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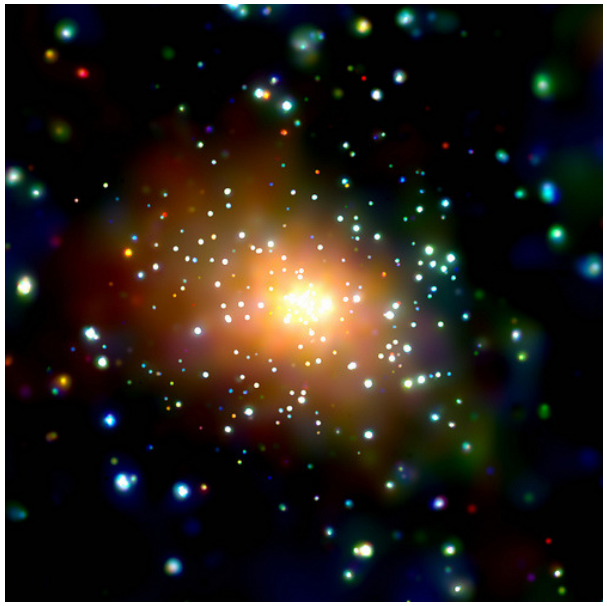
SHARE

High Performance FICON Demystified, Update and User Experience



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5 February 2013

Session 13056

SHARE in San Francisco 2013

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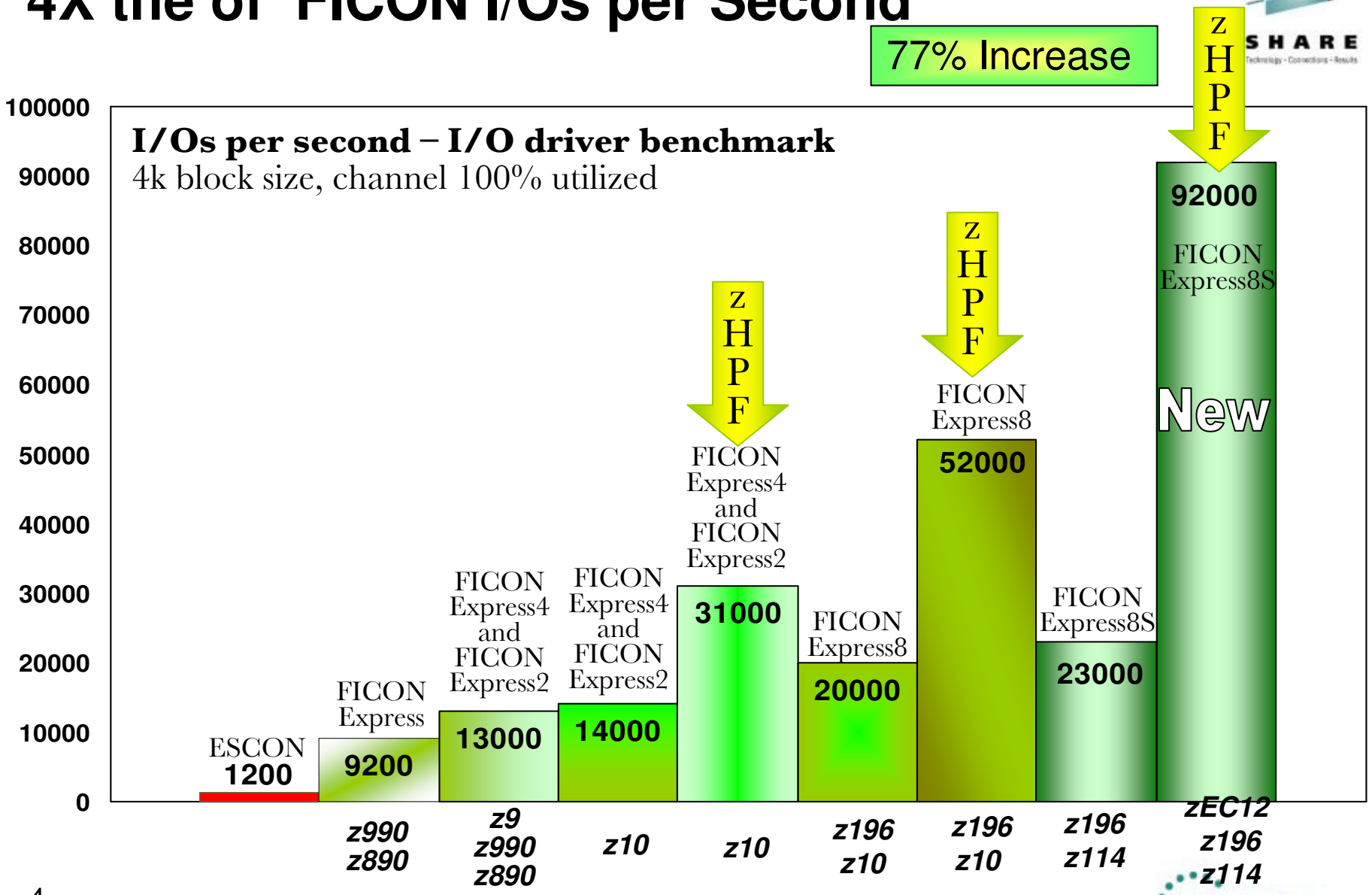
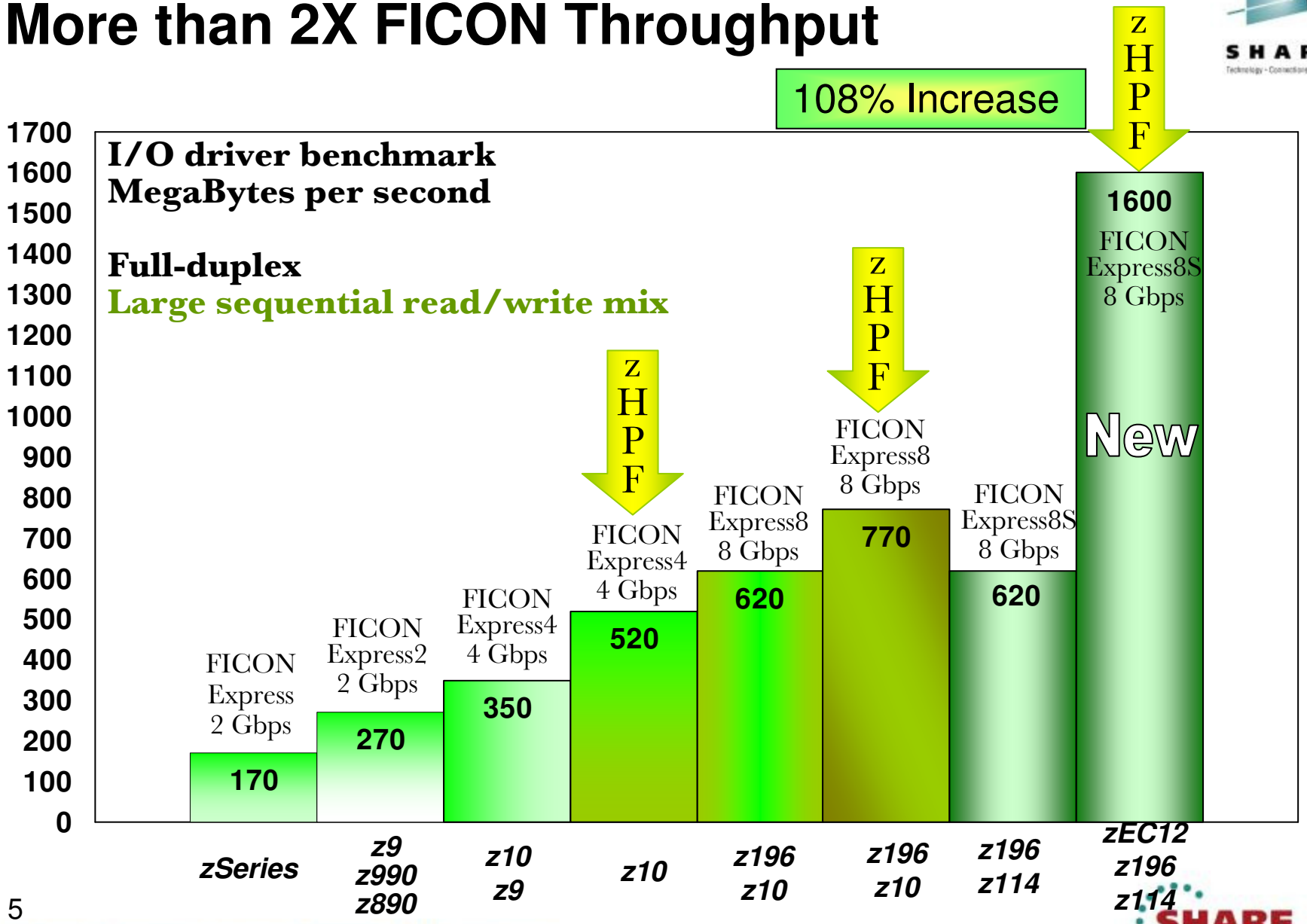
Agenda

- What does zHPF Do For Me?
- How Does zHPF Do It?
- The Effect On Exchanges
- Other Improvements

4X the of FICON I/Os per Second

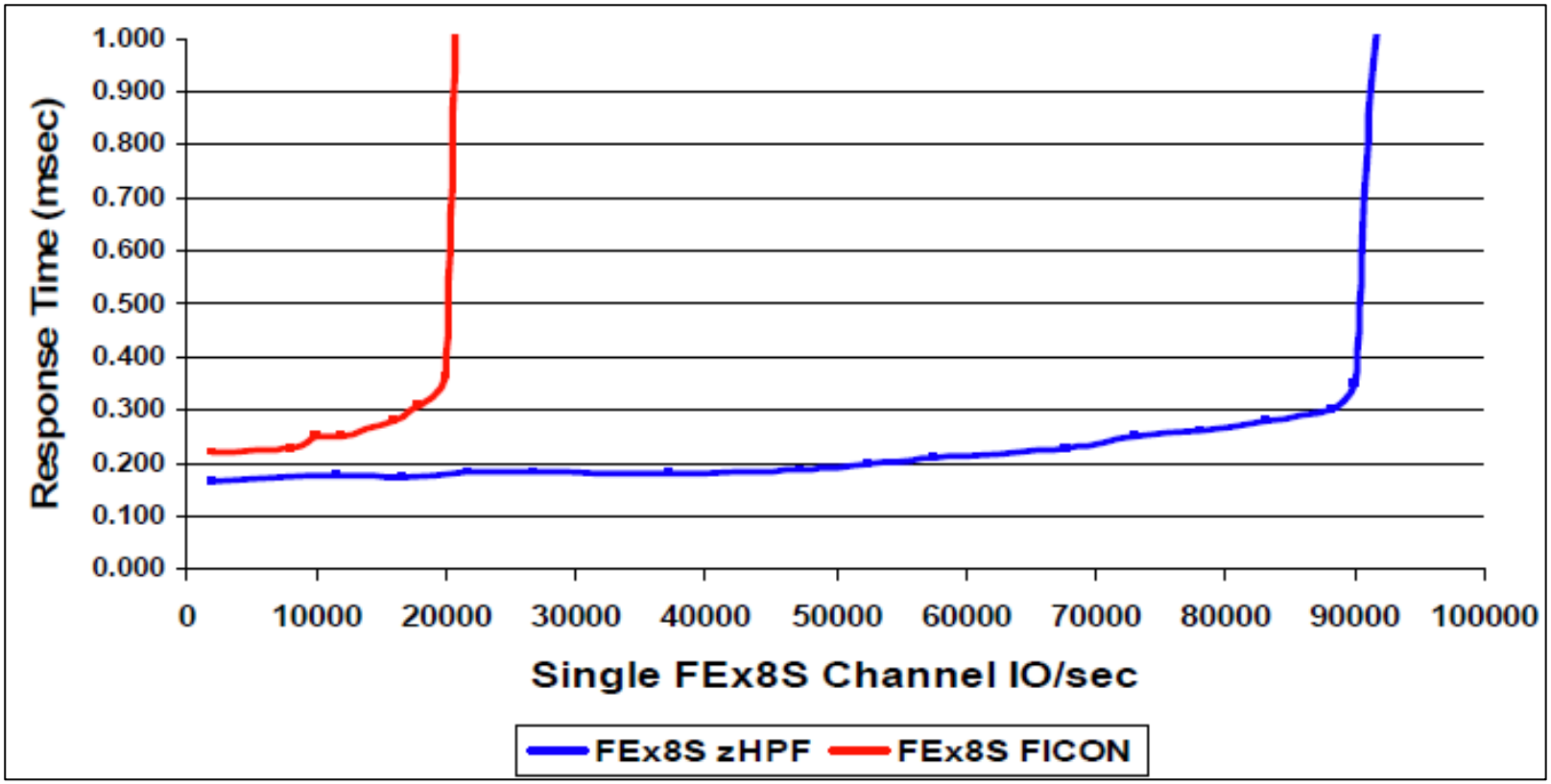


More than 2X FICON Throughput

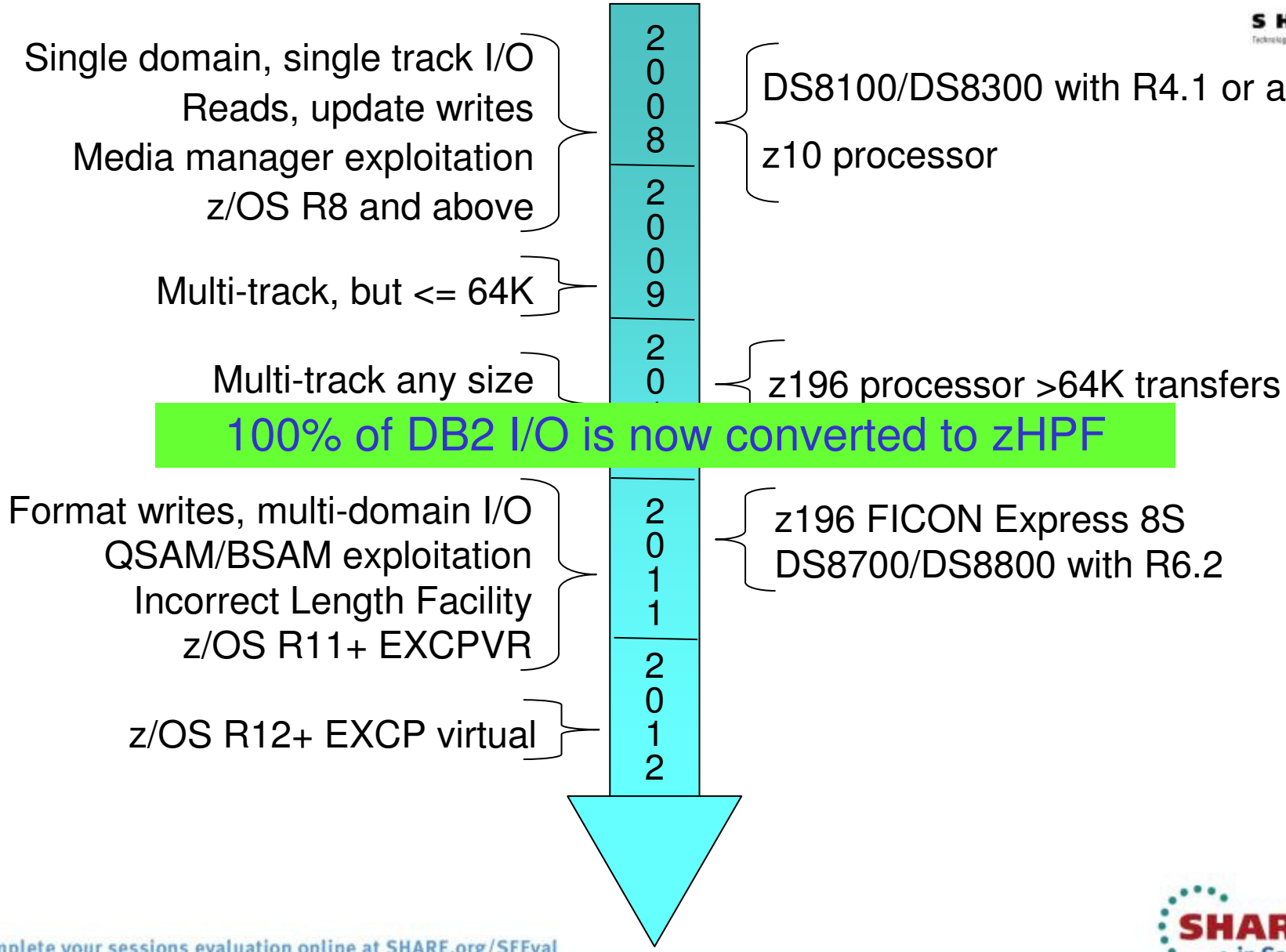


Response Time Improves Too

Single FICON Express8S channel: zHPF vs FICON READ 4k bytes/IO
Total I/O Response Time vs IO/sec



zHPF Evolution



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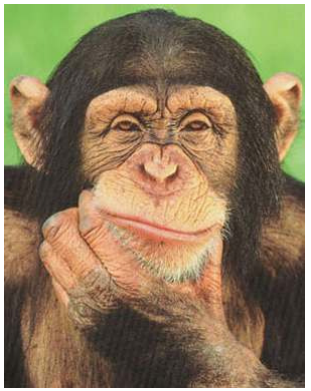
How does zHPF do it?



- Rides on top of an existing standard protocol called….

F. C. P.

FCP ???

- Does zHPF convert my I/O to SCSI ??????

NO !

- FCP is a generic method to transfer commands, data, and status

- FCP  SCSI
  - It is true however, that SCSI is the single largest user of FCP

Why FCP?

- FCP protocol has less ‘Chit Chat’
- Many HBA vendors have optimized firmware and hardware to accelerate FCP I/O

Read Comparison Summary (4 4K Reads)

	Channel to CU in Ficon Mode	CU to Channel in Ficon Mode	Total	Channel To CU in zHPF Mode	CU to Channel in zHPF Mode	Total	% Reduction in zHPF Mode[1]
Exchanges	1	1	2	1	1	1	50
Sequences	6	6	12	1	2	3	75
Frames	6	14	20	1	10	11	45
CRC Gen / Check	5	5	10	1	1	2	80

[1]Except for exchanges, as the number of reads in a single I/O increase, the % reduction in Transport Mode increases

Let's look under the hood

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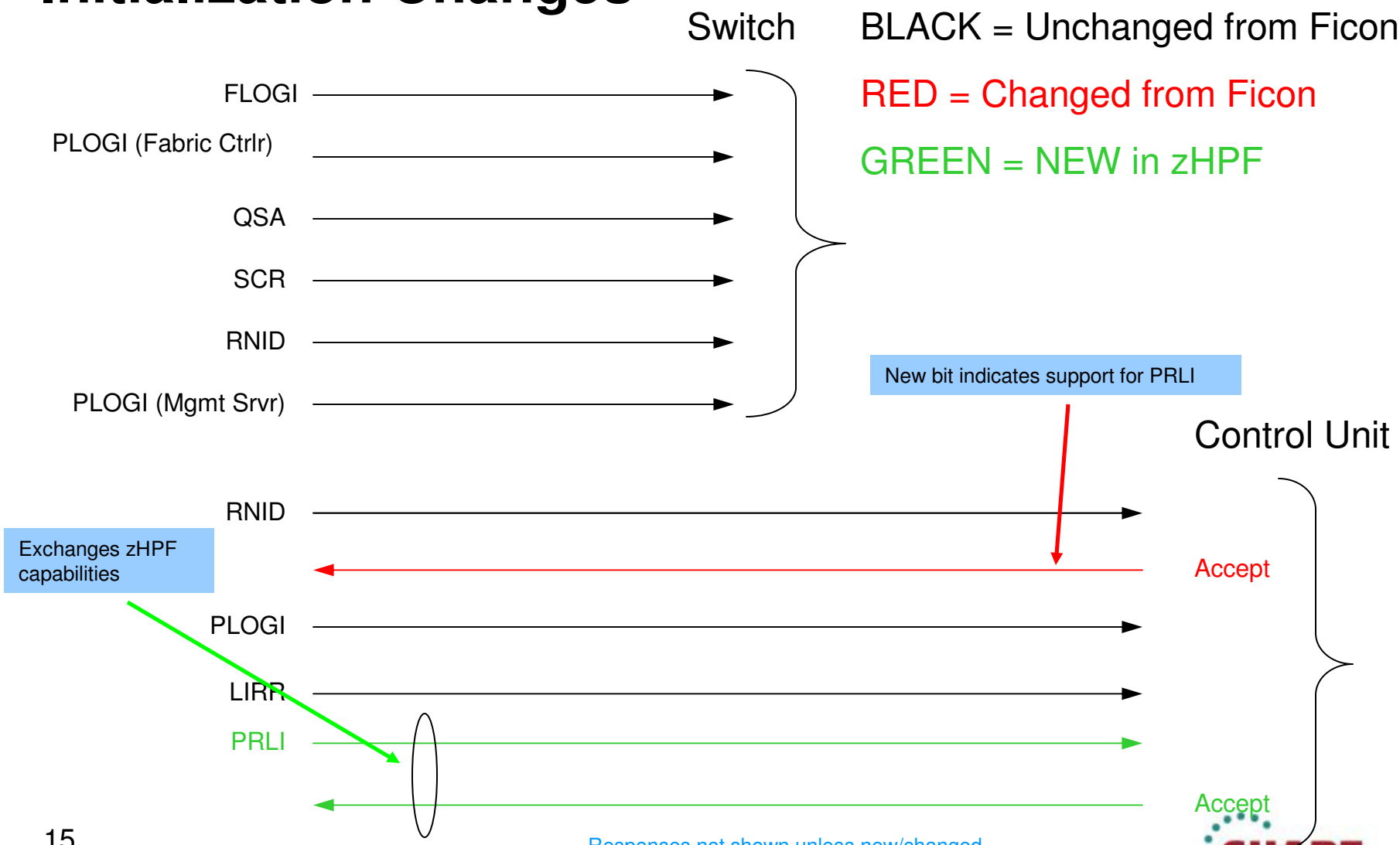
No I/O Definition changes

- zHPF coexists with FICON
- Channel is STILL type=FC
- No I/O configuration (IOCDS/IODF) changes for zHPF capable channels or control units

Initialization Changes



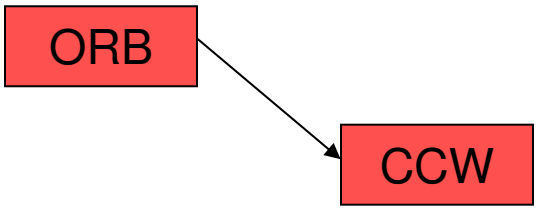
Totally New I/O Structures

- CCWs no longer exist in zHPF (They live on happily in Ficon)
  - Replaced by Device Control Words (DCWs)
- IDAWs and MIDAWs no longer exist in zHPF (They too are alive and well in FICON)
  - Replaced by Transport Indirect Data Address Words (TIDAW)
- New structures added
  - Transport Control Word (TCW)
  - Transport Status Block (TSB)
  - Transport Command & Control Block (TCCB)

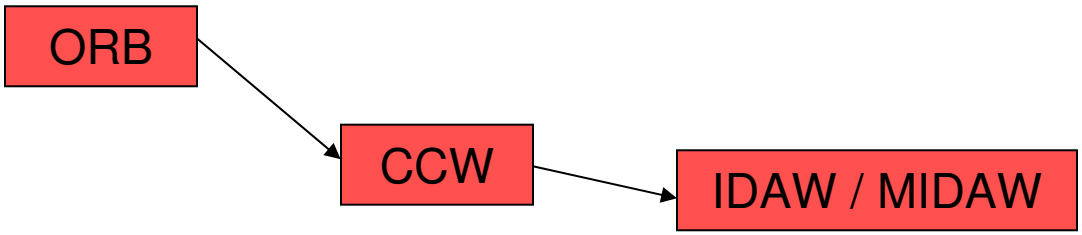
Command Mode Review

ORB

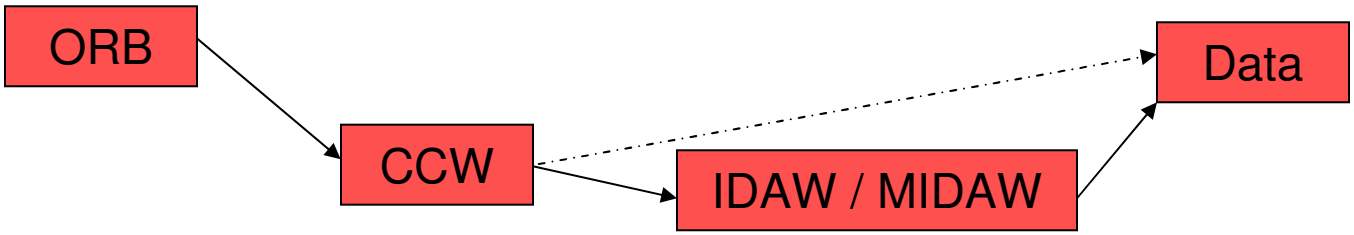
Command Mode Review



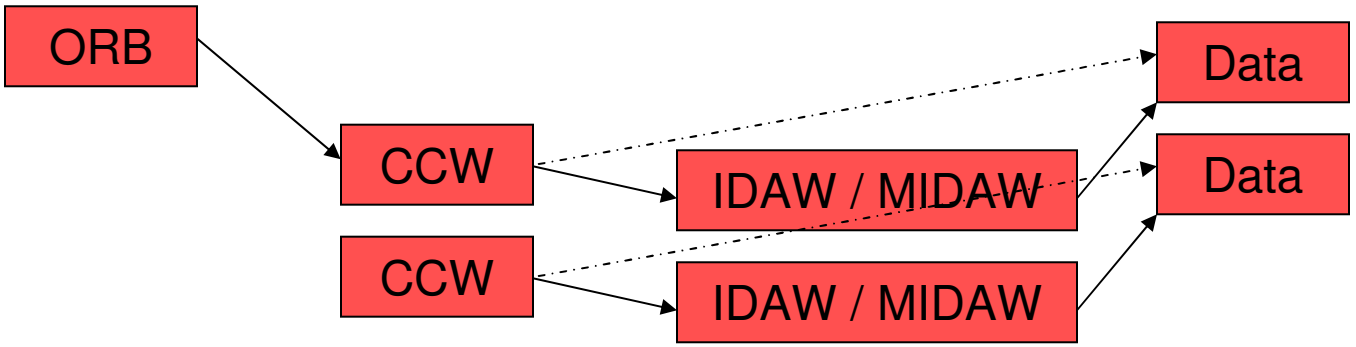
Command Mode Review



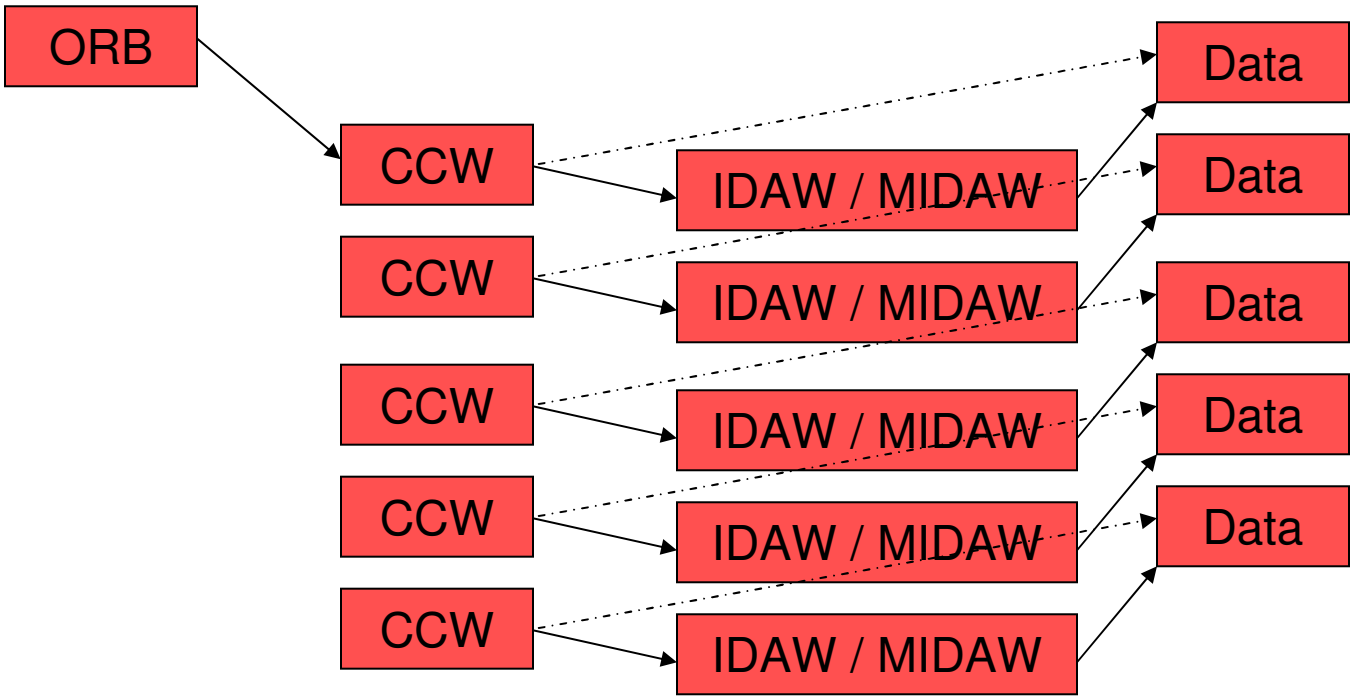
Command Mode Review



Command Mode Review



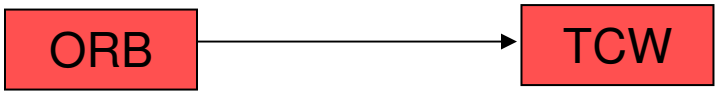
Command Mode Review



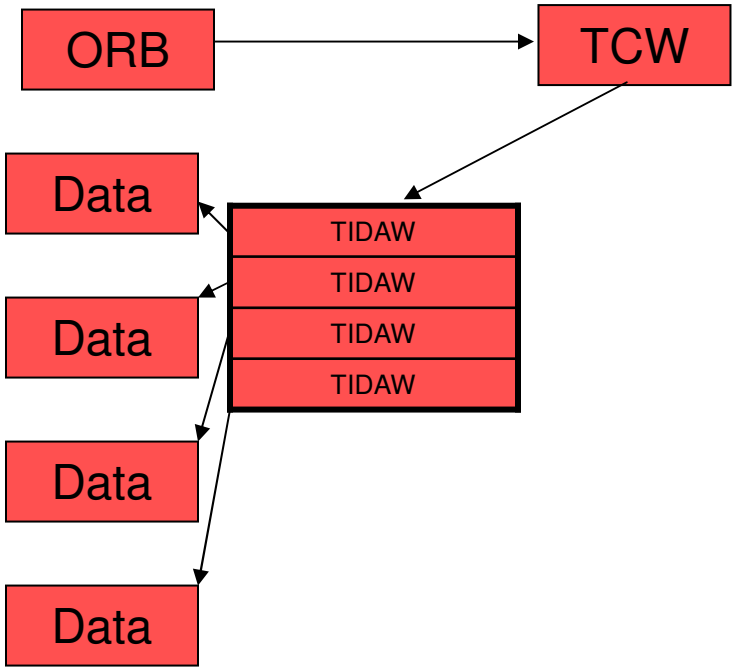
Transport Mode

ORB

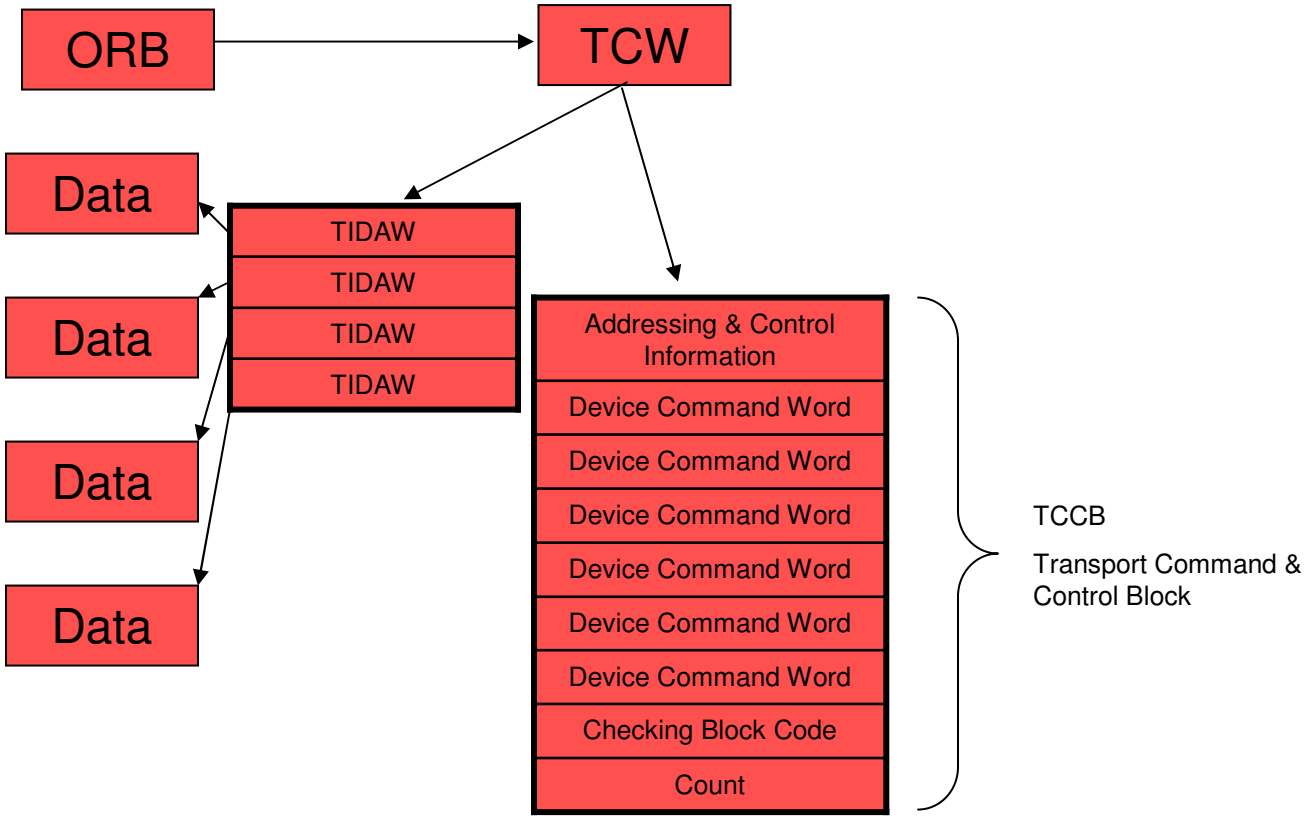
Transport Mode



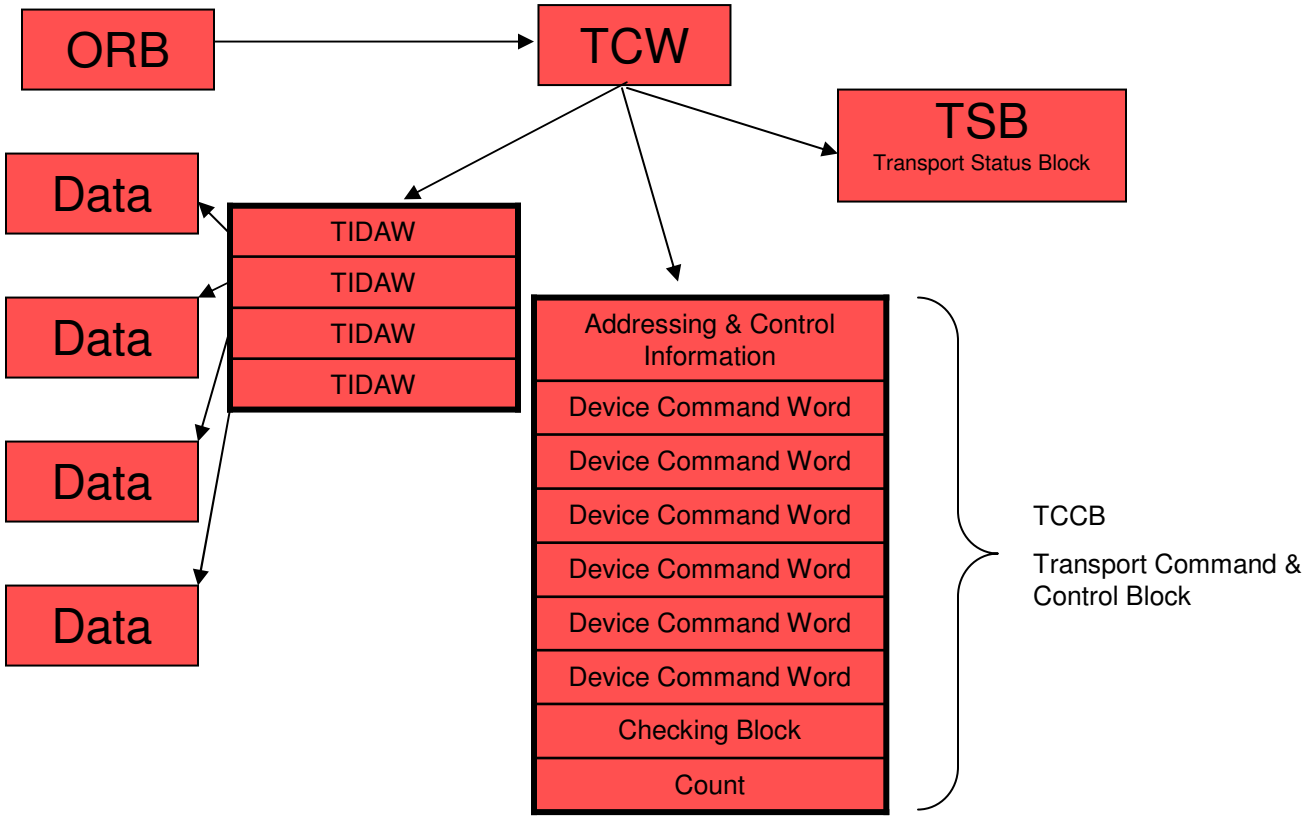
Transport Mode



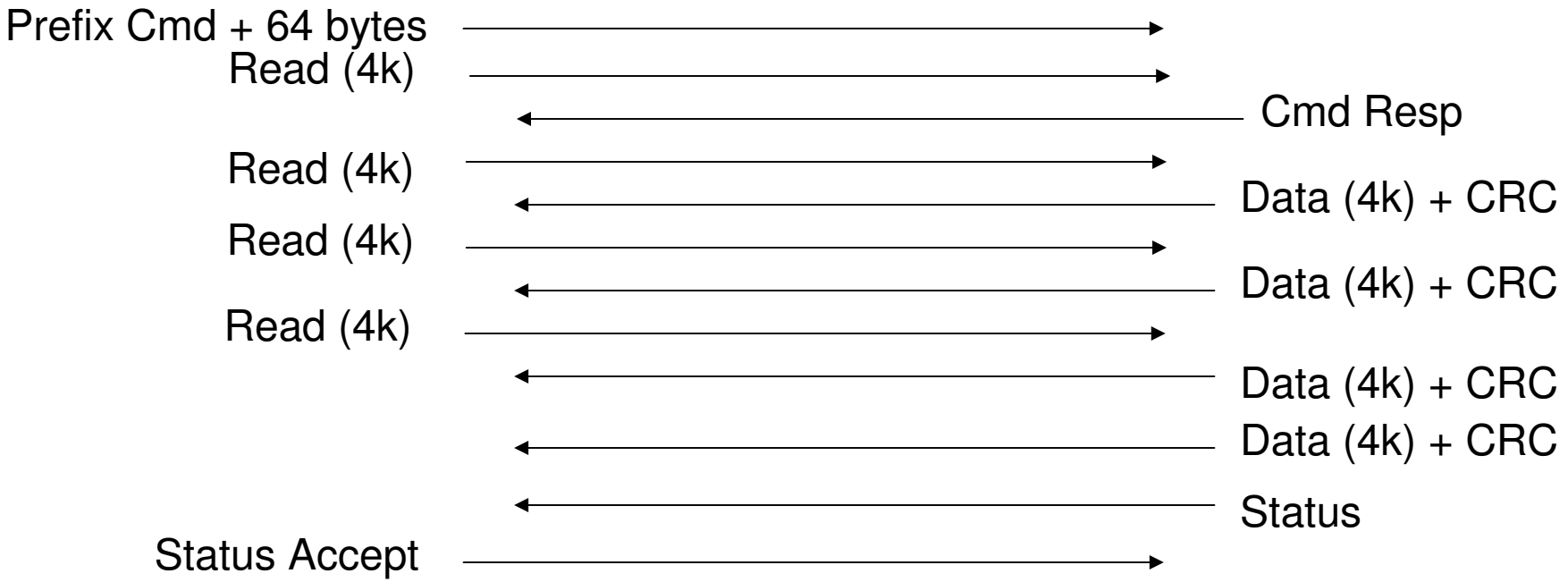
Transport Mode



Transport Mode



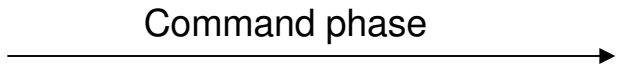
Link View of 4 Reads in Command Mode

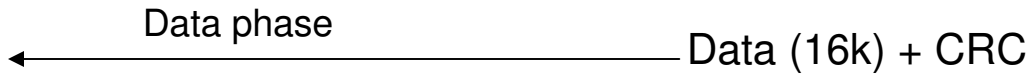


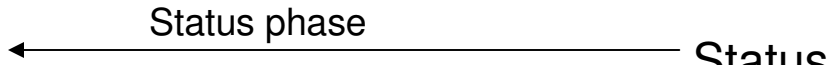
	Channel to Control Unit	Control Unit to Channel
Total Commands	5	N/A
Exchanges	2	2
Sequences	6	6
Frames	6	14
CRC Generate / Check	5	5

Link View of 4 Reads in Transport (zHPF) Mode

Prefix + 64 byes of prefix data +
Read (4k) + Read (4k) + Read (4k) +
Read (4k)

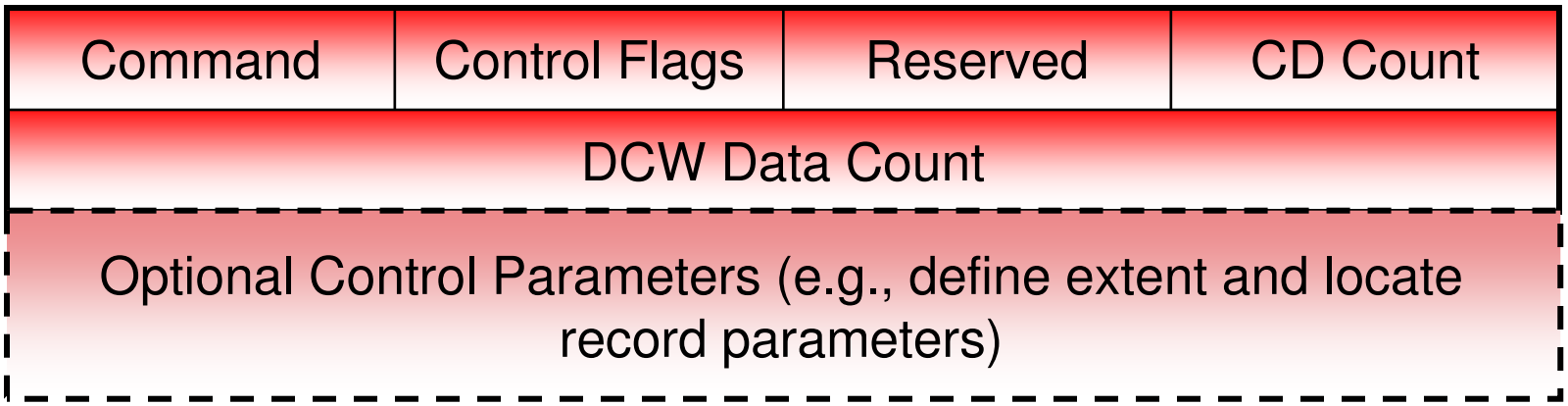






	Channel to Control Unit	Control Unit to Channel
Total Commands	5	N/A
Exchanges	1	1 (same one)
Sequences	1	2
Frames	1	10
CRC Generate / Check	1	1

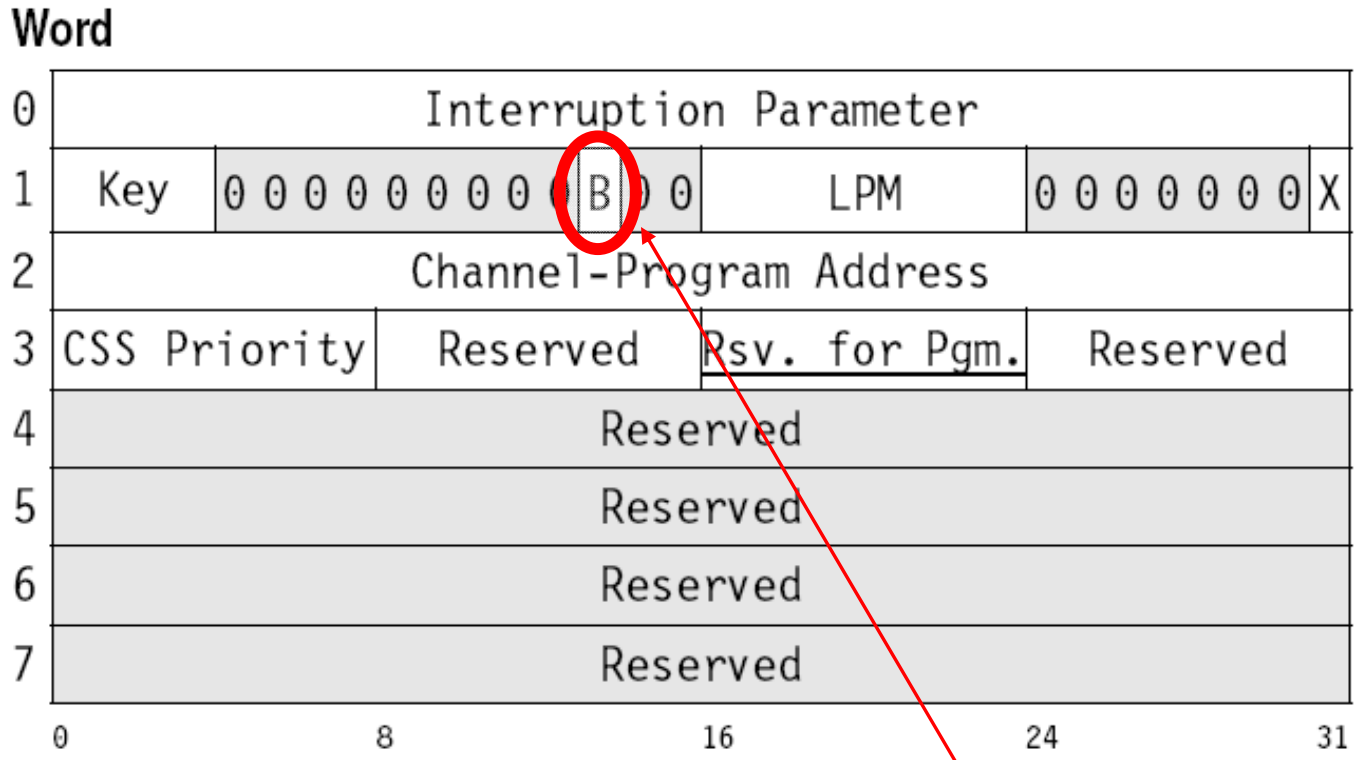
Device Control Word (DCW)



Device Control Word (DCW)

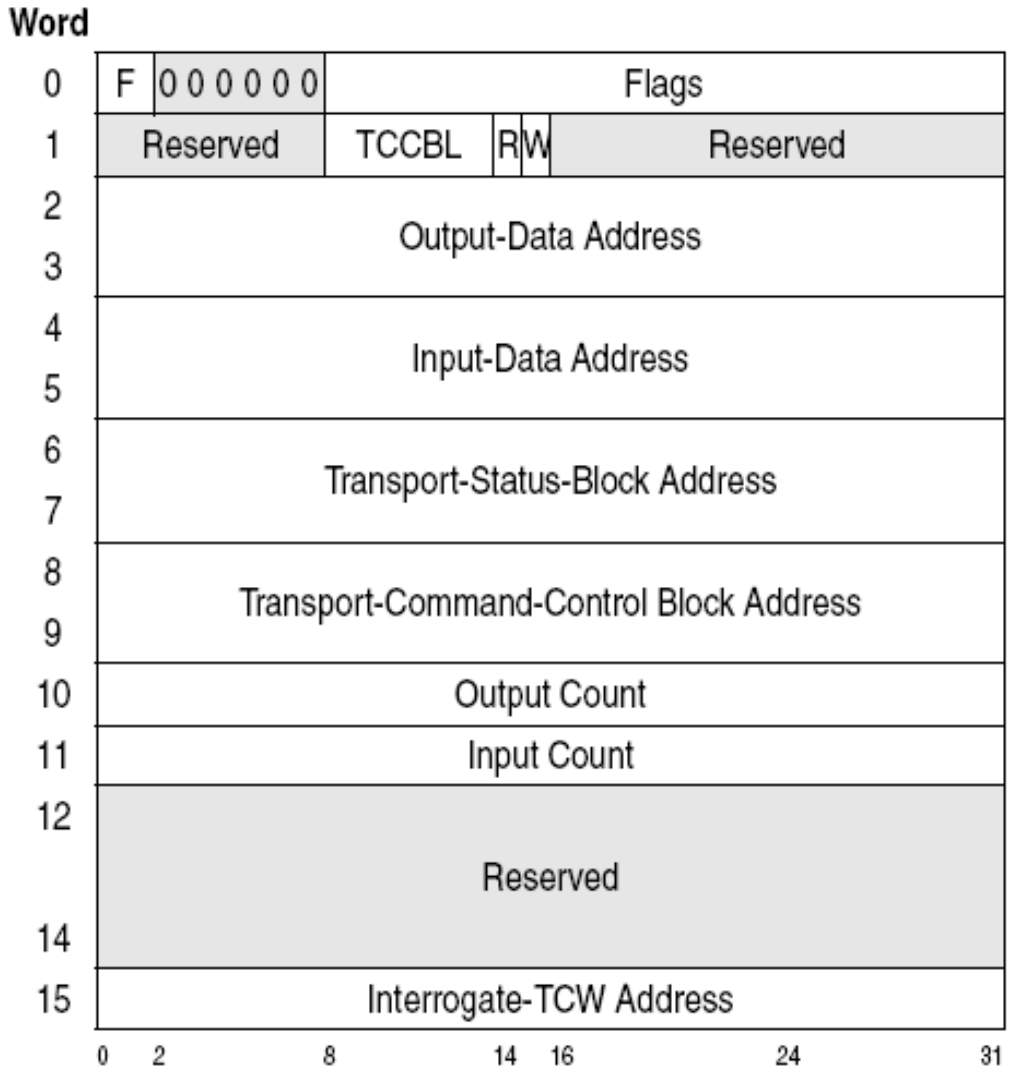
- Control Flags
  - CC (Chain Command)
    - Another command follows. If the command completes “normally” the next command is to be executed
- CD Count
  - Number of bytes that follow the DCW that contain Control Data for the DCW
- Data Count
  - Number of bytes of data to be transferred in the data phase for this DCW not including any Pad and CRC

ORB



Specifies Transport (zHPF) Mode

TCW (Transport Control Word)



Agenda

What does zHPF Do For Me?

How Does zHPF Do It?

The Effect On Exchanges

Other Improvements

How does zHPF affect EXCHANGES ?

- Little's Law states:
  - *The number of "things" in a system can be determined by multiplying the average arrival rate of those "things" by the average time each "thing" stays in the system.*
  - Applied to zHPF:
    - The average number of Exchanges active at any given time = Average I/O rate * Average response time
    - Example: 30000 Ficon I/Os / Second on a given channel with .3ms service time[1] uses 9 Active Exchanges at any given time

[1] The amount of time the I/O is active in the channel

How does zHPF affect EXCHANGES ?

- The CU holds on to the Exchange even if the device:
  - Is reserved
  - Detects an Extent Conflict
  - Cache Miss
  - etc
- Drives requirement for higher number of possible open Exchanges

Example:

Assume we are doing 50,000 I/Os per second with an average service time of 0.5 ms. If 20% hit one of the above conditions and If each of those conditions lasts for 10ms, then:

100 Exchanges are needed for Busies

20 Exchanges are needed for the rest

How does zHPF affect EXCHANGES ?

- CU can dynamically adjust the number of open Exchanges any one channel can open to THAT CU (physical link)

- Channel maintains a Exchange count and Exchange Limit for each physical link to a control unit

New RMF Fields for zHPF

CHANNEL PATH			UTILIZATION(%)			READ(MB/SEC)		WRITE(MB/SEC)		FICON OPERATIONS			ZHPF OPERATIONS		
ID	TYPE	G SHR	PART	TOTAL	BUS	PART	TOTAL	PART	TOTAL	RATE	ACTIVE	DEFER	RATE	ACTIVE	DEFER
00	FC_S	5 Y	100.00	100.00	0.84	0.13	2.15	0.17	2.68	61.5	1.7	0.0	4.6	1.0	0.0
01	FC_S	5 Y	100.00	100.00	0.85	0.13	2.21	0.13	2.69	61.3	1.8	0.0	4.7	1.0	0.0
02	FC_S	4 Y	0.14	2.30	0.85	0.10	2.17	0.13	2.70	61.3	1.3	0.0	4.6	1.0	0.0
03	FC_S	4 Y	0.13	2.27	0.84	0.11	2.14	0.13	2.66	60.0	1.3	0.0	4.4	1.0	0.0
04	FC_S	5 Y	0.13	2.24	0.82	0.10	2.07	0.13	2.63	59.4	1.7	0.0	4.4	1.0	0.0
05	FC_S	5 Y	0.13	2.25	0.83	0.10	2.11	0.12	2.66	59.1	1.7	0.0	4.2	1.0	0.0
06	FC_S	4 Y	0.12	2.23	0.83	0.10	2.09	0.13	2.68	58.7	1.3	0.0	4.2	1.0	0.0

What Do I Need to Exploit zHPF?

- z10 at Driver 76 or higher
  - Power On Reset is REQUIRED to activate zHPF
- z196, z114, zEC12

- FICON Express-2 or above, FICON Express 8S for full exploitation

- Control Unit that supports zHPF
  - Check with your vendor for appropriate code and/or hardware levels
  - Enable the LIC feature

- All supported releases of z/OS
  - zHPF mode has to be enabled (IECIOSxx parmlib or SETIOS command)
  - SAM_USE_HPF=YES in IGDSMSxx (QSAM/BSAM support)

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MIH

- Reduced False Missing Interrupt for reserves
  - Avoids “Go to the end of the line” penalty for MIH due to reserves
  - zHPF allows the OS to interrogate the state of an existing I/O operation
- Enhanced MIH messages and logrec

MIH Message Example

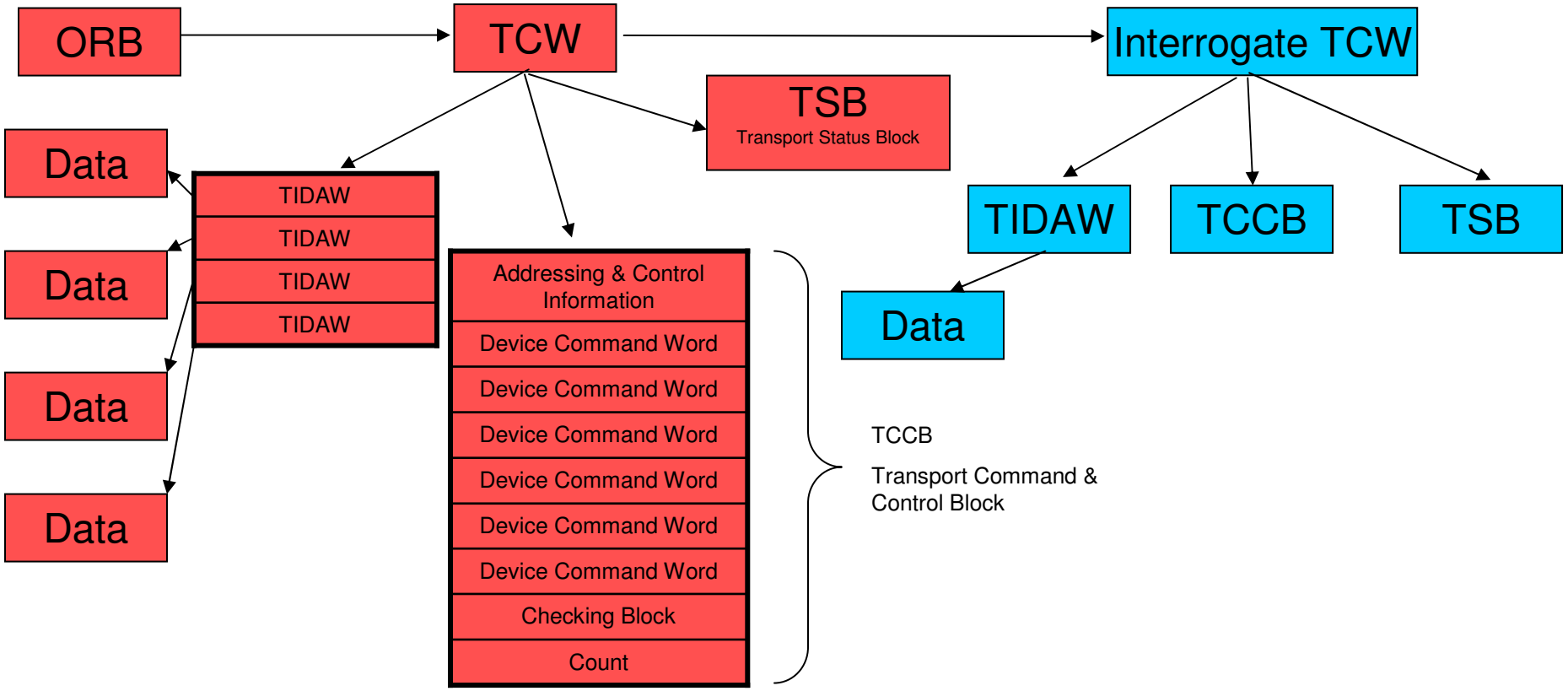
IOS071I 031B,62,*MASTER*, START PENDING
STATUS: DEVICE RESERVED BY ANOTHER SYSTEM

IOS071I 0980,40,IOSAS, START PENDING
STATUS: NO I/O OPERATION IS IN PROGRESS

IOS071I 0410,F2,WHATEVER,START PENDING
STATUS: I/O WAITING FOR EXTENT CONFLICT

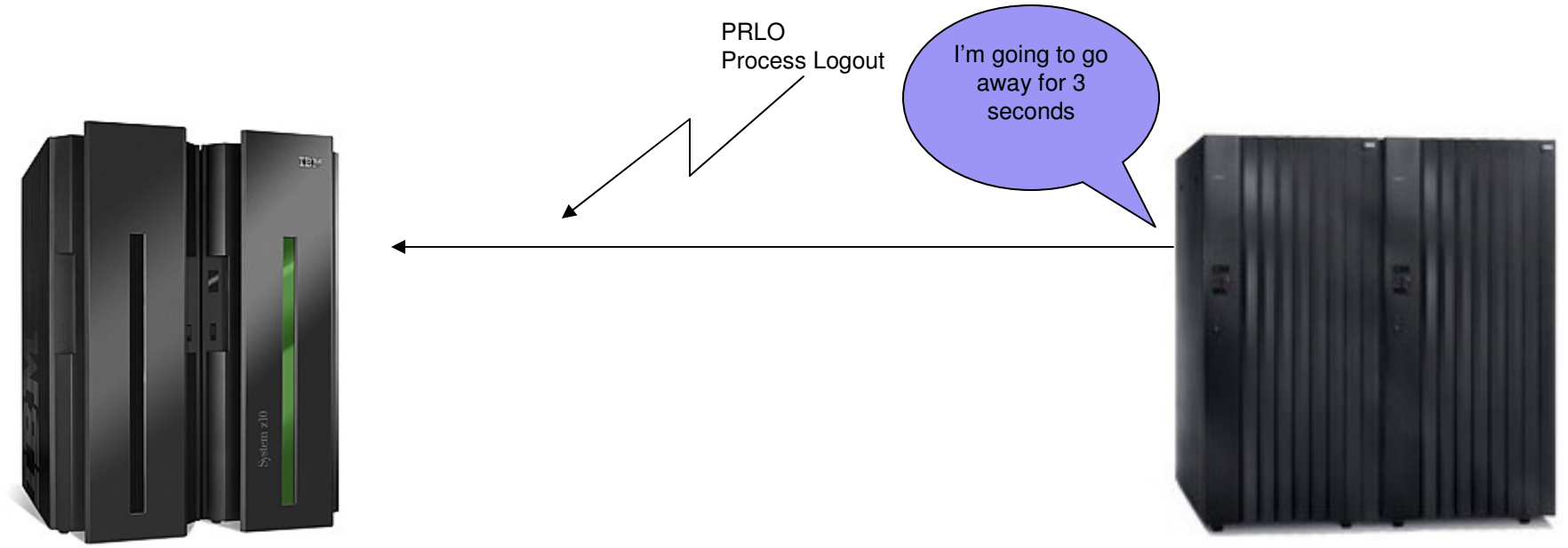
IOS071I 1029,A8,JES3,START PENDING
STATUS: I/O OPERATION IS EXECUTING

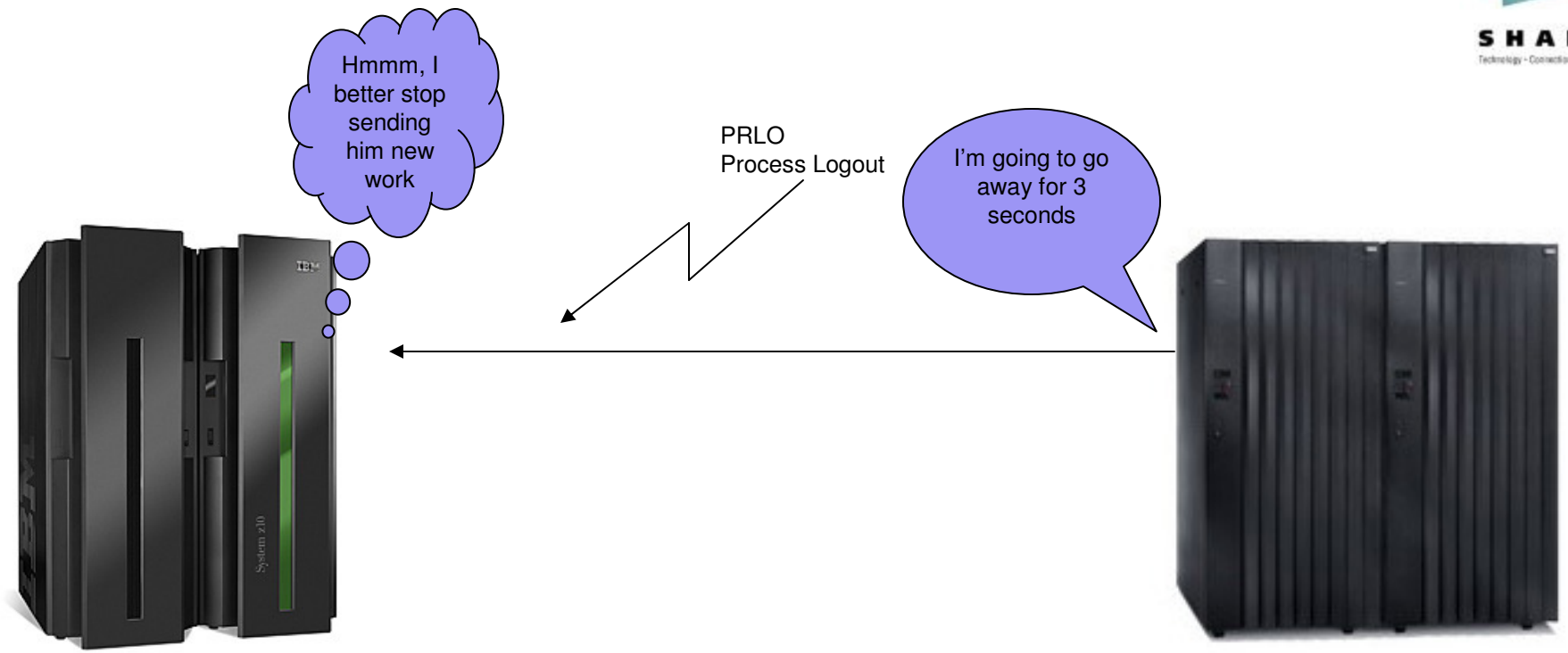
Transport Mode

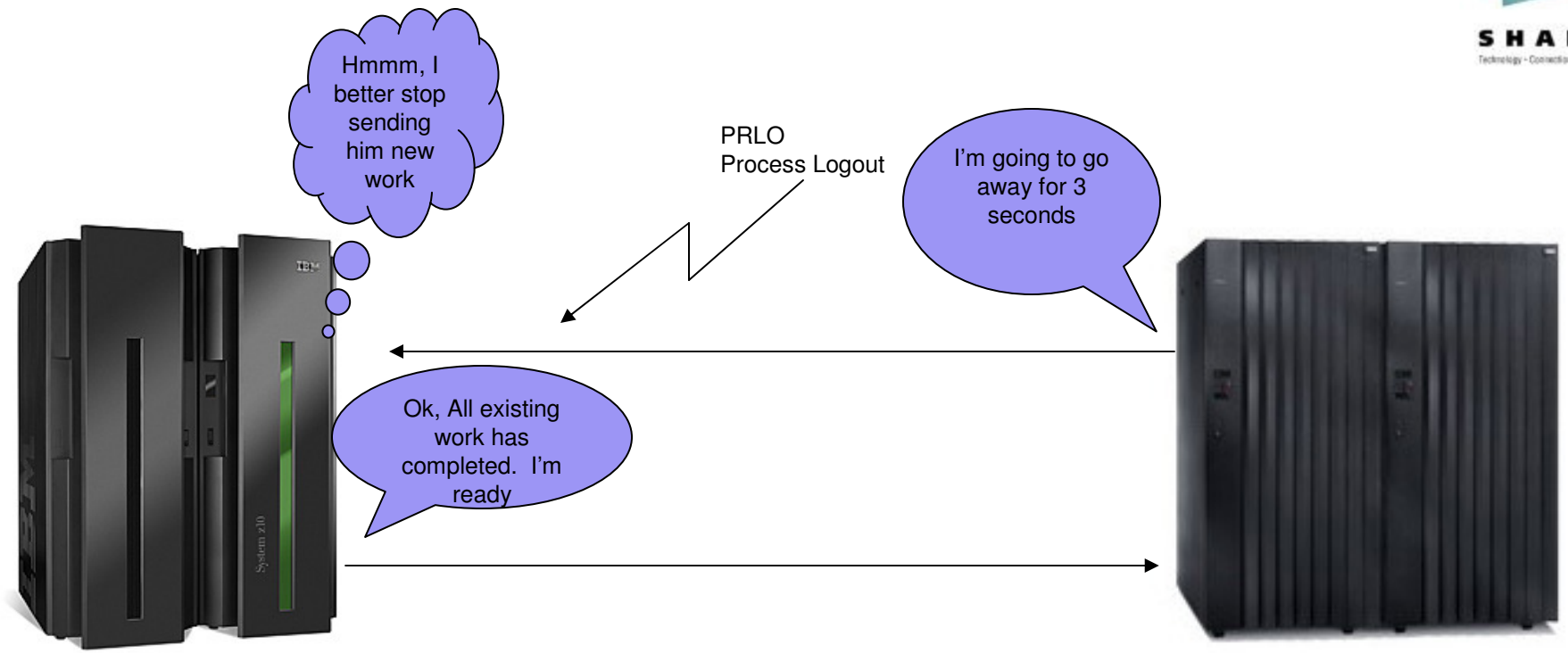


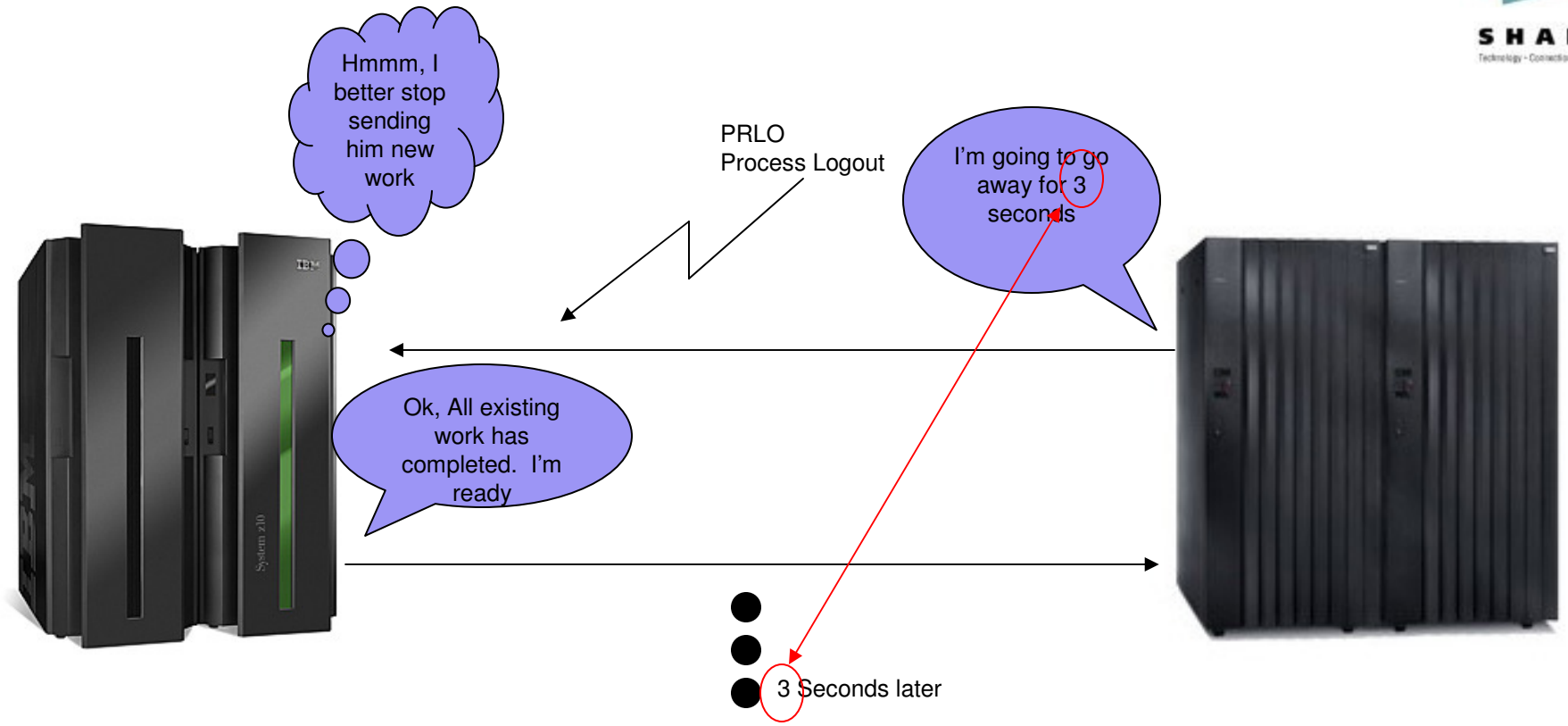
Temporary Logout

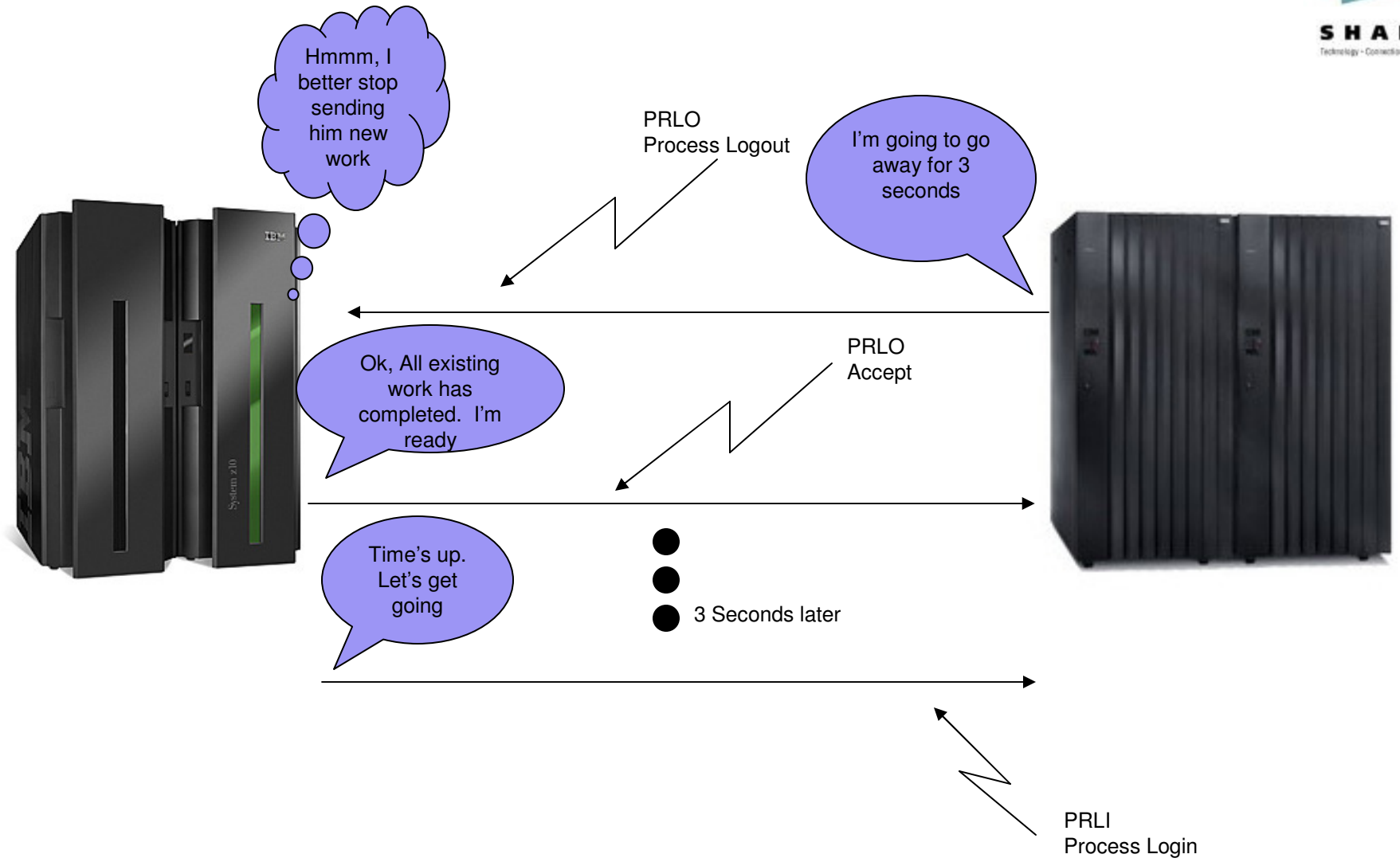
- CU firmware updates can be “cleaner” with zHPF support
- zHPF introduces a “temporary logout” concept
  - CU tells channel that it is ‘going away’











Thank You For Your Time And Attention

Feel free to e-mail me with any zHPF or FICON questions