2012
IBM System z Technical University

Enabling the infrastructure for smarter computing

Oracle on the Mainframe –
Reducing operational cost through consolidation

zLG24

Siegfried Langer

Abstract

zLG24 Oracle on the Mainframe — Reducing operational cost through consolidation
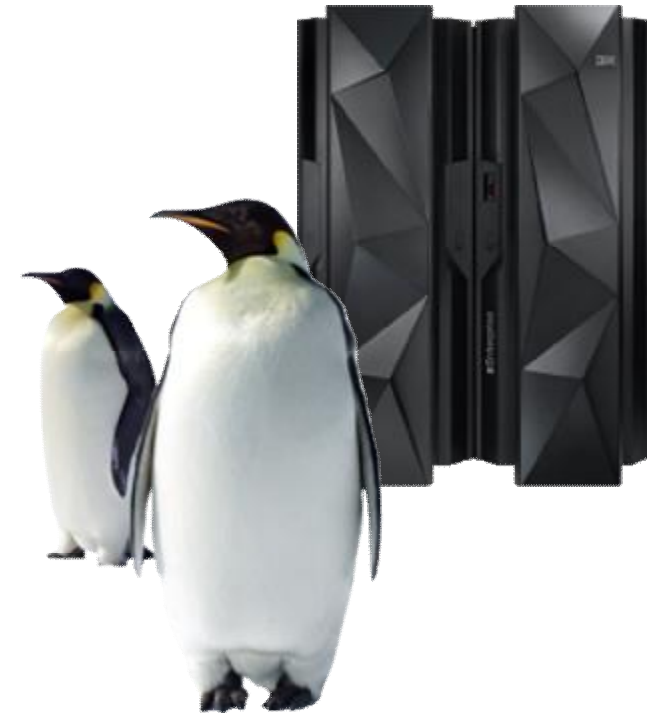
Siegfried Langer

Lecture — Intermediate

Many clients are using Oracle on the mainframe. Linux on System z provides the strategic platform for Oracle on the highly scalable servers of the IBM System z and zEnterprise. The consolidation of distributed Oracle servers explores a large potential for savings on software license cost and operational cost, such as service personnel, power, space, and air-condition. Based on the high degree of integration and virtualization, it is possible to centralize systems management, reducing security risks and management efforts. Centralized backup, high availability, and disaster recovery solutions are easier implemented.

What are the characteristics that make the modern mainframe so attractive for Oracle based solutions? Besides the technical characteristics the presentation will discuss potential savings based on customer examples. In a first step you can consolidate distributed systems in a virtualized environment under Linux. This provides possibilities for further business optimization, for example, the consolidation of single (isolated) databases to a consistent information system without the need to change the physical server infrastructure.

Discussion Topics

- **The IBM & Oracle relationship**

- **Business case for Oracle consolidation**

- **System z virtualization**

- **High-availability and Disaster Recovery**

- **Deploy to the best fit technology**

The IBM & Oracle Relationship

Sustaining Partnership

- **Oracle 24 Yrs, PeopleSoft 21 Yrs, JD Edwards 32 Yrs, Siebel 10 Yrs.**

Oracle is an IBM *"Integrated Account"* (2005)

- **Regular Executive Reviews – Global and Geographic**
- **Named Oracle Sponsor: Charles Phillips, Oracle's Co-President**
- **Dedicated IBM executive-led alliance team**

Over 19,000 Joint Customers Worldwide

- **Hardware and Software support via Apps Unlimited**

Vibrant Technology Relationship

- **Substantial investment in skills and resources**
- **Dedicated International Competency Center**

Market Leading Services Practice

- **IBM's GBS is Oracle's #1 SI Partner (4900 Joint Projects!)**
- **9,500 skilled, of which 5,500 are dedicated to Oracle Practice**

Unrivaled Customer Support Process

- **Dedicated On-Site Resources**
- **Significant Program Investments**

IBM and Oracle business relationship

- **Oracle Software Stack is certified and supported on certified distributions of Linux (RHEL or SLES) running natively in LPARs or as a guest operating system in z/VM virtual machines deployed on the System z platform. (My Oracle Support reference Doc ID: 417770.1).**

- Products certified for the System z platform qualify for the same level of support as any other certified Oracle platform.

- There is a dedicated Oracle team @ Oracle specially trained to support customers running Oracle with Linux on System z servers.

- Oracle support policy for security patches for Linux on System z servers:
  - Security patches also known as "CPU patches" are now included in the quarterly PSU (Patch Set Updates) for all platforms.

- Products ported to Linux on System z servers will be supported according to the Oracle Lifetime Support Policy.

- IBM and Oracle Business Relationship:
  - The IBM and Oracle Web site hosted by IBM at: http://www.ibm.com/solutions/oracle
  - The IBM Partner Relationship Web site hosted by Oracle at: http://solutions.oracle.com/partners/ibm
  - Frequently asked questions from IBM and Oracle customers about Linux on IBM System z http://www.ibm.com/support/techdocs

Oracle and Linux on System z – IBM & Oracle working together

- Linux on System z is Oracle's platform for the mainframe
- Oracle database 11g R2 available on Linux on System z (since 1Q2011)
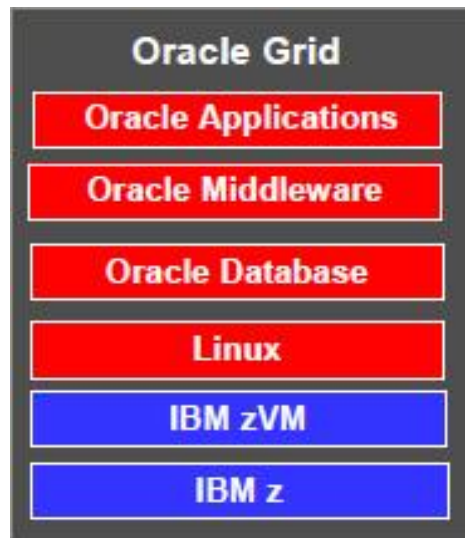
http://www.redbooks.ibm.com/abstracts/sg247191.html

IBM

Why System z for Oracle

- High Availability Requirements

- Open Standards and Linux

- Disaster Recovery Requirements

- Customer Data on Mainframe

- Increased Performance Requirements

- Economics of Linux (IFL) Specialty Engines

- TCO versus Total Cost of Acquisition

- 'Green' Value from Mainframe

- zEnterprise servers can virtualize everything with up to 100% utilization rates

- zEnterprise is the only Heterogeneous platform in the industry

- System z has the highest security rating or classification for any commercial server

State of Oklahoma Department of Human Services: Making a Difference for the Business and Consolidating Servers

"We were so close to the end of our lifecycle on HP-UX, and the hardware was getting very expensive to support," says Sunni Majors, director of Enterprise Technical Services.

"By moving Oracle to the Linux System z platform, we were able to restructure costs for CPUs and move away from licensing by user. This gave us a better return on our investment, since we experienced significant savings in our hardware and software licensing costs by consolidating resources onto a single platform."

OKDHS IT also was pleasantly surprised at the ease of the server and application migration to Linux on System z, although it remains vigilant when it comes to asset management and TCO throughout its IT architecture.

www.mainframezone.com/interviews/state-of-oklahoma-department-of-human-services-making-a-difference-for-the-

Discussion Topics

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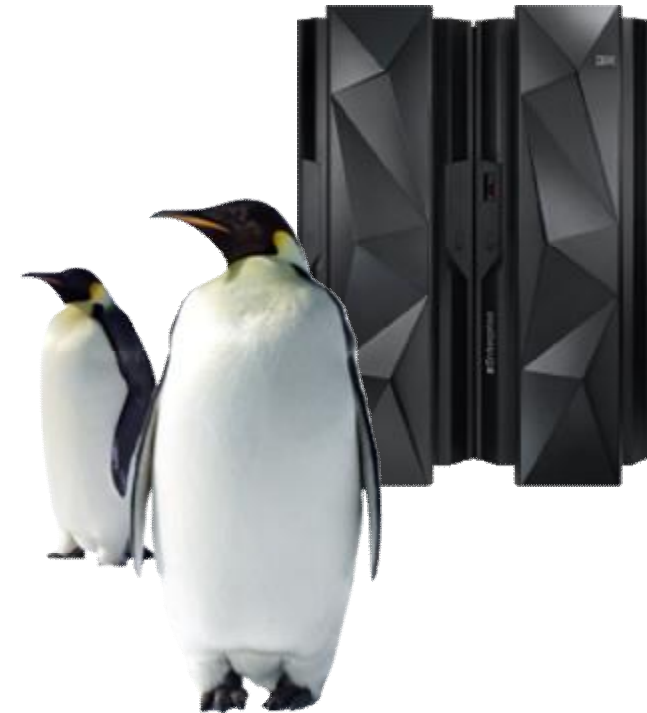
A Government Organization Consolidates Applications and Data to Drive Down Costs of Hardware, Software, and Management by 70%!
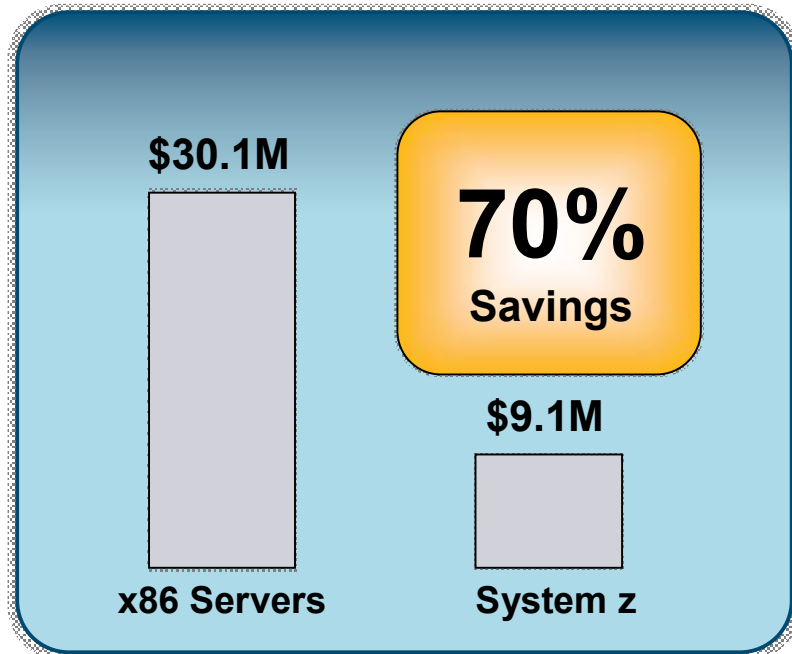
Top three reasons for savings

$30.1M

70%
Savings

$9.1M

x86 Servers   **System z**

Customer: A regional North American government organization

Consolidated 292 Oracle servers to one System z

System administration costs reduced 90%

Subscription and support licenses reduced over 95%

Other benefits:
Superior resiliency and security
Single administrator productivity
Infrastructure simplification
Lower energy costs

IBM

Why High-End Servers?

Utilization on x86 systems

Peak 3 Servers

Peak 3 Servers

Peak 3 Servers

Peak 3 Servers

Peak 3 Servers
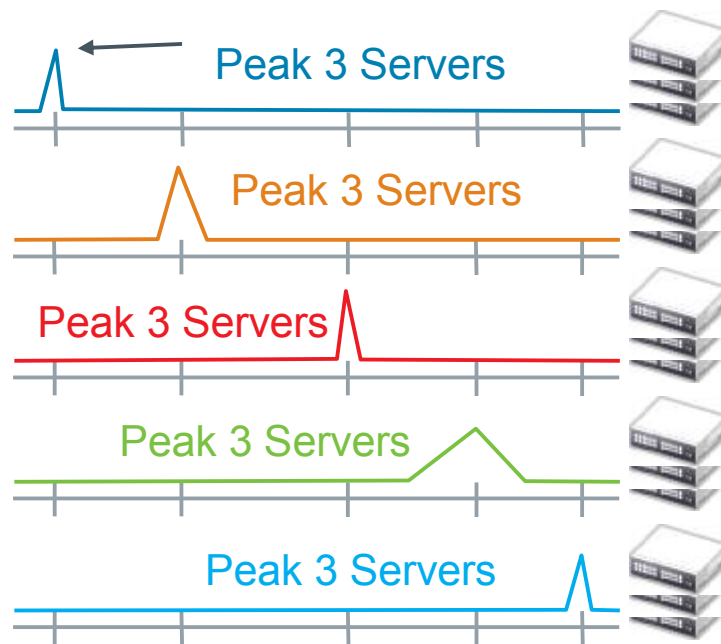
According to a study by Gartner, data centers that do not use virtualization have an average server CPU utilization rate of only 15%.

Mixed Utilization on IBM High End Servers
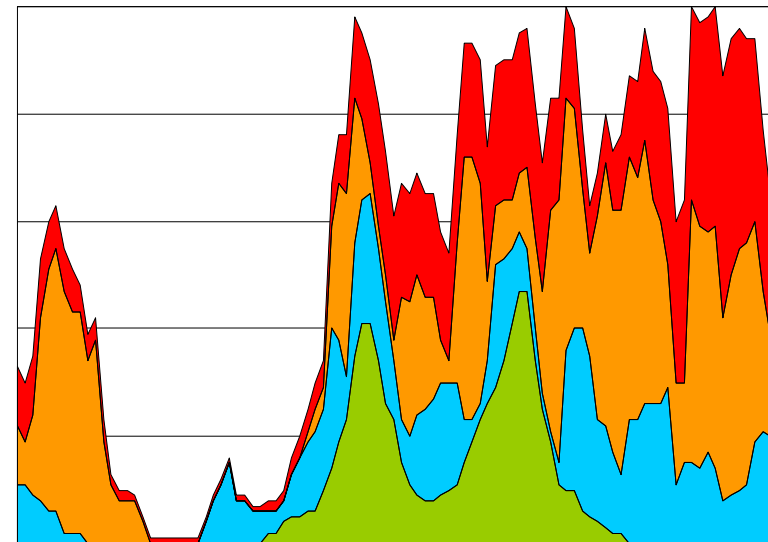
IBM High End Server: Up to 100% utilization

‒ Highly virtualized and shared resources

‒ Fewer servers, less power, cooling & admin

‒ Optimized use of SW assets

High Core-to-Core Ratios for Consolidations
From Distributed IT-Environments to ELS

Real customer examples with real workloads!

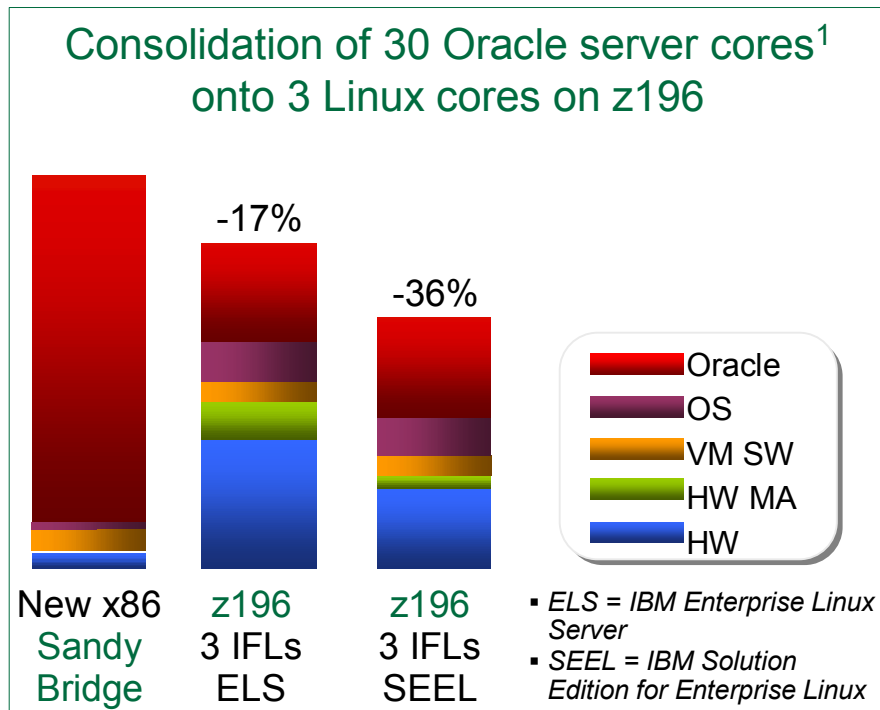| Industry	Distributed Cores	IBM Enterprise Linux Server™ Cores	Core-to-Core Ratio*
Public	292	5	58 to 1
Banking	111	4	27 to 1
Finance	442	16	27 to 1
Banking	131	5	26 to 1
Insurance	350	15	23 to 1
Insurance	500+	22	22 to 1
Banking	63	3	21 to 1
Finance	854	53	16 to 1
Health care	144	14	10 to 1
Transportation	84	9	9 to 1
Insurance	7	1	7 to 1

* Client results will vary based on each specific customer environment including types of workloads, utilization levels, target consolidation hardware, and other implementation requirements.

An IT Optimization platform that is tuned to the task

zEnterprise offers an ideal platform for solving the Server Sprawl Problem with effective IT Optimization

- **Large-scale server consolidation to Linux® on zEnterprise**
  - *Allows hundreds of workloads to be deployed over fewer cores in a single system*
  - *Massive reductions in software license, energy and facilities costs*

Consolidation of 30 Oracle server cores[1]
onto 3 Linux cores on z196

-17%

-36%

■ Oracle	
■ OS	
■ VM SW	
■ HW MA	
■ HW	

New x86
Sandy
Bridge

z196
3 IFLs
ELS

z196
3 IFLs
SEEL

- *ELS = IBM Enterprise Linux Server*
- *SEEL = IBM Solution Edition for Enterprise Linux*

zEnterprise can manage up to 100,000 virtual servers.[1]

*NOTE ALL PRICING AND PERFORMANCE DATA IS PRELIMINARY AND FOR GUIDANCE ONLY
Distributed server comparison is based on IBM cost modeling of Linux on zEnterprise vs. alternative distributed servers. Given there are multiple factors in this analysis such as utilization rates, application type, local pricing, etc., savings may vary by user.

[1] IBM calculations of zEnterprise limits across maximum z196 configuration. Results may vary

Reducing software cost through consolidation
Example: Oracle database

- License and annual Software Update License & Support is based on processor cores
- A "processor core factor" is applied to adjust for different technologies

ORACLE®
Oracle Technology Global Price List
September 26, 2012
Software Investment Guide

http://www.oracle.com/us/corporate/pricing/technology-price-list-070617.pdf

Software Update Licenses & Support (annually) is typically 22% of Processor License (one time charge)
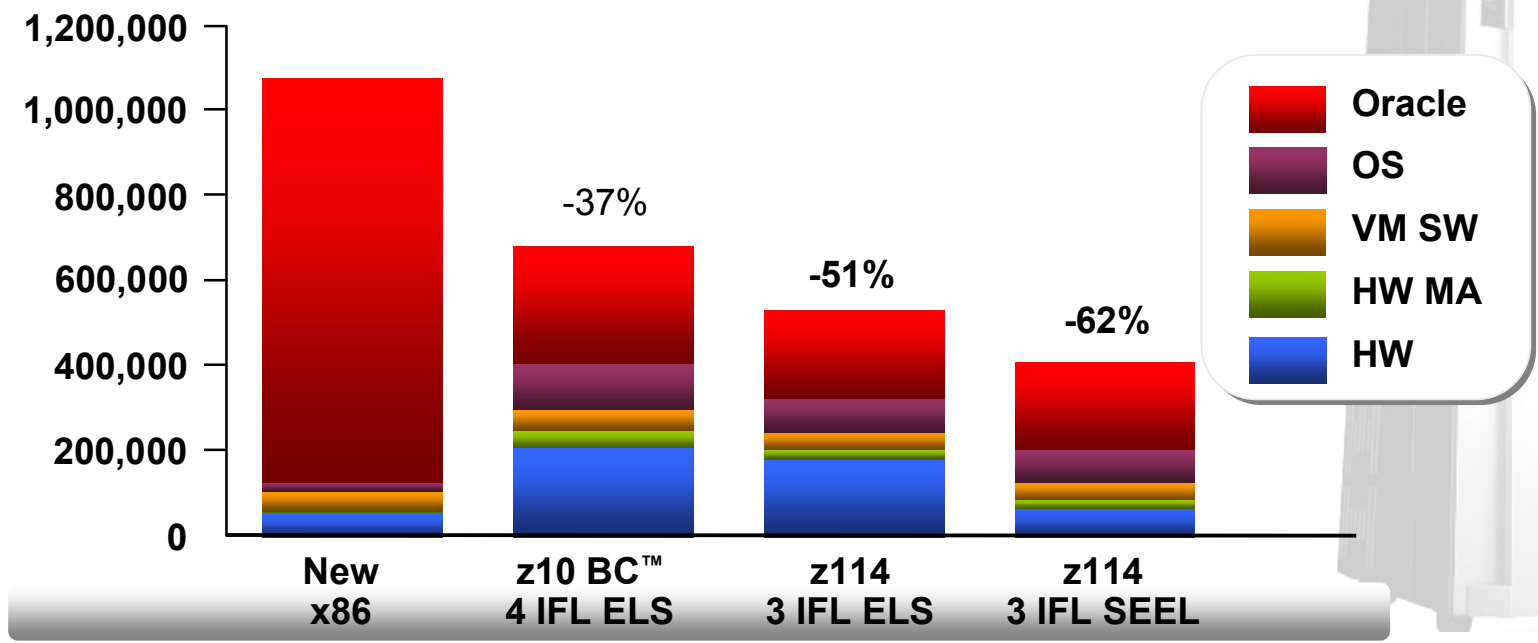
ORACLE®
Oracle Processor Core Factor Table
Effective Date: March 16, 2009

Vendor and Processor	Core Processor Licensing Factor
Intel Xeon Series 56XX, Series 65XX, Series 75XX, Series E7-28XX, Series E7-48XX, Series E7-88XX, Series E5-24XX, Series E5-26XX, Series E5-46XX, Series E5-16XX, Series E3-12XX or earlier Multicore chips	0.5
Intel Itanium Series 93XX (For servers purchased on or after Dec 1st, 2010)	1.0
IBM POWER6	1.0
IBM POWER7	1.0
IBM System z (z10 and earlier)	1.0
All Other Multicore chips	1.0

http://www.oracle.com/us/corporate/contracts/processor-core-factor-table-070634.pdf

The economics of Linux on z114 for consolidation and cost reduction

TCA Analysis:

Consolidate 40 Oracle server cores onto 3 Linux cores on z114

Lower acquisition costs of hardware and software vs. distributed servers
– up to 51% less than Nehalem[2] in new footprint (Enterprise Linux Server (ELS)) –
– or up to 62% less when adding to existing footprint (Solution Edition for Enterprise Linux (SEEL)) –
Plus, additional savings in DR, floor space, power, cooling and labor costs

Legend: Oracle, OS, VM SW, HW MA, HW

Bars: New x86; z10 BC™ 4 IFL ELS (-37%); z114 3 IFL ELS (-51%); z114 3 IFL SEEL (-62%)

[1] Based on US Enterprise Linux Server pricing. Pricing may vary by country. Model configuration included 10 IFL cores running a mixed workload averaging 31 virtual machines per core with varying degrees of activity. Includes zEnterprise hardware and z/VM virtualization software. Does not include Linux OS or middleware software.
[2] Distributed server comparison is based on IBM cost modeling of Linux on zEnterprise vs. alternative distributed servers. Given there are multiple factors in this analysis such as utilization rates, application type, local pricing, etc., savings may vary by user.

Enterprise Linux Server – Entry Configuration (real customer!)

Tangible benefits:

	Existing 4 HP Alpha Server ES45 + HP disks 4x3 CPU Alpha 21264C 9x1 core Oracle license	IBM BladeCenter H 2 HS22 w/2 proc. 4-core IBM Storwize V7000 disks 16x0.5 core Oracle license	IBM BladeCenter H 2 IBM P7 PS700 4-core IBM Storage DS5020 8x1 core Oracle DB license	IBM System z10 ELS 1 IFL IBM Storwize V7000 1 Oracle EE license
1st year	164,234	219,998	242,888	234,040
2nd year	164,234	74,234	74,234	8,248
3rd year	164,234	74,234	74,234	8,248
Total (3 years)	€ 492,701	€ 368,465	€ 391,355	€ 250,537

*Prices based on actual European market prices (Euro). Local pricing and conditions will vary!*

Intangible benefits:
Improved security – no information leak during data copy between servers
Improved availability – no network routers or switches
Highest reliability and centralized systems management

Deploy IBM Software to Utilize Oracle DB on System z

Government Client - USA

- Rapidly growing DB workload, rich in Sun servers, running out of space and power!

▶ Solution: z196, z/VM, Linux, WebSphere Application Server Network Deployment, Tivoli Proventia Network

▶ Net result: 106 Solaris/Sun cores down to „just 6" on z196

| WebSphere ND |
| Tivoli Proventia Network |
| Oracle DB |
| Linux |
| z/VM |
| System z PR/SM |
| z HW Resources |
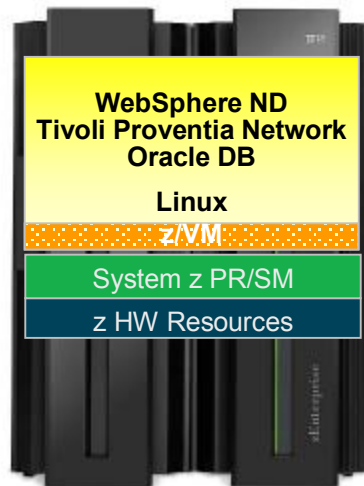
IBM internal reference

Build new and replace existing apps utilizing Oracle DB on Linux on z.

✓ Consolidated DB environment with reduced operating costs and improved performance metrics

✓ Latency between the Oracle and Solaris environments was greatly reduced

✓ Long running batch jobs that had took 30hours in the Sun environment were running in just 15minutes on the z196

✓ Server footprint was sharply reduced, giving up valuable floor space while saving energy, maintenance and software licensing costs

IBM

Dundee City Council

Dundee City Council delivers value through new technologies

Creating a cost-effective IT architecture with IBM System z and IBM XIV Storage System technologies

Overview

Business challenge
Like all UK local authorities, Dundee City Council needs to handle increasing demand for IT and eGovernment services, while also reducing costs in line with central government targets. When the lease on its server and storage hardware needed to be renewed, the Council saw an opportunity to enhance its capabilities and increase value for money.

Solution
Dundee worked with IBM to upgrade its mainframe environment with two powerful IBM System z10 servers, and introduced the IBM XIV Storage System to replace a mixed storage environment. The new infrastructure runs a range of Linux applications and Oracle databases – supporting key systems such as social services 24x7.

Dundee is Scotland's fourth largest city, home to 145,000 people. A former industrial centre, Dundee has transformed itself into a UK centre for life sciences and digital media. As a result, the city has been named one of the world's top seven intelligent communities for three of the past four years (see www.intelligentcommunity.org).

Dundee City Council employs around 10,000 people, and provides a wide range of municipal services for citizens, many of which rely on IT support. The council runs numerous applications to support both internal processes and public-facing systems, such as its Web portal (www.dundeecity.gov.uk), which provides information and online services.

Linux on System z

For several years, the council has run all its core IT systems (mostly Oracle databases and applications) on SUSE Linux Enterprise Server, running on IBM System z servers.

"Running Linux on the System z platform is a cost-efficient approach, especially for software like Oracle, which is licensed on a per-processor basis," explains Tim Simpson, IT Support Manager at Dundee City Council. "We can run 60 virtual machines on just four System z processors – whereas an equivalent x86-based architecture might require several processors for each server! So the savings can be considerable."

Leasing leading-edge hardware

The council's existing servers – a pair of z9 Business Class machines – were leased from IBM, and the existing lease was due to expire.

"The best thing about our leasing strategy is that it allows us to continually upgrade to the latest, fastest IBM hardware, while maintaining our costs at a steady level," says Simpson. "When our latest lease was coming up for renewal, we realised it was a good opportunity to rethink our storage architecture too."

At the time, the council's storage infrastructure was based on a mixture of SGI and IBM storage arrays, virtualised using a solution from LSI.

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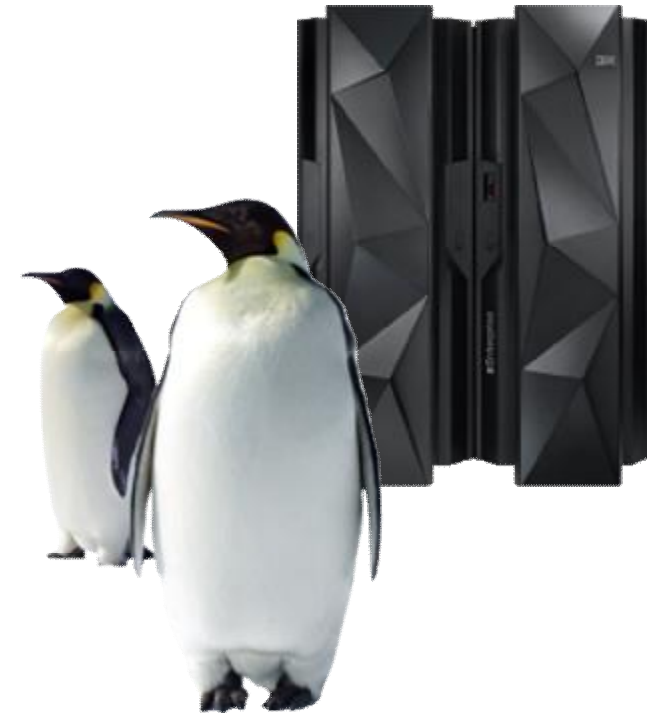
The z10 BC machines each contain two IFL processors, and run approximately 60 virtual Linux servers in total.

"We can run 60 virtual machines on just four System z processors – whereas an equivalent x86-based architecture might require several processors for each server! So the savings can be considerable."

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- **System z virtualization**

- **High-availability and Disaster Recovery**

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System z – Extreme **Virtualisation**
Build-in and Shared Everything Architecture

Hardware assisted
virtualization

LPAR – PR/SM – up to 60 Logical Partitions
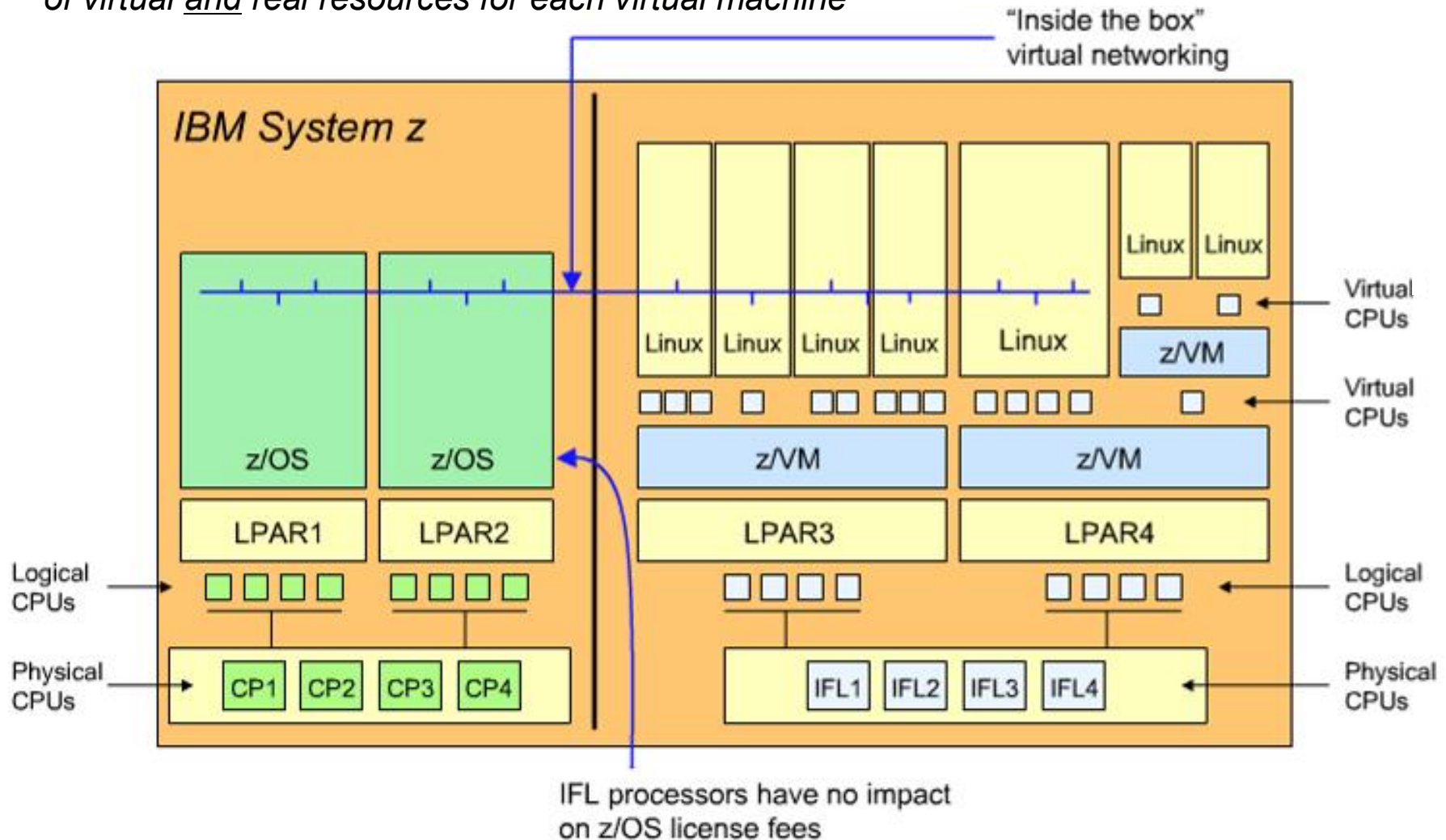
z/VM – 100's of Virtual Machines
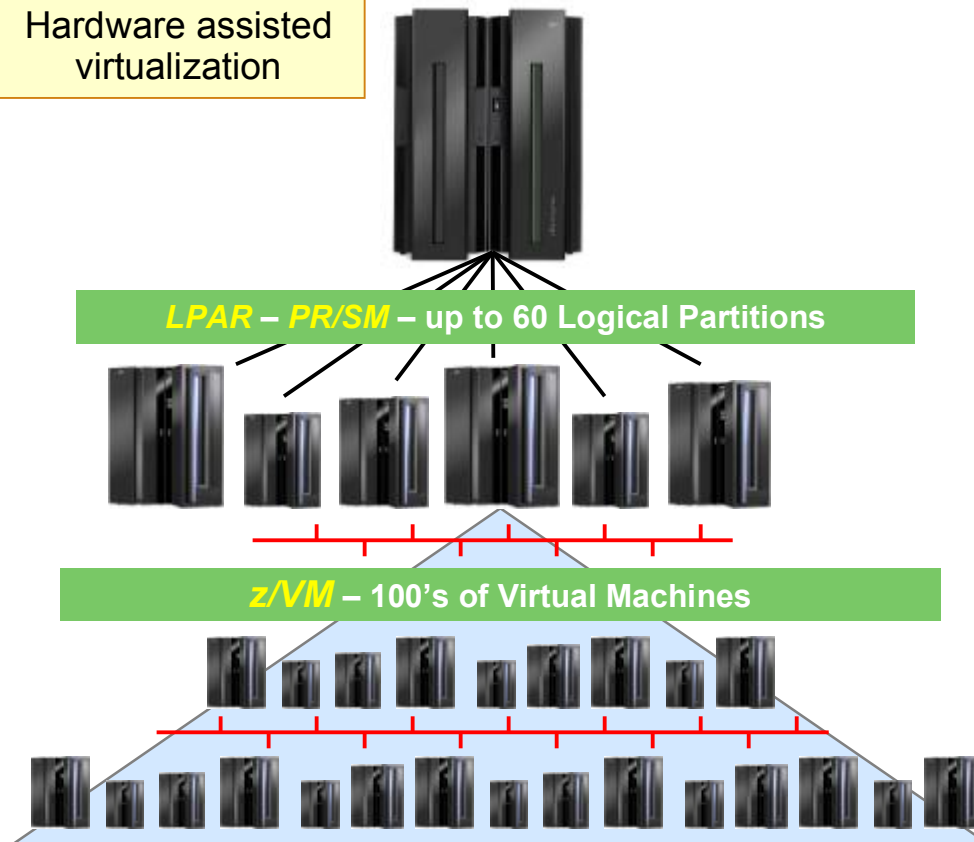
System z

- Provisioning of virtual servers in seconds
- High granularity of resource sharing (<1%)
- Upgrade of physical resources without taking the system down
- Scalability of up to 1000's of virtual servers
- More with less: more virtual servers per core, sharing of physical resources
- Extensive life-cycle management
- HW-supported isolation, highly secure (EAL5 or EAL4+ certified)

Distributed platforms

- Limited virtual server scalability per core
- Scaling requires additional physical servers
- Operational complexity increases with growth of virtual server images
- VMware, Xen, Hyper-V focus on x86, no HW management across multiple platforms

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IBM

Extreme Virtualization with z/VM

z/VM can massively scale a virtual server environment with a mix of virtual <u>and</u> real resources for each virtual machine

"Inside the box" virtual networking

IFL processors have no impact on z/OS license fees

Oracle and System z together
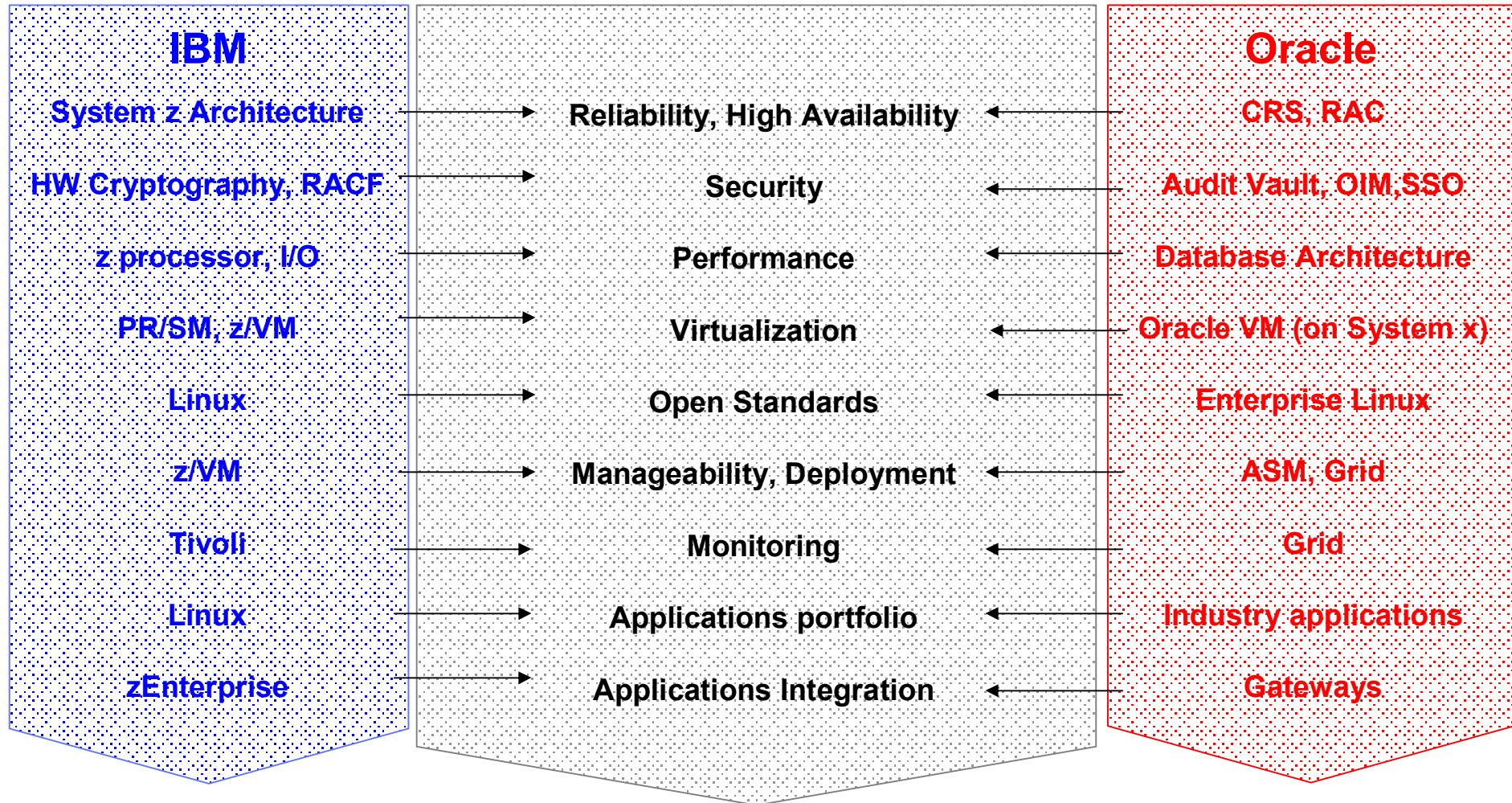
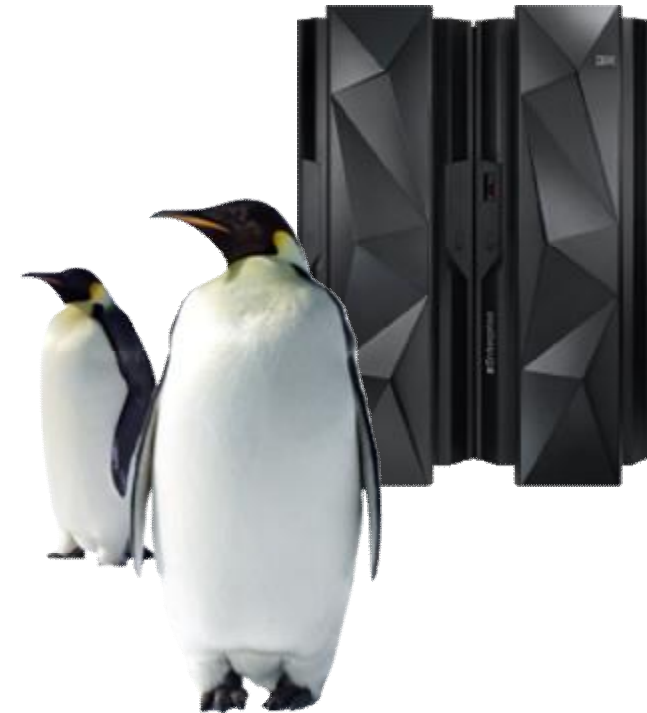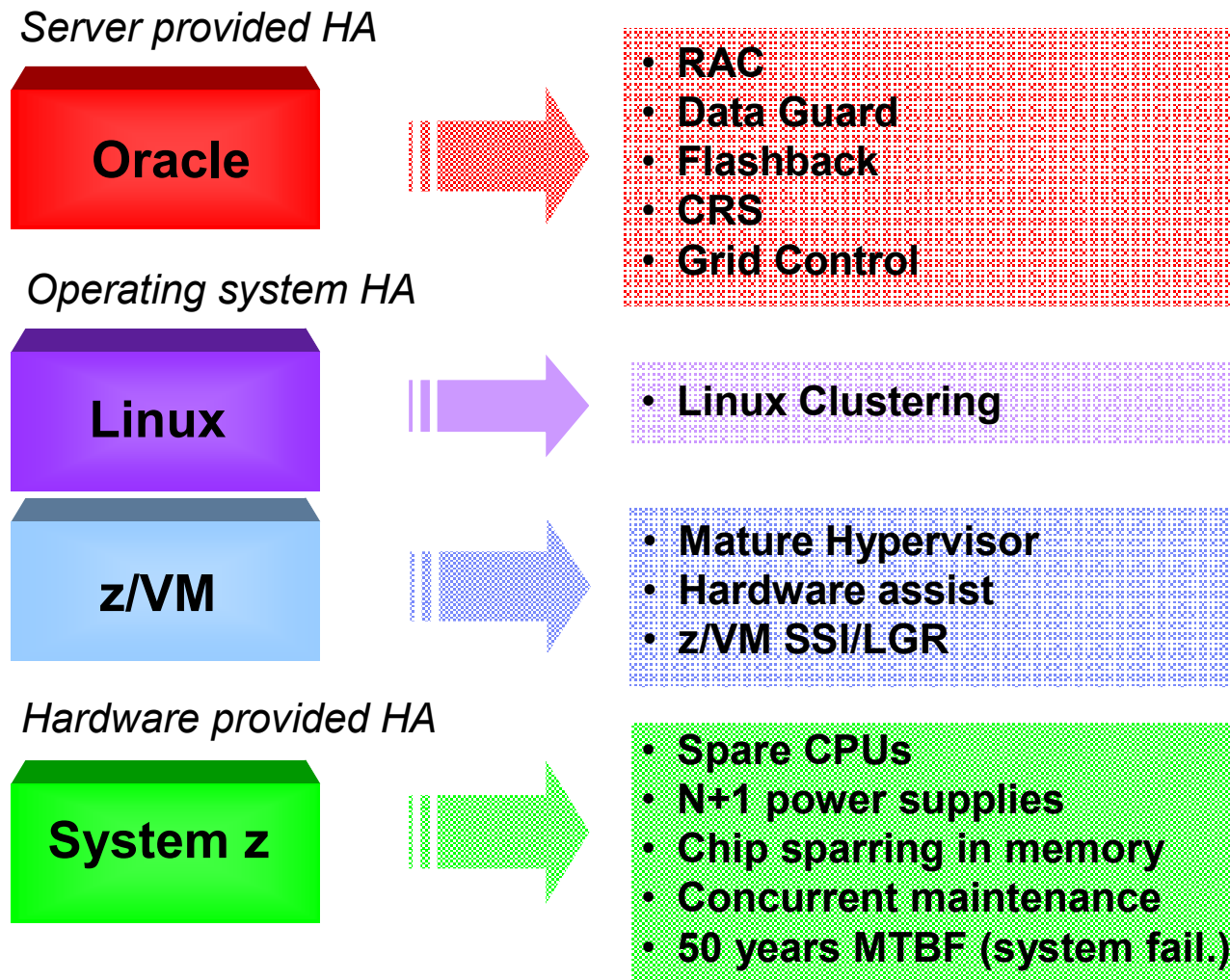| IBM		Oracle
System z Architecture →	**Reliability, High Availability** ←	**CRS, RAC**
HW Cryptography, RACF →	**Security** ←	**Audit Vault, OIM,SSO**
z processor, I/O →	**Performance** ←	**Database Architecture**
PR/SM, z/VM →	**Virtualization** ←	**Oracle VM (on System x)**
Linux →	**Open Standards** ←	**Enterprise Linux**
z/VM →	**Manageability, Deployment** ←	**ASM, Grid**
Tivoli →	**Monitoring** ←	**Grid**
Linux →	**Applications portfolio** ←	**Industry applications**
zEnterprise →	**Applications Integration** ←	**Gateways**

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- **High-availability and Disaster Recovery**

- Deploy to the best fit technology

Oracle HA with System z

Server provided HA

Oracle

→

- **RAC**
- **Data Guard**
- **Flashback**
- **CRS**
- **Grid Control**

Operating system HA

Linux

→

- **Linux Clustering**

z/VM

→

- **Mature Hypervisor**
- **Hardware assist**
- **z/VM SSI/LGR**

Hardware provided HA

System z

→

- **Spare CPUs**
- **N+1 power supplies**
- **Chip sparring in memory**
- **Concurrent maintenance**
- **50 years MTBF (system fail.)**
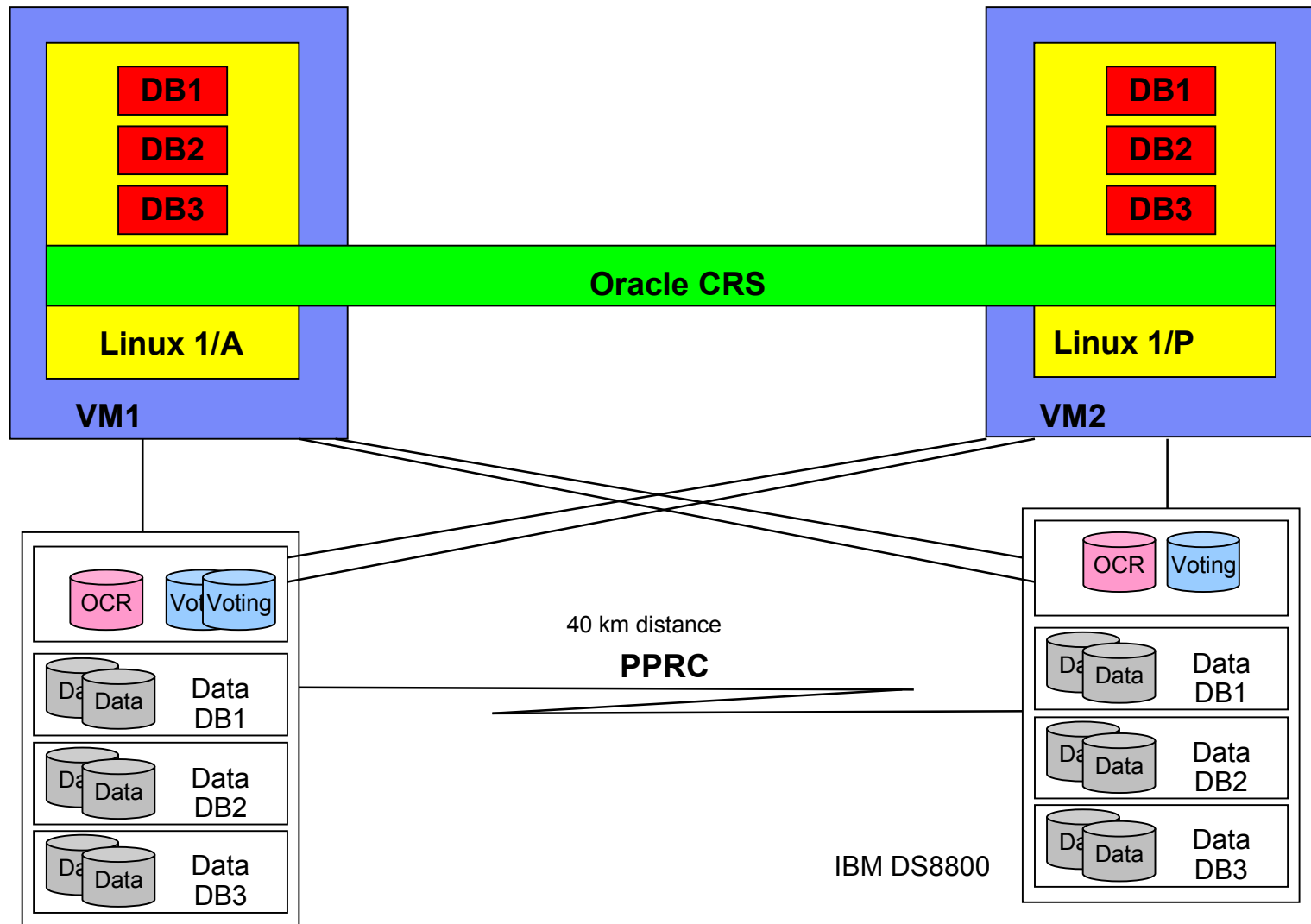
Building Oracle MAA – hot standby

- Guards against hardware (System z) and Linux OS or Oracle DB failure
- Allows for maintenance to Linux and possibly Oracle in the production guest
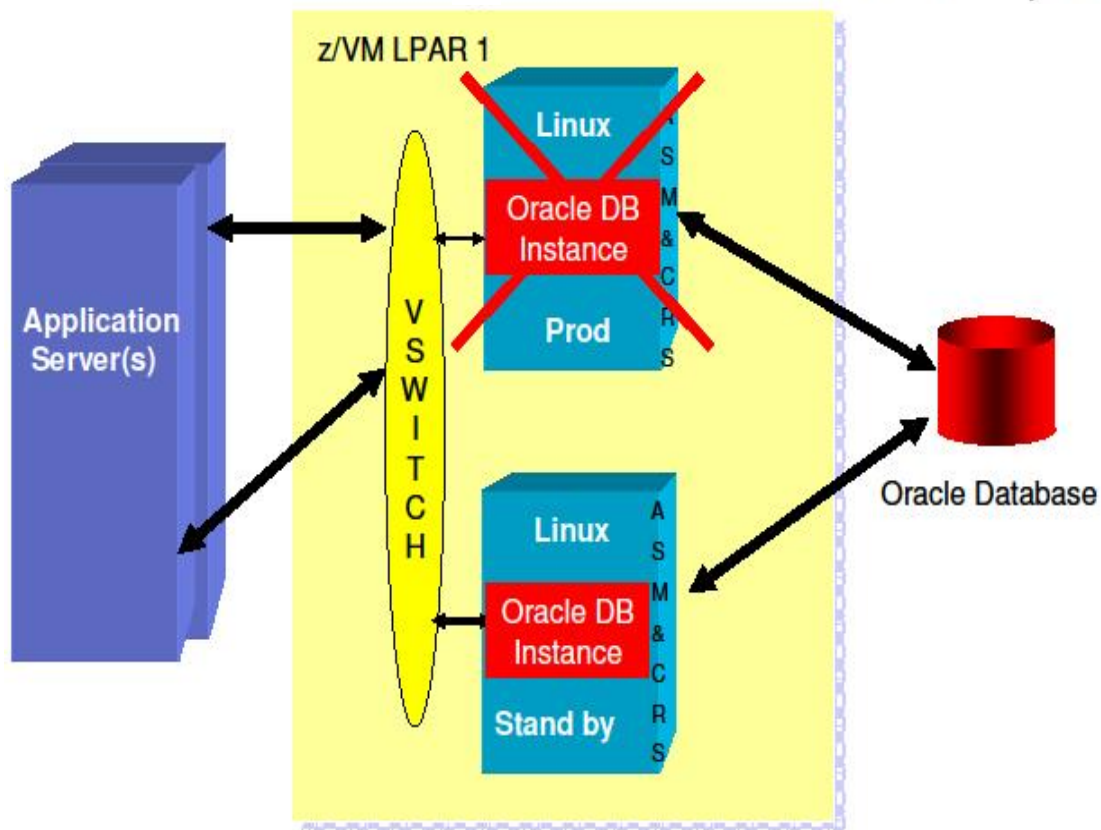
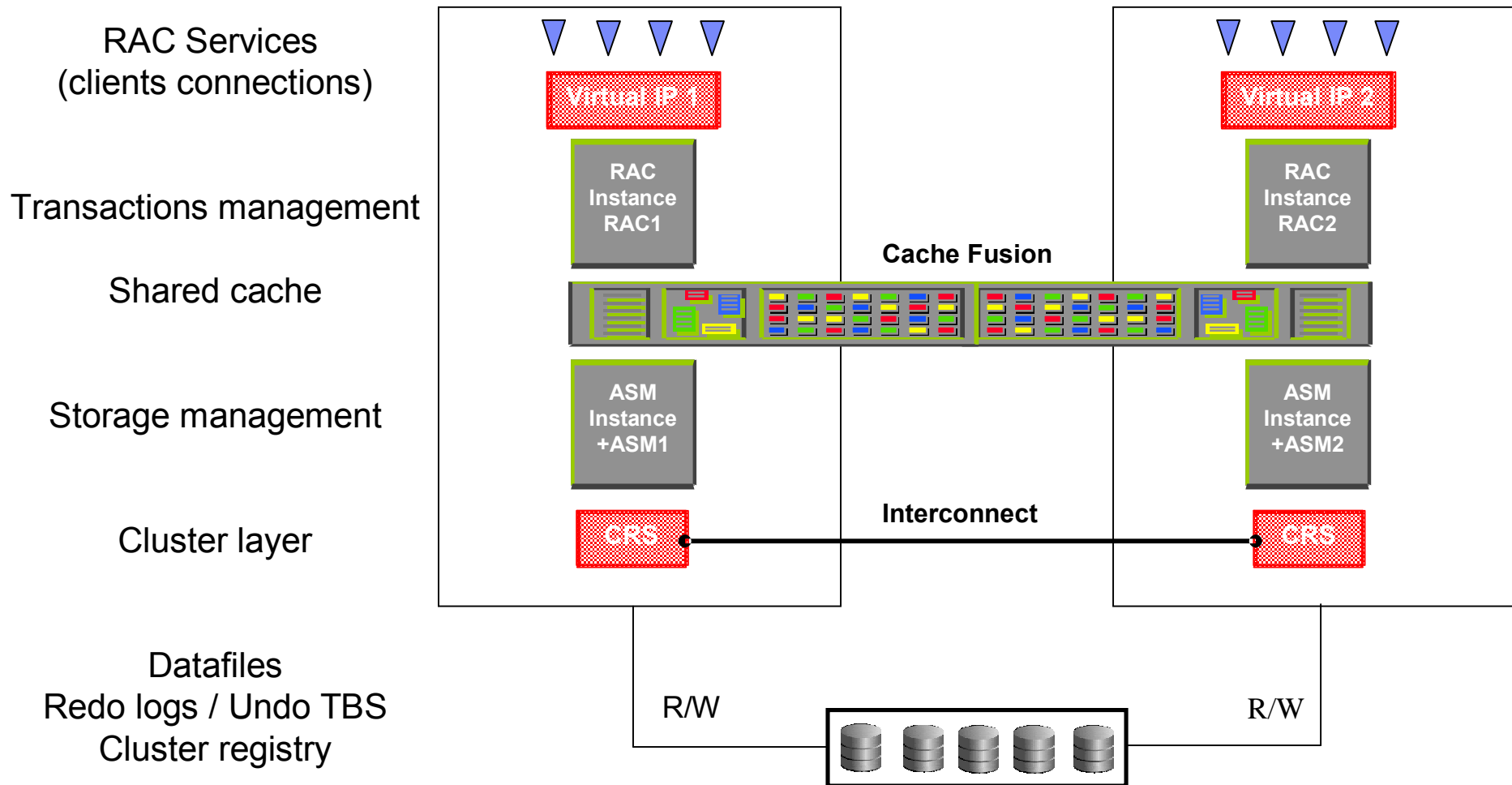Oracle MAA = Maximum Availability Architecture

- Added hot standby Linux to same Oracle DB

- Through the use of CRS, with its heartbeat, and ASM shared disk storage does a fail-over to the standby Linux guest.

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Proof of concept: clustering with CRS and Metro Mirror (PPRC)

Oracle Maximum Availability Architecture
Oracle RAC Architecture Diagram

RAC Services
(clients connections)

Transactions management

Shared cache

Storage management

Cluster layer

Datafiles
Redo logs / Undo TBS
Cluster registry

Virtual IP 1

Virtual IP 2

RAC Instance RAC1

RAC Instance RAC2

Cache Fusion

ASM Instance +ASM1

ASM Instance +ASM2

CRS

Interconnect

CRS

R/W

R/W

Deploying RAC for High Availability

RAC – Real Application Cluster –

- Active/Passive configuration
  - One node processes work
 - The other node waits for the first node to fail

- Active/Active configuration
  - All nodes process work
  - If any node fails the cluster is re-mastered.

- Besides availability, RAC can be used for workload distribution
  - All work does not have to go through all nodes

- Deploy
  - In the same LPAR for test/dev applications
  - Across LPARs for LPAR maintenance or software failures (most common implementation)
 - Across CECs when taking entire systems down is a "common" occurrence

Disaster Recovery (DR) with Oracle Data Guard

Standby – replication to standby database
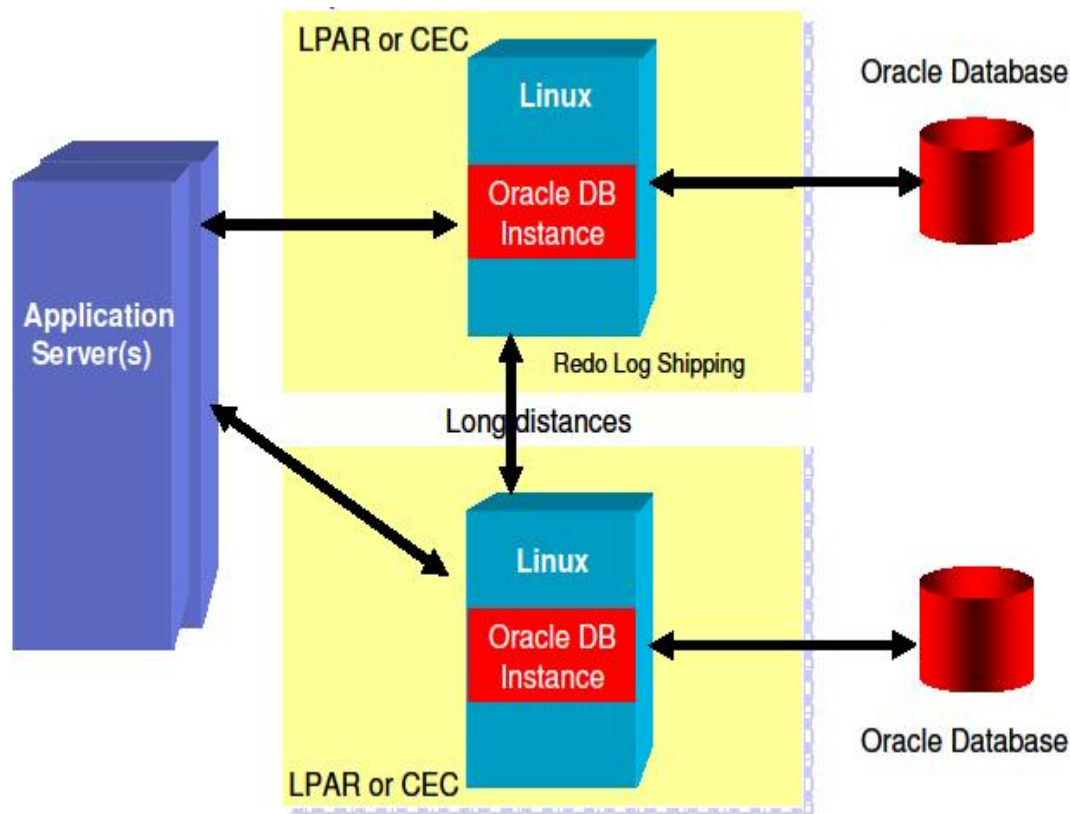
- Uses redo log shipping for log apply or SQL Apply
- Less data transmitted than replication
- Sync or async
- Various configurations of logical and physical standby databases

- Data Guard generally deployed between CECs

Oracle MAA and zEnterprise
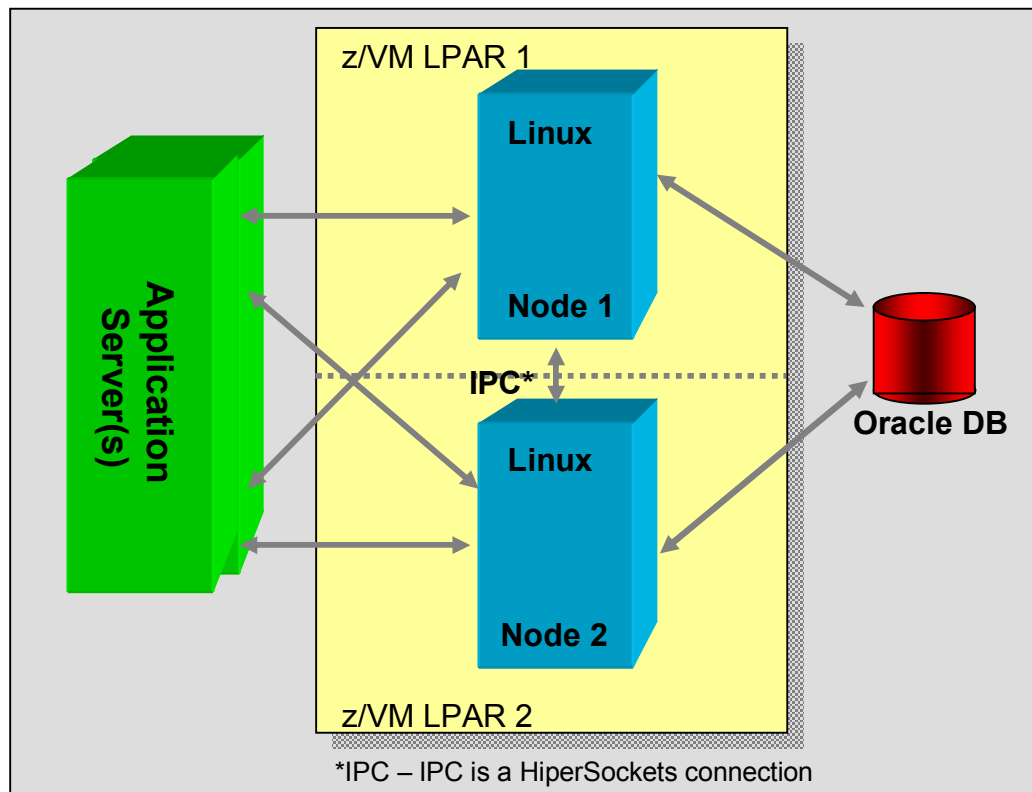
*IPC – IPC is a HiperSockets connection

Server provided HA

Oracle ⟹
- RAC
- Data Guard
- Flashback
- CRS
- Grid Control

Operating system HA

Linux ⟹
- Linux Clustering

z/VM ⟹
- Mature Hypervisor
- Hardware assist
- z/VM SSI/LGR

Hardware provided HA

System z ⟹
- Spare CPUs
- N+1 power supplies
- Chip sparring in memory
- Concurrent maintenance
- 50 years MTBF (system fail.)

- Guards against Linux failure, LPAR failure, z/VM failure, Oracle instance failure, LPAR maintenance
- Can be: Active/active, active/passive
- Not limited to two nodes

Sparda Datenverarbeitung eG chooses IBM zEnterprise

Migrate workloads
from x86 to Linux on z

"Oracle has been consolidated on this platform we are using right now only Oracle on the z196 platform,"
Bernd Bohne, Sparda-Datenverarbeitung e.G., Manager,
Central Systems

"Over the years, the mainframe transformed from traditional workloads, quite simple, to a universal platform for new workloads as well.

And we see a lot of new applications that are coming to this platform.

Especially for Linux, it's perfect.

The z/Enterprise platform is perfect for consolidating Linux workloads because of the high I/O bandwidth, business continuity with capacity backup features."

Watch and listen **to**
- Bernd Bohne, Sparda-Datenverarbeitung e.G., Manager, Central Systems
- Marie Wieck, IBM, General Manager, Application Integration Middleware
- Steve Mills, IBM, Senior Vice President & Group Executive, Software & Systems

ibm.com/systems/z/resources/sparda_bank_video.html

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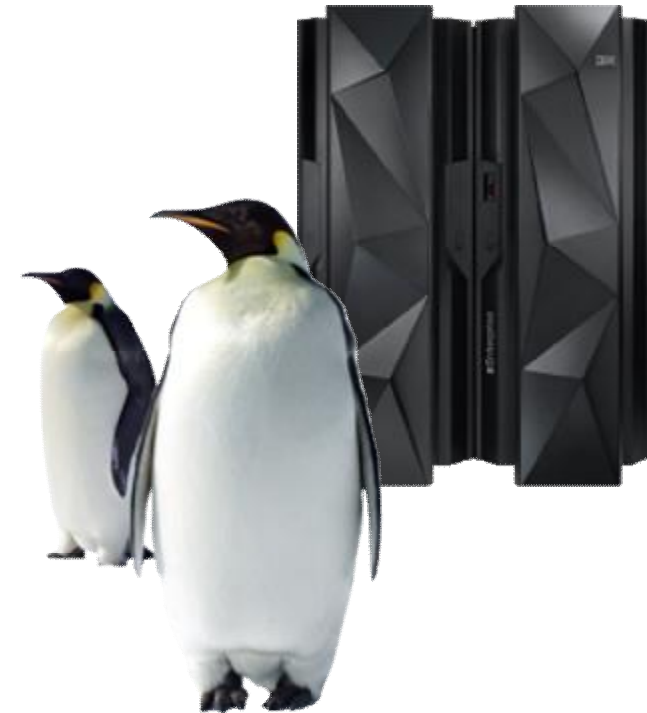
Deploy Oracle Software to the "Best Fit" Technology
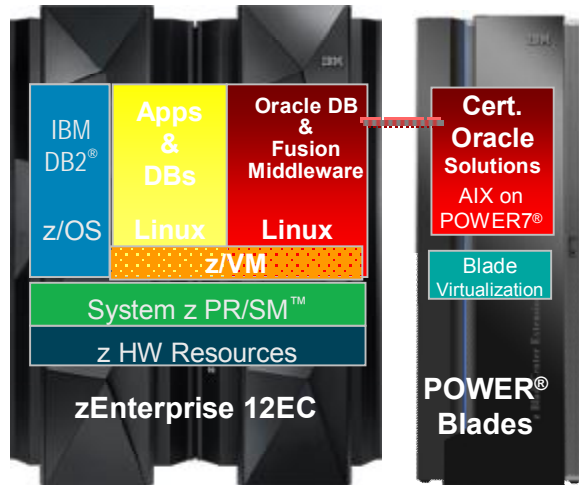
Oracle software deployments (incl. consolidations) with Linux on zEC12 provides an excellent price performance.

- From an Oracle licensing perspective 1 IFL = 1core
- Less operational efforts
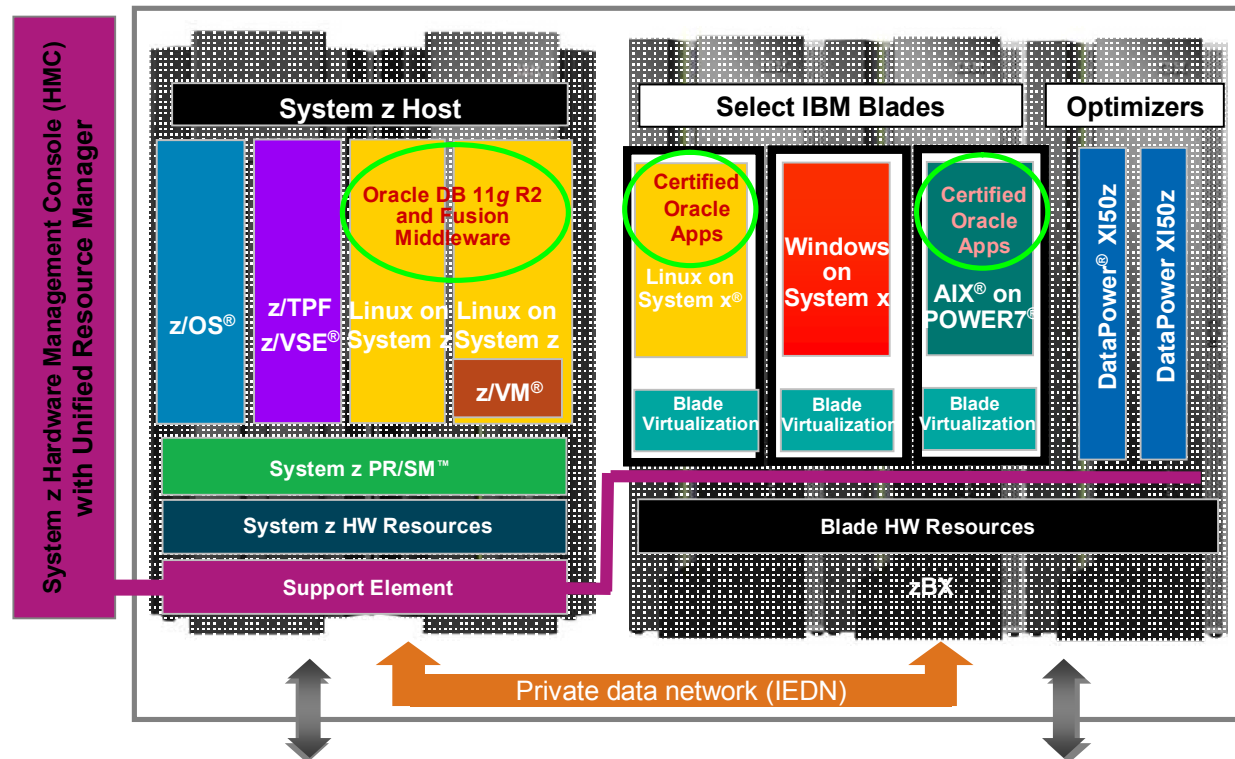- High levels of security and availability

Business Connexion – South Africa	**Sparda Datenverarbeitung eG** – Germany
▪ ICT services to the financial sector, government, … and more	▪ IT provider for approximately 4.2 million customers
▪ Approximately 50 virtual Linux servers; flexible environment for hosted services; high performance for Oracle databases	▪ Runs a number of very large Oracle databases, where the virtual Linux server requires 30 GB memory and ~350 GB storage
▪ Enabled competitive pricing for client services	▪ Experienced >99% availability, which proves the Linux reputation

Examples of Oracle Solutions on IBM System zEnterprise

System z Hardware Management Console (HMC) with Unified Resource Manager

System z Host

Select IBM Blades

Optimizers

z/OS®

z/TPF z/VSE®

Oracle DB 11g R2 and Fusion Middleware

Linux on System z

Linux on System z

z/VM®

Certified Oracle Apps

Linux on System x®

Windows on System x

Certified Oracle Apps

AIX® on POWER7®

DataPower® XI50z

DataPower XI50z

Blade Virtualization

Blade Virtualization

Blade Virtualization

System z PR/SM™

System z HW Resources

Blade HW Resources

**Support Element**

zBX

Private data network (IEDN)

Oracle solution landscape on a single zEnterprise System

- Run Oracle database and Oracle applications on highly available and reliable zEnterprise EC12 (zEC12), zEnterprise 196 (z196) or zEnterprise z114 (z114)

- Run additional Oracle applications (Linux on System x or AIX) on zEnterprise BladeCenter (zBX)

- Fully benefit from zEnterprise, the first hybrid system, and manage all your Oracle solution servers with the zEnterprise Unified Resource Manager

Reference Customers
Linux on System z with Oracle

Bank of New Zealand
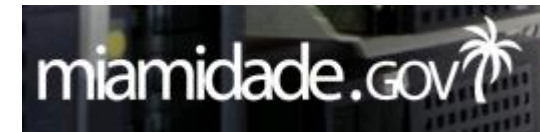
When consolidating Oracle database servers –

- Understand your requirements (and cost implications)
  - High Availability (how much money is at stake if your system is down x minutes/hours?)
  - Disaster Recovery (what is your RTO by application/database?)
- ➢ **Select architecture choices according to requirements**

- Low utilization servers and mix of different peak times are best candidates
  - Selected databases with sustained high CPU utilization may not be good candidates
- Databases with high I/O stress will benefit from System z architecture

- Tune migrated database servers to the virtualized environment
  - Right size servers (memory, number of vCPUs, direct I/O)
  - System z may behave differently compared to x86
- Monitor your system behavior
  - Typically performance behavior is not static
  - Test before and after changes are applied
- Consider Capacity on Demand (CoD) for peak load times

Questions?

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