

# Checklist For z/OS Performance Improvement That Every System Programmer Should Know 16990

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*System Director / z/OS Team Leader*

*ISBANK*

*EWCP Deputy Project Manager*



#SHAREorg



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that provides **education, professional networking and industry influence.**





## Checklist For z/OS Performance Improvement That Every System Programmer Should Know

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# Who Is İŞBANK ?

- **The Biggest Bank Of Turkey**
- **5521 ATMs**
- **1296 Branches In Turkey, 20 Branches Outside Turkey**
- **Has The Highest Profit According To All Bank Announcements 2013**
- **Member Of SHARE Inc.**

# Who Is İŞBANK ?

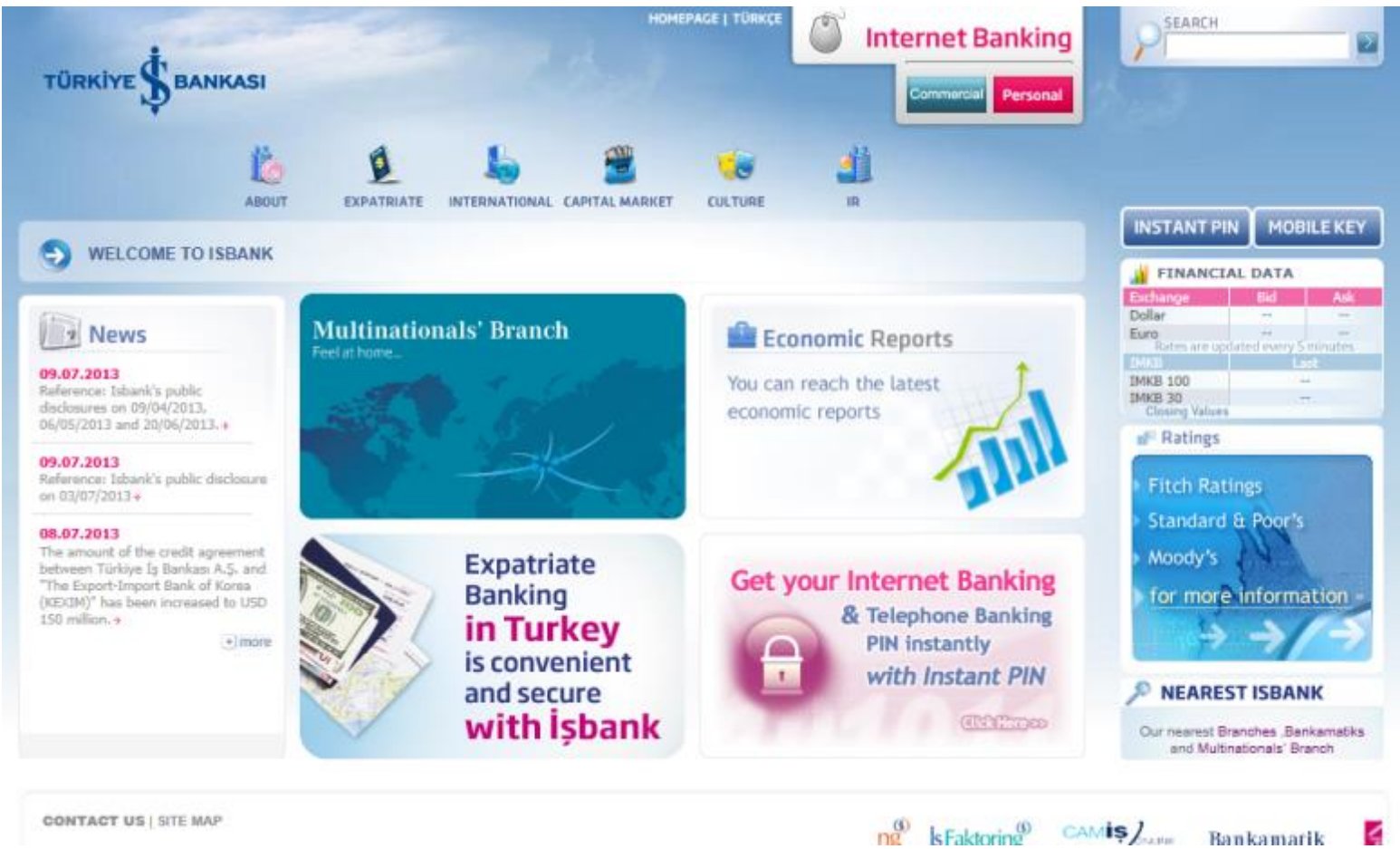
## BRANCHES





# Who Is İŞBANK ?

## INTERNET BANKING



**TÜRKİYE İŞ BANKASI**

HOME PAGE | TÜRKÇE

**Internet Banking**

Commercial Personal

ABOUT EXPATRIATE INTERNATIONAL CAPITAL MARKET CULTURE IR

WELCOME TO İSBANK

**News**

**09.07.2013**  
Reference: İsbank's public disclosures on 09/04/2013, 06/05/2013 and 20/06/2013. +

**09.07.2013**  
Reference: İsbank's public disclosure on 03/07/2013 +

**08.07.2013**  
The amount of the credit agreement between Türkiye İş Bankası A.Ş. and "The Export-Import Bank of Korea (KEKİM)" has been increased to USD 150 million. +

**Multinationals' Branch**  
Feel at home...

**Economic Reports**  
You can reach the latest economic reports

**Expatriate Banking in Turkey is convenient and secure with İşbank**

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**FINANCIAL DATA**

Exchange	Bid	Ask
Dollar	---	---
Euro	---	---
Rates are updated every 5 minutes.		
İMKB	Last	
İMKB 100	---	
İMKB 30	---	
Closing Values		

**Ratings**

- Fitch Ratings
- Standard & Poor's
- Moody's

for more information

**NEAREST İSBANK**

Our nearest Branches, Bankamatik and Multinationals' Branch

CONTACT US | SITE MAP

İs Faktoring CAMİS Bankamatik

# Who Is İŞBANK ?

## ATM



## İŞCEP Mobile Phone Application



## İŞBANK IPAD FINANCE CENTER Application



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# Who Is İŞBANK ?

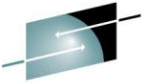
## Credit Cards



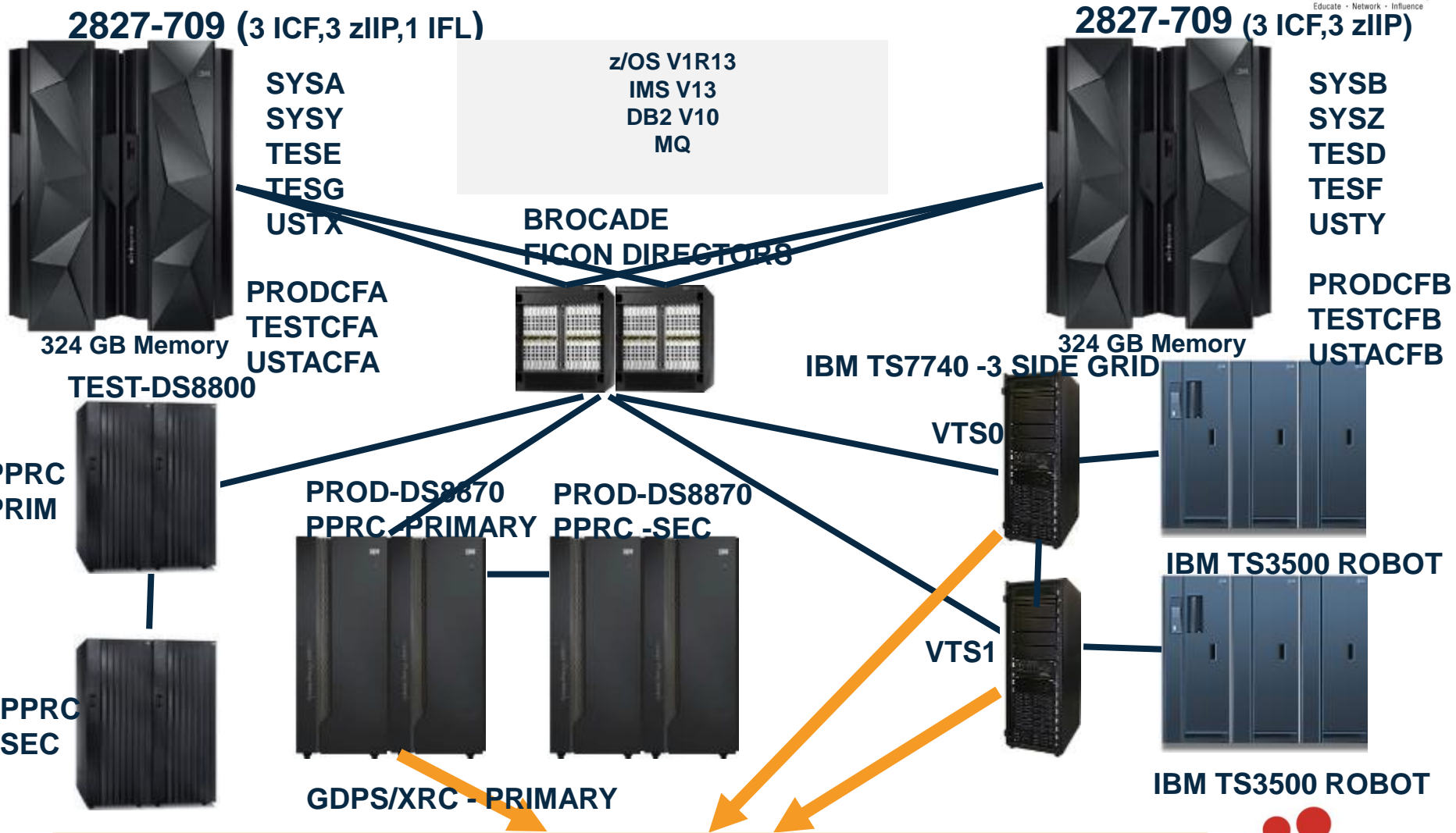
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# MAINFRAME CONFIGURATION



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# z/OS System Programming & Performance



LOVE Dealing With Performance

LOVE! Dealing With z/OS From System Programming Perspective

- 1996- 2010 14 Years z/OS System Programming  
Last 4 Years Mainly Performance
- 2010- 2013 3 Years z/OS Performance Expert
- 2013 – Now 2,5 Years z/OS Team Leader

# KEY JOINTS

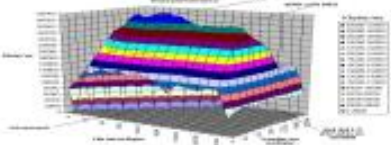
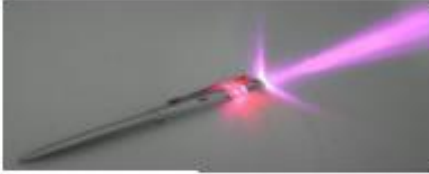
- ✓ Performance Troubleshooting
- ✓ Improving Performance Of Environment
- ✓ Improving Performance Management
  - ✓ DESIGN
  - ✓ ROTS
  - ✓ AWARENESS

# Performance Troubleshooting

Probably , you heard of CSI miami, CSI NY, NCSI...



When we do performance troubleshooting, we work just like agents in CSI series



- desires much deeper knowledge
- knows where to look for the correct clue
- is aware of using latest methods is the way to success
- expected to know best way to use latest technologies
- expected to see the clues as soon as possible
- expected to know well how to combine collected data

# Improving Performance Management





# z/OS Performance & RESOURCES



CPU

MEMORY

CF

I/O

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# CHECKLIST



zOSPerformanceHealthChecker-V1 [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

D6

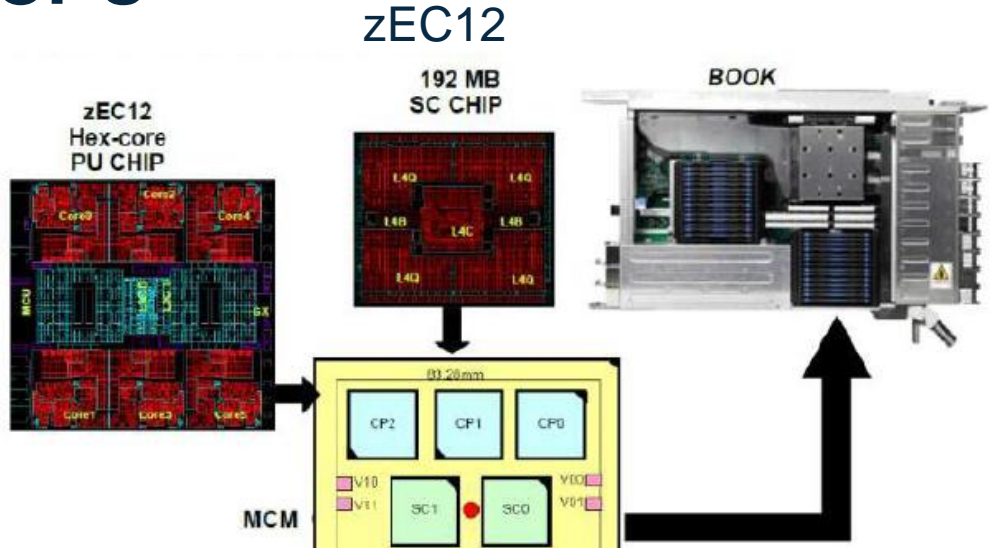
	B	C	
13	Design	If you are a heavy DFSORT user and having limited memory resource, check EXPMAX values to limit DFSORTs memory usage and disable it from causing page outs of your db2s or loved onces frames.	
14	Design	Use Hyperpav	BLWLINTHD=10
15	Design	Use MIDAW	
16	Design	Use zHPF	
17	Design	Use WLM Managed Initiators if appropriate	
18	Design	Use latest ARCHlevel and tune parameters in your compilers	
19	Design	Check Performance Related Recommendations in LE book	
20	Design	Check Performance Related Recommendations in your compiler book	
21	General	Save you normal day values for your cpu-memory-IO related performance items so that you can understand what is abnormal	
22	ROT	Channel Utilization not above %30	
23	ROT	CF Utilization not above %50	
24	ROT	False Lock Contention in Structures not above % 0.1	
25	ROT	Number Of Requests that had path busy condition should not be above %10 of Total Requests	
26	ROT	Subchannel Busy condition should not be above %10 of	
27	ROT	If not using IRD or HD , LCP:PCP ratio above 2 is not good	
28	ROT	Changed CF Async Requests should not be above %10 of all requests.	
29	ROT	Delayed Request % Should not be above %10 of Total Requests	
30	ROT	NVS bypass condition should not be above 5	
31	Warning/Awareness	As CPU Utilization increases cputime increases because of queing and management z10 max %25 with current workload	
32	Warning/Awareness	Make as much equal as possible utilization of CEs	

MVS-BCP | MVS-Memory | MVS-IO | DB2 | CICS | Sheet1 | F ...

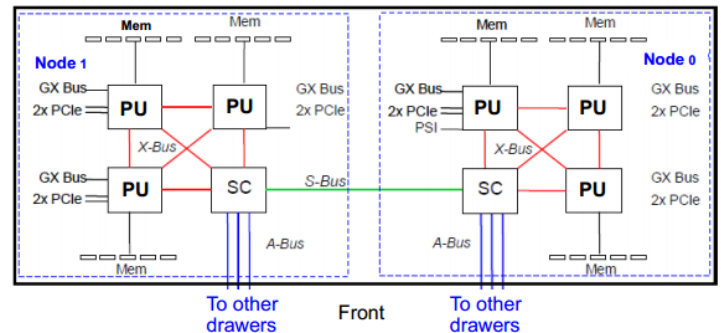
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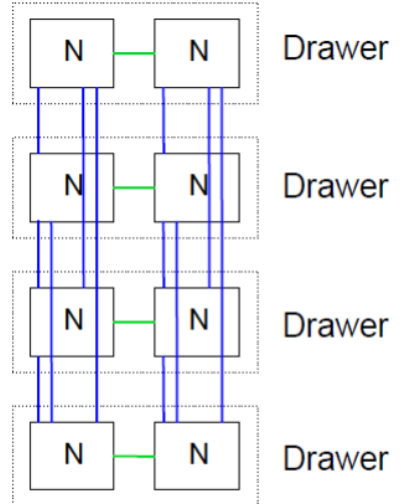
# CPU



## z13



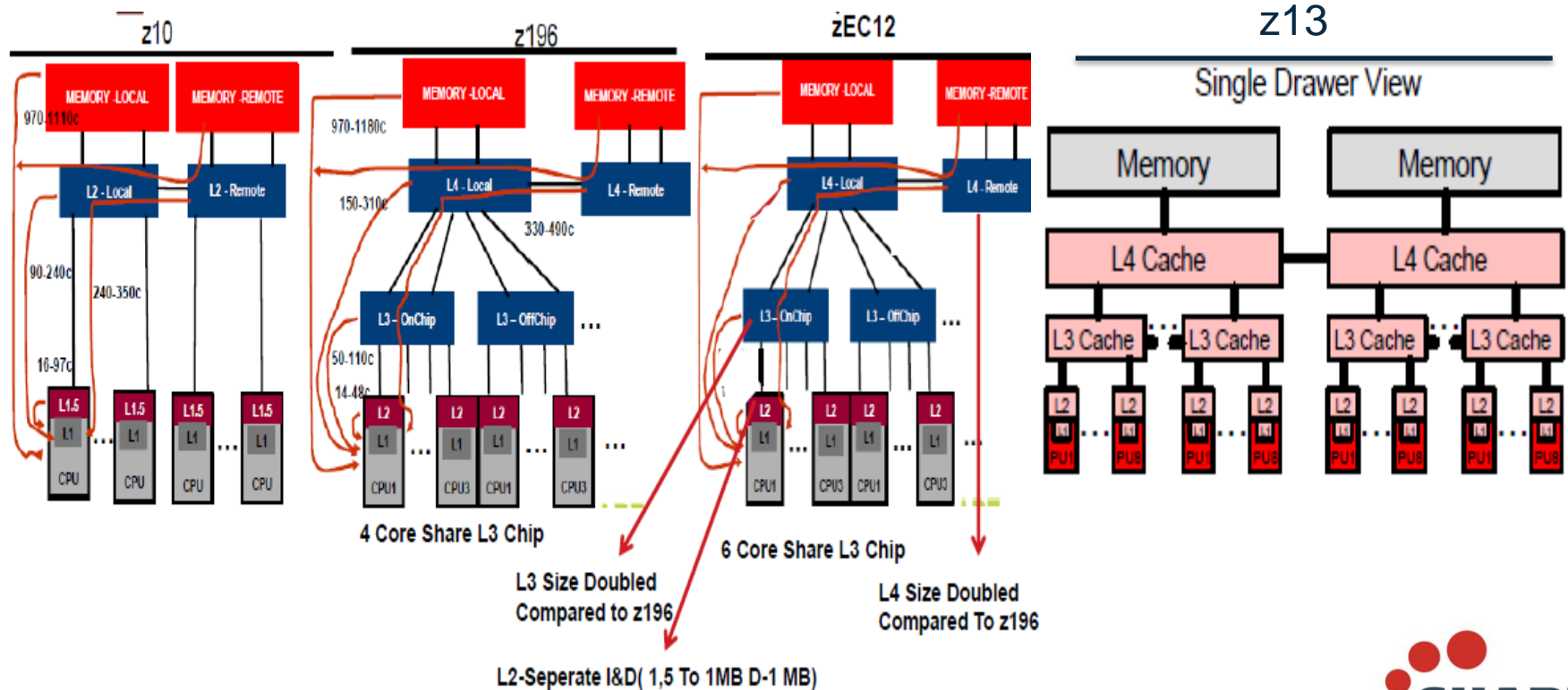
- Physical node: (Two per drawer)**
- **Chips**
    - Three PU chips
    - One SC chip (480 MB L4 cache + 224 MB NIC Directory)
  - **RAIM Memory**
    - Three Memory Controllers: One per CP Chip



# Z13 & Previous HW Improvements

## Upgrade To Latest Machine

- zEC12 Was Amazing!. I have got 15-20 % MSU Decrease.
- Now z13 Has The Greatest Cache Algorithm & Instruction Support





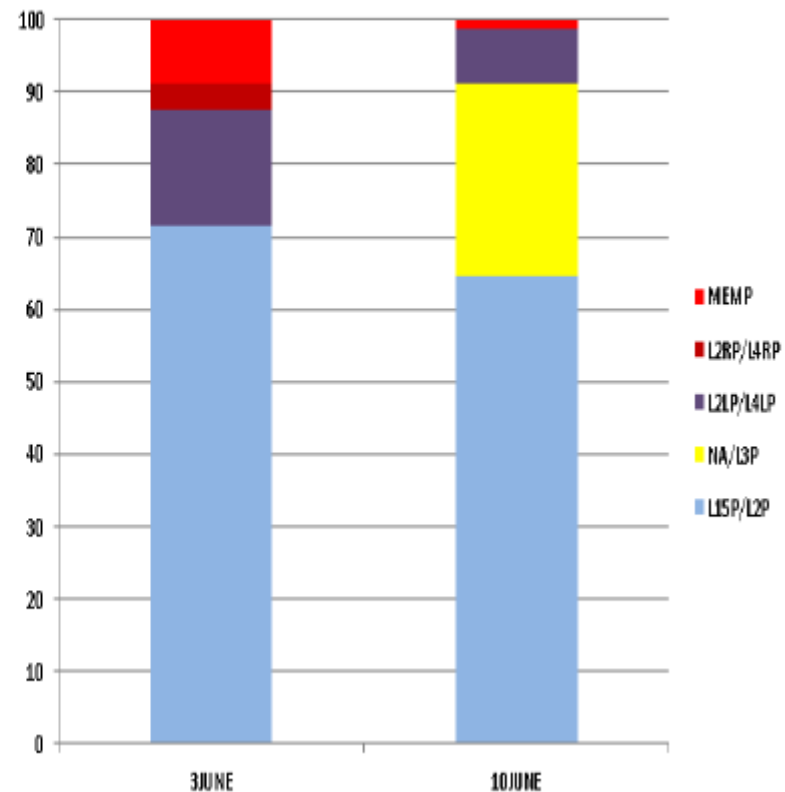
# zEC12 HW Improvements

Where To Look ? Other Than Cputimes, APPL%, MSU Fields In RMF.....

- Collect SMF113s. Cycle Per Instruction Will Decrease

## Cycle Per Instruction Decreased By %49

DATE	3JUNE	10JUNE	DECREASE%
CPI	7,46	3,81	49
L1MP	4,26	4,85	
L15P	71,58	NA	
L2P	NA	64,48	
L2LP	15,90	NA	
L2RP	3,84	NA	
L3P	NA	26,58	
L4LP	NA	7,74	
L4RP	NA	0,03	
LPAR BUSY	7,89	54,67	
MEMP	8,68	1,16	87
MIPSEXEC	46,73	791,00	
ESTICPI	3,07	2,10	32
ESTFINCP	4,40	1,71	61
ESTSCP1M	103,40	35,23	66
RNI	0,90	0,65	
EFFGHZ	4,40	5,50	
TLB1MISS	8,10	5,62	31
TLB1CYCL	79,49	27,28	66
PTEPCTMI	36,74	27,57	25



# z13 & Previous HW Improvements



## RESOURCES ?

SHARE Sessions About SMF113

SHARE Sessions About z13

SHARE Sessions About CF By Gary King

SHARE EWCP Opening – Hot Topics

SHARE MVS Opening – Hot Topics

Don't Have z13 Yet!

Migration To zEC12 – A Journey In Performance – SHARE Boston 2013

Using And Getting Benefit From SMF 113 Records - Customer Experience – SHARE

ResourceLink Website – zEC12 & z13 Books

<https://www-304.ibm.com/servers/resourcelink/svc03100.nsf?Opendatabase>

WSC TecDocs

<http://www-03.ibm.com/support/techdocs/atmastr.nsf/Web/TechDocs>

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# z13 & Previous HW Improvements

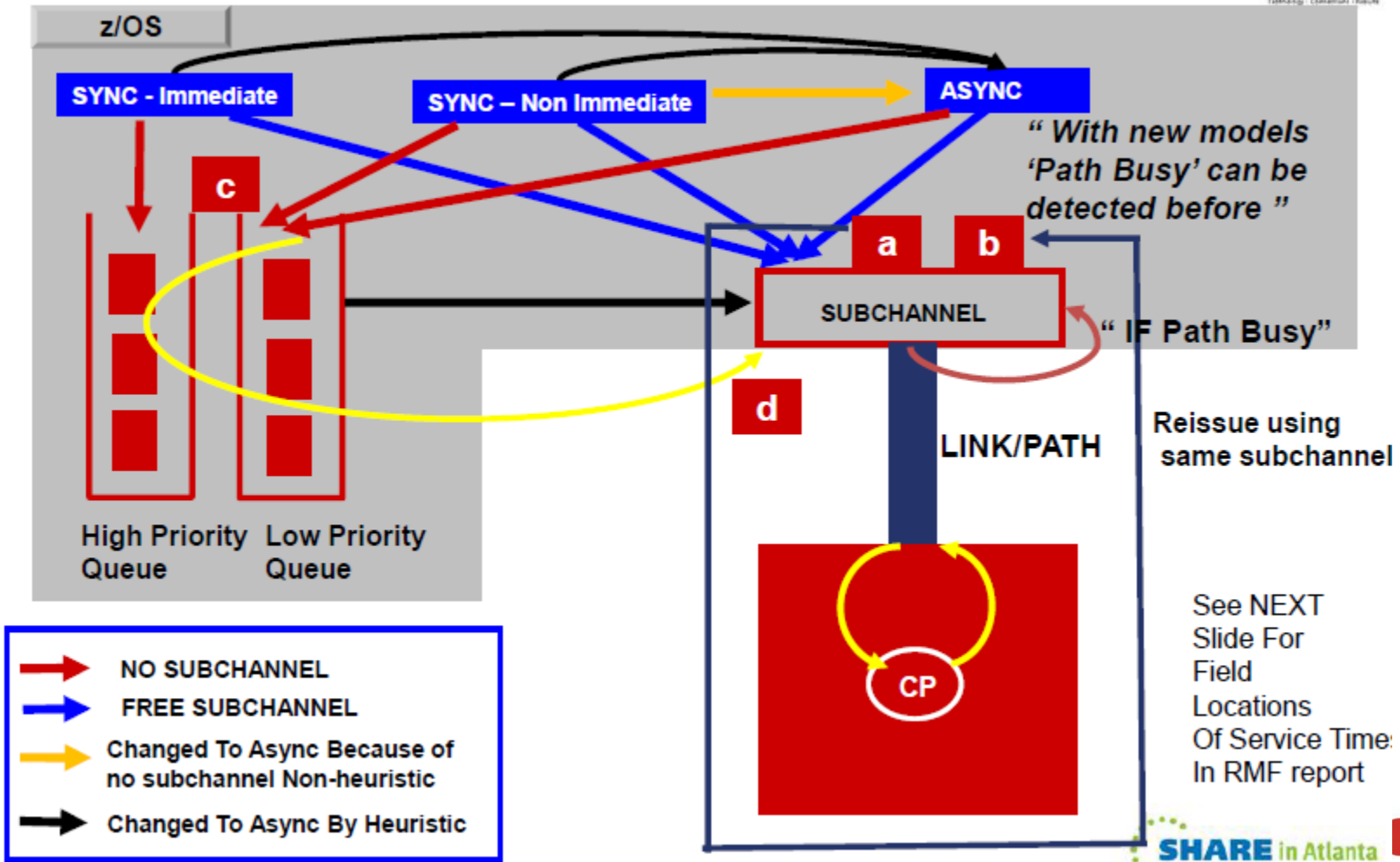
- **Collect SMF113 all the time. Minimum overhead – Can not be realized**  
**Several SHARE Sessions About CPU MF.. This SHARE and the previous SHARES**  
**SHARE 2013 Migration To zEC12 – A Journey In Performance –**  
**SHARE Using And Getting Benefit From SMF 113 Records - Customer Experience**
- **Use zPCR To Learn Your Real LSPR Workload Type**  
**(Uses SMF113 as input)**  
**SHARE 2012 :Usage Of zPCR Both In Performance Management And Capacity Planning Studies - Customer Experience**
- **Use zPCR Not Only For Capacity Planning But Also For LPAR Design**  
**SHARE 2012 :Usage Of zPCR Both In Performance Management And Capacity Planning Studies - Customer Experience**
- **Consider Using Absolute Capping**  
**I consider using it because I need both hardcap and softcap work together**



## CF PERFORMANCE



# CF Request Types & Cases



# Sync/Async Conversion

## NON-HEURISTIC

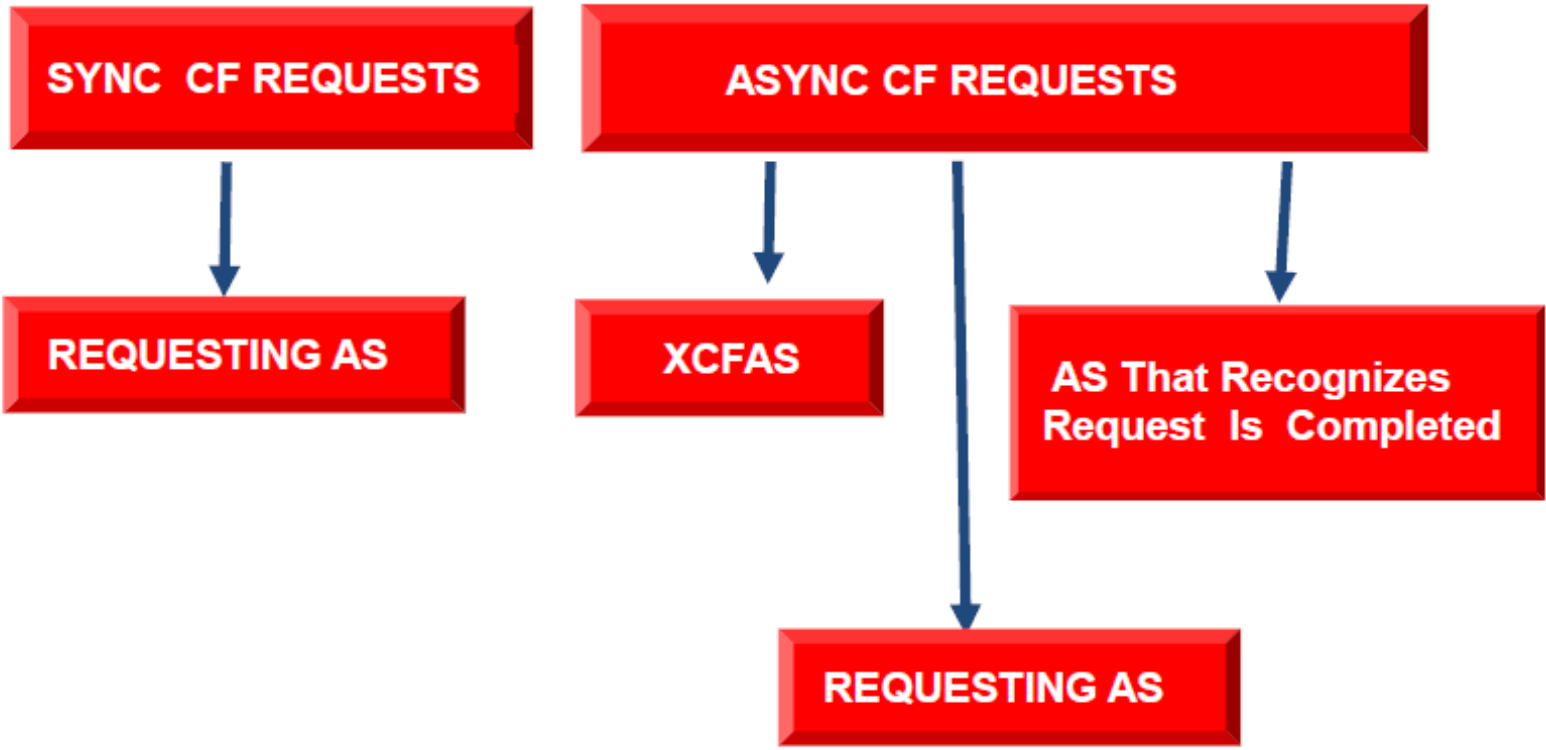
- Subchannel Busy Condition
- Path Busy Condition
- Serialized List or Lock Contention

## HEURISTIC

Introduced with z/OS v1r2...

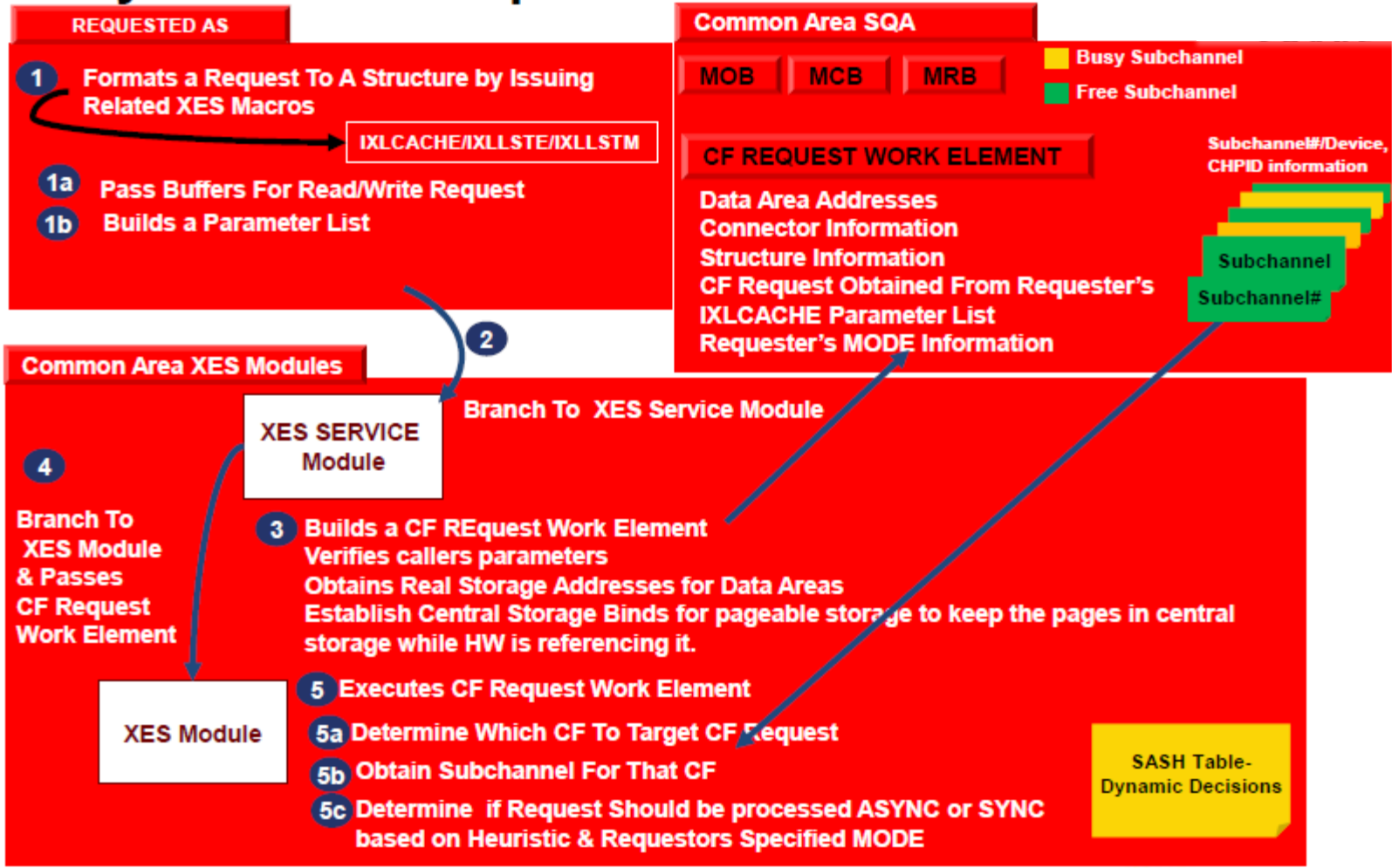
- CF Link Technology
- Types Of Workload – Variable Workload Amount
- Range Of CF Utilization, Shared CP or not,...
- Actual Observed Sync Request Service Time
- Amount Of Data That Needs To Be Transferred
- Other items that effect CF response ex:Distance
- Moving Weighted Averages Of Actual CF Requests
- Every 1 of N Request not converted and send as Sync

# CPU Cost Of CF Requests



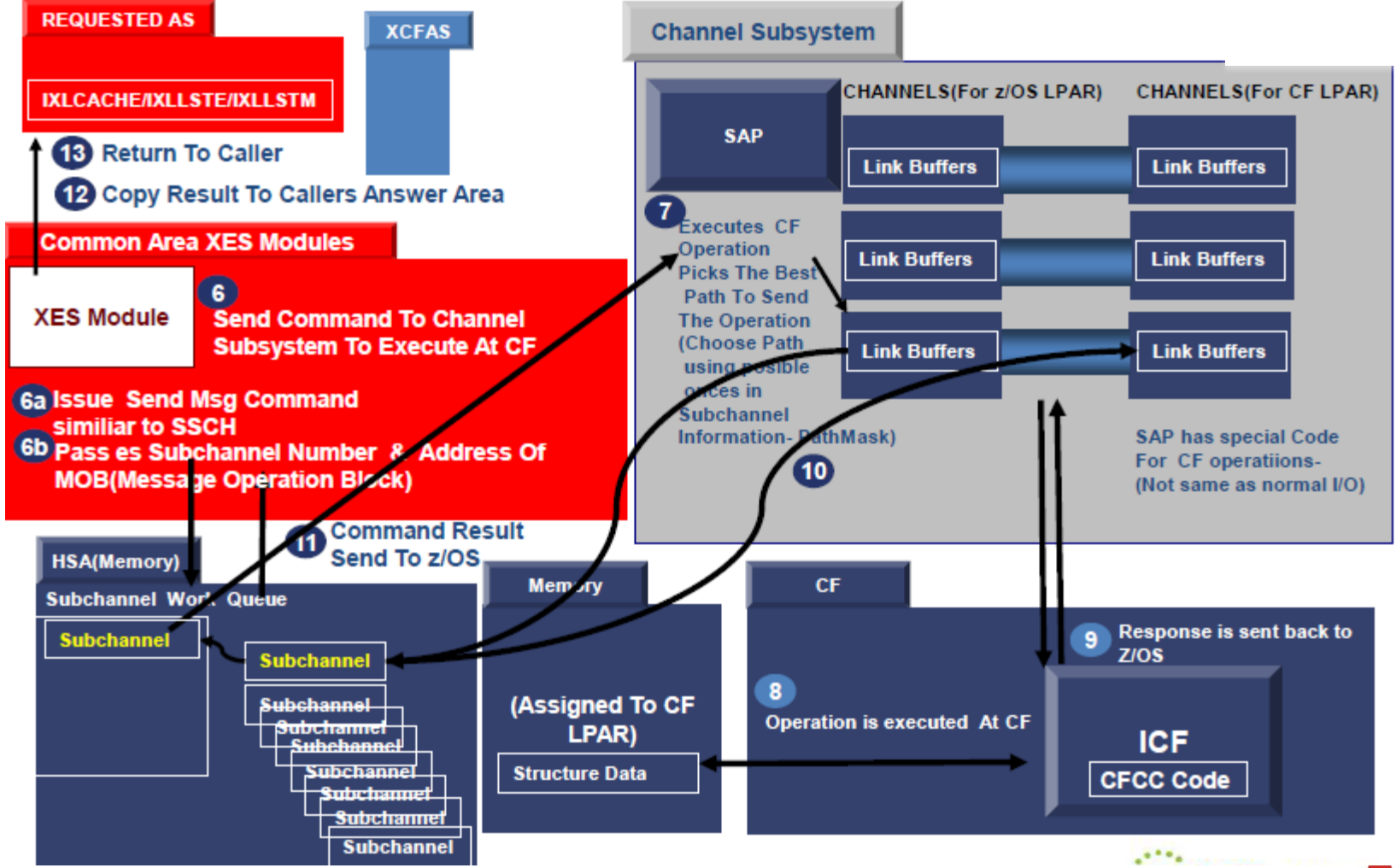
# CF Performance

## CF Synchronous Request Flow-1



# CF Performance

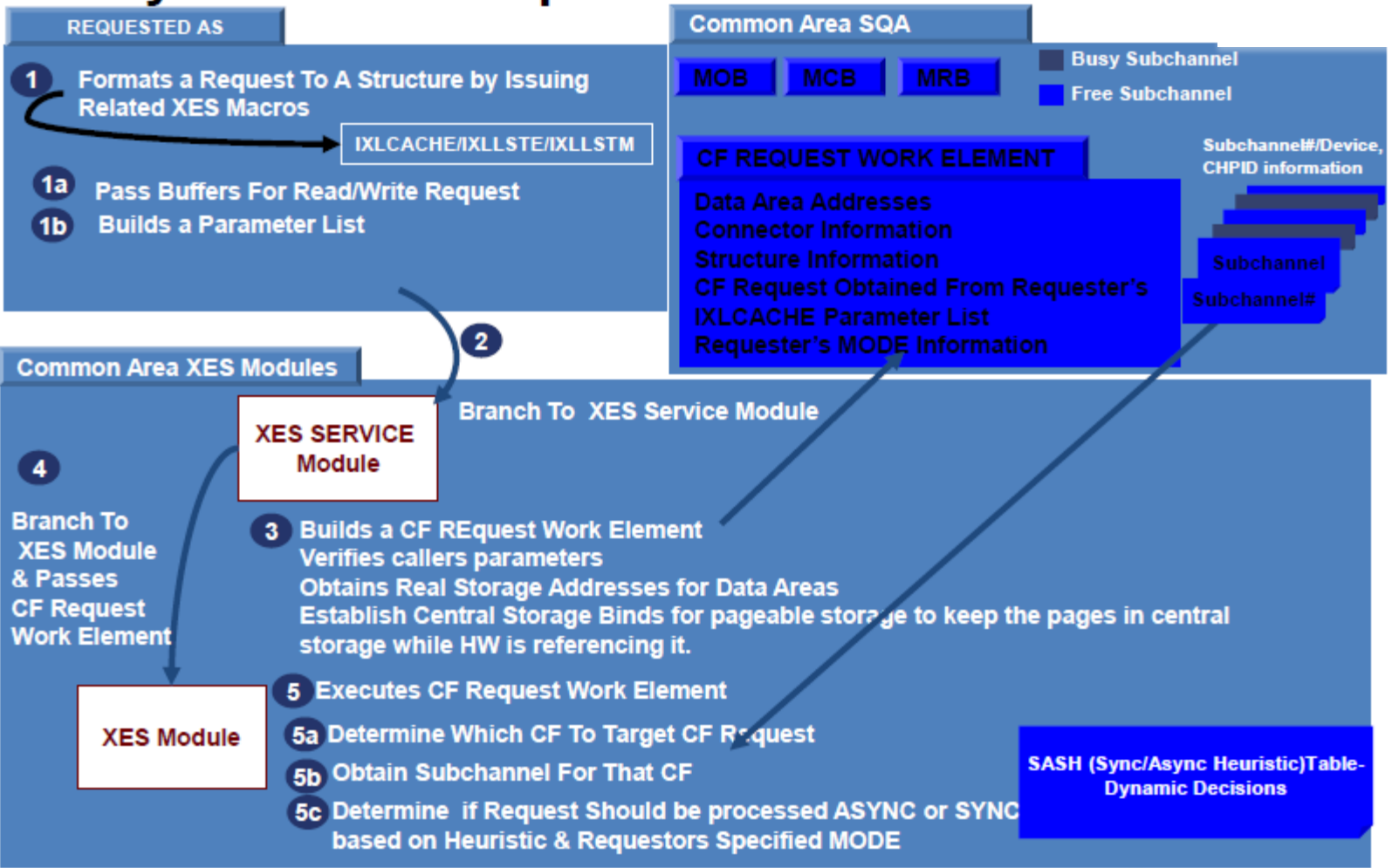
## CF Synchronous Request Flow-2





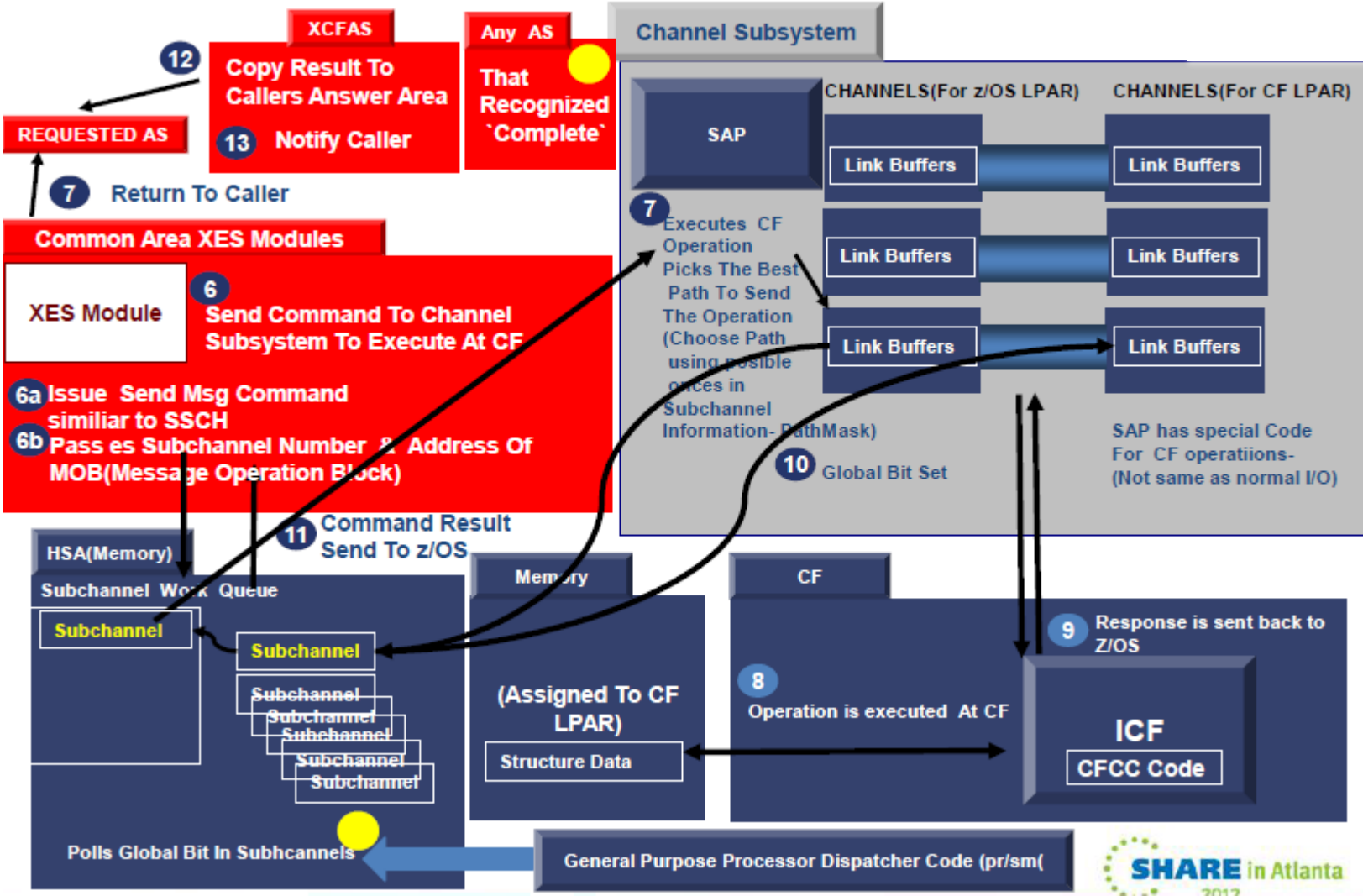
# CF Performance

## CF Asynchronous Request Flow -1



# CF Performance

## CF Asynchronous Request Flow 2



## Previous HW CF Improvements

- CF Links- Infiniband Cards & Protokol Enhancements
- Latest Protokol IFB3 with HCA3-O Cards
- Improvements : Decrease In Service Times  
Decrease In Subchannel Busy Conditions  
Decrease In Sync/Async Conversion

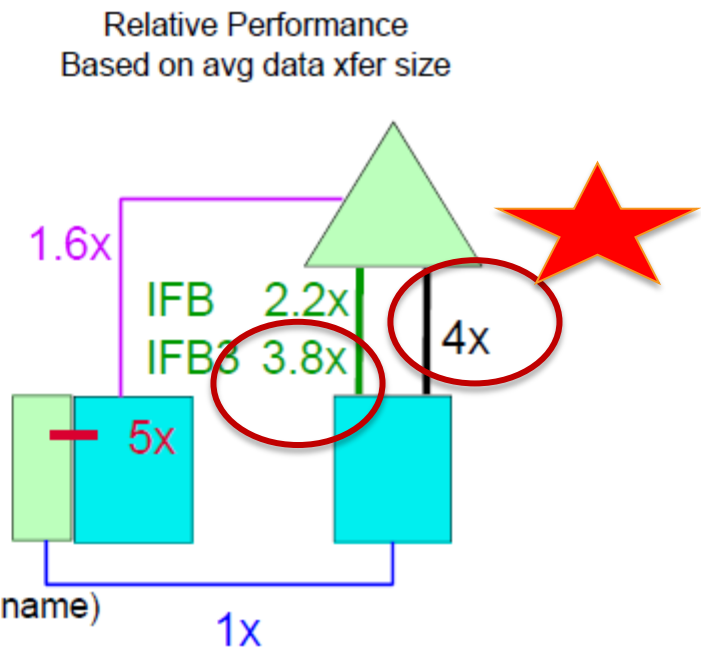
### For Details Of CF Performance Analysis: Using RMF & SMF

- Migrating from z10 ICBs to z196 Infiniband- a Detailed Performance Study and User Experience – SHARE Orlando 2011
- Migration To zEC12 – A Journey In Performance – SHARE Boston 2013

# CF Performance & z13

## Coupling Link Choices - Overview

- **ISC (Inter-System Channel)** – **NA after zEC12/zBC12**
  - Fiber optics, I/O Adapter card, >10km with qualified WDM solutions
- **ICB (Integrated Cluster Bus)** – **NA after z10EC/z10BC**
  - Copper cable plugs close to memory bus, 10m max length
- **IC (Internal Coupling Channel)**
  - Microcode - no external connection
  - Only between partitions on same processor
- **12x IFB and 12X IFB3 (InfiniBand)**
  - 150 meter max distance optical cabling
  - Supports multiple CHPIDs per physical link
  - Multiple CF partitions can share physical link
- **1x IFB**
  - 10km and longer distances with qualified WDM solutions
  - Same multiple CHPIDs and sharing flexibility as 12x
  - 32 subchannels (up from 7) per CHPID (intro z196 GA2)
- **ICA SR (Integrated Coupling Adapter)** – **intro z13**
  - ICA SR connects to PCIe fanout (note CS5 is the CHPID name)
  - 150 meter max distance
  - Supports up to 4 CHPIDs per physical link



# CF Performance



Check For Lock Structures Lock Contention

ROT : Not more than 0.1% Of Total CF Request For Structure

Check For Lock Structures False Lock Contention

ROT : Not more than 0.01% Of Total CF Request For Structure

Check For CF Utilization

ROT : Different ROTs....Not above 50% ( I prefer 40% )

Check For Path Busy %

ROT : Different ROTs....Not above 10% Of Total Requests

Decide Whether To Increase # Of IC s or Infiniband CF links





Balance Your CF Request Rates Between CFs. - Design

Check Async /Sync Conversion % - Not Above 10% Of Total – ROT

Sample: Sync Service times 2-4 microseconds , Async 80-120 microseconds

# CF Performance – Where To Look ?

-  **RMF Monitor I Post Processor Report Fields**
-  **RMF Monitor I Overview/Exception Report Fields**
-  **RMF Monitor III Report Fields**
-  **SMF Record Fields ( RMF Related Records 70-79)**

**If explanation in books is not clear,**

- Cross Check Related Fields in Other Types Of Data**
- Google It – For APARs, Redbooks,WSC Documents**
- Ask IBM – Open PMR For Information Request**

# CF Performance – Where To Look ?

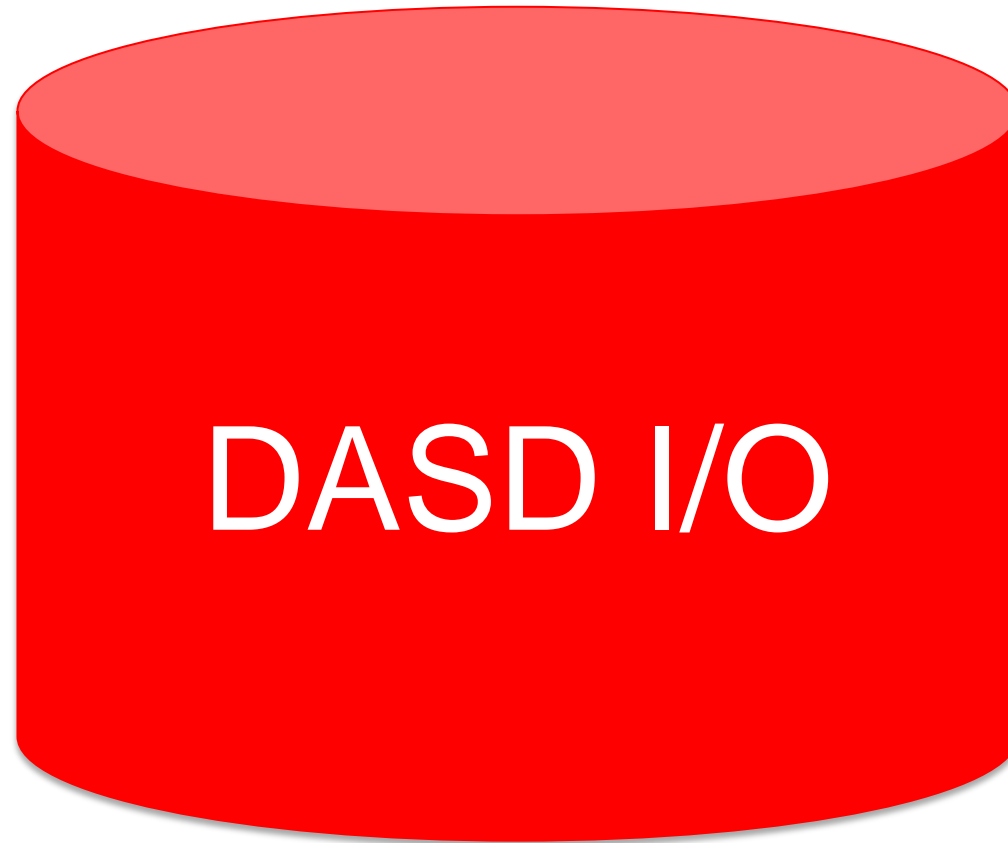


## RMF Monitor I Reports

Postprocessor Statement – SYSRPTS(CF) - See sample JCL in backup slides

- Coupling Facility Usage Summary
  
- Coupling Facility Structure Activity
  
- Subchannel Activity

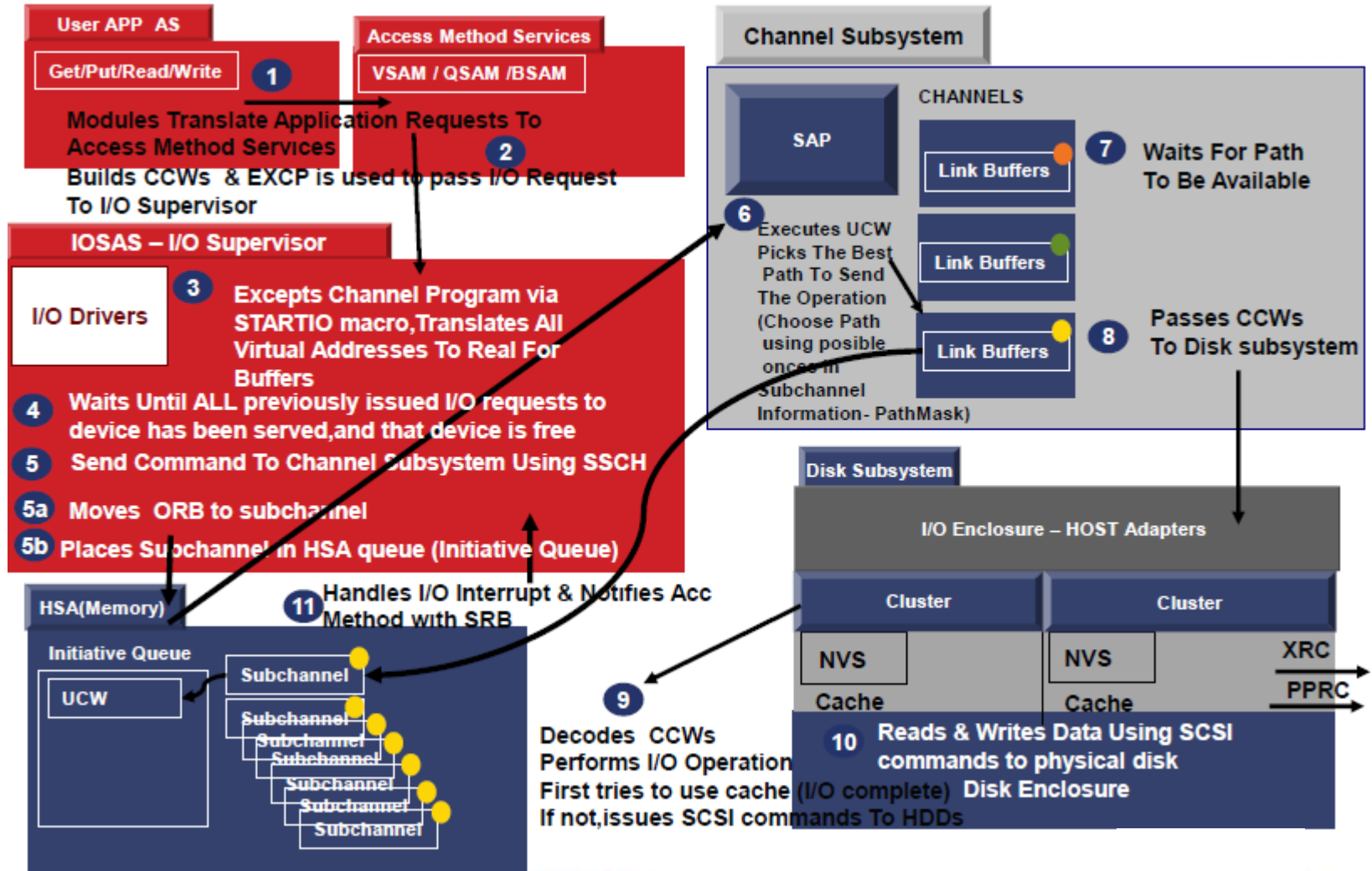
# DASD I/O Performance



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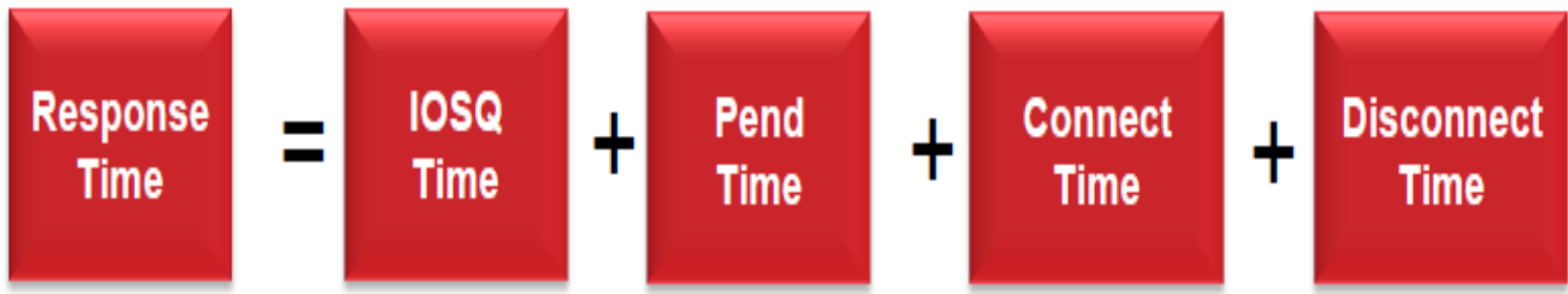


# Life OF I/O





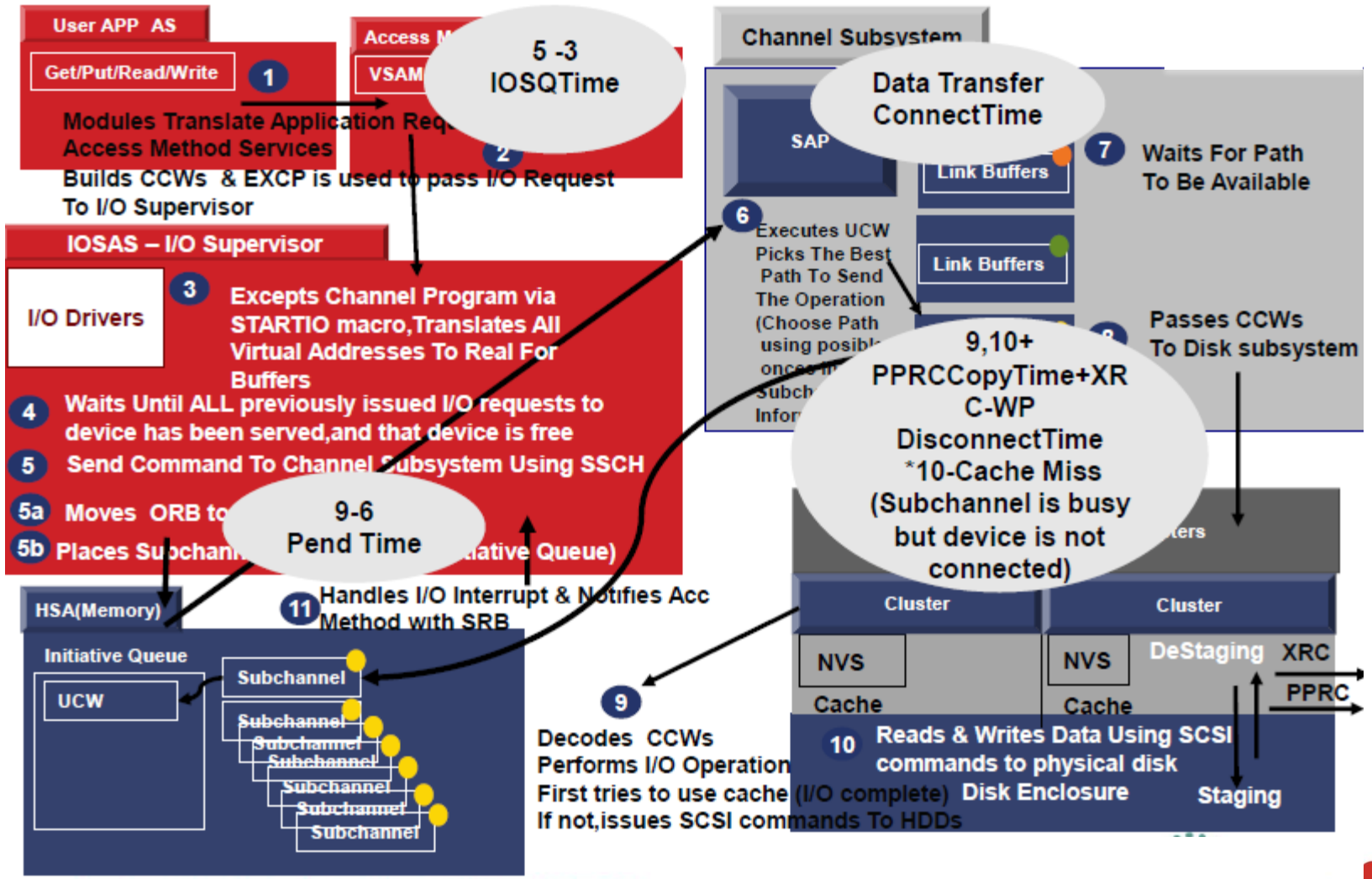
# DASD I/O Response Time Components



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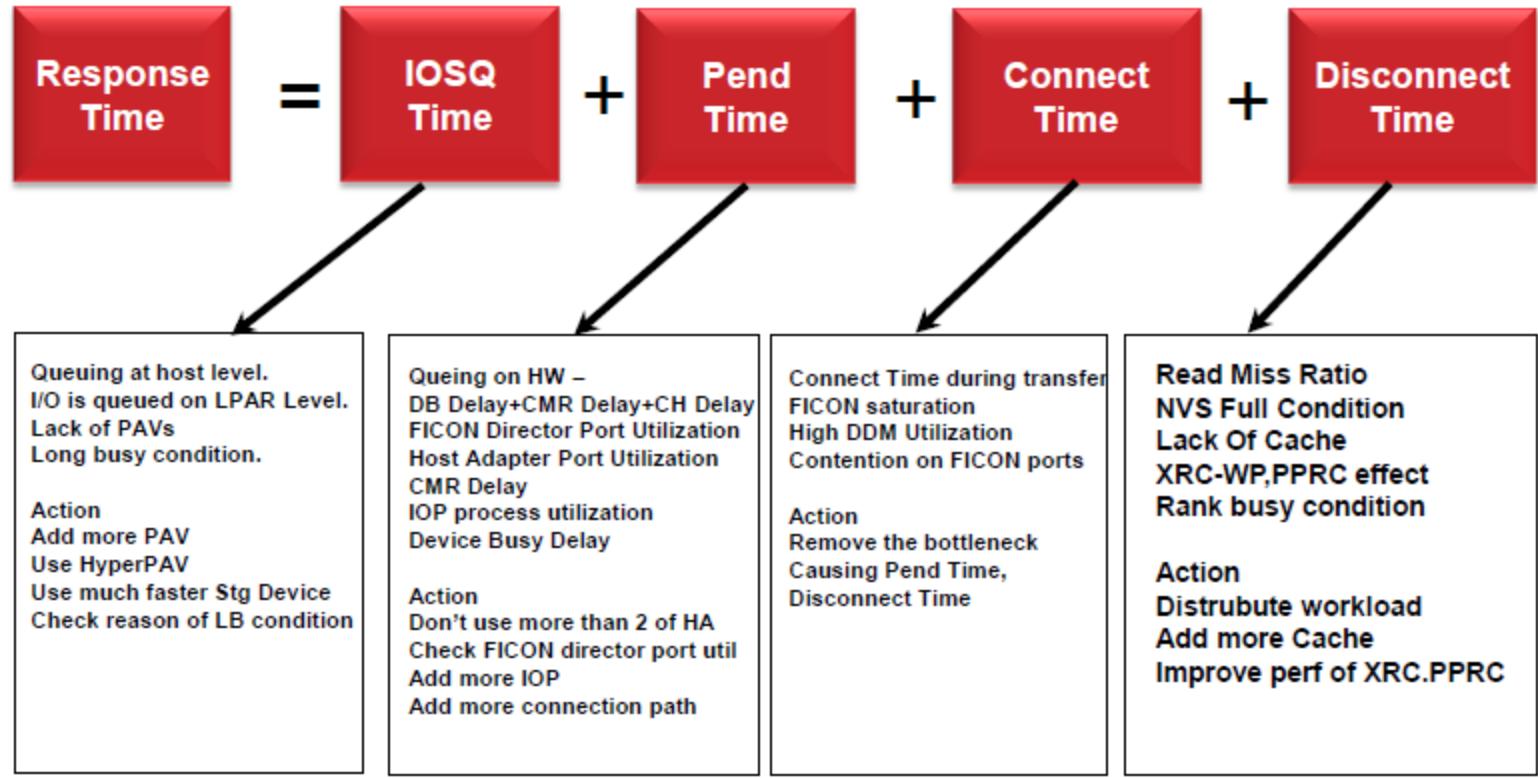
# Life Of I/O & Response Time Components



# DASD I/O Response Time Components



What Are The Possible Reasons? Where To Look ? What To Do ?



# DASD I/O Performance

- Use Hyperpav - (Check IOSQtime Decrease ) DESIGN
- Check I/O Interrupt Time (New Field ) Awareness
- Use MIDAW - DESIGN
- Use zHPF – ( Check PendTime Decrease) DESIGN  
Previous microcodes had some fixes for zHPF  
Modes: Basic Mode , Sequential Dataset Support Mode
- Channel Utilization not above 40% (I prefer 30%) - (Check Pendtime) ROT
- Use Enough HostAdapter Ports In The Box (Check Pendtime – CMR Delay) - Design
- Check NVS ByPass Conditions - ( Check Disconnect Time ) Awareness
- Use Top/Down Approach - Average IS Average ! - Awareness
- Know Your Normal Values For Response Times - Awareness

# DASD I/O Performance



- Separate DB2 Work Datasets To Volumes (IOSQTime ) - Awareness
- Don't put Loved Ones & Other Batch Datasets In Same Volume – Awareness
- Be careful About XRC write pacing - (Disconnect Time) – Awareness
- Be careful About # Of PPRC Links – (Disconnect Time) – Awareness
- Check Dataset BlockSize – Basic But Often Forgotten – SMS Dataclass – DESIGN
- Use Buffers whenever you can – Saves Elapse Time & CPU – DESIGN
- Tape: Use LBI Support – Saves CPU - DESIGN



# I/O Performance



- **USE!!! IBM Tape Tool !... Free SW.**  
SHARE 2012 : Analyzing/Monitoring Performance Of z/OS I/O Operations: DASD and Tape - Performance View
- **Analyze SMF42 Dataset I/O Performance Records**  
SHARE 2013 : Hints And Tips of Data Set I/O Performance
- **Know Your Highest I/O Intensive Volumes – (RespTime\*I/ORate)**  
SHARE 2012 : Analyzing/Monitoring Performance Of z/OS I/O Operations: DASD and Tape - Performance View
- **Know Your Highest Queing Intensive Volumes- ((RespTime- ConTime)\*I/Orate)**  
SHARE 2012 : Analyzing/Monitoring Performance Of z/OS I/O Operations: DASD and Tape - Performance View
- **Consider Using SSDs – Analyze – Free FlashDA program (Using SAS)**  
Checks SMF42s and looks for ReadOnlyDisconnectTime  
SHARE 2013 : Hints And Tips of Data Set I/O Performance

# MEMORY



# MEMORY

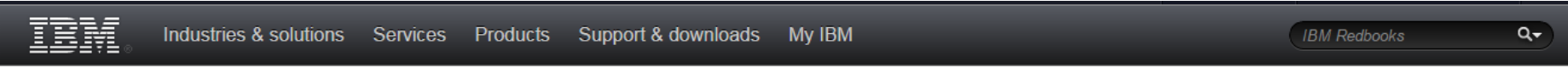
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# z/OS Memory

Please DON'T LET YOUR SYSTEM DO PAGING!  
 MEMORY IS YOUR RESOURCE THAT WILL MAKE YOU HERO!

<http://www.redbooks.ibm.com/abstracts/redp5146.html?Open>



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IBM Redbooks > z Systems >

## z/OS Infrastructure Optimization using Large Memory

An IBM Redbooks Point-of-View publication



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### Author(s)

- Peter Sutton

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REDP-5146-00

Number of pages  
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### Abstract

Businesses can improve their bottom line by changing the way they approach deploying memory on IBM z/OS®. Advances in z Systems memory packaging and pricing have radically shifted the balance between memory, I/O, and CPU, and now favor using large memory for both existing and

# z/OS Memory



This SHARE

By **Kathy Walsh 16802: z/OS Central Storage Management**

SHARE Atlanta 2012

**Analyzing/Measuring/Monitoring Memory Usage and Understanding z/OS  
Memory Management: Performance View**

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# General z/OS Design Related Items



z/OS

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# z/OS General Design



- Check Catalog Caching – `f catalog,report,cache ` & Several Other Commands  
Use RMF monitor III ENQ report to check whether you have any ENQs on these...  
Use VLF For Catalogs (Put only loved ones)  
Check size of VLF definition for Catalogs (CofvlfXX member)  
Separate Catalogs To Remove ENQs  
Don't put more than one catalog to same volume  
Use Enhanced Catalog Sharing (VVDS data read CF Request Instead Of DASD I/O)  
Use RLS type catalog – Planned!.
- Use zEDC If Possible- CPU consumption Of Compression Can be Very Significant  
Check your Compressed /Uncompressed Cpu Usage  
Decide Between I/O Count Cost – CPU Cost  
Use zBNA To Decide On Planning Of zEDC Cards
- USE!!!! zBNA Tool For Batch Analysis



# z/OS General Design



- Create Your Own PDB Database
  - Merged Information Is something you can not get from elsewhere
  - Automated Reports- Alerts
  - SHARE 2010 Performance Management Hints Using RMF Data**
- Amazing actions you can do with enough performance Data in Hand.
  - Use products Alerts & Thresholds
  - Create your own alerts using your own PDB
- Run z/OS HealthChecker All The Time.
  - Not only for availability but there are several checks related to performance items

# z/OS General Design



- WLM Service Classes – don't use too many –  
Velocity Goals' value difference less than 5 does not make sense
- Use WLM BlockWorkload Support  
SHARE EWCP Hot Topics
- Use Hiperdispatch
- Check Your RMPTTOM Value  
IBM Techdoc flashes... Can decrease your cputime
- Check Your CPENABLE Value  
IBM Techdoc flashes
- Check Your COBOL Optime Parameter - Use Optimize(FULL)
- Use Latest ArchLevel Parameter In Compilers

# z/OS General Design



- Help PR/SM do its job much easier ....Check LCP/PCP ratios
- Use 3 digits for LPAR Weights . More granularity will be achieved
- Be careful About Short Engine Effect
- Don't DO PAGING!!!.... Memory is much cheaper now
- Check DFSORT parameters – EXPMAX – EXPOLD not to cause it steal your loved onces pages
- Check Region Parameters  
Increase it if necessary ... Some utilities parallelism is based on amount of memory that can be used
- Use zFlash – If you are being hurt by uncontrollable paging.

# More Resources



**SHARE 2012 Anaheim  
Analizing/Monitoring Performance Of  
z/OS I/O Operations: DASD and Tape -  
Performance View**

**SHARE 2011 Orlando  
Migrating from z10 ICBs to z196  
Infiniband- a Detailed Performance  
Study and User Experience**

**SHARE 2011 Anaheim  
Using And Getting Benefit From SMF  
113 Records - Customer Experience**

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# More Resources



[www.share.org](http://www.share.org) - Several Great Sessions

ResourceLink Website – zEC12 Books

<https://www-304.ibm.com/servers/resourcelink/svc03100.nsf?Opendatabase>

WSC TecDocs

<http://www-03.ibm.com/support/techdocs/atmastr.nsf/Web/TechDocs>

IBM website for Several Tools (FlashDA, IBM Tapetool....)

ResourceLink Website - PR/SM Book

[www.redbooks.ibm.com](http://www.redbooks.ibm.com)

ResourceLink Website - z13 Books

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# Thank You



# THANK YOU!



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