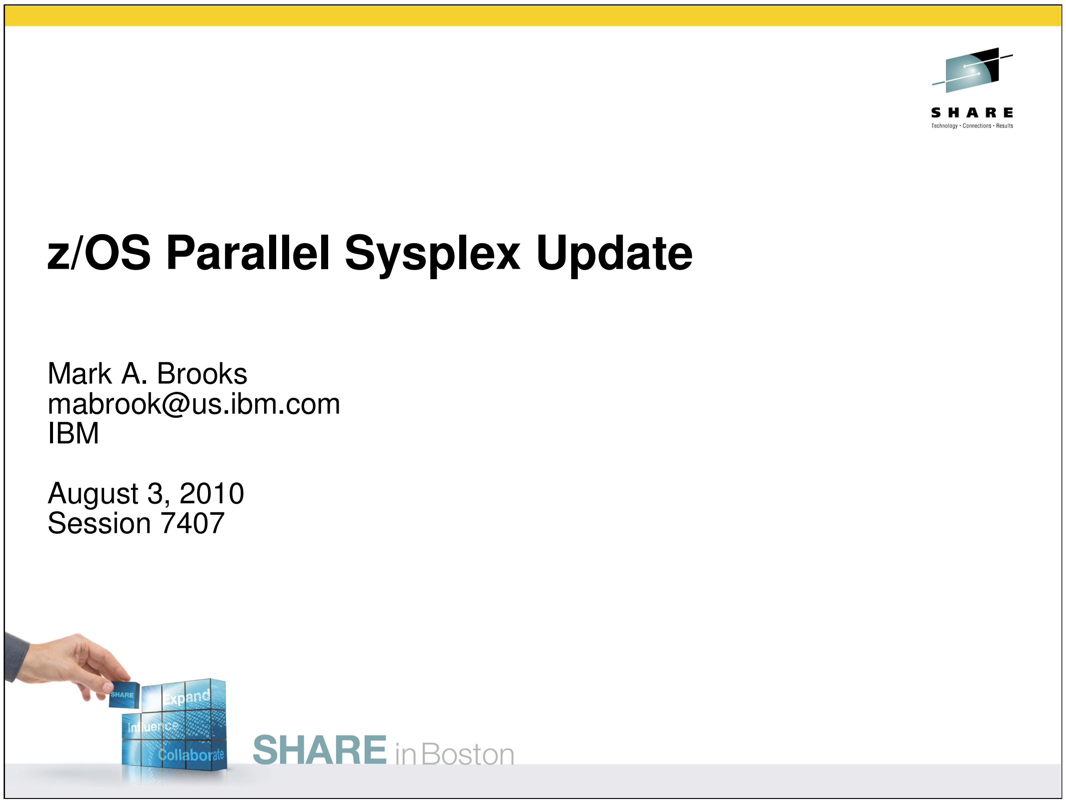

z/OS Parallel Sysplex Update

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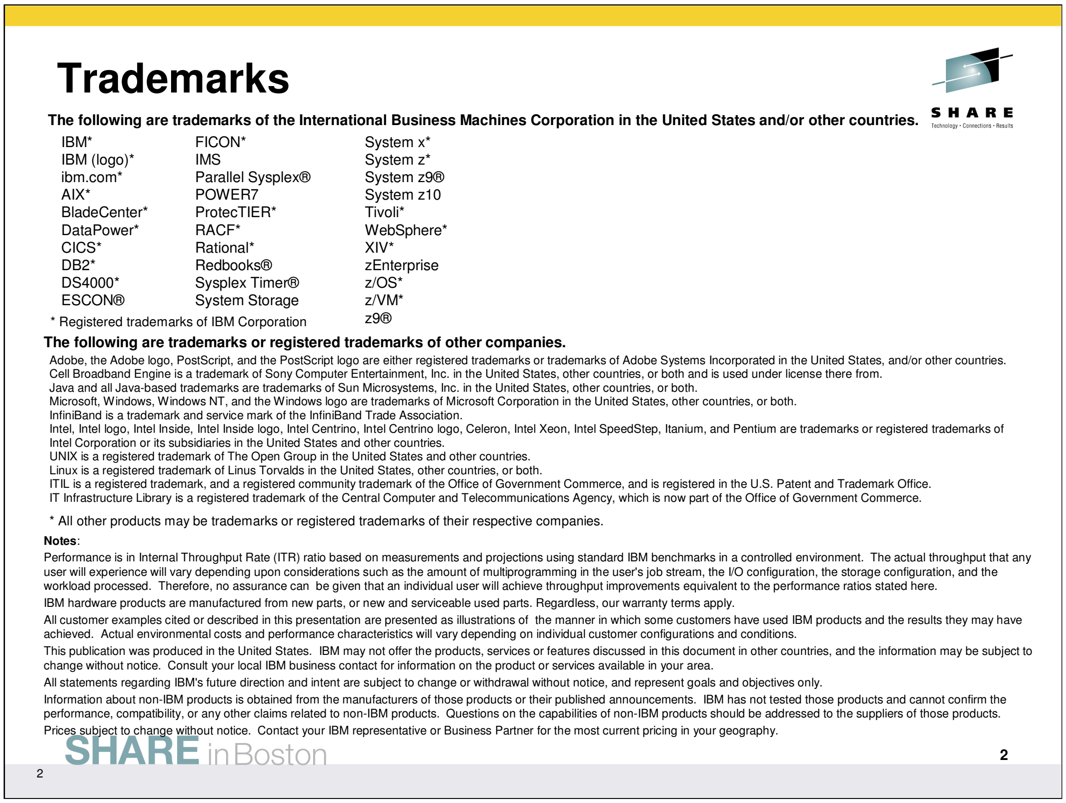
Session 7407

SHARE in Boston

In this session, the speaker will provide updates on Parallel Sysplex, including the latest hardware and coupling link technology, Coupling Facility Control Code (CFCC), and recent z/OS enhancements. A preview of future z/OS items may be included as well. In the past we have heard on such topics as the physical processors, software levels, links to external coupling facilities, upgrade paths, and features in the CFCC code. Plus how Server Time Protocol (STP) fits in the picture. On the software side, what Program Products participate in a Sysplex and how that may increase application availability for you.



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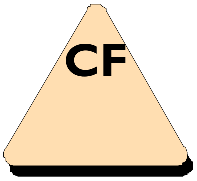
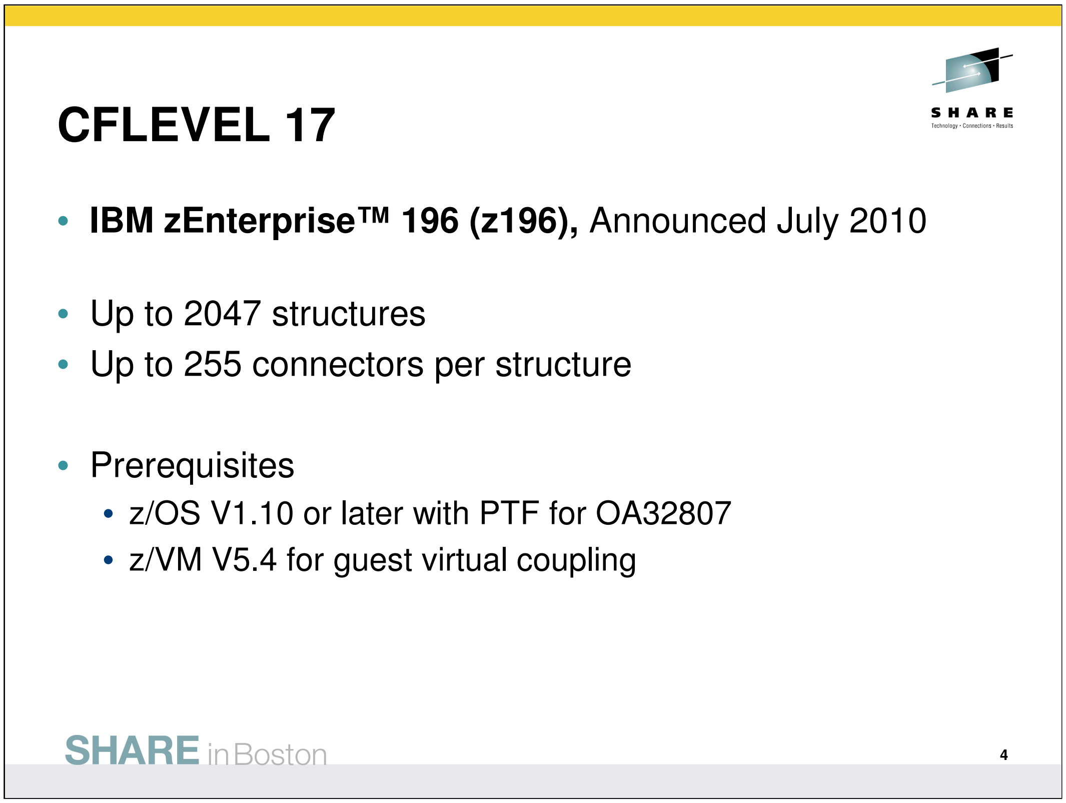
Agenda

- Hardware Updates
  - **CFCC Level 17**
  - CFCC Level 16
  - Parallel Sysplex InfiniBand Links
- z/OS Updates
  - Sysplex Failure Management
  - z/OS V1R12
- Summary





CFLEVEL 17

- **IBM zEnterprise™ 196 (z196),** Announced July 2010

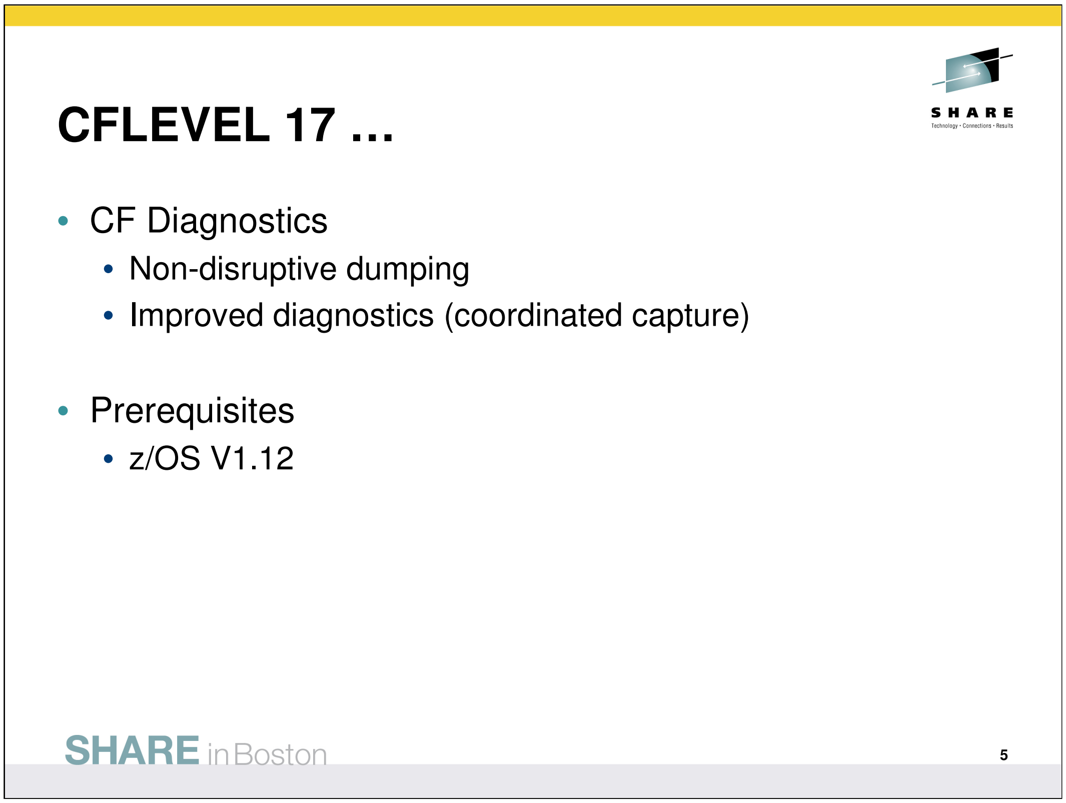
- Up to 2047 structures
- Up to 255 connectors per structure

- Prerequisites
  - z/OS V1.10 or later with PTF for OA32807
  - z/VM V5.4 for guest virtual coupling

zEnterprise 196 servers with Coupling Facility Control Code (CFCC) Level 17 supports **up to 2047 structures per Coupling Facility (CF) image**, up from the prior limit of 1023. This allows you to define a larger number of data sharing groups, which can help when a large number of structures must be defined, such as to support SAP configurations or to enable large Parallel Sysplex configurations to be merged. This function requires z/OS 1.10 or later with the PTFs for APAR OA32807.

zEnterprise 196 servers with CFCC Level 17 supports **more connectors to list and lock structures**. XES and CFCC already support 255 connectors to cache structures. With this new support XES also supports up to 247 connectors to a lock structure, 127 connectors to a serialized list structure, and 255 connectors to an unserialized list structure. This support requires the z/OS 1.10 or later with the PTFs for APAR OA32807.

z/OS V1.12 supports **larger Coupling Facility (CF) structures**. The maximum size you can specify for a CF structure is increased from slightly below 100 GB (99,999,999 KB) to 1 TB. Also, the CFRM policy utility (IXCMIAPU) is updated to allow you to specify structure sizes in units of KB, MB, GB, and TB. These changes improve both Parallel Sysplex CF structure scalability and ease of use.



CFLEVEL 17 …

- CF Diagnostics
  - Non-disruptive dumping
  - Improved diagnostics (coordinated capture)
- Prerequisites
  - z/OS V1.12

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z/OS V1.12, in conjunction with z196 servers and Coupling Facility control code (CFCC) Level 17, is designed to capture Coupling Facility (CF) data nondisruptively in some circumstances, allowing the CF to continue operating. This new function is intended to help improve Parallel Sysplex availability when it is necessary to capture CF data. The CF uses a pre-staged dump capture area to avoid collateral effects observable by z/OS, such as message time-outs (observed as interface control checks) or loss of connectivity.

Before the introduction of this support, there were two ways to capture diagnostic information from the CF. The most useful way required a disruptive CF hard dump, requiring a reboot of the CF and lossconn recovery (rebuilds, etc.) from z/OS. Understandably, customers are rarely willing to install diagnostic CFCC code loads to produce such a dump. A secondary method is a CFCC soft dump, which produces a “blurry”, unserialized picture because CF activity is not quiesced while the dump is captured.

Support for serialized non-disruptive CF dumps is introduced with CFLEVEL 17. Dumps can be triggered in several ways:

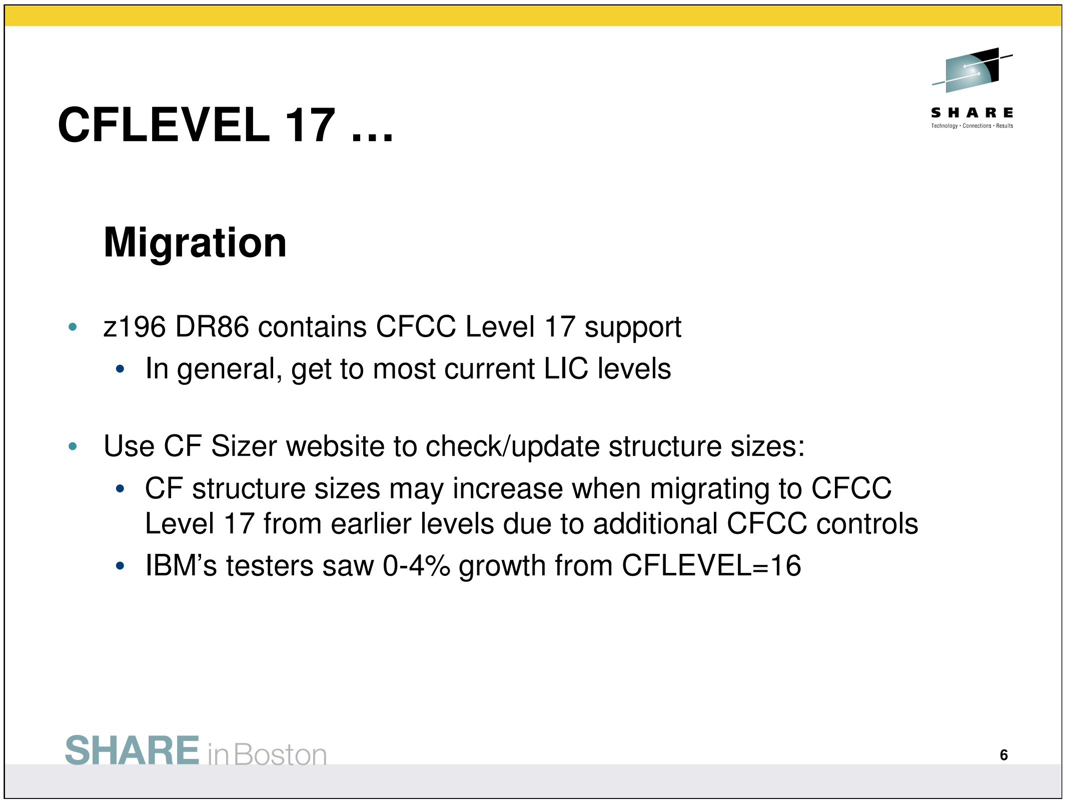
•CFCC has a number of detection points, mostly where it can be recognized that duplexing is about to break.

•z/OS can explicitly request a CF dump.

•When requested by z/OS, the link can recognize an impending timeout and trigger collection of CF, z/OS, and link data. Thus one can obtain a coherent set of problem determination data from the CF, z/OS, and the connecting links (coordinated capture)

The Support Element has been enhanced to provide storage for up to 10 dumps vs. the current 2.

CFCC has implemented a 5-minute refractory period. Once a non-disruptive dump has been taken, CFCC will not take another within the refractory period, no matter what the trigger. This minimizes the likelihood of getting a flood of dumps for the same incident, for example when a duplex break causes many commands against the affected structure to observe the built-in internal triggers.



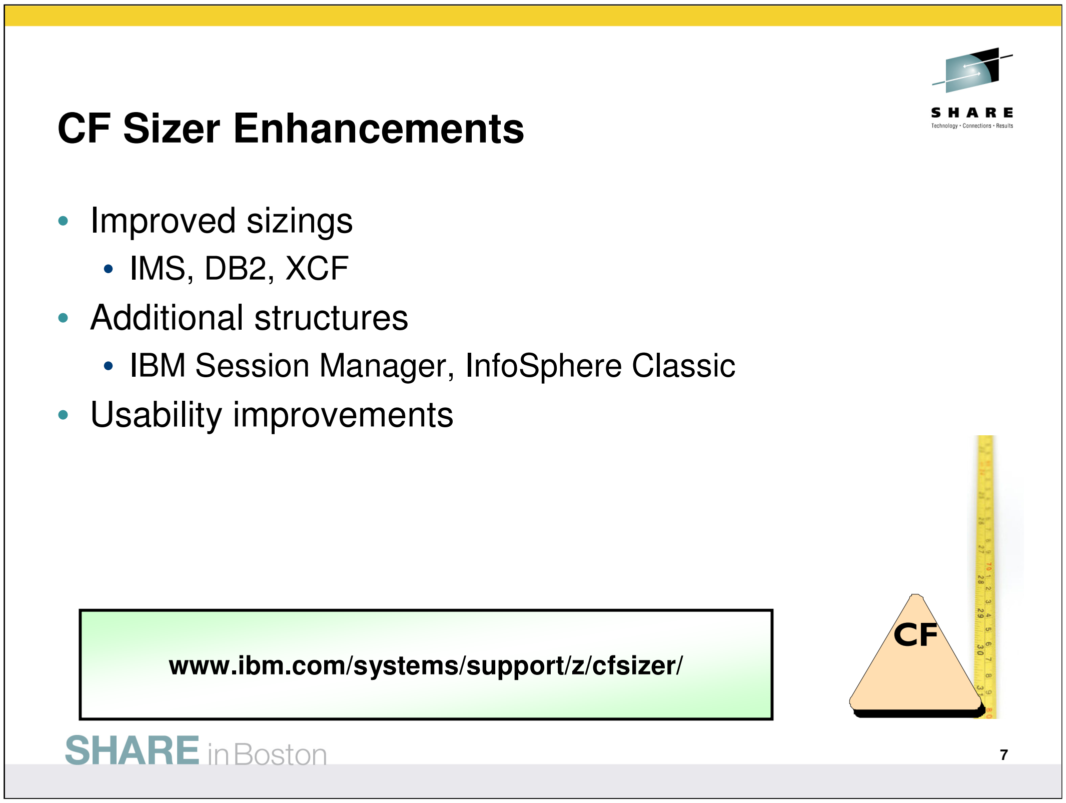
CFLEVEL 17 …

Migration

- z196 DR86 contains CFCC Level 17 support
  - In general, get to most current LIC levels
- Use CF Sizer website to check/update structure sizes:
  - CF structure sizes may increase when migrating to CFCC Level 17 from earlier levels due to additional CFCC controls
  - IBM's testers saw 0-4% growth from CFLEVEL=16

CF Level 17 is expected to have marginal impact to structure sizes. Representative, properly sized structures used by IBM testers grew between 0 and 4% when allocated in a coupling facility running CFLEVEL 17 vs a coupling facility running CFLEVEL 16. These results may not apply to your environment. Thus IBM suggests using the CF Sizer to size structures whenever a new CF level is installed. The CF Sizer can be found at this web site:

www.ibm.com/systems/support/z/cfsizer/index.html



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Technology • Connections • Results

CF Sizer Enhancements

- Improved sizings
  - IMS, DB2, XCF
- Additional structures
  - IBM Session Manager, InfoSphere Classic
- Usability improvements

www.ibm.com/systems/support/z/cfsizer/

CF

The web-based CFSIZER tool is designed to help you perform coupling facility structure sizing calculations.

Concurrently with z/OS V1.12 availability, CFSIZER provides:

– More accurate size calculations for the IMS Operations Management (OM) Audit, Resource, and Overflow Sequential Access Method (OSAM) structures

– Calculated sizes for IBM Session Manager (ISM) Sysplex User structures

– Improved sizes for XCF signaling structures

– Calculated sizes for InfoSphereTM Classic control and filter structures

– Improved sizes for DB2 SCA structures

– Various usability improvements to the CFSIZER Web pages, including consolidated structure input pages to the OEM cache structure page.

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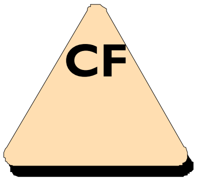

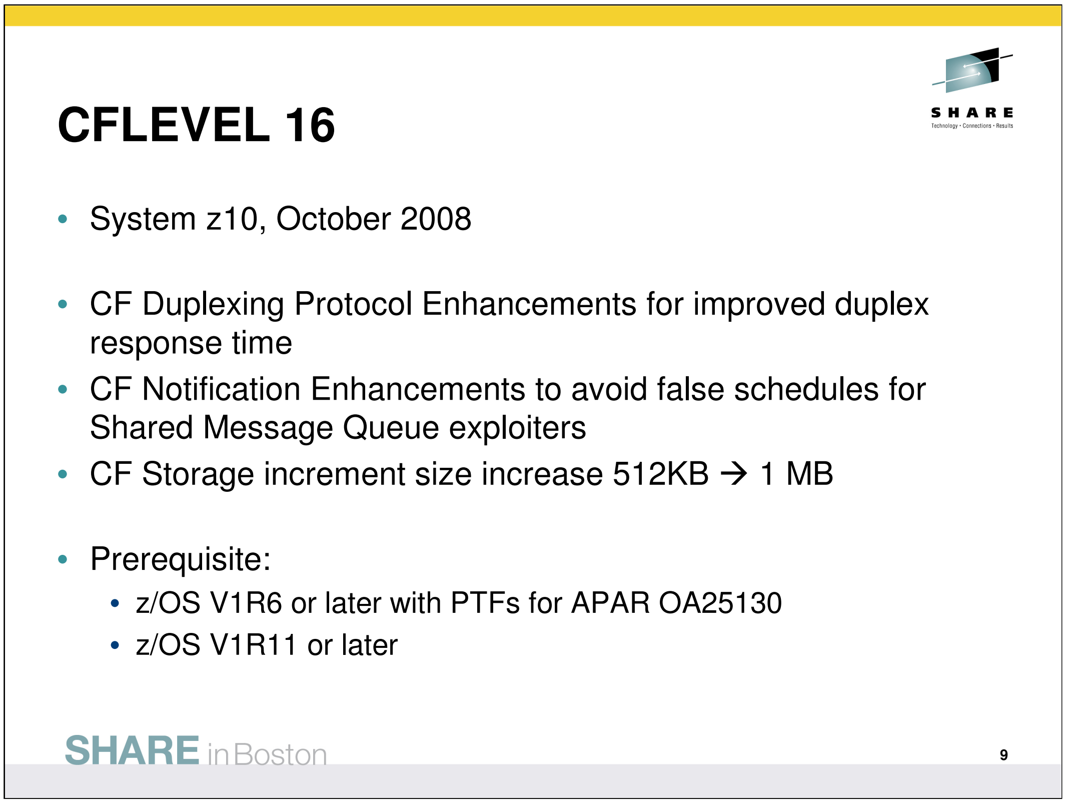

CFLEVEL 16

- System z10, October 2008
- CF Duplexing Protocol Enhancements for improved duplex response time
- CF Notification Enhancements to avoid false schedules for Shared Message Queue exploiters
- CF Storage increment size increase 512KB → 1 MB
- Prerequisite:
  - z/OS V1R6 or later with PTFs for APAR OA25130
  - z/OS V1R11 or later

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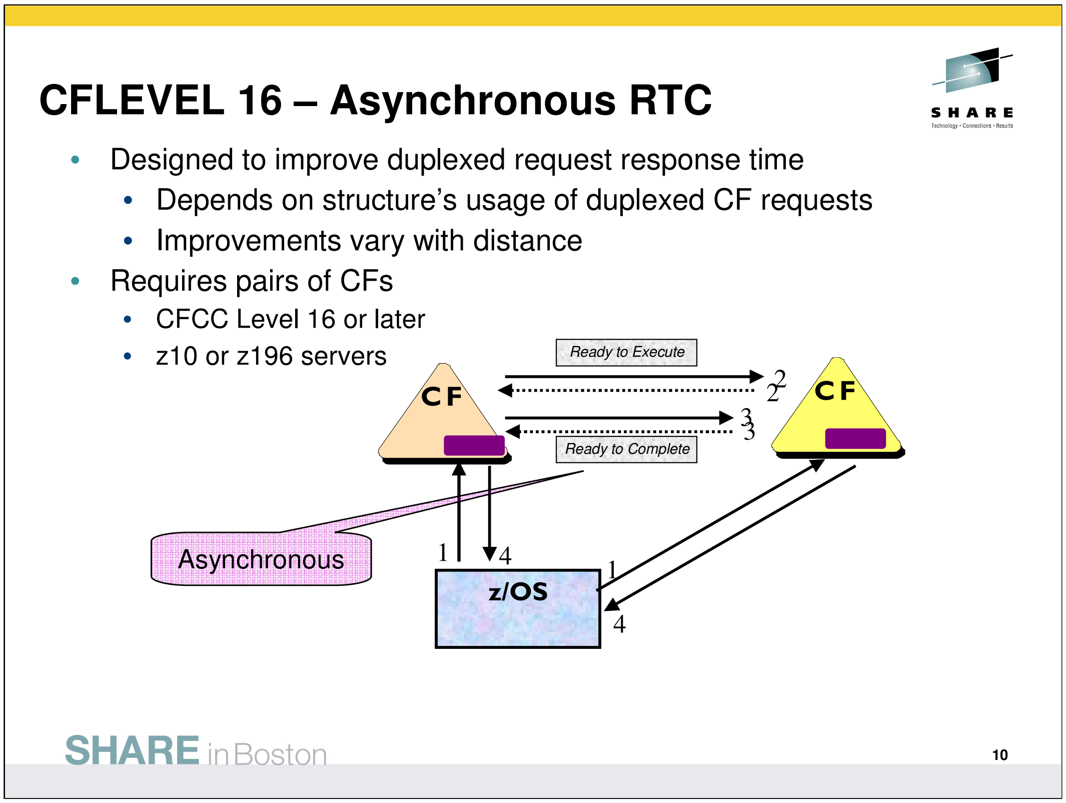
CFLEVEL 16 provides enhancements that may improve the response time of duplexed requests and may reduce the overhead of running certain applications that exploit shared message queues.

CFLEVEL 16 increased the size of the blocks of storage that are managed by the CF. This change will likely change the allocated structure sizes relative to prior CFLEVELs and necessitate updates to the structure sizes specified in the Coupling Facility Resource Manager (CFRM) policy.

z/OS support for CFLEVEL 16 is available at z/OS V1R6 and up.



CFLEVEL 16 – Asynchronous RTC

- Designed to improve duplexed request response time
  - Depends on structure's usage of duplexed CF requests
  - Improvements vary with distance
- Requires pairs of CFs
  - CFCC Level 16 or later
  - z10 or z196 servers

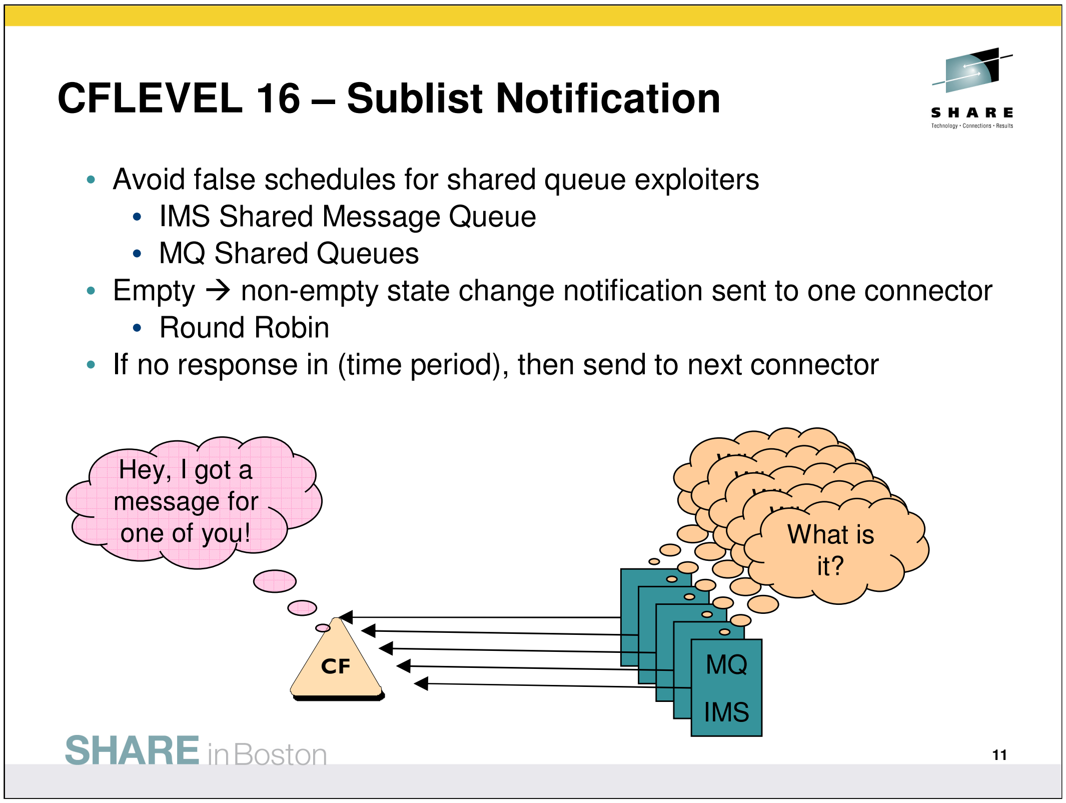
CF (Coupling Facility) requests are likely to have longer service times when issued against a duplexed structure vs. a simplex structure. The duplexed command pairs must execute in a coordinated fashion within the two coupling facilities, a process that requires the exchange of signals between the two CFs. The exchanging of these signals, especially at large distances, takes time. The impact on coupling efficiency for a particular application will vary according to rate at which CF requests are generated, as well as the relative proportion of requests that modify structure objects (writes) to requests that don't (reads).

The coupling facilities containing the duplexed instances of the structure exchange Ready To Execute (RTE) signals to coordinate starting of the duplexed command pair. After completing the command, the coupling facilities exchange Ready To Complete (RTC) signals to commit the results.

Asynchronous RTC allows a duplexed request to complete without waiting for the RTC exchange between coupling facilities to complete. Rather than eliminating the RTC exchange, the RTC exchange will occur asynchronous to the completion of the request – improving the response time for the request. The improvement for any particular customer will of course depend on the particulars of the workload and its access patterns for the structure of interest. In general, one could see roughly 10-15% improvement in response time for duplexed requests. In general, as the distance between the coupling facilities increases, the improvement in response time will be more noticeable.

Use of asynchronous RTC does not impact (reduce) host CPU utilization.

The two coupling facilities containing the duplexed instances of the structure must be running CFCC Level 16 (for z10) and/or CFCC Level 17 (for z196).



CFLEVEL 16 – Sublist Notification

- Avoid false schedules for shared queue exploiters
  - IMS Shared Message Queue
  - MQ Shared Queues
- Empty → non-empty state change notification sent to one connector
  - Round Robin
- If no response in (time period), then send to next connector

Hey, I got a message for one of you!
What is it?
CF
MQ
IMS

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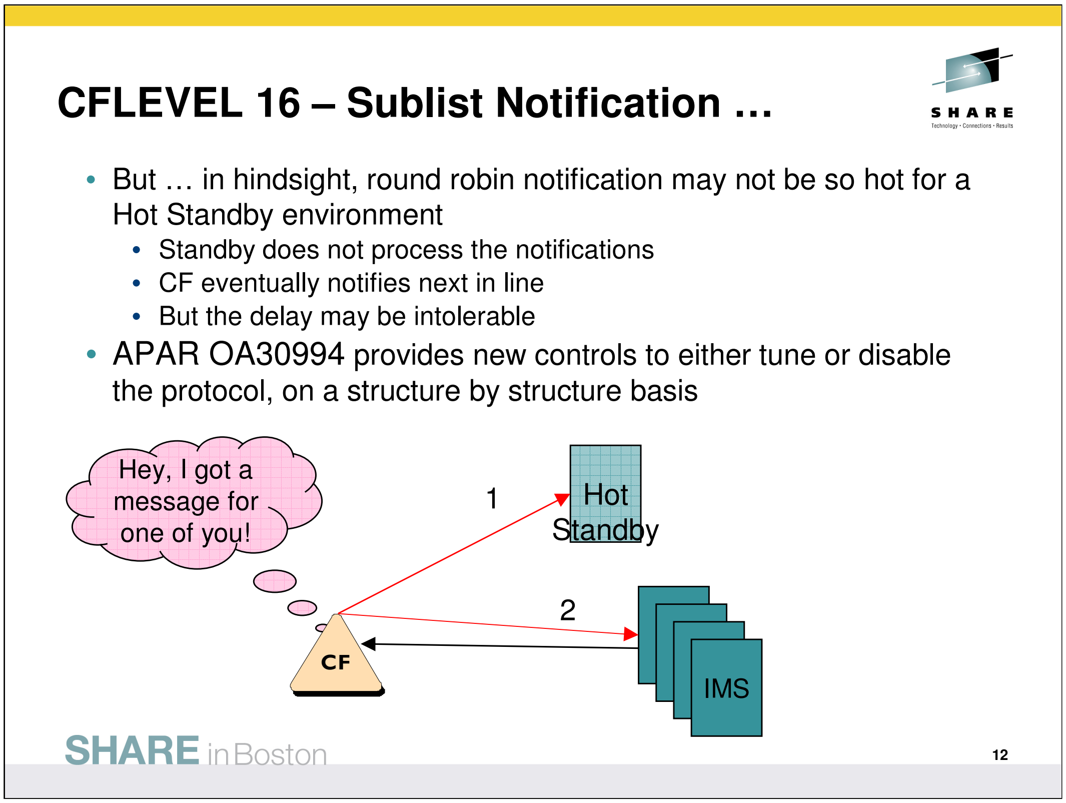
The sublist notification protocol would benefit and be of general interest to Parallel Sysplex customers, particularly those who make use of the existing sublist notification function for CF Keyed List Structures. Exploiters of sublist monitoring, such as MQ Shared Queues and IMS Shared Message Queue, can transparently reduce their scheduling overhead with the enhanced sublist notification mechanism.

This Sublist Notification protocol identifies in a round robin fashion a monitored instance of a sublist transition. The identified instance is notified of the sublist transition immediately without delay. Any other monitored instances may be notified of the sublist transition after a specific delay time. This allows time for the first notified monitored instance to process the work before the other monitored instances are notified. If the first notified monitored instance can process the work, the other monitored instances may not be notified. This prevents the other monitored instances from unnecessarily trying to process work that has already been handled.



CFLEVEL 16 – Sublist Notification …

- But … in hindsight, round robin notification may not be so hot for a Hot Standby environment
  - Standby does not process the notifications
  - CF eventually notifies next in line
  - But the delay may be intolerable
- APAR OA30994 provides new controls to either tune or disable the protocol, on a structure by structure basis

Hey, I got a message for one of you!
1
Hot Standby
2
CF
IMS

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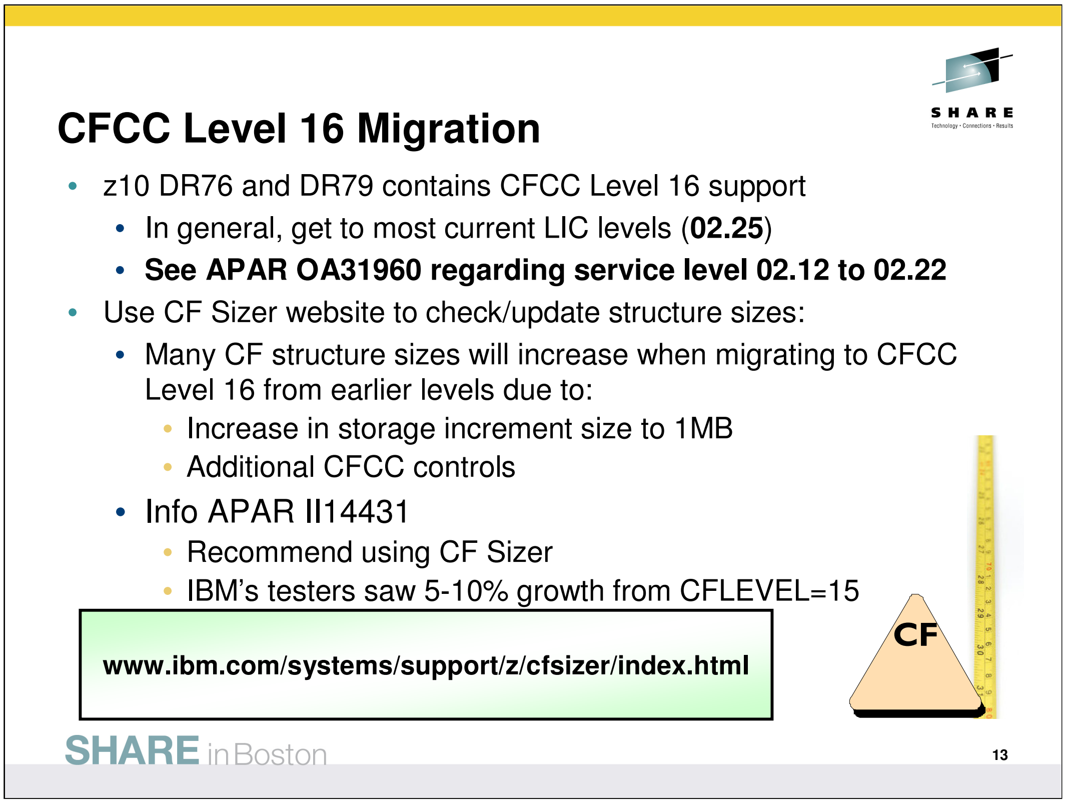
CFCC initially had a defect wherein it was not continuing on to provide subsequent notifications if the first one did not grab the work fast enough. Some customers that had a hot standby environment were significantly impacted if the hot standby was selected to receive the initial (and only) notification. Since the CF in effect lost initiative to provide notifications and the hot standby did not process the work, things hung. The CFCC has now fixed the defect (be sure you have the latest MCL). But analysis of this problem situation suggests that this new form of sublist notification may not be as suitable for all environments as first thought.

Sublist Notification Delay function was delivered in z/OS V1R10 (HBB7750), and requires CFCC Level16. The original support set the sublist notification delay time value to 5 microseconds. The sublist monitoring delay function was automatically applied to any CF List Structure allocated with Primary Keys with monitoring connectors.

With OA30994, enhancements are provided to allow the installation to specify the sublist notification delay time. A new CFRM policy parameter (SUBNOTIFYDELAY) on the existing STRUCTURE definition statement will allow the sublist notification delay time to be specified in microseconds. The delay time will take effect immediately when the policy is activated. The default sublist notification delay time will remain at 5 microseconds if the new parameter is not specified. SUBNOTIFYDELAY can be a number in the range of 0 to 1000000 (1 million) microseconds. For SUBNOTIFYDELAY to work predictably, SUBNOTIFYDELAY support needs to be present on all systems.



CFCC Level 16 Migration

- z10 DR76 and DR79 contains CFCC Level 16 support
  - In general, get to most current LIC levels (**02.25**)
  - **See APAR OA31960 regarding service level 02.12 to 02.22**
- Use CF Sizer website to check/update structure sizes:
  - Many CF structure sizes will increase when migrating to CFCC Level 16 from earlier levels due to:
    - Increase in storage increment size to 1MB
    - Additional CFCC controls
  - Info APAR II14431
    - Recommend using CF Sizer
    - IBM's testers saw 5-10% growth from CFLEVEL=15

www.ibm.com/systems/support/z/cfsizer/index.html

The problem documented in APAR OA31960 was introduced by CF micro-code and is fixed by CF micro-code. The problem is documented in an XES software APAR because the symptoms associated with the problem commonly surface in the CF Activity Report. If you are experiencing the problem documented in this APAR please contact your IBM CE for further assistance, reference RETAIN TIP H195228. Customers running with CFs at CFCC RELEASE 16.00, SERVICE LEVEL 02.12 or higher may experience application or batch job slow downs due to nearly all of the requests going to a structure being changed to async. The slowdowns have been seen particularly during intensive activity caused either by DB2 image copy jobs or write-intensive DB2 reorg jobs, or other similar workloads.

Symptoms seen by several customers, though not a huge number. Typically, online performance is OK, but batch workload performance suffers significantly; DB2 image copy jobs and reorg jobs seem affected, but others certainly possible.

The problem has been resolved by CFCC Release 16 Service Level 2.25

In general, one should always use the CF Sizer to resize structures when a new CF level is installed. In general, the size of a structure allocated at CF Level 16 will be larger than the size of the structure allocated at any lower CF level. The change in size for any particular structure is difficult to predict in general because the size changes are very dependent on the way the exploiting application actually uses the structure (the additional control space needed by the CF will depend on what's in the structure). Info APAR II14431 basically says: sizes will change, use the CFSIZER. Our test results on average saw 5-10% growth over a properly sized structure allocated in a CFLEVEL=15 CF.

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- Hardware Updates
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  - CFCC Level 16
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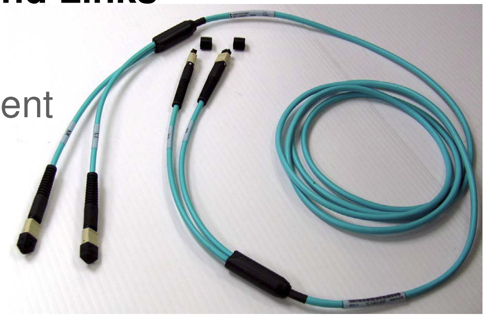
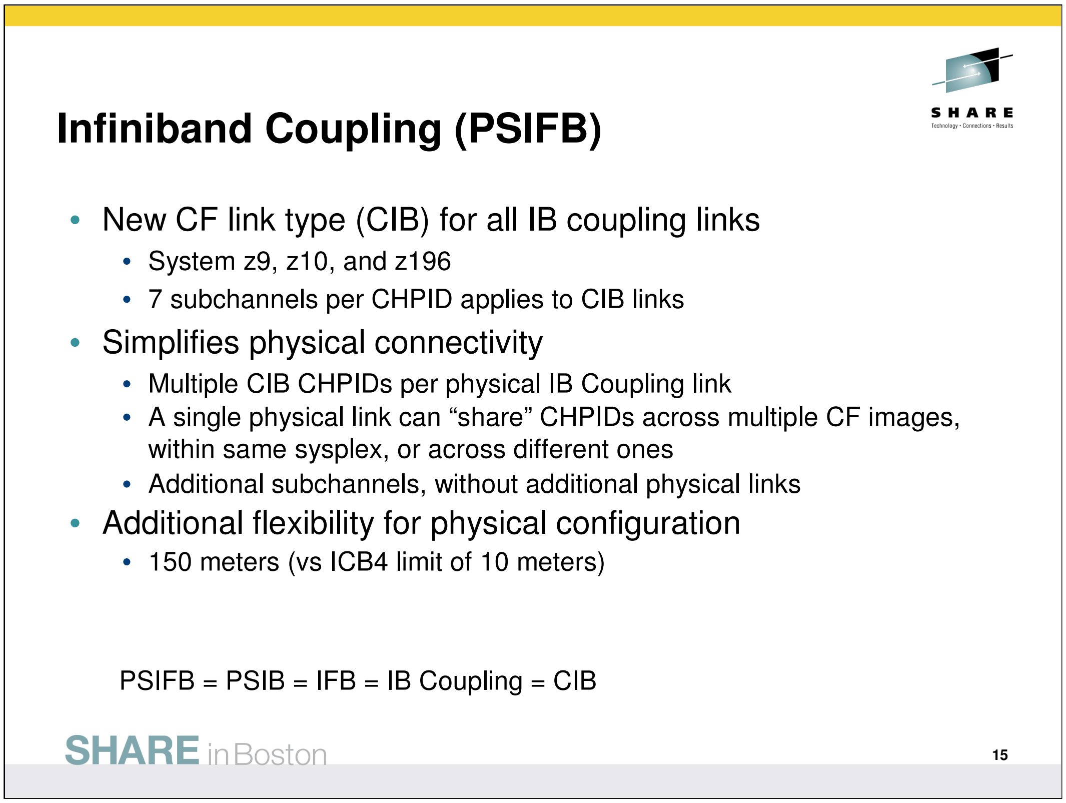
  - z/OS V1R12
- Summary





Infiniband Coupling (PSIFB)

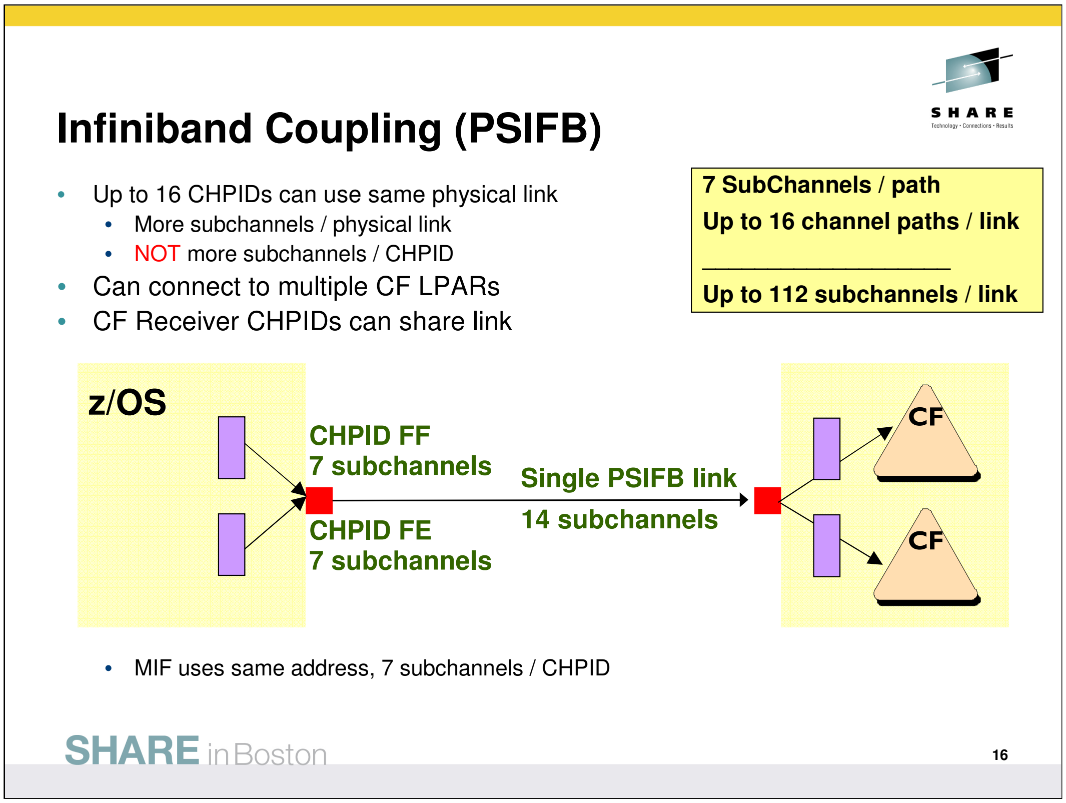
- New CF link type (CIB) for all IB coupling links
  - System z9, z10, and z196
  - 7 subchannels per CHPID applies to CIB links
- Simplifies physical connectivity
  - Multiple CIB CHPIDs per physical IB Coupling link
  - A single physical link can “share” CHPIDs across multiple CF images, within same sysplex, or across different ones
  - Additional subchannels, without additional physical links
- Additional flexibility for physical configuration
  - 150 meters (vs ICB4 limit of 10 meters)

PSIFB = PSIB = IFB = IB Coupling = CIB

Infiniband links are sometimes called IFB, PSIB, PSIFB, IB Coupling, or CIB (coupling over infiniband). They are all the same thing.

There are several ways of classifying IFB links. It can be Double Data Rate (DDR) or Single Data Rate (SDR). The IFB links can also be characterized by the amount of lanes of communication within each physical link. For example, 12x links provide 12 lanes of communication within each physical link. 1x links provide a single lane of communication within each physical link.

7 subchannels per CHPID is same as for other links. What’s unique to infiniband is ability for the physical link to share CHPIDs.



Infiniband Coupling (PSIFB)

- Up to 16 CHPIDs can use same physical link
  - More subchannels / physical link
  - NOT more subchannels / CHPID
- Can connect to multiple CF LPARs
- CF Receiver CHPIDs can share link

7 SubChannels / path
Up to 16 channel paths / link
____
Up to 112 subchannels / link

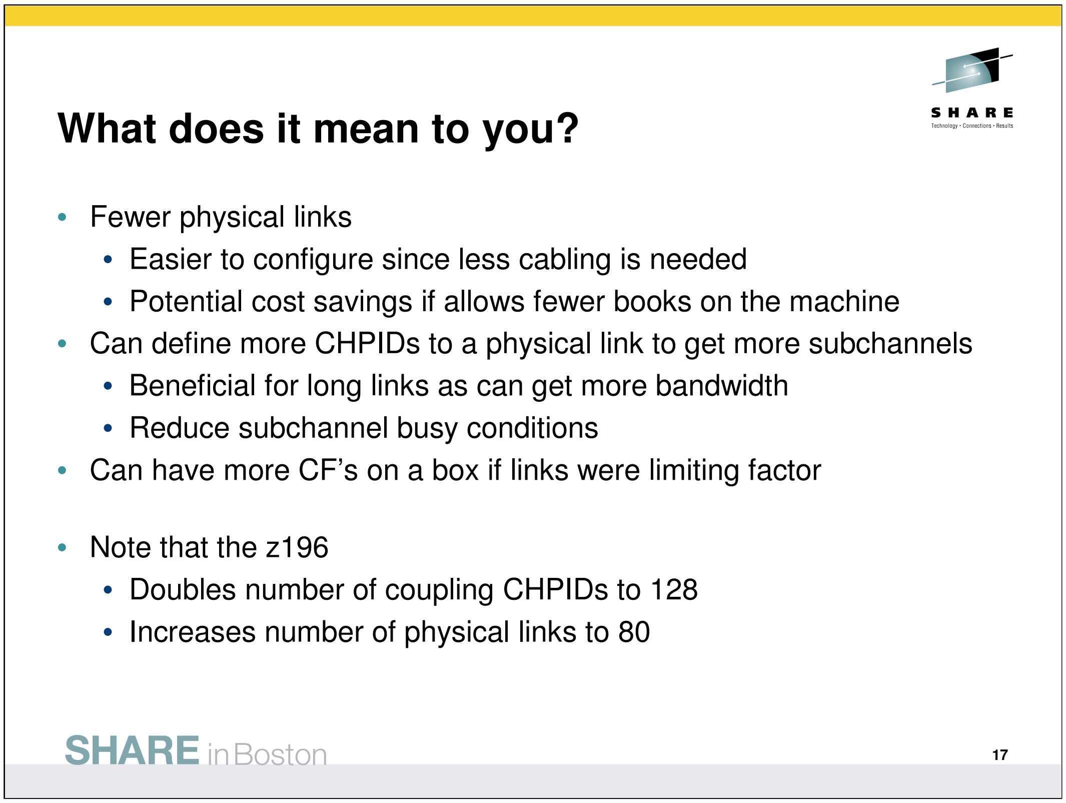
- MIF uses same address, 7 subchannels / CHPID

Note that CF receiver CHPIDs can now share the same physical infiniband link. Prior to this, there was a one-to-one correspondence between receiver CHPID and CF Link. In effect there will be a one-to-one correspondence between a sender CHPID and a receiver CHPID, but the physical link can be shared by many such pairs.

Allowing the same physical link to shared by multiple sysplexes can be quite useful if connecting to a server containing multiple CFs at the “receiver” end. For example, if there are two CHPIDs defined at the “sender”, one can be directed to connect to one CF, the other CHPID to the other CF. Depending on the configuration, this may provide for a reduction in the number of coupling links required.

IBM expects that most clients will not see reasons nor benefits in configuring more than 8 CHPID across the two ports of an InfiniBand coupling HCA. However, this is not a restriction and configuring up to 16 CHPIDs across the two ports of the InfiniBand coupling HCA is indeed supported. However, there is a diminishing benefit to adding these CHPIDs and configuring more than necessary may actually impact performance instead of help.

Thus configuring up to 16 CHPIDs might be reasonable in cases where the load is “light” but the need for connections is “high”. But in cases where the load is “heavy”, one should refrain from going above 8 CHPIDs as one reaches a point of diminishing returns.



What does it mean to you?

- Fewer physical links
  - Easier to configure since less cabling is needed
  - Potential cost savings if allows fewer books on the machine
- Can define more CHPIDs to a physical link to get more subchannels
  - Beneficial for long links as can get more bandwidth
  - Reduce subchannel busy conditions
- Can have more CF’s on a box if links were limiting factor

- Note that the z196
  - Doubles number of coupling CHPIDs to 128
  - Increases number of physical links to 80

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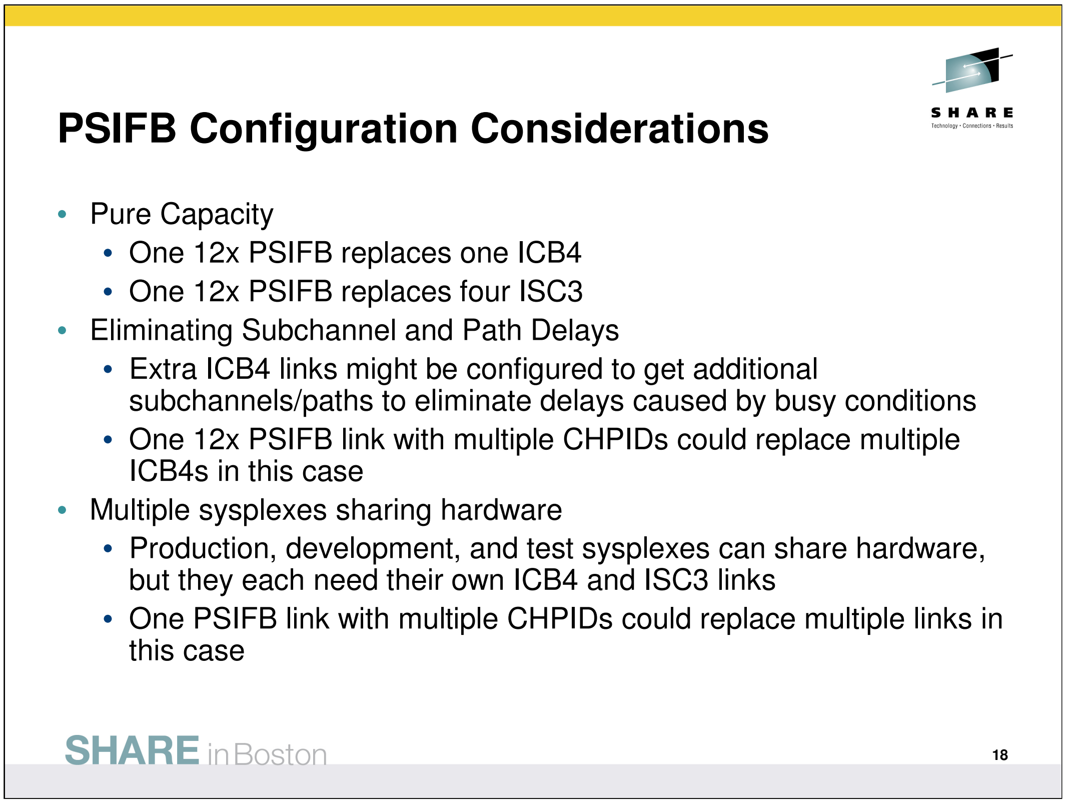
Fewer physical links could enable $$ savings by reducing need for books on the machine, if number of books was related to need for physical connectivity.

Enable more subchannels per physical link: Each peer-mode coupling link supports seven subchannels, or seven concurrent messages to a coupling facility. If the volume and duration of CF accesses is high enough to cause subchannel busy conditions such as when data sharing across distances, then the additional subchannels can improve communication performance without using more physical links.

The zEnterprise 196 provides supports 128 coupling CHPIDs per server: To support larger Parallel Sysplexes with ever-increasing amounts of data sharing traffic to the Coupling Facility, the throughput and capacity of more coupling CHPIDs is also required. With z196, the number of coupling CHPIDs per server has been increased from 64 to 128. Since IFB links allow for multiple (logical) CHPIDs over the same (physical) link, this can also allow for larger Parallel Sysplexes without requiring more coupling link hardware.

In addition, the limit on physical coupling links was raised from 64 to 80 physical CF links (48 ISC + 32 CIB). So the z196 machine provides both more logical coupling CHPIDs and more physical coupling links than z10.



PSIFB Configuration Considerations

- Pure Capacity
  - One 12x PSIFB replaces one ICB4
  - One 12x PSIFB replaces four ISC3
- Eliminating Subchannel and Path Delays
  - Extra ICB4 links might be configured to get additional subchannels/paths to eliminate delays caused by busy conditions
  - One 12x PSIFB link with multiple CHPIDs could replace multiple ICB4s in this case
- Multiple sysplexes sharing hardware
  - Production, development, and test sysplexes can share hardware, but they each need their own ICB4 and ISC3 links
  - One PSIFB link with multiple CHPIDs could replace multiple links in this case

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From a pure capacity perspective, one 12x PSIFB link is equivalent to either one ICB4 link or four ISC3 links.

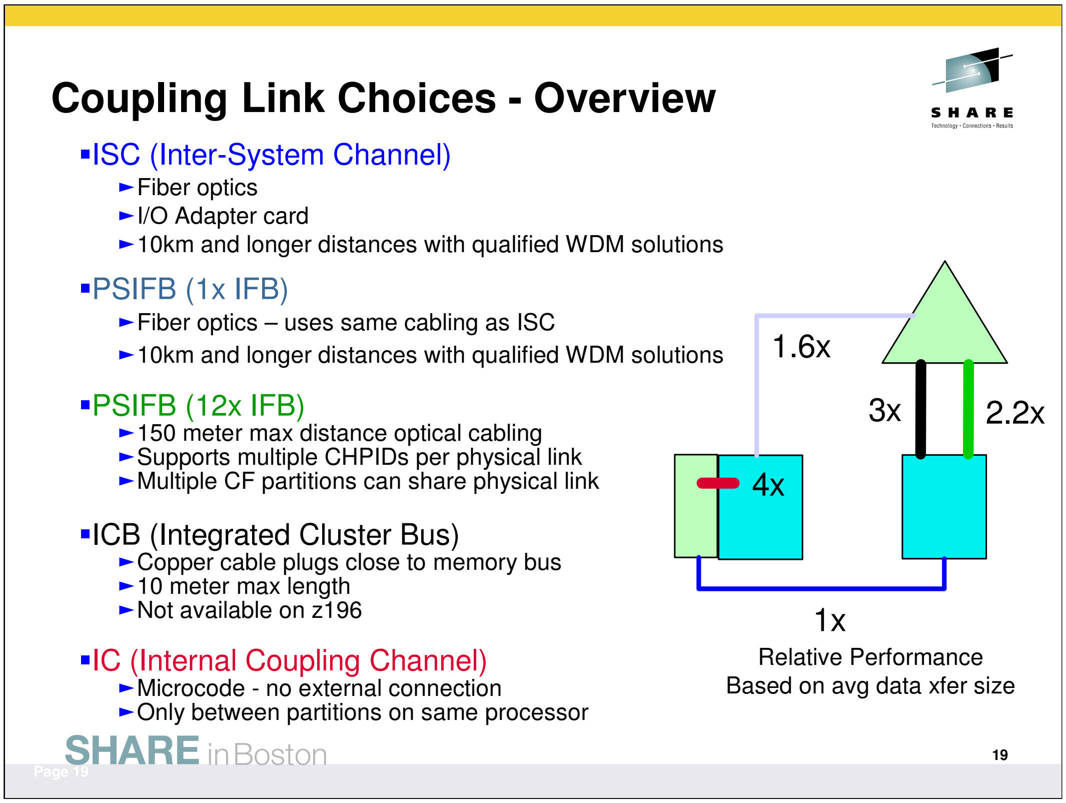
Many installations configuring ICB4 links for their z9 or z10 servers, find that two such links between the z/OS image and the CF are sufficient. Some installations need the added capacity of a 3rd or 4th ICB. In those cases, an installation looking to replace ICB4 links with PSIFB links would do so on a one for one basis. More typically, installations need to configure a 3rd or 4th ICB4 link not for capacity reasons, but to overcome delays caused by “path busy” and “subchannel busy” conditions that can occur due to “bursty” traffic. In those cases, two PSIFB links with a pair of CHPIDs assigned to each link could replace the three or four ICB4 links. That is, one PSIFB link could replace more than one ICB4 link.

Some installations have multiple CECs, with multiple sysplexes running on each CEC. So on CEC “B”, one might for example have coupling facility CF1B used by sysplex 1, and coupling facility CF2B used by sysplex 2. CEC “A” would need at least two ICB4 links (for example) to allow the z/OS images on CEC “A” to communicate with those coupling facilities. One link would connect CEC “A” to coupling facility CF1B, and the other would connect it to CF2B. A separate link would be needed for each CF because there is a one-to-one correspondence between a CF receiver CHPID and an ICB4 link. However, one PSIFB link could be used to connect the two CECs because the receiver CHPIDs for each CF on CEC “B” could share the PSIFB link. In these cases, where multiple ICB4 and ISC3 links are configured to establish necessary connectivity (as opposed to capacity), one PSIFB link with multiple CHPIDs could be used to replace multiple links.

Some real world examples where installations have converted to PSIFB links.

- Consolidating to System z10 model E64 which does not support ICB-4.
- Consolidation of 16 ISC-3 links to 4 IFB (maintaining redundancy across two HCA) within a datacenter. Infrastructure savings and improvement in coupling efficiency.
- Installation had 2 ICB for development and 4 ICB for production Sysplex sharing System z10. Converted to 4 PSIFB links with shared CHPIDs for development and production without a significant decrease in coupling efficiency.

After PSIFB links are configured, additional CHPIDs can be added to a configuration providing additional subchannels without requiring additional physical hardware infrastructure.



Coupling Link Choices - Overview

- ISC (Inter-System Channel)
  - ►Fiber optics
  - ►I/O Adapter card
  - ►10km and longer distances with qualified WDM solutions
- PSIFB (1x IFB)
  - ►Fiber optics – uses same cabling as ISC
  - ►10km and longer distances with qualified WDM solutions
- PSIFB (12x IFB)
  - ►150 meter max distance optical cabling
  - ►Supports multiple CHPIDs per physical link
  - ►Multiple CF partitions can share physical link
- ICB (Integrated Cluster Bus)
  - ►Copper cable plugs close to memory bus
  - ►10 meter max length
  - ►Not available on z196
- IC (Internal Coupling Channel)
  - ►Microcode - no external connection
  - ►Only between partitions on same processor

Relative Performance
Based on avg data xfer size

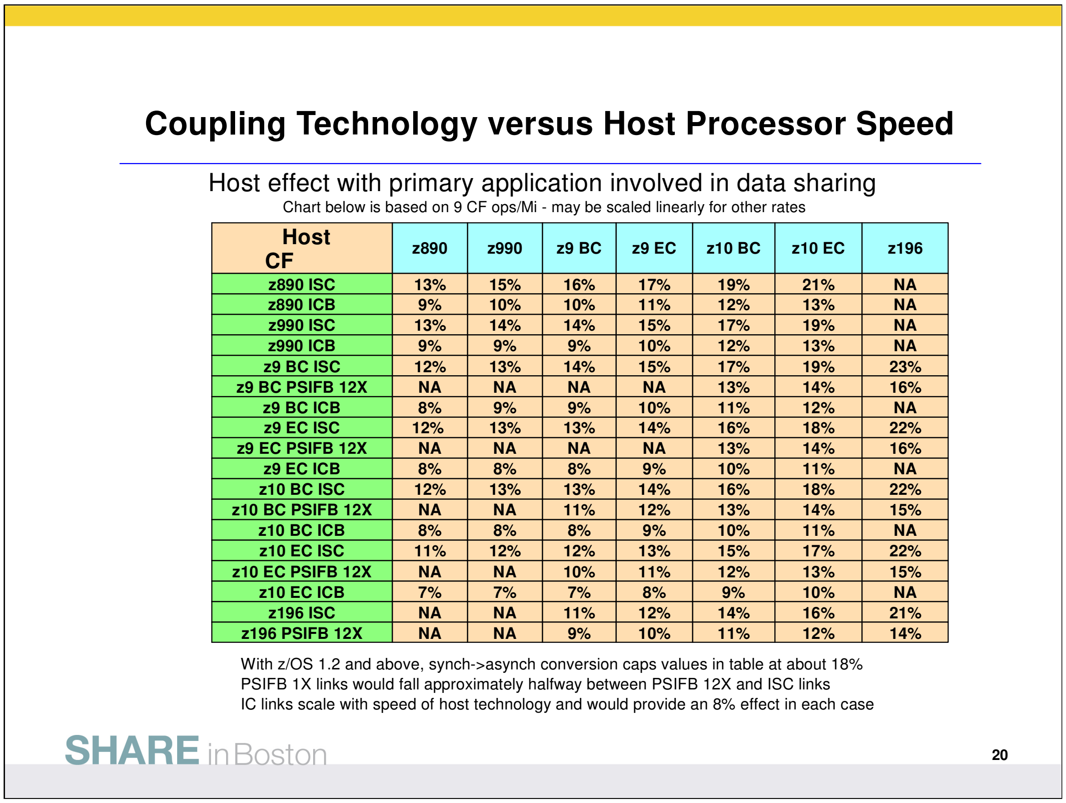
The slide lists the links in order of increasing performance, top to bottom. The 1x IFB links tend be somewhat faster than the ISC links. The 12x IFB links are slightly slower than ICB links, but allow much greater distances.

ISC-3 links provide the connectivity required for data sharing between the CF and the systems. ISC links support point-to-point connections (directly connecting CFs and systems), and require a unique channel definition at each end of the link.

InfiniBand coupling links (PSIFB) are high speed links on z196, z10 and z9 servers. PSIFB coupling links use a fiber optic cable that is connected to a Host Channel Adapter fanout in the server.

Integrated Cluster Bus links are members of the family of coupling link options available on System z10 and previous System z servers. They are faster than ISC links, attaching directly to a Self-Timed Interconnect (STI) bus of the server. The ICB features are highly integrated, with very few components, and provide better coupling efficiency (less server overhead associated with coupling systems) than ISC-3 links. They are an available method for coupling connectivity when connecting System z10 and previous System z servers over short distances (seven meters). For longer distances, PSIFB (up to 150 meter), PSIFB LR (up to 100 km), or ISC-3 links (up to 100 km) must be used.

IC links are Licensed Internal Code-defined links to connect a CF to a z/OS logical partition in the same server. These links are available on all System z servers. The IC link is a System z server coupling connectivity option that enables high-speed, efficient communication between a CF partition and one or more z/OS logical partitions running on the same server. The IC is a linkless connection (implemented in Licensed Internal Code) and so does not require any hardware or cabling.



Coupling Technology versus Host Processor Speed

Host effect with primary application involved in data sharing

Chart below is based on 9 CF ops/Mi - may be scaled linearly for other rates

Host CF	z890	z990	z9 BC	z9 EC	z10 BC	z10 EC	z196
z890 ISC	13%	15%	16%	17%	19%	21%	NA
z890 ICB	9%	10%	10%	11%	12%	13%	NA
z990 ISC	13%	14%	14%	15%	17%	19%	NA
z990 ICB	9%	9%	9%	10%	12%	13%	NA
z9 BC ISC	12%	13%	14%	15%	17%	19%	23%
z9 BC PSIFB 12X	NA	NA	NA	NA	13%	14%	16%
z9 BC ICB	8%	9%	9%	10%	11%	12%	NA
z9 EC ISC	12%	13%	13%	14%	16%	18%	22%
z9 EC PSIFB 12X	NA	NA	NA	NA	13%	14%	16%
z9 EC ICB	8%	8%	8%	9%	10%	11%	NA
z10 BC ISC	12%	13%	13%	14%	16%	18%	22%
z10 BC PSIFB 12X	NA	NA	11%	12%	13%	14%	15%
z10 BC ICB	8%	8%	8%	9%	10%	11%	NA
z10 EC ISC	11%	12%	12%	13%	15%	17%	22%
z10 EC PSIFB 12X	NA	NA	10%	11%	12%	13%	15%
z10 EC ICB	7%	7%	7%	8%	9%	10%	NA
z196 ISC	NA	NA	11%	12%	14%	16%	21%
z196 PSIFB 12X	NA	NA	9%	10%	11%	12%	14%

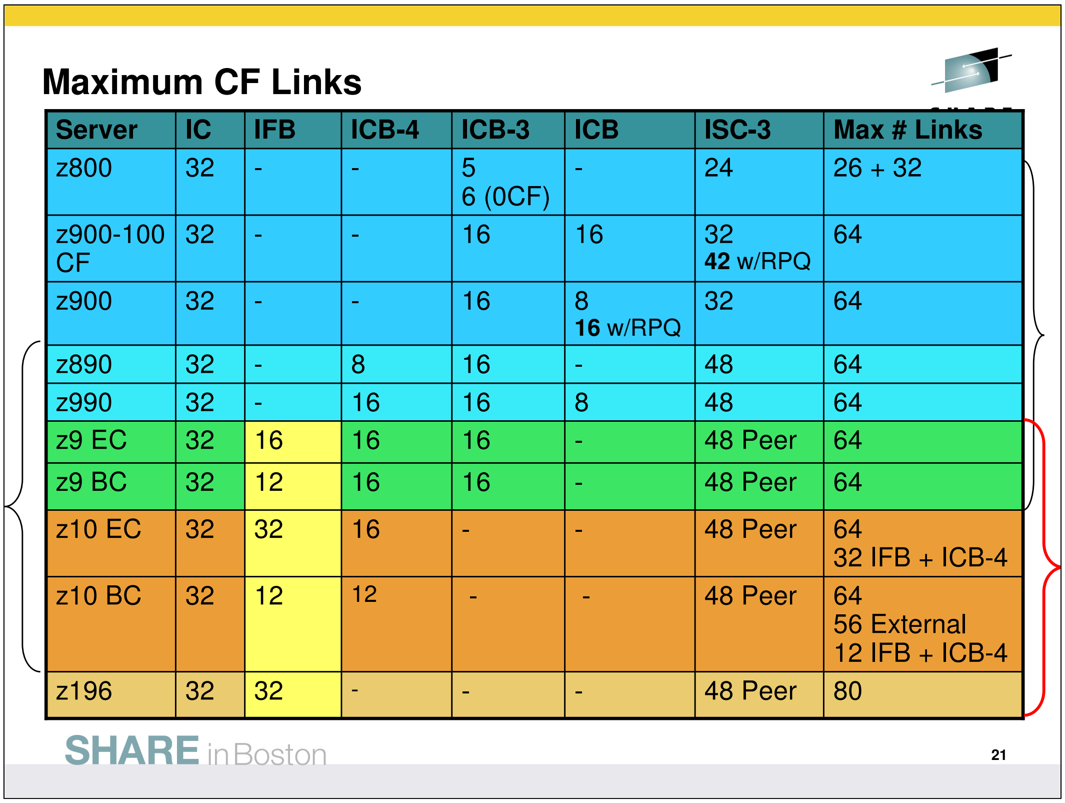
With z/OS 1.2 and above, synch->asynch conversion caps values in table at about 18%
PSIFB 1X links would fall approximately halfway between PSIFB 12X and ISC links
IC links scale with speed of host technology and would provide an 8% effect in each case

The coupling efficiency of a Parallel Sysplex cluster, particularly one that has heavy datasharing, is sensitive to the performance of the operations to the Coupling Facility. The chart estimates the “host effect” for a heavy data sharing production workload for various combinations of host processor and coupling technology. The values in the table represent the percentage of host capacity that is used to process operations to the coupling facility (which includes the time spent communicating with the CF and the time spent waiting for the CF to process the request). For example, a value of 10% would indicate that approximately 10% of the host capacity (or host MIPS) is consumed by the subsystem, operating system and hardware functions associated with coupling facility activity. The table is based on a “coupling intensity” of 9 CF operations per million instructions (MI), which is typical of high end data sharing work loads.

The values in the table can be adjusted to reflect the coupling intensity for any workload. One can calculate the coupling intensity by simply summing the total req/sec of the CFs and dividing by the used MIPS of the attached systems (MIPS rating times CPU busy). Then, the values in the table would be linearly scaled. For example, if the workload was processing 4.5 CF operations per million instructions (or 4.5 CF ops/second/MIPS), then all the values in the table would be cut in half.

For 9 CF requests/MI, host effect values in the table may be considered capped at approximately 18% due to z/OS Synchronous to Asynchronous CF Message Conversion. Configurations where entries are approaching 18% will see more messages converted to asynchronous. z/OS converts synchronous messages to asynchronous messages when the synchronous service time relative to the speed of the host processor exceeds a breakeven threshold at which it becomes cheaper to go asynchronous. When all CF operations are asynchronous, the overhead will be about 18%. By the time you have reached >=18% in the table, that corresponds to the time z/OS must have been converting almost every operation asynchronous. The 18% cap scales proportionally with the CF requests/MI activity rate. For example, at 4.5 CF requests/MI, the cap would 9%.

The hardware cost can be minimized by using the most efficient links with faster engine speeds for the CFs. This reduces the time that z/OS is waiting for the response while the message is on the CF link and while the CF is busy processing the request. With this in mind, it becomes obvious that the best coupling efficiency is generally seen when the CF is on the fastest processor and connected to the z/OS image via the fastest links. The chart bears this out. For example, holding the CF and host processor technology constant, the chart shows that coupling efficiency increases with faster links (z/OS spends less time waiting because the communication with the CF is faster). For a given host processor and link technology, coupling efficiency increases with faster CF technology (z/OS spends less time waiting because the CF processes the request faster). In most cases, upgrading to faster links has a more dramatic impact on coupling efficiency than upgrading to a faster CF.



Maximum CF Links

Server	IC	IFB	ICB-4	ICB-3	ICB	ISC-3	Max # Links
z800	32	-	-	5 6 (0CF)	-	24	26 + 32
z900-100 CF	32	-	-	16	16	32 **42** w/RPQ	64
z900	32	-	-	16	8 **16** w/RPQ	32	64
z890	32	-	8	16	-	48	64
z990	32	-	16	16	8	48	64
z9 EC	32	16	16	16	-	48 Peer	64
z9 BC	32	12	16	16	-	48 Peer	64
z10 EC	32	32	16	-	-	48 Peer	64 32 IFB + ICB-4
z10 BC	32	12	12	-	-	48 Peer	64 56 External 12 IFB + ICB-4
z196	32	32	-	-	-	48 Peer	80

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The zEnterprise 196 increases the number of external coupling links allowed from 64 to 80. This allows the full configuration of 32 PSIFB links and 48 ISC-3 links to be used. In addition, you can also configure up to 32 (internal) IC links for coupling between images defined on the same server. Having more coupling links is important to provide sufficient coupling connectivity for larger single Parallel Sysplexes, as well as for configurations where the same server hosts multiple Parallel Sysplexes and Coupling Facility images.

For z196 servers the maximum number of coupling links (CHPIDs) combined (PSIFB, active ISC-3 links, and IC) is 128 and up to 80 physical external links (PSIFB, active ISC-3). For z9 or z10 servers the maximum number of coupling links (CHPIDs) combined (ICB-3, ICB-4, PSIFB, active ISC-3 links, and IC) is 64.

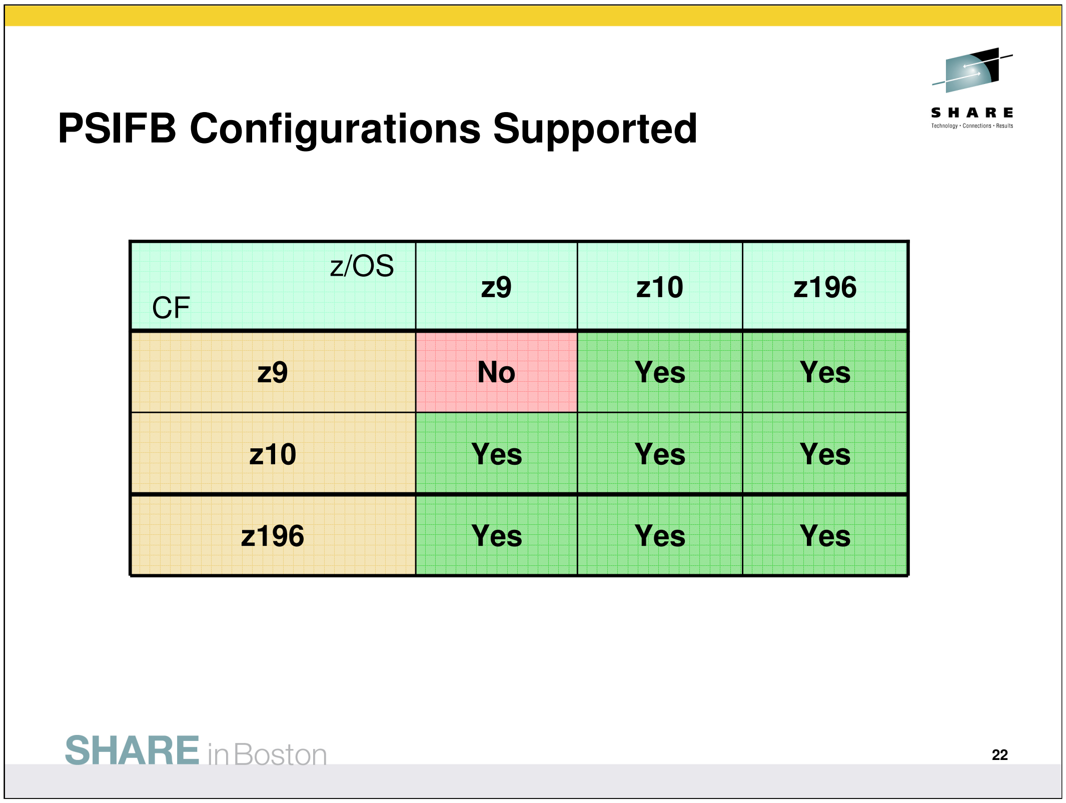
The z10 BC only has room for six fanout cards. Configuring the max of 12 IFB links would use all six fanout cards. Configuring the max of 12 ICB-4 links would use all six fanout cards. So the total number of ICB-4 and IFB links cannot exceed 12. Configuring the max of 48 ISC links would require 2 fanout cards and 2 I/O drawers. Thus configuring one ISC link, reduces the number of high speed (IFB or ICB) links to 8.

The z10 EC supports a max of 32 IFB and ICB-4 links in any combination.

Certain models have smaller limits:

A maximum of 8 ICB-4s are supported with a z9 BC capacity setting A01.
A maximum of 16 PSIFB links are supported on z196 model M15.
A maximum of 16 PSIFB links are supported on z10 EC model E12.
A maximum of 12 PSIFB links are supported on z9 EC model S08.

The brackets on the sides of the chart are meant to suggest configurations that are supported within the same sysplex (to account for N-2 compatibility).



PSIFB Configurations Supported

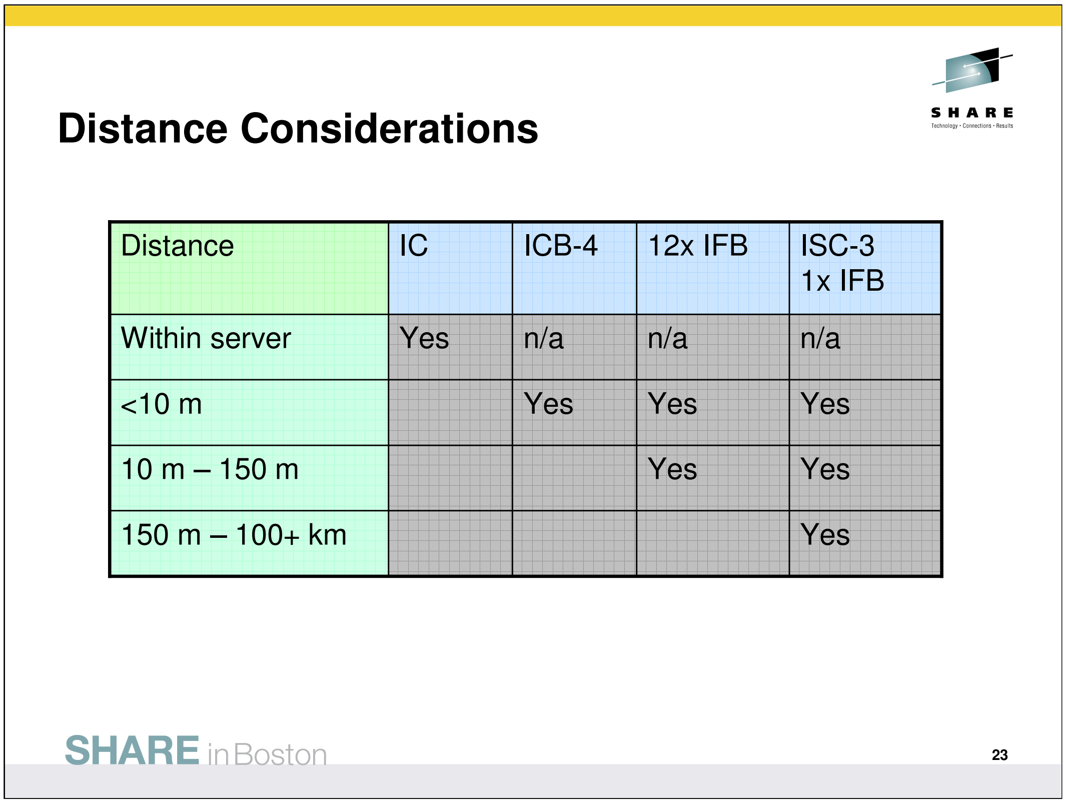
z/OS CF	z9	z10	z196
z9	No	Yes	Yes
z10	Yes	Yes	Yes
z196	Yes	Yes	Yes

The z890 and z990 do not support PSIFB links.

On the z196, z10 and z9 servers InfiniBand coupling links (PSIFB) are available. PSIFB supports peer mode connectivity between:

- Any z196 or z10 to any z9 (Link is 12x IB-DDR but operates at SDR)
- Any z196 or z10 to any z10 or z196 (12x IB-DDR and 1x IB-SDR or DDR)
- z9 to z9 PSIFB is not supported

DDR = double data rate, SDR = single data rate



Distance Considerations

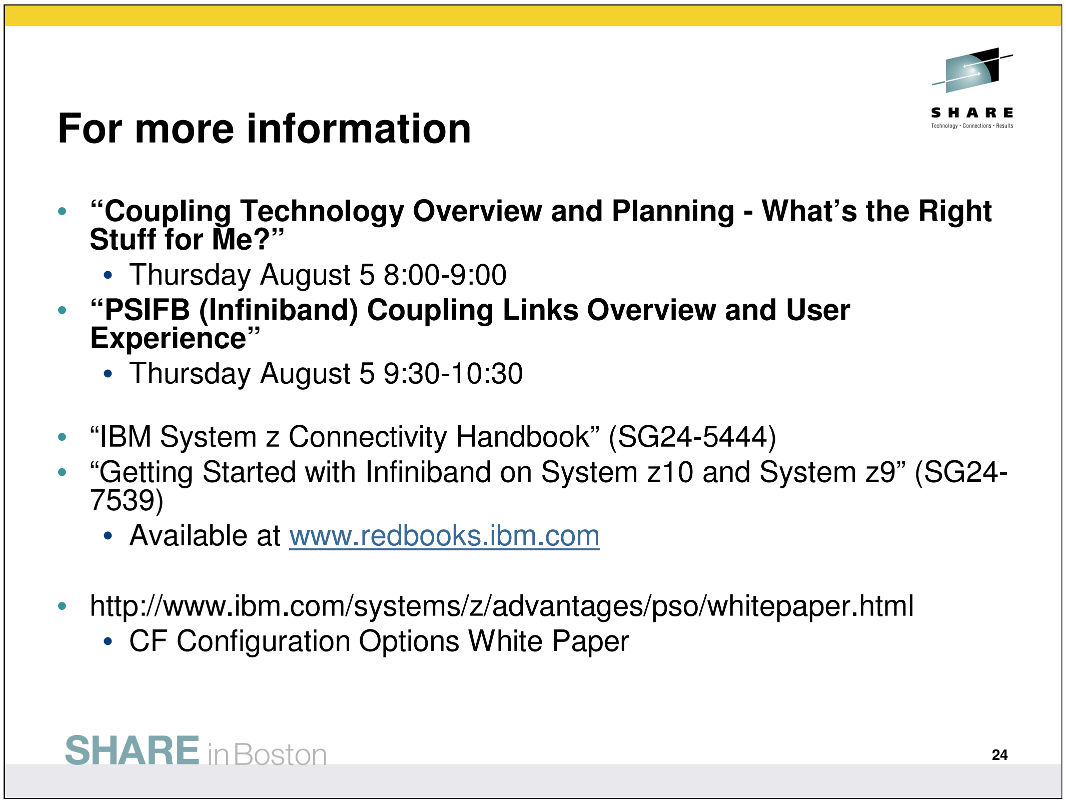
Distance	IC	ICB-4	12x IFB	ISC-3 1x IFB
Within server	Yes	n/a	n/a	n/a
<10 m		Yes	Yes	Yes
10 m – 150 m			Yes	Yes
150 m – 100+ km				Yes

The ISC and PSIFB 1x provide longer links, but slower. The PSIFB is a nice replacement for the ISC links. Both types of links require some sort of repeater (DWDM dense wave division multiplexer) to go beyond 10 km.

The PSIFB 12x and ICB links are shorter range, but faster. PSIFB can extend distance.

1x IFB, like a 1 lane highway, good for up to 10 kilometers

12x IFB, like a 12 lane highway, get more bandwidth / parallelism / striping.



For more information

- **“Coupling Technology Overview and Planning - What’s the Right Stuff for Me?”**
  - Thursday August 5 8:00-9:00
- **“PSIFB (Infiniband) Coupling Links Overview and User Experience”**
  - Thursday August 5 9:30-10:30

- “IBM System z Connectivity Handbook” (SG24-5444)
- “Getting Started with Infiniband on System z10 and System z9” (SG24-7539)
  - Available at www.redbooks.ibm.com

- http://www.ibm.com/systems/z/advantages/pso/whitepaper.html
  - CF Configuration Options White Paper

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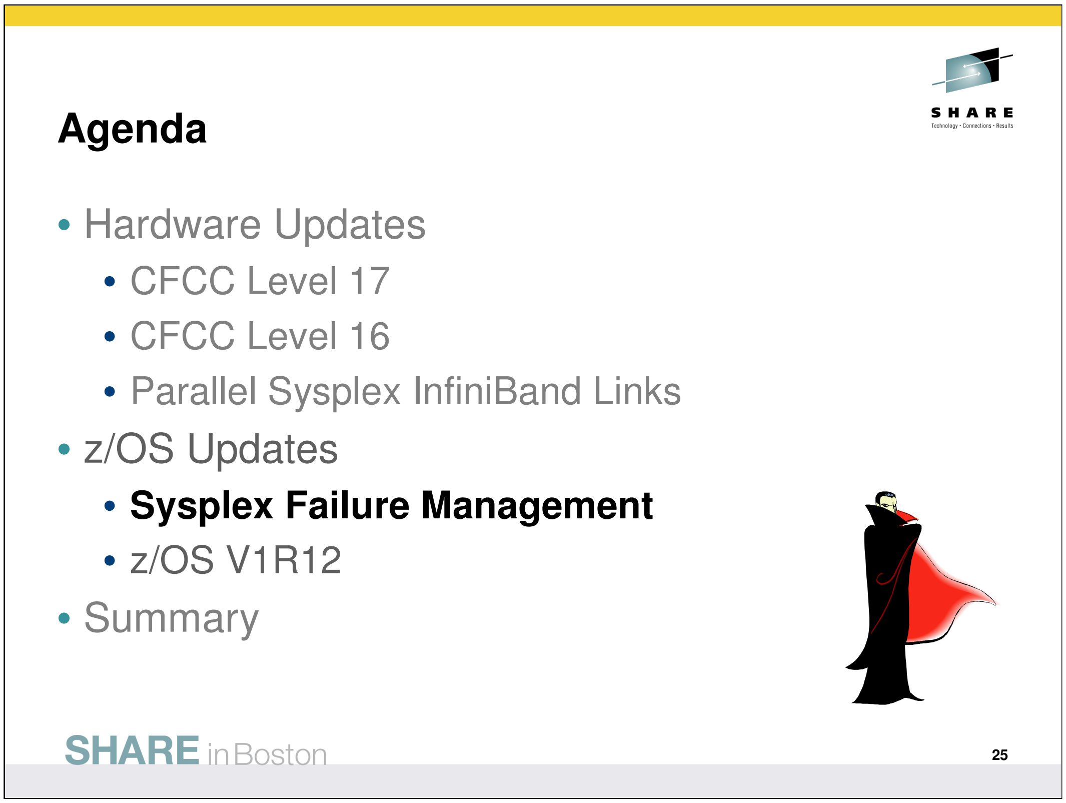
“Coupling Technology Overview and Planning” Whether you are thinking about implementing a Parallel Sysplex or have long since joined the club, this session will give you the basics to decide what is the right coupling technology for your system. After a brief overview of sysplex functionality and performance sensitivities, the questions of what kind, how big, how fast, how far and how many will be addressed for coupling facilities and coupling links. Come and find out how to determine what to install and when to upgrade to keep your sysplex running smoothly and performing well. This session was previously presented, but it has been updated with the latest information on Infiniband (PSIB) coupling links.

“PSIFB (Infiniband) Coupling Links Overview and User Experience” The IBM Washington System Center and customers will provide an overview of IBM PSIFB (Infiniband) Coupling Links technology and a user experience of the deployment both at IBM WSC Gaithersburg customer sites.

www.redbooks.ibm.com/redpieces/pdfs/sg245444.pdf This IBM® Redbooks® publication discusses the connectivity options available for use within and beyond the data center for the IBM System z® family of mainframes. The book highlights the hardware and software components, functions, typical uses, coexistence, and relative merits of these connectivity features. It will assist readers in understanding the connectivity alternatives that are available when planning and designing their data center infrastructure.

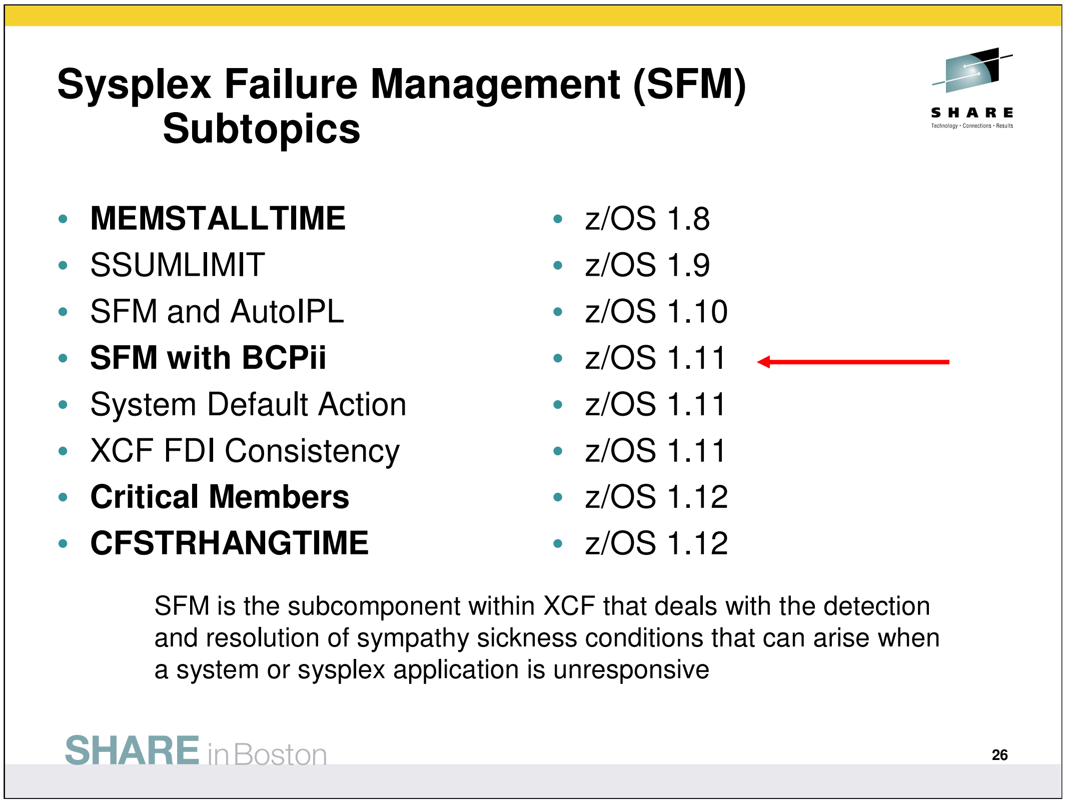
www.redbooks.ibm.com/redbooks/pdfs/sg247539.pdf This IBM® Redbooks® publication provides introductory information about the InfiniBand standard and how that standard is implemented and used to support system connectivity for System z10™ and System z9® servers. The book will help you plan and implement InfiniBand support in your System z10 and System z9 environment. It also provides step-by-step information about configuring InfiniBand connections.

www.ibm.com/systems/z/advantages/pso/whitepaper.html has a link to the white paper on “Coupling Facility Configuration Options”. This paper examines the various *Coupling Facility* technology alternatives from several perspectives. The characteristics of each CF option are compared in terms of function, inherent availability, performance and value. It also looks at CF structure placement requirements based on an understanding of CF exploitation by z/OS® components and subsystems.



Agenda

- Hardware Updates
  - CFCC Level 17
  - CFCC Level 16
  - Parallel Sysplex InfiniBand Links
- z/OS Updates
  - **Sysplex Failure Management**
  - z/OS V1R12
- Summary



Sysplex Failure Management (SFM) Subtopics

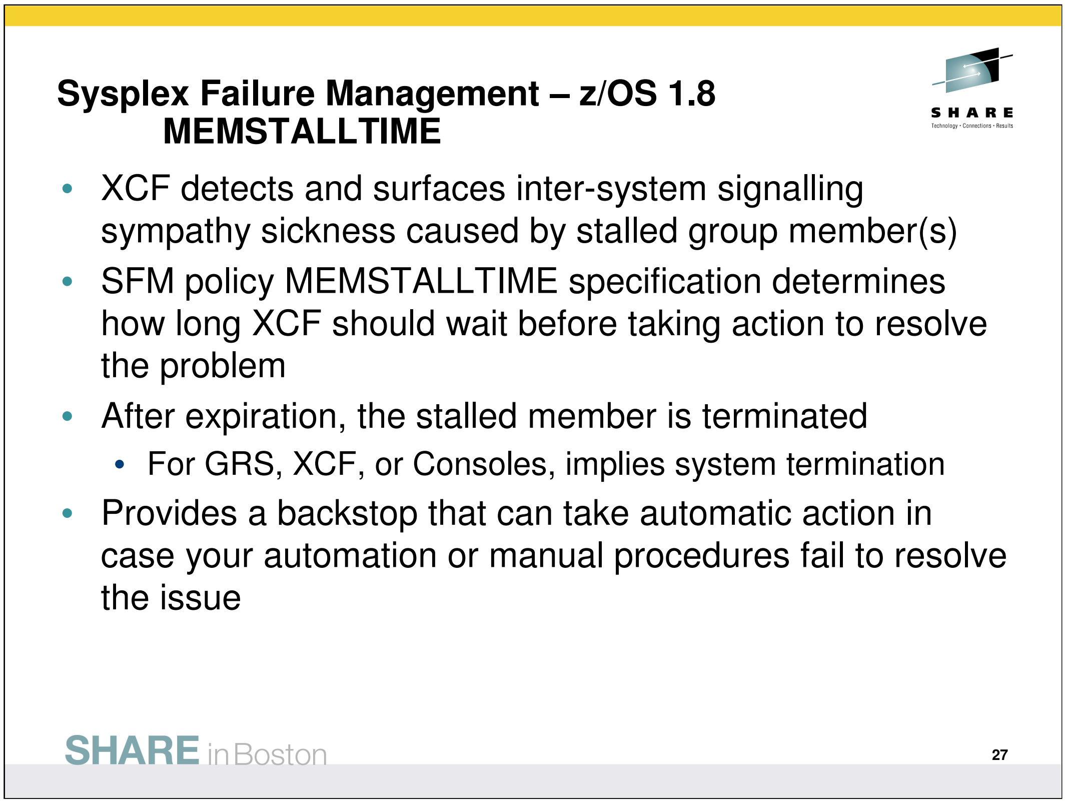
MEMSTALLTIME	z/OS 1.8
SSUMLIMIT	z/OS 1.9
SFM and AutoIPL	z/OS 1.10
SFM with BCPii	z/OS 1.11
System Default Action	z/OS 1.11
XCF FDI Consistency	z/OS 1.11
Critical Members	z/OS 1.12
CFSTRHANGTIME	z/OS 1.12

SFM is the subcomponent within XCF that deals with the detection and resolution of sympathy sickness conditions that can arise when a system or sysplex application is unresponsive

SFM deals with the detection and resolution of sympathy sickness conditions that can arise when a system or sysplex application is unresponsive. This slide summarizes the most recent SFM related technologies. Due to time restrictions, only those topics in boldface will be discussed during the presentation. However, each of the listed items provides benefits. Slides for each topic are included in the presentation and you are encouraged to investigate and exploit them as appropriate. I claim that exploitation of “SFM with BCPii” may well be the most significant thing you can do for your installation with regard to availability in the sysplex.

Single-system “sick but not dead” issues can and do escalate to cause sysplex-wide problems. A sick system typically holds resources needed by other systems and/or is unable to participate in sysplex wide processes. Thus other systems become impacted. But the root cause of the sickness is a single system problem (contention, dispatching delays, spin loops, overlays, queue/data corruption, etc). Routing work away from the troubled system does not necessarily guarantee that other systems will not be impacted.

System/sysplex cleanup when subsystems or systems actually *terminate* is not the problem. Indeed, removal of the sick system from the sysplex generally remedies the problems. Allowing non-terminating problems, where something simply becomes unresponsive, to persist typically compounds the problem. By the time manual intervention is attempted, it is often very difficult to identify the appropriate corrective action. Appropriate SFM specifications enable systems in the sysplex to take corrective action automatically. In general, each parameter arises out of real world situation that led to some sort of (usually quite ugly) outage.



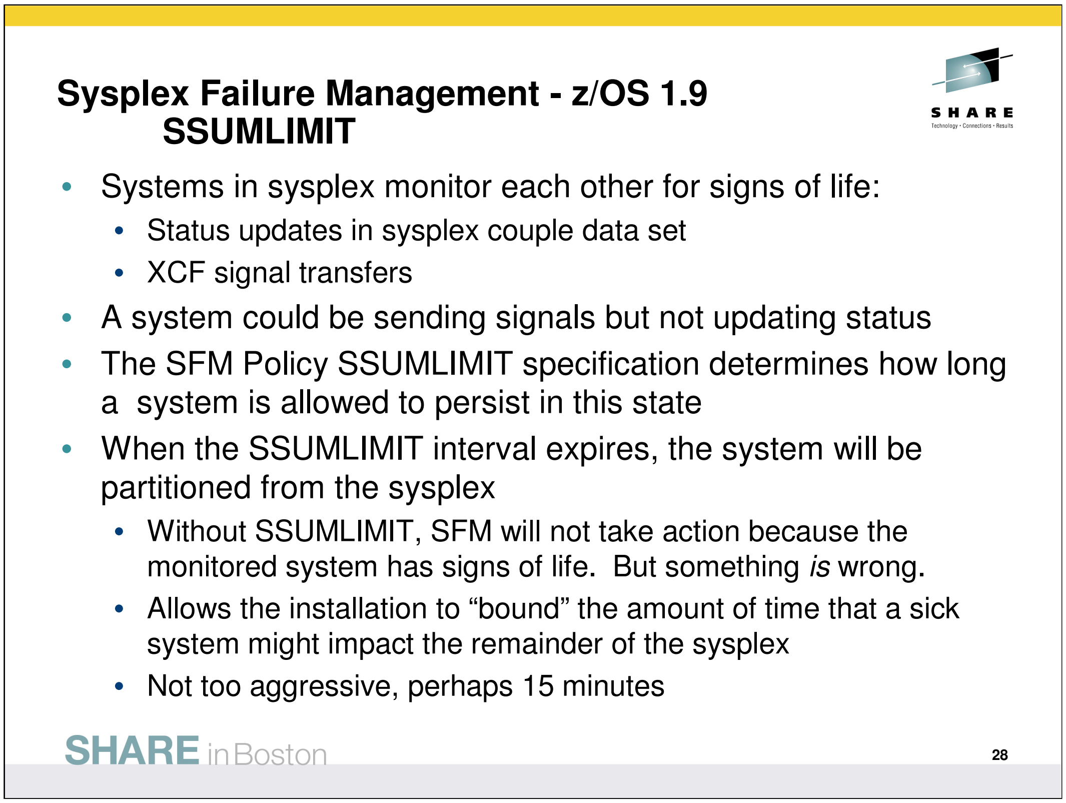
Sysplex Failure Management – z/OS 1.8 MEMSTALLTIME

- XCF detects and surfaces inter-system signalling sympathy sickness caused by stalled group member(s)
- SFM policy MEMSTALLTIME specification determines how long XCF should wait before taking action to resolve the problem
- After expiration, the stalled member is terminated
  - For GRS, XCF, or Consoles, implies system termination
- Provides a backstop that can take automatic action in case your automation or manual procedures fail to resolve the issue

Each pair of systems in the sysplex cooperate to detect signalling sympathy sickness caused by XCF group members that fail to process signals in a timely fashion. Sysplex Failure Management (SFM) for Stalled Members allows the system to automatically terminate such members to alleviate the sympathy sickness. Signalling sympathy sickness occurs when a system has signals to send, but signal traffic has stopped flowing across the signalling paths because the target system has no I/O buffers available. Furthermore, the I/O buffers are unavailable because they contain messages that have yet to be delivered to an XCF group member that is not processing its signals in a timely manner.

If signalling sympathy sickness is detected, both systems issue messages to identify the problem. Information about the stalled member and the sympathy sickness impact can be obtained from either system by issuing appropriate DISPLAY XCF commands. If the SFM policy indicates that automatic action is to be taken to resolve the problem (MEMSTALLTIME parameter is not “NO”), the system will terminate the stalled member. Terminating the stalled member allows XCF to reclaim signalling resources being consumed by the member, which in turn allows signal transfers to resume, which in turn eliminates the signalling sympathy sickness. Even if automatic action is not enabled, manual resolution of the problem should be less error prone because the sympathy sickness problem and the culprit are clearly identified.

The MEMSTALLTIME parameter determines whether a system can take automatic action to alleviate the sympathy sickness, and if so how quickly. In general, it is recommended that some time interval be specified for MEMSTALLTIME so that there is always an automatic “backstop” to take action in case manual intervention does not (or cannot) resolve the problem. The MEMSTALLTIME specification will generally be the amount of time the installation wants to allow for manual intervention (or automation) to resolve the problem. Something in the range of 5 minutes is reasonable.



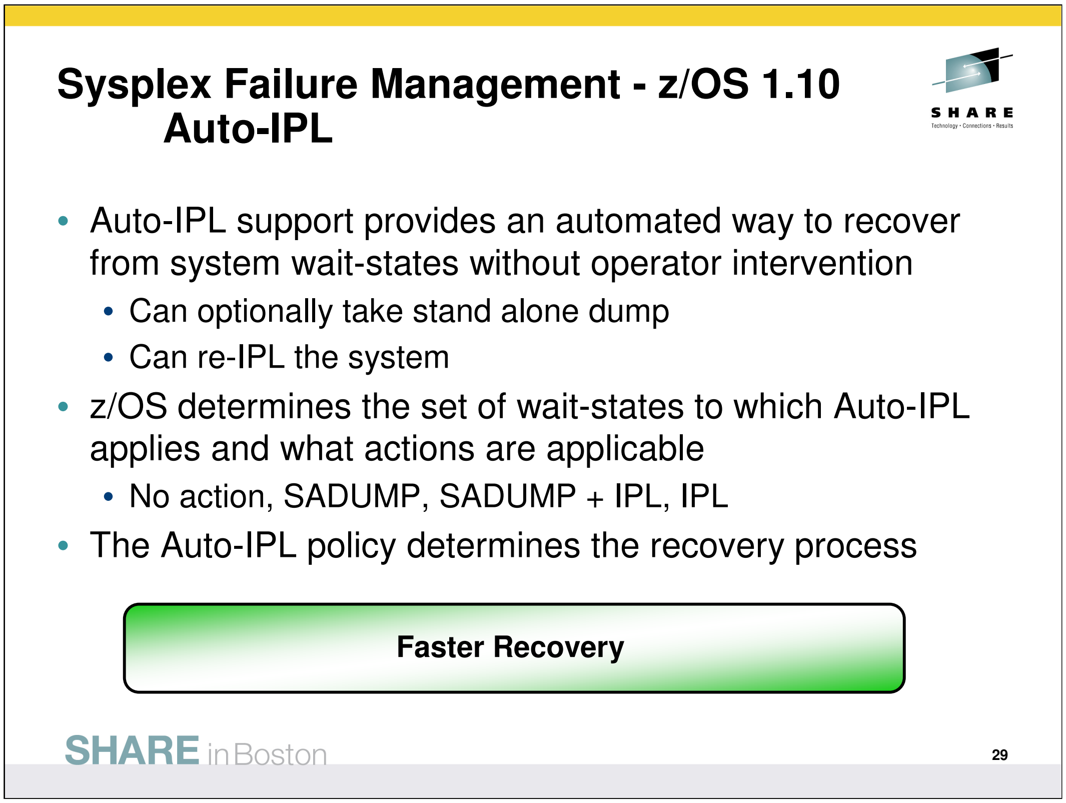
Sysplex Failure Management - z/OS 1.9 SSUMLIMIT

- Systems in sysplex monitor each other for signs of life:
  - Status updates in sysplex couple data set
  - XCF signal transfers
- A system could be sending signals but not updating status
- The SFM Policy SSUMLIMIT specification determines how long a system is allowed to persist in this state
- When the SSUMLIMIT interval expires, the system will be partitioned from the sysplex
  - Without SSUMLIMIT, SFM will not take action because the monitored system has signs of life. But something *is* wrong.
  - Allows the installation to “bound” the amount of time that a sick system might impact the remainder of the sysplex
  - Not too aggressive, perhaps 15 minutes

When SFM was first introduced, it took automatic action to remove a system from the sysplex if it appeared to be unresponsive. Initially, the determination of “unresponsive” was based on the system “heartbeat” (periodic updates to the sysplex couple data set (CDS)). This led to many false positives wherein systems were removed from the sysplex due to DASD issues that were not directly related to whether the system was capable of normal operation. Thus the monitor was extended to incorporate both the “heartbeat” and signalling activity. A system would be deemed unresponsive if it was neither updating the sysplex CDS nor sending signals. This proved to be a much better indicator of system responsiveness and has worked well for many many years.

However, there are sysplex wide processes that do require access to the sysplex CDS. So even though a system may be sending signals (which suggests that it is “alive”), the failure to update the sysplex CDS does suggest the existence of a problem. If the condition persists, there can be a sympathy sickness impact. So in z/OS 1.9, a new SSUMLIMIT keyword was added to the SFM policy. This keyword indicates the amount of time the sysplex should allow a system to persist in a “system status update missing” condition despite the fact that it is continuing to send signals. If the condition persists and the indicated time limit expires, SFM will remove the system from the sysplex.

Note that SSUMLIMIT should not be aggressive. Setting SSUMLIMIT to a small value in effect returns your sysplex to the days where only the system status updates get used to determine whether a system is responsive. That is, you expose yourself to the original SFM behavior that led to may false positives. A value equivalent to 15 minutes seems to be a reasonable value. It provides enough time for systems to be able to deal with DASD problems or other issues that can impact status updates, yet does not let the condition persist for so long that sympathy sickness impacts become severe.



Sysplex Failure Management - z/OS 1.10 Auto-IPL

- Auto-IPL support provides an automated way to recover from system wait-states without operator intervention
  - Can optionally take stand alone dump
  - Can re-IPL the system
- z/OS determines the set of wait-states to which Auto-IPL applies and what actions are applicable
  - No action, SADUMP, SADUMP + IPL, IPL
- The Auto-IPL policy determines the recovery process

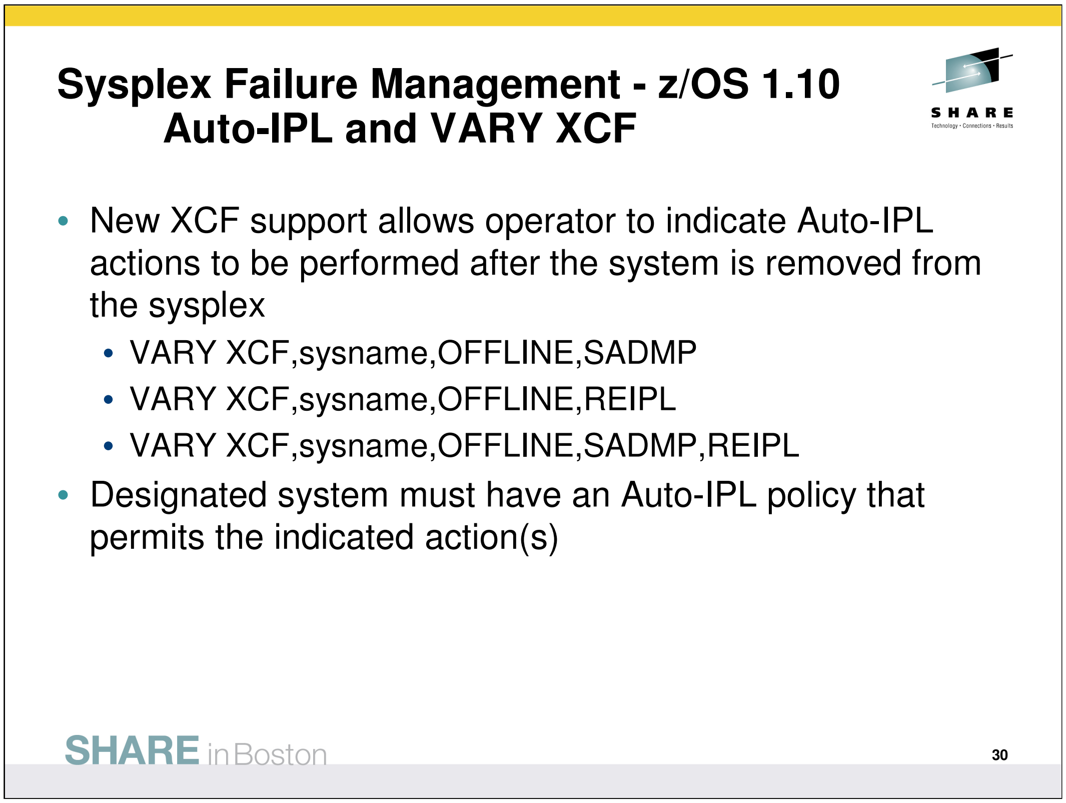
Faster Recovery

Systems sometimes wait-state. Recovery of system is a human intensive process. Human involvement can introduce delay. Especially in cases where a stand-alone dump is needed for diagnosis. Since disabled wait states and non-responsive systems don't happen often, operators may spend 5 to 10 minutes refreshing themselves on the procedure to initiate the Standalone dump, locate usable DASD volumes, etc. Auto-IPL support in z/OS 1.10 provides a way to have the system automatically initiate the dump (as applicable and desired) and IPL the system. Automated recovery of the system can help improve the mean time to recovery (MTTR).

z/OS determines whether and what actions could or should be applied to any particular wait-state code. The actions include (1) None, let the system enter its wait state condition, (2) Initiate Standalone Dump, (3) Initiate Standalone Dump, followed by IPL of z/OS, and (4) Initiate IPL of z/OS only. The customer specified Auto-IPL policy is then applied to the eligible action to determine how to proceed. The Auto-IPL policy is defined by a statement in the DIAGxx parmlib member:

```
AUTOIPL SADMP(dumpinfo) MVS(iplinfo)
```

“dumpinfo” and “iplinfo” indicate whether and how a standalone dump and system IPL will be initiated. So for example, if z/OS determined that “dump and IPL” were appropriate actions for a particular wait-state code, but the Auto-IPL policy indicated that the dump should not be taken, the system would refrain from initiating the dump and would proceed to IPL the system in accordance with the policy.



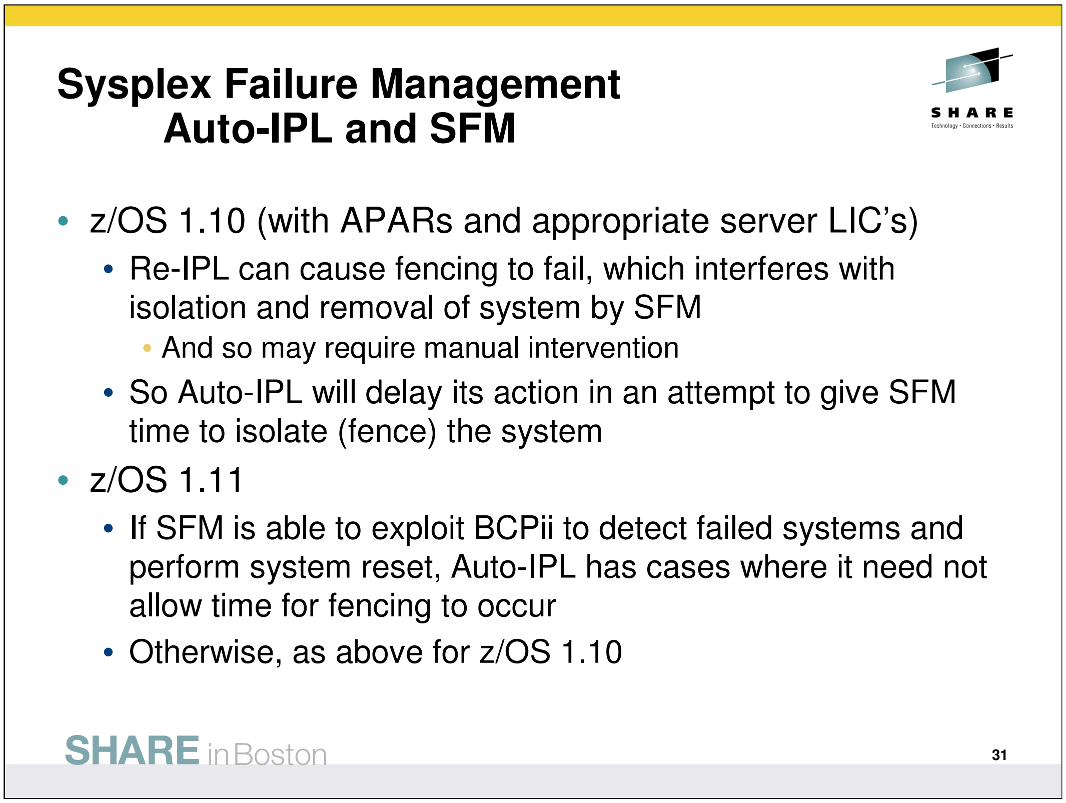
Sysplex Failure Management - z/OS 1.10 Auto-IPL and VARY XCF

- New XCF support allows operator to indicate Auto-IPL actions to be performed after the system is removed from the sysplex
  - VARY XCF,sysname,OFFLINE,SADMP
  - VARY XCF,sysname,OFFLINE,REIPL
  - VARY XCF,sysname,OFFLINE,SADMP,REIPL
- Designated system must have an Auto-IPL policy that permits the indicated action(s)

XCF supports two new optional keywords, REIPL and SADMP, on the VARY XCF command. VARY XCF is used to request the removal of a system from the sysplex via sysplex partitioning. The new keywords, if specified, indicate that the system which is varied out of the sysplex is to be subject to the requested kind of AutoIPL processing when VARY XCF loads a wait state on that system. This of course assumes that the target system is not already in some other wait state, and that it has not already been system reset, manually re-IPLed, fenced, etc., at the time of the VARY XCF processing. By default, systems removed from the sysplex via VARY XCF will not be subject to any AutoIPL processing.

When either or both of the new keywords are specified, XCF will check whether the target system has an appropriate AutoIPL policy in effect. If it does, XCF will drive sysplex partitioning processing with one of three new partitioning reasons, to reflect the AutoIPL options that were specified.

If the target system does not have an appropriate AutoIPL policy in effect, XCF will reject the VARY command (if REIPL or SADMP is specified) and will issue message IXC372I.

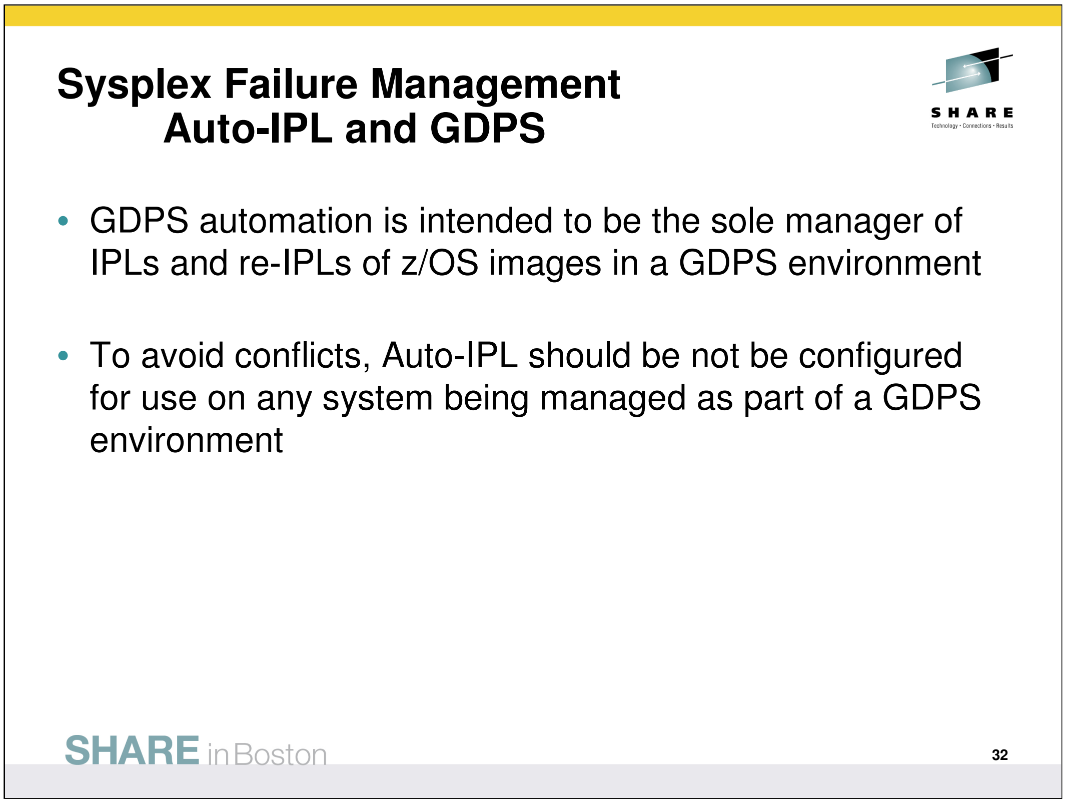


Sysplex Failure Management Auto-IPL and SFM

- z/OS 1.10 (with APARs and appropriate server LIC's)
  - Re-IPL can cause fencing to fail, which interferes with isolation and removal of system by SFM
    - And so may require manual intervention
  - So Auto-IPL will delay its action in an attempt to give SFM time to isolate (fence) the system
- z/OS 1.11
  - If SFM is able to exploit BCPii to detect failed systems and perform system reset, Auto-IPL has cases where it need not allow time for fencing to occur
  - Otherwise, as above for z/OS 1.10

Without coordination between SFM and Auto-IPL, some of the desirable behavior of SFM can be lost. Namely, the ability to recognize that a system has been successfully isolated from the rest of the sysplex. If SFM cannot determine that a system has been isolated from the sysplex, it has to engage the operator. That is, the automatic removal of a failed system is regressed since it entails manual intervention.
The re-IPL of a system, whether it be initiated by Auto-IPL, the operator, or anything else, resets the "fence token" that SFM uses to ensure that it is isolating (fencing) the correct instance of a system. Unfortunately, the manner in which the "fencing token mismatch" condition is surfaced to SFM, it is not possible to distinguish this specific reason from a multitude of other conditions. Since some of those possible conditions do not necessarily imply that the system was appropriately isolated from the sysplex, SFM must proceed under the assumption that the system has not been isolated (in order to avoid data integrity errors).

In z/OS 1.10, there is a rather simplistic coordination between SFM and Auto-IPL wherein SFM indicates to Auto-IPL how long it should delay its re-IPL of a system in order to permit time for fencing to occur. If fencing is not applicable, as would be the case if the system is not part of a multi-system sysplex or if there is no active SFM policy, then there is no delay.
In z/OS 1.11, SFM can exploit BCPii (see subsequent slides) to determine whether a system has been successfully isolated (reset or re-IPLed). Thus, Auto-IPL need not delay the IPL. In addition, the delay time will also be set to zero if the active SFM policy does not specify an action for which fencing is applicable (ISOLATE).

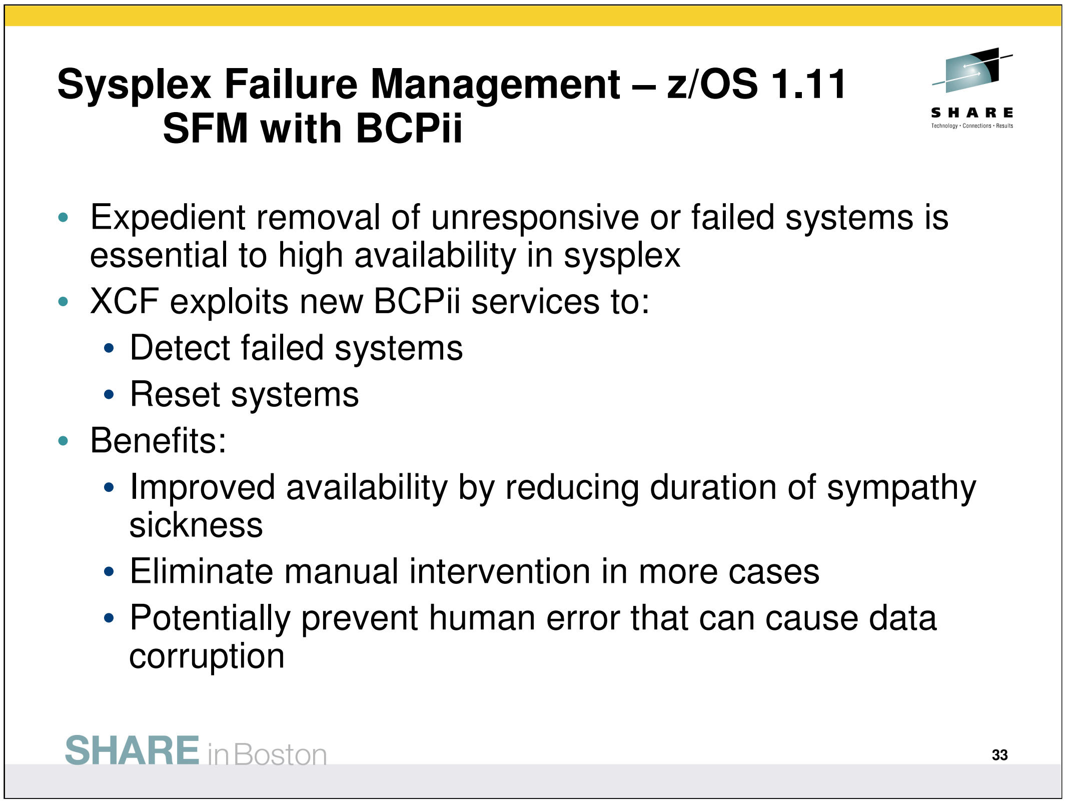


Sysplex Failure Management
Auto-IPL and GDPS

- GDPS automation is intended to be the sole manager of IPLs and re-IPLs of z/OS images in a GDPS environment
- To avoid conflicts, Auto-IPL should be not be configured for use on any system being managed as part of a GDPS environment

From the GDPS/PPRC Installation and Customization Guide, which documents the GDPS AUTOIPL keyword:

“We recommend that you do not enable the AutoIPL capability provided by z/OS (V1.10 and higher) on GDPS systems, irrespective of whether GDPS AUTOIPL is set to YES or NO. Remember, you must IPL your GDPS systems using the LOAD GDPS Standard Action and use other Standard Actions so that GDPS is aware of system status and aware of what you are doing with a system. If you perform such actions outside of GDPS control (which is what z/OS AutoIPL amounts to), GDPS will not be able to interpret certain conditions that it autonomically reacts to and can potentially interfere with the z/OS AutoIPL action. The z/OS Health Checker (on z/OS 1.11) will issue a warning if z/OS AutoIPL is enabled on a GDPS system.”



Sysplex Failure Management – z/OS 1.11 SFM with BCPii

- Expedient removal of unresponsive or failed systems is essential to high availability in sysplex
- XCF exploits new BCPii services to:
  - Detect failed systems
  - Reset systems
- Benefits:
  - Improved availability by reducing duration of sympathy sickness
  - Eliminate manual intervention in more cases
  - Potentially prevent human error that can cause data corruption

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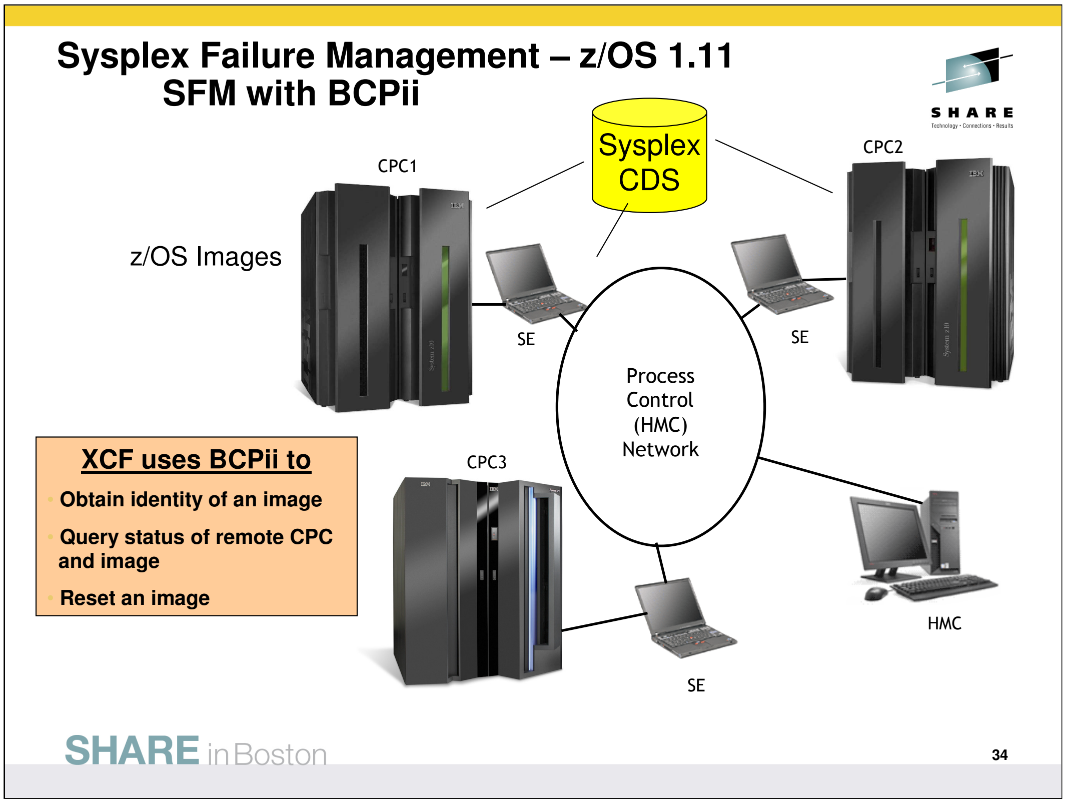
The sysplex failure management (SFM) component of XCF, which is used to manage failures and reconfiguration in the sysplex, has been enhanced in z/OS V1.11. It is now designed to use new Base Control Program internal interface (BCPii) services to determine whether an unresponsive system has failed, expedite sysplex recovery by bypassing delay intervals when possible, and automatically reset failed systems without manual intervention. This function allows SFM to avoid waiting for a period of time before assuming that systems have failed, improves the responsiveness of failure management, avoids operator intervention, and helps limit or avoid sysplex-wide slowdowns that can result from single-system failures.

The Base Control Program Internal Interface (BCPii) component of z/OS provides a set of programming interfaces to allow authorized programs to perform Hardware Management Console (HMC) functions for System z servers within an attached HMC network. These operations include obtaining information about servers and images (LPARs), issuing commands for certain hardware and software-related functions, and listening for certain hardware and software events. BCPii communication to HMCs and Support Elements (SEs) uses internal communication protocols and does not require communication on an IP network. Therefore, it is isolated from other network traffic.

Through the use of BCPii, XCF can detect that a system has entered a non-restartable wait-state, or that it has been re-IPLed. XCF can also perform a system reset on other systems in the sysplex. Thus XCF now has the ability to ascertain with certainty that a system is no longer operational. With this certain knowledge, XCF can ensure that the system is safely isolated from shared resources and remove the failed system from the sysplex – all without operator involvement. Furthermore, since XCF need not wait for the system failure detection interval to expire (to conclude that the system has no signs of life), the isolation of the failed system can occur sooner, which in turn reduces the amount of time that other systems in the sysplex will experience sympathy sickness.

BCPii is available on z/OS V1.10 with PTF UA47493, and requires a System z9 or z10 server with a microcode update. (For more information about required hardware levels, see the appropriate PSP bucket.) In z/OS V1.11, BCPii is designed to allow authorized programs to change or set data for certain HMC-managed objects associated with a CPC, Image, or Capacity Record. In addition, support for interactions with activation profile attributes is planned to be made available with the PTF for APAR OA29638 in first quarter of 2010.



Sysplex Failure Management – z/OS 1.11 SFM with BCPii

XCF uses BCPii to

- **Obtain identity of an image**
- **Query status of remote CPC and image**
- **Reset an image**

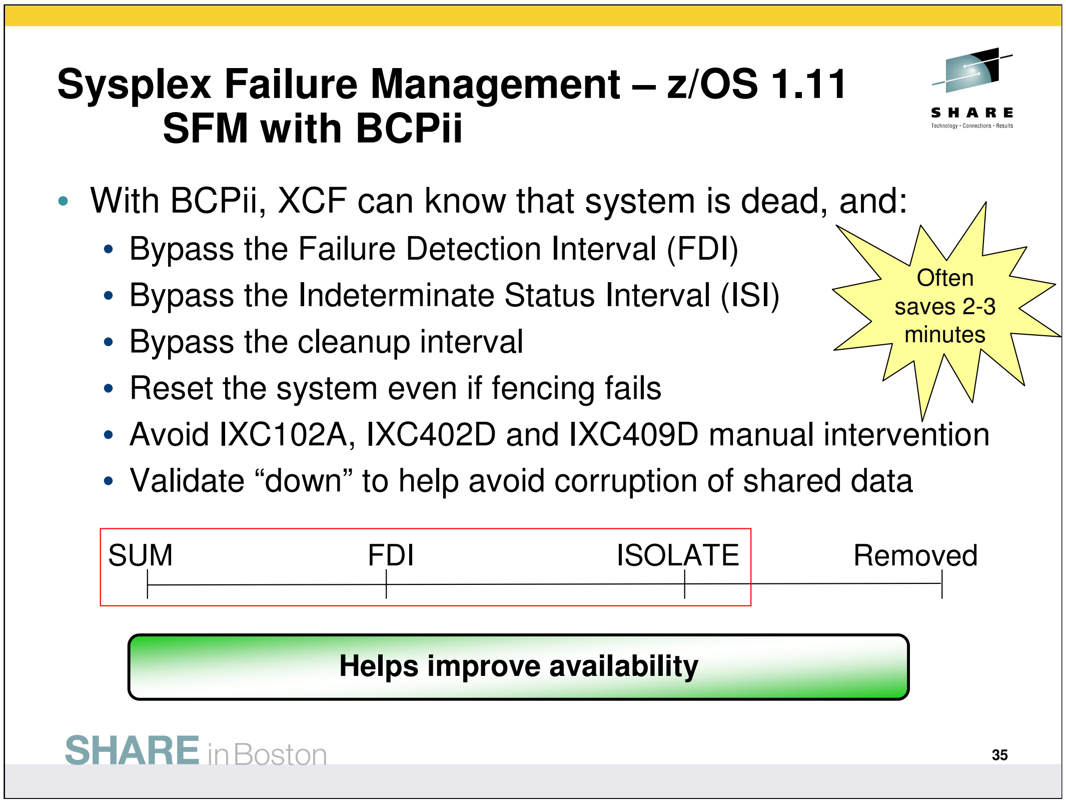
CPC – Central Processor Complex containing images (LPARs)

SE – Support Element

HMC – Hardware Management Console

The Base Control Program internal interface (BCPii) allows authorized z/OS applications to have HMC-like control over systems in the process control HMC network. Note that there is complete communication isolation of existing networks (internet/intranet) from the process control (HMC) network, and communication with the System z support element is completely within base z/OS. BCPii provides a set of authorized APIs to
enable communications between z/OS applications and the local support element, as well as between other support elements connected to other CPCs routed by the HMC. The BCPii query services can provide information about the operational state of any CPC connected to the HMC network, as well as the operational state of any image on the CPC.

As each z/OS image IPLs into the sysplex, XCF sets an IPL token in the hardware to uniquely identify the image. The IPL token is also published in the sysplex couple data set so that each system in the sysplex can ascertain the IPL token for every other system. If a system appears to be unresponsive, XCF uses BCPii query services to inquire as to the state of the subject system. If the system is down, it will be removed from the sysplex. As needed, XCF will use BCPii services to reset the system. For example, a system reset might be needed to ensure that the system has been successfully isolated from the sysplex. The IPL token is used when doing such resets, as it ensures that the reset is applied to the intended instance of the system image.



Sysplex Failure Management – z/OS 1.11 SFM with BCPii

- With BCPii, XCF can know that system is dead, and:
  - Bypass the Failure Detection Interval (FDI)
  - Bypass the Indeterminate Status Interval (ISI)
  - Bypass the cleanup interval
  - Reset the system even if fencing fails
  - Avoid IXC102A, IXC402D and IXC409D manual intervention
  - Validate “down” to help avoid corruption of shared data

Often saves 2-3 minutes

SUM FDI ISOLATE Removed

Helps improve availability

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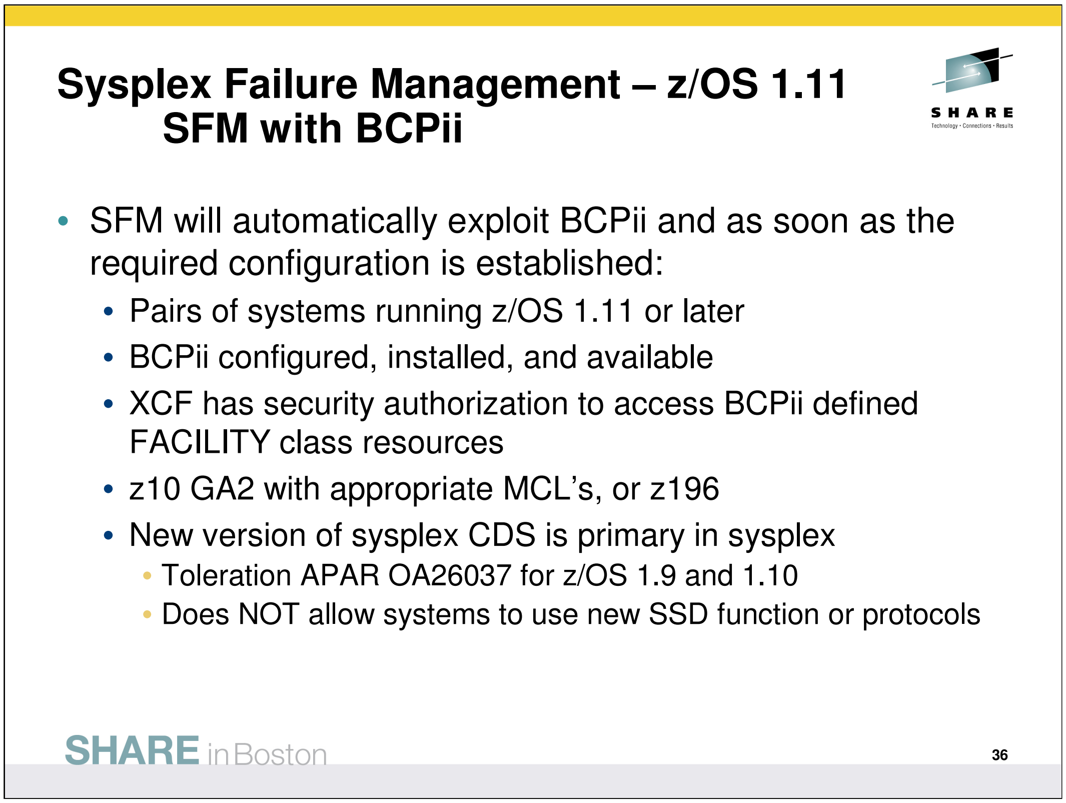
Unresponsive systems must be partitioned from the sysplex in a timely manner to avoid sympathy sickness. But, without BCPii, XCF does not really *know* a system’s operational state. At best, systems can monitor each other for signs of activity (updates to the sysplex couple data set, signals being exchanged). When the monitored activity stops, XCF waits the Failure Detection Interval (FDI) to try to avoid falsely removing an operational system. One would not want remove a system that was suffering a temporary problem. But the penalty for this caution is that the sysplex may suffer workload processing interruptions/delays if the system has truly failed.

A partitioned system must be isolated from the rest of the sysplex to avoid corruption of shared data. In a parallel sysplex, XCF relies on CF Isolate command to fence a system from the channel subsystem. If the installation does not have a CF, or if the isolation fails, manual system reset is required. Manual intervention elongates the partitioning process, which elongates sympathy sickness.

But with BCPii services, XCF can now detect that a system has failed, and if so, whether it has been reset or otherwise isolated from shared resources. With this certain knowledge, XCF can safely remove a failed system from the sysplex without waiting for the failure detection interval to expire. If the failed system has not been isolated, XCF need not wait for the indeterminate status interval (ISI) aka ISOLATETIME to expire before it attempts to fence the failed system. If the fencing fails (or cannot be performed due to a lack of a CF), XCF can use BCPii services to appropriately reset the failed system. In cases where the failed system has been appropriately reset, XCF need not perform any isolation actions.

Thus the certain knowledge that a system has failed enables XCF to immediately partition failed systems from the sysplex, all without operator intervention.

ISI – can behave like ISOLATETIME(0) regardless of ISOLATETIME value specified in policy



Sysplex Failure Management – z/OS 1.11 SFM with BCPii

- SFM will automatically exploit BCPii and as soon as the required configuration is established:
  - Pairs of systems running z/OS 1.11 or later
  - BCPii configured, installed, and available
  - XCF has security authorization to access BCPii defined FACILITY class resources
  - z10 GA2 with appropriate MCL’s, or z196
  - New version of sysplex CDS is primary in sysplex
    - Toleration APAR OA26037 for z/OS 1.9 and 1.10
    - Does NOT allow systems to use new SSD function or protocols

•See topic "Assigning the RACF TRUSTED attribute" in *MVS Initialization and Tuning Reference* for information on using RACF to assign the TRUSTED attribute to the XCF address space.

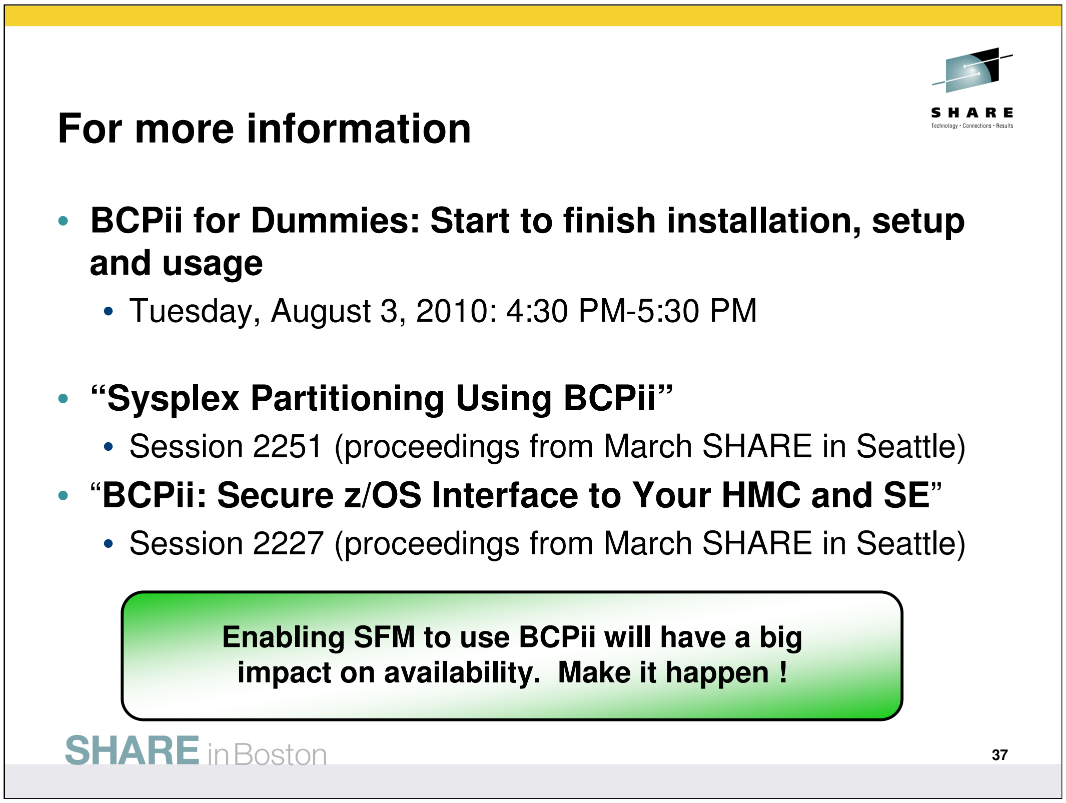
•Refer to the “BCPii Setup and Installation” topic in *MVS Programming: Callable Services for High Level Languages* for information on installation and configuration steps and SAF authorization requirements to enable BCPii to invoke z/Series Hardware APIs.

•A system running on z/OS V1R11 and down-level hardware is only eligible to target other systems that are enabled to exploit the full functionality of the SSD partitioning protocol. A system not running on the requisite hardware can not be the target of SSD partitioning protocol functions.

•Install toleration PTFs for OA26037 on V1R10 and V1R9 systems in the sysplex to use the newly formatted sysplex couple data set required by the protocol.

•By default, the SYSSTATDETECT function is enabled in V1R11. The current setting of the SYSSTATDETECT function can be determined by issuing a DISPLAY XCF,COUPLE command.

For more information on enabling or disabling the SYSSTATDETECT function in V1R11, see *MVS Initialization and Tuning Reference* for information on specifying SYSSTATDETECT in the COUPLExx parmlib member and *MVS System Commands* for information on enabling and disabling the SYSSTATDETECT function via the SETXCF FUNCTIONS command



For more information

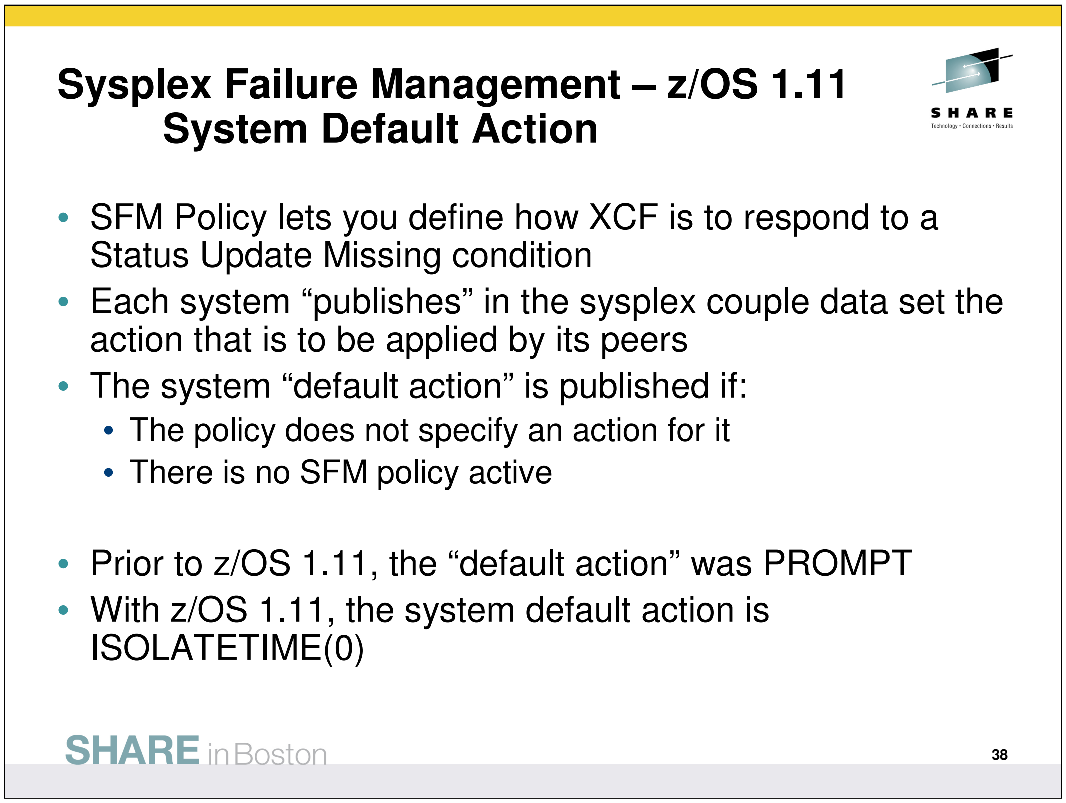
- **BCPii for Dummies: Start to finish installation, setup and usage**
  - Tuesday, August 3, 2010: 4:30 PM-5:30 PM
- **“Sysplex Partitioning Using BCPii”**
  - Session 2251 (proceedings from March SHARE in Seattle)
- “**BCPii: Secure z/OS Interface to Your HMC and SE**”
  - Session 2227 (proceedings from March SHARE in Seattle)

Enabling SFM to use BCPii will have a big impact on availability. Make it happen !

“**BCPii for Dummies**”: This session goes thru a complete BCPii setup, including step by step installation and configuration instructions, including configuration of the support element, security definitions and BCPii address space. Real coding examples will also be given. Included in the presentation will be a quick BCPii update for z/OS 1.12.

March 2009 SHARE in Seattle, Session 2251: In a z/OS Parallel Sysplex, unresponsive systems must be partitioned out of the sysplex in a timely manner to avoid sympathy sickness. Prior to z/OS 1.11, XCF could never truly know the state of the system that appears to be unresponsive. So minutes could elapse while XCF waits expectantly in case the failed system resumes. In the meantime, work elsewhere in the sysplex hangs. When XCF finally does take action to partition the failed system, the inability to fence the system can necessitate the need for operator intervention, further delaying resolution of the problem. With a suitably configured sysplex, XCF can exploit BCPii interfaces to interact with the HMC to know with certainty that a system has failed. XCF can then isolate the failed system without operator intervention even if fencing fails. In this session, the speaker will explain how you too can come to enjoy the benefits of greater availability derived from an expedited sysplex partitioning process that is more robust.

March 2009 SHARE in Seattle Session 2227: In this session, the speaker will provide an overview of how authorized z/OS applications will be able to query, change, and perform basic operational procedures against the installed System z hardware base without the need of communicating thru an IP network. This support will be provided via a set of new high-level APIs for data exchange and command requests. He will describe the functionality, called Base Control Program Internal Interface (BCPii), that will be delivered in the base of the z/OS operating system. This new support will not only allow control of the hardware the APIs are executing on, but extends to other System z processors within the attached process control network. Come and learn about this new z/OS component.

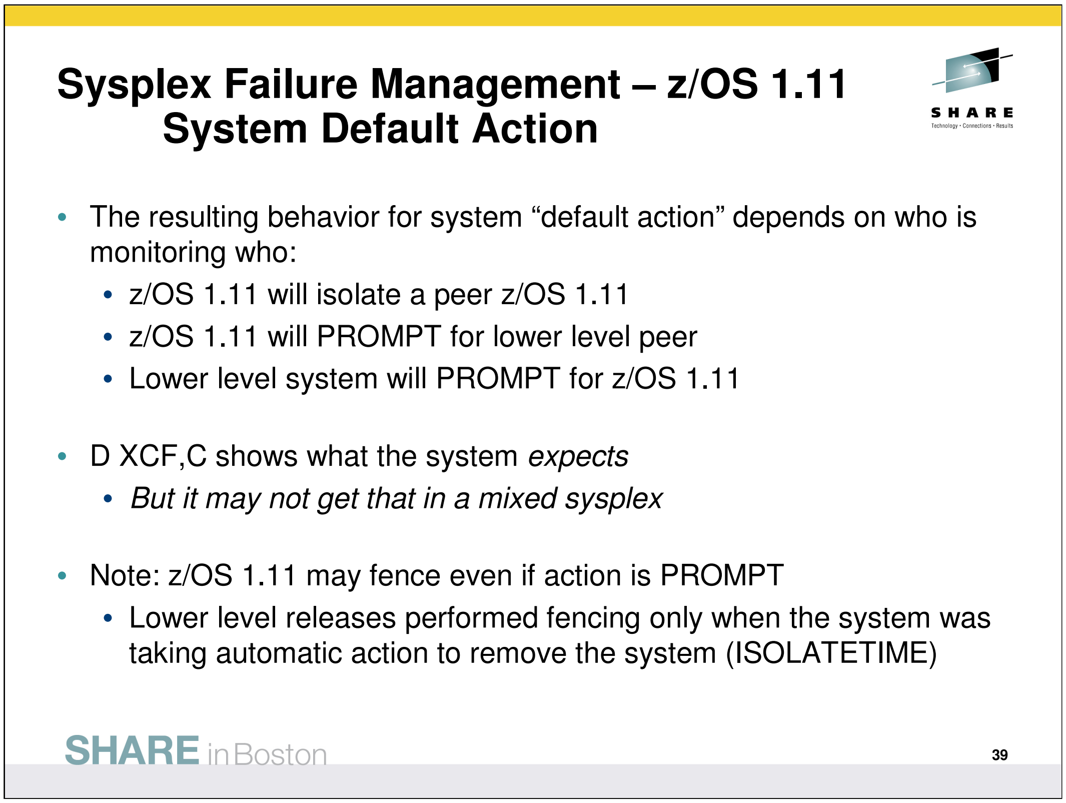


Sysplex Failure Management – z/OS 1.11
System Default Action

- SFM Policy lets you define how XCF is to respond to a Status Update Missing condition
- Each system “publishes” in the sysplex couple data set the action that is to be applied by its peers
- The system “default action” is published if:
  - The policy does not specify an action for it
  - There is no SFM policy active

- Prior to z/OS 1.11, the “default action” was PROMPT
- With z/OS 1.11, the system default action is ISOLATETIME(0)

If you want to preserve past default behavior of PROMPT for a z/OS 1.11 system, you would need to take a migration action to define and activate an SFM policy that explicitly specifies PROMPT. However, this is not recommended since best practice is ISOLATETIME(0). If you already explicitly specify PROMPT, consider changing to use the best practice specification of ISOLATETIME.



Sysplex Failure Management – z/OS 1.11 System Default Action

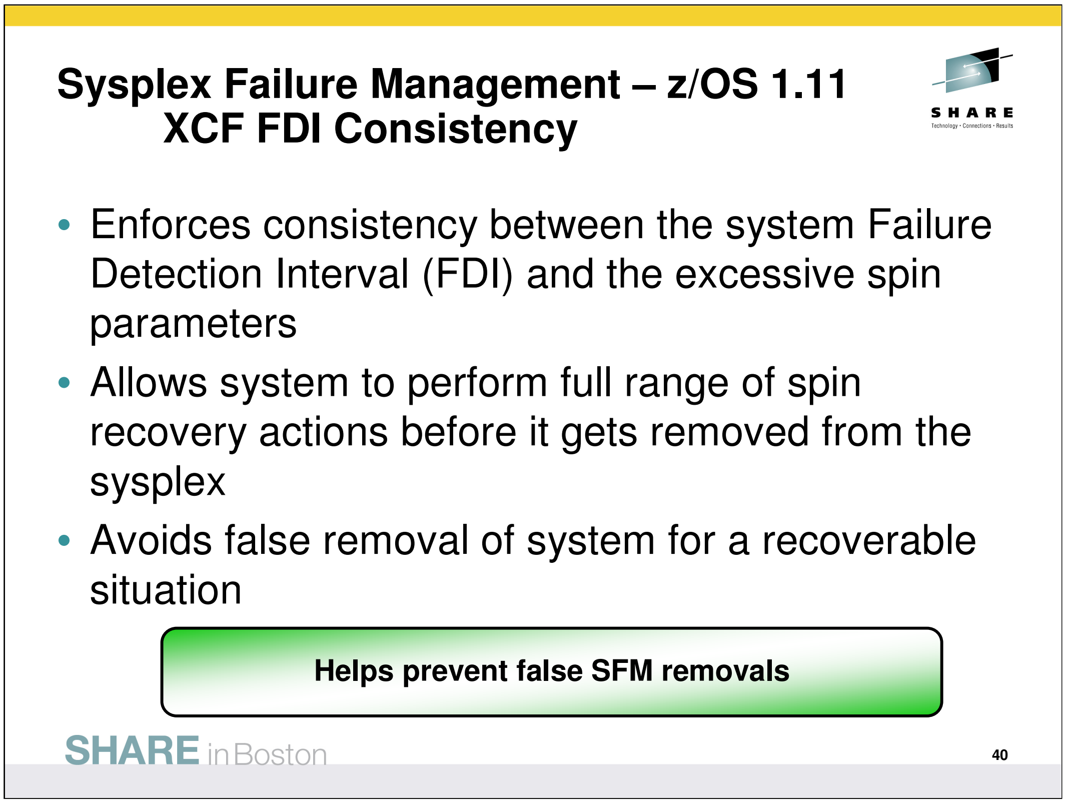
- The resulting behavior for system “default action” depends on who is monitoring who:
  - z/OS 1.11 will isolate a peer z/OS 1.11
  - z/OS 1.11 will PROMPT for lower level peer
  - Lower level system will PROMPT for z/OS 1.11
- D XCF,C shows what the system *expects*
  - *But it may not get that in a mixed sysplex*
- Note: z/OS 1.11 may fence even if action is PROMPT
  - Lower level releases performed fencing only when the system was taking automatic action to remove the system (ISOLATETIME)

The SFM Policy lets you define how XCF is to respond to a Status Update Missing condition. Each system “publishes” in the sysplex couple data set the action that is to be applied by its peers. The system “default action” is published if either (a) the policy does not specify an action for it, or (b) there is no SFM policy active. Prior to z/OS 1.11, the “default action” was PROMPT, which causes the peer systems to prompt the operator (with message IXC402D) when the system appears to be “status missing”.

IBM suggests specifying or defaulting to ISOLATETIME(0) to allow SFM to fence and partition a failed system without operator intervention and without undue delay. As of z/OS V1R11, the system default will be in accord with this suggestion.

If a system enters a status update missing condition and there is no active SFM policy, the monitoring system will take the system default against the failed system. This means if the monitoring system is a pre-z/OS V1R11 system, it will use the old system default and prompt the operator. If the monitoring system is a z/OS V1R11 system, it will use the system default of the failed system. The D XCF,C command shows the isolate action that the system expects, but the monitoring system may use a different action if no action is specified in the SFM policy or if an SFM policy is not active. In a sysplex that does not have an SFM policy and has images running z/OS 1.10 or earlier, the z/OS 1.11 and later systems may display N/A for the expected action because they don’t really know what will happen. The result depends on which system processes the partitioning request.

Default action of ISOLATETIME(0) is not guaranteed. z/OS 1.11 observing a peer z/OS 1.11 knows the new default should be ISOLATETIME(0). But a z/OS 1.10 or 1.9 observing a z/OS 1.11 will continue to treat the default as PROMPT. A z/OS 1.11 observing a z/OS 1.9 or 1.10 system knows that their default action was PROMPT, and continues to honor that old behavior. In order to actually do an ISOLATETIME(0), one either needs to be able to fence the system or use BCPii to reset the system. **So if SFM is unable to do either of those, it still reverts to PROMPT.**



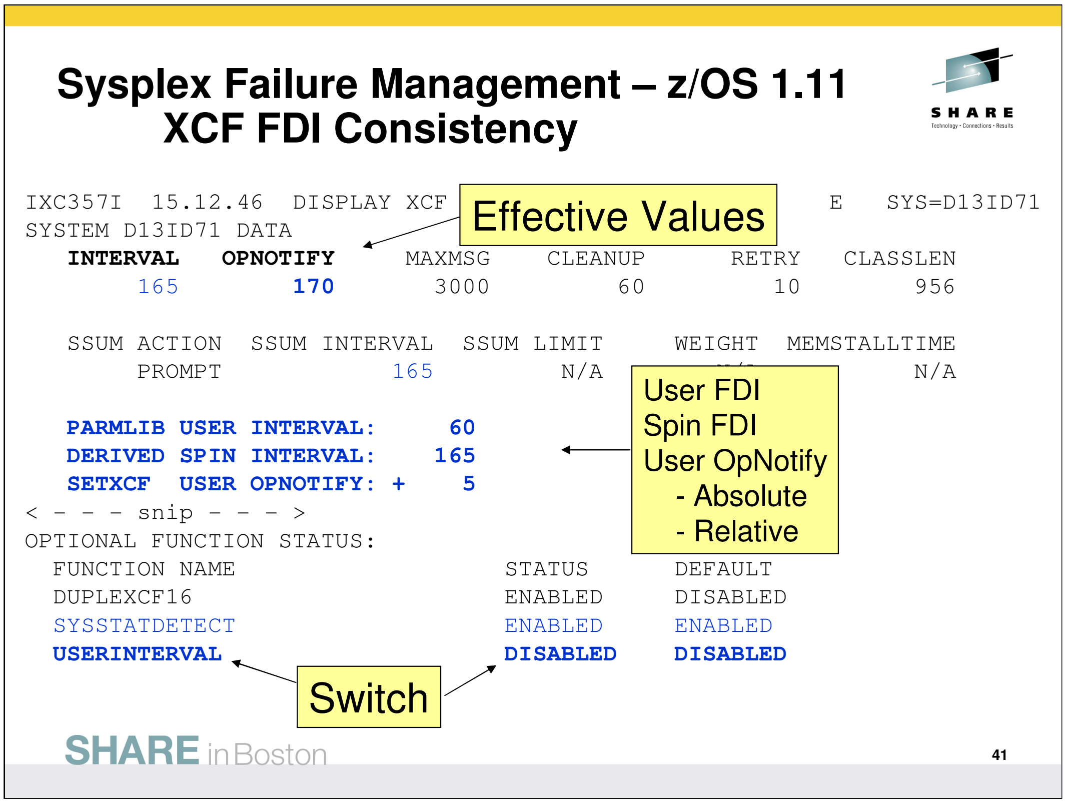
Sysplex Failure Management – z/OS 1.11 XCF FDI Consistency

- Enforces consistency between the system Failure Detection Interval (FDI) and the excessive spin parameters
- Allows system to perform full range of spin recovery actions before it gets removed from the sysplex
- Avoids false removal of system for a recoverable situation

Helps prevent false SFM removals

XCF failure detection interval coordination with spin time
Enforce consistency between XCF FDI interval and the effective excessive spin time actions and intervals, by automatically adjusting the FDI to be at least as high as that implied by excessive spin specifications

In z/OS V1.11, XCF design is changed to automatically adjust the failure detection interval (FDI) to use for systems in the sysplex when needed. The system's effective FDI is now designed to be the longer of the two intervals resulting from the FDI you specify and a value based on the system's excessive spin parameters, making the system's processing of excessive disabled spin conditions, the sysplex's handling of missing system heartbeats, and the initiation of sysplex partitioning to remove unresponsive systems more consistent. Also, a new way to specify an operator notification (OPTNOTIFY) relative to the effective FDI is provided, so that you no longer need to calculate the sum of spin loop timeouts to specify the operator notification interval.



Sysplex Failure Management – z/OS 1.11 XCF FDI Consistency

```
IXC357I  15.12.46  DISPLAY XCF                        E   SYS=D13ID71
SYSTEM D13ID71 DATA
   INTERVAL    OPNOTIFY      MAXMSG    CLEANUP       RETRY    CLASSLEN
        165         170        3000         60          10         956

   SSUM ACTION  SSUM INTERVAL  SSUM LIMIT     WEIGHT  MEMSTALLTIME
        PROMPT            165         N/A                      N/A

   PARMLIB USER INTERVAL:      60
   DERIVED SPIN INTERVAL:     165
   SETXCF  USER OPNOTIFY: +     5
< - - - snip - - - >
OPTIONAL FUNCTION STATUS:
  FUNCTION NAME                     STATUS      DEFAULT
  DUPLEXCF16                        ENABLED     DISABLED
  SYSSTATDETECT                     ENABLED     ENABLED
  USERINTERVAL                      DISABLED    DISABLED
```

This slide shows relevant output from the DISPLAY XCF,COUPLE command. The effective FDI and OpNotify value are reported as in past releases. A new section reports user specified FDI, derived spin FDI, and user specified OpNotify value as well as the source from which the current value was derived (COUPLExx parmlib, SETXCF command, system default). The FUNCTION section now reports the state of the new USERINTERVAL switch.

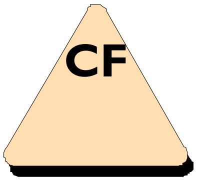
The **Failure Detection Interval** (FDI), is the amount of time that a system can appear to be unresponsive (status update missing) before XCF is to take action to resolve the problem. The **User FDI** is an FDI value explicitly specified by the user, either directly (via COUPLExx parmlib member or SETXCF COUPLE command) or indirectly (through cluster services interfaces – IXCCROS macro). The **Spin FDI** is an FDI value derived by XCF from the excessive spin parameters (spin loop timeout value and the number of excessive spin actions (such as SPIN, TERM, ACR)). The **Effective FDI** is the FDI value that is being used for the system. If the USERINTERVAL switch (FUNCTIONS) is DISABLED, the effective FDI = max(user FDI, spin FDI). If USERINTERVAL is ENABLED, the effective FDI = user FDI. By default, the effective FDI will be the larger of the user FDI and the spin FDI. If the installation really wants the smaller user FDI to be the effective FDI, the USERINTERVAL switch must be ENABLED to force XCF to use it.

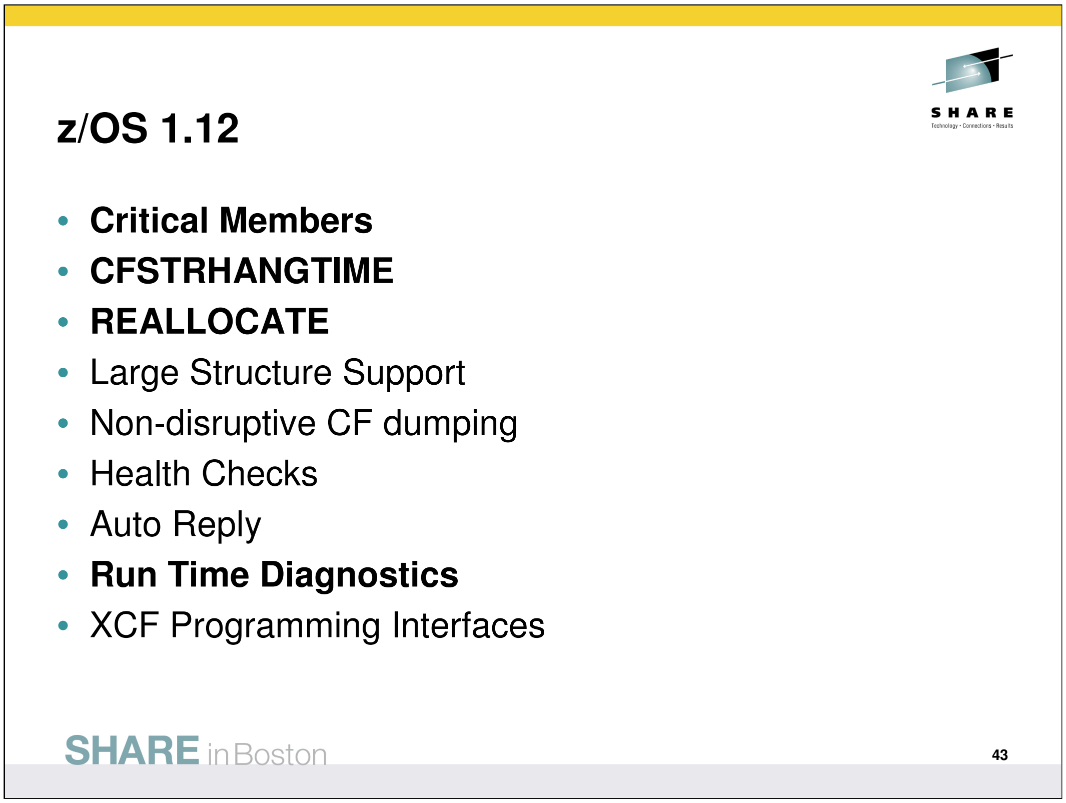
User OpNotify is the operator notification interval explicitly specified by the user, either directly (via COUPLExx parmlib member or SETXCF COUPLE command). OpNotify determines when XCF should alert the operator about a system that is unresponsive. OpNotify can now be **relative** to the effective FDI (ie, a delta). In the past, it was always an **absolute** that had to be greater than or equal to the (effective) FDI. So if one wanted to change one of the values, one might in fact have to change them both (and in a particular order) so as to maintain the required relationship. With a relative OpNotify value, the system automatically maintains the relationship. If the effective FDI changes, the effective OpNotify value changes as well. The **Effective OpNotify** is the OpNotify value being used by the system. The system ensures that effective FDI is always less than or equal to the effective OpNotify value.

If the installation changes the excessive spin parameters, sets a new user FDI value, or changes the USERINTERVAL switch, the effective values are recomputed and then written to the sysplex CDS to make them visible to the rest of the sysplex (via status update processing).

Agenda

- Hardware Updates
  - CFCC Level 17
  - CFCC Level 16
  - Parallel Sysplex InfiniBand Links
- z/OS Updates
  - Sysplex Failure Management
  - **z/OS V1R12**
- Summary



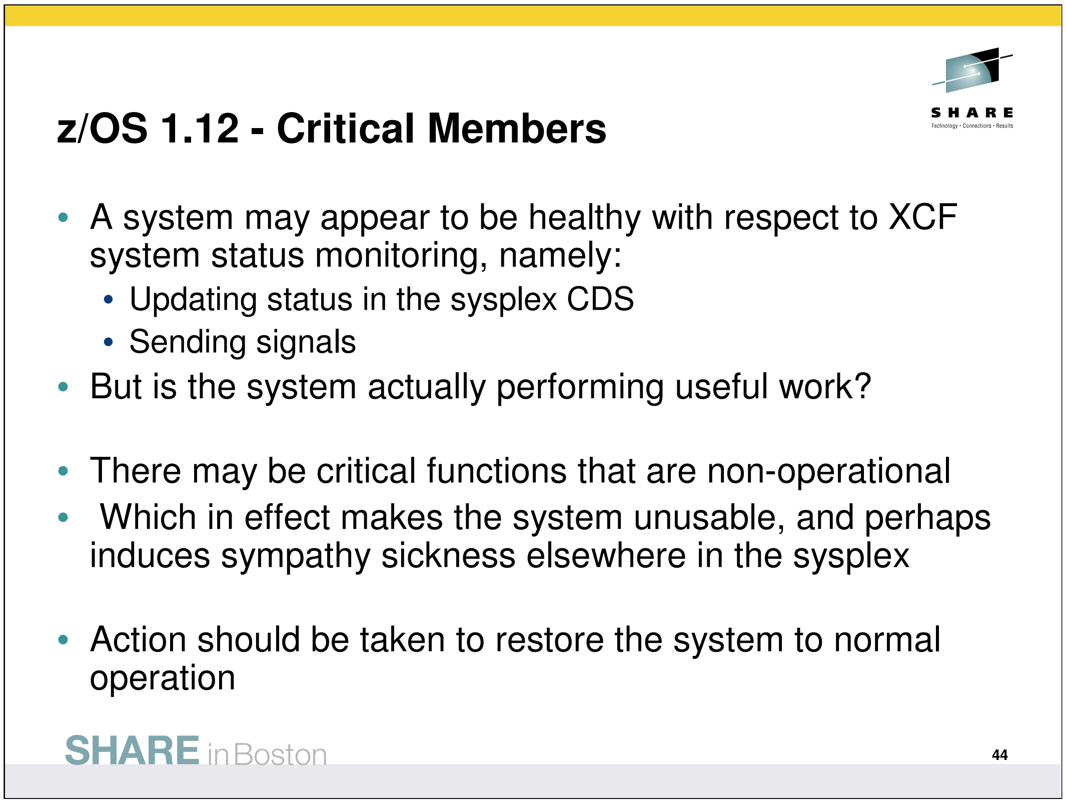


z/OS 1.12

- **Critical Members**
- **CFSTRHANGTIME**
- **REALLOCATE**
- Large Structure Support
- Non-disruptive CF dumping
- Health Checks
- Auto Reply
- **Run Time Diagnostics**
- XCF Programming Interfaces

z/OS 1.12 functionality that may be of interest from a sysplex perspective.

Due to time restrictions, we may only be able to discuss the topics in bold. However slides for the remaining topics are included for your consideration. Feel free to email the speaker if you have additional questions or comments.



z/OS 1.12 - Critical Members

- A system may appear to be healthy with respect to XCF system status monitoring, namely:
  - Updating status in the sysplex CDS
  - Sending signals
- But is the system actually performing useful work?

- There may be critical functions that are non-operational
- Which in effect makes the system unusable, and perhaps induces sympathy sickness elsewhere in the sysplex

- Action should be taken to restore the system to normal operation

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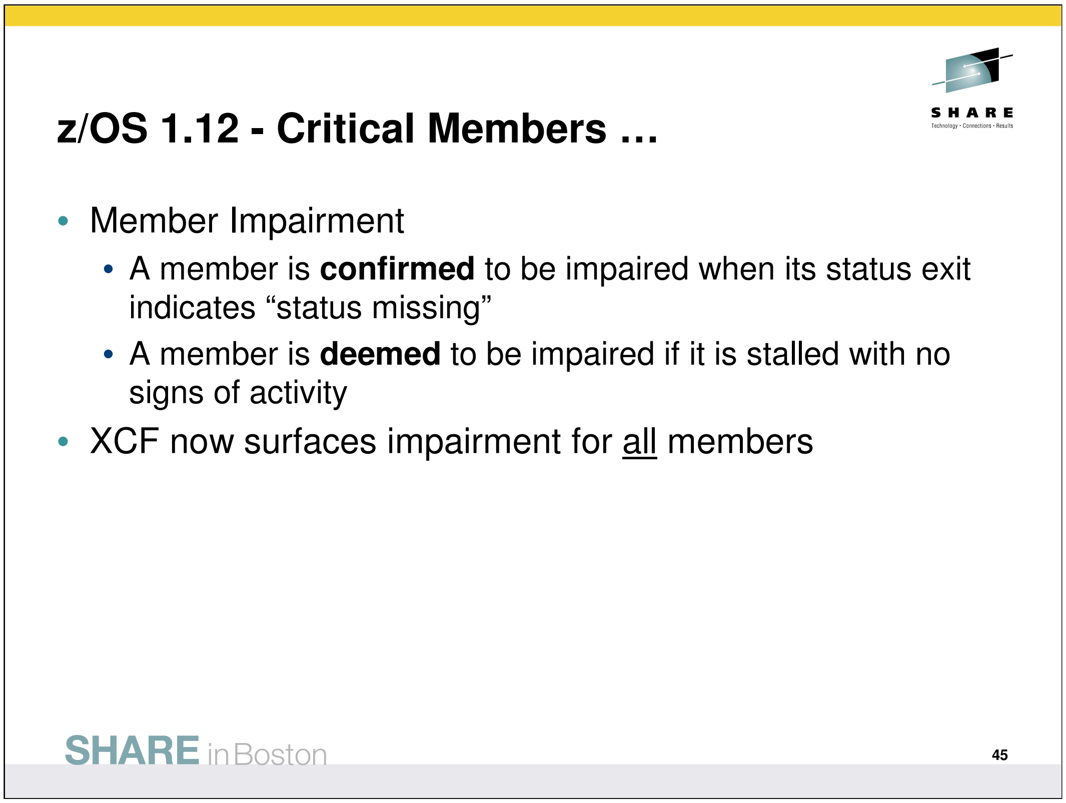
z/OS 1.12 extends XCF System Status monitoring to incorporate status information about critical components (such as GRS). Currently, a system is deemed unresponsive if it stops sending XCF signals and stops updating its status in the sysplex Couple Data Set (CDS). However, these indications of activity do not necessarily imply that a system is able to accomplish useful work. Indeed, an apparently active system could in effect be causing sympathy sickness because critical components are unable to accomplish their intended function. The goal of the “critical member” support is to resolve the sympathy sickness by expeditiously partitioning a sick system out of the sysplex whenever any critical XCF member on that system is deemed unresponsive. Though still not a perfect indicator of whether a system is performing useful work, the discovery of unresponsive critical components should provide an incremental improvement that helps the sysplex better identify (and remove) unresponsive systems.

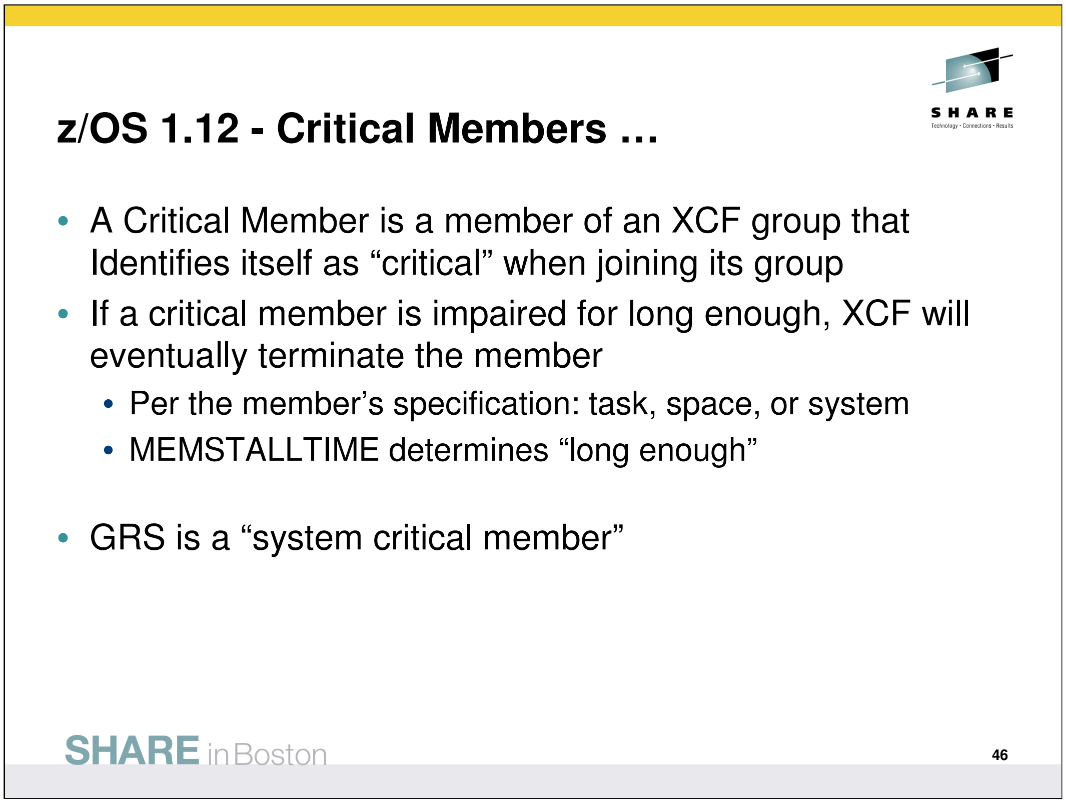


z/OS 1.12 - Critical Members …

- Member Impairment
  - A member is **confirmed** to be impaired when its status exit indicates “status missing”
  - A member is **deemed** to be impaired if it is stalled with no signs of activity
- XCF now surfaces impairment for all members

An XCF group member may tell XCF that it is impaired via the member status exit routine. XCF shares this information with peer members that have a group exit routine, but prior to z/OS 1.12, did not take any overt action to surface the condition or mitigate it.

z/OS 1.12 extends XCF Member Status monitoring to externalize via messages when a member is “impaired”. A monitored member is “confirmed impaired” if it indicates to XCF via its status exit that it is “status missing”. The member is “deemed impaired” if the member’s XCF exits appear to be stalled with no signs of activity. XCF monitoring is extended to include the member status exit routine. In the past such monitoring was limited to the member’s group exit and signal exit routines. Thus if the member status exit routine becomes unresponsive, and thereby unable to “confirm” that the member is impaired, XCF stalled member detection will “deem” the member to be impaired.



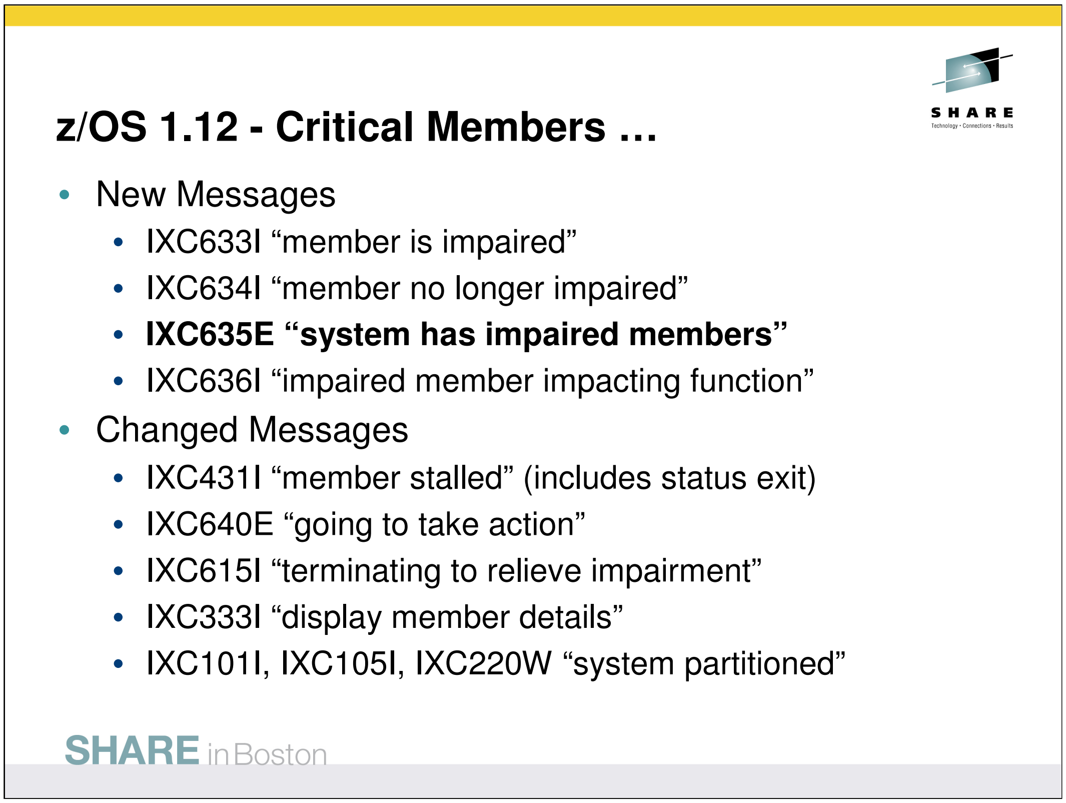
z/OS 1.12 - Critical Members …

- A Critical Member is a member of an XCF group that Identifies itself as “critical” when joining its group
- If a critical member is impaired for long enough, XCF will eventually terminate the member
  - Per the member’s specification: task, space, or system
  - MEMSTALLTIME determines “long enough”
- GRS is a “system critical member”

z/OS 1.12 extends XCF Member Status monitoring to take some form of action when a critical XCF group member appears to be non-operational. XCF externalizes via messages that the member is “impaired”. Furthermore, XCF will terminate the critical member if the impaired state persists long enough. Surfacing the condition should make it easier to identify situations where an application may not be operating normally. Termination of the critical member should relieve the sympathy sickness condition and allow the application to resume normal operation. Alternatively, such termination may also make it possible for more timely restart of the application (or other appropriate recovery action) that can then lead to full recovery. There is some danger that such termination could negatively impact the application, however, that is something for the application writer to assess and exploit as appropriate. The application determines whether it is “critical” and if so, the means by which it should be terminated. Said termination could entail termination of the member’s task, address space, or system. If the system is to be terminated, the member is presumed to be “system critical”. GRS is “system critical”.

If a critical member remains continuously impaired for as long as the system failure detection interval (FDI), XCF inspects the Sysplex Failure Manager (SFM) specification for the MEMSTALLTIME parameter. For MEMSTALLTIME(NO), XCF delays termination of the member for FDI seconds, or two minutes, whichever is longer. If MEMSTALLTIME(nnn) is specified, XCF delays termination for the indicated number of seconds).

This function is intended to help reduce the incidence of sysplex-wide problems that can result from unresponsive critical components. GRS exploits these XCF critical member functions in both ring and star modes. GRS monitors its key tasks and notifies XCF if it detects that GRS is impaired.



z/OS 1.12 - Critical Members …

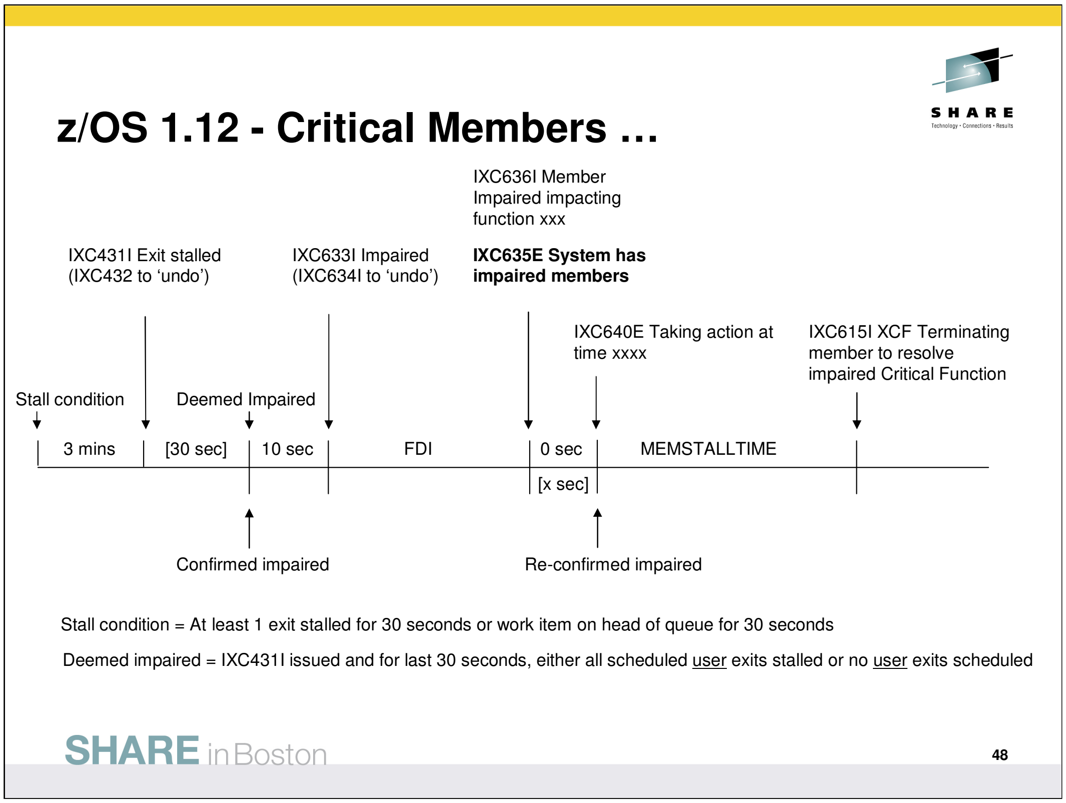
- New Messages
  - IXC633I “member is impaired”
  - IXC634I “member no longer impaired”
  - **IXC635E “system has impaired members”**
  - IXC636I “impaired member impacting function”
- Changed Messages
  - IXC431I “member stalled” (includes status exit)
  - IXC640E “going to take action”
  - IXC615I “terminating to relieve impairment”
  - IXC333I “display member details”
  - IXC101I, IXC105I, IXC220W “system partitioned”

This slide summarizes the essence of the new and changed messages related to impaired member processing.

Installations may choose to develop automation and/or operational procedures to deal with impaired member conditions. The Sysplex Failure Management (SFM) policy MEMSTALLTIME specification should be specified accordingly. For example, if an installation wants operators to investigate and resolve such problems, one will likely specify a longer MEMSTALLTIME value to allow time for such actions to occur. MEMSTALLTIME in effect serves as a back stop to allow the system to take automatic action to alleviate the problem if the operations personnel are unable to resolve the problem in a timely manner. Of course one should recognize that the higher the MEMSTALLTIME value the longer the potential sympathy sickness impact on other systems in the sysplex will persist.

Message IXC635E is likely the key message that would be used to trigger the relevant automation and/or operational procedures.

The sysplex partitioning messages (IXC101I “system being removed”, IXC105I “system has been removed”, and IXC220W “XCF wait-stated system”) have new inserts to indicate that the system was removed as the result of terminating an impaired member. The XCF wait-state code 0A2 has a new reason code (x194) to indicate this condition as well.



z/OS 1.12 - Critical Members …

IXC636I Member Impaired impacting function xxx

IXC431I Exit stalled (IXC432 to 'undo')

IXC633I Impaired (IXC634I to 'undo')

IXC635E System has impaired members

IXC640E Taking action at time xxxx

IXC615I XCF Terminating member to resolve impaired Critical Function

Stall condition

Deemed Impaired

3 mins

[30 sec]

10 sec

FDI

0 sec

[x sec]

MEMSTALLTIME

Confirmed impaired

Re-confirmed impaired

Stall condition = At least 1 exit stalled for 30 seconds or work item on head of queue for 30 seconds

Deemed impaired = IXC431I issued and for last 30 seconds, either all scheduled user exits stalled or no user exits scheduled

This chart summarizes how XCF deals with member impairment conditions. It attempts to combine both "stalled member" monitoring and "member impairment" monitoring as both monitors need to interact in an appropriate fashion. For clarity, message IXC430E, IXC440E, IXC631I, IXC632I, and IXC640E as they relate to signalling sympathy sickness conditions are omitted from the chart.

A member can be "impaired" either because XCF "deems" it to be so, or because the member "confirms" itself to be impaired.

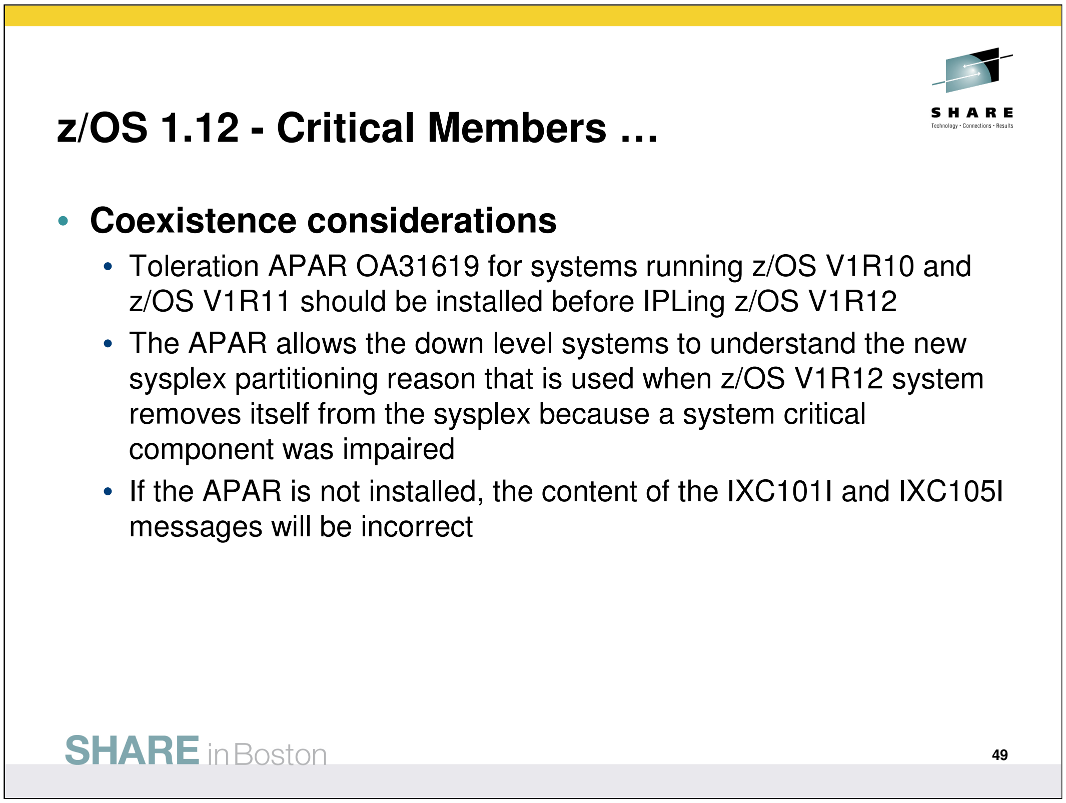
Prior to z/OS 1.12, XCF monitoring detected "stall conditions" wherein one or more exit routines (group or signal) have not made progress, or work items pending for these exits have not been processed. With z/OS 1.12, the monitor is extended to consider the member status exit routine as well. If the stall condition persists long enough (approximately 3 minutes), XCF issues message IXC431I to document the "stalled member". Once the stall condition is externalized, the monitor looks to see if the member should be deemed impaired. To qualify, XCF must find no signs of "user activity" for a 30 second period. Thus, each time a new user exit is scheduled and/or each time XCF observes an exit make progress, XCF restarts the "no user activity" timer. If the 30 second timer expires, the member is **deemed to be impaired**.

A member is "**confirmed impaired**" if its status exit routine reports that the member is "status missing". If a member confirms itself to be impaired, the state of the exit routines is (mostly) irrelevant. The member is responsible for determining its own status correctly. If the member indicates that it is impaired, then XCF assumes it must be so.

So at the point that the member is deemed impaired or confirmed impaired, XCF continues to observe the member. If the impairment condition persists for 10 observations (seconds), XCF issues message IXC633I to the hardcopy log document the fact that the member is impaired. After the message is issued, XCF continues its monitoring. If the impairment condition persists for the system failure detection interval (FDI, aka INTERVAL specification on the COUPLE statement in the COUPLExx parmlib member),XCF issues message IXC636I to the hardcopy log to document the impaired member and the function that it is being impacted. This message also indicates whether the member is "critical" and thus subject to being terminated if the condition persists. XCF also issues message IXC635E to the console to alert the operator. At this point one might have the operator issue DISPLAY XCF,GROUP commands to determine more information about the impaired member. One might then use this information to guide further diagnosis.

After issuing IXC636I for the member, XCF determines whether the impaired member is critical, and if so, whether the member is "deemed impaired" or "confirmed impaired". If "confirmed impaired", XCF redrives the status exit routine to have the member confirm its status one more time. If the critical member confirms "status missing", or if the member is "deemed impaired", XCF issues IXC640E to the console to indicate that impaired members are impacting the sysplex. The message indicates when XCF (SFM) intends to take action to alleviate the situation.

After issuing the IXC640E message, XCF waits MEMSTALLTIME seconds. If MEMSTALLTIME(NO) is in effect, XCF waits FDI seconds or 120 seconds, whichever is greater. For brevity, we just say XCF waits MEMSTALLTIME seconds. If the member is still impaired at approximately MEMSTALLTIME minus 30 seconds, XCF issues abend 00C reason 020F000D and takes a dump for diagnosis. If at the end of the MEMSTALLTIME interval, the member is still impaired, XCF terminates the member per the TERMLEVEL specification from the member's IXCJOIN invocation. XCF issues message IXC615I just before it initiates said termination.



z/OS 1.12 - Critical Members …

- **Coexistence considerations**
  - Toleration APAR OA31619 for systems running z/OS V1R10 and z/OS V1R11 should be installed before IPLing z/OS V1R12
  - The APAR allows the down level systems to understand the new sysplex partitioning reason that is used when z/OS V1R12 system removes itself from the sysplex because a system critical component was impaired
  - If the APAR is not installed, the content of the IXC101I and IXC105I messages will be incorrect

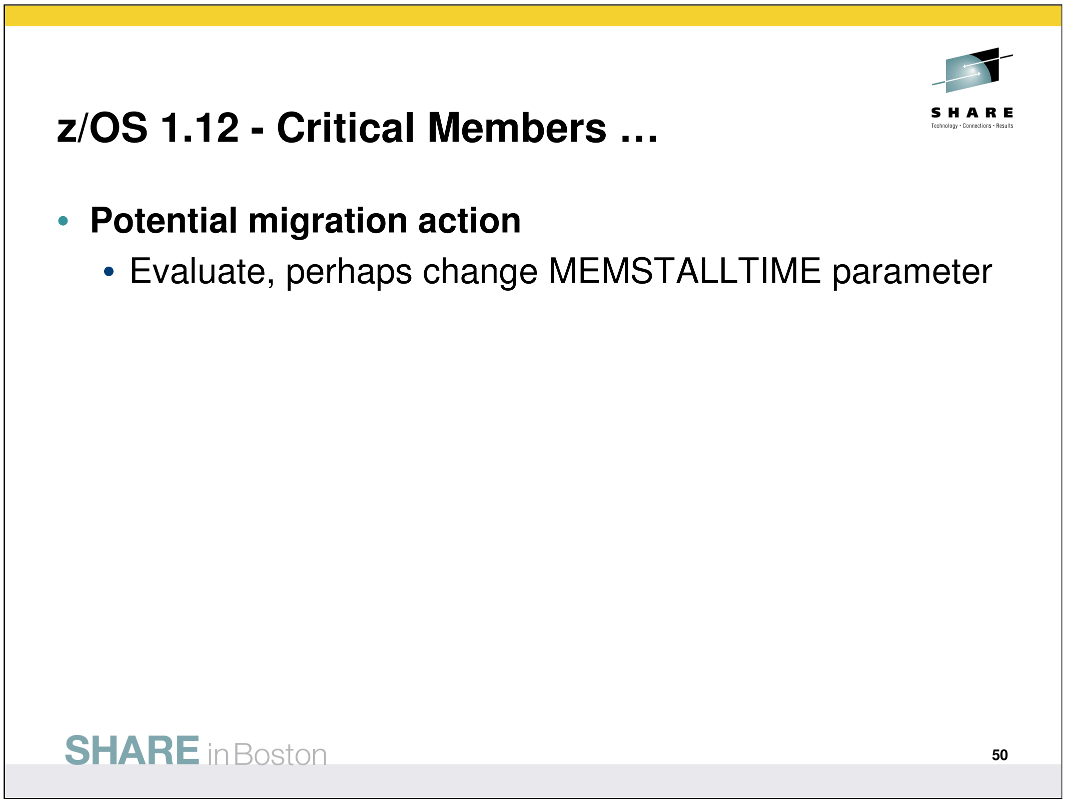
The z/OS V1R12 system has a new sysplex partitioning reason code and a new 0A2 wait-state reason when a system is removed from the sysplex. We now have so many reasons for killing systems that we have exhausted the internal data structures that were used to share this information among systems in the sysplex. To add the new “impaired member” reason, we had to make changes that will cause down-level systems to issue partitioning messages with completely misleading inserts. For example, a down level system would issue the following messages if a z/OS V1R12 system was removed from the sysplex to terminate an impaired critical member:

```
IXC101I SYSPLEX PARTITIONING IN PROGRESS FOR SY4 REQUESTED BY
XCFAS. REASON: LOSS OF COUPLE DATA SET
IXC105I SYSPLEX PARTITIONING HAS COMPLETED FOR SY4
- PRIMARY REASON: LOSS OF COUPLE DATA SET
- REASON FLAGS: 800015
```

The toleration APAR allows the down level systems to issue messages with the correct text. For example:

```
IXC101I SYSPLEX PARTITIONING IN PROGRESS FOR SY4 REQUESTED BY
XCFAS. REASON: SYSTEM HAS AN IMPAIRED CRITICAL MEMBER
```

We believe the only detrimental impact of running without the toleration APAR is the misleading messages. Still, we recommend that it be installed before a z/OS V1R12 system is IPL’ed into the sysplex.



z/OS 1.12 - Critical Members …

- **Potential migration action**
  - Evaluate, perhaps change MEMSTALLTIME parameter

If you do not currently have an active SFM policy, or your SFM policy does not specify MEMSTALLTIME, MEMSTALLTIME(NO) is the default. With MEMSTALLTIME(NO), SFM will terminate an impaired critical member after the system failure detection interval (FDI) or two minutes, whichever is greater. The default FDI on a z/OS V1 R12 system is likely 165 seconds. You can issue the DISPLAY XCF,COUPLE command to see the FDI (aka INTERVAL) value that is being used by your system.

If your active SFM policy specifies MEMSTALLTIME(n) where “n” is some integral number of seconds, that value “n” will determine the number of seconds that SFM waits before it terminates an impaired critical member that is deemed to be impacting its function (and thus the system, and thus the sysplex). This specification is likely suitable for z/OS V1R12 as well. The rationale used to pick a MEMSTALLTIME value for dealing with signalling sympathy sickness conditions is likely valid for critical member support as well. Namely, a situation has occurred in which the system has recognized that there might be a sympathy sickness impact. MEMSTALLTIME indicates how long XCF should delay before taking action to alleviate the condition (i.e. terminate the member). However much time was needed for automation and/or operational procedures to run their course for resolving a signalling sympathy sickness problem is very likely the same as would be needed to resolve an impaired member problem. Installations that want to preserve past behavior to the greatest extent possible, which is to say, they want to prevent the system from terminating impaired critical members, will need to create and activate an SFM policy with a MEMSTALLTIME specification.

It is NOT possible to completely disable the termination of impaired critical members. However, by specifying a large MEMSTALLTIME value, one can in effect delay the action for so long that it is unlikely to be taken. One would expect one of two things to have happened before the MEMSTALLTIME value expires, either (1) the system resumes normal behavior, or (2) the system is re-IPLed because the “sick but not dead” issues effectively rendered the system unusable.

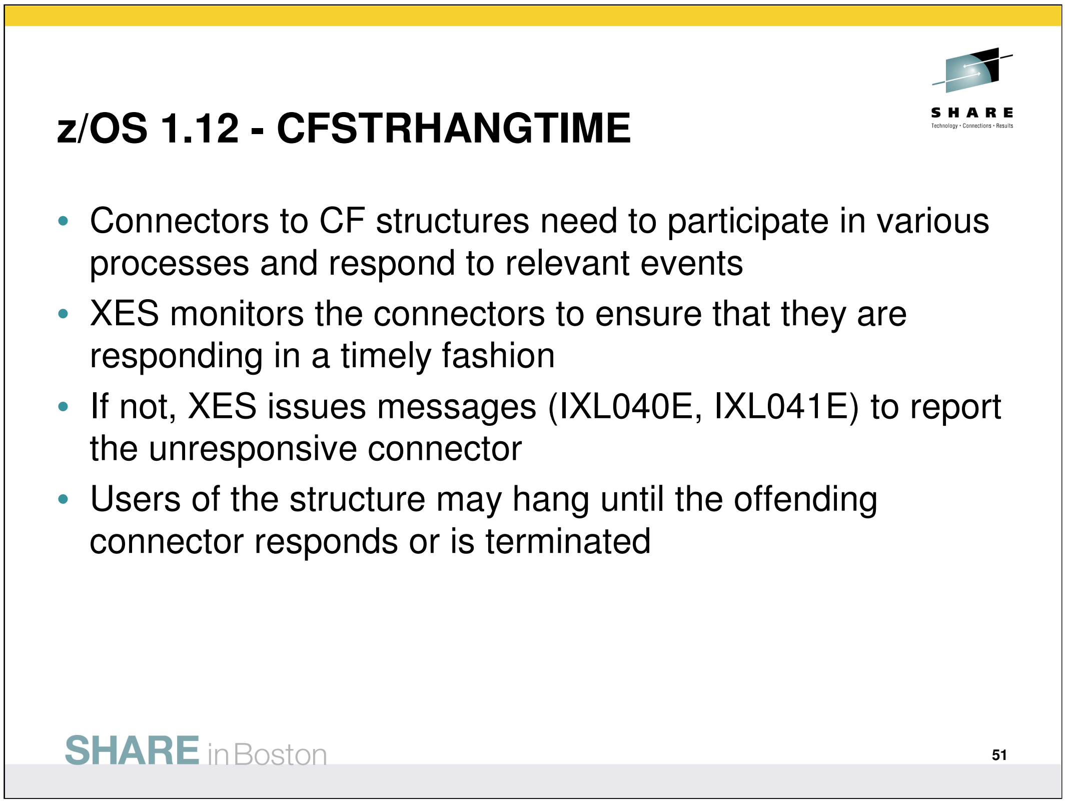
If you want/need to set an SFM policy MEMSTALLTIME specification, then depending on what you already have set up, you might need to:

-Run the IXCL1DSU utility to create a couple data set that will be used to hold SFM policies

-Run the IXCMIAPU utility to create SFM policies with the desired MEMSTALLTIME value

-Make the SFM CDS available to the sysplex (COUPLExx or SETXCF COUPLE)

-Start the desired SFM policy (SETXCF START,POLICY,TYPE=SFM,POLNAME=xxx)



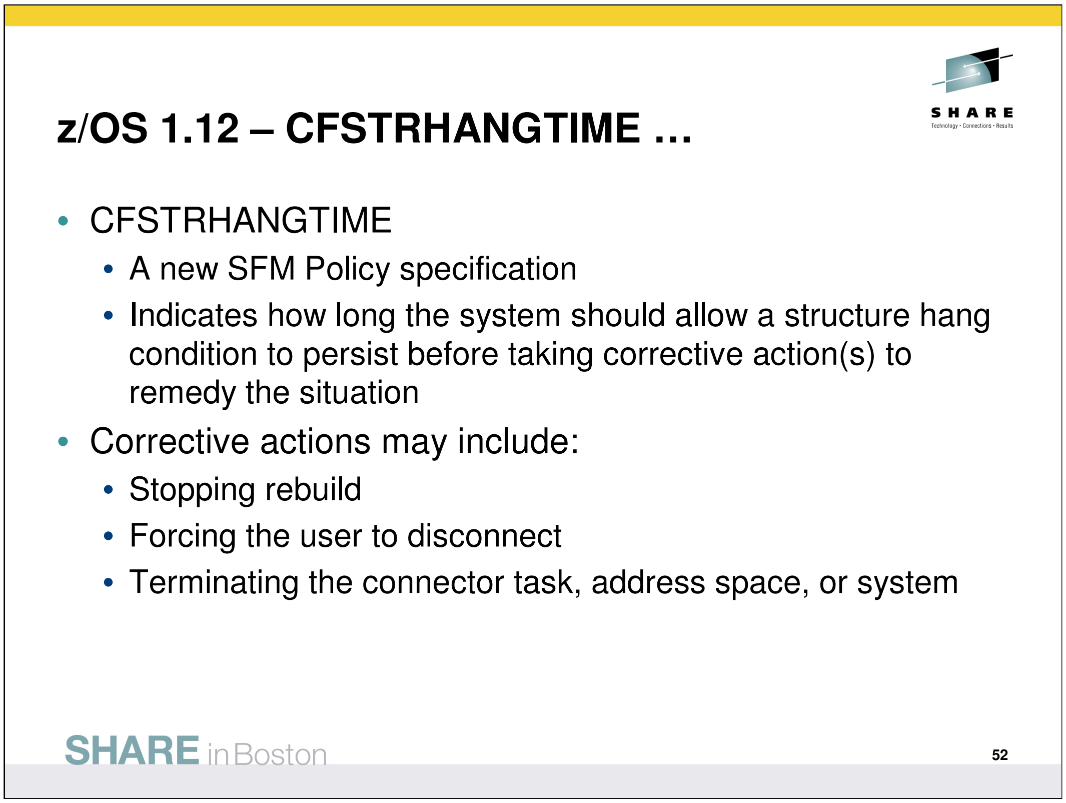
z/OS 1.12 - CFSTRHANGTIME

- Connectors to CF structures need to participate in various processes and respond to relevant events
- XES monitors the connectors to ensure that they are responding in a timely fashion
- If not, XES issues messages (IXL040E, IXL041E) to report the unresponsive connector
- Users of the structure may hang until the offending connector responds or is terminated

The XES hang detect function was introduced in OS/390 V1R8 (HBB6608) to report cases when an expected response to a structure-related event is not received in a timely manner. After 2 minutes without a response, XES issues IXL040E or IXL041E to identify the unresponsive connector, the associated structure, the event, and the affected process. Installations often fail to react to these messages, or worse, react by terminating the wrong connector.

IXL040E CONNECTOR NAME: conname, JOBNAME: jobname, ASID: asid
HAS NOT responsetext
process
FOR STRUCTURE strname CANNOT CONTINUE.
MONITORING FOR RESPONSE STARTED: mondate montime
DIAG: x x x

IXL041E CONNECTOR NAME: conname, JOBNAME: jobname, ASID: asid
HAS NOT RESPONDED TO THE event FOR
SUBJECT CONNECTION: subjectconname.
process
FOR STRUCTURE strname CANNOT CONTINUE.
MONITORING FOR RESPONSE STARTED: mondate montime
DIAG x x x



z/OS 1.12 – CFSTRHANGTIME …

- CFSTRHANGTIME
  - A new SFM Policy specification
  - Indicates how long the system should allow a structure hang condition to persist before taking corrective action(s) to remedy the situation
- Corrective actions may include:
  - Stopping rebuild
  - Forcing the user to disconnect
  - Terminating the connector task, address space, or system

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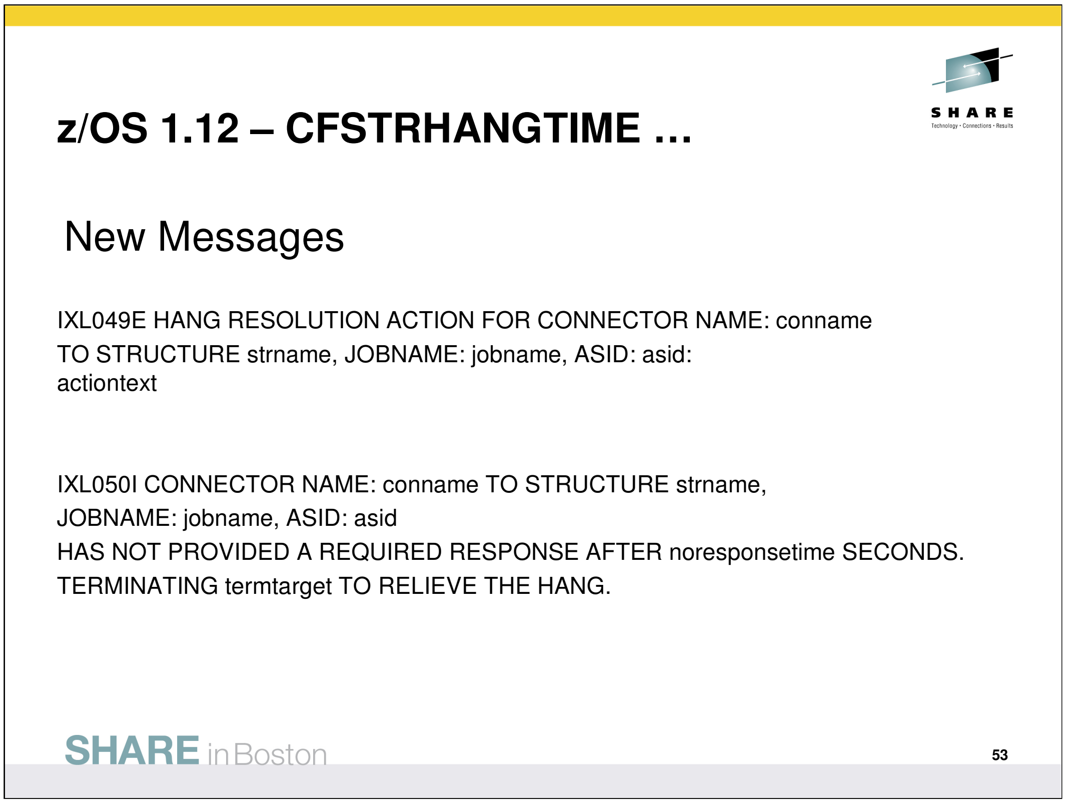
The existing XCF/XES CF structure hang detect support is extended by providing a new CFSTRHANGTIME SFM Policy option that allows you to specify how long CF structure connectors may have outstanding responses. When the time is exceeded, SFM is designed to drive corrective actions to try to resolve the hang condition. This helps you avoid sysplex-wide problems that can result from a CF structure that is waiting for timely responses from CF structure connectors.

The IXCMIAPU policy utility provides a new keyword CFSTRHANGTIME for the SFM policy:

```
DEFINE POLICY NAME(TEST) CONNFAIL(YES) REPLACE(YES)
       SYSTEM NAME(*)
         ISOLATETIME(0)
         WEIGHT(10)
         CFSTRHANGTIME(300)
```

The interval specified with the CFSTRHANGTIME keyword begins after a hang is recognized, approximately 2 minutes after the delivery of the event that requires a response. CFSTRHANGTIME(0) means that the system is to take action immediately upon recognizing that the response is overdue. The initial suggestion, documented by way of the new XCF_SFM_CFSTRHANGTIME health check, is to set CFSTRHANGTIME at 5 minutes. This allows time for the installation to evaluate the situation and decide whether to take manual action, and possibly allow the hang to clear spontaneously, while not permitting the hang to persist long enough to cause sysplex-wide problems.



z/OS 1.12 – CFSTRHANGTIME …

New Messages

IXL049E HANG RESOLUTION ACTION FOR CONNECTOR NAME: conname
TO STRUCTURE strname, JOBNAME: jobname, ASID: asid:
actiontext

IXL050I CONNECTOR NAME: conname TO STRUCTURE strname,
JOBNAME: jobname, ASID: asid
HAS NOT PROVIDED A REQUIRED RESPONSE AFTER noresponsetime SECONDS.
TERMINATING termtarget TO RELIEVE THE HANG.

If no SFM policy is active or the policy specifies CFSTRHANGTIME(NO), no hang relief action is taken. If a policy is started, stopped, or changed, the monitor will re-evaluate the required response and possibly reissue IXL049E.

IXL049E may indicate that:

(1) The system will not take action because (a) there is no SFM policy, (b) the SFM policy requires manual intervention, or (c) the system has tried everything it knows how to do, or

(2) The system is taking action now (either because the policy specified CFSTRHANGTIME(0) or it was changed in a way that makes the action past due), or

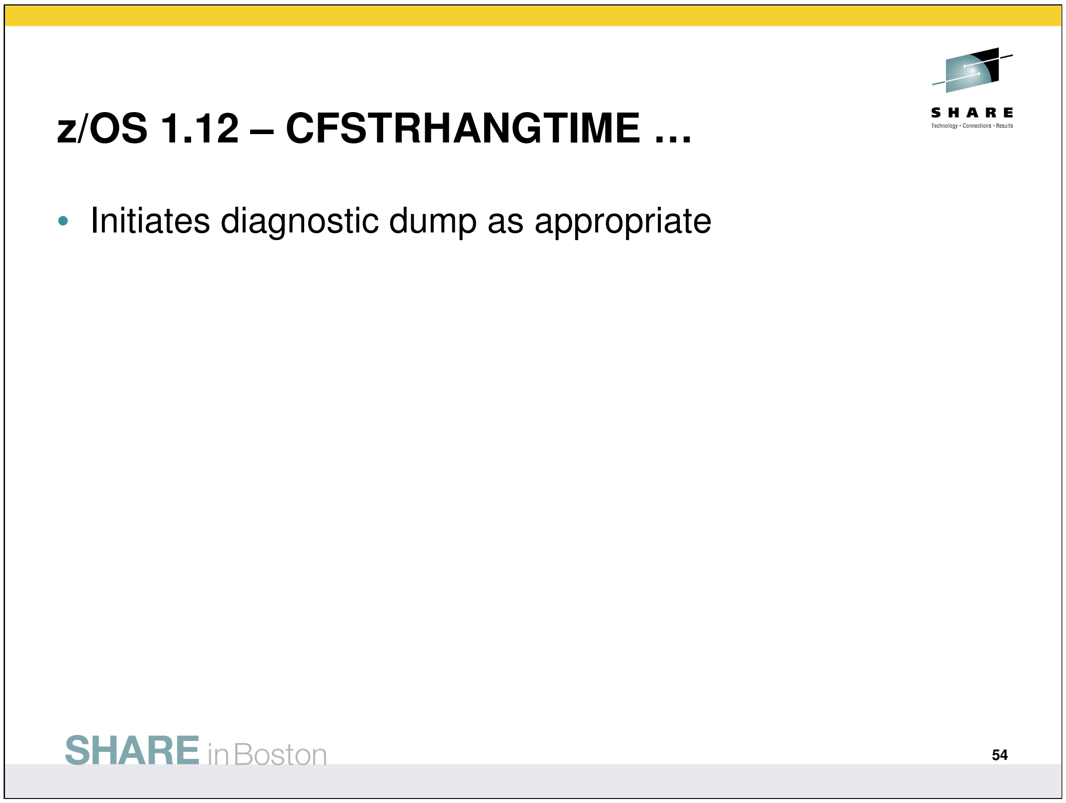
(3) The system will take action at the time specified in the message.

For IXL049E, *actiontext* is one of:

SFM POLICY NOT ACTIVE, MANUAL INTERVENTION REQUIRED.
SFM POLICY REQUIRES MANUAL INTERVENTION.
SYSTEM IS TAKING ACTION.
SYSTEM WILL TAKE ACTION AT termdate termtime
SYSTEM ACTION UNSUCCESSFUL, MANUAL INTERVENTION REQUIRED

For IXL050I *termtarget* is one of:

REBUILD
SIGNAL PATHS (ATTEMPT 1)
SIGNAL PATHS (ATTEMPT 2)
SIGNAL PATHS (ATTEMPT 3)
CONNECTION
CONNECTOR TASK
CONNECTOR SPACE (WITH RECOVERY)
CONNECTOR SPACE (NO RECOVERY)
CONNECTOR SYSTEM



z/OS 1.12 – CFSTRHANGTIME …

- Initiates diagnostic dump as appropriate

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XES will take only one dump per set of monitored events. If monitoring multiple events, any one or any combination of them may have caused or contributed to the hang, but since we can't analyze those possible relationships there is no point in taking repeated dumps after the hang is first recognized. Once a dump is taken, no further dumps will be taken until all events being monitored have been processed.

If the hang action analysis concludes that automatic action will not be taken to relieve the hang, a dump is taken on the same analysis cycle. Except for the case of policy changes, that would be on the same cycle in which the hang is recognized, which implies that the dump is taken after issuing the IXL040E / IXL041E and IXL049E messages.

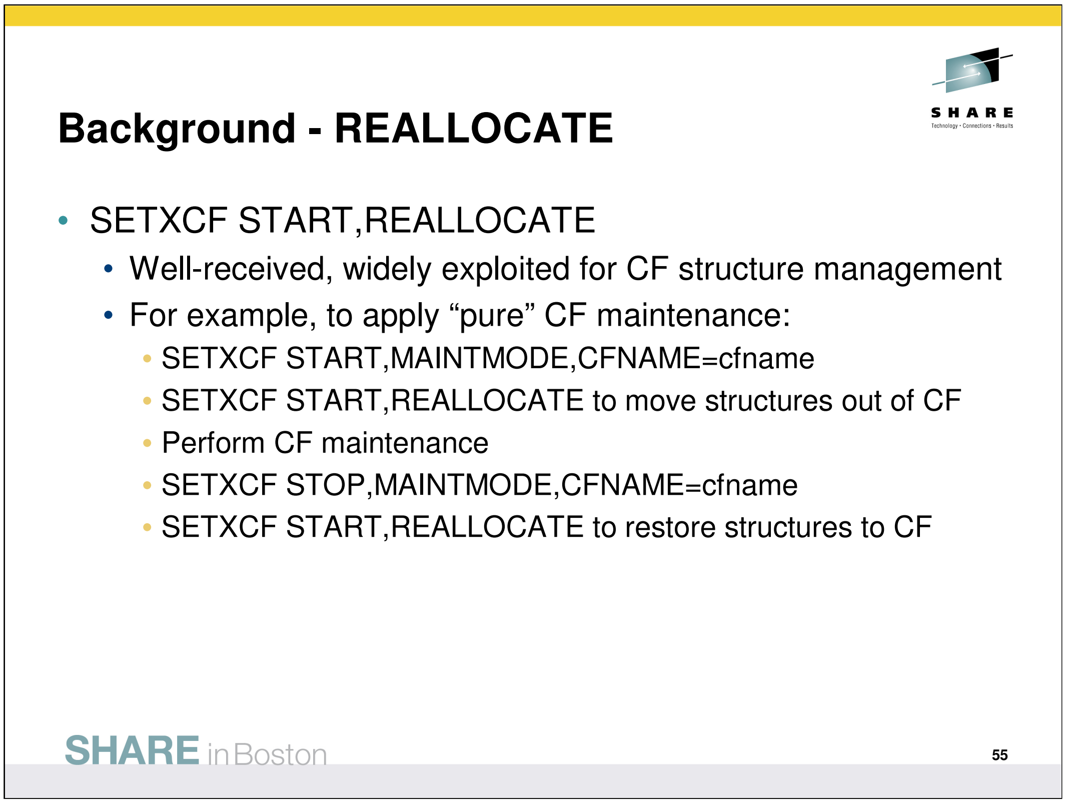
If the next anticipated hang relief action is termination of the connector's task or "soft" termination of the connector's address space (i.e., task recovery will be allowed to run), the connector's recovery will presumably take a dump. We expect that an application dump would be more valuable in debugging root cause than a XES dump, so we avoid taking a dump that might inadvertently prevent capture of the application's dump. Only if we believe that there is sufficient time to capture a XES dump before initiating action will we do so.

If the next anticipated action is not expected to produce a connector dump, XES will take one.

For down-level releases, OA28298 introduced dumping of connector address and data spaces at hang recognition time.

Dump title is tailored to indicate a connector issue:

ABEND=026, REASON=08118001, CONNECTOR HANG: CONNAME=conname, JOBNAME=jobname



Background - REALLOCATE

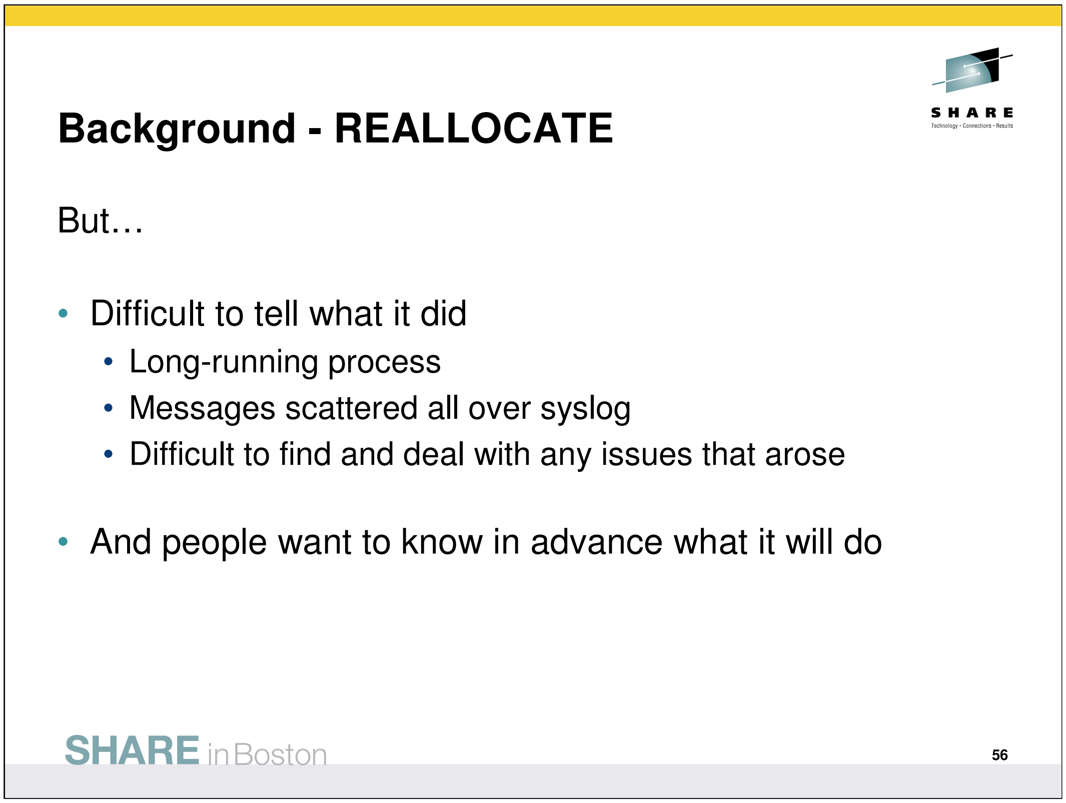
- SETXCF START,REALLOCATE
  - Well-received, widely exploited for CF structure management
  - For example, to apply “pure” CF maintenance:
    - SETXCF START,MAINTMODE,CFNAME=cfname
    - SETXCF START,REALLOCATE to move structures out of CF
    - Perform CF maintenance
    - SETXCF STOP,MAINTMODE,CFNAME=cfname
    - SETXCF START,REALLOCATE to restore structures to CF

The SETXCF REALLOCATE command is an existing system command used for CF structure management. The command causes the Coupling Facility Resource Manager (CFRM) subcomponent of XCF to analyze existing coupling facility structures with respect their placement in various CFs. The command then effects the necessary changes to correct any structure-related problems that it finds that are within its “scope of expertise.” As appropriate, the command may initiate actions (such as stop duplexing, rebuild, and/or start duplexing) in an orderly fashion to correct any problems it finds.

When a coupling facility is in maintenance mode, no new structures will be allocated in the CF and REALLOCATE will move allocated structures to alternate CF per the preference list in the CFRM policy.

The SETXCF START,MAINTMODE command, which is available as of z/OS V1R9, can be used in conjunction with the SETXCF START,REALLOCATE command to simplify planned reconfiguration and maintenance actions. In particular, one need not update the CFRM policy in order to prevent structures from being allocated in the CF.

In the example illustrated in the slide, we have a case where (disruptive) CF maintenance is to be applied. The subject CF is placed in “maintenance mode” so that CFRM will refrain from allocating new structures in the CF. The REALLOCATE command takes maintenance mode into account, and concludes that structures need to be moved out of the subject CF. REALLOCATE will take the necessary actions to get the structures moved to an alternate CF (per the preference list).



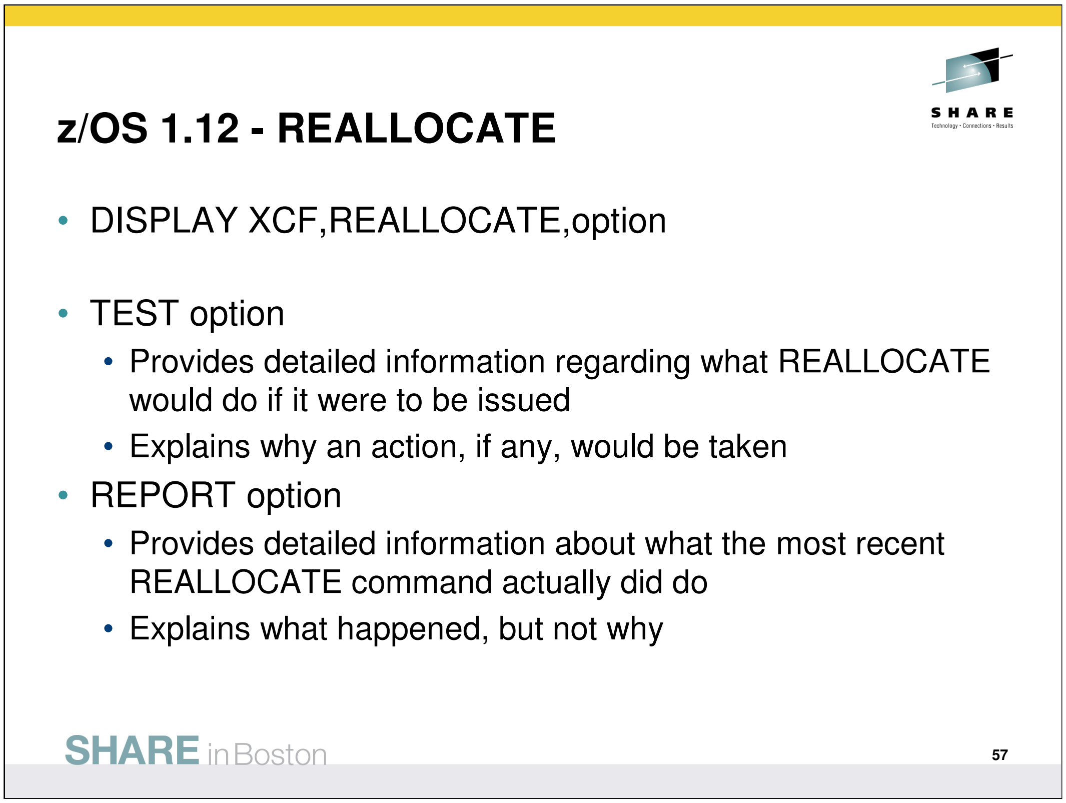
Background - REALLOCATE

But…

- Difficult to tell what it did
    - Long-running process
    - Messages scattered all over syslog
    - Difficult to find and deal with any issues that arose
- And people want to know in advance what it will do

The existing SETXCF REALLOCATE command causes CFRM to analyze all allocated structures in the sysplex with respect to their placement in various CFs, and initiate the necessary changes to correct any structure-related problems that it finds. Each structure is successively evaluated and processed (as needed) one at a time so as to minimize disruption to the sysplex. As each structure is processed, REALLOCATE issues messages to describe its decisions and actions. In some cases, REALLOCATE is unable to successfully resolve a structure, and issues messages to so indicate. It is often the case that some form of manual intervention is needed in order to accomplish the desired reallocate of those structures. Prior to z/OS V1R12, the installation would have to search logs to find the messages for structures that had issues – a rather tedious task.

Furthermore, installations have also wanted to know in advance what actions reallocate was going to take. Depending on the structures to be manipulated, it might for example be desirable to delay the reallocate to a "slow" time of day so as to minimize the disruption to the exploiting application.



z/OS 1.12 - REALLOCATE

- DISPLAY XCF,REALLOCATE,option

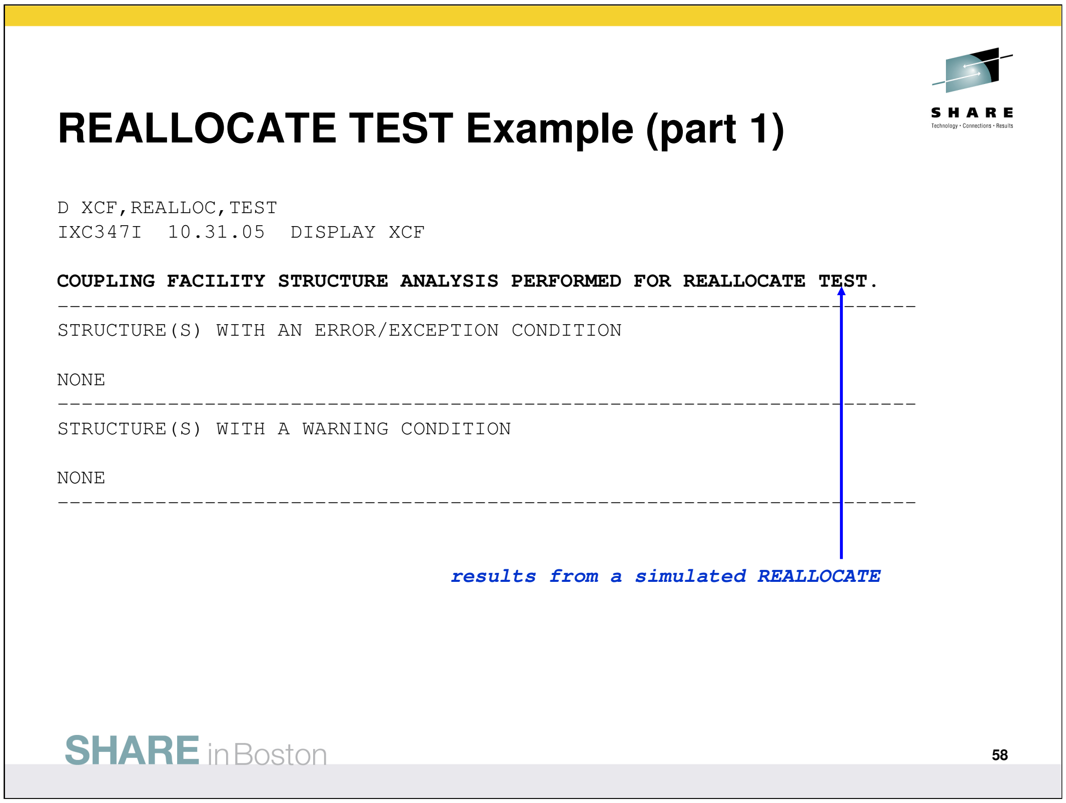
- TEST option
  - Provides detailed information regarding what REALLOCATE would do if it were to be issued
  - Explains why an action, if any, would be taken
- REPORT option
  - Provides detailed information about what the most recent REALLOCATE command actually did do
  - Explains what happened, but not why

In z/OS V1.12 a new DISPLAY XCF,REALLOCATE,TEST command simulates the reallocation process and provides information about the changes that REALLOCATE (were it to be initiated by the SETXCF START,REALLOCATE command) would attempt to make, as well as any errors that it might encounter. This capability will provide information you can use to decide when to invoke the actual REALLOCATE process, and also whether you might need to make coupling facility configuration changes before issuing the actual REALLOCATE command.

For TEST, the CFRM policy is read into local storage (and it is not written back). The same processing that a real REALLOCATE would do is then applied against the in-store copy of the policy.

A new DISPLAY XCF,REALLOCATE,REPORT command provides detailed information on the results experienced by a previously executed REALLOCATE command. This capability is intended to help you find such information without searching through the system log for REALLOCATE related processing and exception messages.

An actual REALLOCATE process stores “history” in the CFRM CDS for each structure defined in the policy. D XCF,REALLOC,REPORT reads the data and builds message text to reflect those results.



REALLOCATE TEST Example (part 1)

```
D XCF,REALLOC,TEST
IXC347I  10.31.05  DISPLAY XCF

COUPLING FACILITY STRUCTURE ANALYSIS PERFORMED FOR REALLOCATE TEST.
----------------------------------------------------------------------
STRUCTURE(S) WITH AN ERROR/EXCEPTION CONDITION

NONE
----------------------------------------------------------------------
STRUCTURE(S) WITH A WARNING CONDITION

NONE
----------------------------------------------------------------------
```

results from a simulated REALLOCATE

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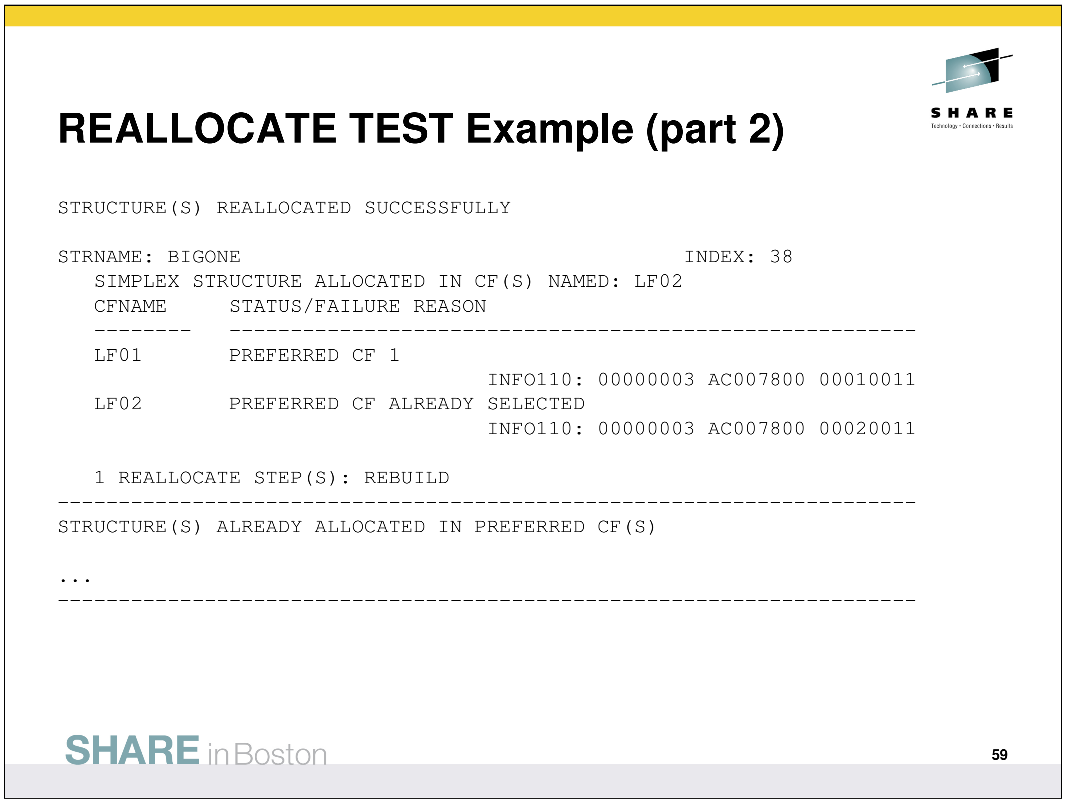
The TEST output has four sections. The first section lists any structures for which there would be issues, which makes it easy to find the ones that might require intervention. The report will also indicate what manual actions (if any) might be need to be taken to deal with these exceptions.

What sort of issues might there be?

- Structures that would not be reallocated to reside in their “most preferred” CF(s) for some reason
- Structures that would not be re-duplexed as they were supposed to be
- Pending policy changes that would not be cleared by the reallocate process and therefore would remain pending even after the completion of reallocate processing



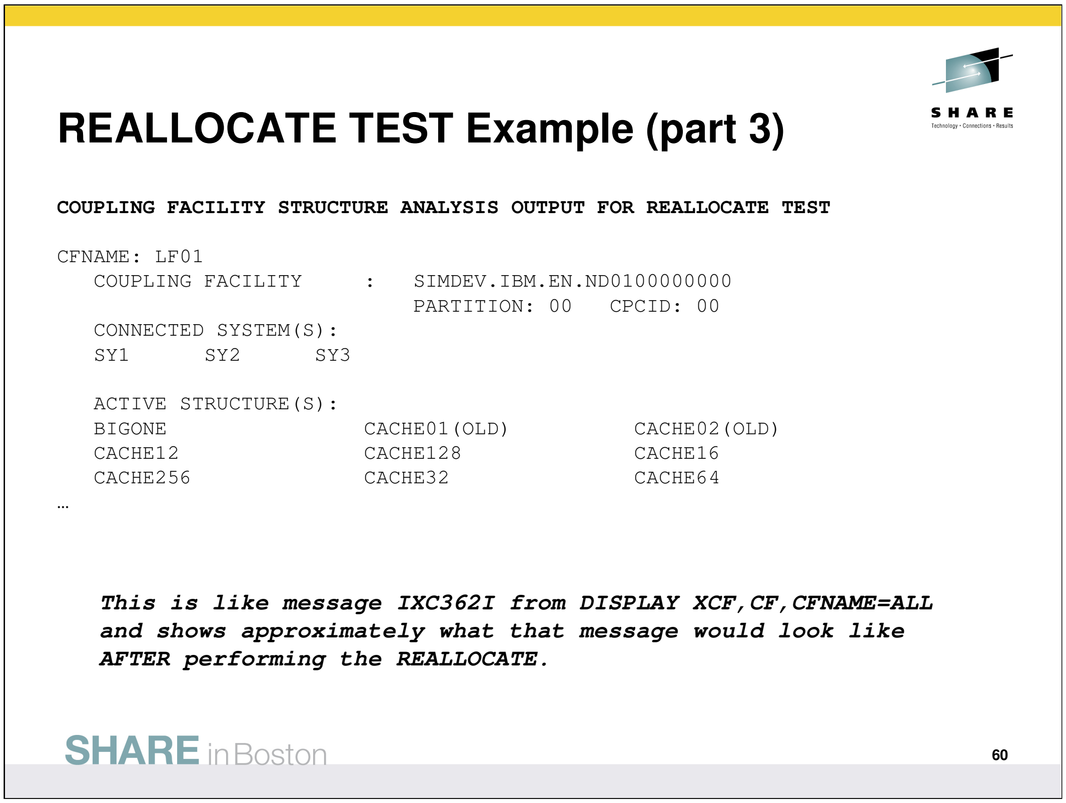
REALLOCATE TEST Example (part 2)

```
STRUCTURE(S) REALLOCATED SUCCESSFULLY

STRNAME: BIGONE                                    INDEX: 38
   SIMPLEX STRUCTURE ALLOCATED IN CF(S) NAMED: LF02
   CFNAME     STATUS/FAILURE REASON
   --------   --------------------------------------------------------
   LF01       PREFERRED CF 1
                                     INFO110: 00000003 AC007800 00010011
   LF02       PREFERRED CF ALREADY SELECTED
                                     INFO110: 00000003 AC007800 00020011

   1 REALLOCATE STEP(S): REBUILD
----------------------------------------------------------------------
STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF(S)

...
----------------------------------------------------------------------
```

SHARE in Boston

In the second section of the report, we find information about structures that TEST would expect REALLOCATE to successfully process. First it lists each structure for which REALLOCATE would be expected to take action. For these structures, the output explains what actions would be taken against the structure. It also lists each CF that was considered and explains why the various CF's would or would not have been selected. Then it lists the structures for which REALLOCATE would not be expected to take action. Again similar information about the relevant CF's would be presented.

The INFO110 is diagnostic information similar to what is provided with message IXC574I. Intended for use by IBM service personnel as needed.

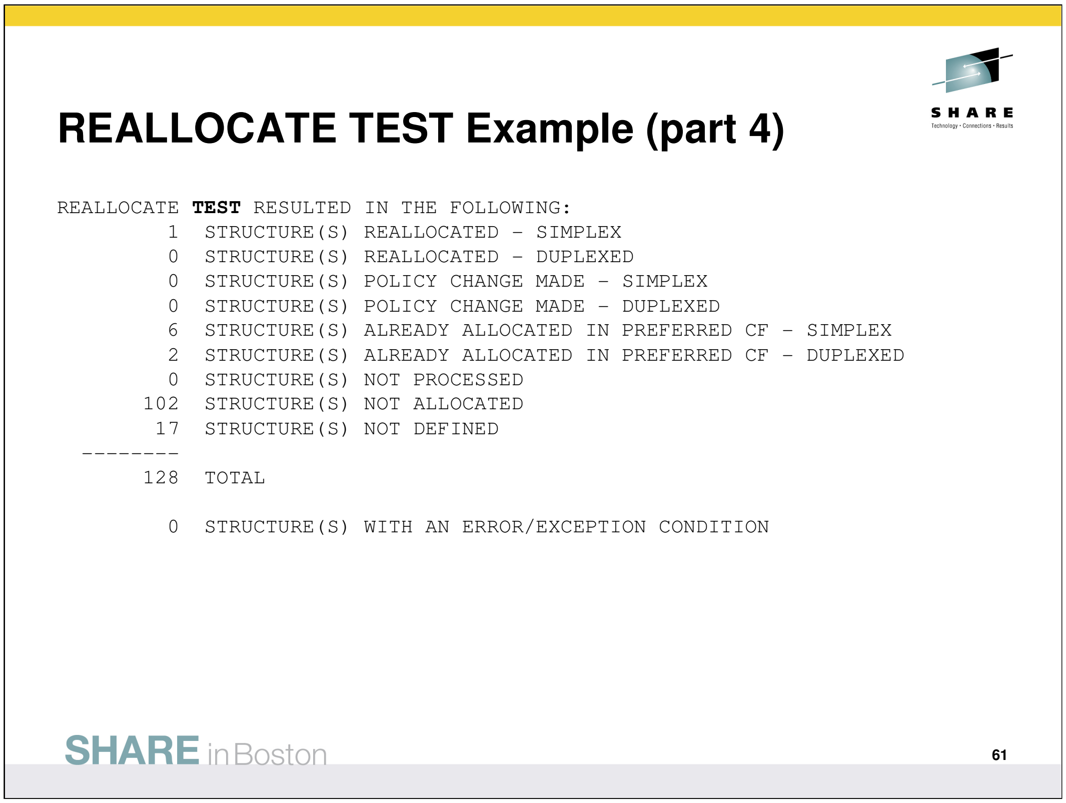


REALLOCATE TEST Example (part 3)

```
COUPLING FACILITY STRUCTURE ANALYSIS OUTPUT FOR REALLOCATE TEST

CFNAME: LF01
   COUPLING FACILITY     :   SIMDEV.IBM.EN.ND0100000000
                             PARTITION: 00   CPCID: 00
   CONNECTED SYSTEM(S):
   SY1      SY2      SY3

   ACTIVE STRUCTURE(S):
   BIGONE                 CACHE01(OLD)           CACHE02(OLD)
   CACHE12                CACHE128               CACHE16
   CACHE256               CACHE32                CACHE64
…
```

This is like message IXC362I from DISPLAY XCF,CF,CFNAME=ALL and shows approximately what that message would look like AFTER performing the REALLOCATE.

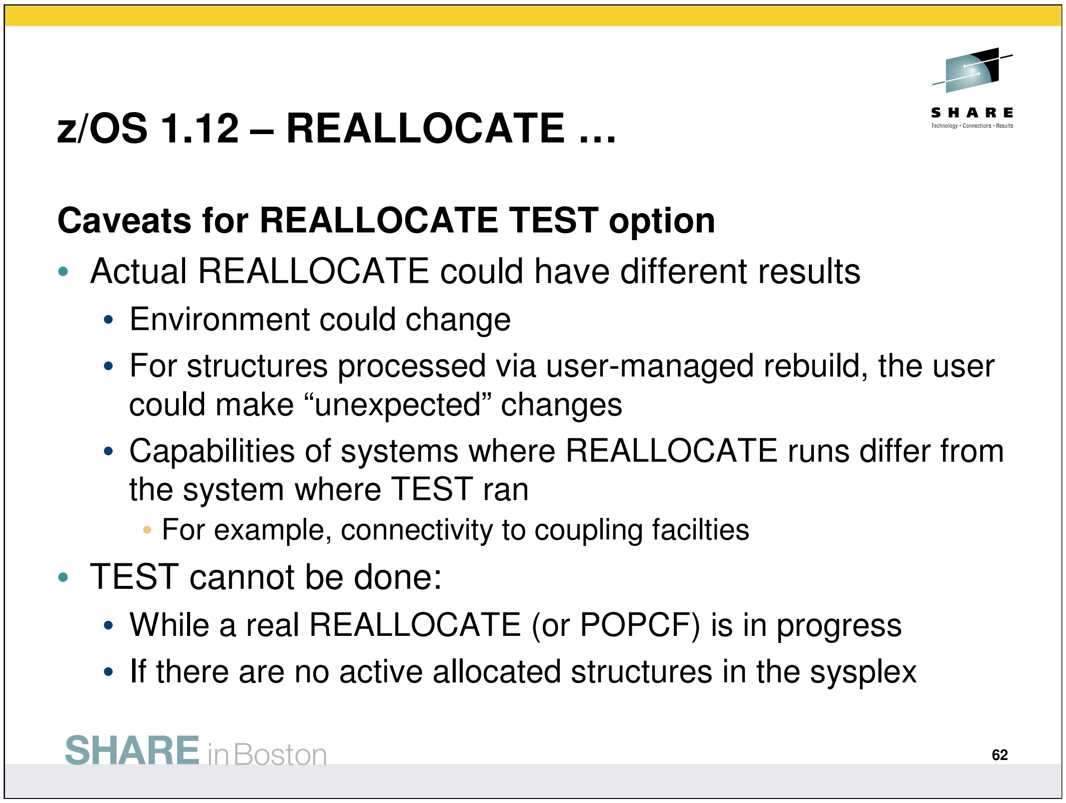
In the third section, the TEST output summarizes on a CF by CF basis, the collection of structures that would be expected to reside in each CF after the proposed REALLOCATE was finished.



REALLOCATE TEST Example (part 4)

```
REALLOCATE TEST RESULTED IN THE FOLLOWING:
         1  STRUCTURE(S) REALLOCATED - SIMPLEX
         0  STRUCTURE(S) REALLOCATED - DUPLEXED
         0  STRUCTURE(S) POLICY CHANGE MADE - SIMPLEX
         0  STRUCTURE(S) POLICY CHANGE MADE - DUPLEXED
         6  STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF - SIMPLEX
         2  STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF - DUPLEXED
         0  STRUCTURE(S) NOT PROCESSED
       102  STRUCTURE(S) NOT ALLOCATED
        17  STRUCTURE(S) NOT DEFINED
  --------
       128  TOTAL

         0  STRUCTURE(S) WITH AN ERROR/EXCEPTION CONDITION
```

In the final section, the TEST output summarizes what it expects would have happened if the proposed REALLOCATE were initiated.



z/OS 1.12 – REALLOCATE …

Caveats for REALLOCATE TEST option

- Actual REALLOCATE could have different results
  - Environment could change
  - For structures processed via user-managed rebuild, the user could make “unexpected” changes
  - Capabilities of systems where REALLOCATE runs differ from the system where TEST ran
    - For example, connectivity to coupling facilties
- TEST cannot be done:
  - While a real REALLOCATE (or POPCF) is in progress
  - If there are no active allocated structures in the sysplex

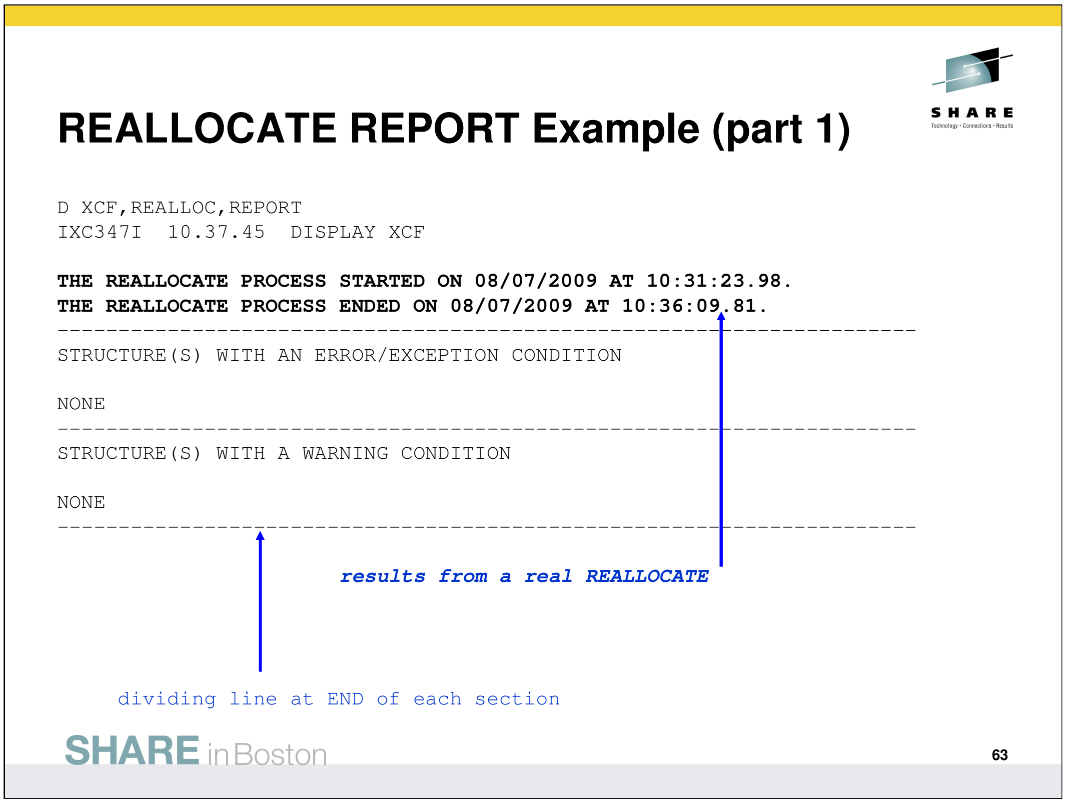
The major things that could cause the TEST results to be different from the actual REALLOCATE:

•The environment could change between the TEST and the actual REALLOCATE. For example, the CFRM policy might be changed, or the set of connected coupling facilities might change.

•User-managed rebuild could do something "unexpected“. When REALLOCATE initiates a user-managed rebuild, it has no real control over what the exploiter will actually do during the rebuild. For example, certain structure attributes and/or parameter could be changed by the user as part of the rebuild. Since TEST cannot know what the exploiter will really do during its processing, it makes a reasonable guess. If the guess is sufficiently divergent from what the exploiter actually does during the rebuild, the TEST results could differ from what the real REALLOCATE ultimately achieves.

•TEST and REALLOCATE might run on systems with different capabilities. TEST runs on exactly one system in the sysplex. REALLOCATE processing can run on different systems as it makes progress. Thus it could be that the system that processed the TEST has connectivity to a different set of CFs than one or more of the systems that participate in the actual REALLOCATE. Those differences could cause the REALLOCATE to put a structure in a different CF than the TEST expected.

TEST recognizes when it would not be worthwhile for it to run. If a REALLOCATE is currently in progress, the state of the structures is in flux and TEST cannot really make reliable predictions.



REALLOCATE REPORT Example (part 1)

```
D XCF,REALLOC,REPORT
IXC347I  10.37.45  DISPLAY XCF

THE REALLOCATE PROCESS STARTED ON 08/07/2009 AT 10:31:23.98.
THE REALLOCATE PROCESS ENDED ON 08/07/2009 AT 10:36:09.81.
----------------------------------------------------------------------
STRUCTURE(S) WITH AN ERROR/EXCEPTION CONDITION

NONE
----------------------------------------------------------------------
STRUCTURE(S) WITH A WARNING CONDITION

NONE
----------------------------------------------------------------------
```

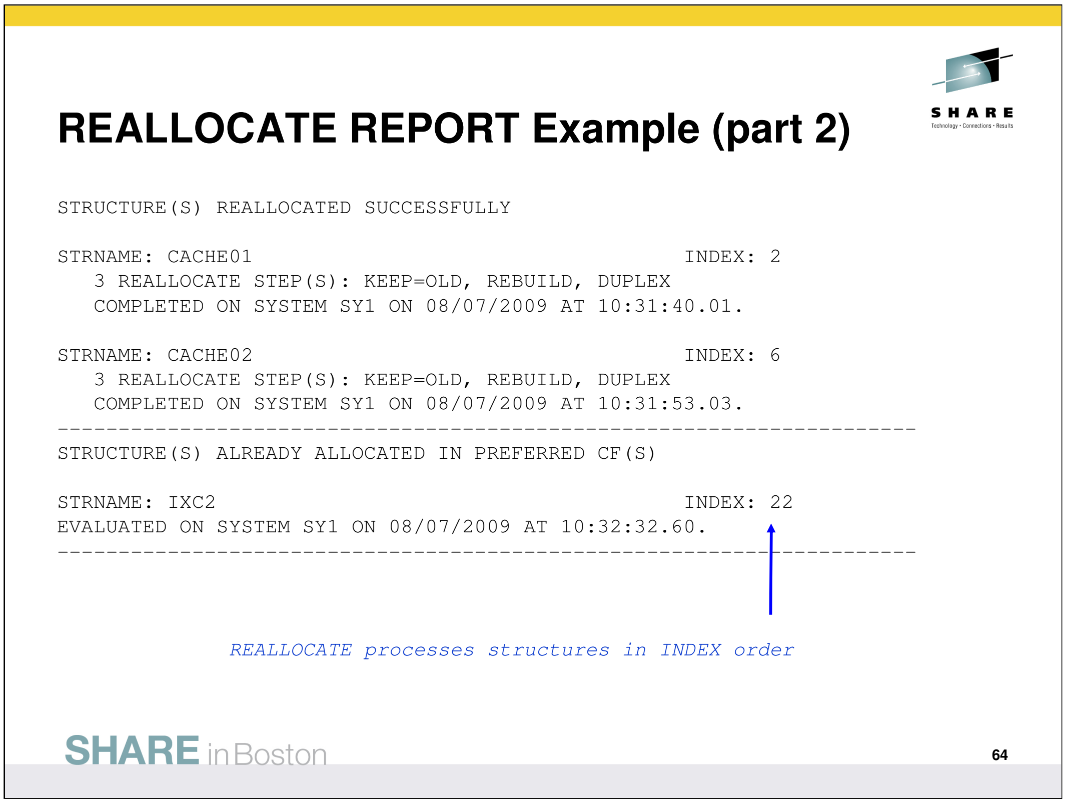
results from a real REALLOCATE

dividing line at END of each section

The REPORT has three sections. The first section lists any structures for which reallocate had issues, thus making it easier to find the ones that require intervention. The report identifies the system, time and reason for the failure that will help identify any manual actions that may need to be taken to deal with these exceptions.

What sort of issues might there be?

- Structures that could not be reallocated to reside in their “most preferred” CF(s) for some reason
- Structures that could not be re-duplexed as they were supposed to be
- Pending policy changes that could not be cleared by the reallocate process and therefore remained pending even after the completion of reallocate processing



REALLOCATE REPORT Example (part 2)

```
STRUCTURE(S) REALLOCATED SUCCESSFULLY

STRNAME: CACHE01                                   INDEX: 2
   3 REALLOCATE STEP(S): KEEP=OLD, REBUILD, DUPLEX
   COMPLETED ON SYSTEM SY1 ON 08/07/2009 AT 10:31:40.01.

STRNAME: CACHE02                                   INDEX: 6
   3 REALLOCATE STEP(S): KEEP=OLD, REBUILD, DUPLEX
   COMPLETED ON SYSTEM SY1 ON 08/07/2009 AT 10:31:53.03.
----------------------------------------------------------------------
STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF(S)

STRNAME: IXC2                                      INDEX: 22
EVALUATED ON SYSTEM SY1 ON 08/07/2009 AT 10:32:32.60.
----------------------------------------------------------------------
```

REALLOCATE processes structures in INDEX order

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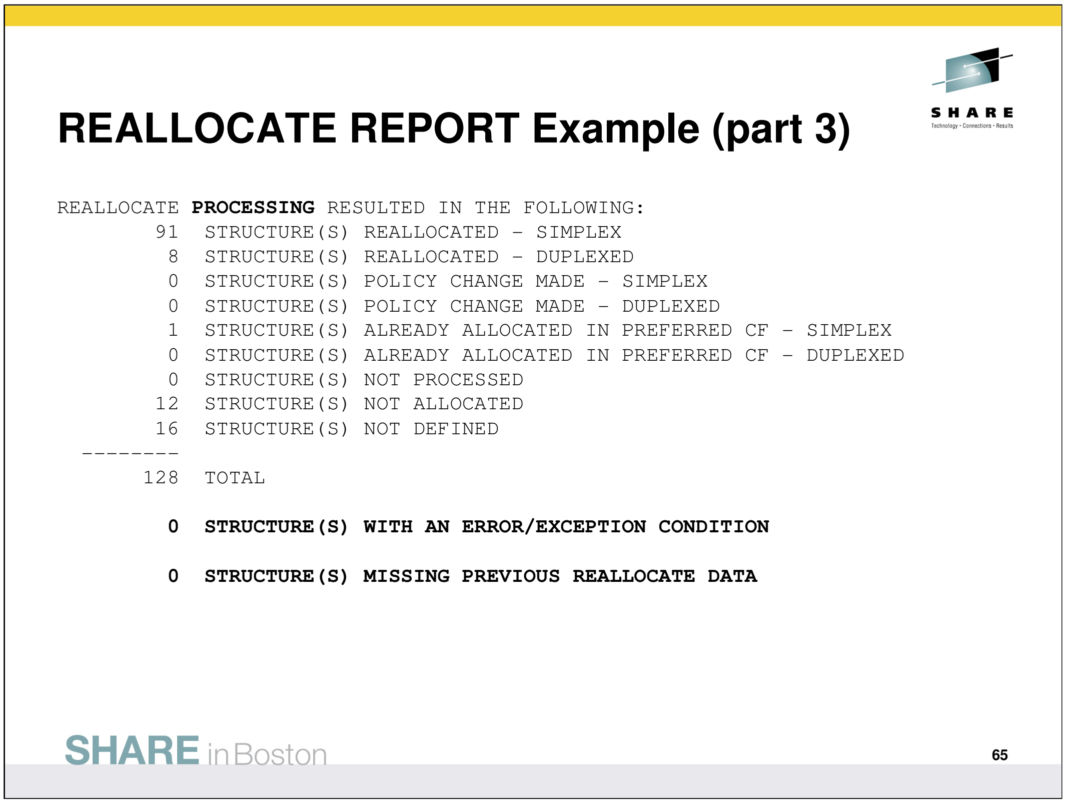
The second section of the report shows what actions, if any, were taken by reallocate. There are two subsections, one showing structures that were manipulated by reallocate, and another showing the structures for which no action was needed. In this example, we see that reallocate stopped the duplexed rebuild for CACHE01 and CACHE02, rebuilt them, and then re-established duplexing. No action was taken against structure IXC2.

The CFRM policy in effect maintains a table of structures, with one entry per structure. Reallocate processes the structures in index order. Note that reallocate only processes structures that are physically allocated in some coupling facility.



REALLOCATE REPORT Example (part 3)

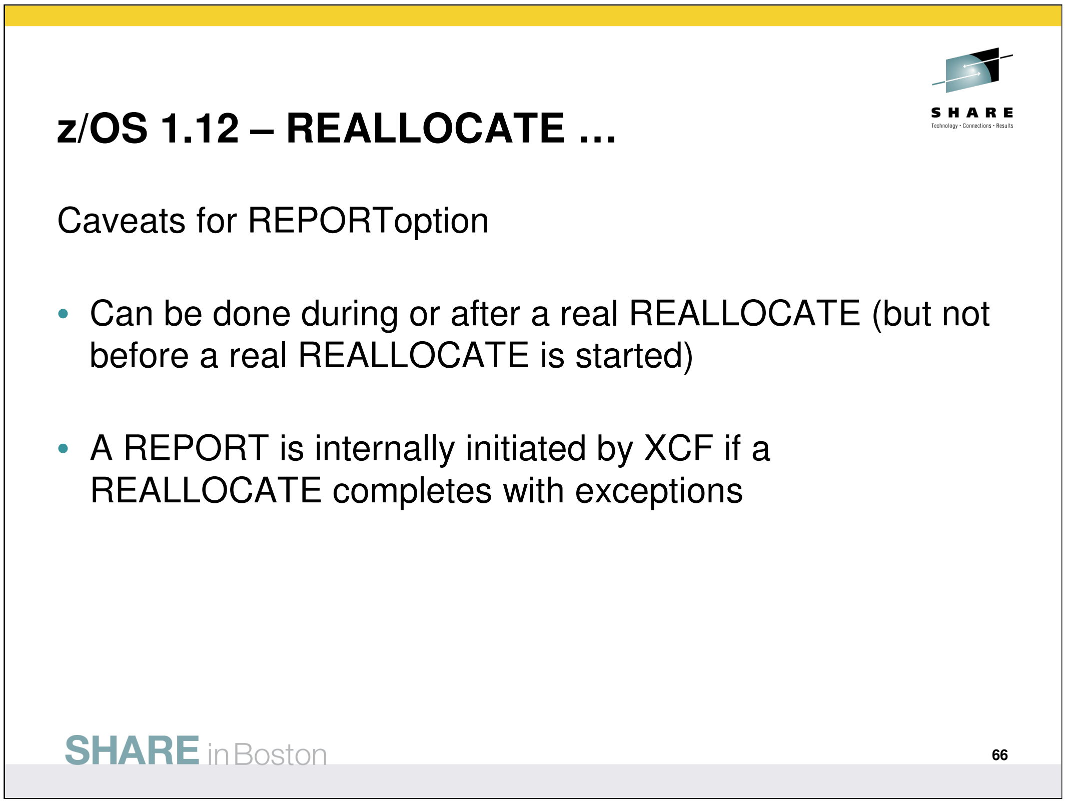
```
REALLOCATE PROCESSING RESULTED IN THE FOLLOWING:
        91  STRUCTURE(S) REALLOCATED - SIMPLEX
         8  STRUCTURE(S) REALLOCATED - DUPLEXED
         0  STRUCTURE(S) POLICY CHANGE MADE - SIMPLEX
         0  STRUCTURE(S) POLICY CHANGE MADE - DUPLEXED
         1  STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF - SIMPLEX
         0  STRUCTURE(S) ALREADY ALLOCATED IN PREFERRED CF - DUPLEXED
         0  STRUCTURE(S) NOT PROCESSED
        12  STRUCTURE(S) NOT ALLOCATED
        16  STRUCTURE(S) NOT DEFINED
  --------
       128  TOTAL

         0  STRUCTURE(S) WITH AN ERROR/EXCEPTION CONDITION

         0  STRUCTURE(S) MISSING PREVIOUS REALLOCATE DATA
```

SHARE in Boston

65

The final section of the report summarizes everything that reallocate did or discovered.

There may be structures missing reallocate data if structures were removed from the CFRM policy since the last REALLOCATE started. It may also be missing if the last REALLOCATE that was done was performed in a sysplex that did not have all z/OS V1R12 and/or the necessary coexistence PTFs installed on systems running lower releases.



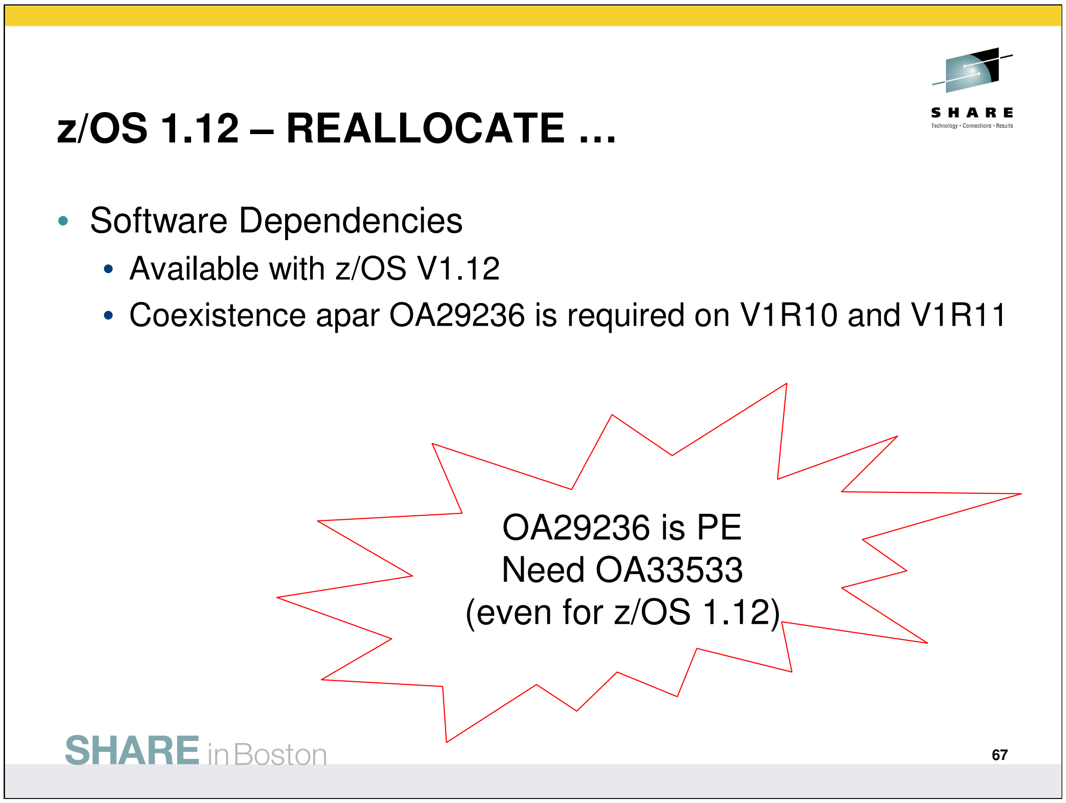
z/OS 1.12 – REALLOCATE …

Caveats for REPORToption

- Can be done during or after a real REALLOCATE (but not before a real REALLOCATE is started)
- A REPORT is internally initiated by XCF if a REALLOCATE completes with exceptions

Since the REPORT option gathers the data from the CFRM policy that describes the results of the most recent REALLOCATE, if the installation never performed a REALLOCATE, there would be nothing to report. Changes to the policy that result in structures being deleted will also delete the related history records. If a REPORT is requested while a real REALLOCATE is in progress, structures that have not yet been processed would appear in the “warning” section of the report.

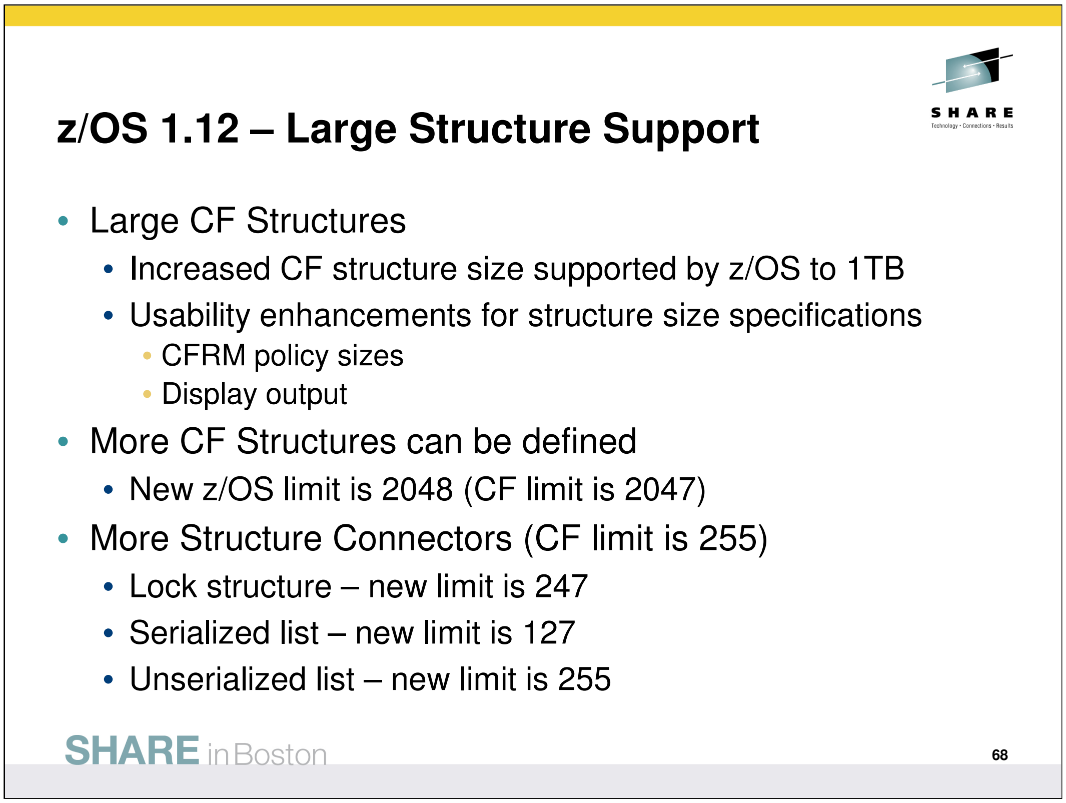
If REALLOCATE completes with exceptions, XCF will internally initiate a DISPLAY XCF,REALLOCATE,REPORT request so that the results can be neatly summarized in the log. A comment on the DISPLAY command that is issued will indicate “ISSUED TO LOG REALLOCATE ERROR(S)/EXCEPTION(S)”.



z/OS 1.12 – REALLOCATE …

- Software Dependencies
  - Available with z/OS V1.12
  - Coexistence apar OA29236 is required on V1R10 and V1R11

OA29236 is PE
Need OA33533
(even for z/OS 1.12)



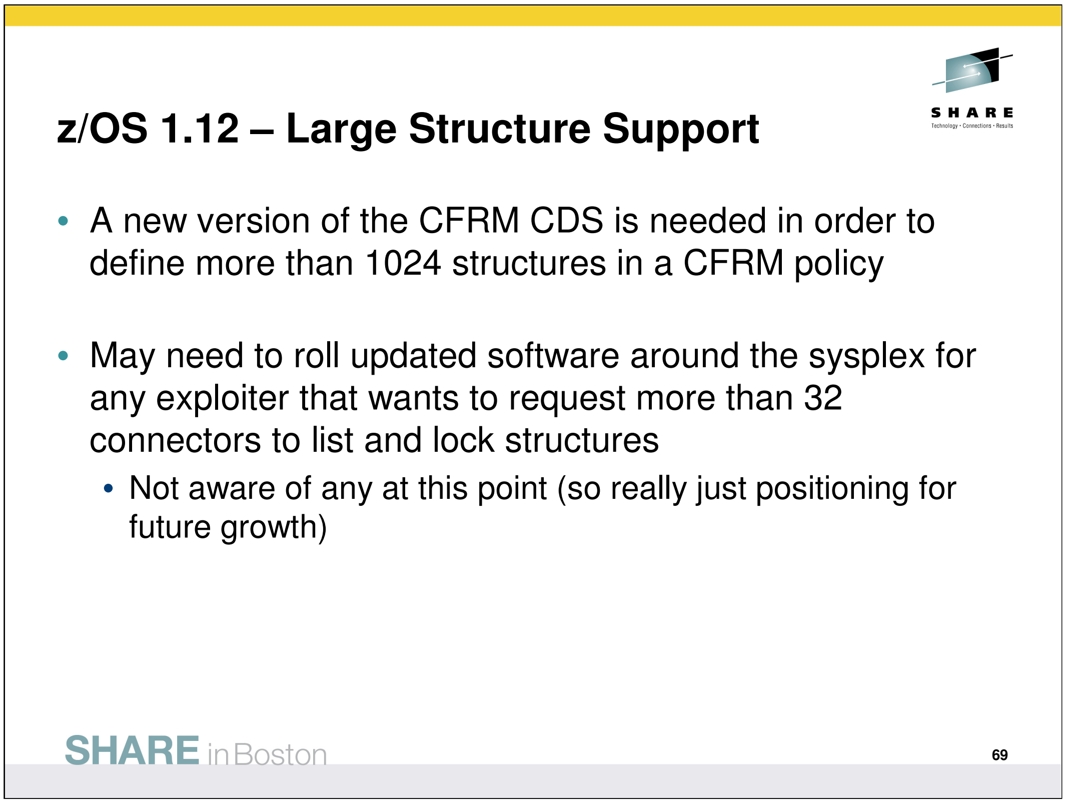
z/OS 1.12 – Large Structure Support

- Large CF Structures
  - Increased CF structure size supported by z/OS to 1TB
  - Usability enhancements for structure size specifications
    - CFRM policy sizes
    - Display output
- More CF Structures can be defined
  - New z/OS limit is 2048 (CF limit is 2047)
- More Structure Connectors (CF limit is 255)
  - Lock structure – new limit is 247
  - Serialized list – new limit is 127
  - Unserialized list – new limit is 255

z/OS V1.12 on z/Enterprise 196 servers with Coupling Facility Control Code (CFCC) Level 17 supports up to 2047 structures per Coupling Facility (CF) image, up from the prior limit of 1023. This allows you to define a larger number of data sharing groups, which can help when a large number of structures must be defined, such as to support SAP configurations or to enable large Parallel Sysplex configurations to be merged. This function requires the PTF for APAR OA32807; PTFS are also available for z/OS v1.10 and z/OS V1.11. CFRM supports up to 2048 structures, whereas CFLEVEL 17 supports at most 2047. So in actual use, at most 2047 structures could be allocated at one time in any one CF.

z/OS V1.12 on z/Enterprise 196 servers with CFCC Level 17 also supports more connectors to list and lock structures. XES and CFCC already support 255 connectors to cache structures. With this new support XES also supports up to 247 connectors to a lock structure, 127 connectors to a serialized list structure, and 255 connectors to an unserialized list structure. This support requires the PTF for APAR OA32807; PTFs are also available for z/OS V1.10 and z/OS V1.11. CF Level 17 supports 255 connectors to all types of structures. The nature of the z/OS exploitation of those structures requires that the software impose smaller limits than what the CF supports. For lock structures, 8 bits of the 32 byte lock table entry is consumed for “global ownership”, leaving only 247 bits to represent shared interest. For a serialized list, one bit of the one byte lock table entry is used for lock management, so x’7F’ = 127 is the largest number of connectors that can be represented in the remaining bits of the byte.

z/OS V1.12 supports larger Coupling Facility (CF) structures. The maximum size you can specify for a CF structure is increased from slightly below 100 GB (99,999,999 KB) to 1 TB. The CFRM policy utility (IXCMIAPU) is updated to allow you to specify structure sizes in units of KB, MB, GB, and TB. These changes improve both Parallel Sysplex CF structure scalability and ease of use.



z/OS 1.12 – Large Structure Support

- A new version of the CFRM CDS is needed in order to define more than 1024 structures in a CFRM policy
- May need to roll updated software around the sysplex for any exploiter that wants to request more than 32 connectors to list and lock structures
  - Not aware of any at this point (so really just positioning for future growth)

The Couple Data Set (CDS) containing Coupling Facility Resource Manager (CFRM) policies for the sysplex needs to be reversioned in order to allow CFRM policies that define more than 1024 coupling facility (CF) structures.

Only systems running z/OS V1R10 (or later) with the functionality of APAR OA32807 installed can use a CFRM CDS that is formatted to support more than 1024 structure definitions. Once such a CDS is brought into use, down level systems that need to exploit CFRM will not be able to join the sysplex. Since a sysplex-wide outage is required to fall back to a CFRM CDS that does not support more than 1024 structures, it is advisable to delay using this support until you are satisfied that no system in the sysplex will need to run (fall back to) down level code. Versioning the CFRM CDS to support new functions and protocols is the same technique used in the past for message-based protocols, system-managed rebuild, and again for system-managed duplexing. The new version allows CFRM to ensure that all systems can deal with the greater number of structure definitions.

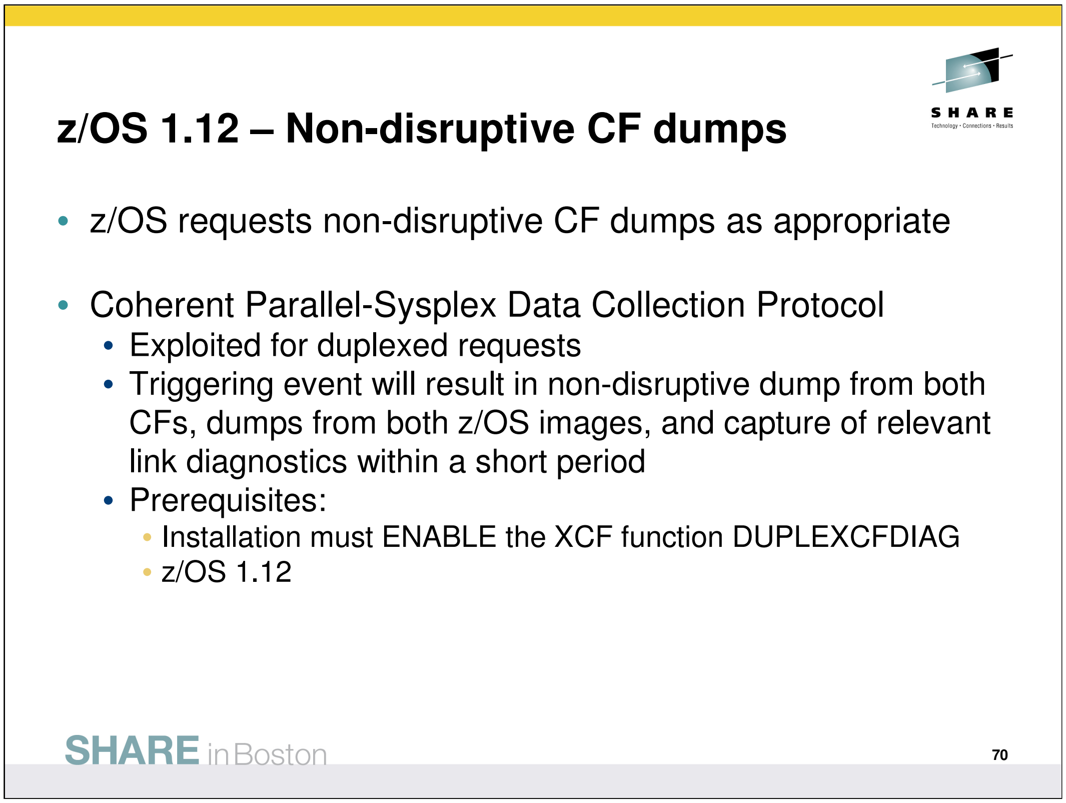
Use the Couple Data Set (CDS) format utility IXCL1DSU to format a CFRM CDS that supports more than 1024 structures by coding the NUMBER keyword with an appropriate value: (see “Setting Up A Sysplex” for complete details):

ITEM NAME(STR) NUMBER(nnnn)

Finally bring the new CFRM CDS into use. For an existing sysplex that is already using CFRM (most likely case), use the SETXCF COUPLE,TYPE=CFRM,ACOUPLE command to define the new CFRM CDS as an alternate, then use the SETXCF COUPLE,TYPE=CFRM,PSWITCH command to make it the primary CFRM CDS. Don’t forget to fix the single point of failure by issuing another SETXCF COUPLE,TYPE=CFRM,ACOUPLE command to define another CFRM CDS that supports at least as many structure definitions as an alternate for redundancy. For an existing sysplex that is not using CFRM (not likely), use the SETXCF COUPLE,TYPE=CFRM,PCOUPLE command to define an appropriate CFRM CDS as the primary. If IPLing the first system into the sysplex, define the CFRM CDS (primary and alternate) in the COUPLExx parmlib member.

The Administrative Utility (IXCMIAPU) can then be used to define CFRM policies with as many structure definitions as the CDS supports.

Enabling support for more than 32 connectors to lock and list structures requires software upgrades. The new version of the CFRM CDS is not needed for this aspect of z/OS 1.12 support. All systems in the sysplex that need to connect to a structure that can have more than 32 connectors will need to have z/OS V1R10 (or later) with the PTFs for APAR OA32807 installed. In addition, the exploiters are required to code a new MAXCONN keyword on the invocation of the IXLCONN macro that is used to connect to the structure.

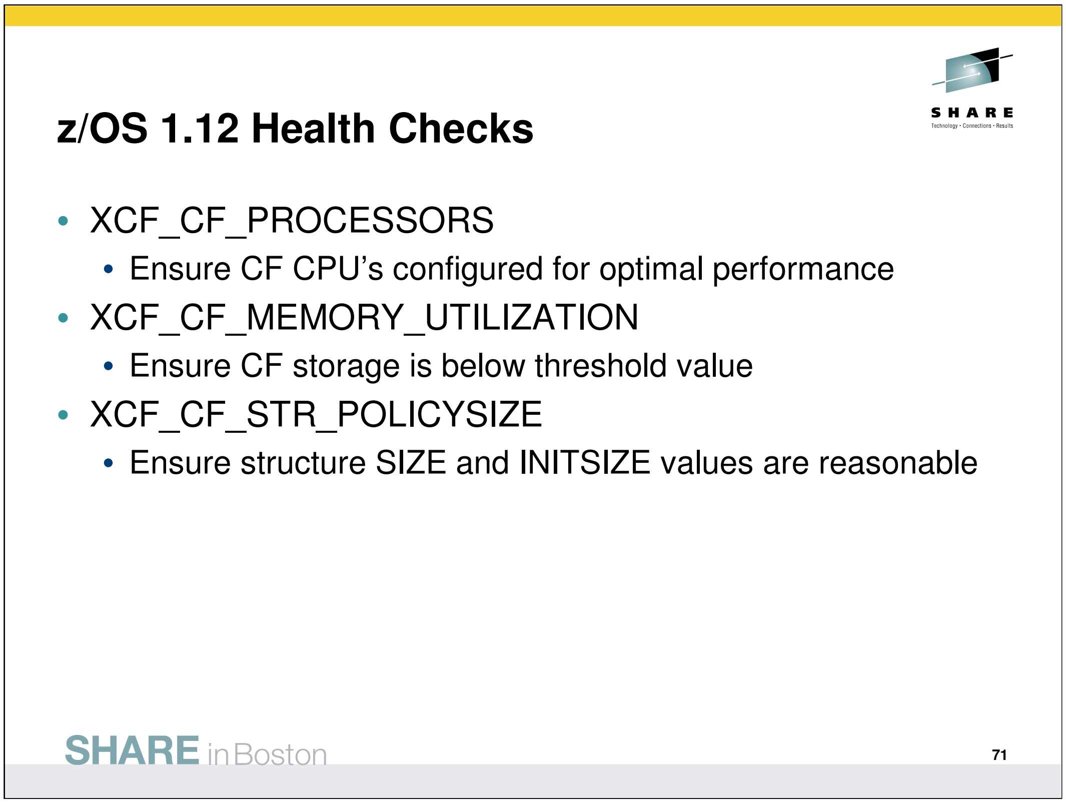


z/OS 1.12 – Non-disruptive CF dumps

- z/OS requests non-disruptive CF dumps as appropriate
- Coherent Parallel-Sysplex Data Collection Protocol
  - Exploited for duplexed requests
  - Triggering event will result in non-disruptive dump from both CFs, dumps from both z/OS images, and capture of relevant link diagnostics within a short period
  - Prerequisites:
    - Installation must ENABLE the XCF function DUPLEXCFDIAG
    - z/OS 1.12

The DUPLEXCFDIAG optional function is defined to allow an installation to control the use of the “Coherent Parallel-Sysplex Data Collection Protocol”, aka the “link diagnostics” protocol. By default, the protocol is disabled, and it is expected that an installation would only enable it if it experiences duplexing issues. If the DUPLEXCFDIAG function is disabled, z/OS will not request use of the protocol when issuing duplexed CF requests. DUPLEXCFDIAG is enabled and disabled using the same parmlib (COUPLExx) and command (SETXCF FUNCTIONS) interfaces as all other optional XES / XCF functions.

Even if the function is ENABLED, the protocol is requested only if both CFs are at or above CFLEVEL 17, since there’s no point collecting link data if we aren’t going to get the whole picture. The protocol relies on the CF to capture non-disruptive dumps and to propagate the request for data to the peer CF and connected z/OS images.



z/OS 1.12 Health Checks

- XCF_CF_PROCESSORS
  - Ensure CF CPU's configured for optimal performance
- XCF_CF_MEMORY_UTILIZATION
  - Ensure CF storage is below threshold value
- XCF_CF_STR_POLICYSIZE
  - Ensure structure SIZE and INITSIZE values are reasonable

New health checks for the Parallel Sysplex components, XCF and XES, are included in z/OS 1.12. These checks can help you correct and prevent common sysplex management problems.

XCF_CF_PROCESSORS

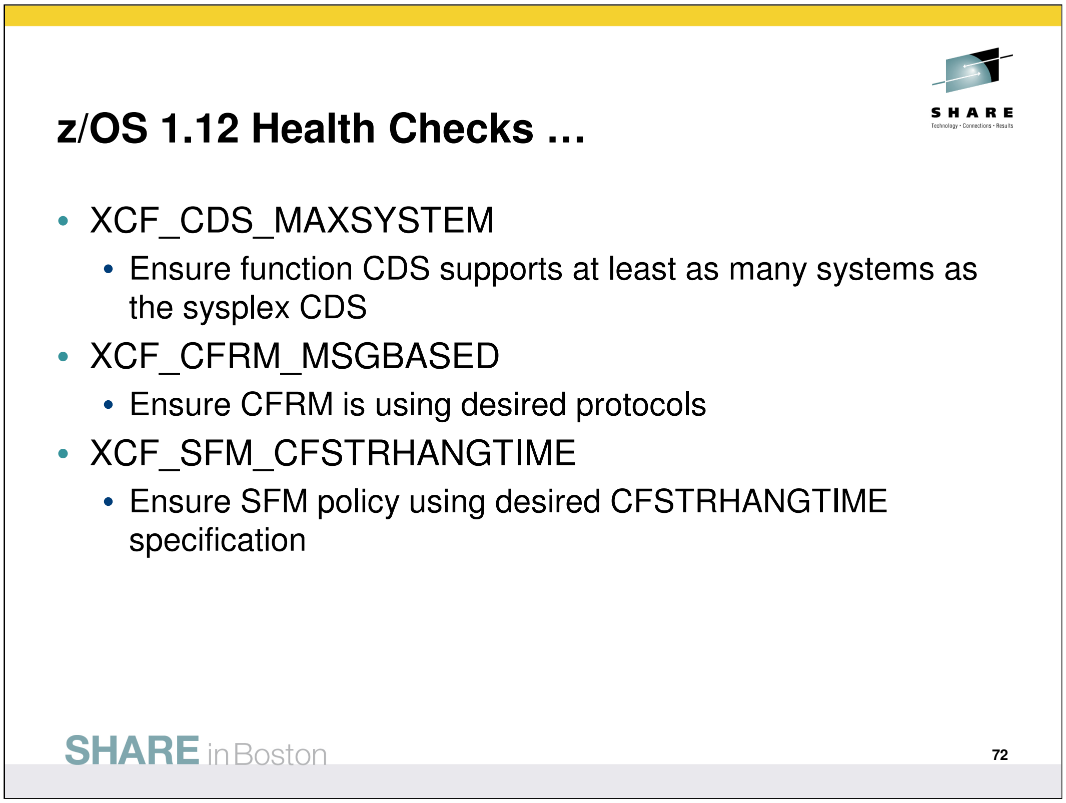
Raises an exception if a CF is not configured with all CPs dedicated. The IBM supplied check raises an exception if any CF in use by the sysplex is configured with one or more shared CP's. To obtain maximum CF performance and throughput, a coupling facility should be configured completely with dedicated processors instead of shared processors. The installation can specify a check parameter to exclude designated CF's from being considered by the check. For example, one might elect to exclude a CF that is using shared CP's because it is part of a test configuration.

XCF_CF_MEMORY_UTILIZATION

Raises an exception if the CF storage usage exceeds the indicated threshold. The IBM supplied check raises an exception if the storage utilization exceeds 60%. The percentage of memory utilization in a coupling facility should not approach an amount so high as to prevent the allocation of new structures or prevent the expansion of existing structures. The installation can specify a check parameter to designate some other threshold.

XCF_CF_STR_POLICYSIZE

Raises an exception if the CFRM policy definition for a structure has size specifications (SIZE and INITSIZE) that can either (a) cause CF storage to be wasted, or (b) make the structure unusable, or (c) prevent the structure from being allocated. Specifying different INITSIZE and SIZE values provides flexibility to dynamically expand the size of a structure for workload changes, but too large a difference between INITSIZE and SIZE may waste coupling facility space or prevent structure allocation.



z/OS 1.12 Health Checks …

- XCF_CDS_MAXSYSTEM
  - Ensure function CDS supports at least as many systems as the sysplex CDS
- XCF_CFRM_MSGBASED
  - Ensure CFRM is using desired protocols
- XCF_SFM_CFSTRHANGTIME
  - Ensure SFM policy using desired CFSTRHANGTIME specification

XCF_CDS_MAXSYSTEM

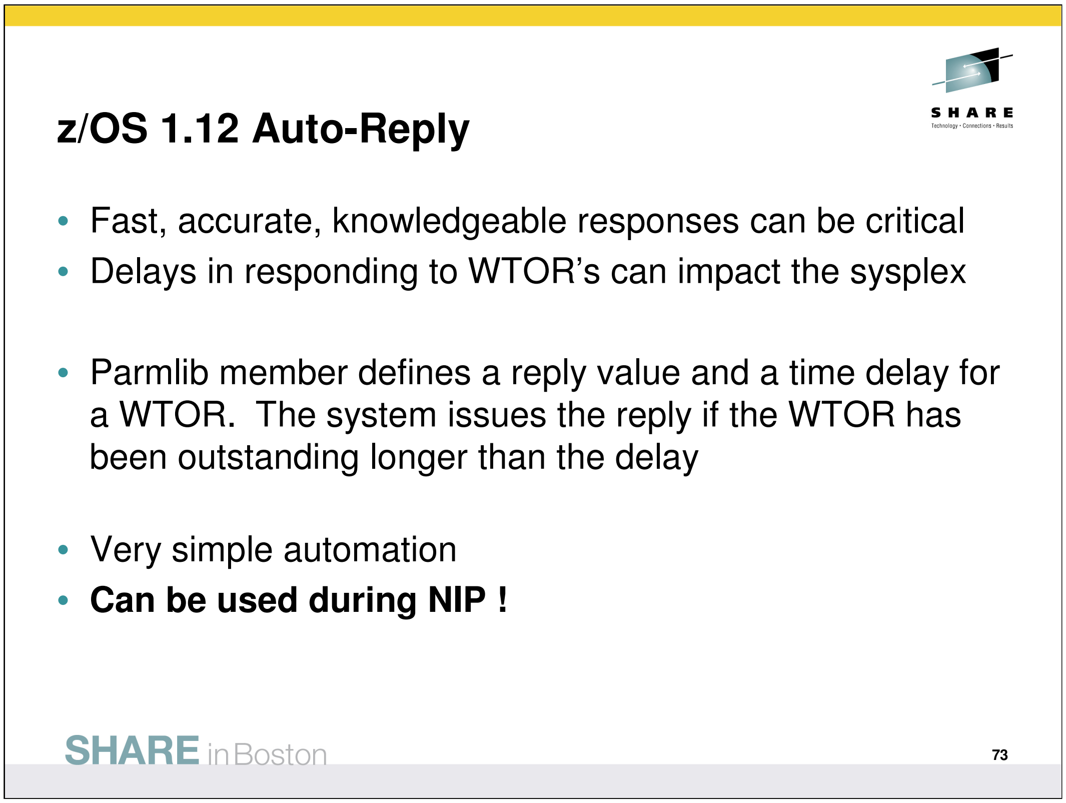
Raises an exception when a function couple data set (CDS) is formatted with a MAXSYSTEM value that is less than the MAXSYSTEM value associated with the primary sysplex CDS. A “function CDS” is any CDS other than the sysplex CDS. For example, a function CDS might contain CFRM policies or SFM policies. If a function CDS does not support at least as many systems as the sysplex CDS, a new system might not be fully functional when it joins the sysplex (if it can join at all).

XCF_CFRM_MSGBASED

Raises an exception if CFRM is not configured to exploit the desired structure event management protocols. The IBM supplied check raises an exception if CFRM is not configured to exploit “message based” protocols. The CFRM “message based” protocols were introduced in z/OS V1R8. Use of this protocol reduces contention on the CFRM policy CDS, which can significantly reduce the recovery time for events that trigger CFRM activity against lots of structures (such as loss of a CF or a system). The installation can specify a check parameter to indicate which CFRM protocol is desired, “message based” or “policy based”.

XCF_SFM_CFSTRHANGTIME

Raises an exception if the active SFM policy is not consistent with the indicated CFSTRHANGTIME specification designated by the check. The IBM supplied check will raise an exception if the SFM policy specifies (or defaults to) CFSTRHANGTIME(NO), or if the SFM policy specifies a CFSTRHANGTIME value greater than 300 seconds. The installation can specify a check parameter to indicate the CFSTRHANGTIME value that the installation wants to use. The check will then raise an exception if the SFM policy is not in accordance with the check parameter.



z/OS 1.12 Auto-Reply

- Fast, accurate, knowledgeable responses can be critical
- Delays in responding to WTOR's can impact the sysplex

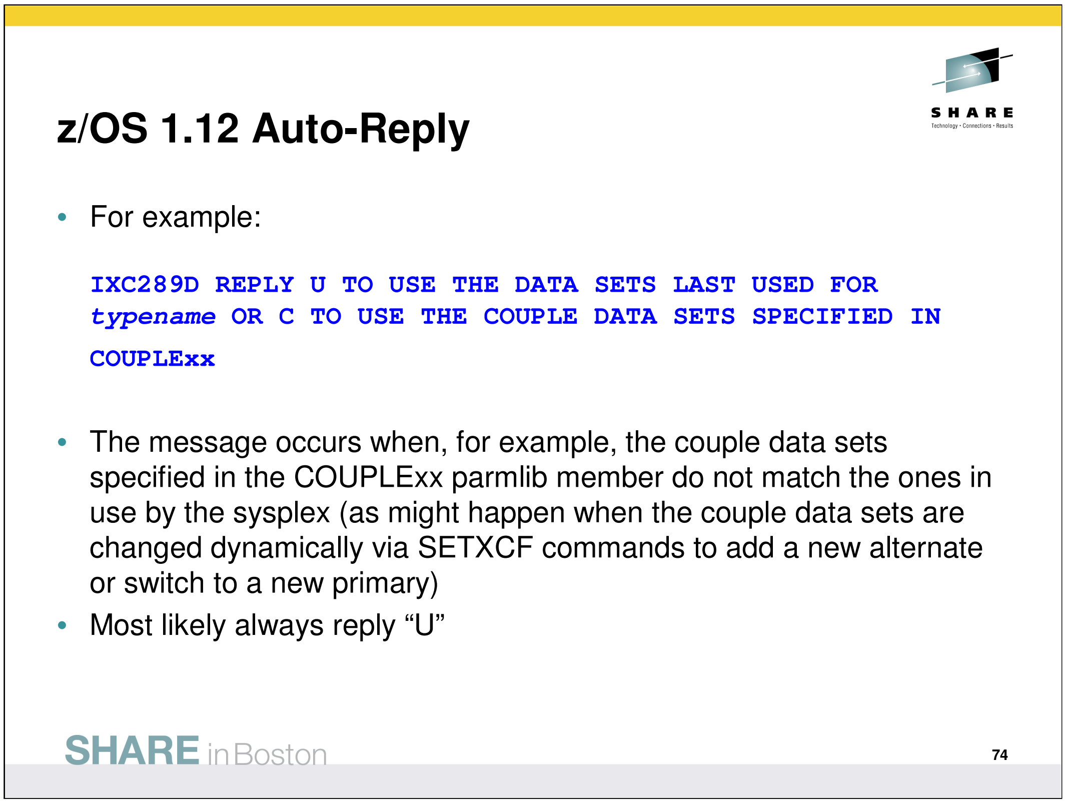
- Parmlib member defines a reply value and a time delay for a WTOR. The system issues the reply if the WTOR has been outstanding longer than the delay

- Very simple automation
- **Can be used during NIP !**

In z/OS V1.12, a new Timed Auto Reply function enables the system to respond automatically to write to operator with reply (WTOR) messages. This new function is designed to help provide a timely response to WTORs and help prevent delayed responses from causing system problems.

The Timed Auto Reply Function allows you to specify message IDs, timeout values, and default responses in an auto-reply policy, and to be able to change, activate, and deactivate autoreply with operator commands. Also, when enabled, it starts very early in the IPL process, before conventional message-based automation is available, and continues unless deactivated. You can also replace or modify an IBM-supplied auto-reply policy in a new AUTOR00 parmlib member. This new function is expected to help provide a timely response to WTORs and help prevent delayed responses from causing system problems.

A new Timed Auto Reply Function provides an additional way for the system to respond automatically to write to operator with reply (WTOR) messages. This new function allows you to specify message IDs, timeout values, and default responses in an auto-reply policy, and to be able to change, activate, and deactivate autoreply with operator commands. Also, when enabled, it starts very early in the IPL process, before conventional message-based automation is available, and continues unless deactivated. You can also replace or modify an IBM-supplied auto-reply policy in a new AUTOR00 parmlib member. This new function is expected to help provide a timely response to WTORs and help prevent delayed responses from causing system problems.



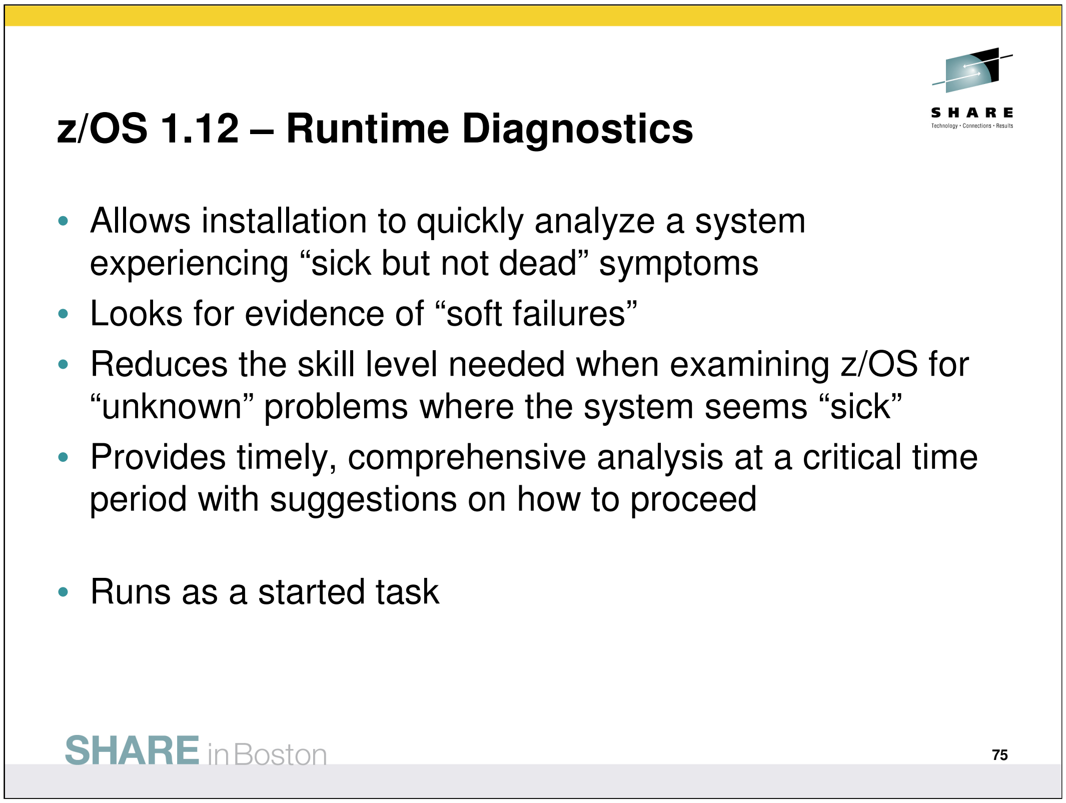
z/OS 1.12 Auto-Reply

- For example:

```
IXC289D REPLY U TO USE THE DATA SETS LAST USED FOR
typename OR C TO USE THE COUPLE DATA SETS SPECIFIED IN
COUPLExx
```

- The message occurs when, for example, the couple data sets specified in the COUPLExx parmlib member do not match the ones in use by the sysplex (as might happen when the couple data sets are changed dynamically via SETXCF commands to add a new alternate or switch to a new primary)
- Most likely always reply “U”

From a sysplex perspective, Auto-Reply will likely prove useful for messages to which the operator must reply while the system is IPLing. May prove quite useful for disaster recovery testing.

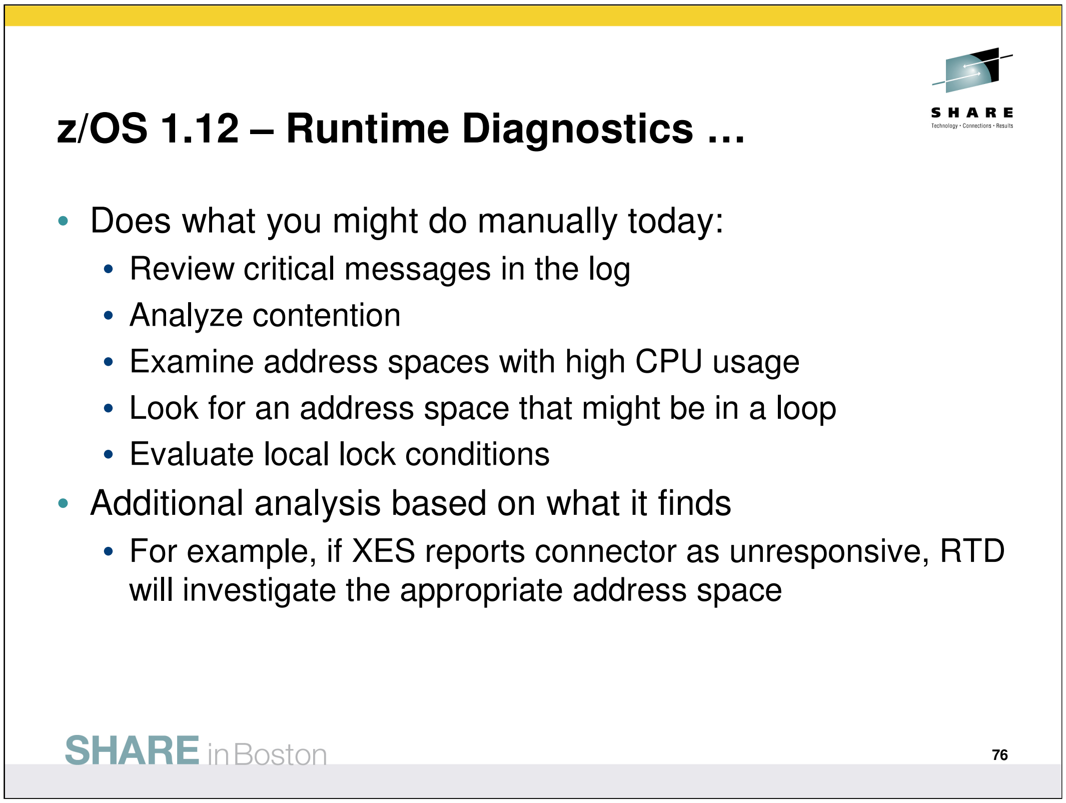


z/OS 1.12 – Runtime Diagnostics

- Allows installation to quickly analyze a system experiencing “sick but not dead” symptoms
- Looks for evidence of “soft failures”
- Reduces the skill level needed when examining z/OS for “unknown” problems where the system seems “sick”
- Provides timely, comprehensive analysis at a critical time period with suggestions on how to proceed
- Runs as a started task

In z/OS V1.12, a new capability, z/OS Runtime Diagnostics, is designed to help when the need for quick decision-making is required. With Runtime Diagnostics, your z/OS system is designed to analyze key system indicators of a running system. The goal is to help you identify the root of problems that cause system degradation on systems that are still responsive to operator commands. Runtime Diagnostics is anticipated to run quickly to return results fast enough to aid you in making decisions about alternative corrective actions and facilitate high levels of system and application availability.

Run Time Diagnostics runs using the START operator command. It identifies critical messages, searches for serialization contention, finds address spaces consuming a high amount of processor time, and analyzes patterns common to looping address spaces.



z/OS 1.12 – Runtime Diagnostics …

- Does what you might do manually today:
  - Review critical messages in the log
  - Analyze contention
  - Examine address spaces with high CPU usage
  - Look for an address space that might be in a loop
  - Evaluate local lock conditions
- Additional analysis based on what it finds
  - For example, if XES reports connector as unresponsive, RTD will investigate the appropriate address space

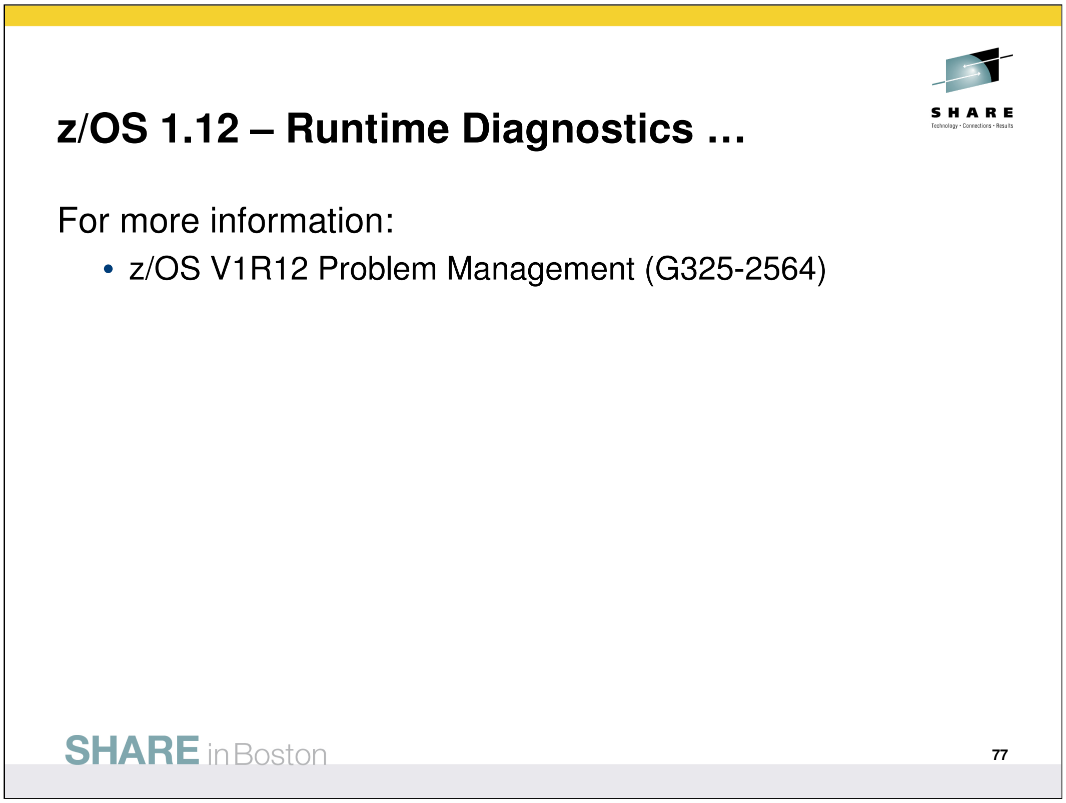
Critical Message Analysis: Reads through the last hour of OPERLOG looking for critical messages. If any are found, lists the critical message as an error event. For a subset of critical messages, performs additional analysis based on the message identifier and the content of the message.

Contention Analysis: Provides a point in time check of ENQ contention equivalent to issuing the D GRS,AN,WAITER command. Compares the list of job names that are waiters with the list of system address spaces that are started at IPL to determine if any system address spaces are waiters. If ENQ contention is found, issues an error event message.

CPU analysis: Provides a point in time check of any address space that is using more than 95% of the capacity of a single CPU, which might indicate the address space is in a loop.

Loop Detection: Looks through all tasks in all address spaces to determine if a task appears to be looping. Examines various system information for indicators of consistent repetitive activity that typically appears when a task is in a loop. When both a HIGHCPU event and a LOOP event list the job name, there is a high probability that a task in the job is in a loop.

Local Lock Contention: Provides a point in time check of local lock suspension for any address space. Calculates the amount of time an address space is suspended waiting for the local lock. If an address is suspended more than 50% of the time waiting for a local lock, issues an event message.

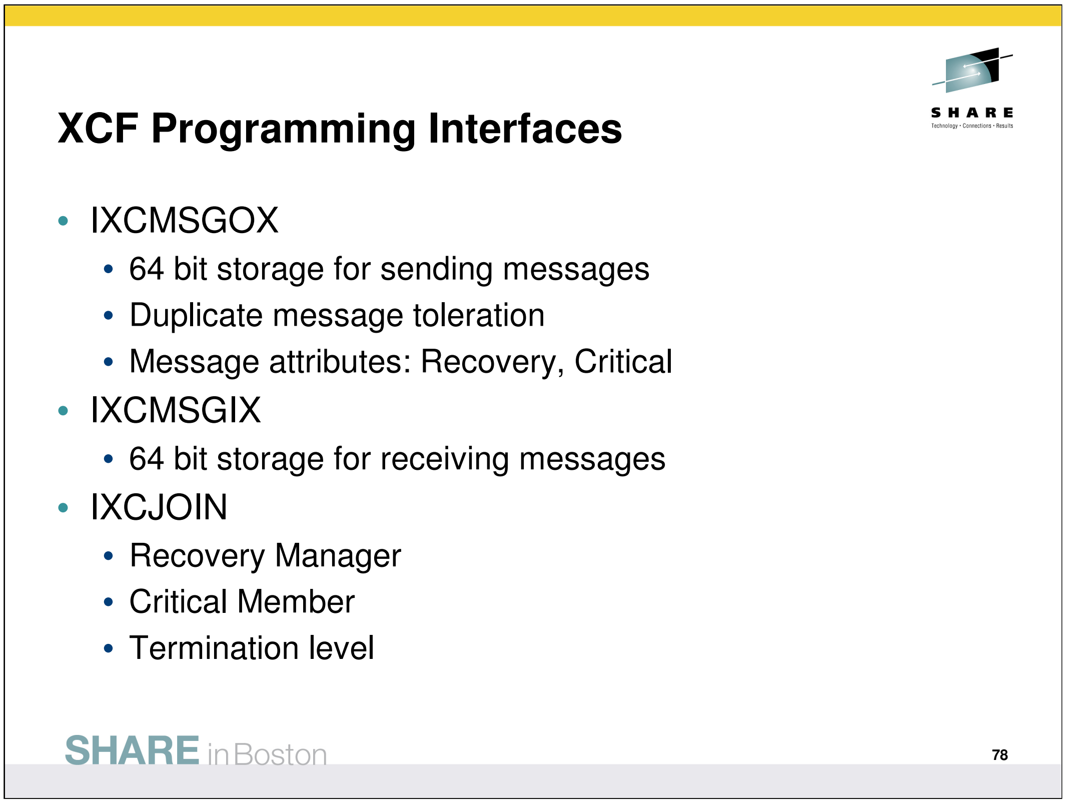


z/OS 1.12 – Runtime Diagnostics …

For more information:

- z/OS V1R12 Problem Management (G325-2564)

Runtime Diagnostics may prove quite useful when XCF surfaces various hang conditions or situations for which sympathy sickness might arise. That is, those situations that are to be addressed automatically via SFM parameters such as MEMSTALLTIME and CFSTRHANGTIME.



XCF Programming Interfaces

- IXCMSGOX
  - 64 bit storage for sending messages
  - Duplicate message toleration
  - Message attributes: Recovery, Critical
- IXCMSGIX
  - 64 bit storage for receiving messages
- IXCJOIN
  - Recovery Manager
  - Critical Member
  - Termination level

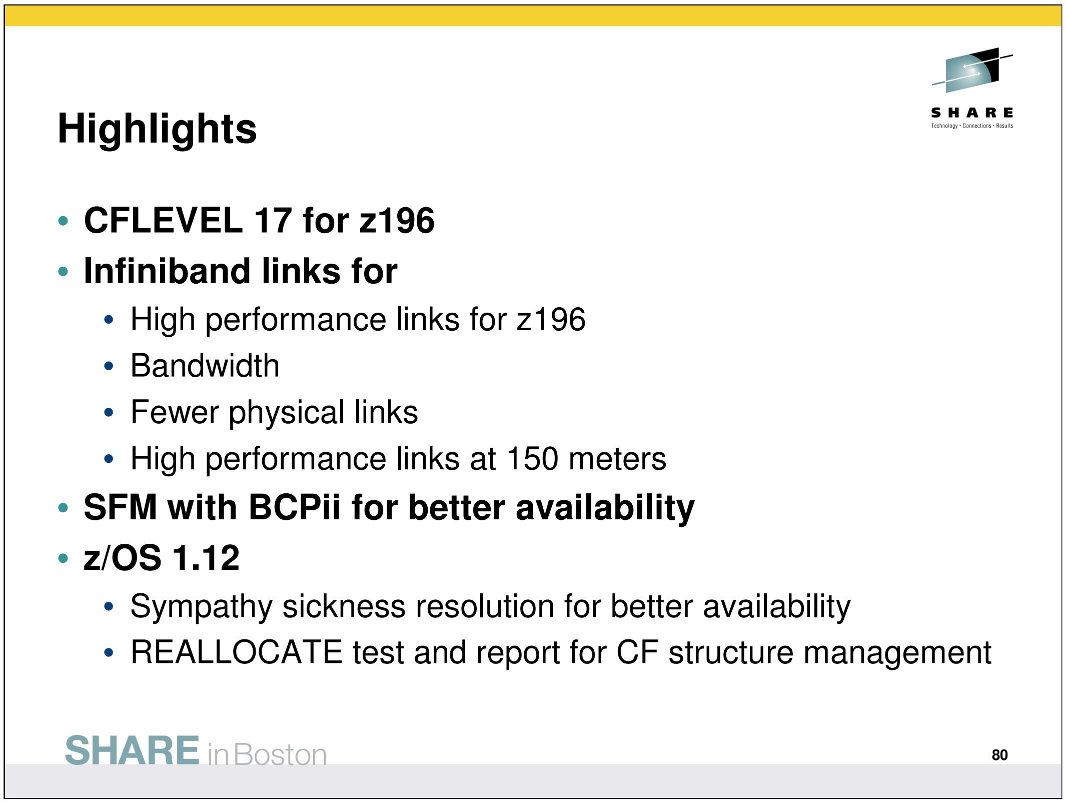
Two new services based on existing XCF signaling services are introduced to support the use of 64-bit addressable virtual storage message buffers and associated input and output parameters. The two new services, IXCMSGOX and IXCMSGIX, are the 64-bit counterparts of the existing IXCMSGO and IXCMSGI services, which are used by XCF group members to send and receive messages. These new services make it easier for exploiters to achieve virtual storage constraint relief by removing the need to copy message buffers and associated storage structures from 64-bit addressable virtual storage to 31-bit storage and back.

IXCMSGOX allows the sender to indicate that the target(s) can tolerate receiving duplicate copies of the message, which allows XCF to resend the message sooner if there should be a signal path failure while the message is being sent. Other new message attributes include “recovery” which is used to identify signals that are involved in recovery processes, and “critical” which indicates that the message is critical to the exploiter.

The IXCJOIN service, which is invoked to become a member of an XCF group, has some new keywords that enable the member to indicate that it is a “recovery manager” that performs a sysplex-wide recovery process, or that it is a “critical member” that is to be terminated by XCF if it appears to be unresponsive. The “termination level” allows the member to indicate the scope at which it wants to be terminated (task, address space, or system) when XCF decides to do so.

Agenda

- Hardware Updates
  - CFCC Level 17
  - CFCC Level 16
  - Parallel Sysplex InfiniBand Links
- z/OS Updates
  - Sysplex Failure Management
  - z/OS V1R12
- **Summary**



Highlights

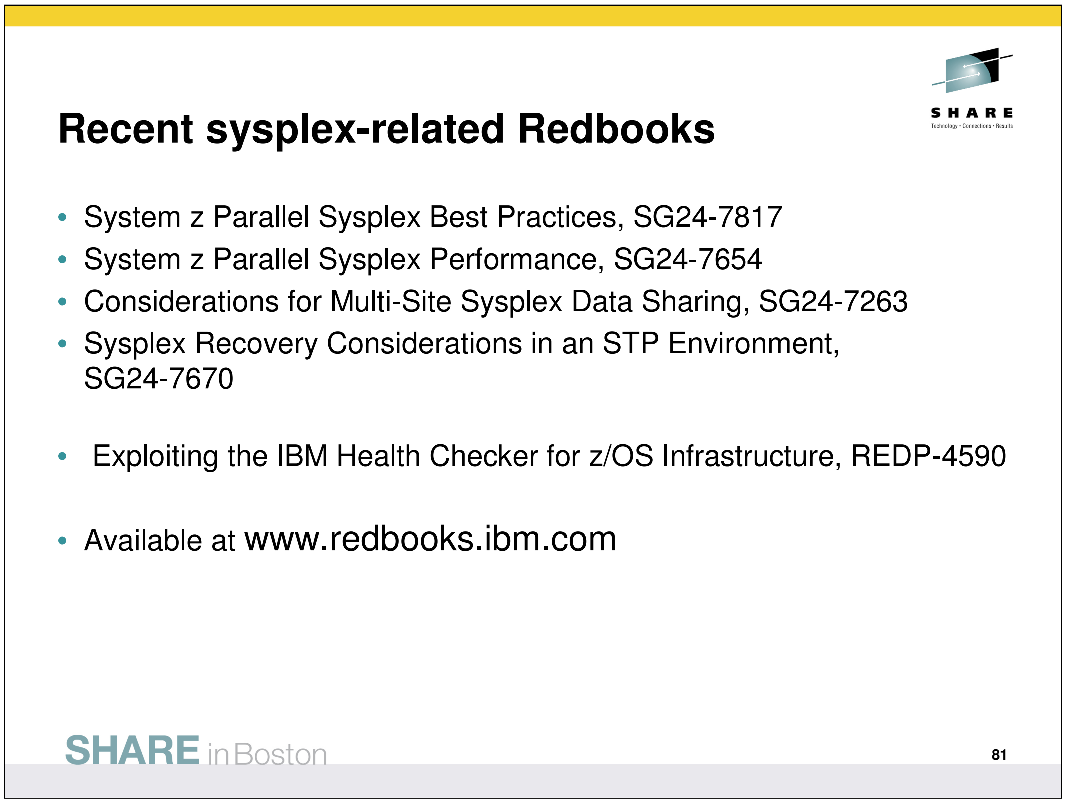
- **CFLEVEL 17 for z196**
- **Infiniband links for**
  - High performance links for z196
  - Bandwidth
  - Fewer physical links
  - High performance links at 150 meters
- **SFM with BCPii for better availability**
- **z/OS 1.12**
  - Sympathy sickness resolution for better availability
  - REALLOCATE test and report for CF structure management

Coupling Facility Control Code (CFCC) CFLEVEL 17 for the z196 supports up to 2047 structures and up to 255 connectors per any type of structure (though note that z/OS limits on number of connectors are lower for lock structures and serialized list structures)..

Infiniband links can be used for increased bandwidth, can help simplify sysplex configurations by reducing the number of links needed to connect CECs, and can provide high performance links at greater distances than do current links. They are also provide high performance links for z196 (ICB links not available for z196).

SFM with BCPii is a critical technology for improving sysplex availability as it allows XCF to know with certainty that an apparently unresponsive system is in fact not operational. This knowledge enables XCF to remove systems from the sysplex without operator intervention.

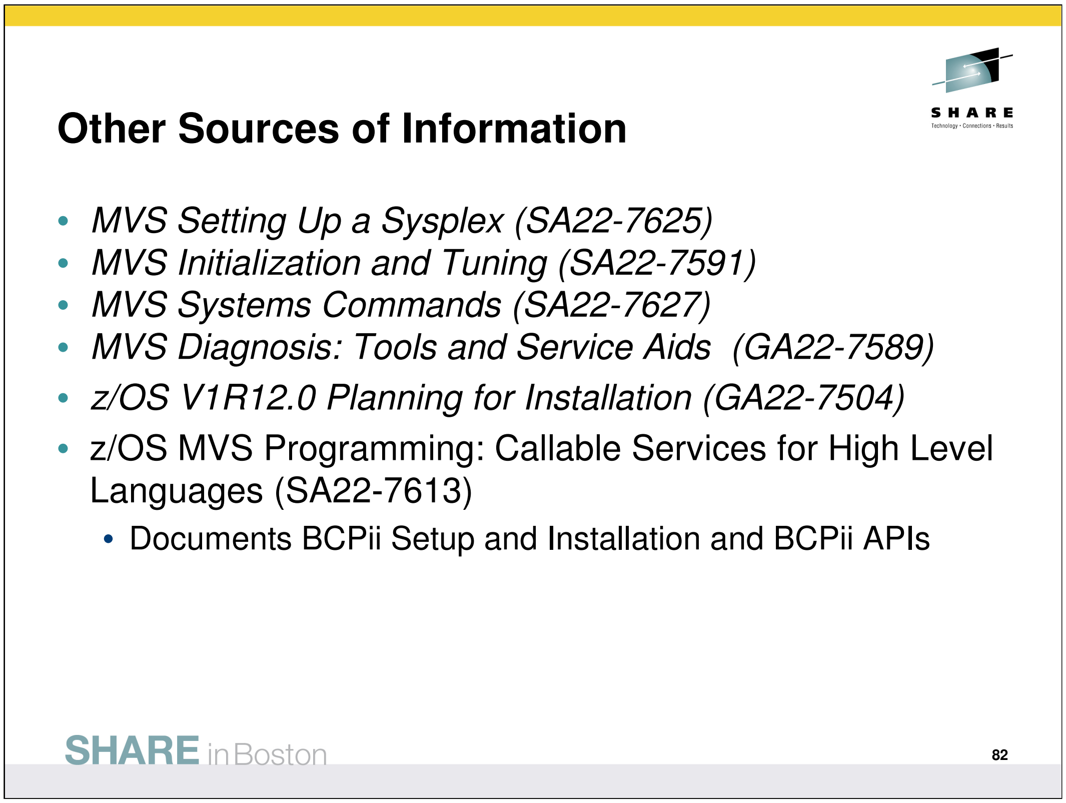
z/OS 1.12 extends Sysplex Failure Manager (SFM) support to provide automatic resolution of additional sympathy sickness conditions which would otherwise impact the sysplex. It also provides some enhancements related to the Coupling Facility Resource Manager (CFRM) REALLOCATE function that customers have requested, namely the ability to determine what the function might do and what it most recently did.



Recent sysplex-related Redbooks

- System z Parallel Sysplex Best Practices, SG24-7817
- System z Parallel Sysplex Performance, SG24-7654
- Considerations for Multi-Site Sysplex Data Sharing, SG24-7263
- Sysplex Recovery Considerations in an STP Environment, SG24-7670
- Exploiting the IBM Health Checker for z/OS Infrastructure, REDP-4590
- Available at www.redbooks.ibm.com

Redbooks often provide clear, concise, comprehensive material. The indicated books were recently published or revised.



Other Sources of Information

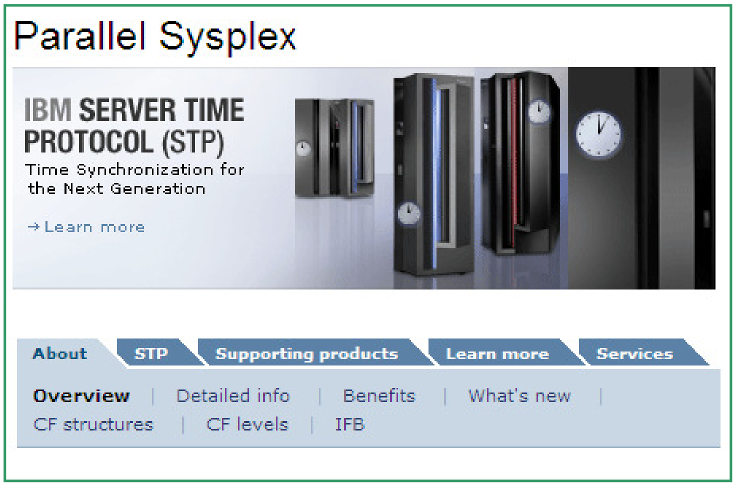
- *MVS Setting Up a Sysplex (SA22-7625)*
- *MVS Initialization and Tuning (SA22-7591)*
- *MVS Systems Commands (SA22-7627)*
- *MVS Diagnosis: Tools and Service Aids (GA22-7589)*
- *z/OS V1R12.0 Planning for Installation (GA22-7504)*
- z/OS MVS Programming: Callable Services for High Level Languages (SA22-7613)
  - Documents BCPii Setup and Installation and BCPii APIs

These publications are available at
http://www.ibm.com/systems/z/os/zos/bkserv/

Most of the z/OS V1R12 levels of the books are already up on the web.

Parallel Sysplex Web Site

- www.ibm.com/systems/z/pso

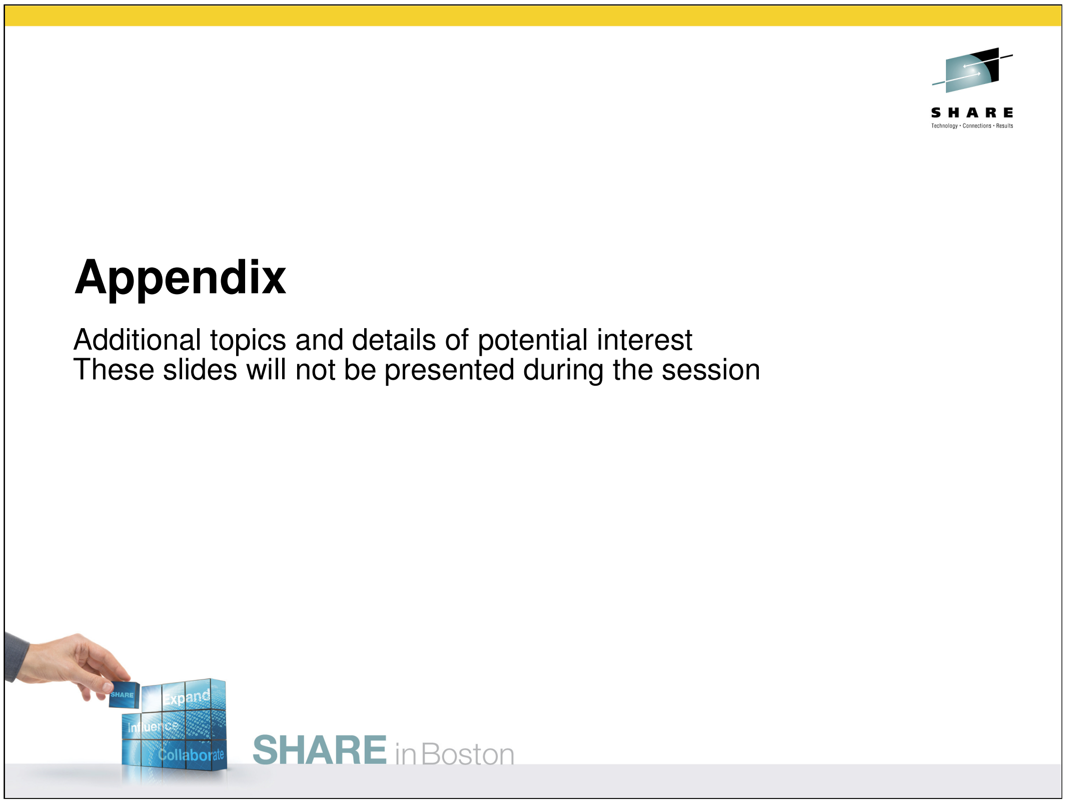

Parallel Sysplex
IBM SERVER TIME PROTOCOL (STP)
Time Synchronization for the Next Generation
→ Learn more
About
STP
Supporting products
Learn more
Services
Overview | Detailed info | Benefits | What's new |
CF structures | CF levels | IFB

The parallel sysplex web site is a good starting point for sysplex information. Under the “Learn More” tab one can find white papers and other documentation that is helpful with respect sysplex configuration and management.

Questions?

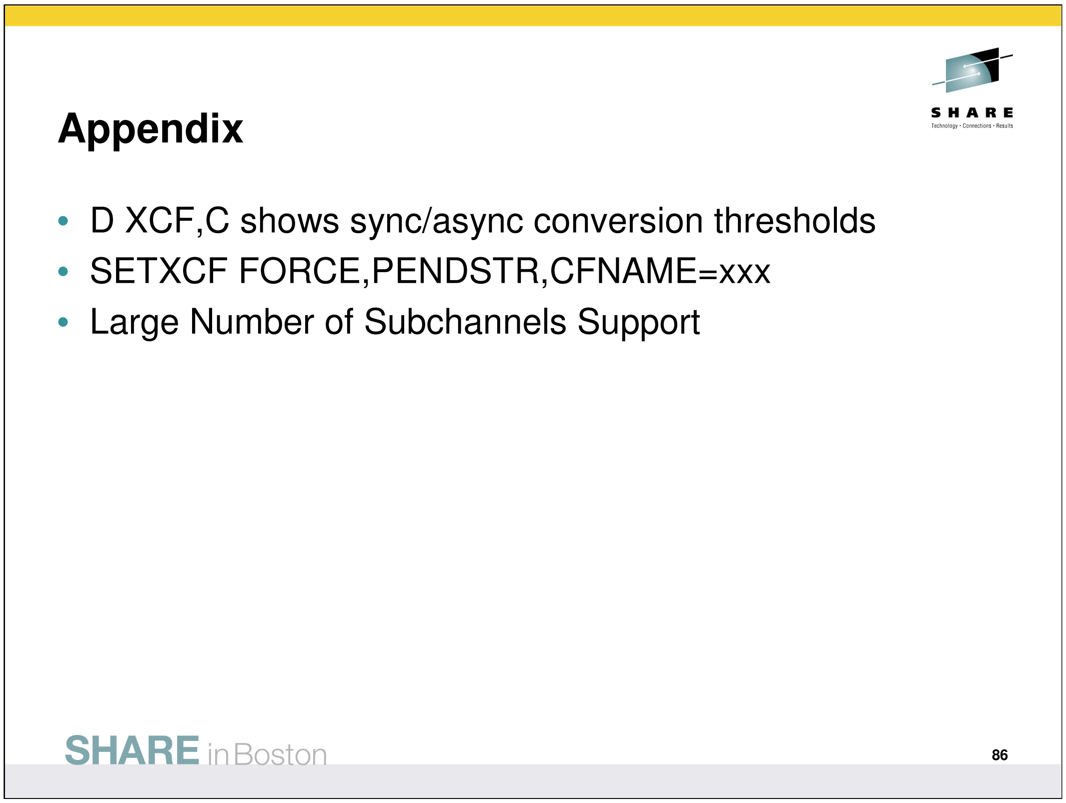
- Questions?

SHARE in Boston


SHARE
Technology • Connections • Results
SHARE
Expand
Influence
Collaborate
SHARE in Boston

Appendix

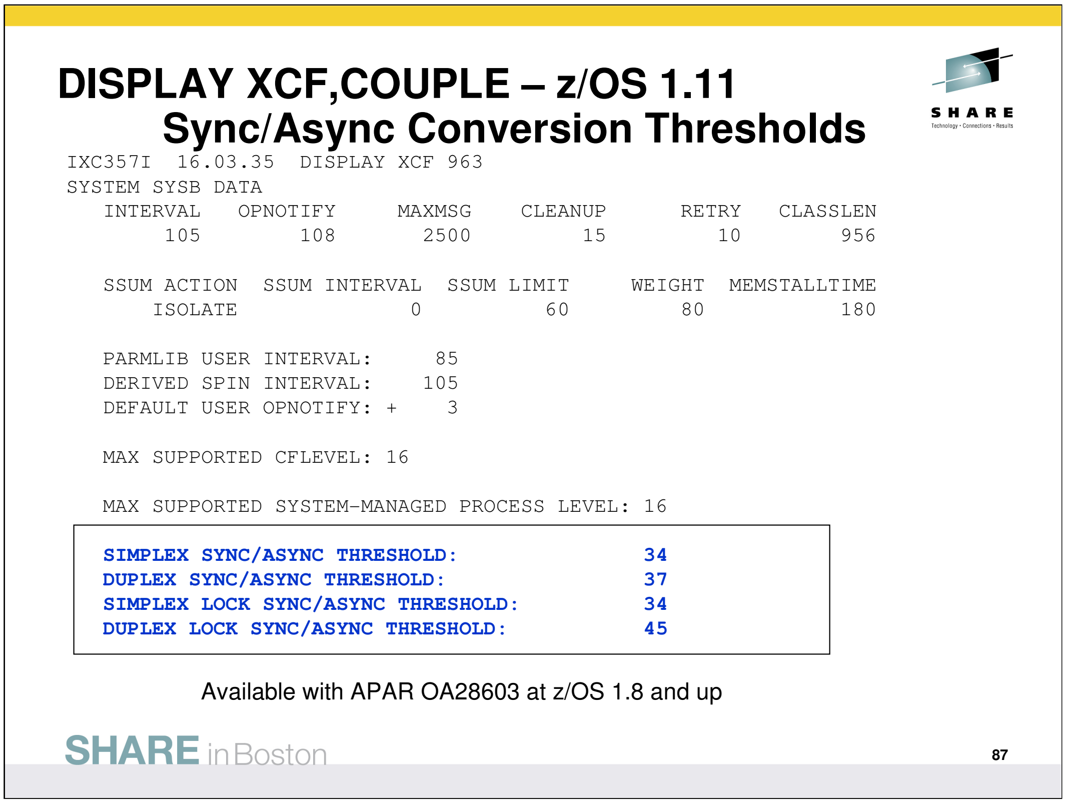
Additional topics and details of potential interest
These slides will not be presented during the session



Appendix

- D XCF,C shows sync/async conversion thresholds
- SETXCF FORCE,PENDSTR,CFNAME=xxx
- Large Number of Subchannels Support

Some sysplex topics of potential interest.

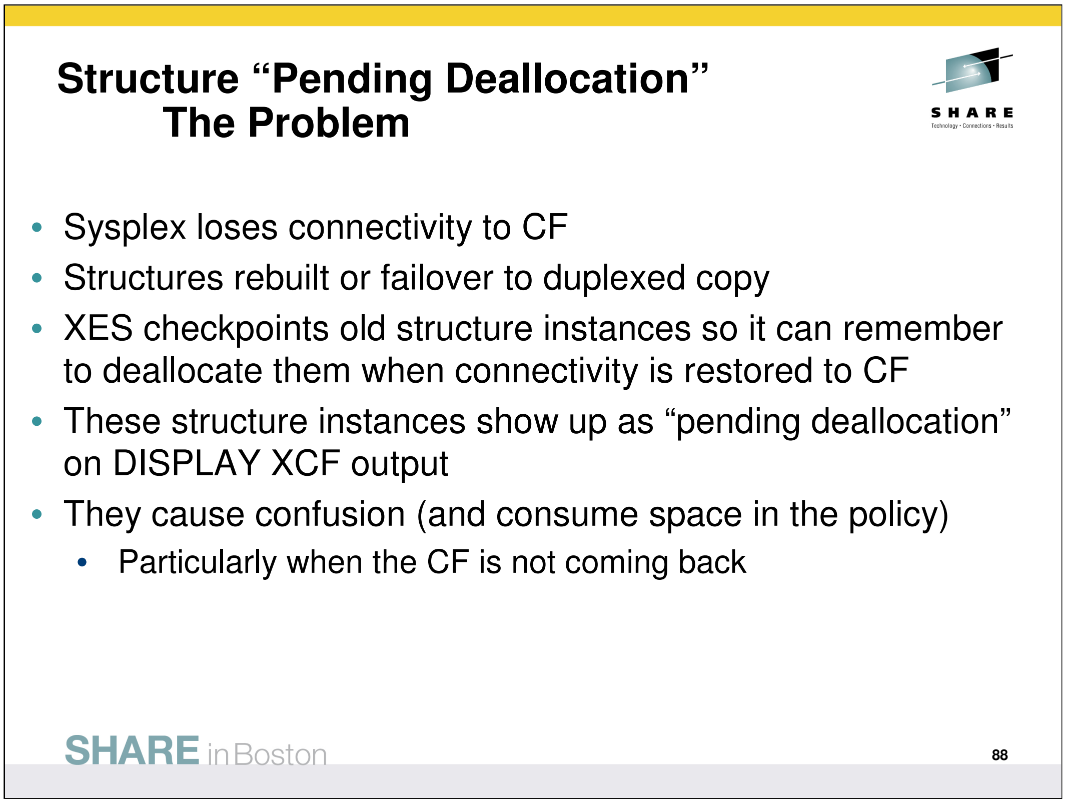


DISPLAY XCF,COUPLE – z/OS 1.11 Sync/Async Conversion Thresholds

```
IXC357I  16.03.35  DISPLAY XCF 963
SYSTEM SYSB DATA
   INTERVAL    OPNOTIFY     MAXMSG     CLEANUP      RETRY    CLASSLEN
        105         108       2500          15         10         956

   SSUM ACTION  SSUM INTERVAL  SSUM LIMIT     WEIGHT  MEMSTALLTIME
       ISOLATE                0          60         80            180

   PARMLIB USER INTERVAL:     85
   DERIVED SPIN INTERVAL:    105
   DEFAULT USER OPNOTIFY: +    3

   MAX SUPPORTED CFLEVEL: 16

   MAX SUPPORTED SYSTEM-MANAGED PROCESS LEVEL: 16

   SIMPLEX SYNC/ASYNC THRESHOLD:                     34
   DUPLEX SYNC/ASYNC THRESHOLD:                      37
   SIMPLEX LOCK SYNC/ASYNC THRESHOLD:                34
   DUPLEX LOCK SYNC/ASYNC THRESHOLD:                 45
```

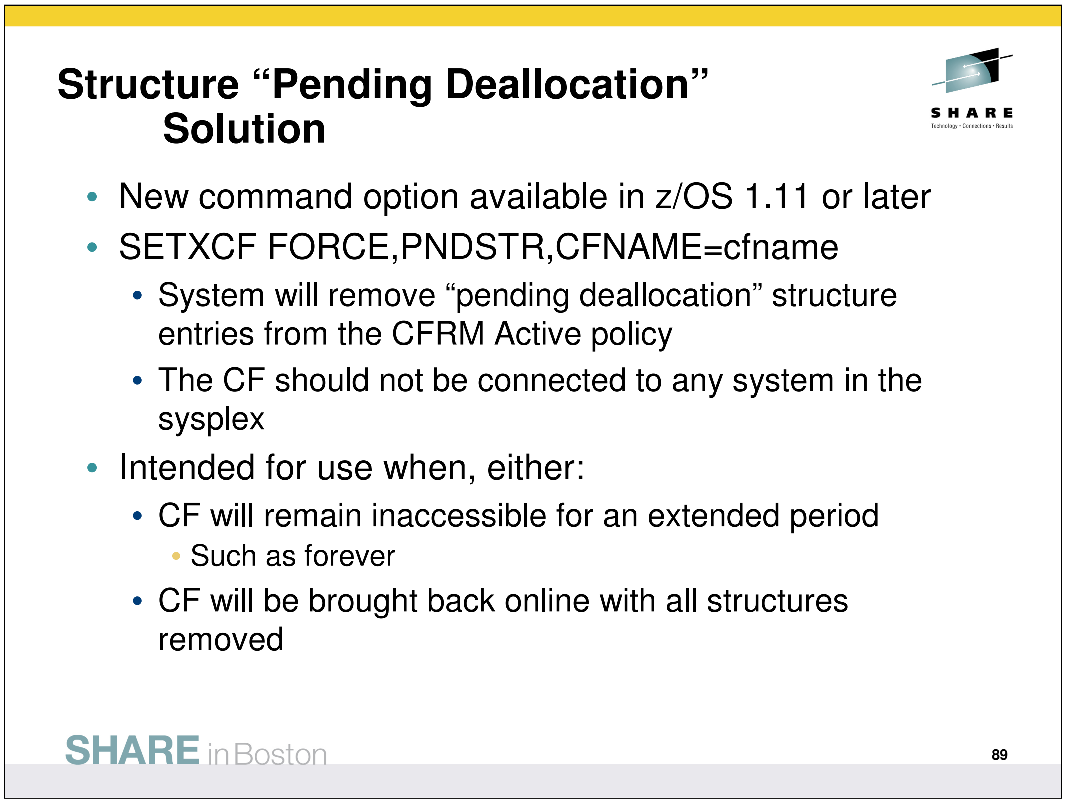
Available with APAR OA28603 at z/OS 1.8 and up

APAR OA28603 provides this support. The APAR ostensibly was shipped to address an issue wherein excessive sync-to-async conversion for coupling facility requests over short-distance ISC-3 coupling links can result in elapsed time performance problems for some workloads, and must be avoided. A side effect of the implementation is these new lines on the display output.



Structure “Pending Deallocation” The Problem

- Sysplex loses connectivity to CF
- Structures rebuilt or failover to duplexed copy
- XES checkpoints old structure instances so it can remember to deallocate them when connectivity is restored to CF
- These structure instances show up as “pending deallocation” on DISPLAY XCF output
- They cause confusion (and consume space in the policy)
  - Particularly when the CF is not coming back



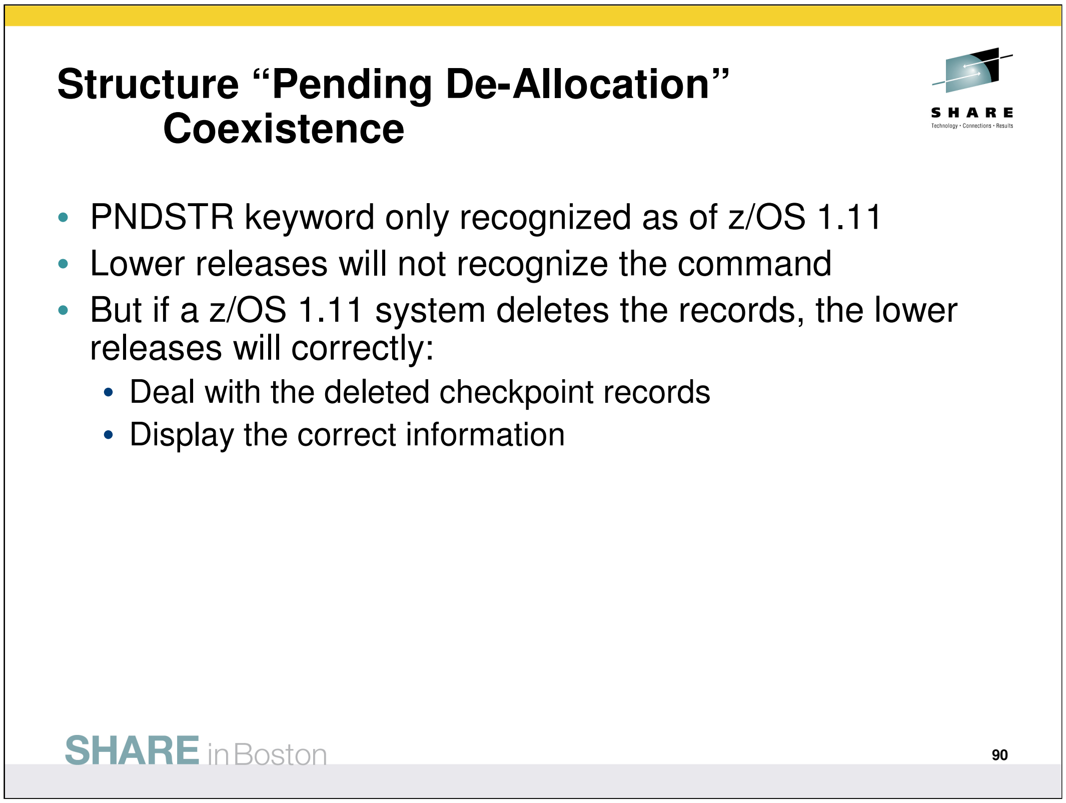
Structure “Pending Deallocation” Solution

- New command option available in z/OS 1.11 or later
- SETXCF FORCE,PNDSTR,CFNAME=cfname
  - System will remove “pending deallocation” structure entries from the CFRM Active policy
  - The CF should not be connected to any system in the sysplex
- Intended for use when, either:
  - CF will remain inaccessible for an extended period
    - Such as forever
  - CF will be brought back online with all structures removed

PNDSTR is not available on IXLFORCE service; it is only available through the SETXCF command interface.

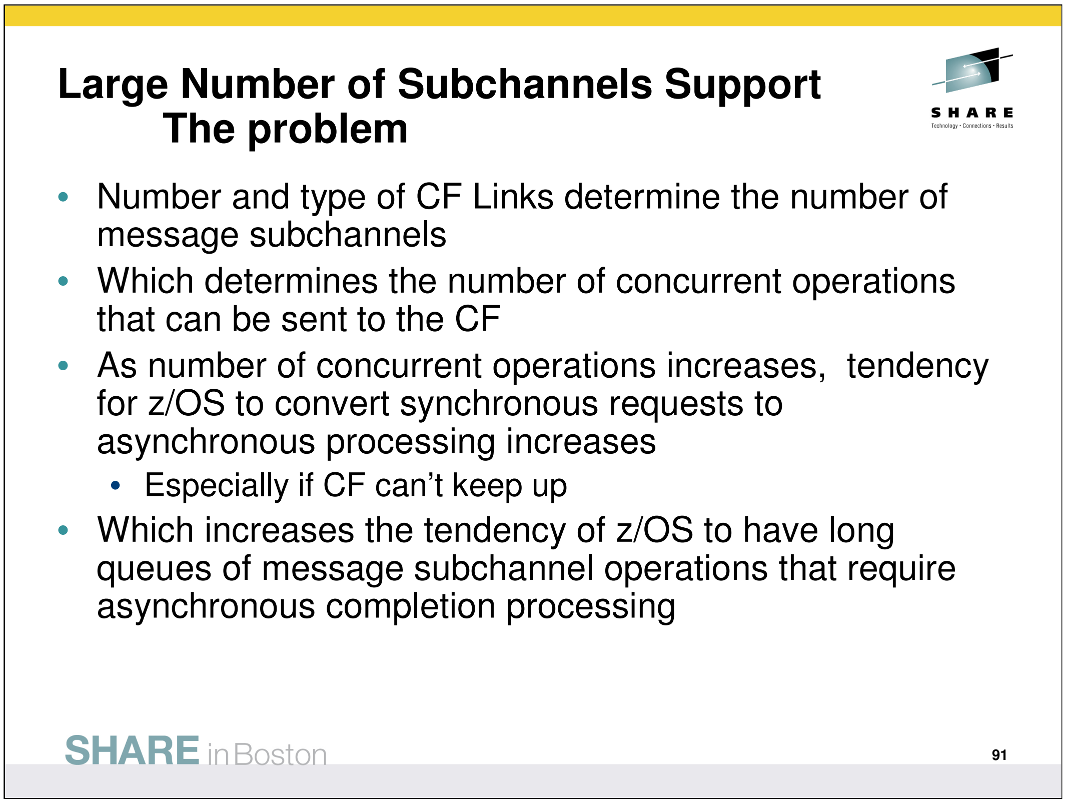
The SETXCF FORCE Command option for PNDSTR will only execute successfully on z/OS V1R11 systems and above.

> Lower level releases will correctly handle the deleted checkpoint entries and display the correct information if a z/OS V1R11 system has deleted the structure checkpoint entries



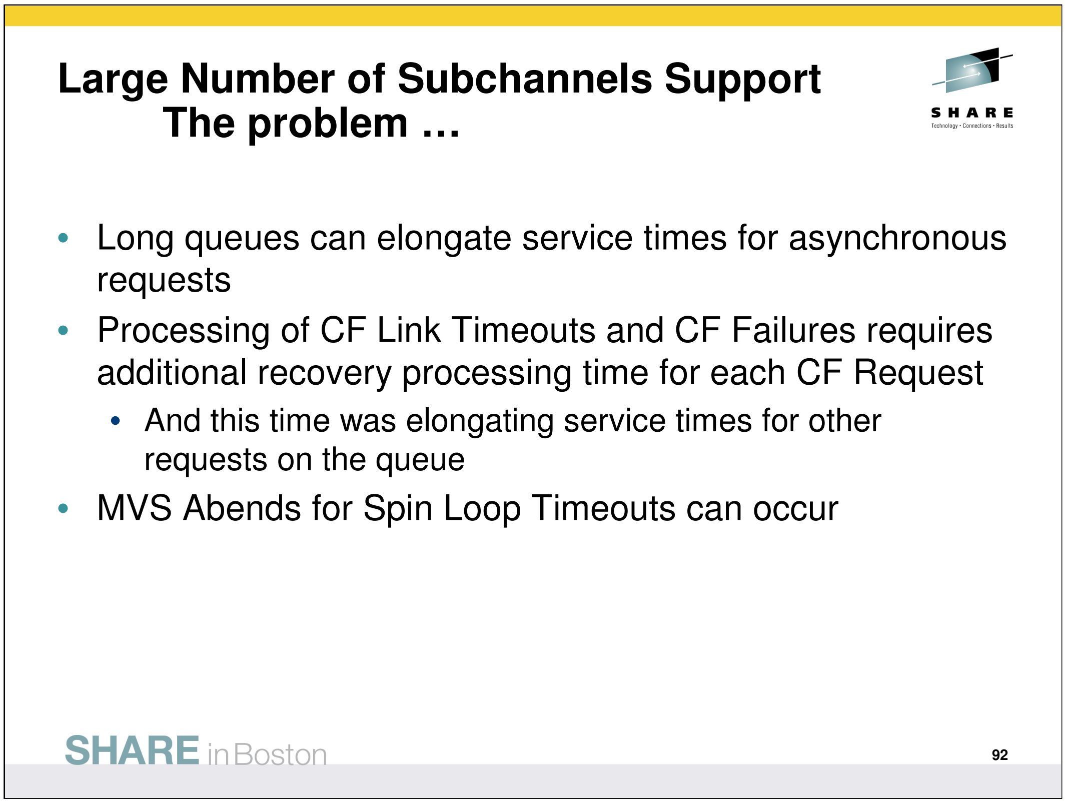
Structure “Pending De-Allocation” Coexistence

- PNDSTR keyword only recognized as of z/OS 1.11
- Lower releases will not recognize the command
- But if a z/OS 1.11 system deletes the records, the lower releases will correctly:
  - Deal with the deleted checkpoint records
  - Display the correct information



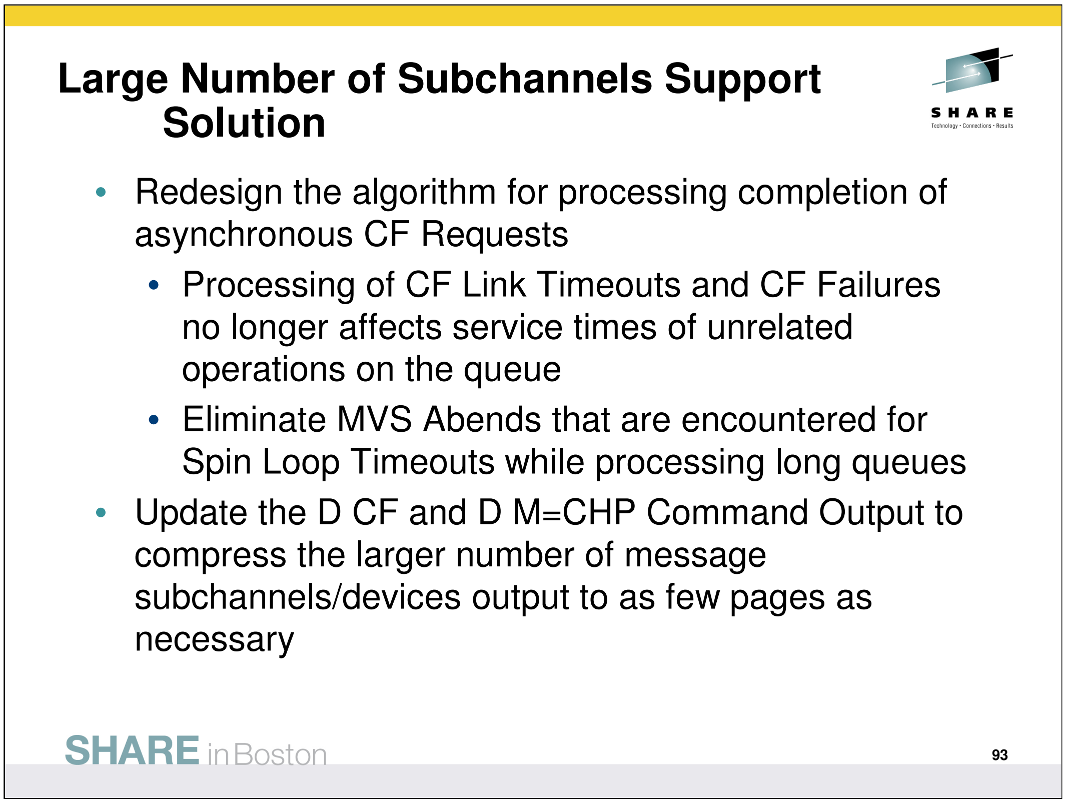
Large Number of Subchannels Support
The problem

- Number and type of CF Links determine the number of message subchannels
- Which determines the number of concurrent operations that can be sent to the CF
- As number of concurrent operations increases, tendency for z/OS to convert synchronous requests to asynchronous processing increases
  - Especially if CF can’t keep up
- Which increases the tendency of z/OS to have long queues of message subchannel operations that require asynchronous completion processing



Large Number of Subchannels Support
The problem …

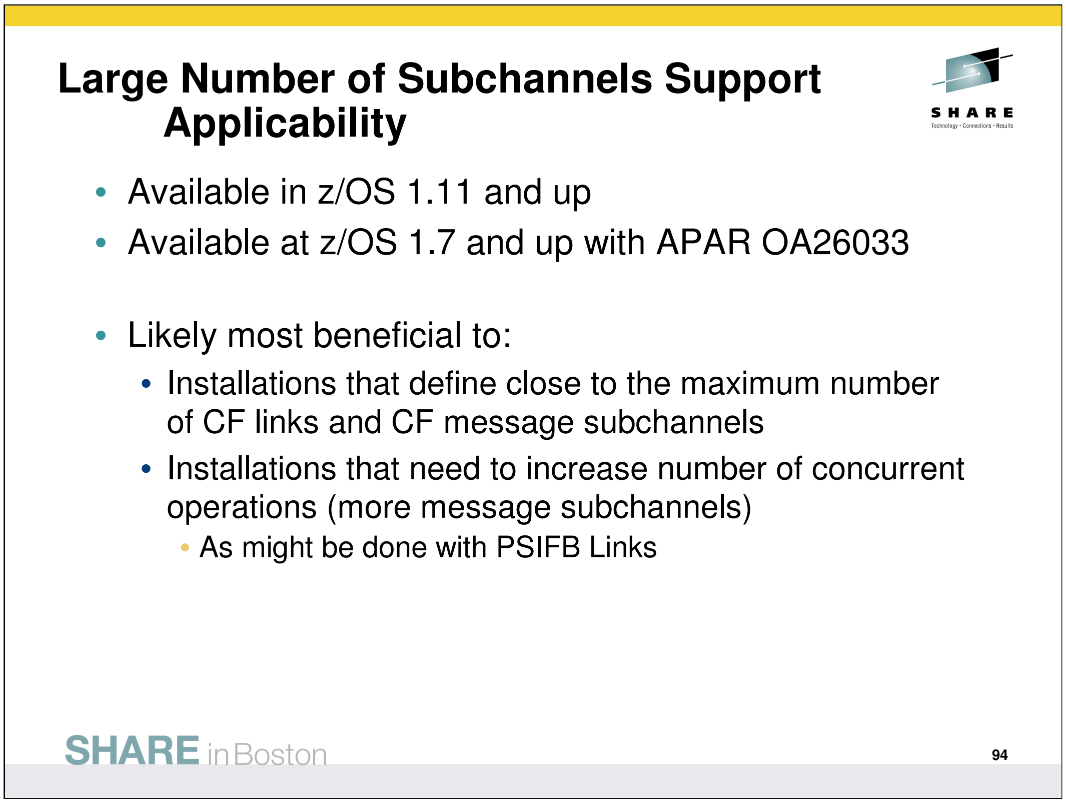
- Long queues can elongate service times for asynchronous requests
- Processing of CF Link Timeouts and CF Failures requires additional recovery processing time for each CF Request
  - And this time was elongating service times for other requests on the queue
- MVS Abends for Spin Loop Timeouts can occur



Large Number of Subchannels Support Solution

- Redesign the algorithm for processing completion of asynchronous CF Requests
  - Processing of CF Link Timeouts and CF Failures no longer affects service times of unrelated operations on the queue
  - Eliminate MVS Abends that are encountered for Spin Loop Timeouts while processing long queues
- Update the D CF and D M=CHP Command Output to compress the larger number of message subchannels/devices output to as few pages as necessary

A new XES design provides algorithmic enhancements for Coupling Facility subchannel operation completion, recovery, and notification processing, and improves efficiency for processing a large number of Coupling Facility subchannels. Coupling Facility subchannel information provided by console DISPLAY commands is changed to accommodate a large number of Coupling Facility subchannels. This new function supports larger CF and CF link configurations that require more concurrent I/O capability.



Large Number of Subchannels Support Applicability

- Available in z/OS 1.11 and up
- Available at z/OS 1.7 and up with APAR OA26033
- Likely most beneficial to:
  - Installations that define close to the maximum number of CF links and CF message subchannels
  - Installations that need to increase number of concurrent operations (more message subchannels)
    - As might be done with PSIFB Links