zEnterprise – The Ideal Platform For Smarter Computing

The Reality Of Rehosting

Smarter Computing Means Transforming IT With Workload Optimized Systems

Typical workloads

Batch
OLTP
Data Warehouses
Financials
Business Processing

ERM
CRM
Web Commerce
Email
File/Print services

zEnterprise *IDAA* *DS8800*

Workload Optimized Systems

New metric for the age of Smarter Computing

Cost Per Workload

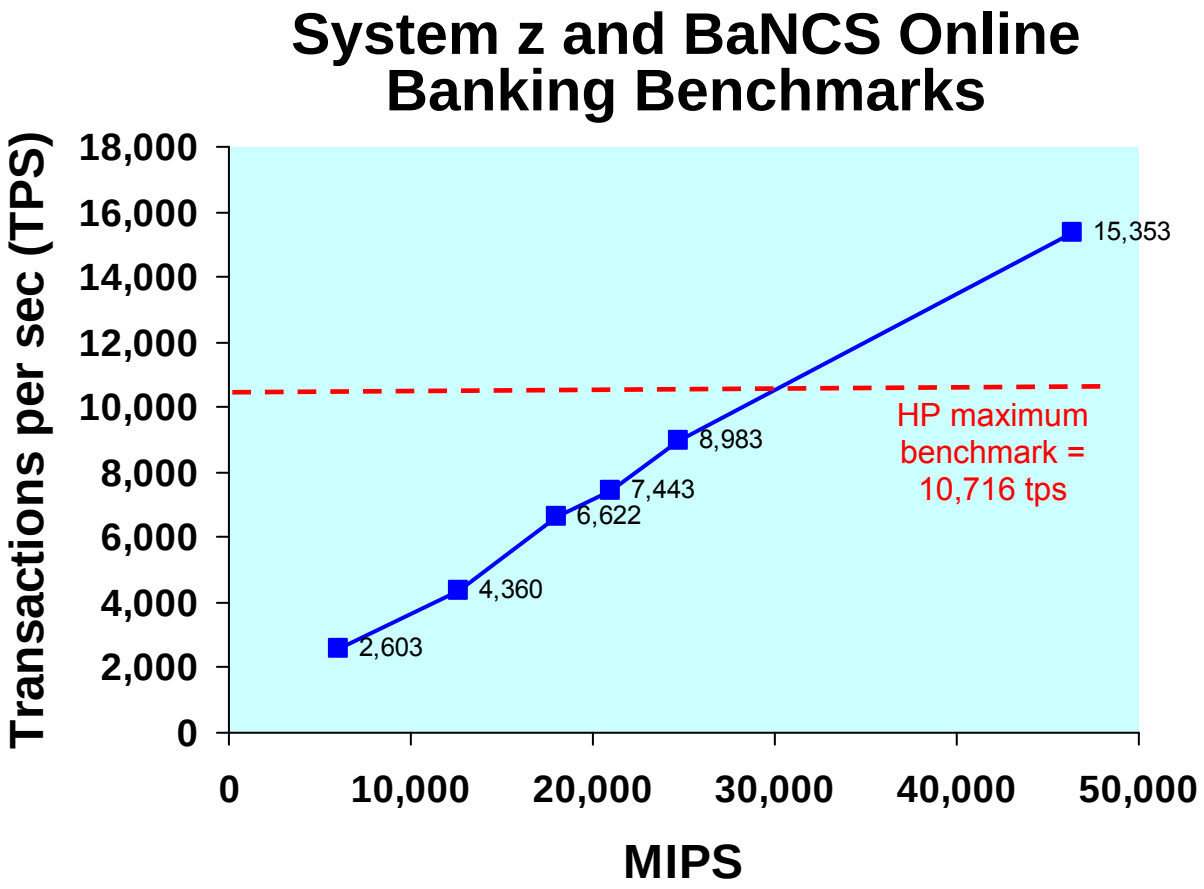
System z Has Better Scalability

Kookmin Bank

- **IBM System z9 and DB2**
- TCS BaNCS
- **15,353** Transactions/second
- **50** Million Accounts
- IBM benchmark for customer
- DB2 V9, CICS 3.1, z/OS V1.8

State Bank of India[1]

- **HP Superdome**
- **TCS BaNCS**
- **10,716** Transactions/second
- **500** Million Accounts
- Largest banking benchmark performance claimed by HP



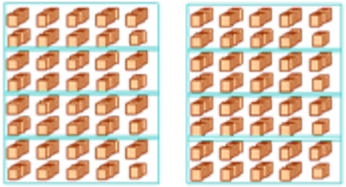
[1] Source: http://www.enterprisenetworksandservers.com/monthly/art.php?2976 and *InfoSizing FNS BANCS Scalability on IBM System z – Report Date: September 20, 2006* ; Clement Report; http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA1-4027ENW.pdf Feb 2010

System z Cost Per Workload Is 16% Less

Compare processors needed to achieve same throughput (10,716 tps)

HP Superdome Servers

448 processors
1,834,304 Performance Units



HP-UX, Oracle

Total (5yr TCO) **$97.5M**

Annual Cost per TPS = $1,820

Cost per transaction = 0.006¢

37 Processors
(31 GPs + 6 zIIPs)
30,837 MIPS

z/OS, DB2

IBM z196

Total (5yr TCO) **$82.1M**

Annual Cost per TPS = $1,532

Cost per transaction = 0.005¢

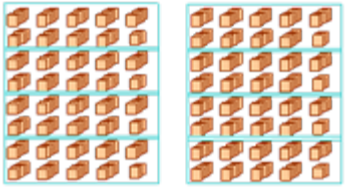
Note: Cost of platform infrastructure for production. Cost of packaged application software not included. List prices used.

Adding AD/Test, System z Cost Per Workload Is 49% Less

Compare processors needed to achieve same throughput (10,716 tps)

HP Superdome Servers

896 processors
3,668,608 Performance Units



HP-UX, Oracle

Total (5yr TCO) **$195M**

Annual Cost per TPS = $3,639

Cost per transaction = 0.012¢

49 Processors
(41 GPs + 8 zIIPs)
39,112 MIPS

z/OS, DB2

IBM z196

Total (5yr TCO) **$99M**

Annual Cost per TPS = $1,848

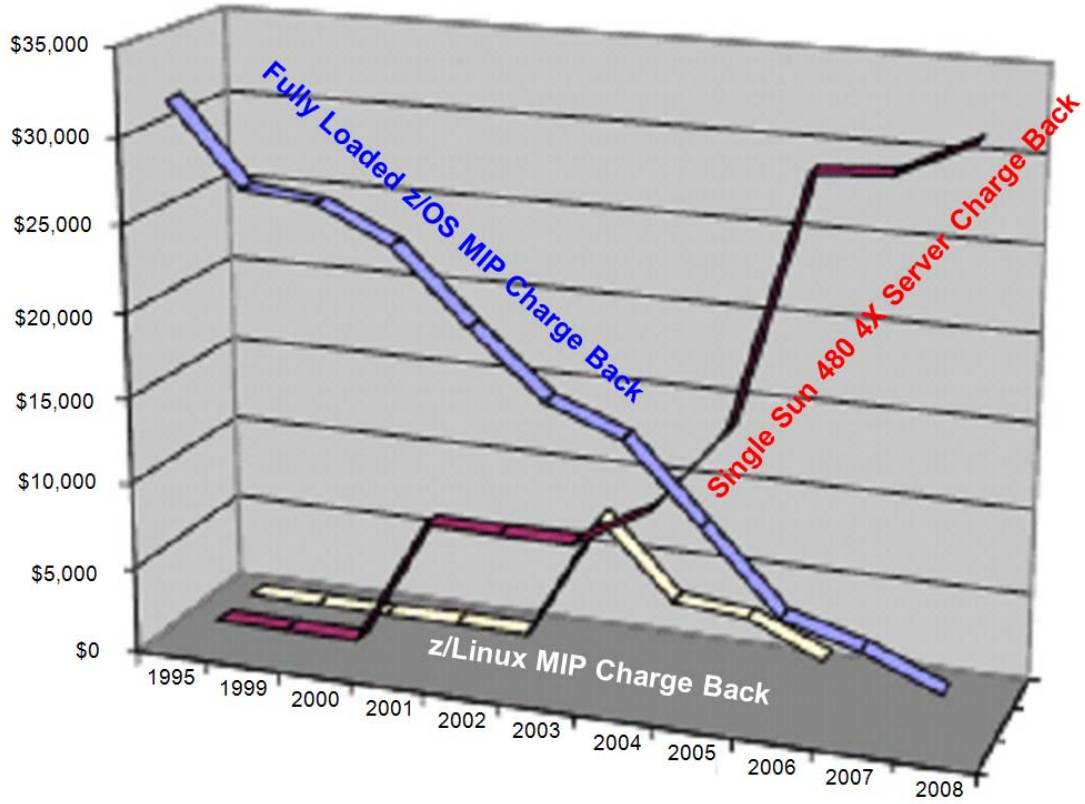
Cost per transaction = 0.006¢

Note: Cost of platform infrastructure for production. Cost of packaged application software not included. List prices used.

So Why Do People Think Distributed Computing Is Cheaper?

Inaccurate charge back!

Charge Back Practices Were Improved Over Time at a Large Financial Institution



More Accurate Charge Back Can Correct Perceptions of Relative Costs

Accounting Hasn't Kept Up With The Times

	Typical Allocation – Management Estimates			
	Distributed	%	MF	%
Power Cost	0	0	$15,084	100
Labor Cost	0	0	$350,000	100
Floor space	0	0	$11,620	100
Software OTC depreciation	$120,240	60	$102,472	40
Software S&S and MLC	$168,783	50	$168,783	50
Hardware OTC depreciation	$103,691	25	$311,074	75
Hardware Maintenance	$20,276	25	$60,829	75
Network	0	0	$4,758	100
Total	$412,990	29	$1,024,620	71

Total $1,437,610

Accurate Cost Allocations Show A Truer Picture Of Costs And Aid Investment Decisions

- Best practice allocation should use ***actual*** distributed and mainframe costs
- In this example, the mainframe allocation decreased from 71% to 40%

	Typical Allocation – Management Estimates				Best Practice Allocation – Actual Costs			
	Distributed	%	MF	%	Distributed	%	MF	%
Power Cost	0	0	$15,084	100	$11,917	79	$3,167	21
Labor Cost	0	0	$350,000	100	$210,000	60	$140,000	40
Floor space	0	0	$11,620	100	$6,300	54	$5,320	46
Software OTC depreciation	$120,240	60	$102,472	40	$216,194	97	$6,518	3
Software S&S and MLC	$168,783	50	$168,783	50	$181,242	54	$156,324	46
Hardware OTC depreciation	$103,691	25	$311,074	75	$184,435	44	$230,330	56
Hardware Maintenance	$20,276	25	$60,829	75	$37,152	46	$43,953	54
Network	0	0	$4,758	100	$4,758	100	$0	0
Total	$412,990	29	$1,024,620	71	$851,997	60	$585,613	40

Total $1,437,610 Total $1,437,610

So Suppose This Customer Succeeded In Eliminating The Mainframe

- Assume rehosting costs the **same** (we will show later it costs **more**)
- Distributed allocation increases by 248%

	Before		After
	Distributed	%	Distributed
Power Cost	0	0	$15,084
Labor Cost	0	0	$350,000
Floor space	0	0	$5,320
Software OTC depreciation	$120,240	60	$222,712
Software S&S and MLC	$168,783	50	$337,566
Hardware OTC depreciation	$103,691	25	$414,765
Hardware Maintenance	$20,276	25	$81,105
Network	0	0	$4,758
Total	$412,990	29	$1,437,610

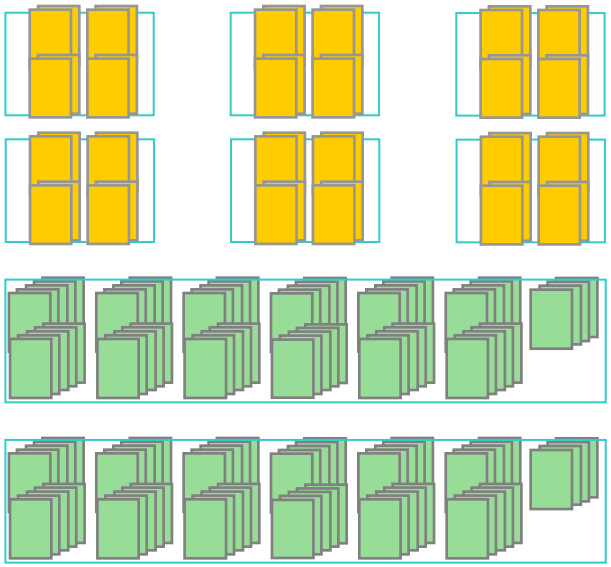
3.48X

Final state when the mainframe is eventually decommissioned

(Interim phases would include parallel production and thus drive higher costs)

Core Proliferation for a Mid-sized Offload Project

6x 8-way Production / Dev
2x 64-way Production / Dev
Application/MQ/DB2/Dev partitions

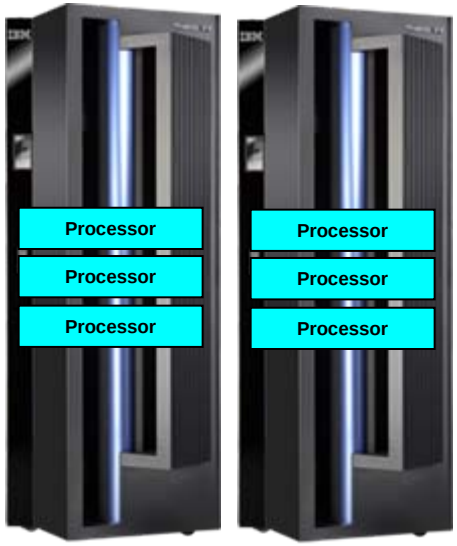


$25.4M TCO (5yr)

6 processors
(1,660 MIPS)

176 distributed processors
(800,072 Performance units)

2x z900 3-way Production / Dev / QA / Test

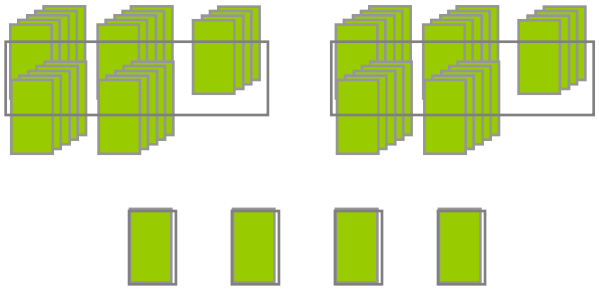


$17.9M TCO (5yr)

482 Performance Units per MIPS

Core Proliferation For A Small Offload Project

2x 16-way Production / Dev / Test / Education
App, DB, Security, Print and Monitoring
4x 1-way Admin / Provisioning / Batch Scheduling

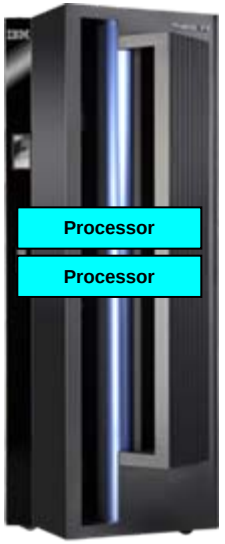


36 Unix processors
(222,292 Performance Units)

$17.9M TCO (4yr)

z890 2-way Production / Dev / Test / Education
App, DB, Security, Print, Admin & Monitoring

2 processors
(332 MIPS)



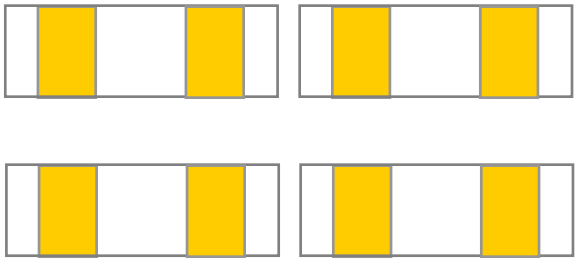
$4.9M TCO (4yr)

Plus:
2x HP SAN Servers (existing)
Many (existing) Windows servers

670 Performance Units per MIPS
No Disaster Recovery

Core Proliferation for a Smaller Offload Project

4x p550 (1ch/2co)
Application and DB



1x z890
(production + test)

0.24 processors
(88 MIPS)

8 Unix processors
(43,884 Performance Units)

$8.1M TCO (5yr)

$4.7M TCO (5yr)

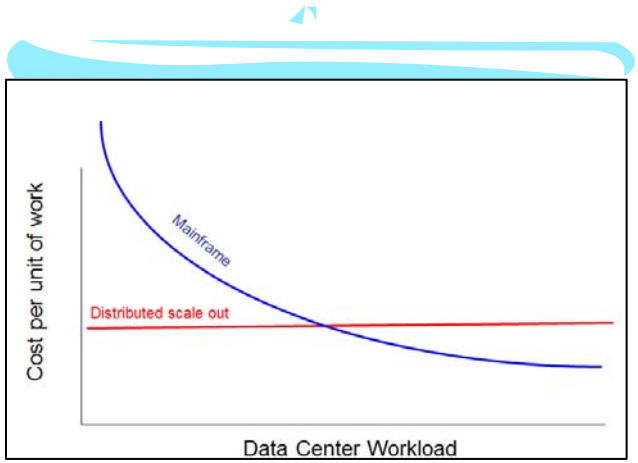
499 Performance Units per MIPS

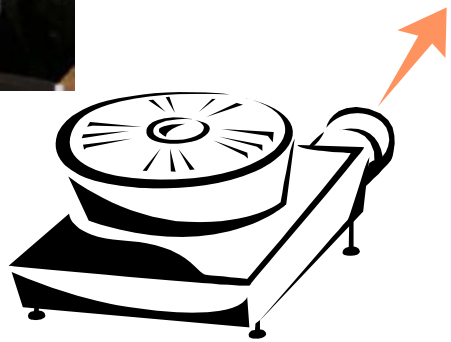
Migration duration 3 years

Is There A Cross-Over Point?

Is a 500 MIPS workload small enough to offload from System z?

CIO





It depends on the ***nature*** of the workload, rather than the ***size***!

IBM

Different Workloads Have Different Characteristics

- High volume OLTP workload
- High I/O bandwidth
- High quality of service requirements

- High processing intensity
- Integer or floating point

- Light to moderate processing
- Modest quality of service requirements

zEnterprise Environments Are Optimized For Different Workload Types

OLTP Characteristics

- Transactions *Read*, *Calculate* and *Write*
  - Complex transactions can be decomposed into ‘atoms’
  - Complexity arises when many threads *write* to the *same* database, especially if mistakes are costly
- Modern systems *Read* and *Calculate* the same
- *Writing* to the same data-store requires specialized systems
  - OLTP systems solve this – need TP monitor and hardware…
  - Unique requirements on hardware design (centralized system image → highly parallel systems → cache structure; I/O; RAS)
- What are the requirements? Do alternatives meet them?

What Is System z Optimized For?

- Optimized for transaction processing and master data base
  - Linear scalability with Parallel Sysplex and streamlined middleware
- Optimized for high I/O bandwidth workloads (e.g. batch)
  - Dedicated I/O processing plus DS8000 and Easy Tier
- Optimized for managing mission-critical data
  - Built-in DFSMS capability automates efficient data management
- Optimized for ultra high availability
  - Multi-layered strategy for reliability and serviceability
- Optimized for business critical workloads
  - Centralized data mirroring and systematic disaster recovery
- Optimized for easy growth in processing capacity
  - Elastic scaling through Capacity On Demand
- Optimized to achieve full use of processing resources
  - Intelligent prioritization of multiple workloads/ensembles to service objectives

Most Workloads on System z are Already Best-Fit

- **IBM Eagle Studies are TCO analyses for customers**
  - Cost and risk analysis of mainframe vs. alternative
  - Tailored to individual customer workloads
    - Cost factors unique to each enterprise
    - Costs evaluated over five-year period
- **63 out of 67 IBM Eagle studies concluded that System z offered a better solution than the distributed alternative**
  - System z is 52% the cost of distributed when offloading from z/OS
  - System z is 60% the cost of distributed when consolidating Linux applications
- Contact *Craig Bender* (csbender@us.ibm.com)

Some Typical Eagle Studies Under 3,000 MIPS – Most Stayed On System z

Customer	z (MIPS)	distributed (PUs)	5-Year TCO z	5-Year TCO distributed	5-Year TCO z/dist %
Average	**1,166**	**218,472**	**9,050,451**	**16,325,492**	
SA Government Agency	475	241,291	19,773,442	25,261,624	78.27%
German Financial	1,200	263,177	3,939,889	4,701,033	83.81%
NA Financial Servieces	2,526	308,144	3,456,611	5,939,476	58.20%
US utility company	456	163744	6,157,295	13,380,866	46.02%
European Insurance	904	171,062	13,019,980	15,877,484	82.00%
US Manufacturor	900	453,168	11,277,266	16,019,269	70.40%
Asian Bank	1,416	136,013	2,342,300	7,237,681	32.36%
US Retailer	1,700	215,124	3,543,154	8,951,851	39.58%
US County Government	88	43,884	4,717,394	8,108,668	58.18%
US Retailer	1,500	184,732	9,254,186	20,861,515	44.36%
AP bank	1,336	168,113	17,300,000	27,200,000	63.60%
AP bank	300	24,162	5,200,000	11,500,000	45.22%
US Manufacture	1,917	261,040	4,758,313	7,350,216	64.74%
US Food Services	1,600	424,952	21,966,475	56,167,206	39.11%

Typical Decision Factors: Cost and Risk

Re-hosting Dynamics

- Competitors team up to promise substantial cost savings by offloading
  - Oracle, HP, Micro Focus, Clerity, TmaxSoft, Microsoft…
  - Projections of cost savings and benefits are unproven
  - Benefits of successful projects often glorified

- Clients likely to be approached for re-hosting
  - Outdated hardware and software (less cost-effective)
  - Smaller footprints
  - Poor understanding of mainframe cost and value
    - Inaccurate charge backs
    - High mainframe costs due to high cost ISV software, failure to exploit price concessions…

What Happens When You Try To Move A Best Fit Workload On System z To Another Platform?

1. Core Proliferation
   - Long-term costs go up
2. Missing Function & Processes
   - Long-term costs go up
3. Sub-optimized Performance
   - Long-term costs go up
4. Risks – Failure, Delay, Degraded Qualities Of Service
   - Business case does not close

Bottom line – you spend MORE, not less

1. Why Core Proliferation Happens

- De-consolidation of applications to dedicated servers
  - Dedicated servers for functional roles - application, database, security, batch, systems management
  - Separate servers for production, development, quality assurance test
  - Low utilization due to provisioning for the peak on each server and pre-provisioning for growth
- Disaster Recovery
  - 100% coverage doubles the number of cores required
- Processing comparisons
  - Language expansion (CICS/COBOL path lengths are highly optimized)
  - Zero network on mainframe reduces computation (and latency)
  - Mainframe has dedicated processors for I/O operations, distributed does not
  - Converting IMS hierarchical database to relational results in a 3x expansion

2. Missing Function

- No distributed alternatives to handle large transactional workloads against a single-image database
  - Oracle RAC has a “glass ceiling” on scalability
- Systematic error and disaster recovery is not well-supported in distributed environments
  - HyperSwap, scripted failover, system automation may be missing
  - No discounts for dark standby processors
- Storage capabilities of DFSMS and DS8000 may be missing
  - Shared virtualized storage across a sysplex environment
  - Hierarchical Storage Management, Hyper Swap disk mirroring, Easy Tier SSD optimization
  - Tape operations, encryption

More Missing Function

- Replacement technologies aren't always available
  - Hierarchical data base
    - IMS DB and IMS DC
  - Languages
    - PL/I, ASM …
  - Batch environments
    - JCL with symbolic substitution, batch pipes, Generation Data Group files for batch recovery
    - Scheduling capability
  - System management and database tools
  - 3270-style user interfaces, BMS maps, APIs…
  - File structures
    - VSAM, QSAM and Partitioned Data Sets
  - Print
    - PSF, AFP, Info Print Server, JES2/3 spool

Missing Systems Management Function

- Case Study (US retailer):
  - 200 system management products used on the mainframe
  - Only 15 of them had equivalent distributed replacements (7.5% coverage)
  - Cost of those 15 products was $8.4M OTC plus $1.8M annual
  - Distributed system management pricing is generally based on the number of cores to be managed
- Case Study (another US retailer):
  - 261 system management products used on the mainframe
  - Only 37 of them had equivalent distributed replacements (14% coverage)
- If replacement product unavailable:
  - Need to re-write applications to not need it
  - Or write code to perform the function from scratch
  - Or add operations labor to do the function manually

All Functionality Must Be Considered

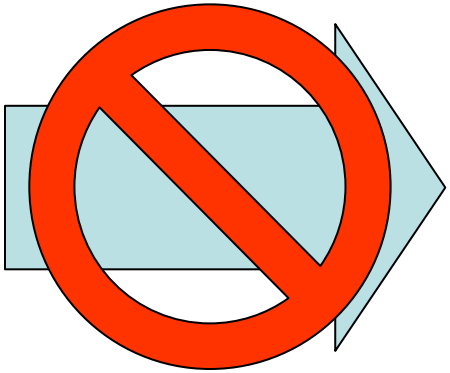
- Rehosting proposal to a major Bank
  - As well as rehosting CICS and BATCH there's a need to migrate major z/OS utilities

Sort and ETL

Rexx, JCL & Batch

Database Print, & Backup

Assembler Development and Maintenance



"Is it possible to include these utilities in Workbench?"

Oracle Tuxedo
ART Workbench

"Should we modify ART Workbench to include new utilities?"

"Can we continue conversion without checking errors?"

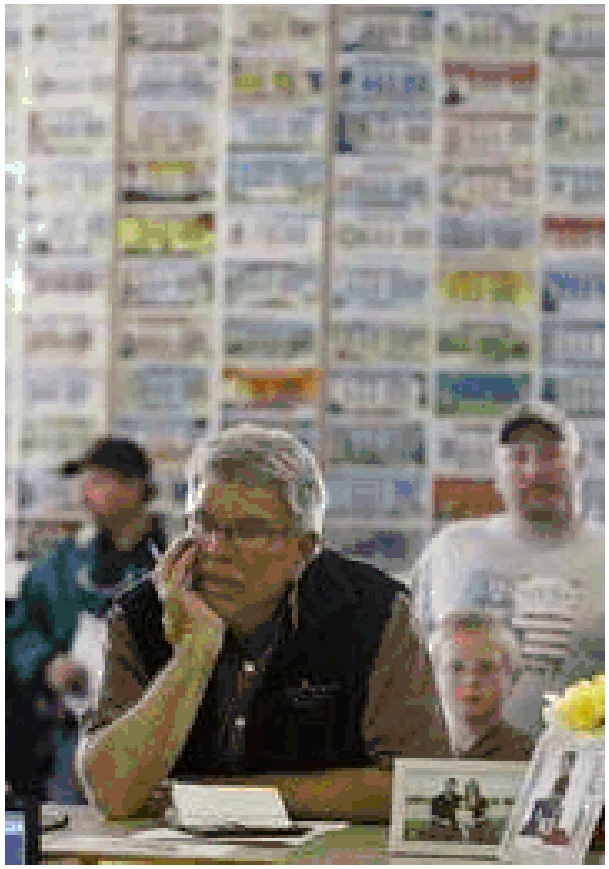
- Better understanding of z/OS and Mainframe Architecture needed

Source: https://forums.oracle.com/forums/thread.jspa?threadID=2296851&tstart=0

3. Sub-Optimized Performance

- Offload project to move State of Montana Department of Motor Vehicles license registration system (MERLIN) from CICS to Microsoft
- Performed by Microsoft and Bearing Point
- CICS solid sub-second response times
- Microsoft 30 second response times
- Cost of project $28.3M, 3 years late

"Transferring titles is taking two to three hours instead 15 minutes," Anderson said. One employee told him she had never heard so many "four-letter words" from customers.



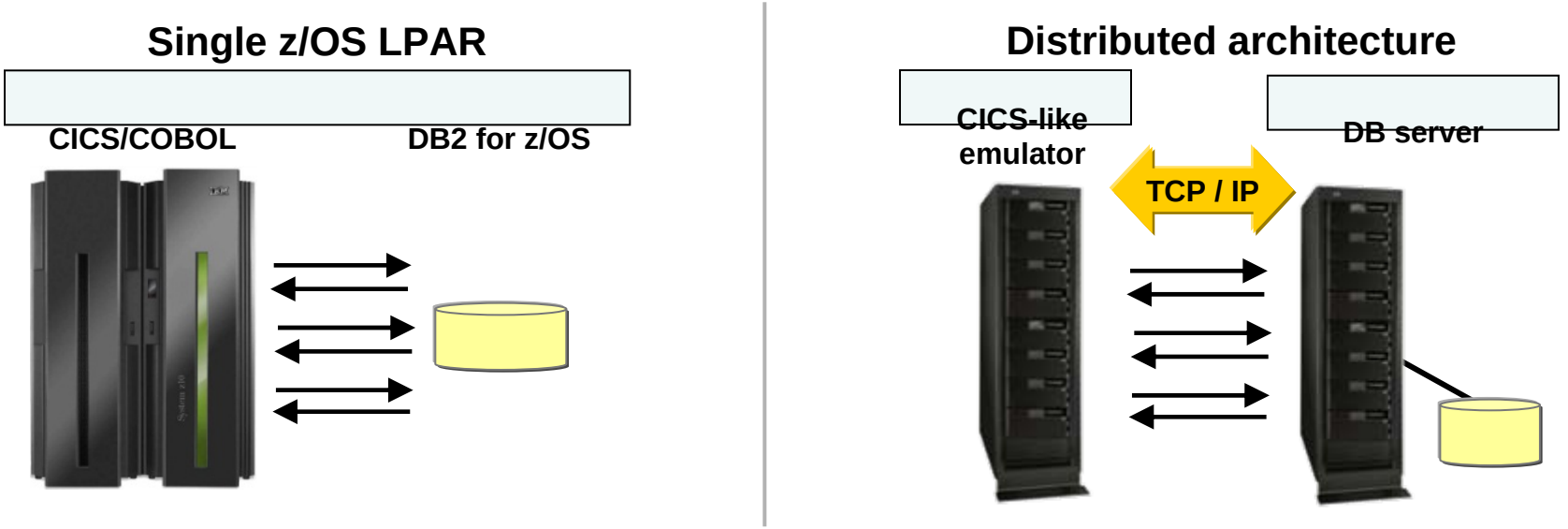
COBOL Recompiled With Micro Focus Had Inferior Performance

- Offloads require a different COBOL compiler
- IBM Enterprise COBOL on z/OS performed best in customer benchmarks
- Micro Focus COBOL is a COBOL interpreter, so code is over 4.5 times less efficient
- ACUCOBOL, a compiler acquired by Micro Focus, was 12 times less efficient
- Micro Focus functional differences required additional debugging

Internal customer study

Some Applications Originally Designed With Co-located Data

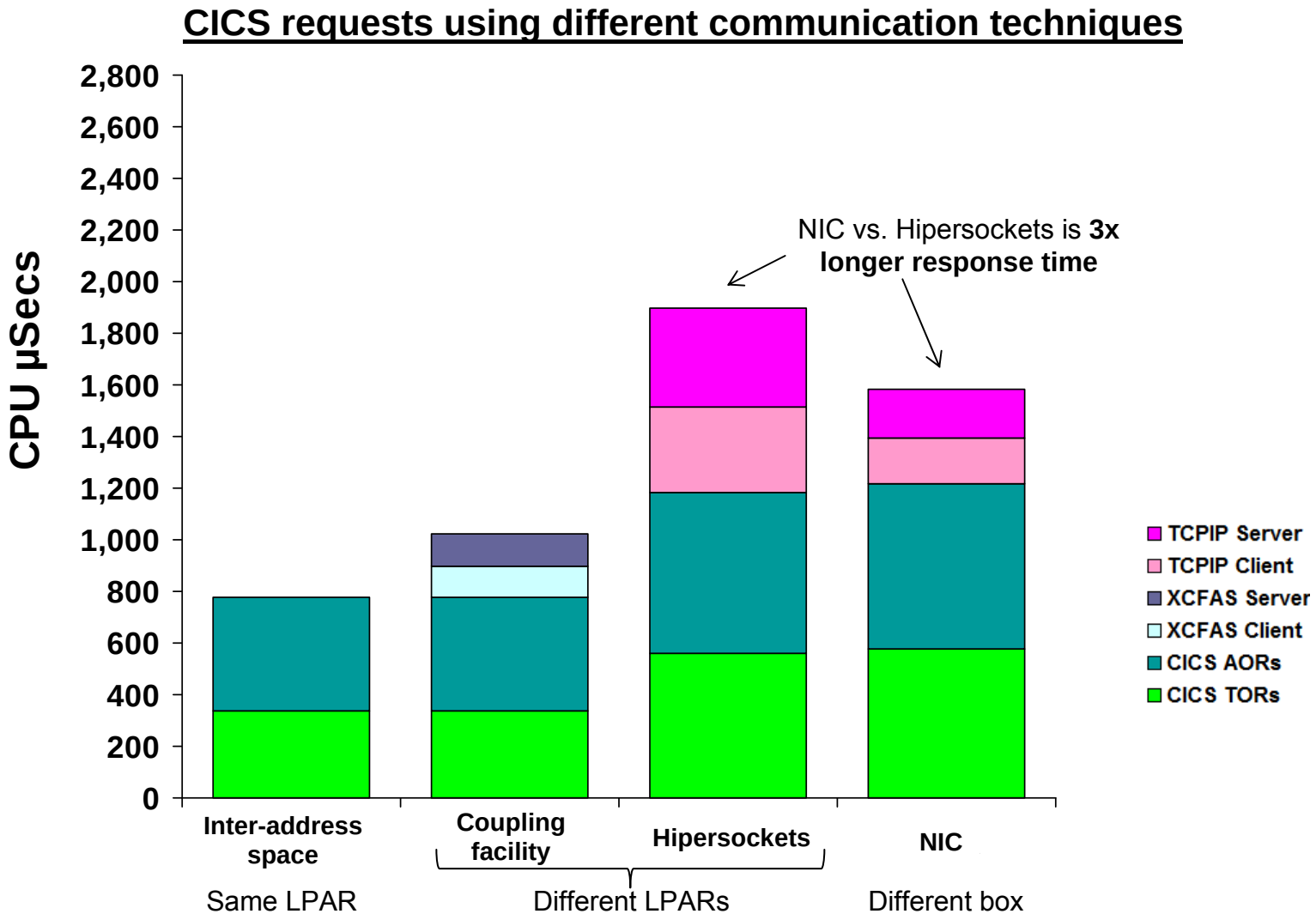
- A large insurance company rehosted a portion of an application as a Proof Of Concept
  - *"When folks wrote screen-based transactions many years ago, they wrote it at a business function viewpoint…"* = very 'chatty' (and no separation of presentation, business logic, data logic)
  - SQL suboptimized for networking (comms performance wasn't originally an issue)
- Various tuning/tweaking done for several months, but ultimately the POC was stopped
- TCP/IP stack consumes considerable CPU overhead/resource AND introduces security considerations (firewalls …) and latency (network delay)



Some transactions are not easily moved

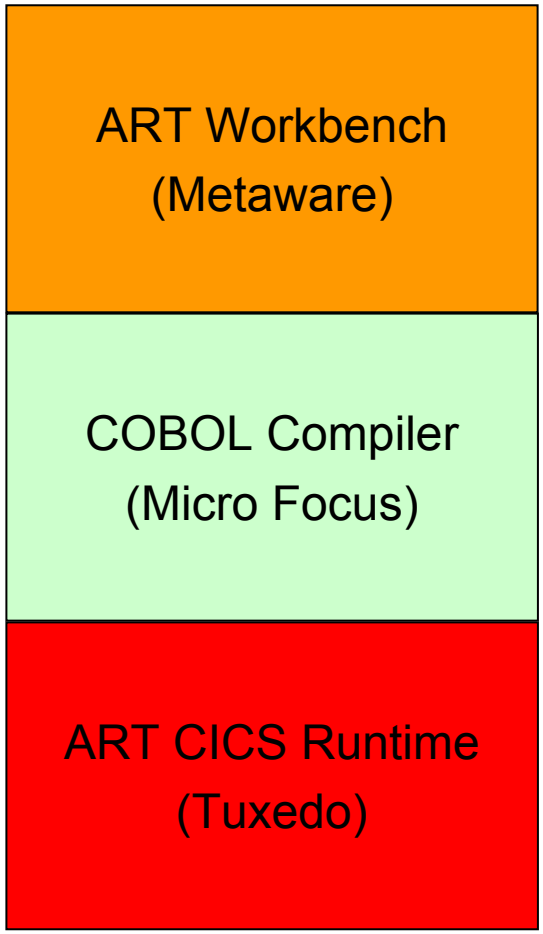
Source: Phil Murphy, Forrester Research

Co-locating In the Same Address Space Is More Efficient



Source: http://hurgsa.ibm.com/projects/t/tp_performance/public_html/OS390CICS/reports/CICS%20TS%20V4.2%20Performance.ppt and email with z/OS Communications Server development team

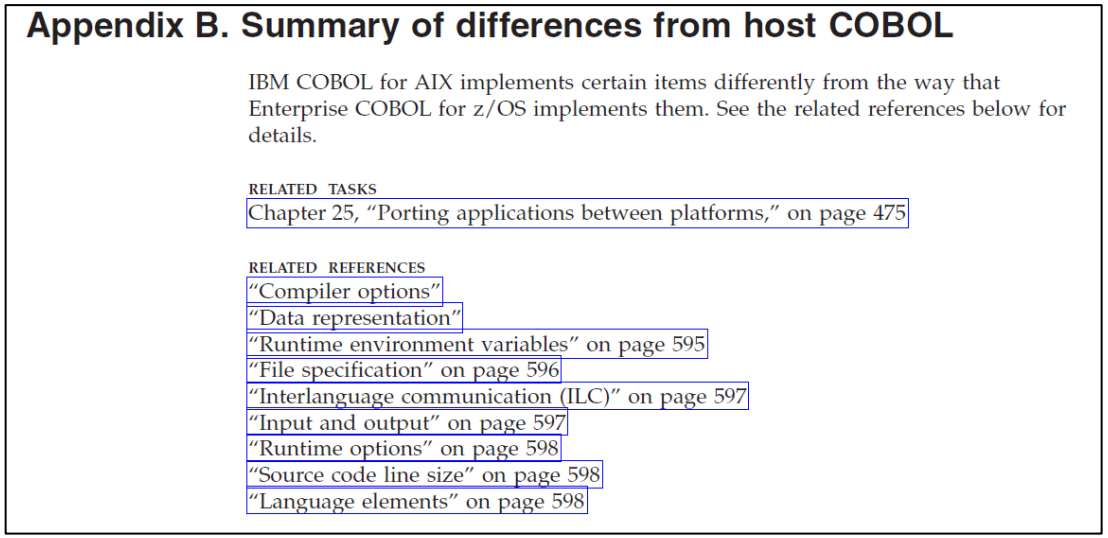
4. Risk of Migration Failure – Tuxedo ART



- Workbench:
  - Need workarounds for certain migration tasks
  - Tools generate incorrect code that leads to compilation problems
- Micro Focus Compiler/Runtime:
  - Poor integration with Tuxedo
  - Very limited scope of debugging when running on Tuxedo
- ART CICS Runtime
  - Service Crashes with memory errors
  - Behavior of application not the same after porting

Compiler Differences May Lead To Changed Behavior

- Even the closest COBOL compiler has differences:



Appendix B. Summary of differences from host COBOL

IBM COBOL for AIX implements certain items differently from the way that Enterprise COBOL for z/OS implements them. See the related references below for details.

RELATED TASKS

Chapter 25, "Porting applications between platforms," on page 475

RELATED REFERENCES

"Compiler options"
"Data representation"
"Runtime environment variables" on page 595
"File specification" on page 596
"Interlanguage communication (ILC)" on page 597
"Input and output" on page 597
"Runtime options" on page 598
"Source code line size" on page 598
"Language elements" on page 598

From SC27-3601-00 http://publib.boulder.ibm.com/epubs/pdf/cob4pg00.pdf

Potential collation problems (EBCDIC vs. ASCII) especially with VSAM keys

- What about Micro Focus COBOL?
  - *"Indeed, some of the Micro Focus COBOL compiler options do change the behavior of the executed code."*
    http://download.oracle.com/docs/cd/E18050_01/artwb/docs11gr1/wbref/CobolConverter.html

Risk Of Migration Failure

Lombard Canada Ltd., one of the oldest property and casualty insurance operations in Canada, partnered with Micro Focus to replace old mainframe

- 200 MIPS S/390
- CICS, COBOL, VSAM, DB2

"We estimate this project will save us in excess of $1 million a year, but more importantly, it will enable us to become more competitive in our industry both today and in the future."

VP of IT
Lombard Canada Ltd., 2005

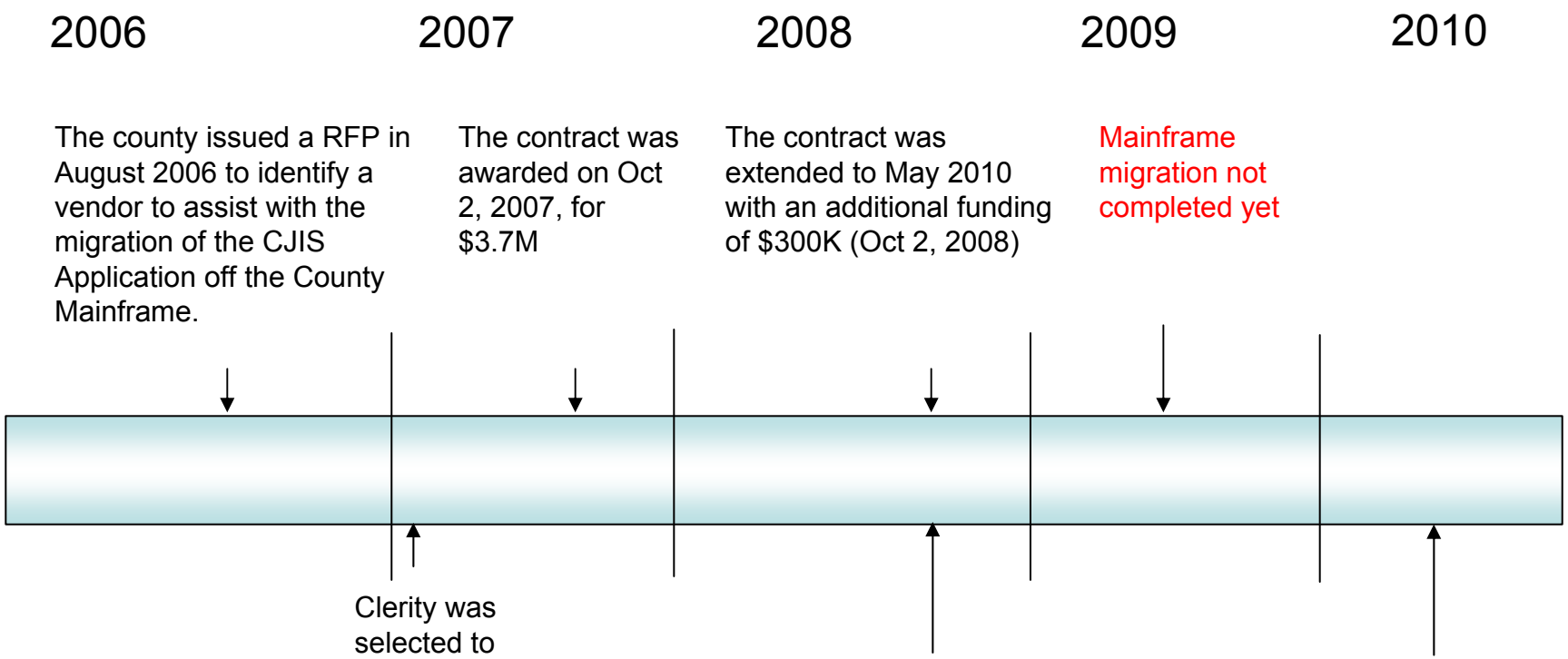
Project abandoned in 2006:

- System Integrator and Micro Focus did not have the skills
- Lombard spent millions on conversion with no results
- VP lost his position
- Installed a new z890 platform and re-architected front end to access CICS
- New VP stated Disaster Recovery capability of System z as a key benefit

Source of quote: http://www.finextra.com/news/Announcement.aspx?pressreleaseid=4858

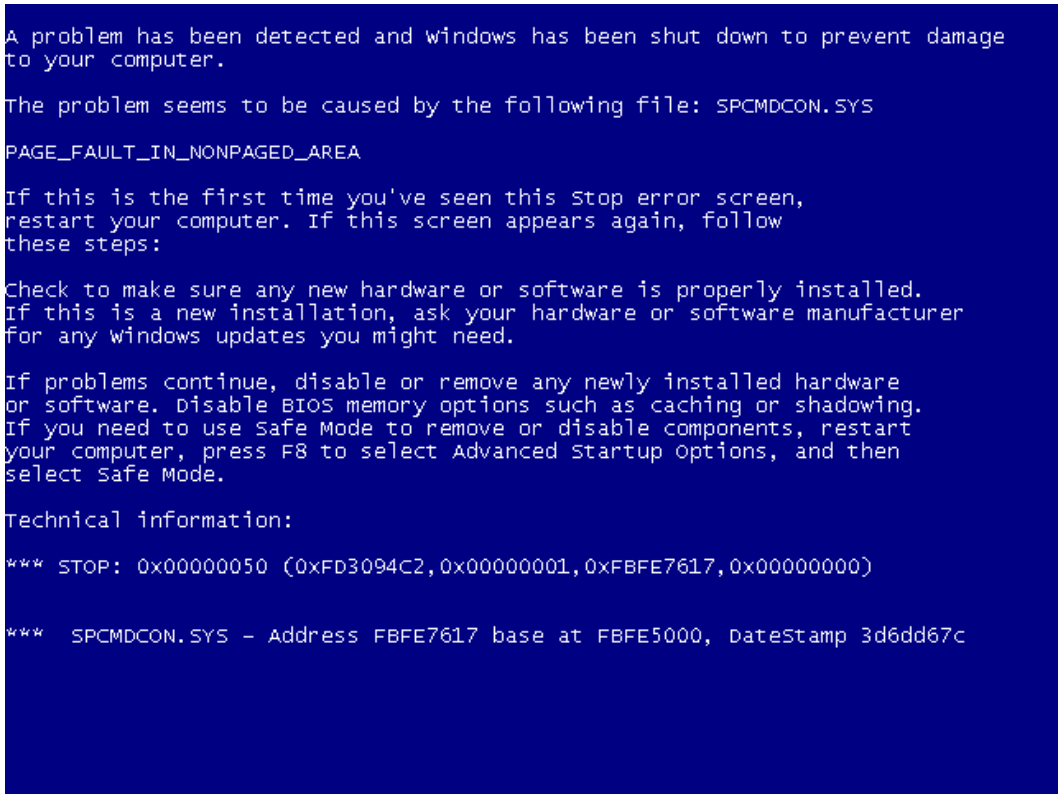
Project Delays Can Be Greater Than Anticipated

US County Government Offload Project Delayed By Complexity



Risk Of Code Stability

- Mature System z software is very stable
- Some distributed software is not



Familiar Microsoft “Blue Screen Of Death”

Compare Code Stability

DB2 for z/OS Security

- Less than 10 security-related patches in the last 10 years

Oracle's Security Exposures

- Oracle.com – October 2011
  57 security patches, including **5** for the database
- Oracle.com – July 2011
  78 security patches, including **13** for the database
- Oracle.com – April 2011
  73 security patches, including **6** for the database
- Oracle.com – January 2011
  66 security patches, including **6** for the database

In the last year Oracle has issued 274 security patches, 30 for the database

Source: http://www.oracle.com/technetwork/topics/security

IBM's Track Record For Reliability Gives Customers Peace Of Mind

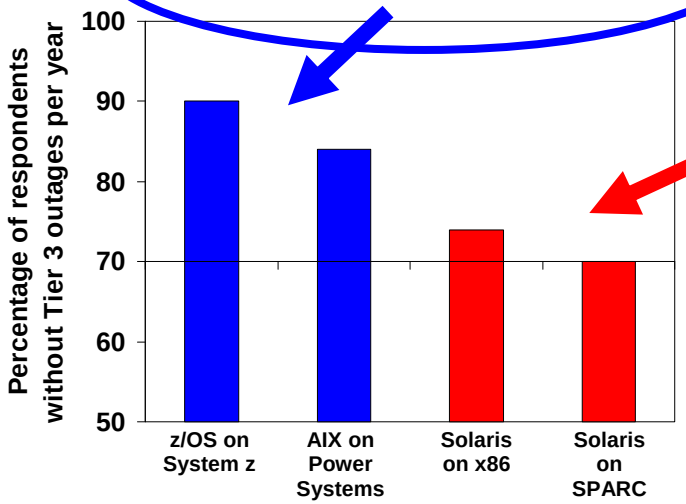
IBM

From a 2011 ITIC global server hardware and server operating system reliability survey (468 business worldwide polled):

Which platform experienced the least amount of severe (Tier 3) outages per server per year? Hint: It's IBM's!

✓ z/OS – 90%[3] on System z

✓ AIX – 84%[3] on Power Systems



Oracle

"Oracle's Solaris operating system and the company's x86 and SPARC servers uptime and reliability do not match the leaders"[2]. This downtime may cost you big $$$ bucks.

× Sun Solaris on x86 – 74%[1]

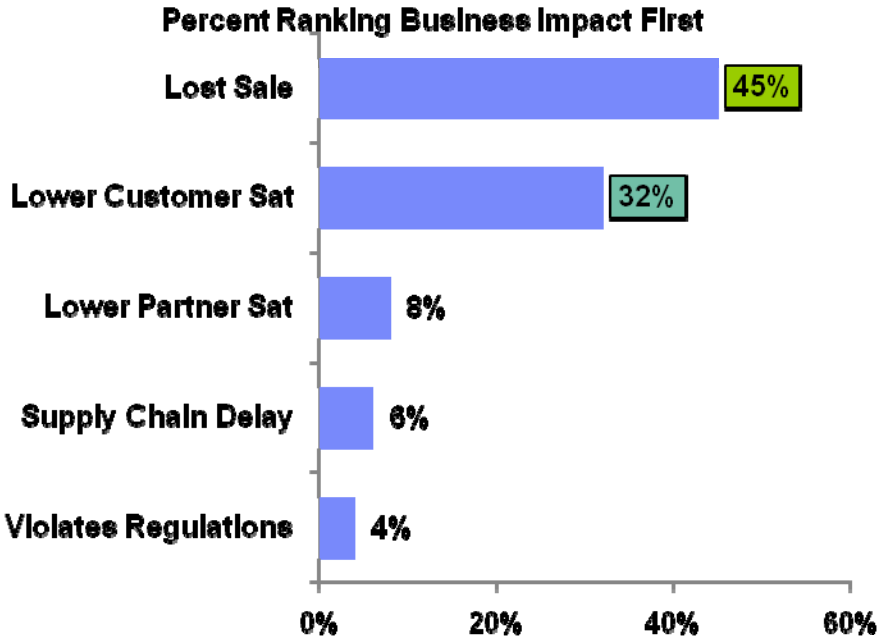
× Sun Solaris on SPARC – 70%[1]

"Overall, with respect to the most severe and prolonged unplanned Tier 3 outages, **Sun Solaris 10** also **lagged behind all of the major OS distributions**."[1]

[1] January 27, 2011 article titled, "IBM, Stratus, HP, Fujitsu Top ITIC/GFI Software Hardware Reliability Survey"
[2] February 3, 2011 article titled, "ITIC Reliability Survey: Oracle Users Anxious/Angry Over Service, Support Slippage"
[3] January 18, 2011 article titled, "Big Iron in a Class by Itself" by Stephen Swoyer"
The information provided is based on a point in time (11/29/2011).

Downtime Costs Sales, Customer Sat ...

Business Impact of 10 Minutes Of Downtime



Source: IBM Customer Survey

Financial Impact of Downtime Per Hour

Figure 1 Cost of downtime by industry segment

Industry/Sector	Revenue/Hour
Energy	$1,468,798
Telecommunications	$4,611,604
Financial	$8,213,470
Information Technology	$3,316,058
Insurance	$2,582,382
Pharmaceuticals	$2,058,710
Banking	$1,145,129
Consumer Products	$989,795
Chemicals	$1,071,404
Transportation	$1,463,128

Source: Robert Frances Group 2006

Average = $2.7M

Bottom Line: Actual Costs Go Up

- Core proliferation is underestimated
  - Distributed solutions require far more cores than suggested by simple benchmarks
  - Drives up hardware and software costs (priced per core)
- Equivalent system management costs can be significantly more
  - Multiple products needed to achieve equivalent function
  - Also priced per core
- Re-architecture may require to work-arounds for missing function
  - E.g. to contain “batch window”
- Repurchase distributed servers after 4-5 years
  - No credit for existing processing capacity when upgrading
- Operational labor costs increase

Case Study – A Recent “Success” Story

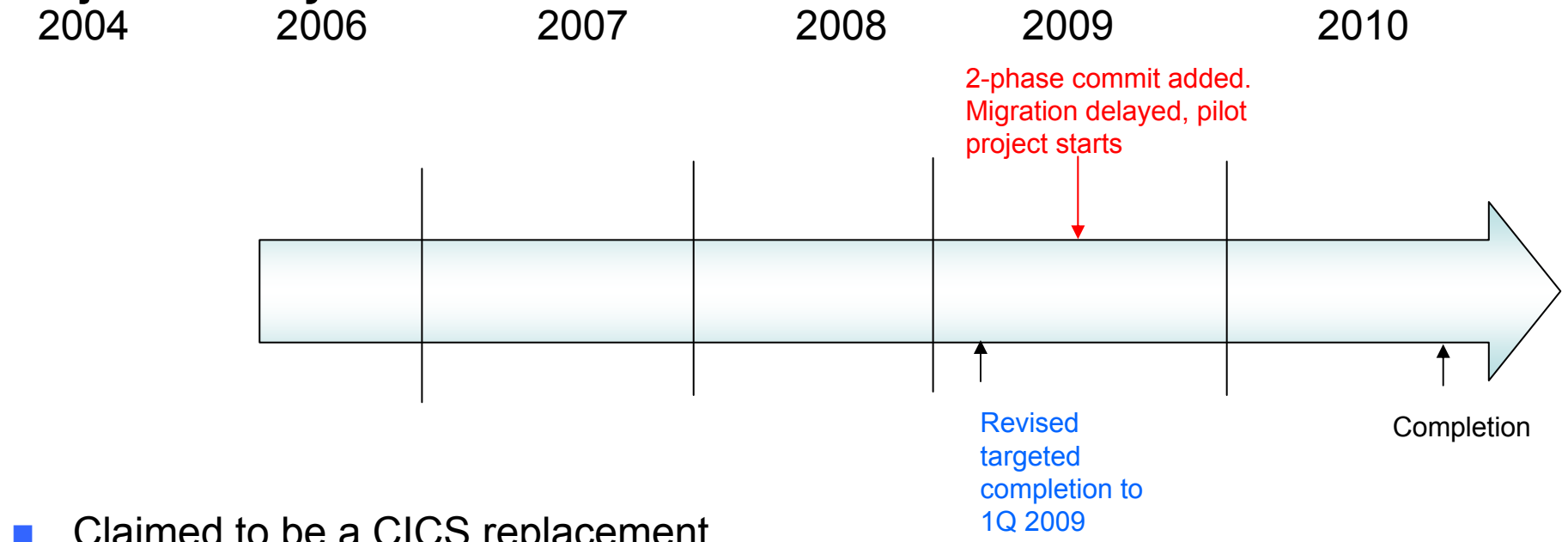
IBM

Customer Feedback Confirms The Following

1. 6:1 Core Proliferation
   - 900 MIPS rehosted by 6 z10 EC IFLs, utilization rate dropped (100% to 75%)
2. Missing Function
   - 2,500 COBOL lines changed in 50 programs AND all Assembler rewritten
   - Micro Focus COBOL integrating/debugging problems
3. Sub-optimized performance
   - Micro Focus COBOL compiler less efficient and required more hardware
4. Risk Of Failure
   - Qualities of Service (Non Functional Requirements) compromised
   - Very costly extensive testing by professionals to protect against subsequent customer problems
   - 1st attempt failed using different COBOL compiler
   - Migration to UniKix on zLinux had never been done before

Delays Greater Than Anticipated

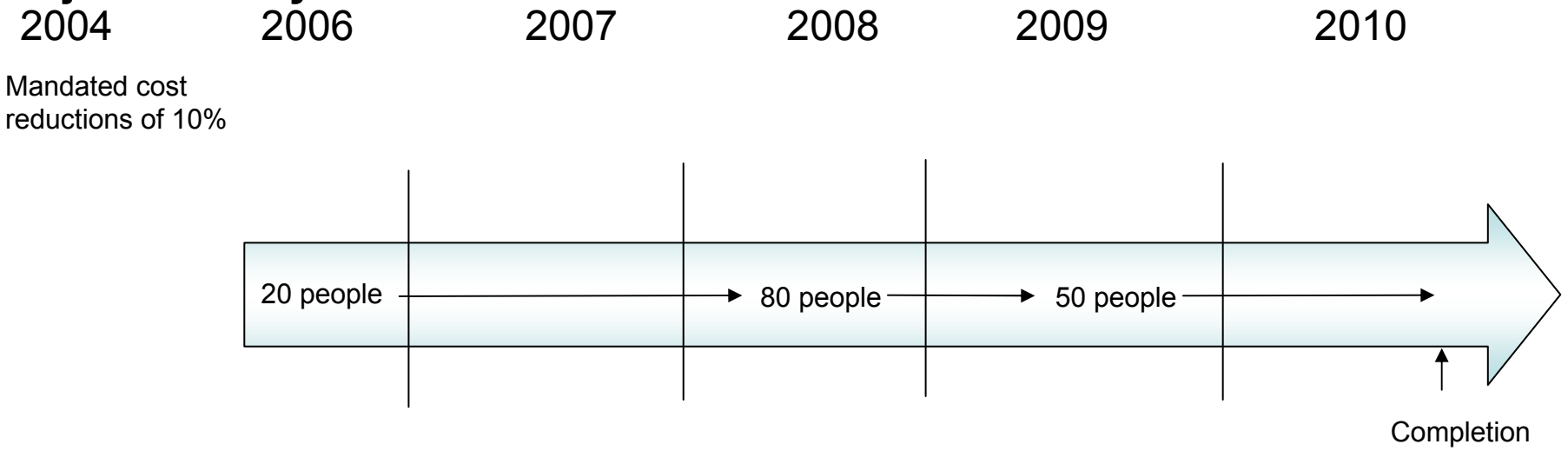
Project History



- Claimed to be a CICS replacement
- Project delay upon discovery of missing 2-phase commit support
- 3+ months to switch compilers (estimated $1M labor)
- Change-management issues

Bottom Line: Actual Costs Probably Increased

Project History



- 170 person years @ $100K/PY **$17M to migrate, $19.6M with hw/sw**
- Best-case estimate savings on operating cost **$0.77M per year**
- Payback > **29 years**
- After 10 Years NPV = **-$13.15M,** IRR = **-25%**
- Mainframe was **NOT** removed (kept DB2 and batch on z/OS to lessen risk)

Conclusions

- Offloading existing System z workloads rarely saves money, often increases risk, and freezes innovation
- Instead, zEnterprise enables a new strategy for cost reduction
  - Consolidate peripheral workloads using fit for purpose assignments to reduce cost of acquisition
  - Multiple virtualized architectures managed as one system reduces operational costs
  - No other vendor offers this choice