GATESAIR

Installation and Operation Manual

Intraplex®
T1 CrossConnect

DCS-9500 CrossConnect System (1RU)

DCS-9530 CrossConnect System (3RU)

DCS-9560 CrossConnect System (3RU)

DCS-9565 CrossConnect System (3RU)

Version 2

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Customer Service Contact Information

www.gatesair.com

GatesAir
3200 Wismann Lane
Quincy, Il 62305 USA

For Technical Support including Service, Training, Repair and Service Parts:

www.gatesair.com/services/technical-support.aspx

Americas:

24/7 Technical Support	+1 217 222 8200
Email	tsupport@gatesair.com

Europe, Middle East and Africa:

24/7 Technical Support	+1 217 222 8200
Email	tsupport.europe@gatesair.com

Asia:

24/7 Technical Support	+1 217 222 8200
Email	tsupport.asia@gatesair.com

*Version numbers usually correspond to software releases. If the manual versions differ in number from the release, the front page shows both the manual version and the release version.

Table of Contents

Section 1 – Introduction

1.1 Manual Scope

This manual is the primary reference covering the configuration, installation, and operation of the Intraplex CrossConnect products. The manual has eight sections:

- Section 1 – "Introduction" provides an overview of this manual and T1 CrossConnect Systems and Servers and their components.
- Section 2 – "Theory of Operation" provides descriptions of the T1 CrossConnect Systems and Servers' concepts and applications.
- Section 3 – "Installation and Wiring" provides information for the installing and wiring T1 CrossConnect Systems and Servers.
- Section 4 – "Mapping Basics" provides an introduction to the concepts of time slot mapping and switching with examples of six system configurations with ISiCL and IntraGuide sample maps.
- Section 5 – "Configuration Using Intraplex IntraGuide" provides an introduction to IntraGuide use for configuring and controlling T1 CrossConnect Systems and Servers.
- Section 6 – "Configuration Using ISiCL" provides an introduction to ISiCL (Intraplex Simple Command Language) use for configuring and controlling T1 CrossConnect Systems and Servers.
- Section 7 – "CM-95 Operation" provides an introduction to the operating T1 CrossConnect Systems and Servers.
- Section 8 – "Specifications" provides operational, physical, and environmental specifications for T1 CrossConnect Systems and Servers.

1.2 Product Overview

The Intraplex DCS-9500 and DCS-9530 CrossConnect Systems and the Intraplex DCS-9560 and DCS-9565 CrossConnect Servers provide switching of multiple payload channels over standard 1.536 Mbps T1 circuits as well as time slot cross-connect capabilities. The DCS-9560 and DCS-9565 also feature versatile multiplexer capabilities that provide access to voice, data, video, and high-fidelity audio payloads on the T1. Key features include

- Interface with as many as six T1 ports
- Local access, termination, and multiplexing of individual user payload channels, up to 48 time slots
- Programmable T1 line protection switching
- Individual time slot routing among all T1 ports
- Automatic protection switching on any of the T1 ports
- Eight time slot grooming maps that can be configured to switch based on T1 port failure, external TTL inputs, or ASCII command strings
- Versatile system timing options to connect to almost any network
- Reliability, small size, low power consumption, and configuration flexibility
- Compliance with ESF and SF T1 frame formats
- Support for both B8ZS and AMI T1 line codes
- Convenient built-in diagnostic capability
- Optional redundant power supply (DCS-9530, DCS-9560, and DCS-9565)
- Optional LAN, wideband data, synchronous and asynchronous data, voice, video, and high fidelity program audio channel modules (DCS-9560 and DCS-9565)
- Remote configuration through IntraGuide, the graphical user interface, or Intraplex Simple Command Language (ISiCL)

1.3   Product Configurations

There are four Intraplex T1 CrossConnect products:

- DCS-9500 CrossConnect System
- DCS-9530 CrossConnect System
- DCS-9560 CrossConnect Server
- DCS-9565 CrossConnect Server

1.3.1   DCS-9500 CrossConnect System

The DCS-9500 provides T1 line time slot cross-connect and grooming capability. The DCS-9500 includes these components:

- 1 RU (rack-unit) chassis
- DCS-6A CrossConnect module
- CM-95 CrossConnect processor module
- MA-252A module adapter
- MA-255A or C module adapters

Figures 1-1 through 1-3 give front and rear views of a typical DCS-9500 unit. The rear view of your system may look slightly different if it uses different module adapters.
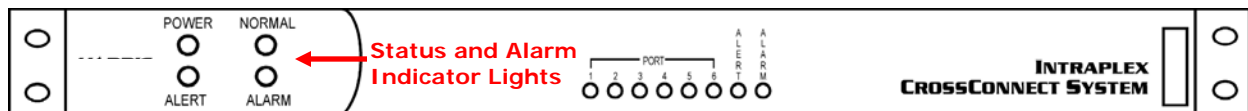
Figure 1-1. DCS-9500 Front (closed)
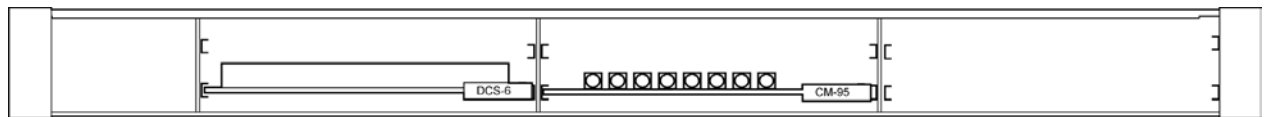
Figure 1-2. DCS-9500 Front (Open)
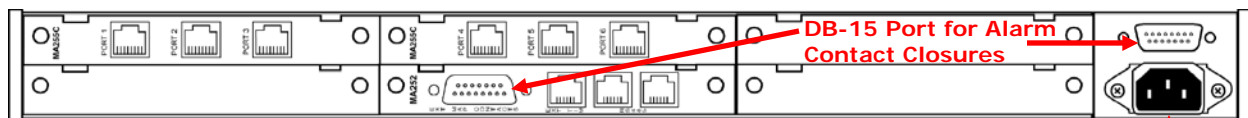
Figure 1-3. DCS-9500 Rear (MA-255C Configuration Shown)

1.3.2   DCS-9530 CrossConnect System

The DCS-9530 provides T1 line time slot cross-connect and grooming capability. Its 3 RU chassis allows for an easy upgrade to a DCS-9560 or DCS-9565 with the addition of the appropriate common modules and module adapters. The DCS-9530 includes these components:

- 3 RU chassis
- DCS-6A CrossConnect module
- CM-95 CrossConnect processor module
- MA-251A module adapter
- MA-255A or C module adapters

Figures 1-4 through 1-6 give front and rear views of a typical DCS-9530 unit. The rear view of your system may look slightly different if it uses different module adapters.
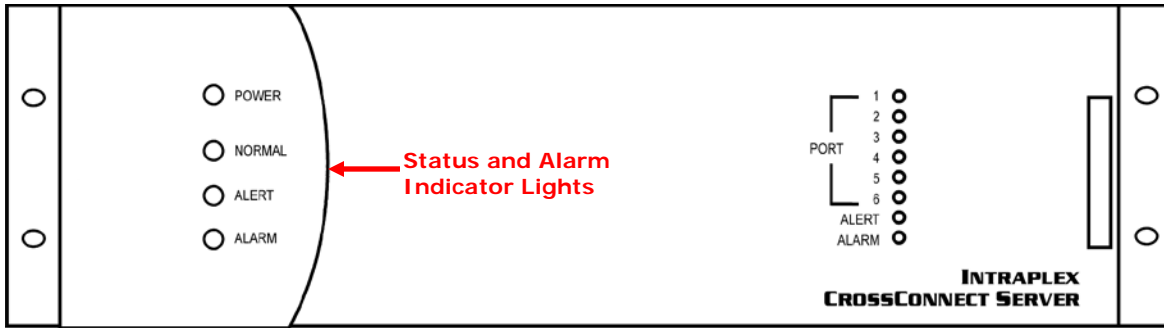
Figure 1-4. DCS-9530 Front (closed)
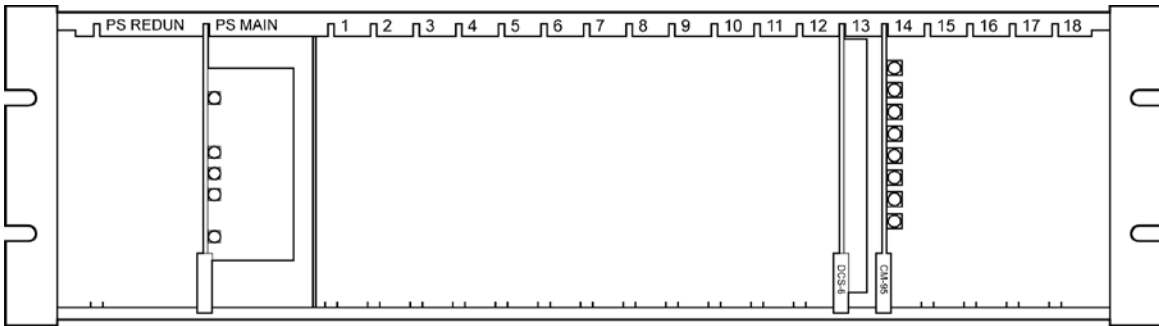
Figure 1-5. DCS-9530 Front (open)
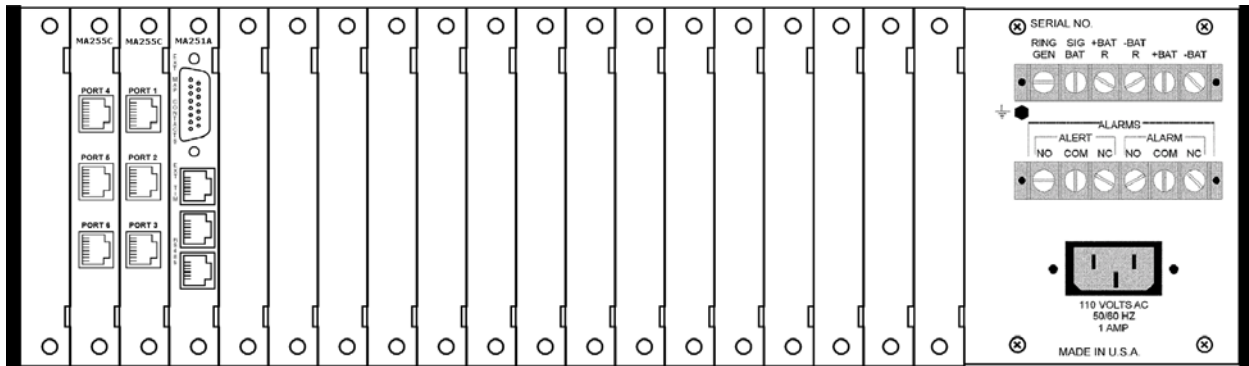
Figure 1-6. DCS-9530 Rear (MA-255C Configuration Shown)

This unit has a dedicated slot for a redundant power supply and the ability to use either AC or DC power supply modules.

1.3.3   DCS-9560 CrossConnect Server

The CrossConnect Server provides terminal multiplexing, time slot cross-connect, and grooming capability. The DCS-9560 includes these components:

● 3 RU chassis

● DCS-6A CrossConnect module

● CM-95 CrossConnect processor module

● CM-5 common module

● MA-216 module adapter

● MA-251A module adapter

● MA-255A or C module adapters

Fgures 1-7 through 1-9 give front and rear views of a typical DCS-9560 unit. The rear view of your system may look slightly different if it uses different module adapters.
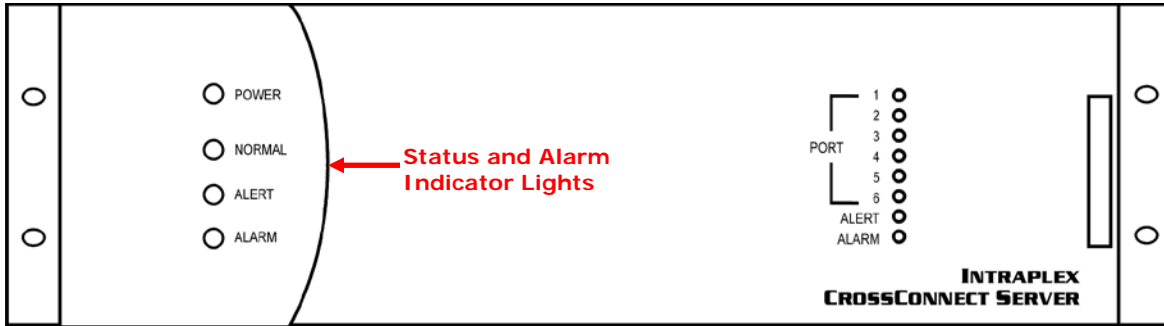
Figure 1-7. DCS-9560 Front (Closed)
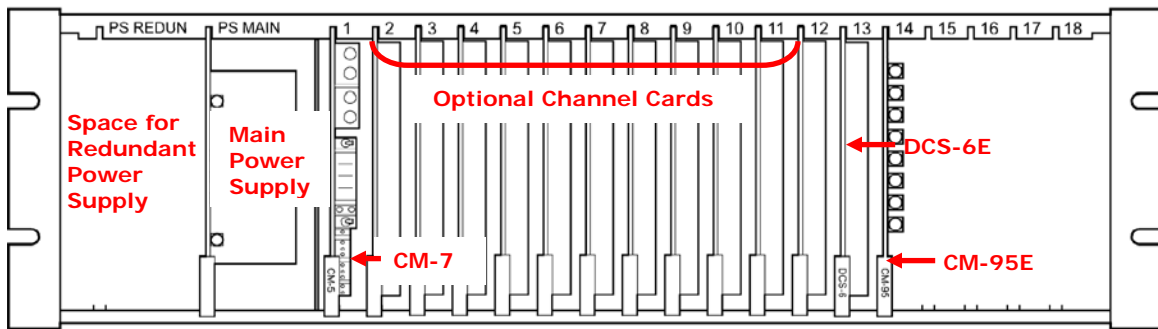
Figure 1-8. DCS-9560 Front (Open)
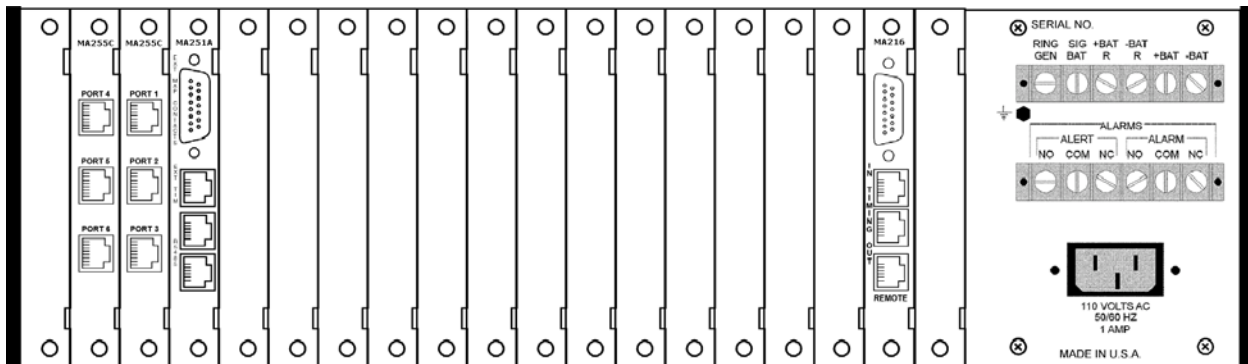
Figure 1-9. DCS-9560 Rear (MA-216 and MA-255C Configuration Shown)

1.3.4 DCS-9565 CrossConnect Server

The DCS-9565 provides drop and insert multiplexing, time slot cross-connect, and time slot grooming capability. The DCS-9565 includes these components:

- 3 RU chassis
- DCS-6A CrossConnect module
- CM-95 CrossConnect processor module
- Two CM-5 common modules
- Two MA-216 module adapters
- MA-251A module adapter
- MA-255A or C module adapters

Figures 1-10 through 1-12 give front and rear views of a typical DCS-9565 unit. The rear view of your system may look slightly different if it uses different module adapters.
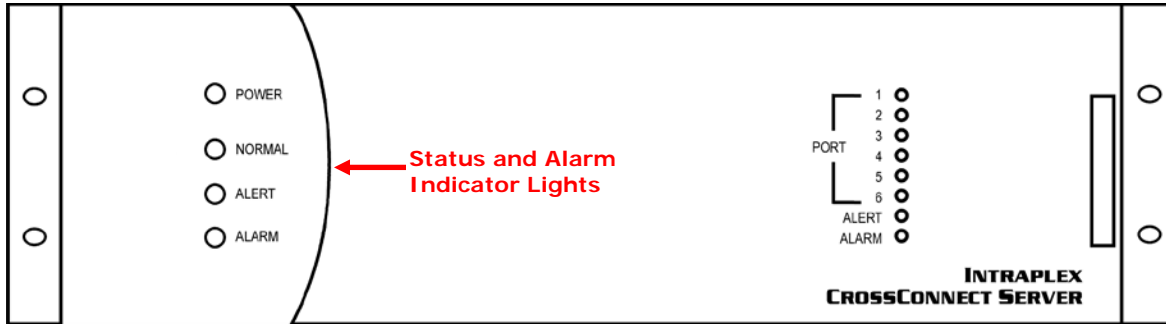
Figure 1-10. DCS-9565 Front (Closed)
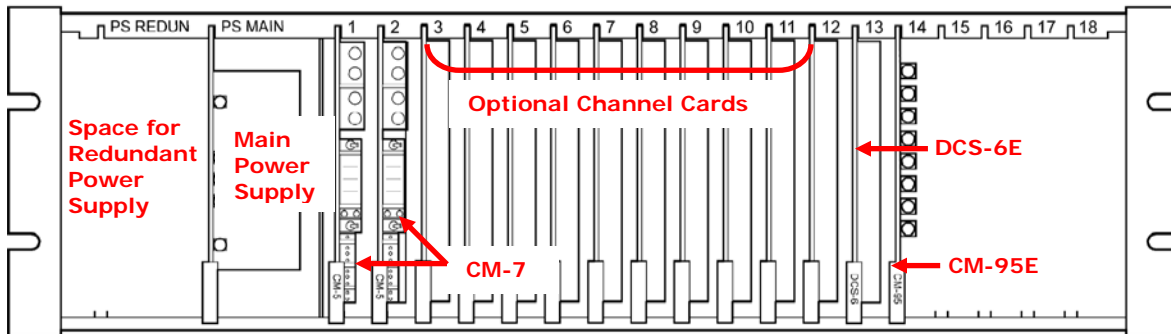
Figure 1-11. DCS-9565 Front (Open)
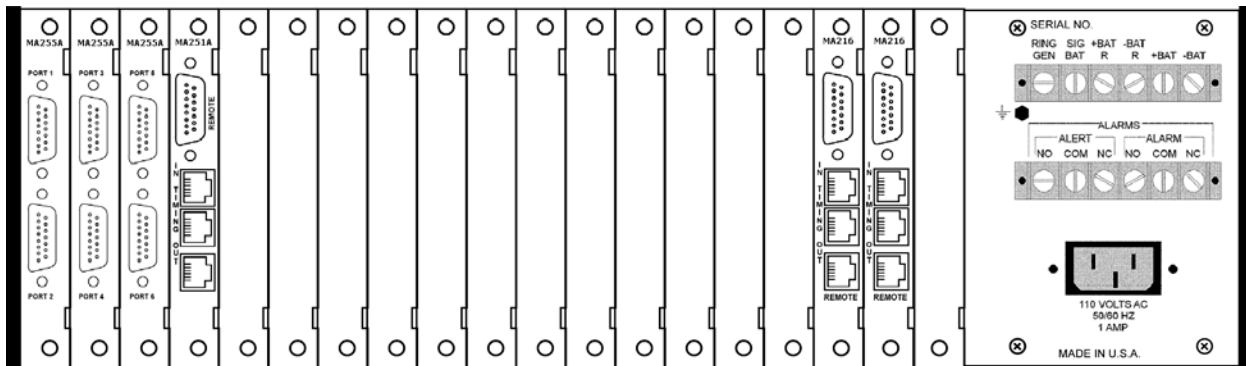
Figure 1-12. DCS-9565 Rear (MA-216 and MA-255A Configuration Shown)

1.4   CrossConnect System and Server Components

1.4.1   One Rack-Unit Chassis for CrossConnect System

The DCS-9500 mainframe chassis is a one rack-unit, 19-inch wide by 1.75-inch high equipment shelf. The chassis houses one power supply, a CrossConnect module, a CrossConnect processor module, and module adapters and provides connections for signals and power.

1.4.2   Three Rack-Unit Chassis for CrossConnect System

The DCS-9530 mainframe chassis is a three rack-unit, 19-inch wide by 5.25-inch high equipment shelf. The chassis houses the power supplies, a CrossConnect module, a CrossConnect processor

module, and module adapters and provides connections for signals and power. In addition to the system components, the chassis has room for 12 additional common and channel modules. You can also upgrade it in the field to a CrossConnect Server with the addition of one or two common modules and module adapters.

1.4.3   Three Rack-Unit Chassis for CrossConnect Server

The DCS-9560 or DCS-9565 mainframe chassis is a three rack-unit, 19-inch wide by 5.25-inch high equipment shelf. The chassis houses the power supplies, common modules, CrossConnect modules, CrossConnect processor modules, and module adapters and provides connections for signals and power. In addition to the system components, the chassis has room for up to 11 channel modules (10 in the DCS-9565).

1.4.4   Common Module — CM-5

The CM-5 common module provides multiplexing and de-multiplexing of a T1 port. A CrossConnect Server with terminal multiplexer capability has one CM-5 module. A CrossConnect Server with drop and insert multiplexer capability has two CM-5 modules. These products include the *T1 Access Server Installation and Operation Manual* with shipment.

Its operation is essentially identical to that of the CM-5 module in the T1 Access Server multiplexers. The *T1 Access Server Installation and Operation Manual* gives a complete description of the functionality of this module, and the setup of the multiplexing section of the Access Server. Control and signal connections to the CM-5 are made through an MA-216 module adapter on the rear panel.

1.4.5   CrossConnect Processor Module — CM-95

The CM-95 processor module controls digital cross-connect system (DCS) features such as control of the T1 ports connected to the DCS-6 CrossConnect module as well as the CrossConnect mapping and switching operations. Control and status connections for the CM-95 are made through the MA-251A module adapter on the rear panel.

The CM-95 module controls all DCS functions. The module communicates with the DCS-6 module and sets its operating parameters. DCS mapping is also handled by this processor. The processor constantly polls the status of T1 links and makes routing decisions based on this status.

1.4.6   CrossConnect Module — DCS-6A

The DCS-6A module reroutes T1 traffic from one port to another and routes time slot traffic among the circuits. It can handle traffic on as many as six T1 circuits. The time slot traffic is received, stored, and retransmitted on the appropriate outgoing T1.

The DCS-6A module has no indicators or controls of its own. All user interfaces with this module is controlled by the CM-95 processor board.

1.4.7   Channel Modules

The DCS-9560/9565 are compatible with all Intraplex T1 channel modules.

1.4.8   Module Adapters

Each common module and channel module in the system has its own module adapter, described in the individual channel module manual sections.

In addition, there are three module adapters always present in the DCS-9560 and DCS-9565:

- MA-216
- MA-251A

● MA-255A or C

The next sections describe these module adapters.

1.4.8.1   MA-216 Module Adapter

The MA-216 is used with the CM-5 T1 common module. It provides a T1 interface which can be connected to any of the T1 port connectors on the MA-255A or C, as well as a remote control port and timing I/O jacks. Section 3 – "Installation & Wiring" gives connector and pin assignment information for the MA-216.

1.4.8.2   MA-251A and MA-252A Module Adapters

The MA-251A and MA-252A module adapters provide connection for the

● Map contacts
● Remote control port
● External timing I/O

The MA-252A is used only with the DCS-9500. Section 3 – "Installation & Wiring" gives connector and pin assignment information for the MA-251A and MA-252A.

1.4.8.3   MA-255A and C Module Adapters

The MA-255 module adapters provide connections for six T1 circuits. Section 3 – "Installation and Wiring" gives connector and pin assignment information for the MA-255s.

1.4.9   Power Supply

The power supply provides power for the chassis, controls, and front-panel indicators. The indicator lights are visible when the chassis front cover is closed.

AC power is connected to the rear-panel connectors. Another option with the DCS-9530, DCS-9560, and DCS-9565 is to connect DC power to the rear-panel connectors. In addition, the DCS-9530, DCS-9560, and DCS-9565 chassis can accommodate a main power supply and a redundant power supply.

Section 2 – Theory of Operation

2.1 CrossConnect Concepts

2.1.1 Digital Cross-connect Systems (DCS)

Digital cross-connect systems (DCS) perform switching and routing functions on T1 time slots and entire T1 circuits.

2.1.2 T1 Circuit Routing

Digital cross-connect systems can perform switching and routing operations on entire T1 circuits. In these simple DCS applications, the T1 signal received on an input port is routed unchanged to a T1 output port. Examples of T1 circuit routing applications are

- Loopback
- Pass-through

2.1.3 Grooming

Grooming is the management of the time slots within the T1s on a wide area, public, or private network to use long haul transmission facilities as effectively as possible. Grooming application examples are

- Point-to-multipoint
- Interchange

Section 2.2 – *T1 Circuit Routing* gives more information on these applications.

Time slot cross-connection or grooming takes place by a process known as time slot interchange. Each incoming T1 is captured and disassembled into time slots. Each disassembled time slot is then stored in a CrossConnect matrix circuit on the DCS-6A. When the time slot is ready to be transmitted, it is retrieved from the matrix circuit and re-transmitted. The DCS processor follows the instructions in a time slot interchange map, determining which incoming time slots will be aligned with which outgoing time slots.

Each DCS processor contains eight time slot interchange maps:

- One default normal map
- One alternate normal map
- Six backup maps

These eight maps are configured by the user using the IntraGuide graphical user interface or using the Intraplex Simple Command Language (ISiCL).

2.1.4 Protection Switching

In addition to grooming, you can use the DCS products to build fault-tolerant networks which detect failures or degradation on T1 lines and automatically switch to backup facilities. There are two main configurations for protection switching:

- Point-to-point
- Self-healing ring

Section 2.4 – *Protection Switching Applications* gives more information on these applications.

2.1.5   DCS System Clock

2.1.5.1   System Clock Purpose

The system clock manages signal traffic timing on a DCS product. It coordinates the timing of each T1 frame that is transmitted and received at each T1 port. In order to maintain the integrity of the system clock, the DCS software relies on three types of clock sources. In the event that one source fails, there is a backup available. When the system clock changes over to another clock source, a switchover occurs.

2.1.5.2   Clock Sources

The DCS has three potential clock sources to drive the system clock:

● Clock signal received from one of the six T1 ports
● Internal oscillator (INT) on the DCS-6A
● External clock source (available from the EXT clock input jack on the MA-251A module adapter)

The factory default setting for the source of the system clock is port 1, but your DCS product may have a different setting as a result of a customized configuration. You can select a clock source by using IntraGuide or ISiCL with the `::SET:CLOCK` command. Section 6.15.2 – *DCS System Clock Setting* gives more information on this command.

2.1.5.3   Clock Types

A clock source can act as one of these ways:

● Requested clock: The clock source selected by the user or by the DCS software to replace the current system clock.

● Actual clock: The clock source currently driving the DCS system clock. This clock source is also referred to as the clock-in-use.

● Reference clock: The clock source that provides a reference signal to compare to the signal of the actual clock for switchover synchronization and slip detection. Section 2.1.5.5 – *System Clock Switchovers* explains clock slip.

2.1.5.4   Primary and Alternate Clock Sources

The ISiCL `::SET:CLOCK` command allows you to specify a configuration for two clock sources for the DCS system clock. You can specify a *primary clock source* and an *alternate clock source*. The primary clock source becomes the actual or system clock. The alternate clock source, which is optional, serves as a backup clock source in the event of a failure to the primary clock source.

As an example, you could have a `::SET:CLOCK` command specifying that the primary clock source is an external clock and the alternate clock source is port 1.

```
::SET:CLOCK=EXT,1;
```

There are three important points regarding primary and alternate clock sources:

● There is never any alternate clock source when the internal oscillator is specified as the primary clock source.
● If both the primary and alternate clock sources fail, the DCS software switches over to the internal oscillator, which becomes the source for the system clock.

● If a problem occurs with the primary clock source and the DCS software switches to the alternate clock source, the software does not attempt to switch back if the problem clears unless there is a problem with the alternate.

2.1.5.5   System Clock Switchovers

Various software functions monitor the state of each clock source. The DCS software switches the primary and alternate clock sources based on specific determining factors. Switchovers occur for these reasons:

● A DCS user requests a change in the clock source configuration by means of the `::SET:CLOCK` command. This command executes a clock switchover only if all of these conditions are met:
   • The requested clock source is different from the current source for the system clock.
   • The requested clock source is in service.
   • The hardware successfully latches in the requested clock source.

● The primary clock source (the clock-in-use) has failed or is no longer present. For example, the T1 port driving the system clock may have failed. This forces a switchover to the alternate clock source, or the internal oscillator, if no value for an alternate clock source is expressed in the `::SET:CLOCK` command.

● The DCS software detects in the primary clock source the occurrence of excessive clock slips (3 or more) in the same direction. This forces a switchover to the alternate clock source or the internal oscillator, if no alternate has been set.

Clock slippage is the detection of two clock waveforms out of synchronization. A slip detect circuit compares the waveform of the actual clock to the waveform of the reference clock. If the waveforms differ by three or more T1 bit intervals in the same direction, a switchover occurs from the primary clock to the alternate clock. The switchover causes the alternate clock to become the clock-in-use (the new system clock) and the previous primary clock to become the new alternate clock.

2.1.5.6   Clock Switchover Occurrence

These two examples show what happens when switchovers occur:

Example 1:

Consider a state in which the source of the system clock (the actual clock or clock-in-use) is the internal oscillator. You decide to change this source to port 2 and use ISiCL to execute the command. The events for Example 1 are

1. A user executes

```
<address>:DCS:SET:CLOCK=2,4;
```

   which specifies that the primary clock source is port 2 and the alternate clock source is port 4. The source of the requested clock is port 2, although the actual clock source continues to be the internal oscillator at this time.

2. The source of the requested clock also becomes the source of the reference clock (port 2).

3. A synchronization detection circuit on the DCS-6A compares the waveform of the internal oscillator to the waveform on port 2.

4. When the signals of both sources (actual clock and reference clock sources) are in synchronization, the requested clock source (port 2) is latched in as the new system clock.

5. Now port 2 is the new system clock; the internal oscillator is no longer part of the configuration; and port 4 remains as the alternate clock source.

Example 2:

A problem occurs with the primary clock source and the DCS software initiates a switchover to the alternate clock source. Given that the primary clock source is port 3 and the alternate clock source is port 1, the requested clock is port 1, and these events occur:

1. The DCS requests a switchover.

2. The alternate clock source becomes the source of the reference clock (port 1).

3. A synchronization detection circuit compares the waveform on port 3 to the waveform on port 1.

4. When the signals of the actual clock source (port 3) and the reference clock source (port 1) are in synchronization,

5. The alternate clock source (port 1) becomes the new system clock. Now the previous primary clock source (port 3) becomes the new alternate clock.

Figure 2-1 shows a process flow of the two switchover examples to illustrate how the events during each switchover parallel each other. Although the events that trigger the switchovers (event #1) are different, a reference clock must always use the source of the requested clock to compare signals for synchronization.

EXAMPLE 1

Given that:
Actual clock = INT
Alternate clock = NONE

Event #1

User executes
`::SET:CLOCK=2,4`
(Requested clock = Port 2)

Event #2

Reference clock uses
Port 2 as its source

Event #3

Sync detect circuit
compares waveforms
on INT and Port 2

Event #4

Signals on INT and
Port 2 sync up

Event #5

Port 2 becomes new actual
clock; Port 4 becomes new
alternate source

EXAMPLE 2

Given that:
Primary clock = Port 3
Alternate source = Port 1

Event #1

Problem occurs with primary
clock; DCS requests
switchover to alternate
source

Event #2

Reference clock uses
Port 1 as its source

Event #3

Sync detect circuit
compares waveforms
on Port 3 and Port 1

Event #4

Signals on Port 3 and
Port 1 sync up

Event #5

Port 1 becomes new actual
clock; Port 3 becomes
new alternate source

SWITCHOVER

Figure 2-1. Process Flow for Switchover Examples

2.2 T1 Circuit Routing

2.2.1 Loopback Configuration

The loopback configuration provides the bidirectional connection of a channel back to itself (Figure 2-2), also known as "hairpinning." Either a complete T1 frame can loop back or one or more selected time slots can.
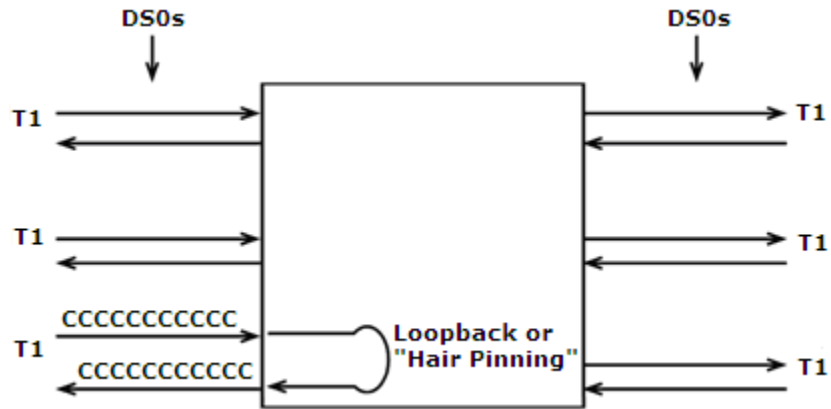
Figure 2-2. Loopback (or Hairpinning) Configuration

2.2.2   Pass-through Configuration

The pass-through configuration provides a connection of one channel to another (Figure 2-3).
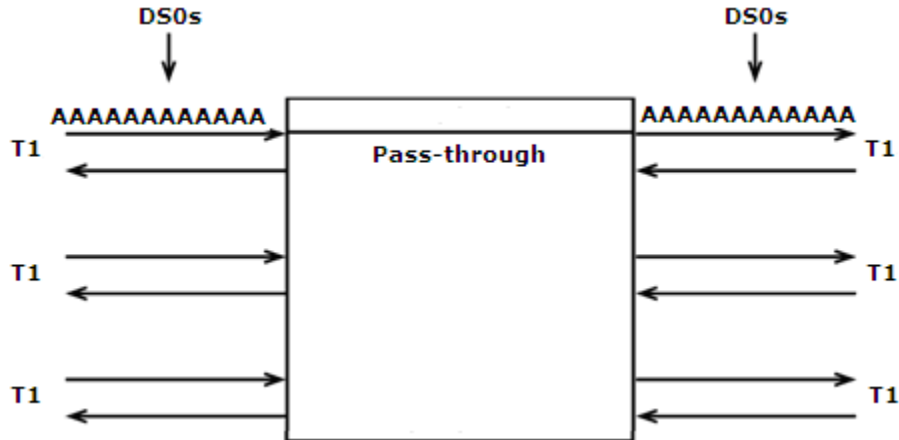
Figure 2-3. Pass-through Configuration

2.3 Grooming Applications

2.3.1   Point-to-Multipoint Systems

Point-to-multipoint systems are commonly used in broadcast applications for distribution of a single signal (either a complete T1 frame or selected time slots) to multiple destinations. Figure 2-4 shows a point-to-multipoint system.
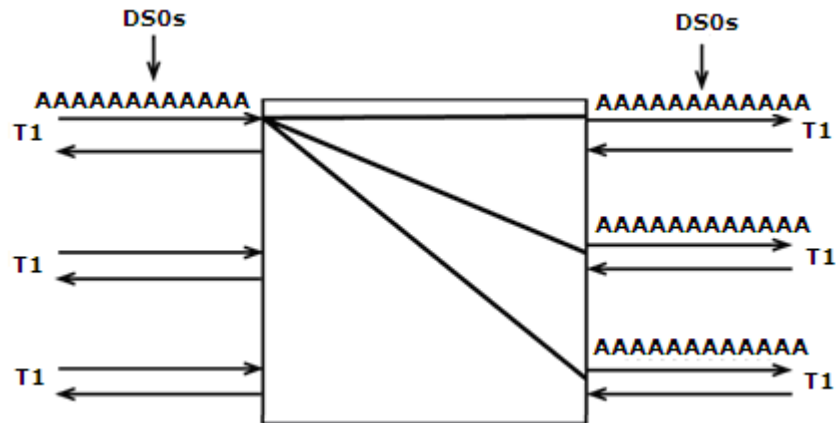
Figure 2-4. Point-to-multipoint system

2.3.2   Interchange Configuration

An interchange configuration provides the bidirectional connection of multiple channels (Figure 2-5).
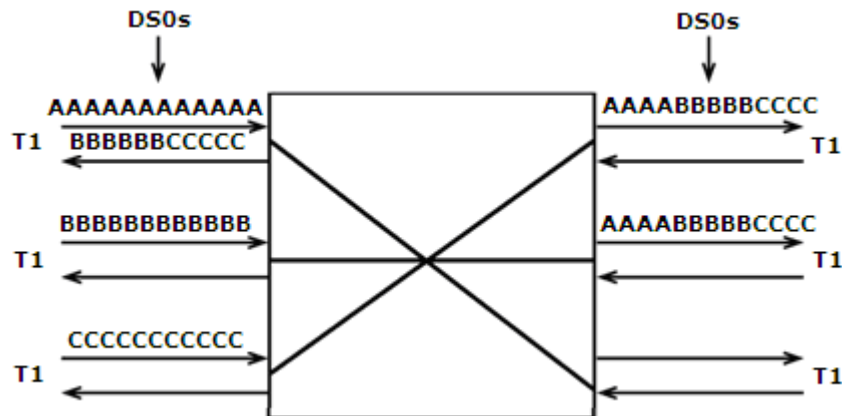
Figure 2-5. Interchange Configuration

2.4 Protection Switching Applications

2.4.1   Point-to-Point Systems

A point-to-point system is typically used to provide backup paths for T1 signals. A T1 signal on the incoming path is routed to the backup path when the primary path fails. During normal operation a DCS monitors the status of the primary path. The DCS switches to the backup T1 on detection of

● Loss of frame synchronization
● Loss of data (carrier loss)
● Excessive bit errors
● Detection of remote alarm

When the failure is restored, the T1 signal is automatically re-routed back to the primary path. The switch back to the primary path has an added delay to prevent oscillation. Figure 2-6 shows a schematic of a point-to-point system before a failure, and Figure 2-7 shows one after a failure.
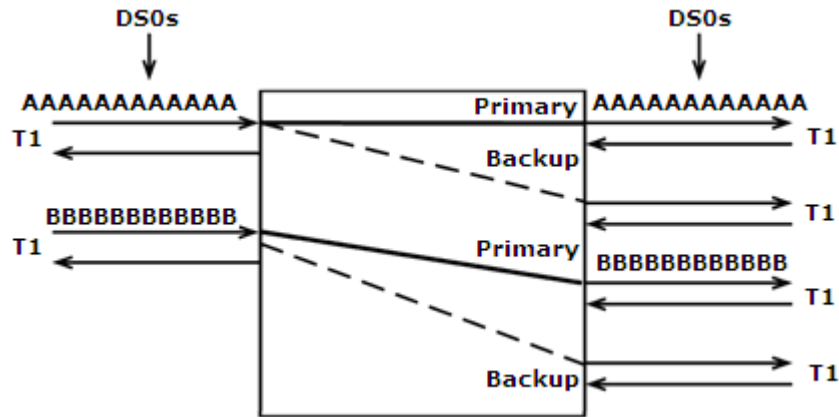
Figure 2-6. Point-to-point System Before Failure
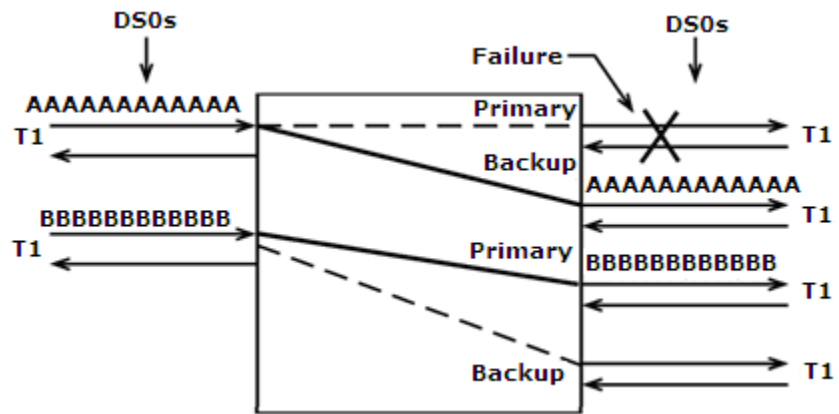
Figure 2-7. Point-to-point System After Failure

2.4.2 Self-Healing Ring Configurations

Self-healing rings provide protection against T1 line failure by providing an alternate path for traffic to follow during failure conditions. Rings can be implemented using CrossConnect Systems or Servers interconnected in a continuous ring or loop. Figure 2-8 shows a single T1 ring configuration. Each CrossConnect System is connected to the two adjacent systems with a single T1 circuit. Each T1 provides transmission in two directions. At each of the four sites or nodes on the ring, a T1 circuit is dropped from the CrossConnect System. Selected time slots in the T1 ring can be dropped out and re-inserted at each node.
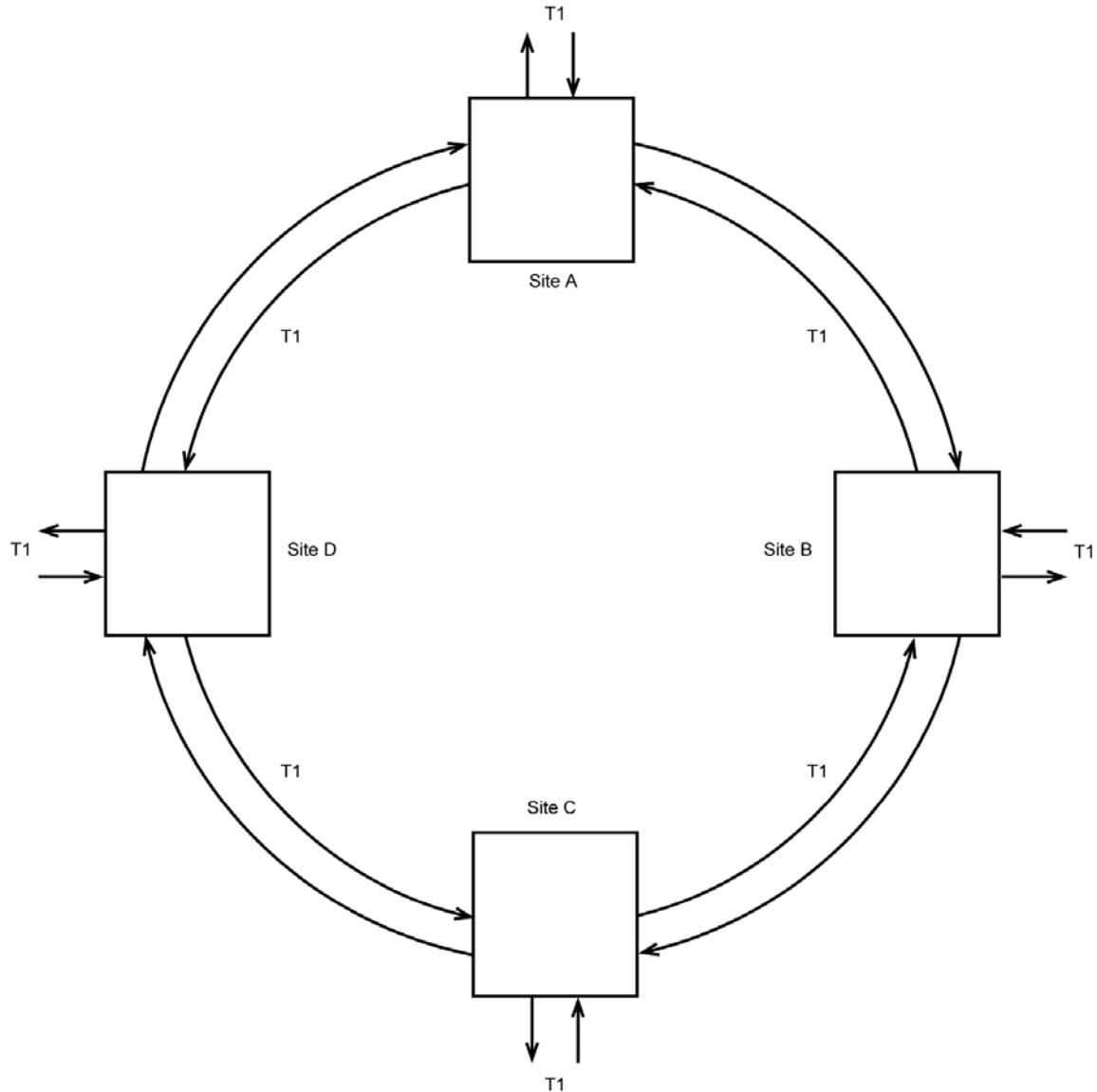
Figure 2-8. Single T1 Ring Configuration

On detection of a failure or degradation in any one of the T1 links, the two CrossConnect Systems connected to that T1 each initiate a map-switch action. The manner in which the maps are preprogrammed determines the route each T1 time slot takes around the ring before and after the failure event. Two different approaches can be taken to programming the maps, resulting in either a unidirectional ring configuration or a counter-rotating ring configuration. The physical equipment and T1 connections are identical for each of these rings. However, based on the expected traffic patterns in the network, one configuration or the other may prove more efficient in use of available T1 capacity around the ring.

2.4.2.1   Unidirectional Rings

In unidirectional rings, the traffic under normal (pre-failure) conditions always proceeds around the ring in a single direction. Figure 2-9 shows this type of ring. All the normal traffic is on the outer path moving in a clockwise direction around the ring. If a circuit is needed, for example, between sites A and B, traffic flows from site A in a clockwise direction to site B. The return traffic, however, travels the long way around the ring from site B through sites C and D back to site A. Since all standard T1 lines are bi-directional, this configuration leaves a completely unused path (the inner ring) in the

counter-clockwise direction. This unused path provides the extra capacity which is utilized in the case of a T1 failure.
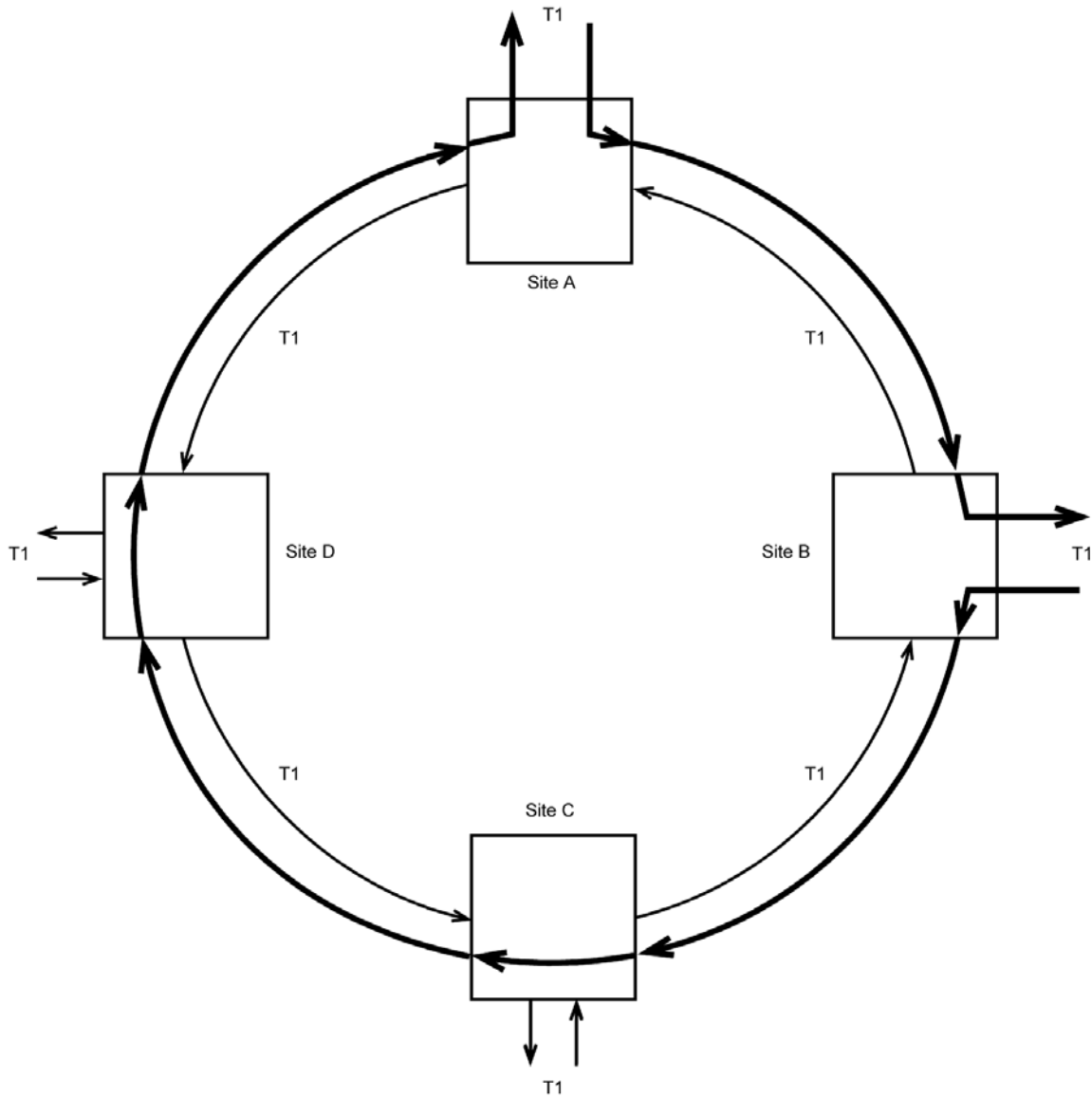
Figure 2-9. Unidirectional Ring Configuration

Figure 2-10 shows this same ring after a failure has occurred in the T1 line between sites C and D. The CrossConnect Systems at sites C and D have each detected the T1 failure and switched to alternate maps. The CrossConnect System at site C redirects the traffic normally sent toward site D back around the ring in the opposite direction toward site B, using the normally empty inner (counter-clockwise) path. The CrossConnect System at site D no longer expects to see incoming traffic from site C, and looks instead for the same traffic to appear coming from site A on the inner path. The CrossConnect Systems at sites A and B have not detected any failure and continue in normal operation. (Notice that in normal mode, all the DCS systems must connect the unused inner path straight-through.) The condition in Figure 2-10 is a stable configuration in which all circuits have been automatically redirected away from the failed T1 line.
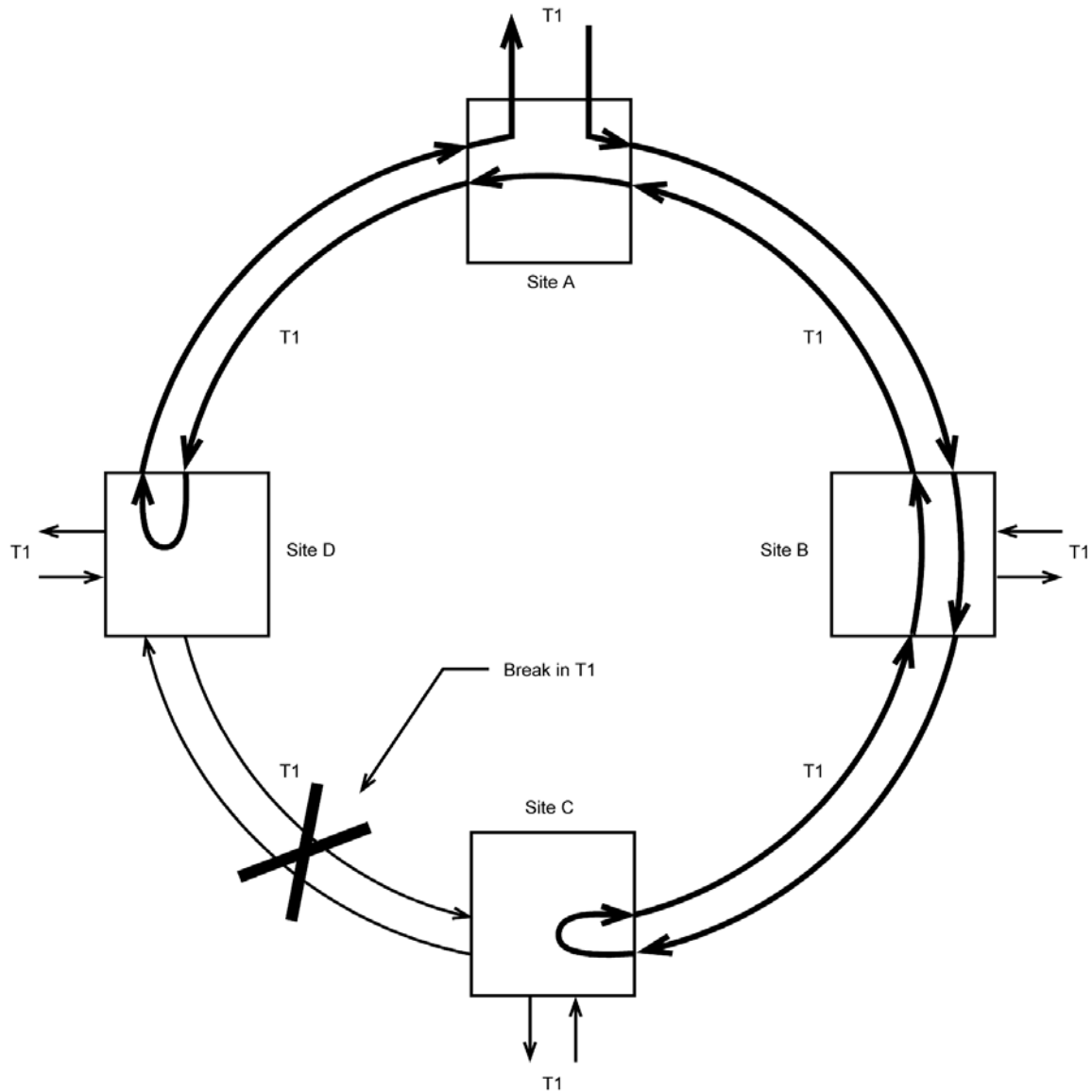
Figure 2-10. Unidirectional Ring Configuration—Failure between Sites C and D

By its nature, the unidirectional ring dedicates a time slot all the way around the ring for each communications circuit, no matter how short. In this example, the circuit of interest was between two adjacent nodes, (A and B) but a time slot was required all the way around the ring to complete the unidirectional path.

2.4.2.2   Counter-Rotating Rings

For networks requiring a large number of "short hops" around the ring, it would be more efficient to re-use time slots as we progress around the ring, which the counter-rotating ring accomplishes. Figure 2-11 shows a single T1 ring programmed in a counter-rotating configuration. Bi-directional traffic flow is shown between sites A and B and between sites C and D. As in the unidirectional ring, the traffic from site A travels clockwise to site B. However, the return traffic travels on the inner path in a counter-clockwise direction from site B back to site A. Since (under normal conditions) this traffic never travels around the rest of the ring, the time slots can be re-used for traffic between sites C and D. In fact, separate circuits could also use these same time slots for independent traffic between sites B and C and sites D and A.
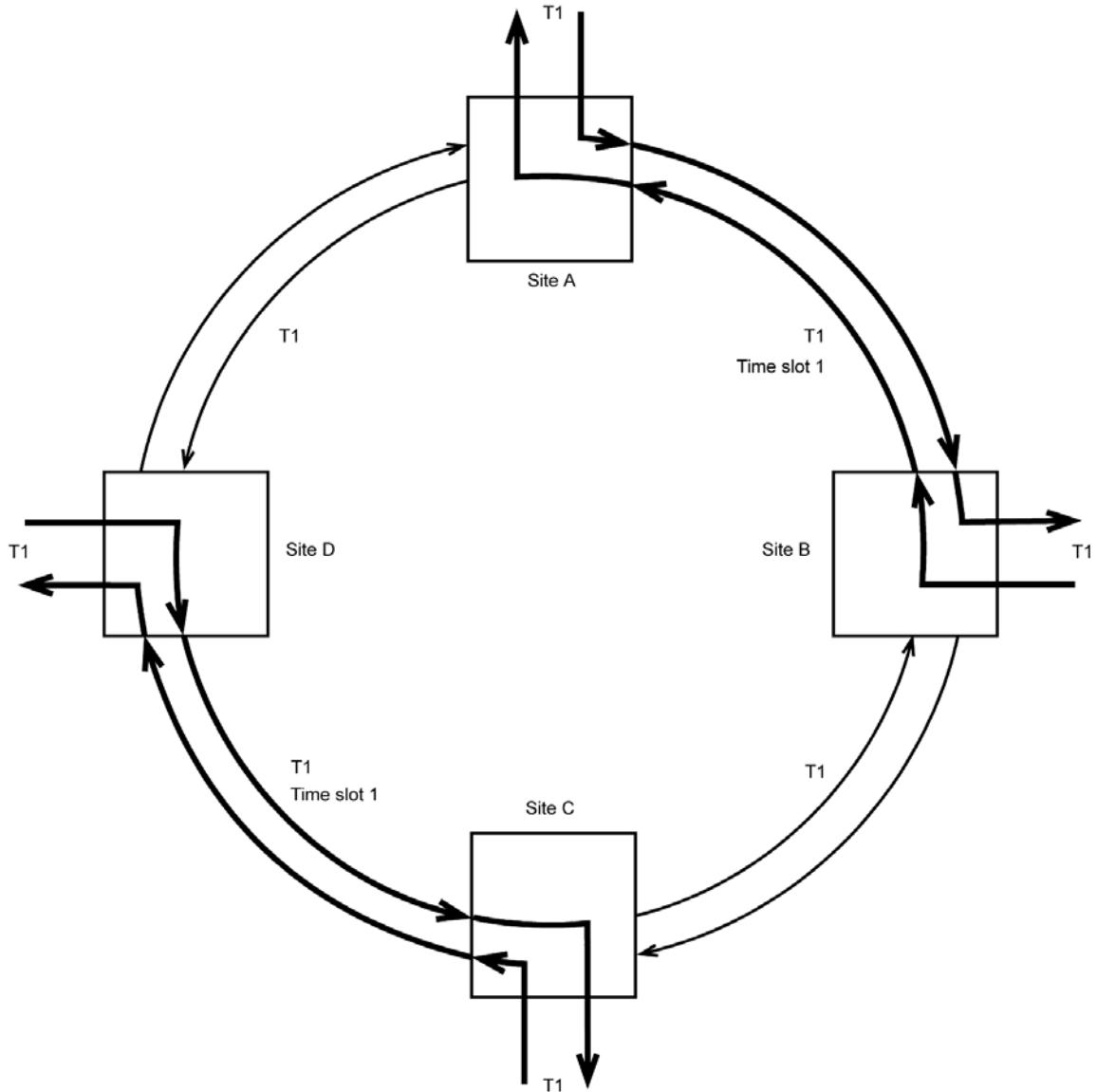
Figure 2-11. Single T1 Ring in Counter-rotating Configuration

Protection switching always requires unused capacity around the ring. In a single T1 counter-rotating ring, provides this unused capacity by leaving half of the T1 time slots empty in both directions around the ring. When a failure occurs, the CrossConnect Systems connected to the failed T1 line switch to alternate maps as they did in the unidirectional ring. However, instead of re-routing an entire T1, only the active time slots (half of the total) are re-routed. Usually the lower-numbered time slots (1 to 12) are used for normal operation. During a failure, time slots 1 to 12 are mapped to unused time slots 13 to 24 in the opposite direction. Figure 2-12 shows the counter-rotating ring after a T1 failure between sites C and D. Notice that the traffic between sites A and B is undisturbed, still using time slot 1 in both directions between the two sites. The traffic between sites C and D, however, has been re-directed around the ring away from the failure, using previously unused time slot 13.
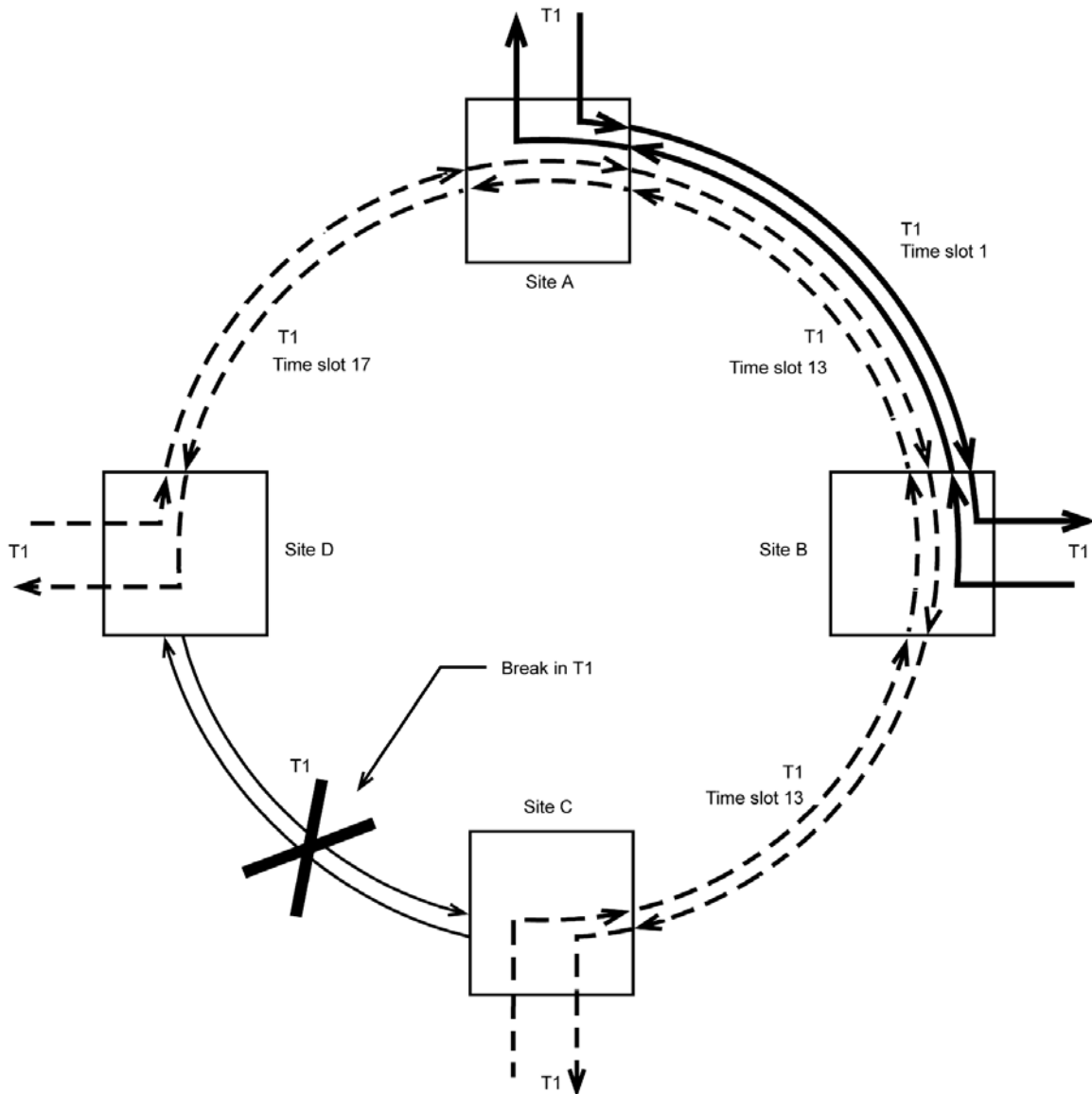
Figure 2-12. Counter-rotating Ring Configuration after Failure between Sites C and D

2.4.2.3   Unidirectional versus Counter-Rotating Rings

Unidirectional rings guarantee a total of 24 circuits. This is because each circuit, regardless of length or number of nodes traversed, requires dedication of a time slot all the way around the ring.

Counter-rotating rings, on the other hand, can provide far more than 24 circuits in a ring, if the circuits are short hops. The maximum number of circuits which can be provided over a single T1 counter-rotating ring is realized in the (unlikely) case where all the circuits are single-hop connections. Each time slot can be re-used for additional circuits in each segment of the ring. Since 12 of the time slots must be left empty for protection switching capacity, the maximum number of circuits is 12 times the number of sites in the ring. A six-site counter-rotating ring, for example, could provide (12 x 6) or 72 single-hop circuits. A ten-site counter-rotating ring could provide up to (12 x 10) or 120 single-hop circuits. In either of these cases, a unidirectional ring would be limited to 24 circuits. Clearly for networks which are dominated by short runs, or for large rings with many nodes, the counter-rotating ring is very likely to provide the best bandwidth efficiency.

There are cases, however, where a counter-rotating ring is not as efficient as a unidirectional ring. One such example involves a network with a large number of overlapping circuits (Figure 2-13). The traffic patterns in this network require 12 bi-directional circuits from site A to site C, and 12 more circuits from site C to site D. In a counter-rotating ring, the maximum number of circuits in any segment of the ring is limited to 12. In this example, the T1 link from site A to site B is filled to this 12 circuit capacity, as is the T1 link from site C to site D. However, the circuits all overlap between sites B and C, requiring double the available capacity. For this application, the counter-rotating ring can only provide 12 of the required circuits, and the unidirectional ring is clearly more efficient. Another example where the unidirectional ring is more efficient than the counter-rotating ring is in point-to-multipoint distribution. If, for example, the network applications require each circuit to pass through every node for multi-point monitoring, the counter-rotating ring provides a maximum of 12 circuits, while the unidirectional ring can provide up to 24.
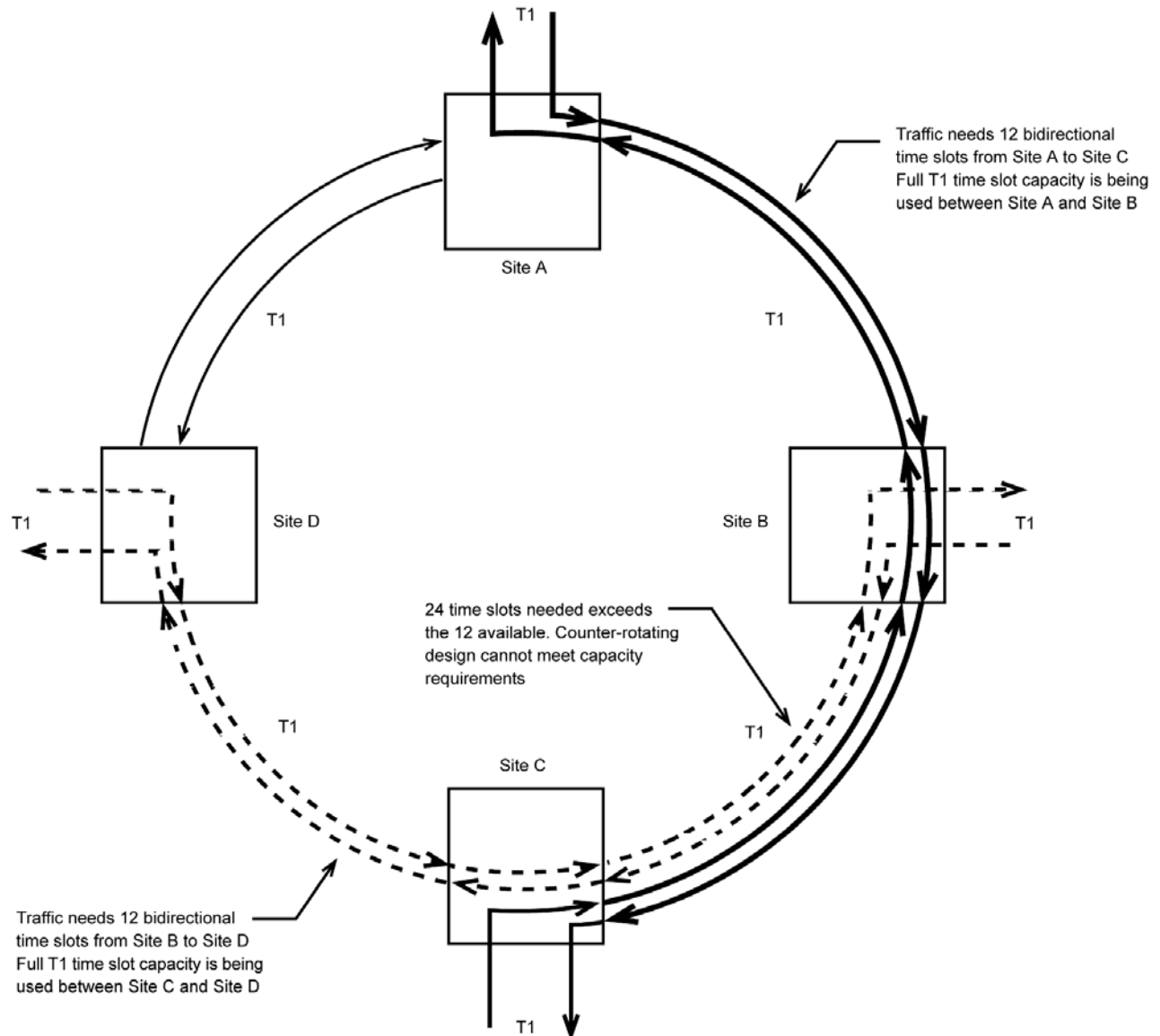
Figure 2-13. Counter-rotating Ring Configuration with Less than 24 Circuits

To make the decision on which ring configuration best suits your communications requirements, first evaluate performance of the counter-rotating ring. In many cases, this ring type yields more than 24 circuits, making it the clear choice. If the counter-rotating ring cannot support 24 circuits in the

required traffic pattern, use a unidirectional ring. Keep these guidelines in mind when selecting a ring configuration:

● You probably need a counter-rotating ring if

  • A large number of short-hop circuits are needed
  • The ring is large, passing through a large number of sites

● You may need a unidirectional ring if

  • A large number of overlapping circuits are needed
  • A large number of multi-drop or broadcast circuits are needed

2.4.2.4 Dual T1 Ring Configurations

Each of the ring configurations discussed above uses three ports on the CrossConnect System at each site. Since Intraplex CrossConnect Systems and Servers each provide six T1 ports, you can implement two identical rings by simply doubling the number of T1 lines. When you implement the rings as counter-rotating, one entire T1 ring can be utilized for normal traffic, with the second T1 reserved for protection capacity rather than using half of each of the two T1 circuits.

2.4.2.5 CrossConnect Servers in Ring Configurations

Each ring network example discussed has been shown using CrossConnect Systems which drop T1 circuits at each site. You can also use CrossConnect Servers at the ring sites making it possible to drop voice, data, video or program audio services directly from the CrossConnect Server shelf. CrossConnect Systems and CrossConnect Servers can be mixed in ring networks based on the termination requirements at each site.

2.4.2.6 Extra Traffic

One consistent characteristic of protection switching networks, whether point-to-point, counter-rotating rings, or unidirectional rings, is that capacity is left unused in case of T1 line failures. Through appropriate map programming, it is possible to use this backup capacity under normal conditions for non-critical traffic. In the case of failure the non-critical traffic is dropped, and the high-priority circuits are protected.

2.5 CrossConnect T1 Product Capabilities

The Intraplex DCS-9500, DCS-9530, DCS-9560, and DCS-9565 all share common digital cross-connect system (DCS) capabilities. Each of these are six-port T1 devices in which any time slot on any input port can be connected to any time slot on any output port.

In DCS-9500 and DCS-9530 CrossConnect Systems, all six of these T1 ports are used for connection to external T1 circuits. In the DCS-9560 CrossConnect Server, one T1 is allocated for internal connection to channel modules for serving local interfaces such as voice, data, LAN, video, or program audio. The DCS-9565 CrossConnect Server allocates two T1 circuits for internal channel modules, leaving four T1 circuits for external connection.

Table 2-1. CrossConnect Product T1 Connections, Time Slots, and Circuit Capacity

Products	External T1 Connections	T1 Circuits Reserved for Local Time Slot Interface	Total T1 Circuit Capacity
DCS-9500	6	0	6
DCS-9530	6	0	6
DCS-9560	5	1	6
DCS-9565	4	2	6

2.6   CrossConnect Server Configurations

In addition to the cross-connection capabilities described previously, the DCS-9560 and DCS-9565 CrossConnect Servers also provide local connections for time slot interfaces. The access or multiplexing functions of the DCS-9560 and DCS-9565 operate similarly to the Intraplex Access Server product line. The CrossConnect Server combines the functionality of the DCS-9500 CrossConnect System with that of the Intraplex Access Server in a single cost and space-efficient unit.

Table 2-2. CrossConnect Servers and Functionally Equivalent Equipment

CrossConnect Server	Functional Equivalent
DCS-9560 CrossConnect Server	DCS-9500 CrossConnect System Plus ACS-163 Terminal Multiplexer
DCS-9565 CrossConnect Server	DCS-9500 CrossConnect System Plus ACS-165 Drop & Insert Multiplexer

The *T1 Access Server Installation and Operation Manual* discusses setting up the DCS-9560 and DCS-9565 CrossConnect Servers.

2.6.1   DCS-9560 CrossConnect Server

The multiplexer part of a DCS-9560 serves as an interface between a single T1 "high-speed" circuit and multiple voice and data "low-speed" circuits (Figure 2-14). Channel modules convert voice, data, or audio signals into one or more 64,000 bit/second (64 Kbps) digital signals. These 64 Kbps signals (also called "channels" or "time slots") are then combined by time division multiplexing into a 1,536,000 bit/second (1.536 Mbps) signal, with an additional 8 Kbps for framing and overhead to equal a T1 signal of 1.544 Mbps. The multiplexed voice, data, and audio circuits become payloads within the T1 circuit.

Figure 2-14 shows a sample configuration. One port is used internally for connection to the CM-5 module. You can choose whichever port you want for this connection. In the figure, to the left of the dotted line, the device configuration is treated as an Access Server configuration (*T1 Access Server Installation and Operation Manual* (ACS-163)).
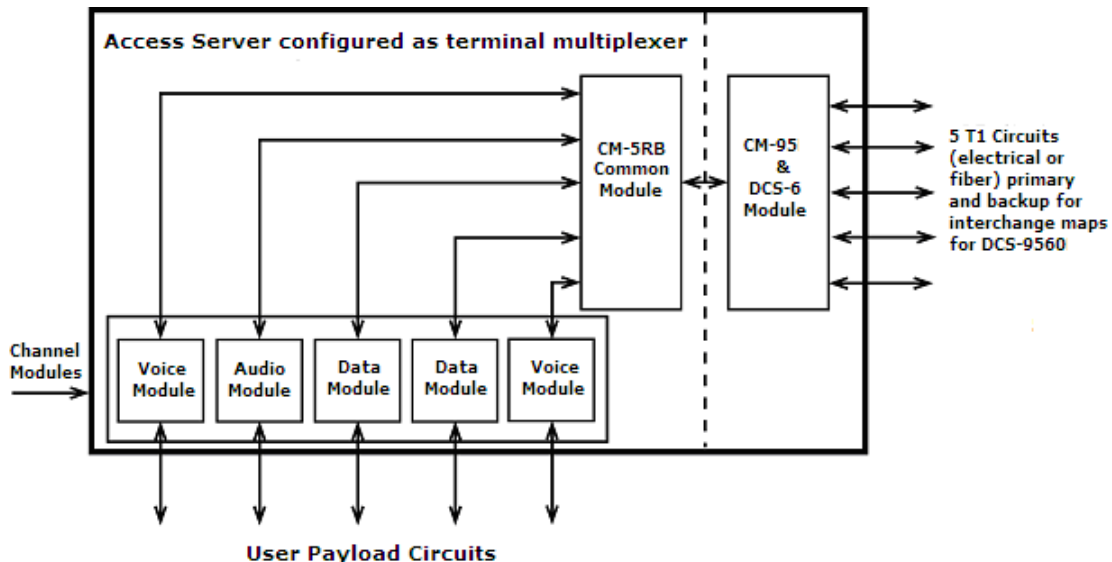
Figure 2-14. Terminal Multiplexer with DCS (Sample Configuration)

A single T1 circuit provides a total bit rate of 1.544 Mbps in each direction. Because the T1 signal format includes 8 Kbps dedicated to frame synchronization, error detection, and other functions, the actual T1 payload capacity is 1.536 Mbps, or 24 full-duplex, 64-Kbps time slots.

2.6.2   DCS-9565 CrossConnect Server

The DCS-9565 combines the function of a drop/insert multiplexer with the DCS. A drop/insert multiplexer is essentially a pair of back-to-back terminal multiplexers, in which some circuits terminate while others pass through. A drop/insert multiplexer can terminate payload circuits from either of two different T1 circuits (that is, from either of two different locations).

With the Figure 2-15 configuration, you can drop twice as many DS0 circuits as you can with only one CM-5 module. These circuits provide locally terminated services, such as voice, data, audio, and video. In the figure, to the left of the dotted line, the device configuration is treated as an Access Server configuration.
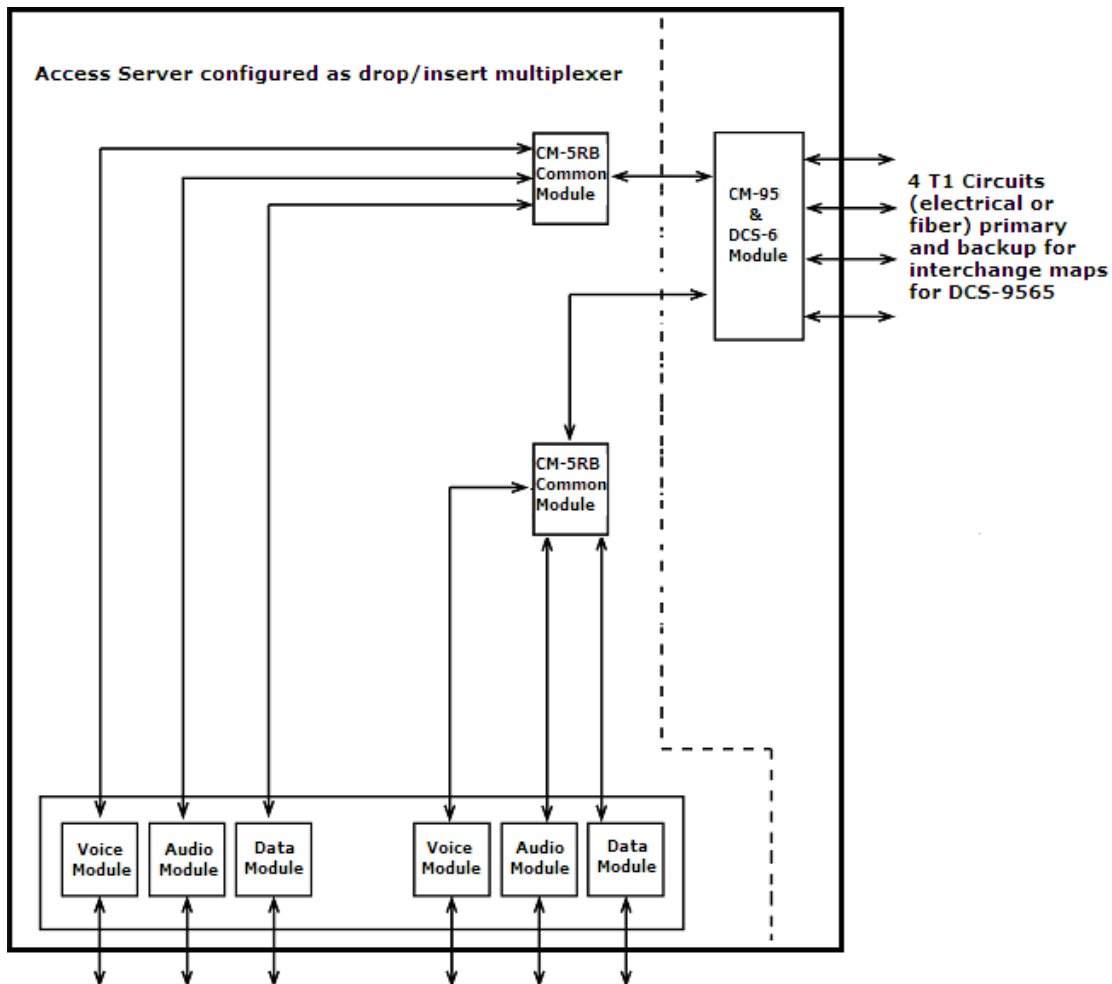
Figure 2-15. Drop/insert Multiplexer with DCS (Sample Configuration)

The drop/insert multiplexer, when connected to a DCS, can also be used as a dual terminal multiplexer, with the ability to locally terminate up to 48 time slots from up to four remote locations. The *T1 Access Server Installation and Operation Manual* gives the correct configuration (ACS-165).

Section 3 – Installation & Wiring

This section describes the general DCS-9500/9530/9560/9565 installation process, which consists of four procedures:

● Unpacking and inspecting the equipment

● Installing the shelves

● Wiring power and signal connectors

● Applying power

3.1   Tools and Cables Required

In addition to the Intraplex equipment provided, these items are necessary to complete installation:

● Basic telecommunications installation tool kit (screwdrivers, wire stripper, and so on)

● Rack mounting hardware (four bolts per shelf)

● One four-wire shielded cable with DB-15 connectors or RJ-45 connectors for each T1 port

Note: Normally, T1 connecting cables may run up to 150 feet in length. If your installation requires a longer cable, please contact Intraplex Customer Service for advice.

● Cables for each payload channel—RS-232, RS-449, or V.35 for data channels between multiplexer and DTE equipment; 22 to 24 gauge wire for program audio channels; and RJ-11 or 50-pin telco for voice

Note: All payload channels connect to the multiplexer via module adapters that plug in at the rear of the shelf. Appendix A of the individual channel module manuals provides detailed descriptions of each module adapter and the cable requirements for the modules shipped with this system.

● 16 to 18 gauge wire for power connection, if the shelf is DC-powered

● AC power cable (included), if the shelf is AC-powered

● Optional: timing cable, if external timing input or output is required; the multiplexer end of this cable must have an RJ-11 connector

● Optional: volt-ohm meter (VOM)

3.2   Equipment Unpacking and Inspection

When unpacking and inspecting the equipment, perform these steps:

1. Upon receiving the equipment, inspect all shipping cartons for damage.

2. If you notice any damage, notify the shipper as soon as possible.

3. Unpack all equipment.

4. Inspect equipment for damage.

5. Verify that the multiplexers are equipped as expected.

6. If you have any questions regarding possible equipment damage or shipping errors, please contact GatesAir Customer Service:

● U.S., Canada, and Latin America: +1-217-221-8200 or tsupport@gatesair.com

● Europe, Middle East, and Africa: +1-217-221-8200 or tsupport.europe@gatesair.com

● Asia and Pacific Rim: +1-217-221-8200 or tsupport.asia@gatesair.com

Warning! Follow all of your company's rules regarding AC- or DC-powered equipment installations. If there is a conflict between any procedure in this manual and your company's safety rules, your company's safety rules must take priority.

3.3 CrossConnect System and Server Installation

The CrossConnect products are normally shipped pre-configured, with common and channel modules already installed. All modules and module adapters can remain in place while bolting the shelf into its equipment rack. To install the CrossConnect equipment, perform these steps:

1. Make sure all modules and module adapters are seated properly.

2. Bolt the shelf into its equipment rack.

Note: If the shelf is AC-powered, make sure that the power cable is accessible for maintenance purposes.
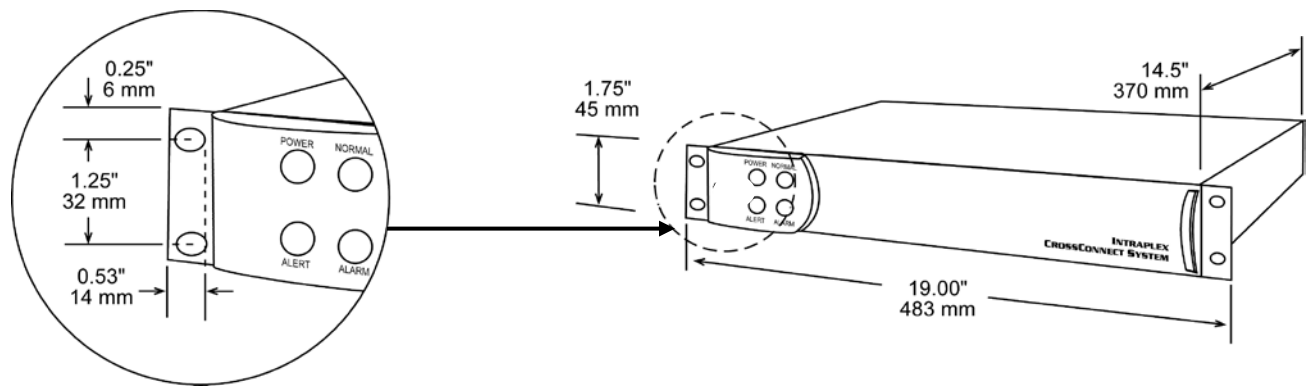
Figure 3-1. DCS-9500 Dimensions
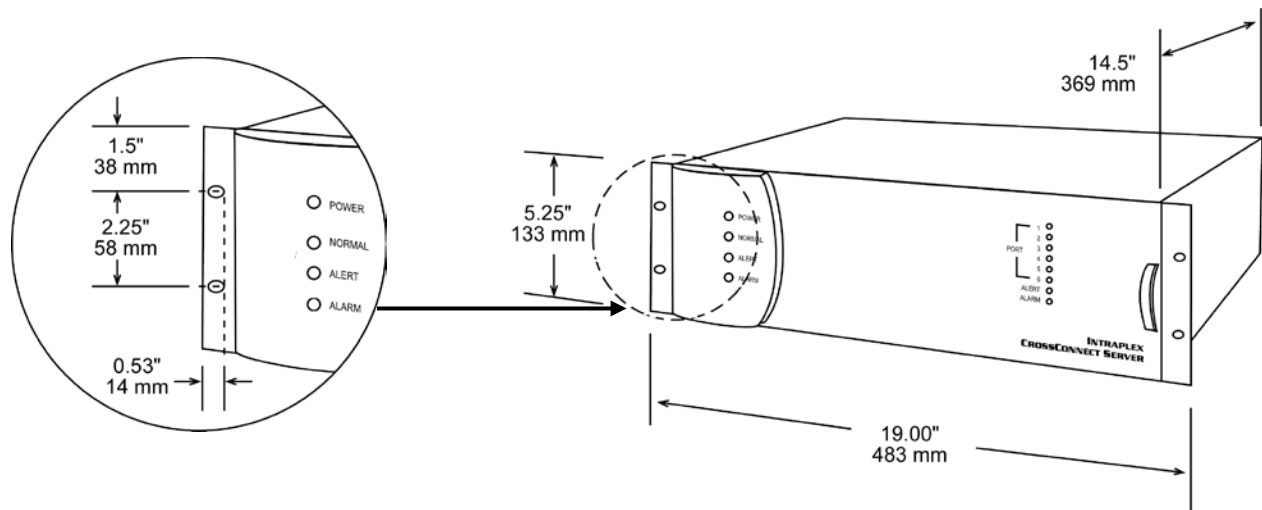
Figure 3-2. DCS-9530/9560/9565 Dimensions

The DCS-9530/9560/9565 can contain a second power supply for redundancy. If the main supply fails, the system continues operating using the redundant supply. To install the redundant power supply, perform these steps:

1.   Remove the front cover of CrossConnect shelf by removing the Phillips screw in the front cover to the right of the Power/Normal/Alert/Alarm indicator lights.

2.   Insert the second power supply into the redundant supply slot on the front. (Its indicator lights turn on identically to those on the main supply.)

3.   Replace the front cover.

Power supply modules require no special setup. As long as they are plugged into their slots and system power is applied, they are operating. If a shelf is equipped with two power supplies (main and redundant) and one of the supplies fails, it may be removed and a new supply inserted without powering down the system.

3.4   Wiring

This section assumes that the equipment is completely wired before placing into service any T1 or payload circuit. Figures 3-3 through 3-6 show the module adapters typically used with CrossConnect products. Your CrossConnect unit may have additional module adapters. Appendix A of the individual channel module manuals gives detailed descriptions of each module adapter and information on wiring and configuring those products. Figures 3-7 through 3-9 show the rear panel connectors on typical CrossConnect Systems and Servers.
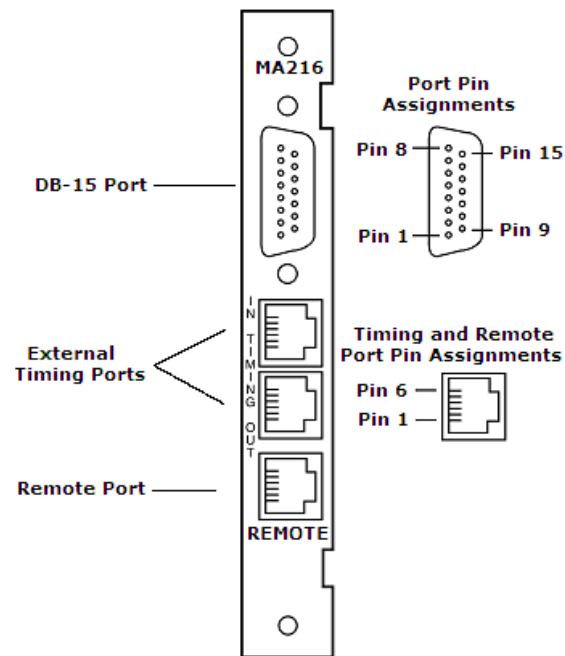
Figure 3-3. MA-216 Module Adapter Connectors
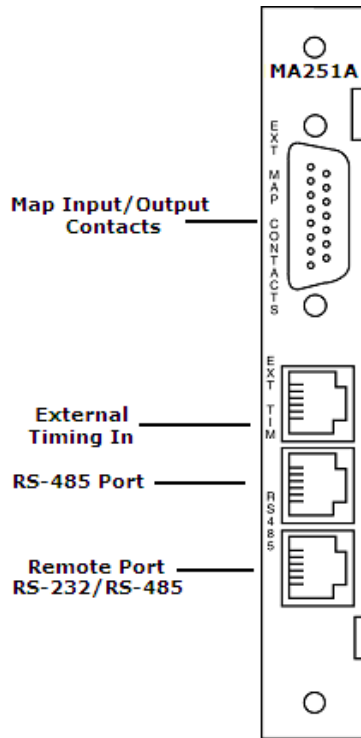
Figure 3-4. MA-251A and MA-252A Module Adapter Connectors
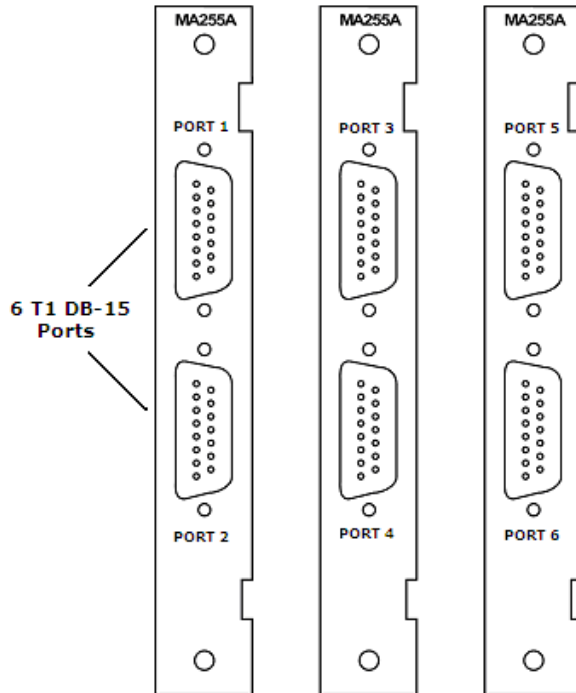
Figure 3-5. MA-255A Module Adapter Connectors
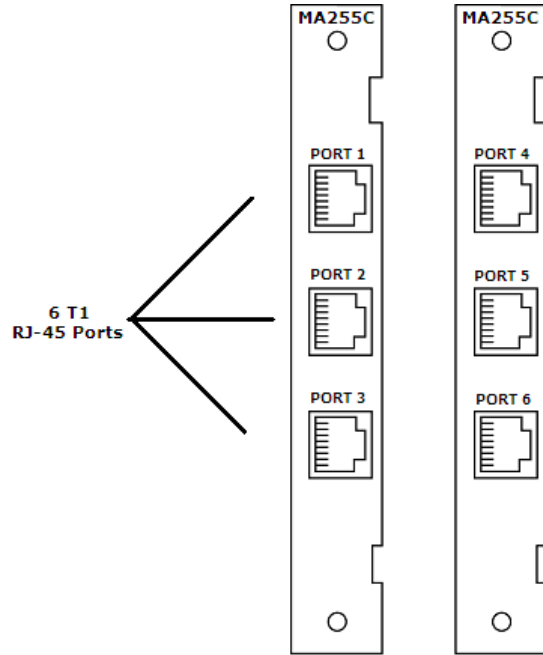
Figure 3-6. MA-255C Module Adapter Connectors
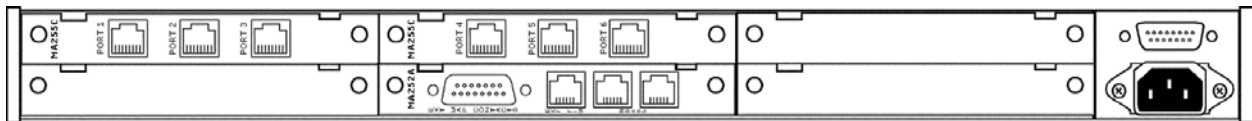
Figure 3-7. DCS-9500 RJ-45 System Rear Panel Connectors
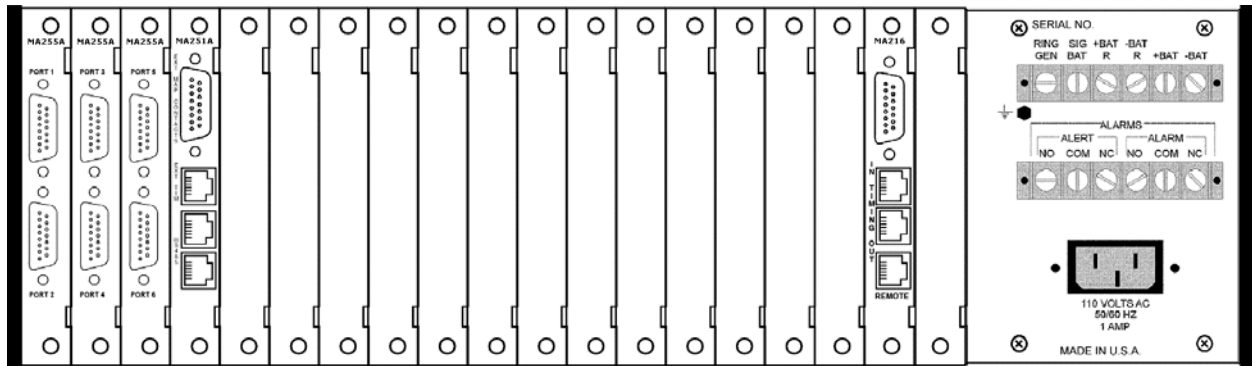
Figure 3-8. DCS-9560 DB-15 System Rear Panel Connectors
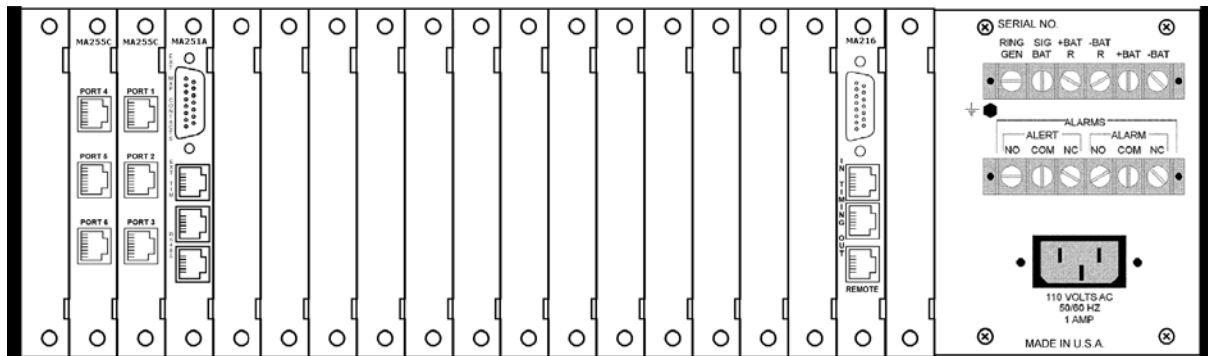
Figure 3-9. DCS-9560 System Rear Panel Connectors
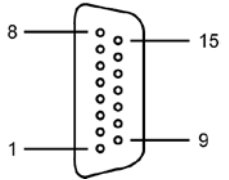
3.4.1   T1 Circuit Wiring

For the DCS-9500 and DCS-9530, wire the T1 ports to the desired T1 circuits. For a DCS-9560 DB-15 system, wire the T1 connectors on the MA-216 to the desired T1 port on the MA-255A using the provided DB-15 cable and then wire the remaining T1 ports to the desired T1 circuits. For a DCS-9560 RJ-45 equipped system, wire the T1 connectors on the MA-216 to the desired T1 port on the MA-255C using the provided adapter (DB-15 to RJ-45) and cable and then wire the remaining T1 ports to the desired T1 circuits.

If you do not have the provided cables, Tables 3-1 through 3-3 list the pin assignments to make your own. Table 3-1 lists the pin assignments for the MA-216 and MA-255A T1 port. Table 3-2 lists the pin assignments for the MA-255C T1 port. Table 3-3 lists the pin assignments for the MA-216 and MA-255C T1 port.
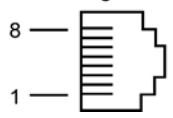
3.4.1.1   MA-216 and MA-255A T1 Port Assignments

Table 3-1. Pin Assignments for T1 Connector on MA-216 and MA-255A

Connector	Pin	Description
DB-15 Pin Assignment	1 (ring) and 9 (tip)	T1 Transmit; the balanced T1 output of the corresponding CM-5 or DCS-6
	3 (ring) and 11 (tip)	T1 Receive; the balanced T1 input of the corresponding CM-5 or DCS-6
	2, 4, 8, and 10	T1 signal grounds. These pins may be used to provide signal ground to an external DCE such as a T1 CSU
	All other pins	Not used

3.4.1.2   MA-255C T1 Port Assignments

Table 3-2. Pin Assignments for MA-255C Ports (RJ-48C)

Connector	Pin	Description
RJ-48C Port Pin Assignment	1	Receive tip 1
	2	Receive ring 1
	3	No connect
	4	Transmit ring 1
	5	Transmit tip 1
	6-8	No connect

3.4.1.3   MA-216 to MA-255C Cable Pin Assignments

Table 3-3. Pin Assignments for MA-216 (DB-15) T1 to MA-255C (RJ-45) T1 Cable

MA-216 Cable End (DB-15)	Description	MA-255C Cable End (RJ-45)
1	T1 Transmit (ring)	2
9	T1 Transmit (tip)	1
3	T1 Receive (ring)	4
11	T1 Receive (tip)	5
2	T1 signal ground	7
4	T1 signal ground	Not used
5,6,7,8,10, 12,13,14,15	Not used	Not used

3.4.2   External Timing Connector Wiring (Optional)

The MA-216 module adapter provides an RJ-11 timing input jack and an RJ-11 timing output jack. *Timing Out* is a balanced 1.544 MHz RS-422 output from the corresponding CM-5 that may be used as an external T1 timing source by other equipment. *Timing In* is a balanced 1.544 MHz RS-422 input to the corresponding CM-5 that may be connected to an external T1 timing source. The CM-5 synchronizes to this source only if timing is set to *External*.

These jacks may also be used to "daisy-chain" several multiplexers together to synchronize them all to the same clock. The *T1 Access Server Installation & Operation Manual* gives more information.

3.4.2.1   MA-216 External Timing Connectors

Table 3-4. MA-216 Port Pin Assignments for External Timing In (RJ-11)
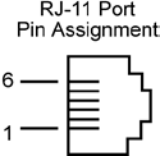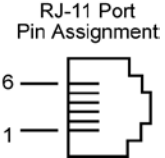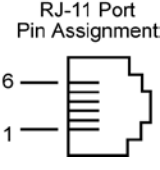
Connector	Pin	Description
RJ-11 Port Pin Assignment	1	External timing input, positive (+)
	2	External timing input, negative (-)
	3	Not used
	4	
	5	VRM timing input, positive (+)
	6	VRM timing input, negative (-)

Table 3-5. MA-216 Port Pin Assignments for External Timing Out (RJ-11)

Connector	Pin	Description
RJ-11 Port Pin Assignment	1	Timing output positive (+)
	2	Timing output negative (-)
	3	Signal ground
	4	
	5	Not used
	6	

3.4.2.2   MA-251A and MA-252A External Timing In Connectors

Table 3-6. Pin Assignments for MA-251A and MA-252A Ports for External Timing In (RJ-11)

Connector	Pin	Description
RJ-11 Port Pin Assignment (6 — 1)	1	External timing input, positive (+)
	2	External timing input, negative (-)
	3	Not used
	4	
	5	
	6	

3.4.3   Remote Port Wiring (Optional)

To take advantage of the optional remote monitoring and control feature of the Intraplex CrossConnect products, connect a PC or ASCII terminal to the remote port on the module adapters of the devices you want to monitor. Connection to the remote port can be made either by direct wiring or over a dial-up circuit using a modem. When connecting the remote port to a modem, use a null modem cable (a null modem cable provides a standard RS-232 DCE to DCE connection). The *T1 Access Server Installation & Operation Manual* describes these options.

On a DCS-9560 with a terminal multiplexer, the CM-5 is controlled from the remote port on its corresponding MA-216. So it must be connected separately from the CM-95. The DCS-9560 is shipped with two phone jack cables and a PC adapter.

On a DCS-9565 with drop and insert multiplexer, each of the two CM-5 modules is controlled from the remote port on its corresponding MA-216, so each must be connected separately. The DCS-9565 is shipped with

● Four phone jack cables

● One modular T-junction

● One PC adapter

These procedures give wiring information to manage a CrossConnect device remotely.

To manage a CM-95 (DCS) module from a PC (in a DCS-9500), perform these steps:

1. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-252.

2. Connect the other end of the phone jack cable to your PC using the RJ-11 to DB-9 adapter provided.

3. Use Table 3-8 to set the RJ-11 jack pin assignments.

To manage a CM-95 (DCS) module from a PC (in a DCS-9500, a DCS-9530, a DCS-9560, or a DCS-9565), perform these steps:

1. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-251A or MA-252A.

2. Connect the other end of the phone jack cable to your PC using the RJ-11 to DB-9 adapter provided.

3. Use Table 3-8 to set the RJ-11 jack pin assignments.

To manage a CM-5 module from a PC (in a DCS-9560 or a DCS-9565), perform these steps:

1. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-216.

2. Connect the other end of the phone jack cable to your PC using the RJ-11 to DB-9 adapter provided.

3. Use Table 3-8 to set the RJ-11 jack pin assignments.

To manage a CM-95 (DCS) module and one CM-5 module from a PC (in a DCS-9560 or a DCS-9565), perform these steps:

1. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-251A.

2. Connect the other end of the phone jack cable to your PC using the RJ-11 to DB-9 adapter provided.

3. Use Table 3-8 to set the RJ-11 jack pin assignments.

4. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-216.

5. Use Table 3-7 to set the RJ-11 jack pin assignments.

6. Connect the other end of the phone jack cable to the RS-485 port on the MA-251A.

7. Use Table 3-9 to set the RJ-11 jack pin assignments.
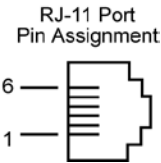
To manage a CM-95 (DCS) module and two CM-5 modules from a PC (in a DCS-9565), perform these steps:

1. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-251A.

2. Connect the other end of the phone jack cable to your PC using the RJ-11 to DB-9 adapter provided.

3. Use Table 3-8 to set the RJ-11 jack pin assignments.

4. Insert an RJ-11 plug into the RS-232/RS-485 remote port on the MA-216 of each CM-5 module.

5. Use Table 3-7 to set the RJ-11 jack pin assignments.

6. Connect the other end of each phone jack cable to a port in the modular T-junction.

7. Take the fourth phone jack cable and insert it into a port in the modular T-junction provided.

8. Connect the other end of the phone jack cable to the RS-485 port on the MA-251A.

9. Use Table 3-9 to set the RJ-11 jack pin assignments.

3.4.3.1   MA-216 Remote Port

The RS-232 pins (pins 2 and 4) provide the remote port for ISiCL commands to the CM-5. (ISiCL, the Intraplex Simple Command Language (pronounced "icicle") provides the basis for communication between the user and the multiplexer. The operator types ISiCL commands at the keyboard and views the responses on the terminal screen. Section 6 – "Configuration Using ISiCL" discusses how to use this language.) The RS-485 pins (pins 1 and 6) provide daisy-chain connection for the remote port signals to multiple multiplexers at one location.
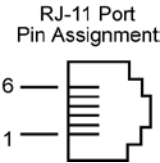
Table 3-7. Pin Assignments for MA-216 Remote Port (RJ-11)

Connector	Pin	Description
RJ-11 Port Pin Assignment 6 — 1 —	1	RS-485 negative (-)
	2	RS-232 transmit
	3	Not used
	4	RS-232 receive
	5	Signal ground
	6	RS-485 positive (+)

3.4.3.2   MA-251A and MA-252A Remote Port

The RS-232 pins (pins 2 and 4) provide the remote port for ISiCL commands to the CM-95.
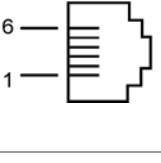
Table 3-8. Pin Assignments for MA-251A and MA-252A Remote Port (RJ-11)

Connector	Pin	Description
RJ-11 Port Pin Assignment	1	RS-485 negative (-)
	2	RS-232 transmit
	3	Not used
	4	RS-232 receive
	5	Signal ground
	6	RS-485 positive (+)

3.4.3.3   MA-251A and MA-252A RS-485 Port

The RS-485 pins (pins 1 and 6) provide "daisy-chain" connection for the remote port data signals to multiple multiplexers at one location.

Table 3-9. Pin Assignments for MA-251A and MA-252A RS-485 Port (RJ-11)

Connector	Pin	Description
RJ-11 Port Pin Assignment	1	RS-485 negative (-)
	2	Not used
	3	
	4	
	5	
	6	RS-485 positive (+)

3.4.3.4   MA-251A/MA-252A Bias Resistor Settings

If the network topology consists of one or two DCS units, Figure 3-10 shows how the connections can be made.
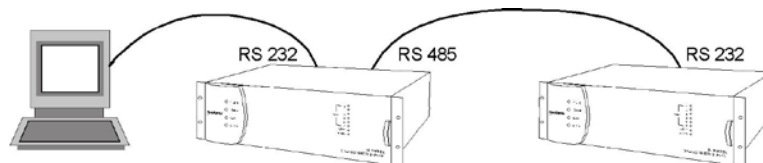
Figure 3-10. Basic Two DCS Network Topology (Using Factory Defaults)

Normally, each DCS unit has an active bias resistor. However, if a DCS network is comprised of three of more DCS units, only the first and last DCS units should have their bias resistor turned on (Figure 3-11).
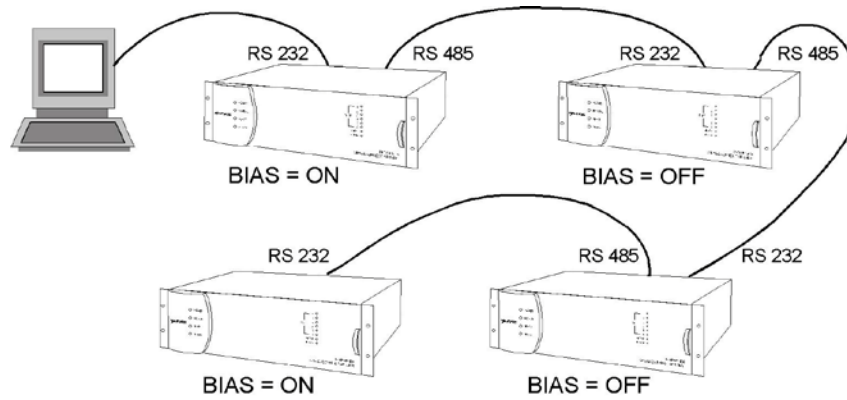
Figure 3-11. Network of Three or More DCS Units

The MA-251A/252A module adapter default bias resistor setting is ON. To turn off the bias resistor, remove the jumpers from JMP3, JMP4, and JMP5. All three jumpers must be removed to turn off the bias resistor (Figures 3-12 and 3-13).
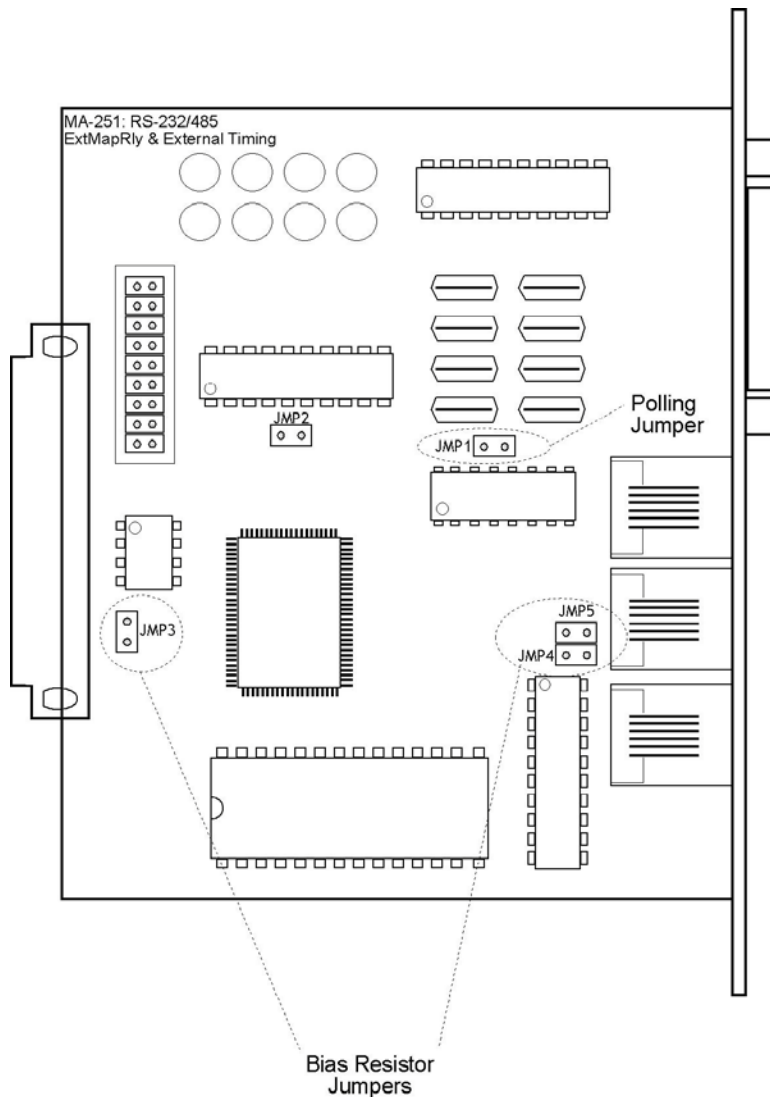
Figure 3-12. Jumper Connection Locations on MA-251A/MA-252A Module Adapters
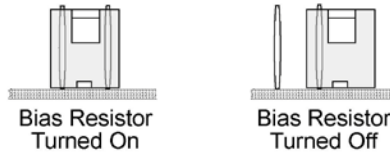
Figure 3-13. Turning On/Off the Bias Jumper Connectors

Figure 3-14 shows a modified network structure using a null modem. This structure is another alternative to the network structure in Figure 3-11.
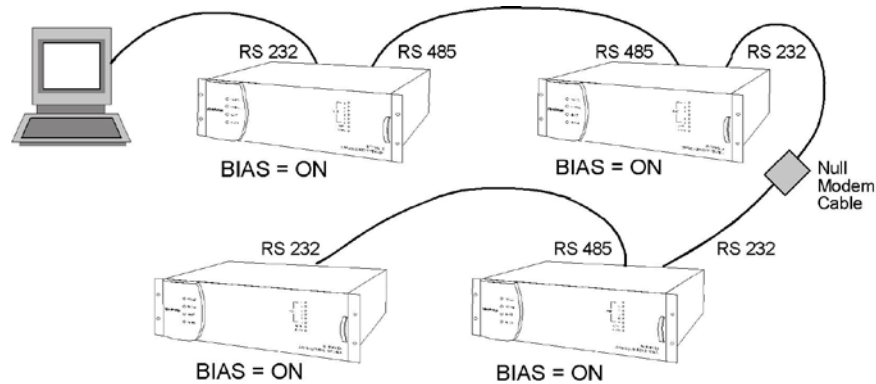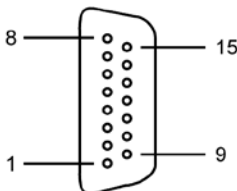
Figure 3-14. Alternative Network Structure with a Null Modem

In this network structure using a null modem, the sections using the RS 485 are isolated so the bias resistor can remain turned on for all the DCS units. However, a null modem cable (not included) is needed to swap the transmit and receive when running from the RS 232 of a DCS to the RS 232 of another DCS.

3.4.4   External Contact/Status Port Wiring (Optional)

The external status port on the MA-251A and MA-252A allows you to connect external contact closure devices and map status/alarm indicators. Table 3-10 lists the pin assignments. Section 3.9.1 – *External Contact/Status Port Inputs*, and Section 3.9.2 – *External Contact/Status Port Outputs* give more information on using this port.

Table 3-10. Pin Assignments for MA-251A and MA-252A External Contact/Status Port (DB-15)

Connector DB-15p (pin)	Pin	Description
DB-15 Pin Assignment	1	Select map 0 input
	2	Select map 2 input
	3	Select map 4 input
	4	Select map 6 input
	5	Alert indication
	6	Active map number, bit 0
	7	Active map number, bit 2
	8	Signal ground
	9	Select map 1 input
	10	Select map 3 input
	11	Select map 5 input
	12	Select map 7 input
	13	Fail alarm indication
	14	Active map number, bit 1
	15	No connection

3.4.4.1   External Contact/Status Port Inputs

The external status port can receive signals from external contacts to select a map. Table 3-11 shows the relationship of pins to map selection. To select a map, connect between the map input and ground (pin 8).

Table 3-11. Pin Input Signals for MA-251A and MA-252A External Contact/Status Port to Select a Map

Pin	Description
1	Select map 0 input
2	Select map 2 input
3	Select map 4 input
4	Select map 6 input
9	Select map 1 input
10	Select map 3 input
11	Select map 5 input
12	Select map 7 input

3.4.4.2   External Contact/Status Port Outputs

The external status port can report a failure alarm state, an alert state, and the active map. The signal from pin 5 indicates an alert condition, and the signal from pin 13 indicates a failure alarm condition. Active maps are indicated in binary form through the signals from pins 6, 7, and 14 in the sequence 7, 14, and 6 (Table 3-12). Zero (0) volts is a logic zero in the table.

Table 3-12. Pin Output Signals for MA-251A and MA-252A External Contact/Status Port Indicating Active Map

Pin 7	Pin 14	Pin 6	Active Map
1	0	0	Map 0
2	0	1	Map 1
3	1	0	Map 2
4	1	1	Map 3
9	0	0	Map 4
10	0	1	Map 5
11	1	0	Map 6
12	1	1	Map 7

3.4.4.3   MA-251A/MA-252A Map Polling Feature

The map polling feature of the MA-251A/252A module adapter allows the module adapter to poll the DCS for the current map number. The map number is reported on the module adapter map output contact (the DB-15 connector in Figure 3-15).
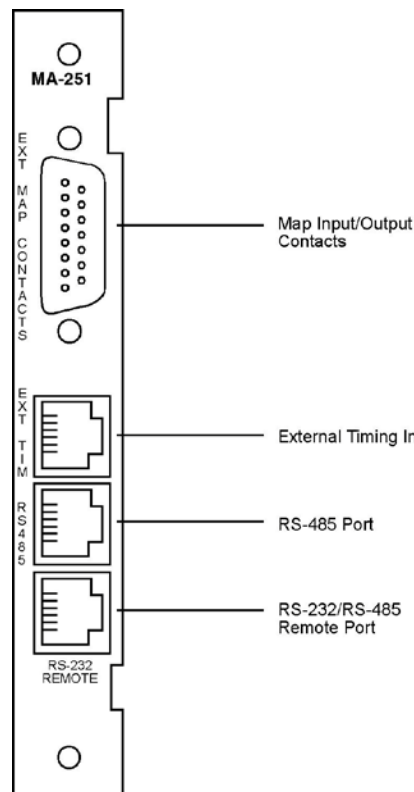
Figure 3-15. MA-251A/MA-252A Connectors

Polling can result in unreliable remote communication on the network, so by default the feature is disabled. Jumper connection JMP1 controls the polling feature. Since the default setting is disabled, the jumper is factory installed to connect both pins. To enable map polling, the shunt is only connected to one side of the jumper (Figure 3-16).

Figure 3-16. JMP1 Map Polling Jumper

3.4.5   Power and Alarm Connection Wiring

Standard AC power supplies provide 60 watts and are available in universal (110/230) VAC. A 130 watts AC power supply is also available. DC power supplies provide 50 watts and are available in –48 VDC, –24 VDC, and +24 VDC versions. One is always included. A second of the same capacity may be added. The DCS-9500 is 60 watts AC-powered only with no redundancy.

The second power supply module, if installed, provides power supply redundancy if the main power supply fails. The redundant supply automatically comes online with no loss of transmission. The first power supply is inserted into the main power supply slot, and if used, the redundant power supply is inserted into the redundant power supply slot.

3.4.5.1   CrossConnect Power Requirements Determination

Table 3-13 shows how much power the modules in a CrossConnect Server draw. To use the table, write down the number of modules of each type in the chassis in the Quantity column. Multiply the quantity by the power consumption to determine the total power consumption for all modules of that type. When you are finished, add up all the totals to determine the total power consumption for the chassis.

Table 3-13. Power Requirements for CrossConnect Server Components

Module	Power (watts)	Quantity	Total
CM-5 T1 interface module	3.1	1 or 2	--
MA-255x module adapter*	0.0	1	0.0
MA-251A or MA-252A module adapter	0.5	1	0.5
MA-216 module adapter DCS-6A module	0.0**	1	0.0
CM-95 modules	4.5	1	4.5
Channel modules†	--	--	--
Total Power Consumption	--	0	--††

*   These modules have no active components and therefore draw no power.

**   Included in the input power requirement for the CM-5 common module.

†   This depends on the type and number of channel modules in the system. Each channel module's manual section on power gives the module's power requirements.

†† If total power consumption exceeds 50 watts, the 100-watt power supplies are required. If total power consumption exceeds 35 watts, the optional 100-watt power supplies are recommended.

Table 3-14 defines the power and alarm terminals on the DCS-9530, DCS-9560 and DCS-9565 and lists the equivalent connection points on a DCS-9500 (these equivalents are pins of the DB-15 alarms

connector). Figures 3-17 through 3-20 (in Section 3.4.5.3) show the typical power connections for the CrossConnect products.

3.4.5.2   Power Connections

To make connections for power and alarms, perform these steps:

1. Connect the GND screw to station ground.

2. If the shelf is AC-powered, verify that the AC cord is available. Do not plug the cord into the AC source yet.

3. If the shelf is DC-powered

    a. Verify that a 2A slow-blow external fuse is available in the DC power line to protect the multiplexer. Remove this fuse and do not replace it until you are ready to power up the shelf.

Warning!   This fuse must be installed, both to protect the multiplexer and to provide a safe means of removing power from a DC-powered shelf.

---

    b. Connect the -BAT terminal to the negative terminal of the station battery.
    c. Connect the +BAT terminal to the positive terminal of the station battery, tied to ground.

4. If the shelf contains one or more Foreign Exchange Station End modules, used for Automatic Ring Down or Off Premise Extension, connect RING GEN to external ringing generator or loop current source.

Warning!   When using an external ring generator, place a 0.5A slow-blow fuse in line. For safety reasons, this fuse must be installed unless the back of the multiplexer will be enclosed.

---

5. If the shelf contains one or more of these modules, connect SIG BAT to signaling battery:

    •   Foreign Exchange Station End modules
    •   4-wire E&M voice modules using signaling

    Check with Intraplex Customer Service if you are not sure whether this battery is necessary.

6. If the shelf is DC-powered, connect SIG BAT to -BAT R. A separate signaling battery is not required.

Warning!   When using a separate signaling battery, place a slow-blow fuse in line. The value of the fuse should be 1A for up to 12 voice circuits or 2A for 13 to 24 circuits. For safety reasons, this fuse must be installed unless the back of the multiplexer is enclosed.

---

7. If ALARM and ALERT contacts are to be used, connect the desired contacts to terminal strip 2.

Table 3-14. Power and Alarm Connectors

Terminal	Description	DCS-9500 Pin Equivalent
GND screw	Chassis GROUND.	13
RING GEN	RING GENERATOR input. For an external ring generator referenced to -48VDC Signaling Battery input. Connect one side of the ring generator to this point, and the other side to the SIG BAT input. **WARNING!** The ring generator must be externally fused or have its current limited.	14
SIG BAT	-48VDC SIGNALING BATTERY input. For connection to an external signaling voltage source when this is needed by one or more channel modules. This input may also be connected to an external loop current generator. **WARNING!** This voltage source must be externally fused or its current limited.	15
+BAT R	Not used	None
-BAT R	Jumper this terminal to SIG BAT in a DC-powered shelf requiring talk battery.	None
+BAT	Battery common (+DC power input)	None
-BAT	Battery (-DC power input)	None
ALERT NO	ALERT relay: normally OPEN contact*	3
ALERT COM	ALERT relay: COMMON	11
ALERT NC	ALERT relay: normally CLOSED contact*	4
ALARM NO	ALARM relay: normally OPEN contact*	1
ALARM COM	ALARM relay: COMMON	9
ALARM NC	ALARM relay: normally CLOSED contact*	2

* When the shelf power is not on, all relays default to their alarm positions; normally open contacts are closed and normally closed contacts are open.

3.4.5.3   Power Connections for the DCS-9500
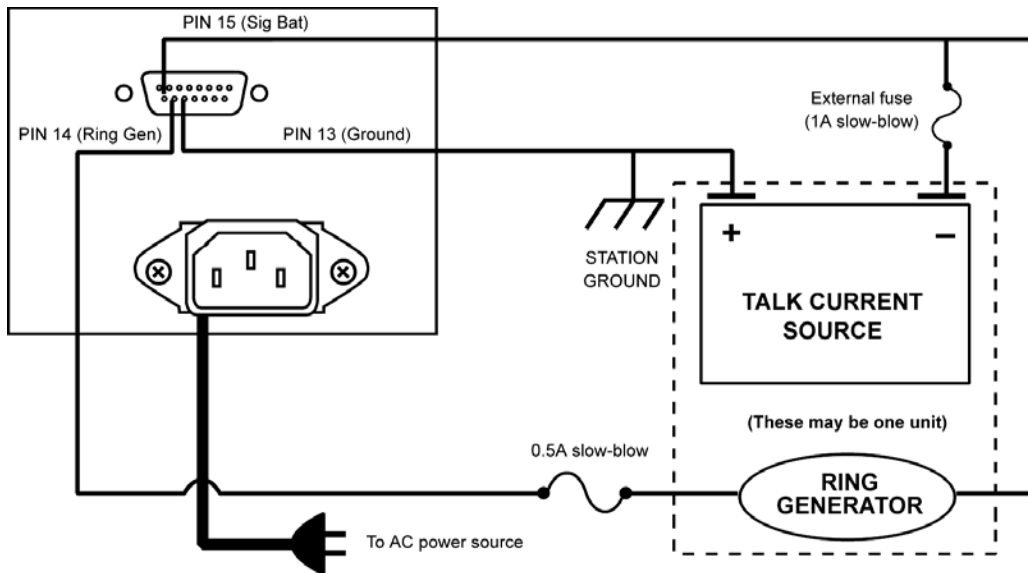
Figure 3-17. AC Power Connections for DCS-9500

3.4.5.4   Power Connections for the DCS-9530/9560/9565
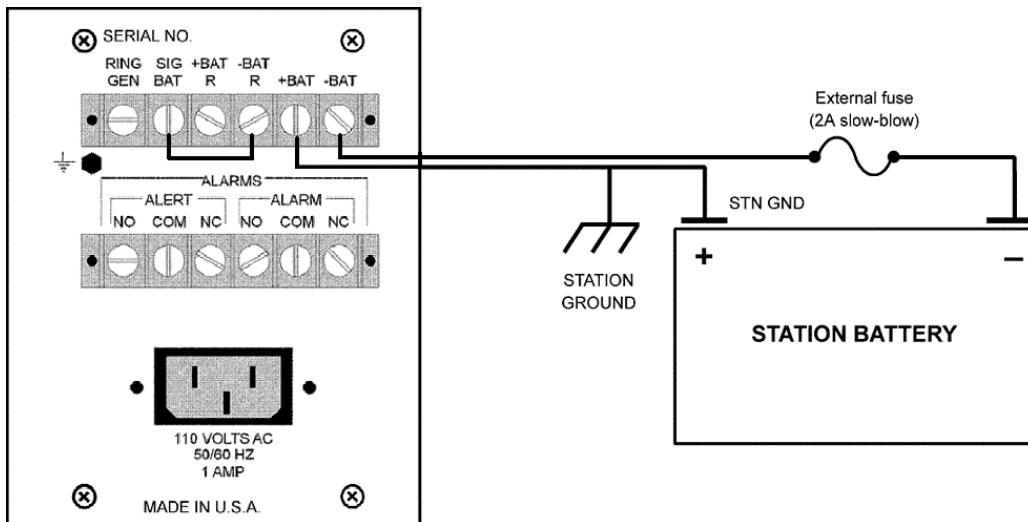
Figure 3-18. AC Power Connections for DCS-9530/9560/9565
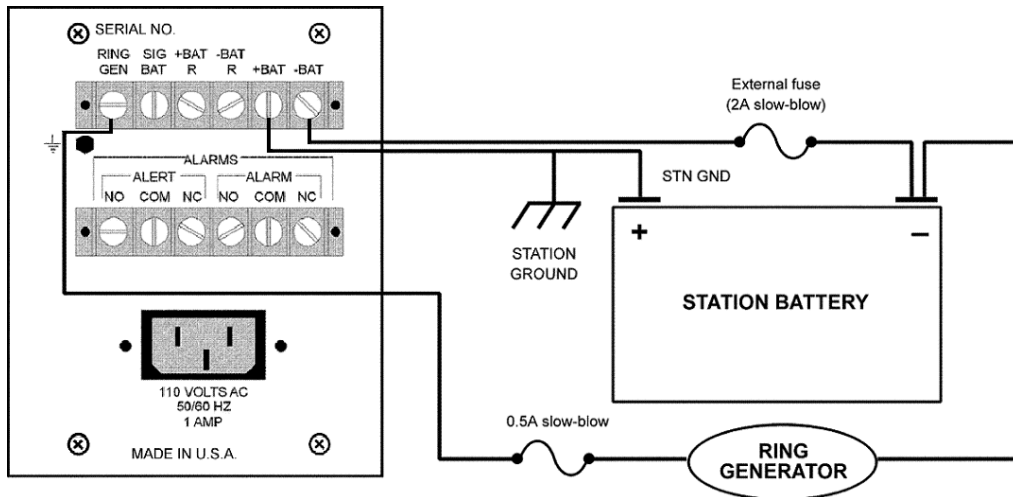
Figure 3-19. AC with Ring Generator Power Connections for DCS-9530/9560/9565
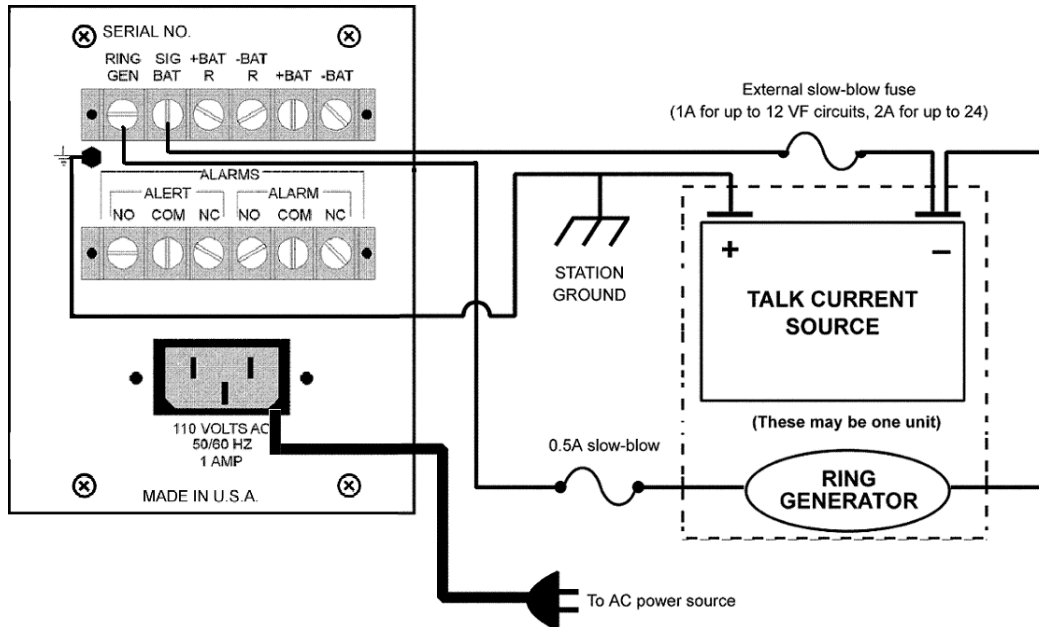
Figure 3-20. AC Power Connections for DCS-9530/9560/9565

3.4.5.5   Power Supply Indicators

There are six indicators on the power supply module, five lights and one switch. All the indicator lights are either ON or OFF; there is no transition state, such as a green light changing to yellow or orange before turning red.

When the lights are ON, the POWER and NORMAL lights are green; the SUPPLY FAIL and FAIL lights are red; and the ALERT light is yellow. The Alarm Cut-Off (ACO) switch is located behind the ALERT light. When the ACO is switched to the ON position, the ALERT light turns yellow, and the green NORMAL light goes OFF.

3-15. Power Supply Front Panel Indicators

Label	Label on Front Panel	Description
SUPPLY FAIL	(None)	When this red light is on, the power supply module has failed.
	POWER	When the green power light is on, the CrossConnect is powered. If the CrossConnect is equipped with a redundant power supply, this light remains on if one of the power supplies has failed and the remaining supply has enough capacity to power the CrossConnect by itself.
S1	(None)	The Alarm Cut-Off (ACO) switch enables and disables external alert and alarm relays. When this switch is in the ON (disabled) position and there is no alert or alarm condition, the ALERT light is on. When this switch is in the OFF (enabled) position, the alert and alarm relays are online and can activate a response (visual or audible) to system fault conditions.
NORMAL	NORMAL	When this green light is on, neither an ALERT nor a FAIL condition exists.
ALERT	ALERT	When this yellow light is on, a primary path has been lost. This light has additional indications in the DCS-9560 and DCS-9565 multiplexers; the *Access Server Installation & Operation Manual* gives details on these indications.
FAIL	ALARM	When this red light is on, two or more primary paths have been lost. This light has additional indications in the DCS-9560 and DCS-9565 multiplexers; the *Access Server Installation & Operation Manual* gives details on these indications.

3.4.6   Channel Module Wiring

Input and output connections for each payload channel are made to the module adapters installed behind the channel modules. Each channel module's manual gives information on wiring.

It is not necessary to power down an existing system in order to add new channel modules.

If you are adding modules to an existing system equipped with dual power supplies, always verify that the total power consumption does not exceed the capacity of a single supply, thus ensuring power supply redundancy.

3.5 Power

After all equipment has been installed and wired, perform these steps to apply power to each shelf:

1. Verify that all modules (common, channel, and power) are seated snugly.

2. If the shelf is AC-powered, plug in the AC line cord.

3. If the shelf is DC-powered, insert the external power fuse.

4. Verify that the POWER indicator light is on, and the POWER FAIL indicator light is off. In a DCS-9530, DCS-9560, or DCS-9565, both the MAIN POWER FAIL and REDUNDANT POWER FAIL indicator lights should be off. To view these DCS indicator lights, remove the front panel and power supply covers. Ignore all other lights on the shelf for the time being.

If no indicator lights are on for any power supply, one of these scenarios has occurred:

• Both power modules have failed.
• The fuses on both power supply circuit boards have blown.
• Most likely, power has not been wired to the shelf.

5. Observe that each CM-5 module displays its current mode setting (TERM, DI-A, or DI-B) for several seconds after power is first applied. To view the mode setting, remove the front panel and power supply covers.

3.6 Certification

Once you have completed the installation and applied power, complete and submit the "Affidavit for the Connection of Customer Premises Equipment to 1.544 Mbps and/or Subrate Digital Services" (Section 8.3) to the telephone company as necessary.

Section 4 – Mapping Basics

Mapping is configuring a DCS product at the time slot level on a port by port basis. A *map* is a layout of the 24 time slots (1-24) on each of the six DCS ports. The time slots act as transmission channels. With six ports of 24 time slots each, there are 144 (6 x 24) possible channels. All six ports can operate as either internal communications ports or as ports for network paths. You can configure a map using ISiCL or IntraGuide (**Map Control** tab – Section 5.3.4.3).

4.1 Map Switching

The DCS has eight maps (map 0 to map 7). Map 0 is the default normal service map. You can configure map 0 in any way that meets the needs of your environment. The default, alternate, normal service map is map 7. You could use it, for example, for normal operation at a different time of the day. You can configure Maps 1 through 6 to allow switching based on any of these events:

- Definable T1 port failure, such as
  - Loss of frame (LOF)
  - Loss of data (LOD)
  - Alarm indication signal (AIS), all ones signal
  - Bit error rate (BER) threshold exceeded
  - Remote alarm
- Execution of a command with ISiCL or IntraGuide; that is, map switching is remotely initiated by either
  - User
  - Automated application on a client PC
- External transistor transistor logic (TTL) input. A TTL input interfaces with contact closures and third party equipment

Section 6 – "Configuration Using ISiCL" gives specific information on creating and editing time slot maps with ISiCL, and Section 5 – "Configuration Using Intraplex IntraGuide" gives IntraGuide information.

The DCS can be programmed to switch from one map to another if a failure occurs on a port. For example, if the DCS is operating on the normal service map (map 0) and a failure occurs on the network path connected to port 1, it switches from map 0 to map 1. All ports are affected in this switch, not just port 1. Table 4-1 shows the map switching logic for the DCS.

The DCS can only change to one other map, upon the first failure. Subsequent failures do not cause it to change to another map.

Table 4-1. DCS Switching Logic

When Failure Occurs on...	DCS Switches from Map 0 to...
Port 1	Map 1
Port 2	Map 2
Port 3	Map 3
Port 4	Map 4
Port 5	Map 5
Port 6	Map 6

4.2 Time Slot Mapping Benefits

By designing maps with different configurations, you can manage the traffic on your T1 lines to

- Utilize bandwidth efficiently
- Reduce transmission costs.

You can employ time slot mapping for

- Time of day routing (switching to another map when traffic volume changes during peak hours)
- Emergency routing (for backup protection and switching in the event of failures)
- Loopback testing
- Priority and non-priority routing (critical traffic not interrupted in event of a failure)
- Cost cutting

In addition, you can later use any underutilized time slots as your operations expand.

One example of cutting the cost of leased T1 lines is to employ time slots so that you use fewer T1 lines (Figure 4-1). Suppose that Station WXYC is broadcasting music and video on two separate T1 lines to two receiving stations, using a total of four T1 lines. They could cut their costs in half by using only two T1 lines by combining the music and video in different time slots on one frame. They would be sending the same transmissions to the two stations on two T1 lines instead of four. Figure 4-1 shows that time slots 9 to 24 would remain available for future use.
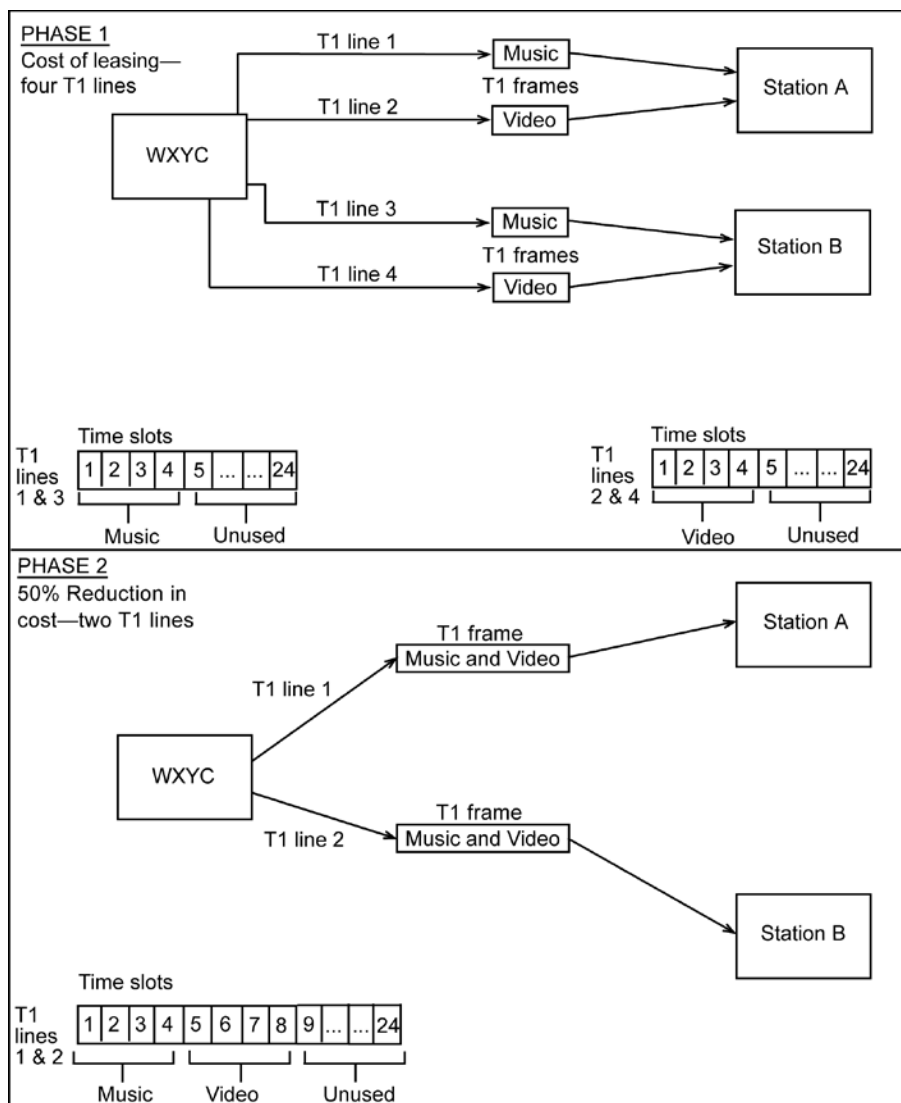
Figure 4-1. Station WXYC Cost Savings from Greater Time Slot Utilization

4.3 Time Slot Designations

Every time slot is specified by a port number and a time slot number. ISiCL and IntraGuide express these numbers a little differently.

Table 4-2. Specifying Time Slots

Application	Port 1, Time Slot 9	Port 6, Time Slot 22
ISiCL	1, 9	6, 22
IntraGuide	P1, TS9	P6, TS22

The next sections present six examples of time slot mapping for different system configurations:

- Loopback
- Pass-through
- Point-to-multipoint
- Interchange

- Simple
- Complex
● Point-to-point

Each example shows the active map(s) in both ISiCL and IntraGuide.

4.4 Loopback Configuration Mapping

In a loopback configuration, a sending device transmits a signal across a medium and waits for its return. This process is used for diagnostic testing. In this example, signal traffic flows

● From port 1, to port 1

● From port 2 to port 2

● From port 3 to port 3

● From port 4 to port 4

● From port 5 to port 5

● From port 6 to port 6
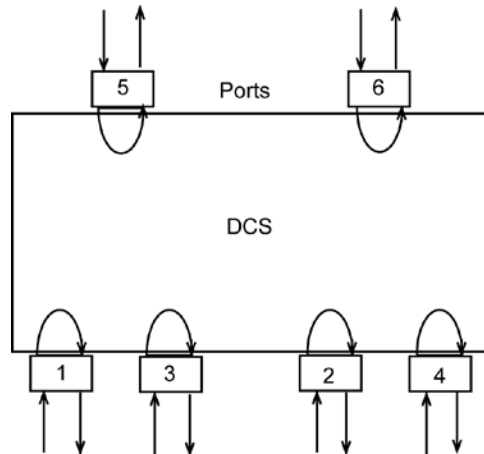
Figure 4-2. Loopback Configuration

In the example, all six DCS ports send and receive signals in a loopback fashion. Table 4-3 shows a map for this configuration in ISiCL. All the time slots for each port map to the same time slot on the same port. Figure 4-3 shows the equivalent IntraGuide map.

Table 4-3. ISiCL Map for Loopback Configuration

Port 1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 2	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24
Port 3	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3,10	3,11	3,12
	3,13	3,14	3,15	3,16	3,17	3,18	3,19	3,20	3,21	3,22	3,23	3,24
Port 4	4,1	4,2	4,3	4,4	4,5	4,6	4,7	4,8	4,9	4,10	4,11	4,12
	4,13	4,14	4,15	4,16	4,17	4,18	4,19	4,20	4,21	4,22	4,23	4,24
Port 5	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,8	5,9	5,10	5,11	5,12
	5,13	5,14	5,15	5,16	5,17	5,18	5,19	5,20	5,21	5,22	5,23	5,24
Port 6	6,1	6,2	6,3	6,4	6,5	6,6	6,7	6,8	6,9	6,10	6,11	6,12
	6,13	6,14	6,15	6,16	6,17	6,18	6,19	6,20	6,21	6,22	6,23	6,24

Figure 4-3. IntraGuide Map for Loopback Configuration

4.5 Pass-through Configuration Mapping

In this example of a pass-through configuration (Figure 4-4), signals are sent from one port and received by another in a duplex transmission. There are duplex transmissions between ports 1 and 3 and ports 2 and 4, and unidirectional traffic from port 1 to port 5 and from port 2 to port 6. This also demonstrates multi-drop or broadcast operation since the signal received on port 1 is transmitted on ports 3 and 5 and the signal received on port 2 is transmitted on ports 4 and 6.
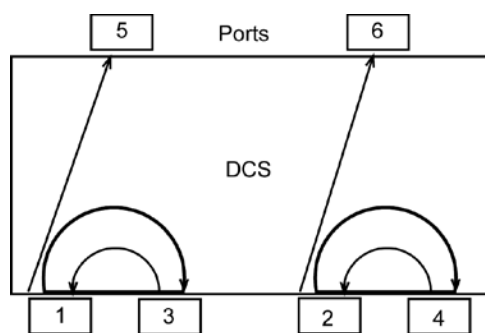
Figure 4-4. Pass-through Configuration

Map 0 for the pass-through configuration in ISiCL (Table 4-4) shows (from top to bottom) all the time slots from

- Port 3 mapping to the same time slots on port 1
- Port 4 mapping to the same time slots on port 2
- Port 1 mapping to the same time slots on port 3
- Port 2 mapping to the same time slots on port 4

- Port 1 mapping to the same time slots on port 5
- Port 2 mapping to the same time slots on port 6

Figure 4-5 shows the equivalent IntraGuide map.

Table 4-4. ISiCL Map 0 for Pass-through Configuration

Port												
Port 1	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3,10	3,11	3,12
	3,13	3,14	3,15	3,16	3,17	3,18	3,19	3,20	3,21	3,22	3,23	3,24
Port 2	4,1	4,2	4,3	4,4	4,5	4,6	4,7	4,8	4,9	4,10	4,11	4,12
	4,13	4,14	4,15	4,16	4,17	4,18	4,19	4,20	4,21	4,22	4,23	4,24
Port 3	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 4	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24
Port 5	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 6	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24

Figure 4-5. IntraGuide Map 0 for Pass-through Configuration

4.6 Point-to-Multipoint Configuration Mapping

Point-to-multipoint configurations allow delivery of data from a single source to several destinations. In Figure 4-6, port 1 is transmitting to ports 2, 3, 4, and 5.
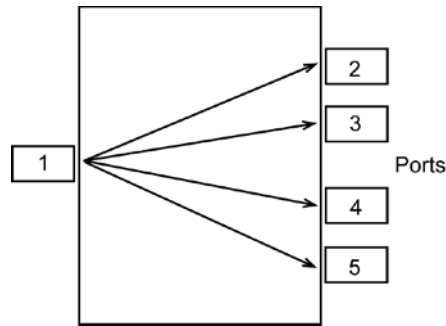
Figure 4-6. Point-to-multipoint Configuration

Suppose that port 1 is located at a radio production studio that is generating a program audio signal which is to be monitored simultaneously at four remote sites. The studio has reserved time slots 19, 20, 21, and 22 on port 1 for this 256 Kbps signal. Ports 2 through 5, connected to the remote sites, have each reserved time slots 19, 20, 21, and 22 for the signal. The signal travels in one direction from the studio to the four remote sites.

The map for the point-to-multipoint configuration in Table 4-5 does not include Port 6 because it is not involved in the point-to-multipoint transmissions. The map shows all the time slots broadcasting from port 1.

Table 4-5. ISiCL Map for Point-to-multipoint Configuration

Port 1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 2	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 3	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 4	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 5	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24

Figure 4-7 shows the equivalent IntraGuide map.

Figure 4-7. IntraGuide Map for Point-to-multipoint Configuration

4.7 Interchange Configuration Mapping

4.7.1 Simple Interchange

This simple interchange example shows how telephone circuits from four remote locations can be combined into a single T1 for delivery to a telephone switch or PBX at port 1. Although it may look like the point-to-multipoint example at first, a different signal goes to each location, and the transmission is duplex (Figure 4-8).
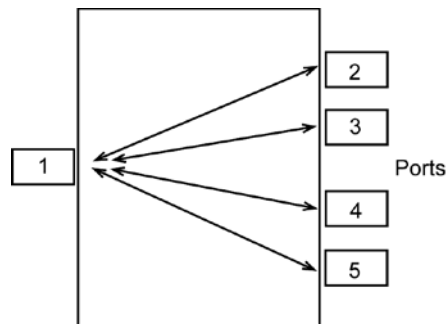
Figure 4-8. Simple Interchange Configuration

Suppose that port 1 is located at a station that has four live channels for telephone circuits so that it can take calls from four substations. The station has reserved time slots 19, 20, 21, and 22 on port 1 for this. Ports 2 through 5 at the substations have each reserved time slot 24 as a line for phone calls.

The map for the simple interchange configuration (Table 4-6) has bold entries that emphasize

● In time slot 19, port 1 receives signals from time slot 24 of port 2; and in time slot 24, port 2 receives signals from port 1 time slot 19.

- In time slot 20, port 1 receives signals from time slot 24 of port 3; and in time slot 24, port 3 receives signals from port 1 time slot 20.
- In time slot 21, port 1 receives signals from time slot 24 of port 4; and in time slot 24, port 4 receives signals from port 1 time slot 21.
- In time slot 22, port 1 receives signals from time slot 24 of port 5; and in time slot 24, port 5 receives signals from port 1 time slot 22.

Port 6 is not included in the map because it is not involved in the point-to-multipoint transmissions.

Table 4-6. ISiCL Map for Simple Interchange Configuration

Port 1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	**2,24**	**3,24**	**4,24**	**5,24**	1,23	1,24
Port 2	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	**1,19**
Port 3	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	**1,20**
Port 4	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	**1,21**
Port 5	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	**1,22**

Figure 4-9 gives the equivalent IntraGuide map.
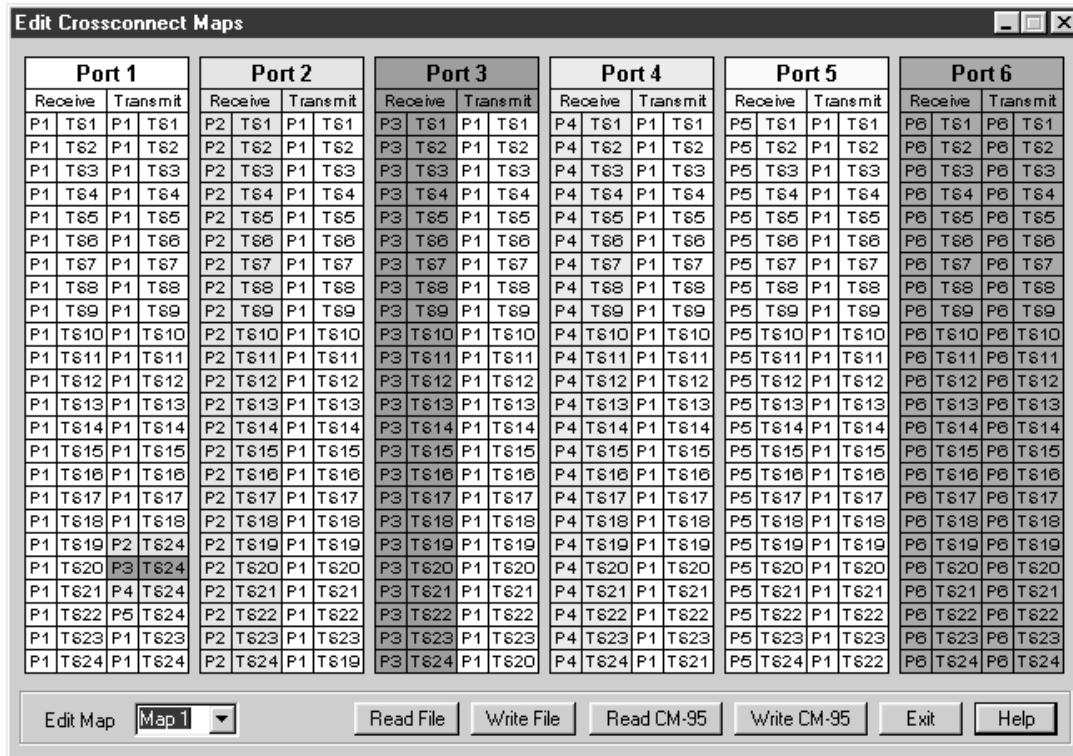
Figure 4-9. IntraGuide Map for Simple Interchange Configuration

4.7.2   Complex Interchange

In an interchange configuration, there is a central transmission point (a storage register) where incoming frames are routed to one or multiple destinations. Figure 4-10 shows ports 1, 2, 3, and 4 involved in interchange transmissions. Because there is so much traffic, the figure presents the activity on each port separately. The activity of each port is basically the same—to transmit its own time slot 1 to each of the other three ports and to receive each of the other ports' time slots (TS1). The example of a complex interchange configuration (Figure 4-10) combines the concept of simple interchange with a point-to-multipoint configuration.
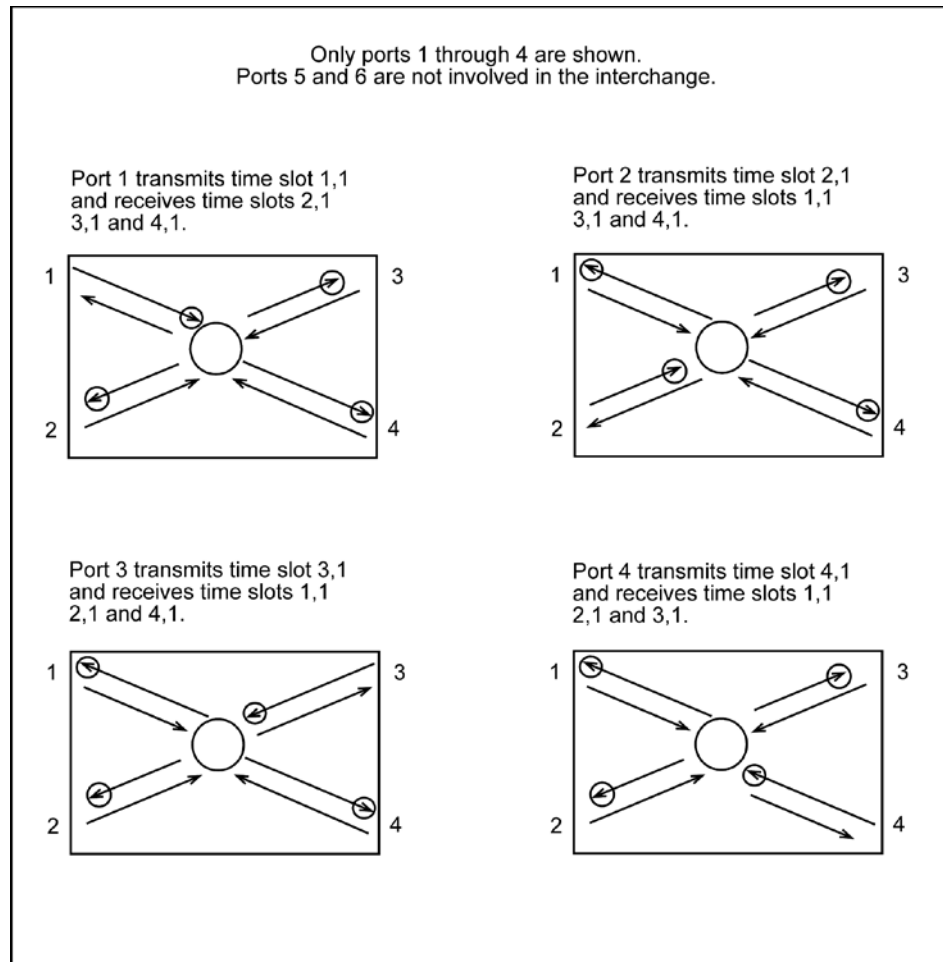
Figure 4-10. Complex Interchange Configuration

Table 4-7 and Figure 4-11 show the map for this example of interchange configuration. The ISiCL map shows time slots 5, 6, and 7 for ports 1 through 4 in bold to emphasize the three time slots that each port has reserved. Ports 5 and 6 do not appear in the map because they are not involved in the interchange. Suppose that all four ports have reserved the same three time slots for receiving the other ports' transmissions—time slots 5, 6, and 7. The map shows

● In time slot 5, port 1 receives data from port 2 time slot 1; in time slot 6, port 1 receives data from port 3 time slot 1; in time slot 7, port 1 receives data from port 4 time slot 1.

● In time slot 5, port 2 receives data from port 1 time slot 1; in time slot 6, port 2 receives data from port 3 time slot 1; in time slot 7, port 2 receives data from port 4 time slot 1.

- In time slot 5, port 3 receives data from port 1 time slot 1; in time slot 6, port 3 receives data from port 2 time slot 1; in time slot 7, port 3 receives data from port 4 time slot 1.
- In time slot 5, port 4 receives data from port 1 time slot 1; in time slot 6, port 4 receives data from port 2 time slot 1; in time slot 7, port 4 receives data from port 3 time slot 1.

Table 4-7. ISiCL Map for Complex Interchange Configuration

Port 1	1,1	1,2	1,3	1,4	**2,1**	**3,1**	**4,1**	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 2	1,1	1,2	1,3	1,4	**1,1**	**3,1**	**4,1**	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 3	1,1	1,2	1,3	1,4	**1,1**	**2,1**	**4,1**	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 4	1,1	1,2	1,3	1,4	**1,1**	**2,1**	**3,1**	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
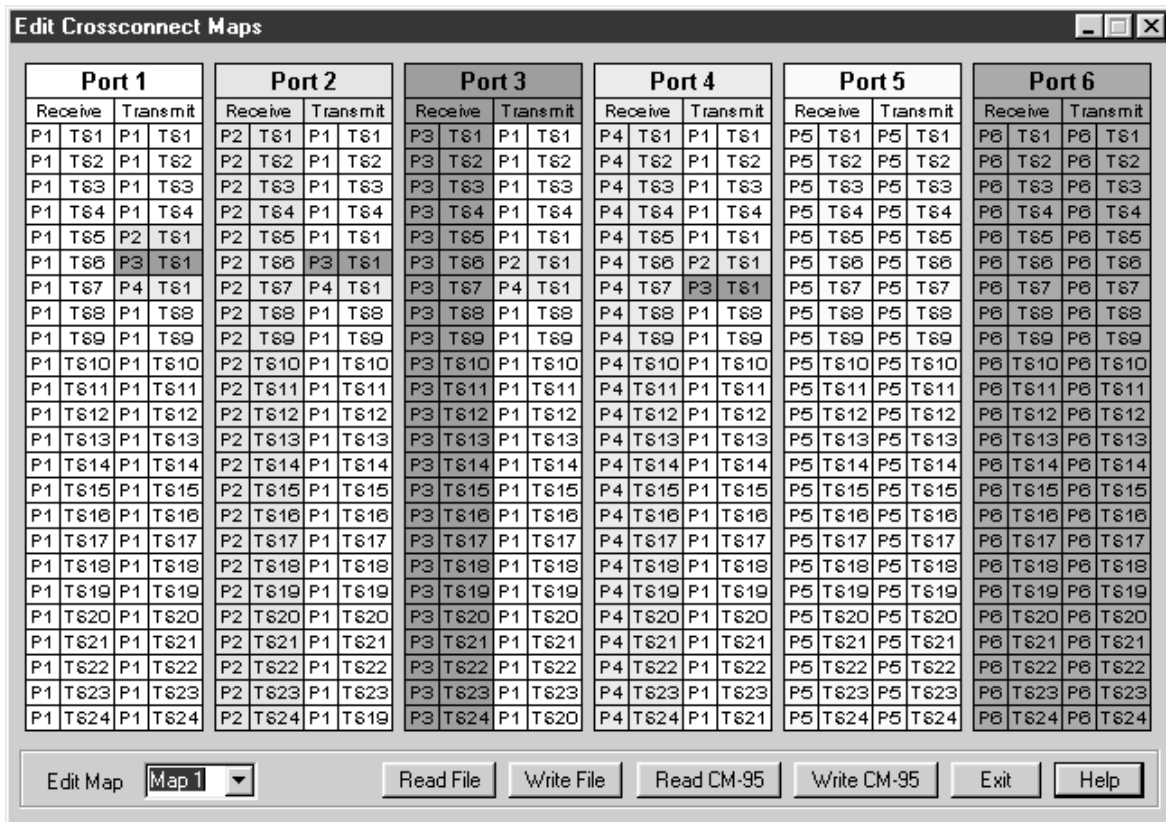
Figure 4-11. IntraGuide Map for Complex Interchange Configuration

4.8   Point-to-Point Configuration Mapping

In point-to-point protection switching applications, when a failure, or degradation of a primary T1 line, is detected, both DCS nodes switch to the backup path. In Figure 4-17, the primary path appears as a thick line, and the backup one as a thin line.
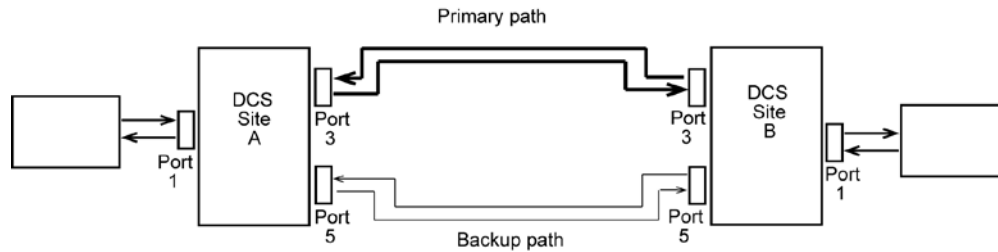
Figure 4-12. Point-to-point Configuration

Map 0 (the normal service map before a failure and switchover) for the point-to-point configuration in ISiCL (Table 4-8) shows (from top to bottom) all the time slots from

● Port 3 mapping to the same time slots on port 1
● Port 4 mapping to the same time slots on port 2
● Port 1 mapping to the same time slots on port 3
● Port 2 mapping to the same time slots on port 4
● Port 1 mapping to the same time slots on port 5
● Port 2 mapping to the same time slots on port 6

Figure 4-13 gives the equivalent IntraGuide map.

Table 4-8. ISiCL Map 0 for Point-to-point Protection Switching

Port 1	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3,10	3,11	3,12
	3,13	3,14	3,15	3,16	3,17	3,18	3,19	3,20	3,21	3,22	3,23	3,24
Port 2	4,1	4,2	4,3	4,4	4,5	4,6	4,7	4,8	4,9	4,10	4,11	4,12
	4,13	4,14	4,15	4,16	4,17	4,18	4,19	4,20	4,21	4,22	4,23	4,24
Port 3	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 4	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24
Port 5	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 6	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24

Figure 4-13. IntraGuide Map 0 for Point-to-point Protection Switching

A failure on port 3 causes the DCS to switch to map 3. Map 3 for the point-to-point configuration in ISiCL (Table 4-9) shows (from top to bottom) all the time slots from

● Port 5 mapping to the same time slots on port 1

● Port 6 mapping to the same time slots on port 2

● Port 1 mapping to the same time slots on port 3

● Port 2 mapping to the same time slots on port 4

● Port 1 mapping to the same time slots on port 5

● Port 2 mapping to the same time slots on port 6

Figure 4-14 shows the equivalent IntraGuide map.

Table 4-9. ISiCL Map 3 for Point-to-point Protection Switching

Port 1	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,8	5,9	5,10	5,11	5,12
	5,13	5,14	5,15	5,16	5,17	5,18	5,19	5,20	5,21	5,22	5,23	5,24
Port 2	6,1	6,2	6,3	6,4	6,5	6,6	6,7	6,8	6,9	6,10	6,11	6,12
	6,13	6,14	6,15	6,16	6,17	6,18	6,19	6,20	6,21	6,22	6,23	6,24
Port 3	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 4	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24
Port 5	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	1,13	1,14	1,15	1,16	1,17	1,18	1,19	1,20	1,21	1,22	1,23	1,24
Port 6	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	2,13	2,14	2,15	2,16	2,17	2,18	2,19	2,20	2,21	2,22	2,23	2,24

Edit Crossconnect Maps

Port 1		Port 2		Port 3		Port 4		Port 5		Port 6	
Receive	Transmit	Receive	Transmit	Receive	Transmit	Receive	Transmit	Receive	Transmit	Receive	Transmit
P1 TS1	P5 TS1	P2 TS1	P6 TS1	P3 TS1	P1 TS1	P4 TS1	P2 TS1	P5 TS1	P1 TS1	P6 TS1	P2 TS1
P1 TS2	P5 TS2	P2 TS2	P6 TS2	P3 TS2	P1 TS2	P4 TS2	P2 TS2	P5 TS2	P1 TS2	P6 TS2	P2 TS2
P1 TS3	P5 TS3	P2 TS3	P6 TS3	P3 TS3	P1 TS3	P4 TS3	P2 TS3	P5 TS3	P1 TS3	P6 TS3	P2 TS3
P1 TS4	P5 TS4	P2 TS4	P6 TS4	P3 TS4	P1 TS4	P4 TS4	P2 TS4	P5 TS4	P1 TS4	P6 TS4	P2 TS4
P1 TS5	P5 TS5	P2 TS5	P6 TS5	P3 TS5	P1 TS5	P4 TS5	P2 TS5	P5 TS5	P1 TS5	P6 TS5	P2 TS5
P1 TS6	P5 TS6	P2 TS6	P6 TS6	P3 TS6	P1 TS6	P4 TS6	P2 TS6	P5 TS6	P1 TS6	P6 TS6	P2 TS6
P1 TS7	P5 TS7	P2 TS7	P6 TS7	P3 TS7	P1 TS7	P4 TS7	P2 TS7	P5 TS7	P1 TS7	P6 TS7	P2 TS7
P1 TS8	P5 TS8	P2 TS8	P6 TS8	P3 TS8	P1 TS8	P4 TS8	P2 TS8	P5 TS8	P1 TS8	P6 TS8	P2 TS8
P1 TS9	P5 TS9	P2 TS9	P6 TS9	P3 TS9	P1 TS9	P4 TS9	P2 TS9	P5 TS9	P1 TS9	P6 TS9	P2 TS9
P1 TS10	P5 TS10	P2 TS10	P6 TS10	P3 TS10	P1 TS10	P4 TS10	P2 TS10	P5 TS10	P1 TS10	P6 TS10	P2 TS10
P1 TS11	P5 TS11	P2 TS11	P6 TS11	P3 TS11	P1 TS11	P4 TS11	P2 TS11	P5 TS11	P1 TS11	P6 TS11	P2 TS11
P1 TS12	P5 TS12	P2 TS12	P6 TS12	P3 TS12	P1 TS12	P4 TS12	P2 TS12	P5 TS12	P1 TS12	P6 TS12	P2 TS12
P1 TS13	P5 TS13	P2 TS13	P6 TS13	P3 TS13	P1 TS13	P4 TS13	P2 TS13	P5 TS13	P1 TS13	P6 TS13	P2 TS13
P1 TS14	P5 TS14	P2 TS14	P6 TS14	P3 TS14	P1 TS14	P4 TS14	P2 TS14	P5 TS14	P1 TS14	P6 TS14	P2 TS14
P1 TS15	P5 TS15	P2 TS15	P6 TS15	P3 TS15	P1 TS15	P4 TS15	P2 TS15	P5 TS15	P1 TS15	P6 TS15	P2 TS15
P1 TS16	P5 TS16	P2 TS16	P6 TS16	P3 TS16	P1 TS16	P4 TS16	P2 TS16	P5 TS16	P1 TS16	P6 TS16	P2 TS16
P1 TS17	P5 TS17	P2 TS17	P6 TS17	P3 TS17	P1 TS17	P4 TS17	P2 TS17	P5 TS17	P1 TS17	P6 TS17	P2 TS17
P1 TS18	P5 TS18	P2 TS18	P6 TS18	P3 TS18	P1 TS18	P4 TS18	P2 TS18	P5 TS18	P1 TS18	P6 TS18	P2 TS18
P1 TS19	P5 TS19	P2 TS19	P6 TS19	P3 TS19	P1 TS19	P4 TS19	P2 TS19	P5 TS19	P1 TS19	P6 TS19	P2 TS19
P1 TS20	P5 TS20	P2 TS20	P6 TS20	P3 TS20	P1 TS20	P4 TS20	P2 TS20	P5 TS20	P1 TS20	P6 TS20	P2 TS20
P1 TS21	P5 TS21	P2 TS21	P6 TS21	P3 TS21	P1 TS21	P4 TS21	P2 TS21	P5 TS21	P1 TS21	P6 TS21	P2 TS21
P1 TS22	P5 TS22	P2 TS22	P6 TS22	P3 TS22	P1 TS22	P4 TS22	P2 TS22	P5 TS22	P1 TS22	P6 TS22	P2 TS22
P1 TS23	P5 TS23	P2 TS23	P6 TS23	P3 TS23	P1 TS23	P4 TS23	P2 TS23	P5 TS23	P1 TS23	P6 TS23	P2 TS23
P1 TS24	P5 TS24	P2 TS24	P6 TS24	P3 TS24	P1 TS24	P4 TS24	P2 TS24	P5 TS24	P1 TS24	P6 TS24	P2 TS24

Edit Map [Map 3 ▼]   [Read File] [Write File] [Read CM-95] [Write CM-95] [Exit] [Help]

Figure 4-14. IntraGuide Map 3 for Point-to-point Protection Switching

4.9 Error Detection and Switching

The DCS constantly monitors its network paths for these errors:

- Loss of frame
- Loss of data
- All ones signal
- Bit error rate exceeded
- Remote alarm

Any error can cause an alarm condition and a corresponding map switch, but only if each alarm condition has been enabled by the user in ISiCL or IntraGuide. In addition, any combination of the T1 paths can be unused. In this case, the user must disable the unused ports. A failure in a path does not cause a change in operation or an alarm if the port for that path has been disabled.

Before switching, the DCS waits a selected time. If the error is removed during this period, the DCS does not switch. *Switch time delay* is the amount of time that the DCS takes to switch over to the map assigned to a specific port failure. Section 5.3.4 −*Settings Review and Change* gives a review of the IntraGuide setting for switch time delay.

When the DCS discovers that a port has failed, it starts the switch delay timer. The DCS does not switch over to the new map until the switch delay time expires. The default setting is 100 milliseconds. Figure 5-8 shows this setting in the Configuration View of IntraGuide.

Section 5 – Configuration Using Intraplex IntraGuide

5.1   IntraGuide

Intraplex IntraGuide Configuration and Management software works with Intraplex T1 CrossConnect Systems, T1 CrossConnect Servers, and other Intraplex network access equipment. IntraGuide allows a user to

● Communicate with all intelligent channel modules located in each multiplexer
● Configure CrossConnect products at the time slot level and obtain status information
● Change module parameters in real time
● Perform network troubleshooting and maintenance

The IntraGuide online Help gives detailed instructions for using IntraGuide with the T1 CrossConnect products. IntraGuide requires a PC with

● Pentium 100 MHz
● 32Mb RAM
● Microsoft Windows 95, Windows 98, or WindowsNT 4.0 with Service Pack version 4.0 or higher
● 4Mb of free disk space for the application
● One available serial port
● SVGA monitor capable of displaying 16-bit color

5.2   System Setup to Work with IntraGuide

5.2.1   PC Connection to Network

To use IntraGuide, your PC must be connected to a node on the network. There are two ways you can connect:

● A direct connection can be made using an RS-232 cable (Figure 5-1).
● A remote connection can be made over a phone line (Figure 5-2).

You can use a modem in any configuration shown in either figure. GatesAir Intraplex provides RJ-11 cables and a DB-9 to RJ-11 adapter for the PC serial port. Activate a COM1 or COM2 connection and set the baud rate of the PC to 9600.
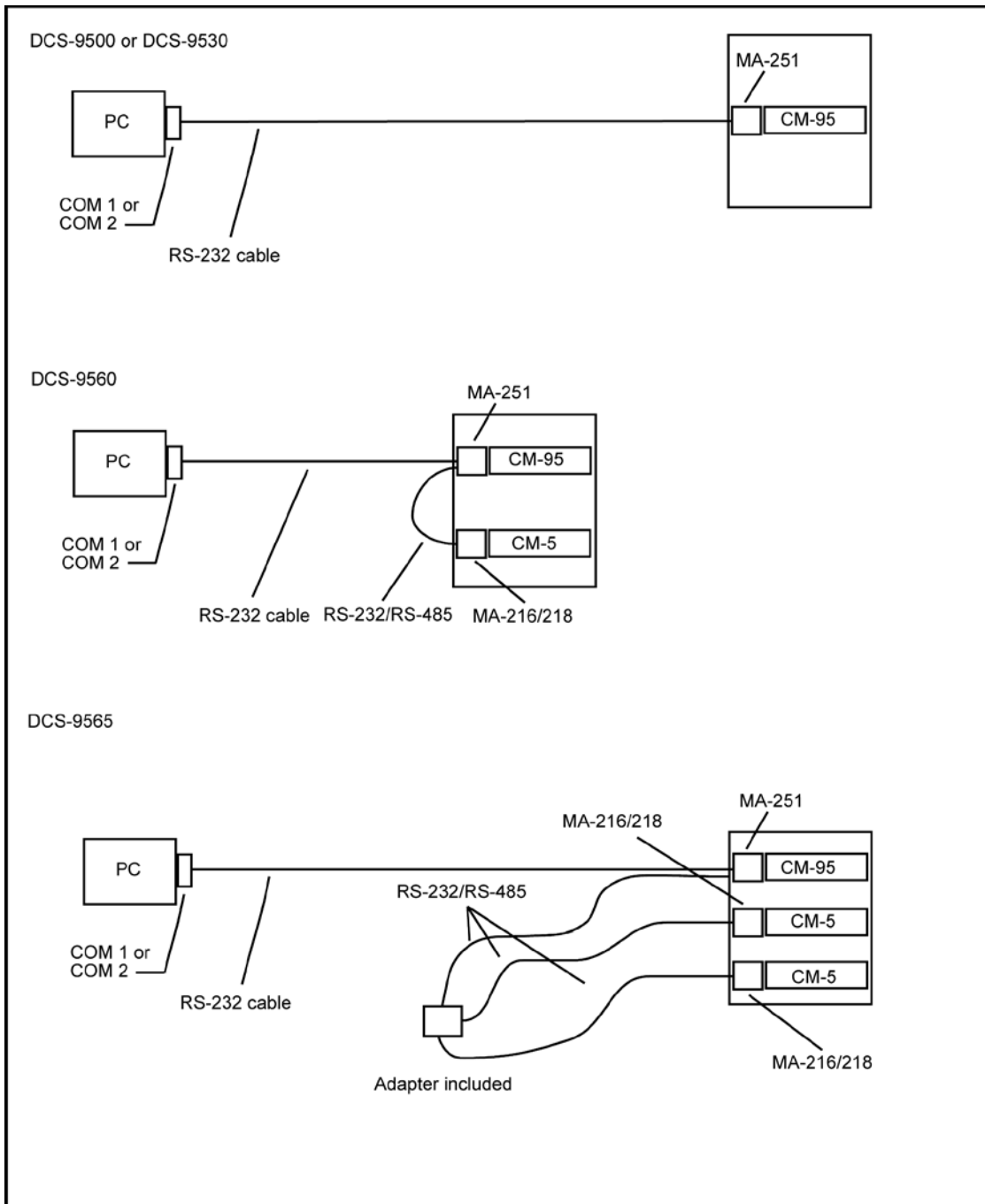
Figure 5-1. PC Connected Directly to Node Using RS-232 Cable
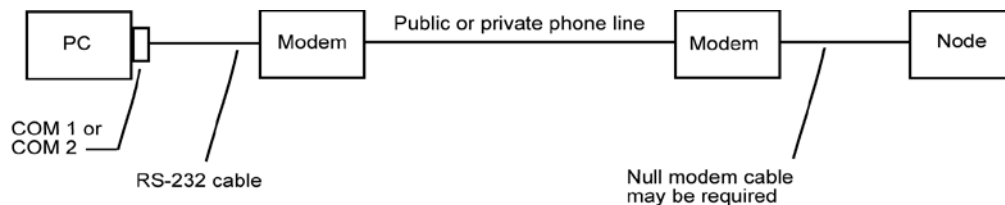
Figure 5-2. PC Connected to Node from Remote Location

5.2.2   Network Communication Paths

For the DCS-9560 and DCS-9565, all or part of a time slot can be allocated for network management communications. The *T1 Access Server Installation and Operation Manual* gives detailed instructions on using this capability.

5.3   DCS Configuration with IntraGuide

5.3.1   Beginning Steps

Before you use IntraGuide to configure your CrossConnect products, perform these basic setup procedures:

1. Setup the hardware at each node, including all necessary

    * Modules
    * Modems
    * Cables

2. Run the IntraGuide installation program on your PC.

3. Connect the PC or laptop (baud rate set to 9600) to the serial port on the equipment shelf either directly or remotely using a modem.

4. Run a communications program, such as HyperTerminal, to set the communications parameters (Table 5-1).

    Table 5-1. Communications Parameters

Parameter	Value
Baud rate	9600 bps
Data bit	8-bit word
Start bit	1
Stop bit	1
Parity	none

5. Ensure that all the hardware is securely connected.

6. Execute the ISiCL default STATUS? command.
    A response to this command confirms that the communications port is working. It is able to respond to this command without an address. In IntraGuide, you can execute ISiCL commands by selecting ISiCL Terminal from the Setup menu.

    `:::;`

7. Execute the FLAGS11 command to get the address of the DCS.

    `:DCS:CONFIG?:FLAGS11;`

8. Write down this address number and save it. You must enter this address when you configure the DCS in IntraGuide.

The next sections explain how to

* Add the DCS as a device
* Run Auto Detect
* Change some of the default settings to fit your environment

5.3.2   Addition of DCS as Device

You can configure your DCS system or server by first adding the DCS as a device and then running Auto Detect to discover the other modules in your configuration, or you can just run Auto Detect to discover all the modules including the DCS.

Because the processor module, the CM-95, and the DCS are internally connected by the CrossConnect bus, IntraGuide recognizes them as one device. To add the DCS as a device, perform these steps:

1. On the **File** menu, click **New** to create a new configuration file which you can save (Figure 5-3).
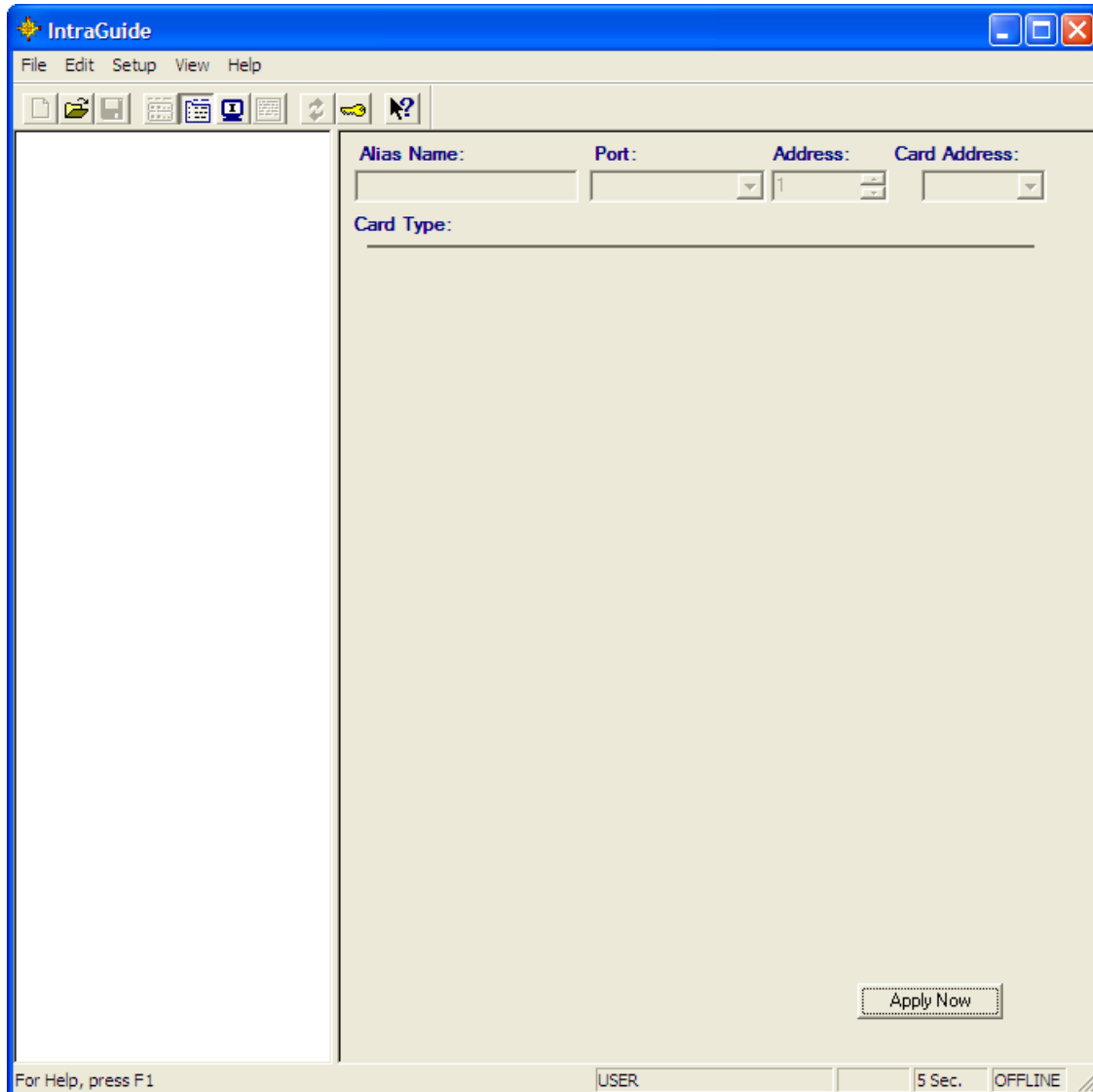
Figure 5-3. New Configuration File

2. On the **Setup** menu, point to **Device Configuration** and then click **Add**. The **Device Configuration** window appears (Figure 5-4).
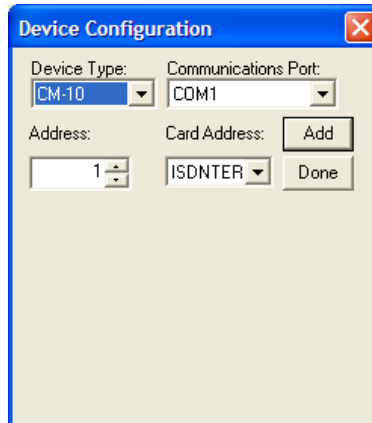
Figure 5-4. Device Configuration Window

3. In the **Device Type** field, select **CM-95**. **DCS** appears in the **Card Address** field.

4. In the **Communications Port** field, select a communications port (1 through 4).

5. In the **Address** field, select an address from 1 to 63. (This address must correspond to the address in the DCS.)

6. Click **Add**.

Figure 5-5 shows IntraGuide with the CM-95 added.
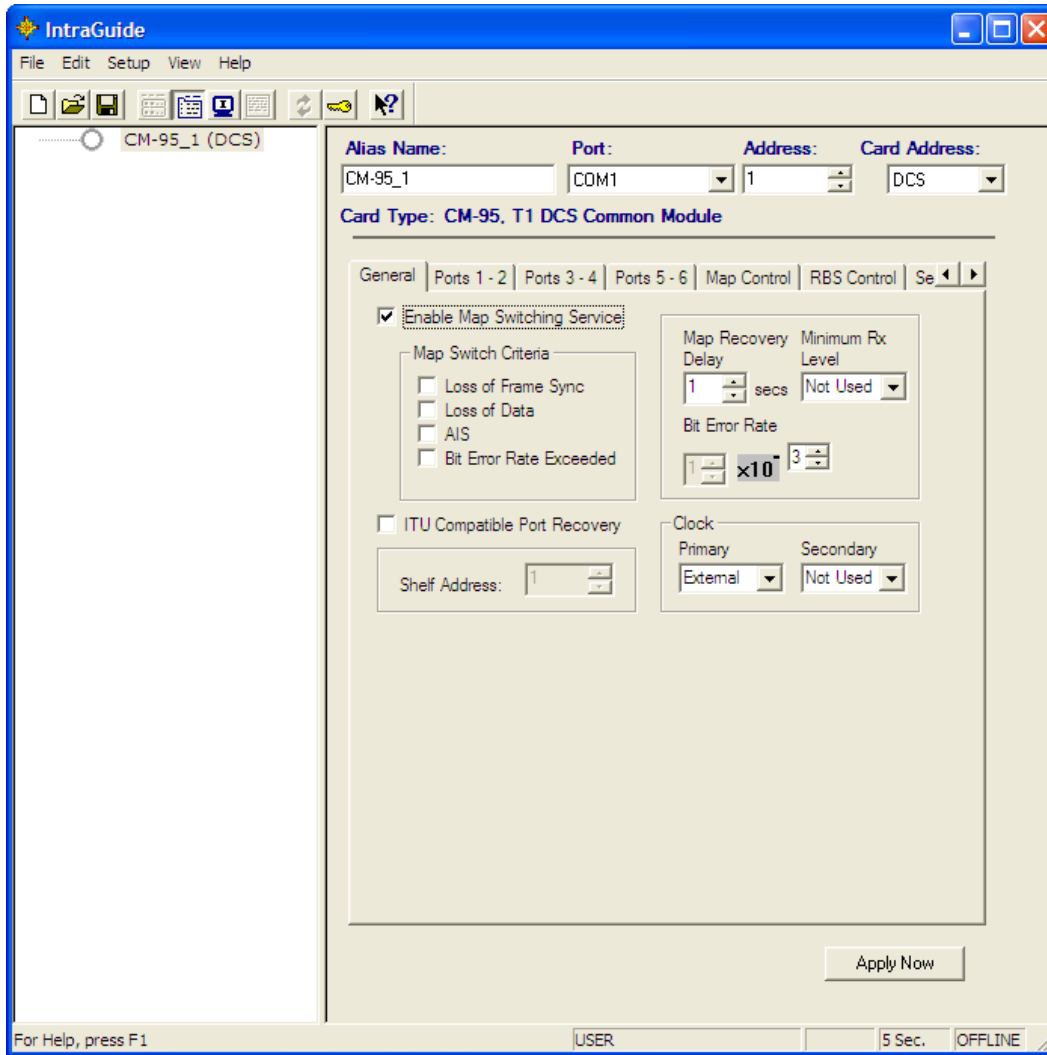
Figure 5-5. CM-95, Configuration Pane

5.3.3   Auto Detect

When you run Auto Detect, you can specify the full range of addresses for the devices in your system, from the first address to the last, but the discovery process takes longer than if you run Auto Detect in several discovery sessions with smaller address ranges.

To run Auto Detect to discover all the devices in the network, perform these steps:

1.   On the menu bar, click **Setup**.

2.   Point to **Device Configuration** and click **Auto Detect Devices**. The **Device Discover Wizard** dialog box appears (Figure 5-6).
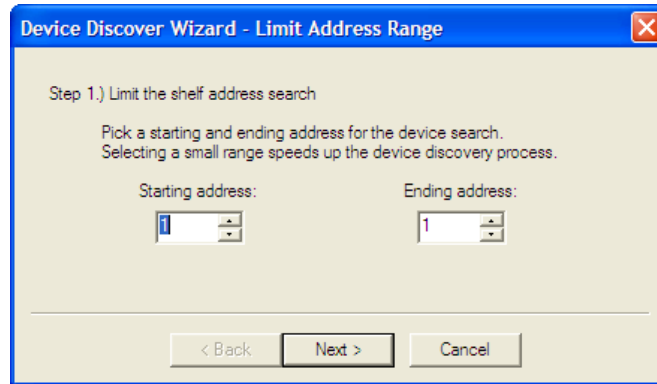
Figure 5-6. Limit Address Range Dialog Box

3. Enter a **Starting Address** and an **Ending Address** for the range of the search.

4. Click **Next**. The **Select COM Port** dialog box appears (Figure 5-7).
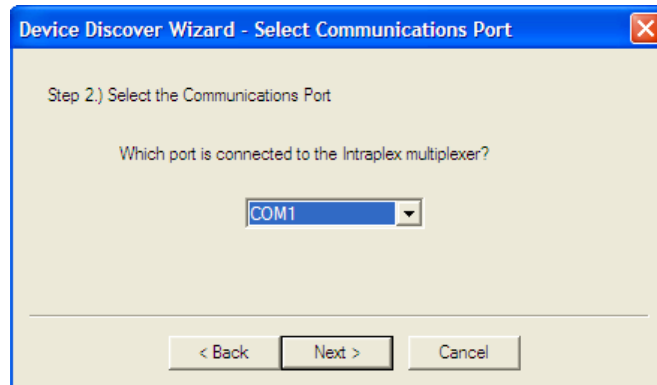
Figure 5-7. Select COM Port Dialog Box

5. Click a communications port on the list.

6. Click **Next**. The final wizard dialog box appears (Figure 5-8).
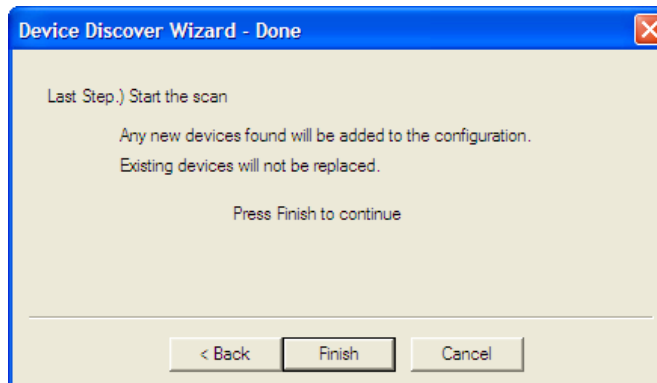
Figure 5-8. Select COM Port Dialog

7. To begin the discovery process, click **Finish**. A progress dialog box appears for the scan, and settings for the device with the lowest address in the search range appear in the Configuration pane (Figure 5-9).
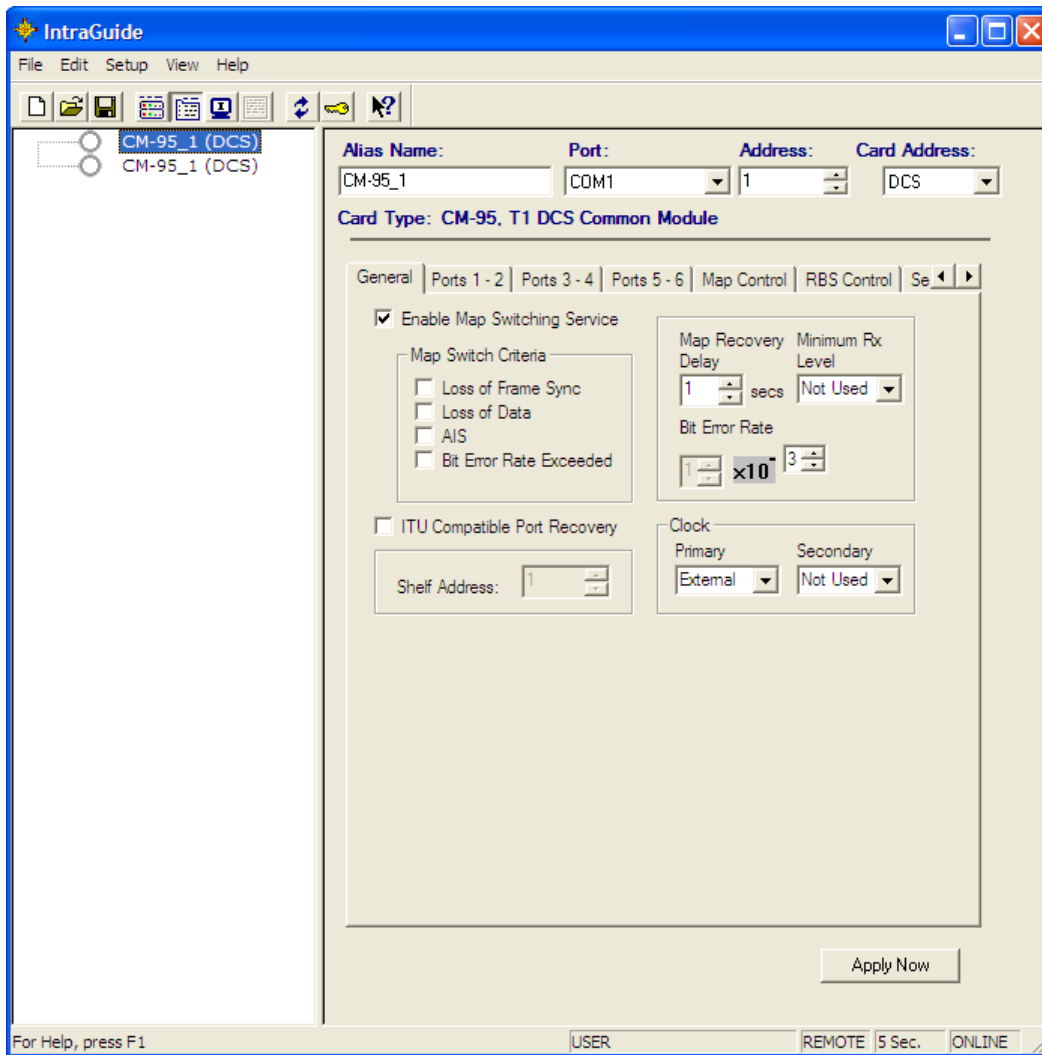
Figure 5-9. Configuration Pane after Completion of Auto Detect

5.3.4   Settings Review and Change

5.3.4.1   General Tab

For **Clock** source, on the **General** tab, you can select a port from the list (for example, **Internal** for internal oscillator). If **Internal** is the **Primary Clock** source, the field for the **Secondary Clock** source should be blank (Figure 5-9). Section 2.1.5 - *DCS System Clock* and Section 6.14 - *ISiCL Commands Used to Manage the System Clock* give more information about the DCS system clock.

Map recovery delay is the amount of time that the DCS takes to check additional signals and ensure that there are no errors after an error in a previous signal has caused a port to fail. If there are additional errors, port recovery fails. The recovery process repeats with the DCS starting the recovery delay timer again. The default setting is two seconds (Figure 5-9). **Minimum Rx Level** sets the required minimum strength level of the received T1 signal for all ports.

5.3.4.2   Port Tabs

Switch time delay on the port tabs is the amount of time that the DCS takes to switch over to the map assigned to a specific port failure. Table 4-1 gives the map associated with each port in the event of a failure. When the DCS discovers that a port has failed, it starts the switch delay timer. The DCS does not switch over to the new map until the switch delay time expires. The default setting is 100 milliseconds (Figure 5-10).

Figure 5-10. Ports 1-2 Tab, Configuration Pane

Line build out is the required minimum strength level of the transmitted T1 signal. You can set this on a port-by-port basis. It indicates the minimum distance in feet or strength in decibels required to transmit to remote equipment. The default value is 0 to 133 feet (Figure 5-8).

5.3.4.3   Map Control Tab

Select Active Map on the **Map Control** tab is set to **Automatic** by default, which allows for manual map switching. You must run the DCS under normal operating conditions with either map 0 or the alternate normal service map 7 in order to have error detection and switching on all six ports (**Normal Map** in Figure 5-11). **Map 0** is the default.

Figure 5-11. Map Control Tab, Configuration Pane

If you want to set a selected map to ON for testing purposes, such as to clear a circuit, click the option for that map at **Select Active Map**. Setting the map to ON disables error detection and switching. After the circuit is cleared, you should set the map to OFF by clicking the **Automatic** option.

You can also perform map switching through external contacts. At **External Switching**, you can select a check box to enable any of the maps for this kind of switching. You then have to close a contact switch (on the MA-251A adapter module) to actually trigger the external map switch.

To change the port and time slot settings in a map, perform these steps:

1. In the Configuration pane, on the **Map Control** tab (Figure 5-11), click **Edit Maps**. A progress dialog box indicates that IntraGuide is communicating with the DCS and reading in the current map configurations. Then the **Edit CrossConnect Maps** window appears. Figure 5-12 shows this window with the initial defaults.
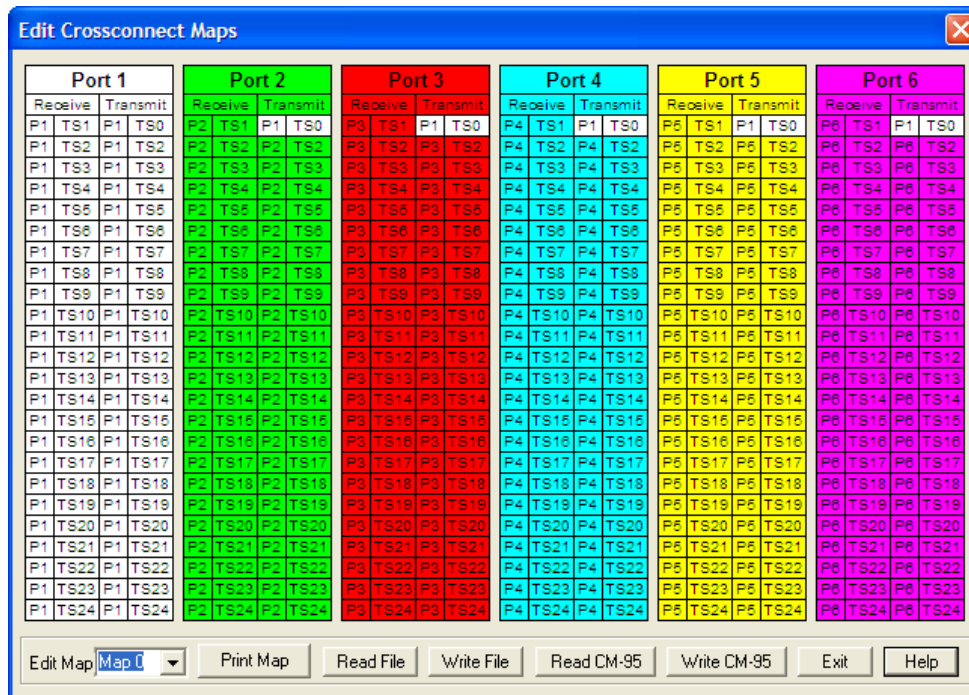
Figure 5-12. Edit CrossConnect Maps

2. Select the map to edit from the **Edit Map** list.

3. To change the setting for one or two time slots

    a. Right-click a time slot.
    b. On the right-click menu, click **Edit Time Slot**.
    c. Select the port and time slot that you want the current port and time slot to map to.
    d. Click **OK**.

4. To change settings for groups of adjacent time slots

    a. Select the time slots in a **Receive** column.
    b. Drag and drop the selected time slots to move them to a **Transmit** column.

5. To save the new map configuration in a file, click **Write File**.

6. Click the map number, and click **OK**.

7. Enter a file name in the **Save As** dialog box, and click **Save**.

5.3.4.4   RBS Control Tab

The **RBS Control** tab allows you to select any time slots on a port to have robbed-bit signaling (Figure 5-13). To set a time slot for RBS, perform these steps:

1.   Click the **RBS Control** tab.
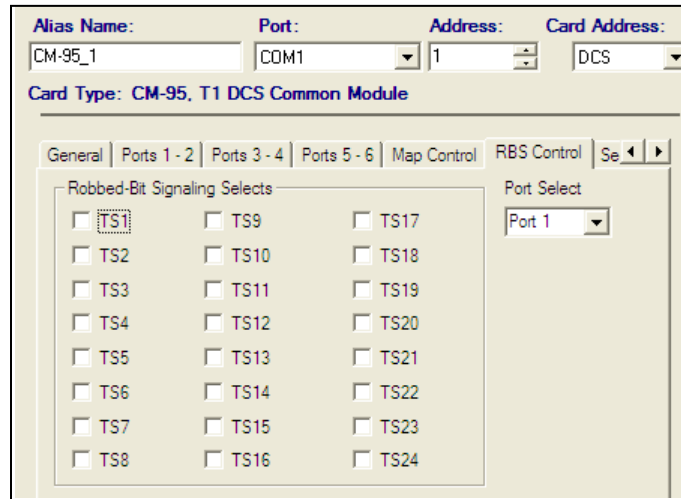
Figure 5-13. RBS Control Tab, Configuration Pane

2.   Select the time slot or time slots to enable robbed-bit signaling.

3.   Click **Apply Now** to apply the RBS.

5.3.4.5   Secondary Port Control Tab

The **Secondary Port Control** tab allows you to select any ports to set as secondary for the primary port (Figure 5-14). All signals go to the primary port first. If it's busy, the signals are rerouted to the selected port.

Figure 5-14. Secondary Port Control Tab, Configuration Pane

To set up a secondary port, perform these steps:

1. Select the primary **Port** from the list.

2. Select the check box next to the **Secondary Port Pre-Qualifier** port.

3. Click **Apply Now**.

5.3.4.6 Port Color Changes on Map

To change the port colors on a map, perform these steps:

1. On the IntraGuide menu bar, click **Edit**.

2. On the **Edit** menu, click **Preferences** (Figure 5-15).
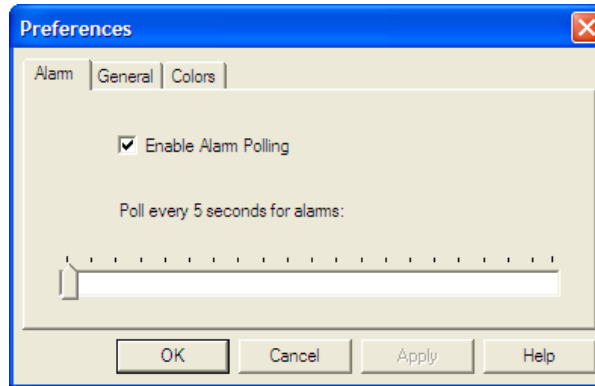
Figure 5-15. Preferences Dialog Box

3. Click the **Colors** tab (Figure 5-16).
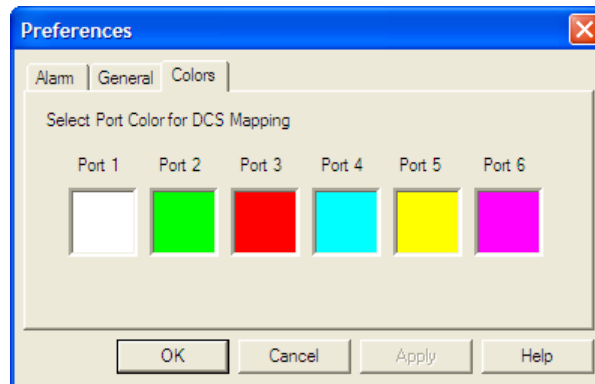
Figure 5-16. Preferences, Colors Tab

4. On the **Colors** tab, click the color of a port to activate a colors palette for that port.

5. Click the new color.

6. Repeat steps 2 and 3 for each port you want to change.

7. Click **Apply**.

8. Click **OK**.

5.3.5   IntraGuide Files

You can build a configuration file in IntraGuide by clicking **New** on the **File** menu to create the file and then adding devices or running Auto Detect to discover the devices. IntraGuide saves the file with an .icf (IntraGuide Configuration File) extension after you click **Save As** on the **File** menu and enter a file name.

In later IntraGuide sessions, you can open the configuration file and edit it offline. A line status toggle button appears on the right in the status bar on IntraGuide screens.

When you open a configuration file, the status of the IntraGuide session is OFFLINE. The light icon (or icons) in the left view of the IntraGuide window also indicate the status (Figure 5-16); the light icons do not appear in color when the status is OFFLINE.
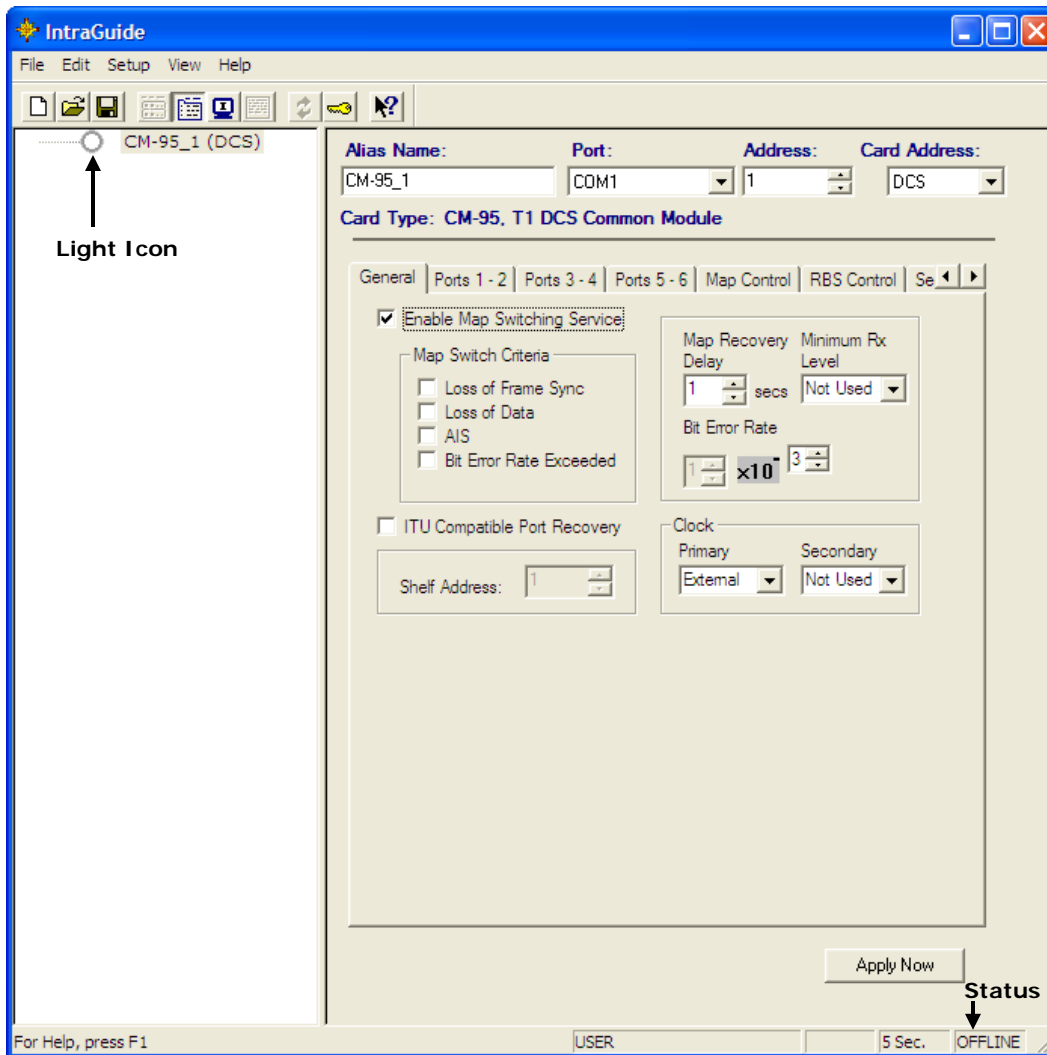
Figure 5-17. Line Status

To go online, double-click the status button. When your session is online, IntraGuide uses the configuration settings from the device, not the configuration file.

When you finish editing a map, click **Write File** in the **Edit CrossConnect Maps** window to save the map to a file and enter a name for it (Figure 5-12). Each map has its own file with the extension .mpf (map file). A map file is not associated with the device configuration file that is open when you create the map file. Therefore, it is helpful to give the map file a name that matches the name of the configuration file if you want to keep the association clear. For example, when saving a configuration file called myDCS.icf, you may want to call the map file for map 5 in this configuration myDCSmap5.mpf.

The DCS can create one map file for all eight maps and gives it the extension .mps. To create one map file for all eight maps, perform these steps:

1. In the Configuration pane of the **Map Control** tab, click **Edit Maps** (Figure 5-11). The **Edit CrossConnect Maps** window appears (Figure 5-12).

2. Click **Write File**. The **Select Map(s)** dialog box appears.

3. Click the **All** option if it is not already selected, and click **OK**. A **Save As** dialog box appears.

4. Enter a file name.

5. Click **Save**.

Section 6 – Configuration Using ISiCL

Intraplex CrossConnect systems and servers can be controlled using the Intraplex Simple Command Language (ISiCL, pronounced "icicle"). ISiCL works in a command–response mode, where the DCS only generates messages in response to ISiCL commands from an external controller.

ISiCL commands can be entered manually, you type commands on the controller's keyboard and view the responses on the terminal display, or a network management system can enter the commands automatically.

6.1 Hardware and Protocol

6.1.1 Remote Port

Each CM-95 module has two remote ports-one for connection to the PC, the other for daisy-chaining to CM-5s or to other Intraplex network access products. CrossConnect Servers with terminal multiplexing has two remote ports, while Access Servers with drop/insert multiplexing have only one remote port. CrossConnect Server remote ports are RS-232/485 compatible, asynchronous, serial interfaces which operate at a fixed baud rate of 9.6 bps.

The DCS is preset to 9600 baud, 7-bit word, no parity, and cannot be changed. For communications over a network, all CM-5 modules should be set to match this DCS protocol.

The *T1 Access Server Installation and Operation Manual* gives information on setting the remote port baud rate and parity. Section 3.5.3 – *Remote Port Wiring (Optional)* in this manual gives remote port pin assignments.

6.1.2 Handshaking

ISiCL does not support hardware or software flow control or "handshaking," which is not an issue when entering ISiCL commands manually from a terminal or PC keyboard. However, if you plan to download setup information or poll for status information using a PC or any other type of automated controller, be aware that flow control must be handled by the controller itself. Generally, controller software must be designed to wait until it has received a response to the last command sent to a given Intraplex Series multiplexer before issuing another command to the same multiplexer.

6.1.3 Data Circuits

For local operation, connect a controller directly to the remote port on the Intraplex CrossConnect server or system using an RS-232 cable. Or, using modems, establish a remote connection over a dial-up voice circuit.

Intraplex CrossConnect servers or systems can also be connected to a controller over a public switched network, which can be DDS, X.25, or any type of data network capable of providing asynchronous RS-232 interfaces for the Intraplex remote ports. ISiCL commands issued over switched network circuits may include the network address of the "target" multiplexer to facilitate record keeping and network management.

6.2 ISiCL Command Line Format

An ISiCL command line contains four fields, separated by colons. Each command line must be terminated by a semicolon and carriage return:

```
<address>:<subaddress>:<command>:<parameter=value>;
```

For example, to set the primary clock to "external" in a DCS whose shelf address is 13, you would type

```
13:DCS:SET:CLOCK=EXT;
```

and then press Enter on your keyboard.

Here are the components of this example:

- `13` is the DCS's address
- `DCS` is the subaddress (also called the *card address*)
- `SET` is the command
- `CLOCK` is the parameter being set (primary clock)
- `EXT` is the value for the parameter

Note that colons (`:`) separate the address, subaddress, and command fields while a semicolon (`;`) ends the ISiCL command line. A carriage return *must end* every command line.

Sections 6.4 through 6.7 discuss the ISiCL command line fields. For most CrossConnect System or Server commands, use a format similar to this one:

```
<address>:DCS:<command>:<parameter=value>;
```

This example shows DCS as the value for the subaddress field. Section 6.4 - *Address Fields* gives more information on the subaddress field.

6.3 Address Fields

The first field in an ISiCL command line is the address field. Multiplexer addresses cannot be changed remotely. The address must be entered locally using the Group and Set/Next switches (*T1 Access Server Installation & Operation Manual*). The CM-95 DCS processor module address can only be set by remote control.

6.3.1   Address Numbers

Valid ISiCL addresses are the integers from 1 to 63 or no address (field left blank). For address numbers, leading zeros are not required. An address of "05" can be entered simply as 5. Zero (0) is not a valid ISiCL address and should not be used.

The address field is optional when sending ISiCL commands to a single common module, but is required when multiple Intraplex devices are connected to a central controller via RS-485. It provides a means of identifying the device to which a command was addressed.

6.3.2   Blank Addresses

In systems with only one device being controlled, you can generally leave the address field blank. For example, if you are connected to a single DCS, the example `SET` command discussed previously could be entered as

```
:DCS:SET:CLOCK=EXT;
```

Note that the colon terminating the network address field is required, even when the address field itself is left blank.

6.3.3   Subaddress Fields

The second field in an ISiCL command line is the subaddress field. If you are controlling a DCS, you can leave the subaddress field blank. For example, you can use this command to send a configuration inquiry to a DCS:

```
::CONFIG?;
```

Valid addresses for the DCS are DACS and DCS.

6.4 Command Field

The third field in the ISiCL command line is the *command* field. For the DCS there are three ISiCL commands. Each command can have multiple parameters that are associated with it. As you might expect, *parameters* are entered in the parameter field (Section 6.5). Table 6-1 lists the ISiCL commands.

Table 6-1. Valid Command Fields Entries

Command	Description

SET	Used to set a particular parameter on the common module, channel module, or DCS (CM-95 module) as identified by the subaddress field (Section 6.4). Every `SET` command must include a valid parameter name and value in the parameter field.
	
	Command example:
	    `13:DCS:SET:CLOCK=1,2;`
	
	Response:
	    `*OK;`

CONFIG?	Lists the configuration settings for the module named in the subaddress field (Section 6.4). The parameter field in a `CONFIG?` command should be left blank.
	
	Command example:
	    `13:DCS:CONFIG?:;`
	
	Response:
	    `*OK`
	    `SRVC=ON`
	    `ELOS=ON`
	    `ELOD=ON`
	    `EA1S=ON`
	    `EBER=ON EFLOF=OFF`
	    `EYEL=ON`
	    `EITU=OFF`
	    `ACT1=ON`
	    `ACT2=ON`
	    `ACT3=OFF`
	    `ACT4=OFF`
	    `ACT5=OFF`
	    `ACT6=OFF;`

STATUS?	When addressed to a module, lists the state of all "S" (status) parameters associated with that module (Section 6.11).
	
	Command example:
	`13:DCS:STATUS?:;`
	
	Response:
	    `*OK`
	    `ALERT=ON`
	    `FAIL=OFF LOF1`
	    `LOD1`
	    `LOF2`
	    `LOD2`
	    `MAP=1;`
	
	In this case, the `STATUS?` command's parameter field should be left blank. `STATUS?` is the default command if the command field is left blank. This feature is convenient, providing a quick method for checking the status of a device. The colon terminating the field must always be present. A `STATUS?` command can be issued simply by typing three colons and a semicolon:
	    `:::;`

6.5 Parameter Field

The fourth field in an ISiCL command line is the parameter field. This field is used in conjunction with the command field (Section 6.4) to define intended action of the ISiCL command line. Values in the parameter field are typically blank, a password, or in the "parameter=value" format.

6.5.1   Blank Parameters

The parameter field needs to be left blank for some commands such as the `STATUS?` and `CONFIG?` commands. These commands are typically entered as

```
13:DCS:STATUS?:;
```

There is no space or text between the last colon and the semicolon.

6.5.2   Parameter = Value Format

This type of entry in the parameter field is usually used for `SET` commands. The parameter field must include a valid parameter name, followed by an equal sign (=), followed by a valid parameter value. For example, to specify the normal service map for a DCS with an address of 13, issue this command:

```
13:DCS:SET:NORMALMAP=7;
```

6.6 Comment Field

The ISiCL command line format also allows a free-form comment to be included after the command, between the semicolon and the carriage return:

```
13:DCS:SET:NORMALMAP=7; Set normal service map to 7
```

Anything typed in the comment field, that is, anything after the semicolon but before the carriage return, is ignored. Comments may be used when ISiCL commands are embedded in batch files or data files accessed by an automated controller, to make the commands more readable later. The comment field is optional at all times.

6.7 Valid Characters

ISiCL command line fields may contain

- Valid addresses
- Subaddresses
- Commands
- Parameters
- Space characters

Space characters are ignored by the common module, so you can use them to make command lines more readable. Also ISiCL commands are not case-sensitive. You may enter subaddresses, commands, and parameters in upper or lower case, or a combination of both. For example, these three ISiCL commands are perceived as identical by the multiplexer:

```
3:TERM:SET:PTIME=EXT;
3:Term:SET:PTime = EXT;
3: TERM: SET: PTIME = ext;
```

Line feed `<lf>` characters are also ignored. A terminal or PC may be configured to generate either a single carriage return `<cr>` character or a `<cr><lf>` pair when you press the Enter (or Return) key. The comment field may contain any printable ASCII characters.

6.8 General Format of ISiCL Responses

Upon receiving a valid command, a device always responds initially with the line:

    *OK

This line indicates only that a valid command was received, and not necessarily that the device itself is "okay." If the received command is SET and does not require any explicit response, no additional response lines are generated. However, if the received command is CONFIG? or STATUS?, the *OK line is followed by one or more lines that contain the requested information.

If the received command is invalid (for example, if it contains an unrecognizable command or an invalid subaddress), the addressed device responds with one of three invalid command response formats:

    *WHAT?;

or

    *WHAT? <descriptive message>;

or

    *WHAT? <descriptive message>
    <rest of descriptive message>;

The last line of an ISiCL response, and only the last line, terminates with a semicolon (;). All responses are immediately followed by a carriage return and line feed <cr><lf>.

6.9 Alert/Alarm Status Check

You can determine the overall alert and alarm status of a DCS by issuing a STATUS? command to its CM-95 module. For example, to determine the overall status, issue a command of the form:

    <address>:DCS:STATUS?:;

The response to this command shows the status of the remote alarms for the six DCS ports and indicates whether any of them is in an alert or alarm state. If no DCS ports are in alert or alarm states, the DCS responds as follows to a STATUS? command:

    *OK
    ALERT=OFF
    FAIL=OFF

This response indicates that no alerts or alarms are detected. A remote alarm for one port would indicate that there is a problem somewhere on the line, not that there is an error in the signal. A bit indicating the problem is set in the signal, and this bit triggers an alert (ALERT=ON). If there is a remote alarm for two or more ports, the signals at these ports trigger alarms (FAIL=ON), and there is no alert (ALERT=OFF). The alert response is only for one port in an alarm condition.

If all six ports are in an alarm state, the DCS generates a response with the this format:

    *OK
    ALERT=OFF
    FAIL=ON
    YEL1
    YEL2
    YEL3
    YEL4
    YEL5
    YEL6;

Note that the `*OK` in the first line of the response indicates that the received command was valid, not that the DCS is "okay."

6.10 DCS SET Parameters

6.10.1 DCS SET Command Use

The setup of a DCS chassis can be changed by issuing `SET` commands with the appropriate parameter names and values. The key is to include the `DCS` value in the subaddress field of the command line. For example, to set the recovery time to 0.1 second of a DCS connected to a multiplexer at address 32, issue this command:

```
32:DCS:SET:REC=0.10;
```

Table 6-2 lists the valid DCS:SET: parameters that can be changed remotely.

Note: CrossConnect products shipped before November 1, 1999 only respond to the command `:DACS:SET:` while products shipped after that date respond to either `:DCS:SET:` or `:DACS:SET:` commands.

Table 6-2. Valid :DCS:SET: Parameters and Legal Values

Parameter	Function	Legal Value	Sets Parameter To
ACT1	Port 1 active/ not active	ON	Port 1 in service
		OFF	Port 1 not in service
ACT2	Port 2 active/ not active	ON	Port 2 in service
		OFF	Port 2 not in service
ACT3	Port 3 active/ not active	ON	Port 3 in service
		OFF	Port 3 not in service
ACT4	Port 4 active/ not active	ON	Port 4 in service
		OFF	Port 4 not in service
ACT5	Port 5 active/ not active	ON	Port 5 in service
		OFF	Port 5 not in service
ACT6	Port 6 active/ not active	ON	Port 6 in service
		OFF	Port 6 not in service
ADDR	Shelf address	1 – 63	Sets CM-95 shelf address
BER	Bit error rate	10^{-6} to 10^{-3}	Bit error rate
CLOCK	Clock source	Alt1, Alt2	Alt1 = Alternate Clock 1 (I (Internal), E (External), 1-6) Alt2 = Alternate Clock 2 (1 to 6) (optional)
CODE, P	T1 line code	AMI	Alternate Mark Inversion
	P – port number (1 to 6)	B8ZS	High Density Bipolar
DLY1	Delay	0 to 100 (ms)	Switch time delay, port 1
DLY2	Delay	0 to 100 (ms)	Switch time delay, port 2
DLY3	Delay	0 to 100 (ms)	Switch time delay, port 3
DLY4	Delay	0 to 100 (ms)	Switch time delay, port 4
DLY5	Delay	0 to 100 (ms)	Switch time delay, port 5

Table 6-2. Valid `:DCS:SET:` Parameters and Legal Values (continued)

Parameter	Function	Legal Value	Sets Parameter To
DLY6	Delay	0 to 100 (ms)	Switch time delay, port 6
DS0,M,TxP,TxC	DS0 Remapping	RxP, RxC	DS0 remapping parameters where: 　M=Map number (0–7) 　TxP=Tx Port number (1 to 6) 　TxC= Tx Port Channel number (1 to 24) 　RxP= Rx Port number (1 to 6, 0=constant) 　RxC= Rx Port Channel number (1 to 24; if RxP=0, then RxC=the constant value) **Note:** A constant can be entered in decimal or hexadecimal format as shown in this example: 　decimal　　　　255 　hexadecimal　　FFH or 0XFF If a constant FFH is selected, enter it as follows: 0,FFH
TxC	DS0 Remapping	RxP, RxC	DS0 remapping parameter where: 　M=Map number (0–7) 　TxP=Tx Port number (1 to 6) 　TxC= Tx Port Channel number (1 to 24) 　RxP= Rx Port number (1 to 6, 0=constant) 　RxC= Rx Port Channel number (1 to 24; if RxP=0, then RxC=the constant value) **Note:** A constant can be entered in decimal or hexadecimal format as 　decimal　　　　255 　hexadecimal　　FFH or 0XFF If a constant FFH is selected, enter it as 0,FFH
EAIS	All ones failure	ON	Enable all ones failure
		OFF	Disable all ones failure
EBER	Bit error rate	ON	Enable bit error rate failure
		OFF	Disable bit error rate failure
EFLOF*	Fast loss of frame	OFF	(Must be OFF)
EITU	International Telecommunications Union (ITU) compatibility	ON	Enable ITU compatibility mode
		OFF	Disable ITU compatibility mode
ELOD	Loss of data	ON	Enable loss of data failure
		OFF	Disable loss of data failure
ELOS	Loss of sync	ON	Enable loss of sync failure
		OFF	Disable loss of sync failure
EXTEN,<e>	Enable external inputs	ON or OFF	Set external input (0 to 7) ON or OFF, where <e> = external input
EYEL	Yellow (remote) alarm failure	ON	Enable yellow alarm failure
		OFF	Disable yellow alarm failure
FTYPE, P	Frame type P = port number (1 to 6)	SF	Super Frame
		ESF	Extended Super Frame

Table 6-2. Valid `:DCS:SET:` Parameters and Legal Values (continued)

Parameter	Function	Legal Value	Sets Parameter To
LEVEL	Strength level of received signal	NONE, -7.5, =15 dB	Set the required minimum strength level of the received T1 signal for all ports
LOOPBACK, <p>	Set loopback for port <p>=port (1-6)	LINE	Activates line loopback on selected port <p>
		OFF	
LOSDLY, <p>**	Loss of sync switch delay <p> = port number (1-6)	5 to 999 (milliseconds)	Loss of synch switch delay, for example: `:DCS:SET:LOSDLY,<p>=17;`
MAP, <m>	Enable/disable map	ON or OFF	Set selected map (0 to 7) ON or OFF, where <map> = map
NODE,<p>	Define critical/ primary node <p>=port (1–6)	ON	Critical node enabled
		OFF	Critical node disabled
NORM,<p>	Normal switching <p>=port (1–6)	ON	Normal switching enabled
		OFF	Normal switching disabled (will not switch on failure)
NORMALMAP	Current normal service map	0 or 7	Select map 0 or map 7 as normal service map
RBS,<p>	Robbed-bit signaling	n1,n2,n3	Select time slots on a specified port to have robbed-bit signaling enabled where <p> = port number (1 to 6) `n1,n2,n3` = hexadecimal numbers which encode the selected time slots. Section 6.10.2 –*Robbed-Bit Signaling Specification* gives more information.
REC	Recovery time	0 to 60 sec	Recovery time delay
RESET	Reset counters	ON	Reset DCS status counters
		OFF	Do not reset DCS status counters
SRVC	Service	ON	DCS in service
		OFF	DCS out of service

*   Functionality of the EFLOF parameter is disabled for the CM-95.

** Functionality of the LOSDLY parameter is disabled for the CM-95.

6.10.2   Robbed-Bit Signaling Specification

The syntax for the `SET` command with the robbed-bit parameter is:

        `::SET:RBS,p=n1,n2,n3;`

where `p` is the port number and the values for `n1,n2,n3` are hexadecimal numbers which encode the selected time slot. With this command, you can select any one of the time slots on a port to have robbed-bit signaling.

Each parameter value (`n1,n2,n3`) represents a bit mask for a grouping of eight time slots. The bit mask, or byte, is a series of eight zeroes if no time slot in the group is selected. A selected time slot has a bit value of one. The bit mask groupings are

        0xn1 = TS8, TS7, TS6, TS5, TS4, TS3, TS2, TS1
        0xn2 = TS16, TS15, TS14, TS13, TS12, TS11, TS10, TS9
        0xn3 = TS24, TS23, TS22, TS21, TS20, TS19, TS18, TS17

Example 1: Suppose that you want to set time slot 3 to have robbed-bit signaling. All the bits in the bit masks for n2 and n3 would remain set to zero. In the bit mask grouping for n1, to set the third bit for time slot 3 (TS3) to one, specify a value for n1 of 0x04 (hexadecimal format). ISiCL accepts only hexadecimal format, not decimal format. Table 6-3 gives the values to set time slot 3 to robbed-bit signaling.

Table 6-3. RBS Values for Time Slot Examples

Time Slot	Parameter Value	Binary Format	Hexadecimal Format
TS3	n1	00000100	0x04
	n2	00000000	0x00
	n3	00000000	0x00
TS13	n1	00000000	0x00
	n2	00010000	0x10
	n3	00000000	0x00
TS23	n1	00000000	0x00
	n2	00000000	0x00
	n3	01000000	0x40

Example 2: Suppose that you want to set time slot 13 to have robbed-bit signaling. All the bits in the bit masks for n1 and n3 would remain set to zero. In the bit mask grouping for n2, to set the fifth bit for time slot 13 (TS13) to one, specify a value for n2 of 0x10 in hexadecimal format. Table 6-3 gives the values to set time slot 13 to robbed-bit signaling.

Example 3: Suppose that you want to set time slot 23 on port 1 to have robbed-bit signaling. All the bits in the bit masks for n1 and n2 would remain set to zero. In the bit mask grouping for n3, to set the seventh bit for time slot 23 (TS23) to one, specify a value for n3 of 0x40 in hexadecimal format. Table 6-3 gives the values to set time slot 23 to robbed-bit signaling.

The SET command line for Example 3 is:

```
:DCS:SET:RBS,1=0x00,0x00,0x40;
```

The syntax for the query command for one port is:

```
:DCS:CONFIG?:RBS,p;
```

The syntax for the query command for all ports is:

```
:DCS:CONFIG?:RBS;
```

A query command for all ports in Example 3, in which time slot 23 is selected for robbed-bit signaling, would return this response with the hexadecimal time slot encoding for all ports.

Response to :DCS:CONFIG?:RBS; command:

```
*OK
Port 1:  0x00,  0x00,  0x40
Port 2:  0x00,  0x00,  0x00
Port 3:  0x00,  0x00,  0x00
Port 4:  0x00,  0x00,  0x00
Port 5:  0x00,  0x00,  0x00
Port 6:  0x00,  0x00,  0x00;
```

6.11 DCS STATUS? Parameters

You can check the status of alarm, event, and error counters in the CrossConnect System or Server using the `STATUS?` command. Using `STATUS?` with one of the `FLAGS` or `COUNT` parameters returns the status of a group of parameters in the DCS. A typical command line might look like

```
:DCS:STATUS?::FLAGS1;
```

And the response might look like

```
*OK
ALERT=ON
FAIL=OFF
.  .  .
.  .  .
(list of active alarms)
.  .  .
.  .  .
MAP=N;
```

Table 6-4 lists the `DCS STATUS?` parameters and potential responses.

Note: CrossConnect products shipped before November 1, 1999 only respond to the command `:DACS:STATUS?:` while products shipped after that date respond to either `:DCS:STATUS?:` or `:DACS:STATUS?:` commands.

Table 6-4. Valid `:DCS:STATUS?:` Parameters and Responses

Parameter	Possible Response	Description
COUNT1	MAP 1 COUNT	The number of times map 1 was used.
	MAP 2 COUNT	The number of times map 2 was used.
	MAP 3 COUNT	The number of times map 3 was used.
COUNT2	MAP 4 COUNT	The number of times Map 4 was used.
	PORT 1 BER	The bit error ratio for T1 port 1.
	PORT 2 BER	The bit error ratio for T1 port 2.
COUNT3	PORT 3 BER	The bit error ratio for T1 port 3.
	PORT 4 BER	The bit error ratio for T1 port 4.
	LOF5	Loss of frame on framer 5.
	LOD5	Loss of data on framer 5.
	AIS5	All ones signal on framer 5.
	BER5	Bit error rate exceeded on framer 5.
	LOF6	Loss of frame on framer 5.
	LOD6	Loss of data on framer 6.
	AIS6	All ones signal on framer 6.
	BER6	Bit error rate exceeded on framer 6.

Table 6-4. Valid `:DCS:STATUS?:` Parameters and Responses (continued)

Parameter	Possible Response	Description
COUNT4	CLOCK SOURCE	The user-configured desired timing source (FLAGS5) and status.
	CLOCK IN USE	The timing source currently being used.
	CLOCK CHANGES	The number of times the timing source was changed.
	VERSION	The software version number of the DCS firmware.
COUNT5	PORT 5 BER	The bit error ratio for T1 port 5.
	PORT 6 BER	The bit error ratio for T1 port 6.
COUNT6	MAP 5 COUNT	The number of times Map 4 was used.
	MAP 6 COUNT	The number of times Map 6 was used.
	EXTERNAL INPUTS	Returns a value in the format "bbbbbbbb:" where each "b" represents the state of an external input (1=on, 0=off).
DIAG,<n>		<n> selects which port information is displayed. No entry displays all six ports.
	CRBL/ARBL	Current/accumulated unframed all ones.
	CRYEL/ARYEL	Current/accumulated receive yellow (remote) alarm.
	CRCL/ARCL	Current/average number of carrier loss (CL) alarms.
	CRLOS/ARLOS	Current/average number of loss of signal alarms.
	CBPV/ABPV	Current/average number of bi-polar violations (BPVs).
	CRESS/ARESS	Current/average number of elastic store slips.
	CBERS/ABERS	Current/average number of seconds the BER threshold has been exceeded.
	CMFOS/AMFOS	Current/average number of MFOS alarms.
FLAGS1	LOF1	Loss of frame on framer 1.
	LOD1	Loss of data on framer 1.
	AIS1	All ones signal on framer 1.
	BER1	Bit error rate exceeded on framer 1.
	LOF2	Loss of frame on framer 2.
	LOD2	Loss of data on framer 2.
	AIS2	All ones signal on framer 2.
	BER2	Bit error rate exceeded on framer 2.
	LOF3	Loss of frame on framer 3.
	LOD3	Loss of data on framer 3.
	AIS3	All ones signal on framer 3.
	BER3	Bit error rate exceeded on framer 3.
	LOF4	Loss of frame on framer 4.
	LOD4	Loss of data on framer 4.
	AIS4	All ones signal on framer 4.
	BER4	Bit error rate exceeded on framer 4.
	EXTA	External clock alarm (requested external clock no longer in use).

Table 6-4. Valid `:DCS:STATUS?:` Parameters and Responses (continued)

Parameter	Possible Response	Description
FLAGS2	YEL1	Yellow (remote) alarm on port 1.
	YEL2	Yellow (remote) alarm on port 2.
	YEL3	Yellow (remote) alarm on port 3.
	YEL4	Yellow (remote) alarm on port 4.
	YEL5	Yellow (remote) alarm on port 5.
	YEL6	Yellow (remote) alarm on port 6.
Response header	The response header is included with every STATUS? response and always includes these two status items.	
	ALERT	Alert condition on/off.
	FAIL	Failure condition on/off.

6.12 DCS CONFIG? Parameters

You can check the configuration (setup) of a CrossConnect System or Server using the CONFIG? command. Using CONFIG? with one of the FLAGS or map parameters will return the current configuration values for various setup parameters. A typical command line might look like

    :DCS:CONFIG?:FLAGS1;

And the response might look like

    *OK
    SRVC=ON
    ELOS=ON
    ELOD=ON
    EA1S=ON
    EBER=ON
    EFLOF=OFF
    EYEL=ON
    EITU=OFF
    ACT1=ON
    ACT2=ON
    ACT3=OFF
    ACT4=OFF
    ACT5=OFF
    ACT6=OFF
    MAPIND=OFF;

Table 6-5 lists the :DCS:CONFIG? parameters and responses.

Note: CrossConnect products shipped before November 1, 1999 only respond to the command :DACS:CONFIG?: while products shipped after that date respond to either :DCS:CONFIG?: or :DACS:CONFIG?: commands.

Table 6-5. Valid :DCS:CONFIG?: Parameters and Responses

Parameter	Possible Response	Description
DS0,<m>, <p>,<c>		Returns the source of the DS0 specified in the command: <m> = map number (0–7) <p> = port number (1–6) <c> = channel number (1–24)

		For example, the command line
		  `:DCS:CONFIG?:DS0,0,1,1;`
		would return a response like this one:
		  `*OK`
		  `DS0,0,1,1 = <p>,<c>;`
		This response indicates that the data on T1 port 1, channel (time slot) 1 is coming from the T1 on port <p>, channel <c>.
		If you leave any one of the <m>, <p>, or <c> values blank, the DCS treats it like a wildcard and returns all of the matching DS0 mappings, which can result in a very long response:
		● `:DCS:CONFIG?:DS0,0,1;`
		  would return all 24 DS0 mappings for map 0, port 1.
		● `:DCS:CONFIG?:DS0,0;`
		  would return all 24 DS0 mappings for each of the six ports in map 0.
		● `:DCS:CONFIG?:DS0;`
		  would return all 24 DS0 mappings for each of the six ports in every map
		  ($24 \times 6 \times 8 = 1152$ channels).

FLAGS1	ELOF	Enable port switching on loss of frame.
	ELOS	Enable port switching on loss of (frame) synchronization.
	EFLOF	Enable fast loss of frame.
	EYEL	Enable yellow (remote) alarm.
	EITU	Enable ITU compatibility mode.
	ELOD	Enable port switching on loss of data.
	EAIS	Enable port switching on AIS alarm.
	EBER	Enable on port switching on BER threshold exceeded.
	ACT1	Port 1 active/not active.
	ACT2	Port 2 active/not active.
	ACT3	Port 3 active/not active.
	ACT4	Port 4 active/not active.
	ACT5	Port 5 active/not active.
	ACT6	Port 6 active/not active.
	MAPIND	DCS Map Change Indicator active/not active.
FLAGS2	RECOVERY	Recovery time delay
	BER	Bit error ratio threshold
FLAGS3	DLY1	Switch time delay for port 1
	DLY2	Switch time delay for port 2

Table 6-5. Valid `:DCS:CONFIG?:` Parameters and Responses (continued)

Parameter	Possible Response	Description
FLAGS4	DLY3	Switch time delay for port 3
	DLY4	Switch time delay for port 4
FLAGS5	CLOCK=<n>,<n>	Clock source=<alt1>,<alt2> (port number)
	LEVEL	Strength level of received signal
	FTYP5	Frame format, port 5
	CODE5	Line code, port 5
	FTYP6	Frame format, port 6
	CRC45	CRC-4 status, port 5
	CODE6	Line code, port 6
	CRC46	CRC-4 status, port 6
FLAGS6,<p>		<p> is the T1 port (framer) number (1–6)
	FTYPE,<p>	Frame format, port <p>
	CODE,<p>	Line code, port <p>
	EFAST,<p>	Fast switching enabled, port <p> (yes/no)
	LOSDLY,<p>	Loss of synch delay, port <p>
	NORM,<p>	Normal switching mode
	NODE,<p>	Critical node (loss of all ports if failure)
	MPORT,<p>	Enable Multiple Port, port <p>
	SPORT,<p>,1	Secondary Port 1
	SPORT,<p>,2	Secondary Port 2
	SPORT,<p>,3	Secondary Port 3
	SPORT,<p>,4	Secondary Port 4
	SPORT,<p>,5	Secondary Port 5
	SPORT,<p>,6	Secondary Port 6
FLAGS7	DLY5	Switch time delay, port 5
	DLY6	Switch time delay, port 6
FLAGS8	EXTERNAL ENABLE	Returns a value in the format bbbbbbbb: where each b represents the enabled state of an external input (1=on, 0=off).
FLAGS10	REQUESTED MAP	Active map number
	NORMAL MAP	Normal map number (0 or 7)
	LINE LOOPBACK1	Loopback on or off, port 1
	LINE LOOPBACK2	Loopback on or off, port 2 (LINE/OFF)
	LINE LOOPBACK3	Loopback on or off, port 3
	LINE LOOPBACK4	Loopback on or off, port 4
	LINE LOOPBACK5	Loopback on or off, port 5
	LINE LOOPBACK6	Loopback on or off, port 6

Table 6-5. Valid `:DCS:CONFIG?:` Parameters and Responses (continued)

Parameter	Possible Response	Description
`FLAGS11`	`ADDRESS`	Shelf address
`RBS, <p>`		Returns the hexadecimal time slot encoding for one or all ports, where `<p>` = port number (1 to 6)
Response header	`SRVC`	The service status (SRVC) is always returned with each `CONFIG?` command. Service will either be on or off

6.13 DCS Address

Before you can configure a DCS, you need to know what its address is. Intraplex recommends that you use ISiCL to find the address. The address can be any number from 1 to 63. To find the address, perform these steps:

1. Run a communications program, such as HyperTerminal, to set the communications parameters (Table 6-6).

Table 6-6. Communications Parameters

Parameter	Value
Baud rate	9600 bps
Data bit	8-bit word
Start bit	1
Sop bit	1
Parity	None

2. Make all necessary hardware connections.

3. Execute the ISiCL default `STATUS?` command.
   A response to this command confirms that the communications port is working. It is able to respond to this command without an address. In IntraGuide, you can execute ISiCL commands by selecting ISiCL Terminal from the Setup menu.

        :::;

4. Execute the `FLAGS11` command to get the address of the DCS.

        :DCS:CONFIG?:FLAGS11;

5. Write down this address number and save it. You must enter this address when you configure the DCS in IntraGuide.

6.14 ISiCL Commands Used to Manage the System Clock

You can specify a primary and an alternate clock source for the DCS system clock with the `SET` command and the `CLOCK` parameter. You can also query the DCS software for the current clock source configuration and for status information, such as the number of times the clock source has been changed.

Commands in the next example use two colons (`::`) to indicate that the address and subaddress fields are not specified. Such commands are valid when a user has a local connection to a single DCS.

6.14.1   DCS System Clock Setting

You can specify the clock source configuration for the DCS system clock by entering two values with the `CLOCK` parameter. The first value specifies the primary clock source; and the second value, the alternate clock source. The syntax of the command is

```
::SET:CLOCK=<primary>,<alternate>;
```

For example, in the command,

```
::SET:CLOCK=1,3;
```

port 1 is the primary clock source, and port 3 is the alternate clock source.

In this command, the primary clock source is an external source, and there is no alternate source:

```
::SET:CLOCK=EXT,NONE;
```

Because the DCS switches over to the internal oscillator to provide the source for the system clock when both the primary and secondary clock sources fail, there is never any alternate clock source when the internal oscillator is specified as the primary clock source, as shown in this command:

```
::SET:CLOCK=INT;
```

Although the alternate clock source is optional, the primary is not. Possible values for the `CLOCK` parameter when specifying the primary clock source are 1 to 6, `EXT`, or `INT`. Possible values for the `CLOCK` parameter when specifying the alternate clock source are 1 to 6 or `NONE`. If you do not choose an alternate, you do not need to enter the `NONE` value:

```
::SET:CLOCK=EXT;
```

where the primary clock is an external source.

6.14.2   DCS Software Query for Clock Information

The ISiCL command `::CONFIG?:FLAGS5;` displays the primary and alternate clock sources, along with other information about the DCS. A response to a `::CONFIG?:FLAGS5;` command would be

```
*OK
...
...
CLOCK=1,2
...
...
```

The ISiCL command `::STATUS?:COUNT4;` displays this information about the DCS system clock:

● **Clock source:** The requested clock (either user-requested primary clock source, or the alternate source if the DCS made an internal clock switch due to port failure or exceeded clock slips)

● **Clock in use:** The actual clock which is latched into the DCS hardware and driving the system clock

● **Clock changes:** The number of times the clock source has been changed

A response to a `::STATUS?:COUNT4;` command would be

```
    *OK
    ...
    ...
    CLOCK SOURCE = 1
    CLOCK IN USE = 1
    CLOCK CHANGES = 0
    ...
    ...
```

6.15 ISiCL Commands Used for Mapping

There are four ISiCL SET parameters that allow you to manage maps and time slots:

- MAP: Allows you to turn a map on or off
- NORMALMAP: Allows you to specify the normal service map
- MAPIND: Allows you to control the Map Change Indicators
- DS0: Allows you to change port and time slot settings in a map

In addition to the SET command, you can use the CONFIG? command to view the current map configurations.

6.15.1   MAP Parameter

You can set a selected map to ON and then later to OFF with the SET:MAP command. For error detection and switching, you must run the DCS under normal operating conditions with either map 0 or the alternate normal service map 7. However, you might need to force a particular map ON for testing purposes, for example, to clear a circuit. After the circuit is cleared, you should set the map to OFF and resume operation with the normal service map. All maps should be set to OFF to allow error detection and switching through the normal service map.

To set a map ON or OFF, use the command syntax:

```
    ::SET:MAP,<m>=<v>;
```

where m is the map number and v is the value of the parameter, as in the example:

```
    ::SET:MAP,3=ON;
    ::SET:MAP,3=OFF;
```

6.15.2   NORMALMAP Parameter

Use the NORMALMAP parameter with the SET command to specify the value 0 or 7. Use the command syntax:

```
    ::SET:NORMALMAP=<v>;
```

where v is the value.

Suppose you are operating with map 0 as the normal service map, and you want to change to map 7, the alternate service map:

```
    ::SET:NORMALMAP=7;
```

6.15.3   MAPIND - DCS Map Change Indicator

The MA-251A has a set of contact closures on its Status Port that indicate which map is currently selected (Section 3.4.4.2). When a map change is made, the new map takes effect immediately; but it may take up to three minutes for these contact closures to reflect the new map selection.

The `MAPIND` command enables the contact closures on the MA-251A to change immediately when a map change is made. Use this commands to set MAPIND on or off:

```
::SET:MAPIND=ON;
```
```
::SET:MAPIND=OFF;
```

● When `MAPIND=ON`, the contact closures on the MA-251A changes immediately when a map change is made. The jumper labeled JMP 1 on the MA-251A must be removed to enable `MAPIND=ON` to take effect.

● When `MAPIND=OFF`, the contact closures do not change immediately upon a map change.

The default setting is `MAPIND=OFF`. `MAPIND` should always be turned off unless immediate reporting via the Status Port contact closures is necessary, since a change in map number may result in an interruption of other ISiCL communication.

Note: The `MAPIND` command can only be used if the CM-95E is Rev. A4 or higher, and is installed with an MA-251A, not an MA-251.

To change the map number under the default conditions, use this command:

```
:DACS:SET:MAP x=ON;
```

(where `MAP x=0-7`)

6.15.4   DS0 Parameter

The DS0 parameter allows you to specify time slot settings on a port by port basis for any map. The syntax is:

```
::SET:DS0,<m>,<p>,<ts>=<p>,<ts>;
```

where `m` is the map number; `p` is the port; and `ts` is the time slot number. The value for the DS0 parameter follows the equal sign. For the value, you must specify both a port and a time slot number. As an example for map 3, suppose you want port 5, in time slot 21, to receive signals from port 1, time slot 18. You would set the `DS0` parameter as

```
::SET:DS0,3,5,21=1,18;
```

6.15.5   CONFIG? Command

Use the `CONFIG?` command to view the current map configurations. The complete command syntax is

```
::CONFIG?:DS0,<m>,<p>,<ts>;
```

where `m` is the map number; `p` is the port; and `ts` is the time slot number. To view how a specific time slot is configured, enter

```
::CONFIG?:DS0,<m>,<p>,<ts>;
```

To view how all the time slots on one port are configured, enter

```
::CONFIG?:DS0,<m>,<p>;
```

To view how an entire map is configured, enter

```
::CONFIG?:DS0,<m>;
```

This example requests a display of the configuration for time slot 13 on port 5 in map 2:

```
::CONFIG?:DS0,2,5,13;
```

Section 7 – CM-95 Operation

The CM-95 has eight indicator lights on the front-panel (Figure 7-1). Table 7-1 describes these indicator lights. All the lights are either ON or OFF; there is no transition state, such as a green light changing to yellow or orange before turning to red. When a light is OFF, it is lit. A port light is green, the alert light is yellow, and the alarm light is red.
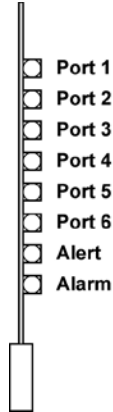
Figure 7-1. CM-95 CrossConnect Processor Module - Front View

Table 7-1. Indicator Lights on CM-95 Installed in DCS-9500/9530/9560/9565

Front Panel Label	Description When Light Is ON
PORT 1	Green when Port 1 is active. (ACT1 flag has been set ON and is reporting no problems.)*
PORT 2	Green when Port 2 is active. (ACT2 flag has been set ON and is reporting no problems.)*
PORT 3	Green when Port 3 is active. (ACT3 flag has been set ON and is reporting no problems.)*
PORT 4	Green when Port 4 is active. (ACT4 flag has been set ON and is reporting no problems.)*
PORT 5	Green when Port 5 is active. (ACT5 flag has been set ON and is reporting no problems.)*
PORT 6	Green when Port 6 is active. (ACT6 flag has been set ON and is reporting no problems.)*
ALERT	Yellow when an error has been detected on one port.
ALARM	Red when an error has been detected on two or more ports.

* Ports 1 through 6 can have their active flags set ON or OFF by the user via the user interface. This can be done using ISiCL commands (Section 6), or with Intraplex IntraGuide software (Section 5).

Section 8 – Specifications

8.1 Detailed Specifications

Features	**DCS-9500**	6 port T1 CrossConnect System 1 RU package Cross-connect protection switching and multicasting capability
	DCS-9530	6 port T1 CrossConnect System 3 RU package Cross-connect protection switching and multicasting capability with future migration to DCS-9560
	DCS-9560	6 port T1 CrossConnect Server 3 RU package Up to 24 DS0 terminations (capacity of one T1 line) Includes the functions of the DCS-9500 Accepts Intraplex plug-in channel modules for integrated voice, data, video, and program audio applications
	DCS-9565	6 port T1 CrossConnect Server 3 RU package Up to 48 DS0 terminations Includes the functions of the DCS-9500 Accepts Intraplex plug-in channel modules for integrated voice, data, video, and program audio applications
T1 Inputs/Outputs	**Electrical Interface**	6 DSX-1 interface ports per ANSI T1.102-1993
	Output Timing	Internal, 1.544 Mbps ±30 PPM External, RS-422 input Any of the 6 T1 inputs
	Frame Formats	Extended Superframe (ESF) D4/Superframe (SF)
	Line Codes	Bipolar with 8 Zero Substitution (B8ZS) Alternate Mark Inversion (AMI)
	Line Build Out (LBO)	Up to 655 feet from standard DSX or CSU LBO 0, -7.5. or -15 dB
	Input Connector	8-pin RJ-48C for CSU applications DB-15 for non-CSU applications 100 watt resistive (nominal)

Throughput Delay	One to three T1 frames 125 to 375µS Two frames average 250µS
DS0 Interfaces (CrossConnect Server)	Optional 4-wire voice frequency (VF), 2-wire VF, synchronous, asynchronous, and variable rate data, program audio, and video

Timeslot Mapping	Maps Supported	Eight: Two normal service maps and six alternate service maps configurable to switch based on T1 port failure (BER, LOS, AIS, LOF), external contact closure inputs or ASCII command
	Switch Time	Protection switching delay, programmable down to 1 millisecond

Status & Diagnostics	Indicator Lights	Shelf Power, Normal, Alert, Alarm DCS Port Status, Alert, Alarm
	Contact Closures	Shelf Alert, Alarm DCS Alert, Alarm, Active Map Indicators
	Diagnostics	T1 and time slot loopback

Remote Access &	Functionality	Remote programming and monitoring, PC-based graphical user interface and command line interfaces Off-line copying and editing of cross-connect maps
	Interface	RS-232C and RS-485 asynchronous

Physical & Environmental	Nominal Power Requirements	3 RU Universal AC standard Optional -48VDC, -24VDC, or +24VDC Optional hot-standby redundant supply 1 RU Universal AC
	Nominal Power Consumption	DCS-9500/9530: 5 watts DCS-9560: 8 watts DCS-9565: 11 watts
	Operating Temperature	0° - 50°C
	Humidity	0% to 90% non-condensing
	Dimensions	3 RU: 5.25" x 14.5" x 19" rack-mount 1 RU: 1.75" x 14.5" x 19" rack-mount
	Regulatory Compliance	CE Approved UL 1950 FCC Part 15, FCC Part 68 CS-03

Specifications are subject to change without notice.

8.2 Notice to T1 Service Users

To ensure compliance with the Federal Communications Commission (FCC) Rules, Part 68, perform these steps:

1. All direct connections to T1 lines must be made using standard plugs and jacks.

2. Before connecting your unit, you must inform the local telephone company of this information (Table 8-1):

Table 8-1. Information for Local Telephone Company

Port ID	REN/SOC	FIC	USOC
DCS-95XX	6.0 F	04DU9-BN 04DU9-DN 04DU9-1KN 04DU9-1SN 04DU9-1ZN	RJ-48C

3. If the unit appears to be malfunctioning, disconnect it from the telephone lines until you learn if your equipment or the telephone line is the source of the trouble. If your equipment needs repair, it should not be reconnected until it is repaired.

4. The CSUIDSU has been designed to prevent harm to the TI network. If the telephone company finds that the equipment is exceeding tolerable parameters, the telephone company can temporarily disconnect service, although they will attempt to give you advance notice if possible.

5. Under the FCC Rules, no customer is authorized to repair this equipment. This restriction applies regardless of whether the equipment is in or out of warranty.

6. If the telephone company alters their equipment in a manner that will affect use of this device, they must give you advance warning so as to give you the opportunity for uninterrupted service. You will be advised of your right to file a complaint with the FCC.

7. The "Affidavit for the Connection of Customer Premises Equipment to 1.544 Mbps and/or Subrate Digital Services" in Section 8.3 must be completed by the installer.

8. In the event of equipment malfunction, all repairs should be performed by our Company or an authorized agent. It is the responsibility of users requiring service to report the need for service to our Company or to one of our authorized agents.

For service issues, please contact GatesAir Customer Service:

- U.S., Canada, and Latin America: +1-217-221-8200 or tsupport@gatesair.com
- Europe, Middle East, and Africa: +1-217-221-8200 or tsupport.europe@gatesair.com
- Asia and Pacific Rim: +1-217-221-8200 or tsupport.asia@gatesair.com

Notice: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier, Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Warning!	Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

8.3   Certification

Submit the affidavit on the next page to the telephone company. This affidavit is required if you use digital terminal equipment without encoded analog content and billing protection to transmit digital signals containing encoded analog content which are intended for eventual conversion into voiceband analog signals and retransmitted on the network. Here are more qualifications of this requirement:

- The affidavit shall affirm that either no encoded analog content or billing information is being transmitted or that the output of the device meets Part 68 encoded analog content or billing protection specifications.
- The end user/customer is responsible to file an affidavit with the local exchange carrier when connecting unprotected CPE (customer premises equipment) to a 1.544 Mbps or subrate digital services.
- Until such time as subrate digital terminal equipment is registered for voice applications, the affidavit requirement for subrate services is waived.

Affidavit for the Connection of Customer Premises Equipment to 1.544 Mbps and/or Subrate Digital Services

For work to be performed in the certified territory of

Telco's Name:_____

State of: _____

County of:_____

I, _____, of_____,

(Name Authorized Representative)   (Customer Name)

_____,_____,

(Customer's Address)   (Telephone Number)

being duly sworn, state:

I have responsibility for the operation and maintenance of the terminal equipment to be connected to _____ 1.544 Mbps and/or _____ Subrate digital services. The terminal equipment to be connected complies with Part 68 of the Commissions rules except for the encoded analog content and billing protection specifications. With respect to encoded analog content and billing protection:

- I attest that all operations associated with the establishment, maintenance and adjustment of the digital CPE with respect to encoded analog content and encoded billing information continuously complies with Part 68 of the FCC's Rules and Regulations.
- The digital CPE does not transmit digital signals containing encoded analog content or billing information which is intended to be decoded within the telecommunications network.
- The encoded analog and billing protection is factory set and is not under the control of the customer.

I attest that the operator(s) maintainer(s) of the digital CPE responsible for the establishment, maintenance and adjustment of the encoded analog content and billing information has (have) been or trained to perform these functions by successfully completing one of the following: Check appropriate one(s):

- A training course provided by the manufacturer/grantee of the equipment used to encode analog signals; or
- A training course provided by the customer or authorized representative, using training materials and instructions provided by the manufacturer/grantee of the equipment used to encode analog signals; or
- An independent training course (e.g., trade school or technical institution) recognized by the manufacturer/grantee of the equipment used to encode analog signals; or
- In lieu of the proceeding training requirements, the operator(s) maintainer(s) is(are) under the control of a supervisor trained in accordance with _____ above.

I agree to provide _____ with proper documentation to

<div style="text-align:center">(Telco's Name)</div>

demonstrate compliance with the information as provided in the proceeding paragraph, if so requested.

_____ (Signature)

_____ (Title)

_____ (Date)

Subscribed and Sworn to before me this _____ day of _____, 20____

_____

Notary Public

My Commission expires: _____