Oracle on Linux on System z with z13 Update -- Why this is one of the Best and Fastest Growing Linux on z Solutions Available

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IBM

Topics -- Oracle On Linux on System z with z13 Update

- Oracle on Linux on z Systems Solution, Certification and Support

- zVM and IBM z13 and Linux with Oracle

- Oracle and I/O and z13 Performance

- IBM Flash System with Oracle

Oracle continues to demonstrate to the marketplace their commitment in delivering solutions as planned for Linux on z Systems

Oracle DB 12C Release 1 Version 12.1.0.2.3 Q114

New

E-Business Suite Release 11x,12.0, 12..1 accessing Oracle DB 12c 12.1.0.1 Q414

New

Siebel Solutions Version 8.1.1.10 accessing Oracle DB 12c 12.1.0.2 Q414

New

Oracle DB 12C Release 1 Version 12.1.0.2 Q414

PeopleTools 8.54 accessing Oracle DB Versions 12.1.0.1 11.2.0.4 Q313

Oracle DB 12C Release 1 Version 12.1.0.1.4 Q314

Siebel Solutions Version accessing Oracle DB 12c Version 12.1.0.1 Q114

E-Business Suite Release 12.2 accessing Oracle DB 11*g* Release 2 Version 11.2.0.3 Q114

Oracle DB 11g Release 2 Version 11.2.0.4.3 Q214

Oracle DB 12C Release 1 Version 12.1.0.1.3 Q214

E-Business Suite Release 12.2.2 accessing Oracle DB 11*g* Release 2 Version 11.2.0.4 Q214

Enterprise Manager Agent 12c Release 2 Version 12.1.0.4 Oracle DB 11gR2, 12c Q214

WebLogic Server 12c Release 1 with Coherence Version 12.1.2 Q413

Oracle DB 11g Release 2 Version 11.2.0.3.8 Q413

Oracle DB 11g Release 2 Version 11.2.0.3.7 Q313

Oracle DB 11g Release 2 Version 11.2.0.3 RHEL 6.2 Support Q113

Siebel CRM Version 8.1.1.10 accessing Oracle DB 11*g* Release 2 10gR2 Q213

Siebel Solutions Version accessing Oracl DB 11g Release 2 Version 11.2.0.4 Q114

Oracle DB 12C Release 1 Version 12.1.0.1.1 Q114

Siebel Solutions Version accessing Oracl DB 11g Release 2 Version 11.2.0.4 Q114

Siebel Public Sector, Loyalty Management Version 8.2.2.3 accessing Oracle DB 11*g* Release 2 10gR2 Q213

Oracle BIEE Version 11.1.1.7 with Oracle DB as DSR* 10*g* Release 2 11*g* Release 2 Q213

SOA and WebCenter 11*g*R1 PS6 WebLogic Server 11*g*R1 11.1.1.6 Q213

Oracle DB 11g Release 2 Version 11.2.0.3.6 Q213

Oracle DB 10*g* Release 2 Version 10.2.0.5.10 Q113

PeopleTools 8.52 accessing Oracle DB 11*g* Release 2 11.2.0.3.1 Q212

Oracle DB 11g Release 2 Version 11.2.0.3.4 Q412

Oracle DB 11g Release 2 Version 11.2.0.4.2 Q114

Oracle DB 11g Release 2 Version 11.2.0.3.5 Q113

Hyperion EPM Version 11.1.2.3 accessing Oracle DB 10*g* Release 2 11*g* Release 2 Q213

Enterprise Manager Agent 12c Release 2 Version 12.1.0.2 Q212

WebLogic Server 12c Release 1 Version 12.1.1x Q212

Oracle DB 11g Release 2 Version 11.2.0.3.3 Q312

PeopleTools 8.51 accessing Oracle DB 11*g* Release 2 11.2.0.3 Q212

Oracle DB 11g Release 2 Version 11.2.0.3.2 Q212

Oracle Billing and Revenue Management Version 7.5.0.0.0 accessing Oracle DB 11g Release 2 Version 11.2.0.3 Q113

Hyperion EPM Version 11.1.2.2 accessing Oracle DB 10*g* Release 2 11*g* Release 2 Q212

PeopleSoft 9.2 PeopleTools 8.53 accessing Oracle DB 11*g* Release 2 11.2.0.3 10gR2 10.2.0.5 Q213

E-Business Suite Release 12.1x accessing Oracle DB 11*g* Release 2 Version 11.2.0.3 Q112

WebLogic Server, SOA, WebCenter 11*g*R1 PS5 Q112

Enterprise Manager Agent Release 12c Version 12.1.0.1 Q212

Oracle DB 11g Release 2 Version 11.2.0.2.5 Q112

Oracle DB 11g Release 2 Version 11.2.0.3.1 Q112

***** Data Source or Repository**

Oracle Technology Solutions for IBM z Systems

		Oracle DB Server on z/OS	**Oracle DB Server on Linux**
Database	Oracle Database 10gR2	**Oracle DB 10g Release 2** *(10.2.0.5) Terminal Release*	**Oracle DB 10g Release 2** *(10.2.0.5)*
	Oracle Database 11gR2	No	**Oracle DB 11g Release 2** *(11.2.0.2, 11.2.0.3, 11.2.0.4)*
	Oracle Database 12c	No **New**	**Oracle DB 12c Release 1** *(12..1.0.1, 12.1.0.2)*

		Oracle Fusion Middleware on z/OS	**Oracle Fusion Middleware on Linux**
Fusion Middleware	Oracle FMW 11gR1	**Not Applicable Oracle DB/FMW**	*WebLogic Server 11g Release 1* (11.1.1.6+) *SOA 11g Release 1* (11.1.1.6+) *WebCenter 11g Release 1* (11.1.1.6+) *Tuxedo 11g Release 1* (11.1.1.2+) *WebLogic Portal 11g Release 1* (10.3.2)
	Oracle FMW 12cR1	**Not Applicable Oracle DB/FMW**	*WebLogic Server* 12c Release 1 (12.1.1+, 12.1.2+) Note: 12.1.2 includes Coherence
Enterprise Manager	Oracle Enterprise Cloud Control Agent	**Not Applicable Oracle DB/FMW**	*12c Release 2* (12.1.0.3 [1] ,12.1.0.4) *Oracle DB 12c* (12.1.0.1) *Oracle DB 11gR2* (11.2.0.3 [1],11.2.0.4)
			12c Release 1 (12.1.0.1, 12.1.0.2) *Oracle DB 11gR2* (11.2.0.2, 11.2.0.3)
Golden Gate	Oracle GoldenGate	*11g Release 2* *(11.2.1.0.5+)* *DB2 v10, 9.1 for z/OS* *(11.2.1.0.1+)* *DB2 v10, 9.1, 8.1 for z/OS* *11g Release 1* *(11.1.1.1.1)* *DB2 v10, 9.1, 8.1 for z/OS*	*11g Release 2* (11.2.1.0.2+) *Oracle DB 10g R2* (10.2.0.4+)

Oracle on Linux on z – Strengths and Growth

- Solution Current with Oracle 12c
- Entire stack officially certified by Oracle (support.oracle.com)
- Oracle Patch Set Updates and Critical Patches for Loz same date as other platforms
- Over 1,000 Customers running Oracle on Loz, all sizes, industries
- Oracle is 'Best Fit' Solution for Loz
- SUSE and RedHat Support
- Dedicated IBM Team, continued growth, new z customer, over 12 POCs underway now
- IBM Oracle Alliance and International Competency Center
- Dedicated System z team in Oracle Development
- Dedicated System z team in Oracle Support
- Oracle presentations on Loz at SHARE, COLLABORATE, SIG, and Webcasts
- Over 10 Redbooks on Oracle z, latest May 14, Oracle participation
    http://www.redbooks.ibm.com/abstracts/sg248159.html?Open
- System z 'My Oracle Support Community' on support.oracle.com
- Active z Oracle User Group, Volunteer led, Oracle and IBM Supported
    www.oraclezsig.org (longest running still active official Oracle user group, 27 years)
- 28th Annual z Oracle SIG User Group Annual Conference, NY, April 2015, Oracle and IBM Supported
    www.oraclezsig.org (includes presentations from past conferences)
- Customer Testimonials
    https://www.youtube.com/watch?v=yIBy6aNTqhQ (Radixx)
    https://www.youtube.com/watch?v=o1SJyv7rNlA&feature=youtu.be (Evertec)

Oracle License Requirements With Linux on z Systems and z13

For **Oracle Enterprise Edition (EE)** Database and **Core Based Pricing**:

- Any z eligible, Oracle licenses are not processor specific, and are transferrable

   1 IFL = 1 Core for any and all z Systems IFLs

-- The Oracle Core Factor for any/all System z is 1.0
      www.oracle.com/us/corporate/contracts/processor-core-factor-table-070634.pdf

 -- There are no special contracts or Oracle licenses for z Systems,
          same licenses, same backup, DR etc terms apply to z as all other systems

-- z LPAR's are considered 'Hard Partitions' by Oracle
      for SubCapacity Pricing, where applicable

-- Oracle license requirements not chanced by multiple threads/core etc (SMT, z13)

IBM z13: SMT – Simultaneous Multi-Threading

- Double the number of hardware threads per core
  - Independent threads can be more effective pipeline utilization

- Threads share resources – may impact single thread performance
  - Pipeline (eg. physical registers, fxu, fpu, lsu etc)
  - Cache

- Throughput improvement is workload dependent
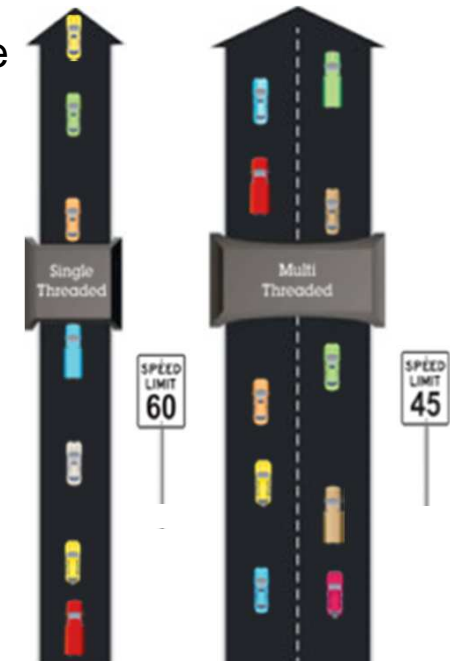
Two zIIP lanes handle more traffic overall
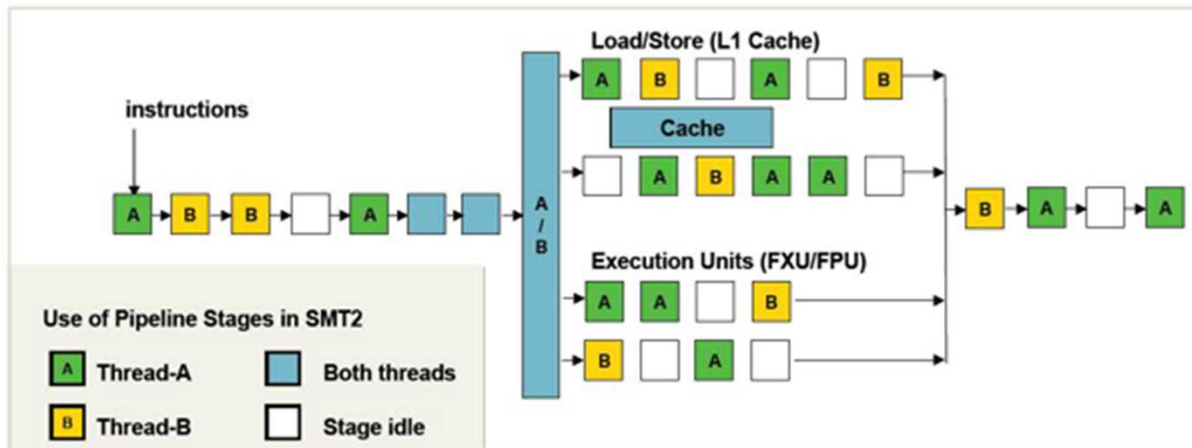
- **Oracle (12c) 12.1.0.2** was released for System z on November 14, 2014 (same date as other platforms). Patches continue to be released for System z on the same date as **ALL** other platforms and are right up to date.

- **IBM z13** supports up to 141 Oracle configurable cores with up to 10 TB of memory.
  - ➢ Clock speed of new cores - 5 GHz
  - ➢ Simultaneous multithreading (SMT) support with z/VM 6.3
  - ➢ z/VM support for Single Instruction Multiple Data (SIMD): In a future deliverable

REC
☆ **Patch 20299023: DATABASE PATCH SET UPDATE 12.1.0.2.3 (APR2015)**

Last Updated   Apr 14, 2015 1:18 AM (Tuesday)

Product   Oracle Database - Enterprise Edition
(More...)

Size   50.9 MB
Download Access   Software
Classification   Security

Release   Oracle 12.1.0.2.0
Platform   IBM: Linux on System z

Patch Tag   All Database

Oracle Database 12.1 Support Update for Linux on System z

Linux on System z specifics

- It's Fast
  - Built using PDF (Profile Directed Feedback).
  - Approximately 5% Faster even with all the new features.
- New Features – less resources
- EM agent 12.1. enabled
  - OEM Cloud Control 12cR3 or 12cR4
- IBM Redbook
  - **Experiences with Oracle Database 12c Release 1 on Linux on System z SG248159** http://www.redbooks.ibm.com/abstracts/sg248159.html?Open

Sizing Consolidated CPU consumption – equivalent MIPS

October 2012 - equivalent MIPS (wo z/VM)
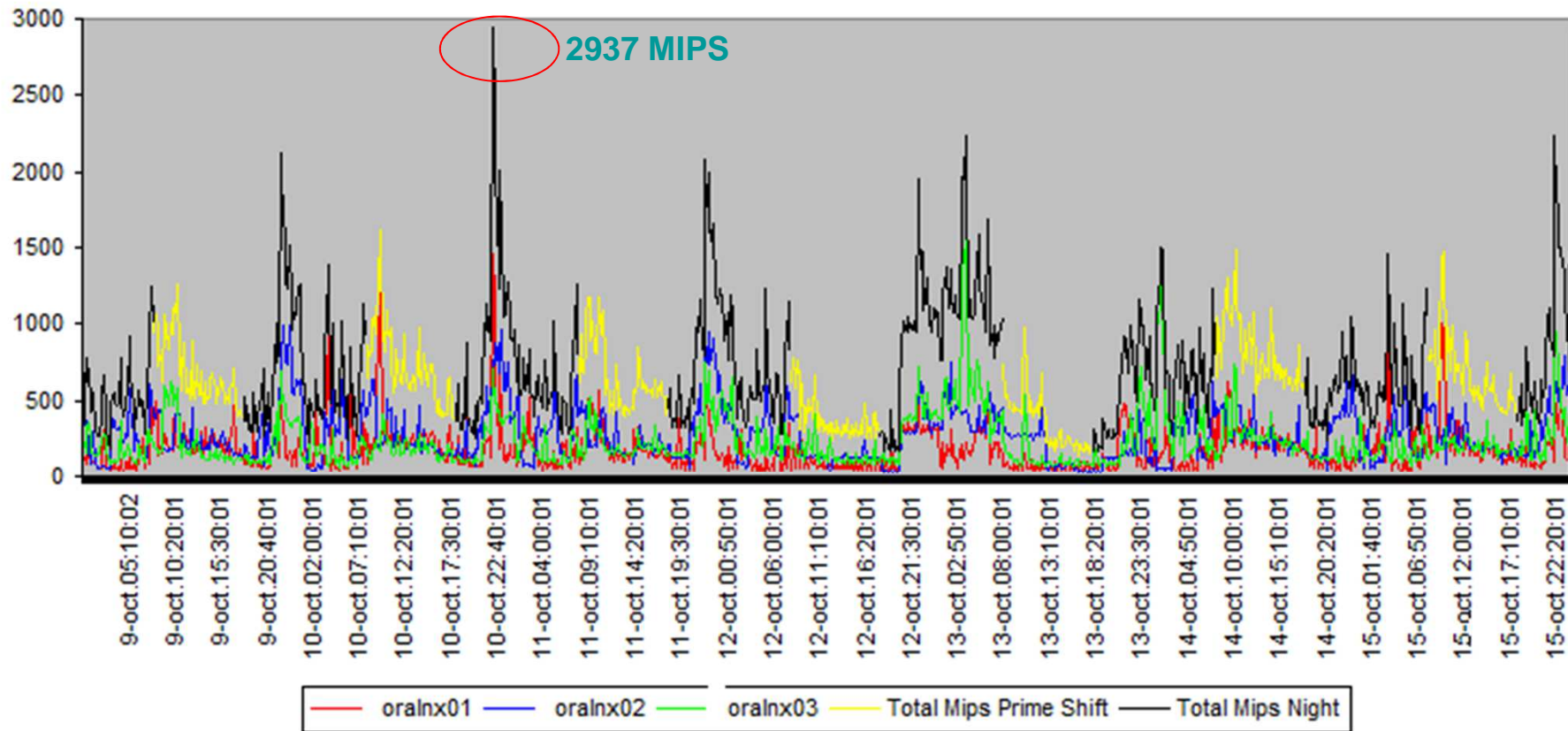
zEC12 vs z13 Testing Parameters

IBM

- Test results in this presentation are my own for Educational purposes only.

- Test results should not be construed as typical for a particular customer workload.

- z/VM development recommend getting good MONWRITE data BEFORE moving to z13 and initially disable SMT if possible.

- Use the z/VM CPUMF / SMTMET tool to extract SMT metrics

http://www.vm.ibm.com/perf/reports/zvm/html/1q5smt.html

- REALLY Important to be on the recommended z/VM service and Linux kernel levels: Suse 11 SP3+ (3.0.101-0.40.1) / Red Hat 6.6+ (2.6.32-504.16.2.el6) per http://www-03.ibm.com/systems/z/os/linux/resources/testedplatforms.html

Testing on zEC12 with 2 Dedicated IFLs

IBM

Instance Efficiency Percentages (Target 100%)

Buffer Nowait %:	100.00	Redo NoWait %:	100.00
Buffer Hit %:	100.00	In-memory Sort %:	100.00
Library Hit %:	99.99	Soft Parse %:	87.07
Execute to Parse %:	99.99	Latch Hit %:	100.00
Parse CPU to Parse Elapsd %:	100.00	% Non-Parse CPU:	99.99
Flash Cache Hit %:	0.00		

Top 10 Foreground Events by Total Wait Time

Event	Waits	Total Wait Time (sec)	Wait Avg(ms)	% DB time	Wait Class
DB CPU		239.6		99.6	
db file sequential read	328	.1	0.33	.0	User I/O
control file sequential read	298	.1	0.36	.0	System I/O

- Silly Little Oracle Benchmark (SLOB)
- Logical I/O (Random memory access to Oracle SGA)
- Want to have 99% + DB CPU and 100% Buffer Hit Ratio for a clean test from Oracle Automatic Workload Repository (AWR) Report.

z13 versus zEC12 hardware comparison

- **zEC12**
  - ► CPU
    - – 5.5 GHz
    - – Enhanced Out-Of-Order
  - ► Caches
    - – L1 private 64k i, 96k d
    - – L2 private 1 MB i + 1 MB d
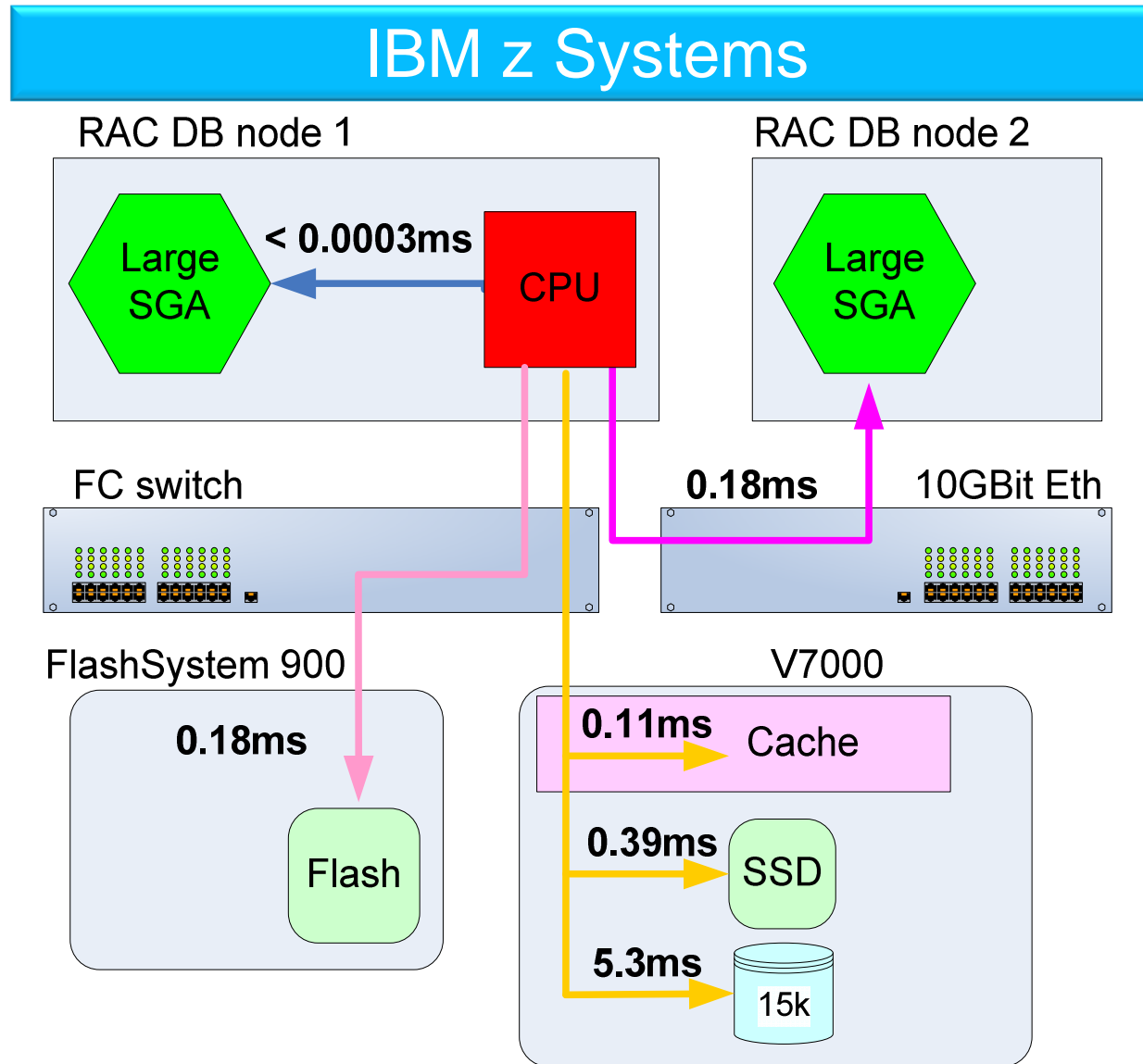   - – L3 shared 48 MB / chip
    - – L4 shared 384 MB / book

Single Book View
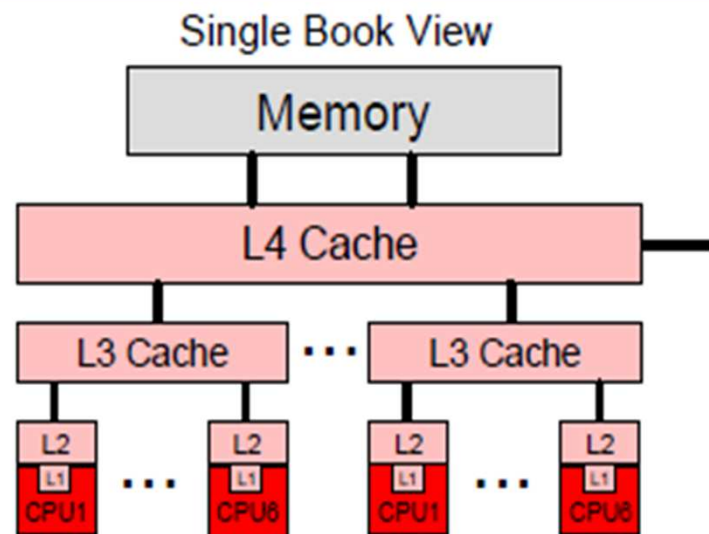
- **z13**
  - ► CPU
    - – 5.0 GHz
    - – Major pipeline enhancements
  - ► Caches
    - – L1 private 96k i, 128k d
    - – L2 private 2 MB i + 2 MB d
    - – L3 shared 64 MB / chip
    - – L4 shared 480 MB / node
      - • plus 224 MB NIC

Single Drawer View
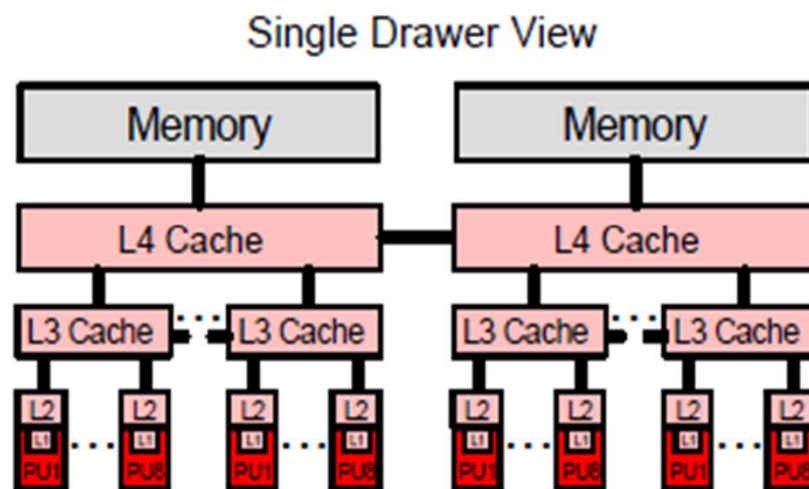
Cache Data Close to the DB

IBM

IBM z Systems

RAC DB node 1

Large SGA

< 0.0003ms

CPU

RAC DB node 2

Large SGA

FC switch

0.18ms 10GBit Eth

FlashSystem 900

0.18ms

Flash

V7000

0.11ms Cache

0.39ms SSD

5.3ms 15k

•The service times shown on this slide reflect the expected random read service time for an 8KB block of data, some are estimated.

System z Networking
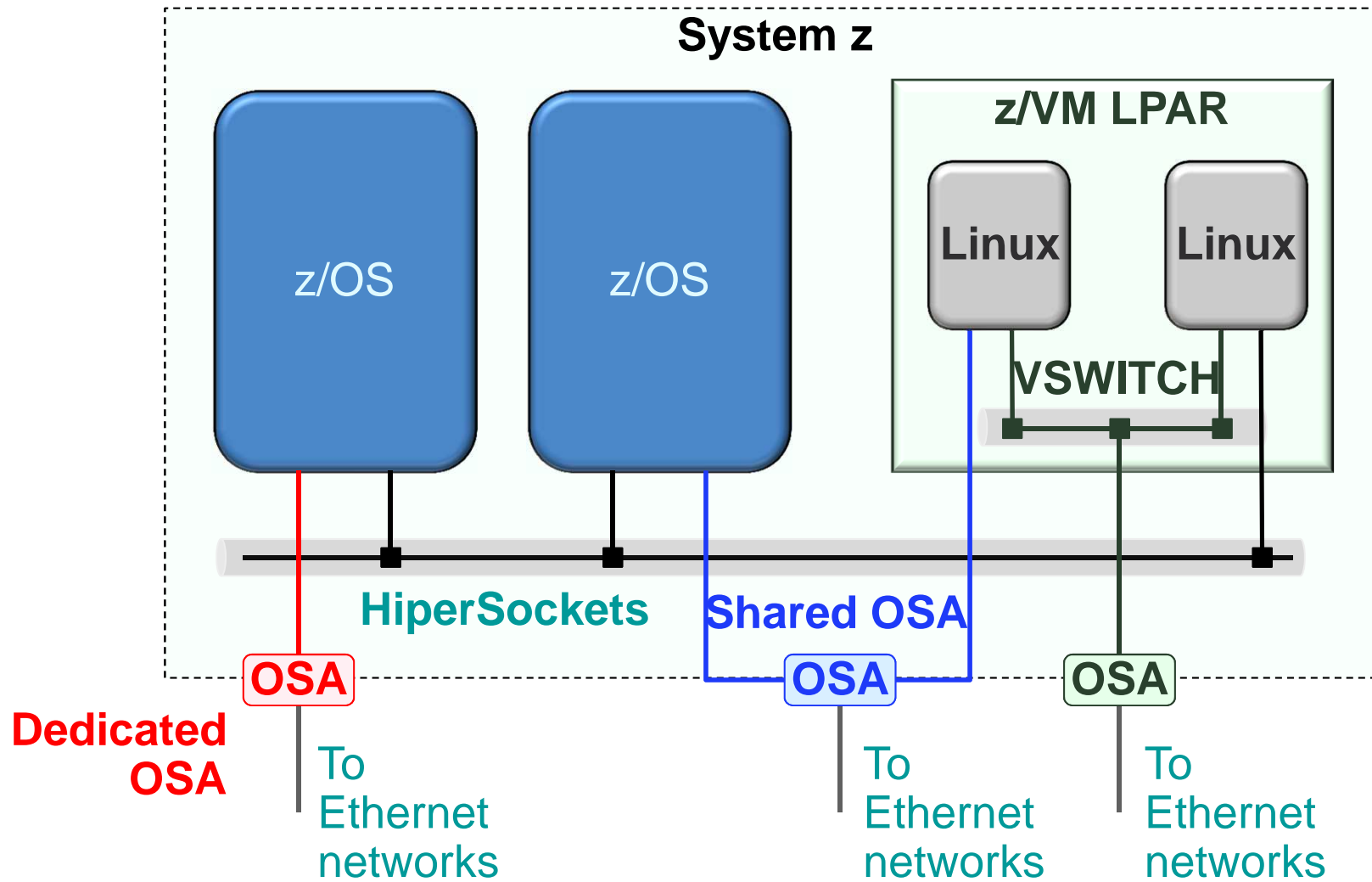
- Choose correct MTU size (should match with App or DB Server)
- Adjust Network queue length kernel parameter
- For high transactional applications try to reduce number of hops (latency) between app and db server
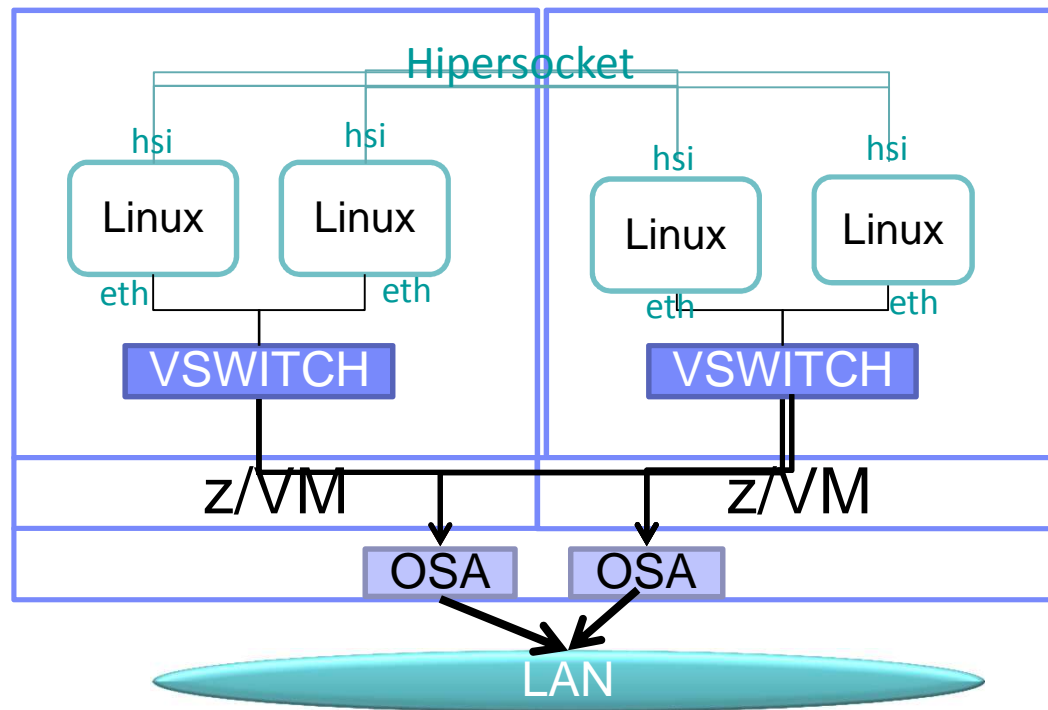
Choose the Correct Network MTU size

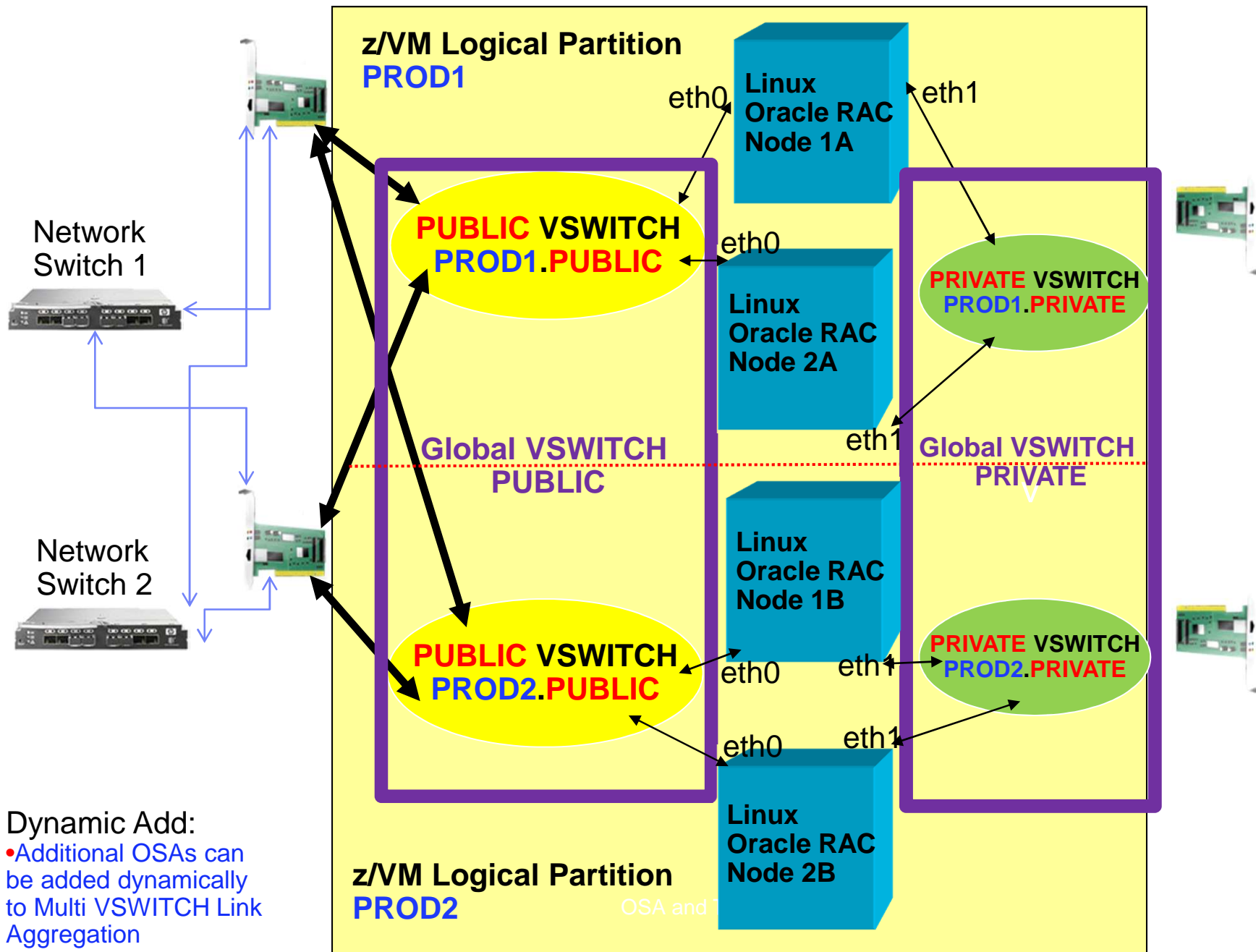| netstat –s of Interconnect	MTU Size of 1492 (default)	MTU Size of 8992 (with 8K DB block size, especially RAC)
Before reassemblies	43,530,572	1,563,179
After reassemblies	54,281,987	1,565,071
Delta assemblies	10,751,415	1,892

Oracle High Availability Networking Options:

- **Link Aggregation** – (Active / Active) Allow up to 8 OSA-Express adapters to be aggregated per virtual switch Each OSA-Express feature must be exclusive to the virtual switch (e.g. OSA's can now be shared

- **Linux Bonding** – create 2 Linux interfaces – e.g. **eth1** & **eth2** and create a bonded interface **bond0** made up of eth1 and eth2.

- **Oracle HAIP** – Oracle 11gR2+ can now have up to 4 Private interconnect interfaces to load balance interconnect traffic.

Oracle Interconnect with z/VM Link Aggregation (zEC12)

IBM

IBM z/VM LPAR

Guest 1: RAC Cluster A

Public Network

eth0: VLAN 100
129.40.18.10

Private Network

eth1 : VLAN 182
10.1.28.1

Guest 2: RAC Cluster B

Public Network

eth0: VLAN 100
129.40.18.12

Private Network

eth1 : VLAN 183
10.1.28.10

Guest 3: RAC Cluster C

Public Network

eth0: VLAN 100
129.40.18.14

Private Network

eth1 : VLAN 184
10.1.28.17

z/VM

**Public z/VM
VSWITCH #1**

**Private z/VM
VSWITCH #2**

OSA 1   OSA 2   OSA 3   OSA 4

LAN
Switch 1

LAN
Switch 2

OSA Card
Dedicated to each VSWITCH
With Link Aggregation

Oracle RAC with z/VM Multi VSWITCH LAG

Multi VSWITCH Link Aggregation

- z/VM 6.3 with APARS VM65583 and PI21053.

- OSA-Express4S & OSA-Express5s support for Multi-Vswitch Link Aggregation requires IBM z13

- A port group (LAG) can be connected to up to 16 LPARS (single CEC). A port group cannot span multiple CECs.

- *Please See Rick Tarcza's presentation* *http://www.vm.ibm.com/virtualnetwork/63lnkag.pdf* *for more information*

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System z & IBM Flash System: Highest Reliability, Maximum Performance

IBM

Now you can leverage the "Economies of Scale" of Flash

- **Easily added to your existing SAN**
- **Accelerate Application Performance**
- **Gain Greater System Utilization**
- **Lower Software & Hardware Cost**
- **Save Power / Cooling / Floor Space**
- **Drive Value Out of Big Data**

IBM FlashSystem is certified (reference SSIC) to attach to Linux on System z, with or without an SVC, to meet your business objectives

Would you like to demo this architecture?

You can now demo hardware either in person or virtually.
Demo Location: Benchmark Center in Poughkeepsie, NY

Performance of Linux on System z with FlashSystem

I/O bound relational databases can benefit from IBM FlashSystem over spinning disks.

- ➢ **21x** reduction in response times*
- ➢ **9x** improvement in IO wait times*
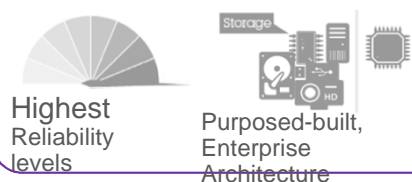- ➢ **2x** improvement in CPU utilization*
  - *** IBM internal test results**
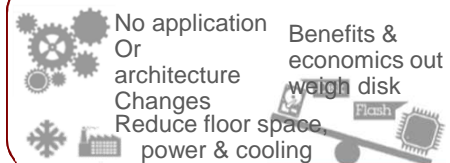
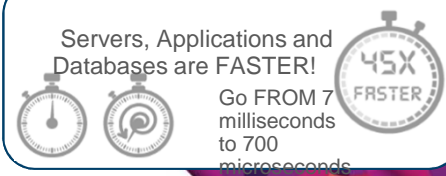## Why IBM FlashSystem for Linux on System z?

Extreme Performance	Enterprise Reliability	Macro Efficiency	IBM MicroLatency™
Cut IO Wait Time 80%+ — **3X increase IOPS** — Latency Under 100 Microseconds	Highest Reliability levels — Purposed-built, Enterprise Architecture	No application Or architecture Changes — Reduce floor space, power & cooling — Benefits & economics out weigh disk	Servers, Applications and Databases are FASTER! Go FROM 7 milliseconds to 700 microseconds — **45X FASTER**

- ## **Summary**

  - I/O bound AWR's can benefit from "Flash" Storage in the following way:
  - **21x** reduction in response times
  - **957%** improvement in IO wait time

Top 5 Timed Foreground Events

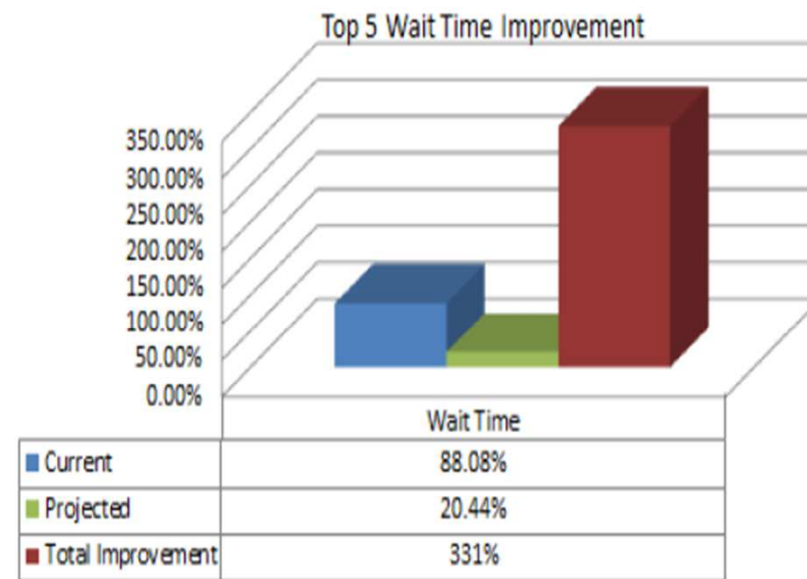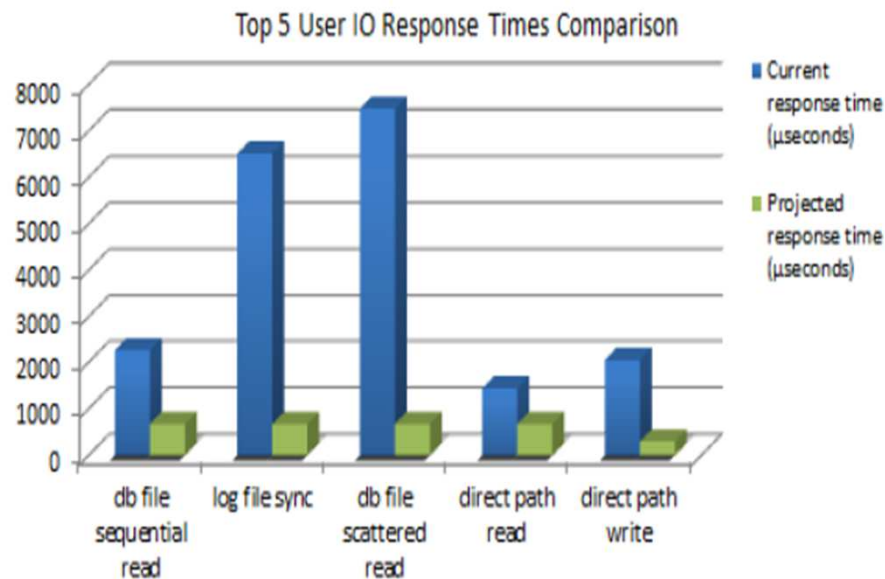| Event	Waits	Time(s)	Avg wait (ms)	% DB time	Wait Class
db file sequential read	16,543,046	126,308	8	47.26	User I/O
log file sync	453,034	81,895	181	30.64	Commit
DB CPU		42,771		16.00	
local write wait	42,921	2,858	67	1.07	User I/O
db file parallel read	94,662	1,847	20	0.69	User I/O

- Other Recommendations

  - Rerun AWR reports after implementing to validate outcomes
  - Use application partitioning on the app-tier to ensure data files and log files are located on the faster storage.

Top 5 Timed Foreground Events

Event	Waits	Time(s)	Avg wait (ms)	% DB time	Wait Class
DB CPU		4,497		78.46	
log file sync	2,047,256	982	0	17.14	Commit
library cache: mutex X	212,427	105	0	1.82	Concurrency
db file scattered read	58,832	44	1	0.77	User I/O
db file sequential read	43,311	18	0	0.31	User I/O

Aggregating factors for FlashSystem implementation

- Reduce User IOWait time

Top 5 User IO Response Times Comparison

	Current response time (μseconds)	Projected response time (μseconds)

Categories: db file sequential read, log file sync, db file scattered read, direct path read, direct path write

Top 5 Wait Time Improvement

	Wait Time
Current	88.08%
Projected	20.44%
Total Improvement	331%

User IOWait events indicate a reduction in IOWait times are possible with a FlashSystem implementation. Db file sequential read is causing the majority of the disk contention across all three AWRs. The IOWait time would decrease from 88.08% of overall wait time to 22.44%, an improvement of **331%**.

Aggregating factors for FlashSystem implementation

- Reduce Response Time / Latency

Latency Reduction

	Current	Projected
■ Average Latency	2.896	0.510
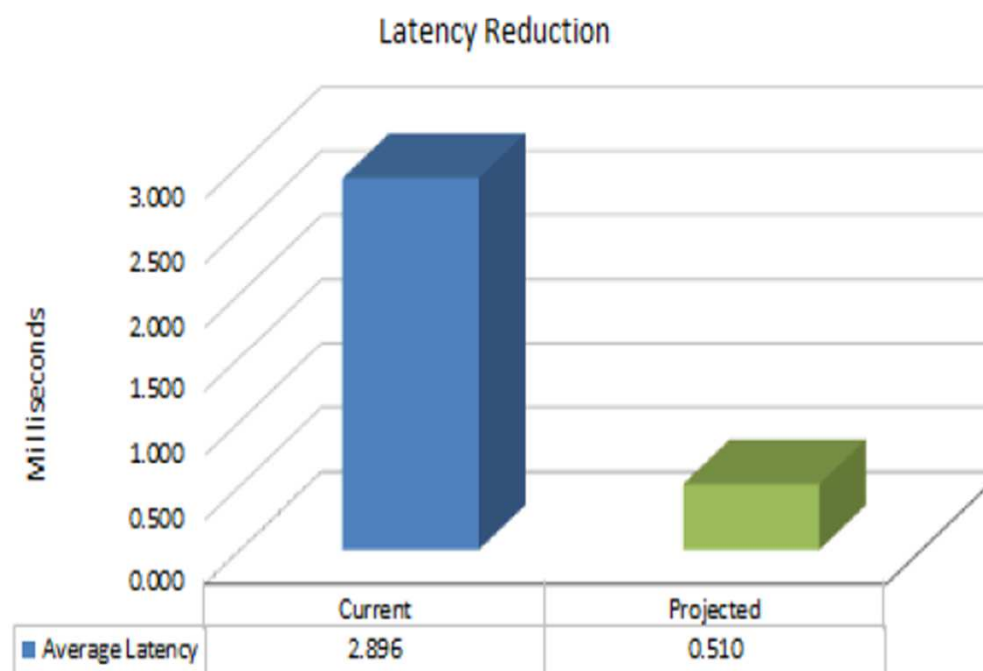
The microsecond response times of the FlashSystem would significantly reduce latency while driving higher utilization at the server and application level. Average Latency would decrease from 2,896 microseconds to 510 microseconds.

Acceleration of Database with IBM FlashSystem
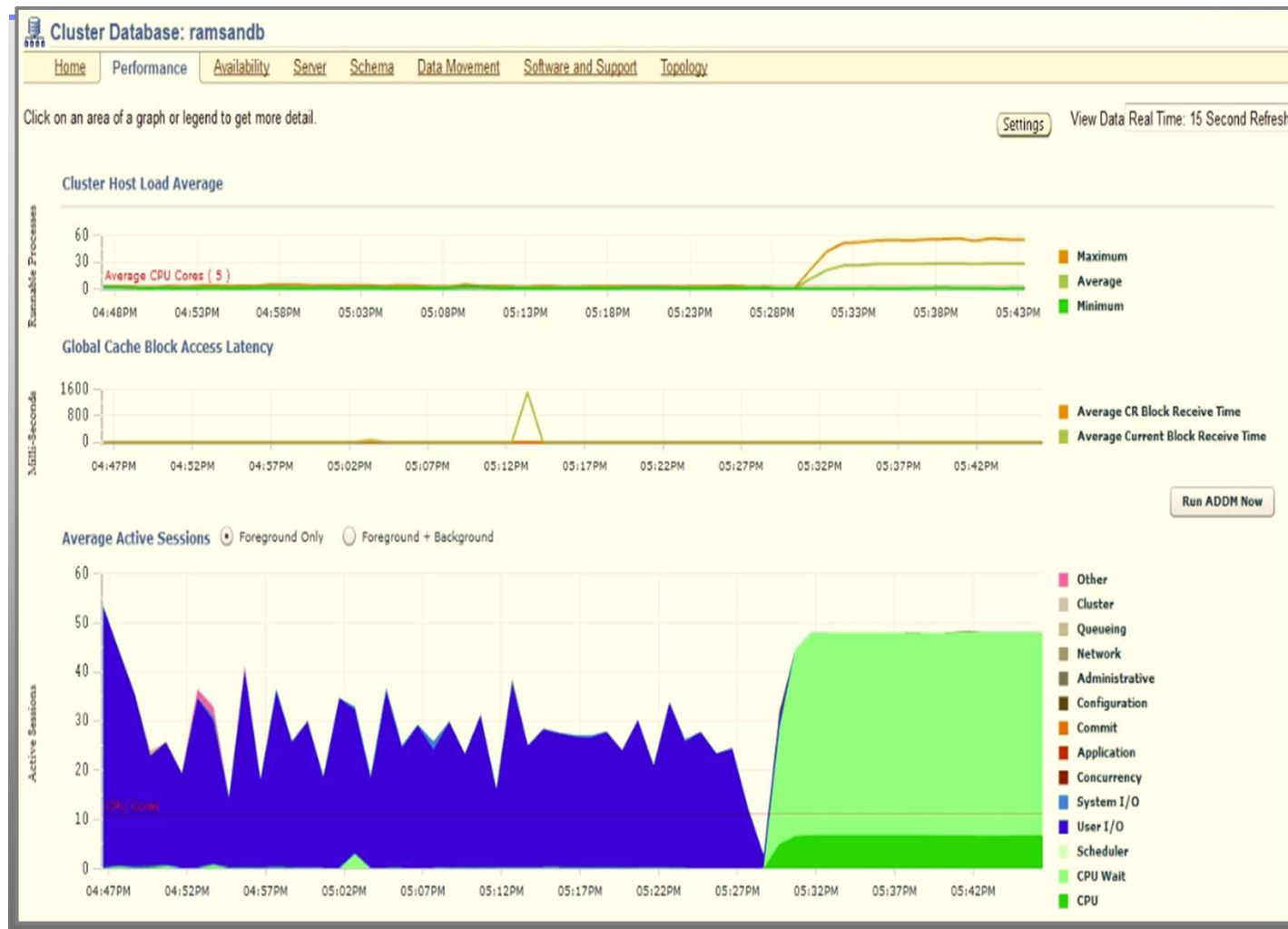
After switching to FlashSystem

(05:27 PM) Disk IO wait disappears and waiting is now on host CPU. This graph shows the effect of the low latency of FlashSystem and how it increases the host CPU utilization.

IBM Flash Systems vs. Competitor Flash Array   **IBM**

In same space and power, IBM FlashSystem delivers 2.4x higher IOPS and up to 14x the usable capacity at around 1/5th the cost per usable Terabyte

	Other Vendor	IBM FlashSystem 900 (5.7 TB cards)	IBM FlashSystem 900 (2.8 TB cards)	IBM FlashSystem 900 (1.2 TB cards)
Max 8k Read IOPS	400,000[1]	955,000 est	955,000 est	845,000 est
Raw Storage	12.8 TB[1]	105.5 TB	52.7 TB	21.4 TB
Usable Storage	3.7 TiB[2]	51.8 TiB[4]	26.3 TiB[4]	10.9 TiB[4]
3-year TCO (List)	$330,880[3]	$947,700	$498,900	$254,100
$/Usable TB (List)	$89k	$18k	$19k	$23k

* In 2014, IBM was the #1 seller of Flash Based storage systems

[1] Data Sheet for 3 servers - 1,036,000 IOPS
[2] ASM High redundancy assumed
[3] Includes disk license and 3 years maintenance
[4] With Variable Stripe RAID

Oracle Certified Virtualized Platforms

- Oracle VM & IBM z/VM Hypervisors are CERTIFIED to run Oracle workloads. (IBM PowerVM, z PR/SM support LPAR virtualization as well)

- VMWARE supported but NOT certified by Oracle.

- Oracle VM cannot do memory overcommit – maximum recommended overcommit of virtual to real processors is 2:1

- IBM z/VM handles over commitment of Memory and Virtual processors very well. (You still need to conserve resources where possible!)

Source: http://www.oracle.com/technetwork/database/virtualizationmatrix-172995.html

Summary

IBM

- Performance
  - Oracle runs well on System z for both memory access (Logical I/O)
  - Integration with Flash Systems allows Oracle to run well with Physical I/Os

- Consolidation
  - z/VM can virtualize / overcommit resources well.
  - System z can run Oracle at very high cpu utilization rates with little degradation.
  - System z can dynamically add system resources (memory, network, cpu)

- Highly Available
  - System z runs Oracle workloads highly available (hardware) and in some cases can avoid configuring Oracle RAC for availability.
  - Linux HA solutions can be leveraged to increase application availability.

- Security
  - Oracle on System z can be ran highly secure with FIPs (US Govt.) 140-2 compliance at z/VM and Oracle levels.
  - SSL Crypto card support for Oracle SQL*net network traffic.

Information Sources

- http://www.oracle.com/ibm
  - Oracle IBM Partner Relationship
- http://otn.oracle.com
  - Oracle Select "Downloads"
- http://www.vm.ibm.com/perf/tips
  - General z/VM Performance & Tuning Tips, Capacity planning
  - http://www.vm.ibm.com/virtualnetwork/63lnkag.pdf
- https://support.oracle.com
  - Oracle Support Webpage (My Oracle Support)
- http://www-124.ibm.com/developerworks/oss/linux390/index.shtml
  - Lot's of information on Linux for zSeries, IBM DeveloperWorks
- http://www-128.ibm.com/developerworks/linux/linux390/perf/index.html
  - Hints and Tips for tuning Linux on System z
- http://www.zseriesoraclesig.org
  - Special Interest Group of Oracle users on the mainframe (z/OS and Linux)
- http://www.mail-archive.com/linux-390%40vm.marist.edu/
  - Marist List Server
- http://www.ibm.com/redbooks
  - SG24-6482-00 Experiences with Oracle Database 10g on Linux for zSeries
  - SG24-7191-00 Experiences with Oracle 10gR2 Solutions on Linux for System z
  - SG24-7573-00 Using Oracle Solutions on Linux on System z
  - SG24-7634-00 Experiences with Oracle Solutions on Linux for IBM System z
  - SG24-8159-00 Experiences with Oracle Database 12c Release 1 On Linux on System z
  - REDP-4788-00 Installing Oracle 11gR2 RAC on Linux on System z

Questions?