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Why Customers Should Deploy Switches In Their SAN and FICON Environments

- David Lytle, BCAF
- Brocade Communications Inc.
- Monday February 4, 2013 – 1:30pm to 2:30pm
- Session Number - 13015

QR Code

SHARE in San Francisco 2013

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Notes as part of the online handouts

I have saved the PDF files for my presentations in such a way that all of the audience notes are available as you read the PDF file that you download.

If there is a little balloon icon in the upper left hand corner of the slide then take your cursor and put it over the balloon and you will see the notes that I have made concerning the slide that you are viewing.

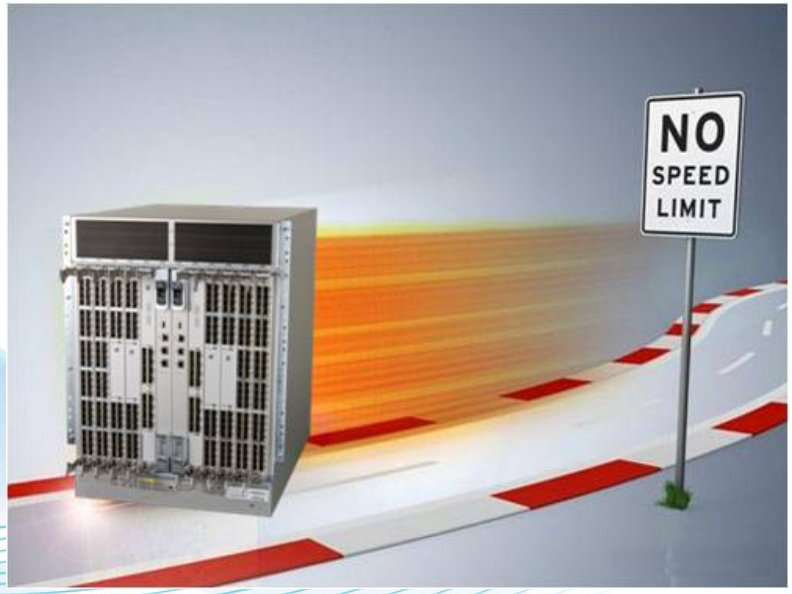
This will usually give you more information than just what the slide contains.

I hope this helps in your educational efforts!

8GIG AND 16Gbps

First, an Overview of Brocade's Current Generation of FC Products

- Supported for FICON and for FCP!



After All ----

I Am A Vendor!

Brocade B-Series 8Gbps Fabric Solutions

Best-in-class solutions for FICON

DCX and DCX-4S

DS-5300B

48, 64, 80 ports

8 Gbps

DS-5100B

24, 32, 40 ports

7800 FX8-24

SAN Extension Solutions

FC8-16 – 16 FC Ports
FC8-32 – 32 FC Ports
FC8-48 – 48 FC Ports
FX8-24 – 12xFC, 10x1GE, and 2x10 GE

Brocade B-Series 16Gbps Fabric Solutions

DCX 8510-8
DCX 8510-4

Best-in-class Solutions for FICON

6510

24-48 ports

16 Gbps

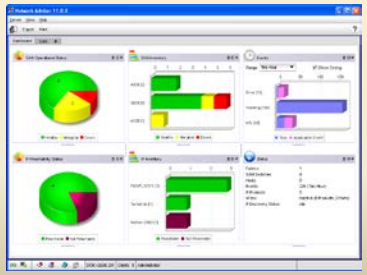
7800

SAN Extension Solutions

FX8-24

Brocade Network Advisor

F C



I P

FC16-32 – 32 FC Ports
FC16-48 – 48 FC Ports
FX8-24 – 12xFC, 10x1GE, and 2x10 GE

Switched-FICON is a Best Practice for System z

- Brocade FICON switching devices do not cause performance problems within a local data center
- Architected and deployed correctly, Brocade FICON switching devices do not cause performance problems even across very long distances
- In fact, use of Brocade switched-FICON and Brocade FCIP long distance connectivity solutions can even enhance DASD replication performance and long distance tape operations effectiveness and performance
- Switched-FICON is the only way to efficiently and effectively support Linux on System z connectivity
- Switched-FICON is the only way to really take advantage of the full value of the System z I/O subsystem

Why A Customer Should Consider Deploying Switched-FICON

- A smaller or older System z can start at about US$50,000 while an IBM System zEC12 can be a little more ☺
- zEC12 provides a max of 320 FICON Express8S CHPIDs
- z196 provides a max of 320 FICON Express8S CHPIDs
- z114 provides a max of 128 FICON Express8S CHPIDs
  - CHPID ports to storage ports/mainframe are limited
  - Large Sequential throughput per CHPID/System z is limited
    - zEC12: 320x620MBps=198,400MBps– or 39% of full duplex 8G

Why A Customer Should Consider Deploying Switched-FICON

- Direct–attached FICON, along with direct-attached SAN, simply provides very little value for your expensive enterprise computing environment
  - Direct-attached connections lack performance and scalability!

- Switched-FICON and/or switched-SAN can overcome these two basic limitations as well as providing many more benefits!
  - Can utilize 8Gbps Directors…or…
  - 16Gbps Directors

System z: Why Deploy Switched-FICON

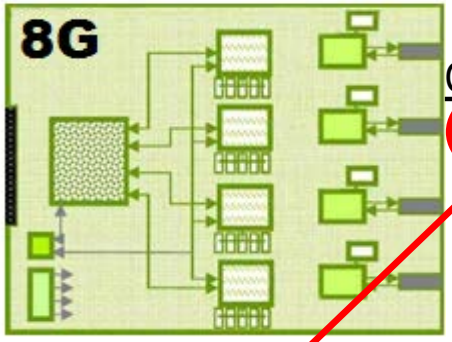
- With direct-attached FICON you must consume one CHPID to access one storage port
  - Very wasteful since neither CHPIDs nor DASD storage ports can make use of the full bandwidth of any of the channel paths
  - So CHPIDs and Storage Ports are always under-utilized resources that you have paid full price to deploy

- The CHPIDs on most mainframe channel cards cannot really perform at their listed line rate -- FICON Express8S running zHPF is the exception
  - In real use cases the data rate is less than ½ the performance these channel CHPIDs are rated to achieve

….BUT….

Customer's can use switched-FICON, making use of Fan In – Fan Out, to mitigate these limitations!

Mainframe Channel Cards

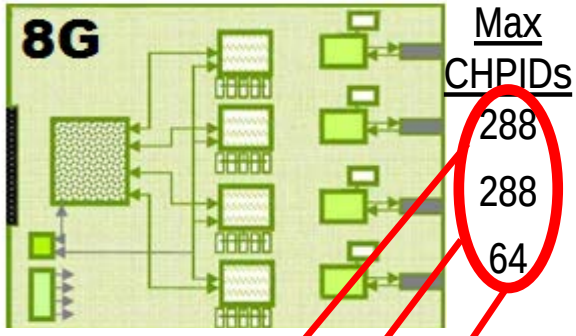


FICON Express8 – 4 ports
800MBps+800MBps=1600MBps

FICON Express8

- z10
- 2, 4 or 8 GBps link rate
- Cannot Perform at 8Gbps!
- Standard FICON Mode:
  32% <= 620 MBps Full Duplex out of 1600 MBps
- zHPF FICON Mode:
  46% <=770 MBps Full Duplex out of 1600 MBps
- 40 Buffer Credits per port
  - Out to 5km assuming 1K frames

FICON switching devices will provide BCs for long distances



FICON Express8 – 4 ports
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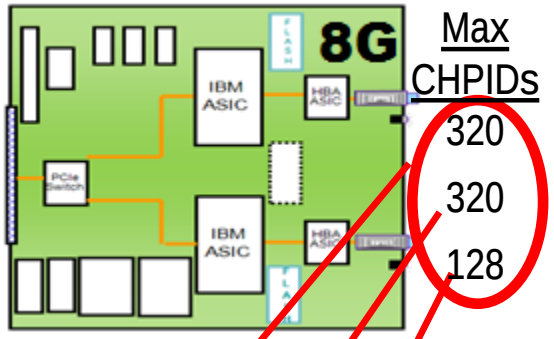
Faster Processors but fewer total CHPIDs available

One or more IBM graphics are used above

Mainframe Channel Cards



FICON Express8S

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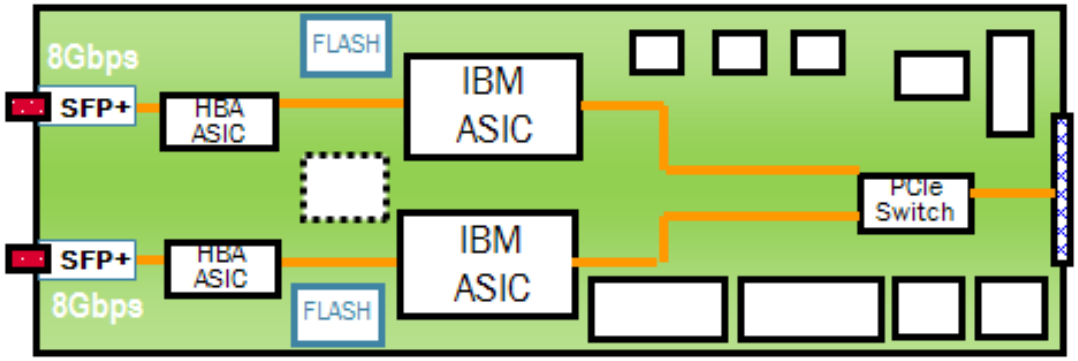
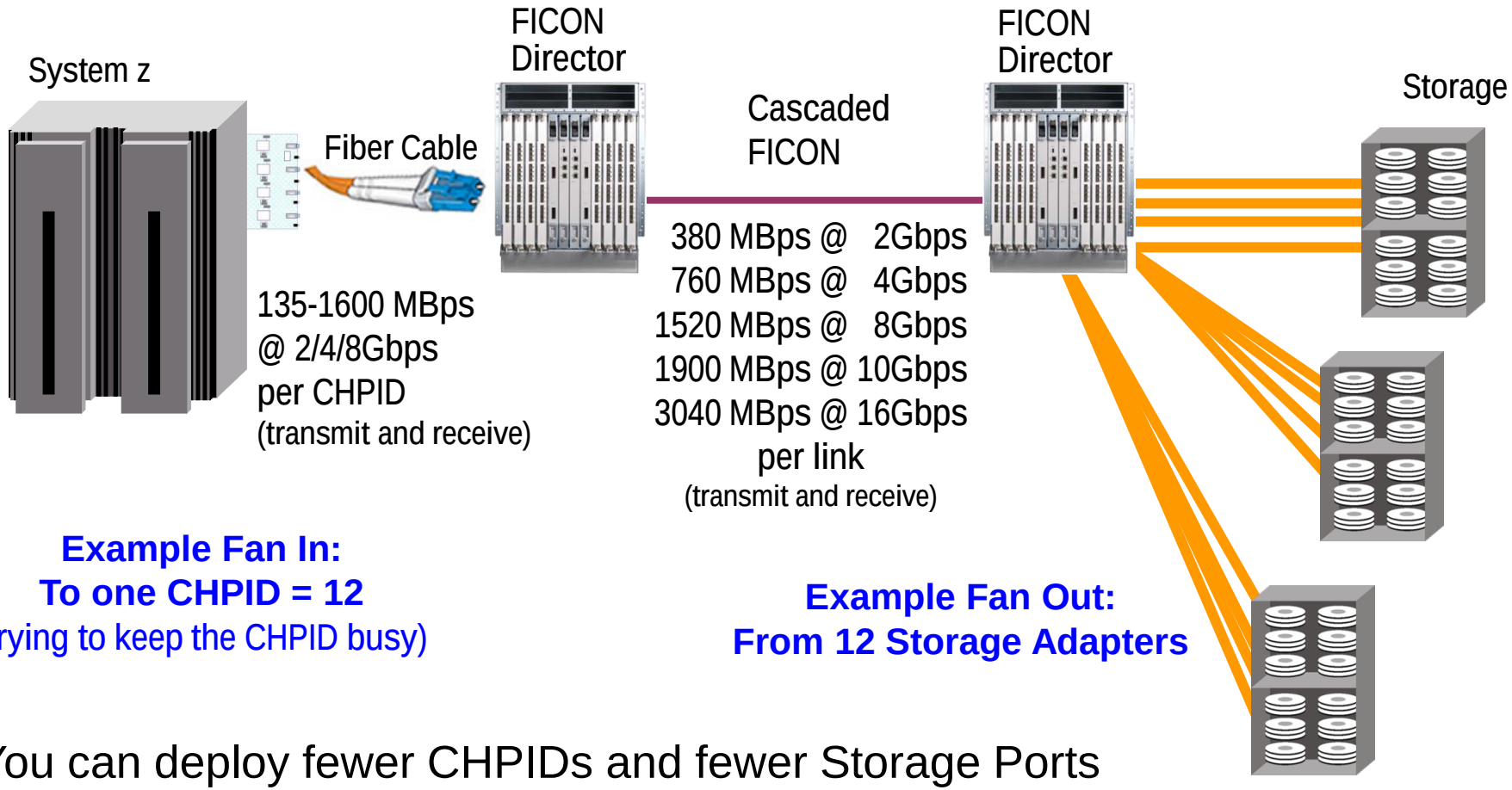
Standard, long PCIe card



- For FICON, zHPF, and FCP environments
  - CHPID types: FC and FCP
    - 2 PCHIDs/CHPIDs
- Auto-negotiates to 2, 4, or 8Gbps
- Increased performance versus FICON Express8
- 10KM LX - 9 micron SM fiber
  - Unrepeated distance - 10 kilometers which 6.2 miles
  - Receiving device must also be LX
- SX - 50 or 62.5 micron multimode fiber
  - Distance variable with link data rate and fiber type
  - Receiving device must also be SX
- 2 channels of LX or SX (no mix)
- Small form factor pluggable (SFP) optics
  - Concurrent repair/replace action for each SFP

Fan In-Fan Out Reduces System Bottlenecks



- You can deploy fewer CHPIDs and fewer Storage Ports
- You can utilize the assets you have purchased at 100%
- You can scale up very easily without purchasing a lot of hardware
- You actually achieve a higher level of system availability

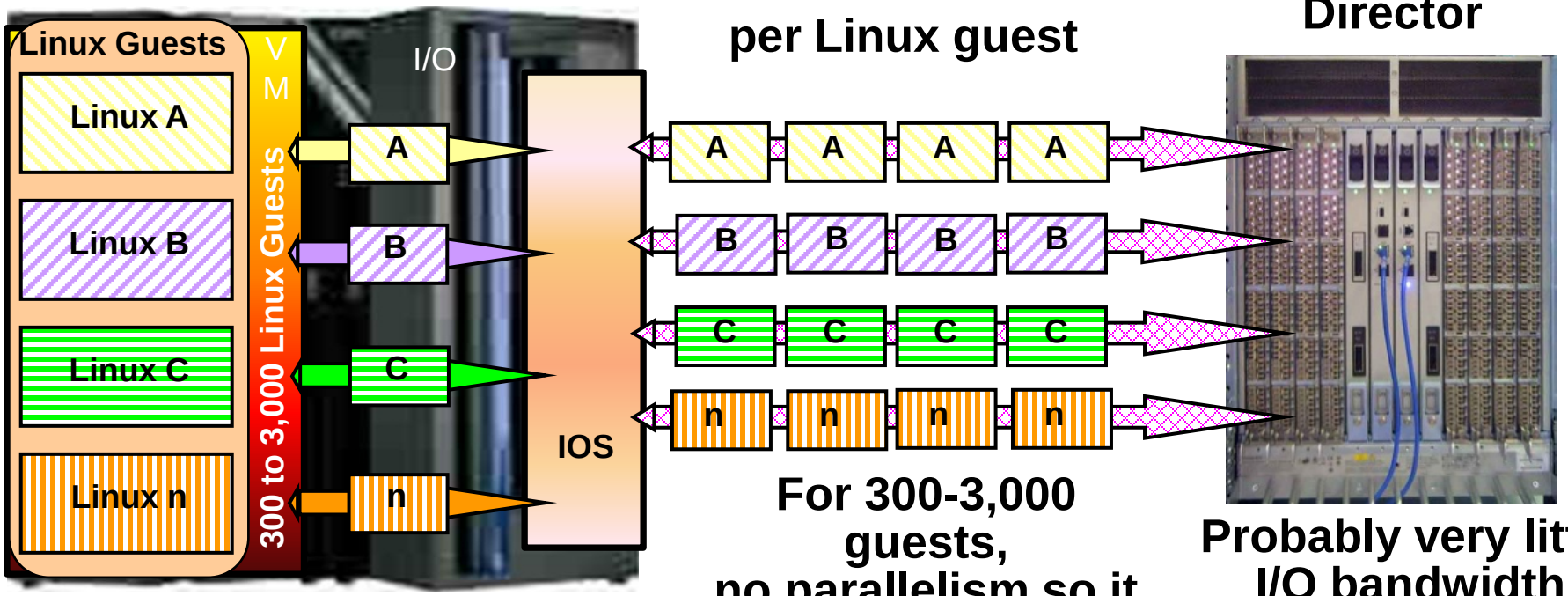
New z/OS and System z Functionality

System z functionality that REQUIRES customers to deploy switched–FICON:

- **FICON Express8 CHPID buffer credits:** Only 40 BCs per FICON Express8 and FICON Express8S CHPID limits long distance direct connectivity to ~5km. So customers can use up to 1,300 BCs at 8G and about 7,000 BCs at 16G, on a port on FICON switching devices, for longer distances.
- **FICON Dynamic Channel Management:** Ability to dynamically add and remove channel resources at Workload Manager discretion can be accomplished only in switched-FICON environments.
- **zDAC:** Simplified configuration of FICON connected disk and tape through z/OS FICON Discovery and Auto Configuration (zDAC) capability of switched-FICON fabrics.
- **NPIV:** Excellent for Linux on the Mainframe, Node_Port ID Virtualization allows many FCP I/O users to interleave their I/O across a single physical channel path

A Simplified Schematic - Linux without NPIV

An Example of Linux on System z without NPIV



Linux on System z can run in its own LPAR(s) but usually it is deployed as guests under VM

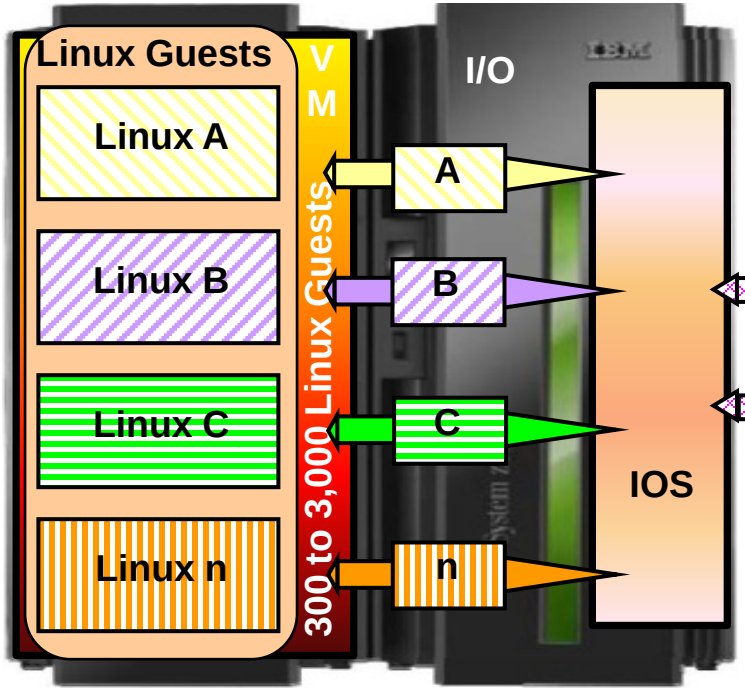
For 300-3,000 guests, no parallelism so it is very difficult to drive I/O for lots of Linux images with only 256 CHPIDs

Probably very little I/O bandwidth utilization per CHPID and switch port

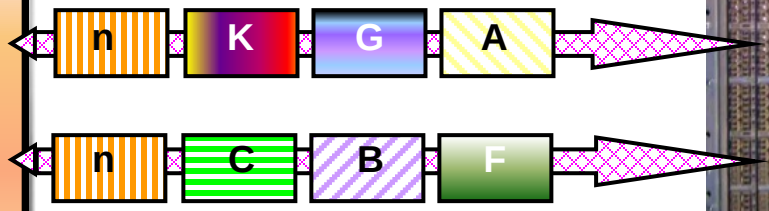
A Simplified Schematic - Linux with NPIV

NPIV is ONLY available in a switched-FICON fabric!

An example of System z when using NPIV



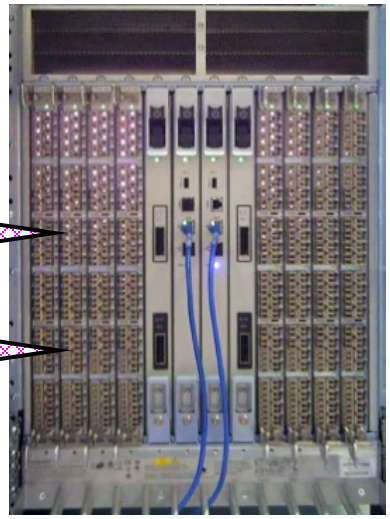
One FCP channel for many Linux guests



Lots of Parallelism

Fewer switch ports required!

FICON Director NPIV enabled



Much better I/O bandwidth utilization per path

8Gbps Is Great For NPIV!

Some of my favorite photos

In Technical Sessions, Your Brain Should Be Allowed To Take A Break!

America's Historic Roads

Beautiful Palma de Mallorca

Looking Glass Arch, Utah

Arkansas River and its Suspension Bridge

Brain Interlude Is Over….

Back to Work!

Using FICON Dynamic Channel Mgmt

FICON Dynamic Channel Path Management (DCM) provides the ability for the z/OS system to manage FICON channel path assignment dynamically based on current workload conditions and availability characteristics.

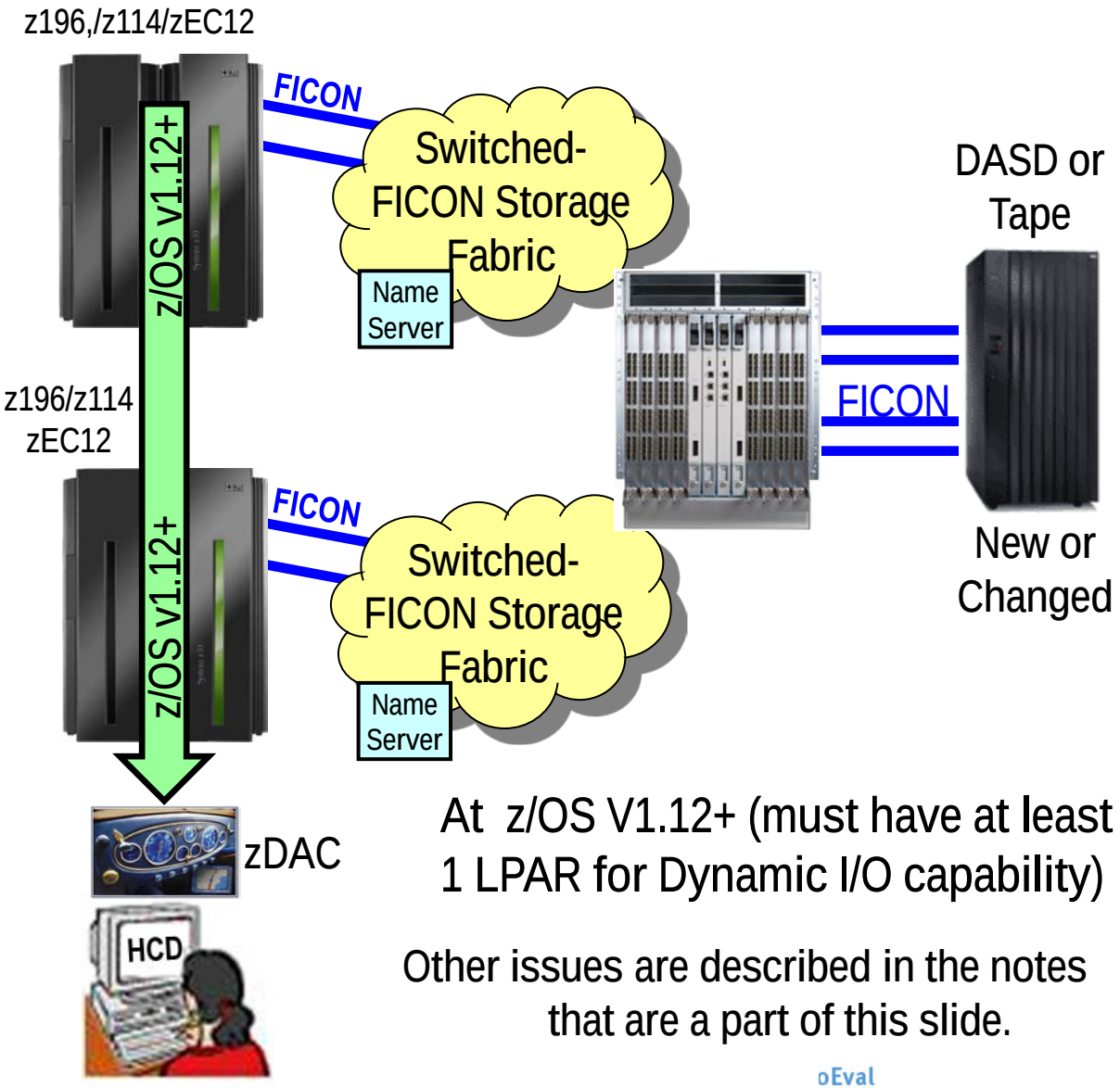
- z/OS allows pools of FICON CHPIDs to be unassigned so that workload manager can use them when it is operating in GOAL mode.
- But mainframe channels and control units must be Switch Attached in order to make use of Dynamic Channel management (DCM)

Using zDAC with System z196, z114 & zEC12

Simplified configuration for FICON connected DASD and tape through z/OS FICON Discovery and Auto Configuration (zDAC)

- zDAC is only useful for switched-FICON storage/host connections
  - zDAC must make use of the FICON fabric name server
- Uses intelligent analysis to help validate that server and storage definitions are compatible with each other
- Transparent to existing configurations and settings
- Invoked through and integrated with z/OS Hardware Configuration Definition (HCD) and z/OS Hardware Configuration Manager (HCM)
- Use on single systems or across your Sysplex's

Using zDAC with System z196, z114 & zEC12



- The Fabric Name Server makes it possible to automatically discover what is new or has been changed in the fabric
- When a change is discovered, zDAC proposes a channel configuration based on:
  - High availability best practices
  - Customer configuration policies
  - Existing configurations
- zDAC attempts to make a symmetric configuration:
  - And this is repeated for each server in a sysplex

At z/OS V1.12+ (must have at least 1 LPAR for Dynamic I/O capability)

Other issues are described in the notes that are a part of this slide.

oEval

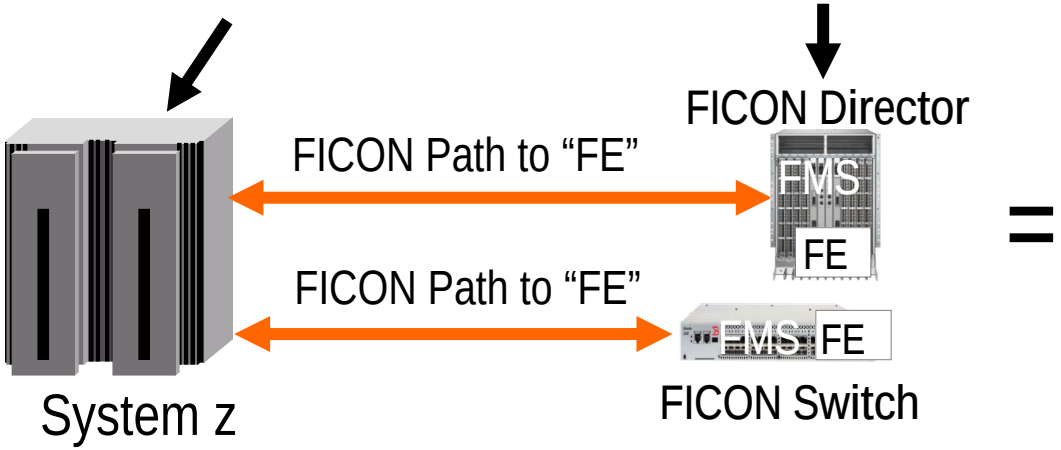
More Reasons For Deploying Switched-FICON

- Switched-FICON for RMF reports and z/OS Systems Automation control

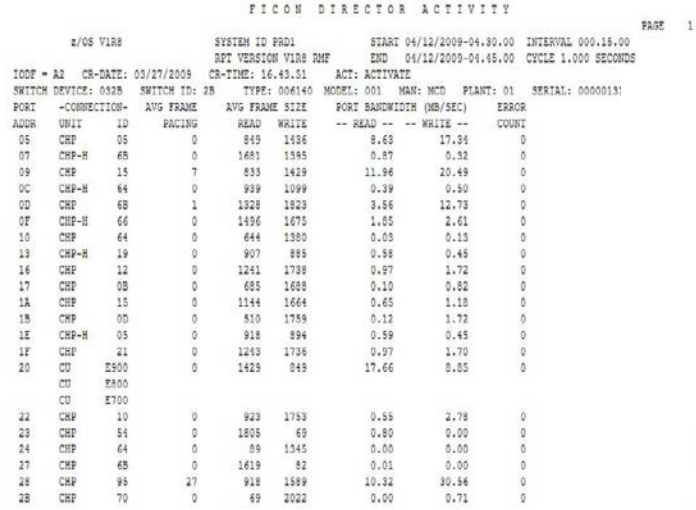
CUP on a FICON Switch For Use By RMF

Sys1.Parmlib options allow RMF to produce the RMF FICON Director Activity Report

Control Unit Port (CUP) on a FICON switching device allows z/OS to access switch and fabric information and provide that into RMF



FICON Director Activity Report per FICON Domain ID per Interval



F I C O N D I R E C T O R A C T I V I T Y

PAGE 1

z/OS V1R8 SYSTEM ID PRD1 START 04/12/2009-04.30.00 INTERVAL 000.15.00
RPT VERSION V1R8 RMF END 04/12/2009-04.45.00 CYCLE 1.000 SECONDS

IODF = A2 CR-DATE: 03/27/2009 CR-TIME: 16.43.51 ACT: ACTIVATE

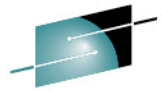
SWITCH DEVICE: 032B SWITCH ID: 2B TYPE: 006140 MODEL: 001 MAN: MCD PLANT: 01 SERIAL: 0000013!

PORT ADDR	-CONNECTION- UNIT	ID	AVG FRAME PACING	AVG FRAME SIZE READ	WRITE	PORT BANDWIDTH (MB/SEC) -- READ --	-- WRITE --	ERROR COUNT
05	CHP	05	0	849	1436	8.63	17.34	0
07	CHP-H	6B	0	1681	1395	0.87	0.32	0
09	CHP	15	7	833	1429	11.96	20.49	0
0C	CHP-H	64	0	939	1099	0.39	0.50	0
0D	CHP	6B	1	1328	1823	3.56	12.73	0
0F	CHP-H	66	0	1496	1675	1.85	2.61	0
10	CHP	64	0	644	1380	0.03	0.13	0
13	CHP-H	19	0	907	885	0.98	0.46	0
16	CHP	12	0	1241	1738	0.97	1.72	0
17	CHP	0B	0	685	1688	0.10	0.82	0
1A	CHP	15	0	1144	1664	0.65	1.18	0
1B	CHP	0D	0	510	1759	0.12	1.72	0
1E	CHP-H	05	0	918	894	0.59	0.45	0
1F	CHP	21	0	1243	1736	0.97	1.70	0
20	CU	E900	0	1429	849	17.66	0.85	0
	CU	E800						
	CU	E700						
22	CHP	10	0	923	1753	0.55	2.78	0
23	CHP	54	0	1805	69	0.80	0.00	0
24	CHP	64	0	89	1345	0.00	0.00	0
27	CHP	6B	0	1619	82	0.01	0.00	0
28	CHP	95	27	918	1589	10.32	30.56	0
2B	CHP	70	0	69	2022	0.00	0.71	0

- FICON Management Server (FMS) is a license to enable Control Unit Port (CUP) on a FICON switching device – always uses the "embedded" port x"FE"
- FICON Director Activity Reports are very useful to customers who would like to understand their average frame sizes traversing their fabrics as well as information about how buffer credits are being utilized

Using Buffer Credits is how FC does Flow Control, also called "Frame Pacing"

FICON Director Activity Report



F I C O N D I R E C T O R A C T I V I T Y

PAGE 1

z/OS V1R8 SYSTEM ID ABCD START 04/12/2009-04.30.00 INTERVAL 000.15.00
RPT VERSION V1R8 RMF END 04/12/2009-04.45.00 CYCLE 1.000 SECONDS

IODF = A2 CR-DATE: 03/27/2009 CR-TIME: 18.43.51 ACT: ACTIVATE
SWITCH DEVICE: 032B SWITCH ID: 2B TYPE: 006140 MODEL: 001 MAN: MCD PLANT: 01 SERIAL: 0000HIJKLMN

PORT ADDR	-CONNECTION- UNIT	ID	AVG FRAME PACING	AVG FRAME SIZE READ	WRITE	PORT BANDWIDTH (MB/SEC) -- READ --	-- WRITE --	ERROR COUNT
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09	CHP	15	0	833	1429	11.96	20.49	0
0C	CHP-H	64	0	939	1099	0.39	0.50	0
0D	CHP	6B	0	1328	1823	3.56	12.73	0
0F	CHP-H	66	0	1496	1675	1.85	2.61	0
10	CHP	64	0	644	1380	0.03	0.13	0
13	CHP-H	19	0	907	885	0.58	0.45	0
16	CU	C800	0	1241	738	20.97	5.72	0
	CU	CA00				70.10	3.82	0
1A	CHP	15	0	1144	1664	0.65	1.18	0
1B	CHP	0D	0	510	1759	0.12	1.72	0
1E	CHP-H	05	0	918	894	0.59	0.45	0
1F	CHP	21	0	1243	1736	0.97	1.70	0
20	CU	E900	0	1429	849	17.66	8.85	0
	CU	E800						
	CU	E700						
22	CHP	10	0	923	1753	0.55	2.78	0
23	CHP	54	0	1805	69	20.80	7.30	0
24	CHP	64	0	89	1345	0.00	0.00	0
27	CHP	6B	0	1619	82	0.01	0.00	0
28	SWITCH	95	270	998	789	50.32	10.56	0
2B	CHP	70	0	69	2022	0.00	0.71	0

In the last 15 minutes

This port had a frame to send but did not have any Buffer Credits left to use to send them.

And this happened 270 times during the interval.

And this is an ISL Link!

Indicators of Potential Buffer Credit Starvation

Fabric with zHPF Enabled

Eval

More Reasons For Deploying Switched-FICON

- Point-to-Point versus switched-FICON Reliability and Availability
- Can host both SAN and FICON on the same I/O infrastructure

Reliability versus Availability

- **Reliability is NOT the same as Availability!**
- **Reliability is a measurement of the dependability of the customer's system, fabric and/or devices**
- Often characterized as Mean Time Before Failure (MTBF)
- **Availability is the ability of a system, fabric and/or device to continue to provide services when they are needed, without delay, even if reliability has failed**
- In the data center this is typically discussed as a percentage such as two-9s, three-9s, four-9s or five-9s (99.999%) of availability
- The calculation for this percentage is the length of time that a given system, fabric and/or device will be online and functioning during the course of a years worth of time – it is really an up-time ratio
- So Availability is NOT the same as Reliability and customers do realize that it is very difficult to achieve High Availability unless a system, fabric and/or device does have High Reliability!

Availability

- **High availability** refers to a system or component that is continuously operational for a desirably long length of time.
- Availability can be measured relative to "100% operational" or "never failing with a difficult-to-achieve standard of availability for a system or product being "five-9s" (99.999 percent) availability.

	Calculating Percent of Availability Downtime	Seconds	Minutes	Hours	Days
Availability	Downtime per year (31,536,000 seconds in a year) Calculation: (Seconds in year * %) Outages would cause the following max downtime:	31536000			
99.9999%	32 seconds	31.536			
99.999%	5 minutes, 15 seconds	315.36	5.256		
99.99%	52 minutes, 36 seconds	3153.6	52.56		
99.95%	4 hours, 23 minutes	15768	262.8	4.38	
99.9%	8 hours, 46 minutes	31536	525.6	8.76	
99.5%	1 day, 19 hours, 48 minutes	157680	2628	43.8	1.825
99%	3 days, 15 hours, 40 minutes	315360	5256	87.6	3.65

Five-9s is really the ultimate goal for data center deployments.

These figures are just an "**annual risk of outage**" not a guarantee that an outage will actually occur

Customers might go for years before having a problem but that does not matter. Availability is calculated on an annual basis.

Loss of Availability Is Very Costly!

- Few customers know what an hour of downtime costs them!
- Some industry statistics may help to put a context to potential losses from downtime. The numbers differ, depending on the source, but they give some idea of possible impact. Check these yourself on the internet!
- *Even if a vendor GAVE YOU the hardware, or if they even GAVE YOU the Hardware and ALL Maintenance costs – if it is not deployed as five-9s of high availability, and then their system causes you to take an outage, the hardware cost [maintenance cost] will not offset the cost of the outage!*

Example:
Vendors provide Virtual Fabrics hosted on a single chassis.

If you use two VFs on one chassis for your HA redundancy, but then the chassis firmware fails, both of the VFs fail as well.

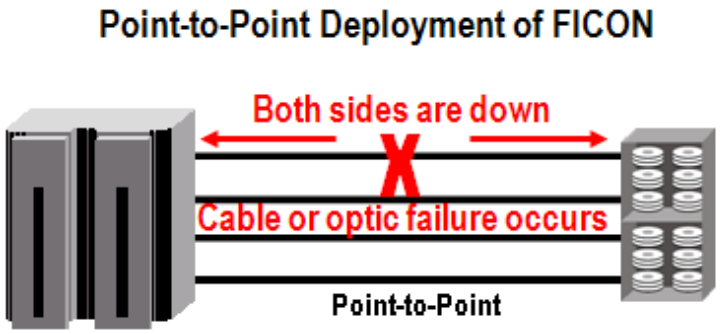
All of the I/O paths on these VFs fail which would be poor availability.

INDUSTRY SECTOR	AVG. COST/HOUR*
Energy	$2.8 Million
Financial Institutions	$1.4 Million
Information Technology	$1.3 Million
Insurance	$1.2 Million
Health Care	$686,000
Transportation	$668,586
Utilities	$643,000
Avg. Cost Per Hour Per Employee	$205

Source: : META Group, Inc.,"Quantifying Performance Loss: IT Performance Engineering and Measurement Strategies"

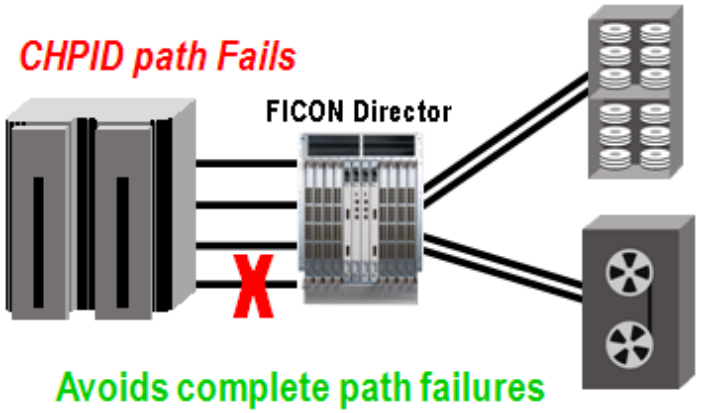
Downtime Losses

Availability After A Component Failure



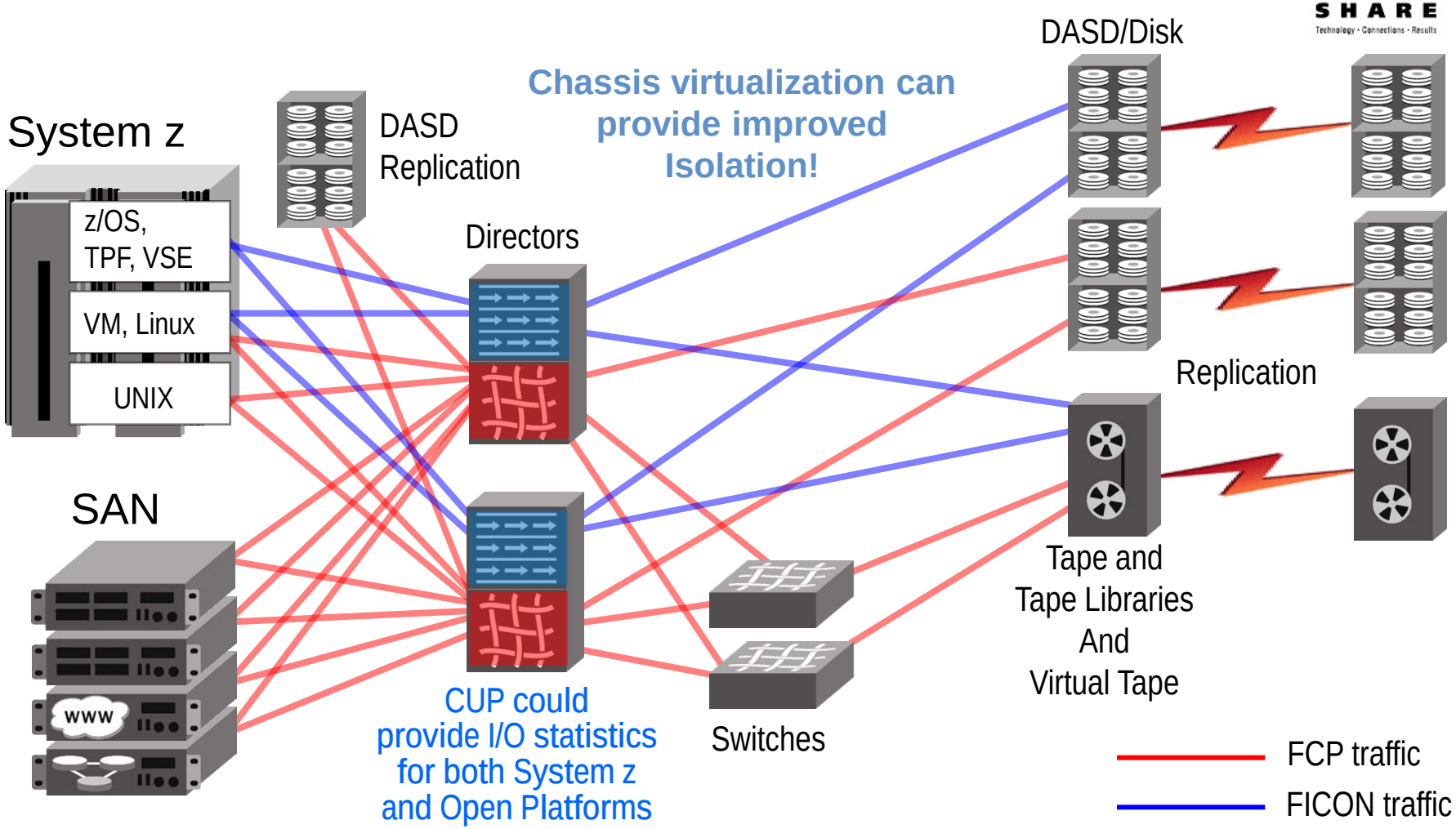
...BUT... Storage Port Remains Available!

- A failure of a FICON CHPID or cable or storage port means that you lose two valuable resources:
  - Channel port will become unavailable AND
  - Storage port becomes unavailable for everyone!
- A failure ***anywhere*** affects both the mainframe connection and the storage connection
  - The WORST possible reliability and availability is provided by a direct-attached FICON and/or SAN storage topology!



- In a switched-FICON environment, only a connection segment is rendered unavailable:
  - The non-failing side remains available
  - If the storage port has not failed, its port is still available to be used by other CHIPDs
  - If the CHPIP has not failed, its port is still available to be used by other storage ports

FICON and FCP Intermix



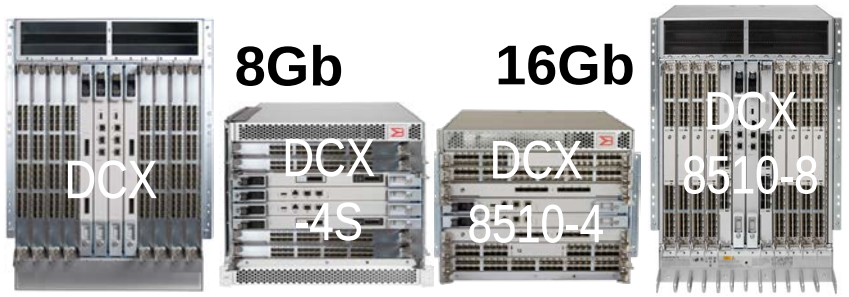
- FICON infrastructure vendors support a variety of Directors/switches that will allow you to host FICON and FCP connectivity intermixed together on the same chassis

And There Are Many More Reasons For Deploying Switched-FICON in Mainframe Shops

- Balancing workload across all the ports in a Port Group
- Intermixing Long wave and Short wave FICON Connections As You Desire
- FICON switching devices provide lots of scalability not possible with direct attached FICON
- Consolidation of Channel Cards, CHPIDs and Storage

How Are Directors and Switches Different

B-Series can run at up to 1600MBps on a port-by-port basis



FICON Switches

- Good Availability up to **99.99%**
- Based upon ***motherboard*** design
- Some redundant components like power supplies and fans
- **24-80** Fiber Channel ports
- Decent fabric Scalability (100's of ports)
- Motherboard problems will require the switch to be replaced!

It is not when it is working, but rather when a problem occurs, that truly differentiates a Director from a Switch!

FICON Directors

- Superb Availability up to **99.999%**
- Based on **discrete, redundant** parts
- Complete Redundancy and hot swap FRUs throughout the architecture
- Highest port counts – up to **384** ports
- Superior fabric Scalability (1,000s of ports)
- + Online Error Recovery (non-disruptive failover)
- + *Online Repair of the error* (hot swap)

99% of System z Customers should deploy Director-based FICON Fabrics!

Eval

How Are Directors and Switches Different Physical Differences

- **Since switches are motherboard-based, they are engineered to run at the then current line rate – cannot be upgraded -- and**
  - Each port of an 8Gbps switch can be run using 4Gbps or 8Gbps SFPs
  - Each port of a 16Gbps switch can be run using 8Gbps or 16Gbps SFPs
  - Failing SFPs can be hot-swapped but physical ports cannot be replaced
  - A switch must be completely replaced to repair a failed physical port(s) or ASIC

- **Directors have discrete, redundant components that are engineered to run at current line rate – but can be upgraded – and non-disruptive firmware loads**
  - Today each port of a 16Gbps Director can run using 8Gbps or 16Gbps SFPs
  - Failing SPFs can be hot-swap replaced (along with fans and power supplies…)
  - New blades can replace blades that have failing or failed physical ports

- **It is likely that IBM will have 16Gbps CHPIDs within a couple of years**
  - The next gen mainframe will probably be engineered to handle 16G CHPIDs
  - Brocade's older 8Gbps Directors are upgradable to 16Gbps now
    - Once again providing our customers with investment protection!
  - But existing 8G switches will have to be completely swapped out and replaced with newer 16G capable switches in order to achieve 16G fabrics

How Are Directors and Switches Different Availability

- **Complete non-disruptive Hot Code Load is supported on Director class switches**
  - Since 2000
- **Comprehensive, non-disruptive Hot Code Load is not currently supported for FCIP blades and extension switches**:
  - On extension switches and blades, the FCIP tunnels will go down for 10-15 seconds and all traffic in the tunnels will be disrupted.
- **Brocade FICON switches do try to support non-disruptive firmware upgrades but when upgrading firmware on a fixed port, motherboard-based switch, customers may experience recoverable IFCCs**:
  - The IFCCs are for dropped frames that are part of normal fibre channel recovery so this recovery happens with FCP and FICON channels and devices as well.
  - The only difference is that mainframes report absolutely everything. For most of our mainframe customers, they just need a warning that they may see a few IFCCs during firmware upgrades
  - IFCCs, regardless of the impact to traffic flow, then their best option is to always deploy a Director-class platform.

oEval

Direct-attached FICON -- Just Do Not Do It!

- Cannot take advantage of changes to z/OS and System z Functionality such as:
  - Node-Port ID Virtualization (NPIV) which enhances Linux on System z performance
  - Dynamic Channel Management (DCM)
  - FICON Device Discovery and Auto Configuration (zDAC)
- Cannot achieve the same availability as is possible with switched-FICON
- Cannot get RMF reports about FICON path buffer credit usage
- Cannot take advantage of FICON switches as distance extenders
- Cannot consolidate and reduce CHPIDs and Storage Ports and thereby also reduce power and cooling and possibly floor space
- Scalability becomes limited to the total mainframe CHPID pool
- Cannot fully utilize all I/O resources
- Cannot make use of storage Fan In – Fan Out

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For people who do or will work in FICON environments

Brocade provides a free on-site or in area 2-day class (Brocade Design and Implementation for FICON Environments – FCAF200), to assist customers in obtaining the knowledge to pass this certification examination – ask your local sales team about this training – also look at www.brocade.com under Education

Certification tests a person's ability to understand IBM System z I/O concepts, and demonstrate knowledge of Brocade FICON Director and switching fabric components

After the class a participant should be able to design, install, configure, maintain, manage, and troubleshoot Brocade hardware and software products for local and metro distance (100 km) environments

Check the following website for complete information:

- http://www.brocade.com/education/certification-accreditation/certified-architect-ficon/index.page

.....My Next Presentation.....

SAN (Storage Area Networks) – Part 2

- David Lytle, BCAF
- Brocade Communications Inc.
- Monday February 4, 2013 -- 3:00pm to 4:00pm
- Session Number - 13011

SAN Sessions at SHARE this week

Monday:

Time-Session

1500 - 13011: Further on SAN (Storage Area Networking) – continuation of this session

Tuesday:

Time-Session

1100 – 12166: What Every Mainframer Needs to Know About Networking

Wednesday:

Time-Session

0800 - 13062: FICON Channel Extension
0930 – 13013: Datacenter SAN & LAN Networking Convergence
1100 – 13117: Best Practices For SAN Management - For Both Open and FICON
1700 - 12734: Enhanced Availability and IT Resilience: An Integrated TS7700 Grid

Thursday:

Time-Session

0800 – 13010: A First Look at the Inner Workings and Hidden Mechanisms of FICON
0930 – 13009: A Deeper Look Into the Inner Workings and Hidden Mechanisms of FICON Performance
1300 – 13012: Buzz Fibrechannel - To 16G and Beyond

Mainframe Resources For You To Use

Visit Brocade's Mainframe Blog Page at:

http://community.brocade.com/community/brocadeblogs/mainframe

Also Visit Brocade's New Mainframe Communities Page a

http://community.brocade.com/community/forums/products_and_solutions/mainframe_solutions

You can also find us on Facebook at:

https://www.facebook.com/groups/330901833600458/

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13015

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2 = "A Few Good Nuggets!"
1 = "You Got a nice nap!"

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