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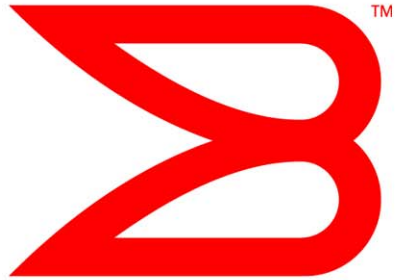

To CUP, or Not To CUP? That is the (FICON) Question!

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Abstract

- CUP, or Control Unit Port is a holdover from ESCON directors. In a FICON environment, CUP allows for in-band management, and opens the door to FICON director performance metrics via the RMF 74-7 record, more commonly known as the FICON Director Activity Report. In an effort to reduce acquisition costs and be more competitive on price, many vendors will try and make the case why you do not need CUP on FICON directors. This presentation will present the reasons why, from a performance management perspective, "that not to CUP" is the wrong answer to the question posed by the title.

Handouts

http://www.steveguendert.com/Presentations.html

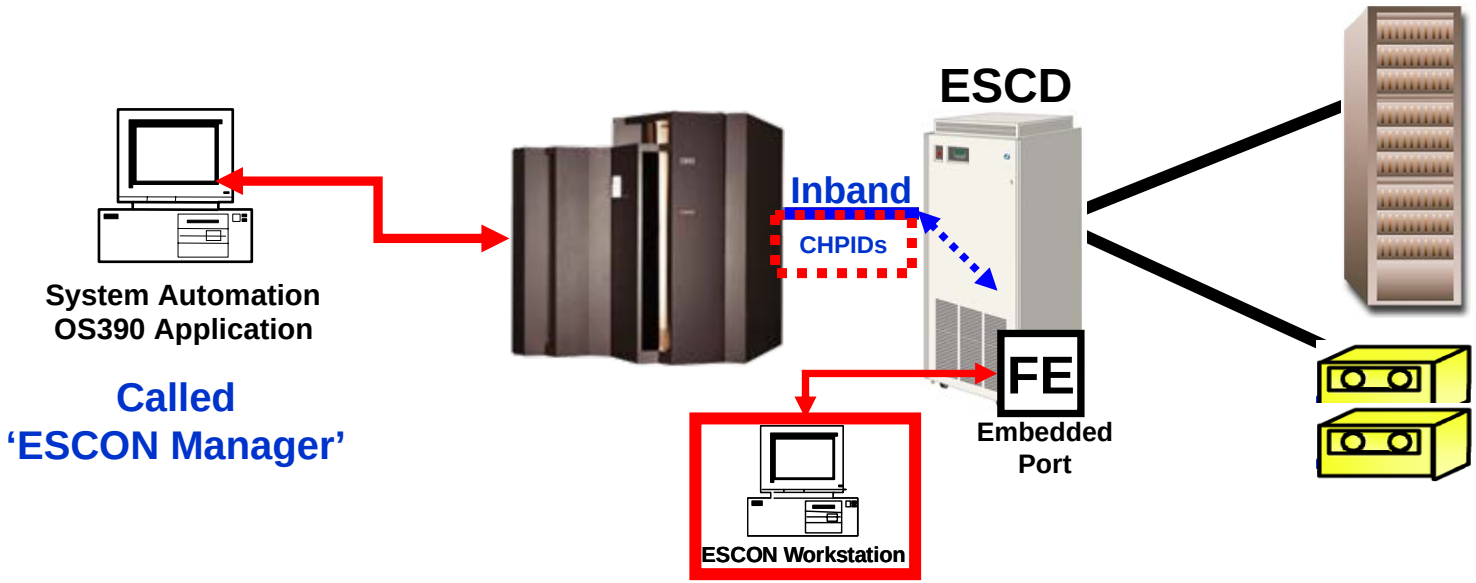
Agenda

- What is CUP?
- History of CUP
- ESCON use
- FICON use
- FICON Director Activity Report (RMF 74-7)

Control Unit Port – CUP

- CUP on FICON is a legacy of CUP on ESCON
- The 9032-5 ESCON Directors have an in-band management capability that utilized an embedded port in the control processing cards to provide a communications path to an MVS console
  - It was used to report hardware errors up to MVS (Helpdesk)
  - It was used to block and unblock ports (PDCMs)
  - It was used to monitor performance
- When switched-FICON was being engineered, IBM wanted to be sure that its users would have a consistent look and feel between ESCON and FICON including CUP
- Take note - the mainframe sets the clock to GMT through CUP
  - This is not really desirable for open systems people if you have an intermix environment

CUP Under ESCON



- ESCON manager
- Embedded port FE is also called the 'Control Unit Port' or CUP
- MVS Consoles or ESCON workstation can control the ESCON Director
- Best practice was to have 2 or more CHPIDs with access to the CUP
- Safe switching

FICON CUP Support

- CUP = Control Unit Port (an embedded not physical port)
  - Allows in-band management of Directors from the management applications on a Mainframe
  - Used for configuration, monitoring, and error handling
- CUP support is provided by all vendors
  - Usually it is an optional licensed feature
  - Supported in single or cascaded FICON environments
- CUP is typically used by customers with:
  - SA/zOS (System Automation software) configuration tool
  - RMF (Resource Measurement Facility) monitoring tool
    - There are a lot of things going on in a FICON storage network
    - Some very important information is gathered by RMF from CUP

Details of CUP
Control Unit Port

- There are 39 CUP commands, or Channel Command Words (CCWs), for monitor and control of switch functions

- Due to the historic nature and use of ESCON CUP, FICON CUP commands are oriented toward management of a single switch

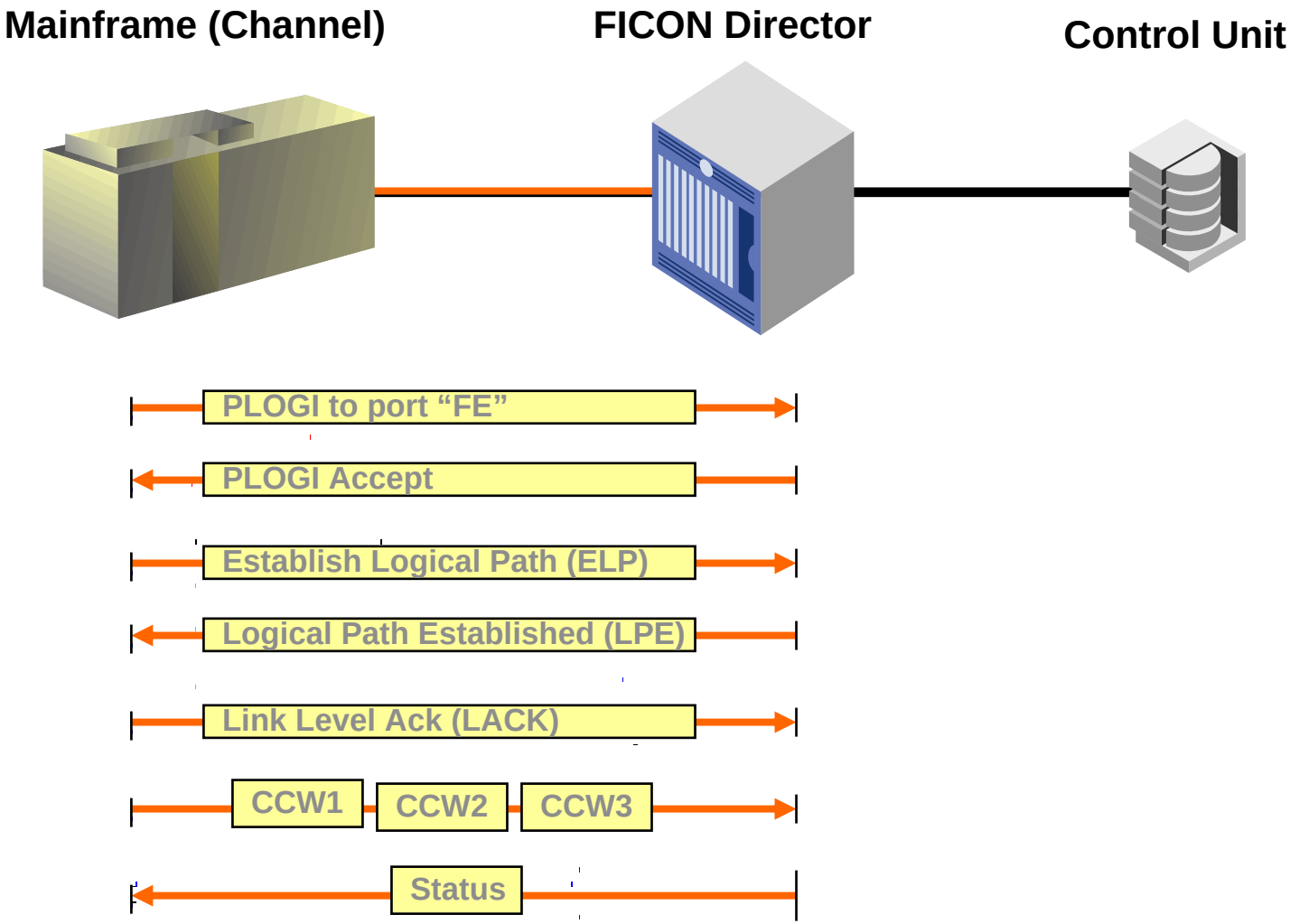
- Although the use of CUP in a cascaded environment is supported, CUP is primarily limited to controlling a single switch at a time

Initial Program Load (IPL)

- The IPL is a special configuration file identified by the unique file name “IPL”
- The parameters contained in the IPL file are the same as other configuration files, but there are special uses for this file
- The configuration defined by the IPL will be applied upon reboot of the FICON Director/switch
  - This could be a scheduled downtime reboot
  - Or this could be an unscheduled power failure for example
- Active=Saved Setting (a Mode Register bit - discussed later):
  - When the Active=Saved Mode is enabled, changes made to the active configuration (HCD settings) are also stored in the IPL
  - When Active=Saved Mode is disabled, at reboot the HCD settings will be restored to the FICON switching device which might not accurately reflect the hardware state of the box
    - Especially if port swaps have not been updated in the HCD

CUP

Logical Path Establishment and CCW Flow



Using CUP
In-band Monitoring of the FICON Director

- Port Statistics
  - Number of words transmitted, received, etc
  - These counters are already available in the switch
- Switch Node Identifier
  - Serial Number, Manufacturer, etc
  - The information is the same Switch Node ID provided in the RNID ELS
- Configuration File Information
  - List of Configuration files residing on the switch
  - Actual file content, including port address name and port connectivity
- History Summary (Directory History Buffer)
  - Each change in status or configuration of the ports is logged in a history buffer
  - The history buffer can be retrieved through CUP
- Switch Configuration Data
  - Timeout values, number ports per card, etc

PDCMs
Prohibit Dynamic Connectivity Mask and Zoning

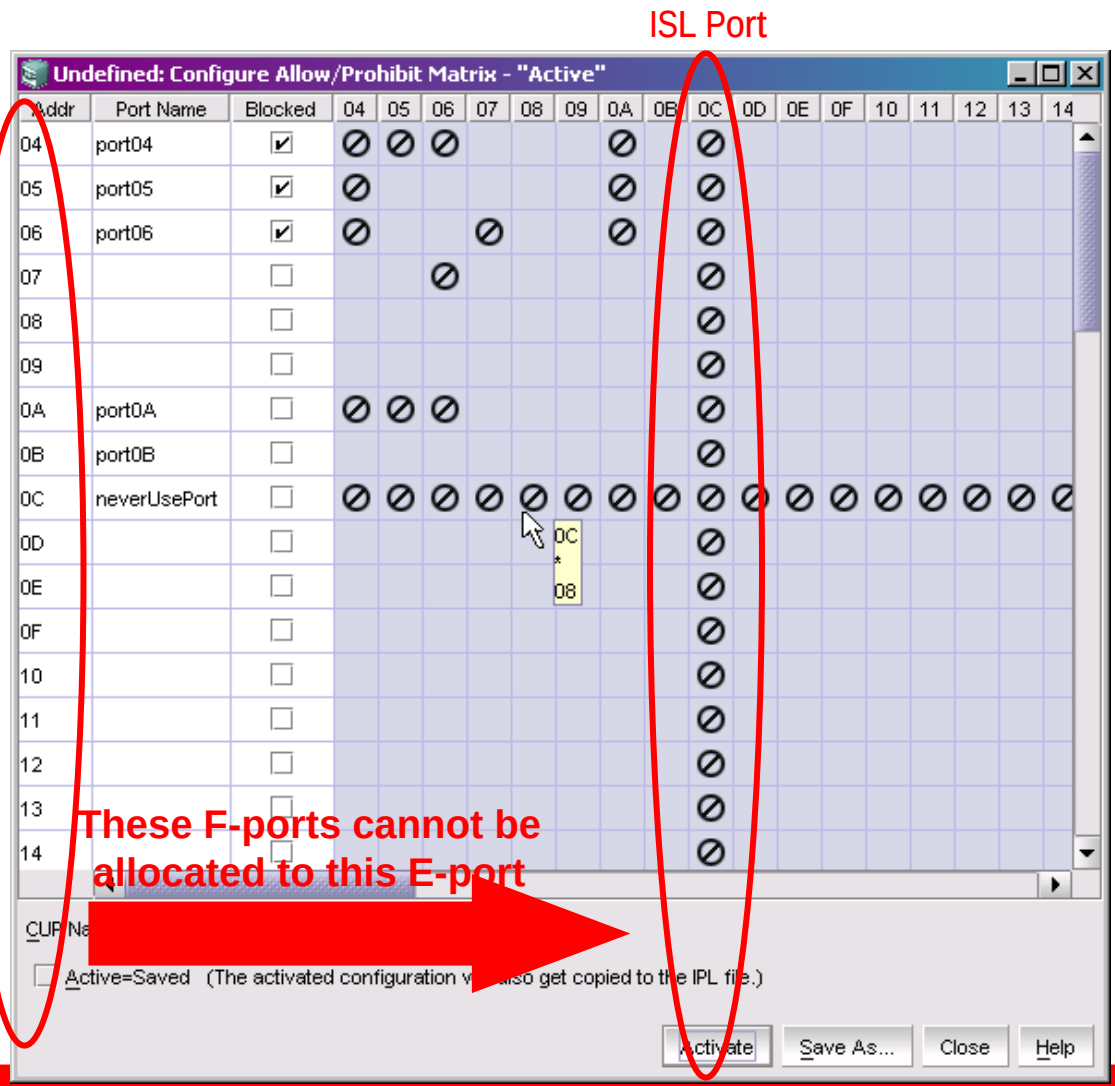
- The Prohibit Dynamic Connectivity Mask (PDCM) is a mechanism to define port connectivity (also referred to as prohibit/allow and blocking and unblocking)
- Prohibiting ports using PDCM across zones is redundant
  - Zoning rules already prohibit the devices from communicating
  - In the event of a conflict between zoning and PDCM definitions, the most restrictive rules are automatically applied
- E-Ports and PDCM
  - Classic-Brocade: E-Ports are not disabled through PDCM
    - E-Ports will not be prohibited from connectivity with other E-ports regardless of the settings in the PDCM matrix
    - A command received through the CUP port that prohibits connectivity to one or more E-Ports will be accepted, but the connectivity will still be allowed
  - Legacy-McDATA: E-Ports and F-Ports can be blocked/unblocked

FICON Configure Allow/Prohibit Matrix

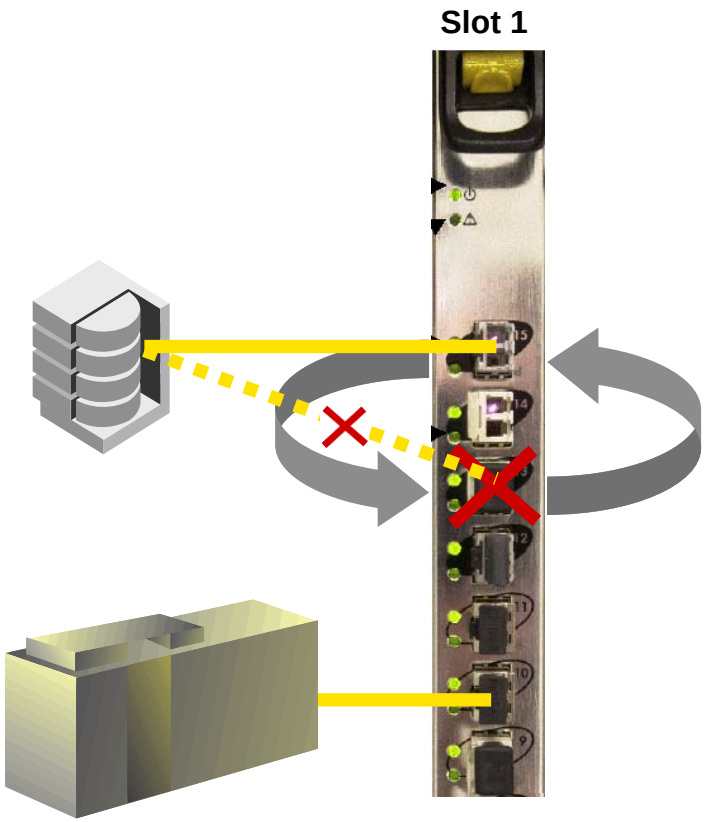
PDCMs

- Notice the tool tip is showing that the mouse is over the cell that intersects 0C and 08.

- Using the PDCM matrix, we can physically block the connection of F-port(s) to E-port(s)
- Physically cannot send a frame to that E-port



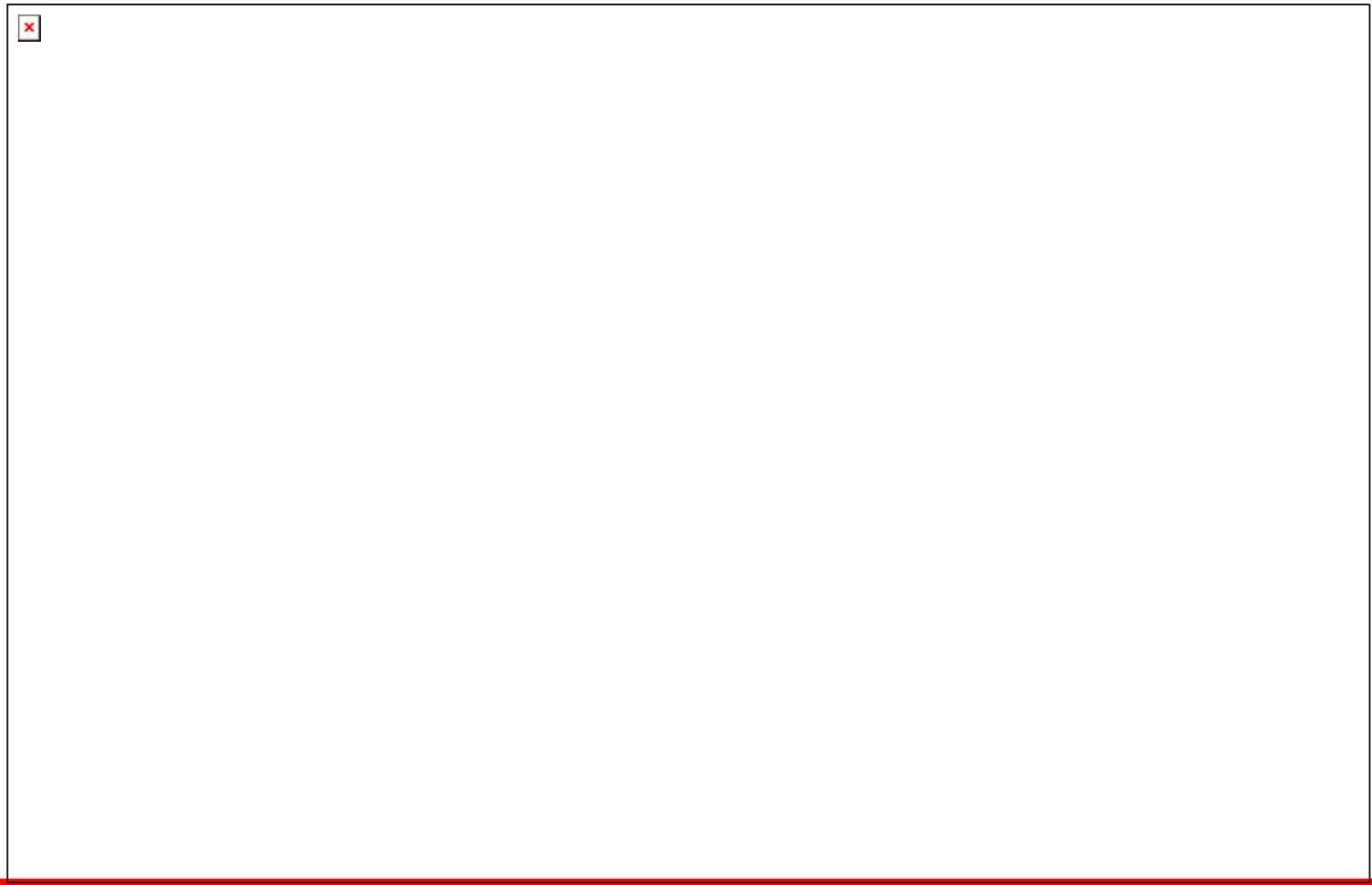
Additional Benefit - Port Swapping
Move FICON Cables without IOCP Update



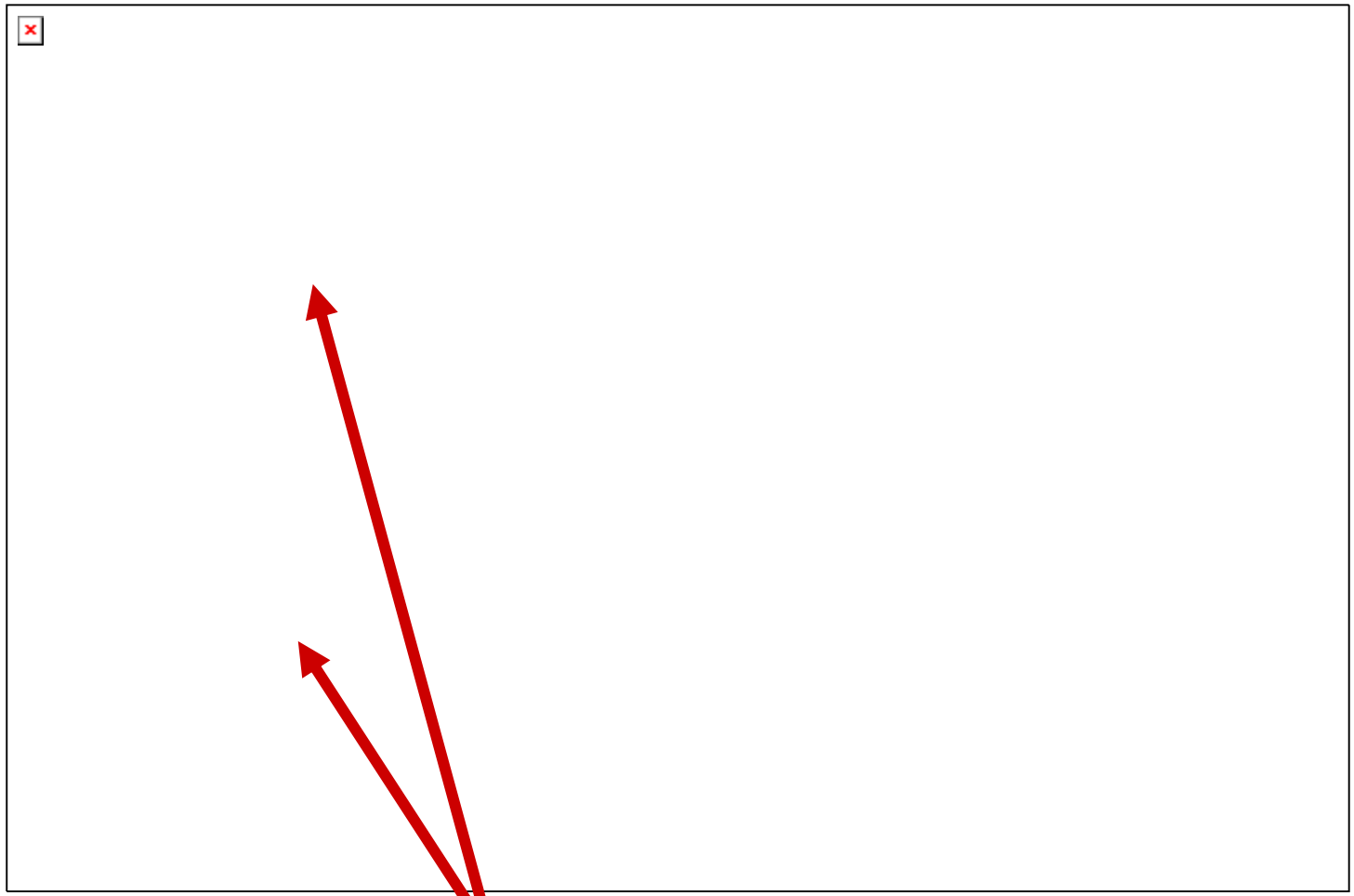
Defective port is address-swapped to a good port

- Swaps port assignments for a pair of switch ports
- Enables FICON storage devices to be moved onto different ports without the need to update the mainframe I/O configuration file (via HCD usually)
- Supports Mainframe zOS use of static I/O definitions
- Users can swap ports across all ports within a switch or Director
- NOTE: If the optical transceiver has failed, and not the port, just swap out the optics and re-cable back into the original port
  - A port swap would not be necessary!

EFC Manager for FICON Management
“Port Swap“



FICON Management - Port Swap



Port address swapping

Reasons That CUP Is Very Useful

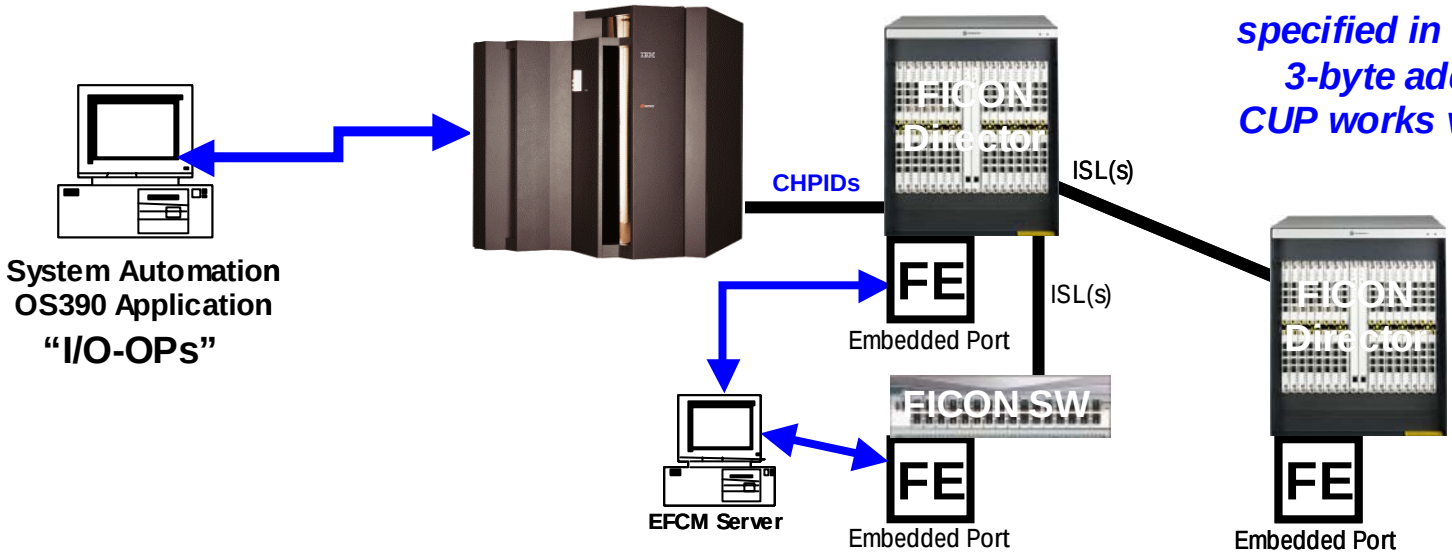
- If the user wants to be able to do in-band management from their Hardware management consoles, they need CUP
  - If they want to be able to use the management tools they are familiar with from ESCON, be it ESCON manager, System Automation OS/390 I/O-Ops, etc.
- If it is important to them to get the Service Information Messages (SIM) to the MVS console for FICON device hardware failures
- If the user plans on using the Dynamic Channel Path Management function of Workload Manager and IRD (DCM) when it becomes available for FICON
- If they want to do RMF Monitor I reports for reporting on FICON Director activity statistics in the SMF Record Type 74 Subtype 7, they need CUP
  - RMF Monitor I does long term data collection for resource utilization
  - I'll cover RMF in more detail in a few slides

Differences in CUP from ESCON to FICON

- **ESCON did not use buffer credits**
  - ESCON was half-duplex so an acknowledgement had to be received after each and every frame was sent
- **FICON does use buffer credits**
  - FICON is full-duplex, buffer credits provide flow control
- **RMF needs to report on these fancy, new "Buffer Credits"**
  - IBM chose to do this by creating RMF 74 subtype 7 records
  - RMF 74 subtype 7 records are new with FICON
  - RMF 74 subtype 7 records are only provided via FICON CUP
  - RMF 74 subtype 7 records are needed to understand FICON performance
  - RMF 74 subtype 7 records create a "FICON Director Activity Report" during each reporting interval for each CUP found

CUP Under FICON

Control Unit Port



Because Domain ID as well as CUP address are specified in the normal FCID 3-byte address, remote CUP works very well indeed!

- Switches/Directors have an embedded port "FE" in the control processor
- On 256 port Directors, this logical "FE" overlaps the physical port "FE"
- Using CUP, on 256 port boxes, physical ports "FE" and "FF" cannot be used
- In that case, use "FE" and "FF" for port swapping and for intermix ports
- Only one RMF should attempt to access "CUP" at any one time
- Too much activity to "CUP" can cause missing interrupts – boxed device
- Best practice is still to have 2 or more CHPIDs with access to the CUP

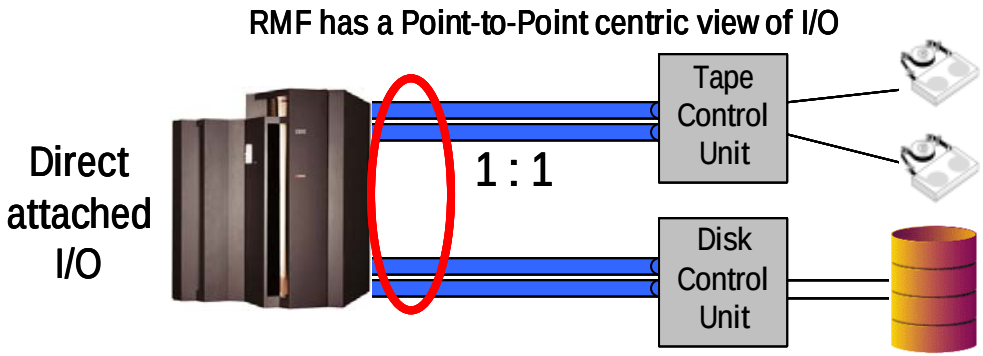
CUP for Use With RMF

- Much has changed in FICON
  - Multiple ESCON links can be aggregated onto a single FICON link
  - FICON allows full-duplex operations rather than the unidirectional technology of ESCON
  - FICON allows Fan In and Fan Out to really be effective (ESCON did not)
  - ESCON did not have a function like FICON Cascading
  - And lets not forget that all of these could be out of tune at the same time!

CUP for Use With RMF

- In MY opinion, RMF is the KEY motivator for using CUP:
  - RMF is a mainframe-centric view of the channel and device activity
  - Without CUP, RMF has no idea how fabric connectivity is affecting the I/O activity that it sees on any given CHPID
  - With CUP, an RMF FICON switch shares the gathered statistics about each of its ports enabling RMF to accurately report I/O channel and device activity as well as network timings
- CUP is turned on by implementing FICON Management Server (FMS)
  - A Fee-based software key that must be configured on each and every FICON switch for which CUP will be enabled
- What has changed that makes CUP more important in FICON?

CUP for Use With RMF

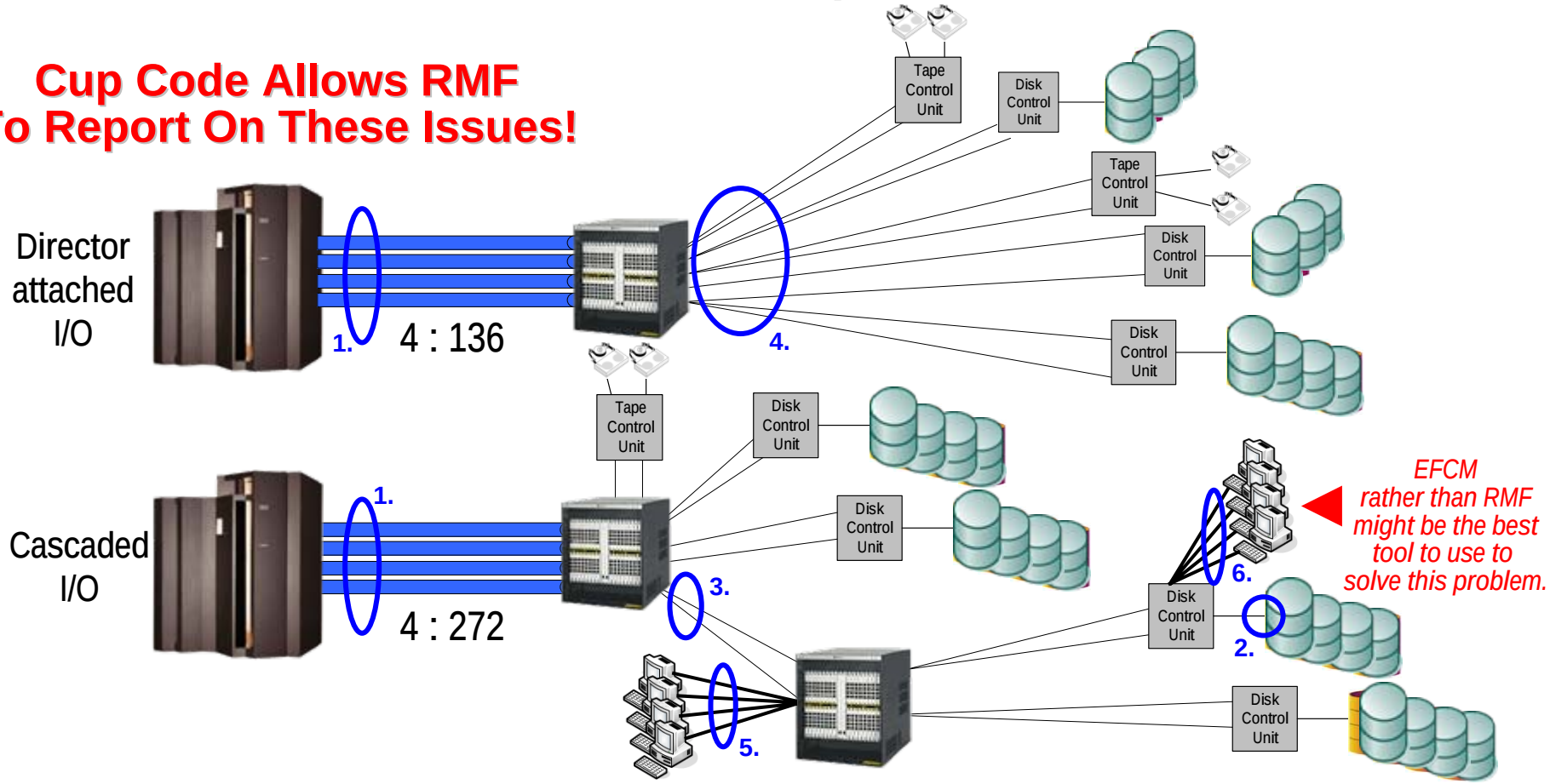


Does EXACTLY what RMF Should Do!

- **For RMF reporting, constructs such as Unit Control Block (UCB) and Logical Control Unit (LCU) are used to store gathered statistics (RMF Monitor I)**
- **A UCB is a device that is accepting or creating frame traffic**
- **A LCU is a control unit definition that encompasses one or more UCBs at a higher level**
- **RMF assumes he owns and controls everything in the universe (what SAN?)**
- **Can only measure and report on what is told to him about devices and paths**
- **Does not really understand anything about channel aggregation, fan in-fan out, and ISLs**
- **Most z/OS customers live and die by their RMF performance tuning!**

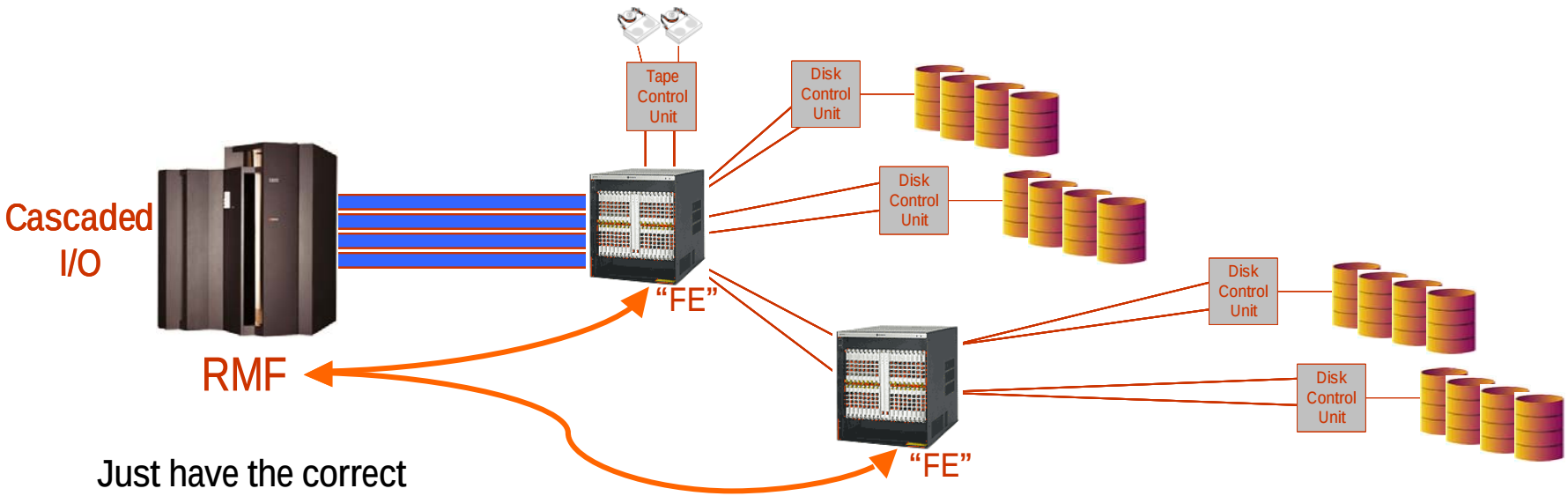
Networked FICON Has Special Issues

Cup Code Allows RMF To Report On These Issues!



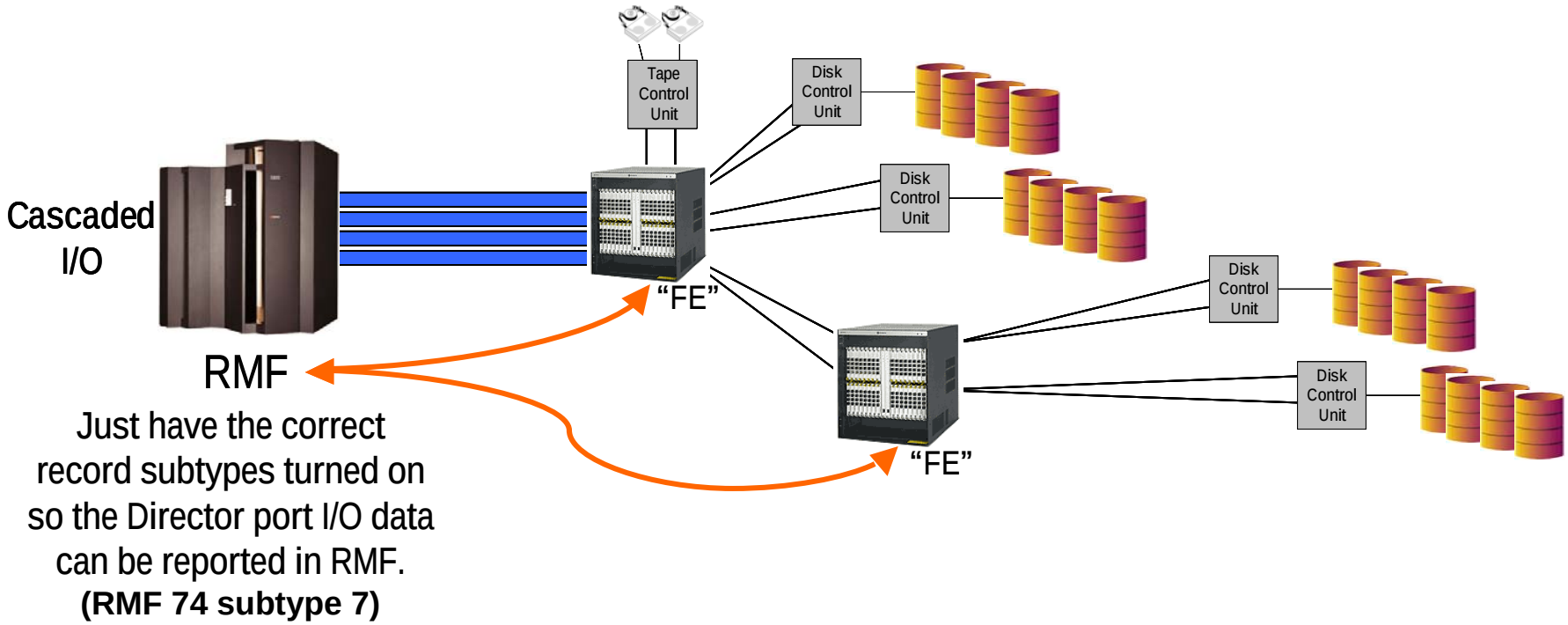
1. Could have FICON CHPID oversubscription due to incorrect aggregation
2. Could have Storage Port oversubscription due to incorrect Fan-Out aggregation
3. Could have ISL congestion due to changing workloads or improper FanIn-FanOut aggregation
4. Could have a permanent or intermittent frame pacing delay situation affecting performance
5. Maybe in a FICON and FC intermix structure, the SAN is causing CU busy problems out in storage
6. Maybe FICON and FC are using the same DASD and Open Systems is causing CU busy problems

CUP for Use With RMF



Just have the correct record subtypes turned on so the Director port I/O data can be reported in RMF.
(RMF 74 subtype 7)

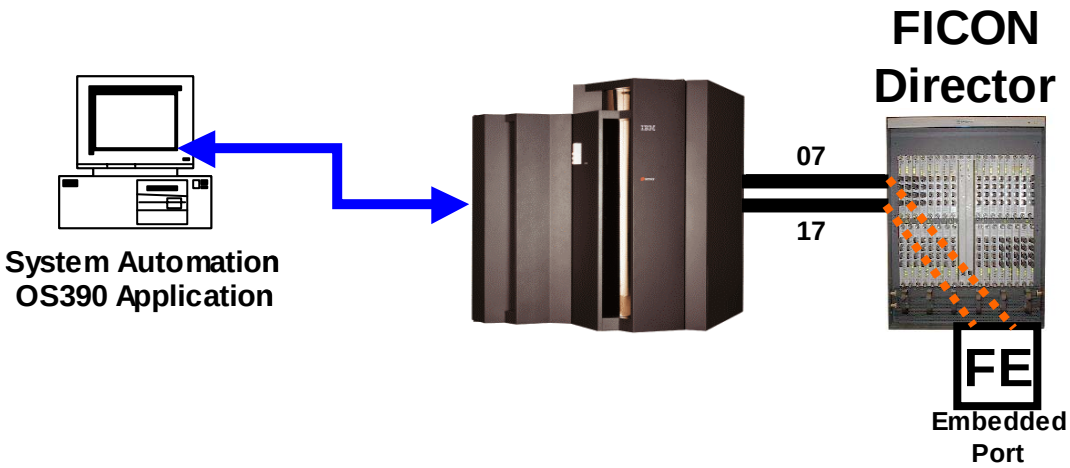
CUP for Use With RMF



- From one, and only one LPAR's path, RMF communicates with each FICON switch in turn, requesting that its "FE" port dump all FICON port statistics down to the mainframe.
- Then RMF distributes that information to all the other LPARs on the mainframe
- A FICON Switching Device report is generated for each FICON device with CUP

Also, timeout values need to be changed from 30 seconds to 3 minutes on the Missing Interrupt Handler (MIH) on older EOS's

Generating a CUP Device Address



Because Domain ID as well as CUP address are specified in the normal FCID 3-byte address, remote CUP works very well indeed!

- The CUP address is always FE and a specific CUP address notation in a fabric is dd-FE-xx where dd is the domain ID of the switch, FE is the embedded port address and xx we do not care about currently

- CHPID PATH=(07,17),SHARED,TYPE=FC,SWITCH=7A
- CNTLUNIT CUNUMBR=F008,PATH=(07,17),UNIT=2032,
  - UNITADD=((00,1)),LINK=(7AFE,7AFE)
- IODEVICE ADDRESS=(F008,1),UNITADD=00,CUNUMBER=(F008),UNIT=2032

ALWAYS the unit type!

- With multiple switches in a fabric with CUP, define them all in the same way, but the LINK statement will have the different domain IDs of the different switches: i.e. LINK=(61FE) or LINK=(6EFE) or LINK=(74FE) etc.

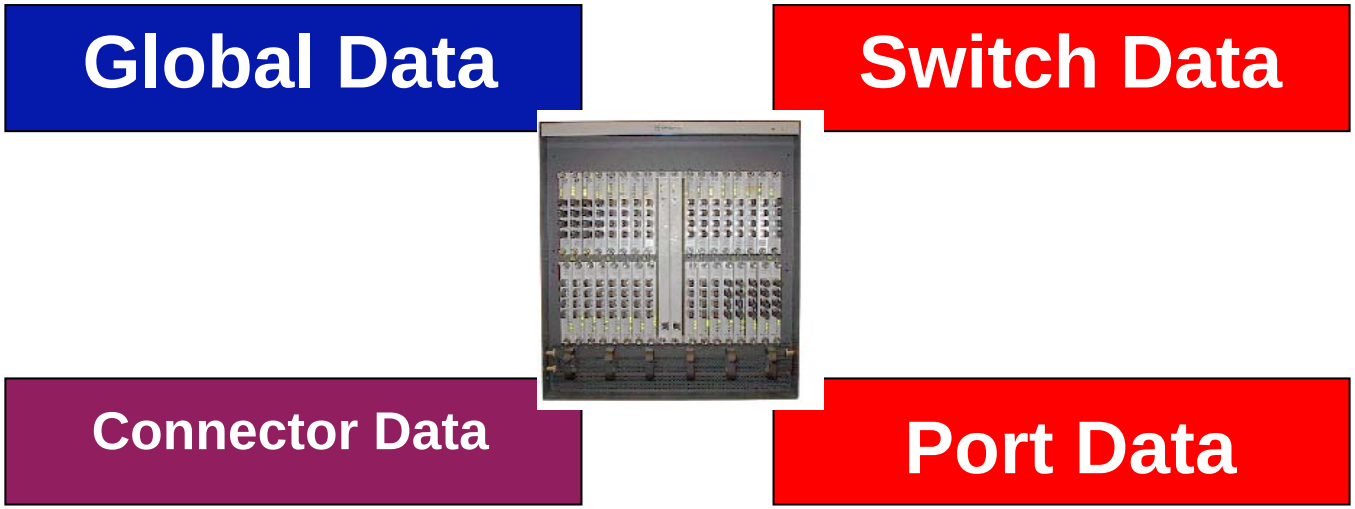
Using CUP

Genning CUP

CHPID PATH=(07,17),SHARED,TYPE=FC,SWITCH=7A
CNTLUNIT CUNUMBR=xxxx,PATH=(07,17),UNIT=2032,
UNITADD=((00,1)),LINK=(7AFE,7AFE)
IODEVICE ADDRESS=(xxxx,1),UNITADD=00,CUNUMBER=(xxxx),UNIT=2032

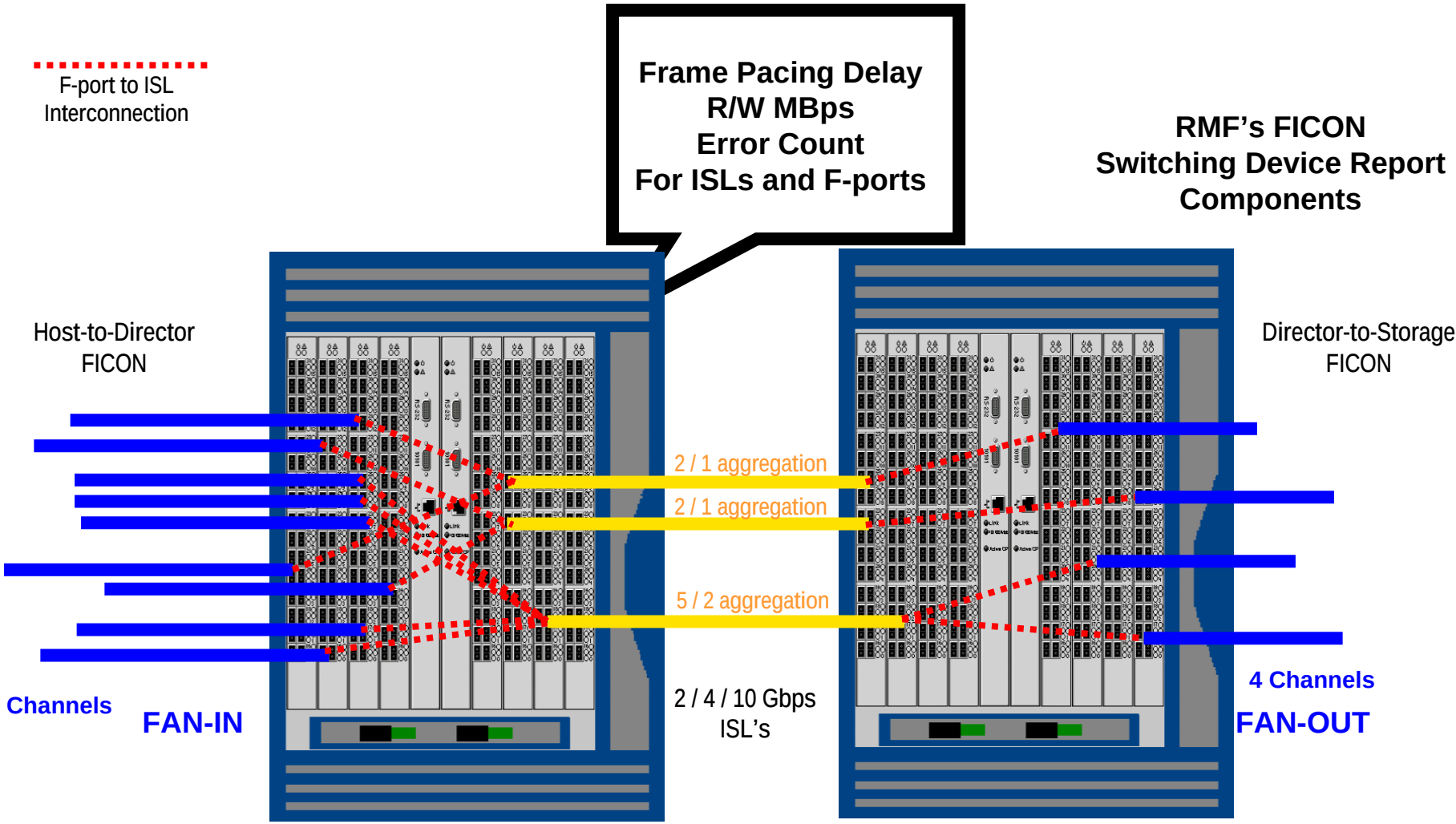
- From one, and only one LPAR path, RMF communicates with each FICON switch (the CTP card) in turn, requesting that its “FE” port dump all FICON port statistics down to the mainframe
- The “master” RMF then distributes that information to all the other LPARs on the mainframe
- A FICON Switching Device report is generated for each FICON device with CUP
- If necessary, timeout values for the Missing Interrupt Handler (MIH) need to be changed from the default 30 seconds to 3 minutes

RMF 74 Subtype 7 Records



- Four data classes of data are reported by the 74 subtype 7
- Port data includes average read/write frame sizes, average bandwidth, error count, and pacing delays for each port. *Frame pacing occurs when a director port exhausts its available credits.* Frame pacing delays are measured in 2.5 micro-second units
- Data is collected for each RMF interval if FCD is specified in your *ERBRMFnn* parmlib member

FICON Director Measurements



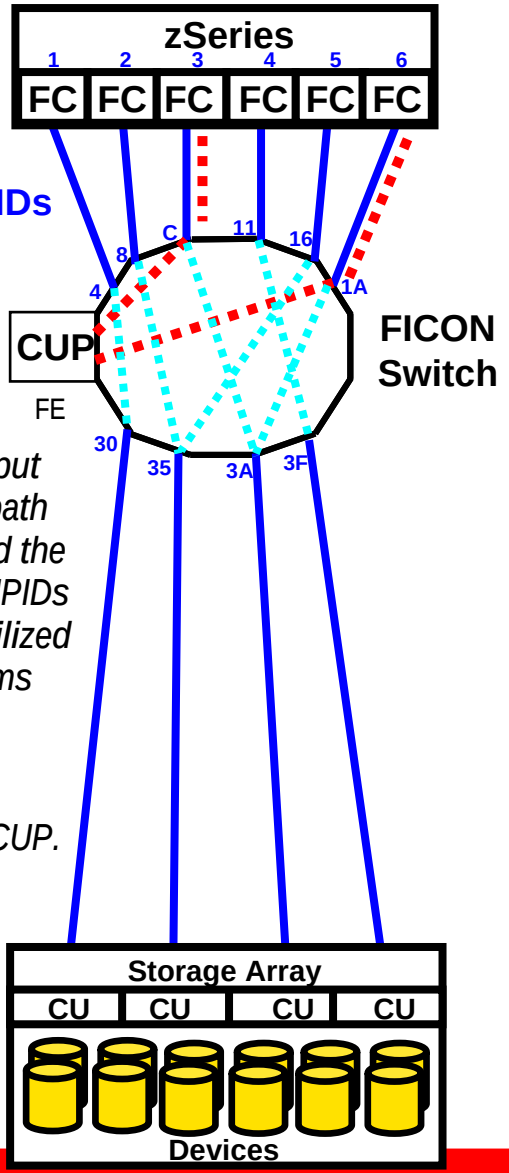
RMF 74 subtype 7 records turned on and CUP code implemented!

Frame Pacing Delay

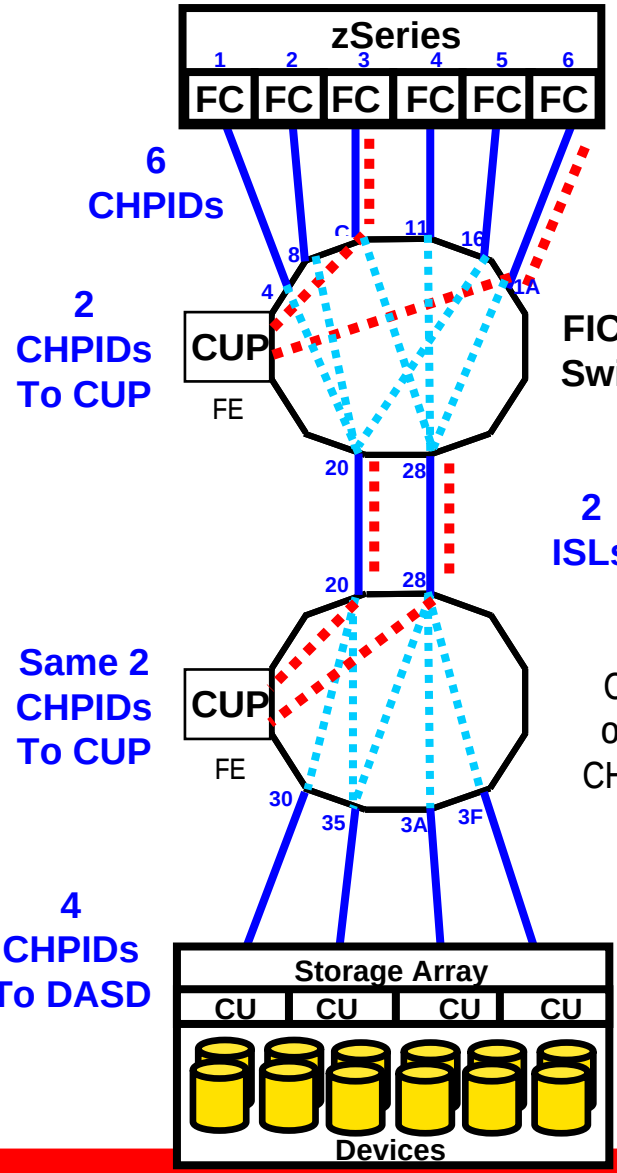
- AVG FRAME PACING
  - Defined by RMF as the number of 2.5 microsecond intervals that a frame has to wait before it could be transmitted due to no buffer credits being available.
- You always want to see a zero value in this field!
  - Reporting on this value was one of the primary reason that the RMF 74-7 record was developed – it was not needed for ESCON
  - A non-zero value in the AVG FRAME PACING field indicates that you have an issue with insufficient BB Credits
  - It is critical to use CUP in any FICON environment in which distance extension is being utilized
  - 4Gbps may create more Frame Pacing Delay issues than 2Gbps
- z/OS disk workloads rarely use a "full" 2148 byte credit
  - For example, with a 4k block transfer, the average frame size for each 4k transfer is typically about 819 bytes

Access CUP via Low Utilized CHPIDs

EXAMPLE



The CUP is going to put a data load onto the path between the switch and the mainframe. Choose CHPIDs that are more lightly utilized to handle this systems created workload so that performance is not affected by the CUP.



Things most often left out of proposals

Dual Cabinets to provide a five-9's, non co-located high availability environment

FICON Management Server to provide CUP services on FICON switching devices

- Dual cabinets and FMS are the most important of the features that are often removed from proposals

An Observation about FICON CUP

- IBM has been talking for years about moving away from CUP
- Their intent is to move the functionality that is only available from the CUP into other applications sometime in the future
- With that said, there may be new features that IBM wants to roll out and they may be making some progress on this plan
- We will not know until IBM finally makes an announcement at some time in the future – until then – Enjoy CUP!

Session

- Understanding the Performance Implications of Buffer to Buffer Credit Starvation: Frame Pacing Delay
  - "Sequel" session expanding on frame pacing delay.

Questions??

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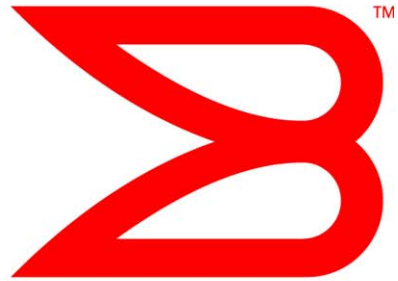

THANK YOU