Programs
Chapter 4	4.2.3	Program Viewing
Reference 2	3.15	Program Viewing

5.19 Caption and Teletext Scrambling and Display Priority

5.19.1 Caption

- -The default ES group basically depends on receiver unit product planning to display captions during scramble broadcasting. As a guideline, when the caption display becomes valid regardless of the scramble status for the caption component, it is preferable to display the default ES group only when descrambling has been normally carried out.

5.19.2 Superimpose

5.19.3 -The display of Superimpose while the default ES group is scrambled basically depends on receiver unit product planning.

5.20 Use of Devices which are Not Available for Pay Broadcasting in the Partial Reception Layer

5.20.1 Operations for Detecting the Conditional access system Descriptor in the PMT

- -In receiver units exclusively used for the partial reception of non-compliant conditional access systems, when pay broadcasting is received by the placement of the conditional access system descriptor in the first PMT loop, display the following error messages (example) which are non-compliant, and design it so as not to cause any malfunctions. However, when the conditional access system descriptor is placed in the PMT, the display of contents that are broadcast by non-scramble is a product planning matter.
- -Pay broadcasting　　Non-compliant message
  The program being viewed cannot be received by pay broadcasting.
  Error code: EC03
- -The pay service in the partial reception layer does not apply to the conditional access system in accordance with Part 1 of ARIB STD-B25 provided by this volume, and because it is provided at the start of operation, it is not necessary to install the pay broadcasting function in conditional access non-compliant receiver units during the start of broadcasting of the partial reception layer.
-

A Commentary

A.1　Specifications of the Conditional access system for Reception at the Start of Terrestrial Digital Television Broadcasting

A.1.1　Operation Limits in the 1st part of ARIS STD-B25

From the functions described in Part 1 of ARIB STD-B25 for terrestrial digital television broadcasting, some of the functions have been limited because they are not scheduled for use at the start of broadcasting.

Firstly, the functions that have been limited are PPV use, charge by ES, and the IRD data communication functions. Since operation of these functions will not be denied in the future but when operations actually begin, from the perspective of introducing the best operation method according to the environmental situation at that time, these provisions will be reviewed before the start of operations and introduced after completion of this review. In receiver units being sold at the start of broadcasting, the above limited functions do need not be installed but when new operations start, the identification procedure, etc. for PPV use at the start of operations is described in the provisions so as not to cause any malfunctions.

A.1.2 Operation of Multiple Condition Access Systems

For contents protection of terrestrial digital television broadcasting in this manual, the conditional access system used is provided in accordance with Part 1 of ARIB STD-B25. However, these provisions can operate multiple conditional access systems by preparing for the future introduction of an exclusive contents protection system that is suitable for when contents protection appears. The main purpose of these provisions is not to cause malfunctions in receiver units at the start of broadcasting even when multiple conditional access system descriptors are operated in the introduction of an exclusive method for contents protection. Therefore, it is the conditional access system descriptors and the CA service descriptor that can be arranged in the CAT and PMT. And provisions for an exclusive system for contents protection is not described since they depend on considerations in the future.

In receiver units sold at the start of broadcasting, it is assumed that the conditional access system only is installed in accordance with Part 1 of ARIB. In order to make it possible for these receiver units to view free programs for the purpose of contents protection, in the future, when an exclusive system for contents protection is introduced, the same Ks must be transmitted with both a Part 1 of ARIB STD-B25 compliant ECM and an exclusive system for contents protection compliant ECM as the following operation image shows.

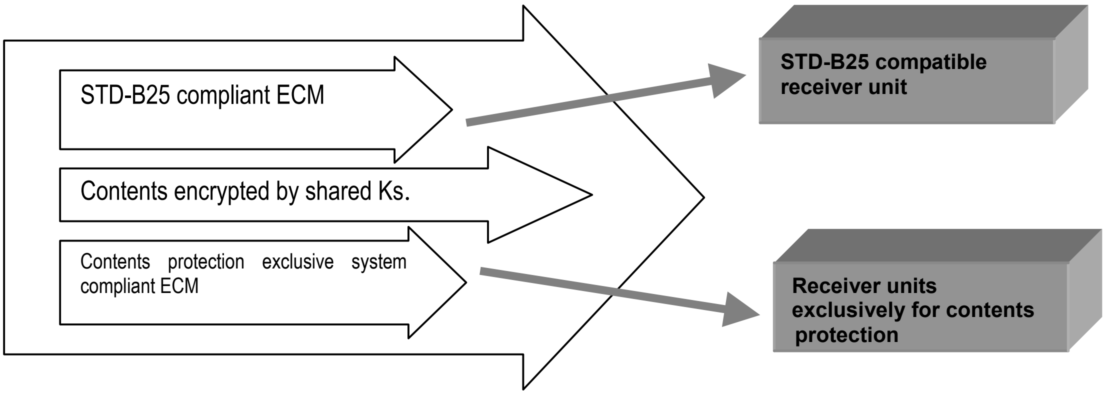


Figure A-1 Image when multiple conditional access systems are used for contents protection

The possibility of using multiple conditional access systems provided at this time is not limited to the contents protection purpose shown in figure A-1. For example, it does not mean that conditional access system operation for different charges in each program and channel (service_id) in the same TS are denied. The provisions are set up based on the assumption that processing will be carried out properly without causing any malfunctions by displaying a non-compatible message in conditional access system services that have not been installed in the receiver units even when this kind of operation is carried out.

A.1.3 Idea for a System Conforming with Part 1 of STD-B25 (Proposal)

In this manual, as previously mentioned, the use of multiple conditional access systems at the start of terrestrial digital television broadcasting has not been taken into consideration. The intention of this manual is the continuous use of circulated receiver units without as much confusion as possible, until such time that scramble broadcasting with contents protection uses a different and separate system from the system at the start of terrestrial digital television broadcasting in the future.

Here, since the clarification of the relationship between a contents protection method in broadcasting, a conditional access system, a system conforming to Part 1 of ARIB STD-B25, and the CA_system_id, which are operational parameters, is very important when the above opportunity occurs, an idea for this manual is described in below.

[Contents protection method in broadcasting]

Since contents are meaningless if they are not provided to the viewers, they are always handled as plain in receiver units. Therefore, a procedure to protect these plain contents through the contents themselves does not exist, and it is expected that the receiver units will function to protect the contents. The contents protection method in broadcasting is a method that can be carried out contractually by using technical procedures instead of legal measures for the functions in the receiver units. Therefore, they are not confined within the conditional access system.

Here, the usage of terms described in this volume "Contents protection method in broadcasting" and Vol. 8 "Contents protection method for recording" are different. The technology that prevents the falsification and the illegal copying of contents by using codes etc. is broadly defined as the contents protection method. And the contents protection method in broadcast is called a "Contents protection method in broadcasting" which here uses the conditional access system for this purpose. The contents protection method when recording in removable media etc. is distinguished as "Contents protection method for recording".

[Conditional access system]

The basic format for the conditional access system for digital broadcasting in Japan is provided by government regulations. These base elements are as follows.

a) Scrambling of contents is carried out at the TS level through encryption called MULTI2.

b) The key to releasing the scrambling is encrypted and transmitted by a table called ECM.

c) The key to solving the ECM code is called a work key and is encrypted and transmitted by a table called EMM that has identifiers according to the receiver.

d) The EMM with the identifier matching the receiver is decoded with an encrypted key in the receiver units according to the receiver.

e) A table called CAT has the conditional access system descriptor, and this descriptor clarifies the PID by which the CA_system_id and EMM are transmitted. The CA_system_id displays a specific conditional access system.

f) A table called PMT also has the same conditional access system descriptor, and this descriptor clarifies the relationship between the CA_system_id that displays a specific conditional access system, the ECM and the ES_PID that should be descrambled.

The conditional access system is based on the basic composition above.

[ARIB STD-B25 Part 1 compliant system]

Although the conditional access system outlined in government regulations has been brought together in a specific system by Part 1 of ARIB STD-B25, it does not display individual conditional access systems partly because the encryption method of relevant information has not been specified. Therefore, it is a set of conditional access systems. However, because the ARIB standards are revised by changes over time, it is necessary to sort out ARIB STD-B25 Part 1 compliant system. In this manual, the parts that may not change even if Part 1 of STD-B25 is revised in the future are assumed to be the following points.

a) Relevant parts in the conditional access system shown in government regulations.
b) As a security module, the low speed interface system that uses IC cards electrically in accordance with ISO7816.
c) Ones that completely conform to the current default setting command for IC card command/responses

[CA_system_id]

The CA_system_id is an identifier that displays individual conditional access systems. (Identifiers within the scope of conditional access systems in Figure A-2)

Figure A-2 shows the relationship of the above four concepts and a contents protection method in broadcasting that may be introduced in the future.

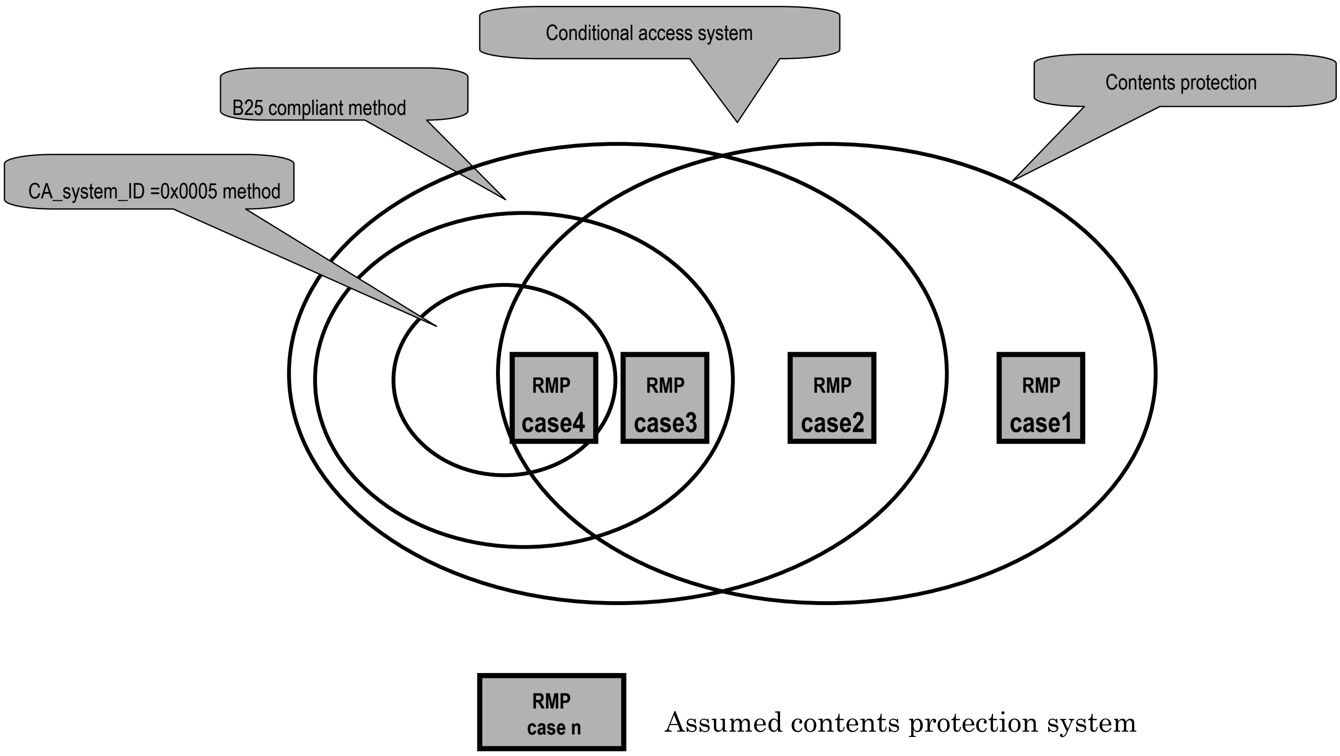


Figure A-2 Placement of contents protection systems in broadcasting with possibilities

The contents protection system in broadcasting that may be decided on in the future was classified into the above four in this manual, and in each case the operation standards have been decided so that the receiver units that have been circulated until then can continue to be used without problems as much as possible.

case1: This is a completely unknown method and at present preparation is impossible and moreover it is a case that requires government regulations and ARIB standards. In addition, this case will exceed the categories of operation standards for the conditional access system which is the role of this manual. Therefore, in this case, new standards must have the responsibility that receiver units that have been circulated until then can continue to be used without as much trouble as possible.

case2: In this case, since multiple conditional access systems will exist, they will be standardized in this manual so that the existence of multiple conditional access systems do not cause any malfunctions in the receiver units. In this case, it is necessary to set up additional new standards when this method appears.

case3: In this case, as in case 2, since multiple conditional access systems will exist, this case will be standardized by this manual so that the existence of multiple conditional access systems do not cause any malfunctions in the receiver units. In this manual, consideration has been carried out so that establishing new standards is not necessary when this method appears.
In preparation for this case, a specific number for the CA_system_id is not specified in this manual.

case4: In this case, the method for contents protection in terrestrial digital television broadcasting means operation will be similar to contents protection used in BS/wide-band CS digital broadcasting, and in particular, there are no large, technical worries.

The above cases describe the basic ideas examined as preparations for newly established contents protection systems in broadcasting in the future while the operation provisions for conditional access systems for terrestrial digital television broadcasting are being settled on.

A.1.4 Valid IC Cards

This paragraph is written as an explanation for when Chapter 5.13, which was a TBD matter until when 1.3 was revised, is clarified.

First, it was assumed that the one to identify the conditional access system was the CA_system_id in this manual. Then, when multiple conditional access systems were used, the handling of the CA_system_id was considered as follows.

It was provided that the conditional access broadcast service can be operated regardless of the value of the CA_system_id when a valid IC card was installed in the receiver units and the conditional access system is valid.

Here, the valid IC card refers to cards compliant with Part 1 of STD-B25 (version 4.0). Therefore, non IC card formats are not targeted, and non IC card formats will be provided along with the revisions/maintenance of the ARIB standard, etc. The standard for judging validity by the default setting command/response is used so that the valid/invalid judgments can be conducted when the ECM is not received such as when the power is on and the card installed.

For the system_management_id which is one of the valid card conditions, the contents of the original conditional access system are irrelevant values. There was also the idea of removal from the valid condition. But, considering the consistency with TR-B15, the ones including system_management_id in the terrestrial digital television broadcasting are valid and considering consistency with CA_system_id set to 0x0005 at the start of broadcasting, the ones including 0x0201 is described are valid.

Regarding the card type, as described in A2 of this volume, for example, when the mutual authentication function of the receiver units and the IC card are installed, they are not compatible with receiver units compliant with version 1.3 of this manual. Therefore, it is considered that the use of cards other than the 0x01 card type and incompatible cards are able to be assessed by the receiver units.

Also, for valid conditional access systems, as described in this manual, it is provided that a valid conditional access system is a service in which a valid IC card and CA_system_id in broadcasting wave are matched and that valid conditional access method does not depend on the value of CA_system_id. Therefore, the provision is that pay broadcasting by conditional access systems other than those with CA_system_id set to 0x0005 is possible if the above conditions are met.

A.2 Mutual Authentication Function

In Chapter 5.6 of version 1.0 of this manual, the Mutual Authentication Function (TBD) was described. When the conditional access system is used for the purpose of contents protection, the Mutual Authentication Function should be a function to authenticate the receiver unit for the enforcement of the provisions in contents protection, and should not be a function to authenticate the individual viewer which was the original purpose of conditional access service. Therefore, the introduction had been examined.

For the Mutual Authentication Function, like the exclusive system for contents protection described in A.1.2, the maintenance of method development, contract scheme, etc. is necessary and it was difficult to meet the date for the receiver units at the start of broadcasting. Therefore, at the start of broadcasting, conditional access method installation specifications were compliant with Part 1 of ARIB STD-B25, which does not have the mutual authentication function.

For the Mutual Authentication Function, consideration will be given together with an exclusive system for contents protection, and the revision of operation provisions is required according to necessity when the details are decided.

In version 1.1 of this manual, due to the above reasons, Chapter 5.6 Mutual Authentication Functions has been changed to “Judgement of Valid Conditional Access Systems” for the operation of multiple conditional access systems.

A.3 EMM

A.3.1 EMM transmission TS in terrestrial digital television broadcasting

As TS for transmitting EMM's in BS and wideband CS, in addition to the TS for programs of each broadcaster, the expected method is the sharing of specific TS by multiple broadcasters and using the specific TS as an exclusive TS for EMM transmission.

Since, in terrestrial broadcasting , network IDs are given to each transmission master and a receiver unit cannot receive all the domestic network, the operation of sharing specific TS by multiple broadcasters is difficult. Therefore, in terrestrial digital television broadcasting, all EMM's will be transmitted by TS for programs, and not by specific TS.

A.3.2 EMM Transmission of Partial Reception Layer(T.B.D.)

A.3.3 Notification to Users of a Power Control Function

It has been previously described that power control and power call-out control will be operated to create an energy saving design possible in this conditional access system. Since the receiver unit is required to manage EMM reception by an internal timer in this method, it is preferable that a notification is sent out to users in order to maintain the function. In other words, along with working hard to save energy during standby, it is preferable to notify users with the operation manual, etc, to be sure about the reception of EMM during standby through the following points.

- -Receiver units are designed to save energy during standby..
- -It is recommended that power should be turned off by remote control for the control of the reception of individual information (EMM), except in emergency cases and long term absences such as trips when receiving conditional access service.

A.3.4 EMM message

(1) Format Creation Background

The EMM message format is not provided in Part 1 of ARIB STD-B25 and it is standardized in this document for the supplementation. The background is described in below.

There are mail and automatic display messages in EMM messages. For the display format, the receiver unit specifications are ok with mail, but since the automatic display message is an imposed message, a control code to allow the display position to be controlled even roughly is defined. Not providing a CAS exclusive function for displaying some characters, the usage of measures installed in receiver units such as subtitles was also considered, but due to the reasons such as it is not possible to specify the image format in which a message will be displayed, as described in this manual, the format was adapted which controls only the rough display position and details will be up to with receiver units.

For the maximum number of characters in the automatic display message, in Part 1 of ARIB STD-B25, it is described that the maximum is 400 bytes, but due to the expectation for character size installed in receiver units and considering the position control of up, middle, down, right and left justification at the stage of examination, a limit has been set for the number of characters and lines. Also, for the frame of the image, in order to allow for as much of the image to be seen as possible, a frame for the image is used to distinguish it from other captions, etc., and the frame will be optimized by receiver units with the maximum number of characters per transmitted line and the maximum number of lines.

(2) Regarding the number (N) of message IDs that one broadcaster can send simultaneously.

The number of messages that 1 broadcaster can transmit to one receiver at the same time in ARIB TR-B15 (version 2.0) is N=4 in BS digital broadcasting and N=7 in wideband CS digital broadcasting. In terrestrial digital television broadcasting receiver units, when the devices to be used for BS digital broadcasting and wideband CS digital broadcasting are shared, BS digital broadcasting or terrestrial digital television broadcasting can not be identified by the value of each broadcast ID.. Therefore, a large numerical number is used in order not to cause the confusion in these common receiver units and N is set to 7.

A.3.5 EMM Transmission Specifications Type A and Type B

・Type A and Type B are defined as EMM transmission specifications. Only Type A has been adopted in BS digital broadcasting, while both can be used for wideband CS digital broadcasting and terrestrial digital television broadcasting.

・Type A is a transmission method with the transmission efficiency of EMM as the main objective. In order to pack and send multiple EMM's in 1 section (4096 bytes or less), the overhead of the section format (12 bytes total for the header and CRC error detection) can be minimized with good transmission efficiency. However, the filtering process that pulls out only the EMM which is for that receiver unit needs software processing and the upper limit of the EMM transmission rate is limited to 320kbit/s so that the CPU load does not hang the receiver units (When it is sent by TS for programs).

・Type B is a transmission method with mass transmission of EMM’s as the main objective. Because it sends 1EMM with one section, the overhead of the section format increases compared to Type A.(However, a multi section format is possible and it is possible to pack multiple sections in 1TS packet and send.)However, it becomes possible for the receiver units to carry out the filtering process with hardware, and the upper limit in the EMM transmission rate can be raised to 2.0Mbit/s.

Because the hardware filter for the receiver units is required, it is necessary to narrow them down to only one kind of card ID to save filter resources. The use of group ID's is prohibited.

・The size of the EMM's is different depending on the contract and CA method but, for example, the following differences appear when both specifications are compared under the condition that an EMM is 40 bytes.

(Type A)

1 section(4092 bytes)=header(8)+EMM(40)×102 parts+CRC error detection (4).

Overhead rate=12/4092=0.29%

No. of EMM's that can be transmitted in 1 second=Approx. 900*1(When 320 k bits/s are transmitted)

(Type B)

1 section(52byte)=header(8)+EMM(40)×1 part+CRC error detection (4).

Overhead rate=12/52=23%

No. of EMM's that can be transmitted in 1 second=Approx.4700*2

(When 2 M bits/s are transmitted)

・Initially, Type A only was standardized as operation standards for BS digital broadcasting. When wideband CS digital broadcasting standards were being decided, contract changes will frequently be generated in CS broadcasting and it will be necessary to send a large amount of EMM's. Because of these characteristics, Type B specifications were added.

Since the number of EMM's that should be sent and the EMM transmission capacity that can be allocated are different by the broadcaster, each broadcaster (accurately, TS units) can select Type A or Type B by itself.

Note*1(Type A)

・Number of necessary TS packet for transmitting 1 section (102EMM)=4092/184=23 packets.

・Number of EMM's that can be sent in 1 second when a maximum of 320 k bits/s is allocated =320kbit/(188×23×8bit)×102=943 parts.

Note*2(Type B)

・Number of EMM's that can be sent in 1 second when a maximum of 2.0 k bits/s is allocated =(2.0Mbit×184/188)/(52×8bit)=4705 parts

Since multi section operations that extend over multiple TS packets with a total of 14 bytes for the section header (8) + card ID (6) is prohibited, actually, it decreases a little more.

A.4 ECM Operation

A.4.1 Repetition Cycle

The ECM repetition cycle is described in 4.10.5.2 Updates/Repetition Cycle of this volume and the maximum amount allowable is described in 4.10.6.2 ECM Suspension of this volume.

Specifically,

100ms□ECM repetition cycle < 2 seconds

Since the ECM repetition cycle decides the "Time until the contents display when a channel is selected", it should be short. Then, it is operated by the ECM repetition cycle approx. 100ms excluding the partial reception layer.(TBD for operation of ECM's in the partial reception layer.)

However, it is recommended that the design of receiver units be based on the ECM repetition cycle within a range of approximately 100ms-1000ms.

A.4.2 Update Cycle

The ECM update cycle is described in Vol. 4.10.5 ECM Updates/Repetition. Specifications for receiver units are based on timing corresponding to the processing performance of the IC card,

- -with a maximum 800ms for processing 1 ECM and
- -the update interval of different ECM's is 1000ms or more.

Additionally, the following assumes the update cycle is 2 seconds or more.

-Terrestrial counterprogram recording while watching terrestrial broadcasting on a TV screen is processed with 1 IC card.

-The same thing is also processed in 2 screens simultaneous display of 2 random channels with 1 IC card.

From the above if the update interval of an ECM is 2000 ms or more, it will be possible to process two random channels in different TS with one IC card.

- -Additionally, a standard recommendation value of the update cycle was described from the viewpoint of securing security for scrambling.

A.4.3 Relationship of ES and ECM When Updating PMT

A.4.3.1 Background and Details

In terrestrial digital television broadcasting, a lot of broadcaster is expected to broadcast in scramble. For this reason, the transmission system for broadcasting should be a system which can be introduced and operated easily with a small load rather than a progressive and complicated system which is compatible with various charging systems of pay programs. Based on that idea, the operation provisions are set to minimize the control of the scramble/non-scramble status in PMT update as much as possible.

A.4.3.2 Assumed Broadcasting Signal Status and Receiver Operation when Updating the PTM

Factors that should be considered for updating the PMT from the viewpoint of the conditional access system are classified as follows.

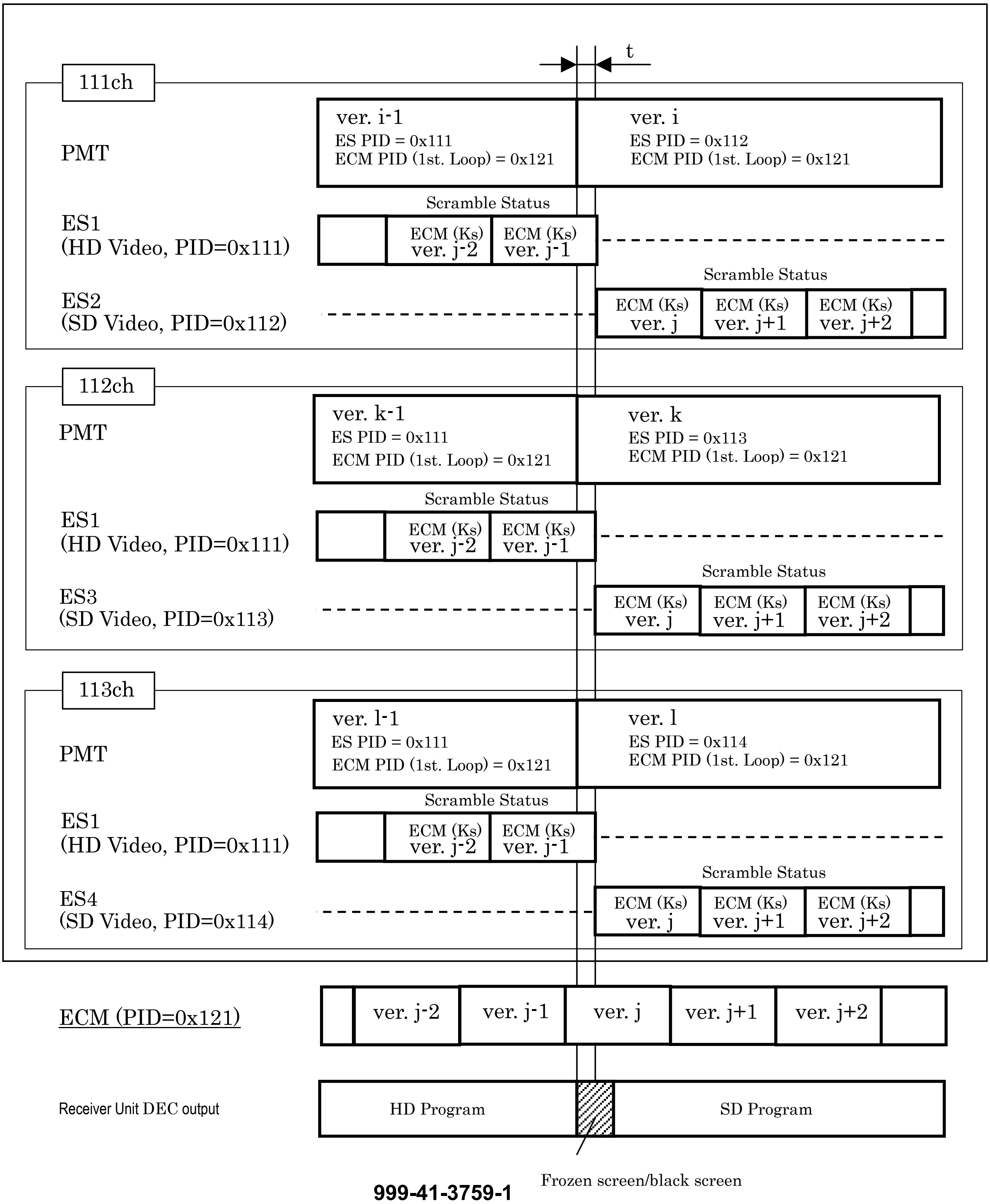
a) Switching from non-scramble broadcasting to scramble broadcasting.
b) Switching from scramble broadcasting to non-scramble broadcasting
c) When the ECM_PID is changed.
d) When the PID for the ES is changed.
e) When the new ES is added.
f) When the ES disappears.
g) When there is no intention to increase and decrease the number of ES's, change of ES PID, change of ECM_PID, and change of scramble or non-scramble status, etc.

Among a) to g) above, for a) and b), follow each respective procedure in 4.10.4.1 Start of Scrambling of this volume and 4.10.4.2 End of Scrambling since the control of scramble/non-scramble status is itself the purpose.

For cases that include c) as a factor in PMT updating, since it is recognized that leaving the control of the scramble key on the transmission side before and after switching the ECM_PID in the scramble status is difficult, follow the procedure described in (1) ECM_PID in 4.10.4.3 Change in the Relationship Between ES and ECM that Transmit Broadcast Program Elements of this manual.

When neither a) to c) are included as factors in PMT updating (specifically, any of d)-g) or when they are combined), it is believed that it would be possible to continue to being compatible with the scramble status without any special load during receiver unit development, because the processing load on the receiver units is reduced by the operational limits on component charging.(Refer to (2) when there is no change in the ECM_PID in 4.10.4.3 Change in the Relationship Between ES and ECM that Transmit Broadcast Program Elements of this manual.)

As one example, it explains the broadcasting signal and the receiver unit operation during the switch from the HD program to the SD program (3ch).



999-41-3759-1

Figure A-3 Broadcasting signal and receiver unit operation when switching from one HD program to three SD programs (3ch)

receiver unit process for switching the ES is carried out by the trigger of the PMT update. At this time, when the AV decoder buffer becomes underflow even by a seamless switching non-compatible receiver unit or by a seamless switching compatible receiver unit as described in Part 2 of 4.3 ARIB STD-B20 Seamless Switching, there may be cases where a frozen or black screen (muting status) image is generated regardless of continued scrambling. Therefore, it is recommended in contents production to consider (insertion of a still picture with no sound, etc.) in this case. Additionally, when scrambling continues during PMT update, some receiver units can exist that re-acquire scramble keys (Ks) by the PMT update. In these kinds of receiver units, compared with non-scramble, it is possible that the freeze and muting time of the image and audio will become longer only for the re-acquisition of Ks. Since there is only one Ks operated at the same time for the same service for operational limits of component charges in terrestrial digital television broadcasting, it is also possible by saving the Ks of before PMT updating to decrease the influence of scrambling for freezing and muting images/audio during PMT updating.

A.5 Assumption for the Operation of the Broadcaster Identifiers

- -For the operation of broadcaster identifiers in terrestrial digital television broadcasting, a single broadcaster identifier number will be commonly used in all the nationwide protected free programs.
- -Since broadcaster identifiers in pay programs are limited in number, it is assumed that one broadcaster identifier will basically be used for each affiliate and shared by broadcasters belonging to the affiliate through tier operation
- -For the operation of multiple conditional access systems, it is assumed that the value for the broadcaster identifier will be unique in a CA_system_id.

A.6 Assumption of Message ID for the CA Substitute Service

The main purpose of CA substitute service is to link viewers with the promotion information of the pay services, etc. when pay channel is selected. It is considered that the contact phone number for the customer center, etc. will be presented in the message of CA substitute service. It is assumed that this customer center will be operated by not each broadcaster but the affiliate which has a common broadcaster identifier.

On the other hand, since a maximum of 32 broadcaster identifiers will be managed in the receiver units, 20 or fewer message ID’s in the CA substitute service will be managed in nationwide terrestrial digital television broadcasting. (Maximum 32 broadcaster identifiers consisting of BS, wideband CS and terrestrial in total.)

It is assumed that the message ID for the CA substitute message will be adjusted by the above mentioned broadcasters which have broadcaster identifiers.

A.7 Correspondence of Receiver Units Installed with the Bound Recording for Automatic display of message

If automatic display messages can be displayed with the play signal in the future, it may cause a problem If this occur, the way to avoid the problem is only to stop the display of messages In order to avoid this possibility, a function is conducted to control whether or not an automatic display message is displayed to the stored/played signal in the Bound Recording installed receiver units.

In this provision, if 0 is used as the lowest bit, the renewal period is an even number day, and if 1 is used it is odd number day. For example, the difference between a 30-day or 31-day renewal period is not significant and the lowest bits of 0 and 1 control the message display in the Bound Recording installed receiver units. Therefore, display control does not affect receiver units which do not have the Bound Recording and these receiver units are controlled by the designated renewal period.

A.8 Card ID Display

The purpose of the Card ID display is the ease to confirm card ID’s by customer centers when viewers make inquiries mainly related to EMM reception for pay services and services which operate automatic display of message, etc. Since these inquiries are related to EMM reception, card ID’s are often handled by the customer centers of the broadcasters and it is required for receiver units to implement the function of presenting card ID. Also it should be noted that viewers can not easily find the installed card location in the receiver units and many viewers do not want to pull out the card because of accidental trouble so the way to handle the card is not recommended.

The user interface for the card ID display function as a function of receiver units is a product planning issue for the manufacturer, but due to the above reasons, in order to avoid viewer confusion as much as possible, it is preferable that the display function operation be simple for viewers to operate. For example, by having fewer buttons to operate, a display is possible with a shallow menu layer in the receiver unit.

A.9 Introduction of Pay Broadcasting in the Partial Reception Layer

At the start of partial reception layer broadcasting, no provisions for pay broadcasting will be provided. Since operations will be conducted with an appropriate method at the start of operations, pay broadcasting function will not be installed in partial reception system receiver units. Therefore, when pay broadcasting begins in the future, pay broadcasting will not be able to be received by the current partial reception system receiver units which are not compatible with pay broadcasting. To prevent from end user confusion the co-existence of free and pay programs should be avoided as much as possible.

A.10 Basic Concept of Necessities/Options

Table A-1 Necessities/option of the receiver units regarding conditional access

No	Service using CAS	Specifications of receiver units	Receiver units exclusively for the partial reception layer system	Receiver units exclusively for other than the partial reception layer system
1	Basics	Low speed CAI/F	C	A
		ID number display	C	A
		Error notification	A	A
		Power control	C	A
		De-scrambler	C	A
		IC card test	C	A
		Support of multiple CAS operation	A	A
2	Protected free program	Normal view	C	A
		Program reservation	C	B
		Error notification	C	A
3	Pay broadcasting: Flat/Tier	Flat/tier view processing	C	A
		Pay broadcasting reservation	C	B
4	Pay broadcasting : pay per view	PPV view processing	C	C
		Implementation of phone modem	C*1	C*1
		Retry over notification function	C	C
		User call-out requirements	C	C
		Phone line availability test	C	C
		Purchasing programs onto tape	C	C
		Charge per ES	C	C
		Power call-out control	C	C
5	CA substitute service		C	B
6	EMM message service	Automatic display of message	C	A
		Mail	C	A
		IC card non installed message (Automatic display message used during non-scramble)	C	A

		Correspondence with Bound Recording installed receiver units	C	A
7	EMM reception	EMM reception	C	A
		EMM sending out type	C	A
8	Parental control	Parental control	C	C
		Deletion of PIN number	C	C
9	IRD data transmission	Data encryption of interactive services	C	C

A:Mandatory, B:Optional, C:Implementation prohibited*2

*1:For telephone modems, due to the operational limitations of PPV and IRD data transmission, modem implementation is not necessary on the viewpoint of CAS. This does not mean that mpdem implementation is not necessary. Please refer to Part6 of this provision for modem implementation for the viewpoint of interactive services .

*2:The reason of prohibition of implementation is as follows.

This volume is based on the usage of terrestrial digital television receiver units. The reason why ‘Implementation prohibited’ is specified is that more appropriate provisions (different and new provisions from current TR-B15) will be provided when the operation of functions which were limited at the start of broadcasting, such as the PPV function, begins in the future.

For example, in the PPV viewlog collection, BASIC modem installation is necessary in BS, but in terrestrial broadcasting, for example, the operation can be conducted via TCP/IP in the future operations. If receiver units setup in accordance with the current TR-B15 as terrestrial PPV functions exist in the future,, provisions for the correspondence of legacy receiver units will be necessary, and the most suitable specification cannot be set up in this case. Therefoe the classification, “‘Implementation prohibited” was specified.

In other words, it should not be implemented only in dedicated receiver units for terrestrial digital television but also in integrated receiver units with BS as a terrestrial digital receiver function. However, in integrated receiver units, it is up to the receiver unit on whether a function setting menu etc., which is not related to providing broadcasting services but which is necessary for BS (for example, parental level (minimum age for viewing) for the parental function, setting of purchasing limits for PPV, etc.) will be displayed or not during terrestrial digital television viewing.

Due to the above ideas, in figure A-1, functions which are not specified in this volume, but which are described in TR-B15 are described for confirmation.

B Appendix

B.1 Requirement Specifications for Common Digital Receiver Units with Terrestrial/BS/Wideband CS

Basically, requirement specifications for integrated digital receiver units with terrestrial/BS/wideband regarding CS for Part 5 should comply with TR-B15 for reception sections of BS/wideband CS digital and this volume for reception parts of terrestrial digital television reception sections. However, for the following items, specifications requirement specifications for integrated digital receiver units are provided.

B.1.1 Mail display

- -For storing mail in integrated receiver units, at least 31 mails in total for BS/wideband CS digital and terrestrial should be stored.
- -Processing of mail which exceeds the storage capacity is a product planning matter. However, it is preferable that 24 mails for BS/wideband CS digital broadcasting and 7 mails for terrestrial digital television broadcasting be managed separately.

B.2 Contact for Inquiries Regarding IC Cards

(1) CA_system_id 0x0005

Management Company	BS Conditional Access Systems Co., Ltd.
Phone	0570-000-250
URL	http://www.b-cas.co.jp

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Vol. 6

DIGITAL TERRESTRIAL TELEVISION BROADCASTING

Provisions for interactive data broadcasting services

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Contents

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1 Introduction

1.1 Forward

Interactive data broadcasting services in digital terrestrial broadcasting are conducted according to the provisions of regulations/notifications of Ministry of Internal Affairs and Communications, and the Association of Radio Industries and Businesses Standard (hereinafter ARIB) standards "Receiver for Digital Broadcasting" (ARIB STD-B21) and "Data coding and Transmission Specification for Digital Broadcasting" (ARIB STD-B24). However, it is necessary to provide separate provisions for operation details in order to execute interactivedata broadcasting services in digital terrestrial broadcasting and this document is provided here as operation provisions.

1.2 Purpose

This document, entitled “Provisions for interactive data broadcasting services”, aims to expand interactivedata broadcasting services by regulating the items to be observed for offering a superior interactive data broadcasting service to viewers, and smooth interactive data broadcasting services.

1.3 Scope

These provisions apply to interactivedata broadcasting services in digital terrestrial television broadcasting intended for fixed receivers (install-type television, STB, and portable televisions, etc.). The installation of fixed receivers compatible with interactive data broadcasting services is required as a necessary function in Provision A of this volume. Provision B is an optional standard. For portable receivers (mobile phones, etc.), the bi-directional function itself is in Provision B (optional) and is not provided here.

2 References

The contents of these provisions are provided for operations related to intreaction channel in digital terrestrial broadcasting systems provided by the following standards.

(1) " Receiver for Digital Broadcasting" standard ARIB STD-B21

(2) " Data Coding and Transmission Specification for Digital Broadcasting" standard ARIB STD-B24

3 Definitions

The terms used in this document are defined as below.

ADSL	Asymmetric Digital Subscriber Line: Asymmetric digital subscriber transmission method. A high speed transmission method using pre-existing phone lines.
ARIB	Association of Radio Industries and Business: An organization composed of broadcasters, telecommunication carriers, and manufacturers for creating technology standards related to domestic broadcast wave use.
AT command	Command for controlling modems.
BASIC Mode Data Transmission	Communication protocols (BASIC protocol) developed between a basic host and terminals for data transmission control protocols with necessary functions only installed.
CATV	Cable and Tele-communication Television System: System that distributes television signals to each household through transmission paths such as coaxial cables. It is available for use as a bi-directional transmission path.
CBC mode	Cipher Block Chaining Mode: IV value (initial value) for the results of operating the code use mode for symmetric cipher, the encryption result and the following input with exclusive-OR in the CBC mode (code use mode)
CRC	Cyclic Redundancy Check: Cyclic error detection code. Cyclic redundancy check sign to verify data accuracy.
DNS	Domain Name Service [RFC1034, RFC1035]: Protocol used to provide services for hostnames on the network and the mapping of Internet Protocol addresses.
DSU	Digital Service Unit: Digital line end terminal device. Device to provide interfaces for digital networks and terminals for digital communication.
Ethernet	One of the LAN communication methods.
FEC	Forward Error Correction
FTP	File Transfer Protocol [RFC959]: Protocol for sharing and forwarding files between two hosts on TCP/IP.
FTTH	Fiber To The Home: Service to provide a communication transmission path to the homes of users with optical fiber.
HDLC protocol	High-level Data Link Control: Mainly a highly secure transmission control protocol for communication between computers in a LAN and on the Internet.
HTTP	Hypertext Transfer Protocol [RFC1945]: Protocol used for data transfer on the World Wide Web with the application layer protocol.
ICMP	Internet Control Message Protocol [RFC792]: Protocol for message transmission such as various error notifications and operation confirmations generated during protocol data transfers.
IEC	International Electrotechnical Commission
IP	Internet Protocol [RFC791]: Carries out network layer protocols, definitions for the structure of Internet addresses and data delivery processing.
IPCP	IP Control Protocol [RFC1332]: Protocols which set various settings when using IP in the PPP network layer protocol phase.
IPv4	International standard protocol that is used as a base for the current LAN and Internet.

IPv6	Successive protocol to IPv4. Protocol that extends the address part and adds security functions, etc.
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISP	Internet Service Provider: Company that offers various content services on the Internet.
ISP connection information	Information such as ISP access point telephone numbers and authentication protocols, etc. It is set by viewers and maintained in the receiver.
MAC	Message Authentication Code: Symbol to confirm that the message was sent to the other party without being altered and without any transmission errors.
MNP4	Error correction method for modem communication.
MSB	Most Significant Bit
M affiliate	Numerical rows with a comparatively long time period used when simple pseudo-random numbers are generated.
NNTP	Network News Transfer Protocol [RFC977]: Application layer protocol used to distribute, post, and acquire NetNews on the Internet.
PDC	Personal Digital Cellular: Digital automobile and cellular phone method. 9600bit/s data communication is possible.
PDC-P	Personal Digital Cellular Packet: Communication with the PDC packet data exchange method. 9600bit/s-28800bit/s communication is possible.
PHS	Personal Handy-phone System
PIAFS	PHS Internet Access Forum Standard: Data communication methods of 32kbits/s, 64kbits/s using PHS.
PIN	Personal ID Number: Individuals are identified/recognized by using a secret number allocated beforehand to obtain access to certain systems.
PKCS	Public-Key Cryptography Standard: Cryptographic systems are centered on public key cryptography and include symmetric-key cryptography, the hash function, and pseudo-random number functions, etc.
PN signal	Pseud Noise: Signal with a property of appearing randomly at 1 and 0. Used for energy diffusion etc. of digital signals. The M sequence is often used.
POP3	Post Office Protocol version3 [RFC1939]: Protocol used to delete, acquire e-mail lists and e-mail from the SPOOL on the mail server.
PPP	Point to Point Protocol [RFC1661]: Protocol to enable the forwarding of multiple protocols in Point to Point links. It is used for dial-up connections.
PPP in HDLC-like Flaming	Frame composition to stack high level ppp protocols. Construction method for headers and footers as a frame configuration used by HDLC protocols.
PSTN	Public Switched Telephone Network
RSA encryption	Most popular public key cryptography system at present. Has a code/decoding function and signature/verification function.
SMTP	Simple Mail Transfer Protocol [RFC821]: Protocol for e-mail relay and delivery.
SSL	Secure Socket Layer: It is located midway between the TCP layer and application layer, and provides encryption, decoding and authorization.
STD	Standard
TA	Terminal Adapter: Device that converts protocols to allow analog communication terminal, etc. connections with ISDN.

TCP	Transmission Control Protocol [RFC793]: Provides end-to-end transport layer protocols and connection-type, reliable forwarding with error detection/correction.
TCP/IP application setup information	Information related to application protocols used in the TCP/IP protocol. It is set by viewers and maintained in the receivers.
TLS	Transport Layer Security: Standardized security protocol based on SSL. In particular, it changes in relation to hash processing.
Telnet	Protocol that offers virtual terminals where certain servers can be remotely operated from terminals on a [RFC854, RFC855] TCP/IP network.
UDP	User Datagram Protocol [RFC768]: Transport layer protocol between two hosts without a confirmation function but which does minimize protocol overhead and is a connectionless type of communication suitable for services with high transmission efficiency.
UTC	Universal Time Coordinated: Time commonly used in the world that has been decided by international agreements.
V.22bis	Modulation system for full duplex modems for telephones up to 2400bits/s provided by ITU-T recommendations.
V.34	Modulation system for full duplex modems for telephones up to 33.6kbits/s provided by ITU-T recommendations.
V.42 bis	Data compression method and error correction method for communication between modems provided by ITU-T recommendations.
V.90	Standard specifications for 56Kbits/s analog modems provided by ITU-T recommendations.
X.28	Communication protocol to convert non-packet receivers equipped with modems, etc. to enable connections with packet switching networks, etc.
closed network provider	Providerthat manages closed networks not connected to the Internet.
reserved	Undefined. Shows there is a possibility to be defined in ISO for the future improvement of definitions for encoded bit streams. All bits which do not have separate definitions in the ARIB standards are set as "1".
reserved_future_use	Undefined. Shows there is a possibility to be defined in ARIB standards for improvements in future for definitions of encoded bit streams. All bits without separate definitions are set as "1".
rpchof	remainder polynomial coefficients, highest order first
time stamp	The recycling detection of communication data is possible by adding the communication time and random numbers to important communication data.
uimsbf	unsigned integer, most significant bit first
access point	Communication equipment that receives call-outs from receivers.
Application information	Information on access point telephone number and circuit types, etc. specified by broadcasting stations.
Echo back	Means characters that are received are sent back or is an operation to confirm the transmission characters on the sending side.
Card ID	Number or symbol allotted uniquely beforehand to cards installed in receivers.
Cut thru call	Call to connect with centers whose call is specified partially from receivers in network services that receive a large amount of calls.
Cut call	Call for communication from the receivers that end at the switchboard on the sending side and in network services that receive a large amount of calls.
Code independent mode	Improvement method to make it possible to also transmit binary data with the BASIC mode data transmission.

Copy control	Control copy generations. Limits when the program and other copyright objects are copied for the recording equipment connected with the broadcasting receiver.
Service code(SC)	Service division code for network services offered by communications carriers that are identified with 00XY, etc.
Security level	Index used when security strength is defined and operated in stages according to the necessary confidentiality level for the handled data, etc.
Security communication related information	Security communication related information is maintained in the receivers by information related to the security type and root CA certificate installed in the receivers.
Session key	Key used from the perspective of security strength maintenance for one session only (disposable).
Center	Equipment including the necessary host to provide bi-directional transmission services.
Time stamp	time stamp
Tamper resistant	Physical casing used for those handling devices to read internal data functions so that functions cannot be analyzed.
Data transmission function	Directions described in the BML contents and it is a function for data transmission between the receivers and the center.
Debit	Settlement in which the cost is transferred between the user's bank account and the bank account of the member store at the time of use.
Token	Electronic voting card used for electronic ballots.
Traffic	Communication traffic added in lines and exchange plants of PSTN, etc.
Negotiation	For modems that have multiple modulation systems, error correction functions and re-sending functions, negotiation will be conducted first in order to search for methods and functions shared by both modems.
Network services	Value added services for aggregrate data and data processing, etc. done on the network between receivers and the center.
Network representative accounting	Accounting method that communications carriers claim to users by using information fee accounting instead of information providers.
Hash function (message digest)	Mathematical function to map a large (according to circumstances, it is very large) area in a small range. The high quality function shall be one way and without conflict at the same time.
Vernam cipher	An encryption method. The random number sequence and the exclusive-OR of correspondence held by the sending and receiver side are transmitted as cipher text and the receiver side decodes it by taking this random number sequence and exclusive-OR for the received correspondence. If true random numbers are used, this is theoretically a safe communication encryption method.
Value	Information on money and value used by the prepaid method.
Prepaid ID	When network type prepaid payments are used, identifiers are associated with each user corresponding to the pre-paid card.
BASIC mode data transmission(Code Independent Mode)	Communication protocol that has been developed for the basic host and terminal of the data transmission control protocol. A communication protocol is installed to minimize data transmission mistakes.
host	Necessary access point device and server device for bi-directional transmission services.
Mass calling service	Mass calls reception services, etc. are included by one of the network services.
Master key	Compared with the session key, the master key is used. It is a key used in order to share the session key.

Message digest	Summarizes (digesting) optional data length to a constant length, or the summarized data.
Message authorization code	MAC
Mall	Electronic store or collection of stores.
Root certificate	The root certificate is necessary for verifying authenticity of the signature used by public key cryptography. It is a public key of a reliable third party (certification authority), and is used to verify the validity of the signature recorded in the certificate issued by this certification authority.
Log collection accounting	The data broadcasting use charge is recorded for each user. It is an accounting method that does collective adjustments later.
Uni-direction	Impossible or very difficult characteristics with which to do inverse operations in a mathematical operation.
Circuit class	Displays different types of telecommunication lines such as PSTN, cellular lines, and PHS.
Diffusion	When, in digital signals, 1 or 0 or a constant pattern continues, an emission line spectrum is generated to cause interference or else clock recovery becomes impossible. In order to prevent this problem, a known PN signal is provided to make the signal random.
Management server	In the management of private information, it is a server that concentrates and manages private information, and has a function to return private information in response to inquiries from the host.
Simple encryption	Simple encryption is used for conditions that are not necessary that have not been decoded by a third party.
Simple authentication	To authenticate other parties, simple authentication is an authentication protocol used when security strength is not really necessary, and which can be realized by using symmetric cipher.
Well-known plain text attack	Already known plaintext is input and cipher text is generated, and is a method of attacking encryption algorithms by leading the encryption key from plaintext and cipher text.
Pseudo-random number	In general, since the generation of true random numbers is difficult, a numerical row with very long periodicity and uniformity (difference) often substitutes random numbers.
Symmetric cipher	Also called secret key encryption and symmetry encryption. The sender and receiver secretly use and own a shared key which is encrypted by the sending side and decoded on the receiver side. It is necessary to share the shared key by using other measures in advance.
Common information	Information set depending on the viewer and is maintained in receiver units with information on the priority use line type and the outside line acquisition number, etc.
Verifier	Person who verifies whether or not the signee and the content are certain.
Strict authorization	Authorization measure that uses public key cryptography.
Excuses	To disavow after the sender themself transmits the contents of the communication.
Private information	Excluding the name and address, etc., the bank account number and credit card number, etc. may be included.
Call	Call unit
Fixed IP connection information	Information that is set depending on the viewer and which is saved in the receiver units with information in a fixed format to allocate internet protocol addresses, etc.

Priority carrier roiuting	By registering the communications carrier to a regional communications carrier, a connection is always connected to the selected communucation carrier by a priority connection option which makes the connection possible without dialing the communications carrier's IDnumber (00XY, etc.).
Public key cryptography	Also called asymmetric cipher. The key (public key) for coding and the key (private key) for decoding are different. Encrypted communication is possible even if there is no common sensitive information by opening the public key, and by managing the private key secretly. Part of the public key cryptography (RSA encryption) also has a signature function.
Participation rate	Value in which the number of users of certain interactive data broadcasting service programs are divided by the number of viewers.
Viewer setup information	Collective term for information that be decided by individual viewers for common information, ISP connection information, fixed IP connection information, connection type information, and TCP/IP application setup information.
Receiver setup information	Collective term for information that is set and maintained in receivers that consists of communication relevant information, communication device information, security communication related information, common information, ISP connection information, fixed IP connection information, connection type information, and TCP/IP application setup information.
Collection network	Network where data from many receivers is collected.
Signature	Makes the calculated results into electric signatures by using operation characteristics which can be generated only by those who have a private key for public key cryptography.
Product planning	Receiver functions or actions which depend on the hardware design, the software design of the receiver planed by each manufacturer.
Conflict free	Necessary quality for hash function. The probability that the output result is different from 2 optional different inputs is sufficient.
Certificate	Necessary for verifying the authorization and signatures that use public key cryptography. It is electronically issued by a reliable third party (certifying body).
bi-directional channel carrying request	Line connected with equipment in the center from a receiver with modems, etc.
Information fee accounting	Instead of having users pay information providers for information services such as telephone information services, etc. carried out through telephone lines, the communication carriers pay the information providers (information charge, etc.) and then charge the users.
Connection type information	Information set and saved by the viewers in the receiver units with protocols related to IP address acquisition when connecting by ethernet.
Other party authorization	The other party is authorized by using the security function when it is necessary to confirm the other communication party.
Mass calls reception service	Service that can receive a large volume of calls in a very short time by using the switchboard function.
Toll free	Accounting method to absorb communication charges on the receiving side.
Communication device information	Information saved in the receivers by information that be provided between network terminal devices installed in access points and receivers.
Communication related information	Information such as the circuit class installed in the receivers and protocols, etc., and information that is maintained in the receivers.

Communications carrier	Class 1 telecommunications carrier and class 2 telecommunications carriers that offer telecommunication services.
Communications carrier ID number	Number to identify broadcasters specified in each communications carrier by their telephone number.(00XY)
Transmission mode	The transmission mode is defined to classify modulation schemes and error correction systems.
Special number	Short number that begins with one in the telephone number. 1XY number.
Certificate Authority	Third-party organization that guarantees the reliability of the certificate.
Call	Call with a telephone.
Call (sending) limit	Limit on the receivers for sending on the receiver side to prevent congestion at the access point.
Call function	Instructions described in BML contents and a function for calls for the center.
Transmission delay	Transmission is delayed only on the receiver side arbitrarily to prevent congestion at the access point.
Plaintext	Data displayed before encryption.
Personal ID	Method for confirmation on whether it is a person (person in question) with authority to access receivers and IC cards. Uses a password (phrase) and PIN.
Free Procedure (TTY Procedure)	Communication without providing protocols such as re-sending of the physical layer or higher. The simplest communication method that began from text communication of teleterminals with remote hosts.
Priority use net	Circuit class selected by the viewer when multiple circuit class (PSTN and mobile phones, etc.) use is possible in receivers.
Programs to record confirmation number	The issued number of programs to record to manage cancellations, changes, issuing and inquiries for one reservation, etc., when reservation such as tickets are purchased on the network.
Congestion	The phenomenon of the telephone not connecting due to the concentration of communication that exceeds the unit time processing performance in the switchboard. The congestion increases due to the repeated re-dialing of the other party until a connection is made.

4 System configuration and connection format for interactive data broadcasting services

This chapter describes the required communication system and connection format to realize interactive services.

4.1 System configuration

Figure 4-1 is a conceptual diagram of the interactive data broadcasting service format.

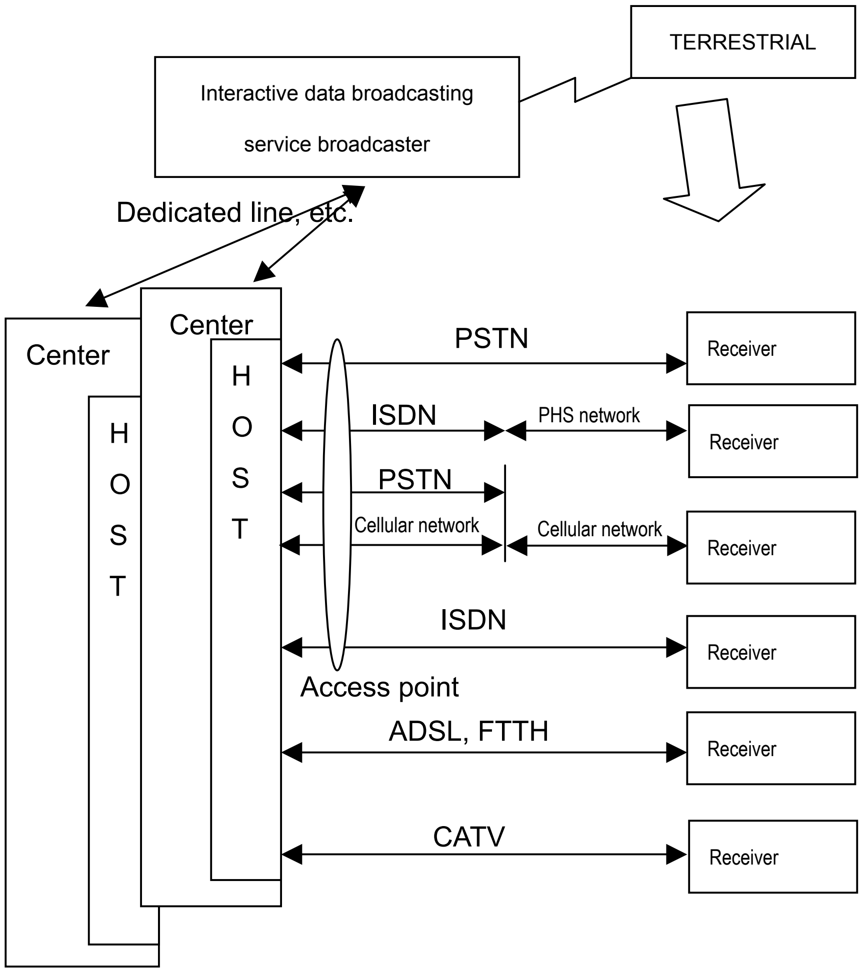


Figure 4-1 Interactive data broadcasting service format conceptual diagram

4.2 Facilitiesrelated to interactive data broadcasting service broadcasters

When required the interactive data broadcasting service broadcasters will provide telecommunication lines such as dedicated lines as lines with the center. The line class will determined by the interactive data broadcasting service broadcasters and the center while taking into account the service contents and the amount of the data communication, reliability guarantee, etc..

4.3 Facilitiesrelated to the host

The host in the center provides the line equipment if required from among PSTN (PSTN, during cellular use), ISDN (during PHS use), a cellular network (to accommodate a cellular network directly), ADSL, FTTH, and CATV as lines on the receiver side. The number of lines for access points that are connection points to the host is determined by taking into account the service contents and the amount of the data communication. Additionally, if required the host will provide a telecommunication line between the interactive data broadcasting service broadcasters.

4.4 Functions related to the line connections of receivers

The receivers are connected to lines such as PSTN, PHS networks, cellular networks, ISDN, ADSL, FTTH and CATV, and have a function to allow communication with the center.

4.5 Connection format

4.5.1 Direct connection

(1) Receivers are connected directly with the center by using PSTN etc.

Advantages: If the protocol is appropriately selected, installation of the receivers may be easier.

Disadvantages: The center needs to secure the access point.

Figure 4-2 shows a connection format.

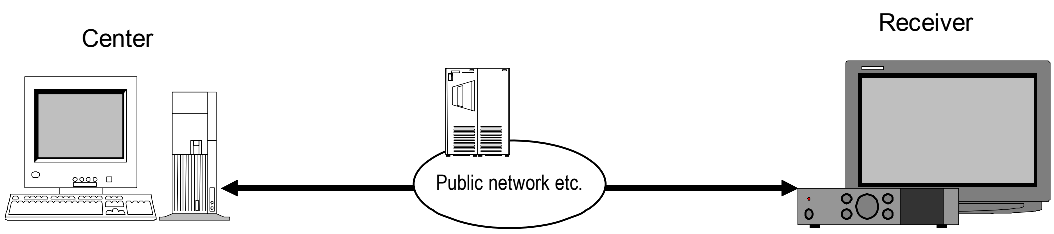


Figure 4-2 Direct connection

(2) An arbitrary center is connected directly to the receivers and each application by using PSTN, etc.

Advantages: If the protocol is appropriately selected, installation of the receivers may be easier.

Each center can share the access points.

Disadvantages: Since multiple centers use a shared access point, it can be assumed that there are cases where scheduling of the access point is necessary.

Figure 4-3 shows the connection format.

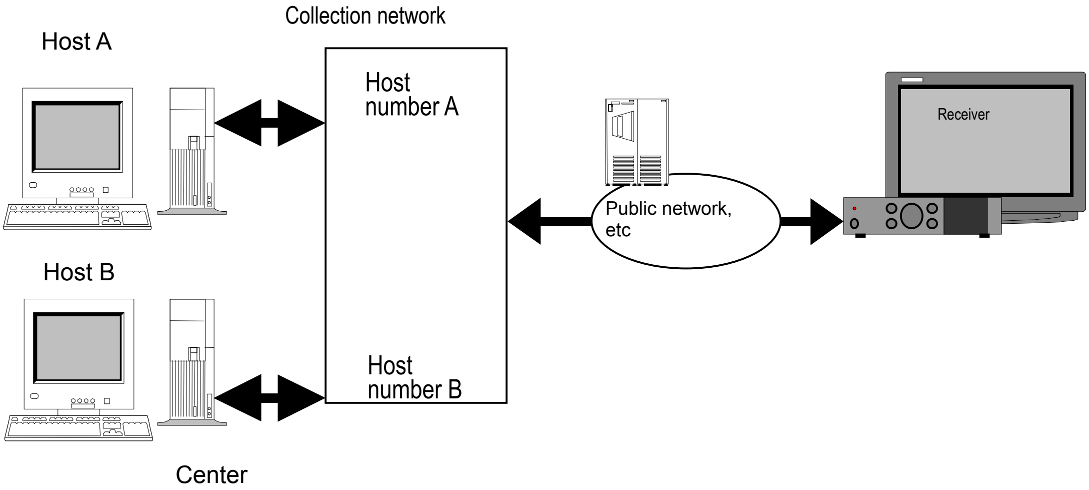


Figure 4-3 Direct connection using host numbers

4.5.2 Network service

In data communication between receivers and the center, the total amount of data etc. is processed by the network.

The data processing contents are different according to the individual service. In particular, there is a mass calling service as a network service associated with broadcasting. In typical, mass calls reception services in this service, the number of calls is tabulated and processed with the receiver call switchboard, and the total result is sequentially notified to the center.

Advantages: Installation of the receiver is easier. The processing of the total data for the center, etc. is easier.

Disadvantages: Some services require contracts with the communications carrier beforehand.

Figure 4-4 shows the connection format.

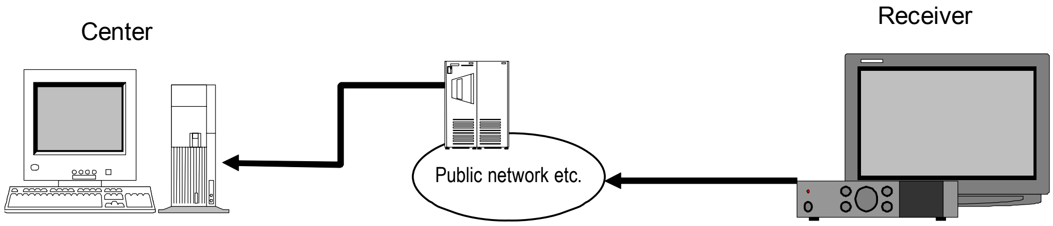


Figure 4-4 Connection for a mass calls reception service

4.5.3 Broadcast channel carrying response, and bi-directional channel carrying request.

Among interactionchannels, requests such as uplink signals, etc. are delivered by public lines and the responses to the requests are delivered bybroadcasting.

Advantages: When broadcasting is used in the delivery of large amounts of shared data, services can be provided at a low price. A wide array of new applications never seen before in broadcasting and communication is imaginable.

Since each receiver will use the bi-directional communication line, and the common center, communication between receivers is also possible.

Disadvantages: The system is complex. When protocols that can link ascending public lines with descending broadcasting are necessary, large-scale development will be required.

Figure 4-5 shows the connection format.

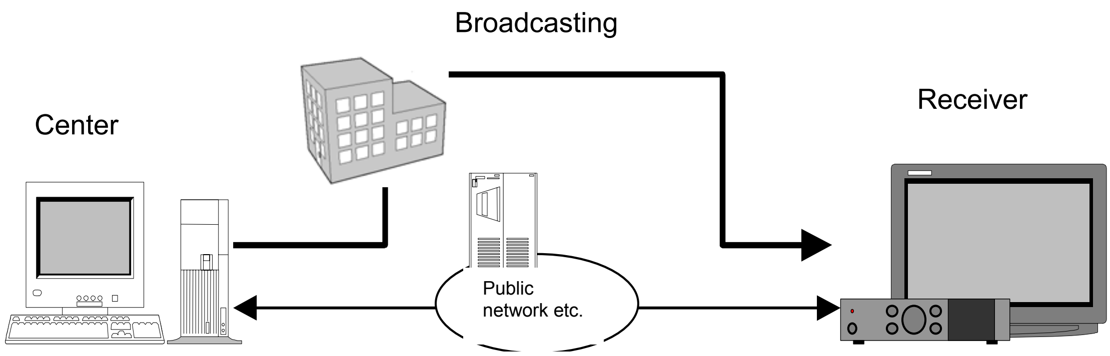


Figure 4-5 Connection that uses Broadcasting and PSTN

4.5.4 Internet connection

The receiver is connected to the access point of the Internet Service Provider (ISP) via a PSTN, etc. In addition, it is connected from the ISP to the ISP for the center via the Internet, and is connected with the center with a dedicated line, etc.

Advantages: Existing access points throughout the entire country can be used.

Disadvantages: It is necessary to install TCP/IP, PPP with the ISP connection protocol in the receivers. In order to receive service from the center, the viewer shall join an ISP.

Figure 4-6 shows the connection format.

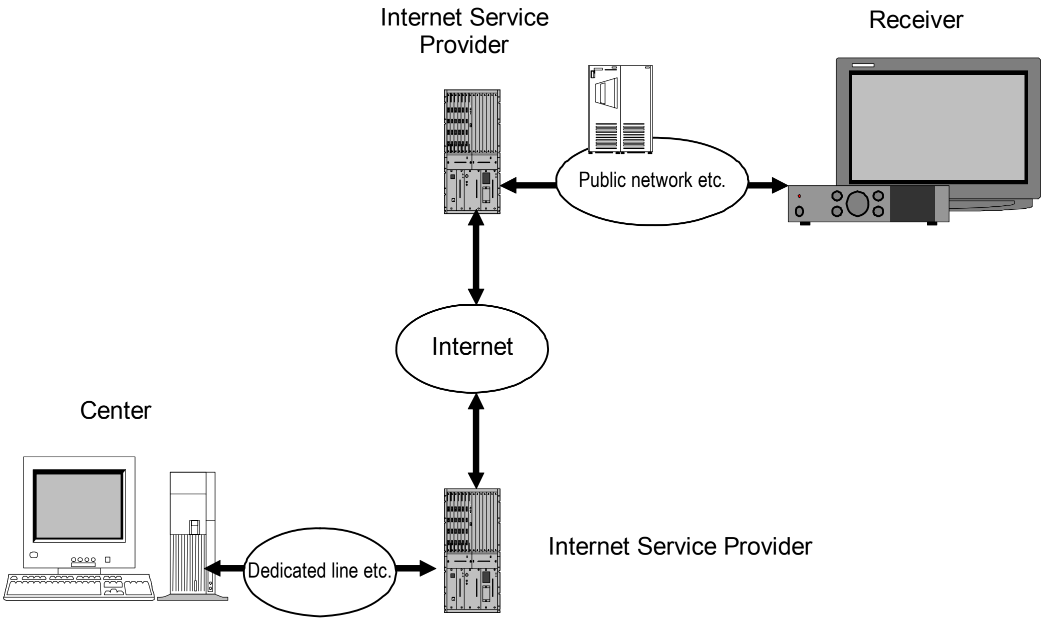


Figure 4-6　Connection that uses the Internet

5 BASIC mode protocol

5.1 Bi-directional channel and transmission phases

Figure 5-1 displays the protocols that use PSTN, etc. such as PSTN, cellular networks and PHS networks in bi-directional transmission divided into 5 phases, and provide the communication protocol for each phase in section 5.2.

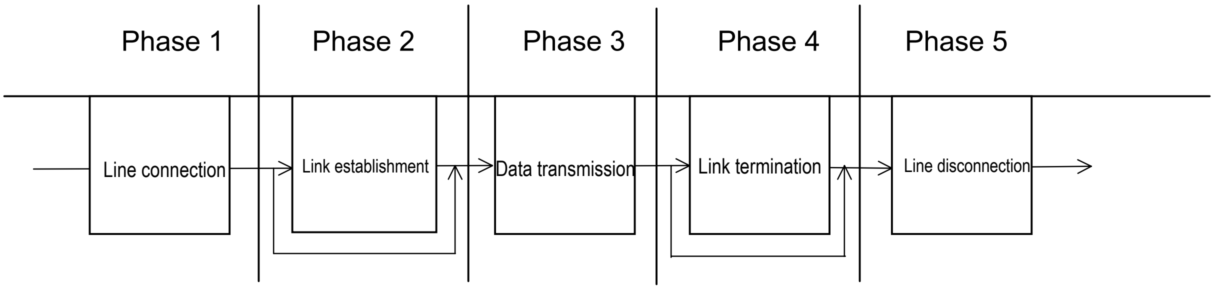


Figure 5-1 Transmission phases

5.2 Transmission phase and protocol stack

5.2.1 Line connection and disconnection phase

Phase in which the receivers connect/terminate with the center using PSTN, etc. The line connection and disconnection will be conducted by using the AT command, etc. for the modem, etc.

5.2.2 Data Link establishment and termination phase

The data link establishment/termination phase is a phase for establishing the link between the receiver and the center for data transfer after line connection, and terminating it after data transfer is over.

Table 5-1 shows the protocol stack for the data Link establishment and termination phase. When protocols besides the communication protocol for PSTN are selected, the following Provision A is not applied in the installation of the TCP/IP communication protocol specified in Chapter 6.

Table 5-1 Protocol stack for the Data Link establishment and termination phase

Layer	Protocol stack
Data link layer Provision A	Protocol conforming to part of X.28(Refer to 5.3)
Physical layer	
Modem Provision A	V.22bis + MNP4
Mobile phone (circuit switched service) Provision B	PDC: 9600 bits/s*
PHS Provision B	PIAFS: 32 kbits/s or greater

*May be converted into V.22bis + MNP4 within a cellular network.

5.2.3 Data transfer phase protocol

The data transfer phase carries out data communication between the receiver units and the center after establishment of a link.

Table 5-2 shows the protocol for BASIC communication. When protocols besides the communication protocol for PSTN are selected, the following Provision A is not applied in the installation of the TCP/IP communication protocol specified in Chapter 6.

Table 5-2 Data transfer phase protocol stack for BASIC mode data communication

Layer	Protocol stack
Application layer	Select according to service.
Data link layer Provision A	BASIC mode protocol code independant mode(Refer to 5.3 for details)
Physical layer	
Modem Provision A	V.22bis + MNP4
Mobile phone (circuit switched service) Provision B	PDC: 9600 bits/s*
PHS Provision B	PIAFS: 32 kbits/s or greater

*May be converted into V.22bis + MNP4 within a cellular network.

5.3 Detailed specifications for BASIC mode protocol Provision A

While bi-directional service data is collected using the collection network that connects the receivers with the center, the connection between the receivers and the collection network or the data transfer sequence is provided. When protocols besides the communication protocol for PSTN are selected, the following Provision A is not applied in installation of the TCP/IP communication protocol specified in Chapter 6.

Figure 5-2 shows a bi-directional data broadcasting service system.

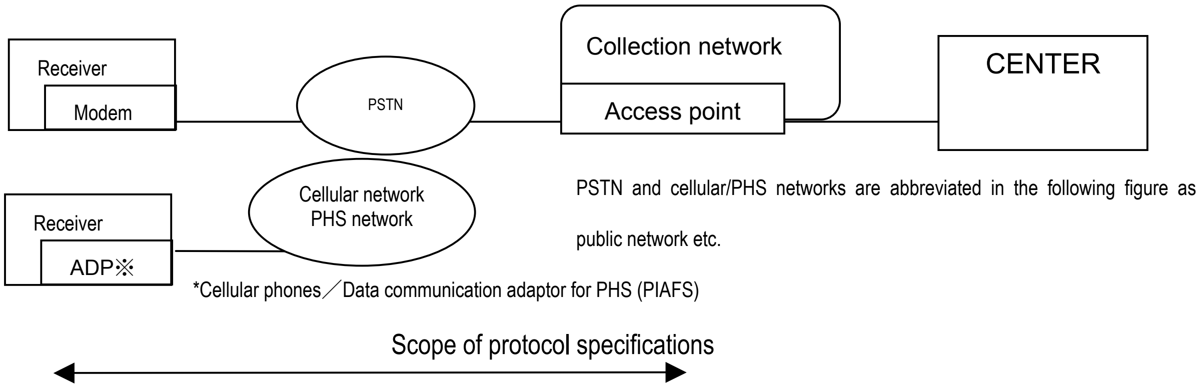


Figure 5-2 Bi-directional data broadcasting service system

5.3.1Protocol conditions

Table 5-3 displays the protocol conditions.

Table 5-3 Protocol conditions

Item	Set conditions
Transmission format	Alternate communications by ENQ and EOT
Transmission confirmation	Positive acknowledgement or negative acknowledgement return of each transmission message
Re-sending control	Re-sending with a negative acknowledgement or re-sending when there is no reply.
Maximum transmission text length	2048 bytes
Non-communication monitoring	Monitoring with a timer

5.3.2 Communication conditions

Table 5-4 shows the connection, data transfer and the communication conditions of the modem.

Table 5-4 Receiver communication conditions

Item	Set conditions	Remarks
Data length(Character length)	8 bits	Communication conditions when connecting
Parity	None	
Stop bit	1 bit	
Transmission code system	JIS C6220(8 Unit code)	
Local echo back	None(Remote echo back present)	
Line break control	Receiver→Collection network: CR only transmission Collection network→Receiver: CR+LF transmission	
Transmission separator code	CR(0D H)code	
Line break code	LF(0A H)code	
Input correction code	BS(08 H)code	
LSB/MSB(bit)	LSB First	Communication conditions during data transfer
Data transfer sequence	Refer to 5.3.4	Modem communication conditions
Communication method	Asynchronous full duplex	
Transmission rate	Refer to 5.2.3	
Flow control	RS/CS	
MNP class	Refer to 5.2.3	

5.3.3 Connection, termination sequence

To connect with the center from the receiver via the collection network, it is necessary to connect with the collection network and to transmit the host number command to identify the center.

(1) Connection sequence

a) Figure 5-3 shows a normal sequence.

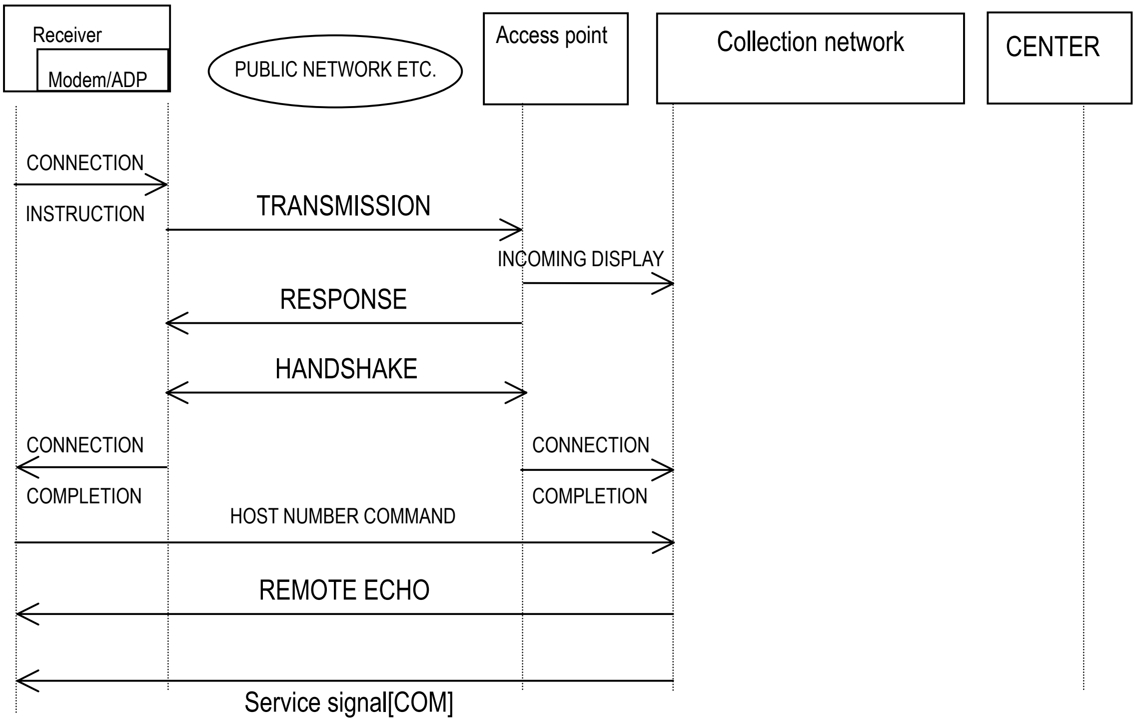


Figure 5-3 Normal sequence

b) Figure 5-4 shows an abnormal sequence (host number command mistake).

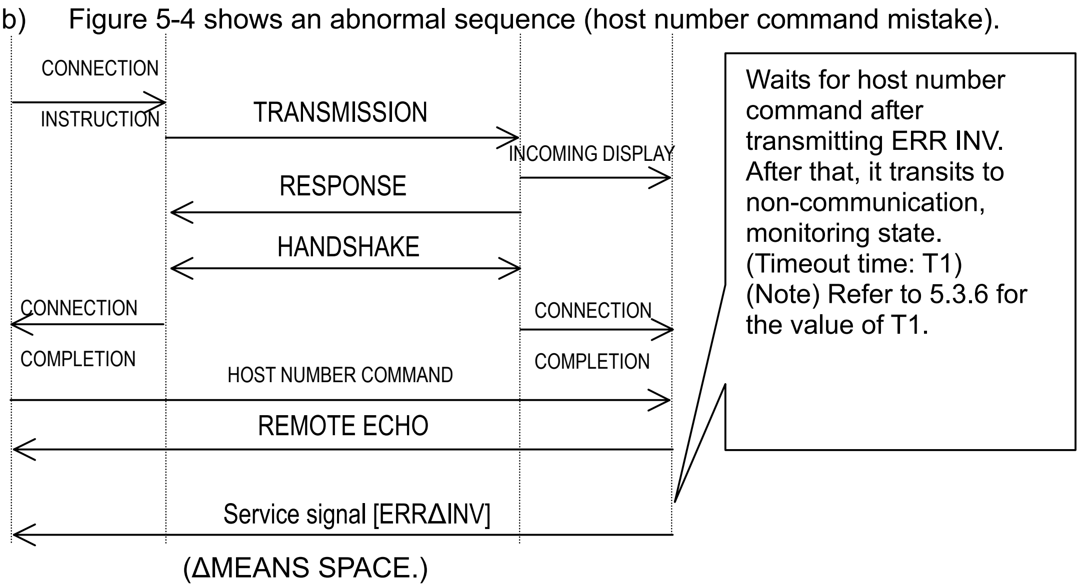


Figure 5-4 Abnormal sequence (host number command mistake)

c) Figure 5-5 shows an abnormal sequence (center side time-out for the host number command wait).

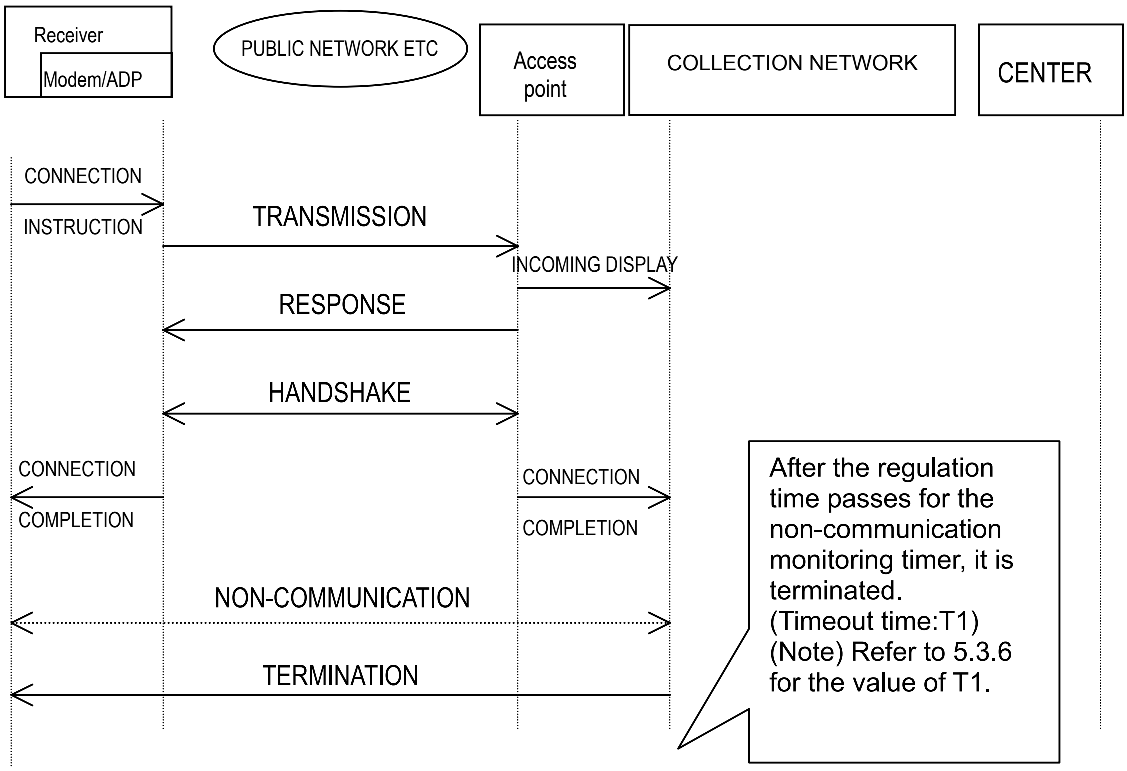


Figure 5-5 Abnormal sequence (center side time-out for host number command standby)

d) Figure 5-6 shows an abnormal sequence (center call rejection).

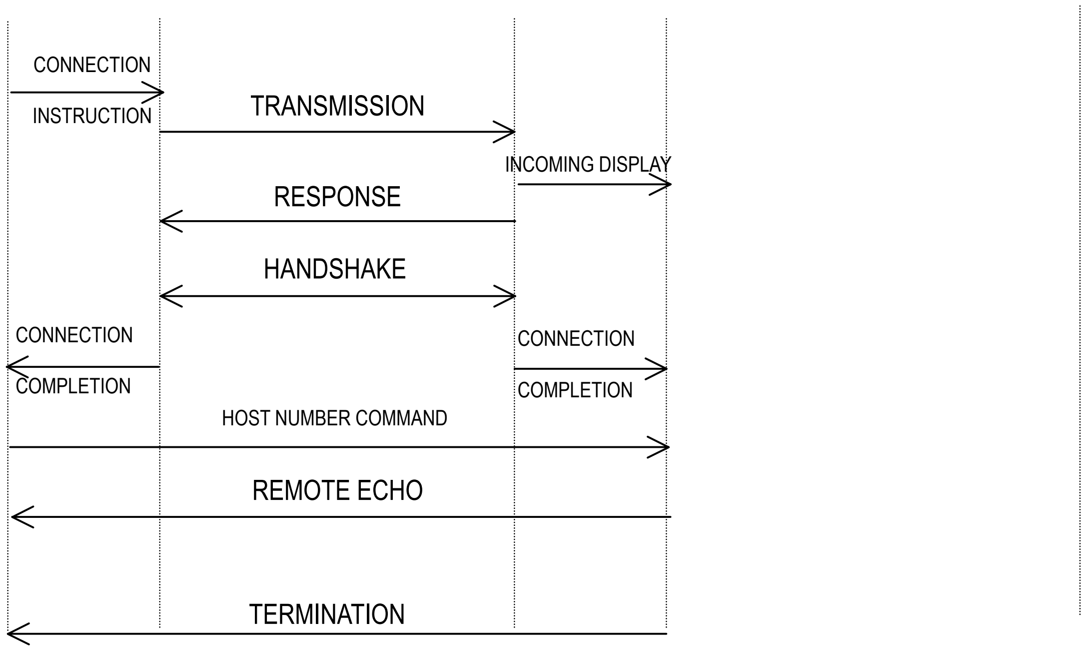


Figure 5-6 Abnormal sequence(Center call rejection)

e) Figure 5-7 shows an abnormal sequence (remote echo mistake). Refer to Table 5-6 remote echo standby for the receiver behavior.

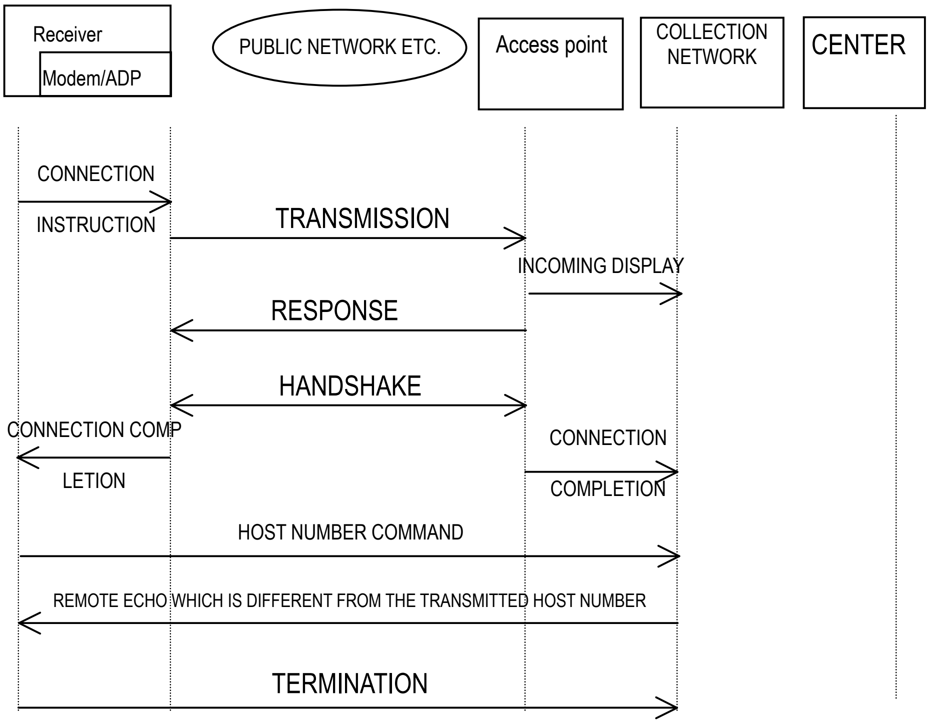


Figure 5-7 Abnormal sequence(remote echo mistake)

f) Figure 5-8 shows an abnormal sequence (receiver side time-out for the remote echo standby). Refer to Table 5-6 remote echo standby for the receiver behavior.

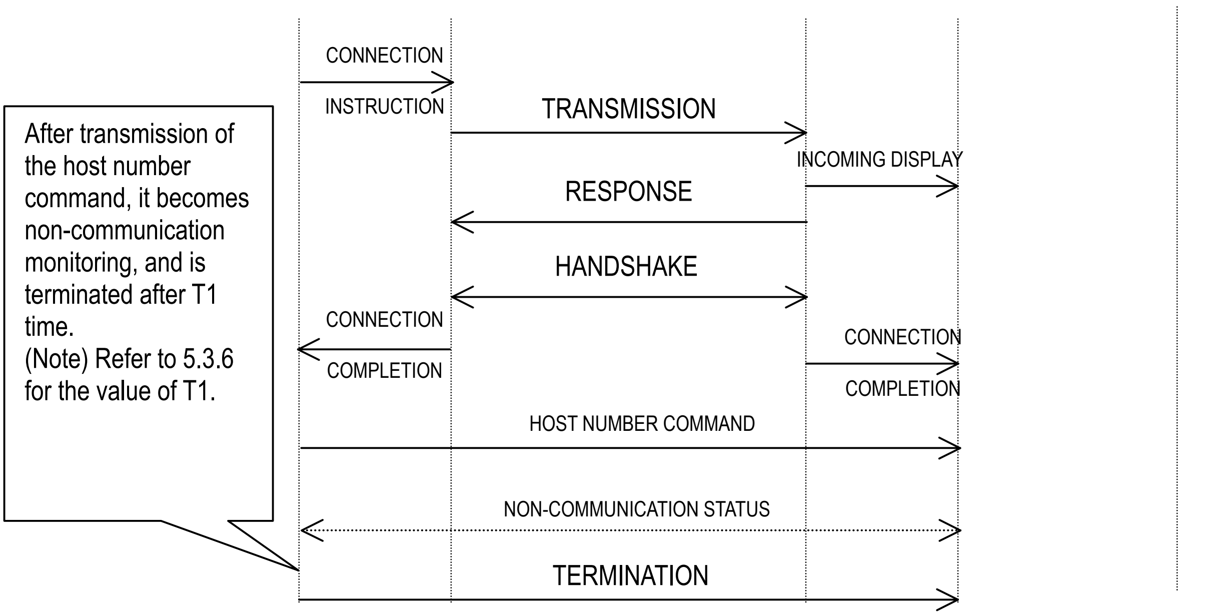


Figure 5-8 Abnormal sequence (receiverside time-out for the remote echo standby)

g) Figure 5-9 shows an abnormal sequence (service signal mistake). Refer to Table 5-7 service signal standby for receiverbehavior.

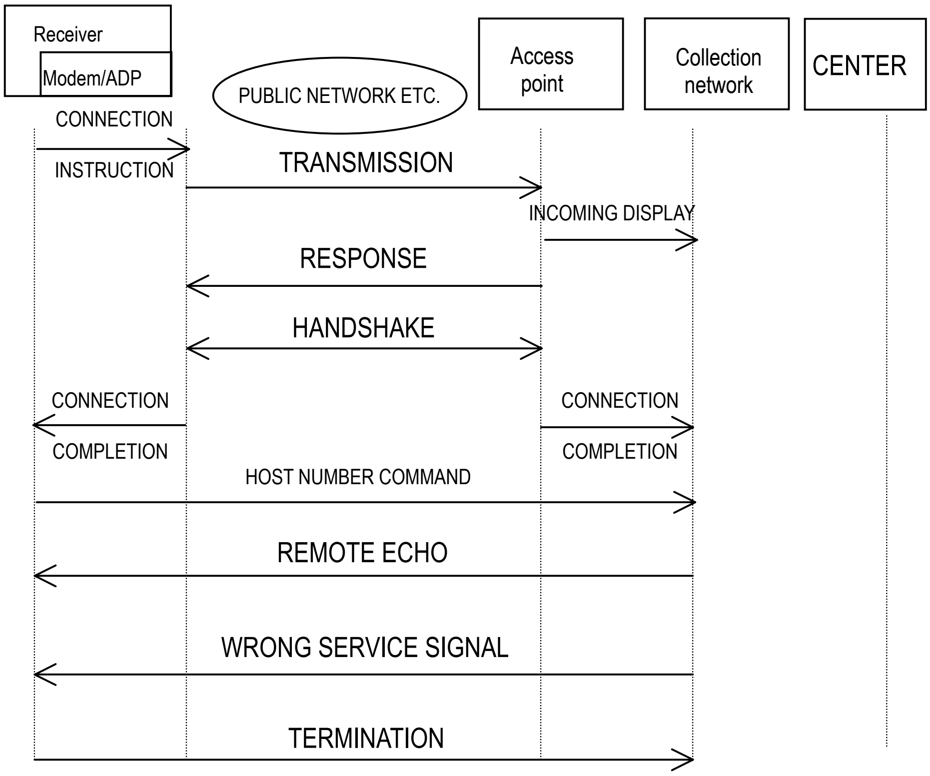


Figure 5-9 Abnormal sequence (service signal mistake)

h) Figure 5-10 shows an abnormal sequence (receiver side time-out for the service signal standby). Refer to Table 5-7 service signal standby for receiver behavior.

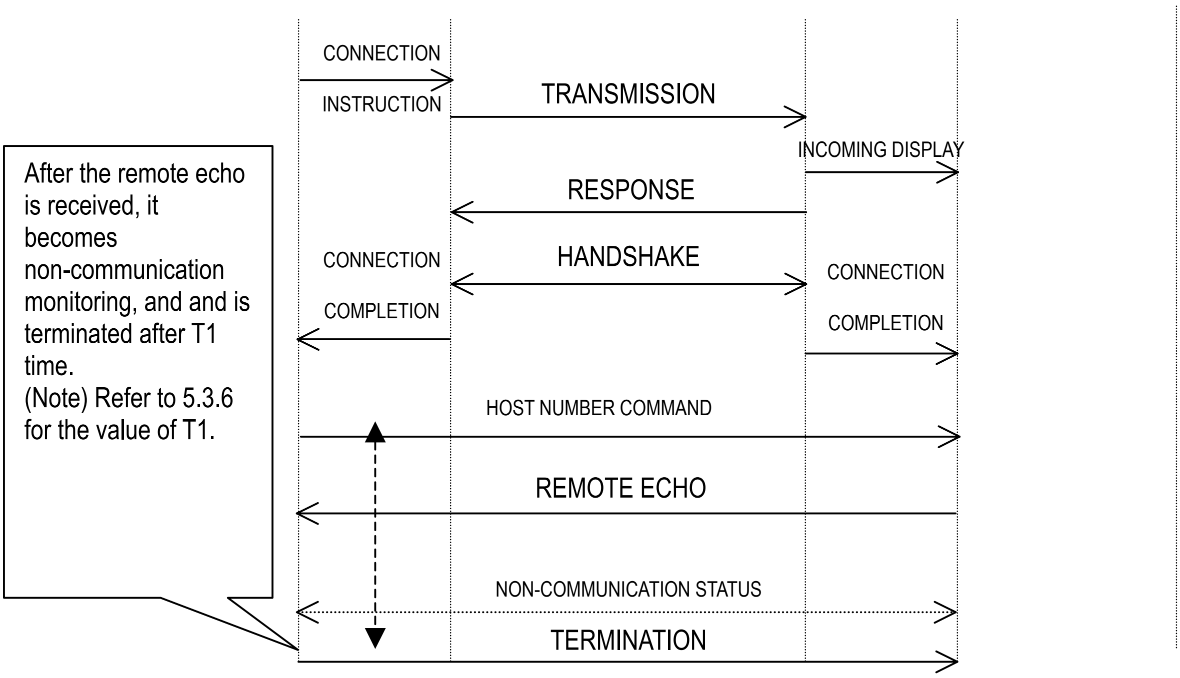


Figure 5-10 Abnormal sequence (receiver side time-out for the service signal standby)

(2) Termination sequence

a) Figure 5-11 shows the termination sequence from the receiver.

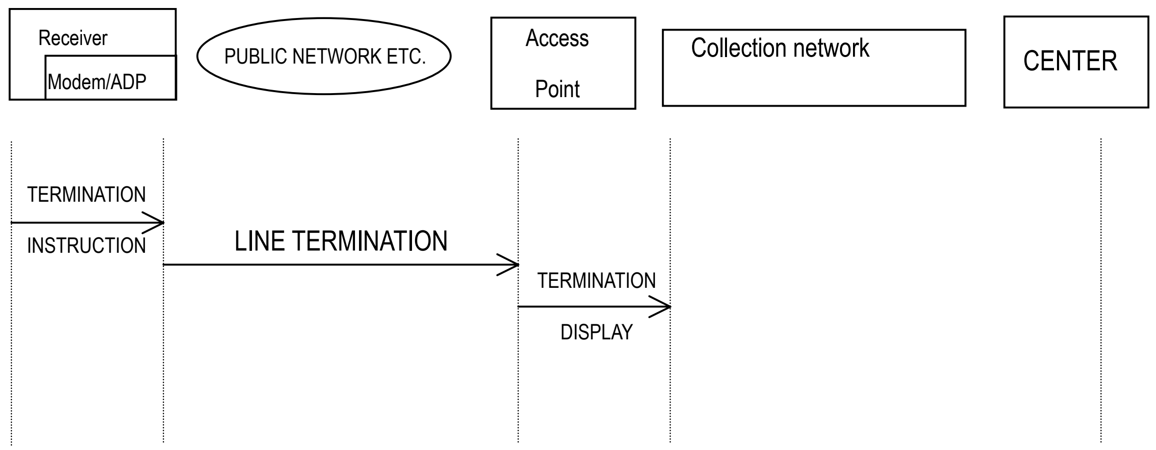


Figure 5-11 Termination sequence for receivers

b) Figure 5-12 shows the termination sequence from the center.

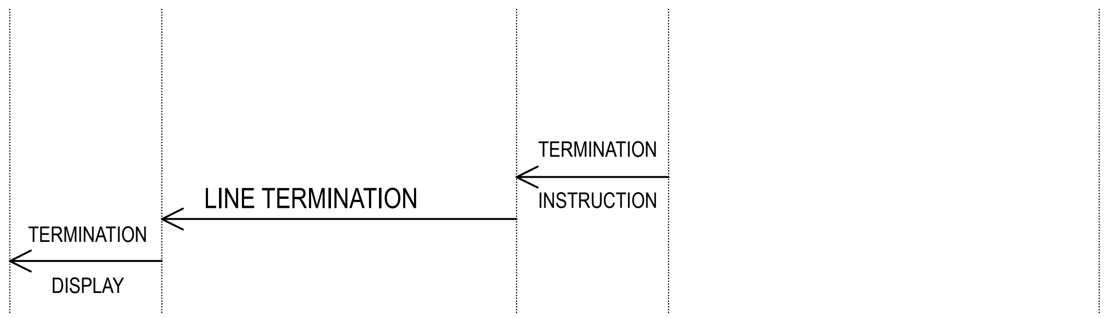


Figure 5-12 Termination sequence from the center

(3) Host number command and service signal

Table 5-5 shows the format for the host number command and the service signal.

Table 5-5 Format for the host number command and the service signal

Item		Format	Notes
Host number command		$N_1N_2N_3N_4N_5N_6N_7N_8$ CR (Characters that echo back) $N_1N_2N_3N_4N_5N_6N_7N_8$ CRLF	8-digit alphanumeric character(JIS 8 unit code: Echo backing is done by (0-9, A-Z, a-z).
Service signal	Connection completion	CR LF COM CR LF	CR: Transmission separator code LF: Line break code
	Command error	CR LF ERRΔINV CR LF	Δ means space.

(4) Receiver behavior after host number command transmission

a) Remote echo standby status for the transmitted host number

The receivers transit to remote echo reception standby after the transmission of the host number. Table 5-6 shows the receiver behavior for the remote echo standby.

Table 5-6 Receiver behavior for remote echo standby

Reception signal	Behavior after the signal is received
Same remote echo as the transmitted host number $N_1N_2N_3N_4N_5N_6N_7N_8$ CRLF is received. (Only eight characters N1-N8 from before CRLF are compared, and the 9th character is disregarded.)	Jumps to service signal standby
Different remote echo from the transmitted host number ■■■■CRLF is received (■■■■ are the arbitrarylength code rows for 0 bytes or more excluding $N_1N_2N_3N_4N_5N_6N_7N_8$.)	Immediate termination
After transmission of the host number or after it is re-sent, the CRLF is not received in the specified time (receiver unit side timeout time within T1). (Note1)	Immediate termination

(Note 1)The non-communication monitoring timer of the receiver unit begins after transmission of the host number command and after it is re-sent.

(Refer to 5.3.6 for the value of T1)

b) Service signal standby

The receiver transits to service signal standby after receiving the same remote echo $N_1N_2N_3N_4N_5N_6N_7N_8$ CRLF as the transmitted host number. Table 5-7 shows the behavior of the receivers in service signal standby.

Table 5-7 Operation of receivers in service signal standby

Received signal	Behavior after the signal is received
Correct service signal(Connection completion)(Note 1) CRLF COM CRLF is received.	Transition to the data transfer sequence.
Correct service signal(Command error)(Note 1) CRLF ERRΔINV CRLF is received. (Δ is a space)	The host number command is immediately re-sent It is re-sent 3 times. (CRLF ERRΔINV CRLF reception is terminated after 4 times)
Incorrect service signal (Note 1) CRLF COM◊ CRLF ERRO CRLF□□□□CRLF is received. (◊ is the code for other than CR, O is the code for other than a space, □□□□ are the arbitrary length code rows for 0 bytes or more excluding COM and ERRΔINV.)	Immediate termination
After transmission of the host number or after it is re-sent, the correct service signal is not received in the specified time (receiver side timeout time within T1).(Note 2)	Immediate termination

(Note 1)Data until the initial CRLF is received after transition to the service signal standby status isdiscarded.

(Note 2)The non-communication monitoring timer of the receiver begins after transmission of the host number command and after it is re-sent.

(Refer to 5.3.6 for the value of T1)

(5) Remote echo

Since echo back is carried out from the host to the receiver when the host number command is transmitted from the receiver there is no necessity for a local echo back in the receiver.

The host receives the host number command from the receiver, carries out echo back, and continuously tranmits the service signal.

(6) Timing start of the non-communication monitoring timer on the host side

The non-communication monitoring time-out value T1 on the host side begins counting from when the line connection is completed (modem negotiation end), and is reset after transmission of the service signal CRLF ERRΔINV CRLF.

5.3.4 Data transfer sequence

(1) Telegram sequence(Example)

Figure 5-13 shows a receiver and 1 example of the data transfer sequence for the collection network.

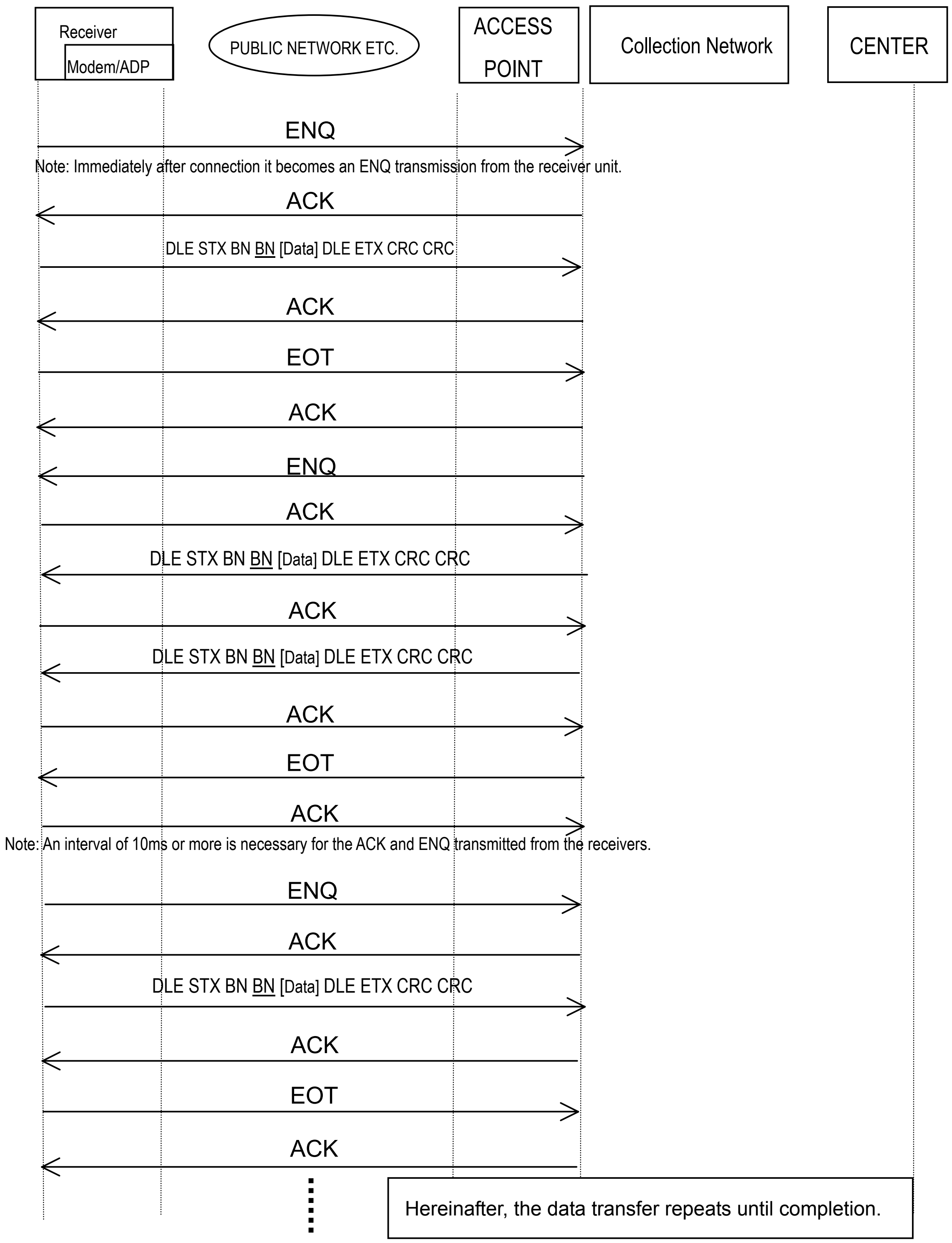
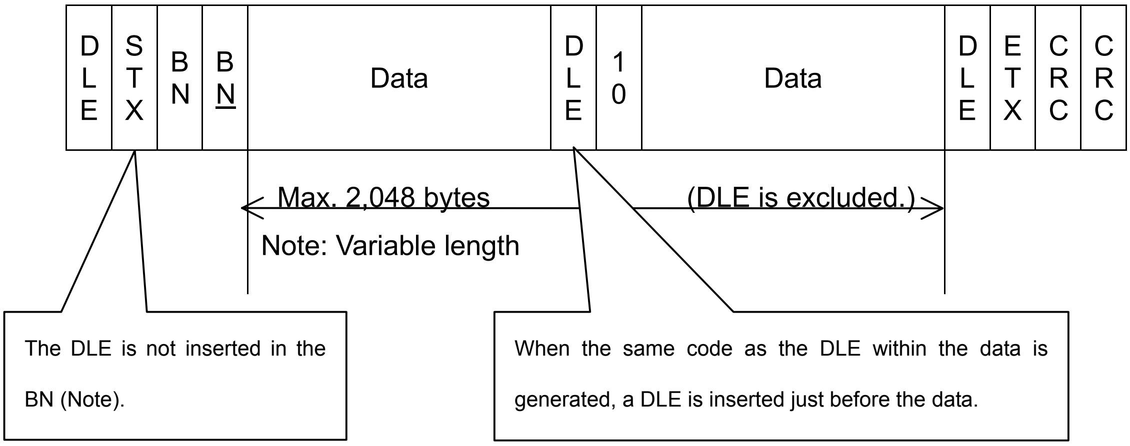


Figure 5-13 Data transfer sequence

(2) Telegram format

a) Telegram format for transmission

Figure 5-14 shows a telegram format for transmission.



Note BN: Block sequence number(From 0 to 255)

BN: 1's complement of block sequence number (BN)

Figure 5-14 Telegram format for transmission

b) CRC calculation scope

Figure 5-15 shows the CRC calculation scope.

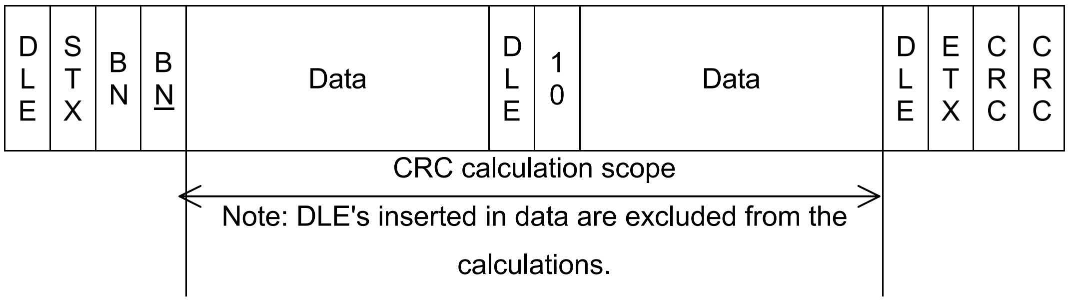


Figure 5-15 CRC calculation scope

c) CRC calculation method

A 16-bit CRC is used for the CRC calculation method.

CRC-16

Multiply the polynomial for calculation that is sorted from the least significant bit of the first byte to the most significant bit of the last byte by X^{16} and divide it by the generating polynomial "$X^{16}+X^{15}+X^{2}+1$". The remainder is CRC-16.

In CRC-16, the remaining (16 bits) is arranged in the highest and lowest 8-bit units. But, in the BASIC mode data transmission protocol, in order to improve security, all bits are rearranged in reverse order so that the most significant bit of the remainder becomes the least significant bit of the CRC and the least significant bit of the remainder become the most significant bit of the CRC.

[Calculation example]

Data to be calculated:10_H

X^3 that are sorted in reverse order is multiplied by X^{16},
and is divided by $X^{16+}X^{15+}X^{2+}1$
and the remainder becomes $X^{15+}X^{5+}X^{4+}X+1$(8033_H).

8033_H(1000 0000 0011 0011) is resorted,
16 bits is the unit for the bi-directional service data collection protocol
and $CC01_H$(1100 1100 0000 0001) is regarded as the CRC.
In general CRC-16 becomes $01CC_H$.

d) Block sequence number

The block sequence number (BN) begins from 01. In this case the 1's complement (BN) for the block sequence number becomes FE (254). When text is continuously transmitted from one side (From between ENQ and EOT), the block sequence number counts up by 1. When the block sequence number reaches FF (255), the next block sequence number becomes 00.

Figure 5-16 shows the block sequence flow and figure 5-17 is a block sequence number sequence example.

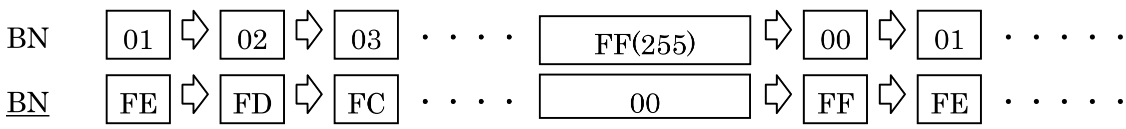


Figure 5-16 Block sequence number flow

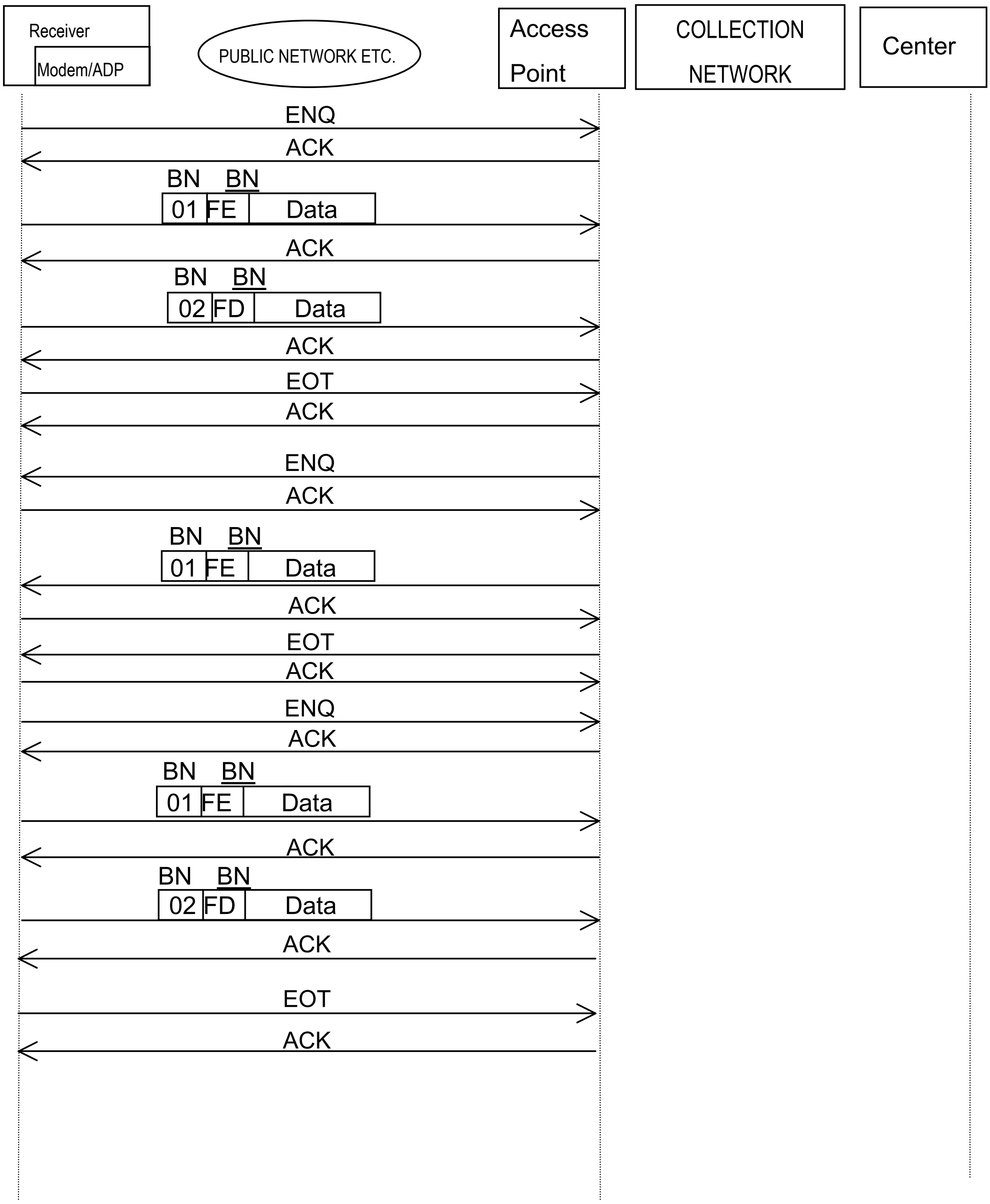


Figure 5-17 Block sequence number sequence example

(3) Control code format

Table 5-8 displays the control code format.

Table 5-8 Control code format

Control code	HEX code	Meaning	Notes
DLE STX	1002H	Data start	
DLE ETX	1003H	Data end	
ENQ	05H	Line control rights	1 byte sending and receiving
ACK	06H	Positive acknowledgement	Same as above
NAK	15H	Negative acknowledgement	Same as above
EOT	04H	Transmission end	Same as above
DLE	10H	Transmission control	Inserted just before 10H in data.

5.3.5Transition state

(1) Transition state table

Table 5-9 shows the transition state.

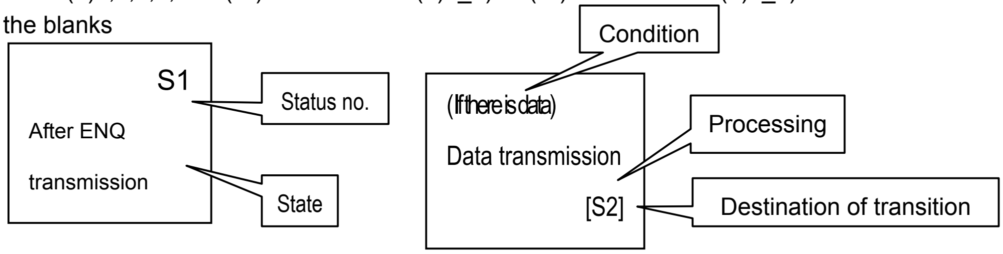
Table 5-9 Transition state

State / Reception Code	Data transmission side				Data reception side	
	(*1)S0	With ACK			R1	R2
	ENQ Transmission [S1]	S1 After ENQ Transmission	S2 After data Transmission	S3 After EOT Transmission	With ENQ	With data
ENQ					ACK Transmission [R2]	
ACK		Data transmission [S2]	(If there is data) Data transmission [S2] (If there isn't any data) EOT transmission [S3]	[R1]		
NAK		ENQ re-send [S1]	Data re-send [S2]	EOT re-send [S3]		
Data						(If OK) ACKTransmission [R2] (If NG) NAKTransmission (*2) [R2] ACKTransmission (*3) [R2] Terminate (*4)
EOT						ACKTransmission [S0]
Timeout [T2]		ENQ re-send [S1]	Data re-send [S2]	EOT re-send [S3]	NAK Transmission [R1]	NAKTransmission [R2]
Re-try out [C1]		Terminate			Terminate	

(*1) When in the S0 state, and there is no data for transmission from the receivers, it is preferable to save ENQ transmission until the data for transmission is input. Additionally, when a T2 time-out (ENQ standby) on the center side is generated in the pending state, the NAK is received but it is ignored on the receiver side.

(*2) Refer to 5.3.5(2)1,3,4,5,6 (*3) Refer to 5.3.5(2)2_1) (*4) Refer to 5.3.5(2)2_2)

Note: Ignore the blanks



(2) Errors during data reception

When errors are received (When the transition state table R2 data reception is NG), there are the following patterns.

1 When the relationship between BN and BN (1's complement) does not match, NAK transmission

2 The relationship between BN and BN matches, and it differs from the expected value,

1) When it is BN and the BN immediately before it, the relevant data is annulled and ACK transmission

2) When not listed above, termination

3 In case of a CRC error, NAK transmission

4 When there is no DLE STX, NAK transmission

5 When there is no DLE ETX, NAK transmission

6 Additionally, when the data is in a format outside the provisions, NAK transmission

5.3.6 Time-out, Re-try out value

The time-out value and the re-try out value for when the collection network is used are displayed in Table 5-10.

Table 5-10 Time-out, Re-try out value

Time-out value	T1	30 secs
	T2	10 secs
Re-try out value	C1	3 times

6 TCP/IP communication protocols

6.1 Bi-directional channel and transmission phases

Figure 6-1 shows the protocols for the formats that use continuous connections such as ADSL, FTTH, and CATV, and protocols that use PSTN such as PSTN, ISDN, cellular networks and PHS networks in bi-directional transmission divided into 5 phases, and provides the communication protocols for each phase in section 6.2.

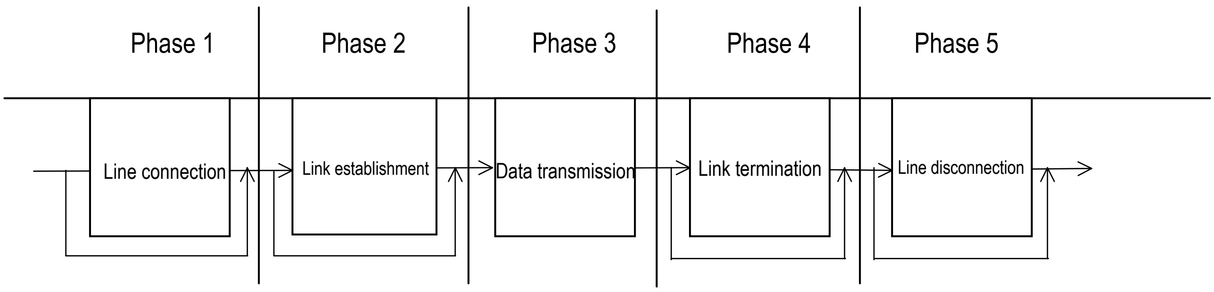


Figure 6-1　Transmission phases

6.2 Transmission phases and protocol stack

6.2.1 Line connection and disconnection phase

Phase in which receivers use PSTN, etc. to connect/disconnect with the center. Line connection and disconnection is carried out by using the AT command, etc. for the modem, etc. This phase is skipped in formats that use Ethernet.

6.2.2 Link establishment/Link termination/Data transfer phase

The data link establishment/termination phase is a phase for establishing the link between the receiver and the center for data transfer after line connection, and terminating it after data transfer is over.The data transfer phase is a phase in which data is transferred between the receivers　and the center after a data link is established. The necessary protocols are different depending on the connection format.

Table 6-1 to table 6-6 shows the data Link establishment and termination phase/data transfer protocol stack.

(1) Communication protocol for PSTN

Table 6-1 shows the protocol stack for a PSTN connection. The BASIC mode data protocol specified by Chapter 5 is installed in conjunction with communication standard V.34 or greater and V.42bis for modems used in this physical layer.

Provision A

Table 6-1 Communication protocol for PSTN

Layer	Protocol stack
Application layer	HTTP1.1(RFC2616) ,DNS(RFC1123)Provision A, HTTP1.0(RFC1945),Telnet, FTP, NNTP, SMTP, POP3 Etc. Provision B Selected according to services.
Transport layer	TCP(RFC793) , UDP(RFC768)
Network layer	IP(RFC791)/ICMP(RFC792)
Data link layer	PPP(RFC1661, 1662)/IPCP(RFC1332) PAP(RFC1334)/CHAP(RFC1994), PPP Internet Protocol Control Protocol Extensions for Name Server Addresses(RFC1877) CCP(RFC1962) Provision B
Physical layer	V.34 or greater, V.42bis

(2) Communication protocol for ISDN

a) ISDN-DSU-TA connection

Table 6-2 shows the ISDN-DSU-TA connection protocol stack.

Table 6-2 Communication protocols for ISDN-DSU-TA connections

<table>
<tr><td>Channel type</td><td>B channel</td><td colspan="2">D channel</td></tr>
<tr><td>Layer</td><td>Protocol stack</td><td colspan="2">Protocol stack</td></tr>
<tr><td>Application layer</td><td>HTTP1.1(RFC2616),DNS(RFC1123) Provision A,
HTTP1.0(RFC1945), Telnet, FTP, NNTP, SMTP, POP3, etc.
Provision B
Selected according to services.</td><td colspan="2" rowspan="2">Select according to the service</td></tr>
<tr><td>Transport layer</td><td>TCP(RFC793) , UDP(RFC768)</td></tr>
<tr><td>Network layer</td><td>IP(RFC791)/ICMP(RFC792)</td><td>TTC JT-Q.931</td><td>X.25(Packet level)*1</td></tr>
<tr><td>Data link layer</td><td>PPP(RFC1661,1662)/IPCP(RFC1332)
PAP(RFC1334)/CHAP(RFC1994),
PPP Internet Protocol Control Protocol Extensions for Name Server Addresses(RFC1877)
CCP(RFC1962) Provision B</td><td colspan="2">TTC JT-Q.921</td></tr>
<tr><td>Physical layer*2</td><td colspan="3">RS-232C
USB</td></tr>
</table>

*1: Uses the Dch packet call control phase.

*2: Same standard as the physical interface installed in the TA.

b) ISDN-DSU-(TA built-in)connection

Table 6-3 shows the ISDN-DSU-(TA built-in) connection protocol stack.

Table 6-3 ISDN-DSU-(TA built-in) connection protocol stack

Channel type	B channel	D channel	
Layer	Protocol stack	Protocol stack	
Application layer	HTTP1.1(RFC2616) ,DNS(RFC1123) Provision A, HTTP1.0(RFC1945) ,Telnet, FTP, NNTP, SMTP, POP3, etc. Provision B Selected according to services .	Select according to the service	
Transport layer	TCP(RFC793) , UDP(RFC768)		
Network layer	IP(RFC791)/ICMP(RFC792)	TTC JT-Q.931	X.25 (packet level)*1
Data link layer	PPP(RFC1661,1662)/IPCP(RFC1332) PAP(RFC1334)/CHAP(RFC1994), PPP Internet Protocol Control Protocol Extensions for Name Server Addresses(RFC1877) CCP(RFC1962) Provision B	TTC JT-Q.921	
Physical layer	TTC JT-I.430		

*1: Uses the Dch packet call control phase.

(3) Communication protocol for Ethernet

When ISDN, ADSL, FTTH, and CATV are used as a return line.

a) Direct connection in the network terminal device.

Table 6-4 shows the protocol stack when directly connecting with the network terminal device.

Table 6-4 Protocol stack when directly connecting to the network terminal device

	Protocol stack
Application layer	HTTP1.1(RFC2616) ,DNS(RFC1123) Provision A, HTTP1.0(RFC1945),Telnet, FTP, NNTP, SMTP, POP3, ,DHCP etc. Provision B Selected according to services.
Transport layer	TCP(RFC793) , UDP(RFC768)
Network layer	IP(RFC791)/ICMP(RFC792)
Data link layer	PPP(RFC1661,1662)/PPPoE(RFC2516) /IPCP(RFC1332) (*1) PAP(RFC1334)/CHAP(RFC1994), PPP Internet Protocol Control Protocol Extensions for Name Server Addresses(RFC1877) CCP(RFC1962) Provision B IEEE802.2/ARP(RFC826)
Physical layer	IEEE802.3

*1: PPP/PPPoE/IPCP is necessary to use the continuous connection service.

b) Router connection

Table 6-5 shows the protocol stack when the router is connected.

Table 6-5 Protocol stack when the router is connected

	Protocol stack
Application layer	HTTP1.1(RFC2616) ,DNS(RFC1123) Provision A, HTTP1.0(RFC1945),Telnet, FTP, NNTP, SMTP, POP3, ,DHCP etc. Provision B Selected according to services.
Transport layer	TCP(RFC793) , UDP(RFC768)
Network layer	IP(RFC791)/ICMP(RFC792)
Data link layer	IEEE802.2/ARP(RFC826)
Physical layer(*1)	IEEE802.3 (*2) IEEE802.11 (*3)

*1: Same standard as the physical interface which was installed in the dial-up router.
*2: 10BASE-T, 100BASE-TX
*3: Wireless LAN

(4) Protocol for data communication using mobile phones/PHS(PIAFS)

Table 6-6 shows the protocol stack when using mobile phones/PHS(PIAFS).

Table 6-6 Protocol stack when using mobile phones/PHS(PIAFS)

<table>
<tr><td>Layer</td><td colspan="4">Protocol stack</td></tr>
<tr><td>Application layer</td><td colspan="4">HTTP1.1(RFC2616) ,DNS(RFC1123) Provision A, HTTP 1.0(RFC1945), Telnet, FTP, NNTP, SMTP, POP3, etc. Provision B Selected according to services.</td></tr>
<tr><td>Transport layer</td><td colspan="4">TCP(RFC793) , UDP(RFC768)</td></tr>
<tr><td>Network layer</td><td colspan="4">IP(RFC791)/ICMP(RFC792)</td></tr>
<tr><td>Data link layer</td><td colspan="4">PPP(RFC1661, 1662)/IPCP(RFC1332)
PAP(RFC1334)/CHAP(RFC1994),
PPP Internet Protocol Control Protocol Extensions for Name Server Addresses(RFC1877)
CCP(RFC1962) Provision B
LCP Extensions(RFC1570)</td></tr>
<tr><td rowspan="2">Physical layer
(*1)</td><td colspan="3">Mobile phones</td><td>PHS</td></tr>
<tr><td>PDC
CDMA Cellular System</td><td>PDC-P etc.(*2)
CDMA Cellular System</td><td>DS CDMA,
MC CDMA</td><td>PIAFS</td></tr>
</table>

*1 The physical layer notes the communication method on the DIRD side.
There are cases when cellular phone (PDC)/PHS(PIAFS) communication with the center is converted into analog communication by the mobile network or the center.
*2 Packet switched service for mobile phones

6.2.3 Physical layer protocol implementation Provision A

For implementation of the physical layer protocol, at least one from the ones specified from in 6.2.2 (1) -6.2.2(4) shall be installed. Multiple protocol implementations are up to product planning.

7 Interaction channel operation

7.1 Telephone number system and network

The network configuration and the telephone number systemdescribes at the start of Digital Terrestrial Television Broadcasting.

7.1.1 Network configuration example

Figure 7-1 shows an example of network configuration for the interactive data broadcasting service envisioned at the start of Digital Terrestrial Television Broadcasting.

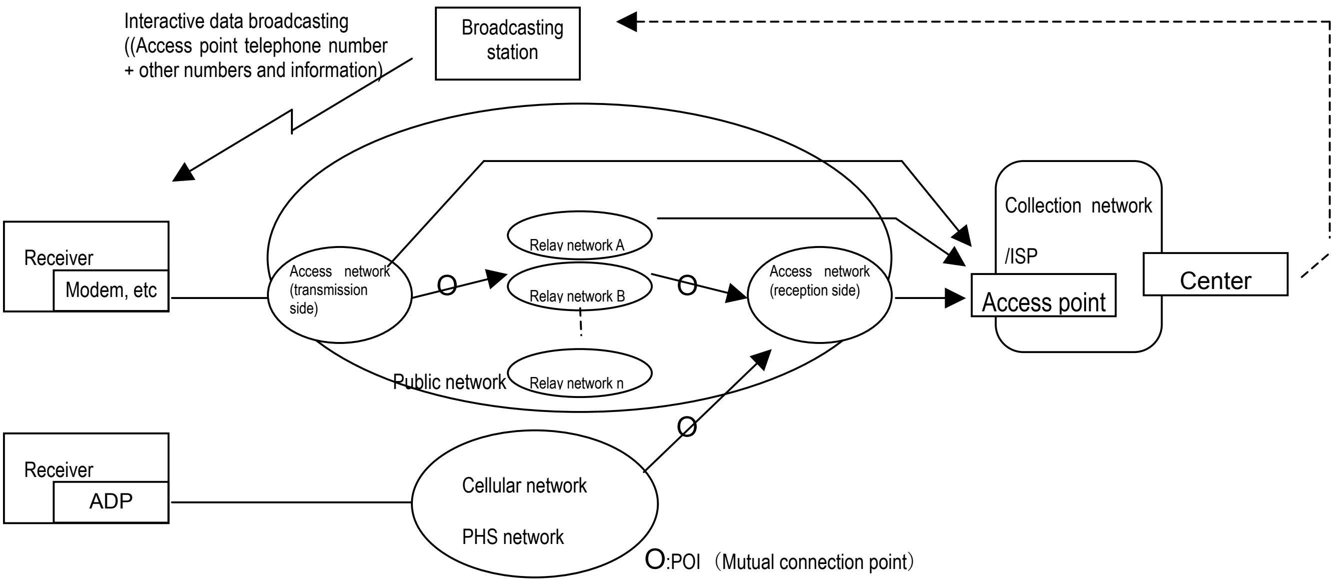


Figure 7-1 Interactive data broadcasting service network configuration example

7.1.2 Telephone number system

Table 7-1 shows the telephone number system as of August 25, 1999. The telephone number system is according to the provisions of ministerial ordinance No. 82 of the Ministry of Posts and Telecommunications and is subject to change.

Table 7-1 Telephone number system

	Service identification number	Charge share	Number example
Special number	1XY	-	184, 186
			122(*1)
Carrier ID number	00XY(*3)	Transmission side	00XY+0ABCDEFGHJ(K)
Toll free Number	0120 (Incoming charge function)	Reception side	0120+DEFGHJ
	0800 (Incoming charge function)	Reception side	0800+DEFGHJK
	00XY+SC	Reception side	00XY+SC+********(*2)
General number	0ABCDEFGHJ(K)	Transmission side	0ABCDEFGHJ(K)
	00XY+SC	Transmission side	00XY+SC+********(*2)
Number for network services	0180 (Large volume call reception function)	Transmission side	0180+ DEFGHJ
	0990 (Information charge alternate collection function)	Transmission side	0990+ DEFGHJ
	0570 (Uniform number function)	Transmission side	0570+ DEFGHJ

(*1)Number for fixed priority connection (option for specific broadcasters only) cancellation.

(*2)SC: Service Code. Network service identification code provided by 00XY carrier. The method for bearing the charge is identified by the SC code.

(*3)The communications carrier identification number shown with 00XY includes 00X, 00XY, 002YZ, and 002YZN1N2,0091N1N2.

7.1.3 Transmission order and digit length for special numbers, etc.

(1) [Transmission number notification number <3>]+Fixed priority connection cancellation number <3>]+[Communications carrier identification number <7>]+0ABCDEFGHJ(K)<10>/<11>

(2) [Transmission number notification number <3>]+0AB0DEFGHJ(K) <10>/<11>

(3) [Transmission number notification number <3>]+Communications carrier identification number <7>+SC+********<Indefinite>

(Attention)[ ] may be unnecessary. In the < >:Maximum digit length as of September 1999

7.1.4 Necessary telephone numbers for calls and classification

The aforementioned special number, other communications carrier identification numbers and an external line aquisition number are necessary for calling. Here, necessary telephone numbers were classified in Table 7-2 during calling. If this classification is used, necessary telephone numbers for calling are in the format shown in Figure 7-2.

Table 7-2 Classification of necessary telephone numbers for calling

Class name	Table classification	Definition
Ountside line	External line transmission number from PBX, etc.	Number granted to the lead telephone number by a mandatory number in unique callss to each telephone terminal such as external line acquisition.
Special number	Transmission number notification number Fixed priority connection cancellation number	Number to select the add service function.
Carrier ID number	Communications carrier identification number	Number granted to general telephone numbers to select communications carriers to connect to.
Mandatory telephone number *1 (Telephone number)	General telephone number Number for incoming charges Number for network services	Necessary minimum telephone numbers that can establish communications by dialing.

*1 Hereinafter, a mandatory telephone number is described as telephone number unless specifically noted.

Outside line	+	Special number	+	Carrier IDnumber	+	Mandatory telephone number

Figure 7-2 Necessary telephone numbers for calling

7.2 Flow of telephone number selection processing

The bi-directional data broadcasting application (hereinafter application) and the receivers sequentially execute the following phases from multiple telephone numbers, select the appropriate telephone number, call the appropriate special number and the Carrier ID number. Figure 7-3 shows a processing outline. In the discarded format (ADSL, FTTH, CATV) of the dial-up connection, phase 1-phase 3 are not processed.

- Phase1: Connection point telephone number selection(Application function)
  - Phase that reads communication related information maintained in the receivers and selects appropriate, unique telephone numbers from information related to necessary telephone numbers for application execution.
- Phase2: Special number and communications carrier identification number addition
  - (Receiver function)

  Phase that adds the appropriate special number and communications carrier identification number in telephone numbers that have been solely selected with Phase 1, based on viewer setup information.
- Phase3: Call(Receiver function)

  Phase that calls Phase 1 and Phase 2 based processing. When the external line acquisition number is set, it adds. In addition, a host number is transmitted if necessary.

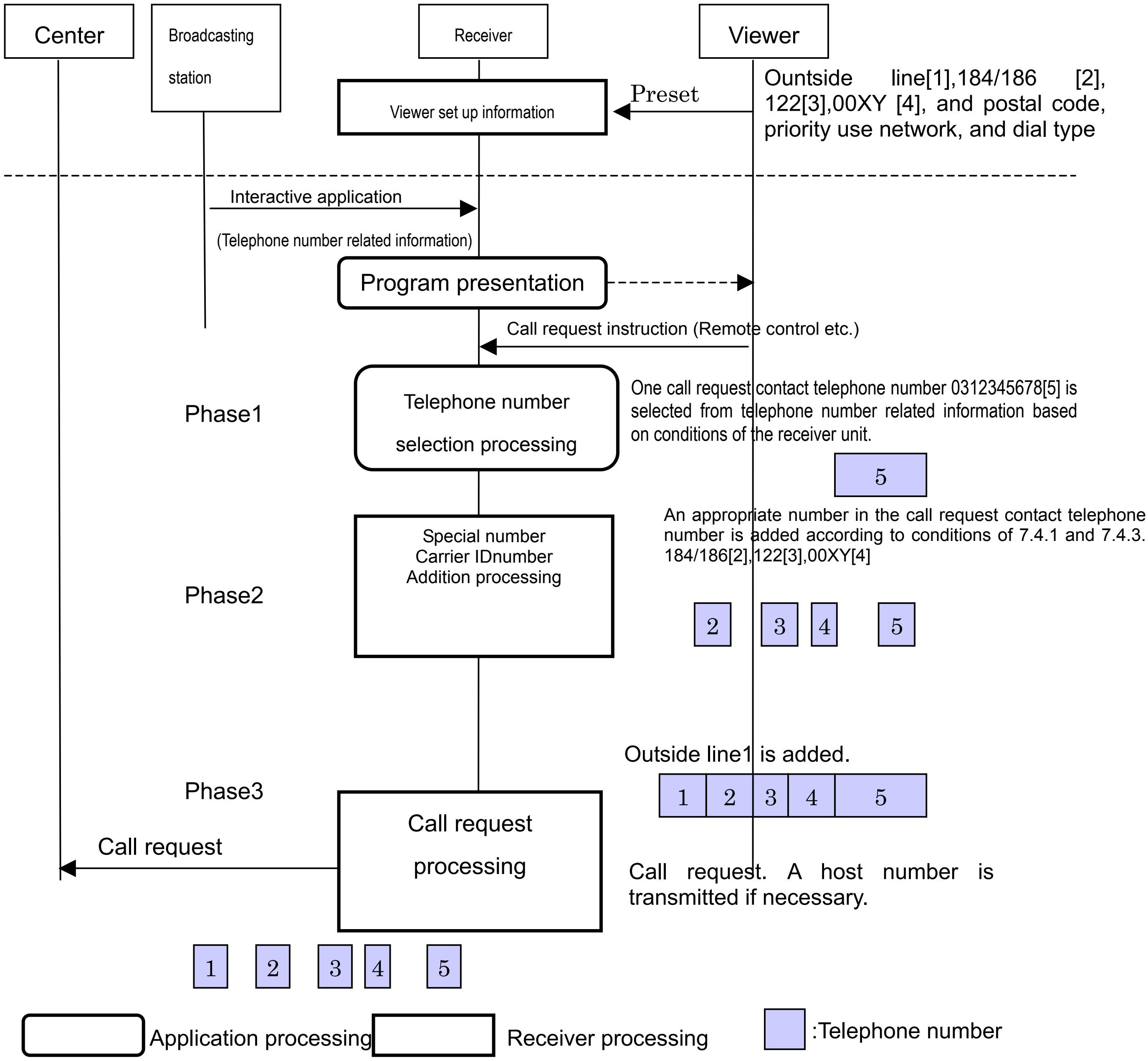


Figure 7-3 Call processing outline

7.3 Broadcasting station operation Provision A

7.3.1 Transmission conditions of telephone numbers

The transmission conditions of telephone numbers in Interactive data broadcasting services are as follows.

(1) Broadcasting stations that broadcast only mandatory telephone numbers.

– Do not add the Carrier ID number (00XY etc.) to broadcast. However, number (00XY+SC+********) that begins from 00XY is excluded.

- Do not add special number (122) which forcibly cancels the fixed priority connection to broadcast.
- When viewer consent has not been obtained, do not add special number (186) which focibly notifies the transmission telephone number to broadcast. When adding and broadcasting special number (186), it is preferable to obtain consent by a reliable method such as the method for requesting users for their concents on the BML contents by displaying confirmation messages prior to the transmission and the method for requesting addition by the receiver function (186).

(2) Operation of network specification identification

- The broadcasting station shall turn ON this flag for telephone numbers that can provide the caller ID notification number and the communications carrier identification number to broadcast. When the number addition function of the receiver is temporarily invalidated, the broadcasting station shall turn OFF this flag to broadcast. Table 7-3 shows the operation of the flag by a current telephone number system.

(3) Description of telephone numbers in the contents

- For telephone numbers decribed in the contents, when SDT (second dial-tone) detection in the telephone number is necessary, use a "," pause, and conduct SDT detection. The pause time of the dial pause is 2-3 seconds for one ",".

Table 7-3 Operation of network specification identification

Telephone no. etc.	Network specification identification operation
0ABCDEFGHJ(K)	On
0AB0+DEFGHJ(K)	Off
00XY+SC+*****	Off
When the numbered addition function of the receiver unit is temporarily invalidated.	Off

7.3.2 Application functions

(1) Telephone number selection function

There shall be a function that refers to the saved viewer setup information and communication related information in the receivers, compares them with the telephone number related information maintained by the application and selects the best telephone number.

(2) Condition for not conducting call operations

When the following conditions apply, the application will not execute the call.

- When selecting the telephone number with postal code information in the receivers, the postal code has not been input in the receivers.
- When the line, etc. possessed by the receiver unit and the line requested by the application are different.

(3) Reference for information on the receivers

The application has an API in order to refer to the communication related information and viewer setup information necessary in receivers in telephone number selection.

(4) Operation during Interaction channel of the caller's charge

When telephone numbers for transmission accounting are used, etc., and when Interactionchannel of the caller's charge is conducted, it is preferable to obtain consent by an application.

(5) Error processing during delayed calls

When busy and no carrier errors occur during delayed calls, re-call processing, error processing, and necessary error displays are carried out by the application.

At this time, there is a possibility that the viewer settings related to the calls in the receiver are incorrect in no carrier and busy error factors. Therefore, it is recommended that there be an error display and script that considers this point.

(6) Processing for the mass calls reception service

The cut through connection of the mass calls reception service can be reagrded as a cut call due to processing on the switchboard side after the call. Therefore, in order to carry out cut through connection for the mass calls reception service, when the return value (-6) "Forcibly cut" or the return value (-8) "The line was busy" is returned on the application side, conduct processing to regard them as a "Success of cut call".

(7) Specification for the timeout time of connect( )

When a call is made using connect( ), in order to guarantee the return value (-5) "The carrier has not been detected" with the modem's carrier detection timer, it is recommended to specify 90000 milliseconds or more as the time considered for a time-out on the application side when the center response is not detected.

(8) User ID, password presentation

When connecting with the call function by BML contents, do not display the user ID and the password to the viewer.

(9) ISP connection information usage limits

When connecting with the call function by BML contents, only use ISP connection information in the relevant BML and do not maintain it in the receivers on a permanent basis.

(10) Operation when the caller ID notification number is granted by the BML contents

When settings for the "Number to cancel the priority carrier routing" and " Carrier IDnumber" exist, replay the "Fixed priority connection cancellation number" and "Communications carrier identification number" with the BML contents and guarantee the order of the dial numbers. However, cases in which the telephone number cannot be given for the communications carrier identification number are excluded.

(11) Operation when functions for BASIC mode data protocols are used

For BML contents, considering the co-existance in the market of PSTN (modem) installed receivers which can exectute functions for BASIC mode data protocols and only Ethernet installed receivers that cannot execute functions for BASIC mode data protocols, when functions for BASIC mode data protocols are used, whether or not the relevant receiver is PSTN or not has to be evaluated, and for receivers without PSTN, the communication shall be carried out with protocols that those receivers can execute.

(12) Termination of PPP connection line established by the automatic connection function

When the PPP connection line established by the automatic connection function of the receivers is terminated with the termination function disconnectPPP( ) from the BML contents, viewer consent for BML contents shall be obtained.

7.3.3 Information that the application shall maintain

The following information is necessary for the application to maintain.

(1) Host number

Identification numbers for centers, etc. specified by the application.

(2) Telephone number related information

It is neccessary for the application to maintain information composed of the following information elements.

a) Transmit region control postal code

Postal code specifing the region allowed calling the number.

b) Telephone number

General telephone number of the connection point.
(e.g. 0ABCDEFGHJ(K), 00XY-SC******)

c) Line class

Specify the line class on the receiver. Multiple data input is possible.
(e.g. PSTN/ Cellular phone line/ PHS line)

d) Physical layer protocol

Specify the physical layer protocol on the receiver. Each line class has been set.
(e.g. V.22bis-MNP4, 32kPIAFS)

e) Data link and transfer protocol

Specify data link establishment and data transfer protocols between the receivers and the center (between the collection networks).
(e.g. X.28 compliant part –BASIC mode data,TCP/IP)

f) Network specification identification

When the caller ID notification number and the communications carrier identification number are given to relevant telephone numbers in the receiver units, set it to ON.

(3) ISP connection information

a) ISP name

Specify the name of the ISP. The maximum character string is 64 digits (128 bytes or less).

(e.g. terrestrial network, ARIB-net)

b) AP telephone number

A telephone number for the access point of the ISP specified by the broadcaster or the closed network provider. Multiple data input is possible, and the selection logic depends on the BML contents.

(e.g. 0ABCDEFGHJ(K),00XY+SC******)

c) User ID

A user ID to access the ISP specified by broadcaster or the closed network provider. It is used by combining single-byte alphanumeric character symbols. The maximum character string is 64 digits (64 bytes or less).(e.g.abcd1234,abcd@arib.or.jp)

d) Password

A password to access the ISP specified by broadcaster or the closed network provider. It is used by combining single-byte alphanumeric character symbols. The maximum character string is 32 digits (32 bytes or less).

e) Header compression

When the TCP/IP header is compressed in order to improve the transfer rate of data, it is "Used".

f) Software compression

When data compression is conducted to improve the transfer rate of data, it is "Compress".

g) DNS-IP address(primary)

The IP address for the DNS server of the ISP specified by the broadcasting station or closed network provider(primary). Decimal number symbols (0-255), "." is a separator.

(e.g. ***.***.***.***)

h) DNS-IP address(secondary)

The IP address for the DNS server of the ISP that the broadcasting station specifies or the closed network broadcaster (secondary) is specified. Decimal number symbols (0-255), "." is a separator.

(e.g. ***.***.***.***)

i) Non-communication termination timer value

In the line that connects PPP using call functions, the line is terminated by referring to the following values when there is no definite packet sending and receiving time.

idleTime:1 minute or more, 20 minutes or less.

7.3.4 Information for host connection

(1) URI

Table 7-4 shows the URI information elements.

Table 7-4 URI information elements

Information element name	Literal	Remarks
Scheme name	http:	
	https:	When TLS1.0 and SSL3.0 security are used
Host name	Alphanumeric character symbol	Refer to (2) for direct IP address specifications Follow RFC2396.
Port number	Figure(0~65535)	Refer to (3) for use of the port number.
Path name	Alphanumeric character symbol	Follow RFC2396.

(2) IP address

8 bits at a time, the decimal number is written (0-255), and "." is the separator in the IPv4 network.

(Ex.) ***.***.***.***

Do not carry out address specifications for the IPv6 network.

(3) Port number

When the port number is used, follow the Assigned Number (RFC1340) provisions. Table 7-5 shows the port number provisions.

Table 7-5 Port numbers

Port number	Remarks
1 ~ 1023	well known port
1024 ~ 49151	IANA registered port
49152 ~ 65535	IANA dynamic

7.4 Recommended receiver functions

7.4.1 Information managed by receivers Provision A

The receivers maintain the viewer setup information that is set by communication related information and viewers to display the state of hardware of the receivers.

(1) Communication related information

a) Line class

The line class that can be used in the line classes provided by the receivers is shown. Multiple line classes are possible.

(e.g. PSTN/ Cellular line/ PHS line)

b) Physical layer protocol

The physical layer protocol that can be used in each line class provided by the receivers is shown. Multiple protocols are possible.

(e.g. V.22bis-MNP4(PSTN), 32kPIAFS(PHS), PDC(cellular))

c) Data link and transfer protocol

The data link establishment and the data transfer protocol between the receivers and the center (collection network) provided by the receivers are shown. Multiple protocols can be displayed.

(e.g. X.28 compliant part –BASIC mode data,TCP/IP)

(2) Viewer setup information

The following is the information inputed by the viewers and maintained in the receivers. This information is stored in the nonvolatile memory of the receivers. Additionally, having the expandability that can correspond to changes that accompany telephone number system changes is recommended.

a) Postal code

The postal code of the location where the receiver exists (7 digits) is shown.

(e.g. 100-0004)

b) Priority use line type

One line class that is given priority from the lines connected with the receivers is shown.

(e.g. PSTN/ Cellular line/ PHS line)

c) Carrier IDnumber

Identification number to select the communications carrier selected by the viewer. (Currently 7 digits)

(e.g. 00X, 00XY, 002YZ, 0091N_1N_2)

d) Number to cancel the priority carrier routing

Number that cancels the priority connection.(Currently 3 digits)

(e.g. 122)

e) Caller ID notification number

Number that sets whether a caller's telephone number is notified to the receiver or not. (Currently 3 digits)

(e.g. 186, 184)

(3) Ountside line

The saving of necessary numbers in nonvolatile memory for unique calls in the receivers such as outside line.

(e.g 0,)

(4) Dial type

The saving of the dial type of the PSTN line used in nonvolatile memory.

(e.g Tone, 10pps, 20pps)

7.4.2 Information managed by receivers(TCP/IP) Provision A

Contents for the information elements depend on the provisions of STD-B21.

(1) Communication related information STD-B21 11.5.7.2

CAS is excluded as a security class value.

(2) Security communication related information STD-B21 11.5.7.3

Implementation security type

As shown in Table 8-6.

(3) Communication device information STD-B21 11.5.7.4

The one selected by 6.2.3 physical layer protocol implementation is implemented.

(4) Viewer set up information STD-B21 11.5.7.1

* Common information STD-B21 11.5.7.1(1)
* ISP connection information STD-B21 11.5.7.1(2)1

The following information elements are provided in this volume.

a) ISP name

The ISP name information element is in Provision B in the required receivers for connection to a specific ISP.

b) User ID

It is a combination of the single-byte alphanumeric character symbols of a maximum 64 digits.

c) Password

It is a combination of the single-byte alphanumeric character symbols of a maximum 32 digits.

d) Header compression Provision B

e) Software compression Provision B

f) Non-communication termination timer value

The recommended default value is 180 seconds. A range that can be set for changes for more than 1 minute and less than 20 minutes is recommended. In the following cases, the line is terminated when non-communication time is over this value.

* When PPP is connected by the automatic connection function of the receivers.
* When the argument idelTime in the connectPPPWithISPParams( ) execution time is not specified.
* When sendTextMail( ) and sendMIMEMail( ) are executed

g) Communications carrier identification information

Maintain the value specified with setISPParams( ).

* Fixed IP connection information STD-B21 11.5.7.1(2)2

In receivers that are not compatible with the Ethernet, it is not a management object.

* Connection format information STD-B21 11.5.7.1(2)3

- In receivers that are not compatible with the Ethernet, it is not a management object.

- The value "PPP/PPPoE protocol" in the IP address acquisition specification is in Provision B.

Reference: For cases in which it is connected and used in routers equipped with the PPP/PPPoE protocol, the PPP/PPPoE protocol equipped in the receivers is in Provision B.

* TCP/IP application setup information STD-B21 11.5.7.1(2)4

a) SMTP server name/address Provision B

b) POP server name/address Provision B

c) Mail address Provision B

d) Mail password Provision B

e) HTTPProxy server name/address Provision B

f) HTTPProxy server port name Provision B

g) FTPProxy server name/address and FTPProxy server port number are not operated.

7.4.3 Setup conditions for each line class

The information elements that are necessary according to each line class and device installed in the viewer setup information is different. Table 7-6 to Table 7-8 show the information element items of each line class. Refer to Chapter 11 of STD-B21 and explanation 9 for the line class and connection format.

- The priority use line type (*1) for the viewer setup information is selected from the line class for communication related information. However, receivers that are not compatible with multiple line classes are excluded.
- Only when the communications carrier identification (*2) for the viewer setup information is set, the fixed priority connection cancellation number (*3) for the viewer setup information can be set.

Table 7-6 Setup conditions of PSTN, ISDN, and mobile phones

Line class / Information element	PSTN	ISDN				Cellular phone		
	Modem	Modem	TA (Serial)	TA (ST)	Router	PDC	PHS	PDC-P
Priority use Line class(*1)	O	O	O	O	O	O	O	O
Carrier ID (*2)	O	O*1	O*1	O*1	-	-	-	-
Number to cancel the priority carrier routing(*3)	O	O*1	O*1	O*1	-	-	-	-
Caller ID Notification number	O	O*1	O*1	O*1	-	O*2	O*2	-
Ountside line	O	O*1	O*1	O*1	-	-	-	-
Dial type	O	O	-	-	-	-	-	-
IP address Acquisition specification	-	-	-	-	O	-	-	-

Explanatory notes O: Item that requires setting -: Disregard

*1 : Note that there is the TA model with the number addition function shown in 7.4.4 depending on the model.

*2 : Note that the number shown in 7.4.4 according to the cellular terminal setting is added.

Table 7-7 ADSL,FTTH setup conditions

Line class / Information element	ADSL				FTTH	
	ADSL Modem	ADSL Modem (Non-shared)	Router	Modem (Analog)	ONU	Router
Priority use Line class(*1)	O	O	O	O	O	O
Carrier ID (*2)	-	-	-	O*1	-	-
Number to cancel the priority carrier routing(*3)	-	-	-	O*1	-	-
Caller ID Notification number	-	-	-	O*1	-	-
Ountside line	-	-	-	O*1	-	-
Dial type	-	-	-	O	-	-
IP address Acquisition specification IP	O	O	O	-	-	O

Explanatory notes O: Item that requires setting -: Disregard

*1: Note that there is ADSL modem model with the number addition function shown in 7.4.4 depending on the model.

Table 7-8 CATV setup conditions

Line class / Information element	CATV	
	Cable modem	Router
Priority use Line class(*1)	O	O
Carrier ID (*2)	-	-
Number to cancel the priority carrier routing(*3)	-	-
Caller ID Notification number	-	-
Ountside line	-	-
Dial type	-	-
IP address Acquisition specification	O	O

Explanatory notes O: Item that requires setting -: Disregard

7.4.4 Number addition function Provision A

Add the special number and communications carrier identification number to the receivers based on the conditions shown in Table 7-9.

Table 7-9 Number addition conditions for receivers

Circuit class	Network specification identification	When the transmission number notification (186/184) is set	When the fixed priority connection cancellation number (122) is set	When the communications carrier identification number (00XY, etc.) is set
PSTN(*2)	OFF	×	×	×
	ON	O	O(*1)	O
Cellular line	OFF	×	×	×
	ON	O	×	×
PHS line	OFF	×	×	×
	ON	O	×	×

O: Adds ×: Does not add

(*1) It is recommended to grant 122 only when communications carrier identification numbers other than the communications carrier with the fixed priority connection designation is input when using the line that sets the fixed priority connection.

(*2) When the mass calls reception service (vote( ) function) is specified, do not add the special number or the communications carrier identification number regardless of the specifications for the network specification identification.

7.4.5 Call function Provision A

(1) The outside line maintained in the receivers can add and call.

(2) According to the dial type maintained in the receivers, dialing is possible by tone, with 10 pulses per second or 20 pulses per second.

(3) A dial pause is possible before and after the arbitrary point of the outside line, and each special number/ Carrier IDnumber provided by the receivers.(The pause time depends on product planning.)The dial pause is possible according to the "," described in the telephone number by contents in the arbitrary point of the telephone number when dialing.(The pause time is 2-3 seconds for one ",".)

Note) (1)-(3) are valid only for the dial-up connection.

(4) When the data transmission function etc., is executed from the BML contents when un-connected with the ISP, calling can be done by using the ISP connection information that has been set in the receivers beforehand.

(5) When the call function is executed from the BML contents when un-connected to the ISP, calling can be done by referring to the ISP connection information that has been set in the receivers beforehand. However, the priority use line type excludes cases for the Ethernet.

(6) Calling can be done from the BML contents to the ISP according to the call function when not connected.

(7) When multiple communication lines are connected to the receivers, calling uses the priority use line selected by the viewer. However, when the priority use line type is Ethernet and a PPP connection is possible, only if the viewer has given consent, the call function connectPPP( ) for the relevant call only can be executed.

(8) When a call has already been established, a new call cannot be made.

7.4.6 Call prohibited function Provision B

(1) Call prohibited settings

– In order to prevent prank calls by children, etc., it is recommended the receivers have a call-prohibited setting. A 4-digit personal identification number is required for the setting/cancellation to prohibit calls and it is recommended that only the owner of the PIN number be able to change the number.

(2) Receiver behavior during an incoming call

Does not make calls during an incoming call.

7.4.7Operation of viewer setup information

Conduct the following operations for viewer setup information from the viewpoint of preventing the use of other services besides Interactive data broadcasting or preventing the leakage of personal information.

Security function for the viewer setup information Provision A

(1) When the access authorization and viewer setup information is set as a receiver function by the user ID, password of the ISP or the network for continuous connection, display a character string such as "*" instead of displaying the password in order to maintain security.

(2) Install a function that can nullify the viewer setup information when the receiver is transferred or disposed.

Viewer setup information settings, User interface guidelines

The receivers shall have a user interface function to input, change and delete viewer setup information. Provision A

(1) They shall have a user interface function to avoid setting mistakes by using induced settings, etc., according to the menu format, help and navigation. Provision B

(2) When changing the setup information with the receiver function, display the current setup information when the viewer setup information is being input. However, from the viewpoint of security protection the password is not displayed. Provision B

7.4.8 Display operation during a call Provision A

(1) When a connection has already established or when it has been connected using the call function, do not display the dialog box related to the connection.

(2) When calling by the data transmission function, etc. while unconnected, displaying the announcement of connection with the connection point information (ISP name and telephone number, etc.) is recommended. Provision B

(3) When the line is busy, carry out a recognizable display (LED and OSD, etc. on the front panel) for the viewer.

(4) When an error occurs in call processing, conduct the recognizable error occurrence display (LED and OSD, etc. of the front panel) for the viewer.

7.4.9 Operation of ISP connection information

(1) Identification information

When the ISP connection information for the viewer setup information has been set, save the identification information on a permanent basis with the receiver. Table 7-10 shows the setting conditions of the identification information.

Table 7-10 Identification information setting conditions

Value(Hexadecimal format)	Remarks
00 (1byte) | XXXX (2 bytes) | XX (1 byte)	Settings when deleted by the un-set state or the receiver
8F (1byte) | XXXX (2 bytes) | XX (1 byte)	Setting when set by the receiver
Not listed above FF (1 byte) | original_network_id (2 bytes) | broadcaster_id (1 byte)	When it has been set by a broadcaster with an ID on the left

Note:X means don't care.

(2) status value

Operation limits are not installed when the receiver unit has set the ISP connection information. The changed status value is saved on a permanent basis by the receivers.

(3) ispname

The ispname setting method is up to product planning. The character string length is a maximum 64 digits (128 bytes).

7.4.10 Operation of the registration call

Have a function to record unsuccessful bi-directional calls due to the concentration of communication in the registration call area of the receivers by the contents, and to process calls and data transmissions according to instructions given by the viewer after the program ends. Transmission in the registration call function is carried out by the receiver application with the registration call contents or the registration call function but the registration call by the receiver application is in Provision B. Refer to Vol. 3, 5.16 "Operation of the registration call" for details.

7.5 Guidelines for when there is a communication error Provision A

When normal connection, data transmission, and termination, etc., by the automatic connection function are not carried out, an error notification is sent. The method of the display is up to product planning. The error notification detected excluding the automatic connection and the error notification when the data is transmitted are in Provision B.

7.6 Details of telephone number processing

Figure 7-4 shows a detailed relationship between processing and application information, and the viewer setup information and communication related information from phase 1 to phase 3. Figure 7-5 shows when to use the TCP/IP protocol.

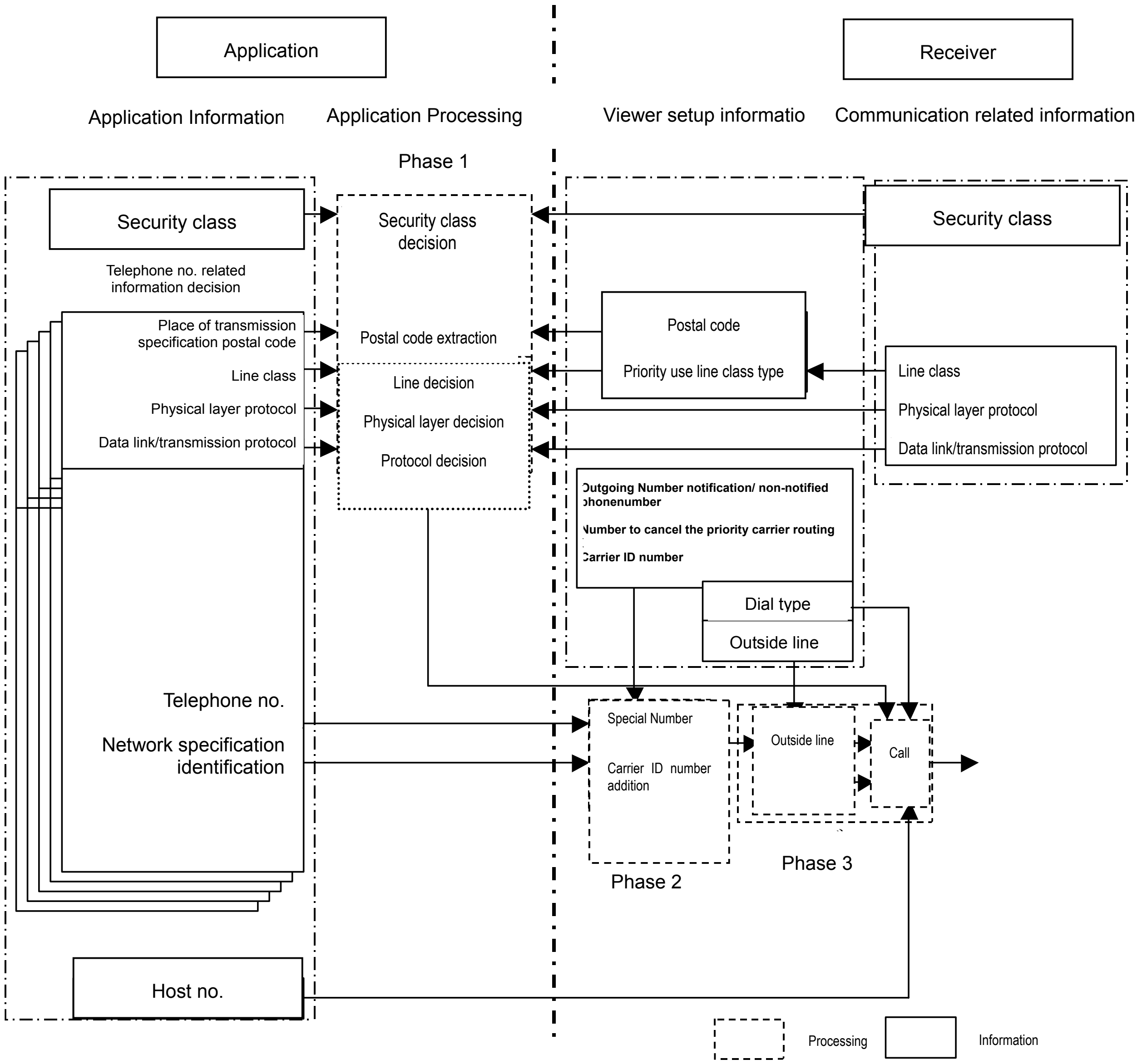


Figure 7-4 Call processing details

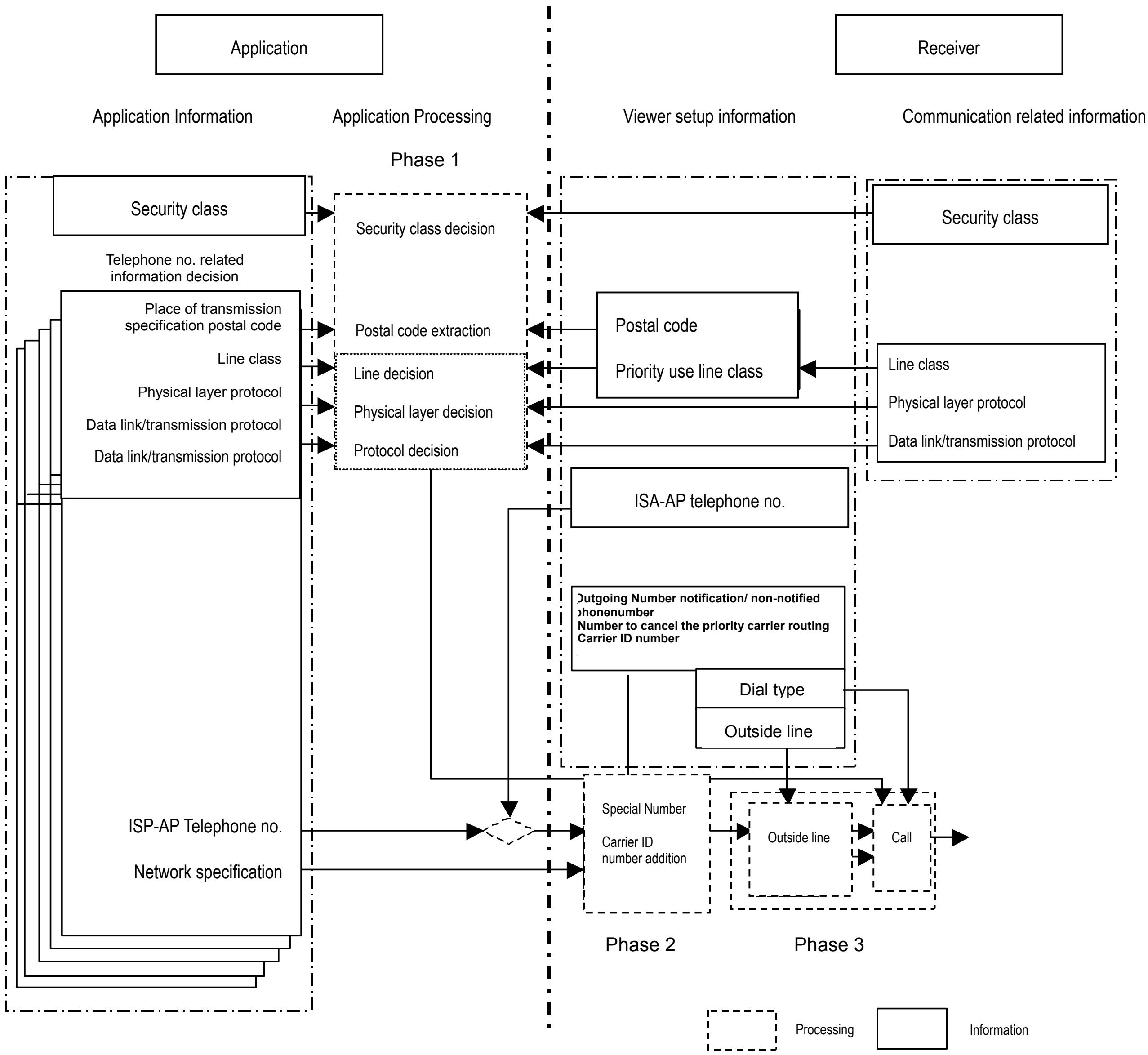


Figure 7-5 Call processing details

8 Security

In section 8.1, a concept for the security function necessary for carrying out bi-directional services is explained. Additionally, section 8.2 specifies the necessary receiver functions to carry out encryption communication by public key cryptosystem (PKCS) using TLS1.0 and SSL3.0.

8.1 Necessary security functions in bi-directional services

In bi-directional data broadcasting services, to conduct services that are necessary for the sending and receiving of viewer information and in consideration of comparatively small payments and fairness, security functions may be necessary. Bi-directional services are classified into 3 service classes from the viewpoint of security. Table 8-1 shows the necessary security functions for each service class.

Table 8-1 Service class and necessary security functions

Service class	Simple services	Standard services	Advanced services
Service outline	Simple services that do not require payment and authorization	Service that require small payments, personal authentication, and fairness	Services in which charged digital contents are delivered.
Target application example	* Anonymous surveys * Document requests	* Shopping * Gambling * Signed surveys * Accurate opinion research	* Music software delivery * Game software delivery
Security functions			
Simple mutual authentification function	-	O(Level 1)	O(Level 1)
Information protection function	-	O(Level 3)	O(Level 3)
Tamper prevention function	-	O	O
Simple signature function	-	-	O(Level 1)

(Note 1)Outlines and security levels for each respective security function are explained in the following paragraphs.

8.1.1 Simple mutual authentification function

Items that shall be considered as simple mutual authentification on the viewer and the center side are classified into levels shown in Table 8-2.

Table 8-2 Mutual authentification levels

Security level		Assumed application service	Necessary module
Level 2	Strict authentification (PKCS)	Internet system service	Both: Public key cryptography and hash function.
Level 1	Protected simple authentification	Comparatively low price article purchase	Both: Symmetric cipher processing and time stamp
Level 0	Unprotected simple authentification	Total for the other party's un-confirmed surveys, etc.	Receiver units: Receiver ID

When using necessary applications to confirm privacy protection and the legitimacy of the viewer in communication, it is necessary to confirm the identity of the other party and the connection point at an early stage in the transaction. The mutual (other party) authentification function is used for this procedure. The mutual authentification function can be classified into two kinds, one is strict authentification that mainly uses public key and second one is simple authentification that substitutes strict authentification when the public key cannot be used due to some restriction.

(1) Level 0

It is recommended that the viewer confirm whether or not the other party is a fake center when individual privacy information and credit card numbers, etc. are sent to the host at the center. Therefore, in communications that are not protected, limiting the information to be sent to a reasonable level where there is no harm even if the information is intercepted and falsified is recommended.

(2) Level 1

Using the "Message restoration method" is recommended for mutual authentification.

In order to prevent spoofing, It is recommended to send timestamp and random numbers processed by one-way function before sending information to the center.

[Message restoration method]

Figure 8-1 shows a method for authenticating the other party using the message restoration method. Mutual authentification is also possible in the opposite direction.

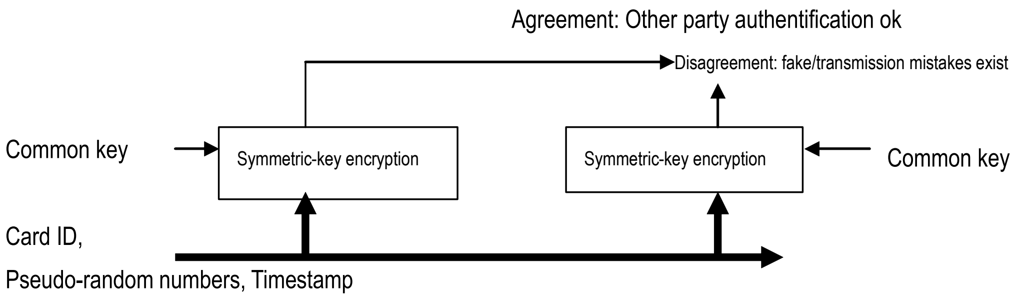


Figure 8-1 Other party authentification using the message restoration method

In symmetric cipher, when the sender and receiver (verifier) share a common key beforehand, messages are encrypted by the transmission side using the common key, and the sender can be confirmed if it becomes a message with some meaning when the receiver decodes the encrypted text.

(3) Level 2

A series of code processing systems known as public key cryptosystem (PKCS) widely used by the Internet is used.

- Necessary modules(In addition to level 1): Public key cryptography processing function, one-direction function, and certification function
- Necessary organizations: Certificate Authority(CA)(Issue, reference, change, update, disposal)

8.1.2Information protection

Items that shall be considered as information protection are classified into levels and shown in Table 8-3.

Table 8-3 Information protection levels

Security level		Handled viewer information	Necessary modules/systems
Level 3	Other network connections	Integrated with Internet system services	Center: Firewall
Level 2	Information access authority management	Customer management information	Center: Access management function
Level 1	Information encryption management	Individual names and addresses, etc.	Both: Common code processing function
Level 0	No considerations	Individual acknowledgement scope	-

In bi-directional data transmission services, the service provider may need to know the viewer's name and address in order to specify the receiver as shopping. In these kinds of bi-directional services, taking into account the following information is recommended to prevent the leaking of viewer information from the viewpoint of privacy protection.

- Eavesdropping prevention on the network
- Leak prevention in the center
- Invasion prevention from the outside to the center.

- Handling necessary personal data only, not using information for other purposes without permission, and not transferring information.

(1) Level 0

- The center carries out recommended functions and behaviors.

It is recommended to obtain permission from the person in question before handling personal information in services which require it.

(2) Level 1

- Recommended functions and behaviors carried out by the receivers.

Check the server whether it is the intended destination or not, before performing communication. (Refer to 8.1.1(2))

Send back viewer information that is the target of privacy protection after encryption.

- The center carries out recommended functions and behaviors.

Only entitled persons shallhandle viewer information, which is the targetof privacy protection.

(3) Level 2

- Recommended functions and behaviors carried out by the center

Carry out access authority control (control to limit people from possibly reading and registering viewer information etc.) management for viewer information that has become the targetof privacy protection.

(4) Level 3

- Recommended functions and behaviors carried out by the center

Strive to prevent the leakage of viewer information by setting up firewalls when connecting with other networks on the Internet, etc., for the expansion of service contents.

8.1.3Falsification prevention function

When there is fake information in the communication pathways, having a function to detect fake information is recommended.

8.1.4Signature function

Items that shall be considered as signature functions are classified in levels shown in Table 8-4.

Table 8-4 Signature function levels

Security level		Main application example/features	Necessary modules/system
Level 3	Digital signature function	Necessary information exchange for legal evidence ability	Public key cryptography and certificate issuing authority
Level 2	Substitution of the symmetric cipher	Symmetric cipher	Symmetric cipher and third party signature organization
Level 1	Simple signature function	One way function and message application method	Symmetric cipher
Level 0	No considerations	Memo of the confirmation number	Unnecessary

(1) Level 0

Since the memory system and output method are expected to be limited depending on the receiver, even if a reception confirmation sheet, etc. is received for the reservation like when tickets are reserved, at a minimum it is recommended that the center issue a reservation confirmation number to handle trouble with the procedure. However, it is necessary that the center be completely reliable for the handling of the reservation confirmation number.

(2) Level 1

When there are monetary and product (including digital contents) transactions from online shopping, it is necessary to leave proof of both transactions to prevent trouble. In this case, although it is ideal to use a digital signature, since a digital signature cannot be used if the public key cryptography function is not installed, a message authentication code (MAC) that can also be used in systems implemented with symmetric cipher only is recommended.

However, although signature results that are not generated by a third party can be confirmed, since those who receive the signatures can also create the same message, fraudulent acts from the center side still cannot be prevented.

(3) Level 2

It is possible to deal with fraud on the center side by connecting a reliable third party's message authentication code to the message, and adding the message authentication code from the center. However, receiver units and third-party organizations shall continue to secure the shared common key.

(4) Level 3

Since admissible legal proof is needed, using an organization that issues certificates by using public key cryptography is recommended.

8.2 TLS1.0 and SSL3.0 Operation Provision A

The receivers implement TLS1.0 and SSL3.0, and have a mechanism that carries out encryption communication by public key cryptosystem (PKCS). Refer to Vol. 3 for the operation protocol and transmission of the root certificate.

8.2.1 Assumptions of rootcertificate storage module operation

Management of the root certificate storage module

* The general-purpose rootcertificate storage module transmitted by the broadcaster, or, the general-purpose root certificate included in the module itself, general-purpose root certificate identification ID and general-purpose certificate version, general-purpose root certificate storage number, are assumed to be managed by an organization (hereinafter, certificate management organization) composed of broadcasters, etc. When a general-purpose root certificate is used, each broadcaster follows the provisions of the certificate management organization.
* The certificate management organization adjusts the general-purpose root certificate to the desired operation of each broadcaster, numbers an identification ID (root_certificate_id) and version number (root_certificate_version) in each general-purpose root certificate, allocates a general-purpose root certificate storage number and manages a list of general-purpose root certificate information.
* The certificate management organization provides a list of general-purpose root certificate information to each broadcaster and receiver manufacturer when requested.
* The certificate management organization creates a root certificate storage module that each broadcaster transmits, and distributes it to each broadcaster.
* Root certificate modules for root certificates exclusively for broadcasters are managed by the broadcasters.

General-purpose root certificate identification ID, and numbering of the versions, and allocation of the storage numbers.

* The general-purpose root certificate identification ID and version are numbered by the certificate management organization in a way that the certificates can be uniquely identified. When the root certificates are exclusively for the broadcasters, the root certificate identification ID is 0xFFFFFFFF and the root certificate version is 0xFFFFFFFF.
* One root certificate storage number is allocated for the general-purpose root certificate having the same root certificate ID and version. Moreover, the same general-purpose root certificate storage number is not allocated to a different general-purpose root certificate at the same time.
* The number for the general-purpose root certificates used at the same time is 8 digits or less, including when the certificate is renewed.

8.2.2 Renewal of the general-purpose root certificate

* When it is necessary to switch the general-purpose root certificate due to reasons such as the cutoff of the expiration date, set up a transition time period before expiry, store and transmit both the new and old certificates in the general-purpose root certificate storage module, and in the meantime update the server certificate on the bi-directional server side one at a time. Refer to Vol. 3, 2.3.1.8 "Transmission of the root certificate" for details concerning the transmission of the certificate.

8.2.3 Format of the root certificate storage module

The data structure of the root certificate stored in the root certificate storage module uses specifications from Vol. 2 of ARIB STD-B24 9.1.2 "Resource-to-module mapping". Conduct mapping of the root certificate storage number, root certificate identification ID, and the root certificate version for the resource name.

Use of the resource name is as follows, and is written without using extensions.

[Root certificate storage number]+ '.'+ [Root certificate identification ID]+ '.'+[Root certificate version]

Here, express the "root certificate storage number", "root certificate identification ID", and the "root certificate version" in decimals, and connect them with a '.'. The character code used is ASCII, and only '0'~'9', '_', 'A', 'B', '.' are used. Also, the root certificate storage number for the root certificate exclusively for broadcasters is '_ A' or '_ B'. The possible scope for each number of the general-purpose root certificate is shown in Table 8-5. Therefore, the length of the resource name is changeable, and at a maximum, becomes 2 bytes +'.'+10 bytes +'.'+10 bytes = 24 bytes.

For example, the resource name when the root certificate storage number is 0x03, the root certificate identification ID is 0x0000003F, and the root certificate version is 0x0000007D is as follows.

Ex. 3.63.125

Additionally, the root certificate exclusively for broadcasters becomes the following since the root certificate identification ID is 0xFFFFFFFF and the root certificate version is 0xFFFFFFFF(8.2.1.2).

Ex. _A.-1.-1, or _B.-1.-1

The value for num_of_resources is a maximum of 2. The actual data in the certificate is stored in an entity-body.

Table 8-5 General-purpose root certificate storage number and identification ID, version range

	Allocated bytes	Range	
		Hexadecimal form	Decimal form
Root certificate storage number	2	0x0000~0x0007	0~7
Root certificate identification ID	4	0x00000001~0x7FFFFFFF	1~2147483647
Root certificate version	4	0x00000001~0x7FFFFFFF	1~2147483647
	Total 10		

8.2.4 Cipher suite installed by the receivers STD-B21 11.5.7.3

The receivers shall be installed with the following Cipher Suite. However, for installations other than the following Cipher Suite, shall be according to the product standards.

Table 8-6 Cipher Suite list supported by receivers

Cipher Suite	Key exchange	Data code	Hash
TLS_NULL_WITH_NULL_NULL	NULL	NULL	NULL
TLS_RSA_WITH_NULL_MD5	RSA	NULL	MD5
TLS_RSA_WITH_NULL_SHA	RSA	NULL	SHA
TLS_RSA_EXPORT_WITH_DES40_CBC_SHA	RSA_EXPORT	DES40	SHA
TLS_RSA_WITH_DES_CBC_SHA	RSA	DES	SHA
TLS_RSA_WITH_3DES_EDE_CBC_SHA	RSA	Triple-DES	SHA
SSL_NULL_WITH_NULL_NULL	NULL	NULL	NULL
SSL_RSA_WITH_NULL_MD5	RSA	NULL	MD5
SSL_RSA_WITH_NULL_SHA	RSA	NULL	SHA
SSL_RSA_EXPORT_WITH_DES40_CBC_SHA	RSA_EXPORT	DES40	SHA
SSL_RSA_WITH_DES_CBC_SHA	RSA	DES	SHA
SSL_RSA_WITH_3DES_EDE_CBC_SHA	RSA	Triple-DES	SHA

8.2.5 Contents and limits of root certificates and server certificates

(1) Root certificate contents

Table 8-7 Receivers equipped with general-purpose root certificates

Type	Number	Size
X.509 (ASN.1/DER format)	8	1certificate 3Kb or less

* Certificates that use Cipher Suite supported by 8.2.4.

* Either MD2, MD5 or SHA-1 as the hash function for the signature of the root certificate.

* Japanese language certificates are used. The Japanese character string is the UTF8String.

* Do not operate Version 3 certificates without extensions.

* It is the same as the above provisions for root certificates exclusively for broadcasters defined by Vol. 3, "5.14.14.4 Guidelines for receiver operation when root certificates exclusively for broadcasters are received".

(2) Limitations of server authentication certificates and intermediate certificates

* The server authentication certificate and intermediate certificate are limited to MD5 or SHA-1 as a hash function of the signature.

8.2.6 Root certificate display Provision B

Possess a function in which the general-purpose root certificate can be displayed in the receivers. The method of display shall be according to the product design.

8.2.7 Authentification function

In order to prevent "Disguises" in services, the receivers support server authentication. Additionally, although the client authentication function is up to product planning, when digital terrestrial broadcasting services operate, the function doesn’t work.

8.2.8 Certificate verification items

(1) Number of verifiable certificates

WEB server certificates shall be 5 layers or less. The receivers shall be able to verify a minimum of 5 certificates.

(2) Verification items

* Follow RFC3280 and verify the basic certificate field,and KeyUsage, ExtendedKeyUsage, BasicConstraints in the extension field, and CommonName. However, as for the root certificate, verification of the signature is not needed.

* Verification of the cancellation information in the certificate is in Provision B.

8.2.9 Use of the server certificate revocation list (CRL) Provision B

Installation of the server certificate revocation list (CRL) shall be according to the product design.

8.2.10 Certificate references

Refer to Vol. 3, "5.14.14.2 Storage of general-purpose root certificates in the receivers, 5.14.14.4 Receiver operation guidelines when a root certificate exclusively for broadcasters” is received.

8.2.11 Alert when there are TLS and SSL errors

The receivers have a function to display alert messages when TLS and SSL errors occur. The display method shall be according to the product design.

Table 8-8 Alert message example when TLS or SSL errors occur

	Cause	Message example
1	There is no root certificate on the receiver side	"A root certificate has not been set on the receiver side. Although the safety of the connection point cannot be confirmed, do you still want to connect?"
2	Although there is a root certificate on the receiver side, the server certificate for the connection point cannot be verified.	"The safety of the connection point cannot be confirmed with the root certificate that has currently been set. Do you still want to connect?"
3	Expiration cutoff date of the root certificate	“The term of the root certificate currently set has expired. Do you want to connect even though the safety of the connection point cannot be confirmed?”
4	Authentification processing error such as line disturbances(Timeout processing)	"A connection could not be made within the set time."
5	The certificate for the connection point has expired.	"The certificate for the connection point has expired. Do you want to connect even though the safety of the connection point cannot be confirmed?"
6	The server certificate CommonName does not match.	"The name of the page that is to be displayed is not included in the certificate for the connection point. Do you still want to connect even though the safety of the connection point cannot be confirmed?"
7	"The certificate is invalid on the receiver side."	"The root certificate for the receiver that certifies the connection point has been invalidly set. Validate the root certificate and connect again."
8	Fake certificate	"Since an irregularity of the certificate for the connection point has been detected, the connection will be terminated."
9	Authorization errors such as an unauthorized chaining	"Since a problem has occurred in the certificate setting of the connection point, the connection will be terminated."

9 Congestion avoidance

9.1 Congestion measures

In bi-directional data broadcasting services, unlike existing communication by telephone, communication to the specified center tends to concentrate for a short time due to opinion surveys/ ticket purchasing corresponding to the program, and as a result network congestion occurs easily. If the network is congested, interference can occur in program operations and communication from viewers may not be completed, etc. Additionally, since other types of communication such as general phones, etc. can be affected, prevention measures are necessary.

9.2 Congestion measures by broadcasting stations

For the production of programs in bi-directional data broadcasting services, it is necessary to avoid concentration of communication from viewers.

Specifically, it is preferable to forecast the audience rate, participation rate, communication time period, time period for reception of communication, etc. of bi-directional data broadcasting services, and to take the following measures (combination is possible) to avoid congestion if it is judged that measures to avoid congestion are necessary.

9.2.1 Transmission delays

– Consider dispersing the call time of individual receivers by using the protocol function shown below in application programs sent through broadcast waves.

1. Random number generation (random( ))
2. Timer specification (setInterval( ))
3. Registration of calls(connect( ), sendTextData( )etc.,BASIC mode data, connectPPP( ),connectPPPWithISPParams( ),transmitTextDataOverIP( )etc., TCP/IP system transmission function and automatic calling by receivers triggered by the TCP/IP system transmission function)

Even when communication concentrates, traffic will be dispersed due to the short transmission delay in each receivers. The traffic image during execution of the transmission delay is shown in figure 9-1.

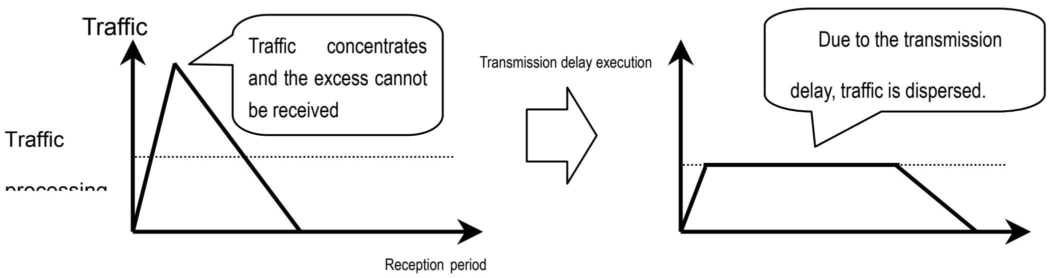


Figure 9-1 Traffic image during transmission delay

Also, by setting up local contents that continue after the end of the main program, call processing can be conducted after the end of the program unless another service is selected.

9.2.2 Transmission restrictions

– Consider providing instructions to approve which receivers can communicate (application program level) by providing final digit restriction on the receiver ID etc. through broadcasting.

Existing restrictions that allow viewers to call according to what the final digit in their phone number is depends on the honesty of viewers and it is possible to communicate using other than the specified telephone number. However, since the receivers restrict transmission in bi-directional data broadcasting services, communication can be limited. But due to the rules for transmission, there may be some viewers who cannot transmit.

Figure 9-2 shows a traffic image when transmission is being restricted.

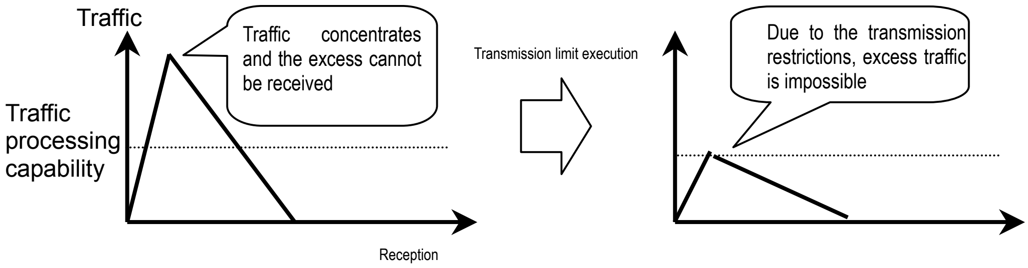


Figure 9-2 Traffic image when transmission is being restricted.

9.2.3 Transmission delays/Transmission delay notification Provision B

It is preferable that broadcasting stations notify viewers of transmission delays and transmission being restricted to avoid misunderstanding by the viewers.

9.2.4 Use of network services

Consider using the mass calls reception service when it is expected that communication will be concentrated in a short period of time.

Since the mass calls reception service can receive many calls without the line becoming busy, complaints from viewers about telephone connections can be decreased.

9.2.5 Prior information provided to communication carriers

It is preferable that broadcasting stations provide communication carriers with information in advance when a lot of communication is expected.

When congestion occurs in spite of the above measures, consider avoiding any reoccurrence by using this experience in the next program with the cooperation of the communication carriers.

9.3 Congestion measures by communication carriers

It is preferable to consider the following to disperse the access points and the number of lines.

9.3.1 Dispersal of access points

In order to avoid congestion due to the concentration of communication on a specific switchboard, consider setting up access points based on the number of receivers by area, etc.

9.3.2 Number of lines at access points

Consider the number of lines at access points which meets the amount of communication from receivers in order to avoid congestion.

Additionally, it is necessary to review the appropriate number of lines according to any changes in the number of receivers being used.

9.4 Receiver function Provision A

- Shall have a function to generate random numbers which are necessary for delaying transmissions.
- Re-transmission is conducted 2 times every 3 minutes.

9.5 Avoidance of center server congestion

Major causes of delayed responses by center server are a lack of performance of the server and equipment, etc. along the route in which requests are made.

In order to avoid this problem, taking following measures is recommended.

(1) Improvement in the processing performance of the server
(2) Dispersal of the workload on the server
(3) Introduction of a cache server
(4) Introduction of a TLS or SSL accelerator when using TLS or SSL
(5) Introduction of a BML contents delivery server (Distribution to a mirror server)
(6) Improvement in the design of BML contents (Avoidance of long periods of suspension)

10 Processing glitches

10.1 Action to be taken when the power of receivers is off Provision A

When the receivers enter a state of power discontinuity during communication, a DC circuit for the phone line is quickly opened.

11 Emergency measures

11.1 Functions for emergencies Provision B

These are functions to maintain important communications for situations such as disaster prevention, etc., and are functions for viewers to switch to emergency communication when emergencies such as large scale disasters, etc. occur during interactive data broadcasting service execution/planning.

Figure 11-1 shows the functions for emergencies such as disasters, etc.

Figure 11-1 Functions for emergencies such as disasters, etc.

	Function
Broadcaster	* It is recommended that interrupting or controlling the interruption of interactive data broadcasting services be possible. * It is recommended that not allowing new communication be possible.
Receivers	* It is recommended that not allowing new communication by broadcasting be possible.

12 Related laws and rights

12.1Related laws

Related laws which are necessary for conducting bi-directional data broadcasting services are shown below.

12.1.1 Laws which shall be considered for responding to emergencies

(1) Telecommunications Business Law

* Article 8 Ensuring of Essential Communications

12.1.2 Laws which shall be considered for congestion in communication networks

(1) Rules for terminal equipment, etc.

* Article 11, Article 18 Transmission Functions

Appendix 1 Supplemental explanation regarding security

This chapter contains general information regarding security.

1.1 Security function

1.1.1 Data encryption

It is appropriate to use common key encryption in addition to public key cryptography according to the level of security for digital data encryption. Additionally, although it is necessary to be aware of usage for applications which require simple scrambling, simple encryption functions can be used. An outline and characteristics of each method are explained below.

(1) Symmetric cipher

Symmetric cipher is also called secret key cryptography/symmetrical cryptography. Secret keys shared by senders and receivers are used, with the transmission side coding the key and the receiver side decoding the key. It is necessary for a common key to be shared by both senders and receivers with some measures beforehand.

Legitimate code processing is necessary for data, etc. which can cause damage to privacy information and financial damage on the viewer side when data is stolen or decoded. In general, at least 56/64 bit symmetric cipher is used from the point of view of cost effectiveness in applications in which credit card numbers and viewer information notification is necessary when using PSTN, electrical waves/radio waves. The symmetric code algorithm is registered in JIS X5060 (ISO/IEC9979). Since these algorithms do not guarantee the security of code algorithms, consideration of this fact is necessary during selection.

(2) Public key cryptography

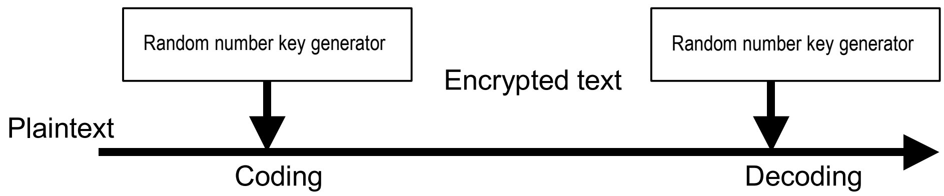
Public key cryptography is also called asymmetric cryptography. The key for coding (public key) and the key for decoding (secret key) are different. Communication by coding is possible by disclosing the public key and secretly managing the secret key. The calculation amount is much larger in comparison with common keys. Therefore, it is mainly used to share common keys for symmetric cipher.

Part of the public key cryptography (RSA encryption, etc.) also has signature function. When using it as signature function, calculations are made for the private key in data to be signed and the public key is then used by verifier to verify the signature results.

(3) Simple encryption

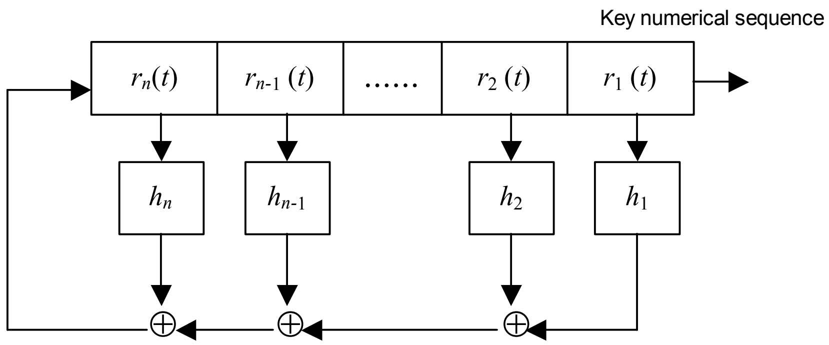
As an example of simple encryption, there is a synchronous sequence code for the linear feedback shift register method to use the M sequence in the vernam cipher and the random number key generator. However, since this method has linearity and it can be deciphered by a known plain text attack, it is necessary to be aware of this in order for there to be linearity in the application.

The vernam cipher is a basic code that can be expressed as in appended figure 1-1.



Appended figure 1-1　Vernam symmetric cipher

The output of the linear feedback shift register is used as a random number generator for the vernam cipher.



$r_i(t)$: Value of each digit register　　h_i: Function that changes the register value

Appended figure 1-2　Simple encryption device using the linear feedback register

1.1.2　Modules used for other security

(1)　Message digest (Hash function)

Mathematical function to map large (sometimes extremely large) areas into small areas. For a quality hash function, it is necessary to satisfy the conditions of one direction and collision free at the same time.

(2)　Message authentication code

Message authentication can be realized by symmetric cipher. In general, the message authentication code is the initial vector (initial value) of the results calculated by the CBC mode (Cipher Block Chain mode) of symmetric cipher. When the message is short, padding can be used.

(3) False random numbers

Although in some cases pseudorandom numbers and strict random numbers are necessary, it seems that the pseudorandom numbers are sufficient for the random numbers handled in this chapter.

In symmetric cipher, when the same data is sent, the results are exactly the same when the key and the initial value are the same, even if they are encrypted. By misusing this property, confusion can be created by recycling the encryption data exploited within the communication pathway. In order to prevent this, a different pseudorandom number for each communication, etc. is included and transmitted, and by executing and returning a simple operation (Adding 1 etc.) in receiver side, handling the above fraud is possible (challenge code). The results of the calculations for symmetric cipher in timer and counter, etc., nodes can be pseudorandom numbers.

(4) Timestamp

To prevent third parties from reusing correct signature data, timestamps are used to prevent signatures without reproducibility from being generated, even if they have the same signature contents.

(5) Simple personal identification function

It is necessary to confirm the person in question in order to confirm whether that person has the right to use certain data and modules. PIN authorization is used for simple personal verification technology.

[PIN authorization]

It is used when the card owner is confirmed. 4-8 digits are suitable as the number since input from remote control is necessary and the number of digits be easily memorized by the user.

(6) Certificate

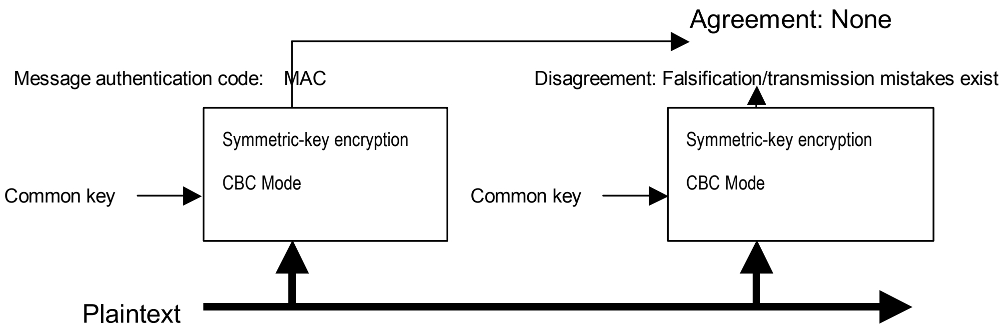
It is necessary to authenticate other party using public key cryptography. Since it is necessary to issue certificates accurately without falsification, etc., it is necessary that the organization that issues the certificate be a neutral organization that has the trust of both of the signer and the verifier.

1.1.3 Data integrity

Basic functions: The symmetric cipher function is used.

The message authentication code (Message Authentication Code: MAC) can be substituted. For details, refer to (JIS X 5055 [ISO/IEC9797]).

Crypto communication is used, not as the purpose, and but to ensure the message is passed on to other party without falsification/transmission errors, etc. Transmission of the message and the coding of entire message in CBC mode are conducted. The value of the IV register following the completion of encryption of the message is transmitted as MAC. The receiver also carries out a similar calculation. If there are a falsifications and transmission errors on the line, abnormalities can be detected since the MAC value is different. Appended figure 1-3 shows how the message authentication code is used.



Appended figure 1-3 Data integrity using the message authentication code

In addition, the CRC can be used as a concise protocol. However, in this case the falsification of data cannot be detected.

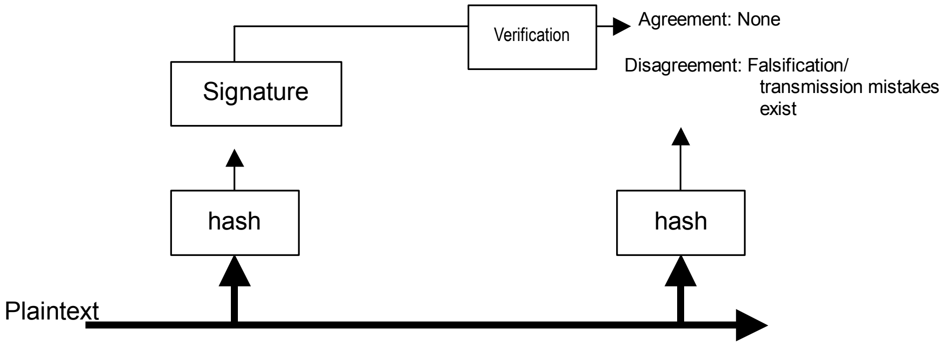
Reference materials:

1 JIS X 5055 Security techniques -- Data integrity mechanism using a cryptographic function employing a block cipher algorithm

2 ISO/IEC9797 Information technology – Security techniques – Data integrity mechanism using a cryptographic check function employing a block cipher algorithm

Advanced functions: Public key cryptography and message digest are used.

After the message is digested, the signature is given to the sent data. Message digest which is also called the hash function (JIS X 5057 ISO/IEC 10118), and is used to generate a summary for the constant length (digest) of arbitrary length data. The signature has the upper limit for the data length. When long data is efficiently signed, a digest is created for the data as preprocessing and the digest is signed (JIS X 5056-3 ISO/IEC 9798-3). Use of public key cryptography and the hash function are shown in appended figure 1-4.



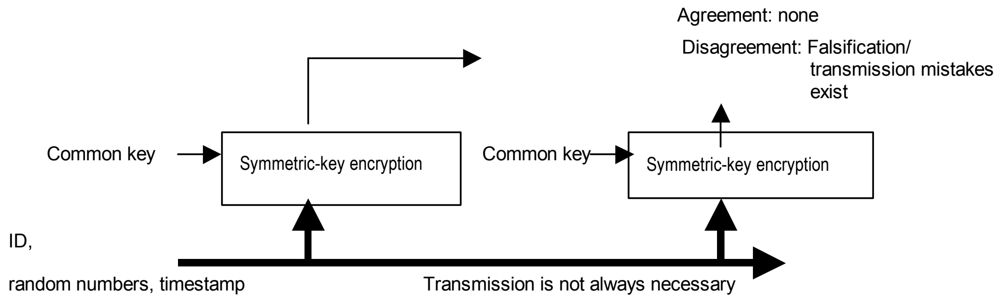
Appended figure 1-4 Data integrity using public key cryptography and the hash function

Reference materials:

1 JIS X 5057-1, “Security Techniques – Hash Function – Part 1 General
2 ISO/IEC 10118-1 Information technology - Security techniques - Hash-functions –
3 JIS X 5057-2, “Security Techniques – Hash Function – Part 2 Hash functions using an n-bit block cipher algorithm”
4 ISO/IEC 10118-2 Information technology - Security techniques - Hash-functions using n-bit block cipher algorithm-
5 JIS X 5056-3 Security Techniques – Entity authentication mechanisms – Part 3 Entity authentication using a public-key algorithm
6. ISO/IEC 9798-3 Information technology - Security techniques – Entity authentication mechanisms Part.3: Entity authentication using a public key algorithm

1.1.4 Other party authentication

Basic functions: The symmetric cipher function (message restoration method) is used. A simple method for authenticating the other party using symmetric cipher is shown in appended figure 1-5.



Appended figure 1-5 Simple authentication of the other party using symmetric cipher

In symmetric cipher, when the sender and verifier are shared beforehand, the message is encrypted by the transmission side using the common key and the sender can be convinced if it becomes a message with some meaning when the receiver decodes the cipher text.

For mutual authentication, the verifier makes a simple calculation pre-agreed to by both parties such as adding 1 to the random numbers generated by the caller, etc., and this can be confirmed by encrypting it again and sending it back.(It is also possible to identify the other party by using the sender ID notification function ,etc. of the network service as a concise protocol according to the security requirements.)

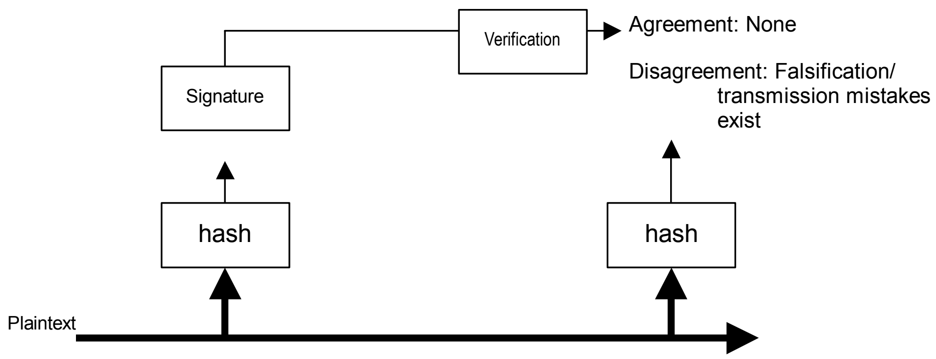
Reference materials:

1 JIS X 5056-3 Security techniques – Entity authentication mechanisms – Part 2 Mechanisms using symmetric encipherment algorithms

2 ISO/IEC 9798-3 Information technology - Security techniques – Entity authentication mechanisms Part.2: Entity authentication using symmetric encipherment algorithms

Advanced functions: The public key cryptography function is used.

Requests the presentation of the certificate issued by the certificate issuing authority in public key cryptography (X.509) to authenticate the other communication party by public key cryptography. The method for authenticating the other party that uses public key cryptography is shown in the appended figure 1-6.



Appended figure 1-6 Other party authentication using public key cryptography

(As a concise protocol, the simple authentication described in X.509 that uses the hash function as a one-direction function is also applicable.)

Reference materials:

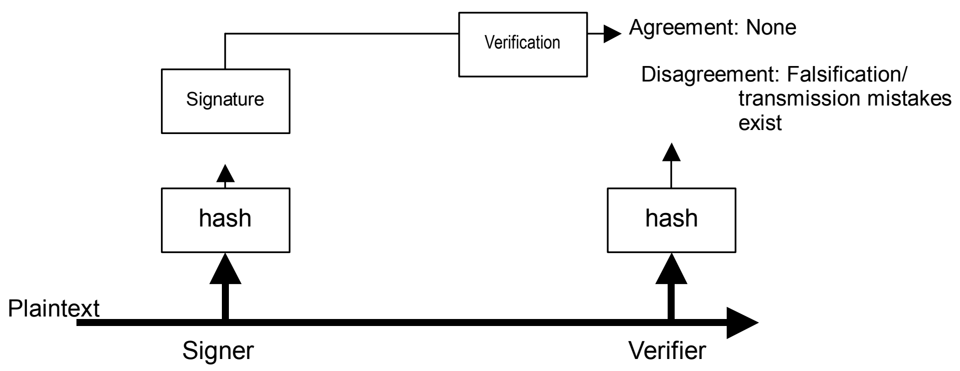
1 X.509 directory - Authentication framework

1.1.5 Signatures

* Basic functions: To use the symmetric cipher function.

Signatures substitute by granting the message authentication code described in the signature data.

Advanced function: The message digest function and the public key cryptography function are used. How to use the message authentication code is shown in appended figure 1-7.



Appended figure 1-7 Signatures using public key cryptography

After the message digest is given to the sent data, the signature of the public key cryptosystem is given.

1.1.6 Key management

Key management includes the key storage method, the key generation method, key update, and key disposal, etc. Since the security level decreases if there is a defect in one item somewhere, all items cannot be disregarded.

Key storage method:

The key storage method concerns the safety of the location to memorize the private key for public key cryptography and the common key for symmetric cipher. This safety is mainly decided from the following items. The security requirements were arranged for reference in the following table. In this example, the center assumes where the center installation site and personal management are precisely carried out. The receivers are assumed to be used for general families and although that there may be attacks against the receiver units to some degree, organized attacks are not considered. During actual operation, the same consideration is necessary based on the security policy.

In general, the private key for public key cryptography and the master key for symmetric cipher are not written with the value as is, once it is encrypted with the key for another symmetric cipher, and when it is used, it requires the input of a PIN number or password, etc.

Appended table 1-1 Features related to key storage locations

	Center	Device (user)
Environment of the location where the device was set up	High safety can be set.	Can easily be attacked.
Entering and leaving management	Strict management possible.	Management impossible
Operator education/management	Strict management possible.	Management impossible
Physical tolerance (tamper registrant)	Intermediate level Can be supplemented with other items.	Most important item Cannot be supplemented with other items.
Chassis structure of the device	Consideration necessary to some degree	Very important.
Wiring circuit on the board	Same as above	Consideration necessary when the chassis is weak against attack
Signal terminal	Same as above	Same as above
LSI structure	Same as above	Same as above
Decipherability level of Software	Same as above	Consideration necessary when physical tolerance is weak against attack
Difficulty level of analysis of firmware/programs	Same as above	Same as above
Access limits to memory	Same as above	Same as above

In IFPS PUB 140-1, the conditions to satisfy the security requirement levels in four stages are arranged.
IFPS PUB 140-1, “security requirements for cryptographic modules,” http://www-09.nist.gov/div897/pubs/fip140-1.htm

(1) Key generation/key disposal

The key for symmetric cipher is a comparatively simple generation since it uses random numbers. On the other hand, since a program and calculation amount of a certain level is required for public key cryptography, to generate a good quality key, a key generation center, etc. may also be necessary according to the system configuration. An example of the generation method for the RSA encryption key is described in appendix X.509.

Additionally, it is also very important for the key disposal to assess the effectiveness of the signature. In general, it is necessary for the center to also manage the function to comprehend renewal and disposal, etc. of the key.

(2) Key update

There is no encryption algorithm which can maintain the security of generated key permanently and it is necessary to renew the key. Generally, public key cryptography has as an example, a valid term of about two years, if there are no problems. When using symmetric cipher with public key cryptography, in almost every case the session key (disposable key) is used.

When public key cryptography only is used, the key management of multiple layers is conducted. It is necessary to minimize use of the master key that is the most important key.

1.1.7 Security expandability

With the improvement of computing power in the future and diversification in the circulation of multimedia data, security techniques have been revised, and it is recommended that expandability be provided to take into account those technologies if required.

(1) Symmetric cipher

Due to the improvement in calculation ability, existing 64-bit symmetric cipher is making a transition to 128-bit public key cryptography. Recently, encryption algorithms which can prove security (prove how safe it is) are being developed.

(2) Public key cryptography

Due to the improvement in calculation ability, the size of bits for public key cryptography continues to expand but, as for the future direction, public key cryptography using encryption which can prove security and which is an elliptical function are being researched and developed. In the future, it is necessary that current algorithms be replaced from the perspective of the maturity level of these algorithms and the amount of security required.

Appended table 1-2 Recent trends in public key cryptography system algorithms

Safety verification	Public key cryptography		Digital signature	
	Algorithm	Record/ presentation	Algorithm	Record/ presentation
Equivalent to prime factorization (Without proof)	RSAES-EPOC	PKCS #1 Ver. 2 (July 1998)	RSASSA-PKCS1-v1_5	De facto standards
			Fiat-Shamir signature	Potential for zero-knowledge signature
			ESIGN	High speed is a characteristic.
Equivalent to prime factorization (With proof)	EPOC (With Hush)	Eurocrypto '98	-	-
Discrete logarithm problem	Diffie-Hellmankey sending	Effective for sending keys	DSA	NIST
	ElGamal	Crypto '84	Shnorr	-
	Cramer-Shoup	Crypto '98		
Elliptic curve discrete logarithm problem	Elliptic curve ElGamal	Characteristic of shortening the key length is possible	Elliptic curve DSA	-
			Elliptic curve Schnorr	-

Derivation of each algorithm and improvement algorithm were omitted.

(3) Copy-right protection method

Due to the diversification of multi media data circulation and ease of copying digital data, it is necessary to solve the copy-right problem according to the contents. In order to solve this problem, copy protection and digital watermark technology that copies correct information, etc. are embedded into contents and super distribution, etc. have to be used.

Appendix 2 Reference information regarding billing methods

In Appendix 2, the reference information for when data broadcasters decide on a charging method is described.

2.1 Billing method

A method (Billing method) in which viewers using bi-directional data broadcasting services pay for using services electronically. Currently available billing methods are described below. Terms used in this reference do not define economic terms, and these terms are only for describing the service image.

2.1.1 Network payments

(1) Network payment transactions

It is a system for using the payment billing services provided by communications carriers. The information charge can be paid according to the telephone rate. There are information charge collection services, etc.

2.1.2 Card payments

(1) Credit

For credit card users, it is a system in which the credit companies pay instead of the users. The money is claimed by the credit company from the users later.

(2) Debit

For users with deposits in a bank account, etc., it is a system in which payment is made directly from the user’s bank account.

2.1.3 Other payments

(1) Prepaid

A system in which payment is made within from value amount managed at the center (information on money and value) and that the payment amounts are deducted from this value.

(2) Log collection

It is a method that records data broadcasting service use charges, and carries out bulk settlements later like PPV billing etc.

(3) Home banking

A service that can carry out account transfers and balance inquiries, etc., from the homes of users.

2.2 Comparison of billing methods

A comparison of billing methods is shown in the appended table 2-1.

Appended table 2-1　Comparison of accounting methods

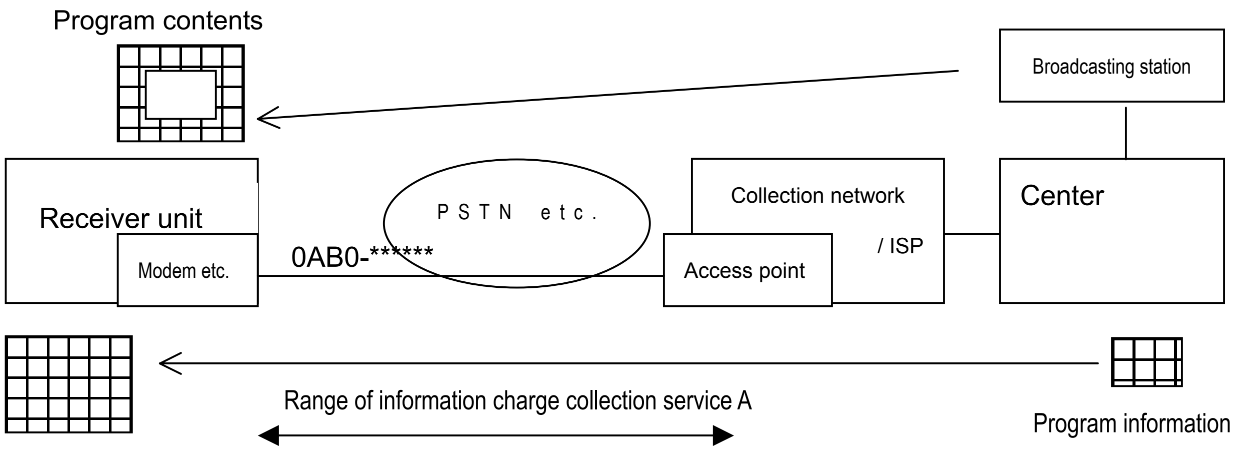
Method	Cost to user	Applicable contents	Main application billing area	Diffusion
Network payment transactions	Small	Excluding product sales	10 yen – 300 yen (Small amount range), 1 yen – 10,000 yen (Large amount range)	◎
Credit	Small	Product sales, contents	Several thousand yen-tens of thousands of yen or more	◎
Debit	Small	Product sales, contents	Several thousand yen-tens of thousands of yen	Δ
Prepaid	Small	Product sales, contents	Several thousand yen-tens of thousands of yen	Δ
Log collection	Small	Streaming contents	Several thousand yen-tens of thousands of yen	◎
Home banking	Medium	Balance confirmation, account transfer	-	Δ

2.3 Network payments

The network payment mechanism is achieved by having the communications carrier represent the original information provider to collect the information charge that the original information provider shall have collected, and collects the charge according to when the telephone rate is due. The information provider does not have to send or manage the bill for a large amount of viewers, and therefore can provide information efficiently. There are information charge collection services currently being provided.

2.3.1　Information charge collection service A

An example of information charge collection service A is shown in the appended figure 2-1.



Appended figure 2-1 Information charge collection service A

(1) Service outline

a) The broadcasting station registers program information provided by information charge collection service A in the center in advance.

b) The receivers call the number (0AB0-******) of the specified information charge collection service A by data broadcasting or some other method.

c) The receiver is connected to the center through the collection network.

d) The receivers receive data for the data broadcasting program information from the center according to the contents of the service.

e) Payment collection is done in the information charge collection service A system for the information charge set beforehand.

(2) Necessary functions in receivers

- Communication function: New protocol implementation by information charge collection service A is not required.

(3) Necessary functions in the center

- Program information notice distribution function

A function to deliver program information related to data broadcasting and necessary information for information charge collection service A (information on outlines, etc. of programs notified before information provision).

(4) Items that shallbe considered for operation

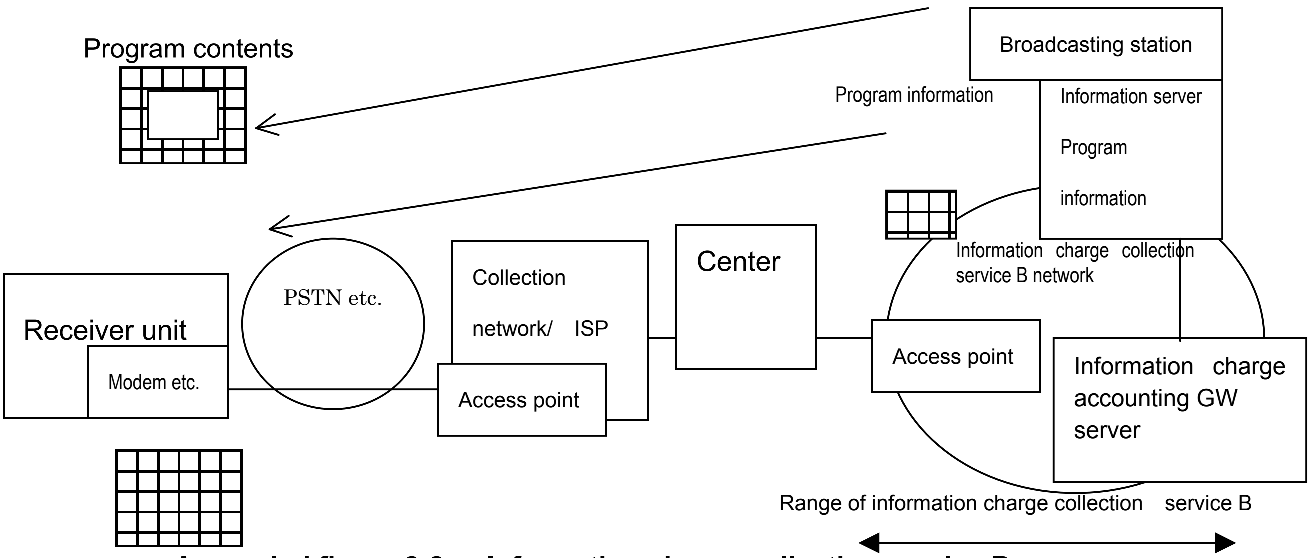
- Prepare a line exclusively for providing information to the access point on the collection network.
- Use is not possible from PHS and mobile phones.

(5) Flow until the start of information charge collection service A

The program planning manual is examined, and after completion of the examination by the ethics examination organization, the information charge collection service A contract is concluded.

2.3.2 Information charge collection service B

An example of information charge collection service B is shown in appended figure 2-2.



Appended figure 2-2 Information charge collection service B

(1) Service outline

a) The broadcasting station registers data broadcasting program information provided by information charge collection service B in the information server connected with the information charge collection service B network in advance.

b) The receivers call the access point for the collection network specified by data broadcasting or some other method.

c) The receiver is connected to the center through the collection network.

d) The center connects with the access point for information charge collection service B network, connects to the information server after user authentication and selects the target information (contents).

e) The pay information connection ID and password for purchasing selected data broadcasting program information are automatically input from the center in the information server .

f) The center receives the data for the data broadcasting program information from the information server.

g) The center transmits data broadcasting program information to the receivers.

h) The information charge is billed in the Information charge accounting GW server.

(2) Necessary functions in receivers

– Communication function: New protocol implementation by information charge collection service B is not required.

(3) Necessary functions in the center

– Program information notice distribution function

Function to deliver data broadcasting program information received from the information server to receivers.

- Security function

  SSL3.0 or higher.

(4) Flow until the start of information charge collection service B

The program planning manual is examined, and after completion of the examination by the ethics examination organization, the information charge collection agency service B contract is concluded. Additionally, SSL PROTOCOL use ID(*) acquisition is required separately.

(*)The SSL PROTOCOL use ID is a required ID for secure communication that uses SSL PROTOCOL. It is issued by a reliable third party.

2.4 Card payments

When bi-directional data broadcasting services are used, payment can be made by using credit cards and debit cards. The same processing as used in actual stores is used, and it is necessary to guarantee the safety of the payments.

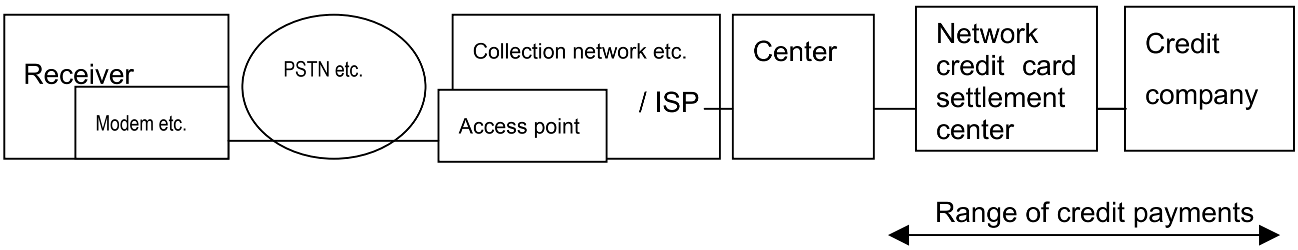
Card payment features are shown in the appended table 2-2.

Appended table 2-2　Card payment features

	Credit card	Debit card
Payment method	Deferred payment	Payment at purchase
Personal identification	Name, card number, and expiration date	Account number and PIN
Line of credit	Depends on the issue subject.	Deposit balance
Special card reader and writer	Not required	Required
Problems		Card reader is necessary in the receiver units.

2.4.1 Credit card payments

An example of credit card payments is shown in the appended figure 2-3.



Appended figure 2-3　Credit card payments

(1) Service outline

a) Necessary data (credit card number, credit company name, etc.) for credit-card transactions is registered in the center beforehand.

b) When payments from bi-directional program viewers are requested, mutual authentication on the viewer and the host side is carried out in the center.

c) The center checks credit according to the transaction amount with the credit company through a network credit card payment center.

d) The user fee is claimed by the credit company from the viewer later, and is deducted from the viewer's bank account.

(2) Necessary functions in receivers

- Communication function

–A security function required by credit-card transactions is installed. New protocol implementation by credit card payment is not required.

(3) Necessary functions in the center

- Credit card number, etc. management function

Function to manage necessary information for credit payments beforehand if required.

- Functions compatible with the network credit card payment center

Credit inquiry and inquiry result reception, etc. function.

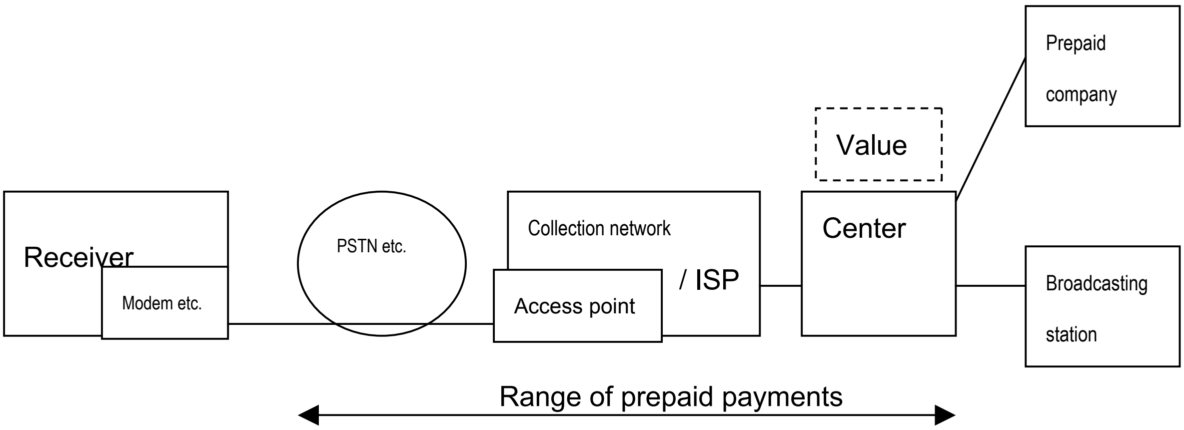
- Sales management function

Function to manage sales transactions in the same way as member stores of the credit company.

2.5 Other payments

2.5.1 Prepaid (network type) payments

An example of prepaid (network type) payments is shown in appended figure 2-4.



Appended figure 2-4 Prepaid payments

(1) Service outline

a) The center manages the prepaid ID, PIN, and prepaid value.

b) When the bi-directional data service payments from bi-directional program viewers are requested, mutual authentication on the viewer and the host side is carried out in the center, and the viewer is requested to input the prepaid ID and PIN number.

c) When the prepaid ID and PIN number are input by the viewer, the center notifies the viewer of the current balance.

d) The center subtracts the bi-directional data broadcasting service price from the managed value balance. When the value balance becomes 0, processing is carried out to invalidate the prepaid ID.

e) The center provides information related to sales to the broadcasting station and prepaid company.

f) The broadcasting station claims the amount from the prepaid company.

(2) Necessary functions in receivers

－ Communication function

Security function required by prepaid (network type) payments. New protocol implementation by prepaid (network type) card payments is not required.

(3) Necessary functions in the center

－ Prepaid card number, etc. management function

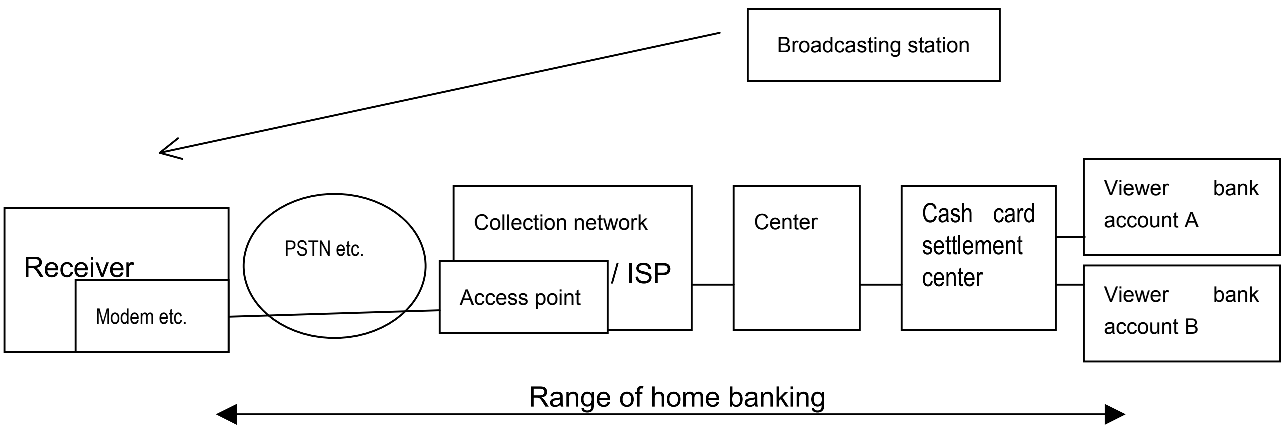
Function to manage necessary information such as the prepaid ID, PIN numbers, and prepaid value, etc.

－ Sales management function

Function to manage information (product code, cost, data broadcasting program, etc.) related to sales of sold products.

2.5.2 Home banking

An example of home banking is shown in appended figure 2-5.



Appended figure 2-5 Home banking

(1) Service outline

a) Necessary data (bank account numbers, bank names, etc.) for home banking is registered at the center in advance as required.

b) When home banking from bi-directional program viewers is requested, mutual authentication on the viewer and the host side is carried out in the center.

c) The center is connected with the bank that holds the viewer account through a cash card payment center.

d) Based on the home banking requests of the viewer, transactions corresponding to the requests are carried out between the bank with the viewer's account and the center. For example, a transfer request is made to bank account B for payment.

(2) Necessary functions in the receivers

－ Communication function

Security function required by home banking payments. New protocol implementation by home banking payment is not required.

(3) Necessary functions in the center

- Bank account number, etc. management function

Function to manage necessary information for home banking beforehand if required.

－ Functions corresponding to the cash card payment center

Function corresponding to balance inquiry and transfer request, etc. transactions.

Appendix 3 Supplementary explanation concerning congestion

3.1 What is congestion?

Congestion is the phenomenon of the telephone not connecting due to the concentration of communication that exceeds the ability of the switchboard to handle the number of calls within a fixed time. The congestion increases due to the repeated re-dialing by the caller to the other party until a connection is made.

3.2 Ramifications obtained by avoiding congestion

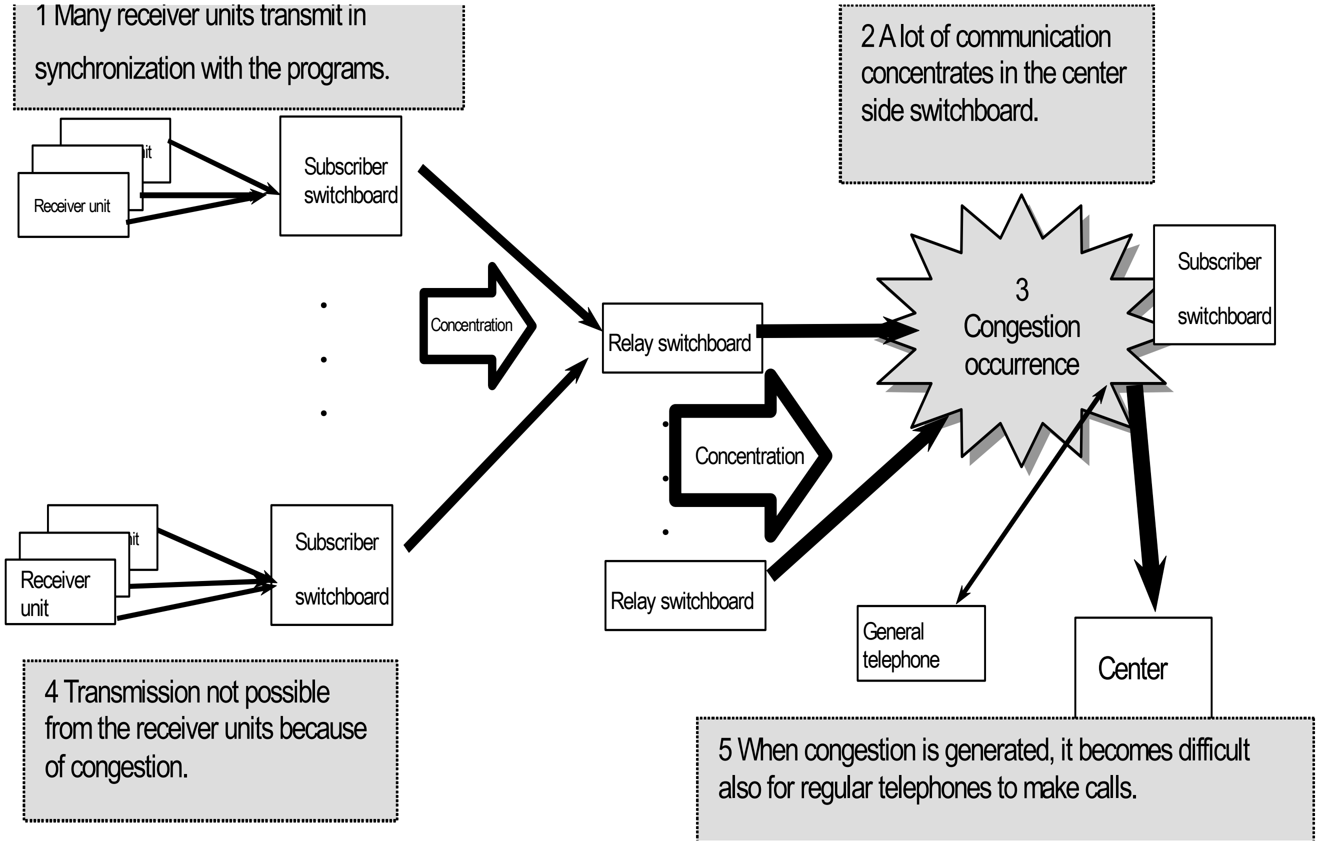
Ramifications obtained for the viewers and broadcaster is shown in the appended figure 3-1.

Appended figure 3-1 Ramifications obtained for the viewers and broadcasting stations

Viewers	Since it is rare for the line to be busy during transmission, almost all communications are possible. Therefore, it is not necessary to make repeated calls.
Broadcaster	When communication synchronizes in programs and concentrates in a short period of time, response data that exceeds the limit of the traffic processing ability cannot be collected, but in hindsight a lot of response data can be collected efficiently by delaying transmission, etc.

3.3 Mechanism of congestion occurrence

Appended figure 3-1 shows an image of a mechanism for congestion occurrence.



Appended figure 3-1　Image of a mechanism for generating congestion

Appendix 4 Supplementary explanation concerning network services

4.1 Mass calls reception service

4.1.1 Service outline

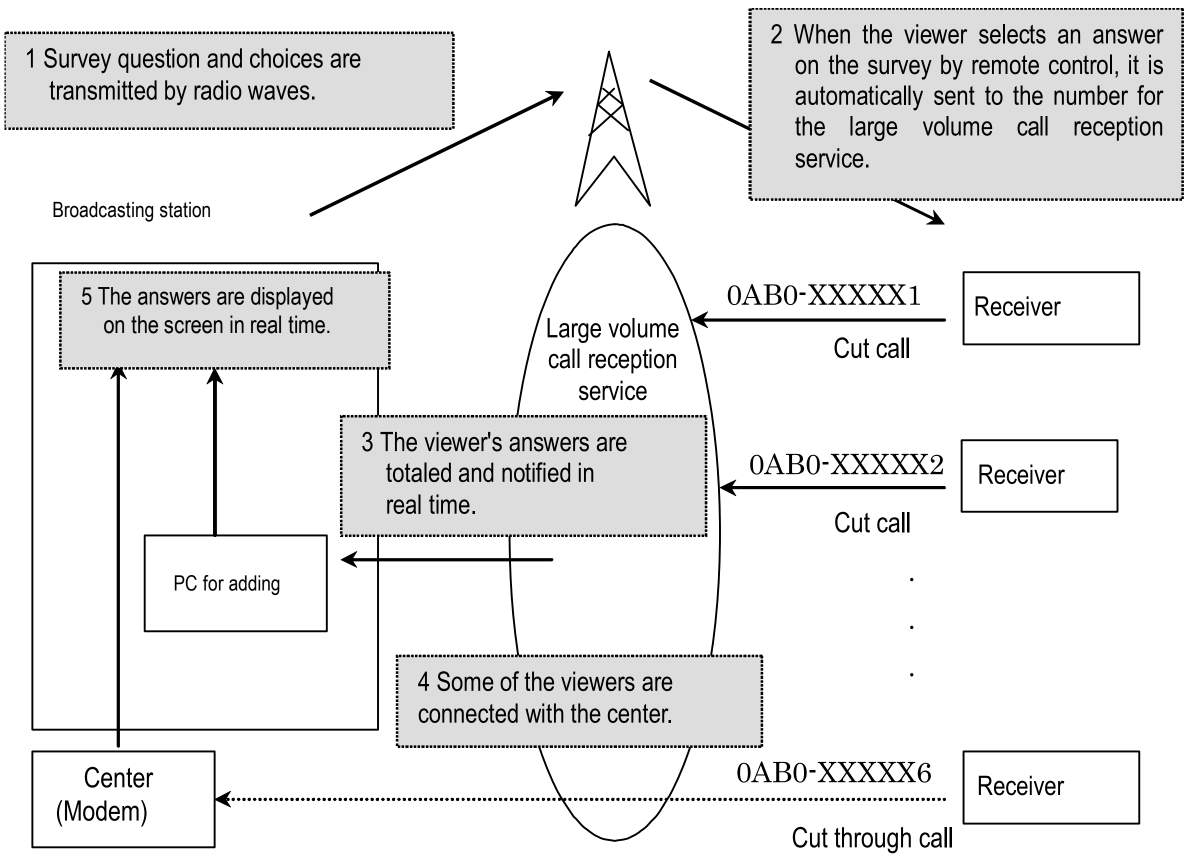
It is a service that automatically counts communication sent for the notified service number (0AB0-xxxxxx) and informs broadcaster of the total result (total number for each service number) in programs with viewer participation.

From among the callers, there is a "Cut through function" that connects with the telephone line (operator or center) for reception of communication that corresponds to the number of lines set in advance.

The number of service numbers for the mass calls reception service that use broadcasting media is possible for a maximum of six numbers in one program.

4.1.2 Use example (Receivers only are service objects)

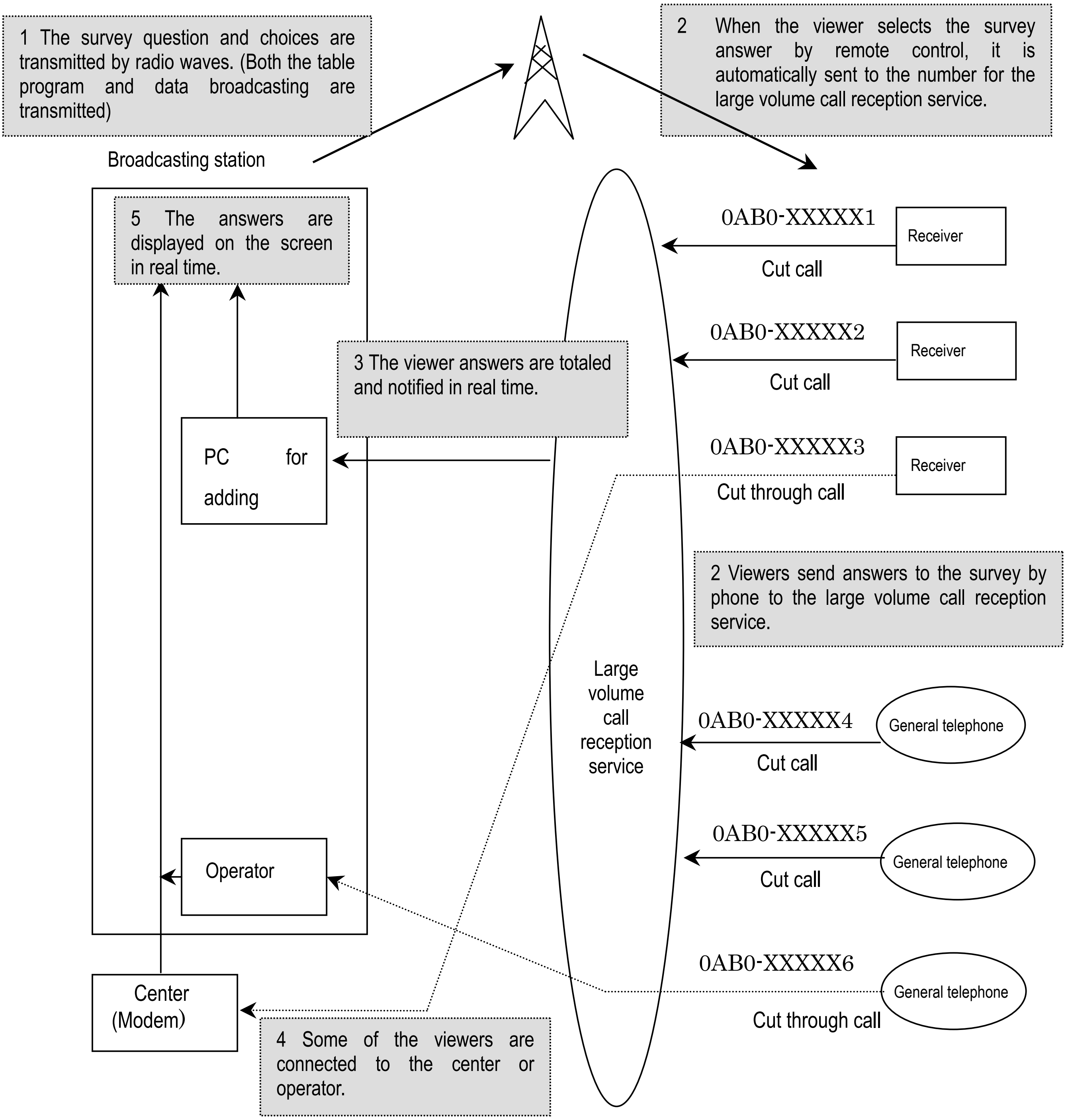
An image of a survey program using the mass calls reception service is shown in appended figure 4-1.



Appended figure 4-1 Survey program image(For receiver only services)

4.1.3 Use example(Services for both receivers and general telephones.)

An image of the survey program used for the mass calls reception service is shown in appended figure 4-2.



Appended figure 4-2 Survey program image(For both receiver units and general telephone services)

4.2 Nationwide common telephone number service

An example using the nationwide common telephone number service is shown to unite the telephone numbers of the access points when multiple access points are set up.

4.2.1 When access point lines are for billing the receiver

Communication using one nationwide common number can be connected with the access point previously specified by the transmission region by using the toll free service for nationwide common telephone numbers.

4.2.2 When billing on the transmission side of the access point lines

Communication using one nationwide common number can be connected with the access point previously specified by the transmission region by using the service that charges the transmission side with the nationwide common telephone number.

Appendix 5 Transmission method and connection requirements of number to cancel the priority carrier routing (122)

5.1 Transmission method

(1) The fixed priority connection is cancelled and the communications carrier is specified.

122 + 00XY + 0ABCDEFGHJ(K)

(2) in (1), a special number (184, 186) of the sender information notification service is used as well.

184(186)+ 122 + 00XY + 0ABCDEFGHJ(K)

5.2 Connection requirements

(1) Transmission with PSTN

A The connection requirements for a telephone number transmission of 122+00XY + access point from the receivers is shown in appended table 5-1.

Appended table 5-1 Connection requirements for a telephone number transmission of 122+00XY + access point

Access point telephone no. example \ Receiver side line		Fixed priority connection is set.	Fixed priority connection is not set.
Transmission side accounting	0ABCDEFGHJ	O	Δ
Reception side accounting	0120+DEFGHJ	×	×
	0800+DEFGHJ	×	×
	00XY+SC+********	×	×
Transmission side accounting	0180+ DEFGHJ	×	×
	0990+ DEFGHJ	×	×
	0570+ DEFGHJ	×	×

[Explanatory notes] O: Connect with 00XY broadcaster that transmits the following 122.
Δ: Connect with 00XY broadcaster that transmits the following 122 after the announcement which says 122 is not necessary
×: Not connected.

B It is not connected when the telephone number for the 122+ access point is transmitted.

(2) Transmission with mobile phones, PHS

a) It is not connected when the telephone number for the 122+00XY + access point is transmitted.

b) It is not connected when the telephone number for the 122+ access point is transmitted.

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Vol. 7

DIGITAL TERRESTRIAL TELEVISION BROADCASTING

Provisions for Carrier Operations

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Contents

1 Introduction

This volume stipulates provisions for general operations and transmission operations at broadcasting stations for digital terrestrial television broadcasting. It is desired that digital terrestrial television broadcasting companies perform broadcasting in accordance with these provisions.

It is also necessary that digital terrestrial television receiver units are able to use signals transmitted in accordance with these provisions in ways expected.

However, depending on the level of facilities installed by each broadcasting company, transmission operations may not be possible in a way to meet all the criteria specified. In this case, receiver units may not be able to work in the way that reflects the intention of the sender.

This volume does not cover audio-based services such as digital audio service and special audio service.

2 References

The documents related to Vol. 7 are listed below.

(1) "Transmission System for Digital Terrestrial Television Broadcasting" ARIB STD-B31
(2) "Video Coding, Audio Coding and Multiplexing Specifications for Digital Broadcasting" ARIB STD-B32
(3) "Service Information for Digital Broadcasting System" ARIB STD-B10
(4) "Receiver for Digital Broadcasting" ARIB STD-B21
(5) "Data Coding and Transmission Specification for Digital Broadcasting" ARIB STD-B24

3 Definitions

The terms used in these provisions are defined as shown below.

16QAM	16 Quadrature Amplitude Modulation: a digital modulation scheme to transmit four bits of information by using 16 sinusoidal waves with different amplitudes and phases. Digital terrestrial television broadcasting uses the SP to specify amplitude and phase criteria.
3/1	3/1 is defined as a multi-channel stereo mode that uses three front channels and one rear channel. The front channels are comprised of left (L), right (R) and center (C) channels, while the rear channel is comprised of a mono surround channel (MS).
3/2	3/2 is defined as a multi-channel stereo mode that uses three front channels and two rear channels. The front channels are comprised of left (L), right (R) and center (C) channels, while the rear channels are comprised of left and right stereo surround channels (LS and RS).

5.1 channel	5.1 channel is defined as a multi-channel stereo system that has an LFE (low frequency enhancement) channel added to 3/2 multi-channel stereo and is therefore also expressed as 3/2+LFE.
64QAM	64 Quadrature Amplitude Modulation: a digital modulation scheme to transmit six bits of information by using 64 sinusoidal waves with different amplitudes and phases. Digital terrestrial television broadcasting uses the SP to specify amplitude and phase criteria.
AAC	Advanced Audio Coding: an audio coding system standardized by the International Organization for Standardization (ISO/IEC13818-7).
AC	Auxiliary Channel: a transmission path for additional transmission control related information on modulated waves.
ADTS	Audio Data Transport Stream.
Layers A, B and C	Hierarchical transmission uses layers called layer A, layer B and layer C (if using three layers) in ascending order of the required CN ratio. If two layers are used for hierarchical transmission, they are called layer A and layer B and if only one layer is used, it is called layer A.
BER	Bit Error Rate: the rate of the number of error bits in a digital signal to the total number of bits transmitted.
BIT	Broadcaster_Information_Table: the table that lists broadcaster information such as transmission parameters for all stations and each station.
CAT	Conditional Access Table: CAT is used to specify the ID of the TS packet that carries individual information from among relevant information comprising chargeable broadcasting.
CDT	Common Data Table: CDT is used to transmit common data such as logos of broadcasting companies to receiver units.
CN ratio	The CN ratio is defined as the carrier to noise ratio, which represents the power ratio of the carrier of high frequency signals to the noise within the bandwidth.
Component_tag	component_tag is defined as the label used to identify components.
DDB	Download Data Block: the message, which together with DII comprises a data carousel, and which contains modularized real data.
DII	Download InfoIndication: the message, which together with DDB comprises a data carousel, and which contains information such as the number of real data (modules), module identifiers, version numbers and whether data are compressed or not.
DQPSK	Differential Quaternary Phase Shift Keying: a digital modulation scheme to transmit two bits of information by using sinusoidal waves with different phases. While QPSK uses the SP to specify phase criteria, DQPSK uses the immediately preceding symbol in each carrier as the phase criterion to specify four phase states for transmission. DQPSK is not used for digital terrestrial television broadcasting.
DTS	Decoding Time Stamp: the time control information for decoding streams.
ECM	Entitlement Control Message: the common information that includes program information (program related information and descrambling keys) and control information.
EIT	Event Information Table: the program related information such as program names, air dates and times and brief program descriptions. Digital terrestrial television broadcasting uses the H-EIT for display on fixed receiver units, M-EIT for display on mobile receiver units and L-EIT for display on partial receiver units.

EPG	Electronic Program Guide: the program information displayed by receiver units using the SI information transmitted by each broadcasting station.
ES	Elementary Stream: the coded video, audio, caption/superimpose or data carousel stream. One ES is carried in a sequence of TS packets with the same PID.
GOP	Group Of Pictures: the MPEG video frame structure and a coding unit for one I picture and multiple P and B pictures.
IIP	ISDB-T Information Packet: a special null packet inserted, only once, during one multiplex frame period in order to transmit modulation information and SFN information.
LFE	Low Frequency Enhancement: the low frequency enhancement channel in multi-channel stereo mode.
MFN	Multi-Frequency Network: the network in which different frequencies are assigned to transmitting stations whose service areas overlap. Although existing broadcast wave relay technologies suffice to construct the network, a large amount of frequency resources is required.
MP@H14L	Main Profile at High-1440 Level.
MP@HL	Main Profile at High Level used to code 1080i HDTV signals.
MP@LL	Main Profile at Low Level used for low resolution coding.
MP@ML	Main Profile at Main Level used to code 480i SDTV signals.
MPEG-2	Moving Pictures Expert Group-2: the compression and coding technology for data (such as moving images and audio data) standardized by the International Organization for Standardization (ISO/IEC 13818).
MSB	Most Significant Bit.
MVTV	Multi-view TV: the Method of switching between each combination of images that a broadcaster intends and transmit multiple images and voice in one service, using the component group descriptor.
NIT	Network Information Table: the table that carries information to relate transmission path information such as frequencies to channels and that lists ID numbers for all the channels contained in a distribution system.
OFDM	Orthogonal Frequency Division Multiplexing: a kind of multicarrier transmission system.
OFDM segment	OFDM segment is defined as the basic bandwidth for transmission signals with control signal carriers added to data carriers (1/14 of the TV channel bandwidth) or as the framed signals.
OFDM frame	OFDM frame is defined as the transmission frame comprised of 204 OFDM symbols.
PAT	Program Association Table: PAT is used to specify the ID of the TS packet that carries the PMT.
PCR	Program Clock Reference: the reference for the timing of transmitting an ES with the PTS/DTS for the video, audio, caption and superimpose stream on receiver units.
PES	Packetized Elementary Stream: the packetized video, audio and other data with variable lengths.
PID	Packet Identifier: the 13-bit stream identifier information in the TS packet header, which shows the attributes of individual streams of the packet.

PMT	Program Map Table: PMT is used to specify the ID of the TS packet that carries coded signals for each program and the ID of the TS packet that carries common information from among chargeable broadcasting related information.
PSI	Program Specific Information: information (comprised of four tables: PAT, PMT, NIT and CAT) necessary to select specific programs and defined by the MPEG-2 system standard and the ordinances of the Ministry of Internal Affairs and Communications.
PTS	Presentation Time Stamp: the presentation and output time control information in the PES packet header.
QPSK	Quaternary Phase Shift Keying: a modulation scheme to send a carrier in four phases: phase 0, phase 1/2π, phase π and phase 3/2π, which respectively correspond to values, 00, 01, 10 and 11.
QPSK(1/2)	QPSK (1/2) is defined as a QPSK transmission system which involves transmission path coding at the convolutional coding rate of 1/2.
SBR	Spectral Band Replication: SBR is extension technology for ACC low bit rate band.
SDT	Service Description Table: the table that lists channel related information such as channel names and broadcasting company names.
SDTT	Software Download Trigger Table: the table used to download software and to send schedule information about differential data for stored broadcasts.
SFN	Single Frequency Network: the network in which relay stations and the master station use the same frequency, thus allowing efficient use of radio frequencies.
SI	Service Information: various information designed to improve the convenience of program selection, defined by the ordinances of the Ministry of Internal Affairs and Communications and specified by the ARIB standard. The information also includes MPEG-2 PSI information in addition to an expansion of the ARIB standard.
TMCC	Transmission and Multiplexing Configuration Control: the transmission control signal that carries information, for example, about the transmission system and frame structure.
TOT	Time Offset Table: TOT is used to specify the current date and time and to specify the time difference between the actual time and the displayed time when the summer time starts.
TS	Transport Stream: the transport stream defined by the MPEG-2 system standard (ISO/IEC 13838-1).
TS packet	The TS packet is defined as the 188-byte (four-byte header) data packet used to send PES and sections.
TS remultiplexing	TS remultiplexing is defined as the function to configure multiplex frame structures necessary to transmit the TS to the OFDM modulator.
UTC	Universal Time Coordinated: the time commonly used around the world based on the international agreement.
component	The component is defined as each element that makes up an event (program) such as video, audio, text and other data.
data_component_id	data_component_id is defined as the identifier to indicate the data coding scheme, which is assigned and managed by the ARIB.
duplicate_packet	duplicate_packet is defined as the packet that specifies the duplication of the same content, which can be identified by Duplicate_packet_indicator. This is not used by digital terrestrial television broadcasting.
event	The event (or program) is defined as a collection of streams with a preset starting and ending time within the same service (channel) such as news and dramas.

network	The network is defined as a collection of multiplexed MPEG-2 TS transmitted by a single distribution system.
network identifier	network identifier is defined as the identifier uniquely domestically assigned and managed by the ARIB.
p/f	p/f is defined as the current program information (p) and the next program information (f) of the EIT.
remote_control_key_id	remote_control_key_id is defined as the identification value used to assign the main broadcasting service by each broadcasting company to the one-touch buttons on the remote controller or as the default one-touch button number carried in the NIT.
service	The service (channel) is defined as a series of scheduled broadcasting programs transmitted by each broadcasting company.
service identifier	service identifier is defined as the identifier for each service in the network.
start_end_flag value	The start_end_flag value is defined as an item in the emergency information descriptor. If the value is set to “1”, it signifies that an emergency warning is being broadcast and if the value is set to “0”, it signifies that a test emergency warning is being broadcast.
transport_stream_id	transport_stream_id (TS_id) is defined as the identifier uniquely assigned to each TS in the network.
Convolutional Inner coding rate	The convolutional coding rate is defined as the rate of the number of bits before coding to the number of bits after convolutional coding.
Aspect ratio	The aspect ratio is defined as the ratio of the horizontal dimension to the vertical dimension of the active area of a display screen.
Up/down channel selection	Up/down channel selection is defined as one of the methods for selecting a channel on the receiver unit; services can be selected in ascending or descending order using the up/down keys on the remote controller.
Event relay	The event relay is defined as the function to enable continuous viewing of events first as a regular service and then as another service or as a special service.
Interleaving	Refer to time interleaving and frequency interleaving.
Countdown	The countdown is defined as changing the transmission parameter switching index on an OFDM frame basis, 15 frames prior to changing the transmission parameters that can be manipulated by the TMCC information (the carrier modulation method, convolutional coding rate, time interleaving length and number of segments).
Current/next	The current information is defined as parameters currently used when changing the transmission parameters that can be manipulated by the TMCC information (the carrier modulation method, convolutional coding rate, time interleaving length and number of segments), while the next information is defined as parameters that will be used after the change of the transmission parameters. The next information is determined when a countdown of the switching index starts.
Guard interval	The guard interval is defined as the data with a specified time length (which comprises a part of data output after IFFT (Inverse Fast Fourier Transform)) added before each effective symbol period. The guard interval is used to solve the problems associated with the multipath phenomenon (caused by time differences) like ghost problems encountered during analog broadcasting.
Component	Component
Service	Service

Service identifier	service identifier
Side panel	The side panel is defined as the system to place black space on both sides of the screen when video with an aspect ratio of 4:3 is displayed on a screen with an aspect ratio of 16:9.
Sampling rate	The sampling rate is defined as the repetition frequency at which samples are taken from the original signal when converting original analog audio signal to the digital signal.
Seamless switching	Seamless switching is defined as a switching technology to ensure that the receiver unit will not freeze or be muted when the broadcasting stations switch to a redundant playout system or change the coding system.
Segment	The segment (OFDM segment) is defined as the basic bandwidth for transmission signals with a control signal added to the data carrier (1/14 of the TV channel bandwidth) or as the framed signals.
Direct channel selection	Direct channel selection is defined as one of the methods for selecting a channel on the receiver unit. To select a channel, number buttons on the remote controller of the receiver unit are used to specify a three-digit decimal number, which is assigned to identify each channel.
Downmix coefficient	The downmix coefficient is defined as the coefficient used to calculate each 2-channel stereo component from each multi-channel stereo component when downmixing (converting) from multi-channel stereo to 2-channle stereo for listening.
Data carousel	The data carousel is defined as a transmission system which involves repetitive transmission of various data over broadcast channels.
Default maximum bit rate	The default maximum bit rate is defined as the value automatically used when no bit rate value is specified in the digital copy control descriptor.
Dual mono	Dual mono is defined as an audio mode that allows the use of two mono audio in a single ADTS.
Transport identifier	transport_stream_id
Null packet	The null packet is defined as the TS packet that does not include effective information but is used for stuffing purpose.
Network	The network for digital terrestrial television broadcasting is defined as the distribution system for signals transmitted from a single master transmitter.
Network identifier	network identifier
Version No.	The version number is defined as the five-bit area that increments when the MPEG-2 section is updated. To indicate that new PSI/SI data that includes updated information will be transmitted when changing information in the table, a sub-table with the next version number will be transmitted.
Fringe area	The fringe area is defined as the farthest service reception area.
Profile	The profile is defined as the classification of functional restrictions of technologies used for the MPEG-2 coding system.
Maximum bit rate	The maximum bit rate is defined as the value representing the maximum amount of information of the entire service or each ES. The information is needed to record data on digital recorders.
Multi-channel stereo	Multi-channel stereo is defined as the stereo audio system comprised of at least three channels: for example, a center channel or surround channel is used in addition to the basic stereo channels (L and R).
Multi-view TV	MVTV

Mute flag	The mute flag is defined as a control flag used by the sender to mute the sound of the receiver unit.
Mode	The transmission mode can be identified by the OFDM carrier spacing.
Mono media	The mono media is defined as an independent media such as video, audio, text and still pictures.
Remote control key identifier	remote_control_key_id
Letter box	The letter box is defined as the system to place black space on the top and bottom of the screen when video with an aspect ratio of 16:9 is displayed on a screen with an aspect ratio of 4:3.
One-touch button	The one-touch button is defined as the button pressed by the viewer for one-touch channel selection.
One-touch button number	The one-touch button number is defined as the number of the button pressed by the viewer for one-touch channel selection.
One-touch channel selection	One-touch channel selection is defined as one of the methods for selecting a channel on the receiver unit. Pressing a button (one-touch button) on the remote controller enables direct, one-touch selection of the channel assigned to the button.
Audio mode	The audio mode is defined as the format used to process audio signals; the mono, stereo, multi-channel stereo, dual audio and multi audio modes are available.
Hierarchical transmission	Hierarchical transmission is defined as simultaneous transmission of OFDM segment groups with different transmission path coding.
Descriptor	The descriptor is defined as the description area placed in the table to list various information.
High/Middle/Low protection layer	Hierarchical transmission uses layers called the High protection layer, Middle protection layer and Low protection layer (if using three layers) in ascending order of the required CN ratio. If two layers are used for hierarchical transmission, they are called layer with a strong resistance to noise and the layer with a weak resistance to noise and if only one layer is used, it is called the layer with a weak resistance to noise for the sake of convenience.
Emergency warning broadcasting (Emergency Warning System (EWS))	The Emergency Warning System is used for disaster broadcasts. The start control signal, for example, forces receiver units to receive the broadcasts.
Start flag for emergency warning broadcasting	The start flag for emergency warning broadcasting in the TMCC signal is defined as the bit to notify receiver units that an emergency warning broadcast will be made.
Portable (partial) receiver units	The portable (partial) receiver unit is defined as a receiver unit that mainly receives partial reception services.
High quality sound stereo	High quality sound stereo is used for stereo broadcasts that use audio quality equivalent to that of standard TV mode B of current analog satellite broadcasting.
Caption	The caption is defined as the service of superimposing related text on the video broadcast on TV.
Time interleaving	Time interleaving is defined as the operation to temporally interleave symbol data after modulation to increase fading resistance.

Automatic display/selective display	The automatic display mode is defined as a mode in which the caption and superimpose are displayed regardless of how receiver units are set to operate, while the selective display mode is defined as a mode in which the caption and superimpose are not displayed only when the caption and superimpose settings are off on receiver units (See Table 4-2, Chapter 4, Section 3 of ARIB STD-B24).
Frequency interleaving	Frequency interleaving is defined as the operation to prevent certain segments from experiencing error bursts by eliminating the periodicity of carrier alignment when the carrier aligning frequency and the frequency selective fading match. Frequency interleaving is a generic term used for inter-segment interleaving, intra-segment carrier rotation and intra-segment carrier randomization.
Frequency repacking	Frequency repacking is defined as changing the frequencies of existing transmitting stations for the purpose of configuring an optimum network.
Required CN ratio	The required CN ratio is defined as the critical reception CN ratio at which the receiver unit can stably demodulate signals.
Product planning	Receiver functions or actions which depend on the hardware design, the software design of the receiver planed by each manufacturer.
Still picture	The still picture is defined as one of the video formats used to reduce the amount of information; more specifically, only I picture is periodically transmitted.
Switching index	The switching index, specified in the TMCC information, is defined as the signal to show the timing for changing transmission parameters that can be manipulated by the TMCC information (the carrier modulation method, convolutional coding rate, time interleaving length and number of segments).
Multiplex frame	The multiplex frame is defined as a signal processing frame to re-multiplex MPEG-2 TS into one TS with the same time length as the OFDM frame.
Type 1/Type 2 start signals	Type 1/Type 2 start signals are defined to classify signals for emergency warning broadcasting. While Type 1 start signal is defined by the Special Measures Law concerning Large Earthquakes and the Disaster Measures Basic Law, while Type 2 start signal is defined by the Weather Service Law.
Region code	The region code is defined as the code indicating the target area, placed in the emergency information descriptor, during emergency warning broadcasting (ARIB STD-B10 Appendix D).
Terrestrial broadcaster identifier	The terrestrial broadcaster identifier is defined as the number to identify each terrestrial broadcaster.
Transmission parameters	The transmission parameter is defined as a generic term for parameters for transmission path coding. The transmission parameters for digital terrestrial television broadcasting include the carrier modulation scheme, convolutional coding rate, time interleaving length, number of segments, transmission mode and guard interval ratio. The information about the transmission mode and the guard interval ratio is not transmitted by the TMCC signal.
Transmission mode	The transmission mode is defined to classify modulation schemes and error correction systems.
Statistical multiplexing	Statistical multiplexing is defined as the system to use variable bit rates depending on the difficulty of coding and to effectively improve the picture quality within a limited bandwidth when sending multiple video streams over a single channel.

Inner code	The inner code is defined as one of the concatenated codes that use the combination of two types of error correcting systems, which is later coded into the error correcting code. When the sending and receiving systems use digital modulation and demodulation, inner coding and decoding take place. Digital terrestrial television broadcasting uses convolutional coding with the constraint length of 7.
Partial reception	Partial reception is defined as the reception of the one central OFDM segment only.
Superimpose	Superimpose is defined as the caption provided asynchronously to the main video, audio or data streams. It is used for up-to-the-minute news, changes in air times and time signals.
Special service	The special service is defined as the service temporarily broadcast using a service identifier, instead of the id for regular service. This service is only temporarily used.
Continuity index	The continuity index is defined as a four-bit area in the TS header which increments with each TS packet with the same PID in order to indicate the continuity of the TS packet.

4 Source Coding

4.1 Video

For more information on partial reception layer-specific operations, see in this document “4.3 Detailed Operation Information Regarding Partial Reception.”

4.1.1 Provisions Regarding Input Signals

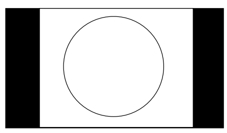
<Video format>

“Conformance to provisions of “Chapter 2 -- Video Input Format” in Part 1 of ARIB STD-B32 should be ensured.”

<Aspect ratio>

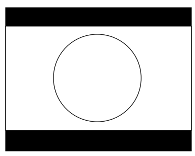
“Conformance to provisions of “2.4 Video Signal Parameters” in Chapter 2 of Part 1 of ARIB STD-B32 should be ensured.” When using a different aspect ratio from that of the original video source for transmission, such as when using the side panel or letter box format, the parameter values in table 4-1 can be set in the sequence header to prevent black-framed display of pictures. It is also necessary that the center of the video source is aligned with the center of the carried signals.

(1) When using the aspect ratio of 16:9 for transmission by adding side panels (basically black panels) to the video source with the aspect ratio of 4:3, the value D should be set to 3/4 of the value B.



Reference drawing (1)

(2) When using the letter box format for transmission by adding black



panels on the top and bottom of the video source with the aspect ratio of 16:9, the value C should be set to 3/4 of the value A.

Reference drawing (2)

Table 4-1 Transmission Using Different Aspect Ratios

<table>
<tr><th rowspan="2">Reference drawing</th><th colspan="3">Parameter Value of sequence_header</th><th>Parameter Value of sequence_ extension</th><th colspan="2">Parameter Value of sequence_display _extension</th></tr>
<tr><th>vertical_ size_value (A)</th><th>horizontal_ size_value (B)</th><th>aspect_ *1 ratio_ information</th><th>progressive *2 _sequence</th><th>display_ vertical_ size (C)</th><th>display_ horizontal _size (D)</th></tr>
<tr><td rowspan="5">(1)</td><td rowspan="2">1080</td><td>1920</td><td rowspan="2">2</td><td rowspan="2">0</td><td rowspan="2">1080</td><td>1440</td></tr>
<tr><td>1440</td><td>1080</td></tr>
<tr><td>720</td><td>1280</td><td>2</td><td>1</td><td>720</td><td>960</td></tr>
<tr><td>480</td><td>720</td><td>2</td><td>1</td><td>480</td><td>540</td></tr>
<tr><td>480</td><td>720</td><td>2</td><td>0</td><td>480</td><td>540</td></tr>
<tr><td rowspan="3">(2)</td><td rowspan="3">480</td><td>720</td><td rowspan="3">3</td><td rowspan="3">0</td><td rowspan="3">360</td><td>720</td></tr>
<tr><td>544</td><td>540</td></tr>
<tr><td>480</td><td>480</td></tr>
</table>

*1 aspect_ratio_information 2=4:3 display, 3=16:9 display
*2 progressive_sequence 0=interlaced scanning system, 1=progressive scanning system

<Colorimetry>

"Conformance to provisions of "2.1 Video Signals" in Chapter 2 of Part 1 of ARIB STD-B32 should be ensured. If the input signal is compliant with the brightness and color-difference signal equation of ITU-R recommendation BT.470 or BT.601 used by the NTSC studio,the difference from the equation * mentioned in "2.1 Video Signals" in Chapter 2 of ARIB STD-B32 should be corrected before transmission.

*: Also specified in ITU-R recommendation BT.709

<Encode area>

"Conformance to provisions of "5.2. Desired Encode Areas" in Chapter 5 of Part 1 of ARIB STD-B32 should be ensured."

4.1.2 Detailed Information on the Operation of MPEG-2 (Video)

<Coding system>

"Conformance to provisions of "Chapter 3 -- Video Coding Scheme and Chapter 4 -- Video

Compression Procedure,“ Sending Procedure and Post-coding Signal Configuration in Part 1 of ARIB STD-B32 should be ensured.”

<Coding parameter restrictions>

“Conformance to provisions of “Chapter 5 -- Coding Parameter Restrictions“ in Part 1 of ARIB STD-B32 should be ensured.” When using MP@LL moving pictures and still pictures, on the other hand, restrictions regarding a} MP@LL moving pictures and b} still picture below should be observed. Although it is not mandatory to transmit sequence_display_extension, frame_center_horizontal_offset (FCHO) and frame_center_vertical_offset (FCVO) should be set to zero for transmission when specifying the display area using sequence_display_extension.

In accordance with MPEG-2, the use of both the field picture format and frame picture format should be possible for interlaced images (progressive sequence=0). These formats should be switched between in sequential units.

The video coding process used for MP@LL moving pictures and still pictures should be MPEG-2 (Video). Restrictions regarding video coding parameters are as shown below. However, it should be noted that the partial reception layer does not use MPEG-2 (Video).

a) MP@LL Moving Pictures

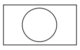
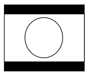
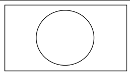
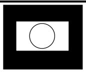
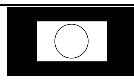
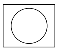
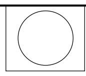
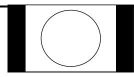
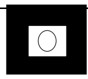
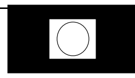
Restrictions regarding coding parameters for MP@LL Moving Pictures are shown in table 4-2, and the image of how the screen is displayed on the receiver unit is also shown in table 4.3.

Table 4-2 Restrictions Regarding Coding Parameters for MP@LL Moving Pictures

Display Image Type	Parameter Value of sequence_header			Parameter Value of sequence_extension	Parameter Value of sequence_display _extension	
	vertical_ size_value	horizontal_ size_value	aspect_ratio_ information *1	progressive_ sequence *2	display_ vertical_ size	display_ horizontal _size
(1)	240	352	3	1	240	360
(2)					480	720
(3)	240	352	2	1	240	360
(4)					480	720

*1 aspect_ratio_information 2=4:3 display, 3=16:9 display
*2 progressive_sequence 0= interlaced scanning system, 1= progressive scanning system

Table 4-3 Image of How the Screen is Displayed on the Receiver Unit

Type	Input Picture to the Encoder	4:3 Monitor	16:9 Monitor
(1)	 16:9		
(2)			
(3)	 4:3		
(4)			

In Type (2) and (4) above, it is assumed that actual images are displayed in the window of the receiver unit in half the size (horizontally and vertically) of what is seen during the full screen display.

b) Still pictures

Formats shown in table 4-4 are used for restrictions regarding coding parameters for still pictures.

To transmit MPEG still pictures (I frame), still_picture_flag of the video decode control descriptor should be set to 1 for transmission.

The I frame should be attached with a sequence header and end code.

Table 4-4 Coding Parameters for Still Pictures

Parameter Value of sequence_header				Parameter Value of sequence_ extension	Other parameter
vertical_size _value	horizontal _size_value	aspect_ratio _information	frame_rate _code	progressive _sequence	
1080	1440,1920	3	4	0	MP@HLmailto:MP@HL
480	720	3	7	1	MP@H14L
		2,3	4	0	MP@ML

<Changes in coding parameters>

It is desirable to ensure conformance to “Appendix -- Operation Guidelines” in Part 1 of ARIB STD-B32.

<Range of video coding rates>

The range of video coding rates provides a guideline regarding video coding rates of transmission devices used during regular operations. It does not specify the scope of guarantee for the operation of receiver units.

The range of video coding rates is as shown below. Each rate (represented by each value below) shows the ES rate.

MP@LL	: 0.2 to 4 Mbit/s
MP@ML	: 1.5 to 15 Mbit/s
MP@H14L	: 4 to 20 Mbit/s
MP@HL	: 8 to 20 Mbit/s

The values representing the rates above are the same in nature as bit_rate* described in the video stream syntax.

Actual bit_rate may have larger values than those in the table.

There are cases where the effective rate of the video stream may be lower than the bit_rate value described in the video stream syntax or below the range of the rates shown above.

Each station should determine the video coding rate for use for actual transmission while paying proper consideration to picture quality.

*: bit_rate...refers to the value shown in bit_rate_value and bit_rate_extension in the packet header.

4.2 Audio

For more information on partial reception layer-specific ES transmission operations, see “4.3 Detailed Operation Information Regarding Partial Reception.”

4.2.1 Provisions Regarding Input Signals

<Sampling rate>

(1) The same sampling rate should always be used for each service, in order not to allow the silent passages from occurring as a result of D/A converter clock changes within services provided by the same broadcasting station.

(2)The sampling rate should be set to 48 kHz or 32 kHz.

<Audio mode>

Regarding audio mode for each ADTS (audio data transport stream,) conformance to the provisions concerning the recommended audio mode in “5.1 Input Audio Format” in Chapter 5 of Part 2 of ARIB STD-B32 should be ensured.

<Downmix coefficient>

Conformance to provisions of “5.2 Audio Coding System” in Part 2 of ARIB STD-B32 as well as Section “6.2.1 Audio Decoding” in Chapter 6 of ARIB STD-B21 should be ensured.

There may be cases where a downmix coefficient is not transmitted. In this case, the default value should be used for decoding. To use a downmix coefficient different from the default value, the coefficient should be transmitted.

<Audio level>

When downmixing from multi-channel stereo sound to two-channel stereo sound for listening, downmixing operation may cause frequent clipping due to overflow and this may seriously impair the sound quality. If using a source like this, it is desirable to attenuate the audio input of the sender, transmit an appropriate downmix coefficient, monitor downmixed sound and take other similar process to reduce the degradation of the sound quality as a result of a downmix.

<Channel mapping of program exchange and at transmission system>

Mapping to AES/EBU channels during program exchange and at transmission system is shown in Table 4-5.

Table 4-5 Mapping of Various Audio Modes to AES/EBU Channels

Audio Mode	AES/EBU_1		AES/EBU_2		AES/EBU_3		AES/EBU_4		Number of ADTS
	ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	
M	M								1
S	L	R							1
2M (D)	M1	M2							1
3M (D+M)	M1	M2	M3						2
4M (2D)	M1	M2	M3	M4					2
5M (2D+M)	M1	M2	M3	M4	M5				3
6M (3D)	M1	M2	M3	M4	M5	M6			3
7M (3D+M)	M1	M2	M3	M4	M5	M6	M7		4
8M (4D)	M1	M2	M3	M4	M5	M6	M7	M8	4
2S	L1	R1	L2	R2					2
3S	L1	R1	L2	R2	L3	R3			3
4S	L1	R1	L2	R2	L3	R3	L4	R4	4
3/1	L	R	C	MS					1
3/2	L	R	C		LS	RS			1
3/2+LFE (5.1)	L	R	C	LFE	LS	RS			1
Stereo and mono (S+M)	L	R	M						2
Stereo and 2 mono (S+D)	L	R	M1	M2					2
5.1+S	L	R	C	LFE	LS	RS	L2	R2	2
3/1+S	L	R	C	MS			L2	R2	2
3/2+S	L	R	C		LS	RS	L2	R2	2

Note 1: See the notes below for abbreviations.
MS, LS and RS…refer to rear speaker sound in the surround mode.
Mono, left and right surround sound
LFE (Low Frequency Enhancement) …refers to the low frequency enhancement channel in multi-channel stereo mode

Table 4-5 defines the relationship between the audio mode during input to the encoder and channel mapping. If coding in the corresponding audio mode is not required, the blank columns can be used by the broadcasting company if opting to do so (for example,Ch5 ando Ch6 in 3/1 stereo mode are used for MS_{-3dB} is convoluted using ch5 and ch6 in 3/1 stereo mode).

4.2.2 Detailed Information on the Operation of MPEG-2 (Audio)

Conformance to provisions of Part 2 -- Audio Signal and Coding System and Appendix -- Operation Guidelines in Part 2 of ARIB STD-B32 should be ensured.

<Coding parameters>

Table 4-6 rincipal Parameters of the Audio Coding System

Bit stream type	AAC Audio Data Transport Stream (ADTS)
Sampling rate	48 kHz and 32 kHz
Profile	Low Complexity (LC)
Maximum number of coded channels	A maximum of 5.1 channels per one ADTS
PES packet	The PES asynchronous with the audio frame is allowed.
Mute flag	Should not be used. * Muted by the input signal.

4.2.3 Precautions when Switching between Audio Parameters

When switching between audio parameters, decoding generates noise under present circumstances and receiver units insert a mute in many cases. It is therefore desirable to insert silent passages in the signal input to the encoder in order to prevent interruption to program audio during switching. However, regarding the silent passages, it is up to each broadcasting company as to what measures are to be taken in consideration of improvement in encoding and decoding functions in the future.

4.2.4 <Range of audio coding rates>

Regarding the range of audio coding rates (at 48 kHz sampling), the following values should be used as a guide. These values representing rates here indicate ADTS rates.

Standard stereo	:	96 kbit/s to 256 kbit/s
High quality sound stereo†	:	192 kbit/s to 256 kbit/s
Multi-channel stereo	:	288 kbit/s to 384 kbit/s

Regarding 32 kHz audio sampling, the following values should be used as a guide for the time being.

Audio mode 2 or 3 should be used; each broadcasting company can choose which mode to use.

† Conformance to Appendix -- Operation Guidelines in Part 2 of ARIB STD-B32 should be ensured.

Monoral : Up to From 24 kbit/s

Stereo : Up to From 32 kbit/s

4.2.5 High Quality Sound Service

Conformance to the provisions concerning mode 1 speech quality in Chapter 2-- Speech Quality Display in the Appendix of Part 2 of ARIB STD-B32 should be ensured. The high quality sound service should be identified by the sound quality display field in the audio component descriptor in the EIT. It has no relation to the coding rate.

4.3 Detailed Operation Information Regarding Partial Reception

4.3.1 Services Available in the Partial Reception Layer

The following services should be available in the partial reception layer.

Table 4-7 Services Available in the Partial Reception Layer

Media Type	service_type		Whether the Service is Available in the Partial Reception Layer
	Value	Service	
TV	0x01	Digital TV service	X
	0xA1	Temporary video service	X
Data	0xC0	Data service	O
	0xA3	Temporary data service	X
	0xA4	Engineering service	X
	0xAA	Bookmark list data service	X

4.3.2 Provisions Regarding Video Coding

The video stream transmitted in the partial reception layer only carries low-frame-rate&low-resolution picture. No TV service is provided in the partial reception layer, low-frame-rate&low-resolution picture can be transmitted as monomedia by data broadcasting. The provisions regarding video coding of low-frame-rate&low-resolution picture should be based on the provisions in Chapter 5 of Volume 3.

4.3.3 Provisions Regarding Audio Coding

<Sampling rate>

The sampling rate should be set to 48 kHz or 24 kHz (half rate).

<Range of coding rates>

Regarding the range of audio coding rates (at 48 kHz sampling), the following values should be used as a guide. Here, these values indicate ADTS rates.

Monoral: 24 kbit/s to 256 kbit/s

Stereo: 32 kbit/s to 256 kbit/s

Regarding the range of audio coding rates (at half rate sampling), the following values should be used as a guide. Here, these values indicate ADTS rates.

Monoral: 24 kbit/s to 96 kbit/s

Stereo: 32 kbit/s to 96 kbit/s

<Use of AAC_SBR>

In a portable service, SBR stored in the fill element of ADTS can be used. However, when SBR is used, the coded sampling rate should be set to the half rate (24kHz). At the same time, it is desirable to add CRC to sbr_extension_data and to insert sbr_header more than once per 500ms.

<Use of multi-channel stereo>

Should not be used.

4.4 Hierarchical Transmission Patterns and Video and Audio Parameters

The relationship between hierarchical transmission patterns and available video and audio parameters is as shown below.

Table 4-8 Available Parameters for Each Hierarchical Transmission Pattern

Pattern	Layer Used	Number of Segments	Transmission	Video	Audio
(1)	A	13	a	a	a
(2)	A	13	b	a	a
(3)	A	1 (Partial reception)	c	-	b
	B	12	a	a	a
(4)	A	8 to 2	b	b	a
	B	5 to 11	a	a	a
(5)	A	1 (Partial reception)	c	-	b
	B	12	b	a	a
(6)	A	1 (Partial reception)	c	-	b
	B	7 to 1	b	b	a
	C	5 to 11	a	a	a

Layers: A, B and C represent layers described in the TMCC signal.

Video and audio: The use of MP@HL should be allowed for the layers that can ensure a maximum rate of 10 Mbit/s. The partial reception layer should be able to carry low-frame-rate&low-resolution picture as part of data broadcasting. For audio transmission, Type c in table 4-11 should be used.

Table 4-9 Transmission Parameters

Type	Mode and Guard Ratio					Time Interleave				Modulation and Error Correction														
	Mode 3			Mode 2		(Mode 3, Mode 2)				64QAM					16QAM					QPSK				
	1/4	1/8	1/16	1/4	1/8	I=0,0	I=1,2	I=2,4	I=4,8	7/8	5/6	3/4	2/3	1/2	7/8	5/6	3/4	2/3	1/2	7/8	5/6	3/4	2/3	1/2
a	O	O	Δ	O	Δ	X	O	O	O	O	O	O	O	O	X	X	X	O*1	O*1	X	X	X	X	X
b	O	O	Δ	O	Δ	X	O	O	O	X	X	X	X	X	X	X	X	O	O	X	X	X	O	O
c	O	O	Δ	O	Δ	X	O	O	O	X	X	X	X	X	X	X	X	X	O	X	X	X	O	O

O: Transmission parameters that can be used

X: Transmission parameters that cannot be used

Δ: The use of mode 3 and 1/16 guard ratio combination and mode 2 and 1/8 guard ratio combination is considered difficult when considering the current conditions surrounding the installation of stations. It is assumed, therefore, that the use of these combinations will be possible following frequency reorganization in the future.

*1: The use of 16 QAM and 1/2 combination and 16 QAM and 2/3 combination in Type a should be limited to emergency situations, such as during accidents and disasters.

Table 4-10 Video Parameters

Type	Coding System	MPEG-2							
		MP@HL			MP@14L	MP@ML			MP@LL
	Size	1920X1080 i	1440X1080 i	1280X720 p	720X480 p	720X480 i	544X480 i	480X480 i	352X240 p
	Frame Rate	30/1.001 Hz	30/1.001 Hz	60/1.001 Hz	60/1.001 Hz	30/1.001 Hz	30/1.001 Hz	30/1.001 Hz	30/1.001 Hz
a		O	O	O	O	O	O	O	O
b		X	X	X	O	O	O	O	O

O: Means that the data can be transmitted.

X: Means that the data cannot be transmitted.

Table 4-11 Audio Parameters

Type	MPEG-2 AAC LC							
	48kHz/32kHz					24kHz		
	Mono	Stereo	Multi-channel	Dual mono	Multiple ES'*1	Mono	Stereo	Dual mono
a	O	O	O	O	O	X	X	X
b*2	O	O	X	O	O	O	O	O

O: Means that the data can be transmitted.

X: Means that the data cannot be transmitted.

*1: The number of audio ES' that can be referenced by a service carried in the layer.

*2: As shown in Table 4-8, this type corresponds to the partial reception layer. Please note that the sampling rates are set to 48kHz and 24kHz (half rate) only.

5 Multiplexing

5.1 Multiplexing of Service

5.1.1 Definition of the ES

(1) ES' carried in layers other than the partial reception layer

It should be ensured that services provided in layers other than the partial reception layer be allowed to reference both the ES' carried in the partial reception layer and all other layers.

Table 5-1 ES' Carried in Layers Other than the Partial Reception Layer

Stream Type		Stream Type ID	Component Tag Value	Data Component Descriptor
MPEG-2 video		0x02	0x00 to 0x0F	Not to be inserted.
MPEG-2 AAC audio (48 kHz or 32 kHz)		0x0F	0x10 to 0x2F	Not to be inserted.
Caption and Superimpose	Caption	0x06	0x30 to 0x37	To be inserted. The data_component_id value is set to 0x0008.
	Superimpose		0x38 to 0x3F	
Mono media	MPEG-1 video	0x01	0x40 to 0x7F	Not to be inserted.
	MPEG-2 video	0x02		
	MPEG-2AAC audio (48 kHz or 32 kHz)	0x0F		
Event message and data carousel (DII and DDB)		0x0D		To be inserted. *1 The data_component_id value is set to 0x000C.

*1 It is optional whether or not to insert the descriptor in the component that only carries an event message.

(2) ES’ carried in the partial reception layer

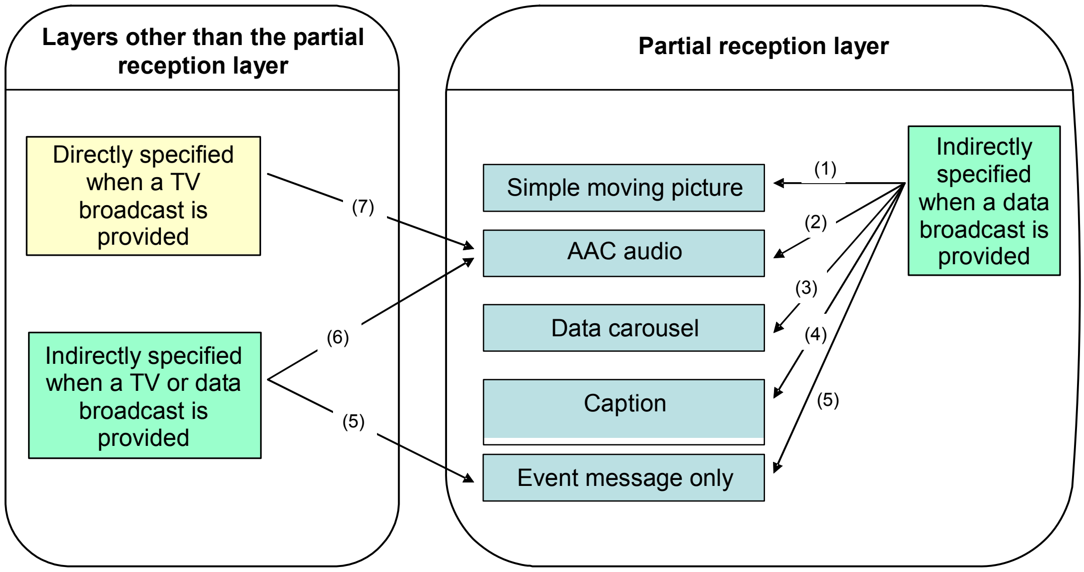
It should be ensured that services provided in the partial reception layer be allowed to only reference the ES’ carried in the partial reception layer.

Table 5-2 ES’ Carried in the Partial Reception Layer

<table>
<tr><th colspan="2">Stream Type</th><th>Stream Type ID</th><th>Component Tag Value</th><th>Data Component Descriptor</th></tr>
<tr><td colspan="2">low-frame-rate&low-resolution picture Video*1, *2</td><td>0x1B</td><td>0x81, 0x82</td><td>Not to be inserted.</td></tr>
<tr><td colspan="2">MPEG-2 AAC Audio (24 kHz)*3</td><td>0x0F</td><td>0x83, 0x84</td><td>Not to be inserted.</td></tr>
<tr><td colspan="2">MPEG-2 AAC Audio (48 kHz)</td><td>0x0F</td><td>0x85, 0x86</td><td>Not to be inserted.</td></tr>
<tr><td rowspan="2">ES’ that can be referenced only by data broadcasting services in layers other than the partial reception layer</td><td>AAC Audio (24 kHz)*3, *4</td><td>0x0F</td><td>0x8C, 0x8D</td><td>Not to be inserted.</td></tr>
<tr><td>AAC Audio (48 kHz)*4</td><td>0x0F</td><td>0x8E, 0x8F</td><td>Not to be inserted.</td></tr>
<tr><td colspan="2">Caption</td><td>0x06</td><td>0x87</td><td>To be inserted.
The data_component_id value is set to 0x0012.</td></tr>
<tr><td colspan="2">Transmission of the data carousel (DII and DDB) only or transmission of the data carousel and event message*2</td><td>0x0D</td><td>0x80, 0x8B</td><td>To be inserted.
The data_component_id value is set to 0x000D.</td></tr>
<tr><td colspan="2">Transmission of the event message only</td><td>0x0D</td><td>0x89, 0x8A</td><td>Not to be inserted.</td></tr>
</table>

*1 For more information on low-frame-rate&low-resolution picture, see Vol. 3.
*2 Cannot be referenced by services other than those in the partial reception layer.
*3 It is optional where it can be referenced by 13-segment receiver units.
*4 An audio stream that cannot be selected from the menu on the receiver unit such as the EPG and replayed only from the data broadcasting contents. See Vol. 3.

Fig. 5-1 shows component tag values used when the services provided in layers other than the partial reception layer reference the ES’ carried in the partial reception layer and component tag values used when the services provided in the partial reception layer reference the same ES’, in accordance with Table 5-2.



(1): 0x81,0x82 (2): 0x83-0x86 (3): 0x80, 0x8B- (4): 0x87 (5):0x89,0x8A (6):0x8C - 0x8F
(7): 0x84-0x86

Figure 5-1 Component Tag Values Used when Referencing the ES' Carried in the Partial Reception Layer

5.1.2 Maximum Number of ES' that Can be Simultaneously Processed (Per Service)

The restrictions regarding the PID filtering resources of receiver units limit the number of ES' that can be simultaneously processed to a maximum of 16. This accordingly means that the maximum number of ES' per service that can be simultaneously displayed (including audio replays) and simultaneously recorded is 16. However, the maximum number of ES' that may be scrambled is 12 due to restrictions regarding the conditional access system.

Although, in consideration of operation, for example, in multi-view mode, the number of ES' that can be transmitted per service should be set to a maximum of 32, the number of ES' exceeding 16 cannot be simultaneously processed. For this reason, if the number of ES' per service exceeds 16, restrictions may occur during the display and recording on the receiver unit.

When transmitting PCR data as an independent packet, the PCR packet is counted as one ES.

5.1.3 Default ES

The table below specifies which ES will be selected as default when the receiver unit selects a service.

This document specifies the component tag value assigned to each ES in “14.2 Assignment of component_tag Values” in Chapter 14 of Vol. 4. According to this, based on the component tag value described in the stream identifier descriptor inserted in the PMT, the default ES for each stream type is defined as follows.

O MPEG-2 video	: ES whose component tag value is set to 0x00
O MPEG-2 AAC Audio	: ES whose component tag value is set to 0x10
O Caption	: ES whose component tag value is set to 0x30
O Superimpose	: ES whose component tag value is set to 0x38
O Data carousel	: ES whose component tag value is set to 0x40
O Data carousel (Partial reception layer)	: ES whose component tag value is set to 0x80
O Low-frame-rate&low-resolution picture Video	: ES whose component tag value is set to 0x81
O MPEG-2 AAC Audio (Partial reception layer)	: ES whose component tag value is set to either 0x83[*1] or 0x85[*2]

In each service, only one ES can be specified as the default for each stream type identifier. However, there is an exception; only when the stream type identifier is set to 0x06, the default ES can be specified for the caption and superimpose, respectively.

In multi-view mode (MVTV: See Paragraph 8.4), ES’ are grouped by component_group_descriptor. These groups are called the component groups. In each component group, the default ES is defined as follows.

“The ES with the lowest component_tag value among all ES’ in the same group is defined as the default ES for each stream type in each component group.”

The first component group selected when an MVTV event has been selected is the one whose component_group_id is set to "0x0" by component_group_descriptor, and the default ES in the component group becomes the default ES of the entire event.

[*1] The elementary MPEG-2 AAC audio (24 kHz sampling) stream transmitted in the partial reception layer must not be specified as the default ES for the services in layers other than the partial reception layer. (The PMT for the services in layers other than the partial reception layer must not specify an ES whose component tag value is set to 0x83.)

[*2] The elementary MPEG-2 AAC audio (48 kHz sampling) stream transmitted in the partial reception layer must not be specified as the default ES for the services in layers other than the partial reception layer at the moment (The PMT for the services in layers other than the partial reception layer must not specify an ES whose component tag value is set to 0x85 at the moment). (Refer to comment 10)

On the other hand, if no component_group_descriptor has been received, the component_tag value in the PMT is used to specify the default ES. It is therefore necessary that the description of the component_tag value of the default ES for the entire event should precede the component_group_id (set to "0x0") of component_group_descriptor.

5.2 Detailed Operation Information Regarding MPEG-2 Systems

5.2.1 Definitions of Services

Services are defined by type as shown below.

Digital TV service is defined as the service, which contains at least one video stream whose stream_type is set to "0x02" and which is primarily designed for the listening and viewing of video streams. This service always enables stable reception of programs even on receivers not equipped with the function to receive data broadcasting.

Digital audio service is defined as the service different from the digital TV service, which contains at least one audio stream whose stream_type is set to "0x0F" and which is primarily designed for the listening of audio streams. This service different from the digital TV service always enables stable reception of programs even on receivers not equipped with the function to receive data broadcasting. However, this volume does not cover this service.

Data service is defined as the service, which contains at least one data section carousel whose stream_type is set to "0x0D" and which is primarily designed for real-time listening and viewing of data contents. [1]

Special service (special video service and special data service) is defined as the service, which uses different service identifier from those of regularly programmed services and which is designed for broadcasting at irregular times. This service is not used during regular operation and no prior notification is given to viewers regarding this service.

Engineering service is defined as the software maintenance service for receiver units. More specifically, the service includes fixing bugs, solving transmission related problems, correcting problems arising from the difference in the interpretation of operation among receiver units, improving the display, accelerating response and improving operationality. The service also includes updating the program category code table, program characteristic code table and reserved words commonly applied to all receiver units. For more information, see Vol. 1.

Bookmark list data service is defined as the service for displaying the bookmark information recorded in NVRAM of receiver units. For more information, see Vol. 3.

5.2.2 Synchronization of the Video, Audio and Caption Streams

Since the receiver unit uses both the PTS and DTS or either of them as the base for synchronization, the sender should control the synchronization of the video, audio and caption streams so as to ensure no failures of receiver units.

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[1] * In the partial reception layer, when a reduced moving picture whose sream_type is set to "0x1B" is included, data section carousel may not be included.

5.2.3 Multiplexing of the EPG and Data

The maximum bit rates assigned to the EPG and data broadcasting are as shown below.

O EPG	: A maximum of 1 Mbit/s for entire SI (Average per second value. For more information, see 11.2 in Vol. 4 of this document.)
O Data broadcasting	: See each section, 2.1.2.6, 4.2.2 and 4.2.3 in Part 2 of Vol. 3 of this document.

5.2.4 Operation of the PAT

The sequential order of services described in the PAT has no meaning and has nothing to do with the operation of receiver units. They are usually listed simply in order of service identifier.

5.2.5 Operation of the NIT

(1) The digital terrestrial television broadcasting network is comprised of one or multiple transmission system that transmit the same TS. Accordingly, the NIT only includes one TS loop.

(2) The sequential order of services described in the NIT has no meaning and has nothing to do with the operation of receiver units. They are usually listed simply in order of service identifier.

(3) Under an MFN environment, the Terrestrial Delivery System Descriptor includes all the frequencies used by transmission system that transmit relevant TS' in one terrestrial delivery system descriptor.

(4) The use of information described in the NIT enables almost automatic setting of receivable services when receiver units are installed. For more information on how to set up receiver units, see 6.2 in Vol. 2.

(5) The TS names in the TS Information Descriptor in the NIT are displayed as the options for inclusion in the service list in order to help users to make a selection when multiple options are available for assignment to one-touch buttons. For more information on one-touch button assignment, see 6.5 in Vol. 2.

(6) As region codes in the Terrestrial Delivery System Descriptor, EWS codes (assigned to 52 areas including prefectural areas and specific wide-areas such as the Kanto region) should be used.

(7) remote_control_key_id in the TS Information Descriptor, which shows the relationship

between each service identifier in each TS and one-touch buttons 1 to 12, is described in the TS loop in the NIT. For more information on remote_control_key_id, see Section 30.4.3.4 in Part 2 of Vol. 4.

5.2.6 How to Handle the PMT and ES

(1) In normal times, if no elementary video or audio stream is present, no description of such an ES should be included in the PMT. However, this does not apply to transient states such as during seamless switching.

(2) The maximum number of elementary caption or superimpose streams should be one. In principle, such ES information in the PMT should be added when the caption or superimpose starts and deleted when they ends. However, it is also possible to always keep the ES information in the PMT.

In multi-view mode, on the other hand, the use of the caption and superimpose in sub channels should also be possible. Therefore, in this case, the number of elementary streams carried is a maximum of three. However, it should be noted that one each of the elementary caption stream whose component_tag is set to 0x30 and the elementary superimpose stream whose component_tag is set to 0x38 in the PMT can only be used for fixed reception. They always belong to a group whose component_group_id is set to 0.

(3) Regarding compatibility between the ES for data broadcasting other than caption or superimpose broadcasting and the PMT (compatibility regarding whether the ES described in the PMT is actually present), see Chapter 2 – Use of the Data Transmission System in Part 2 of Vol. 3 of this document.

5.2.7 Default Maximum Bit Rate

Digital recorders may record only certain services (partial TS) contained in the TS. If this happens, it is necessary to ensure the availability of bandwidth of the interface (IEEE1394) and set the maximum bit rate to calculate the recording time.

If the maximum bit rates at which the services are transmitted are greater or significantly lower than the values shown below, the sender uses the Digital Copy Control Descriptor for transmission.

Shown below are the default maximum bit rates for each component (however, for data, the sum total of the additional data related components is used) and for each service. For more information on how to set the maximum bit rate in the descriptor, see Vol. 4 of this document.

Table 5-4 Default Maximum Bit Rate for Each Component (TS Rate)

Video	1080i	8 to 20 Mbit/s
	720p	8 to 20 Mbit/s
	480p	4 to 12 Mbit/s
	480i	1.5 to 8 Mbit/s
Audio	Standard stereo	Up to 330 kbit/s
	High quality sound stereo	Up to 330 kbit/s
	5.1ch stereo	Up to 458 kbit/s
Additional data		4 Mbit/s
Caption		256 kbit/s
Superimpose		256 kbit/s

Table 5-5 Default Maximum Bit Rate for Each Media Type (TS Rate)

TV	1080i	21 Mbit/s
	720p	21 Mbit/s
	480p	12 Mbit/s
	480i	11 Mbit/s
	Multi-view	21 Mbit/s
Data		2.2 Mbit/s

Table 5-6 Default Maximum Bit Rate for Each Component in the Partial Reception Layer (TS Rate)

Video	Low-frame-rate&low-resolution picture	Up to 650 kbit/s
Audio	MPEG2 AAC Audio	Up to 330 kbit/s
Data		Up to 650 kbit/s
Caption		256 kbit/s

Table 5-7 Default Maximum Bit Rate for Each Media Type in the Partial Reception Layer (TS Rate)

Data		Up to 650 kbit/s

5.2.8 Operation of the PCR

(1) Regarding the PCR of each service, the TS should be so configured that the time interval between the byte containing the last bit of the PCR base field is 100 msec or lower. However, the PCR of partial reception service, while adding the condition above, should also be multiplexed at the same location in the same pattern on a multiplexed frame. Therefore, in mode 3, the PCR is inserted four times in one multiplex frame period and in mode 2, the PCR is inserted twice in one multiplex frame period.

(2) Transmission should be performed, while making sure that the PCR jitter reaching receiver units is within 500 nsec.

5.2.9 Operation of Partial Reception

Since the partial reception layer has a limited bandwidth for transmission, MPEG-2 can be used in a non-standard manner as shown below in order to ensure the capacity for transmitting contents. Incidentally, the method (2) below should be used by all broadcasting companies that use the partial reception layer. However, whether or not to use methods other than (2) is up to each broadcasting company.

(1) PCR repetition rate/transmission layer

Regarding the PCR mentioned in Section 5.2.8, the PCR inserted four times consecutively can be reduced to a minimum of once when it is used for partial reception service. However, it should be noted that the PCR interval in mode 3 should be no longer than one multiplex frame period and it should be no longer than the two multiplex frame periods in mode 2. If the PCR cycle exceeds 100 msec, services in non-partial reception layers should not be allowed to reference the PCR for partial reception.

(2) PAT transmission layer

When using the partial reception layer for transmission, the PAT should be transmitted in the high protection layer (layer B) (most resistant to noise and other interruptions), not in the partial reception layer. As PMT_PID of services to be transmitted in the partial reception layer described in the PAT, the values shown in Table 5-8 should be used by all broadcasting companies. The maximum number of services should be three.

Since PMT_PID for partial reception is assigned to each service number, the multi-section PMT transmission cannot be used.

Table 5-8 PMT_PID Values for Partial Reception

Service Number (Lower 3 Bits of the Service Identifier)	PMT_PID for Partial Reception
0	0x1FC8
1	0x1FC9
2	0x1FCA
3	0x1FCB
4	0x1FCC
5	0x1FCD
6	0x1FCE
7	0x1FCF

(3) PMT repetition rate

The PMT for partial reception layer can be transmitted at time interval of a maximum of 500 msec.

(4) Operation of the PMT

In order to increase the service-selection speed of portable receiver units, the PMT with service no 0 (PMT_PID = 0x1FC8) should be specified as the primary service by receiver units.

5.3 Multiplexing of Services

5.3.1 Maximum Number of Services

The maximum number of services that can be contained in each TS should be 27. The maximum number of each type of service that can be contained is shown below and transmission should be made within the scope not exceeding these limits.

Regarding the assignment of service identifier to each broadcasting company, conformance to Section 9.1.3 should be ensured.

Media Type	Maximum Number of Services
TV	: 8
Data (excluding the partial reception service)	: 16
Data (Partial reception service)	: 3

5.3.2 Statistical Multiplexing

When using statistical multiplexing, for example, to broadcast multiple SDTV channels or multi-view channels, the number of elementary video streams used should be a maximum of eight. The bit rates used then should be within the range specified in 4.1.2 Video Coding Rates.

5.4 Assignment of TS'

One TS should be assigned to one 6 MHz channel.

5.5 TS Operation Guidelines

Guidelines regarding seamless switching to redundant transmission system are given below. To ensure seamless switching, the senders should, whenever possible, perform transmission in accordance with the guidelines below. It is also preferable that receivers are able to make reception in accordance with the guidelines below.

5.5.1 Guidelines for Senders

Guideline T1.1

- Redundant transmission systems should use, whenever possible, the same GOP phase and PCR value as those of the main transmission system in each service unit.

Guideline T1.2

- To prevent a situation where the version number will not change due to switching to a redundant system when the type of processing changes, the sender should ensure the change of the version number.

Guideline T1.3

- The partial reception layer should use the high protection layer and should not use duplicate_packet.

Guideline T1.4

- Whenever possible, switching between systems should be performed when the audio is muted.

5.5.2 Guidelines for Receivers

Guideline R1.1

- If no error has been detected in the transmission system and transport_error_indicator is not set, the video or audio should not be muted even when a discontinuity has been found in the continuity index (continuity_counter).

Guideline R1.2

- If the type of decoding process remains unchanged despite the change in the version number, no processing other than what is required should be performed.

Guideline R1.3

- Even in the presence of a deviation up to 2 times of PTS differences of the audio PES packet before and after the switching between systems, mute or other operations should be avoided whenever possible. Instead, the problem should be lessened, for example, by controlling the pace of the replay clock and performing skipping and repeating processing.

Guideline R1.4

- Incomplete sections such as sections stopped or started halfway through should be discarded and a complete section received next should be used.

6 Transmission

6.1 Methods for Transmitting Signals to the STL/TSL

Regarding the signaling formats and synchronizing methods to transmit digital terrestrial television broadcast signals to the STL and the methods for transmitting signals between transmitting stations to configure networks including the SFN, it is desirable to conform to the methods described in Chapter 5 in Appendix of ARIB STD-B31.

Particularly the types of additional information and relevant transmission methods which are required in transmission of broadcasting TS' to be interfaced by the MPEG-TS signal with the multiplex frame structure are specified in Section 6.1.1. It is desirable to satisfy this specification when multiplexing the transmission control signal into the broadcasting TS signal.

6.1.1 Types of Additional Information and Relevant Transmission Methods

There are following two types of locations for multiplexing the transmission control information into the broadcasting TS signal, and transmission should be performed as shown in table 6-1.

(1) Multiplexing onto the dummy byte in each TSP (transport stream packet)

(2) Multiplexing onto the invalid layer*(hereafter referred to as "IIP: ISDB-T Information Packet").
(*: An invalid layer refers to a layer, which is not part of layer A, B or C, and is not finally transmitted as the OFDM signal.)

Table 6-1 Types of Transmission Control Information and Multiplexing Locations

No	Type of Transmission Control Information	Description	Multiplexing Location	
			Dummy Byte	Invalid Layer
1	TMCC identifier	00: BS digital 10: Digital terrestrial TV 11: Digital terrestrial audio	O	
2	Buffer reset flag	Buffer reset control for the synchronization equipment	O	
3	Startup control for emergency broadcasting	Specification of the emergency warning broadcasting period	O	O
4	First packet flag for TMCC modification	Specification of the first packet for modification	O	
5	First packet flag for the frame	Specification of the first packet for the multiplex frame	O	
6	Frame synchronization identifier (w0 and w1)	Specification of the even and odd frame periods	O	O
7	Layer information for each TSP	Classification of A, B, C and NULL layers Specification of the TSP to transmit IIP and the TSP to transmit the AC data	O	
8	Transmission parameter switching index		O	O
9	TSP counter	The number increments with each packet with the first packet of the multiplex frame set to 0	O	
10	TMCC (including mode and GI)	TMCC and modulator control information		O
11	Broadcast network control information	Control information such as delays under the SFN environment		Optional
12	AC data	Information transmitted by the AC	Optional	Optional

However, if multiplexing information using both the dummy byte and invalid layer, there should be no multiplexing contradictions.

6.2 Assignment of PID of the TSP for Transmitting Information

With regard to the transmission of TS signals, the TSPs for transmitting information shown in table 6.2 should use fixed PID values for the purpose of preventing overlaps with other TSPs. On the other hand, other TSPs should not use the folloeing PID values.

Table 6-2 TSPs for using in Transmission Line

Transmission Line	Information for Transmission	Multiplexing Location	PID Value
Broadcasting station network	Auxiliary data transmission signal		0x1FD0 to 0x1FEF
STL/TTL line	Transmission control information (IIP)	Invalid layer	0x1FF0
STL/TTL line	AC information	Invalid layer	0x1FF1
Optional line	User information		0x1FF2 to 0x1FFE

7 Channel Coding and Modulation of the Transmission Path

7.1 Hierarchical Transmission

(1) The transmission of a single TS using multiple transmission methods is called hierarchical transmission.

(2) Digital terrestrial television broadcasting allows hierarchical transmission in up to three layers.

(3) The three layers used for hierarchical transmission are called the high protection layer, middle protection layer and low protection layer, in ascending order of the required CN ratio; the difference of the required CN ratio reflects the difference of the channel coding system. If using two layers for hierarchical transmission, on the other hand, they are called the high protection layer and low protection layer. However, it should be noted that the partial reception layer should always use the QPSK modulation and that in the presence of multiple layers transmitted at the same required CN ratio, they are arranged in the following order: the high protection layer→middle protection layer→low protection layer (if using the two layers for hierarchical transmission: the high protection layer→low protection layer) in ascending order of the segment number used.

(4) The transmission layer No. 1 is called the low protection layer for the sake of convenience.

(5) Regardless of the layer number., the three layers are also called the layer A, layer B and layer C in ascending order of the required CN ratio. However, the partial reception layer should always be the layer A. † In the presence of multiple layers transmitted at the same required CN ratio, they are arranged in the following order: the layer A→layer B→layer C in ascending order of the segment number used.

† Section 3.11.2 of ARIB STD-B31 defines the partial reception layer as layer A.

7.2 Partial Reception

Regarding the 13 OFDM segments in the middle of the TV broadcast signal, transmission path coding for frequency interleaving only within each segment should be enabled. To perform partial reception, the partial reception layer should be high protection layer. A modulation system, which is more resistant to interference than the QPSK modulation used for the partial reception layer, will not be applied to other layers.

7.3 Transmission Parameters

7.3.1 Mode

Digital terrestrial television broadcasting uses two modes, mode 2 and mode 3.

Table 7-1 Operation Modes

Mode	Carrier Interval	Total Number of Carriers (13 Segments)
Mode 2	125/63 kHz =1.9841...kHz	2809
Mode 3	125/126 kHz =0.99206...kHz	5617

7.3.2 Guard Interval

The guard interval lengths for digital terrestrial television broadcasting should be limited to the following combinations in each mode. To reduce radio interference under the SFN environment, a guard interval length of a minimum of 126 μs is required. However, the use of 63 μs should also be allowed, because the introduction of the digital channel assignment method following frequency repacking in the future may cause a transition from a large scale SFN to an MFN environment and use of a shorter guard interval that results from such a transition may increase the transmission capacity.

Table 7-2 Guard Interval Length

Guard Interval Ratio	1/4	1/8	1/16
Mode 2	126 μs	63 μs	-
Mode 3	252 μs	126 μs	63 μs

7.3.3 Modulation and Error Correction

Digital terrestrial television broadcasting uses the combinations of the modulation system and error correction system (convolution coding rate) selected from among the combinations shown below.

During hierarchical transmission, one parameter should be selected from three types of parameters (a, b and c), in Table 7-3, for use in combination with the modulation system and error correction system (See sectin 7.4).

Table 7-3 Combinations of Available Modulation and Error Correction Systems

Type	Modulation and Error Correction														
	QPSK					16QAM					64QAM				
	1/2	2/3	3/4	5/6	7/8	1/2	2/3	3/4	5/6	7/8	1/2	2/3	3/4	5/6	7/8
a	X	X	X	X	X	O*1	O*1	X	X	X	O	O	O	O	O
b	O	O	X	X	X	O	O	X	X	X	X	X	X	X	X
c	O	O	X	X	X	O	X	X	X	X	X	X	X	X	X

(O: Indicates a possible combination. X: Indicates an impossible combination.)
*1: The use of 16 QAM and 1/2 combination and 16 QAM and 2/3 combination in Type a should be limited to emergency situations, such as during accidents and disasters.

7.3.4 Transmission Capacity

The transmission capacities are determined by the combination of the mode, guard interval and modulation / error correction system are shown below.

Table 7-4 Transmission Capacity (kbit/s) per 1 Segment

Modula-tion System	Convolution Coding Rate	Guard Interval Length				
		Mode 2		Mode 3		
		126 μs	63 μs	252 μs	126 μs	63 μs
QPSK	1/2	280.85	312.06	280.85	312.06	330.42
	2/3	374.47	416.08	374.47	416.08	440.56
16QAM	1/2	561.71	624.13	561.71	624.13	660.84
	2/3	748.95	832.17	748.95	832.17	881.12
64QAM	1/2	842.57	936.19	842.57	936.19	991.26
	2/3	1123.43	1248.26	1123.43	1248.26	1321.68
	3/4	1263.87	1404.29	1263.86	1404.29	1486.90
	5/6	1404.29	1560.32	1404.29	1560.32	1652.11
	7/8	1474.50	1638.34	1474.50	1638.34	1734.71

7.3.5 Interleaving

Time interleave combinations shown in table 7-5 are used. Although the time interleaving length can be changed for each layer, if placing a group of components across different layers, the time interleaving length of related layers should be the same. For more information, refer to section 8.1" Use of Hierarchical Transmission."

Table 7-5 Time Interleave Combinations

Transmission Mode	Mode 2	Mode 3
Delayed frame transmission and reception/Time interleaving	1 frame/I=2	1 frame/I=1
	2 frame/I=4	1 frame/I=2
	4 frame/I=8	2 frame/I=4

7.4 Segment Configuration

The patterns for hierarchical transmission are shown below.

Table 7-6 Segment Configuration during Hierarchical Transmission

Pattern	Layer	Number of Segments	Modulation and Error Correction Type
(1)	A	13	a
(2)	A	13	b
(3)	A	1 (Partial reception)	c
	B	12	a
(4)	A	8 to 2	b
	B	5 to 11	a
(5)	A	1 (Partial reception)	c
	B	12	b
(6)	A	1 (Partial reception)	c
	B	7 to 1	b
	C	5 to 11	a

7.5 How to Change Transmission Parameters

Transmission parameters, more specifically, the carrier modulation method, convolution coding rate, time interleaving length and number of segments, are transmitted in the TMCC information described in Section 3.15.6 in Chapter 3 of ARIB STD-B31. To change these transmission parameters, the transmission parameter switching index described in Section 3.15.6.2 in Chapter 3 of ARIB STD-B31 should be used (For more specific procedures, see Section 7.8.2).

When switching transmission parameters including the mode and guard interval ratio, it is desirable to pay consideration for minimizing the effect on receiver units by switching the transition parameter.

7.6 Transmission Delays

The transmission delays caused in the part of channel coding for digital terrestrial television broadcasting are shown below as a guide. For more information, see Table A1-2 of Reference 1 of ARIB STD-B31.

Table 7-7Upper Limits of Transmission and Reception Delay Time in the Part of Channel Coding (Examples of Estimates)

Mode	Time Interleave	Number of Delayed Frames	Delay Time [ms]		
			Guard Ratio 1/4	Guard Ratio 1/8	Guard Ratio 1/16
Mode 2	I=2	4 frames	514.1	462.7	-
	I=4	5 frames	642.6	578.3	-
	I=8	7 frames	899.6	809.7	-
Mode 3	I=1	4 frames	1028.2	925.3	873.9
	I=2	4 frames	1028.2	925.3	873.9
	I=4	5 frames	1285.2	1156.7	1092.4

7.7 TS Remultiplexing

7.7.1 Provisions Regarding TS Remultiplexing

TS remultiplexing is performed by the TS remultiplexer shown in Fig. 3-2 of ARIB STD-B31. This function is designed to configure multiplex frame structures necessary for transmitting TS to the OFDM modulator.

7.7.2 Remultiplexed TS Structure

(1) A specific example of how packets are arranged when the TS is remultiplexed is shown below. This is based on the segment construction model.

Example:

mode 3, GI 1/8, QPSK (1/2) x 1 segment (Layer A) + 64QAM (7/8) x 12 segments (Layer B)

Notes:

. In each frame, 1152 packets are repeatedly transmitted four times as shown below.
. A and B respectively represents the TS packet in each layer and N represents the null packet.
. The numerical values are the location indices.

```
     0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8
     +------------+------------+-------------+------------+------------+------------+------------+-----------
0000:BBBBBBBBBBBBBBNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBB
0080:BBNNNNNNABBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNNBBB
0160:BBBBBBBBBBBBNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBB
0240:NNNNNNNNBBBBBBBBBBBBBBBNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNNBBBBB
0320:BBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBBNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNBBBBBBBBBBBBBBNNN
0400:NNNNNBBBBBBBBBBBBBBBBNNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNABBBBBBB
0480:BBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNN
0560:NNNABBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNNBBBBBBB
0640:BBBBBBNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNN
0720:NNBBBBBBBBBBBBBBBBNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBB
0800:BBBBNNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNABBBBBBBBBBBBBBBNNNNNNNN
0880:BBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNABBBBBBBBBBBB
0960:BBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBNNNNNNNABB
1040:BBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBBBNNNNNNNNBBBBBBBBBBBBBB
1120:BNNNNNNNABBBBBBBBBBBBBBBBNNNNNNNN
```

(2) The PCR should be added again based on the locations of the TS packets with the multiplex frame structure during remultiplexing.

(3) The TS packets which contain the PCR to be referenced by the partial reception service should always be present in the same locations in the frame.

7.8 Use of TMCC

For more information on the TMCC signal, see “3.15 TMCC Signal” in Chapter 3 of ARIB STD-B31.

7.8.1 System Identification

The two bits for system identification should always be set to “00.”

7.8.2 Switching of Transmission Parameters

(1) To switch transmission parameters, more specifically, parameters that can be manipulated by the TMCC information (the carrier modulation method, convolution coding rate, time

interleaving length and number of segments), a countdown of the four-bit transmission parameter switching index should be done.

(2) If no changes to these transmission parameters are necessary, the transmission parameter switching index is set to “1111” and a countdown by one for each frame takes place, starting from the 15th frame prior to switching. New parameters begin when the index, after reaching “0000”, is set to “1111” again.

(3) The next parameters use the values changed before a countdown starts. No changes to current or next parameters should take place during a countdown.

(4) The moment the transmission parameter switching index is set to “1111”, the next parameter becomes the current parameter.

(5) The changes to the current parameters made up to immediately before a countdown starts become valid in the next parameters.

(6) If no changes to the current parameters take place, a countdown does not start.

(7) The problems with the receiving environment or problems met by senders make it impossible to receive the transmission parameter switching index, which performs a one-by-one countdown. If parameters have been changed despite the presence of such problems, the receiver units obtain the TMCC information again and operate in accordance with the current values obtained. Until correct values are obtained, the receiver units are not guaranteed to work properly.

7.9 Use of Emergency Warning Broadcasting (Emergency Warning System (EWS))

7.9.1 Transmission of Emergency Warning Broadcasting

The following steps should be used to start and stop the EWS.

(When starting the EWS)

(1) The Emergency Information Descriptor that specifies EWS conditions (start_end_flag, the classification of Type 1 and Type 2, and region code) should be carried in the PMT.

(2) Broadcasting companies should set the start flag for emergency warning broadcasting in the TMCC signal to 1 for transmission.

(3) Contents that can be recognized as emergency warning broadcasting should be used to start the broadcasting.

(When stopping the EWS)

(1) The start flag for emergency warning broadcasting should be set to 0 for transmission.

(2) The Emergency Information Descriptor should be deleted from the PMT.

7.9.2 How to Handle the Start Flag for Emergency Warning Broadcasting in the TMCC Signal

Senders should keep the start flag for emergency warning broadcasting in the TMCC signal set to 1 while emergency warning broadcasting is provided on a channel carried by the TS (network) under the emergency warning system, regardless of the transmission layer in which the service that provides the EWS is carried. The receiver units with automatic startup function periodically monitor the start flag for emergency warning broadcasting in the TMCC signal.

7.9.3 Multiplexing Locations of the Emergency Information Descriptor

The Emergency Information Descriptor should be included in the first descriptor's loop of the PMT for the emergency warning broadcasting service. In order to clearly indicate that the emergency warning broadcasting is being provided for EWS-compatible receiver units, it is mandatory to include this descriptor in the PMT for the emergency warning broadcasting service. It is up to each broadcaster as to which PMT (or which service) to use to include the Emergency Information Descriptor. Please note that when services in different layers are described, they may be ignored on receiver units.

Table 7-8 PMT Used to Include the Emergency Information Descriptor

	PMT for the non-emergency warning broadcast on a service carried by the TS (network) under the emergency warning system	PMT for the emergency warning broadcast
Whether or not to include the Emergency Information Descriptor	Optional	Mandatory

7.9.4 Modification of the Information in the Emergency Information Descriptor

If a necessity to change the information (for example, the area code) in the Emergency Information Descriptor arises during emergency warning broadcasting, the procedure to end the EWS should be performed (which specifically involves setting the start flag for emergency warning broadcasting in the TMCC signal to 0 and deleting the Emergency Information Descriptor from the PMT). Then, after inserting the modified Emergency Information Descriptor into the PMT, the start flag for emergency warning broadcasting in the TMCC signal should be set to 1 again. Alternatively, the start flag for emergency warning broadcasting in the TMCC signal should be set to 0, and then, after modifying the information while the Emergency Information Descriptor remains in the PMT, the same flag should be set to 1.

In either case, the duration from when the start flag for emergency warning broadcasting is set to 0 to when the same flag is set to 1 should be a minimum of one second (if the length of the 4 OFDM frame is less than one second) and four OFDM frames (if the length of the 4 OFDM frame is more than one second). The receiver units continuously perform ESW processes for 90 seconds after the start flag for emergency warning broadcasting switches to 0 (See 6.11.4 Reception of Emergency Warning Broadcasting (under the Emergency Warning System (EWS)) in Vol. 2). To change, for example, the target area, without ending the EWS processes, therefore, the broadcaster should switch the start flag for emergency warning broadcasting to 1 within 90 seconds.

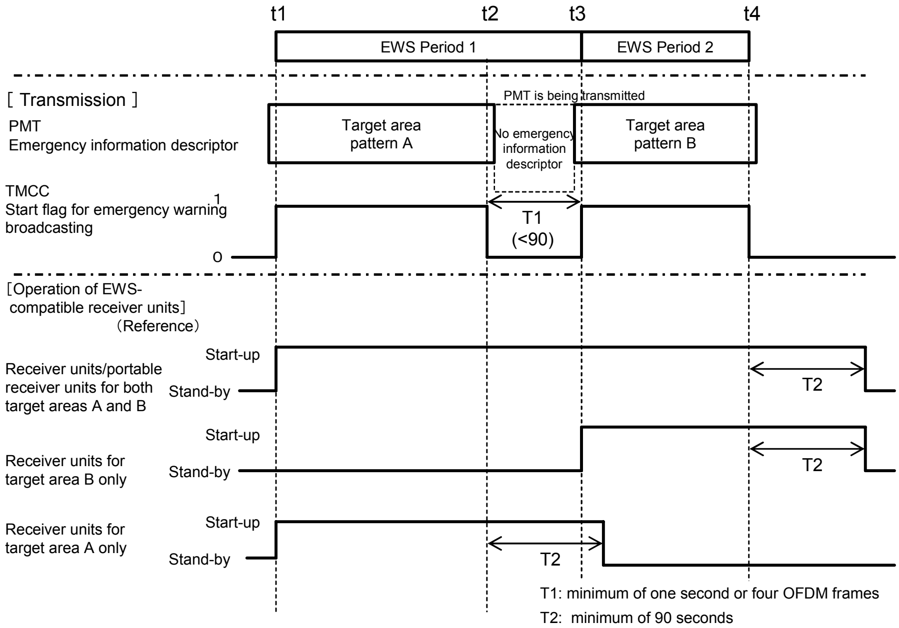


Figure 7-1 Modification of the Emergency Information Descriptor and An Example of Operation of the Receiver Unit

7.9.5 Use of Emergency Warning Broadcasting Test Signals

During the test emergency warning broadcasting, the start_end_flag value in the emergency information descriptor should be set to 0 (meaning an end) from the beginning. During the test broadcasting period, the descriptor should continuously be included in the PMT. After the end of the test broadcasting, when the start flag for emergency warning broadcasting in the TMCC signal switches to 0, the emergency information descriptor should be deleted from the PMT.

7.10 Use of the AC (Auxiliary Channel)

The AC can be used by broadcasting companies as the transmission path to carry the additional transmission control related information. It is up to each broadcasting company as to how the AC should be used. The receiver units should not decode the AC for output.

8 Operation

8.1 Hierarchical Transmission

The purpose of hierarchical transmission is to perform transmission using the channel coding system that suits the characteristics of each service when a single TS carries multiple services. Hierarchical transmission should be operated as explained below.

8.1.1 TS Structure during Hierarchical Transmission

(1) TS packets with the same PID should be carried in the same layer.

(2) When providing scrambled services, the ECM should be carried in the same layer as the PMT or in the layer with a higher resistance to interference.

(3) The PCR should be transmitted in the same layer as the ES (which references the PCR) or in the layer with a higher resistance to interference.

(4) The PAT should be transmitted in the layer with the highest resistance to interference (but not in the partial reception layer). However, the PAT should also include the description of services provided in the partial reception layer.

(5) The NIT, CAT, TOT, SDT and BIT should be transmitted in the layer with the highest resistance to interference (Layer A).

(6) For more information on the hierarchical transmission of the PMT, see Section 8.1.2 and Section 8.1.3.

(7) The transmission layer the SDTT and CDT are shown in Table 8-1 (for more information, see Section 5.1 in Vol. 1 of this document.)

(8) The transmission layer of the EIT is shown in table 8-2. (For more information, see 13.1 in Vol. 4 of this document.)

(9) Regarding partial reception services, it is desirable not to frequently change the ES structure of each service and the PID value of each component. If changes are necessary, the following matters should be taken into consideration.

The post-change PID value should not be the same as the PID value used for components, carousels or sections with different stream type identifiers. This also applied to other services in the same TS. However, if the use of the same PID values is unavoidable, it is desirable that a sufficient time period should be set in between.

It is desirable that the PID value used prior to the change be not used for components of other services although the components have the same stream type identifier.

If there is no change to the default ES when the number of ES' increases or decreased (when there is no change to the description of the ES loop in the default ES of the PMT), it is desirable that the PID value of the default ES will remain unchanged.

Table 8-1 SDTT and CDT Transmission Layers

Pattern	Layer	Number of Segments		SDTT		CDT
				SDTT for low protection layer	SDTT for high protection layer	
(1)	A	13	Fixed	O	O	O
(2)	A	13	Mobile	O	O	O
(3)	A B	1 12	Portable Fixed	X O	O X	X O
(4)	A B	8 to 2 5 to 11	Mobile Fixed	X O	O X	X O
(5)	A B	1 12	Portable Mobile	X O	O X	X O
(6)	A B C	1 7 to 1 5 to 11	Portable Mobile Fixed	X X O	O X X	X X O

O: Means that the data can be transmitted.　X: Means that the data cannot be transmitted.

Table 8-2 Transmitting Layer of the EIT

Pattern (1)

Service layer \ Segment configuration	Layer A (Low protection layer)
Low protection layer	Service layer H-EIT (Basic)

Pattern (2)

Service layer \ Segment configuration	Layer A (Low protection layer)
Low protection layer	Service layer M-EIT (Basic) H-EIT (Extended)

Pattern (3)

Service layer \ Segment configuration	Layer (A High protection layer) (Partial reception layer)	Layer B (Low protection layer)
High protection layer (Partial reception layer)	Service layer L-EIT (Basic) M-EIT (Extended)	H-EIT (Extended)
Low protection layer		Service layer H-EIT (Basic)

Pattern (4)

Service layer \ Segment configuration	Layer A (High protection layer)	Layer B (Low protection layer)
High protection layer	Service layer M-EIT (Basic)	H-EIT (Extended)
Low protection layer		Service layer H-EIT (Basic)

Pattern (5)

Segment configuration / Service layer	Layer A (High protection layer) (Partial reception layer)	Layer B (Low protection layer)
High protection layer (Partial reception layer)	Service layer L-EIT (Basic)	M-EIT (Extended) H-EIT (Extended)
Low protection layer		Service layer M-EIT (Basic) H-EIT (Extended)

Pattern (6)

Segment configuration / Service layer	Layer A (High protection layer)	Layer B (Middle protection layer)	Layer C (Low protection layer)
High protection layer	Service layer L-EIT (Basic)	M-EIT (Extended)	H-EIT (Extended)
Middle protection layer		Service layer OM-EIT (Basic)	H-EIT (Extended)
Low protection layer			Service layer OH-EIT (Basic)

The shaded cells in the table above indicate the absence of Extended delivering EIT type (transmission is not possible).

8.1.2 Component Arrangement Patterns during Hierarchical Transmission

Based on the transmittion layer of a group of components constituting a service (arrangement methods), the three basic patterns shown below are available for classification.

[Condition 1] Transmission of a group of components constituting a service entirely in the same layer

This pattern is used to transmit a group of components constituting a service entirely in the single layer. Since the group of components described in the PMT is transmitted entirely in the same layer, a service can be made available through the reception of a single layer. Since the partial reception service (which refers to the service intended for reception by narrowband receiver units that can receive only the partial reception layer) should be made available using only the partial reception layer, transmission according to [Condition 1] should be used for partial reception service.

[Condition 2] Transmission of a group of components constituting a service in multiple layers (Part 1: When inserting the Hierarchical Transmission Descriptor in the PMT)

This pattern is used, for example, to make step-by-step changes in service quality such as video quality according to the reception conditions and to receive only the audio component of a service comprised of video and audio components when the reception conditions are poor. For example, a high quality video stream with a high bit rate may be carried in the low protection layer and a low quality video stream with a low bit rate may be carried in the high protection layer. If the receiver units, depending on the reception conditions, are no longer able to receive the low protection layer , they can automatically switch to the high protection layer to receive the same video stream at a reduced quality level.

[Condition 3] Transmission of a group of components constituting a service in multiple layers (Part 2: When allowing a group of PMTs placed in multiple layers to reference a single ES (When not inserting the Hierarchical Transmission Descriptor))

This pattern is used to define, in multiple layers, services comprised of identical ES': for example, to allow one PCR to be referenced from multiple services (services transmitted in multiple different layers) and to allow the same audio stream to be referenced from the service transmitted in the low protection layer and from the service transmitted in the high protection layer (the audio stream is transmitted in the high protection layer). While [Condition 2] refers to the transmission of a group of components constituting a service in multiple different layers, [Condition 3] refers to the transmission of services (PMTs) (using identical ES') to be selected by viewers in multiple different layers.

A conceptual diagram of how layers are configured for different conditions is shown in Fig 8-1.

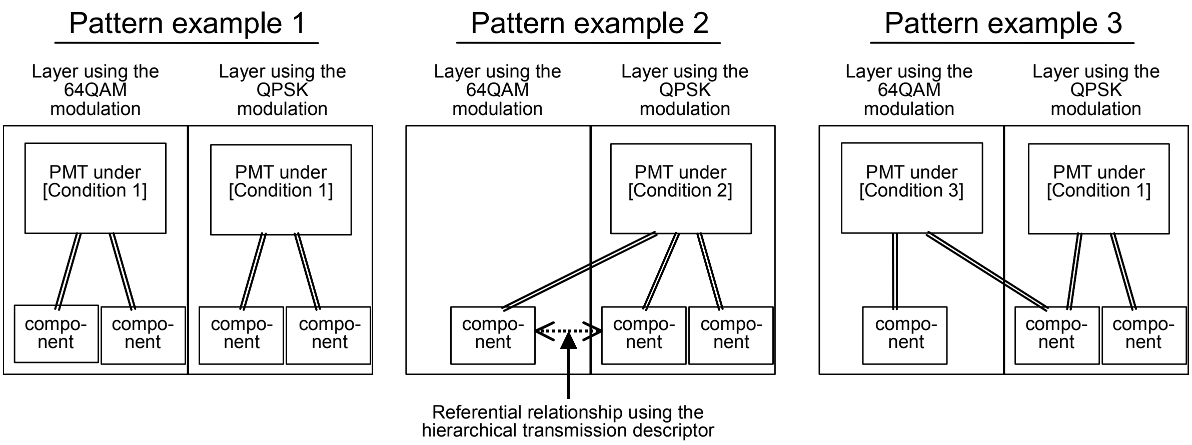


Figure 8-1 Conceptual Diagram of How Layers are Configured for Different Conditions

If, under [Condition 2] and [Condition 3], different time interleaving lengths are used in multiple different layers that transmit a group of components constituting a service, a delay occurs during reception. Therefore, to place components across multiple different layers, it is important for all layers concerned to use the same time interleaving length.

8.1.3 PMT Transmission Layers during Hierarchical Transmission

PMT transmission layers under conditions 1 to 3 mentioned in Section 8.1.2 are shown in table 8-3.

Table 8-3 PMT Transmission Layers

Condition	PMT Transmission Layer
Condition 1	The PMT is transmitted in the same layer as the layer carrying the group of components referenced.
Condition 2	The PMT is transmitted in the layer with the highest resistance to interference among all layers carrying the group of components referenced.
Condition 3	The PMT is transmitted in the layer with the lowest resistance to interference among all layers carrying the group of components referenced.

Under Condition 1, the PMT should be transmitted in the same layer as the layer carrying the group of components constituting a service. Particularly when using narrowband receiver units (partial receiver units), they can only receive the partial reception layer. It is, therefore, necessary to transmit the PMT for the partial reception service in the partial reception layer.

Under Condition 2, it should be made sure that the PMT be received even under difficult reception conditions (for example, when only the high protection layer can be received among multiple different layers collectively carrying a group of components). It is therefore essential that the PMT is transmitted in the layer with the highest resistance to interference among all layers used for transmitting components. Since incompatibility occurs between the components described in the PMT and the components that can actually be received depending on the reception conditions, it is necessary to insert the Hierarchical Transmission Descriptor in the PMT to allow the receiver units to detect transmission problems and deterioration of reception conditions. Incidentally, the Hierarchical Transmission Descriptor can define a referential relationship across a maximum of two layers; it cannot define a referential relationship across three layers.

Under Condition 3, it should be made sure that all components described in the PMT be received. This means in other words that the PMT can be transmitted in the layer with the lowest resistance to interference among all the layers collectively carrying a group of components; if the PMT can be received, all the components described in the PMT can be received.

Table 8-4 shows specific combinations of layers transmittion layer components and the layer for transmitting the PMT under Condition 2 and Condition 3.

Table 8-4 Combinations of ES Transmission Layers and the PMT Transmission Layer

Condition	Combina-tion	ES Transmission Layer			PMT Transmission Layer		
		Low protection layer	Middle protection layer	High protection layer	Low protection layer	Middle protection layer	High protection layer
2	a	O	O			O	
	b	O		O			O
	c		O	O			O
3	d	O			O		
	e		O			O	
	f	O	O		O		
	g			O			O
	h	O		O	O		
	i		O	O		O	
	j	O	O	O	O		

8.1.4 Use of Condition 2

Digital terrestrial television broadcasting should not use Condition 2 (which involves inserting the Hierarchical Transmission Descriptor in the PMT) as a pattern for placing components.

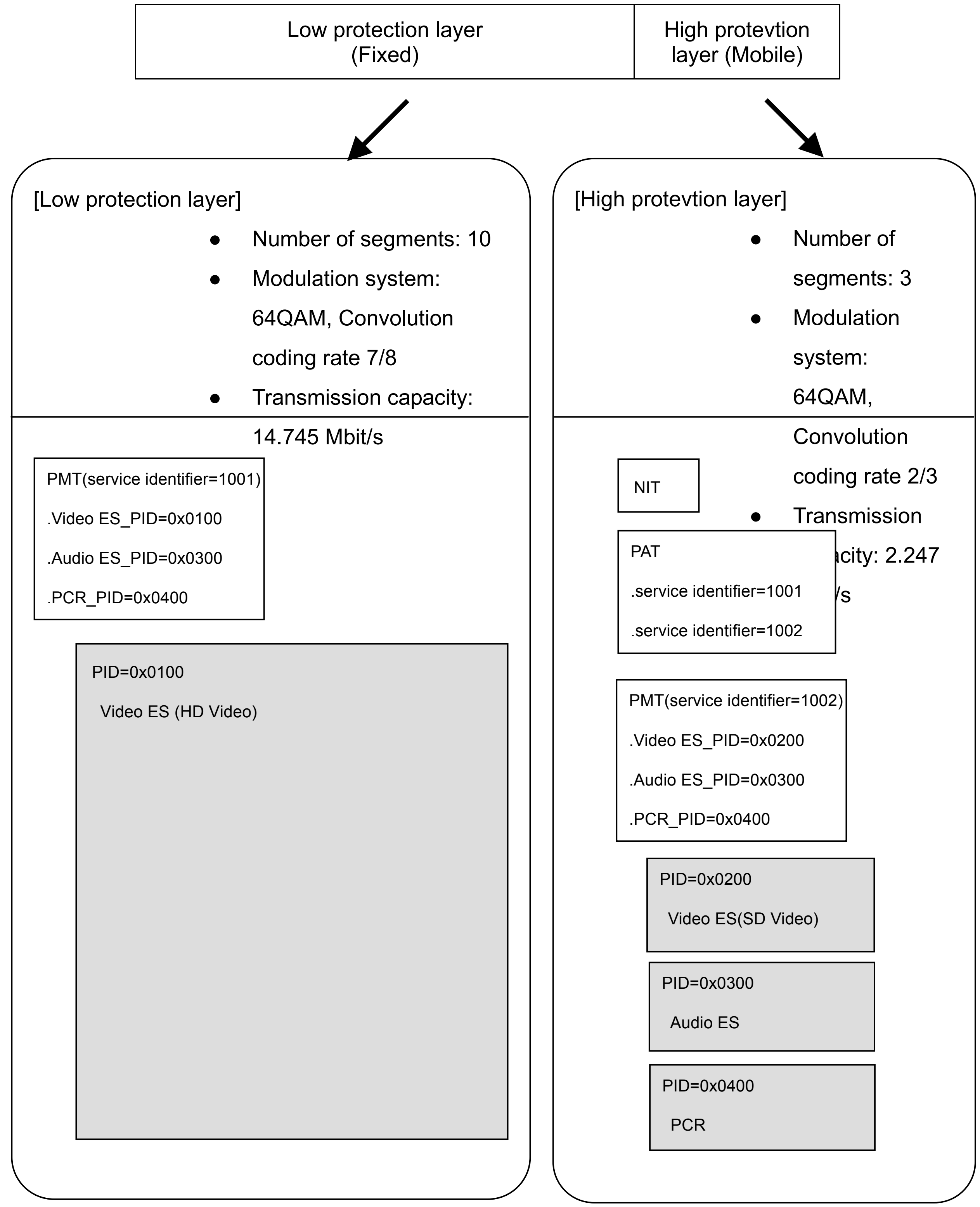
8.1.5 Examples of Placing Components and the PMT under Condition 3

The use of Condition 3 allows the sharing of the same component constituting multiple services in different styles carried in layers other than the partial reception layer. For example, to simultaneously broadcast a program using multiple different layers of different quality, transmitting audio, data and PCR components only in the High protection layer can improve efficiency in terms of transmission capacity, instead of transmitting these same components in each layer.

Case 1 (The provision of the fixed and mobile reception services is assumed)

[Segment Configuration]

mode=2, GI=1/4



[Purpose of transmission (An example)]

When broadcasting the same program on multiple services simultaneously, a modulation system that allows the transmission of a large amount of information should be used for fixed receiver units to broadcast high definition video and a modulation system suited for mobile reception should be used for mobile receiver units to broadcast standard definition video. However, in order to improve the transmission efficiency (by increasing the amount of high definition video information), the audio and PCR should be transmitted only in the layer intended for mobile reception and the fixed and mobile services should reference the same audio ES_PID.

[Operation examples of receiver units]

(1) Fixed receiver units

Since fixed receiver units are able to receive both the High protection layer and Low protection layer, they can receive services whose service identifier is set to 1001 and to 1002.

- When selecting a service whose service identifier is set to 1001
  The high definition elementary video stream (PID=0x0100) transmitted in theLow protection layer and the elementary audio stream (PID=0x0300) transmitted in the High protection layer are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer.
- When selecting a service whose service identifier is set to 1002
  The standard definition elementary video stream (PID=0x0200) transmitted in the High protection layer and the elementary audio stream (PID=0x0300) transmitted in the High protection layer are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer .

(2) Mobile receiver units

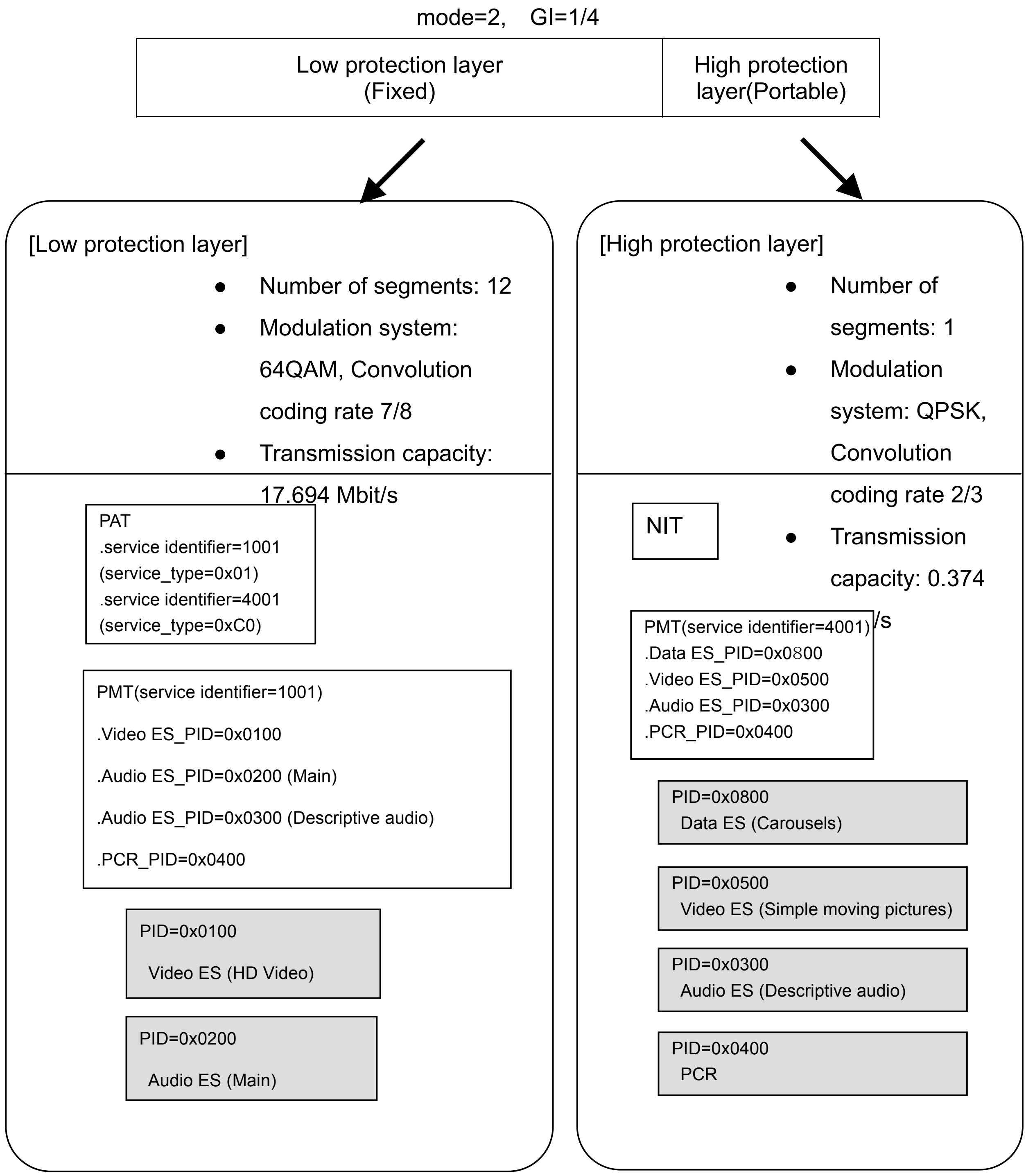
Since mobile receiver units are basically able to receive only the High protection layer , they cannot obtain the PMT for the service whose service identifier is set to 1001 but can only receive service whose service identifier is set to 1002.

- -When selecting a service whose service identifier is set to 1001
  Since the PMT cannot be obtained, a message to the effect that reception is not possible is displayed.
- -When selecting a service whose service identifier is set to 1002
  The standard definition elementary video stream (PID=0x0200) transmitted in the High protevtion layer and the elementary audio stream (PID=0x0300) transmitted in

the layer using the QPSK modulation are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer.

Case 2 (The provision of the fixed and portable reception services is assumed)

[Segment Configuration]



[Purpose of transmission (An example)]

When broadcasting the same program on multiple services simultaneously, a modulation system that allows the transmission of a large amount of information should be used for fixed receiver units to broadcast high definition video and main audio stream and a descriptive audio, which can be regarded as a program on its own, should be transmitted to portable (partial) receiver units. However, in order to also allow fixed receiver units to receive the descriptive audio for listening, it should be ensured that services intended for fixed reception can switch to the elementary audio stream to reference the audio in the partial reception layer.

[Operation examples of receiver units]

(1) Fixed receiver units

Since fixed receiver units are able to receive both the High protection layer and the Low protection layer, they can receive services whose service identifier is set to 1001 and to 4001.

- When selecting a service whose service identifier is set to 1001
  The high definition elementary video stream (PID=0x0100) and the elementary audio stream (PID=0x0200: main audio stream) transmitted in the Low protection layer are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer. The switching of elementary audio streams enables the switching between the main audio stream (PID=0x0200) and descriptive audio (PID=0x0300: transmitted in the High protection layer).
- When selecting a service whose service identifier is set to 4001
  The reduced moving picture and the elementary descriptive audio stream (PID=0x0300), which are referenced by the BML contained in the elementary data stream (PID=0x0800) transmitted in the High protection layer, are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer.

(2) Portable (partial) receiver units

Since mobile receiver units are able to receive only the High protection layer, they cannot obtain the PMT for the service whose service identifier is set to 1001 but can only receive service whose service identifier is set to 4001.

- Since the PMT cannot be obtained when selecting a service whose service identifier is set to 1001, a message, for example, to the effect that reception is not possible is displayed.
- When selecting a service whose service identifier is set to 4001
  The reduced moving picture and elementary descriptive audio stream (PID=0x0300), which are referenced by the BML contained in the elementary data stream

(PID=0x0800) transmitted in the High protection layer are decoded based on the PCR (PID=0x0400) transmitted in the High protection layer.

8.2 Use of Multiple Video Formats

8.2.1 Simultaneous Use of Multiple Video Formats

(1) Multiple different video formats such as high definition and standard definition video formats can be simultaneously used in a single TS.

(2) The high definition video and multiple standard definition videos that can be simultaneously broadcast should have different service identifier and each service should be independent. However, when using the multi-view mode to broadcast multiple standard definition channels, these channels are related to each other as the main channel and sub-channels. In this case, broadcasting using only one service identifier is possible.

(3) The same component can be used by using multiple service identifier. For more information on this, see Chapter 17 – Event Sharing in Vol. 4.

8.2.2 How to Switch between Video Formats

(1) It is desirable that when switching between different video formats with same service identifier, they can be switched between seamlessly. Regarding how to perform seamless switching, see Chapter 4 – Seamless Switching in Appendix of Part 1 of ARIB STD-B32.

(2) With regard to switching between different video formats, it is desirable to implement certain processing to prevent, for example, image fading and freezing and black frame insertion, to reduce the impairing effect on the image display.

8.3 Special Service

8.3.1 Service Image

Concurrently with pre-programmed services, special service using service identifier, which is not used during normal operation. A specific example of this is an breaking news service. The breaking news service or other similar services are broadcast by reducing the bit rate of the pre-programmed service (which is continuously broadcast) and setting up new temporary service identifier using the marginal bandwidth that has become available.

8.3.2 Differences between the Special service and Regular Service

Differences between the special service and regular service are listed below.

- The special service is defined as the service not regularly broadcast or scheduled, whose service_type on the NIT is set to 0xA1 or 0xA3.

- The regular service is defined as the service regularly broadcast. Unless during the maintenance period or late night service suspension period, regular services are almost always provided. The regular service is defined by service_type other that for the special service on the NIT.

8.3.3 Use of Special service

The content of this chapter is applied to services other than the ones transmitted in the partial reception layer. Special services are not transmitted in the partial reception layer.

(1) How to Handle service identifier

The service identifier for the special service should be set within the range of service identifier values assigned to each broadcasting company. The service identifier for the special service should be indicated in the service list descriptor in the NIT and in the service descriptor in the SDT.

(2) Number of special services

Regardless of the layer type, the number of special services of the same type that can be carried in each TS should be a maximum of two.

(3) Unit of broadcasting the special service

The special service should be broadcast one at a time. Multiple time-sequential events should not be broadcast as a special service .

(4) Start of the special service

After the start of multiplexing for the special service, the PAT should be updated immediately so that receiver units can recognize the start of the special service.

(5) Notification of the start of the special service

The notification of the start of the special service is made to viewers, for example, using superimpose or an announcement during a program. (Switching to the special service should be done by the viewers.)

(6) Notification that a special service is being broadcast

It is desirable that the special service is broadcast in such a way that viewers who have switched from another service, while the special service is being broadcast, can recognize that special service.

(7) Transmission of the EIT

The EIT [p/f] can be transmitted for the special service event. However, the EIT [schedule] cannot be transmitted. For more information, see Chapter 23 in Vol. 4.

(8) End of the special service

When the special service ends, the service identifier of the special service should be deleted from the PAT. When the special service ends, the rate is restored to the original rate prior to the start of the service. However, with regard to the temporal data service, when the service ends, the PMT may be lost while the service description remains in the PAT.

(9) Example of broadcasting a special service

The change in the service when the special service is programmed is shown in Fig. 8-2.

.

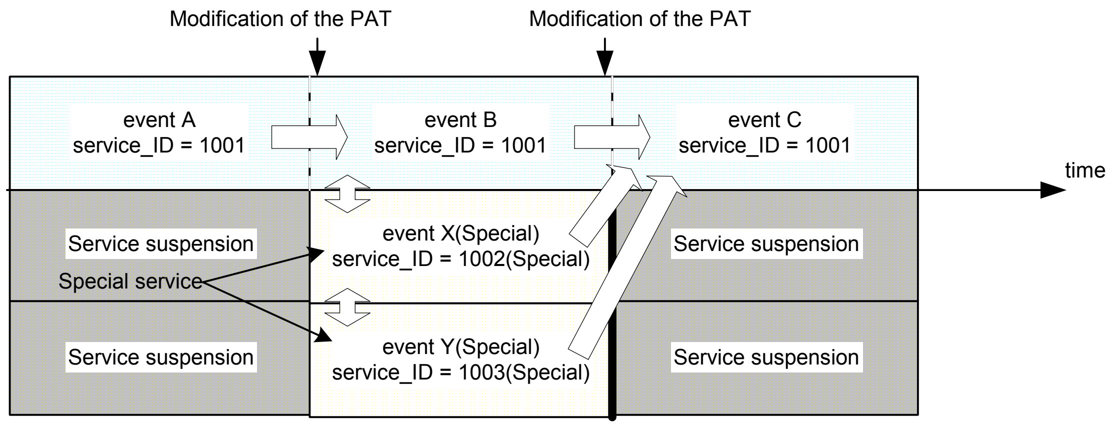


Figure 8-2 An Example of Broadcasting Special services (One Regular Service and Two Special services)

8.3.4 Implementation of Event Relays Using the Special service

When a live broadcast does not end at the scheduled time, the bit rate of the regular event scheduled to be broadcast next may be reduced to make marginal bandwidth available to set up service identifier to continuously broadcast the live broadcast.

In this case, SI can be used to perform relay recording, which means continuous recording of the event first as a regular service and then as a special service. For more information on this operation, see “8.5 Event Relays.” There are following restrictions to this kind of event relay compared to the event relay involving only regular services.

The end of an event relay should be indicated by the disappearance of the service from the PAT.

A further event relay from a special service should be disabled.

8.4 Multi-view Television

8.4.1 Service Image

The multi-view mode (MVTV) is defined as simultaneous broadcasting of related contents in one service using multiple (at a maximum of three) standard definition TV channels.

One specific example is a golf program; a group of three components may be used, the main component (regular video and audio broadcast), sub-component 1 (the video and audio broadcast of the17th hole) and sub-component 2 (the video and audio broadcast of the 18th hole). In this case, when the program starts, the video and audio of the main component are displayed, but after that, it is up to each viewer to switch among the main component, sub-component 1 and sub-component 2 for display.

The content of this chapter is applied to services other than the ones transmitted in the partial reception layer. Multi-view TV is not provided in the partial reception layer

8.4.2 Requirements for MVTV

(1) There should be clear difference among multiple standard definition TV channels: one is regarded as the main channel and the other are regarded as sub-channels.

(2) When a MVTV program starts, the main channel should appear first and automatic switching to the main channel should take place when the program ends.

(3) Basic attributes of the video mode (such as the video coding parameter) should be the same in all components in multi-view mode.

(4) Digital VTRs should be able to record all components grouped but analog VTRs will do if they can record only the video and audio displayed.

(5) It is not mandatory to install a function to simultaneously display multiple standard definition TV channels.

(6) Processing by event is a prerequisite for MVTV broadcasts. No starting/ending should take place in the midst of an event.

(7) The main channel and sub-channels in multi-view mode should be carried in the same layer.

8.4.3 How to Run MVTV Programs

It is a prerequisite that same service identifier should be used for multiple elementary video streams.

<Conditions for running MVTV programs>

(1) In multi-view mode, the EIT [p/f] should always contain component_group_descriptor with component_group_type set to ‘000’. The main and sub components should be identified by component_group_descriptor.

(2) The ES given the component tag value of the default ES should be placed as the main channel. The tag value should be described in the loop of component_group_id set to ‘0x0’ in the component_group_descriptor.

(3) One video stream should be present in each component_group.

<Start of the service>

(1) Sub-streams should be generated and multiplexed, and when the PMT version-up occurs, the service starts.

(2) The main channel should be indicated by the default ES when the service starts.

(3) The notification of the start of the service should be made to viewers, for example, using superimpose or an announcement.

(4) If component_group_descriptor cannot be obtained, for example, within a few seconds from the start of the broadcast, switching by group cannot be done and video and audio components should be separately switched.

(5) Switching between the main channel and sub-channels should be done manually by each viewer, using the video button (or a similar function) on the remote controller.

(6) The EPG should be able to display a message to the effect that a MVTV broadcast is now running.

(7) For more information on the use of caption in multi-view mode, see 5.2.6 (2) How to Handle the PMT and ES.

<End of the service>

(1) When an MVTV event ends, a shift should be made to the default video and audio streams of the next event.

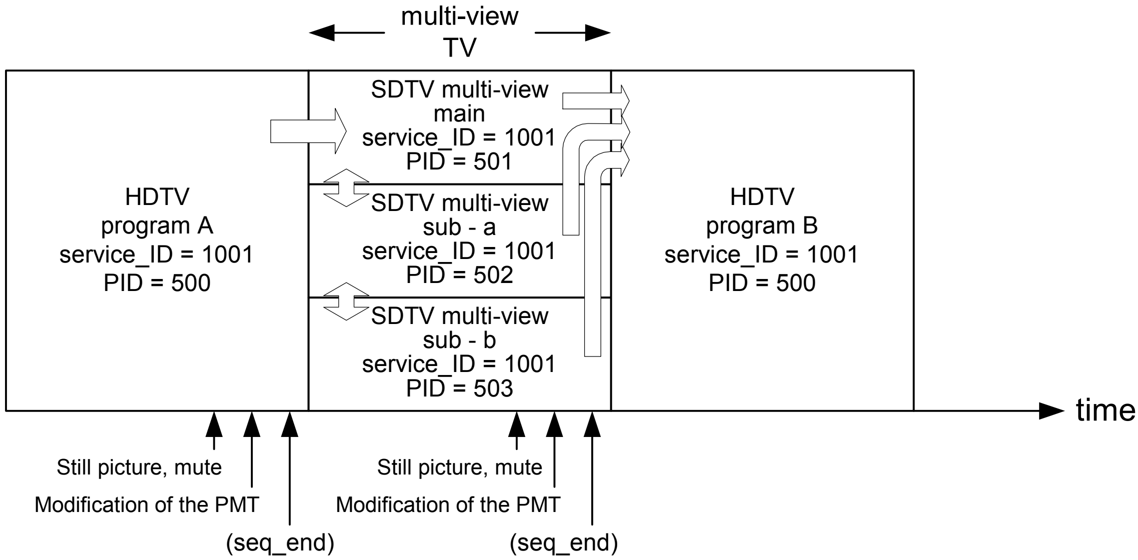


Figure 8-3 Use of MVTV (The Relationship between the Main Channel and Sub-channels is Defined by component_group_descriptor.)

8.4.4 Coexistence with Multiple service identifier

If multiple service identifier specify the same MVTV program when an event is shared, the PMT that has multiple ES' in each service identifier should be used.
component_group_descriptor should be applied to each service. How this works is shown in Fig. 8-4.

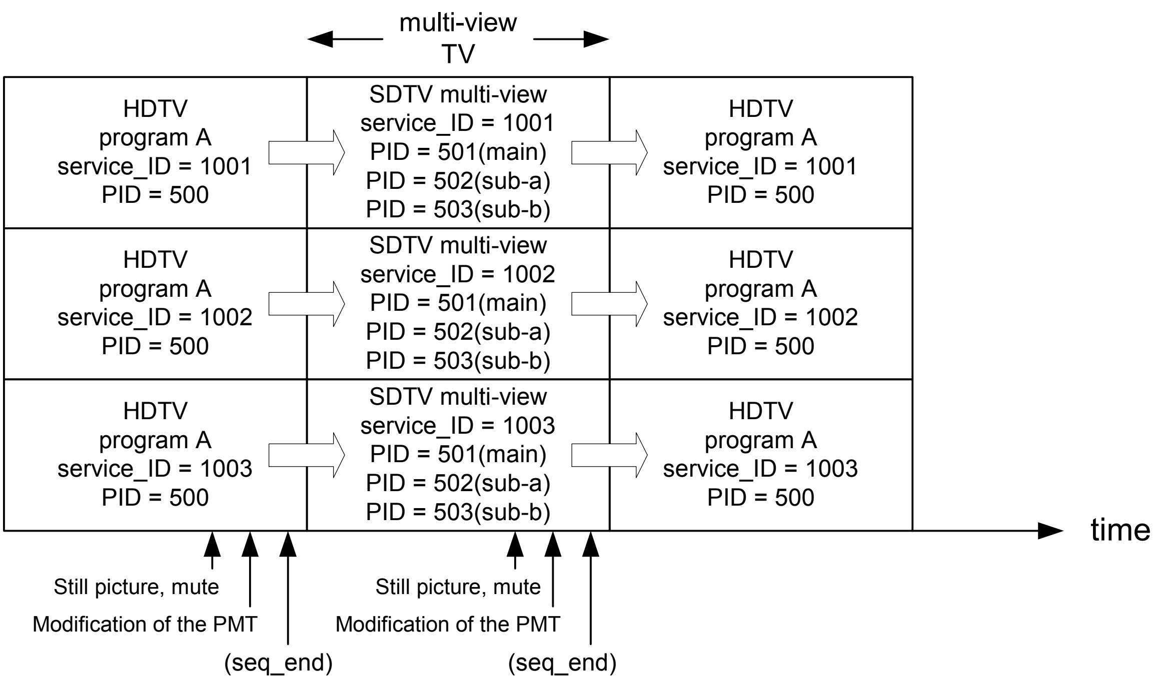


Figure 8-4 Coexistence of Multiple service identifier and MVTV

(Multiple ES' should be described in the PMT of each service and component_group_descriptor should define the relationship between the main channel and sub-channels.)

8.5 Event Relays

(1) General service information

To continuously broadcast the same program as another event, for example, the high school baseball tournament program (when it does not end at the originally scheduled time) or when a live broadcast program cannot end at the originally scheduled time, the broadcast program can continue by using a different service identifier that indicates that the program is extended one. In this case, relay recording is made possible, namely the sequential recording of the original event and another event regarded as a program extention.

(2) Event relay destination

The following can be regarded as program extention when using the event relay function.

- Different events with the same service identifier
- Events with a different service identifier
- Special service events

(3) Start of the service

The notification that after the end of the original event, a program extention is being broadcast will be sent to viewers using superimpose or an announcement during a program broadcast. Switching to another channel on which the same event is being broadcast should be done by individual viewers, who have received the notification.

(4) Start of relay recording

When an event for which the event relay function is enabled is scheduled for recording, receiver units should recognize based on the EIT [p/f] that the event relay function is on and automatically switch to another event constituting the relay destination when the original event ends.

(5) Use of recording compatible SI

When a target event has started, group_type of event_group_descriptor should be used for an event relay to automatically switch to the service constituting the relay destination for recording.The EIT [p/f] for an event relay should be transmitted at least 30 seconds prior to the service start time.

(6) End of relay recording

When recording the special service, receiver units should recognize the end of an event relay when PMT_PID disappears from the PAT. When this takes place, recording should end.

(7) Precautions regarding the start of relay recording

The receiver units so designed to enable event relays, when the original service event ends, switch to standby for the ES' that form the service constituting the relay destination. Switching from one service to another causes the beginning of the service that follows to be cut. It is therefore necessary, when a program starts, to use a still picture or no sounds. It is also necessary to transmit a message that allows viewers to understand the switching of services.

When an event relay that is accompanied by the change in the coding parameter takes place, such as the relay from a high definition TV event to a standard definition TV event, the recorders should change the parameters, and therefore seamless recording may not be possible.

(8) Event relays from a special service

When a special service ends, no further event relay should be allowed.

(9) Event relays among multiple TS'

Event relays among different TS' carried by the same terrestrial broadcaster should be allowed.

(10) Event relays during hierarchical transmission

To perform event relays during hierarchical transmission, it is desirable that relays are performed among the same type as mentioned in Table 3 in General Operation Information of Vol. 1. However, if the service areas of the relay source and relay destination are different, the service cannot be received. It is up to each manufacturer as to how receiver units are designed to solve this problem.

(11) Event relays in the partial reception layer

The partial reception layer does not become the relay source or relay destination.

Fig. 8-5 shows an example of changes in the event and EIT during the special service.

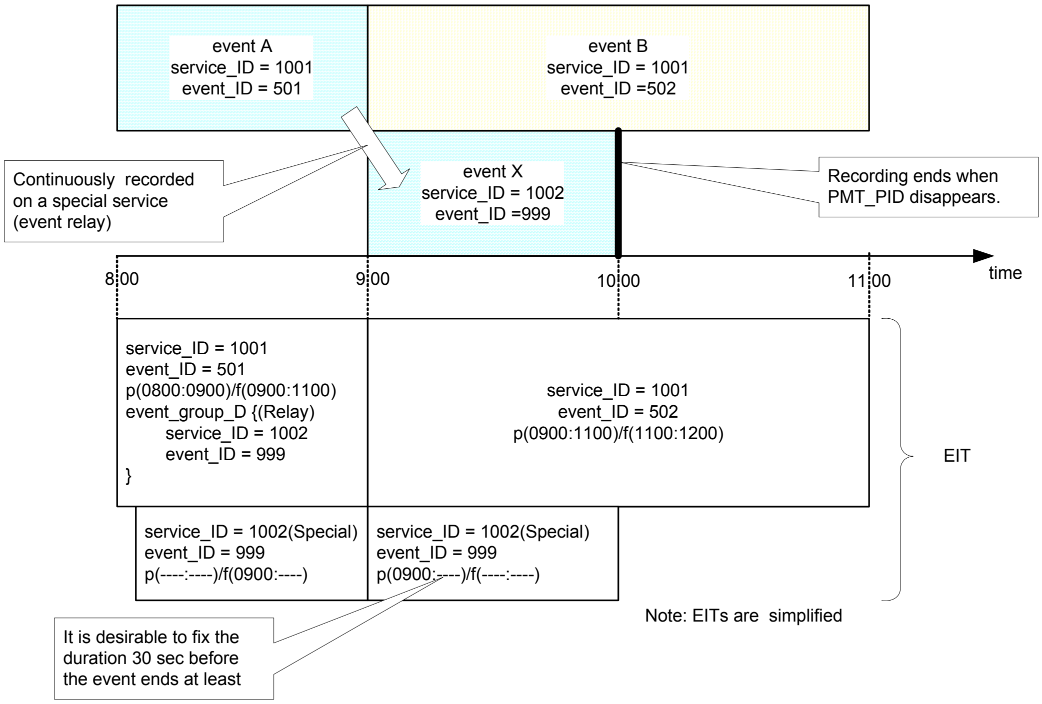


Figure 8-5 Event Relays Using the Special Service

8.6 How to Handle Broadcasting Suspensions

The use of PSI/SI regarding on/off service is as follows.

A valid PAT and PMT should be transmitted without fail to the service.

The service description in the SDT should not be changed depending on the broadcasting status (regardless of whether broadcasting is on/off service).

If all services in the relevant TS are suspended, the PAT should be emptied irrelevant to other PSI/SI.

Only when the media type of the service is data, the PAT contains PMT_PID. In this case, the state where no PMT is transmitted should be allowed (non-standard use of MPEG).

Broadcasting on/off service belongs to one of the status categories shown in Table 8-5 .

Table 8-5 Types of Broadcasting in Progress and Suspension

Status	Whether the NIT is in the TS	Whether the Description is Found in the Service List of the NIT	Whether the Target Service is Described in the PAT	Whether the PMT of the Target Service is Present	Remarks
Broadcasting in progress	Yes	Yes	Yes	Yes	Regular program broadcasting
Broadcasting in suspension	Yes	Yes	No	No	Should be possible in all services
	Yes	Yes	No	Yes	Should be possible in services other than the partial reception service. The PMT in this case is considered invalid.
	Yes	Yes	Yes	No	Should be possible only in data type services
No signal	No	No	No	No	RF only/ Suspension of radio waves

The receiver unit operations are assumed to be as follows.

The presence of a valid PAT and PMT indicates that broadcasting is in progress.

The SDT is not used to determine whether broadcasting is on/off service.

When the PAT is empty, all services in the relevant TS are considered suspended, irrelevant to other PSI/SI.

8.7 Use of the Clock

8.7.1 Absolute Delay Time

Absolute delay time in terrestrial digital broadcasting is considered to take place mainly due to:

(1) Delay along the transmission and relay line
(2) Delay caused by the encoder at senders
(3) Delay caused by the multiplexer
(4) Delay caused by the receiver unit (decoder)
(5) Delay caused by encoding and decoding over the terrestrial network

The absolute delay time is assumed to be a total of one second to several seconds. However, deviations occur associated with the types of equipments installed and parameter settings done by each broadcasting company. It is, therefore, important for each broadcasting company to have accurate information on the absolute delay time expected at their stations. The TOT should also be transmitted in a way so that the deviations from the JST (Japan Standard Time) are within ±500 ms when standard receiver units (which refer to receiver units assumed to directly receive radio waves from transmitting stations) receive inputs.

8.7.2 Event Issue Time (Such as Starting and Ending Time)

The senders should issue all events (broadcasts) according to the station clock. Events should not be issued earlier in consideration of the absolute delay time.

8.7.3 Time Superimpose and Time tone

To provide an on-screen time superimpose service or time tone service, it is desirable that senders transmit the data earlier in consideration of the absolute delay time to minimize as much as possible the difference with the correct time on receiver units.

8.7.4 Use of Simultaneous Analog Broadcasting

When transmitting analog programs simultaneously as digital programs or when transmitting digital programs simultaneously as analog programs, digital broadcasts experience a longer absolute delay time than analog broadcasts. Time tone in simultaneous mode, it is desirable that the data be transmitted in a way to take into consideration the delay time experienced by digital broadcasts.

8.7.5 Effective Screen Area (Time Superimpose Display Area)

The effective screen area should be determined in consideration of the 1035 lines monitor.

8.7.6 Summer Time Adjustment

Summer time adjustment should use the TOT to control the offset time. More specifically, while the time value equals the UTC time + 9 hours in normal times, Local_time_offset_descriptor with an offset value should be inserted in the TOT for transmission when summer time applies.

Incidentally, whether or not to change the station system clock depends on each station.

8.8 Caption and Superimpose

8.8.1 General Matters

(1) The caption and superimpose should be available; the former is used during programs and the latter is used for up-to-the-minute news.

(2) The caption display area (effective display area) should be as specified in Section 8.7.5.

(3) Regarding the character type, font, size and color, they should be used for transmission in consideration of restrictions on the display capability of receiver units.

8.8.2 Caption

(1) The caption should be transmitted using the independent PES system and synchronized with the program.

(2) The caption should be displayed when selected to do so by receiver units.

(3) A maximum of two languages should be handled and transmitted by one ES.

(4) In principle, when the caption is transmitted, the PID of the elementary caption stream should be described on the PMT but can also remain always described on the PMT. For more information on how to handle the caption in multi-view mode, see 5.2.6(2).

8.8.3 Superimpose

(1) Superimpose should be transmitted using the independent PES system. It does not synchronize with the program. It is transmitted in auto display mode and displayed automatically on receiver units.

(2) Regarding the use of superimpose, it can be described on the PMT regardless of whether an ES is transmitted. For more information on how to handle the superimpose in multi-view mode, see 5.2.6(2).

8.9 Transmission of the TS during the Inspection Broadcast

8.9.1 Definition of the Inspection Broadcast

The inspection broadcast is defined as the inspectional and test broadcast not designed for viewers to select or view services. The broadcast is transmitted during the inspection after a transmitting station is completed, during the inspection of the reception area and radio interference, and during the inspection after the maintenance of transmission system. The broadcast is not provided as the service targeting an unspecified number of viewers in the reception area but is solely designed for inspection. Since there are no restrictions to viewing the inspection broadcast, attention should be paid to the fact that it is possible that the broadcast contents such as the video and audio may be viewed by viewers.

8.9.2 TS' Transmitted during the Inspection Broadcast

The TS' transmitted during the inspection broadcast are shown in the Table 8-6.

Table 8-6 TS' Transmitted during the Inspection Broadcast

Classification of the Inspection Broadcast	Transmitted TS
When the area that can receive the inspection broadcast includes the area where the provision of the service has not started (For more information, see Section 8.9.5.)	Inspection TS
When the transmission parameters are temporarily modified while the regular programs are suspended and the inspection broadcast is provided (For more information, see Section 8.9.4.)	Inspection TS
Inspection broadcast other than above	TS transmitted according to the provisions for operations or Inspection TS

As shown in the table above, there are cases where broadcasting the inspection TS is required. The inspection TS is explained more in detail in the next section.

Incidentally, broadcasts other than the inspection broadcast (broadcasts designed for viewing by viewers) should be transmitted in accordance with the provisions for operation, excluding cases where broadcaster facilities are damaged as specified in Section 8.10.

8.9.3 Inspection TS

How the inspection TS is operated is explained below.

(1) Use of PSI/SI

The inspection TS should only transmit the PAT and PMT. It should not transmit other tables (NIT, CAT, TOT, BIT, SDT, EIT [H, M and L], SDTT [for the High/Low protection layer] and

CDT). However, the TOT can be transmitted only when it is guaranteed that the TOT does not deviate not more than ±1 second from the JST time. For more information on the CAT and EMM, see (3).

The PAT and PMT should be transmitted in accordance with the provisions for operation. Using TS_id and service identifier assigned to each broadcasting station, the service loop of the PAT and the relevant service PMT should be transmitted in accordance with the provisions for operation.

(2) Use of components

In accordance with the information listed in the PMT, various components (video, audio, caption and data broadcast) can be transmitted. Each component should be transmitted in accordance with the provisions for operation. Components can also be scrambled. In this case, a correct ECM and PMT should be transmitted as they are necessary to descramble the components.

(3) Use of the CAT and EMM

In principle, the inspection TS should not transmit the CAT and EMM. However, if transmitting them is absolutely necessary, only a correct CAT and EMM can be transmitted.

(4) Transmission of the TS

Broadcasts should be provided in accordance with the transmission system for digital terrestrial television broadcasting specified by ARIB STD-B31. Compliance to the number of segments and transmission parameters shown in Table 2 and Table 3 in general operation information in this document should also be observed.

8.9.4 Temporary Modification of Transmission Parameters for Inspection Purpose

To temporarily modify the parameters shown below while regular programs are suspended and to provide the inspection broadcast, the inspection TS should be transmitted without fail.

[The inspection TS should be transmitted when the parameters below are temporarily modified]

-Transmission mode -GI ratio -Service configuration -Increases or decrease of the transmission parameter types

-Transfer of services between transmission parameter types -Modulation system

Temporary modification of parameters refers to temporary provision of the inspection broadcast using different parameters to those used for regular broadcasts designed for viewer viewing during late night hours when no programs are provided.

8.9.5 When the Area that can Receive the Inspection Broadcast Includes the Area where the Provision of the Service has not Started

The inspection broadcast should always involve the transmission of the inspection TS when the reception area includes the area where the provision of the service has not started (including the cases where the area where the provision of the service has started and the area where the provision of the service has not started are both present), excluding during the period of the preparatory broadcast mentioned in Section 8.10. This is due to the following reason; when viewers perform a scan of channels in the area where the provision of the service has not started (referring to a state where the TS is only partially transmitted or an incorrect NIT is transmitted), the NIT information to be stored in the receiver unit will be incorrect, and the reception of the broadcast in this state may cause problems regarding service selection operation.

8.9.6 Reception of the Inspection TS (Reference)

When receiving the inspection TS, the NIT is not transmitted and thus the NIT cannot be obtained through a channel scan. The receiver units that have no NIT stored regarding the relevant TS are assumed to be unable to select services using the number buttons with the remote-control-Key-ID or three-digit station number. To enable reception in this case, for example, a physical frequency should be directly selected to obtain the PAT and PMT from the TS transmitted over the frequency and perform a decode.

8.10 Test Broadcast Prior to the Start of the Broadcasting Service

The test broadcast referred to here generally means the test broadcast prior to the start of the provision of the broadcasting service. The test broadcast in the area where the provision of the service has not started is classified into two types: the inspection broadcast (See Section 8.9) not designed for viewing by viewers and the preparatory broadcast designed for receiver units to obtain the correct NIT, SDT, CDT and other tables prior to the start of the provision of the broadcasting service. The preparatory broadcast refers to the broadcast that does not cause any problems with the reception when the provision of the service starts even if viewers perform a channel scan on their receiver units during the test broadcast period. However, during the test broadcast period, if viewers perform a channel scan while the TS to be transmitted when the provision of the service starts is only partially received, and then after the test broadcast period, viewers receive the broadcast without performing a channel scan again, the viewers can only partially receive the TS like during the test broadcast period. Accordingly, prior to the start of the provision of the broadcasting service, if the broadcast is only temporarily provided or the entire TS to be transmitted when the provision of the service starts cannot be transmitted all at once, and thus only incorrect information regarding the TS (such as the NIT) can be transmitted, the broadcast should be transmitted as the inspection broadcast. Since the TS transmitted then refers to the TS transmitted “when the area that can receive the inspection broadcast includes the area where the provision of the service has not started” mentioned in Table 8-6, the inspection TS should be transmitted without fail. Moreover, regarding the preparatory broadcast, broadcasts in accordance with the provisions for operation should in principle be transmitted simultaneously by all stations. This means, in other words, that when the test broadcast is provided, it is important to clearly differentiate whether the broadcast is the inspection broadcast or preparatory broadcast.

The preparatory broadcast may not be used when the provision of the service by a relay station or a mini satellite station starts (when a relay station or mini satellite station starts the broadcasting service, only the inspection broadcast may be used without using the preparatory broadcast prior to the start of the provision of the service). This is due to the following reason; immediately prior to the start of the provision of the service from a relay station, the station is unable to transmit the same information (for example, the event information) as the master station and it is assumed difficult for the relay station to independently build facilities to transmit the TS in accordance with the provisions for operation.

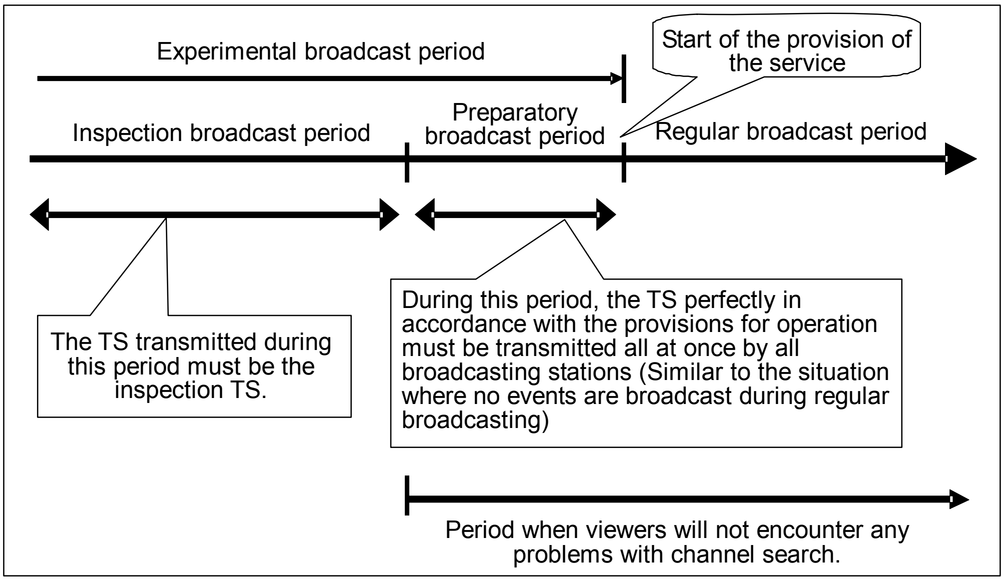


Figure 8-6 Use of the Test Broadcast Prior to the Start of the Provision of the Broadcasting Service

8.11 Use of the TS when Broadcaster Facilities are Damaged

When a disasters, for example, has damaged the broadcasting facilities of broadcasting companies, making it difficult to maintain the transmission service in accordance with the provisions for operation, TS' in other areas can be used for transmission under the following conditions for the purpose of providing information as much as possible to the disaster affected area.

(1) The network identifier, service identifier and area_code values different from the values originally assigned to the broadcasters providing the broadcasting services in the affected area may be used for transmission. However, there should be no overlap of values used among these broadcasting companies and the values are assumed to be the ones already assigned to certain broadcasters listed in the provisions for operation. Compatibility should, therefore, be maintained among tables to be transmitted.

(2) The TOT should be transmitted in the same manner as the inspection TS mentioned in Section 8.9.

(3) If using different transmission parameters from the ones previously used for transmission when the broadcasting service starts under a disaster situation, the countdown of the transmission parameter switching index of the TMCC is not necessarily required.

(4) There may be cases where version_number of each table is the same as immediately previous version_number. However, no consideration is required in this regard because a re-scan is a

prerequisite for service reception.

(5) To use a scramble mode, a correct ECM and PMT should be transmitted in accordance with the provisions for operation. When ending a scramble mode to make a shift to a non-scramble mode under a disaster situation and when resuming a scramble mode when normal operation is restored from a disaster situation, the procedures for starting and ending a scramble mode mentioned in 4.10 of Vol. 5 of this document should be observed.

(6) Operations other than those mentioned above should be performed in accordance with the provisions for operation.

To receive channels transmitted by broadcasters based on the conditions above, it is a prerequisite that receiver units perform a re-scan. Accordingly, a notification to prompt a re-scan should be given to viewers using the services provided by other broadcasters or other media.

To resume transmission in accordance with the provisions for operation following the operation under a disaster situation, a notification to prompt an initial scan should be given before the operation under a disaster situation ends. However, it should be noted that an initial scan may clear the recording schedule information and information on NVRAM (including the information on the broadcasters not affected by the disaster) previously stored in the receiver unit.

9 List of Assignment of Various Values

9.1 Guideline for Assignment Method of each value

9.1.1 Assignment of network identifier

- The values calculated from the following formula are used for the network identifier. This is given and managed by ARIB.
  - network identifier=0x7FF0-0x0010×Region ID+Region broadcaster identifier-0x0400×Second TS flag
  - Regarding the Region ID and Region broadcaster identifier, use the values defined in 9.1.3 “service identifier”.

9.1.2 Guidelines for transport_stream_id assignment

- One transport_stream_id is assigned for each network.
- The transport_stream_id is assigned a unique value all over Japan.

- The transport_stream_id is to be the same value[†1] as the network identifier.

9.1.3 service identifier

- The service identifier (16 bits) is assigned an unique value all over Japan based on the following ideas[†2].

(a)Bit allocation

MSB															LSB
b_{15}	b_{14}	b_{13}	b_{12}	b_{11}	b_{10}	b_{09}	b_{08}	b_{07}	b_{06}	b_{05}	b_{04}	b_{03}	b_{02}	b_{01}	b_{00}
Region ID						Second TS flag	Service type		Region broadcaster ID				Service number		

(b) Meaning of bit

Region ID	Explanation
0 to 9	Wide-area (multi-prefectual area) broadcasting
10 to 63	Prefecture(stations within the prefecture) broadcasting

Service type	Explanation
0	Media-type “TV type” service
1, 2	Media-type “Data type” service (excluding partial reception service)
3	Media-type “Data type” service (partial reception service)

Second TS flag	Explanation
0	This is used for the first TS when transmitting one or two TS’s in the relevant area.
1	This is used for the second TS when transmitting two TS’s for the same Region Broadcaster Identifier in the relevant area.

(Note) When using Second TS flag “1”, use the remote_control_key_id that is the same as the TS which the second TS flag is set to “0” and which of the Identical Region ID and Region Broadcaster Identifier .

Region broadcaster ID	Explanation
0	Broadcaster A
1	Broadcaster B
2	Broadcaster C
3	Broadcaster D
4	Broadcaster E
5	Broadcaster F

†1: The transport_stream_id described in the SDTT may be defferent from the network identifier.

†2: Apart from the engineering services, the same service identifier should not be used in a different network identifier.

6	Broadcaster G
7	Broadcaster H
8	Broadcaster I
9	Broadcaster J
10	Broadcaster K
11	Broadcaster L
12	Broadcaster M
13	Broadcaster N
14	Broadcaster O
15	Broadcaster P

Service Number	Explanation
0 to 7	Number which can be set by broadcasters for each service type within a relevant TS (image of so-called “channel”)

(c)Assignment of Region ID

Identifier	Region	Identifier	Region	Identifier	Region	Identifier	Region
0	undefined	16	Hokkaido (Muroran)	32	Yamanashi	48	Shimane
1	Kanto wide-area	17	Miyagi	33	Aichi	49	Tottori
2	Kinki wide-area	18	Akita	34	Ishikawa	50	Yamaguchi
3	Chukyo wide-area	19	Yamagata	35	Shizuoka	51	Ehime
4	Hokkaido area	20	Iwate	36	Fukui	52	Kagawa
5	Okayama, Kagawa	21	Fukushima	37	Toyama	53	Tokushima
6	Shimane, Tottori	22	Aomori	38	Mie	54	Kouchi
7	undefined	23	Tokyo	39	Gifu	55	Fukuoka
8	undefined	24	Kanagawa	40	Osaka	56	Kumamoto
9	undefined	25	Gunma	41	Kyoto	57	Nagasaki
10	Hokkaido (Sapporo)	26	Ibaraki	42	Hyogo	58	Kagoshima
11	Hokkaido (Hakodate)	27	Chiba	43	Wakayama	59	Miyazaki
12	Hokkaido (Asahikawa)	28	Tochigi	44	Nara	60	Oita
13	Hokkaido (Obihiro)	29	Saitama	45	Shiga	61	Saga
14	Hokkaido (Kushiro)	30	Nagano	46	Hiroshima	62	Okinawa
15	Hokkaido (Kitami)	31	Niigata	47	Okayama	63	undefined

(d)remote_control_key_id and three-digit-numbers

remote_control_key_id

- The number to assigne (by default) a service which the broadcaster provides (specified by service identifier) to the one-touch button of a remote control unit.
- In the low protection layer the broadcaster should define a service to assign a one-touch button of the remote control unit (as default) as a primary service*), and,it should be a TV service of a “0” service number (service type “0”) of each broadcasters.
- The only one remote_control_key_id should be assigned in each NIT and the values of remote_control_key_id are used between [1] to [12], for the time being.
- Refer to Table 9-1 for the correspondence between broadcaster and remote_control_key_id,.

Three-digit-number

- Three-digit decimal numbers that can be shown by the Service type×200+remote_control_key_id×10+(Service number+1)—see table below.

- Used when selecting a service by direct numbering without relying on the one-touch button.
- Used as a number to be shown to viewers during the program selection and EPG display, as well.

remote_control_key_id	Three-digit-number			
	TV	Data1	Data2	Partial reception
1	011-018	211-218	411-418	611-618
2	021-028	221-228	421-428	621-628
3	031-038	231-238	431-438	631-638
4	041-048	241-248	441-448	641-648
5	051-058	251-258	451-458	651-658
6	061-068	261-268	461-468	661-668
7	071-078	271-278	471-478	671-678
8	081-088	281-288	481-488	681-688
9	091-098	291-298	491-498	691-698
10	101-108	301-308	501-508	701-708
11	111-118	311-318	511-518	711-718
12	121-128	321-328	521-528	721-728

(e)Engineering services

Assign 0xFFF0-0xFFF5 as the service identifier of the Engineering service.

9.2 List of Identifiers

The value of identifiers assigned to the Digital Terrestrial Television Broadcasting is listed here.

9.2.1 network identifier, transport_stream_id, Remote Control Key id, and service identifier

The assignment of the network identifier, transport_stream_id (TS id) and the service identifier are shown in a hexadecimal number, and the remote control key identifier is shown in a decimal number, in the Digital Terrestrial Television Broadcasting, in Table 9-1. Furthermore, the value shown in the table is the value when the value of the second TS flag is “0”.

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 1/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Kanto wide-area	1	0	NHK G	7FE0	7FE0	1	0400 - 0407	0480 - 0487	0500 - 0507	0580 - 0587
Kanto wide-area	1	1	NHK E	7FE1	7FE1	2	0408 - 040F	0488 - 048F	0508 - 050F	0588 - 058F
Kanto wide-area	1	2	Nippon TV Broadcasting network	7FE2	7FE2	4	0410 - 0417	0490 - 0497	0510 - 0517	0590 - 0597
Kanto wide-area	1	3	TBS	7FE3	7FE3	6	0418 - 041F	0498 - 049F	0518 - 051F	0598 - 059F
Kanto wide-area	1	4	Fuji TV Network Inc.	7FE4	7FE4	8	0420 - 0427	04A0 - 04A7	0520 - 0527	05A0 - 05A7
Kanto wide-area	1	5	TV Asahi Corp.	7FE5	7FE5	5	0428 - 042F	04A8 - 04AF	0528 - 052F	05A8 - 05AF
Kanto wide-area	1	6	TV Tokyo	7FE6	7FE6	7	0430 - 0437	04B0 - 04B7	0530 - 0537	05B0 - 05B7
Kanto wide-area	1	8	The University of the Air	7FE8	7FE8	12	0440 - 0447	04C0 - 04C7	0540 - 0547	05C0 - 05C7
Kinki wide-area	2	1	NHK Educational	7FD1	7FD1	2	0808 - 080F	0888 - 088F	0908 - 090F	0988 - 098F
Kinki wide-area	2	2	Mainichi Broadcasting System	7FD2	7FD2	4	0810 - 0817	0890 - 0897	0910 - 0917	0990 - 0997
Kinki wide-area	2	3	TV Asahi Corp.	7FD3	7FD3	6	0818 - 081F	0898 - 089F	0918 - 091F	0998 - 099F
Kinki wide-area	2	4	Kansai Telecasting Corp.	7FD4	7FD4	8	0820 - 0827	08A0 - 08A7	0920 - 0927	09A0 - 09A7
Kinki wide-area	2	5	Yomiuri Telecasting Corp.	7FD5	7FD5	10	0828 - 082F	08A8 - 08AF	0928 - 092F	09A8 - 09AF
Chukyo wide-area	3	1	NHK Educational	7FC1	7FC1	2	0C08 - 0C0F	0C88 - 0C8F	0D08 - 0D0F	0D88 - 0D8F
Chukyo wide-area	3	2	Tokai TV Broadcasting Co. Ltd.	7FC2	7FC2	1	0C10 - 0C17	0C90 - 0C97	0D10 - 0D17	0D90 - 0D97
Chukyo wide-area	3	3	Chubu-Nippon Broadcasting Co.,Ltd.	7FC3	7FC3	5	0C18 - 0C1F	0C98 - 0C9F	0D18 - 0D1F	0D98 - 0D9F
Chukyo wide-area	3	4	Nagoya Broadcasting Network	7FC4	7FC4	6	0C20 - 0C27	0CA0 - 0CA7	0D20 - 0D27	0DA0 - 0DA7
Chukyo wide-area	3	5	Chukyo TV Broadcasting Co.,Ltd.	7FC5	7FC5	4	0C28 - 0C2F	0CA8 - 0CAF	0D28 - 0D2F	0DA8 - 0DAF

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 2/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Hokkaido area	4	2	Hokkaido Broadcasting Co.,Ltd	7FB2	7FB2	1	1010 - 1017	1090 - 1097	1110 - 1117	1190 - 1197
Hokkaido area	4	3	The Sapporo Television Broadcasting Co.,Ltd	7FB3	7FB3	5	1018 - 101F	1098 - 109F	1118 - 111F	1198 - 119F
Hokkaido area	4	4	Hokkaido Television Broadcasting Co., Ltd	7FB4	7FB4	6	1020 - 1027	10A0 - 10A7	1120 - 1127	11A0 - 11A7
Hokkaido area	4	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7FB5	7FB5	8	1028 - 102F	10A8 - 10AF	1128 - 112F	11A8 - 11AF
Hokkaido area	4	6	Television Hokkaido Broadcasting Co.LTD	7FB6	7FB6	7	1030 - 1037	10B0 - 10B7	1130 - 1137	11B0 - 11B7
Okayama, Kagawa	5	2	Nishinippon Broadcasting Co.,Ltd	7FA2	7FA2	4	1410 - 1417	1490 - 1497	1510 - 1517	1590 - 1597
Okayama, Kagawa	5	3	Setonaikai Broadcasting Co.Ltd	7FA3	7FA3	5	1418 - 141F	1498 - 149F	1518 - 151F	1598 - 159F
Okayama, Kagawa	5	4	Sanyo Broadcasting Co., Ltd	7FA4	7FA4	6	1420 - 1427	14A0 - 14A7	1520 - 1527	15A0 - 15A7
Okayama, Kagawa	5	5	TV Setouchi Broadcasting Co., Ltd	7FA5	7FA5	7	1428 - 142F	14A8 - 14AF	1528 - 152F	15A8 - 15AF
Okayama, Kagawa	5	6	Okayama Broadcasting Co., Ltd	7FA6	7FA6	8	1430 - 1437	14B0 - 14B7	1530 - 1537	15B0 - 15B7
Shimane, tottori	6	2	San-in Chuo Television Broadcasting Co.,Ltd	7F92	7F92	8	1810 - 1817	1890 - 1897	1910 - 1917	1990 - 1997
Shimane, tottori	6	3	Broadcasting System of San-in Inc	7F93	7F93	6	1818 - 181F	1898 - 189F	1918 - 191F	1998 - 199F
Shimane, tottori	6	4	Nihonkai Telecasting Co.,Ltd	7F94	7F94	1	1820 - 1827	18A0 - 18A7	1920 - 1927	19A0 - 19A7
Hokkaido (Sapporo)	10	0	NHK G	7F50	7F50	3	2800 - 2807	2880 - 2887	2900 - 2907	2980 - 2987
Hokkaido (Sapporo)	10	1	NHK E	7F51	7F51	2	2808 - 280F	2888 - 288F	2908 - 290F	2988 - 298F
Hokkaido (Sapporo)	10	2	Hokkaido Broadcasting Co.,Ltd	7F52	7F52	1	2810 - 2817	2890 - 2897	2910 - 2917	2990 - 2997
Hokkaido (Sapporo)	10	3	The Sapporo Television Broadcasting Co.,Ltd	7F53	7F53	5	2818 - 281F	2898 - 289F	2918 - 291F	2998 - 299F
Hokkaido (Sapporo)	10	4	Hokkaido Television Broadcasting Co., Ltd	7F54	7F54	6	2820 - 2827	28A0 - 28A7	2920 - 2927	29A0 - 29A7
Hokkaido (Sapporo)	10	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F55	7F55	8	2828 - 282F	28A8 - 28AF	2928 - 292F	29A8 - 29AF
Hokkaido (Sapporo)	10	6	Television Hokkaido Broadcasting Co.LTD	7F56	7F56	7	2830 - 2837	28B0 - 28B7	2930 - 2937	29B0 - 29B7

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 3/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Hokkaido (Hakodate)	11	0	NHK G	7F40	7F40	3	2C00 - 2C07	2C80 - 2C87	2D00 - 2D07	2D80 - 2D87
Hokkaido (Hakodate)	11	1	NHK E	7F41	7F41	2	2C08 - 2C0F	2C88 - 2C8F	2D08 - 2D0F	2D88 - 2D8F
Hokkaido (Hakodate)	11	2	Hokkaido Broadcasting Co.,Ltd	7F42	7F42	1	2C10 - 2C17	2C90 - 2C97	2D10 - 2D17	2D90 - 2D97
Hokkaido (Hakodate)	11	3	The Sapporo Television Broadcasting Co.,Ltd	7F43	7F43	5	2C18 - 2C1F	2C98 - 2C9F	2D18 - 2D1F	2D98 - 2D9F
Hokkaido (Hakodate)	11	4	Hokkaido Television Broadcasting Co., Ltd	7F44	7F44	6	2C20 - 2C27	2CA0 - 2CA7	2D20 - 2D27	2DA0 - 2DA7
Hokkaido (Hakodate)	11	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F45	7F45	8	2C28 - 2C2F	2CA8 - 2CAF	2D28 - 2D2F	2DA8 - 2DAF
Hokkaido (Hakodate)	11	6	Television Hokkaido Broadcasting Co.LTD	7F46	7F46	7	2C30 - 2C37	2CB0 - 2CB7	2D30 - 2D37	2DB0 - 2DB7
Hokkaido (Asahikawa)	12	0	NHK G	7F30	7F30	3	3000 - 3007	3080 - 3087	3100 - 3107	3180 - 3187
Hokkaido (Asahikawa)	12	1	NHK E	7F31	7F31	2	3008 - 300F	3088 - 308F	3108 - 310F	3188 - 318F
Hokkaido (Asahikawa)	12	2	Hokkaido Broadcasting Co.,Ltd	7F32	7F32	1	3010 - 3017	3090 - 3097	3110 - 3117	3190 - 3197
Hokkaido (Asahikawa)	12	3	The Sapporo Television Broadcasting Co.,Ltd	7F33	7F33	5	3018 - 301F	3098 - 309F	3118 - 311F	3198 - 319F
Hokkaido (Asahikawa)	12	4	Hokkaido Television Broadcasting Co., Ltd	7F34	7F34	6	3020 - 3027	30A0 - 30A7	3120 - 3127	31A0 - 31A7
Hokkaido (Asahikawa)	12	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F35	7F35	8	3028 - 302F	30A8 - 30AF	3128 - 312F	31A8 - 31AF
Hokkaido (Asahikawa)	12	6	Television Hokkaido Broadcasting Co.LTD	7F36	7F36	7	3030 - 3037	30B0 - 30B7	3130 - 3137	31B0 - 31B7
Hokkaido (Obihiro)	13	0	NHK G	7F20	7F20	3	3400 - 3407	3480 - 3487	3500 - 3507	3580 - 3587
Hokkaido (Obihiro)	13	1	NHK E	7F21	7F21	2	3408 - 340F	3488 - 348F	3508 - 350F	3588 - 358F
Hokkaido (Obihiro)	13	2	Hokkaido Broadcasting Co.,Ltd	7F22	7F22	1	3410 - 3417	3490 - 3497	3510 - 3517	3590 - 3597
Hokkaido (Obihiro)	13	3	The Sapporo Television Broadcasting Co.,Ltd	7F23	7F23	5	3418 - 341F	3498 - 349F	3518 - 351F	3598 - 359F
Hokkaido (Obihiro)	13	4	Hokkaido Television Broadcasting Co., Ltd	7F24	7F24	6	3420 - 3427	34A0 - 34A7	3520 - 3527	35A0 - 35A7
Hokkaido (Obihiro)	13	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F25	7F25	8	3428 - 342F	34A8 - 34AF	3528 - 352F	35A8 - 35AF
Hokkaido (Obihiro)	13	6	Television Hokkaido Broadcasting Co.LTD	7F26	7F26	7	3430 - 3437	34B0 - 34B7	3530 - 3537	35B0 - 35B7

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 4/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Hokkaido (Kushiro)	14	0	NHK G	7F10	7F10	3	3800 - 3807	3880 - 3887	3900 - 3907	3980 - 3987
Hokkaido (Kushiro)	14	1	NHK E	7F11	7F11	2	3808 - 380F	3888 - 388F	3908 - 390F	3988 - 398F
Hokkaido (Kushiro)	14	2	Hokkaido Broadcasting Co.,Ltd	7F12	7F12	1	3810 - 3817	3890 - 3897	3910 - 3917	3990 - 3997
Hokkaido (Kushiro)	14	3	The Sapporo Television Broadcasting Co.,Ltd	7F13	7F13	5	3818 - 381F	3898 - 389F	3918 - 391F	3998 - 399F
Hokkaido (Kushiro)	14	4	Hokkaido Television Broadcasting Co., Ltd	7F14	7F14	6	3820 - 3827	38A0 - 38A7	3920 - 3927	39A0 - 39A7
Hokkaido (Kushiro)	14	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F15	7F15	8	3828 - 382F	38A8 - 38AF	3928 - 392F	39A8 - 39AF
Hokkaido (Kushiro)	14	6	Television Hokkaido Broadcasting Co.LTD	7F16	7F16	7	3830 - 3837	38B0 - 38B7	3930 - 3937	39B0 - 39B7
Hokkaido (Kitami)	15	0	NHK G	7F00	7F00	3	3C00 - 3C07	3C80 - 3C87	3D00 - 3D07	3D80 - 3D87
Hokkaido (Kitami)	15	1	NHK E	7F01	7F01	2	3C08 - 3C0F	3C88 - 3C8F	3D08 - 3D0F	3D88 - 3D8F
Hokkaido (Kitami)	15	2	Hokkaido Broadcasting Co.,Ltd	7F02	7F02	1	3C10 - 3C17	3C90 - 3C97	3D10 - 3D17	3D90 - 3D97
Hokkaido (Kitami)	15	3	The Sapporo Television Broadcasting Co.,Ltd	7F03	7F03	5	3C18 - 3C1F	3C98 - 3C9F	3D18 - 3D1F	3D98 - 3D9F
Hokkaido (Kitami)	15	4	Hokkaido Television Broadcasting Co., Ltd	7F04	7F04	6	3C20 - 3C27	3CA0 - 3CA7	3D20 - 3D27	3DA0 - 3DA7
Hokkaido (Kitami)	15	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F05	7F05	8	3C28 - 3C2F	3CA8 - 3CAF	3D28 - 3D2F	3DA8 - 3DAF
Hokkaido (Kitami)	15	6	Television Hokkaido Broadcasting Co.LTD	7F06	7F06	7	3C30 - 3C37	3CB0 - 3CB7	3D30 - 3D37	3DB0 - 3DB7
Hokkaido (Muroran)	16	0	NHK G	7EF0	7EF0	3	4000 - 4007	4080 - 4087	4100 - 4107	4180 - 4187
Hokkaido (Muroran)	16	1	NHK E	7EF1	7EF1	2	4008 - 400F	4088 - 408F	4108 - 410F	4188 - 418F
Hokkaido (Muroran)	16	2	Hokkaido Broadcasting Co.,Ltd	7EF2	7EF2	1	4010 - 4017	4090 - 4097	4110 - 4117	4190 - 4197
Hokkaido (Muroran)	16	3	The Sapporo Television Broadcasting Co.,Ltd	7EF3	7EF3	5	4018 - 401F	4098 - 409F	4118 - 411F	4198 - 419F
Hokkaido (Muroran)	16	4	Hokkaido Television Broadcasting Co., Ltd	7EF4	7EF4	6	4020 - 4027	40A0 - 40A7	4120 - 4127	41A0 - 41A7
Hokkaido (Muroran)	16	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7EF5	7EF5	8	4028 - 402F	40A8 - 40AF	4128 - 412F	41A8 - 41AF
Hokkaido (Muroran)	16	6	Television Hokkaido Broadcasting Co.LTD	7EF6	7EF6	7	4030 - 4037	40B0 - 40B7	4130 - 4137	41B0 - 41B7
Miyagi	17	0	NHK G	7EE0	7EE0	3	4400 - 4407	4480 - 4487	4500 - 4507	4580 - 4587
Miyagi	17	1	NHK E	7EE1	7EE1	2	4408 - 440F	4488 - 448F	4508 - 450F	4588 - 458F
Miyagi	17	2	Touhoku Broadcasting Company	7EE2	7EE2	1	4410 - 4417	4490 - 4497	4510 - 4517	4590 - 4597
Miyagi	17	3	Sendai Television Incorporated	7EE3	7EE3	8	4418 - 441F	4498 - 449F	4518 - 451F	4598 - 459F
Miyagi	17	4	Miyagi Television Broadcasting Co.,Ltd	7EE4	7EE4	4	4420 - 4427	44A0 - 44A7	4520 - 4527	45A0 - 45A7
Miyagi	17	5	Higashinippon Broadcasting Co.,Ltd	7EE5	7EE5	5	4428 - 442F	44A8 - 44AF	4528 - 452F	45A8 - 45AF

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 5/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Akita	18	0	NHK G	7ED0	7ED0	1	4800 - 4807	4880 - 4887	4900 - 4907	4980 - 4987
Akita	18	1	NHK E	7ED1	7ED1	2	4808 - 480F	4888 - 488F	4908 - 490F	4988 - 498F
Akita	18	2	Akita Broadcasting System	7ED2	7ED2	4	4810 - 4817	4890 - 4897	4910 - 4917	4990 - 4997
Akita	18	3	Akita Television Co.,Ltd	7ED3	7ED3	8	4818 - 481F	4898 - 489F	4918 - 491F	4998 - 499F
Akita	18	4	Akita Asahi Broadcasting	7ED4	7ED4	5	4820 - 4827	48A0 - 48A7	4920 - 4927	49A0 - 49A7
Yamagata	19	0	NHK G	7EC0	7EC0	1	4C00 - 4C07	4C80 - 4C87	4D00 - 4D07	4D80 - 4D87
Yamagata	19	1	NHK E	7EC1	7EC1	2	4C08 - 4C0F	4C88 - 4C8F	4D08 - 4D0F	4D88 - 4D8F
Yamagata	19	2	Yamagata Broadcasting Co.,ltd	7EC2	7EC2	4	4C10 - 4C17	4C90 - 4C97	4D10 - 4D17	4D90 - 4D97
Yamagata	19	3	Yamagata Television System, Inc	7EC3	7EC3	5	4C18 - 4C1F	4C98 - 4C9F	4D18 - 4D1F	4D98 - 4D9F
Yamagata	19	4	TV-U Yamagata Inc	7EC4	7EC4	6	4C20 - 4C27	4CA0 - 4CA7	4D20 - 4D27	4DA0 - 4DA7
Yamagata	19	5	Sakuranbo Television Broadcasting Corporation	7EC5	7EC5	8	4C28 - 4C2F	4CA8 - 4CAF	4D28 - 4D2F	4DA8 - 4DAF
Iwate	20	0	NHK G	7EB0	7EB0	1	5000 - 5007	5080 - 5087	5100 - 5107	5180 - 5187
Iwate	20	1	NHKE E	7EB1	7EB1	2	5008 - 500F	5088 - 508F	5108 - 510F	5188 - 518F
Iwate	20	2	Iwate Broadcast CO.LTD	7EB2	7EB2	6	5010 - 5017	5090 - 5097	5110 - 5117	5190 - 5197
Iwate	20	3	Television Iwate Co.,Ltd	7EB3	7EB3	4	5018 - 501F	5098 - 509F	5118 - 511F	5198 - 519F
Iwate	20	4	Iwate Menkoi Television Co.,Ltd	7EB4	7EB4	8	5020 - 5027	50A0 - 50A7	5120 - 5127	51A0 - 51A7
Iwate	20	5	Iwate Asahi TV Co.,Ltd	7EB5	7EB5	5	5028 - 502F	50A8 - 50AF	5128 - 512F	51A8 - 51AF
Fukushima	21	0	NHK G	7EA0	7EA0	1	5400 - 5407	5480 - 5487	5500 - 5507	5580 - 5587
Fukushima	21	1	NHK E	7EA1	7EA1	2	5408 - 540F	5488 - 548F	5508 - 550F	5588 - 558F
Fukushima	21	2	Fukushima Television Broadcasting Co.,Ltd	7EA2	7EA2	8	5410 - 5417	5490 - 5497	5510 - 5517	5590 - 5597
Fukushima	21	3	Fukushima Central Television Co., Ltd	7EA3	7EA3	4	5418 - 541F	5498 - 549F	5518 - 551F	5598 - 559F
Fukushima	21	4	Fukushima Broadcasting Co.,Ltd	7EA4	7EA4	5	5420 - 5427	54A0 - 54A7	5520 - 5527	55A0 - 55A7
Fukushima	21	5	TV-U Fukushima, Inc	7EA5	7EA5	6	5428 - 542F	54A8 - 54AF	5528 - 552F	55A8 - 55AF

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 6/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier: TV type	service identifier: Data type 1	service identifier: Data type 2	service identifier: Partial reception
Aomori	22	0	NHK G	7E90	7E90	3	5800 - 5807	5880 - 5887	5900 - 5907	5980 - 5987
Aomori	22	1	NHK E	7E91	7E91	2	5808 - 580F	5888 - 588F	5908 - 590F	5988 - 598F
Aomori	22	2	Aomori Broadcasting Corporation	7E92	7E92	1	5810 - 5817	5890 - 5897	5910 - 5917	5990 - 5997
Aomori	22	3	Aomori Television Broadcasting Co.,Ltd	7E93	7E93	6	5818 - 581F	5898 - 589F	5918 - 591F	5998 - 599F
Aomori	22	4	Asahi Broadcasting Aomori	7E94	7E94	5	5820 - 5827	58A0 - 58A7	5920 - 5927	59A0 - 59A7
Tokyo	23	7	Tokyo Metropolitan Television Broadcasting Corp	7E87	7E87	9	5C38 - 5C3F	5CB8 - 5CBF	5D38 - 5D3F	5DB8 - 5DBF
Kanagawa	24	7	Television KANAGAWA, Inc	7E77	7E77	3	6038 - 603F	60B8 - 60BF	6138 - 613F	61B8 - 61BF
Gunma	25	7	Gunma Television Co.,Ltd	7E67	7E67	3	6438 - 643F	64B8 - 64BF	6538 - 653F	65B8 - 65BF
Ibaraki	26	0	NHK G	7E50	7E50	1	6800 - 6807	6880 - 6887	6900 - 6907	6980 - 6987
Chiba	27	7	Chiba Television broadcasting Corp	7E47	7E47	3	6C38 - 6C3F	6CB8 - 6CBF	6D38 - 6D3F	6DB8 - 6DBF
Tochigi	28	7	Tochigi Television Co.,Ltd	7E37	7E37	3	7038 - 703F	70B8 - 70BF	7138 - 713F	71B8 - 71BF
Saitama	29	7	Television Saitama Co.,Ltd	7E27	7E27	3	7438 - 743F	74B8 - 74BF	7538 - 753F	75B8 - 75BF
Nagano	30	0	NHK G	7E10	7E10	1	7800 - 7807	7880 - 7887	7900 - 7907	7980 - 7987
Nagano	30	1	NHK E	7E11	7E11	2	7808 - 780F	7888 - 788F	7908 - 790F	7988 - 798F
Nagano	30	2	TV. Shinshu Broadcasting Co., LTD	7E12	7E12	4	7810 - 7817	7890 - 7897	7910 - 7917	7990 - 7997
Nagano	30	3	Asahi Broadcasting Nagano Co.,Ltd	7E13	7E13	5	7818 - 781F	7898 - 789F	7918 - 791F	7998 - 799F
Nagano	30	4	Shin-etsu Broadcasting Co.,Ltd	7E14	7E14	6	7820 - 7827	78A0 - 78A7	7920 - 7927	79A0 - 79A7
Nagano	30	5	Nagano Broadcasting Systems Inc	7E15	7E15	8	7828 - 782F	78A8 - 78AF	7928 - 792F	79A8 - 79AF
Niigata	31	0	NHK G	7E00	7E00	1	7C00 - 7C07	7C80 - 7C87	7D00 - 7D07	7D80 - 7D87
Niigata	31	1	NHK E	7E01	7E01	2	7C08 - 7C0F	7C88 - 7C8F	7D08 - 7D0F	7D88 - 7D8F
Niigata	31	2	Broadcasting System of NIigata Inc	7E02	7E02	6	7C10 - 7C17	7C90 - 7C97	7D10 - 7D17	7D90 - 7D97
Niigata	31	3	Niigata Sogo Television Inc	7E03	7E03	8	7C18 - 7C1F	7C98 - 7C9F	7D18 - 7D1F	7D98 - 7D9F
Niigata	31	4	Television Niigata Network Co.,Ltd	7E04	7E04	4	7C20 - 7C27	7CA0 - 7CA7	7D20 - 7D27	7DA0 - 7DA7
Niigata	31	5	The Niigata Television Network 21,Inc	7E05	7E05	5	7C28 - 7C2F	7CA8 - 7CAF	7D28 - 7D2F	7DA8 - 7DAF
Yamanashi	32	0	NHK G	7DF0	7DF0	1	8000 - 8007	8080 - 8087	8100 - 8107	8180 - 8187
Yamanashi	32	1	NHK E	7DF1	7DF1	2	8008 - 800F	8088 - 808F	8108 - 810F	8188 - 818F
Yamanashi	32	2	Yamanashi Broadcasting System	7DF2	7DF2	4	8010 - 8017	8090 - 8097	8110 - 8117	8190 - 8197
Yamanashi	32	3	UHF TELEVISION YAMANASHI, Inc	7DF3	7DF3	6	8018 - 801F	8098 - 809F	8118 - 811F	8198 - 819F

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 7/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Aichi	33	0	NHK G	7DE0	7DE0	3	8400 - 8407	8480 - 8487	8500 - 8507	8580 - 8587
Aichi	33	6	Aichi Television Broadcasting Co.,ltd	7DE6	7DE6	10	8430 - 8437	84B0 - 84B7	8530 - 8537	85B0 - 85B7
Ishikawa	34	0	NHK G	7DD0	7DD0	1	8800 - 8807	8880 - 8887	8900 - 8907	8980 - 8987
Ishikawa	34	1	NHK E	7DD1	7DD1	2	8808 - 880F	8888 - 888F	8908 - 890F	8988 - 898F
Ishikawa	34	2	TVkanazawa	7DD2	7DD2	4	8810 - 8817	8890 - 8897	8910 - 8917	8990 - 8997
Ishikawa	34	3	HOKURIKU ASAHI BROADCASTING CO.,LTD	7DD3	7DD3	5	8818 - 881F	8898 - 889F	8918 - 891F	8998 - 899F
Ishikawa	34	4	Hokuriku Broadcasting Co.,ltd	7DD4	7DD4	6	8820 - 8827	88A0 - 88A7	8920 - 8927	89A0 - 89A7
Ishikawa	34	5	ISHIKAWA TV CO.,LTD	7DD5	7DD5	8	8828 - 882F	88A8 - 88AF	8928 - 892F	89A8 - 89AF
Shizuoka	35	0	NHK G	7DC0	7DC0	1	8C00 - 8C07	8C80 - 8C87	8D00 - 8D07	8D80 - 8D87
Shizuoka	35	1	NHK E	7DC1	7DC1	2	8C08 - 8C0F	8C88 - 8C8F	8D08 - 8D0F	8D88 - 8D8F
Shizuoka	35	2	Shizuoka Broadcasting System	7DC2	7DC2	6	8C10 - 8C17	8C90 - 8C97	8D10 - 8D17	8D90 - 8D97
Shizuoka	35	3	SHIZUOKA TELECASTING Co.,Ltd	7DC3	7DC3	8	8C18 - 8C1F	8C98 - 8C9F	8D18 - 8D1F	8D98 - 8D9F
Shizuoka	35	4	Shizuoka Daiichi Television Corporation	7DC4	7DC4	4	8C20 - 8C27	8CA0 - 8CA7	8D20 - 8D27	8DA0 - 8DA7
Shizuoka	35	5	Shizuoka Asahi TV	7DC5	7DC5	5	8C28 - 8C2F	8CA8 - 8CAF	8D28 - 8D2F	8DA8 - 8DAF
Fukui	36	0	NHK G	7DB0	7DB0	1	9000 - 9007	9080 - 9087	9100 - 9107	9180 - 9187
Fukui	36	1	NHK E	7DB1	7DB1	2	9008 - 900F	9088 - 908F	9108 - 910F	9188 - 918F
Fukui	36	2	Fukui Broadcasting Corporation	7DB2	7DB2	7	9010 - 9017	9090 - 9097	9110 - 9117	9190 - 9197
Fukui	36	3	Fukui Television Broadcasting Co.,Ltd	7DB3	7DB3	8	9018 - 901F	9098 - 909F	9118 - 911F	9198 - 919F
Toyama	37	0	NHK G	7DA0	7DA0	3	9400 - 9407	9480 - 9487	9500 - 9507	9580 - 9587
Toyama	37	1	NHK E	7DA1	7DA1	2	9408 - 940F	9488 - 948F	9508 - 950F	9588 - 958F
Toyama	37	2	Kitanihon Broadcasting Co.,ltd	7DA2	7DA2	1	9410 - 9417	9490 - 9497	9510 - 9517	9590 - 9597
Toyama	37	3	TOYAMA TELEVISION BROADCASTING Co.,ltd	7DA3	7DA3	8	9418 - 941F	9498 - 949F	9518 - 951F	9598 - 959F
Toyama	37	4	TulipTelevision Co.,Ltd	7DA4	7DA4	6	9420 - 9427	94A0 - 94A7	9520 - 9527	95A0 - 95A7
Mie	38	0	NHK G	7D90	7D90	3	9800 - 9807	9880 - 9887	9900 - 9907	9980 - 9987
Mie	38	6	Mie Television Co.,Ltd	7D96	7D96	7	9830 - 9837	98B0 - 98B7	9930 - 9937	99B0 - 99B7
Gifu	39	0	NHK G	7D80	7D80	3	9C00 - 9C07	9C80 - 9C87	9D00 - 9D07	9D80 - 9D87
Gifu	39	6	Gifu Broadcasting System, Inc	7D86	7D86	8	9C30 - 9C37	9CB0 - 9CB7	9D30 - 9D37	9DB0 - 9DB7

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 8/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier: TV type	service identifier: Data type 1	service identifier: Data type 2	service identifier: Partial reception
Osaka	40	0	NHK G	7D70	7D70	1	A000 - A007	A080 - A087	A100 - A107	A180 - A187
Osaka	40	6	Television Osaka, Inc	7D76	7D76	7	A030 - A037	A0B0 - A0B7	A130 - A137	A1B0 - A1B7
Kyoto	41	0	NHK G	7D60	7D60	1	A400 - A407	A480 - A487	A500 - A507	A580 - A587
Kyoto	41	6	Kyoto Broadcasting System Company Limited	7D66	7D66	5	A430 - A437	A4B0 - A4B7	A530 - A537	A5B0 - A5B7
Hyogo	42	0	NHK G	7D50	7D50	1	A800 - A807	A880 - A887	A900 - A907	A980 - A987
Hyogo	42	6	Sun Television Co	7D56	7D56	3	A830 - A837	A8B0 - A8B7	A930 - A937	A9B0 - A9B7
Wakayama	43	0	NHK G	7D40	7D40	1	AC00 - AC07	AC80 - AC87	AD00 - AD07	AD80 - AD87
Wakayama	43	6	Television Wakayama Co.,Ltd	7D46	7D46	5	AC30 - AC37	ACB0 - ACB7	AD30 - AD37	ADB0 - ADB7
Nara	44	0	NHK G	7D30	7D30	1	B000 - B007	B080 - B087	B100 - B107	B180 - B187
Nara	44	6	Nara Television Co.,Ltd	7D36	7D36	9	B030 - B037	B0B0 - B0B7	B130 - B137	B1B0 - B1B7
Shiga	45	0	NHK G	7D20	7D20	1	B400 - B407	B480 - B487	B500 - B507	B580 - B587
Shiga	45	6	Biwako Broadcasting Co.,Ltd	7D26	7D26	3	B430 - B437	B4B0 - B4B7	B530 - B537	B5B0 - B5B7
Hiroshima	46	0	NHK G	7D10	7D10	1	B800 - B807	B880 - B887	B900 - B907	B980 - B987
Hiroshima	46	1	NHK E	7D11	7D11	2	B808 - B80F	B888 - B88F	B908 - B90F	B988 - B98F
Hiroshima	46	2	RCC Broadcasting Company	7D12	7D12	3	B810 - B817	B890 - B897	B910 - B917	B990 - B997
Hiroshima	46	3	Hiroshima Telecasting Co.,Ltd	7D13	7D13	4	B818 - B81F	B898 - B89F	B918 - B91F	B998 - B99F
Hiroshima	46	4	Hiroshima Home Television Co.,Ltd	7D14	7D14	5	B820 - B827	B8A0 - B8A7	B920 - B927	B9A0 - B9A7
Hiroshima	46	5	Shinhiroshima Telecasting Co.,Ltd.	7D15	7D15	8	B828 - B82F	B8A8 - B8AF	B928 - B92F	B9A8 - B9AF
Okayama	47	0	NHK G	7D00	7D00	1	BC00 - BC07	BC80 - BC87	BD00 - BD07	BD80 - BD87
Okayama	47	1	NHK E	7D01	7D01	2	BC08 - BC0F	BC88 - BC8F	BD08 - BD0F	BD88 - BD8F
Shimane	48	0	NHK G	7CF0	7CF0	3	C000 - C007	C080 - C087	C100 - C107	C180 - C187
Shimane	48	1	NHK E	7CF1	7CF1	2	C008 - C00F	C088 - C08F	C108 - C10F	C188 - C18F
Tottori	49	0	NHK G	7CE0	7CE0	3	C400 - C407	C480 - C487	C500 - C507	C580 - C587
Tottori	49	1	NHK E	7CE1	7CE1	2	C408 - C40F	C488 - C48F	C508 - C50F	C588 - C58F

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 9/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier											
							TV type			Data type 1			Data type 2			Partial reception		
Yamaguchi	50	0	NHK G	7CD0	7CD0	1	C800	-	C807	C880	-	C887	C900	-	C907	C980	-	C987
Yamaguchi	50	1	NHK E	7CD1	7CD1	2	C808	-	C80F	C888	-	C88F	C908	-	C90F	C988	-	C98F
Yamaguchi	50	2	Yamaguchi Broadcasting Co.,Ltd	7CD2	7CD2	4	C810	-	C817	C890	-	C897	C910	-	C917	C990	-	C997
Yamaguchi	50	3	TV Yamaguchi Broadcasting Systems	7CD3	7CD3	3	C818	-	C81F	C898	-	C89F	C918	-	C91F	C998	-	C99F
Yamaguchi	50	4	Yamaguchi Asahi Broadcasting Co.,Ltd	7CD4	7CD4	5	C820	-	C827	C8A0	-	C8A7	C920	-	C927	C9A0	-	C9A7
Ehime	51	0	NHK G	7CC0	7CC0	1	CC00	-	CC07	CC80	-	CC87	CD00	-	CD07	CD80	-	CD87
Ehime	51	1	NHK E	7CC1	7CC1	2	CC08	-	CC0F	CC88	-	CC8F	CD08	-	CD0F	CD88	-	CD8F
Ehime	51	2	Nankai Broadcasting Co.,Ltd	7CC2	7CC2	4	CC10	-	CC17	CC90	-	CC97	CD10	-	CD17	CD90	-	CD97
Ehime	51	3	Ehime Asahi Television,Inc	7CC3	7CC3	5	CC18	-	CC1F	CC98	-	CC9F	CD18	-	CD1F	CD98	-	CD9F
Ehime	51	4	i-Television,Inc	7CC4	7CC4	6	CC20	-	CC27	CCA0	-	CCA7	CD20	-	CD27	CDA0	-	CDA7
Ehime	51	5	Ehime Broadcasting Co.,Ltd	7CC5	7CC5	8	CC28	-	CC2F	CCA8	-	CCAF	CD28	-	CD2F	CDA8	-	CDAF
Kagawa	52	0	NHK G	7CB0	7CB0	1	D000	-	D007	D080	-	D087	D100	-	D107	D180	-	D187
Kagawa	52	1	NHK E	7CB1	7CB1	2	D008	-	D00F	D088	-	D08F	D108	-	D10F	D188	-	D18F
Tokushima	53	0	NHK G	7CA0	7CA0	3	D400	-	D407	D480	-	D487	D500	-	D507	D580	-	D587
Tokushima	53	1	NHK E	7CA1	7CA1	2	D408	-	D40F	D488	-	D48F	D508	-	D50F	D588	-	D58F
Tokushima	53	2	Shikoku Broadcasting Co.,Ltd.	7CA2	7CA2	1	D410	-	D417	D490	-	D497	D510	-	D517	D590	-	D597
Kouchi	54	0	NHK G	7C90	7C90	1	D800	-	D807	D880	-	D887	D900	-	D907	D980	-	D987
Kouchi	54	1	NHK E	7C91	7C91	2	D808	-	D80F	D888	-	D88F	D908	-	D90F	D988	-	D98F
Kouchi	54	2	Kochi Broadcasting Co.,Ltd	7C92	7C92	4	D810	-	D817	D890	-	D897	D910	-	D917	D990	-	D997
Kouchi	54	3	Television Kochi Co.,Ltd	7C93	7C93	6	D818	-	D81F	D898	-	D89F	D918	-	D91F	D998	-	D99F
Kouchi	54	4	Kochi Sun Sun Broadcasting, Inc	7C94	7C94	8	D820	-	D827	D8A0	-	D8A7	D920	-	D927	D9A0	-	D9A7

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 10/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Fukuoka	55	0	NHK G	7C80	7C80	3	DC00 - DC07	DC80 - DC87	DD00 - DD07	DD80 - DD87
Fukuoka	55	1	NHK E	7C81	7C81	2	DC08 - DC0F	DC88 - DC8F	DD08 - DD0F	DD88 - DD8F
Fukuoka	55	2	Kyushu Asahi Broadcasting Co.,Ltd.	7C82	7C82	1	DC10 - DC17	DC90 - DC97	DD10 - DD17	DD90 - DD97
Fukuoka	55	3	RKB Mainichi Broadcasting Corporation	7C83	7C83	4	DC18 - DC1F	DC98 - DC9F	DD18 - DD1F	DD98 - DD9F
Fukuoka	55	4	Fukuoka Broadcasting System	7C84	7C84	5	DC20 - DC27	DCA0 - DCA7	DD20 - DD27	DDA0 - DDA7
Fukuoka	55	5	TVQ Kyushu Broadcasting Co.,Ltd	7C85	7C85	7	DC28 - DC2F	DCA8 - DCAF	DD28 - DD2F	DDA8 - DDAF
Fukuoka	55	6	Television Nishinippon Corporation	7C86	7C86	8	DC30 - DC37	DCB0 - DCB7	DD30 - DD37	DDB0 - DDB7
Kumamoto	56	0	NHK G	7C70	7C70	1	E000 - E007	E080 - E087	E100 - E107	E180 - E187
Kumamoto	56	1	NHK E	7C71	7C71	2	E008 - E00F	E088 - E08F	E108 - E10F	E188 - E18F
Kumamoto	56	2	RKK Kumamoto Broadcasting	7C72	7C72	3	E010 - E017	E090 - E097	E110 - E117	E190 - E197
Kumamoto	56	3	TV Kumamoto co.,ltd	7C73	7C73	8	E018 - E01F	E098 - E09F	E118 - E11F	E198 - E19F
Kumamoto	56	4	Kumamato Kenmin TV	7C74	7C74	4	E020 - E027	E0A0 - E0A7	E120 - E127	E1A0 - E1A7
Kumamoto	56	5	Kumamoto Asahi Broadcasting Co.,Ltd	7C75	7C75	5	E028 - E02F	E0A8 - E0AF	E128 - E12F	E1A8 - E1AF
Nagasaki	57	0	NHK G	7C60	7C60	1	E400 - E407	E480 - E487	E500 - E507	E580 - E587
Nagasaki	57	1	NHK E	7C61	7C61	2	E408 - E40F	E488 - E48F	E508 - E50F	E588 - E58F
Nagasaki	57	2	Nagasaki Broadcasting Company	7C62	7C62	3	E410 - E417	E490 - E497	E510 - E517	E590 - E597
Nagasaki	57	3	K.k. Television Nagasaki	7C63	7C63	8	E418 - E41F	E498 - E49F	E518 - E51F	E598 - E59F
Nagasaki	57	4	Nagasaki Culture Telecasting Corporation	7C64	7C64	5	E420 - E427	E4A0 - E4A7	E520 - E527	E5A0 - E5A7
Nagasaki	57	5	Nagasaki International Television Broadcasting Co.,Ltd	7C65	7C65	4	E428 - E42F	E4A8 - E4AF	E528 - E52F	E5A8 - E5AF
Kagoshima	58	0	NHK G	7C50	7C50	3	E800 - E807	E880 - E887	E900 - E907	E980 - E987
Kagoshima	58	1	NHK E	7C51	7C51	2	E808 - E80F	E888 - E88F	E908 - E90F	E988 - E98F
Kagoshima	58	2	Minaminihon Broadcasting Co.,Ltd	7C52	7C52	1	E810 - E817	E890 - E897	E910 - E917	E990 - E997
Kagoshima	58	3	Kagoshima Television Station Co.,Ltd	7C53	7C53	8	E818 - E81F	E898 - E89F	E918 - E91F	E998 - E99F
Kagoshima	58	4	Kagoshima Broadcasting Corporation	7C54	7C54	5	E820 - E827	E8A0 - E8A7	E920 - E927	E9A0 - E9A7
Kagoshima	58	5	Kagoshima Yomiuri Television	7C55	7C55	4	E828 - E82F	E8A8 - E8AF	E928 - E92F	E9A8 - E9AF
Miyazaki	59	0	NHK G	7C40	7C40	1	EC00 - EC07	EC80 - EC87	ED00 - ED07	ED80 - ED87
Miyazaki	59	1	NHK E	7C41	7C41	2	EC08 - EC0F	EC88 - EC8F	ED08 - ED0F	ED88 - ED8F
Miyazaki	59	2	Miyazaki Broadcasting Co.,Ltd	7C42	7C42	6	EC10 - EC17	EC90 - EC97	ED10 - ED17	ED90 - ED97
Miyazaki	59	3	Miyazaki Telecasting Co.,ltd	7C43	7C43	3	EC18 - EC1F	EC98 - EC9F	ED18 - ED1F	ED98 - ED9F

Table 9-1 Assignment of the network identifier, transport_stream_id, Remote Control Key_id, and service identifier (excluding the Second TS flag operation) 11/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	network identifier	transport_stream_id	Remote Control Key identifier	service identifier											
							TV type			Data type 1			Data type 2			Partial reception		
Oita	60	0	NHK G	7C30	7C30	1	F000	-	F007	F080	-	F087	F100	-	F107	F180	-	F187
Oita	60	1	NHK E	7C31	7C31	2	F008	-	F00F	F088	-	F08F	F108	-	F10F	F188	-	F18F
Oita	60	2	Oita Broadcasting System, Inc	7C32	7C32	3	F010	-	F017	F090	-	F097	F110	-	F117	F190	-	F197
Oita	60	3	Television Oita System	7C33	7C33	4	F018	-	F01F	F098	-	F09F	F118	-	F11F	F198	-	F19F
Oita	60	4	Oita Asahi Broadcasting Co,Ltd	7C34	7C34	5	F020	-	F027	F0A0	-	F0A7	F120	-	F127	F1A0	-	F1A7
Saga	61	0	NHK G	7C20	7C20	1*	F400	-	F407	F480	-	F487	F500	-	F507	F580	-	F587
Saga	61	1	NHK E	7C21	7C21	2	F408	-	F40F	F488	-	F48F	F508	-	F50F	F588	-	F58F
Saga	61	2	Saga Television Station Co., Ltd	7C22	7C22	3*	F410	-	F41F	F490	-	F497	F510	-	F517	F590	-	F597
Okinawa	62	0	NHK G	7C10	7C10	1	F800	-	F807	F880	-	F887	F900	-	F907	F980	-	F987
Okinawa	62	1	NHK E	7C11	7C11	2	F808	-	F80F	F888	-	F88F	F908	-	F90F	F988	-	F98F
Okinawa	62	2	Ryukyu Broadcasting Corporation	7C12	7C12	3	F810	-	F817	F890	-	F897	F910	-	F917	F990	-	F997
Okinawa	62	4	Ryukyu Asahi Broadcasting Co.,Ltd	7C14	7C14	5	F820	-	F827	F8A0	-	F8A7	F920	-	F927	F9A0	-	F9A7
Okinawa	62	7	Okinawa Television Broadcasting CO., LTD	7C17	7C17	8	F838	-	F83F	F8B8	-	F8BF	F938	-	F93F	F9B8	-	F9BF

(*:T.B.D)

Note) Concerning the duplication of the Broadcasters in the Hokkaido regional and Hokkaido area in the table:
Concerning the Broadcasters in Hokkaido, it is expected that there will be Broadcasters whose broadcasting will start as "Hokkaido regional", then, after establishing a new Master for each area, it will be changed to the Hokkaido Areal Broadcasting later.

When using the Second TS flags, the values should be 0x400 subtracted from the network identifier indicated in Table 9-1, for network identifier and transport_stream_id of TS operated for the flag "1". Similarly, for service identifier operating the second TS flag as '1', add 0x200 to the service identifier shown in Table 9-1.

For example, when NHK G and NHK E in Fukuoka prefecture and the Shizuoka Broadcasting System in Shizuoka prefecture use the Second TS flag='1', each value of the identifier become the value shown in Table 9-2.

Table 9-2 Example of each Identifier value when operated with the Second TS flag='1'

Region name	Region ID	Areal provider	Broadcaster name	network identifier	transport_stream_id	Remote Control Key_identifier	service identifier			
							TV type	Data type 1	Data type 2	Partial reception
Shizuoka	35	2	Shizuoka Broadcasting System	79C2	79C2	6	8E10 - 8E17	8E90 - 8E97	8F10 - 8F17	8F90 - 8F97
Shizuoka	55	0	NHK G	7880	7880	3	DE00 - DE07	DE80 - DE87	DF00 - DF07	DF80 - DF87
Shizuoka	55	1	NHK E	7881	7881	2	DE08 - DE0F	DE88 - DE8F	DF08 - DF0F	DF88 - DF8F

9.2.2 TS name

Table 9-3 shows TS name of each Provider.

Table 9-3 TS names 1/11

Region name	Region ID	Region broadcaster identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Kanto wide-area	1	0	NHK G	7FE0	NHK G, Tokyo
Kanto wide-area	1	1	NHK E	7FE1	NHK E, Tokyo
Kanto wide-area	1	2	Nippon TV Broadcasting network	7FE2	Nippon TV
Kanto wide-area	1	3	TBS	7FE3	TBS
Kanto wide-area	1	4	Fuji TV Network Inc.	7FE4	Fuji TV
Kanto wide-area	1	5	TV Asahi Corp.	7FE5	TV Asahi
Kanto wide-area	1	6	TV Tokyo	7FE6	TV Tokyo
Kanto wide-area	1	8	The University of the Air	7FE8	The University of the Air
Kinki wide-area	2	1	NHK E	7FD1	NHK E, Osaka
Kinki wide-area	2	2	Mainichi Broadcasting System	7FD2	MBS, Mainichi Broadcasting
Kinki wide-area	2	3	TV Asahi Corp.	7FD3	ABC Television
Kinki wide-area	2	4	Kansai Telecasting Corp.	7FD4	Kansai Telecasting
Kinki wide-area	2	5	Yomiuri Telecasting Corp.	7FD5	Yomiuri Telecasting
Chukyo wide-area	3	1	NHK E	7FC1	NHK E, Nagoya
Chukyo wide-area	3	2	Tokai TV Broadcasting Co. Ltd.	7FC2	Tokai TV
Chukyo wide-area	3	3	Chubu-Nippon Broadcasting Co.,Ltd.	7FC3	CBC
Chukyo wide-area	3	4	Nagoya Broadcasting Network	7FC4	Mee Tele
Chukyo wide-area	3	5	Chukyo TV Broadcasting Co.,Ltd.	7FC5	Chukyo TV
Hokkaido area	4	2	Hokkaido Broadcasting Co.,Ltd	7FB2	HBC, Hokkaido Broadcasting
Hokkaido area	4	3	The Sapporo Television Broadcasting Co.,Ltd	7FB3	STV Sapporo Television
Hokkaido area	4	4	Hokkaido Television Broadcasting Co., Ltd	7FB4	HTB, Hokkaido Television
Hokkaido area	4	5	Hokkaido Cultural Broadcasting Co., Ltd.	7FB5	UHB
Hokkaido area	4	6	Television Hokkaido Broadcasting Co.LTD	7FB6	TVH,

Table 9-3 TS names 2/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Okayama, Kagawa	5	2	Nishinippon Broadcasting Co.,Ltd	7FA2	RNC Nishinippon Television
Okayama, Kagawa	5	3	Setonaikai Broadcasting Co.Ltd	7FA3	KSB Setonaikai Broadcasting
Okayama, Kagawa	5	4	Sanyo Broadcasting Co., Ltd	7FA4	RSK Television
Okayama, Kagawa	5	5	TV Setouchi Broadcasting Co., Ltd	7FA5	Television Setouchi
Okayama, Kagawa	5	6	Okayama Broadcasting Co., Ltd	7FA6	OHK TV
Shimane, tottori	6	2	San-in Chuo Television Broadcasting Co.,Ltd	7F92	San-in Chuo Television
Shimane, tottori	6	3	Broadcasting System of San-in Inc	7F93	BSS Television
Shimane, tottori	6	4	Nihonkai Telecasting Co.,Ltd	7F94	Nihonkai Television
Hokkaido (Sapporo)	10	0	NHK G	7F50	NHK G, Sapporo
Hokkaido (Sapporo)	10	1	NHK E	7F51	NHK E, Sapporo
Hokkaido (Sapporo)	10	2	Hokkaido Broadcasting Co.,Ltd	7F52	HBC Sapporo
Hokkaido (Sapporo)	10	3	The Sapporo Television Broadcasting Co.,Ltd	7F53	STV Sapporo
Hokkaido (Sapporo)	10	4	Hokkaido Television Broadcasting Co., Ltd	7F54	HTB Sapporo
Hokkaido (Sapporo)	10	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F55	UHB Sapporo
Hokkaido (Sapporo)	10	6	Television Hokkaido Broadcasting Co.LTD	7F56	TVH Sapporo
Hokkaido (Hakodate)	11	0	NHK G	7F40	NHK G, Hakodate
Hokkaido (Hakodate)	11	1	NHK E	7F41	NHK E, Hakodata
Hokkaido (Hakodate)	11	2	Hokkaido Broadcasting Co.,Ltd	7F42	HBC Hakodate
Hokkaido (Hakodate)	11	3	The Sapporo Television Broadcasting Co.,Ltd	7F43	STV Hakodata
Hokkaido (Hakodate)	11	4	Hokkaido Television Broadcasting Co., Ltd	7F44	HTB Hakodate
Hokkaido (Hakodate)	11	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F45	UHB Hakodate
Hokkaido (Hakodate)	11	6	Television Hokkaido Broadcasting Co.LTD	7F46	TVH Hakodate

Table 9-3 TS names 3/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Hokkaido (Asahikawa)	12	0	NHK G	7F30	NHK G Asahikawa
Hokkaido (Asahikawa)	12	1	NHK E	7F31	NHK E Asahikawa
Hokkaido (Asahikawa)	12	2	Hokkaido Broadcasting Co.,Ltd	7F32	HBC Asahikawa
Hokkaido (Asahikawa)	12	3	The Sapporo Television Broadcasting Co.,Ltd	7F33	STV Asahikawa
Hokkaido (Asahikawa)	12	4	Hokkaido Television Broadcasting Co., Ltd	7F34	HTB Asahikawa
Hokkaido (Asahikawa)	12	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F35	UHB Asahikawa.
Hokkaido (Asahikawa)	12	6	Television Hokkaido Broadcasting Co.LTD	7F36	TVH Asahikawa
Hokkaido (Obihiro)	13	0	NHK G	7F20	NHK G Obihiro
Hokkaido (Obihiro)	13	1	NHK E	7F21	NHK E Obihiro
Hokkaido (Obihiro)	13	2	Hokkaido Broadcasting Co.,Ltd	7F22	HBC Obihiro
Hokkaido (Obihiro)	13	3	The Sapporo Television Broadcasting Co.,Ltd	7F23	STV Obihiro
Hokkaido (Obihiro)	13	4	Hokkaido Television Broadcasting Co., Ltd	7F24	HTB Obihiro
Hokkaido (Obihiro)	13	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F25	UHB Obihiro.
Hokkaido (Obihiro)	13	6	Television Hokkaido Broadcasting Co.LTD	7F26	TVH Obihiro
Hokkaido (Kushiro)	14	0	NHK G	7F10	NHK G, Kushiro
Hokkaido (Kushiro)	14	1	NHK E	7F11	NHK E, Kushiro
Hokkaido (Kushiro)	14	2	Hokkaido Broadcasting Co.,Ltd	7F12	HBC Kushiro
Hokkaido (Kushiro)	14	3	The Sapporo Television Broadcasting Co.,Ltd	7F13	STV Kushiro
Hokkaido (Kushiro)	14	4	Hokkaido Television Broadcasting Co., Ltd	7F14	HTB Kushiro
Hokkaido (Kushiro)	14	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F15	UHB Kushiro.
Hokkaido (Kushiro)	14	6	Television Hokkaido Broadcasting Co.LTD	7F16	TVH Kushiro

Table 9-3 TS names 4/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Hokkaido (Kitami)	15	0	NHK G	7F00	NHK G, Kitami
Hokkaido (Kitami)	15	1	NHK E	7F01	NHK E, Kitami
Hokkaido (Kitami)	15	2	Hokkaido Broadcasting Co.,Ltd	7F02	HBC Kitami
Hokkaido (Kitami)	15	3	The Sapporo Television Broadcasting Co.,Ltd	7F03	STV Kitami
Hokkaido (Kitami)	15	4	Hokkaido Television Broadcasting Co., Ltd	7F04	HTB Kitami
Hokkaido (Kitami)	15	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7F05	UHB Kitami.
Hokkaido (Kitami)	15	6	Television Hokkaido Broadcasting Co.LTD	7F06	TVH Kitami
Hokkaido (Muroran)	16	0	NHK G	7EF0	NHK G, Muroran
Hokkaido (Muroran)	16	1	NHK E	7EF1	NHK E, Muroran
Hokkaido (Muroran)	16	2	Hokkaido Broadcasting Co.,Ltd	7EF2	HBC Muroran
Hokkaido (Muroran)	16	3	The Sapporo Television Broadcasting Co.,Ltd	7EF3	STV Muroran
Hokkaido (Muroran)	16	4	Hokkaido Television Broadcasting Co., Ltd	7EF4	HTB Muroran
Hokkaido (Muroran)	16	5	Hokkaido Cultural Broadcasting Co.,Ltd.	7EF5	UHB Muroran.
Hokkaido (Muroran)	16	6	Television Hokkaido Broadcasting Co.LTD	7EF6	TVH Muroran
Miyagi	17	0	NHK G	7EE0	NHK G, Sendai
Miyagi	17	1	NHK E	7EE1	NHK E, Sendai
Miyagi	17	2	Touhoku Broadcasting Company	7EE2	TBC Television
Miyagi	17	3	Sendai Television Incorporated	7EE3	Sendai Television
Miyagi	17	4	Miyagi Television Broadcasting Co.,Ltd	7EE4	Miyagi Television
Miyagi	17	5	Higashinippon Broadcasting Co.,Ltd	7EE5	KHB, Higashinippon Broadcasting
Akita	18	0	NHK G	7ED0	NHK G, Akita
Akita	18	1	NHK E	7ED1	NHK E, Akita
Akita	18	2	Akita Broadcasting System	7ED2	ABS, Akita Broadcasting
Akita	18	3	Akita Television Co.,Ltd	7ED3	AKT, Akita Television
Akita	18	4	Akita Asahi Broadcasting	7ED4	AAB, Akita Asahi Broadcasting

Table 9-3 TS names 5/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Yamagata	19	0	NHK G	7EC0	NHK G, Yamagata
Yamagata	19	1	NHK E	7EC1	NHK E, Yamagata
Yamagata	19	2	Yamagata Broadcasting Co.,ltd	7EC2	YBC, Yamagata Broadcasting
Yamagata	19	3	Yamagata Television System, Inc	7EC3	YTS, Yamagata Television
Yamagata	19	4	TV-U Yamagata Inc	7EC4	TV-U Yamagata
Yamagata	19	5	Sakuranbo Television Broadcasting Corporation	7EC5	Sakuranbo Television
Iwate	20	0	NHK G	7EB0	NHK G, Morioka
Iwate	20	1	NHK E	7EB1	NHK E, Morioka
Iwate	20	2	Iwate Broadcast CO.LTD	7EB2	IBC Television
Iwate	20	3	Television Iwate Co.,Ltd	7EB3	Television Iwate
Iwate	20	4	Iwate Menkoi Television Co.,Ltd	7EB4	Menkoi Television
Iwate	20	5	Iwate Asahi TV Co.,Ltd	7EB5	Iwate Asahi Television
Fukushima	21	0	NHK G	7EA0	NHK G, Fukushima
Fukushima	21	1	NHK E	7EA1	NHK E, Fukushima
Fukushima	21	2	Fukushima Television Broadcasting Co.,Ltd	7EA2	Fukushima Television
Fukushima	21	3	Fukushima Central Television Co., Ltd	7EA3	Fukushima Central Television
Fukushima	21	4	Fukushima Broadcasting Co.,Ltd	7EA4	KFB, Fukushima Broadcasting
Fukushima	21	5	TV-U Fukushima, Inc	7EA5	TV-U Fukushima
Aomori	22	0	NHK G	7E90	NHK G, Aomori
Aomori	22	1	NHK E	7E91	NHK E, Aomori
Aomori	22	2	Aomori Broadcasting Corporation	7E92	RAB Aomori Broadcasting
Aomori	22	3	Aomori Television Broadcasting Co.,Ltd	7E93	ATV, Aomori Television
Aomori	22	4	Asahi Broadcasting Aomori	7E94	Asahi Broadcasting Aomori
Tokyo	23	7	Tokyo Metropolitan Television Broadcasting Corp	7E87	Tokyo MX Television
Kanagawa	24	7	Television KANAGAWA, Inc	7E77	tvk
Gunma	25	7	Gunma Television Co.,Ltd	7E67	Gunma Television
Ibaraki	26	0	NHK G	7E50	NHK G, Mito

Table 9-3 TS names 6/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Chiba	27	7	Chiba Television broadcasting Corp	7E47	Chiba Television
Tochigi	28	7	Tochigi Television Co.,Ltd	7E37	Tochigi Television
Saitama	29	7	Television Saitama Co.,Ltd	7E27	TeleTama
Nagano	30	0	NHK G	7E10	NHK G, Nagano
Nagano	30	1	NHK E	7E11	NHK E, Nagano
Nagano	30	2	TV. Shinshu Broadcasting Co., LTD	7E12	TV Shinshu
Nagano	30	3	Asahi Broadcasting Nagano Co.,Ltd	7E13	abn, Asahi Broadcasting Nagano
Nagano	30	4	Shin-etsu Broadcasting Co.,Ltd	7E14	SBC, Shin-etsu Broadcasting
Nagano	30	5	Nagano Broadcasting Systems Inc	7E15	NBS, Nagano Broadcasting
Niigata	31	0	NHK G	7E00	NHK G, Niigata
Niigata	31	1	NHK E	7E01	NHK E, Niigata
Niigata	31	2	Broadcasting System of NIigata Inc	7E02	BSN
Niigata	31	3	Niigata Sogo Television Inc	7E03	NST
Niigata	31	4	Television Niigata Network Co.,Ltd	7E04	TeNY, Television Niigata
Niigata	31	5	The Niigata Television Network 21,Inc	7E05	Niigata Television 21
Yamanashi	32	0	NHK G	7DF0	NHK G, Kofu
Yamanashi	32	1	NHK E	7DF1	NHK E, Kofu
Yamanashi	32	2	Yamanashi Broadcasting System	7DF2	YBS, Yamanashi Broadcasting
Yamanashi	32	3	UHF TELEVISION YAMANASHI, Inc	7DF3	UTY
Aichi	33	0	NHK G	7DE0	NHK G, Nagoya
Aichi	33	6	Aichi Television Broadcasting Co.,ltd	7DE6	Aichi Television

Table 9-3 TS names 7/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Ishikawa	34	0	NHK G	7DD0	NHK G, Kanazawa
Ishikawa	34	1	NHK E	7DD1	NHK E, Kanazawa
Ishikawa	34	2	TVkanazawa	7DD2	TVkanazawa
Ishikawa	34	3	HOKURIKU ASAHI BROADCASTING CO.,LTD	7DD3	HOKURIKU ASAHI BROADCASTING
Ishikawa	34	4	Hokuriku Broadcasting Co.,ltd	7DD4	MRO
Ishikawa	34	5	ISHIKAWA TV CO.,LTD	7DD5	ISHIKAWA TV
Shizuoka	35	0	NHK G	7DC0	NHK G, Shizuoka
Shizuoka	35	1	NHK E	7DC1	NHK E, Shizuoka
Shizuoka	35	2	Shizuoka Broadcasting System	7DC2	SBS
Shizuoka	35	3	SHIZUOKA TELECASTING Co.,Ltd	7DC3	SHIZUOKA TELECASTING
Shizuoka	35	4	Shizuoka Daiichi Television Corporation	7DC4	Shizuoka Daiichi Television
Shizuoka	35	5	Shizuoka Asahi TV	7DC5	Shizuoka Asahi TV
Fukui	36	0	NHK G	7DB0	NHK G, Fukui
Fukui	36	1	NHK E	7DB1	NHK E, Fukui
Fukui	36	2	Fukui Broadcasting Corporation	7DB2	FBC Television
Fukui	36	3	Fukui Television Broadcasting Co.,Ltd	7DB3	Fukui Television
Toyama	37	0	NHK G	7DA0	NHK G, Toyama
Toyama	37	1	NHK E	7DA1	NHK E, Toyama
Toyama	37	2	Kitanihon Broadcasting Co.,ltd	7DA2	KNB, Kitanihon Broadcasting
Toyama	37	3	TOYAMA TELEVISION BROADCASTING Co.,ltd	7DA3	BBT, TOYAMA TELEVISION
Toyama	37	4	TulipTelevision Co.,Ltd	7DA4	TulipTelevision
Mie	38	0	NHK G	7D90	NHK G, Tsu
Mie	38	6	Mie Television Co.,Ltd	7D96	Mie Television

Table 9-3 TS names 8/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Gifu	39	0	NHK G	7D80	NHK G, Gifu
Gifu	39	6	Gifu Broadcasting System, Inc	7D86	Gifu Television
Osaka	40	0	NHK G	7D70	NHK G, Osaka
Osaka	40	6	Television Osaka, Inc	7D76	Television Osaka
Kyoto	41	0	NHK G	7D60	NHK G, Kyoto
Kyoto	41	6	Kyoto Broadcasting System Company Limited	7D66	KBS, Kyoto
Hyogo	42	0	NHK G	7D50	NHK G, Kobe
Hyogo	42	6	Sun Television Co	7D56	Sun Television
Wakayama	43	0	NHK G	7D40	NHK G, Wakayama
Wakayama	43	6	Television Wakayama Co.,Ltd	7D46	Television Wakayama
Nara	44	0	NHK G	7D30	NHK G, Nara
Nara	44	6	Nara Television Co.,Ltd	7D36	Nara Television
Shiga	45	0	NHK G	7D20	NHK G, Otsu
Shiga	45	6	Biwako Broadcasting Co.,Ltd	7D26	BBC, Biwako Broadcasting
Hiroshima	46	0	NHK G	7D10	NHK G, Hiroshima
Hiroshima	46	1	NHK E	7D11	NHK E,Hiroshima
Hiroshima	46	2	RCC Broadcasting Company	7D12	RCC Television
Hiroshima	46	3	Hiroshima Telecasting Co.,Ltd	7D13	Hiroshima Television
Hiroshima	46	4	Hiroshima Home Television Co.,Ltd	7D14	Hiroshima Home Television
Hiroshima	46	5	Shinhiroshima Telecasting Co.,Ltd.	7D15	TSS
Okayama	47	0	NHK G	7D00	NHK G, Okayama
Okayama	47	1	NHK E	7D01	NHK E,Okayama
Shimane	48	0	NHK G	7CF0	NHK G, Matsue
Shimane	48	1	NHK E	7CF1	NHK E,Matsue

Table 9-3 TS names 9/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Tottori	49	0	NHK G	7CE0	NHK G, Tottori
Tottori	49	1	NHK E	7CE1	NHK E,Tottori
Yamaguchi	50	0	NHK G	7CD0	NHK G, Yamaguchi
Yamaguchi	50	1	NHK E	7CD1	NHK E,Yamaguchi
Yamaguchi	50	2	Yamaguchi Broadcasting Co.,Ltd	7CD2	KRY, Yamaguchi Broadcasting
Yamaguchi	50	3	TV Yamaguchi Broadcasting Systems	7CD3	TYS, TV Yamaguchi
Yamaguchi	50	4	Yamaguchi Asahi Broadcasting Co.,Ltd	7CD4	YAB, Yamaguchi Asahi
Ehime	51	0	NHK G	7CC0	NHK G, Matsuyama
Ehime	51	1	NHK E	7CC1	NHK E, Matsuyama
Ehime	51	2	Nankai Broadcasting Co.,Ltd	7CC2	Nankai Broadcasting
Ehime	51	3	Ehime Asahi Television,Inc	7CC3	Ehime Asahi Television
Ehime	51	4	i-Television,Inc	7CC4	i-Television
Ehime	51	5	Ehime Broadcasting Co.,Ltd	7CC5	Television Ehime
Kagawa	52	0	NHK G	7CB0	NHK G, Takamatsu
Kagawa	52	1	NHK E	7CB1	NHK E, Takamatsu
Tokushima	53	0	NHK G	7CA0	NHK G, Tokushima
Tokushima	53	1	NHK E	7CA1	NHK E,Tokushima
Tokushima	53	2	Shikoku Broadcasting Co.,Ltd.	7CA2	Shikoku Broadcasting.
Kouchi	54	0	NHK G	7C90	NHK G, Kouchi
Kouchi	54	1	NHK E	7C91	NHK E,Kouchi
Kouchi	54	2	Kochi Broadcasting Co.,Ltd	7C92	Kochi Broadcasting
Kouchi	54	3	Television Kochi Co.,Ltd	7C93	Television Kochi
Kouchi	54	4	Kochi Sun Sun Broadcasting, Inc	7C94	Sun Sun Television

Table 9-3 TS names 10/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Fukuoka	55	0	NHK G	7C80	NHK G, Fukuoka
Fukuoka	55	0	NHK E	7880	NHK E, Kitakyushu
Fukuoka	55	1	NHK E	7C81	NHK E, Fukuoka
Fukuoka	55	1	NHK E	7881	NHK E,Kitakyushu
Fukuoka	55	2	Kyushu Asahi Broadcasting Co.,Ltd.	7C82	KBC, Kyushu Asahi Broadcasting.
Fukuoka	55	3	RKB Mainichi Broadcasting Corporation	7C83	RKB Mainichi Broadcasting
Fukuoka	55	4	Fukuoka Broadcasting System	7C84	FBS, Fukuoka Broadcasting
Fukuoka	55	5	TVQ Kyushu Broadcasting Co.,Ltd	7C85	TVQ Kyushu Broadcasting
Fukuoka	55	6	Television Nishinippon Corporation	7C86	TNC, Television Nishinippon
Kumamoto	56	0	NHK G	7C70	NHK G, Kumamoto
Kumamoto	56	1	NHK E	7C71	NHK E, Kumamoto
Kumamoto	56	2	RKK Kumamoto Broadcasting	7C72	RKK Kumamoto Broadcasting
Kumamoto	56	3	TV Kumamoto co.,ltd	7C73	TKU, TV Kumamoto
Kumamoto	56	4	Kumamato Kenmin TV	7C74	KKT, Kumamato Kenmin
Kumamoto	56	5	Kumamoto Asahi Broadcasting Co.,Ltd	7C75	KAB, Kumamoto Asahi Broadcasting
Nagasaki	57	0	NHK G	7C60	NHK G, Nagasaki
Nagasaki	57	1	NHK E	7C61	NHK E, Nagasaki
Nagasaki	57	2	Nagasaki Broadcasting Company	7C62	NBC, Nagasaki Broadcasting
Nagasaki	57	3	K.k. Television Nagasaki	7C63	KTN Television Nagasaki
Nagasaki	57	4	Nagasaki Culture Telecasting Corporation	7C64	NCC, Nagasaki Culture Telecasting
Nagasaki	57	5	Nagasaki International Television Broadcasting Co.,Ltd	7C65	NIB, Nagasaki International Television
Kagoshima	58	0	NHK G	7C50	NHK G, Kagoshima
Kagoshima	58	1	NHK E	7C51	NHK E, Kagoshima
Kagoshima	58	2	Minaminihon Broadcasting Co.,Ltd	7C52	MBC, Minaminihon Broadcasting
Kagoshima	58	3	Kagoshima Television Station Co.,Ltd	7C53	KTS, Kagoshima Television
Kagoshima	58	4	Kagoshima Broadcasting Corporation	7C54	KKB, Kagoshima Broadcasting
Kagoshima	58	5	Kagoshima Yomiuri Television	7C55	KYT, Kagoshima Yomiuri Television

Table 9-3 TS names 11/11

Region name	Region ID	Areal Providers' identifier	Broadcaster name	TS_id	TS name (Full-width within 10 characters)
Miyazaki	59	0	NHK G	7C40	NHK G, Miyazaki
Miyazaki	59	1	NHK E	7C41	NHK E, Miyazaki
Miyazaki	59	2	Miyazaki Broadcasting Co.,Ltd	7C42	MRT, Miyazaki Broadcasting
Miyazaki	59	3	Miyazaki Telecasting Co.,ltd	7C43	UMK, Miyazaki Telecasting
Oita	60	0	NHK G	7C30	NHK G, Oita
Oita	60	1	NHK E	7C31	NHK E, Oita
Oita	60	2	Oita Broadcasting System, Inc	7C32	OBS, Oita Broadcasting
Oita	60	3	Television Oita System	7C33	TOS, Television Oita
Oita	60	4	Oita Asahi Broadcasting Co,Ltd	7C34	OAB, Oita Asahi Broadcasting
Saga	61	0	NHK G	7C20	NHK G, Saga
Saga	61	1	NHK E	7C21	NHK E, Saga
Saga	61	2	Saga Television Station Co., Ltd	7C22	STS, Saga Television
Okinawa	62	0	NHK G	7C10	NHK G, Naha
Okinawa	62	1	NHK E	7C11	NHK E, Naha
Okinawa	62	2	Ryukyu Broadcasting Corporation	7C12	RBC, Ryukyu Broadcasting
Okinawa	62	4	Ryukyu Asahi Broadcasting Co.,Ltd	7C14	QAB, Ryukyu Asahi Broadcasting
Okinawa	62	7	Okinawa Television Broadcasting CO., LTD	7C17	Okinawa Television (OTV)

Note) Concerning the duplication of the broadcasters in the Hokkaido regional and Hokkaido areal in the table:
Concerning the broadcasters in Hokkaido, it is expected that there will be broadcasters whose broadcasting will start as "Hokkaido regional", then, after establishing a new master for each area will be changed to the Hokkaido areal broadcasting later.

9.2.3 terrestrial_broadcaster_id

The value of the Terrestrial Broadcaster id has to be the same as the value of the network identifier shown in Table 9-1. However,

- Each NHK station binds up together the NHK G and NHK E into one Terrestrial Broadcaster. The value of the Prefectural area broadcast possesses the network identifier of Prefectural NHK E and the Multi-prefectual area broadcast possesses the network identifier of Wide-area NHK E should be same as the id.

- If the same areal broadcaster operates two TS's in the area, the network identifier value of the 2nd TS is the same value as the 1st TS.
- Regarding the Broadcasters in Hokkaido, it is expected that there will be Broadcasters whose broadcasting will start as "Hokkaido Regional", then they will establish a new Master for each area and change to the Hokkaido Areal Broadcasting later. Even in this case, the TS of a new Master will use the same Terrestrial Broadcaster ID as the one being used during "Hokkaido Regional".

9.2.4 affiliation_id

affiliation_id is shown in Table 9-4.

Table 9-4 affiliation_id

affiliation_id	Broadcasters represent grouping
0	NHK G*1
1	NHK E*1
2	Nippon TV Broadcasting network
3	TBS
4	Fuji TV Network Inc
5	TV Asahi
6	TV Tokyo
7	Sun Television Co
8 to 11	Inoperative for the moment*2
12 to 255	Prohibition

*1: Two definitions are for the NHK who binds up the Terrestrial Broadcasters Group all over Japan. One Group id is mainly for NHK G group, and the other Group id is for NHK E group.
*2:However, malfunctioning of the receiver unit should not occur even if the Group id delivered is between 8 and 11.

9.2.5 CA_system_id

0x0005

9.2.6 system_management_id

0x0301

9.2.7 Identifier described in SDTT

(1) original_network identifier

0x7FFF may be used as an original_network identifier described in the SDTT, apart from the network identifier already being used. In this case, it is considered to refer to all the Terrestrial Digital Television Broadcasting.

(2) transport_stream_id

When the original_network identifier value described in SDTT is 0x7FFF, 0xFFFC to 0xFFFF shall be used as the transport_stream_id. Refer to 5.3 of Volume 1 for the operation details of this identifier.

(3) service identifier

As the service identifier described in SDTT, when a Download Contents is not delivered, this identifier is operated at value 0xFFFF. Refer to 5.3 of Volume 1 for the operation details of this identifier.

10 Commentary

10.1 Reference to Audio ES' of the Partial Reception Layer from Services Provided in Layers Other Than the Partial Reception Layer

The current provisions for operations allow to refer to audio ES' carried in the partial reception layer from services provided in layers other than the partial reception layer as the default ES (component tag value is 0x85), but it has been found out that some receiver units do not interpret 0x85 audio ES' as the default ES. Therefore, it has been decided to restrict that audio ES' carried in the partial reception layer cannot be referred as the default Audio ES from services provided in layers other than the partial reception layer for the meantime. Please note this does not restrict referring to audio ES' in the partial reception layer as non-default audio ES from services provided in layers other than the partial reception layer.

It is expected that receiver unit manufacturers will work towards the release of this restriction, but when the restriction is released, broadcasting companies will have to notify of the release to receiver unit manufacturers in advance and then, revise the provisions for operations.

10.2 Deviations between the TOT and the JST When a Leap Second Adjustment is Made

It has been decided that a leap second adustment will be made after an interval of 7 years on January 1st, 2006. The provisions for operations version 2.5 or older says, “the TOT should be transmitted in a way so that the deviations from the JST (Japan Standard Time) are within ±500 ms when standard receiver units receive inputs”, but a leap second adjustment will be made before or after the insertion of leap seconds into the JST, therefore, a maximum deviation of approximately 1.5 seconds from the JST may occur during a few minutes before and after the insertion of leap seconds. Therefore, a new description on deviations between the TOT and the JST when a leap second adjustment is made was added.

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Vol. 8

DIGITAL TERRESTRIAL TELEVISION BROADCASTING

Provisions for Contents Protection

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Basic Concept for the Total System to Protect Contents

To protect contents of digital terrestrial television broadcasting, rules regarding broadcasting signals and receiver unit functions shall be introduced as well as rules regarding interfaces (between receiver units , recorders and other peripheral equipment), and recording media. This means, in other words, to ensure the protection of rights during processes from the signals (contents) to be received by receiver units to transmission or recording, the contents protection information transmitted by broadcasting station shall be reflected on interfaces (between receiver units, recorders and other peripheral equipments),and signals recorded by recording media.

This volume provides provisions for the broadcast signals to be transmitted and receiver unit functions in order to protect contents, including provisions regarding the bound recording and High-Speed Digital Interfaces.

The scramble method for contents protection is not applied to free programs transmitted by the partial reception layer. Such programs require different rules, and are therefore described separately in Part 2.

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Contents

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Part 1

1 Introduction

1.1 Foreword

The contents of digital terrestrial television broadcasting shall be protected in accordance with a part of ARIB standard “Service Information for Digital Broadcasting System” (ARIB STD-B10) and “Receiver for Digital Broadcasting” (ARIB STD-B21).

In addition, more detailed rules are required for actual application of these standards. Since no discrepancies shall be allowed regarding the interpretation of contents protection functions among broadcasters and receiver manufactures, this volume was put together.

Digital terrestrial television broadcasters shall observe the transmission operation rules set out in this volume.

Digital terrestrial receiver manufacturers, on the other hand, shall observe the provisions in this volume and ensure content protection in terms of recording of transmitted signals, outputting such as displaying and storing contents.

It is also desired that enough consideration be given not to allow malfunctions to be caused by signals not specified in this volume.

1.2 Scope

Part 1 of this volume incorporates the transmission operation rules , Compliance Rules and Robustness Rules for receivers concerning the functions for the contents protection of digital terrestrial television broadcasting (except for partial reception),

2 References

(1) "Service Information for Digital Broadcasting System" ARIB STD-B10

(2) "Receiver for Digital Broadcasting" ARIB STD-B21

(3) "Conditional Access of Digital Broadcasting" ARIB STD-B25

3 Definition

The terms used in these provisions are defined as shown below.

Pay Program	Pay Program is defined as the program whose default ES' are chargeable. This means the program whose free_CA_mode described in the SDT and EIT is set to 1.
Free Program	Free Program is defined as the program whose default ES' are non-chargeable. This means the program whose free_CA_mode described in the SDT and EIT is set to 0.
Protected Free Program	Protected Free Program is defined as the free program which is not under customer management but is protected (scrambled) for the purpose of right management.
Content Protection System	Content Protection System is defined as the technology that uses, for example, encryption, to prevent the illegal modification and/or copying of content, for the purpose of right management.
Bound Recording	Bound Recording is defined as the recording function to enable recorded content to reproduce only on the equipment that has recorded the content.
DTCP	Digital Transmission Content Protection : the Content Protection System for transmitting content using a digital interface.
HDCP	High-bandwidth Digital Content Protection System : the Content Protection System for transmitting digital video signal and digital video/audio signal.
No More Copies	No More Copies is defined as the state where content with copy control information indicating that it is originated as Copy One Generation and recorded, therefore no more copies are permitted.
Retention	Retention is defined as temporary storing of content into the bound recording media for the purpose of time-shift viewing.
Move	Move is defined as the transfer of the No more copies content stored in a bound recording media, which involves copying the content to another recording media and then rendering unusable of the original content.
Rendering unusable	Rendering unusable is defined as disabling reproduction, for example, by deleting the contents themselves or by deleting the encryption key.
Internet Retransmission	Internet Retransmission is defined as the transmission of received contents to the Internet, for example, via e-mail or web-based forms.
Local Encryption	Local Encryption is defined as the encryption used for protecting content and/or control signal in case of the bound recording or transmission on the user-accessible bus.
Confidential Information	Confidential Information is defined as the information which affect the safeness of contents protection such as cryptographic algorithms and keys for local encryption, and the information regarding copy control or content protection described in the Digital Copy Control Descriptor or Content Availability Descriptor.
Removable Recording Media	Removable Recording Media is defined as the stand-alone recording media such as tape media or disc media, which can be removed from receiver and can be reproduced on other equipment.
Digital Recording	Digital Recording is defined as the recording content as digital signals on a recording media.
Analog Recording	Analog Recording is defined as the recording content as analog signals on a recording media.
Recording Format	Recording Format is defined as the physical and logical specifications on a recording media, including the rules of recording and playback requirements.

4 Transmission operation rules

4.1 Operation rules for content protection

4.1.1 Operation of Copy Control Information

When copy_control_type of the Digital Copy Control Descriptor is set to '01', operations shall be applied in accordance with the rules specified in Table 4-1.

Table 4-1 Operation rules for content protection

Service	Digital Copy Control Information			EPN
	Copy freely	Copy one generation	Copy never	
Pay per view *1 ● Payment shall be made for viewing a program or a group of programs.	Applicable	Applicable	Applicable	Applicable*3
Pay Television　for example, on a monthly basis ● Flat or as-used basis	Applicable	Applicable	Non-applicable	Applicable*3
Protected Free Program	Applicable	Applicable	Non-applicable	Applicable*3
Other than above*2	Applicable	Non-applicable	Non-applicable	Non-applicable

*1: The pay per view is not in use at present.
*2: Means to free programs whose contents are not protected.
*3: Applicable only when "Copy freely."

- The Digital Copy Control Information in Table 4-1 refers to the digital_recording_control_data information of the Digital Copy Control Descriptor used for copy generation control. (see Vol. 4 of the document)
- EPN in Table 4-1 means the use of the encryption plus non-assertion bit (encryption_mode) of the Content Availability Descriptor to protect the copy freely content from being output to the High-Speed Digital Interface. (see Vol. 4 of the document)

· When copy_control_type of the Digital Copy Control Descriptor is set to '11' and copy control information other than "Copy freely" is used, the output of MPEG_TS is not allowed, as explained in Part 1, Chapter 5 of this volume. In this case, the High-Speed Digital Interface of receiver units only outputs digital audio such as IEC60958 conformant. .

4.1.2 Operation of Descriptors Related to Copy Control

· Regarding the operation of the Digital Copy Control Descriptor and the encryption plus non-assertion bit of the Content Availability Descriptor, digital TV service and special video service shall be provided in accordance with Table 4-2, while data service and special data service shall be provided in accordance with Table 4-3. Combinations not defined in these tables shall not be used.

· For more information on CGMS-A, see Vol. 2 of the document.

· A contract between broadcaster and Macrovision is required to use Macrovision's copy protection technology. For more information, see Vol. 2 of the document.

· Regarding the setting of the contents protection bit indicated by the channel status and the category code specified by IEC60958, see Vol. 4 of the document.

· The resolution limiting bit (image_constraint_token) of the Content Availability Descriptor shall not be used. Image_constraint_token shall always be set to '1'. For more information, see Vol. 4 of the document.

· The Retention control bit (retention_mode) and Retention permitted time (retention_state) of the Content Availability Descriptor shall be fixed for use; more specifically, retention_mode and retention_state shall always be set to '0' and '111' respectively. For more information, see Vol. 4 of the document.

Table 4-2 Operation of Descriptors for Digital TV Service and Special Video Service

<table>
<tr><th rowspan="2">Digital Copy Control</th><th rowspan="2">Analog Copy Control*3</th><th colspan="3">Operation of the Digital Copy Control Descriptor</th><th>Operation of the Content Availability Descriptor</th></tr>
<tr><th>copy_ control_ type</th><th>digital_ recording_ control_ data</th><th>APS_ control_ data</th><th>encryption_ mode *6</th></tr>
<tr><td>Copy freely*5</td><td rowspan="2">Copy freely</td><td rowspan="6">01</td><td rowspan="2">00</td><td rowspan="2">00</td><td>0</td></tr>
<tr><td>Copy freely</td><td>1</td></tr>
<tr><td rowspan="2">Copy never*1</td><td>Copy never without Macrovision protection</td><td rowspan="2">11</td><td>00</td><td>1</td></tr>
<tr><td>Copy never with Macrovision protection *4</td><td>Other than 00</td><td>1</td></tr>
<tr><td rowspan="2">Copy one generation*2</td><td>Copy one generation without Macrovision protection</td><td rowspan="2">10</td><td>00</td><td>1</td></tr>
<tr><td>Copy one generation with Macrovision protection *4</td><td>Other than 00</td><td>1</td></tr>
</table>

*1: When output to the High-Speed Digital Interface, the Copy Never protection of the Source function specified by DTCP shall be applied. When outputting only audio streams in the IEC60958 conformant format, the No More Copies protection shall be applied.
*2: When output to the High-Speed Digital Interface, the Copy One Generation protection of the Source function specified by DTCP shall be applied.
*3: Applicable to composite and component video output. Also applicable to the cases where received video signals are format converted and output. Macrovision copy protection is applied to 480i composite and component video signals.
*4: For more information on analog video output, see Part 1, 5.3 and 5.5.2 in this volume.
*5: When output to the High-Speed Digital Interface, encryption shall be performed in accordance with the DTCP specifications. When output only audio streams in the IEC60958 conformant format, no encryption shall be performed.
*6: In the absence of the Content Availability Descriptor, encryption_mode is assumed to be set to ‘1’.

Table 4-3 Operation of Descriptors for Data Service, Special Data Service and Bookmark List Data Service

<table>
<tr><th rowspan="2">Digital Copy Control</th><th rowspan="2">Analog Copy Control*3</th><th colspan="3">Operation of the Digital Copy Control Descriptor</th><th>Operation of the Content Availability Descriptor</th></tr>
<tr><th>copy_ control_ type</th><th>digital_ recording_ control_ data</th><th>APS_ control_ data</th><th>encryption_ mode *6</th></tr>
<tr><td>Copy freely*5</td><td rowspan="3">Copy freely</td><td rowspan="2">01</td><td rowspan="2">00</td><td rowspan="2">00</td><td>0</td></tr>
<tr><td rowspan="2">Copy freely</td><td>1</td></tr>
<tr><td>11</td><td>00</td><td>00</td><td>1</td></tr>
<tr><td rowspan="2">Copy never*1</td><td>Copy never without Macrovision protection</td><td rowspan="2">01</td><td rowspan="4">11</td><td>00</td><td rowspan="2">1</td></tr>
<tr><td>Copy never with Macrovision protection *4</td><td>Other than 00</td></tr>
<tr><td rowspan="2">Copy never and the output of MPEG_TS is disabled.</td><td>Copy never without Macrovision protection</td><td rowspan="2">11</td><td>00</td><td rowspan="2">1</td></tr>
<tr><td>Copy never with Macrovision protection *4</td><td>Other than 00</td></tr>
<tr><td rowspan="2">Copy one generation*2</td><td>Copy one generation without Macrovision protection</td><td rowspan="2">01</td><td rowspan="4">10</td><td>00</td><td rowspan="2">1</td></tr>
<tr><td>Copy one generation with Macrovision protection *4</td><td>Other than 00</td></tr>
<tr><td rowspan="2">Copy one generation but the output of MPEG_TS is disabled.</td><td>Copy one generation without Macrovision protection</td><td rowspan="2">11</td><td>00</td><td rowspan="2">1</td></tr>
<tr><td>Copy one generation with Macrovision protection *4</td><td>Other than 00</td></tr>
</table>

*1: When output to the High-Speed Digital Interface, the Copy Never protection of the Source function specified by DTCP shall be applied. When output only audio streams in the IEC60958 conformant format, the No More Copies protection shall be applied.
*2: When output to the High-Speed Digital Interface, the Copy One Generation protection of the Source function specified by DTCP shall be applied.
*3: Applicable to composite and component video output. Also applicable to the cases where received video signals are format converted and output. Macrovision copy protection is applied to 480i composite and component video signals.
*4: For more information on analog video output, see Part 1, 5.3 and 5.5.2 in this volume.
*5: When output to the High-Speed Digital Interface, encryption shall be performed in accordance with the DTCP specifications. When outputting only audio streams in the IEC60958 conformant format, no encryption shall be performed.
*6: In the absence of the Content Availability Descriptor, encryption_mode is assumed to be set to ‘1’.

4.2 Operation of the Content Protection System for Broadcasting

4.2.1 Definition of the Content Protection System for Broadcasting

· The content protection system for broadcasting described in Part 1 of this volume means a general system comprised of the scramble system for safely protecting contents carried over broadcast waves and the transmission system for confidential information including key information. Related information is described in Part 1, 7.1 of this volume.

· The content protection system for broadcasting, identified by CA_system_id, is one of the conditional access systems.

4.2.2 Operation of Multiple Content Protection Systems for Broadcasting

· Digital terrestrial television broadcasting can use multiple content protection systems within the same TS. For more information on the operation of multiple content protection systems for broadcasting, see Vol. 5 of the document. (In Vol. 5, this is described as "Operation of Multiple Conditional Access Systems.")

· General information regarding the operation of multiple content protection systems for broadcasting is given below.

- Each system is allowed a CA_system_id.
- Several Conditional Access Descriptors can be placed in the CAT.
- Several Conditional Access Descriptors can be placed in the PMT.
- When several Conditional Access Descriptors are placed in the CAT or PMT, receiver units only read the descriptor of the conditional access system they can handle .These receiver units avoid descriptors of other systems.
- To protect content, an ECM shall always be transmitted. Several Conditional Access Descriptors indicating a valid ECM of CA_system_id shall be placed in the first loop of the PMT.
- Even when several content protection systems are used for broadcasting, content is scrambled with the same scramble key (Ks). In this case, the Ks is transmitted by the each ECM.

4.2.3 Operation of Scramble

· In order to determine whether scramble is used or not in receiver unit, the transport_scrambling_control field in the TS packet header shall be correctly set.
Since free_CA_mode is used to determine whether content is chargeable or free, it does not match the scramble mode. (For example, free_CA_mode set to 0 with Protected Free Program.)

· Whenever components are chargeable or content-protected, the components are not always scrambled in such case that PMT is updated specified in Vol.5 of the document.

· To apply a non-scramble operation with components other than default ES', Conditional Access Descriptors shall be placed in the second loop of the PMT. ECM PID in the descriptor shall be set to 0x1FFF.

· For more information, see Vol. 5 of the document.

4.2.4 Operation of Pay Program, Free Program and Protected Free Program

4.2.4.1 Definition

· Free Program is defined as the program whose default ES' are non-chargeable. Pay Program is defined as the program whose default ES' are chargeable. Protected Free Program is defined as the free program which is not under customer management but is protected (scrambled) for the purpose of right management.

4.2.4.2 Operation

· Regardless of whether scramble is used or not, Free Program shall have free_CA_mode set to 0 and Pay Program shall have free_CA_mode set to 1 in the EIT.

· Regarding Protected Free Program, an ECM shall always be transmitted. In the first loop of the PMT, a valid ECM PID shall be assigned for each CA_system_id.

· Regarding Protected Free Program, no CA Contract Information Descriptor needs to be placed in the SDT or EIT.

· In the case of tier service, Free_CA_mode can be set to 0 in the EIT to make receiver units recognize Protected Free Program as programs can be scheduled to record freely. See Vol. 5 of the document for more information.

4.3 Detailed Information on the Operation of the Content Protection System for Broadcasting

This section provides detailed information on the operation of content protection system for Protected Free Program. Pay Program shall be scrambled based on the conditional access system ruled in Vol. 5 of the document. For more information in this regard, see Vol. 5.

4.3.1 Protection system in accordance with ARIB STD-B25

4.3.1.1 Operation of Protected Free Program in Layers except for the Partial Reception Layer

·"The scrambled Free Program" function described in the ARIB STD-B25 shall be used.

· ECM shall be transmitted. Accordingly, the Conditional Access Descriptor of CA_system_id specified below shall be placed in the first loop of the PMT. To apply a non-scramble operation with components other than default ES', Conditional Access

Descriptors shall be placed in the second loop of the PMT. ECM PID in the descriptor shall be set to 0x1FFF..

· EMMs can be transmitted for the purpose of updating Kw in the case of Protected Free Program. In that case, Conditional Access Descriptor shall be placed in the CAT.

· When using Protected Free Program, Conditional access system identifier and Broadcaster identifier shown below shall be used in order to recognize Protected Free Program.

Conditional access system identifier (CA_system_id): 0x0005

Broadcaster identifier (CA_broadcaster_group_id): 0x1E

4.3.1.2 Operation of the ECM

· For more information on the operation of the ECM based on the ARIB STD-B25, see ARIB STD-B25 and 4.10 in Vol. 5 of the document.

4.3.1.3 Operation of the EMM

· For more information on the operation of the EMM, see 4.11 in Vol. 5 of the document.

4.3.1.4 Operation in the Partial Reception Layer

· ECM and EMM for content protection are not applied to the operation of the partial reception layer, due to non-scramble operation.

5 Compliance Rules for Receiver Units

The receiver unit specified in Part 1, 5.1 of this volume shall not have the following functions for the contents specified for protection by the Digital Copy Control Descriptor and Content Availability Descriptor: [i]the bound recording not specified in Part 1, 5.5 of this volume, [ii]the output function not specified in Part 1, 5.3 of this volume and [iii] the recording function to the removable recordable media not specified in Part 1, 5.6 and 5.7 of this volume. This does not apply to the printed data specified by the functions Part 2, A) and B) of 6.2.1 in Vol. 3 of the document.

5.1 Target Receiver Units

· Digital terrestrial receiver units
If implementing the bound recording in digital terrestrial receiver units, the function shall be implemented in accordance with the rules described in Part 1 of this volume. If implementing the recording function to the removable recordable media, on the other hand, the function shall be implemented in accordance with the rules described in Part 1 of this volume. Related information is provided in Part 1, 7.8.1 of this volume.

·Definition of the recording function to removable recordable media include the recording function via other recordable media (bound recording). Related information is provided in Part 1, 7.8.3 of this volume.

5.2 Copy Control Function and Restricted usage Function

·Copy Control Function and Restricted usage Function shall be controlled by the Digital Copy Control Descriptor and Content Availability Descriptor . In addition , with regard to the copy control information of bound recorded contents, see Part 1, 5.5 in this volume.

5.3 Output Control Rules

5.3.1 Requirements for Output function

· Copy control specified in Vol. 2 of the document shall be applied to the analog video output.

· Copy control shall be applied to the digital audio output in accordance with Table 5-1.

· The analog audio may be output with no restrictions in cases other than where the digital audio output is prohibited in Table 5-1.

· DTCP shall be applied to the protection for High-Speed Digital Interface output.

· DTCP Volume 1, Revision 1.4, and DTCP Volume 1, Supplement E, “Mapping DTCP to IP”, Revision 1.1, shall be applied to the IP interface output. The IP protocol shall be unicast only. The number of streams to be output at a time shall be limited to eight or below for each reception part., This does not apply to the playback output of bound recorded contents. Contents may be transmitted to the IP interface only when the destination IP address of the transmitted packet is in the same subnet as the IP address of the receiver unit.

·Contents may be output to the RGB analog video interface in accordance with the specifications in Vol. 2 of the document. To transmit HD contents those are not Copy freely, the display resolution shall be limited to a maximum of 520,000 pixels per frame. When implementing the RGB output function, it is desirable to use the HDCP compliant digital output that can be content-protected.

· The Copy freely contents may be output through the digital video output or digital video/audio output.

· To output the video and audio which are content-protected by the Digital Copy Control Descriptor and Content Availability Descriptor through the digital video output or digital video/audio output, proper contents protection shall be applied in accordance with the HDCP specifications.

5.3.2 Output control rules by the Digital Copy Control Descriptor and Content Availability Descriptor

· Output control rules applicable to each output terminal in accordance with copy_control_type and digital_recording_control_data of the Digital Copy Control Descriptor and encryption_mode of the Content Availability Descriptor shall be as per Table 5-1.

·The image_constraint_token , retention_mode and retention_state of the Content Availability Descriptor shall be recognized to '1', '0' and '111' respectively regardless of actual bit. For more information, see Vol.4 of the document.

·When DTCP is used in digital TV service, special video service, data service, special data service, or bookmark list data service, DTCP_descriptor shall be inserted.

Table 5-1 Output control rules by the Digital Copy Control Descriptor and Content Availability Descriptor

Digital Copy Control Descriptor		Content Availability Descriptor	High-Speed Digital Interface			Analog Video Output	Digital Audio Output
			Serial interface		IP interface		
copy_ control_ type	digital_ recording_ control_ data	encryption_ mode	MPEG_TS	IEC60958	MPEG_TS		
01	00	1	No encryption	No encryption	No encryption	CGMS-A: 00 Macrovision: off *3	SCMS: Copy freely
		0	Mode B	No encryption	Mode D0	CGMS-A: 00 Macrovision: off *3	SCMS: Copy freely
	10	Don't care	Mode B	Mode B	Mode B0	CGMS-A: 10 Macrovision: off *3	SCMS: Copy one generation
	01 *4	Don't care	Mode C	Mode C	Mode C0	CGMS-A: 11 Macrovision: APS	SCMS: Copy never
	11	Don't care	Mode A	Mode C	Mode A0	CGMS-A: 11 Macrovision: APS	SCMS: Copy never
11 *1	00	Don't care	No encryption	No encryption	No encryption	CGMS-A: 00 Macrovision: off *3	SCMS: Copy freely
	10	Don't care	Output prohibited	No encryption	Output prohibited	CGMS-A: 10 Macrovision: off *3	SCMS: Copy one generation
	01 *4	Don't care	Output prohibited	No encryption	Output prohibited	CGMS-A: 11 Macrovision: APS	SCMS: Copy never
	11	Don't care	Output prohibited	No encryption	Output prohibited	CGMS-A: 11 Macrovision: APS	SCMS: Copy never
10 *5	Don't care	Don't care	Output prohibited	Output prohibited	Output prohibited	Output prohibited	Output prohibited
00 *2	Don't care	Don't care	Output prohibited	Output prohibited	Output prohibited	Output prohibited	Output prohibited
No Descriptor		Don't care	No encryption	No encryption	No encryption	CGMS-A: 00 Macrovision: off	SCMS: Copy freely

*1: Regarding the digital TV service and special video service, the High-Speed Digital Interface output and the output of all the video and audio specified by the document are not allowed.

*2: This is not defined by the document. Also in the case , the High-Speed Digital Interface output and the output of all the videos and audios specified by the document are not allowed.

*3: Macrovision shall be set off regardless of APS_control_data.

*4: These are not defined by the document. In these cases, output shall be transmitted in accordance with this table.

*5: This is not defined by the document. In the case, the High-Speed Digital Interface output, and the output of all the video and audio specified by this document, shall not be transmitted. Output in accordance with Table 5-1, Part 2 may be transmitted.

· For more information on the High-Speed Digital Interface output mode, A to C, see Table 5-2-1 and, for mode A0, B0, C0, and D0, Table 5-2-2 and the DTCP specifications.

· For more information on CGMS-A for the Analog Video Output, see Table 5-3. The APS for the Analog Video Output shall be complied with the APS_control_data value. If digital_recording_control_data is set to '00' or APS_control_data is undefined, APS for the Analog Video Output shall be set to '00'. For more information on CGMS-A and APS, see Vol. 2 of the document.

· For more information on Macrovision, see Vol. 2 of the document.

· SCMS, the abbreviation of the Serial Copy Management System, means the contents protection bit and the copy generation control information in the category code of the channel status specified by IEC60958. For more information, see Vol. 4 of the document.

Table 5-2-1 Definition of the High-Speed Digital Interface Output (Serial interface)

Output Mode	EMI	Definition
Mode A	11	Encryption output Copy-never
Mode B	10	Encryption output Copy-one-generation
Mode C	01	Encryption output No-more-copies
No encryption	00	No encryption Copy-free

Table 5-2-2 Definition of the High-Speed Digital Interface Output (IP interface)

Output Mode	E-EMI	Definition
Mode A0	1100	Encryption output Copy-never
Mode B0	1000	Encryption output Copy-one-generation [Format-non-cognizant recording permitted]
Mode C0	0100	Encryption output No-more-copies
Mode D0	0010	Encryption output Copy-free with EPN asserted
No encryption	0000	No encryption Copy-free

Table 5-3 Definition of CGMS-A

CGMS-A	Definition
11	Copy never
10	Copy one generation
01	(Undefined)
00	Copy freely

5.3.3 Output Control Rules with the Encryption Plus Non-Assertion Bit

· When the Digital Copy Control Descriptor and Content Availability Descriptor are transmitted, the High-Speed Digital Interface output shall be controlled in accordance with Table 5-1 with the encryption plus non-assertion bit of the Content Availability Descriptor and the information of the Digital Copy Control Descriptor.

· When copy_control_type and digital_recording_control_data of the Digital Copy Control Descriptor are set to '01' and '00' respectively, the encryption plus non-assertion bit is enabled. In this case, the High-Speed Digital Interface output shall be encrypted in accordance with Table 5-1. In other cases, the encryption plus non-assertion bit shall be ignored.

· To transmit a partial TS to the High-Speed Digital Interface when the Content Availability Descriptor is transmitted and copy_control_type of the Digital Copy Control Descriptor is set to '01', the EPN bit of DTCP_descriptor shall also be set according to the information of the encryption plus non-assertion bit.

5.4 Internet Retransmission Rules

· Receiver units shall not have the function to enable outputs to retransmission through the Internet, regarding the protected contents with the Digital Copy Control Descriptor and/or the Content Availability Descriptor. The output specified in Part 1, 5.3 of this volume is allowed. For more information, see Part 1, 7.3 of this volume.

· In order not to allow retransmission through the Internet with the user accessible bus and recordable media, contents on the user accessible bus and recordable media shall be managed in accordance with the robustness rules in Chapter 6, Part 1 of this volume.

5.5 Bound Recording

5.5.1 Bound Recording

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '00';Copy freely, contents may be stored with no copy restrictions. When encryption_mode of the Content Availability Descriptor is set to '0', the contents shall be protected as specified in Part 1, 6.2.4.3, of this volume.

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '10' ;Copy One Generation, the copy control information on the recordable media shall be set to "no more copies" specified in Part 1, 5.5.2 of this volume for bound recording. Even when contents are bound recorded as no more copies, it is not required to change to the value of digital_recording_control_data of the Digital Copy Control Descriptor. Regarding the copy control information on the recordable media, see Part 1, 7.2.1 of this volume.

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '10' ;copy one generation, multiple copies shall not be allowed. This does not apply to data storage for backup purpose in the area that is not accessible by users. The above restriction applies to each tuner units. In the case of multiple tuner units, the above restriction is applied respectively.

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '11' ;Copy never, contents shall not be stored using methods other than Retention specified in Part 1, 5.5.3 of this volume.

· For more information on the priority of the Digital Copy Control Descriptor information, see Vol. 4 of the document.

5.5.2 No more copies

· The contents bound recorded as no more copies contents shall not be copied. This does not apply to "move" specified in Part 1, 5.5.4 of this volume.

· To output the contents bound recorded as no more copies contents to the High-Speed Digital Interface, the No More Copies protection specified by the DTCP shall be applied. More specifically, DTCP_CCI of DTCP_descriptor shall be set to No-more-copies and the contents shall be encrypted for output. Regarding the analog video and digital audio outputs, the same process as when digital_recording_control_data in Table 5-1 is set to '11' (i.e. Apply the "Copy never" process to CGMS-A and SCMS) shall be applied. In addition, Macrovision shall be applied when APS_control_data is set to other than '00.'

5.5.3 Retention

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '11' ; copy never, content may be retained up to the maximum allowed retention time.

· When the retention time exceeds the maximum allowed retention time, the contents shall be rendered unusable.

· In principle, contents shall be rendered unusable within one minute after the maximum allowed retention time limit. Even when conditions not to perform accurate time control have occurred such as when power supply to the receiver units is accidentally interrupted, rendering shall be unusable within an <u>appropriate</u> time period. Regarding the rendering unusable of contents, related information is provided in Part 1, 7.2.2 of this volume.

· To output retained contents, the contents shall be encoded and transmitted as Copy never contents. When output to the High-Speed Digital Interface, the Non-Retention-mode specified by the DTCP shall be applied.

5.5.4 Move Function

· If the copy control information after bound recording is set to No more copies, the contents may be moved in accordance with the following conditions.

· The bound recorded content may be moved only to a single built-in recordable media or a digitally connected single recordable media. The move function shall not be used unless output to single recordable media is assured such as analog video output.

· While a move is in progress, it shall be ensured that contents exceeding one minute cannot be playbacked simultaneously at both the move source and destination.

· After a move is completed, it shall be ensured that contents that can be used are not present simultaneously at both the move source and destination. This means, after a move is completed, the contents at the move source shall be rendered unusable. For more information on the rendering unusable of the contents, see Part 1, 7.2.2 of this volume.

· Regarding the output to somewhere other than the move destination during a move operation, Part 1, 5.5.2 of this volume shall be applied.

5.6 Digital Recording with the Removable Recordable media

(1) To receive contents of the digital TV service, special video service, data service, special data service and bookmark list data service, which are copyright-protected by the Digital Copy Control Descriptor and Content Availability Descriptor, and to digitally record these contents to the removable recordable media, the recording formats and contents protection systems for recording described in Appendix B shall be applied.

(2) When digital_recording_control_data of the Digital Copy Control Descriptor is set to ‘10’ ; Copy one generation, more than three copies shall be prohibited. Multiple copies with the same recording format shall be prohibited. This does not apply to digital recording for backup purpose to the area that is not accessible by end users. Related information is provided in Part 1, 7.8.2 of this volume. The recording restriction to the digital recordable media applies to each tuner units. In the case of multiple tuner units, the above restriction applies respectively.

(3) When receiver units include encryption_mode incompliant recording system, the contents which are copyright-protected by copy_control_type and digital_recording_control_data of the Digital Copy

Control Descriptor set to ‘01’ and ‘00’ respectively and encryption_mode of the Content Availability Descriptor set to ‘0’ may be digitally recorded by the recorder in the same manner as Copy One Generation.

(4) The contents which are not copyright-protected by the Digital Copy Control Descriptor and Content Availability Descriptor may be, in principle, digitally recorded in any format. If required conditions applicable to each removable recordable media are listed in Part 1, Appendix B.1 of this volume, the conditions shall be applied.

5.7 Analog Recording with the Removable Recordable media

To make an analog recording of contents of the digital TV service, special video service, data service, special data service and bookmark list data service to the removable recordable media, appropriate copy control shall be applied in accordance with the copy control information described in the Digital Copy Control Descriptor. This means, when copy is prohibited, it shall be ensured that the contents are not recorded to the removable recordable media or that if recorded, proper viewing is not possible during playback. Even if copy is prohibited by the Digital Copy Control Descriptor, analog recording is permitted as long as APS_control_data of the Digital Copy Control Descriptor is set to ‘00’.

6 Robustness Rules for the Receiver Units

6.1Content Protection Robustness Rules

This implementation criteria is defined in order to ensure that receiver units are designed and manufactured in such a way so that the function requirements specified in Part 1, Chapter5 of this volume will be successfully fulfilled by receiver units and that the acts of defeating or bypassing the function requirements will be effectively prevented.

6.1.1 Basic Requirements of Robustness Rules

· Receiver units shall be designed and manufactured in such a way so that the contents protection function including output control and copy control specified as part of compliance rules can not be defeated easily.

· Receiver units shall also be designed and manufactured in such a way so that contents and control signals for Conditional access broadcasting described in Part 1, 6.2.5 of this volume can not be illegally extracted, modified or copied easily.

· Receiver units shall be designed and manufactured in such a way that no piece of confidential information, including cryptographic algorithms used to protect the received contents, can be extracted in a usable manner.

6.1.2 Scope of Protection

·Contents which are copy-controlled by digital_recording_control_data of the Digital Copy Control Descriptor and contents which are copyright-protected by encryption_mode of the Content Availability Descriptor are in the scope of this section..

· The control signals for Conditional access broadcasting described in Part 1, 6.2.5 of this volume are also included in the scope.

6.2 Implementation methods of Robustness Rules

6.2.1 Outline

· Receiver units shall not incorporate the functions that enable defeating or bypassing of the contents protection function specified as part of compliance rule or enable illegal extraction, modification or copying of contents in compressed digital signal format or control signals under protection easily. The examples are as follows:

- A switch, jumper or similar function that enables the bypassing of the protection function.

- Specific wiring (which involves breaking and connecting) that enables the defeating of the protection function.
- Functions such as service menu or remote controller to test the protection function or output control.

Further implementation methods are described in Part 1, 7.4 of this volume.

6.2.2 Content Output

·The content under protection, which is specified in Part 1, 6.1.2 of this volume, is allowed to output in accordance with Part 1, 5.3 of this volume.

· The contents encrypted using local encryption method specified in Part 1, 6.2.4 of this volume may be output in compressed digital signal form to the user accessible bus under protection. Further information is described in Part 1, 7.5 of this volume.

6.2.3 Storing Contents

· In accordance with the compliance rules for receiver units described in Part 1, Chapter 5 of this volume, items under protection specified in Part 1, 6.1.2 of this volume may be stored in the recording media, only if they are encrypted using local encryption described in Part 1, 6.2.4, of this volume, or are protected with a method which prevents illegal extraction or copy by the user. Actual method of implementation is described in Part 1, 7.4.2, of this volume.

6.2.3.1 Prohibition of the Re-use of the Copy

· It shall be ensured that a content which is copied from the storage, even in bit-by-bit manner, is not usable.. Further information regarding the prohibition of the re-use of the copied contents is described in Part 1, 7.6 of this volume.

6.2.3.2 Timer Management for Retention

·Timer function for retention shall have appropriate accuracy and be protected from user access.

6.2.3.3 Management of Other Information

· When the information of copy and use restrictions described in ~~the~~ Digital Copy Control Descriptor or Content Availability Descriptor or the information of copy and use restrictions generated from these information is stored on the recording media , encryption or other similar methods shall be applied to protect from the modification by end users. Examples of prohibited actions are described in Part 1, 7.7 of this volume.

6.2.4 Local Encryption

Cryptographic algorithms, and keys for encryption, shall be handled appropriately to prevent from user access, whenever local encryption is used for the output of contents under protection (Part 1, 6.1.2, of this volume) to the user accessible bus specified in Part 1, 6.2.2 of this volume, or for the storing of such contents in the recording media, as specified in Part 1, 6.2.3, of this volume.

6.2.4.1 Strength of Local Encryption

Local encryption shall be equal or stronger than common key encryption with a 56-bit long key, and use cryptographic algorithms (for example, DES) that can guarantee sufficient safety.

6.2.4.2 Key Management

The keys used for content encryption shall not be extracted from the receiver unit or user accessible bus or stored in the recording media without protection.

Secure key management such as the use of unique receiver key or key derived receiver's unique information shall be used, in order to ensured the playback of the content is disabled, when the recording media is connected to other receiver units or other equipment, or when contents are illegally copied onto the recording media of other equipment.

6.2.5 Control Signals for Conditional Access Broadcasting

ECM, EMM and IC card interface signals shall not be output to user accessible buses except for the interfaces specified by ARIB STD-B25 in plain text nor be output to any external interface. This does not apply to signals not related to decoding of broadcast signals such as EMM messages.

7 Commentary

7.1 Content Protection System for Broadcasting

7.1.1 Differentiated Terms of “the Content Protection System for Broadcasting” and “the Conditional Access System”

While the conditional access system is aimed at controlling viewing the broadcasting programs by viewers, the content protection system for broadcasting is originally aimed at safely transmitting contents over broadcast waves and enabling receivers to perform control in compliance with the provisions in the document. Part 1 of this volume used an expression to differentiate “the content protection system for broadcasting” from “the conditional access system”. This means that “the content protection system for broadcasting”, unlike “the conditional access system”, does not necessary involve viewing control for each viewer. Therefore, even when an exclusive content protection system is introduced in the future, “the conditional access system” and “the content protection system for broadcasting” may not necessarily be the same. Based on this precondition, this volume differentiated the two terms.

7.1.2 Operation of Several Content Protection Systems for Broadcasting

To protect the contents of digital terrestrial broadcasting, this document introduced the conditional access system in compliance with ARIB STD-B25. However, in anticipation of future introduction of an exclusive content protection system more suited for content protection than the conditional access system, the rules were set out in such a way to allow the operation of several conditional access systems for the purpose of allowing the introduction of the exclusive content protection system.

When the provisions were prepared, the main focus was placed on ensuring that even when several Conditional Access Descriptors are used when the exclusive content protection system is introduced, receivers produced at the initial stage of digital broadcasting start will not operate incorrectly. Since the rules and the operation guidelines regarding the exclusive content protection system will be established through future reviews, this document did not include the description of the exclusive content protection system but instead stated that several Conditional Access Descriptors can be placed in the CAT and PMT. For more information, see Vol. 5 of the document, which includes relevant information.

For reference, see also A.1 in Vol. 5 of the document, which includes relevant information such as the relationship between the STD-B25 compliant systems and the exclusive content protection system anticipated for introduction in the future.

Receivers released for sale when digital broadcasting starts are assumed to only incorporate the ARIB STD-B25 compliant conditional access system. To enable the viewing of Protected Free Programs on these receivers when the exclusive content protection system is introduced in the future, it shall be ensured, as shown by the image below, that both the Ks in the ARIB STD-B25 compliant ECM and the Ks in the ECM of the exclusive content protection system are the same.

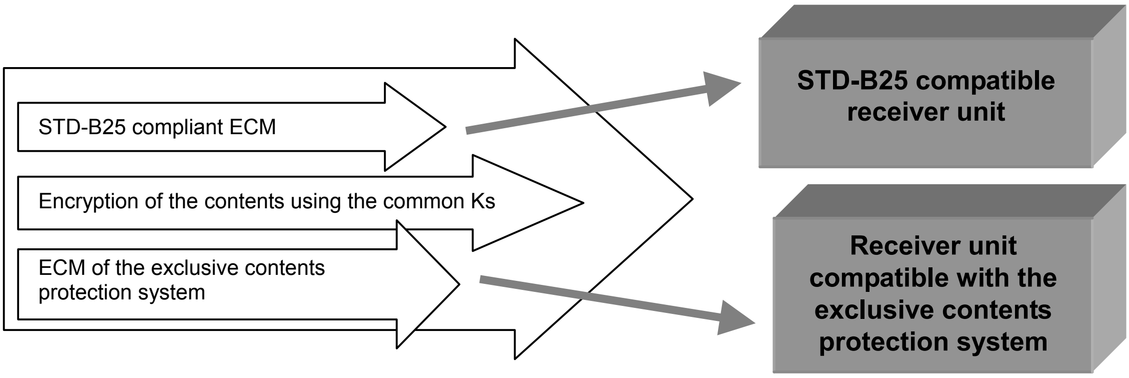

Fig. 7-1 An Image of Operating Several Conditional Access Systems for Content Protection

7.2 Bound recording of Contents

7.2.1 Copy Control Information on the Recording Media

The copy control information on the recording media described in Part 1, 5.5.1 of this volume refers to the information used for copy control of contents stored on the recording media. The copy control information is required to at least identify two status types, the Copy fFreely" status and the No m cMore Copies" status. When installing the temporary bound recording, it is required to identify three status types, including the Retention status.

7.2.2 Rendering unusable of the Contents

Retention shall involve at least minute-by-minute management of the contents, and in principle, the rendering shall be unusable within one minute after the maximum allowed retention time limit. If the maximum allowed retention time is ninety minutes (90 minutes), for example, the rendering of the content received (stored) at 1:00 and 1:01 shall be unusable by 2:31 and 2:32 respectively.

A Move action shall also involve at least minute-by-minute management of the contents, and in principle, the rendering of the contents at the copy source shall be unusable within one minute after copying.

7.3 Restrictions Regarding Internet re-transmission

The output that may lead to re-transmission to the Internet described in Part 1, 5.4 of this volume means the output terminals that have possibilities to output to the Internet or the equipment connectable to the Internet, such as modems and LAN interfaces.

7.4 Implementation Methods to Observe the Robustness Rules for the Content Protection

Implementation methods to observe the Robustness Rules for the content protection described below is based on the level of resistance that cannot defeat or bypass the content protection functions by end users using generally available tools or technologies.

7.4.1 Function Configuration of the Receivers

In each internal component of the receivers (regardless of whether it is an integrated circuit, software module or complex of both) the contents and control signals that are needed for protection described in Part 1, 6.1.2 of this volume shall be appropriately protected against illegal access or copying. The content protection function including output control and copy control as part of function requirements or the MPEG decoder or other components of the receiver shall be designed and manufactured in a way not to allow illegal actions such as defeating or bypassing by implementing exclusive components, which are coupled or integrated components.

7.4.2 Level of Content Protection

Core functions for content protection including the encryption function, decoding function and cryptographic algorithms shall not be easily defeated or bypassed by using general-purpose tools or equipment that are widely available at a reasonable price, such as screwdrivers, jumpers and soldering irons or using electronic tools or software tools that are widely available at a reasonable price, such as EEPROM readers and writers, debuggers or decompilers.

7.5 User Accessible Bus

When the protection targets described in Part 1, 6.1.2 of this volume are transmit to any user accessible buses, they shall be encrypted by local encryption mentioned in Part 1, 6.2.4 of this volume or protected to the same extent as the output mentioned in Part 1, 5.3 of this volume. Alternatively, similar protection shall be applied before output.

A user accessible bus needed for protection means digitally connected interface bus from which users can easily access signals, such as PCI bus, IDE bus, SCSI bus and PCMCIA interface bus that has standard sockets whose specifications are publicly available.

A user accessible bus does not include memory buses, CPU buses and other buses that are difficult to access by end users.

7.6 Prohibition of the Re-use of the Copy

Any bound recorded contents that are encrypted by local encryption specified by Part 1, 6.2.4 of this volume, cannot be used on other equipment even if the contents are copied by bit-by-bit copying. Appropriate implementation to disable re-use coping shall be taken to prevent illegal actions including the following: several copies may be illegally generated by moving the contents from the copy source after they are copied onto another recording media (e.g., back-up copy) and then returning the contents copied to where they were originally located and moving the contents again.

7.7 Other Examples of Actions that shall be Prohibited Regarding Information Control

The examples of actions that shall be prohibited to prevent users from adding modifications described in Part 1, 6.2.3.3 of this volume include the modification of digital_recording_control_data in the Digital Copy Control Descriptor and the copy control information in DTCP_descriptor and the copy control information on the recording media; more specifically, changing Copy never and No more copies to Copy freely and Copy one generation in order to enable copying or changing Copy one generation to Copy freely in order to enable unconditional copying.

7.8 Digital Recording of Contents to the Removable Recording Media

7.8.1 Where to Contact to Have Systems Approved

To use a content protection system or recording format for the removable recording media, except for those listed in Table B-1, Appendix B, Part 1 of this volume, the approval by the following organization shall be obtained.

Contact: Secretariat of Engineering, The Association for Promotion of Digital Broadcasting (D-PA)

URL: http://www.d-pa.org/english/index.html

7.8.2 Limit to the Number of Copies that can be Recorded to the Removable Recording Media

The limit to the number of copies specified in this volume here does not apply to bound recorded contents described in Part 1, 5.5 of this volume. Recording for backup purpose is designed to restore contents when the media or drive is damaged and the contents recorded for backup purpose cannot be accessed by end users for purposes except for restoration. One example of this is the RAID system that records data on redundant hard disks to improve data safety.

7.8.3 Recording Function to the Removable Recording Media

Receivers with tThe recording function to the removable recording media are assumed to introduce the digital recording method to reproduce the contents on the removable recording media by using the contents which are received and bound-recorded, as well as to record received contents directly to the removable recording media. The rules described in Part 1 of this volume also apply to receivers implemented such functions.

7.9 Security of Wireless LAN

Regarding the security of wireless LAN, relevant specifications are described in “4.2 Guidelines concerning the Setting of Security Functions for Wireless LAN Equipment”, Guidelines concerning the Wireless LAN Security, Japan Electronics and Information Technology Industries Association (JEITA).

Appendix A: Certification Criteria for the Recording Format and Contents Protection System for Recording

The contracts concluded between the manufacturers (including sellers) of digital content recorders and all equipment that can playback recorded contents and the licensors of recording formats and contents protection system for recording shall clearly indicate the effect that the manufacturers (including sellers) have the obligation to observe the certification criteria shown below.

(1) Basics of copy control: Appropriate copy control shall be used in accordance with the copy control information specified by the Digital Copy Control Descriptor and Content Availability Descriptor.

(2) Inheritance of the copy control information: The copy control information described above shall, in principle, be inherited after recording and become valid during playback.

(3) Protection during recording: The contents protected by the Digital Copy Control Descriptor or Content Availability Descriptor shall be recorded in the state where they are appropriately protected by encryption.

(4) Protection during playback: The contents protected by the Digital Copy Control Descriptor or Content Availability Descriptor shall also be protected during playback and outputs.

(5) Restrictions regarding Internet retransmission: The contents protected by the Digital Copy Control Descriptor or Content Availability Descriptor shall not be output to the terminals that may make the retransmission of the contents in an unprotected state to the Internet.

(6) Compliance Rule: Receiver units shall functionally be so built as to prevent the acts of bypassing or disabling the contents protection function or the acts of easily illegally extracting, modifying and copying the contents in the compressed digital signal format or control signals that shall be protected.

Appendix B: Contents Protection Systems Applicable to the Removable Recording Media that may be implemented in Receiver Units to which Part 1 of this Volume is applied

- The contents protection systems and recording formats applicable to the removable recording media, which may be implemented in the receiver to which Part 1 of this volume are shown in Table B-1.
- Regarding the implementation of each contents protection systems, receiver unit manufacturer shall make inquiries with relevant licensors.
- In Table B-1, "TV service" in "Targeted services" means the digital TV service and special video service, and "the data service" means the digital data service, special data service and bookmark list data service, respectively.

B-1 Contents Protection Systems Applicable to the Removable Recording Media that may be Implemented in Receiver Units

System No	Certification Item	Certification Detail
1	Contents protection system or recording format	Content Protection System for Blu-ray Disc Rewritable (CPS for BD-RE)
	Targeted media (Recording format)	Blu-ray Disc Rewritable Format Ver1.0
	Targeted services	TV service and data service
	Licensor name	Royal Phillips Electronics Matsushita Electric Industrial Co., Ltd. Sony Corp.
	Whom to contact	http://www.blu-raydisc.info
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.1.
2	Contents protection system or recording format	D-VHS
	Targeted media (Recording format)	D-VHS cassette tape
	Targeted services	TV service and data service
	Licensor name	Victor Company of Japan, Ltd.
	Whom to contact	VHS Standardization Center of Victor Company of Japan, Ltd.
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.2.
3	Contents protection system or recording format	Content Protection for Recordable Media (CPRM)
	Targeted media (Recording format)	DVD-RAM, DVD-R and DVD-RW *1 (Video Recording Format)
	Targeted services	TV service and data service

	Licensor name	4C Entity LLC Intel Corporation International Business Machines Corporation Toshiba Corporation Matsushita Electric Industrial Co., Ltd.
	Whom to contact	http://www.4centity.com/
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.3.
4	Contents protection system or recording format	MagicGate Type-R for Secure Video Recording(MG-R(SVR))for Memory Stick PRO *2
	Targeted media (Recording format)	Memory Stick PRO, Memory Stick PRO DUO, and Memory Stick Micro (Memory Stick Secure Video File Format)
	Targeted services	TV service and data service
	Licensor name	Sony Corporation
	Whom to contact	http://www.memorystick.org
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.4
5	Contents protection system or recording format	MagicGate Type-R for Secure Video Recording (MG-R (SVR))for Hi-MD *3
	Targeted media (Recording format)	Hi-MD (Hi-MD Video File Format)
	Targeted services	TV service and data service
	Licensor name	Sony Corporation
	Whom to contact	Sony Intellectual Property Solutions Corporation
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.5
6	Contents protection system or recording format	Content Protection for Recordable Media (CPRM)
	Targeted media (Recording format)	SD memory card (SD-Video)
	Targeted services	TV service and data service
	Licensor name	4C Entity LLC Intel Corporation International Business Machines Corporation TOSHIBA CORPORATION Matsushita Electric Industrial Co., Ltd.
	Whom to contact	http://www.4centity.com/
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.6
7	Contents protection system or recording format	Video Content Protection System (VCPS) *4

	Targeted media (Recording format)	DVD + RW (DVD+RW Video Format), DVD + R, DVD + R Dual Layer (DVD+R Video Format)
	Targeted services	TV service and data service
	Licensor name	Royal Philips Electronics Hewlett-Packard Company
	Whom to contact	http://www.licensing.philips.com
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.7
8	Contents protection system or recording format	MagicGate Type-R for Secure Video Recording (MG-R (SVR))for EMPR *5
	Targeted media (Recording format)	EMPR Type I and EMPR Type II (EMPR Video File Format)
	Targeted services	TV service and data service
	Licensor name	Sony Corporation
	Whom to contact	Sony Intellectual Property Solutions Corporation
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.8
9	Contents protection system or recording format	Security Architecture for Intelligent Attachment device (SAFIA)
	Targeted media (Recording format)	iVDR Hard Disk Drive (TV Recording Specification)
	Targeted services	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.7
	Licensor name	SANYO Electric Co., Ltd. Sharp Corporation Pioneer Corporation Hitachi, Ltd.
	Whom to contact	http://www.safia-lb.com
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.9
10	Contents protection system or recording format	Advanced Access Content System (AACS)
	Targeted media (Recording format)	HD DVD Recordable/Rewritable (HD DVD Video Recording Format)
	Targeted services	TV service and data service

	Licensor name	Advanced Access Content System License Administrator, LLC (AACS LA, LLC), Disney Technology Operations and Licensing, Intel GF Inc., International Business Machines Corporation, Microsoft Corporation, Panasonic Intellectual Property Corporation of America, SCA IPLA Holdings, Inc. (“Sony”), Toshiba America Information Systems, Inc., Warner Bros. Entertainment, Inc.
	Whom to contact	http://www.aacsla.com/
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.10
11	Contents protection system or recording format	Advanced Access Content System (AACS)
	Targeted media (Recording format)	Blu-ray Disc Rewritable Media/Blu-ray Disc Recordable Media (Blu-ray Disc Rewritable Format Ver 2.0/Blu-ray Disc Recordable Format Ver 1.0)
	Targeted services	TV service and data service
	Licensor name	Advanced Access Content System License Administrator, LLC (AACS LA, LLC), Disney Technology Operations and Licensing, Intel GF Inc., International Business Machines Corporation, Microsoft Corporation, Panasonic Intellectual Property Corporation of America, SCA IPLA Holdings, Inc. (“Sony”), Toshiba America Information Systems, Inc., Warner Bros. Entertainment, Inc.
	Whom to contact	http://www.aacsla.com/
	Required Condition	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.11

*1: Unabbreviated formal names are as follows.
DVD-RAM: Digital Versatile Disc – Rewritable
DVD-R: Digital Versatile Disc – Recordable
DVD-RW: Digital Versatile Disc – Re-recordable

*2: The license name of this contents protection system is “Memory Stick PRO -Secure Video Recording Format- Content Protection License.”

*3: This contents protection system is provided by concluding the two license contracts of “Hi-MD -Secure Video Recording Format- Content Protection License” and “VIDEO ADDENDUM to the Hi-MD -Secure Video Recording Format- Content Protection License.”

*4: This contents protection system is provided by concluding “Video Content Protection System Agreement” and “DVD+RW/+R Recorder Content Protection Agreement.”

*5: The license name of this contents protection system is "Embedded Memory with Playback and Recording Function -Secure Video Recording Format- Content Protection License."

B.1 Required Conditions when Implementing the Contents Protection System for Recording

B.1.1 Required Conditions when Implementing the Content Protection System for Blu-ray Disc Rewritable

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the content protection system for blu-ray disc rewritable is shown in Table B-1.1.

Table B-1.1 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the Copy Control Using the Content Protection System for Blu-ray Disc Rewritable

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using CPS for BD-RE and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Recording is permitted as Copy freely (Copy Control Not Asserted).*4
		0	Recording is permitted as Copy freely. Encryption Plus Non-Assertion (EPN) applies. *4
	10	Don't care	Recording is permitted as Copy one generation (Updated to No More Copy for recording) *3
	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Recording is enabled under the condition that Copy freely (Copy Control Not Asserted). *4
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Recording is permitted as Copy freely (Copy Control Not Asserted). *4

*1 These are not defined by TR-B14.
If these combinations is used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APS in the private data byte of the copy status descriptor, as specified by the CPS for BD-RE (hereafter "APS of CPS for BD-RE").

*4: The APS_control_data shall be recognized as 00. Alternatively, the value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APS of CPS for BD-RE.

B.1.2 Required Conditions when Implementing the D-VHS System

(1) To record received contents by the D-VHS recorder, Copy_control_descriptor described in "D-VHS MPEG Transport Stream Service Information Specification (newer than 2001.02.06 Ver.1.0-)" issued by the licensors shall be inserted. Regarding the DTCP_CCI and APS in the Copy_control_descriptor, the digital_recording_control_data and the APS_control_data in the Digital Copy Control Descriptor shall be inherited. Regarding the EPN, the encryption_mode in the Content Availability Descriptor shall be inherited.

(2) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the D-VHS system is shown in Table B-1.2.

Table B-1.2 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the Copy Control Using the D-VHS System

<table>
<tr><th colspan="2">Digital Copy Control Descriptor</th><th>Content Availability Descriptor</th><th rowspan="2">Whether or not digital recording is possible using the D-VHS system and copy control</th></tr>
<tr><th>copy_control_type</th><th>digital_ recording_ control_data</th><th>encryption_ mode</th></tr>
<tr><td rowspan="5">01</td><td rowspan="2">00</td><td>1</td><td>Permitted to record as Copy freely.</td></tr>
<tr><td>0</td><td>Permitted to record as Copy one generation (The CGMS information in the format information area of the D-VHS standard is updated to Copy restricted for recording)*3</td></tr>
<tr><td>10</td><td>Don't care</td><td>Permitted to record as Copy one generation (The CGMS information in the format information area of the D-VHS standard is updated to Copy restricted for recording)*3</td></tr>
<tr><td>01*1</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td>11</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td rowspan="4">11 *2</td><td>00</td><td>Don't care</td><td>Permitted to record as Copy freely (Copy Control Not Asserted).</td></tr>
<tr><td>10</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td>01 *1</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td>11</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td>10, 00 *1</td><td>Don't care</td><td>Don't care</td><td>Copy never</td></tr>
<tr><td colspan="2">No descriptors</td><td>Don't care</td><td>Permitted to record as Copy freely (Copy Control Not Asserted).</td></tr>
</table>

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: The definitions of the CGMS information (2 bits) are as shown in Table B-1.3. This is in compliance with the CGMS-D bit definitions listed in the Standard Information “TR C 0011” of the Japanese Industrial Standards Committee. For more information, for example, on the recording location of the CGMS information, according to the D-VHS standard, see also “TR C 0011.”

Table B-1.3 Definition of the CGMS Information According to the D-VHS Standard

CGMS	Definition
00	Copy permitted
01	Reserved
10	One generation of copy permitted
11	Copy restricted

B.1.3 Required Conditions for Implementing Content Protection for the Recordable Media (CPRM)

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control when using the CPRM is shown in Table B-1.4.

Table B-1.4 Correspondence between the Digital Recording Control
Using the Digital Copy Control Descriptor and Content Availability Descriptor
and the Copy Control When Using the CPRM

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using the CPRM and copy control
copy_control_type	digital_ recording_ control_data	encryption_ mode	
01	00	1	Permitted to record *3,*6 as Copy freely (“Copy freely” is specified for the CGMS and EPN of RDI Packs*5).
		0	Permitted to record as *4 Copy one generation (Updating the CGMS and EPN of RDI Packs*5 to No more copies for encrypted recording)*3,*7 or under the condition of Encryption Plus Non-Assertion (EPN) (Updating the CGMS and EPN of RDI Packs*5 to Protected using CPRM, but copy control restrictions not asserted for encrypted recording)*3,*6.
	10	Don’t care	Permitted to record as copy one generation (Updating the CGMS and EPN of RDI Packs*5 to No more copies for encrypted recording) , *3,*8

	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Permitted to record as *3,*6. Copy freely ("Copy freely" is specified for the CGMS and EPN of RDI Packs*5).
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Permitted to record as *3,*6. Copy freely ("Copy freely" is specified for the CGMS and EPN of RDI Packs*5).

*1 These are not defined by TR-B14.
If these combinations is used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: For more information on CGMS and EPN definitions, see Table B-1.5.

*4: "Copy one generation" or "EPN" shall be selected according to the specification of the recording equipment,.

*5: See the "CPRM Specification DVD book Revision 0.96 (or newer versions)" issued by the licensors.

*6: The APSTB of RDI Packs*5 shall either inherit the value of the APS_control_data in the Digital Copy Control Descriptor, or be set to 00.

*7: The APSTB of RDI Packs*5 shall be set to 00.

*8: The APSTB of RDI Packs*5 shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor.

Table B-1.5 Definitions of CGMS and EPN information When Using the CPRM

CGMS	EPN*9	DCI_CCI Verification Data*10 verified?	Definition
00	-	-	Copy freely
11	0	-	No more copies
11	1	No	No more copies
11	1	Yes	Protected using CPRM, but copy control restrictions not asserted

*9: The EPN has a logic setting reversed to encryption_mode of the Content Availability Descriptor.

*10: See the "CPRM Specification DVD book Revision 0.96 (or newer versions)" issued by the licensors.

B.1.4 Required Conditions when Implementing MagicGate Type-R for Secure Video Recording (MG-R (SVR))for Memory Stick PRO

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the MG-R (SVR) for Memory Stick PRO is shown in Table B-1.6.

Table B-1.6 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the MG-R (SVR) for Memory Stick PRO

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using MG-R (SVR) for Memory Stick PRO and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as Copy freely (Copy Control Not Asserted).*4
		0	Permitted to record as Copy freely. Encryption Plus Non-Assertion (EPN) (Protection_required) applies. *4
	10	Don't care	Permitted to record as Copy one generation (Updated to No More Copy for recording) *3
	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4

*1 These are not defined by TR-B14.
If these combinations is used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APSTB.

*4: The APSTB is shall be recognized as 00.

B.1.5 Required Conditions when Implementing MagicGate Type-R for Secure Video Recording (MG-R (SVR))for Hi-MD

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the MG-R (SVR) for Hi-MD is shown in Table B-1.7.

Table B-1.7 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the MG-R(SVR) for Hi-MD

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using MG-R (SVR) for Hi-MD and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as Copy freely (Copy Control Not Asserted).*4
		0	Permitted to record as Copy freely. Encryption Plus Non-Assertion (EPN) (Protection_required) applies. *4
	10	Don't care	Permitted to record as Copy one generation (Updated to No More Copy for recording) *3
	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.
*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.
*3: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APSTB.
*4: The APSTB is shall be recognized as 00.

B.1.6 Required Conditions when Implementing Content Protection for Recordable Media (CPRM)

SD-Video

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the CPRM SD-Video is shown in Table B-1.8.

Table B-1.8 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the CPRM SD-Video

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using CPRM SD-Video and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as Copy freely (Not encrypted).*3
		0	Recording is permitted as “Encryption Plus Non-Assertion (EPN)” (Encrypted recording in the status of “EPN asserted[*3]”).[*4]
	10	Don’t care	Permitted to record as “Copy One Generation” (Encrypted recording by updating to the status of “Copy is never permitted[*3]” after recording)[*5]
	01*1	Don’t care	Copy never
	11	Don’t care	Copy never
11 *2	00	Don’t care	Permitted to record as Copy freely (Not encrypted). *3
	10	Don’t care	Copy never
	01*1	Don’t care	Copy never
	11	Don’t care	Copy never
10, 00 *1	Don’t care	Don’t care	Copy never
No descriptors		Don’t care	Recording is enabled under the condition that Copy freely (Not encrypted). *3

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: Regarding the “Not encrypted”, “EPN asserted”, and “Copy is never permitted”, see Table B-1.9.

*4: The APSTB shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor, alternatively be set to 00 (APS is off).

*5: The APSTB shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor.

Table B-1.9 Copy Control Field of the CPRM SD-Video

<table>
<tr><th colspan="2">Normal area</th><th colspan="2">Authorization area</th><th rowspan="2">Significance</th></tr>
<tr><th>Field</th><th>Value</th><th>Field</th><th>Value</th></tr>
<tr><td rowspan="7">TkureIndex[*6], MOTkureIndex[*6]</td><td rowspan="6">Either of the two has the index value of TKURE[*6] (not 0)</td><td rowspan="2">CCCI[*6]</td><td>0000</td><td>Copy is never permitted.</td></tr>
<tr><td>1111</td><td>Copy is permitted unlimited times (EPN asserted)</td></tr>
<tr><td rowspan="4">APSTB[*6]</td><td>00</td><td>APS is Off</td></tr>
<tr><td>01</td><td>Type 1 of APS is On</td></tr>
<tr><td>10</td><td>Type 2 of APS is On</td></tr>
<tr><td>11</td><td>Type 3 of APS is On</td></tr>
<tr><td>Both are set to 0</td><td colspan="2"></td><td>Not encrypted</td></tr>
</table>

*6: See “CPRM Specification SD Memory Card Book, SD Video Part, Revisions 0.92 and after”, issued by the licensor.

B.1.7 Required Conditions when Implementing Video Content Protection System (VCPS)

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the VCPS is shown in Table B-1.10.

Table B-1.10 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the VCPS

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using VCPS and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as Copy freely.*6*7
		0	Permitted to record as EPN=1. *4*6
	10	Don't care	Permitted to record as Copy one generation (The CGMS is updated to The associated AV Sectors may not be copied for recording)*3*5
	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Permitted to record as Copy freely. *6*7
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Permitted to record as Copy freely*6*7

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.
*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.
*3: For the definition of Copy Generation Management System (CGMS), see Table B-1.11.
*4: For the definition of Encryption Plus Non-Assertion (EPN), see Table B-2.12. The EPN is valid while the CGMS is set to 00.
*5: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited.
*6: The APS_control_data is shall be recognized as 00. Alternatively, the value of APS_control_data in the Digital Copy Control Descriptor shall be inherited. For the definition of APS, see Table B-2.13.
*7: Encryption by VCPS is not permitted in recording.

Table B-1.11 Definition of the CGMS* Information According to the Video Content Protection System

CGMS	Definition
00	The associated AV Sectors may be copied without restriction.
01	Reserved
10	Reserved
11	The associated AV Sectors may not be copied.

*The CGMS includes 1/2 CGMS, enabling multiplex writing.

Table B-1.12 Definition of the EPN* Information According to the Video Content Protection System

EPN	Definition
0	The associated AV Sectors are not encrypted.
1	The associated AV Sectors are encrypted.

*The EPN includes 1/2 EPN, enabling multiplex writing.

Table B-1.13 Definition of the APS* Information According to the Video Content Protection System

APS	Definition
00	APS is Off
01	Type 1 of APS is On
10	Type 2 of APS is On
11	Type 3 of APS is On

B.1.8 Required Conditions when Implementing MagicGate Type-R for MagicGate Type-R for Secure Video Recording (MG-R (SVR)) for EMPR

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the MG-R (SVR) for EMPR is shown in Table B-1.14.

Table B-1.14 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the MG-R (SVR) for EMPR

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using MG-R (SVR) for EMPR and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as Copy freely (Copy_control_not asserted).*4
		0	Permitted to record as Copy freely. Encryption Plus Non-Assertion (EPN) (Protection_required) applies. *4
	10	Don't care	Recording is permitted as Copy one generation (Updated to No More Copy for recording). *3
	01*1	Don't care	Copy never
	11	Don't care	Copy never
11 *2	00	Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4
	10	Don't care	Copy never
	01*1	Don't care	Copy never
	11	Don't care	Copy never
10, 00 *1	Don't care	Don't care	Copy never
No descriptors		Don't care	Permitted to record as Copy freely (Copy Control Not Asserted). *4

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APSTB.

*4: The APSTB is shall be recognized as 00.

B.1.9 Required Conditions when Implementing MagicGate Type-R for Security Architecture for Intelligent Attachment device (SAFIA)

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the SAFIA is shown in Table B-1.15.

Table B-1.15 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the SAFIA

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using SAFIA and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as “Copy freely” (No encryption)[*4].
		0	Permitted to record as “Encryption Plus Non-Assertion (EPN)” (Encrypted recording in the status of “Copy control not asserted[*3]”).[*4]
	10	Don’t care	Permitted to record as “Copy Enabled for One Generation Only” (Encrypted recording by updating to the status of “No more copy[*3]” after recording)[*5]
	01 [*1]	Don’t care	Copy never
	11	Don’t care	Copy never
11 [*2]	00	Don’t care	Permitted to record as “Copy freely” (No encryption)[*4].
	10	Don’t care	Copy never
	01 [*1]	Don’t care	Copy never
	11	Don’t care	Copy never
10, 00 [*1]	Don’t care	Don’t care	Copy never
No descriptors		Don’t care	Permitted to record as “Copy freely” (No encryption)[*4].

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: Record as contents of Usage Pass Type = 1 (TV Recording), Content Type = 0 (Audiovisual). Regarding the “Copy control not asserted”, and “No more copy”, see Table B-1.16.

4: The APS of the Copy Control Descriptor shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor, alternatively, be set to 00 (APS Off).

*5: The APS of the Copy Control Descriptor shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor.

Table B-1.16 Copy Control Field

Playback Information Type	Generation Count	Significance
0x00	-	No encryption
0x01	0xF	Copy control not asserted (EPN asserted)
	0x1	Copy one generation
	0x0	No more copy

B.1.10 Required Conditions when Implementing MagicGate Type-R for Advanced Access Content System (AACS) [HD DVD]

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the AACS is shown in Table B-1.17. (HD DVD)

Table B-1.17 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the AACS (HD DVD)

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using AACS (HD DVD) and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01	00	1	Permitted to record as “Copy freely” (Copy Freely the Primitive CCI[*3])[*4*6].
		0	Permitted to record as “Encryption Plus Non-Assertion (EPN)” (Encrypted recording by updating the Primitive CCI[*3] to “Protection using AACS, but copy control restrictions not asserted without redistribution”[*4*6].
	10	Don’t care	Permitted to record as “Copy Enabled for One Generation Only” (Encrypted recording by updating the Primitive CCI[*3] to “No More Copies”)[*5*6].
	01 [*1]	Don’t care	Copy never
	11	Don’t care	Copy never
11 [*2]	00	Don’t care	Permitted to record as “Copy freely” (Copy Freely the Primitive CCI[*3])[*4*6].
	10	Don’t care	Copy never
	01 [*1]	Don’t care	Copy never
	11	Don’t care	Copy never
10, 00 [*1]	Don’t care	Don’t care	Copy never
No Descriptor		Don’t care	Permitted to record as “Copy freely” (Copy Freely the Primitive CCI[*3])[*4*6].

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: For the definition of Primitive CCI, see Table B-1.18. The Primitive CCI is recorded in the RDI Packs in the VOB Recording Mode, and in the Packet Group in the SOB Recording Mode.

*4: Follow the mapping in Table B-1.19 for the setting of APSTB, or set it to 000 (APS OFF). The APSTB is recorded in the RDI Packs in the VOB Recording Mode, and in the Packet Group in the SOB Recording Mode.

*5: Follow the mapping in Table B-1.19 for the setting of APSTB. The APSTB is recorded in the RDI Packs in the VOB Recording Mode, and in the Packet Group in the SOB Recording Mode.
*6: Set the values of ICT, DOT and Trusted Input to 0, 0 and 1 respectively. The ICT, DOT and Trusted Input are recorded in the RDI Packs in the VOB Recording Mode, and in the Packet Group in the SOB Recording Mode.

Table B-1.18 Definition of Primitive CCI in the AACS (HD DVD)

Primitive CCI	Content Status
000	Copy Freely
100	Copy One Generation
010	No More Copies
110	Copy Never
011	Protection using AACS, but copy control restrictions not asserted without redistribution (EPN)

Table B-1.19 Relationship between the APS_control_data in the Digital Copy Control Descriptor, and the APSTB in the AACS (HD DVD)

APS_control_data in the Digital Copy Control Descriptor	Setting of APSTB	Definition of APSTB
00	000	APSTB is OFF
01	001	Type 1 of APS1 is ON
10	010	Type 2 of APS1 is ON
11	011	Type 3 of APS1 is ON

B.1.11 Required Conditions when Implementing MagicGate Type-R for Advanced Access Content System (AACS) [Blu-ray Disc]

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the AACS is shown in Table B-1.20. [Blu-ray Disc]

Table B-1.20 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the AACS [Blu-ray Disc]

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using AACS [Blu-ray Disc] and copy control
copy_control_ type	digital_ recording_ control_data	encryption_ mode	
01	00	1	Permitted to record as Copy freely (Copy Control Not Asserted).*4*5
		0	Permitted to record as Copy freely. Encryption Plus Non-Assertion (EPN asserted) applies. *4*5
	10	Don’t care	Permitted to record as copy is enabled for one generation (Updated to No More Copy for recording) *3
	01 *1	Don’t care	Recording is disabled.
	11	Don’t care	Recording is disabled.
11 *2	00	Don’t care	Permitted to record as Copy freely (Copy Control Not Asserted). *4*5
	10	Don’t care	Copy never
	01 *1	Don’t care	Copy never
	11	Don’t care	Copy never
10, 00 *1	Don’t care	Don’t care	Copy never
No Descriptor		Don’t care	Permitted to record as Copy freely (Copy Control Not Asserted). *5

*1 These are not defined by TR-B14.
If these combinations are used for broadcasting for some reason, the copy never is applied to the control of High-Speed Digital Interface output, and video and audio output in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*2: When the service type is either digital TV service or special video service, and copy_control_type of the Digital Copy Control Descriptor is set to 11, the High-Speed Digital Interface output and video and audio output are prohibited in the TR-B14. Accordingly, copy never shall be applied in the case of this combination.

*3: The value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APS of the CPS Unit Usage File and the Embedded CCI, defined by the AACS. See Table B-1.23.

*4: The APS_control_data is shall be recognized as 00. Alternatively, the value of APS_control_data in the Digital Copy Control Descriptor shall be inherited to the APS of the CPS Unit Usage File and the Embedded CCI, defined by the AACS. See Table B-1.23.

*5: Regarding the CPS Unit Usage File, the values of DOT, Trusted Input, and ICT shall be set to 0, 1 and 1 respectively.

Table B-1.21 Copy Control Field of the CPS Unit Usage File and the Embedded CCI

CCI	Significance in the CPS Unit Usage File	Significance in the Embedded CCI
00	Copy Control Not Asserted	Copy Control Not Asserted
01	No More Copy	No More Copy
10	Reserved	Copy One Generation
11	Reserved	Reserved

Table B-1.22 EPN Control Field of the CPS Unit Usage File and the Embedded CCI

EPN	Significance
0	EPN-asserted
1	EPN-unasserted

Table B-1.23 APS Control Field of the CPS Unit Usage File and the Embedded CCI

APS_control_data in the Digital Copy Control Descriptor	APS of the CPS Unit Usage File	APS of the Embedded CCI	Significance
00	000	00	APS off
01	001	01	Type 1 of APS1 is ON
10	010	10	Type 2 of APS1 is ON
11	011	11	Type 3 of APS1 is ON

1 Introduction

1.1 Foreword

Same as Part 1 of this volume.

1.2 Scope

Part 2 of this volume incorporates the transmission operation rules, Compliance Rules and Robustness Rules for receivers concerning the functions for the contents protection of partial reception in digital terrestrial television broadcasting.

2 References

Same as Part 1 of this volume.

3 Definition

The terms used in Part 2 of this volume of these provisions are defined below. See Part 1 of this volume for other terms.

Free Program with Right Management	Free Program with Right Management is defined as the free program in the partial reception layer which is not scrambled but copy-controlled in accordance with the information described in the Digital Copy Control Descriptor and Content Availability Descriptor.

4 Transmission operation rules

4.1 Operation rules for Content Protection

4.1.1 Operation of Copy Control Information

· In the partial reception layer, the copy_control_type of Digital Copy Control Descriptor shall be only set to '10.' Operations shall be applied in accordance with the rules specified in Table 4-1.

Table 4-1 Operation rules for Content Protection

Service	Digital Copy Control Information			EPN
	Copy freely	Copy one generation	Copy never	
Free Program with Right Management	Applicable*1	Applicable	Non-applicable	Applicable
Other than the above*2	Applicable	Non-applicable	Non-applicable	Non-applicable

*1: Applicable only when "encryption plus non-assertion" is operated.
*2: Means to free program whose content are not protected.

– - The Digital Copy Control Information in Table 4-1 refers to the digital_recording_ control_data information of the Digital Copy Control Descriptor used for copy generation control. (see Vol. 4 of the document)

– - EPN in Table 4-1 means to the use of the encryption plus non-assertion bit (encryption_mode) of the Content Availability Descriptor to protect the Copy freely content from being output to the High-Speed Digital Interface. (see Vol. 4 of the document)

· The copy_control_type of Digital Copy Control Descriptor shall be only set to '10.' The value '10' is set specially for the copy control of partial reception layer.

4.1.2 Operation of Descriptors Related to Copy Control

· Regarding the operation of the Digital Copy Control Descriptor and the encryption plus non-assertion bit of the Content Availability Descriptor, data service shall be provided in accordance with Table 4-2. Combinations not defined in this table shall not be used.

· For more information on CGMS-A, see Vol. 2 of the document.

·A contract between broadcaster and Macrovision is required to use Macrovision's copy protection technology. For more information, see Vol. 2 of the document.

· Regarding the setting of the contents protection bit indicated by the channel status and the category code specified by IEC60958, see Vol. 4 of the document.
· The resolution limiting bit (image_constraint_token) of the Content Availability Descriptor shall not be used. Image_constraint_token shall always be set to ‘1.’ For more information, see Vol. 4 of the document.
· The Retention control bit (retention_mode) and Retention permitted time (retention_state) of the Content Availability Descriptor shall be fixed for use; more specifically, retention_mode and retention_state shall always be set to ‘0’ and ‘111’ respectively. For more information, see Vol. 4 of the document.

Table 4-2 Operation of Descriptors for Data Service

<table>
<tr><th rowspan="2">Digital Copy Control</th><th rowspan="2">Analog Copy Control *2</th><th colspan="3">Operation of the Digital Copy Control Descriptor</th><th>Operation of the Content Availability Descriptor</th></tr>
<tr><th>copy_ control_ type</th><th>digital_ recording_ control_data</th><th>APS_ control_ data</th><th>encryption_ mode *4</th></tr>
<tr><td>Copy freely*1</td><td rowspan="2">Copy freely</td><td rowspan="4">10</td><td rowspan="2">00</td><td rowspan="2">00</td><td>0</td></tr>
<tr><td>Copy freely</td><td>1</td></tr>
<tr><td rowspan="2">Copy one generation *1</td><td>Copy one generation without Macrovision protection</td><td rowspan="2">10</td><td>00</td><td rowspan="2">1</td></tr>
<tr><td>Copy one generation with Macrovision protection *3</td><td>Other than 00</td></tr>
</table>

*1: Regarding the partial reception layer, the output from High-Speed Digital Interface is prohibited for protected contents (i.e. contents with the digital_recording_control_data other than ‘00’ or the encryption_mode ‘0’).
*2: Applicable to composite and component video output. Also applicable to the cases where received video signals are format converted and output. Macrovision copy protection is applied to 480i composite and component video signals.
*3: For more information on analog video output, see 5.3 and 5.5.2 of Part 2 in this volume.
*4: In the absence of the Content Availability Descriptor, encryption_mode is assumed to be set to ‘1.’

4.2 Operation of Content Protection

4.2.1 Operation of Free Program and Free Program with Right Management

4.2.1.1 Definition of “Free Program with Right Management”

·“Free Program ” means the program comprised of non-chargeable default ES.’

·"Free Program with Right Management" is defined as the free program in the partial reception layer which is not scrambled but copy-controlled in accordance with copy control information.

4.2.1.2 Operation

· Free Program shall have free_CA_mode set to 0 in the SDT and EIT .

· Regarding Free Program with Right Management, the copy_control_type in Digital Copy Control Descriptor shall be set to '10' only.

· Regarding the Pay Program, see Vol. 5 of the document.

5 Compliance Rules for One-segment Receiver Units

The receiver unit specified in 5.1, Part 2 of this volume shall not have the following functions for the contents specified for protection by the Digital Copy Control Descriptor and Content Availability Descriptor: [i]the bound recording not specified in 5.5, Part 2 of this volume; [ii]the output function not specified in 5.3, Part 2 of this volume; and [iii] the recording function to the removable recordable media not specified in 5.6 and 5.7, Part 2 of this volume. This does not apply to the printed data specified by the functions A) and B) of 8.1.15.9 in Part 4, Vol. 3 of the document. .

5.1 Target Receiver Units

· Digital terrestrial one-segment receiver units

If implementing the bound recording in digital terrestrial one-segment receiver units, the function shall be implemented in accordance with the rules described in this volume. If implementing the recording function to the removable recordable media, on the other hand, the function shall be implemented in accordance with the rules described in this volume. Related information is provided in 7.2.2, Part 2 of this volume.

·Definition of the recording function to removable recordable media include the recording function via other recordable media (bound recording). Related information is provided in 7.8.3, Part 1 of this volume.

5.2 Copy Control Function and Restricted usage Function

·Copy Control Function and Restricted usage Function shall be controlled by the Digital Copy Control Descriptor and Content Availability Descriptor . In addition , with regard to the copy control information of bound recorded contents, see Part 1, 5.5 in this volume.

5.3 Output Control Rules

5.3.1 Requirements for Output Function on One-segment Receiver Unit

· Copy control specified in Vol. 2 of the document shall be applied to the analog video output.

·Copy control shall be applied to the digital audio output in accordance with Table 5-1.

· The analog audio may be output with no restrictions in cases other than where the digital audio output is prohibited in Table 5-1.

·Table 5-1 shall be applied to output with High-Speed Digital Interface.. This is only available when the copy_control_type is set to '10', and the output of MPEG_TS from High-Speed Digital Interface is not available for contents other than "Copy freely."

·Contents may be output to the RGB analog video interface in accordance with the specifications in Vol. 2 of the document. When implementing the RGB output function, it is desirable to use the HDCP compliant digital output that can be content-protected.

. · The Copy freely contents may be output through the digital video output or digital video/audio output.

· To output the video and audio which are content-protected by the Digital Copy Control Descriptor and Content Availability Descriptor through the digital video output or digital video/audio output, proper contents protection shall be applied in accordance with the HDCP specifications.

5.3.2 Output control rules by the Digital Copy Control Descriptor and Content Availability Descriptor on One-segment Receiver Unit

· Output control rules are applicable to each output terminal in accordance with copy_control_type and digital_recording_control_data of the Digital Copy Control Descriptor and encryption_mode of the Content Availability Descriptor shall be as per Table 5-1.

Table 5-1 Output control rules by the Digital Copy Control Descriptor and Content Availability Descriptor on One-segment Receiver Unit

Digital Copy Control Descriptor		Content Availability Descriptor	High-Speed Digital Interface			Analog Video Output	Digital Audio Output
			Serial Interface		IP Interface		
copy_control_type	digital_recording_control_data	encryption_mode	MPEG_TS	IEC60958	MPEG_TS		
01*1 or 11	Don't care	Don't care	Output disabled	Output disabled	Output disabled	Output disabled	Output disabled
10	00	1	No encryption	No encryption	No encryption	CGMS-A: 00 Macrovision: off*4	SCMS: Copy is enabled unconditionally
		0	Output disabled	No encryption	Output disabled	CGMS-A: 00 Macrovision: off*4	SCMS: Copy is enabled unconditionally
	10	Don't care	Output disabled	No encryption	Output disabled	CGMS-A: 10 Macrovision: off*4	SCMS: Copy is enabled for one generation
	01*2	Don't care	Output disabled	No encryption	Output disabled	CGMS-A: 11 Macrovision: APS*5	SCMS: Copy never
	11*2	Don't care	Output disabled	No encryption	Output disabled	CGMS-A: 11 Macrovision: APS*5	SCMS: Copy never
00*3	Don't care	Don't care	Output disabled	Output disabled	Output disabled	Output disabled	Output disabled

No Descriptor	Don't care	No encryption	No encryption	No encryption	CGMS-A: 00 Macrovision: off	SCMS: Copy is enabled unconditionally

*1: This is not defined by the document. Also in the case , the output of all the videos and audios specified by the document are not allowed. Output in accordance with Table 5-1, Part 1 of this volume, may be admitted.

*2: These are not defined by the document. In these cases, output shall be transmitted in accordance with this table.

*3: This is not defined by the document. Also in the case, the High-Speed Digital Interface output and the output of all the videos and audios specified by the document are not allowed.

*4: Macrovision shall be set off regardless of APS_control_data.

*5: These are not defined by the document.; Macrovision may be triggered in accordance with the APS_control_data or set to 'off'.

· For more information on CGMS-A for the Analog Video Output column, see Table 5-2. The APS for the Analog Video Output shall be complied with the APS_control_data value. If digital_recording_control_data is set to '00' or APS_control_data is undefined, APS for the Analog Video Output shall be set to '00.' For more information on CGMS-A and APS, see Vol. 2 of the document.

· For more information on Macrovision, see Vol. 2 of the document.

· Macrovision is not triggered in the combinations defined in the provisions for operations in Part 2 of this volume. Therefore, the Macrovision function may not be implemented to one-segment receiver units without recording media.

· SCMS, the abbreviation of the Serial Copy Management System, means the contents protection bit and the copy generation control information in the category code of the channel status specified by IEC60958. For more information, see Vol. 4 of the document.

Table 5-2 Definition of CGMS-A

CGMS-A	Definition
11	Copy never
10	Copy one generation
01	(Undefined)
00	Copy freely

5.3.3 Output Control Rules with the Encryption Plus Non-Assertion Bit

· When copy_control_type and digital_recording_control_data of the Digital Copy Control Descriptor are set to '10' and '00' respectively, the encryption plus non-assertion bit is enabled. In other cases, the encryption plus non-assertion bit shall be ignored.

5.4 Internet Retransmission Rules

· Same as Part 1 of this volume.

5.5 Bound Recording

5.5.1 Bound Recording

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '00' ;Copy freely, contents may be stored with no copy restrictions. When encryption_mode of the Content Availability Descriptor is set to '0', the contents shall be protected using local encryption specified in 6.2.4, Part 2 of this volume.

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '10' ; Copy One Generation, the copy control information on the recordable media shall be set to "no more copies" specified in Section 5.5.2 of this volume for bound recording. Even when contents are bound recorded as no more copies, it is not required to change to the value of digital_recording_control_data of the Digital Copy Control Descriptor. Regarding the copy control information on the recordable media, see Section 7.2.1 of this volume.

· When digital_recording_control_data of the Digital Copy Control Descriptor is set to '10' ;copy one generation, multiple copies shall not be allowed. This does not apply to data storage for backup purpose in the area that is not accessible by users. The above restriction applies to each tuner units. In the case of multiple tuner units, the above restriction is applied respectively.

· For more information on the priority of the Digital Copy Control Descriptor information, see Vol. 4 of the document.

5.5.2 No more copies

· The contents bound recorded as no more copies contents shall not be copied. This does not apply to "move" specified in Section 5.5.4, Part 2 of this volume.

· To output the contents bound recorded as no more copies contents to the analog video output and the digital audio output shall use the same process as when digital_recording_control_data in Table 5-1 is set to '11' (i.e. Apply the "Copy never" process to CGMS-A and SCMS). In addition, Macrovision shall be applied when APS_control_data is set to other than '00.'

5.5.3 Retention

· Because the digital_recording_control_data '11' is not applied to the Digital Copy Control Descriptor, the retention function is not defined.

5.5.4 Move Function

· If the copy control information after bound recording is set to no more copies, the contents may be moved in accordance with the following conditions.

·The bound recorded content may be moved only to a single built-in recordable media or a digitally connected single recordable media. To move bound recorded content to another recordable media connected by the High-Speed Digital Interface, the move function shall be performed in accordance with the DTCP specifications. The move function shall not be used unless output to single recordable media is assured such as analog video output.

· While a move is in progress, it shall be ensured that contents exceeding one minute cannot be playbacked simultaneously at both the move source and destination.

· After a move is completed, it shall be ensured that contents that can be used are not present simultaneously at both the move source and destination. This means, after a move is completed, the contents at the move source shall be rendered unusable. For more information on the rendering unusable of the contents, see Part 1, 7.2.2 of this volume.

· Regarding the output to somewhere other than the move destination during a move operation, Part 2, 5.5.2 of this volume shall be applied.

5.6 Digital Recording with the Removable Recordable Media

(1) To receive contents of the data service, which are copyright-protected by the Digital Copy Control Descriptor and Content Availability Descriptor, and to digitally record these contents to the removable recordable media, the recording formats and contents protection systems for recording described in Appendix B shall be applied.

(2) When digital_recording_control_data of the Digital Copy Control Descriptor is set to '10' ; Copy one generation, more than three copies shall be prohibited. Multiple copies with the same recording format shall be prohibited. This does not apply to digital recording for backup purpose to the area that is not accessible by end users. Related information is provided in Part 1, 7.8.2 of this volume. The recording restriction to the digital recordable media applies to each tuner units. In the case of multiple tuner units, the above restriction applies respectively.

(3) When receiver units include encryption_mode incompliant recording system, the contents which

are copyright-protected by copy_control_type and digital_recording_control_data of the Digital Copy Control Descriptor set to ‘01’ and ‘00’ respectively and encryption_mode of the Content Availability Descriptor set to ‘0’ may be digitally recorded by the recorder in the same manner as Copy One Generation.

(4) The contents which are not copyright-protected by the Digital Copy Control Descriptor and Content Availability Descriptor may be, in principle, digitally recorded in any format. If required conditions applicable to each removable recordable media are listed in Part 2, Appendix B.1 of this volume, the conditions shall be applied.

5.7 Analog Recording of Contents to the Removable Recording Media

To make an analog recording of contents of data service to the removable recording media, appropriate copy control shall be applied in accordance with the copy control information described in the Digital Copy Control Descriptor.

6 Robustness Rules for the Receiver Unit

6.1 Content Protection Robustness Rules

Same as Part 1 of this volume.

6.1.1 Basic Requirements of Robustness Rules

Same as Part 1 of this volume.

6.1.2 Scope of Protection

Same as Part 1 of this volume.

6.2 Implementation methods of Robustness Rules

6.2.1 Outline

Same as Part 1 of this volume.

6.2.2 Content Output

Same as Part 1 of this volume.

6.2.3 Storing Contens

Same as Part 1 of this volume.

6.2.3.1 Prohibition of the Re-use of the Copy

Same as Part 1 of this volume.

6.2.3.2 Management of Other Information

Same as Part 1 of this volume.

6.2.4 Local Encryption

Same as Part 1 of this volume.

6.2.4.1 Strength of Local Encryption

Same as Part 1 of this volume.

6.2.4.2 Key Management

Same as Part 1 of this volume.

7 Commentary

7.1 Rights Protection for One-segment Broadcast

In one-segment broadcast, Copy Control Information for rights protection is added to protect the rights of cast, staff and other related persons. Therefore, the receiver unit shall operate in conformity with the Copy Control Information specified by the Digital Copy Control Descriptor and the Content Availability Descriptor.

Most mobile terminals are expected to have an e-mail transmission function. In general, Copy Control Information cannot be inherited under the e-mail environment. Therefore, it is important to take sufficient measures for rights protection, by restricting or disabling the e-mail transmission function, so that all or part of protected contents will not be transmitted as attachment to e-mails, without applying technical protection or inheriting Copy Control Information.

7.2 Digital Recording of Contents to the Removable Recording Media

7.2.1 Approval of Removable Recording Media for One-segment Receiver Unit

A separate section was provided in Part 2 for the approval of removable recording media, because recording systems for removable recording media that specialized in one-segment broadcast may be developed.

7.2.2 Contact to Have Systems Approved

Application shall be made through the following contact office, and its approval shall be obtained, to use a contents protection system or recording format for the removable recording media except for those listed in Table B-1, Appendix B, part 2 of this volume.

Contact: Secretariat of Engineering, The Association for Promotion of Digital Broadcasting (D-PA)

URL: http: //www.d-pa.org/english/index.html

Appendix A: Certification Criteria for the Recording Format and Contents Protection System for Recording

Same as Part 1 of this volume.

Appendix B: Contents Protection Systems Applicable to the Removable Recording Media that may be Implemented in One-segment Receiver Units

The contents protection systems and recording formats applicable to the removable recording media, which may be implemented in the receiver units, to which Part 2 of this volume is applied are shown in Table B-1.

Regarding the implementation of each system, each receiver unit manufacturer shall make inquiries with relevant licensors.

Table B-1 Contents Protection Systems Applicable to the Removable Recording Media that can be Implemented in One-segment Receiver Units

System No.	Certification Item	Certification Detail
1	Contents protection system or recording format	Content Protection for Recordable Media (CPRM)
	Targeted media (Recording format)	SD Memory Card (SD-Video)
	Targeted services	Data Service
	Licensor name	4C Entity LLC Intel Corporation International Business Machines Corporation Toshiba Corporation Matsushita Electric Industrial Co., Ltd.
	Whom to contact	http: //www.4centity.com/
	Required conditions	Functions shall be implemented in accordance with the conditions shown in Appendix B.1.1.

B.1 Required Conditions when Implementing the Contents Protection System for Recording

B.1.1 Required Conditions when Implementing the Content Protection System for Content Protection for Recordable Media (CPRM) SD-Video

(1) The correspondence between the recording control using the Digital Copy Control Descriptor and Content Availability Descriptor and the copy control using the CPRM SD-Video is shown in Table B-1.1.

Table B-1.1 Correspondence between the Digital Recording Control Using the Digital Copy Control Descriptor and Content Availability Descriptor and the Copy Control Using the CPRM SD-Video

Digital Copy Control Descriptor		Content Availability Descriptor	Whether or not digital recording is possible using CPRM SD-Video, and copy control
copy_control_type	digital_recording_control_data	encryption_mode	
01, 11	Don't care	Don't care	Copy never
10	00	1	Permitted to record as "Copy freely" (Not encrypted *1).
		0	Permitted to record as "Encryption Plus Non-Assertion (EPN)" (Recorded in the state of 'EPN asserted' *1). *2
	10	Don't care	Permitted to record as "Copy One Generation" (Recorded by updating to the status of 'Copy is never permitted' *1 after recording). *3
	01	Don't care	Copy never
	11	Don't care	Copy never
00	Don't care	Don't care	Copy never
No Descriptor		Don't care	Permitted to record as "Copy freely" (Not encrypted *1).

*1: Regarding "Not encrypted," "EPN asserted," and "Copy is never permitted," see Tables B-1.2 and B-1.3.
*2: The APSTB shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor ,alternatively be set to 00 (APS is off).
*3: The APSTB shall inherit the value of the APS_control_data in the Digital Copy Control Descriptor.

Table B-1.2 Copy Control Field of the CPRM SD-Video (Strm CCI is ‘0’)

Normal area		Authorization area		Significance
Field	Value	Field	Value	
TkureIndex [*4], MOTkureIndex [*4]	Either of the two has the index value of TKURE [*4] (not 0)	StrmCCI [*4]	0	Copy control by TKURE
		CCCI [*4]	0000	Copy is never permitted.
			1111	Copy is permitted unlimited times (EPN asserted)
		APSTB [*4]	00	APS is Off
			01	Type 1 of APS is On
			10	Type 2 of APS is On
			11	Type 3 of APS is On
	Both are set to 0			Not encrypted

*4: See “CPRM Specification SD Memory Card Book, SD Video Part, Revision 0.95 or later” issued by the licensor.

Table B-1.3 Copy Control Field of the CPRM SD-Video (Strm CCI is ‘1’)

Normal area		Authorization area		Significance
Field	Value	Field	Value	
TkureIndex [*5], MOTkureIndex [*5]	Either of the two has the index value of TKURE *5 (not 0)	StrmCCI [*5]	1	Copy control by RDI Packet
		CCCI [*5]	0000	
		APSTB [*5]	00	
	Both are set to 0			Not encrypted
E_CPF of RDI Packet [*5]	00			Not encrypted
	10			EPN asserted
	11			Copy is never permitted
E_APSTB of RDI Packet [*5]	00			APS is Off
	01			Type 1 of APS is On
	10			Type 2 of APS is On
	11			Type 3 of APS is On

*5: See “CPRM Specification SD Memory Card Book, SD Video Part, Revision 0.95 or later” issued by the licensor.

Vol. 9

DIGITAL TERRESTRIAL TELEVISION BROADCASTING

Provisions for Transmission Operations

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Contents

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1 Introduction

This volume describes the inspection techniques concerning transmission and transmission station installation in terrestrial digital television broadcasting. It is hoped that terrestrial digital television broadcasters will examine transmission and transmission station installation by following these provisions for stable terrestrial digital television broadcasting reception into the future.

2 References

The standards related to this volume are as follows.

(6) "Receiver Units for digital broadcasting" standard ARIB STD-B21

(7) "Transmission method of terrestrial digital television broadcasting" standard ARIB STD-B31

3 Definitions

The terms used in these regulations are defined as below.

16QAM	16QAM, an abbreviation of 16 Quadrature Amplitude Modulation, is defined as a digital modulation scheme to transmit four bits of information by using 16 sinusoidal waves with different amplitudes and phases. Digital terrestrial television broadcasting uses the SP to specify amplitude and phase reference.
64QAM	64QAM, an abbreviation of 64 Quadrature Amplitude Modulation, is defined as a digital modulation scheme to transmit six bits of information by using 64 sinusoidal waves with different amplitudes and phases. Digital terrestrial television broadcasting uses the SP to specify amplitude and phase reference.
AD conversion quantization noise	Noise element caused by quantization roughness when analog signals are converted into digital signals (AD conversion).
A to D interference	Interference from analog broadcasting signals to digital broadcasting signals.
BER	BER, an abbreviation of the Bit Error Rate, is defined as the rate of the number of error bits in a digital signal to the total number of bits transmitted.
CN ratio	The CN ratio is defined as the carrier to noise ratio, which represents the power ratio of the carrier of high frequency signals to the noise within the bandwidth.
DU ratio	The DU ratio is defined as the desired to undesired ratio, which represents the power ratio of electrical power in preferred waves (Desired) of high frequency signals to interference waves (Undesired).
FFT	FFT is an abbreviation of Fast Fourier Transform. It is a method of converting time axis signals into frequency axis elements. The opposite conversion from the frequency axis into the time axis is IFFT (Inverse FFT).
FFT Window	Processing duration for a certain period of time in which the time axis signal is taken in order to calculate the FFT.
OFDM	OFDM, an abbreviation of Orthogonal Frequency Division Multiplexing, is defined as a kind of multi-carrier transmission system.
QPSK	QPSK, an abbreviation of Quaternary Phase Shift Keying, is defined as a modulation scheme to send a carrier in four phases: phase 0, phase $1/2\pi$, phase π and phase $3/2\pi$, which respectively correspond to values, 00, 01, 10 and 11.
SFN	SFN, an abbreviation of the Single Frequency Network, is defined as the network in which relay stations and the master station use the same frequency, thus allowing efficient use of radio frequencies.
SFN reception disturbance	Situation in which broadcasting signals cannot be properly received due to delay waves originating in the SFN.
SP	Scattered Pilot: Pilot signal inserted to show the standard phase and reference level of QAM.
SP interpolation LPF	The filter that carries out interpolation processing in order to speculate on the data carrier phase between the SPs and the amplitude correction component from the demodulated SP signal. It is handled as the equivalent of a low pass filter (LPF:Low Pass Filter)

Guard interval	The guard interval is defined as the data with a specified time length (which comprises a part of data output after IFFT (Inverse Fast Fourier Transform)) added before each effective symbol period. The guard interval is used to solve the problems associated with the multipath phenomenon (caused by time differences) like ghost problems encountered during analog broadcasting.
Clip noise	Noise component generated by limiting (clipping) the amplitude of the signal.
Fixed noise	Noise component that is not related to size of the signal, and exists in regular thermal noise and city noise.
Required CN ratio	The required CN ratio is defined as the critical reception CN ratio at which the receiver unit can stably demodulate signals.
Required DU ratio	The required DU ratio is defined as the critical reception DU ratio at which the receiver unit can stably demodulate signals.
Amplitude proportion noise	The AD conversion quantization noise etc. corresponds to the noise component considered to be proportional to the size of the equivalent signal.
Convolutional code	Error correction code in which bit rows of consecutive digital data is consecutively encoded by constant width. A superior correction ability is showed for random mistakes in digital data.
Location dispersion	Statistically handles the distribution of electrical field strength as decentralized locations because the electrical field strength in the vicinity of the reception point is regularly distributed.
Bathtub characteristic	It is an abbreviation of the characteristic that displays the relationship between the delay time of the delay wave and the guard interval in demodulation of the OFDM. Although the demodulation characteristic of the OFDM deteriorates due to the delay wave which exceeds the guard interval, it is called a bathtub characteristic since it resembles the shape of a bathtub when the characteristic is showed in the delay time of the delay wave and the necessary DU ratio.
Viterbi decoding	Viterbi decoding is one of the decoding methods of convolutional coding. It is a decoding method that corrects mistakes by observing received digital data rows and requesting data rows assumed to be the most correct.
Fading	Fading is a change in the strength of the received radio waves. A physical change in the meteorological conditions etc. and reception condition of are thought to be the cause.
Encoding rate	Ratio in the number of bits before encoding to the number of bits after convolutional coding.
Multi-path	Radio waves that come to the receiving antenna arrive through multiple routes (multi-path) from the transmission point.
Yagi antenna	General receiving antenna for terrestrial television broadcasting. Antenna that sharpens direction by arranging multiple waveguide elements and reflection elements in parallel. They are also called Yagi-Uda antennas.

4 Reception system model envisaged by terrestrial digital television broadcasting transmitter station installation inspections

4.1 Forward

When terrestrial digital television broadcasting transmission stations are set up, it is necessary thorough inspections are carried out on the impact of interference from other transmission stations and on the interference conditions to other stations, to promote the optimisation of transmission patterns, etc. It is also necessary to optimise the transmission delay adjustment for SFN configurations. Since the best transmission conditions for the transmission pattern and transmission delay adjustment, etc., depend on reception conditions, standard reception conditions are considered in the design of the transmission stations and the best transmission conditions are provided for this feature. Provisions in Chapter 4 provide the calculation method for promoting the optimisation of parameter values for transmission delays, etc. of transmission stations with the envisaged reception system model in the design of transmission stations.

4.2 Scope

Provisions in Chapter 4 apply to the reception system model envisaged in the calculation method to optimise transmission conditions of the relevant transmission station and the calculation method for the construction of transmission stations in terrestrial digital television broadcasting network configurations.

4.3 Calculation method for optimising transmission conditions

The received signal of each reception point in the broadcasting area is difficult to accurately forecast due to the influence of geographical features, buildings in the vicinity of the reception point, and trees etc., and it is impossible to assess in advance whether digital reception is possible in all areas. Therefore, in the design of transmission stations, multiple representation points are installed in the area, and the rate of possible reception (hereinafter, reception rate) in the vicinity of the representation point is calculated as criteria for the reception rate of various locations in order to promote the optimisation of transmission. Although maximizing the reception rate of various locations is conducted to optimise the transmission conditions, in general, the optimisation of transmission conditions should be assessed individually while considering the possibility of reception of other transmission stations, and the scale and regional characteristics, etc. of the relevant transmission station.

The reception system model envisaged by this calculation method is shown in figure 4-1. In this calculation, SFN waves, same channel digital waves (different program type), and same channel analog waves are raised as sources of interference jamming. Additionally, since the use of boosters is required in regions with weak electric current fields, the noise index and the lowest input voltage characteristic of the receiver units should not be related to the judgement on reception posibility. The 4 items of "Amplitude proportion noise", "FFT window setting margin", "SP interpolation LPF band", and "AtoD interference exclusion characteristic" (Refer to section 4.3.2) should provide the numerical values by the envisaged receiver units.

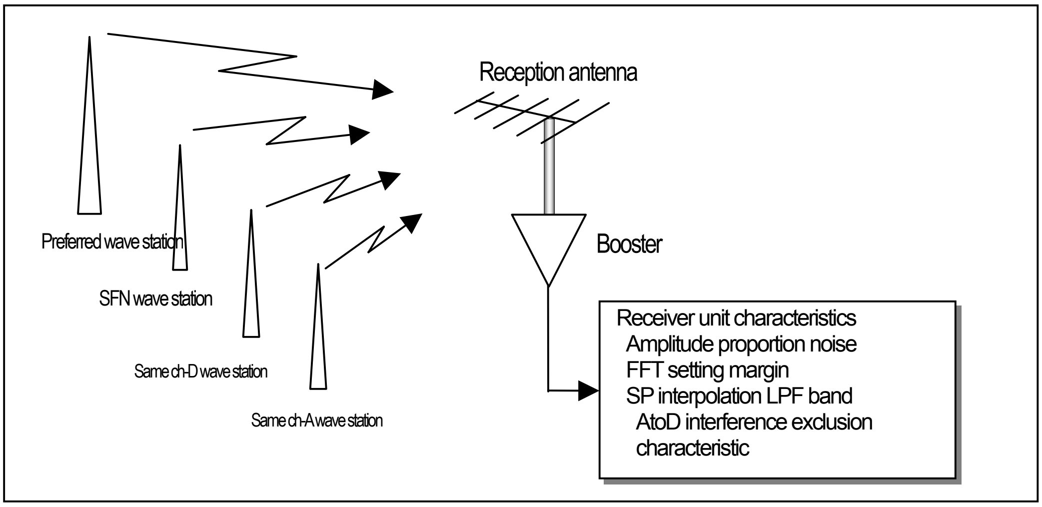


Figure 4-1 Reception system model in the design of transmission stations

4.3.1 Calculation method for judgement on reception posibility

The judgement on reception posibility of each location in the area are based on the following calculation when transmission stations are set up.

Required CN ratio(Power ratio): $$CN_0 \cdot CN_{up}\left(U_{eq}^2 / D^2\right) \quad (1)$$

Equivalent component in the GI.: $$U_{eq}^2 = \sum_k (1-\tau_k)U_k^2 \quad (2)$$

Equivalent noise:
$$\begin{aligned} N_{eq}^2 = N_{fix}^2 + N_{amp}^2 + \sum_k \tau_k U_k^2 + \sum_k \tau_k (1-\tau_k)U_k^2 + \\ 1.5 \cdot \sum_k (1-\tau_k)(1-LPF(DL_k))^2 U_k^2 + \sum_m CoD^2 + \sum_n CoA^2 / AtoD \end{aligned} \quad (3)$$

CN_0 is the required CN ratio (Dependent only on the modulation scheme and encoding rate) in the white Gaussin noise environment, and CN_{up}(*) is a mathematical function that shows the necessary CN increasing amount when SFN waves exist. τ_k is the part that exceeded the guard interval of each SFN wave delay time, and as shown in equation (2), U_{eq}^2 is the power of the component effectively considered to be the SFN wave in the guard interval, and D^2 is the preferred wave power. In equation (3), N_{fix}^2 is the fixed noise power, N_{amp}^2 is the amplitude proportion noise power, term 3 is the interference power between symbols, term 4 is the interference power between carriers, and term 5 is the scattered pilot (hereinafter, SP) interpolation error margin power. *LPF*(*) is the SP interpolation LPF characteristic and DL_k is the delay time of the SFN wave. Additionally, CoD^2 is the power of the same channel digital wave (different program type), CoA^2 is the same channel analog wave power, and AtoD is a coefficient to convert into the equivalent digital wave which puts out the same interference as analog interference.

Equations (1)-(3) above are calculated for all interference waves and the reception possibility is judged from the relationship of the required CN ratio noise and equivalent noise.

Specifically,

(Required CN ratio) $^{-1}$ *> For equivalent noise*: Reception possible

(Required CN ratio $^{-1}$ *< For equivalent noise*: Reception not possible

Here, the required CN increasing mathematical function (dB mark) in equation (1) is as shown in equation (4) and table 4-1.

$$\begin{aligned} CN_{up}\left(U_{eq}dB\right) &= \alpha \cdot \exp\left\{-\left|\beta \cdot U_{eq}dB\right|^{\gamma}\right\} & (U_{eq}dB \le 0) \\ &= \alpha \cdot \exp\left\{-\left|\beta \cdot U_{eq}dB\right|^{\gamma}\right\} - U_{eq}dB & (U_{eq}dB > 0) \end{aligned} \quad (4)$$

Table 4-1 Coefficient for the required CN increasing mathematical function (dB)

Coefficient	Modulation method	Encoding rate:7/8	Encoding rate:5/6	Encoding rate:3/4	Encoding rate:2/3	Encoding rate:1/2
α	64QAM	27.749	20.257	12.090	8.1386	3.8797
	16QAM	29.800	22.163	13.874	9.8342	5.4002
	QPSK	32.255	24.378	15.953	11.827	7.2391
β	64QAM	0.5592	0.4117	0.2953	0.2527	0.2074
	16QAM	0.6074	0.4453	0.3171	0.2702	0.2251
	QPSK	0.6702	0.4876	0.3450	0.2922	0.2437
γ	64QAM	1.0662	0.7253	0.9096	1.0341	1.2100
	16QAM	0.5954	0.6936	0.8616	0.9776	1.1378
	QPSK	0.5710	0.6608	0.8115	0.9172	1.0662

In the above calculation, it is assumed that all interference sources have been considered. Therefore, the ones requested as receiver unit models are characteristic values when each interference source exists individually.

In the equivalent noise equation, the ones related to receiver unit performance are N_{fix}^2, N_{amp}^2, *AtoD* and definitions of τ, and LPF characteristics. The definition of τ is the FFT window setting margin. Other terms are caused by the mathematical calculation of the OFDM modulation, and ones with the same characteristics in all receiver units. Refer to appendix A "Transmission provisions" for technological explanations in this volume for details on derivations, etc., of this calculation method.

4.3.2 Standard value of assumed receiver units

Figure 4-2 is a description of the bathtub characteristic derivation of the assumed receiver units. Figure 4-2(A) is the required DU ratio from intersymbol interference, and this is the same characteristic (mathematical calculation related to OFDM modulation only) with all receiver units. Figure 4-2(B) is the SP interpolation characteristic, the LPFbw or less bandwidth in the figure is a flat characteristic, and the LPFbw-nyquist band (168μs).is the transition bandwidth. For the delay wave in the region where the LPF is flat, the required DU ratio is the same as the one with intersymbol interference since SP interpolation has been correctly carried out. On the other hand, for the delay wave in the transition band region, the required DU ratio increases by that amount only to cause a SP interpolation error. This is shown in figure 4-2.

In actual receiver unit operation, it is necessary to set the FFT window position to "Appropriate" for multiple input delay waves. However, the type of algorithm for assessing "Appropriate" is a design matter of the receiver units. Therefore, although not provided here, eventually as shown in Figure 4-2(C), whether a main wave (preferred waves) can be close to the edge of the FFT window and up to what extent becomes a problem. In the figure this was written as Tm. In this case, it becomes a characteristic described in this figure if the delay time of each wave for the main waves is expressed. For example, when Tm is 6 μs, the bottom of the bathtub becomes -6 μs~+120 μs.

Figure 4-2(D) is figure of when the SP interpolation characteristic is optimised independently of the FFT window position. The band setting of interpolation LPF can be adaptively changed according to the input delay wave (Specifically, since the sampled SP signal is a complex mathematical function, the base band is not limited to the lower component). When the post delay wave (wave that lags behind the main wave) is assessed as larger than the pre delay wave (wave that comes before the main wave), the influence of the SP interpolation error margin can be reduced by shifting the LPF characteristic in the direction of the delay as shown in figure.

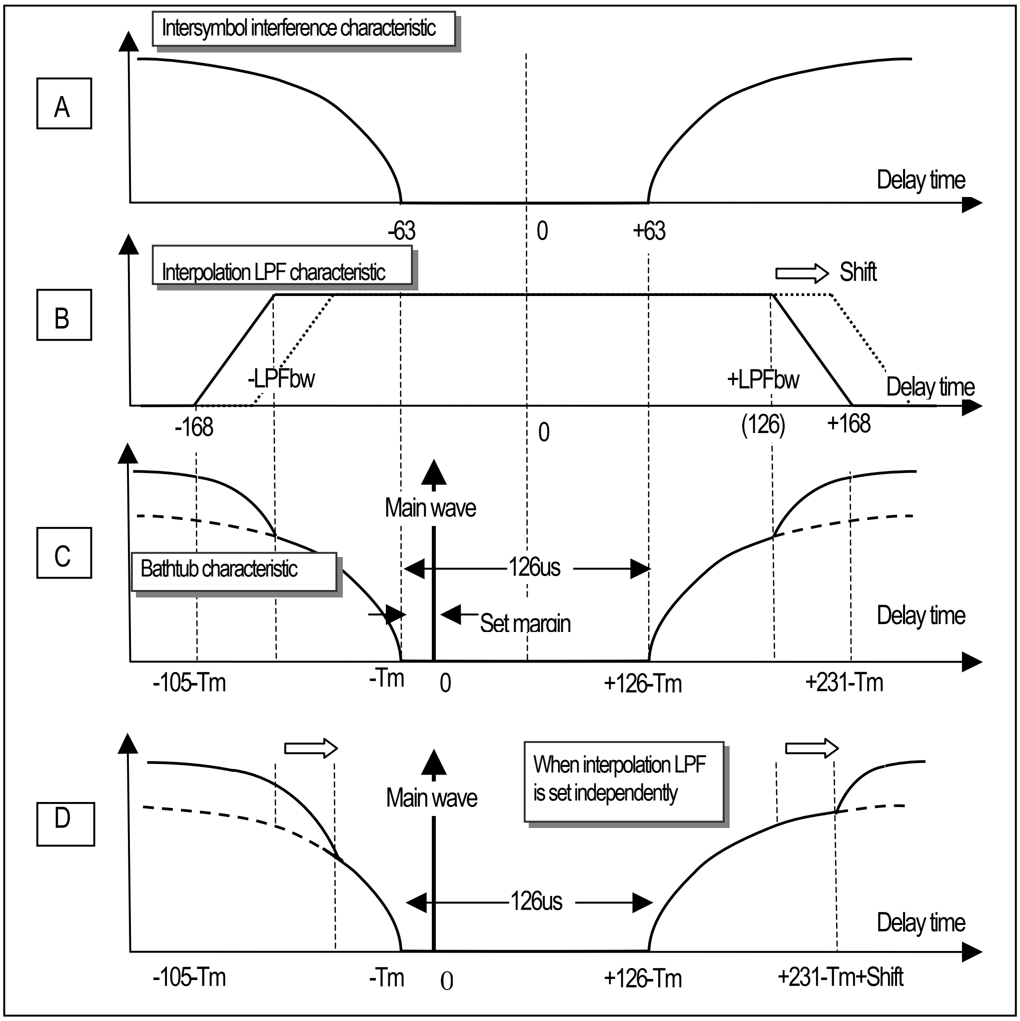


Figure 4-2 Assumed bathtub characteristic(For GI=126 μs)

This type of processing is not included in receiver units used with this calculation because it becomes an adaptive process that depends on input waves. Additionally, although the required DU ratio also depends on decoding methods for the convolutional code (Viterbi decoding disappearance processing, etc.) in addition to the above, this is not included either.

Fixed noise: N_{fix}^2 does not depend on receiver unit characteristics since booster use is a condition in this calculation.

Amplitude proportion noise: N_{amp}^2 is -35 dB from the measurement result of the receiver units.

LPF characteristics: Flat area:-126~+126µs
Transition region:-168~-126µs or +126~+168µs
Damping characteristic: Straight line descent characteristic

FFT window setting margin: Tm=6µs

AtoD interference exclusion characteristic: 5dB (64QAM-3/4) or 13dB (7/8) from the measurement results. Thus, coefficient AtoD of equation (3) is 15dB (64QAM-3/4) or 9.5dB (7/8).

The standard value of the receiver units above is 64QAM-3/4 or 64QAM-7/8, and the guard interval length is 126µs. For other modulation schemes, encoding rates and guard interval lengths will be provided in the future.

4.3.3 FFT window position setting

Figure 4-3 shows the relationship between the incoming wave and the FFT window. The Mt. Fuji-like curve recorded in the figure as "Exceeding GI mask characteristic" is a reciprocal of the bathtub characteristic (the one with positive and negative dB value reversed in Figure 4-2), and shows the maximum value of the acceptable delay wave. Reception becomes impossible when a delay wave that is larger than this mask exists. Therefore, the receiver units will appropriately set the FFT window so that each delay wave will not exceed this mask, but when there are multiple delay waves close to the size of the mask value, reception is not necessarily possible even if individual delay waves settle in the mask. In addition to achieving the delay wave in the mask, it is important to achieve a delay wave in the mask with a margin that is as large as possible.

As an index that shows the amount of room with the mask, the dB difference between each delay wave and the mask is defined, as "Defective power". When this defective power (PdB) becomes 0dB or more, reception becomes impossible

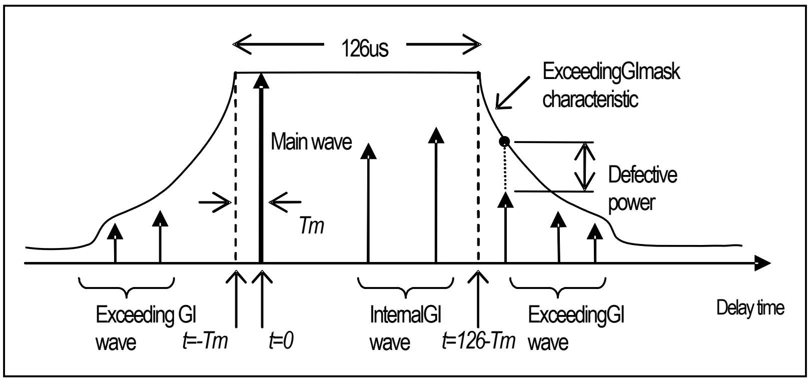


Figure 4-3 FFT window optimal setting

because the delay wave will exceed the mask value. Additionally, when the total for the defective power for each delay wave becomes 0dB or more, it can be considered that the delay wave aggregate total exceeds the mask. Therefore, defective power is calculated for each delay wave, and a mask position where the total (P_{und})becomes the minimum (specifically, FFT window position) should be the optimum position. Specifically,

$$PdB_k = UdB_k - MaskdB(DL_k) \quad \text{(dB)}$$
$$P_{und} = \sum_k 10^{PdB_k/10} \rightarrow \text{Minimized} \qquad (5)$$

In the design and research of transmission stations, for each reception point in the region, the transmission station parameters should be optimised based on the fact that the FFT window position of the receiver units will be set according to equation (5) above.

4.3.4 Reception antenna installation, etc.

Appropriate assumptions are required in the design and research of transmission stations since the judgement on reception posibility in each reception point depends a lot on reception antenna installation conditions (optimal antenna direction etc.). However, because the installation of reception antennas is up to the individual receiver, setting numerical provisions is not appropriate. In the installation inspection of transmission stations, assumed antennas and antenna directions are hypothesized as follows. Consider turning the antenna towards the best transmission station location together with a super-direction antenna such as stack antennas in regions where there is a lot of interference.

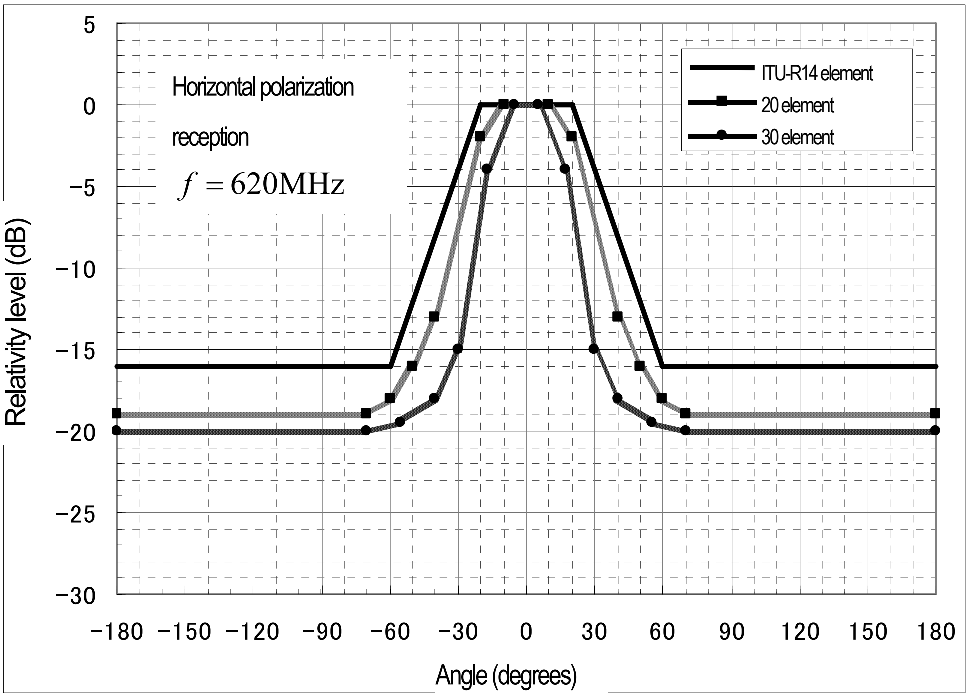
Reception antenna: 20 device Yagi Antennas

Antenna direction: Direction of transmission station location which provides the maximum field in the same program wave.

Model characteristics of Yagi antennas have been inspected in the Nationwide Conference for Promotion of Terrestrial Digital Broadcasting. These provisions refer to these characteristics. The following is an excerpt.

Nationwide Conference for Promotion of Terrestrial Digital Broadcasting(Excerpt)

In committees for measures and digital reception WG's, the horizontal directivity of all commercially available UHF Yagi antennas of 14 element, 20 element, and 30 element classes (30 elements from 25 elements) were inspected, and a characteristic model for efficient reception antennas was settled on to perform unified armchair simulations on reception measures. Because the direction characteristic changes by frequency, the characteristics of central frequency (620MHz) for UHF were adopted as model characteristics. Therefore, there is a possibility that real characteristics of antennas will become broader than the model characteristic in simulations with UHF raw channels. For more accuracy in simulations in UHF raw channels, a 20 element Yagi characteristic model as 30 element raw channel characteristic and a 14 element Yagi characteristic model (ITU-R model) as a 20 element raw channel characteristic are supposed to be used.



Reference figure 1 Model characteristic of reception antennas(Horizontal direction characteristics)

Super-directional antenna (stack antenna) case

Figure 4-4 is one example of a super-directional antenna that improved direction characteristics with a household reception antenna. Use in regions, etc. where interference is severe is assumed.

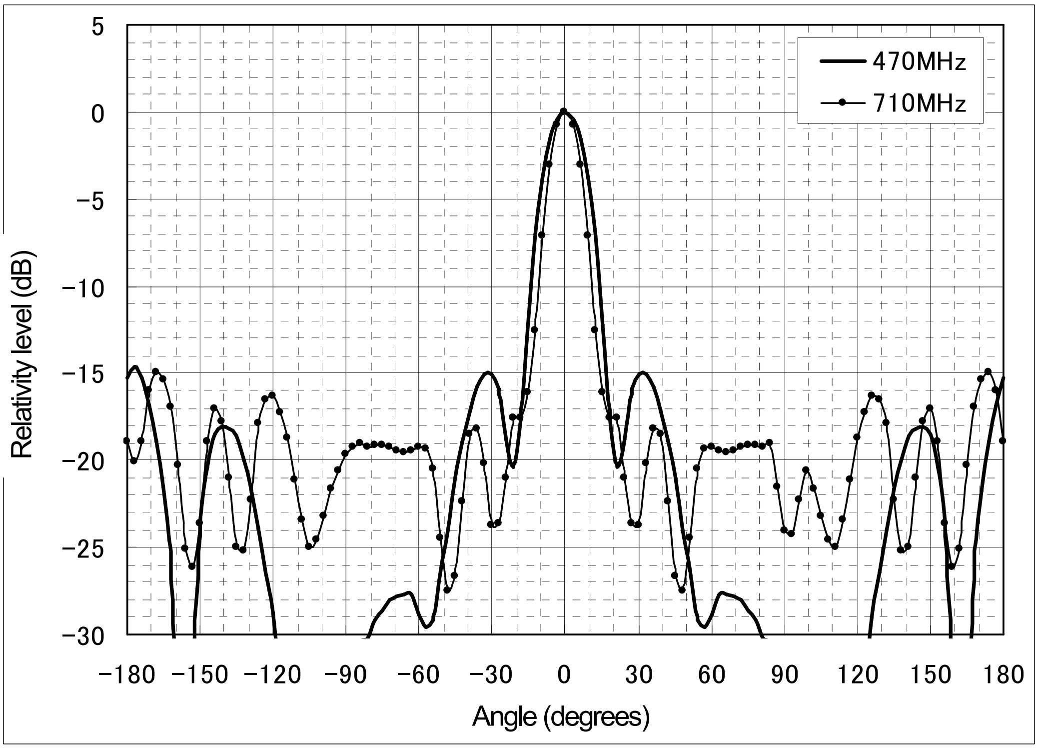


Figure4-4　Example of super-directional antenna characteristics

4.3.5 Other characteristics

Depend on Chapter 5 of ARIB standards STD-B21 "Ratings and specifications for each part of terrestrial digital television broadcasting receivers".

Appendix A Technological explanation

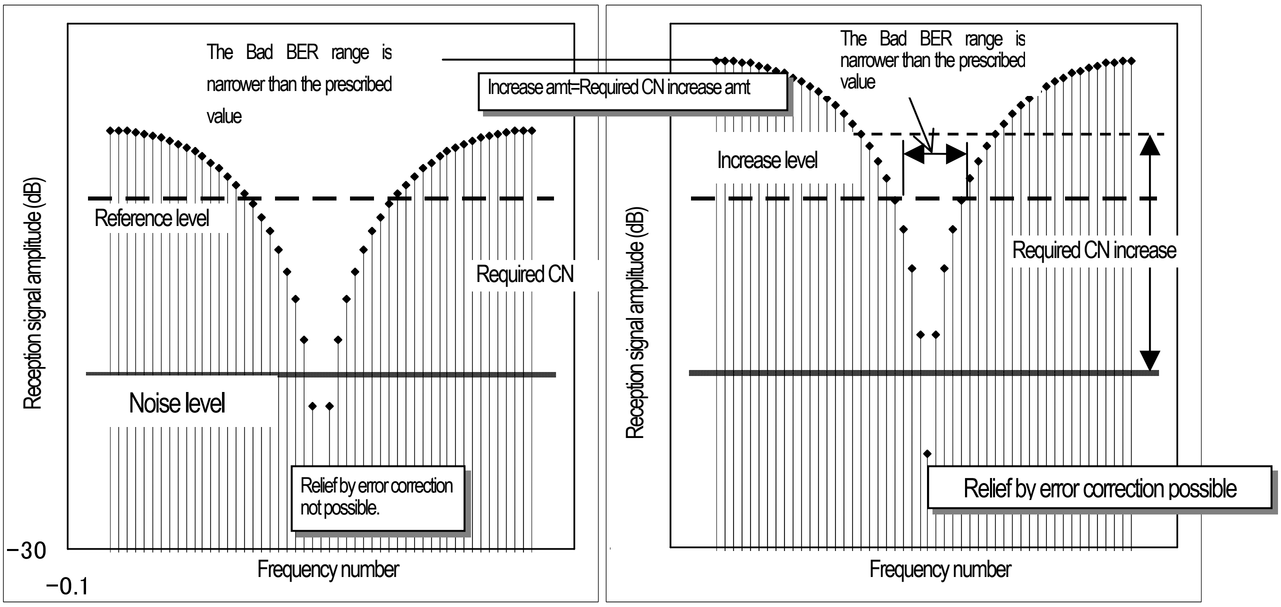
"Derivation of a standard reception system assumed by terrestrial digital television broadcasting transmission station installation inspections"

A.1 SFN in the guard interval

Firstly, conditions of SFN reception disturbance (= required average error rate or below) are derived for single SFN waves. Based on this, the case of multi-wave SFN waves is examined. Additionally, necessary "Receiver performance" to estimate the SFN reception disturbance region is examined.

A.1.1 When the SFN waves are single waves

The results of the mutual interference of the preferred waves and the SFN waves and the received signal have a ripple characteristic in the band when there are SFN waves. In this case, although the BER of the carrier improves because the input level grows for the carrier with the ripple peak, the BER deteriorates for the carrier with the ripple trough because the input level decreases. Therefore, the BER of all carriers is calculated, and when the mean value is more than the prescribed bit error rate, generation of SFN reception disturbance can be known.Figure A-1 is an example. The same figure (a) is a reception spectrum when the SFN waves are interfused with the preferred waves of the reference level (level that satisfies the required CN ratio). In this example, one with an average bit error rate lower than the admissible value is used because there are more carriers deteriorated than the prescribed BER. Even in this case, when both the preferred waves and SFN waves increase as shown in figure (b), the number of carriers with the prescribed BER value or lower decreases and the number of carriers with the prescribed BER value or larger increases. As a result, the bit error rate average of all carriers becomes secured for the admissible value or greater, and reception becomes possible.



(a) Reception spectrum (b) Reception spectrum during reception disturbance

Figure A-1 Example of a reception spectrum when there are SFN

Specifically, when there are SFN waves, it seems the required CN ratio increases. With this kind of thinking, even if the DU ratio, which is the ratio of the preferred wave and the SFN wave, is the same, SFN reception disturbance may or may not occur depending on the size of the reception electrical field.

A.1.1.1 Basic expressions

The BER under the white Gaussin noise environment and the relationship with the CN ratio are as follows.

• For QPSK

$$BER = \frac{1}{2} Erfc\left(\sqrt{\frac{1}{2}\frac{C_p}{N_p}}\right) \quad \& \quad \frac{C_a}{N_a} = \sqrt{\frac{C_p}{N_p}} = \sqrt{2} \cdot Erfc^{-1}(2 \cdot BER) \qquad (1)$$

• For 16QAM

$$BER = \frac{3}{8} Erfc\left(\sqrt{\frac{1}{10}\frac{C_p}{N_p}}\right) \quad \& \quad \frac{C_a}{N_a} = \sqrt{\frac{C_p}{N_p}} = \sqrt{10} \cdot Erfc^{-1}\left(\frac{8}{3} \cdot BER\right) \qquad (2)$$

• For 64QAM

$$BER = \frac{7}{24} Erfc\left(\sqrt{\frac{1}{42}\frac{C_p}{N_p}}\right) \quad \& \quad \frac{C_a}{N_a} = \sqrt{\frac{C_p}{N_p}} = \sqrt{42} \cdot Erfc^{-1}\left(\frac{42}{7} \cdot BER\right) \qquad (3)$$

However, C_p: [illegible] of the signal, C_a: rms amplitude of the [illegible]$_a$: rms amplitude of noise

Or, $Erfc(x) = \frac{2}{\sqrt{\pi}} \int_x^{\infty} \exp\left(-t^2\right) dt$

Generally, the relationship between the normal distribution function *(Ndist)* used in mathematics and the above *Erfc* function is as follows.

$$Ndist(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} \exp\left(-t^2/2\right) dt$$

$$\begin{aligned} Erfc(x) &= \frac{2}{\sqrt{\pi}} \int_x^{\infty} \exp\left(-t^2\right) dt \qquad (u = \sqrt{2}\ t \quad \text{with variable exchange}) \\ &= \frac{2}{\sqrt{\pi}} \int_{\sqrt{2}x}^{\infty} \exp\left(-u^2/2\right) \frac{du}{\sqrt{2}} = 2 \frac{1}{\sqrt{2\pi}} \int_{\sqrt{2}x}^{\infty} \exp\left(-u^2/2\right) du \\ &= 2 \cdot Ndist\left(-\sqrt{2}\ x\right) \end{aligned} \tag{4}$$

Additionally, the relationship between the inverse function *Erfc* -1 and the normal distribution inverse function *Ndist* -1 is as follows.

$$\begin{aligned} &P = Erfc(x) = 2 \cdot Ndist\left(-\sqrt{2}x\right) \quad \text{From the relationship} \\ &\frac{P}{2} = Ndist\left(-\sqrt{2}\ x\right) \quad \Rightarrow \quad x = \frac{-1}{\sqrt{2}} Ndist^{-1}\left(\frac{P}{2}\right) \\ &\therefore \quad Erfc^{-1}(P) = \frac{-1}{\sqrt{2}} Ndist^{-1}\left(\frac{P}{2}\right) \end{aligned} \tag{5}$$

A.1.1.2 Required CN ratio increase

When there is a single SFN wave, the frequency characteristic (Fa) of the received signal is acquired by the following equation.

$$F_a(\omega) = \sqrt{1 + U_a^2 + 2U_a \cdot \cos(\omega \cdot \tau)} \tag{6}$$

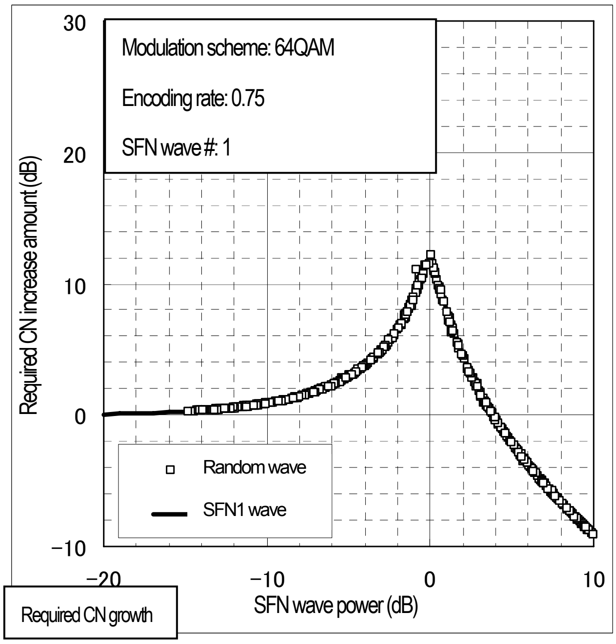
However, U_a: Relative amplitude to preferred waves of SFN waves, τ: Delay time of SFN waves.

Figure A-2 is a calculation for the growth of the required CN ratio for 64QAM. The horizontal axis of the figure is the electrical power of the SFN wave to the preferred wave electrical power, and the UD ratio (reciprocal of the DU ratio). The vertical axis is the growth of the required CN ratio, and by adding the required CN ratio (20dB for 64QAM-3/4, 22.5dB for 64QAM-7/8 etc.) when there is no SFN wave, it becomes an actual required CN ratio. The dots in figure are the CN growth that became 8.5×10^{-3} (encoding rate: 3/4) and 1.1×10^{-3} (encoding rate: 7/8) of the prescribed value for the average error rate for each respective case which caused the SFN waves with random values for the amplitude and delay time. Additionally, the solid line is growth of the required CN ratio requested when the delay time is constant, and later is called the required CN increasing function.

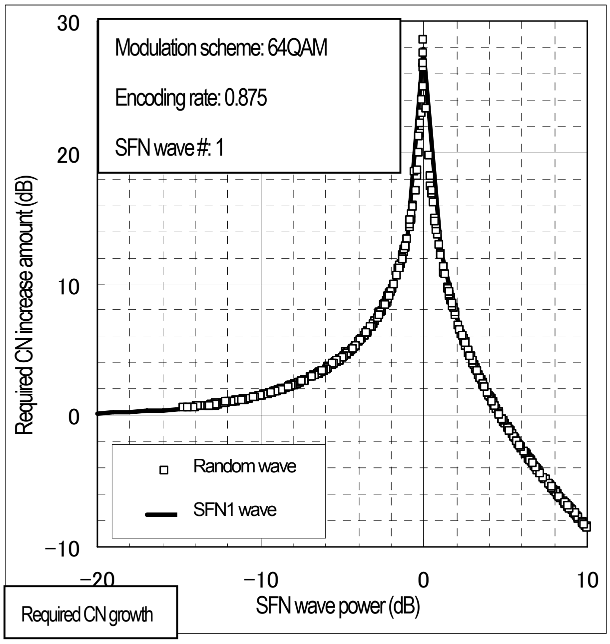
It is difficult to obtain the required CN increasing function analytically, and although it was obtained numerically here, an approximation function is used because calculations later are inconvenient. It is defined by the next equation.

$$
\begin{aligned}
CN_{up}(UdB) &= \alpha \cdot \exp\left\{-|\beta \cdot UdB|^{\gamma}\right\} && (UdB \le 0) \\
&= \alpha \cdot \exp\left\{-|\beta \cdot UdB|^{\gamma}\right\} - UdB + A \cdot UdB && (UdB > 0)
\end{aligned} \tag{7}
$$

Here, UdB is the SFN wave power expressed in dB and CN_{up} (UdB) is growth of the required CN expressed in dB. The value of each coefficient α, β, and γ is shown in table A-1. Additionally, when normal A=0.



(a) Encoding rate = 3/4



(b) Encoding rate = 7/8

Figure A-2 Example of the required CN increasing function

In the UdB >0 region in equation (7), the difference in the function type (with the - UdB term) depends on the following reason. *UdB* > 0 means the SFN wave is at higher level than the preferred signal. In this case, the receiver unit interprets the SFN waves as the preferred waves, and the preferred signal as the delayed signal, and demodulates. More specifically, because the signal level grows in this region in proportion to the increase of the UdB, the required CN growth amount based on the level of the preferred waves will become smaller in proportion to the UdB. This is the reason -UdB is added. The UdB >0 region does not exist if the highest-level wave is defined as the preferred wave. Here, in order to discuss two dimensional voltage regions such as in figure A-5, UdB >0 is defined.

The coefficient α, as the type of required CN increasing function shows, is a coefficient (dB value) which shows the largest value for the required CN increase (caused when DU=0dB). As in the figure, the encoding rate is 3/4 and 7/8, and the largest value for the required CN increase differs greatly. The difference in the required CN ratio when there are no SFN waves is at most 2-3 dB and although the reception characteristic is not enormously different from the difference in the encoding rate, when there are SFN waves, the reception characteristic is very different because the difference in the required CN ratio is about 15dB.

Table A-1　Coefficient for the required CN increasing function

Coefficient	Modulation scheme	Encoding rate:7/8	Encoding rate:5/6	Encoding rate:3/4	Encoding rate:2/3	Encoding rate:1/2
α	64QAM	27.749	20.257	12.090	8.1386	3.8797
	16QAM	29.800	22.163	13.874	9.8342	5.4002
	QPSK	32.255	24.378	15.953	11.827	7.2391
β	64QAM	0.5592	0.4117	0.2953	0.2527	0.2074
	16QAM	0.6074	0.4453	0.3171	0.2702	0.2251
	QPSK	0.6702	0.4876	0.3450	0.2922	0.2437
γ	64QAM	1.0662	0.7253	0.9096	1.0341	1.2100
	16QAM	0.5954	0.6936	0.8616	0.9776	1.1378
	QPSK	0.5710	0.6608	0.8115	0.9172	1.0662

A.1.1.3　Noise characteristics of receiver units

Noise that affects reception can be divided into 2 types. One becomes a steady value independent of the input signal as typified by thermal noise, and the other increases and decreases in proportion to the input signal level. The former will be called fixed noise and the latter will be called amplitude proportion noise. Additionally, although there is noise proportional to the 2nd power and the 3rd power of the input signal as the intermodulation distortion of the amplifier, since these are regarded as quite small, they are not considered here.

Fixed noise is thermal noise of 300K, city noise, and noise figures (NF), etc. of receiver units. In the line design of the Electronic Communication Technology Council report, thermal noise is (300K) ≒1dBμV, NF≒3dB, and city noise ≒700K. From these, fixed noise (equivalent to 1300K) ≒8.5dBμV(@75Ω) is obtained.

The amplitude proportion noise is decided by the receiver performance. As envisioned noise sources, there are AD conversion quantization noise (AD conversion bit length dependent), clip noise (dynamic range dependent), and PLL phase jitter, etc.

A.1.1.3.1 Clip noise

The amplitude distribution of the OFDM signal requires a very large dynamic range to process signals with no distortion because almost all the signal is normally distributed. In normal receiver units, components with a constant signal level or higher are clipped and treated. Figure A-3 explains the influence of a signal clip. As in the figure, the shape of the clipped waves is equivalent to adding the input signal to components higher than the clip level by reverse-polarity. Components higher than the clip level have a spiked wave shape as shown in the figure. Here, the rms value of the signal is $S_{rms,}$ the CL regular probability density function for the clip level is Gauss (*), and the probability that the signal takes a certain level x is Gauss (x /Srms). Additionally, the amplitude of the spiked wave when the signal exceeds the clip level can be written (x - CL). Therefore, the electrical power of the spiked wave is calculated as follows.

$$NP_{clip} = \int_{CL/S_{rms}}^{\infty} (x - CL)^2 \cdot Gauss\left(x/S_{rms}\right) dx \tag{8}$$

Since the frequency component for the spike shaped wave can be almost considered as flat noise, it can be considered that the noise for the electrical power of the above equation is generated by the receiver units. The transmission device also actually causes a similar clip action, and the resulting clip noise component is transmitted. Since this component is proportional to the signal level, the results do not change even though it is regarded that the receiver units generate all the clip noises.

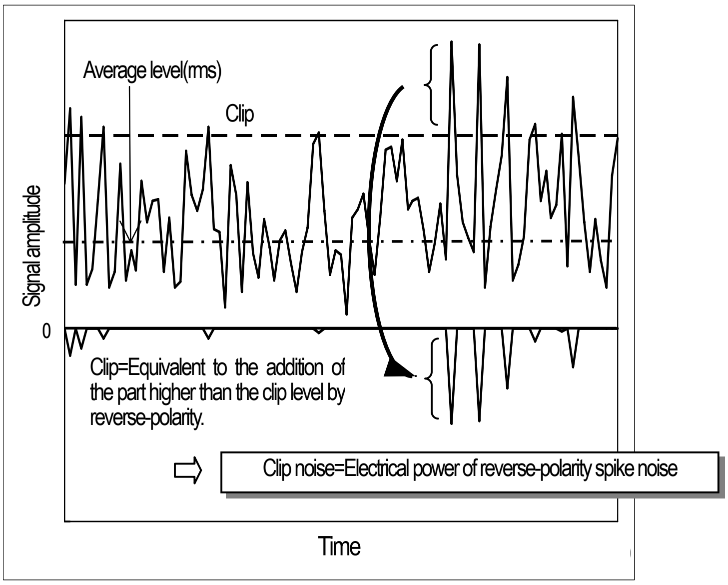


Figure A-3 Clip noise

A.1.1.3.2 AD conversion quantization noise

In normal receiver units, the clip level is assumed to be full-scale and the equal of AD converters. In this case, when a minimum quantization level is LSB, the quantization noise electrical power is provided by the following equation.

$$\begin{aligned} NP_{adc} &= LSB^2/12 \\ &= \left(CL \cdot 2^{-N}\right)^2/12 = CL^2 \cdot 2^{-2N}/12 \qquad \text{However,} \quad LSB = CL \cdot 2^{-N} \end{aligned} \tag{9}$$

The noise power provided by equation (8) and equation (9) above is proportional to the 2nd power of the clip level CL. Since it is normal for the relationship between the input signal level (Srms) and the clip level to be constantly maintained by AGC, etc., functions, it can be said that these noise amplitudes are components that increase and decrease in proportion to the input signal amplitude.

Figure A-4 is a calculation example of the amplitude proportion noise. The clip noise is surprisingly large, and it appears a clip level of about 4 times the signal level (+12dB) is necessary. On the other hand, because the quantization of AD conversion roughens if the clip level is set unnecessarily large, the overall noise characteristics deteriorate. More specifically, the clip level has an optimum value according to the bit length of the AD conversion.

A.1.1.3.3 Other amplitude proportion noises

Although PLL phase noise and calculation errors, etc. are conceivable, the overall amplitude proportion noise including the following is expressed by the relative value to the rms value of the input signal (same as figure A-4).

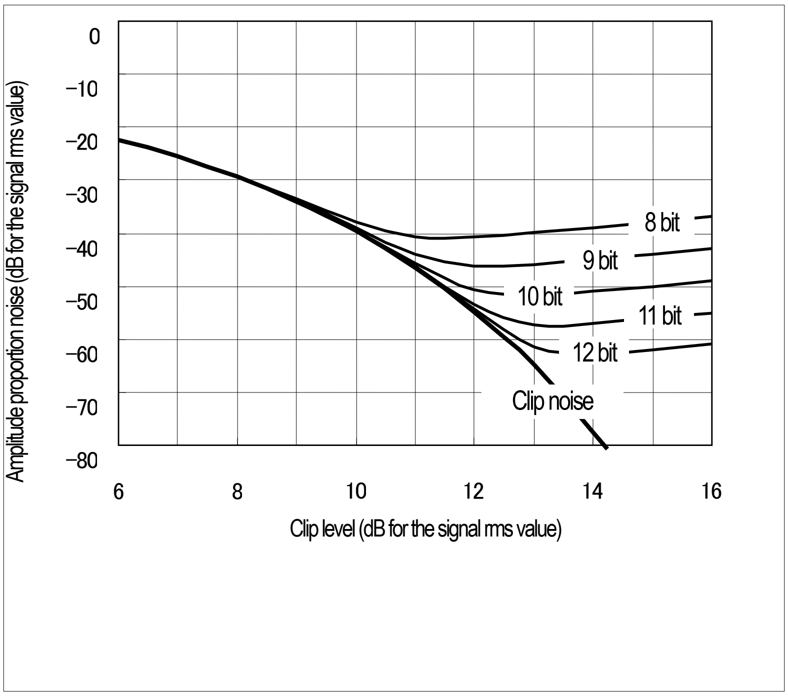


Figure A-4 Amplitude proportion noise example

A.1.1.4 SFN reception disturbance area

Elements for calculating whether digital reception was possible or not were obtained from the above inspection. Specifically,

$$
\begin{aligned}
CN &= CN_0 \times CN_{up}\left(U_{rms} / D_{rms}\right) \\
NP &= NP_{fix} + NP_{amp}\left(S_{rms}\right) \qquad (10) \\
S_{rms} &= \sqrt{D_{rms}^2 + U_{rms}^2}
\end{aligned}
$$

Here, CN : Required CN ratio when SFN waves exist (power ratio)

CN_0: Required CN ratio when there are no SFN waves (power ratio)

$CN_{up}(*)$: Required CN increasing function Defined by equation (7)

U_{rms}: rms amplitude of SFN waves

D_{rms}: rms amplitude of preferred waves

S_{rms}: rms amplitude of synthetic waves of preferred waves and SFN waves (receiver unit input amplitude)

NP : Harmony of fixed noise electric power and amplitude proportion noise electric power

NP_{fix}: Fixed noise power

$NP_{amp}(*)$: Amplitude proportion noise power expression. Sum value of equation (8) and equation (9)

When the preferred wave power ${D_{rms}}^2$ which is calculated by equation (10) is CN times or higher for noise power NP, reception is possible since the required CN ratio can be secured, and oppositely when it is less than CN times the NP, reception is not possible since the required CN ratio cannot be secured. Specifically, it becomes a SFN reception disturbance area. In this perspective, the boundaries of the SFN reception disturbance area are obtained from the solution to the following equation.

$$\begin{aligned} D_{rms}^2 &= CN \times NP \\ &= CN_0 \cdot CN_{up}\left(U_{rms}/D_{rms}\right) \times \left\{ NP_{fix} + NP_{amp}\left(\sqrt{D_{rms}^2 + U_{rms}^2}\right)\right\} \end{aligned} \tag{11}$$

Figure A-5 is the result of the calculation for equation (11) above for 64QAM. In the calculation, the amplitude proportion noise is -40 dB, and the fixed noise is 8.5dBμV. The area with the range enclosed by the curve in the figure is an SFN reception disturbance. For an encoding rate of 3/4, even in the worst case of DU=0dB, when the preferred wave level goes above a certain level there is no SFN reception disturbance, while at the same time for 7/8, the DU≒0dB vicinity is a SFN reception disturbance area regardless of the preferred wave level.

Figure A-6 follows the same calculation when the amplitude proportion noise is -35 dB. In this case, even if the encoding rate is 3/4, the DU≒0dB vicinity is a SFN reception disturbance area. Also, for 7/8, the DU ratio range that has become SFN reception disturbance has widened. Thus, the SFN reception disturbance area depends on the amplitude proportion noise (= receiver performance) at the same time as depending on the encoding rate.

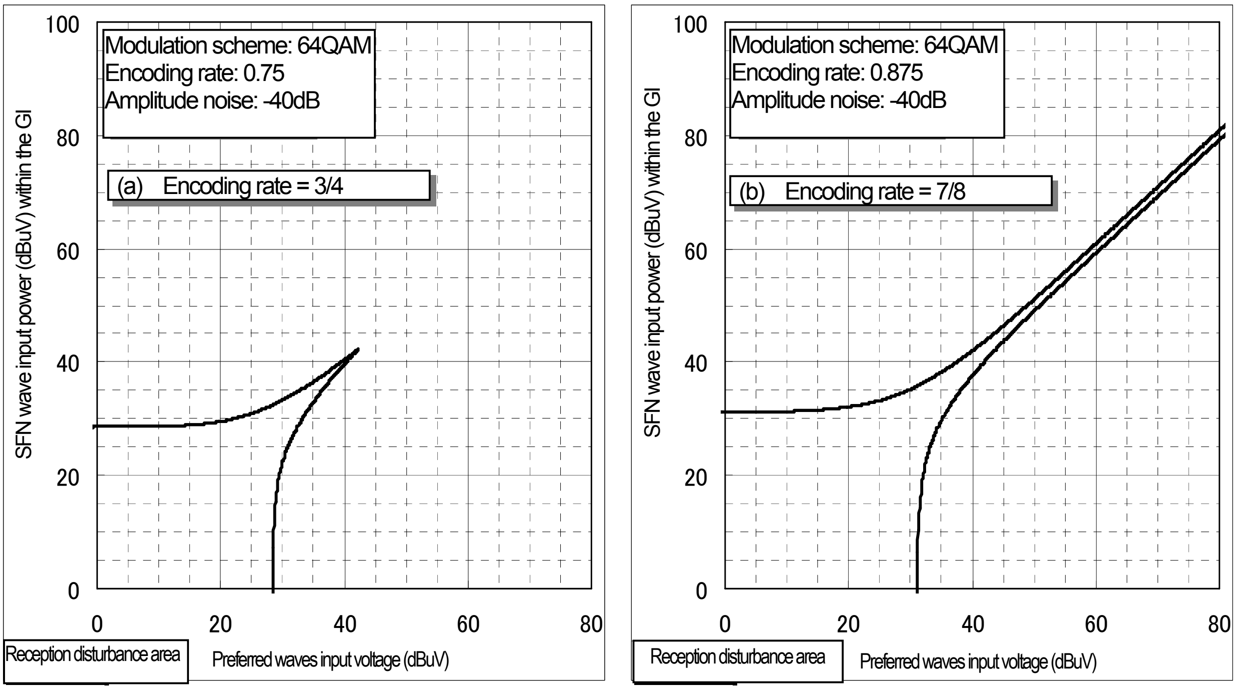


Figure A-5 Example of SFN reception disturbance(64QAM, amplitude proportion noise:-40dB)

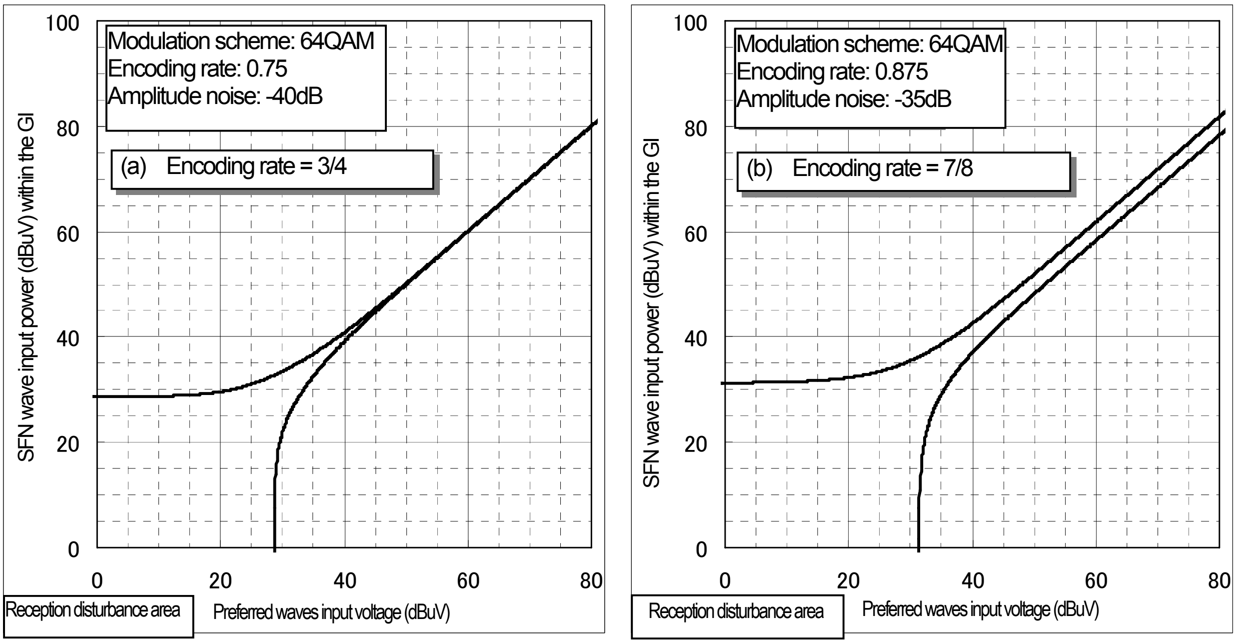


Figure A-6 Example of SFN reception disturbance(64QAM, amplitude proportion noise:-35dB)

A.1.1.5 Non-generation conditions for SFN reception disturbance

As shown in figure A-5(a), the area where there is no SFN reception disturbance generated is great. Let's look at how this comes into effect. In the non-generation SFN reception disturbance area, the preferred wave level is to a certain degree a large area (Refer to figure A-5(a)). Noise related to the judgement on reception posibility only has to consider the amplitude proportion noise since fixed noise can be ignored in this area. When the preferred wave and the SFN wave are the same level, the required CN increase becomes the maximum. That is, the required CN increase at this time for DU=0dB (Refer to figure A-2), is given by coefficient α in table A-1. For example, for 64QAM-3/4 the required CN ratio is the one (32.1dB) that adds the CN ratio increase (12.1dB) to the required CN ratio (20dB) when there are no SFN waves, and in the same way, for 64QAM-7/8, it is 22.5dB+27.7dB=50.2dB.

Since the input signal is a combination of the preferred waves and SFN waves, the input signal level at this time (DU=0dB) is +3dB of the preferred wave level. Therefore, for this large 3dB amplitude proportion noise, a SFN reception disturbance non-generation condition is the preferred wave level that becomes the increased required CN ratio or higher above. More specifically,

$$NP_{amp} \leq -\left(CN_0 + CN_{up} \ \text{(Max. value)}\right) = -\left(CN_0 + \alpha + 3\right) \qquad \text{(Expressed by dB)} \qquad (12)$$

Concretely, the amplitude proportion noise is -35 dB or less for 64QAM-3/4, and for 7/8, if the amplitude proportion noise is -53dB or less, a SFN reception disturbance will not be generated.

If you look at the calculation example in figure A-4, an amplitude proportion noise of -35dB can be achieved with an AD converter with an effective 8-bit ability level, but to obtain an amplitude proportion noise of -53dB, an AD converter with an effective ability of 11bits or more is required. Furthermore, besides AD conversion, when considering PLL phase jitter, etc., achieving an amplitude proportion noise of -50 dB or less achievement may be difficult. From this, although SFN reception disturbance areas exist in 64QAM-7/8, for 64QAM-3/4, it can be thought that SFN reception disturbances are not generated in areas where the preferred wave input voltage is 40-45dBμV or more. However, as this depends on receiver unit performance, confirmation is necessary for the performance of real receiver units.

A.1.1.6 Location dispersion

If the preferred waves in each reception point and the electrical field strength of the SFN waves (therefore, receiver unit input voltage) can be accurately known, from figure A-5, etc. above, it can be quickly understood whether the reception point is the SFN reception disturbance point. However, since knowing the electrical field strength accurately is impossible, the idea of location dispersion is introduced.

The average electrical field strength in the vicinity of a certain calculated area with an electrical field intensity calculation tool, etc., is **μ_x** for the preferred wave and **μ_y** for the SFN wave. Additionally, the standard deviation of the electrical field strength distribution in the vicinity of the area is σ_x for the preferred wave and σ_y for the SFN wave. Furthermore, when the cross-correlation coefficient of the preferred wave electrical field strength and the SFN wave electrical field strength is ρ, the electrical field strength distribution can be shown by the regular probability density function of two variables.

$$F(E_x, E_y) = \frac{1}{2\pi\sqrt{A}} \exp\left[-\left\{ a_{11}(E_x - \mu_x)^2 + 2a_{12}(E_x - \mu_x)(E_y - \mu_y) + a_{22}(E_y - \mu_y)^2 \right\}\right] \quad (13)$$

$$However, \quad A = \sigma_x^2 \sigma_y^2 (1 - \rho^2)、 a_{11} = \sigma_y^2 / A 、 a_{12} = -\rho \sigma_x \sigma_y / A 、 a_{22} = \sigma_x^2 / A$$

by extending and integrating the SFN reception disturbance generation area (for example, area enclosed by the curve in figure A-5) in the probability density function for equation (13), the probability of whether or not the region becomes an SFN reception disturbance can be calculated. Specifically, the SFN reception disturbance generation probability of the area whose average electrical field strength (Reception voltage to be precise) is (**μ_x**, **μ_y**) becomes the following equation.

$$P(\mu_x, \mu_y) = \iint_{\text{Reception disturbance occurrence}} F(E_x, E_y)\, dE_x\, dE_y \quad (14)$$

Figure A-7 is a calculation of equation (14) for 64QAM-3/4, etc., and figure A-8 is for 64QAM-7/8. When the encoding rate is 3/4, the reception disturbance generation probability for the reception voltage 45dBμV (electrical field strength ≒60dBμV/m) or higher region is almost 0, and when the encoding rate is 7/8, the reception disturbance generation probability is several % even if the DU ratio is near 10 dB in the 45dBμV or higher region. Although assessing things from only this may not be always appropriate, for the use of 64QAM-7/8, sufficient prior inspections for SFN reception disturbance generation and confirmation that the electric field region that generates reception disturbances does not exist in the service area become important.

If the graphs in figure A-7 and figure A-8 are calculated in advance, as long as the electrical field strength of specific locations is calculated with an electrical field intensity calculation tool, etc., the reception disturbance generation probability can be immediately known by referring to the graph.

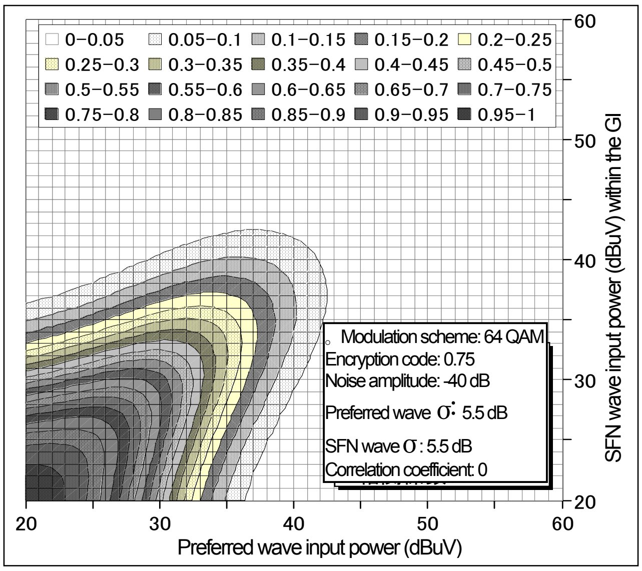


Figure A-7 SFN reception disturbance generation probability

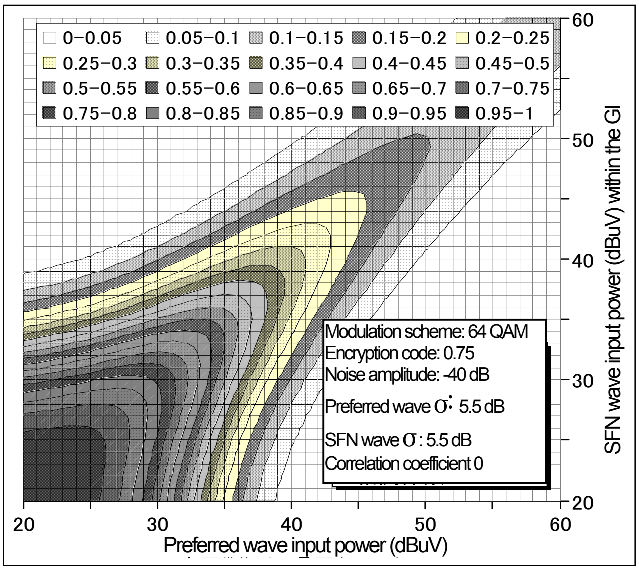


Figure A-8 SFN reception disturbance generation probability

A.1.1.7 Electrical field strength cross-correlation coefficient

Although the preferred waves and the SFN waves come from generally different directions, it is not a problem to assume that the distribution of each electrical field has statistically the same decentralization. In ITU-R recommendation P.1546, the location dispersion of the digital spectrum is recorded as σ=5.5dB. By the way, when thinking that the location dispersion caused by the reception electric field that is different by location mainly due to the influence of geographical features, trees and buildings etc., around the reception point, it can be imagined that there is a correlation in the electrical field strength distribution of the preferred waves and SFN waves. For example, in depressed geographical areas, regardless of the incoming direction, the electrical field strength is lower than other locations and the electrical field strength is higher in slightly elevated locations, etc. Moreover, it is easily estimated that the correlation will strengthen the nearer the waves come together.

Figure A-9 shows how the reception disturbance incidence changes according to the difference of the cross-correlation coefficient ρ. Although the area of the reception disturbance generation narrows as the correlation rises, it is understood that the position shifts towards the area where the preferred wave electrical field strength is higher.

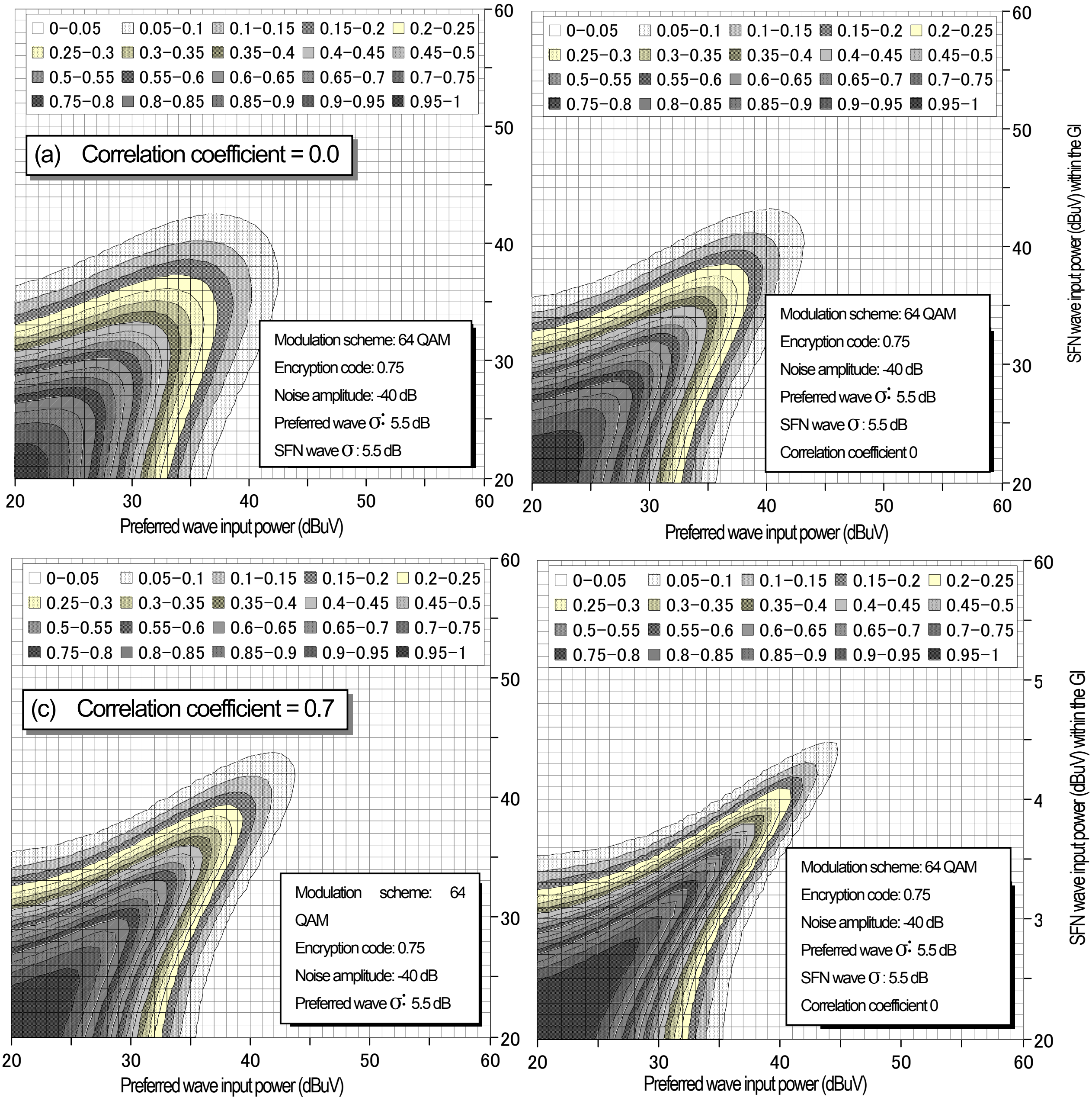


Figure A-9 Change in the reception disturbance generation probability according to cross-correlation coefficient of location dispersion

A.1.2 For multiple SFN waves

A.1.2.1 How to coalesce multiple SFN waves

Since the amplitude distribution of the maximum/minimum value, etc. of the reception spectrum can be represented as a mathematical function only for the electrical power value when there are single SFN waves, the required CN increase amount can be uniquely obtained as a mathematical function of the SFN wave electric power. (Refer to figure A-2). However, when there are multiple SFN waves, the relationship between reception spectrum amplitude distribution (therefore, required CN increase amount) and SFN wave electrical power does not become one to one any longer. For example, even if the SFN wave electrical power is the same, when there are many small-power waves with one high-power SFN wave, and when all SFN waves are the same power level, the amplitude distribution of the received signal becomes different and as a result, the required CN increase amounts are different. When multiple SFN waves exist in this way, it becomes important that for what standard of SFN wave that becomes an interference source, the required CN increase amount should be expressed. To rephrase this, it becomes important to express the required CN increase amount as which mathematical function. Understandably, it is important to use correlativity with high standards.

The dots in figure A-10 are calculations of required CN increase amounts for multiple SFN waves with a random amplitude and delay time generated many times. The average approximation function of the figure is the required CN increase function (same function as equation (7)) obtained from the required CN increase amount for each random wave by the least squares method. In the figure, the variation is the largest for the SFN2 wave, and the variation almost remains constant for 4 waves or more. At any rate, the required CN increase amount increases more than the SFN1 wave excluding the DU≒0dB area.

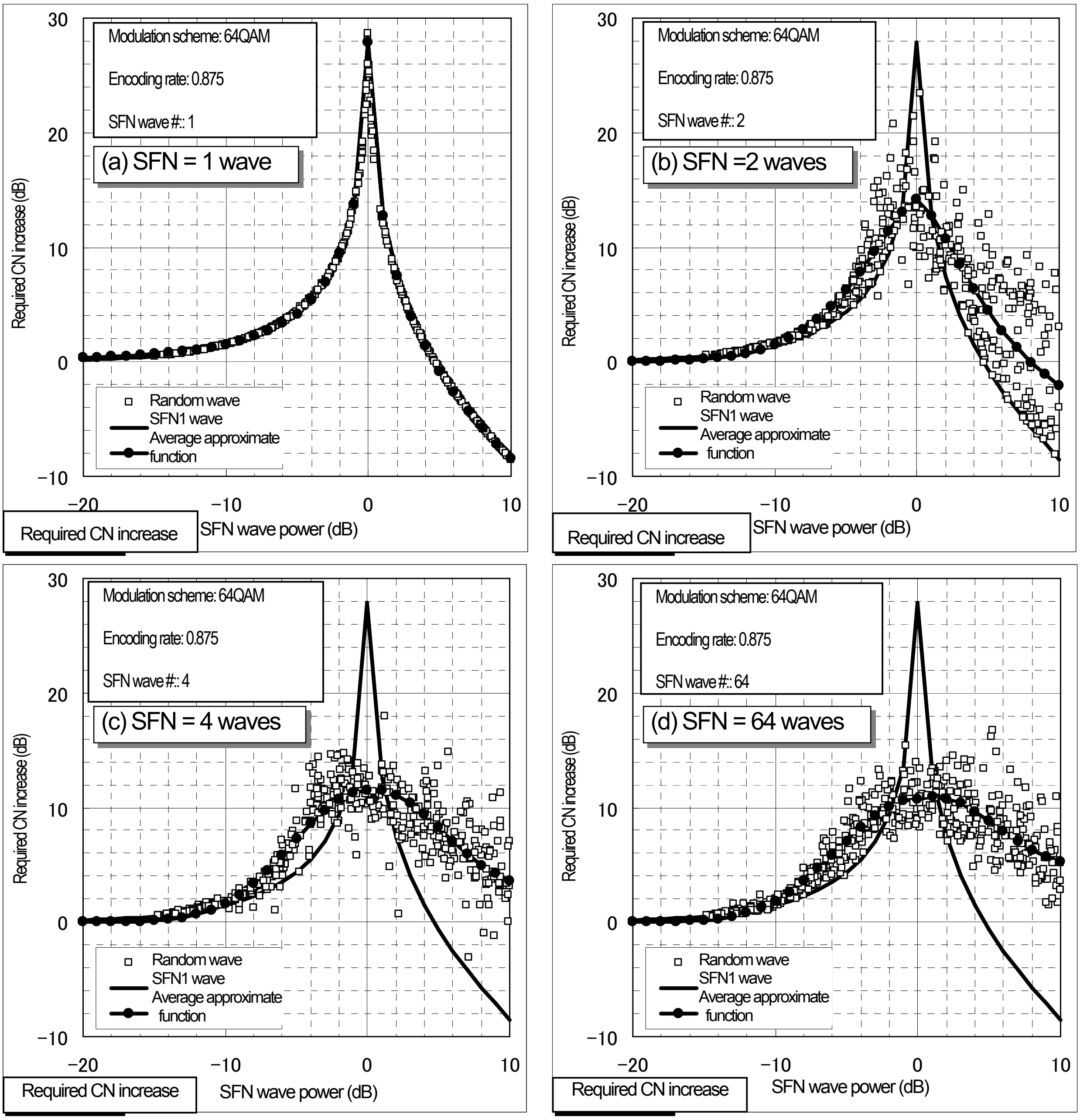
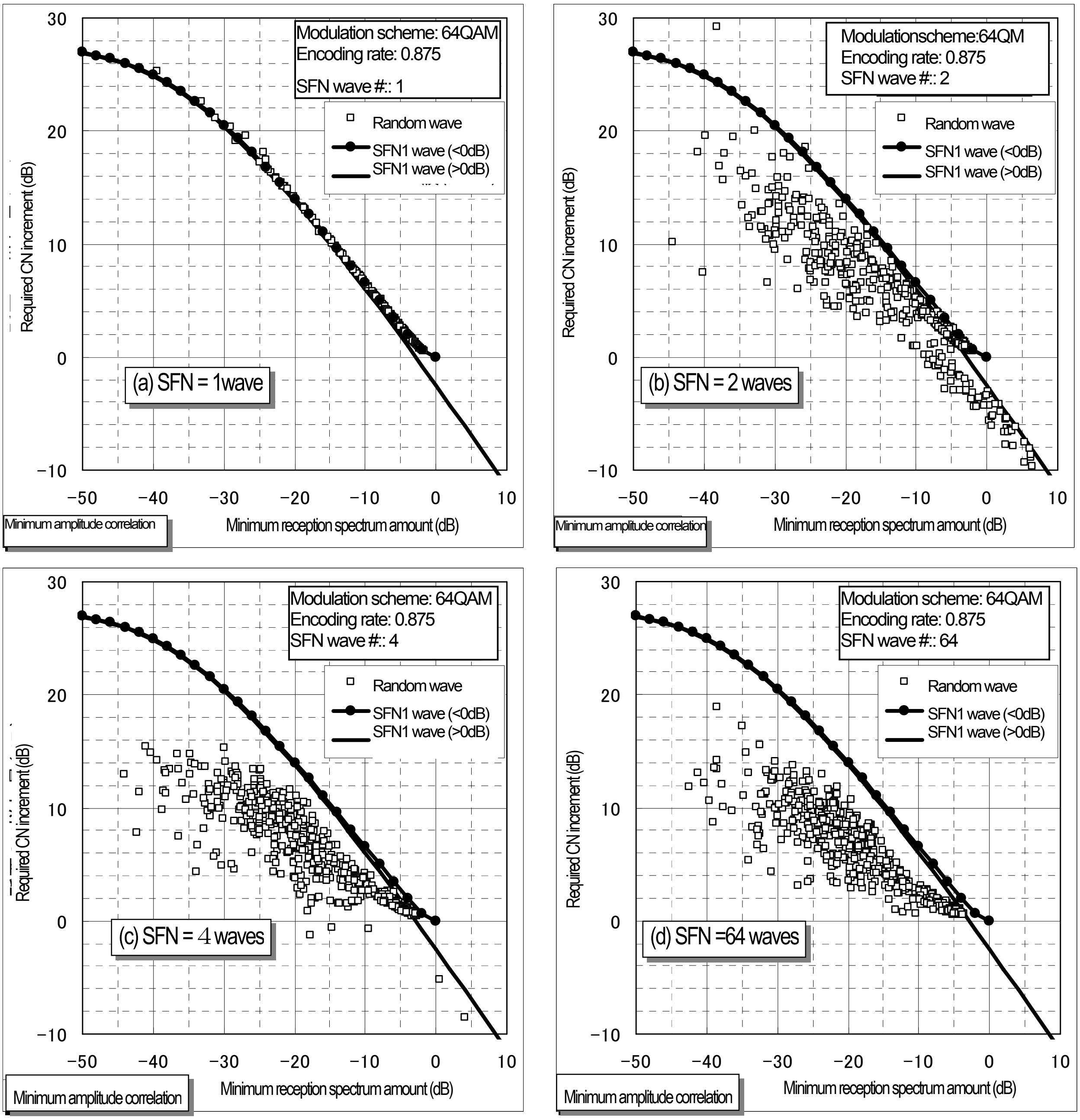


Figure A-10 Number of SFN waves and required CN increasing amount(64QAM-7/8)

Figure A-11 plots the minimum values for the reception spectrum (input level for the dip frequency) for the required CN increasing amount in figure A-10. In this case, variations become the smallest for the SFN2 wave, and are the opposite of figure A-10. Also, the required CN increasing amount does not exceed the amount for the SFN1 wave for any condition.



FigureA-11 Minimum reception spectrum values and required CN increasing amount(64QAM-7/8)

Figure A-12 shows the same calculation for 64QAM-3/4. In this case, the variation of the required CN increasing amount for the SFN electrical power compared with 64QAM-7/8 is small. Additionally, the required CN increasing amount almost remains within the amount for the SFN1 wave in the DU< 0dB area. On the other hand, the required CN increasing amount for the minimum values of the reception spectrum are more diverse when the variations are compared to 64QAM-7/8 in figure A-10. In particular, for DU>0dB (showed by dots with a * mark in the figure), it is difficult to see the correlation between the minimum value of the reception spectrum and the required CN increasing amount.

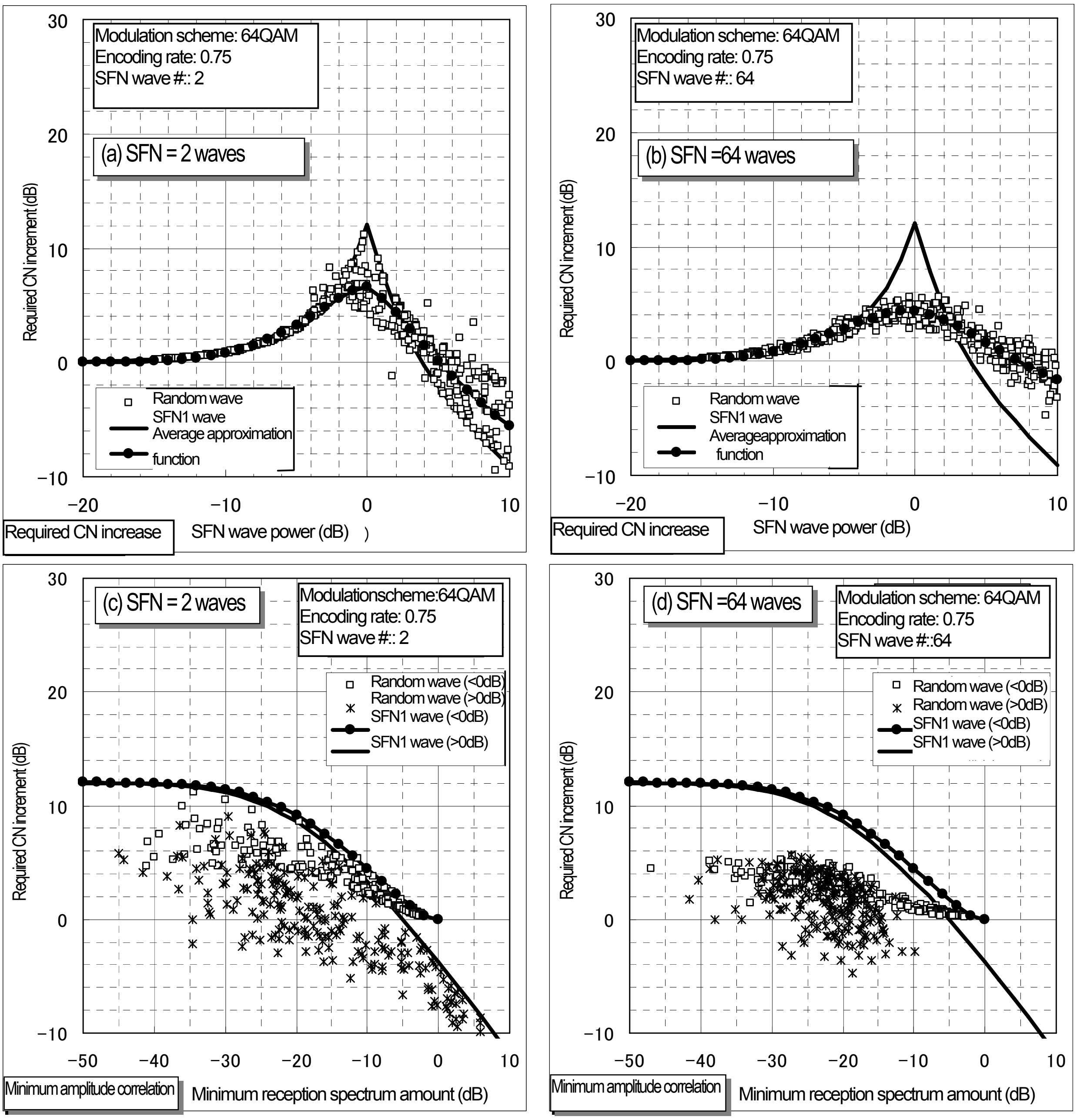
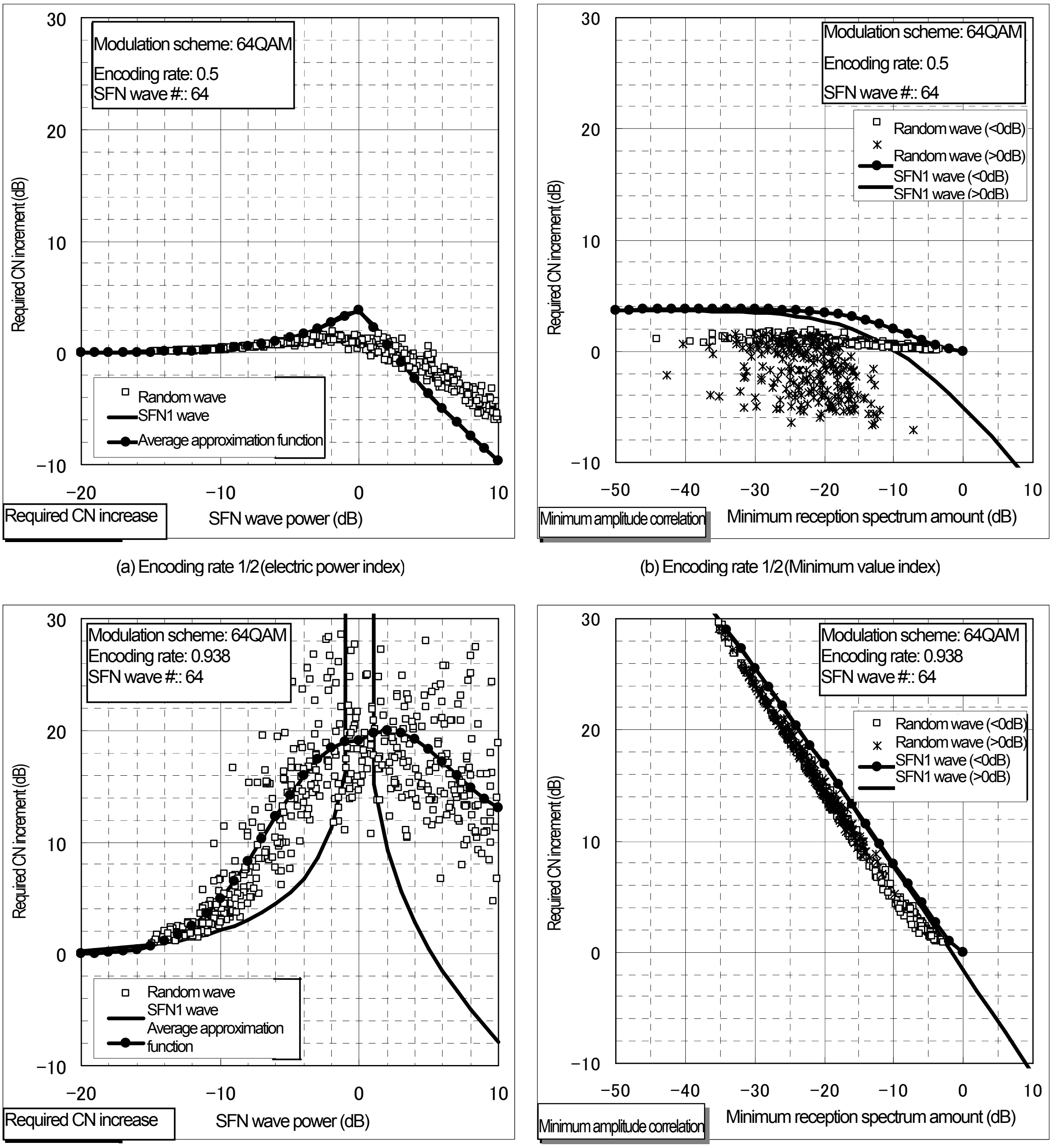


Figure A-12　Number of SFN waves and required CN increasing amount(64QAM-3/4)

As above, the required CN increase and the high correlation index differ depending on the number of SFN waves and the encoding rate, and in all cases, the proper characteristic for the correlation rise (how to bring the multiple SFN waves that are the source of interference together) cannot be found. However, as a general trend, using the SFN electrical power as an index for the interference source when the encoding rate is low (high error correction ability) and using the minimum value of the reception spectrum when the encoding rate is high (low error correction ability) seem appropriate.

Figure A-13 is a comparison between the 64QAM-1/2 case and the case when the permissible error rate is a system of $3x10^{-5}$ (hereinafter 64QAM-15/16) in order to show the difference of the "Appropriate" index due to the difference in the encoding rate. When the encoding rate is high, since the permissible error rate is small, the error correction ability will be exceeded by a very small number of OFDM carriers falling below the prescribed level. Specifically, in order for carriers with a minimum level error rate to become dominant, the minimum values of the reception spectrum become the main element for deciding the required CN increasing volume. When the encoding rate is low, even if carriers with a low BER level fades, for carriers with a high BER level to be better than the prescribed value, the average BER of all carriers does not always fade. All the electrical power of the SFN wave is the main element for deciding the required CN increasing amount (including decreases also) because it can be considered that the entire error rate will improve with the improvement of carriers with a high BER level.



(a) Encoding rate 1/2(electric power index)

(b) Encoding rate 1/2(Minimum value index)

(c) Encoding rate 15/16(electrical power index)

(d) Encoding rate 15/16(Minimum value index)

Figure A-13 Difference in required CN increase according to the encoding rate

Although the above has been considered widely, 64QAM-3/4 is the main current for the modulation scheme actually used. Therefore, in the following, an electrical power index thought to be "Appropriate" for this demodulation method is used. Specifically the required CN increasing amount is treated as a mathematical function for all SFN wave electrical power.

A.1.2.2 SFN reception disturbance area for SFN2 waves

When there are SFN2 waves, how the SFN reception disturbance generation area is examined. The reception disturbance generation area is uniquely decided by the required CN increase but even if the SFN wave power is the same, the required CN increase amount varies according to the status of the SFN wave (each SFN amplitude of the wave and delay time). In the following, the required CN increase with this variation is thought to be defined as "Appropriate" as a mathematical function of the SFN electric power.

The required CN increase for SFN2 waves often grows more than the SFN1 wave, and it may be improper to use the mathematical function of the SFN1 wave as is. Figure A-14 is a calculation of the cumulative distribution for the difference between both in order to show the difference with the actual required CN increase and SFN1 wave function. It is understood that the required CN increase is greater than the SFN1 wave function with a probability of 80% or more. The calculation for the cumulative distribution above is limited to ones in which the SFN wave power is in the -10dB~+3dB range as the intended required CN increase. The reason is as follows.

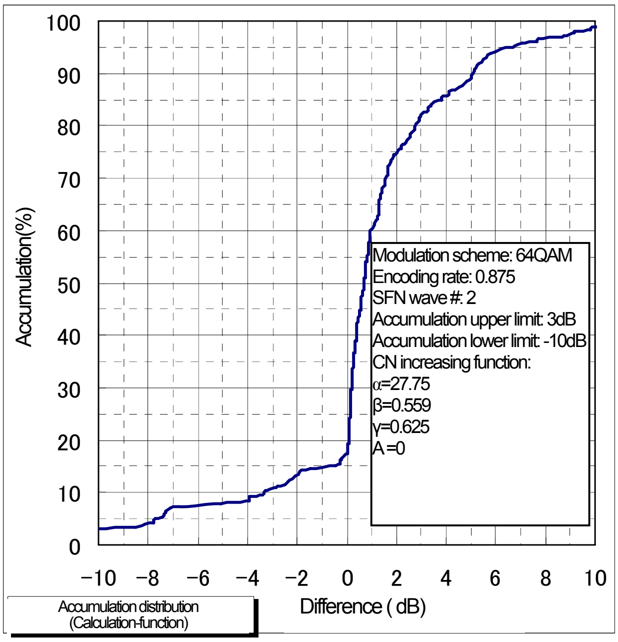


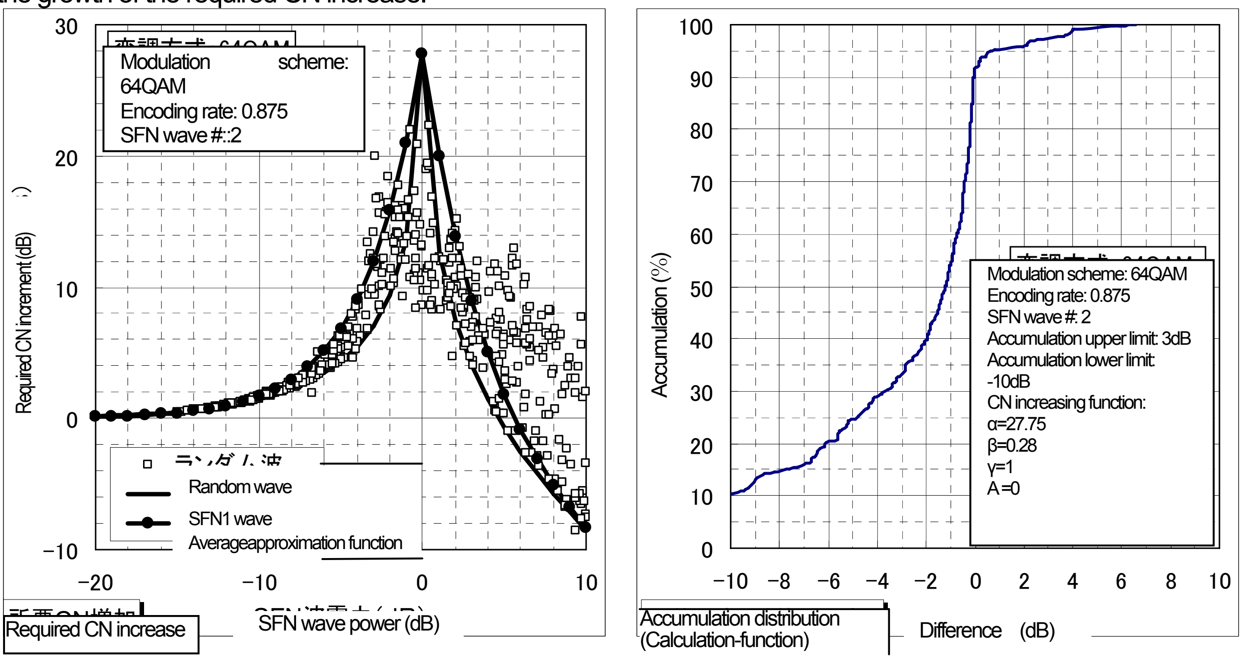
Figure A-14 Cumulative distribution of the CN increase difference

(1) The SFN power is not an object of interest of this computation model since the required CN increase is small in the 10dB or less area.

(2) For this model, since the wave for the maximum electrical power is interpreted as "Preferred wave", the interfered SFN wave does not grow more than the preferred wave. The maximum wave considered as the SFN wave of the interference source is the one with the same electrical power as the preferred wave. Therefore, all SFN wave electrical power does not exceed twice (+3dB) the preferred wave in case of an SFN2 wave.

Figure A-15(1/2) shows an example of a mathematical function in which the required CN increase is an “Appropriate” approximation function or less when the SFN wave electrical power is -10dB~+3dB. This mathematical function is an adjustment of coefficient β (coefficient α is a value in table A-1) in equation (7) for the above probability (accumulation value of the difference =0dB) to become 90% after the index is set to γ=1. Based on the same idea, an approximation function for the arbitrary accumulation value can be created.

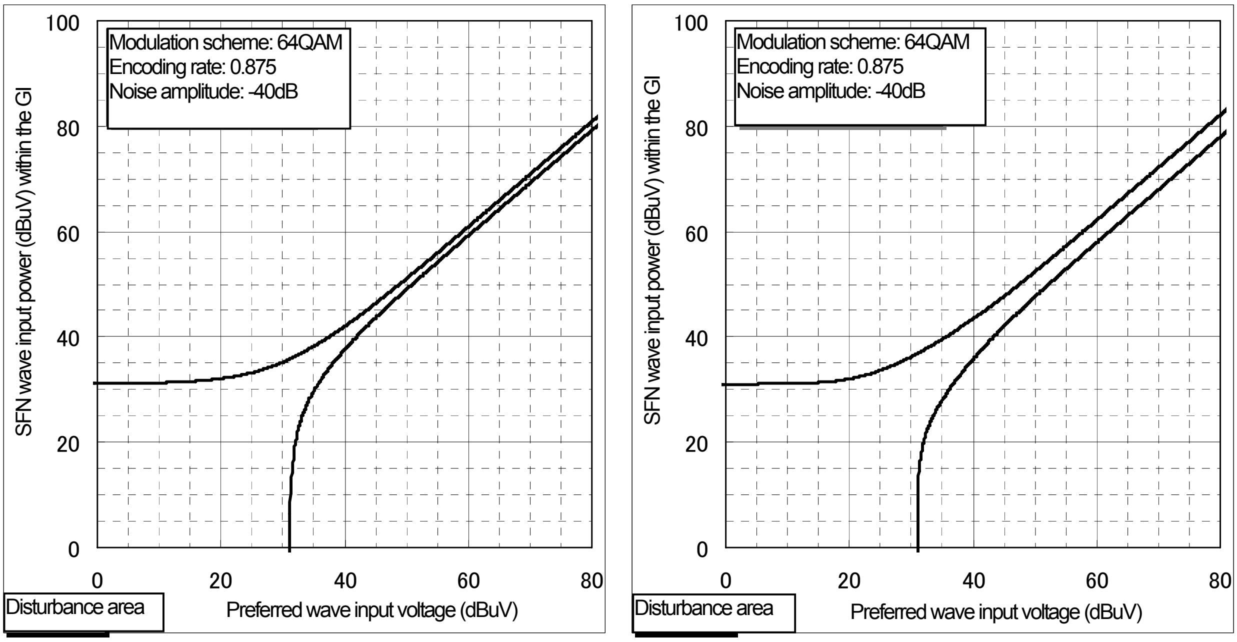
Figure A-15 (2/2) is a calculation of the SFN reception disturbance area for above approximation function. As shown in figure, compared with the case of one wave, the SFN reception disturbance area has expanded with the growth of the required CN increase.



(a) Required CN increase approximation function(90% accumulation)

(b) Cumulative distribution of the CN increment difference

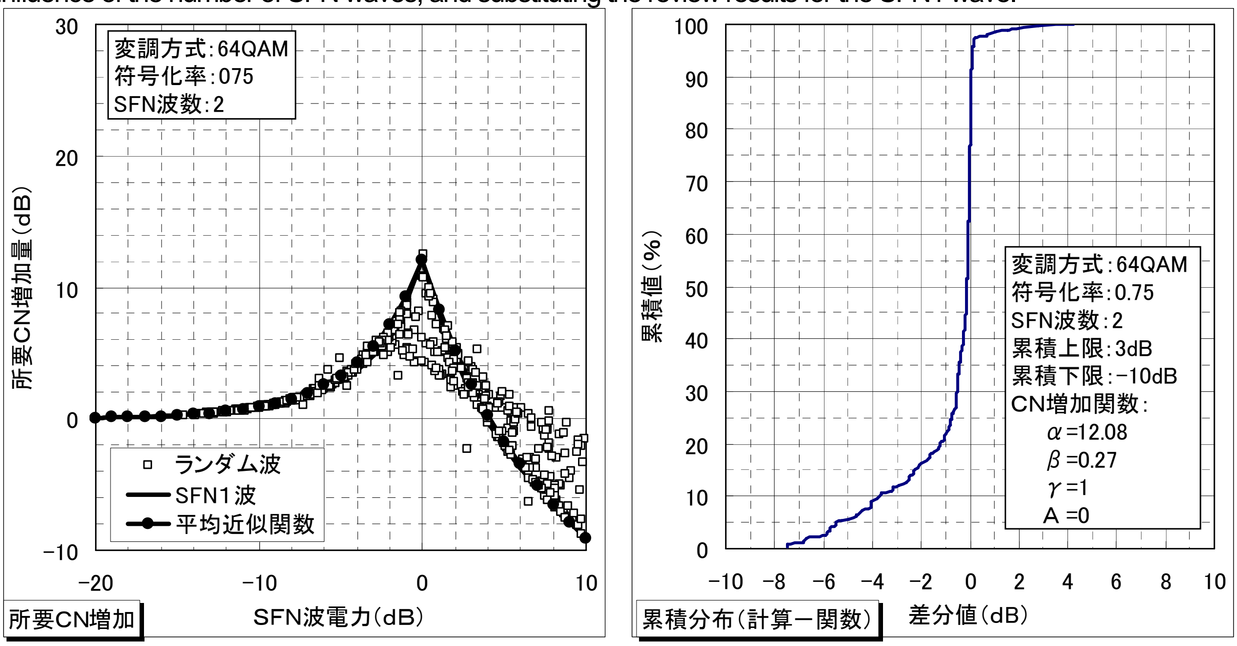
FigureA-15(1/2) "Appropriate" approximation function for 64QAM-7/8(γ= 1 type function)



(a) For SFN1 wave function (b) For SFN2 wave "Appropriate" approximation function

Figure A-15(2/2) Comparison of SFN reception disturbance areas for 64QAM-7/8

Figure A-16 (1/2) and A-16 (2/2) are the same calculations for 64QAM-3/4. In this case, because the required CN increase is almost the same as the SFN1 wave, the SFN reception disturbance area is also the same level. From the comparison between figure A-15 and figure A-16, for 64QAM-7/8, it is necessary to consider whether the interfered SFN wave is singular or plural but for 64QAM-3/4, it can be said there is no problem ignoring the influence of the number of SFN waves, and substituting the review results for the SFN1 wave.



(a) Required CN increase approximation function(90%Accumulation) (b)Cumulative distribution of the CN increment difference

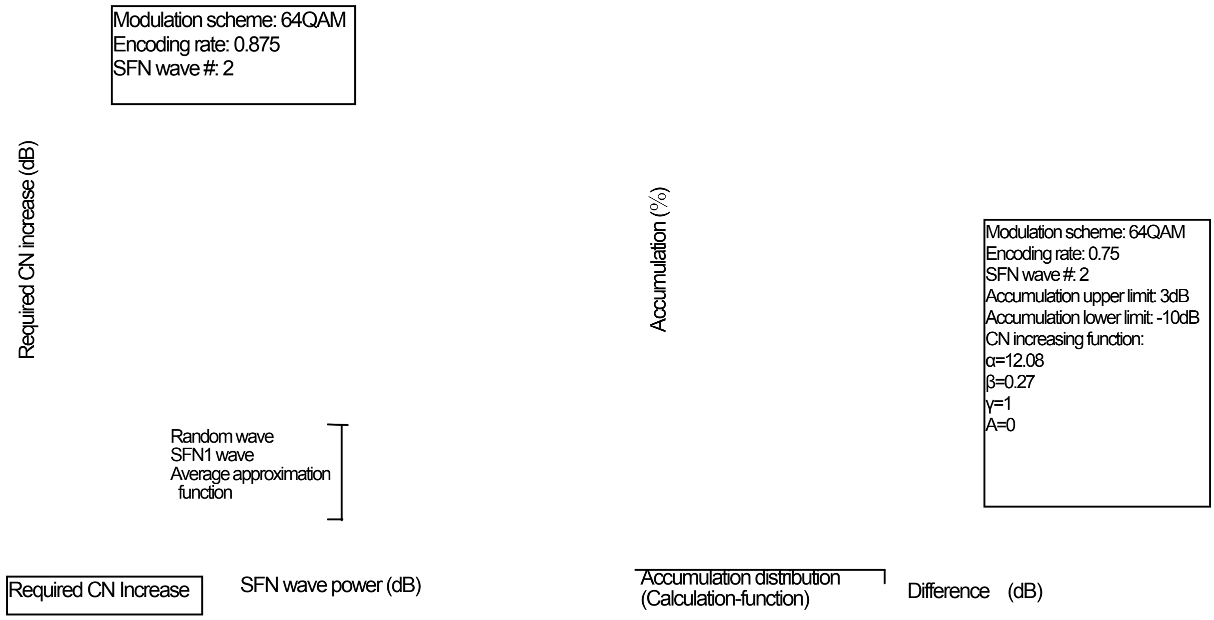
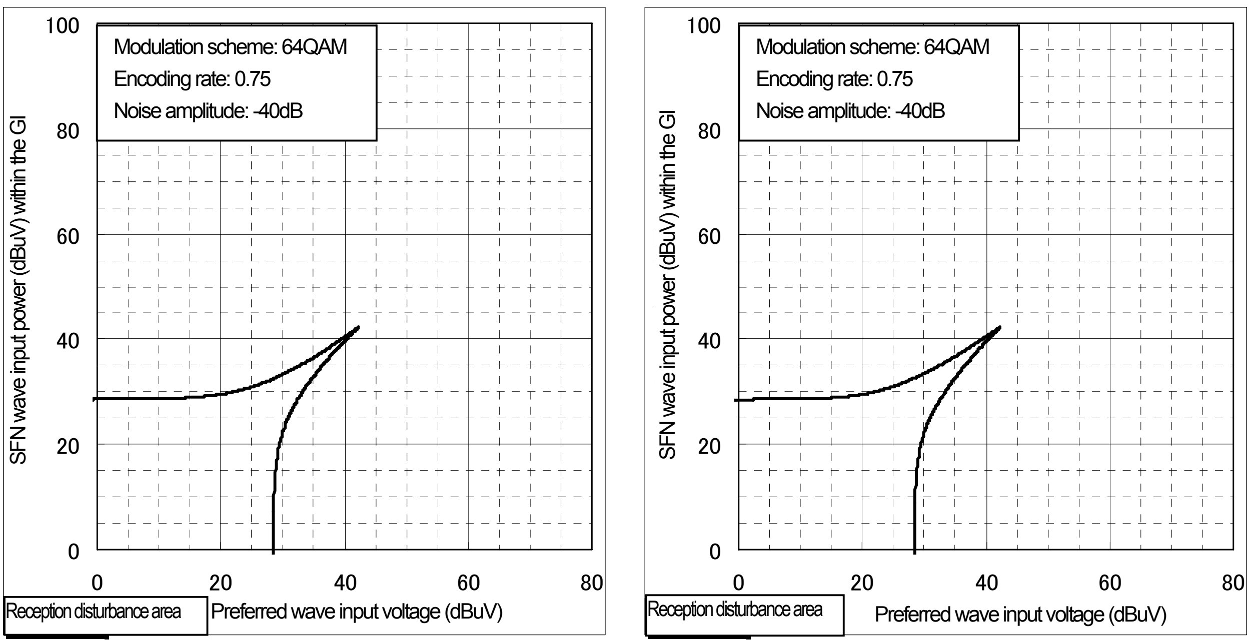


Figure A-16(1/2) 64QAM-3/4 "Appropriate" approximation function(γ = 1 type function)

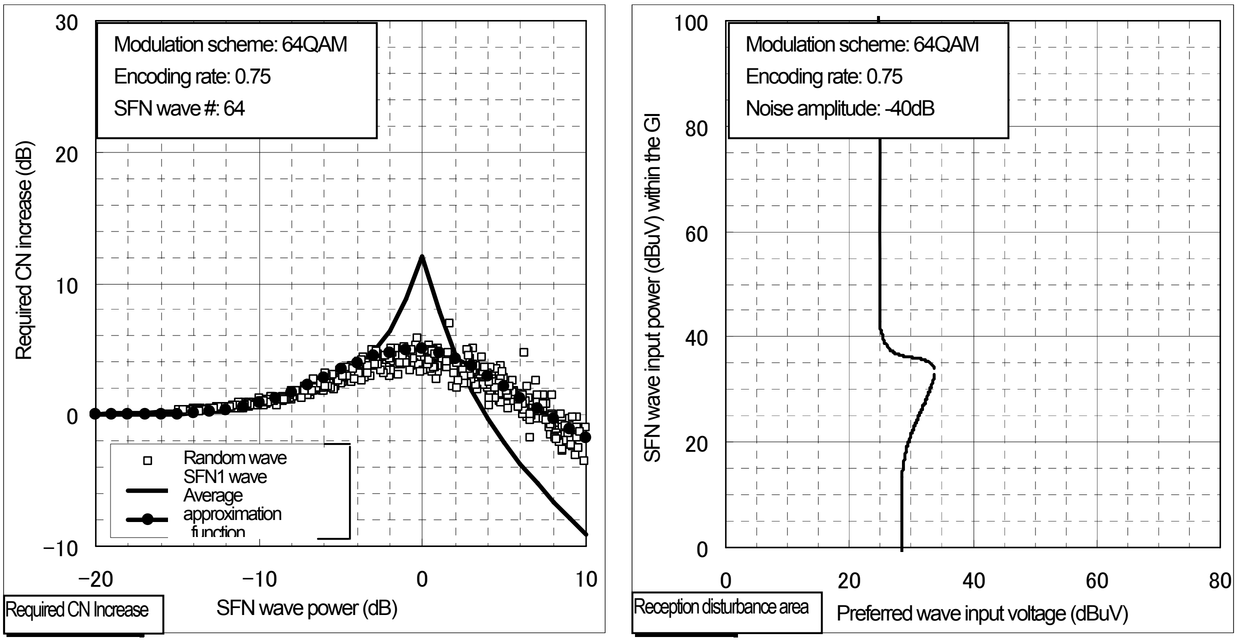


(a)For the SFN1 wave function For the SFN2 wave "Appropriate" approximation function

Figure A-16(2/2) Comparison of 64QAM-3/4 SFN reception disturbance areas

A.1.2.3 For multiple SFN waves

When there are many SFN waves, an "Appropriate" approximation function can be requested as in the preceding chapter. However, it is necessary to increase the accumulated SFN wave electrical power range in proportion to the number of waves (refer to condition (2) in the preceding chapter). For example, the -10dB~+18dB (64 times) range when there are 64 waves. Also, when looking at the required CN increases near DU=0dB which are not large, when there are many waves, the “Appropriate” approximation function seems to be a deformation of the least square approximation function. (Refer to the Chapter A1.2.1) In figure A-17, in case of SFN 64 waves, the adjusted coefficient α for the least square approximation function is used so that the accumulated value is 90%.



(a) Required increase approximation function(90%accumulation)　　(b)"Appropriate" approximation function for multiple SFN waves

Figure A-17　Multiple SFN wave characteristics example(64QAM-3/4: Least square function)

A.1.2.4 Multi-path environments

When there are multiple paths, mathematically it can be handled in the same way as in the case of SFM multi waves above. However, what is essentially different from the case of SFM multiple waves is the amount of electrical waves. In SFN, since transmission electrical waves actually exist, SFN waves can exist in the same degree as preferred waves in some reception location (near gap fillers, etc.). In multi paths, it is hard to imagine that reflection waves, which have a similar amount of electricity as preferred waves, exist. Also, even if there are such locations, it is unimaginable that receivers receive such electrical waves. It is because that reception antennas are installed in locations where current analog waves can (manage to) be received. In that case, it is expected at least 20dB as multi path DU ratio is secured. Therefore, even if multiple path waves are handled as

SFN waves, a sufficiently high DU ratio (Interference wave power is small) will be the condition. As Figure A-10 shows, since the required CN increase almost matches the SFN 1 wave function in the area where the DU ratio is -6dB or below, a multi path environment can be calculated as that SFN 1 wave which is equal to all reflection wave electric power.

A.1.2.5 "Appropriate" mathematical function used for SFN reception disturbance simulation

In the above, various examinations regarding the case of multiple SFN waves have been conducted. As a result, a mathematical function for the SFN 1 wave is used as the required CN increasing function. The reasons are as follows.

(1) In actual reception environments, the existence of areas where multiple SFN waves come with the same power as preferred waves is unimaginable.

(2) In fixed reception (purpose of this model), the use of Yagi antennas is assumed. In that case, even though multiple SFN waves come, many of the other SFN waves besides the ones with the same direction as preferred wave are decayed due to the directional characteristics of antennas. Therefore, considering only SFN 1 waves with same direction seems to be enough.

(3) By installing relay stations and gap fillers later, there is a case in which an SFN wave with the same degree of preferred wave is added. Even in this case, only one SFN wave, which becomes an interference source, is increased at maximum.

(4) Multi path environments can be replaced with the equivalent 1 SFN wave which has same amount of electrical power as all the existing reflection electrical power.

(5) The modulation method mainly used is 64QAM-3/4 and in this case, SFN reception disturbance is barely affected by the number of SFN waves.

Due to the above reasons, it is appropriate to use the equations in figure A-7 to figure A-9 in the simulation.

A.2 SFN exceeding the guard interval

If SFN waves exceed the guard interval, the orthogonality of OFDM breaks up and the required DU ratio dramatically increases. Therefore, in the calculation of the channel plan, required value is DU=28dB including various margins. In the establishment of a channel plan, due to the characteristics, it must be safe and it is natural to consider various margins. Considering the purpose of this calculation model is to estimate digital reception disturbance, using directly the plan parameters as the required DU ratio is not always appropriate.

A.2.1 SFN wave exceeding the GI when the delay time is long

It is assumed that SFN waves exceeding the guard interval in intense electric fields where noise such as thermal noise, etc. can be ignored arrive. Since digital waves exceeding the guard interval with long delay times can be regarded as the same as random noise, it can be thought that the required DU ratio in this case becomes the same value as the required CN ratio (22.5dB in 64QAM-7/8, etc.). Also, in cases where thermal noise, etc. can not be ignored, the required DU ratio can be calculated as follows.

$$CN_0 = \frac{C_{rms}^2}{N_{thrm}^2 + U_{rms}^2} = \quad \text{and} \quad DU_0 = \frac{C_{rms}^2}{U_{rms}^2} \quad \text{From these relationships,}$$

$$DU_0 = \frac{CN_0}{1 - CN_0 \cdot \left(N_{thrm}^2 / C_{rms}^2\right)} \qquad (15)$$

Here, C_{rms} is the average amplitude of the preferred wave, U_{rms} is the average amplitude of the SFN wave, N_{thrm} is thermal noise, CN_0 is the prescribed signal against the unnecessary components ratio (such as 22.5dB in 64QAM-7/8, etc. and value which is usually expressed as the required CN ratio) and DU_0 is the required DU ratio.

In this way, the required DU ratio, which is a maximum value of acceptable interference, differs at the level of preferred waves and the level of unnecessary components such as noise, etc. Therefore, in the following equation (15), SFN waves exceeding the guard interval are handled as fixed noise with electrical power in the same way as other unnecessary components in our calculation. Additionally, same channel digital waves are the same.

A.2.2 SFN waves exceeding the GI when the delay time is not long

Consider the modulation signal when SFN wave delay is longer than the length of guard interval. As shown in figure A-18, τ (normalization in the FFT interval) is the amount by which the delay time exceeds the guard length and U is amplitude of the delay wave. Equation (16) is the OFDM transmission signal, and the demodulation signal is equation (16) multiplied by each OFDM carrier and integrated in the FFT interval. Therefore, demodulation components of the main wave *(X)* and delay wave *(Y)* are expressed in the following formula.

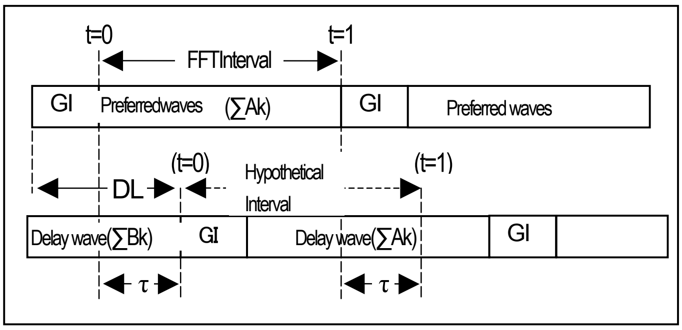


Figure A-18 OFDM Demodulation

$$S_o = \sum A_k \exp(j2\pi kt) \tag{16}$$

$$X = \int_0^1 \sum A_k \exp(j2\pi kt) \times \exp(-j2\pi k_o t)dt = \int_0^1 \sum A_k \exp(j2\pi(k-k_o)t)dt = A_{ko} \tag{17}$$

$$Y = U\left[\int_0^{\tau} \sum B_k \exp(j2\pi kt) \times \exp(-j2\pi k_o t)dt + \int_{\tau}^1 \sum A_k \exp(j2\pi kt) \times \exp(-j2\pi k_o t)dt\right] \tag{18}$$

For the delay wave, in consideration of the guard interval (GI), the integral for the 2nd term in equation (18) can obtain the same result as the hypothetical interval.

$$\begin{aligned} \text{2nd term} &= U\left[\int_0^1 \sum A_k \exp(j2\pi(k-k_o)t)\,dt - \int_{1-\tau}^1 \sum A_k \exp(j2\pi(k-k_o)t)\,dt\right] \\ &= UA_k - U\int_{-\tau}^0 \sum A_k \exp(j2\pi(k-k_o)t)\,dt \end{aligned} \tag{19}$$

$$Y = UA_{ko} + U\int_0^{\tau} \sum B_k \exp(j2\pi(k-k_o)t)\,dt - U\int_{-\tau}^0 \sum A_k \exp(j2\pi(k-k_o)t)\,dt \tag{20}$$

The 1st term in equation (20) is the signal component, the 2nd term is the interference component between symbols and the 3rd term is the interference component between carriers. In this way, signal components are included in SFN waves exceeding the GI as well, and this is called, "wave component within the effective GI". Since this component causes ripples in the reception spectrum due to interference with main waves, the required CN is increased in the same way as SFN waves within the GI. This component can be handled the same way as SFN waves within the GI, but the period when the ripple is generated is (1-τ)as shown in figure A-18, and it is thought that the effect is smaller than in the case of SFN within the GI. When τ is close to zero, the main wave and delay wave cause interference in most of the signal modulation period. And, the effect is almost the same degree as waves within the GI. However, the closer τ is gets to 1, the shorter the interference period becomes and the effect of the interference decreases. Therefore, it can be thought that the effect of interference is proportional to the interference period (1-τ). In addition, the OFDM demodulation signal is the sum of the main wave component in equation (17) and the 1st term of equation (20). But, since the required CN increase is calculated by including the increase of these signal components in this model, it is not necessary to review this again.

Since it can be assumed that the interference component of the 2nd term is not correlated with the signal component, this can be handled in the same way as the noise component which becomes larger in proportion to τ**.** The 3rd term can be regarded as the noise component which becomes larger in proportion to τ when τ is small. Also, when the value of τ is close to 1, the 1st term (UA_{ko}) becomes asymptotic. Therefore, it can be regarded that the noise component which is not correlated to the signal is in proportion to (1-τ). Components which are not correlated to these signals are called, wave components exceeding the effective GI.

Considering the characteristics of the 2nd and 3rd terms in equation (20) above when fixed noise can be ignored due to a sufficient high reception field, the required DU ratio for SFN waves exceeding the GI can be obtained with the following equation.

$$
\begin{array}{lll}
\text{Required CN} & = CN_0 + CN_{up}\left(UdB + 10 \cdot \log(1-\tau)\right) & \text{Expressed by dB} \\
\text{Noise electrical power} & = \tau U_{rms}^2 + \tau(1-\tau) U_{rms}^2 + N_{amp}^2 & \text{Actual number} \\
\text{Required DU} & : -10 \cdot \log\left(\tau U_{rms}^2 + \tau(1-\tau) U_{rms}^2 + N_{amp}^2\right) = CN_0 + CN_{up}\left(UdB + 10 \cdot \log(1-\tau)\right) & \text{Solution}
\end{array}
\qquad (21)
$$

Here, U_{rms}^2 is the electrical power of delay wave, N_{amp}^2 is the noise electrical power in proportion to amplitude, CN_0 is the standard required CN ratio decided by modulation method and encoding rate, CN_{up}(*) is the required CN increase function and *UdB* is the electrical wave expressed in dB. In the noise electrical power equation (21), the 1st term is the component for the interference between symbols (2nd term of equation (20)) and the 2nd term is the interference component between carriers (3rd term of equation (20)).

Equation (22) is a detailed description of equation (21). Coefficients α, β, γ were obtained by equation (7)in Chapter A1.1.2. Here, in equation (21), when τ is 0, the solution becomes the required DU ratio versus SFN waves within the GI (in other words, the bottom of the bathtub characteristic). Additionally, in equation (21), if there is no solution when τ is 0, it means a SFN reception disturbance within the GI will not be generated. Figure A-19 and A-20 show the characteristics calculated by equation (22).

$$
\begin{array}{ll}
\text{Required CN} & = CN_0 + \alpha \cdot \exp\left(-\left|\, \beta \cdot \left(UdB + 10 \cdot \log(1-\tau)\right)\right|^{\gamma}\right) \\
\text{Noise electrical power} & = \left(2\tau - \tau^2\right) 10^{UdB/10} + 10^{NampdB/10}
\end{array}
\qquad (22)
$$

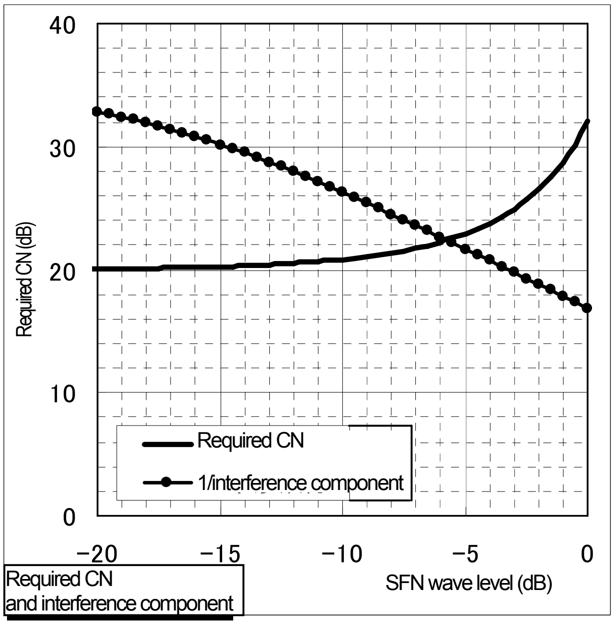


Figure A-19 Required CN of SFN wave exceeding GI and

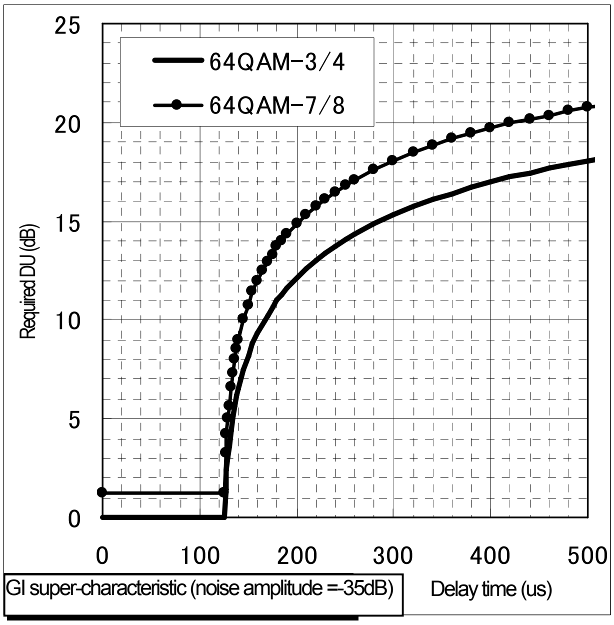


Figure A-20 Characteristics exceeding GI (Calculated value)

A.2.3 Aliasing distortion of the scattered pilot signal

In the previous section, interference characteristics between symbols in OFDM demodulation were analysed. In that examination, it was assumed that frequency characteristic ripple due to the delay wave component was ideally corrected by some measure. This correction is equivalent to the interpolation of reference amplitudes and the phase of each OFDM carrier from observed scattered pilot signals (hereinafter SP signal). Since the SP signal can only be sent by 1 out of 3 OFDM carriers, the cycle of fluctuation for observable frequency characteristic (=delay time of delay waves) is limited. When delay waves exceeding this limit exist, observation can not be conducted correctly in the same way as sampling aliasing distortion.

Figure A-21 explains this. The figure is the frequency characteristics of the reception signal when there are delay waves with short delay times and delay waves with long delay times. Since delay waves with long delay times exist, the frequency

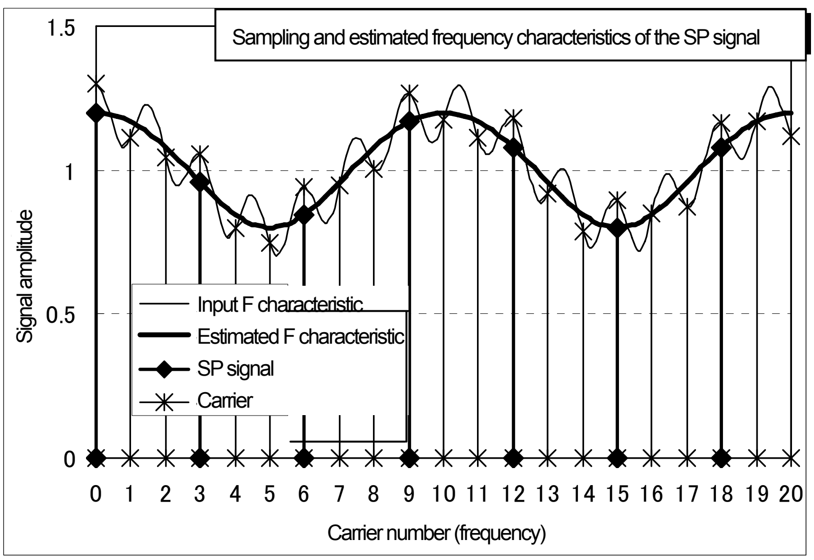


Figure A-21 Frequency characteristic assumed from the SP signal characteristics fluctuate minutely and OFDM carrier with reception signals are marked with a ☀ amplitude in the figure. On the other hand, since the SP signals can be detected only by ♦ marked carriers in the figure, obtainable estimated frequency characteristics from this only shift gradually as shown in the bold lines. As a result, each carrier reference used for demodulation includes an error.

Errors in the reference of each carrier can be various values due to the delay time and the phase of the input delay wave or interpolation filter characteristics, and the average error can be analysed in the same way as distortion included in the restored signal from a general sampling signal.Specifically, if the average error electrical power (distortion electrical power) is A_e^2 then,

$$A_e^2 = \sum \text{Electrical power outside the band} + \sum \text{Interpolation filter error electrical power} \qquad (23)$$

Additionally, in normal sampling system analysis, the time function is used as a table function and the frequency function, which is the Fourier transformation of the time function, is used as a reverse function, but note that the frequency function of the amplitude and the SP phase is a table function, and the time function, which is the Fourier transformation of the frequency function, is a reverse function in this section.

By the way, A_e^2 is the average error electrical power when frequency characteristics constantly exist as shown in figure A-22. Considering these frequency characteristics are the results of interference between the main waves and delay waves. These frequency characteristics occur during the period when both the main waves and delay waves are the same symbol. (During the period when they are different symbols, interference between the main waves and delay waves does not occur and different symbols are handled as simple non-correlated noise.). Specifically, components which actually affect carrier reference are in proportion to the interference period ($1\text{-}\tau$).

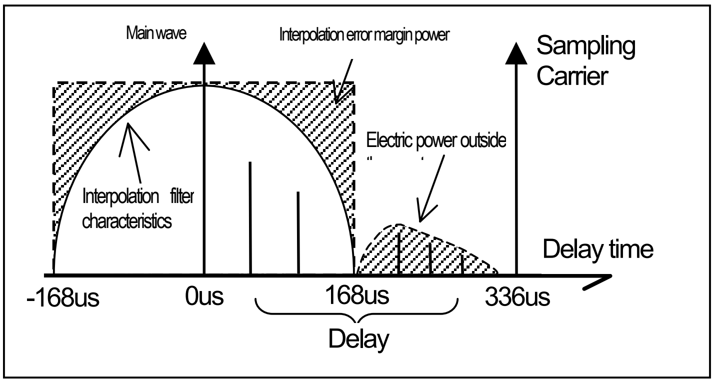


Figure A-22 Delay profile and electric power outside the spectrum/interpolation error margin electric

As shown in figure A-23, the effect of the SP replay error is different by signal points and the effect becomes larger when the signal points are on the outside of the constellation. In the following examination, the calculation is simplified by assuming all signal points have the same error as the SP. However, this simplification contributes in the direction

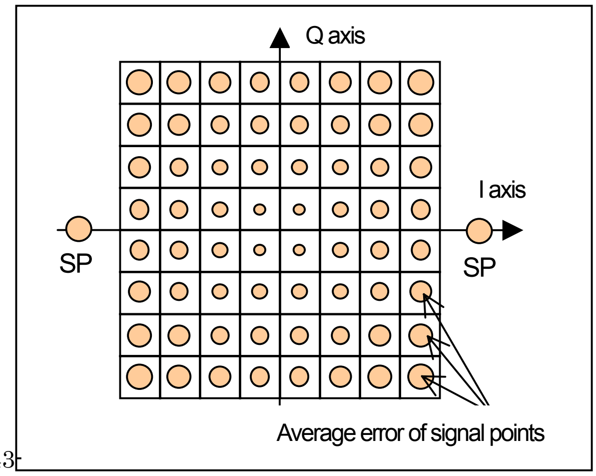


Figure A-23 Average error influence level with signal points

in which the calculated BER deteriotes more than the actual BER. (Safe side)

A.2.3.1 Calculation method of required DU characteristics

Based on the above examinations, the required DU ratio for the delay waves is calculated. The DU ratio when various interference factors exist can be written as the following general type.

$$\frac{1}{CN_0} = W_1\left(U^2\right) + W_2\left(U^2\right) + \bullet\bullet\bullet \quad \text{When it becomes like this}$$
$$\text{Required DU} \quad = -10\log\left(U^2\right) \qquad (dB) \tag{24}$$

Here, CN_0 is the required CN ratio decided by modulation methods, etc. (for example, 20dB in 64QAM-3/4, etc.), U^2 is the delay wave electrical power, andW_1 (*),W_2(*),••• are weighted functions which convert input delay waves into equivalent noise electrical power for each factor. More specifically, this equation converts delay waves into equivalent noise electrical waves for each factor related to judgement on reception posibility. Details of factors related to judgement on reception posibility are the interference component between symbols in the 2nd term of equation (20) and interference components between carriers in 3rd term of the same equation and the carrier reference replay error handled in this section.

By transforming equation (24), the following is obtained.

$$\left[CN_0 \cdot CN_{up}\left(U_{rms}^2\right)\right]^{-1} = N_{amp}^2 + \tau \cdot U_{rms}^2 + \tau\left(1-\tau\right) \cdot U_{rms}^2 + \left(1-\tau\right) \cdot A_e^2 \tag{25}$$

The 2nd term on the right side of equation (25) is interference between the symbols, the 3rd term is interference between the carriers, the 4th term is each equivalent noise electrical power of the carrier reference, N_{amp}^2 is the amplitude proportion noise and CN_{up}(*) is the required CN increasing function (formula (7)). Additionally, it is common that the required DU ratio is examined under the condition that fixed noise can be ignored due to a sufficiently high signal level. Therefore, the fixed noise term is omitted in equation (25). Solving equation (25) for the U_{rms},, inverse number is the required DU ratio.

In equation (25), characteristics of hardware only affect the amplitude proportion noise (N_{amp}^2)and the replay error electrical power (A_e^2), and other terms are not affected because other terms are generated by the result of mathematical calculations in OFDM demodulation. In other words, in the provisions for the characteristics of receiver units, it is only necessary to provide amplitude proportion noise and play error electrical power.

Although amplitude proportion noise is as written in §A.1.1.3, N_{amp} is -35dB or so when measuring actual receiver units of various companies. On the other hand, it is possible that replay error electrical power can be largely different due to the design of each company such as adjustment processing, etc. in addition to the effect of interpolation characteristics.

Before discussing provision methods of replay error electrical power, let's take an overview of what kind of characteristics they will be. If ideal LPF is used as the interpolation filter, equation (25) can be written as follows,

$$\begin{aligned} \left[CN_0 \cdot CN_{up}\left(U_{rms}^2\right)\right]^{-1} &= N_{amp}^2 + \tau \cdot U_{rms}^2 + \tau(1-\tau) \cdot U_{rms}^2 && (|delay| < 168\mu s) \\ \left[CN_0 \cdot CN_{up}\left(U_{rms}^2\right)\right]^{-1} &= N_{amp}^2 + \tau \cdot U_{rms}^2 + \tau(1-\tau) \cdot U_{rms}^2 + (1-\tau) \cdot U_{rms}^2 && (|delay| \geq 168\mu s) \end{aligned} \qquad (26)$$

When the interpolation filter is ideal LPF and the delay time is within the Nyquist band, the replay error electrical power will not occur because the carrier reference has been perfectly and correctly replayed. Additionally, the delay wave electrical power becomes A_e^2 outside the Nyquist band. Calculations for various interpolations LPF's are shown in figure A-24.

When the interpolation filter is not an ideal LPF, the replay error electrical power can be obtained with the following equation.

$$A_e^2 = \sum_{|DL_j| < 168\mu s} \left[\left(1 - LPF(DL_j)\right) \cdot U_j\right]^2 + \sum_{|DL_k| \geq 168\mu s} U_k^2 \qquad (27)$$

Here, Uj is the delay wave amplitude in the Nyquist band (< 168μs), Uk is the delay wave amplitude outside the nyquist band and LPF(*) is the amplitude response of the interpolation filter for the delay time DL. The required DU characteristic can be obtained by substituting A_e^2 obtained in equation (27) in equation (25) and solving U_{rms}.

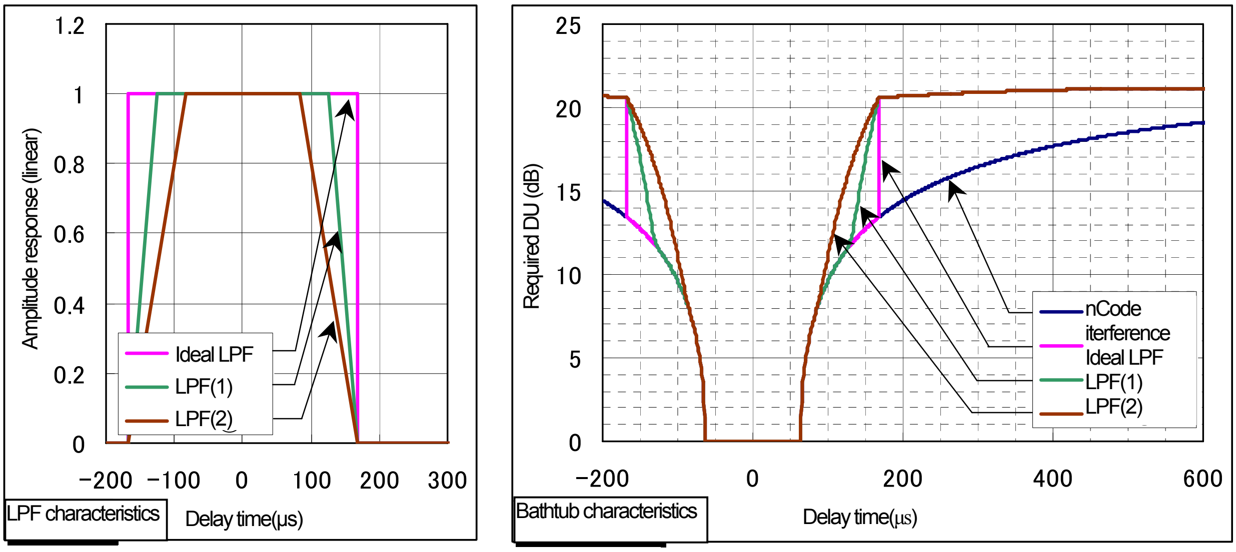


Figure A-24 Interpolation LPF characteristic and required DU characteristic(For 64QAM-3/4, Namp=-35dB in expression (25))

A.2.4 Aliasing distortion reconsideration of scattered pilot signals

In the previous paragraph, the influence of the SP aliasing distortion was analysed in proportion to the average error electrical power (distortion power) A_e^2. When the delay time for the required DU ratio is large, it grows by about 1dB more than the calculated value in figure A-24 (or equation (25)). This fact shows that the carrier reference replay error margin is also related to items other than the average error electrical power (A_e^2).

As shown in figure A-21, the replay error margin of each carrier for the OFDM is not the amplitude (rms value) that corresponds to the average error electrical power. Instead it is the interpolation error margin voltage in the carrier. This error margin voltage is different in each carrier. In some carriers it is large but in other carriers it is small, and according to this, the reception error rate is different in each carrier. In this way when the error margin voltage is different in each carrier, the average error rate of all carriers is lower in comparison to when the error margin voltage of all carriers is same. Because the amount of deterioration is large, when the deterioration amount for the error rate of carriers with a large error margin is compared with the improvement amount in the error rate of small carriers. When equation (25) is used to calculate the replay error margin of the carrier reference from the average error voltage, it is necessary to add the effect that the error margin voltage is different in each carrier above.

Since it is quite difficult to expect the above effect with a calculation, and since the effect is different depending on the delay requirements and the phase condition, etc. of the input delay wave, and also because the size in this effect is a maximum 1-2 dB, here, to conform with the DU ratio achieved by actual receiver units, a correction factor (=1.5) is introduced into equation (25).

$$\left[CN_0 \cdot CN_{up}\left(U_{rms}^2\right)\right]^{-1} = N_{amp}^2 + \tau \cdot U_{rms}^2 + \tau\left(1-\tau\right) \cdot U_{rms}^2 + \underline{1.5} \cdot \left(1-\tau\right) \cdot A_e^2 \qquad (28)$$

When equation (28) is used, the calculated required DU characteristic is shown in figure A-25.

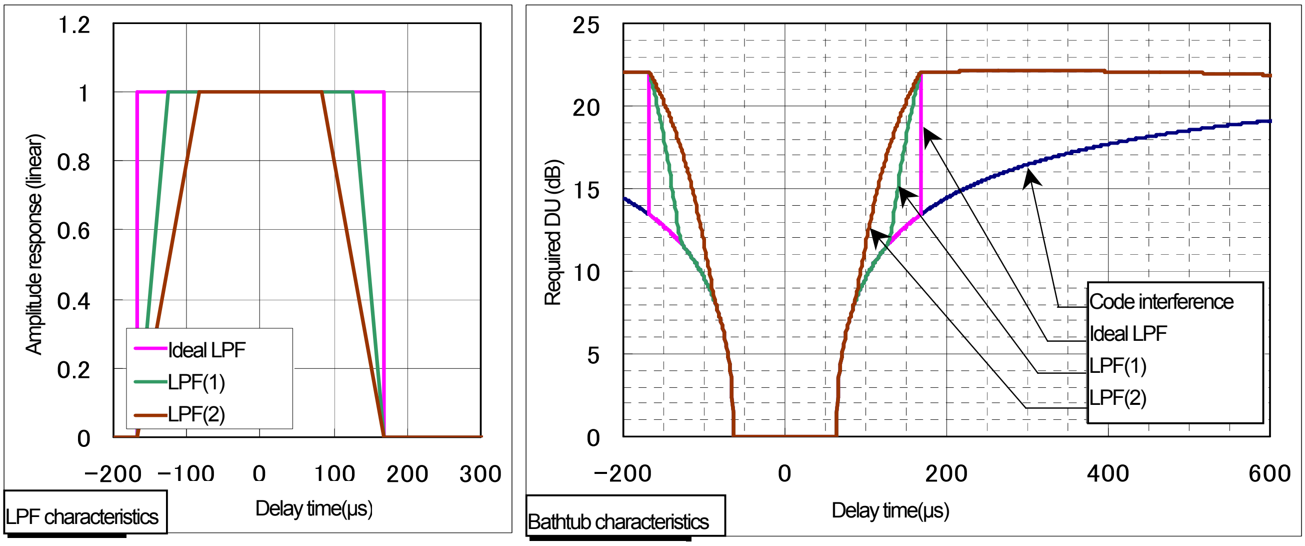


Figure A-25 Interpolation LPF characteristic and required DU characteristic (Depends on Equation (28) 64QAM-3/4 and Namp=-35dB)

A.2.5 FFT window setting

Figure A-26 shows the relationship between the FFT window position and the required DU characteristic (bathtub characteristic). The figure shows when GI is 126µs. Figure (A) is the characteristic of intersymbol interference (interference between symbols and the interference between carriers). Figure (B) is the SP interpolation LPF characteristic which is a filter that becomes 1 for the amplitude response in ± or less LPFbw and 0 for the nyquist band (±168µs). Adding the required DU characteristic decided by this LPF is figure (C). As in the figure, the bottom of the bathtub, where the required DU ratio is minimized, becomes the same width as the GI.

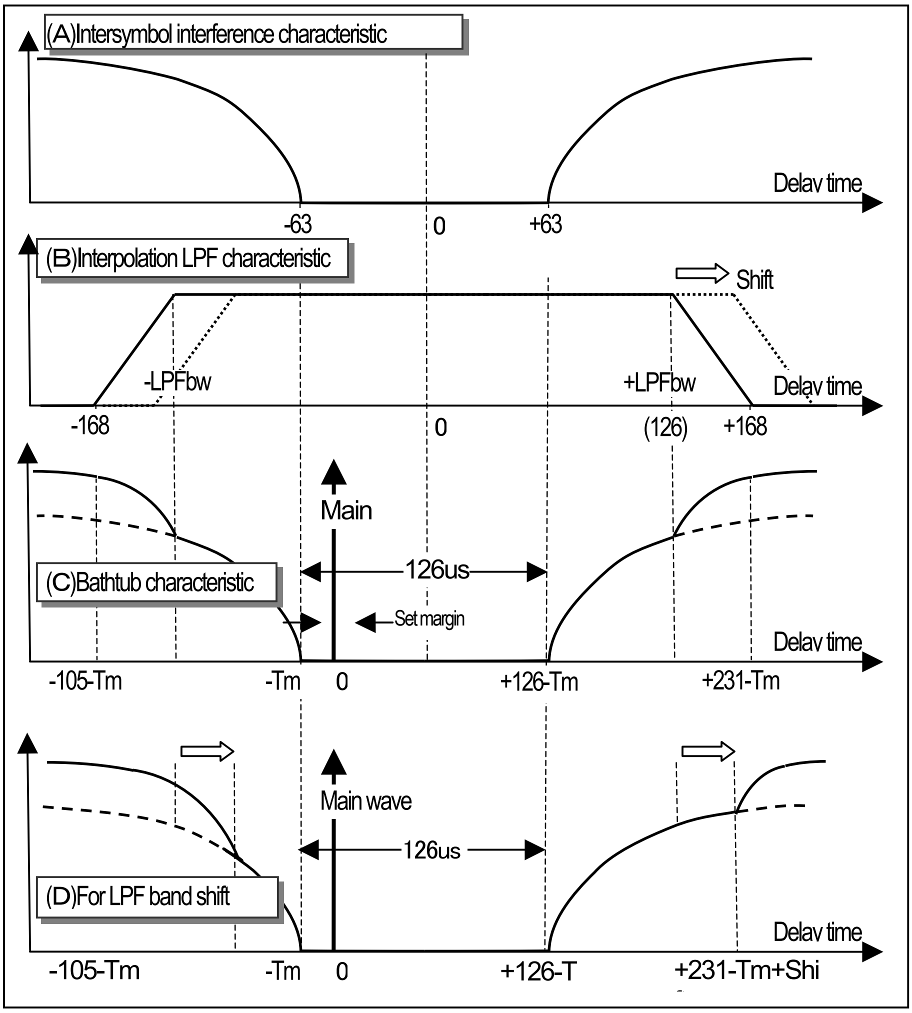


Figure A-26 FFT window position and bathtub characteristic

The receiver units set this bathtub characteristic in the best position for the input wave but in this case, the main wave will be set to come to the bottom of the bathtub characteristic (if not, intersymbol interference increases). Specifically, the setting range for the position of the main wave (FFT window position) is a maximum ± GI/2. However, in the design of receiver units, a set margin (Tm) as in the figure is necessary in consideration of the detection accuracy of the main wave position and avoiding false detection, etc. Therefore, the setting range of the FFT window becomes ± (GI/2-Tm). It is normal to express the delay time based on the main wave, and in that case, it becomes the numerical value shown.

By the way, the FFT window position setting and the bandwidth setting of the SP interpolation LPF are items that can be set independently. In figure A-26(D), it is assumed that a negative SFN wave at delay time did not exist but in this case, the required DU characteristic can be improved for the positive delay time of the SFN wave by shifting the LPF passband forward. Moreover, when there is no positive delay time for the SFN wave, a characteristic improvement for the negative delay time wave can be attempted by shifting the LPF passband in a negative direction. Figure A-27 shows a specific calculation example.

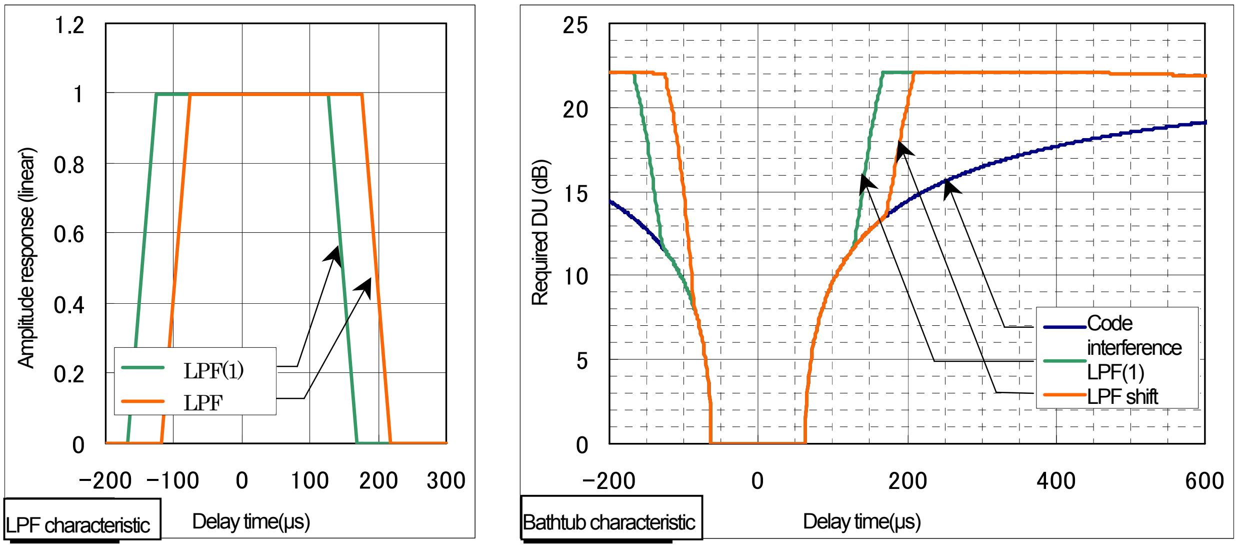


Figure A-27　Passband of the SP interpolation LPF and bathtub characteristic example

In this way, the required DU characteristic can be improved by appropriately setting the LPF passband according to the input wave but this kind of processing becomes adaptive processing in accordance with the delay profile of the input wave. There will be a different algorithm for each company in this adaptive processing (chance to show their ability), and, the effect of the characteristic improvement also depends on the input wave. Therefore, this adaptive processing is not included in this computation model. More specifically, the characteristics in figure A-26(C) are presumed to be receiver unit characteristics.

A.2.5.1　Optimal window position

The calculation method for the digital reception failure in this computation model was arranged before thinking about the optimisation of the window setting.

(1) Each SFN wave is separated into components in the effective GI and effective Exceeding GI components.

For the effective component within the GI, it is assumed that one equivalent wave within the GI for the electric power addition of each effective component within the GI exists. Specifically,

$$U_{eq}^2 = \sum_k (1-\tau_k) U_k^2 \tag{29}$$

For the effective Exceeding GI components, the intersymbol interference component, the interference component between carriers, and the SP aliasing distortion component of each wave are requested in each wave, and the noise for the total harmonized electrical power exists. Specifically,

$$N_{eq}^2 = \sum_k \tau_k U_k^2 + \sum_k \tau_k (1-\tau_k) U_k^2 + 1.5 \cdot \sum_k (1-\tau_k)(1-LPF(DL_k))^2 U_k^2 \tag{30}$$

(2) All electrical power of the non-correlated noise component is requested. Fixed noise, the same channel digital wave (different program type), and the same channel analog wave are included as non-correlated noise besides equation (30) above.

N_{fix}^2 is the fixed noise electric power, CoD^2_k is the same channel digital wave electrical power (different program type), and CoA_k^2 is the same channel analog wave electrical power. Also, when the correction factor is $AtoD^2$ when the analog spectrum is handled as non-correlated noise, all noise electrical powers N_{total}^2 become the next equation.

$$N_{total}^2 = N_{fix}^2 + N_{eq}^2 + \sum_k CoD_k^2 + \sum_k CoA_k^2 / AtoD^2 \tag{31}$$

(3) The SFN reception disturbance area (equation (11)) and the SFN reception disturbance generation probability (equation (14)) are calculated, and a failure probability of this point is requested for all this noise power. The optimal position for the FFT window is a position in which all noise electrical power of equation (31) is the minimum.

(4) Since it is not practical to actually calculate each input voltage for equation (11) and equation (14), here, it will depend on the following equivalent method.

(5) The preferred waves and component in the equivalent GI is plotted in the two dimension voltage graph (■mark in figure A-28). When equation (11) is calculated as in (3) above, although the area shown with the dotted line in figure A-28 becomes the SFN reception disturbance area, this area shifts up to the right of the former area shown by the detailed solid line.

The previous area enclosed by the minute solid line is non-correlated noise for N_{fix} only. The area in the thick broken line is the non-correlated noise for N_{total}. Specifically, the shift amount of the area in the figure is the next equation.

$$10 \cdot \log\left(N_{total}^2 / N_{fix}^2\right) \quad dB \tag{32}$$

Even if equation (11) is not actually calculated in this way, the SFN reception disturbance can be judged by operations for the area shift. Also, not by shifting the area but shifting (■ sign in figure A-28) down and to the left, and comparing the former area. By judging with a signal point shift such as this, it is more convenient since not only equation (11) but

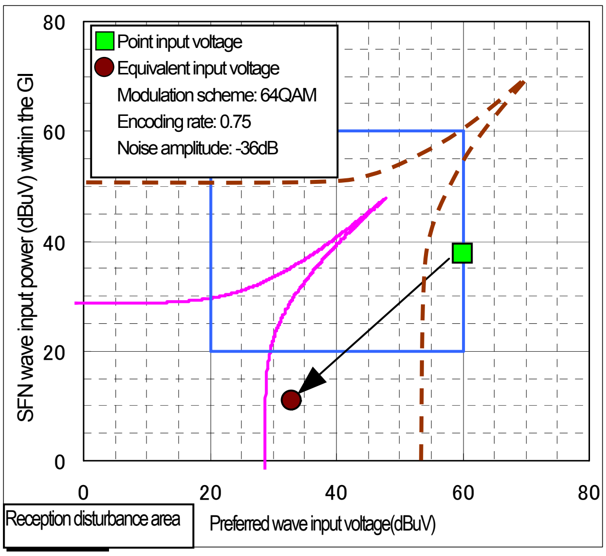


Figure A-28 Equivalent input voltage

also equation (14) can be used as they are (it will not be necessary to calculate different input voltages in each point.).

(6) Equation (14) is calculated for the signal point shifted above, and this is the failure probability of the relevant reception point.

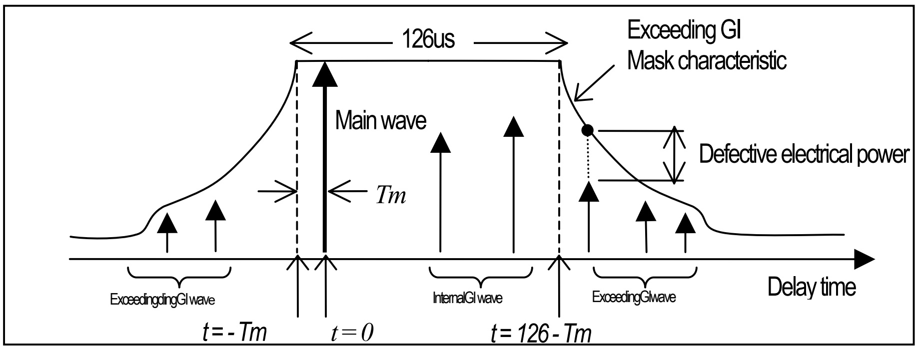


Figure A-29 FFT window optimal setting

It is a calculation method for digital reception problems used by the above computation model.

Well, as the optimum value for the FFT window position is as above in (3), it is not practicable to obtain the minimum value of equation (31) through simulations from the viewpoint of computing time. Therefore, the following approximation technique is used.

Figure A-29 shows the relationship between the incoming wave and the FFT window. The Mt. Fuji-like curve recorded as the "GI super-mask characteristic" shows the maximum value of the delay wave that can be allowed with the reciprocal of the bathtub characteristic, (positive and negative reversed for the dB value in figure A-24). In order to become non-reception when a delay wave that exceeds this mask exists, the receiver units will appropriately set the FFT window so that each delay wave does not exceed this mask but when multiple delay waves close to the size of the mask value exist, reception may or may not be possible even if individual delay waves collect in the mask. It is important that there be as much room as possible in the mask in addition to achieving delay wave in the mask.

The dB difference between each delay wave and mask is defined, "Defective electric power", as an index that shows the amount of room with the mask. When this defective electric power (PdB) becomes 0dB or more, reception becomes impossible because the delay wave will exceed the mask value. Moreover, when the total defective electric power for each delay wave is 0dB or more, it can be considered that the aggregate delay wave total exceeds the mask. Therefore, defective electrical power is obtained for each delay wave and the mask position where the total (P_{und}) becomes the minimum (specifically, the FFT window position) is used as an optimal position. Specifically,

$$PdB_k = UdB_k^2 - MaskdB(DL_k) \qquad \textit{(Expressed by dB)}$$
$$P_{und} = \sum_k 10^{PdB_k/10} \rightarrow \ \ \textit{Minimized} \qquad (33)$$

A.2.6 AtoD interference elimination characteristic

Interference trouble from same channel analog waves is largely influenced by the modulation contents of the analog spectrum in addition to receiver unit characteristics. In the examination of digital reception trouble, if the worst signal in various analog modulation contents is examined, it is sufficient. Generally, the spectrum of analog waves is concentrated in each frequency neighborhood of the video carrier, color sub-carrier and the sound carrier. Therefore, the affected OFDM carrier is limited to one of these frequency neighborhoods. In normal digital receiver units, the disappearance processing of Viterbi decoding is carried out, and it has a strong interference elimination ability for these types of interference waves. Therefore, as the worst interference signal, analog waves diffused for the spectrum should be examined as much as possible in signals that can actually be broadcast. Various analog signals, as the measured results of the required DU ratio of receiver units, are thought to be the worst signal normally possible for the following conditions.

Video signal: Color multi-burst

Audio signal: Stereo 100% modulation

From measurement results in actual receiver units, the AtoD interference elimination limit DU ratio has obtained about 5dB in the case of 64QAM-3/4 and about 13dB is obtained in the case of 7/8.

A.2.7 Items that should be provided as receiver unit characteristics

As in the above consideration, many of the characteristics for Exceeding GI waves are fundamental according to the OFDM demodulation, and provisions are not necessary. The following items are hardware characteristics affected in required DU characteristics.

- Amplitude proportion noise
- SP interpolation filter characteristic
- Set limit of the FFT window (set margin)
- AtoD interference elimination characteristic (or value of coefficient $AtoD^2$ for equation (31))

The broadcasters attempt the optimisation of the transmission delay adjustment, etc. of each transmission station when designing transmission stations in environments where many SFN delay waves exist by using the numerical values and this computation model to provide the 4 items above.

A.3 Fading

A.3.1 Fading margin

Figure A-30 is the fading margin (1% time rate) requested from ITU-R recommendation P.1546. Since there is no direct description in recommendation P.1546 for the fading margin, here, the difference between the incoming electrical field strength of the target time rate and the incoming electrical field strength of the 50% time rate is defined as the fading margin. The calculation method of the margin for various time rates and transmission highs/reception highs, etc., follows recommendation P.1546.

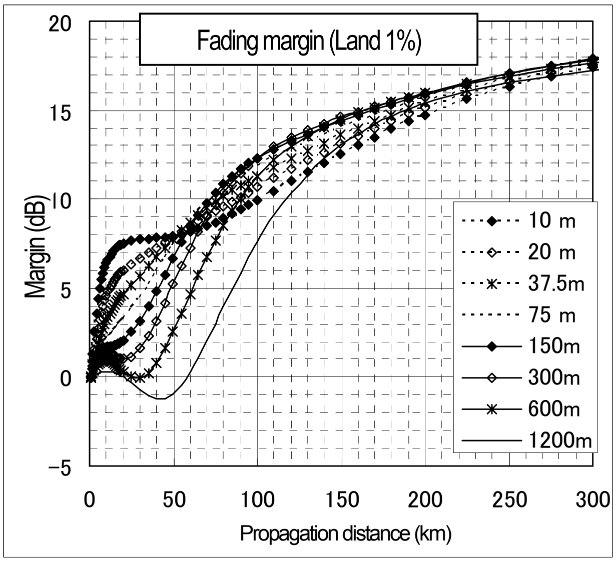


Figure A-30 Fading margin example

Recommendation P.1546 describes the effect that can be applied only within the time rate 1%-50% range. Specifically, it is only valid when interference waves come larger than the yearly average value (time rate is 50% or less), and cannot be applied for the "fading" phenomenon of preferred waves' that decrease more than yearly average value. In the Electronic Communication Technology Council report, the "fading" that decreases preferred waves is assumed to be a symmetrical characteristic (dB value polarity reversed for positive and negative) of the above "Fading margin" defined by the difference between the incoming electrical field strength and the yearly average electrical field strength.

Although the preferred waves and the interference wave receive each respective fading, it is envisioned that it will be extremely rare to generate the phenomenon in which the preferred wave electrical field decreases and the interference wave electrical field rises at the same time. Both the preferred waves and the interference may decrease or rise. It is difficult to set the margin for this type of various fading phenomena, and also, even if the examination is more extensive, the benefits cannot be imagined. Additionally, when SFN waves and same channel waves that become a source of interference are multiple waves, all the interference waves will not come at the same time for same margin value. It can be expected that in most of the cases a specific wave among multiple interference waves arrive in a large amount by abnormal propagation.

When multiple radio waves spread abnormally, although examination for the correlation of each wave is necessary, there is no appropriate measurement data now. At the moment, it is undeniable that there is no correlation. Specifically, in our calculations, it is assumed that the interference wave with large influence comes by the above margin and that other interference waves come by the yearly average value (50% time rate value).

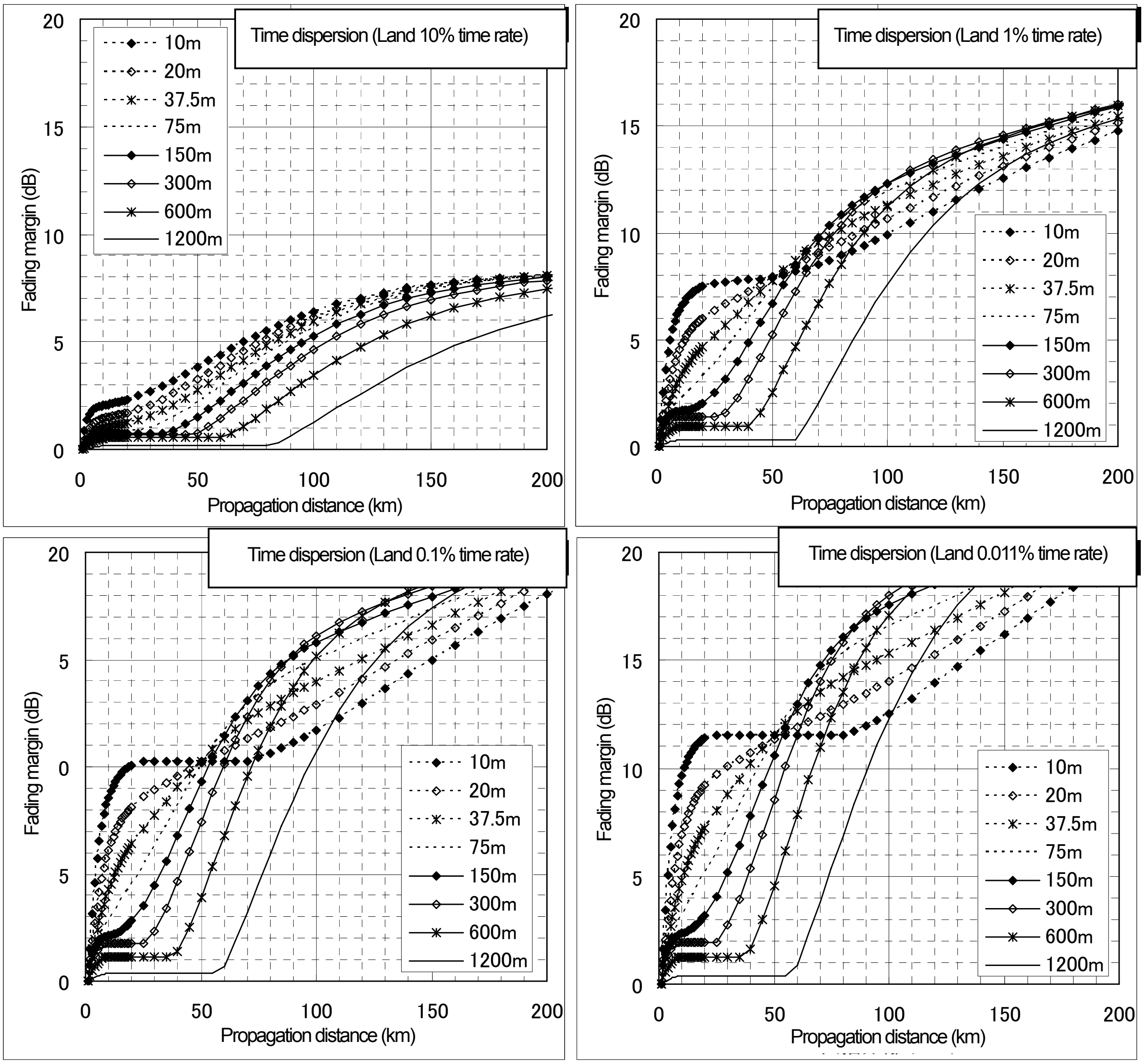
More precisely, the calculation is conducted based on the SFN waves, etc. which become sources of interference that arrive with the fading margin of recommendation P.1546.

By the way, there is a part where the fading margin is a negative value in figure A-30. Since the fading margin for the above definition is the difference of the accumulated value, a negative value is not expected to be taken. This cause is thought to be due to the accuracy shortage of the incoming electrical field strength data in each time rate for the recommendation P.1546 description. It is necessary to add an appropriate correction when using our calculations.

A.3.2 Handling of time rate 1% or less fading

Since recommendation P.1546 does not describe the time rate 1% or less, we must originally set the fading margin for the time rate 1% or less.

According to the long-term measurement results calculated for foreign wave interference, a constant relationship can be seen between the incoming wave electrical field strength and the time rate. Specifically, the electrical field strength difference between the 10% time rate and the same 1% in one month (dB value difference) is A, and when the electrical field strength difference between the same 1% and 0.1% is B, a relationship of A:B = 2:2 is calculated for a lot of the measurement data. Additionally, a similar relationship is also recognized between 0.1% and 0.01%.Although this measurement is for transmission over the sea, it is assumed this relationship is effective for transmission over land. Figure A-31 shows the fading margin requested from recommendation P.1546 data and these assumptions.



FigureA-31 Fading margin(Time rate 10%~0.01%)

A.3.3 Handling of other margins

The various margins in system design that have been set are for securing safety in order to prevent system failures, even for the assumed worst case. The margin for the meaning of securing safety should not be considered at all because for this computation model, the purpose is to estimate the real scale of the SFN reception disturbance. In this sense, it can be said that it is a mistake to refer to the plan parameters as is without examination.

In this computation model, the location dispersion and the time dispersion (fading) are considered. For the interference margin and the multi-path margin, the calculation result of this model will give the margin value for the minimum requirements under various conditions. Additionally, it is assumed that the receiver unit performance should be based on the measured performance and when there is a difference in receiver unit performance, a calculation method that considers the distribution of the performance should be used (for example, setting location dispersion values, etc., considering the differentiation of receiver performance).

A.4 Simulators

"Digital reception simulator" calculation software, based on the above computation model has been developed, and is used to promote terrestrial digital broadcasting in conferences nationwide.

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Nittochi Bldg. 11F
1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013, Japan

TEL 81-3-5510-8590
FAX 81-3-3592-1103

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