From A (AIX) to Z (Linux/z):

A Customer Experience

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By Uriel Carrasquilla

Agenda

- Initial Scope: Benchmark Linux
  - Objectives
  - Application Profile
  - H/W Configurations
  - Results
- New Scope: Sunset AIX
  - Reach Consensus
  - Linux on System z9
  - Linux and Our Environment
  - Unix Roadmap
- Summary

Benchmark Objectives

- Original Proposition:
  - Feasibility:
    - Can we run a mission-critical application under Linux/z?
  - Performance:
    - Will it run faster than AIX?
  - Support:
    - Can we do it with the same head count?
  - Infrastructure:
    - What else do we need?
  - Cost benefits and ROI over three years

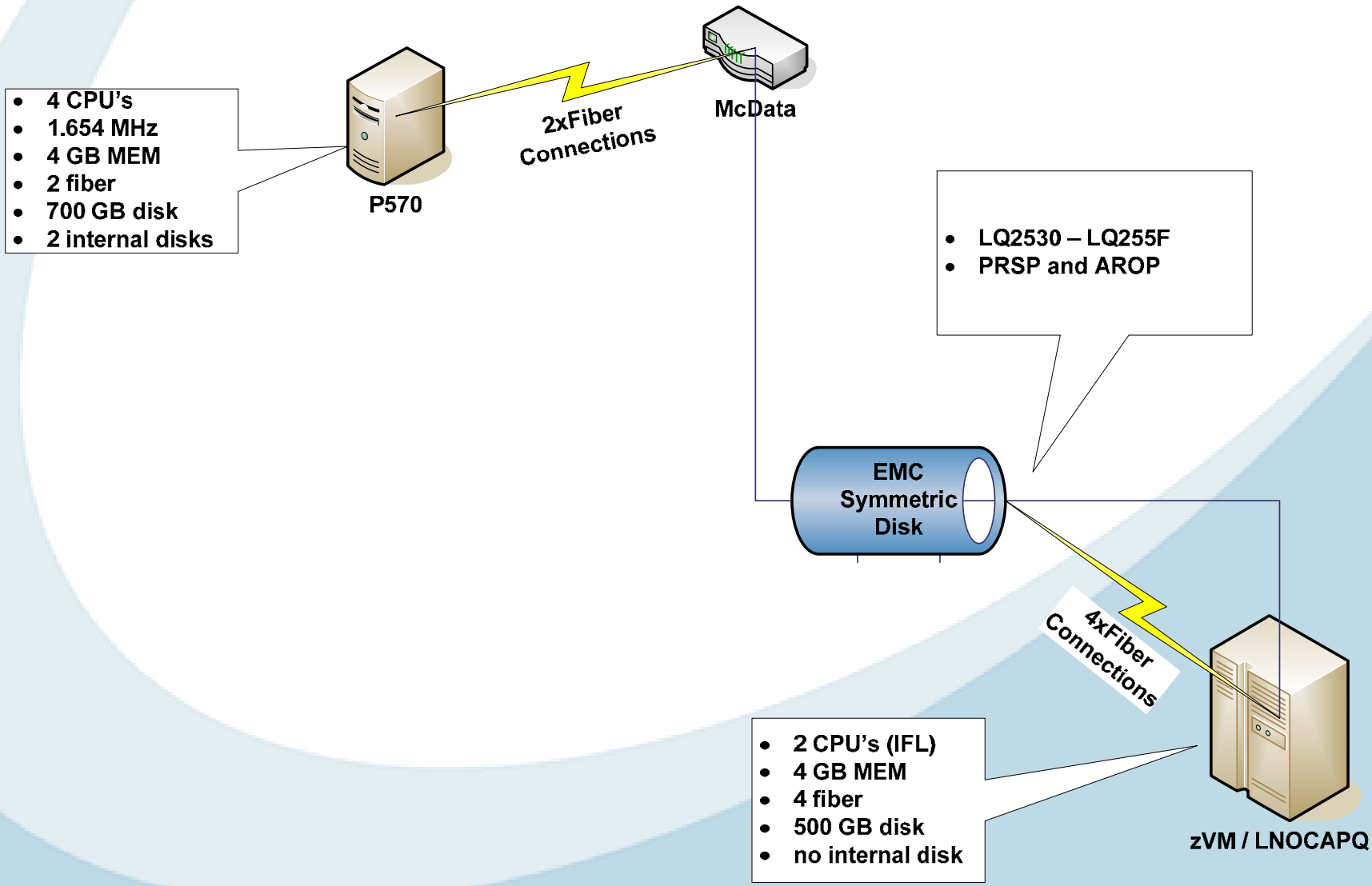
Benchmark Plan

- Freeze application changes before benchmark
- Oracle: same versus optimized parameters
- Run on z890, P570, and z9 (IBM WA Center)
- Document effort to convert APP to Linux
- DBA's effort to support Linux
- SysAdmin effort to support Linux/zVM
- Size z890 and z9

Application Profile

- Java, multithreaded, with Oracle back end
- About 700 GB disk in production and growing
- Mission-critical but fail-over missing
- Heavy I/Os (40% of CPU power under AIX going to support I/Os)
- Long batch in AIX with 14 CPUs (10+ hours)
- AIX online response time acceptable to Web

Benchmark



Benchmark Realities

- Application improvements during benchmark:
  - Triangle step was converted from single to multi-threaded, saving 1.5 hours in the critical path
  - Closed “connects” (z9 was fast)
  - Scripts were written to simplify multiple runs of same benchmarks
  - Compiled application for each platform
  - Ran same code and same data on all platforms after application changes

Run Results (Three Threads/DEV)

- The P570 is the slowest at over 85% CPU
- The z890 is faster at 65% CPU
- The z9 is the fastest (x2) at 50% CPU
- Hardware/software used
  - P570: 4 (1.6 GHz) CPU, 4 GB MEM, Oracle 9i
  - z890: 2 IFL, 4 GB MEM, Oracle 10g
  - z9: 2 IFL, 4 GB MEM, Oracle 10g

Results (Without Optimization)

PRO Benchmark Results

One Concurrent Job

Step		Times for 3 Threads P570	z890	z9 (2IFL)
	PSL	1:24:00	1:17:54	0:28:26
	SL	0:59:04	1:02:10	0:51:41
	SP	0:15:30	0:11:28	0:03:21
	PC	0:03:39	0:04:04	0:01:34
	PM	1:02:29	1:09:32	0:54:48
	CG	0:39:08	0:19:13	0:11:35
	LP-DS	0:18:49	0:06:46	0:00:39
	2SL	0:08:38	0:03:30	0:00:25
	SMP	0:19:22	0:03:30	0:00:31
	TRI	0:54:14	1:09:53	0:27:06
Total		6:04:53	5:28:38	3:00:06
	End-to-End	**6:44:19**	**6:15:00**	**3:10:00**

Results (With Optimization)

z9 PRO Benchmark Results

One Concurrent Job		4 IFL	4 IFL	2 IFL
Step		**4 Threads**	**6 Threads**	**3 Threads**
	PSL	0:19:14	0:21:35	0:32:16
	SL	0:15:23	0:28:50	0:19:03
	SP	0:02:39	0:02:53	0:03:02
	PC	0:01:07	0:01:12	0:01:15
	PM	0:14:02	0:14:29	0:21:23
	CG	0:04:42	0:03:41	0:07:00
	LP-DS	0:00:24	0:00:21	0:00:36
	2SL	0:00:18	0:00:15	0:00:26
	SMP	0:00:24	0:00:26	0:00:26
	TRI	0:24:25	0:24:39	0:24:14
Total		1:22:38	1:38:21	1:49:41
	End-to-End	**1:32:04**	**1:47:52**	**2:00:00**

Findings: App to Linux

- No effort involved to move application
- Same PC-based DEV environment
- Java is 100% equivalent

Findings: DBA R&R

- No changes in tools
- No changes in GUI
- Very much BAU
- Tuning required when moving to z
- Self-tuning in 10

Findings: SysAdmin on Linux

- We have been doing it for just over a year
- Some time to get used to MF H/W and zVM
- Some different tools versus AIX and SUN
- Project was in progress to fully integrate
- Some functionality might need to be investigated (ext3/xfs/jfs, SLES 10)
- More training is needed

Findings: SysAdmin and zVM

- Our zOS systems programmer was a valuable resource
- Our Linux systems administrator became proficient with zVM and mainframe hardware
- This group is the most impacted by this change
- Patience will be expected from our DEV customers during early stages
- AIX to Linux skills are transferable

Recommendations for APP

- DEV/QA/PROD applications to z9
- Three-tier: APP and DBMS zVM guests
- Will need 16 GB MEM (2:1 virtualization)
- Will need 4 IFLs for APP migration (4:1)
- Will need 2 IFLs for CAPLAN, STS, UC4
- Java HA: KeepAlived (VRRP) Master/Slave
- Oracle HA: RAC for seamless fail-over

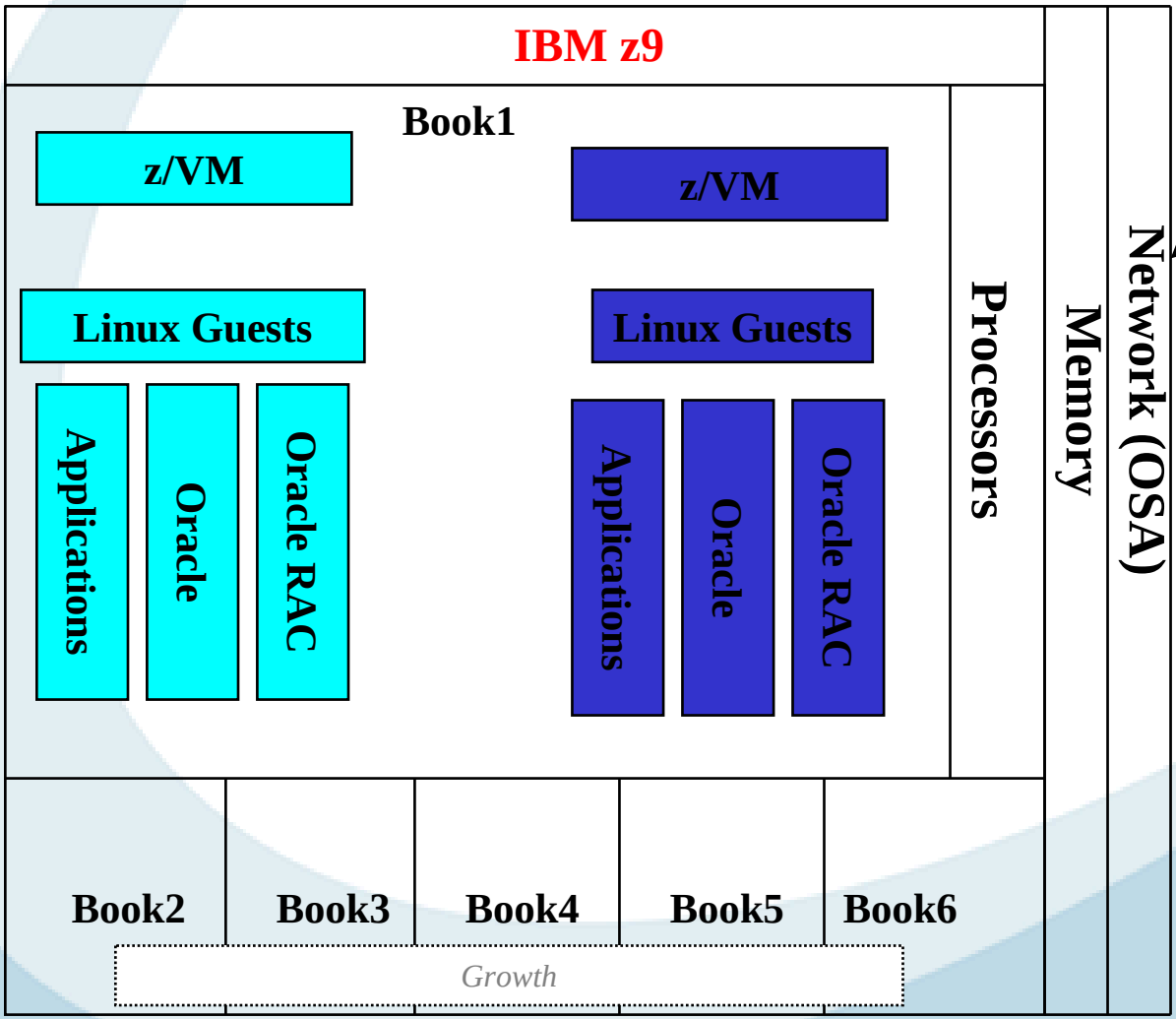
Stop the Press/New Scope

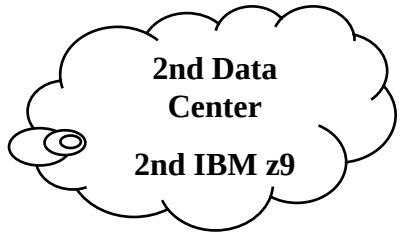
- IT management expanded the scope to include the AIX platform elimination
  - Five PROD servers (22 CPUs)
  - Three supporting DEV servers (9 CPUs)
  - Three supporting QA servers (11 CPUs)
- Investigate HA and propose new architecture
- Advise on Sun environment: 8 PROD servers with 37 CPUs plus DEV and QA servers

New Scope: Sunset AIX

- From our CIO:
  - Reach consensus
  - Consider all implications of this change
  - Freeze budget for AIX
  - Get customers onboard

Linux on System z9 HA





Points of Failure	Risk Mitigation
Whole Frame	Redundant Frame (Not today)
Physical Components	Redundant Hardware
z/VM LPAR	2nd z/VM LPAR
Linux Guest	2nd Linux Guest on 2nd z/VM (VRRP)
Database	Oracle RAC/ 2nd Guest on 2nd z/VM
Application	2nd Guest

Linux on System z9 Virtualization

- Consolidation—fewer servers doing more work
- Greater utilization—ability to handle increased workloads and multiple applications on a single machine
- Standardization—ability to apply standard management tools across a diverse work environment
- Application workloads are shared for better utilization
- Server resources are allocated dynamically based on demand

Linux on System z9 Flexibility

- Simplifies systems management through centralization
- Prioritizes workloads
- Prevents runaway processes from degrading performance of other applications
- Increases capacity to handle unpredictable fluctuations, as well as planned increases
- Provides a low level of granularity for resource allocation and control

Linux on System z9 Performance

- Separate I/O processors allow for parallel processing for I/O and application at the same time
  - Our tests showed I/O rates of 1ms on z9 compared to 9ms on z890 and 11ms on AIX
- Deployment of new server/LPAR from days/weeks to hours
- True shared resources (processors, memory, I/O, network, z/VM)
- Internal communications between LPARs via Hypersockets™ (dedicated 10GBs compared to 1GB)
- Faster recovery time at DR—Linux and all LPARs come up with the mainframe

Hypersockets™ is an IBM product.

Linux on System z9 Cost Avoidance

- Software Licensing
  - Multiple servers on one physical engine
  - Oracle pricing by engine (AIX 40 engines, System z approximately 1/3 required)
- Environmental
  - Reduction on external cabling, routers, hubs, switches, energy, and floor space

Linux on System z9 Redundant Hardware

- Transparent CP sparing
- Fault-tolerant interconnect design
- Dynamic memory sparing
- Enhanced firmware simulation
- Remote operations support
- N+1 power supply technology
- Concurrent channel, OSA-E, and coupling link maintenance
- Dynamic I/O reconfiguration
- FICON purge path extended
- Enhanced book availability
- System Assist Processor (SAP) reassignmentand sparing
- Sparing for storage protect preservation keys
- Partial memory restart
- Dual support elements
- Hybrid cooling
- Concurrent hardware management console (HMC) and support element
- Redundant I/O interconnect
- Enhanced driver maintenance
- Dynamic oscillator switchover
- Enhanced application preservation
- Failure containment for MBA
- Concurrent book add
- Dynamic channel path management
- Concurrent power and thermal maintenance
- Enhanced dynamic reconfiguration management

Single points of failure exist, but mean time between failure = 100 years.

Linux and Our Environment

Areas that Linux may impact:

- Application Development
- Change Management
- Security
- Languages and Integration
- Linux Management Tools
- Risks

Linux and Our Environment: Application Development

Development Platforms	Note	
Visual Studio	Not Impacted	
PL/SQL Developer	Not Impacted	
J Developer	Not Impacted	
Development Languages	**Linux Supported**	**Note**
Java	YES	
C/C++	YES	
Cobol	YES	
Stored Procedures	YES	
Perl	YES	
Ksh Shell	YES	
SAS	NO	Code can be developed on SUN or Mainframe and access data on Linux.

Note: Have the ability to install VMWare Virtual Server on PC desktop to load Linux and have a local development environment on PC.

Linux and Our Environment: Change Management

Same tools and processes as current Change Management.

Tools Used	Supported on Linux	Function
TeamTrack	NA	Migration Requests and Special Run Request
ChangeMan DS	Yes	Code Repository, Check-in/Check-out/Promote

Linux and Our Environment: Security

- Batch Application Security Architecture
  - Will be the same as on AIX
- Batch Application Security Administration
  - Will be the same as on AIX
- End User Security Administration
  - Password Synchronization and Group Membership Management
    - BMC has reported that they will provide a connector that supports SuSE Linux on zVM by February 2007. This connector will allow us to manage end user security in the same manor as currently on AIX.
- Monitoring
  - BindView does not currently support Linux on zVM
  - Will need to procure the BindView Agentless version to get functionality

Linux and Our Environment: Languages and Integration

Software	Function
Database Connectivity	
Oracle TNS	Access Oracle
DB2 Connect	Access DB2
Messaging	
MQ Series	Messaging between DBs and Systems
Languages	
Cobol, C/C++, Java, Perl, KSH, PL*SQL	Coding between DBs and Systems
Extract/Transform/Load (ETL)	
DTS, SSIS (Microsoft)	Integrated Development Platform

Linux and Our Environment: Linux Management Tools

Tool/Process	Function
Database	
Grid Control	DBMS Administration
DBArtisan	DBMS Administration
Security	
Contol-SA	1st Qtr 2007—Password Sync
BindView	Procure Agentless Version—Reporting
MANUAL/YaST	ID Setup
Scheduling	
UC4	Scheduling
Change Management	
ChangeMan DS	Source Code Migration and Control
System Administration	
YaST	Linux Administration, Installation
SAR	Linux Performance/Accounting
VMWare	VM System Management
Backup and Recovery	
Netbackup	Backup/Restore/Recovery

Linux and Our Environments: Risk Mitigation

Risks	Risk Mitigation
Vendor Support	• **Vendor does not support Linux but can use Sun/Solaris**
Legacy System Rewrite	• **We own our current AIX environment** • **Only stopping further growth and development at this time** • **Migration from AIX can be scheduled with planned system rewrites** • **Not forcing migrations today**
Virtual Mind Set/VM Administration	• **VM training** • **Cross-training for system administrators** • **Linux is just another flavor of Unix, and all basic skills exist today**
Security—Linux Open Source	• **We currently receive all Linux alerts and separate documentation on high alerts** • **Linux out of box comes with the doors closed and we have to open it up**
Single Hardware Platform	• **Create 2 z/VMs to support fail-over for microcode, z/VM, Linux, and application failover** • **Implement Oracle RAC for database fail-over** • **Implement Linux HA for application fail-over** • **Future—If we decide to have separate data centers, we can set up fail-over between sites, eliminating single hardware risk**

In Summary

Linux runs on many platforms, but running it on a System z9 provides additional benefits in the following areas:

- High availability (HA) and customer satisfaction
- Flexibility
  - Virtualization to minimize scheduled downtime
  - Workload management to handle peaks
- Performance and capacity to grow the business
- Cost savings in terms of TCO