Exploring IT Economics – How to Maximize your IT Investments

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How to evaluate IT Economics… What are your true IT costs?

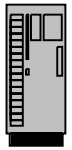
- IT Economics is the **financial assessment** of **IT operations**
  - IT expenses by platform
  - IT expenses by line of business
  - CAPEX
  - OPEX
  - Total annual IT spend
- Different methodologies are used to calculate IT spend
- Do they calculate your **true IT spend**?
- The most immediate/obvious choice is not necessarily the cheapest
- Evaluate your **TCO** vs. **TCA**
- Consider ALL cost factors over a 5 years time period
- Build a **Business Case** to Make a **Financially-Based** IT Decision
- How do true costs compare to cost allocation (Chargeback)

Many Cost Components – 1st Dimension

80:20 rule helps to achieve reasonable results in a short time

Components

Hardware



List vs Discounted
Fully configured vs. basic, Prod. vs. DR
Refresh / upgrade, Solution Edition…

Software

IBM and ISV, OTC and Annual maint (S&S)
MLC, PVU, RVU, ELA, core, system

People

FTE rate, in house vs. contract

Network

Adapters, switches, routers, hubs
Charges, Allocated or apportioned, understood or clueless

Storage

ECKD, FBA, SAN, Compressed, Primary, secondary
Disk (multiple vendors), tape, Virtual, SSD

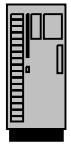
Facilities

Space, electricity, air cooling, infrastructure including UPS and generators, alternate site(s), bandwidth

Environments Multiply Components – 2nd Dimension

Environments

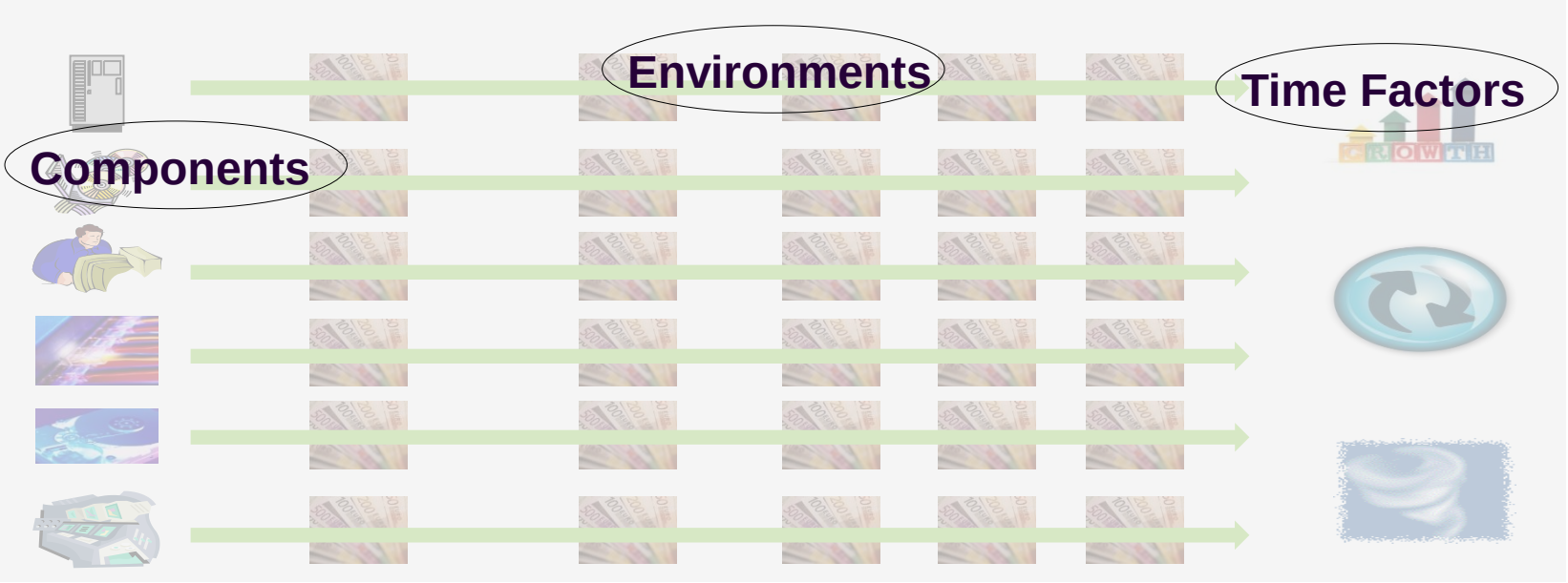
Components

	Production/Online Batch/Failover	Development	Test	QA	DR
Hardware					
Software					
People					
Network					
Storage					
Facilities					

Time Factors Drive Growth And Cost – 3rd Dimension

- Migration time and effort including parallel costs
- Business organic growth and/or planned business changes affect capacity requirements
  - e.g. Change of access channel or adding a new internet accessible feature can double or triple a components workload
  - Link a business metric (e.g. active customer accounts) to workload (e.g. daily transactions) and then use business inputs to drive the TCO case
- Other periodic changes – hardware refresh or software remediation
- Net Present Value of Money

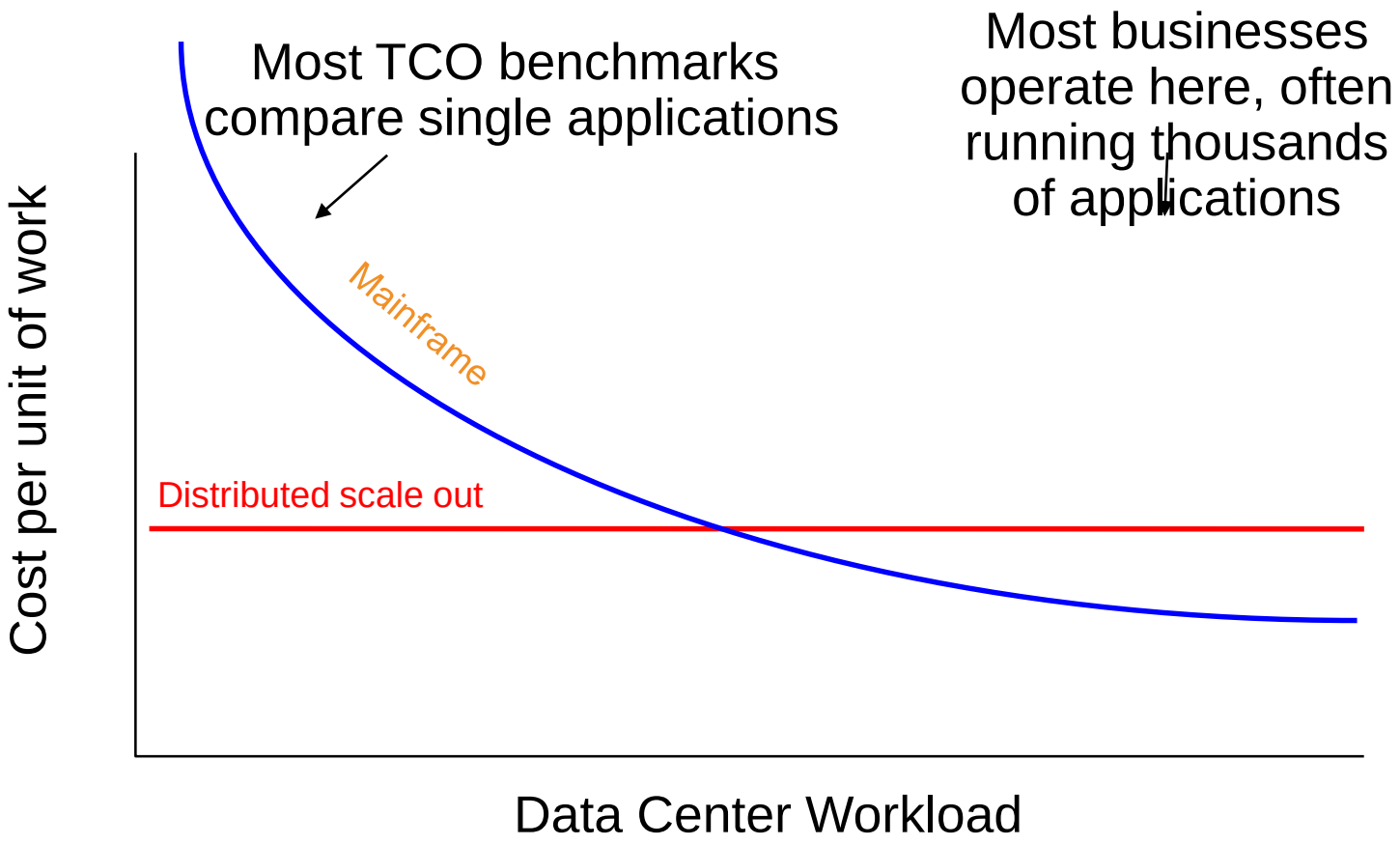
Non-Functional Requirements Can Drive Additional Resource Requirements – 4th Dimension



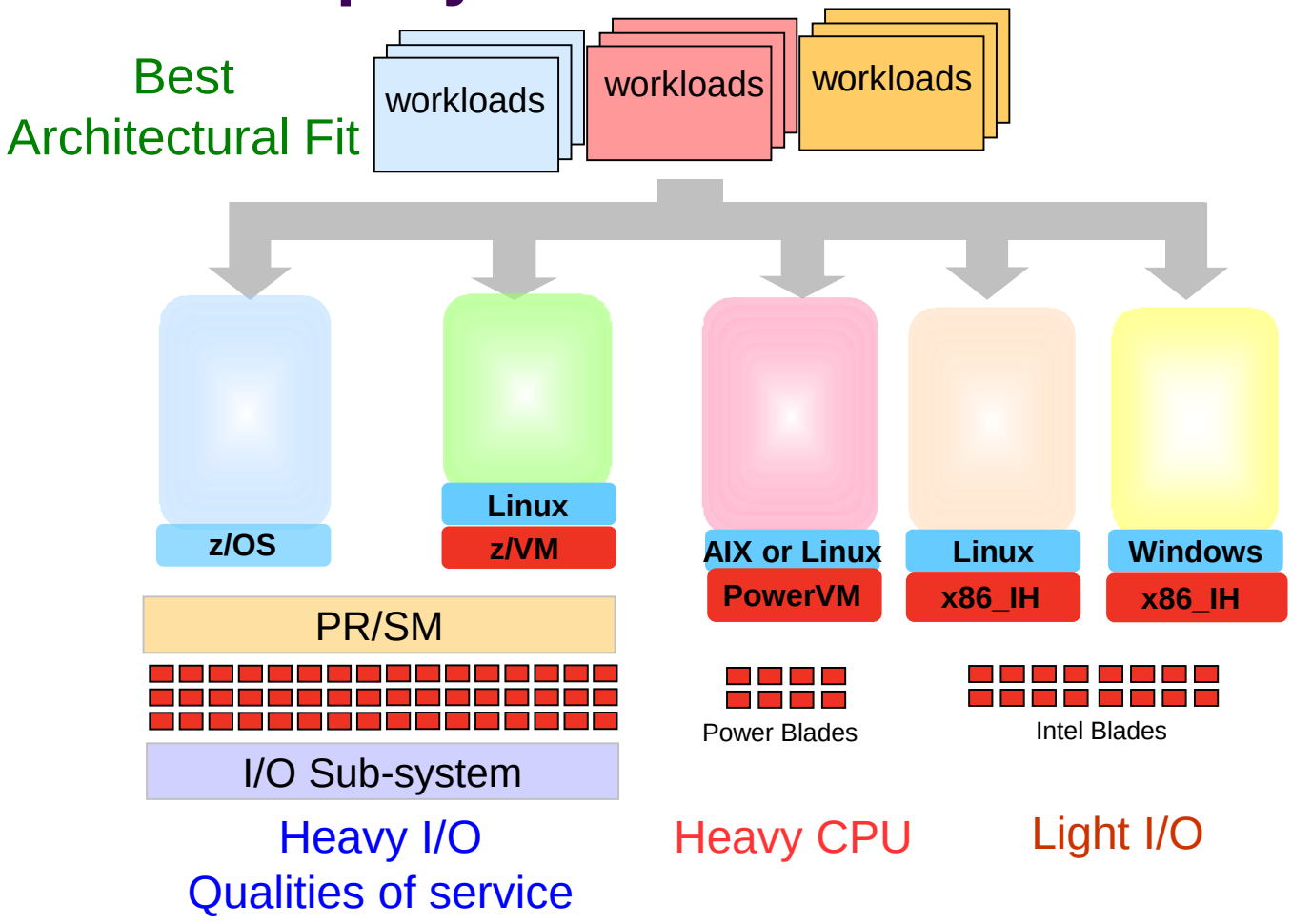
Availability …Security …Resiliency …Scalability …

Qualities of Service, Non-Functional Requirements

Mainframe Cost/Unit of Work Decreases as Workload Increases



Workload Characteristics Influence The Best Fit Deployment Decision

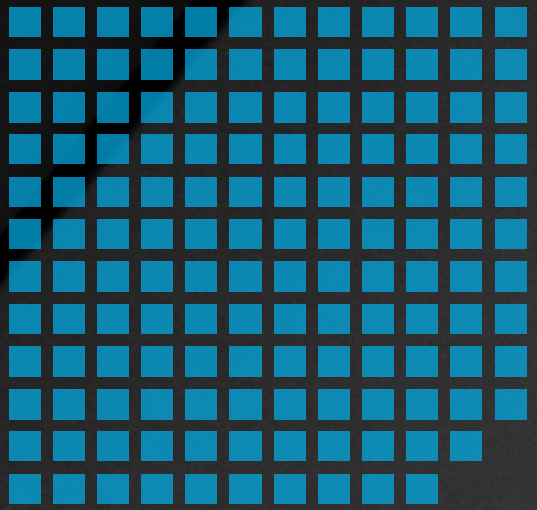


Deploy or consolidate workloads on the environment best suited for each workload to yield lowest cost

Balanced System Design

I/O and coprocessors bring added compute power to workloads

Up to 141 cores on a CPC



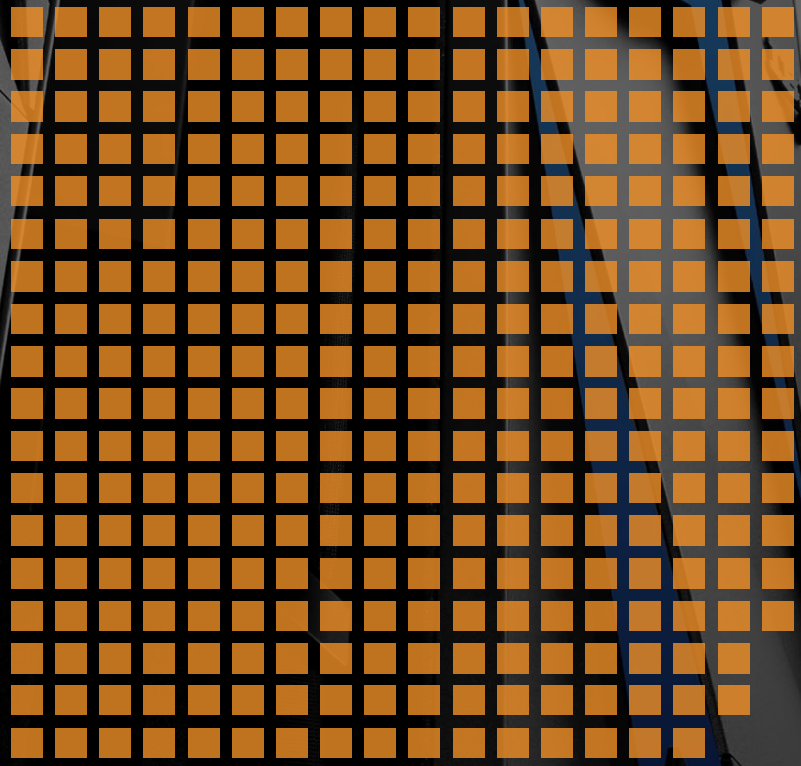
- Share up to 141 processors with up to 85 LPARS
- Configure the processors as CPs, IFLs, zIIPs, or ICFs

Up to 27 cores for offload system processing

24 SAPs
2 Spares
1 IFP

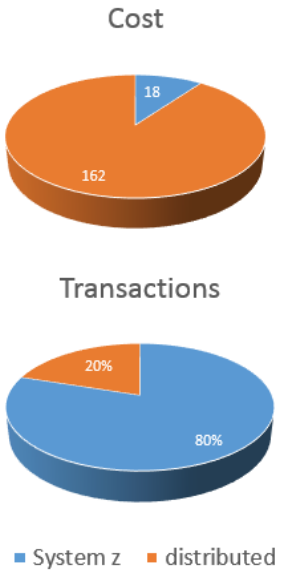
Plus up to 640 POWER cores:

I/O and Coprocessors



Top Down Cost Analysis

- Total infrastructure coats - $180M
  1. Mainframe costs - $18M
     - 70% of mission critical apps
     - 80% of business transactions
     - 80% of the data
  2. Distributed costs - $162M
     - Remaining 30% of critical apps
     - Remaining 20% of business transactions
     - Remaining 20% of the data



- 9 Times Less Cost
- 4 Times More Transactions
- 36 Times Less Cost Per Transaction

The problem is inaccurate financial “charge-back”

IBM System z CICS/DB2

Total MIPS 11,302

MIPS Used for commercial claims processing production/dev/test **2,418**

Claims per year **4,056,000**

Build

Which system costs less for future growth?

Calculate cost per workload

HP Servers + ISV

Production Servers

HP 9000 Superdome rp4440

HP Integrity rx6600

Dev/Test Servers

HP 9000 Superdome rp5470

HP Integrity rx6600

Claims per year **327,652**

Buy

Allocated annual costs for two systems

	Mainframe	Distributed
Hardware	$1,302,205	$87,806
Hardware Maint	$315,548	
Software IBM MLC	$4,842,384	
Software Non IBM OTC	$647,843	$196,468
Software Non IBM MLC	$5,027,936	
Storage	$877,158	
Network	$418,755	
Support Staff	$2,324,623	$257,289
Platform + Staff Total	$15,756,452	$541,563
Platform + Staff Claims Allocation	$3,371,880	$541,563
Billing Center	$1,611,650	
Call Center	$2,920,090	
Development	$1,907,382	
Total	$9,811,002	$541,563
Claims Processed	4,056,000	327,652
$ Per Claim	**$2.42**	**$1.65**

Provided by customer finance department

Mainframe costs easily identified, distributed costs difficult to identify

Billing and call center costs allocated to mainframe, but would be the same for either option

Development still required to customize packaged software for each new contract

Chargeback says distributed is lower cost

True costs per workload – later agreed by customer

	Mainframe	Distributed
Hardware	$1,302,205	$87,806
Hardware Maint	$315,548	
Software IBM MLC	$4,842,384	
Software Non IBM OTC	$647,843	$196,468
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Storage	$877,158	?
Network	$418,755	?
Support Staff	$2,324,623	$257,289
Platform + Staff Total	$15,756,452	$541,563
Platform + Staff Claims Allocation	$3,371,880	$541,563
Billing Center	Same	Same
Call Center	Same	Same
Development	$1,907,382	$193,271
Total	$5,279,262	$734,834
Claims Processed	4,056,000	327,652
$ Per Claim	**$1.30**	**$2.24**

Still can't identify distributed storage and network costs

Billing and call center costs would be the same for either option

Development cost to customize ISV packaged software for each new contract

Mainframe actually has lower cost per claim

A private cloud on z13 yields the lowest TCO compared to a public cloud and a private cloud on x86

64 Light Workloads (128 VMs)

32 Medium Workloads (64 VMs)

27 Heavy I/O Workloads (27 VMs)

123 workloads (219 VMs)

Public Cloud

219 instances

$21.1M (3yr TCO)

Private Cloud on x86

264 x86 cores

$10.6 (3yr TCO)

Private Cloud on z13

32 IFLs

$7.2M (3yr TCO)

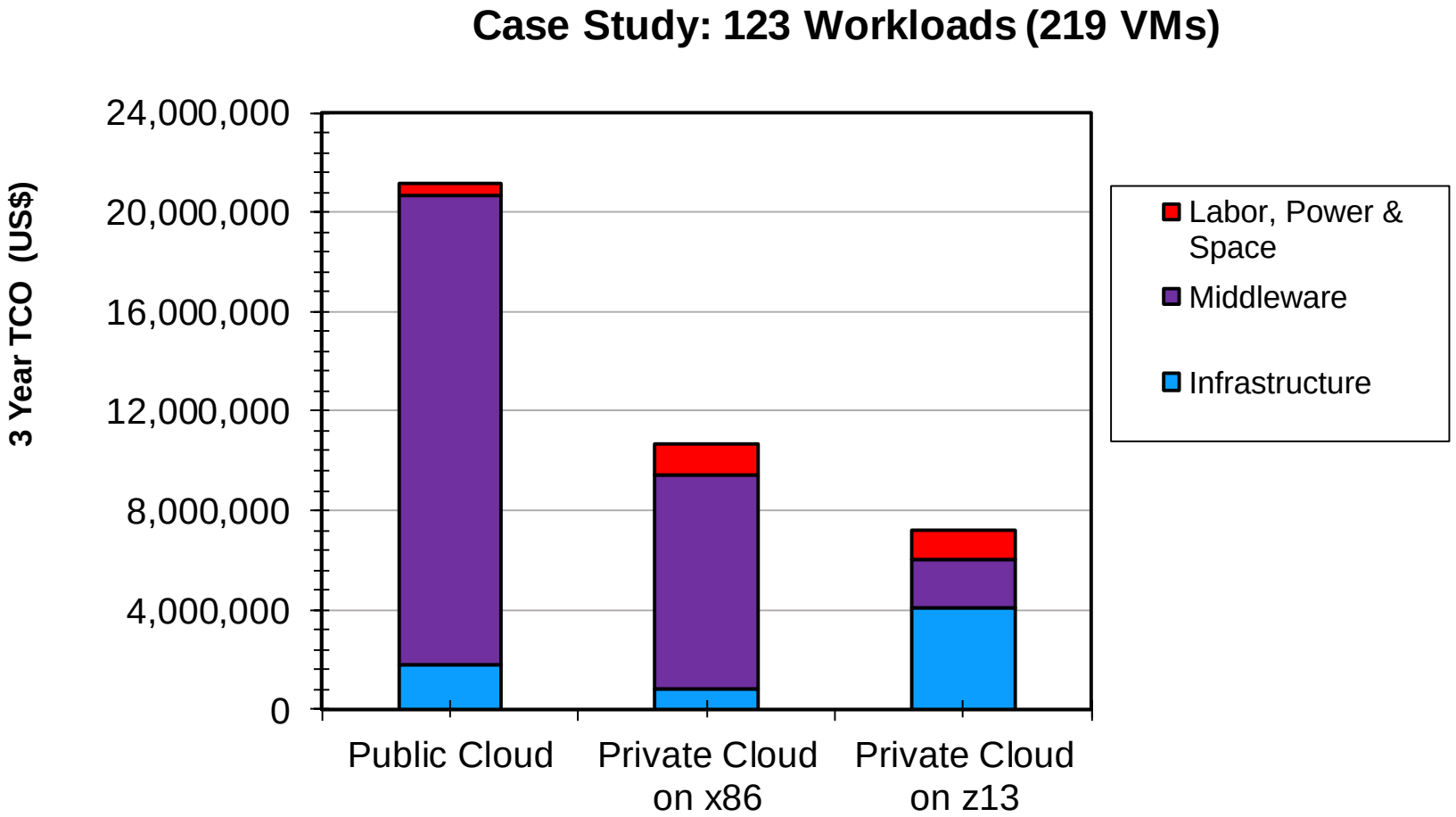
32% Less than x86 cloud*

66% Less than public cloud*

*estimated

Performance comparison based on IBM Internal tests comparing IBM z13 cloud with one comparably configured private x86 cloud and one comparably configured public cloud running an aggregation of light, medium and heavy workloads designed to replicate typical IBM customer workload usage in the marketplace. System configurations are based on equivalence ratios derived from IBM internal studies and are as follows: Public Cloud configuration: total of 219 instances (128 for light workloads, 64 for medium workloads and 27 for heavy workloads); x86 Cloud configuration: total of eleven x86 systems each with 24 Intel E7-8857 v2 3.0GHz cores, 512GB memory, and 7x400GB SSDs; z13 Cloud configuration: total of 32 IFLs, 3806GB memory, and Storwize v7000 with 47x400GB SSDs. Price comparison estimates based on a 3YR Total Cost of Ownership (TCO) using publicly available U.S. prices (including a 20% discount for middleware) current as of January 1, 2015. Public Cloud TCO estimate includes costs (US East Region) of infrastructure (instances, data out, storage, support, free tier/reserved tier discounts), middleware and labor. z13 and x86 TCO estimates include costs of infrastructure (system, memory, storage, virtualization, OS, cloud management), middleware, power, floor space and labor. Results may vary based on actual workloads, system configurations, customer applications, queries and other variables in a production environment and may produce different results. Users of this document should verify the applicable data for their specific environment.

A breakdown shows how middleware costs soar on both the x86 cloud and the public cloud



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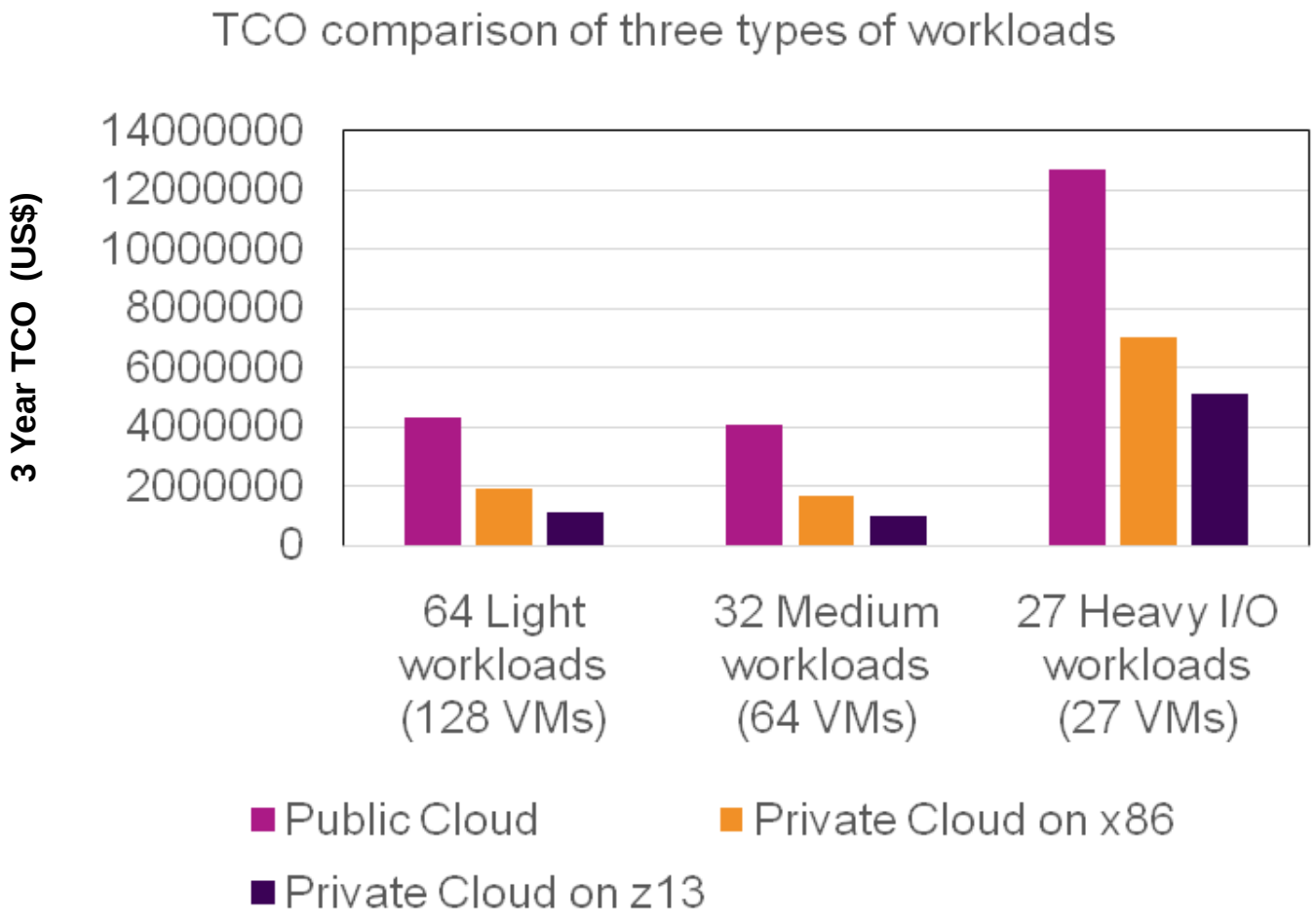
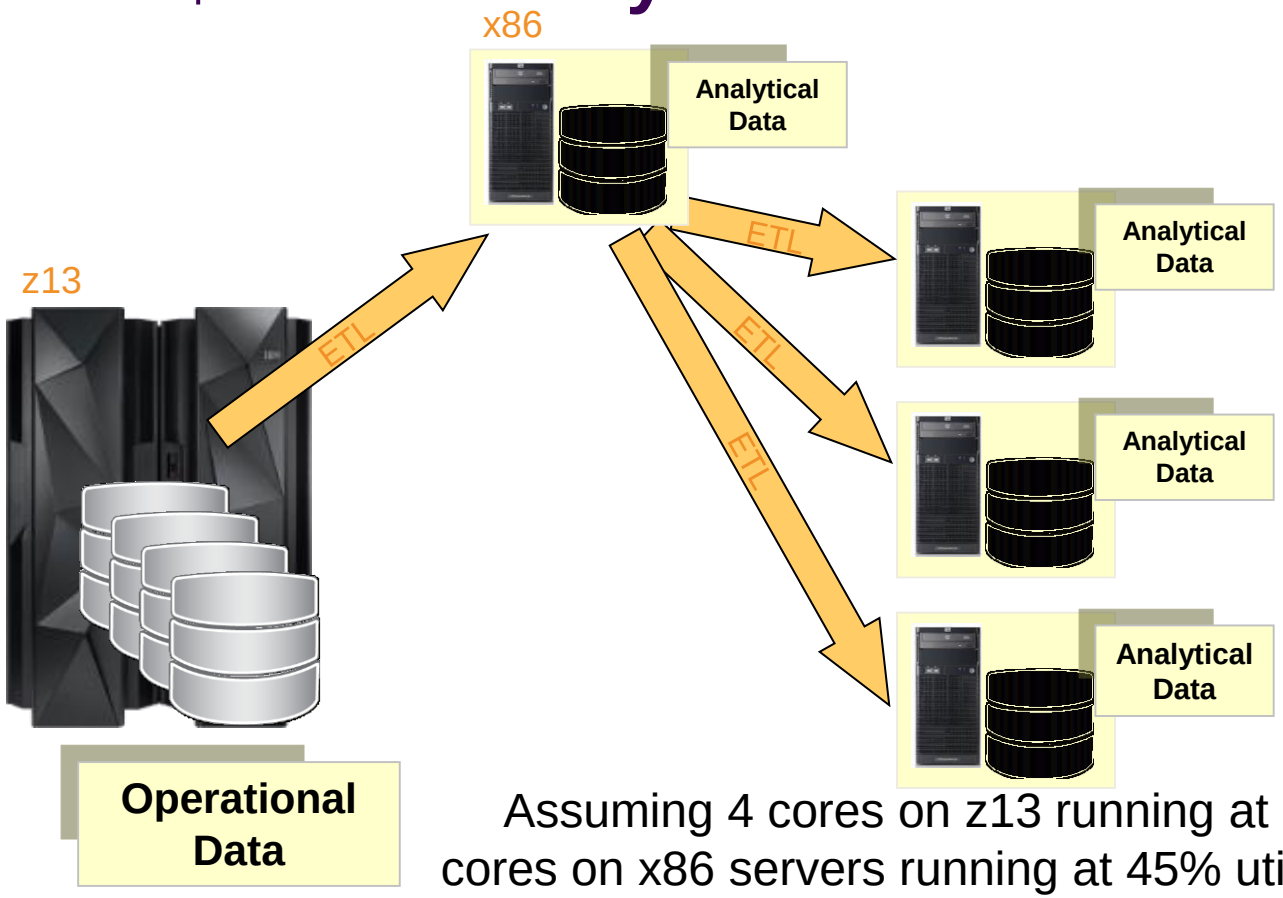
A private cloud on z13 yields lowest TCO for a variety of workloads



To move 1TB of data daily off z Systems can cost over $10M over 4 years



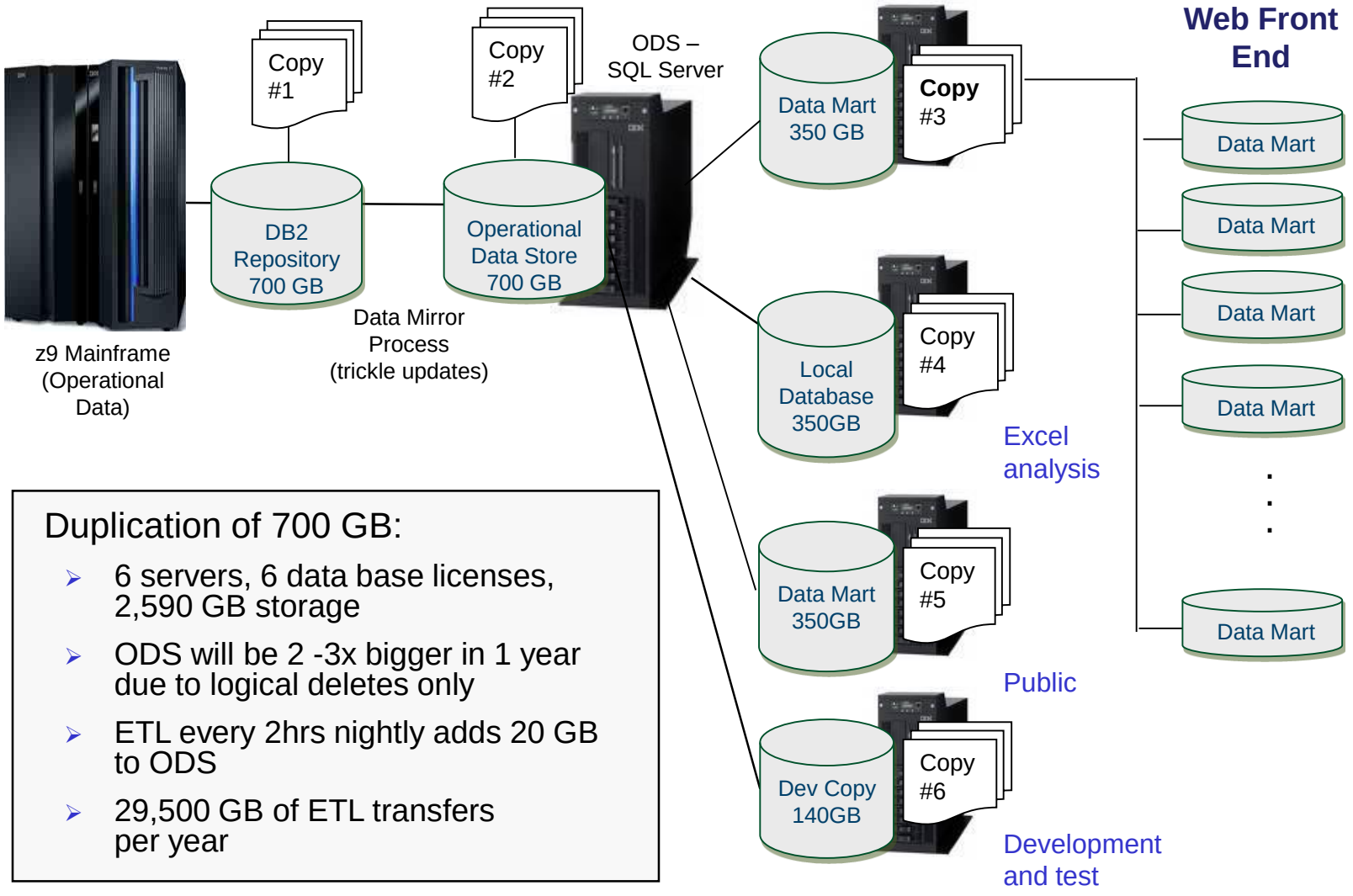
Estimated 4 yr. cost summary

System costs = $9,864,412
Labor costs = $393,927
Total = $10,258,339

Assuming 4 cores on z13 running at 85% utilization and 12 cores on x86 servers running at 45% utilization, transfer will burn **519 MIPS** and use **10 x86 cores** *per day*

This is based on an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Test involved measuring in a controlled laboratory environment elapsed time for system and administrator to extract, send and receive 130GB file from z13 to an x86 server running with 12 x Xeon 2.4GHz E5-2440 processors. Prices, where applicable, are based on US prices as of 12/31/2014 for both IBM and competitor. Estimated amortized cost from 4 Year Total Cost of Acquisition (TCA) that includes all HW, SW (OS, DB and tools) and 4 years of service & support. For Labor costs, used annual burdened rate of $159,600 for IT Administrator for z Systems and x86. Results may not be typical and will vary based on actual workload, configuration, applications, queries and other variables in a production environment. Users of this document should verify the applicable data for their specific environment.

Data proliferation within a state government judicial system is out of control



Duplication of 700 GB:

- 6 servers, 6 data base licenses, 2,590 GB storage
- ODS will be 2 -3x bigger in 1 year due to logical deletes only
- ETL every 2hrs nightly adds 20 GB to ODS
- 29,500 GB of ETL transfers per year

Keeping the data on z13 and making a copy for DB2 Analytics Accelerator saves over 88%

Estimated
***88%** lower cost*
for systems compared

Estimated 4 yr. cost summary

System costs = $1,052,901
Labor costs = $137,613
Total = $1,190,513

Assuming 4 cores on z13 running at 85% utilization and 140 x86 cores on N3001-010 running at 45% utilization, transfer will burn **260 MIPS** and use **0.44 x86 core** *per day*

This is based on an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Test involved measuring in a controlled laboratory environment elapsed time for system and administrator to extract, send and receive 1,118GB file from z13 to DB2 Analytics Accelerator N3001-010 (Mako Full Rack. Prices, where applicable, are based on US prices as of 12/31/2014 for both IBM and competitor. Estimated amortized cost from 4 Year Total Cost of Acquisition (TCA) that includes all HW, SW (OS, DB and tools) and 4 years of service & support. For Labor costs, used annual burdened rate of $159,600 for IT Administrator for z Systems and x86. Results may not be typical and will vary based on actual workload, configuration, applications, queries and other variables in a production environment. Users of this document should verify the applicable data for their specific environment.

z Systems Is Optimized For Operational Analytics

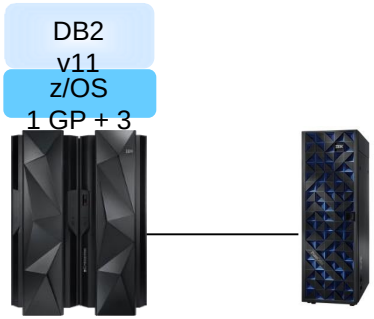
***17x** performance*
***13x** price performance!*
for systems compared

Standalone Pre-integrated Competitor V4

Eighth Unit

Workload Time	1,810 mins
Reports per Hour (RpH)	5,343
Competitor Eighth Unit (HW+SW+Storage)	$2,746,041

$514
Per Report per Hour (3yr TCA at no discount)



z13 + IBM DB2 Analytics Accelerator (N3001-010)

Workload Time	105 mins
Reports per Hour (RpH)	92,095
z13 (1 GP + 3 zIIP, HW+SW+ Storage) + Accelerator V4.1 with PDA N3001-010 hardware	$3,652,131

IBM zEnterprise Analytics System 9700

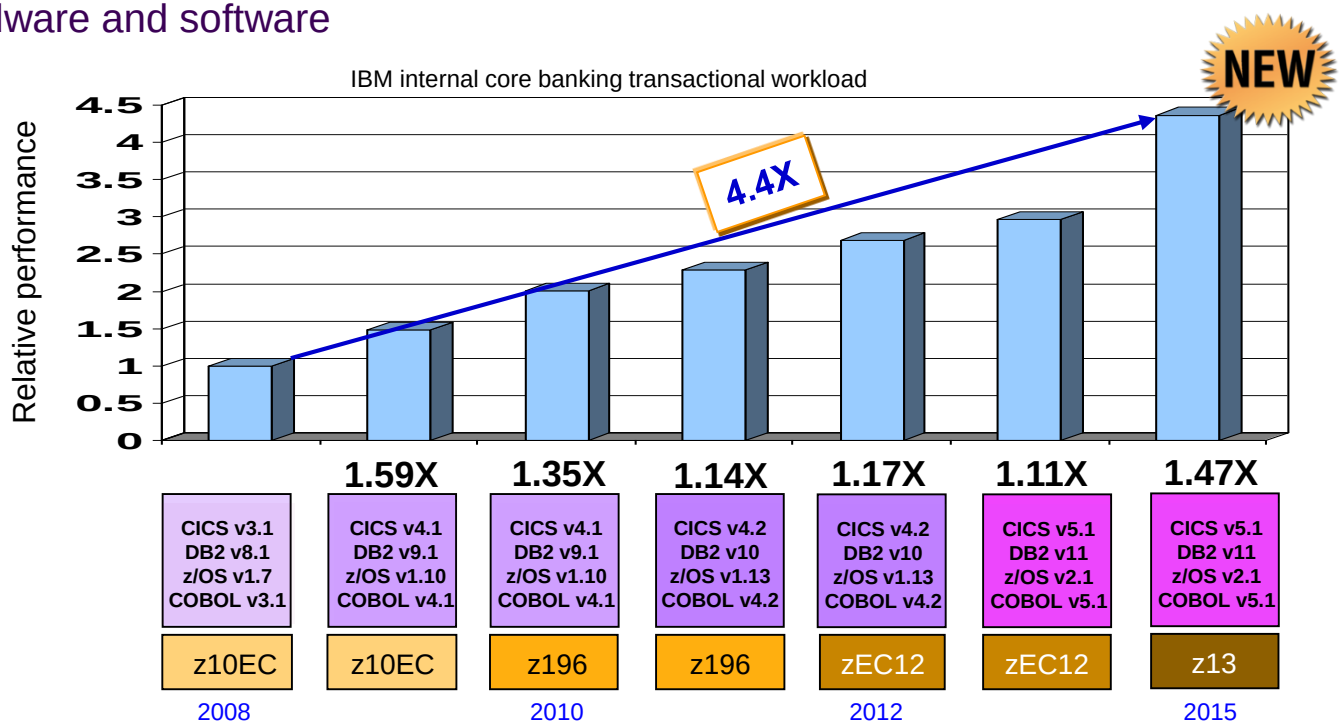
$40
Per Report per Hour (3yr TCA at no discount)

Based on IBM sponsored and internal tests comparing IBM zEnterprise Analytics System 9700 with a comparably priced, comparably tuned competitor Eighth Unit configuration (version available as of 12/31/2014), executing a materially identical 10 TB BIDAY "Fixed Execution" workload in a controlled laboratory environment. Test conducted with BIDAY "Fixed Execution" workload measures elapsed time for executing 161,166 concurrent reports using 80 concurrent users. Intermediate and complex reports are automatically redirected to IBM DB2 Analytics Accelerator for z/OS (powered by N3001-010 hardware or Mako). Price comparison based on a 3YR Total Cost of Acquisition (TCA) using U.S. prices current as of December 31, 2014, including hardware, software, and maintenance. Compared prices exclude applicable taxes, and are subject to change without notice. Competitor configuration: Eighth Unit including competitor recommended software options and features. IBM configuration: z13 platform with 1CP and 3 zIIPs with 128GB memory and DB2 Analytics Accelerator Full Rack (N3001-10) with 7 S-blades (140 Intel E5-2680v2 2.8GHz cores and 128 GB RAM), 2 Hosts (1 active – 1 passive) with 20 Intel E5-4650v2 2.4GHz cores each and 12 disk enclosures, each with 24 600GB SAS drives . Results may not be typical and will vary based on actual workload, configuration, applications, queries and other variables in a production environment. Users of this document should verify the applicable data for their specific environment.

Lessons Learned Can Be Grouped Into Three Broad Categories

- Always compare to an optimum z System environment
- Look for not-so-obvious distributed platform costs to avoid
- Consider additional platform differences that affect cost

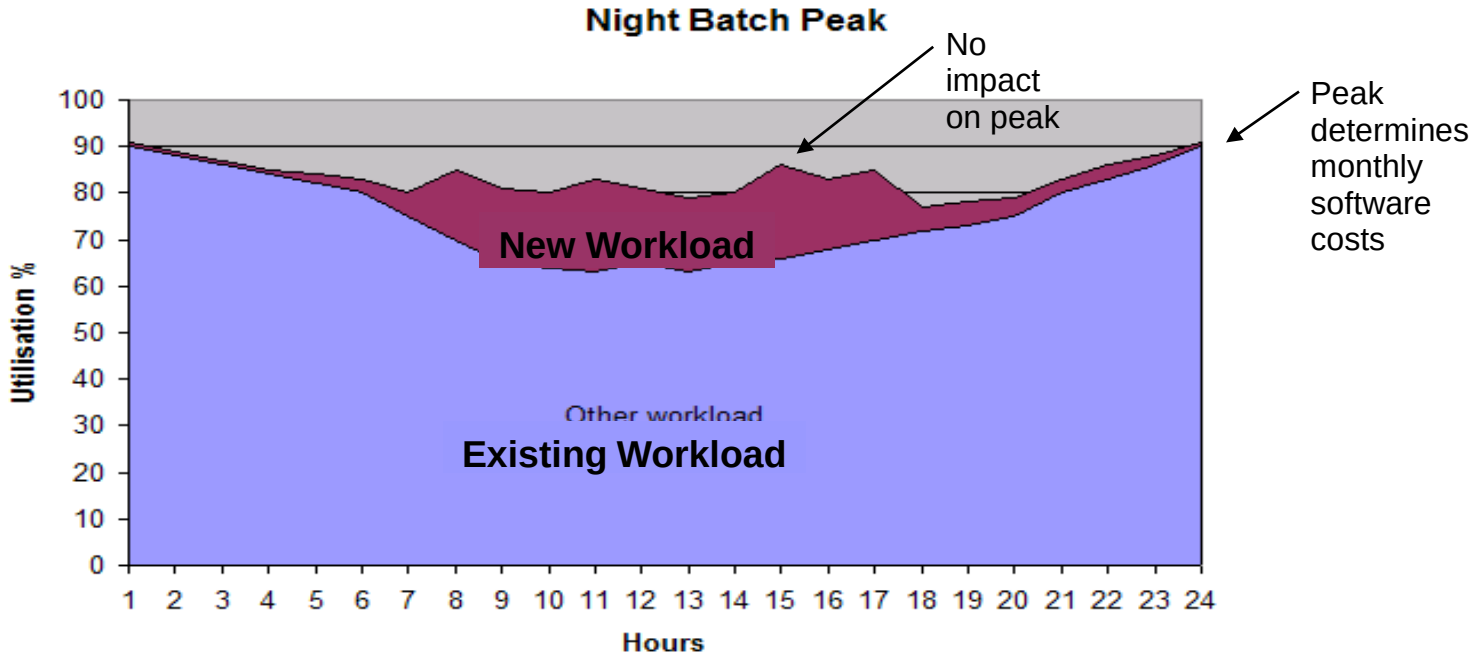
Transactional workloads see processing (~23% per annum) improvements with each upgrade of hardware and software



New software adds significant new functionality (security, mobile, cloud...) AND boosts performance by 47%

Performance measured in User Interactions per second. Results may vary.

Sub-Capacity May Produce Free Workloads



- Standard “overnight batch peak” profile – drives monthly software costs
- Hardware and software are free for new workloads using the same middleware (e.g. DB2, CICS, IMS, WAS, etc.)
- Ensure you exploit any free workload opportunities, and conversely, avoid offloading free applications!

Why does consolidation to Linux on System z reduce cores?

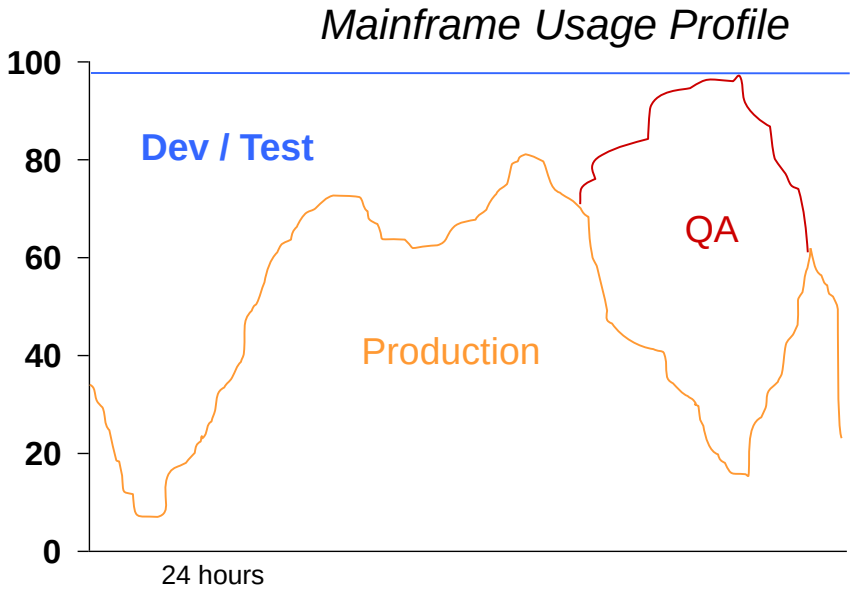
- Better workload management
- Better total utilization due to reduced peak to average ratio
- Fewer systems needed for development and test
- Reduced communication (fewer cycles for TCP/IP)
- System Assist Processors (SAP) for I/O
- Better caching infrastructure
- Better availability characteristics so additional cores not required
- Capacity Backup Units (CBU) for Disaster Recovery
- Fewer Virtual Servers required (scale up instead of scale out)
- All resources shared (cores, memory, I/O)

24

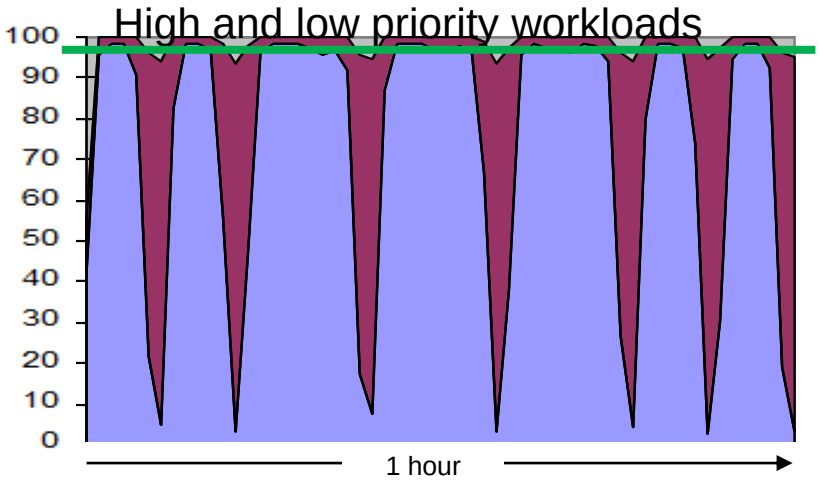
Non-production environments require fewer resources on the mainframe

- Development and Test Capacity
  - Mainframe – Prod +20%
  - Distributed – a range, often Prod +200%

Production *QA* *Dev/Test*

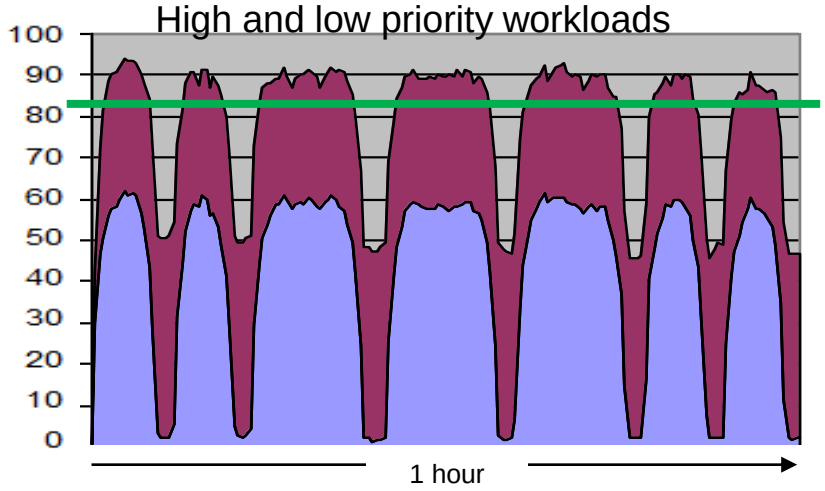


z Systems has advanced workload management, guaranteeing service delivery and high utilization



z Systems –
Advanced workload management

High priority workloads (blue) run at very high utilization and do not degrade
Low priority workloads (maroon) consume all but 2% of remaining resources (gray)



x86 hypervisor –
Imperfect workload management

High priority workloads (blue) run at *less* high utilization and *degrade* when low priority workloads (maroon) added
Too much resource (gray) *remains unused* (22%)

U.S. Customer Example

Oracle DB
Weblogic
WebSphere

Case 1

(24) Distributed Servers

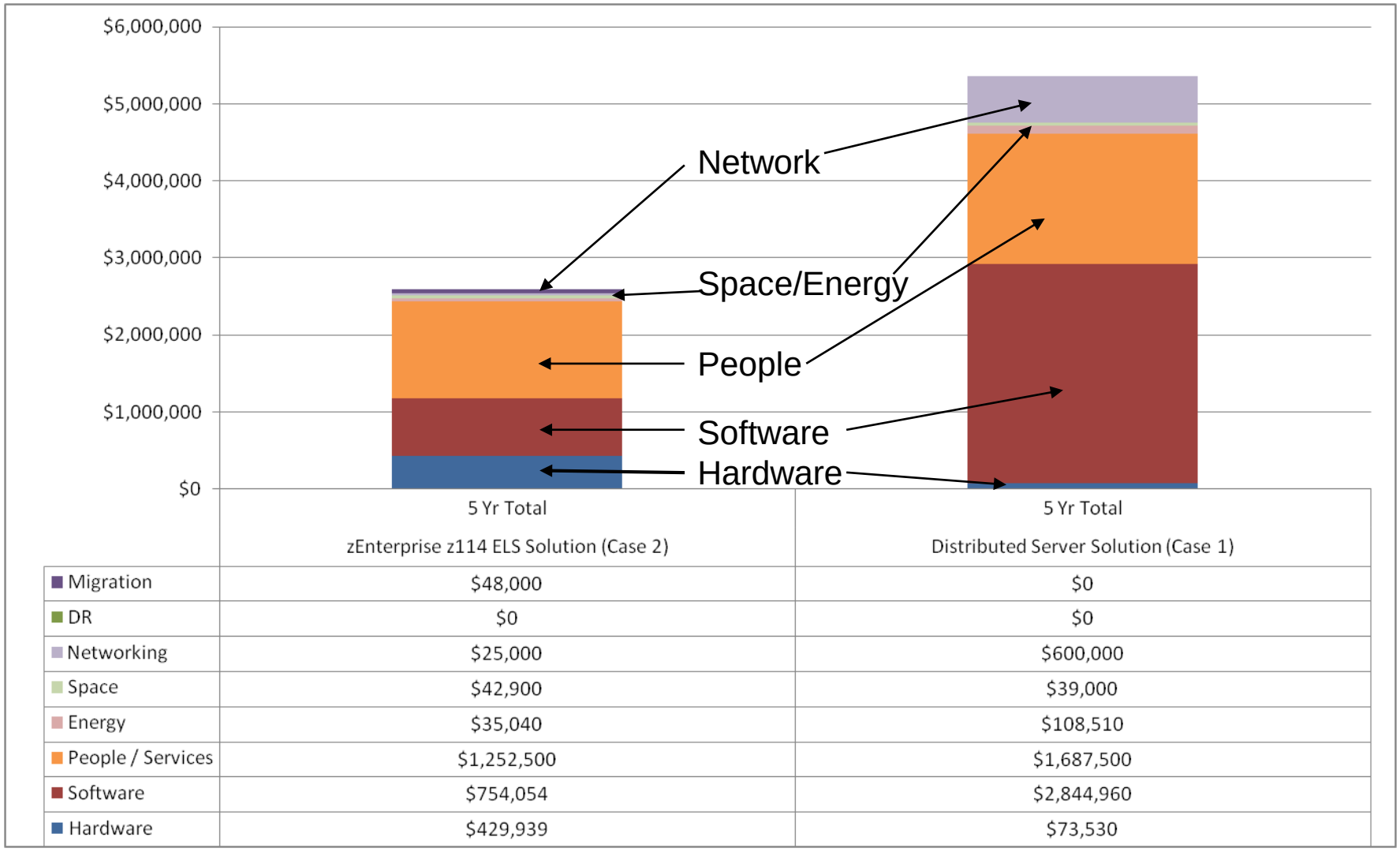
(168) Physical Cores

Case 2

(1) System z

(7) IFLs

5 Year TCO: System z vs Distributed 1/2 Cost



	5 Yr Total zEnterprise z114 ELS Solution (Case 2)	5 Yr Total Distributed Server Solution (Case 1)
Migration	$48,000	$0
DR	$0	$0
Networking	$25,000	$600,000
Space	$42,900	$39,000
Energy	$35,040	$108,510
People / Services	$1,252,500	$1,687,500
Software	$754,054	$2,844,960
Hardware	$429,939	$73,530

$2.6 Million

$5.4 Million

Disaster Recovery On z System Costs Much Less Than On Distributed Servers

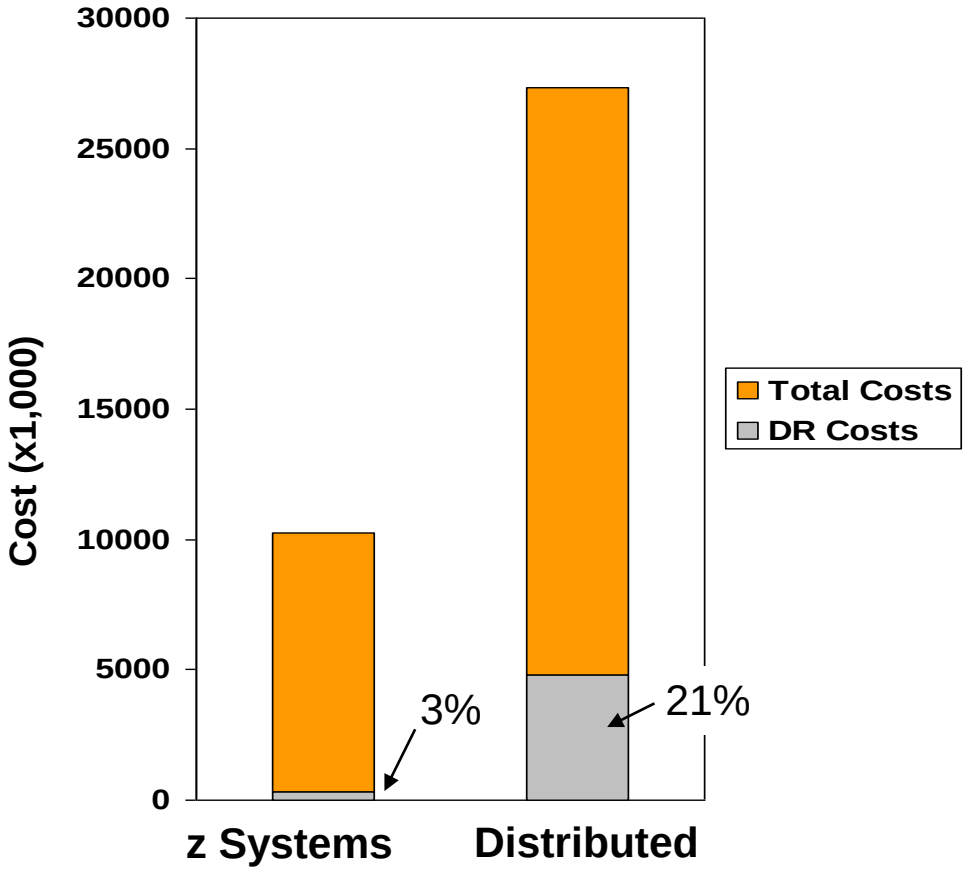
A large European insurance company with mixed distributed and z Systems environment at :

Disaster Recovery Cost as a percentage of Total Direct Costs:

z Systems– **3%**

Distributed – **21%**

Two mission-critical workloads on distributed servers had DR cost > 40% of total costs



Disaster Recovery Testing Is Typically More Expensive On Distributed Platforms Too

- A major US hotel chain
  - ~ 200 Distributed Servers (LinTel, Wintel, AIX, and HP-UX)

	Person-hours	*Elapsed days*	*Labor Cost*
Infrastructure Test (7 times)	1,144	7	$89,539
Full Test (4 times)	2,880	13	$225,416
Annual Total – Distributed	14,952*	73	$1,170,281
Mainframe Estimate	2,051*	10	$160,000

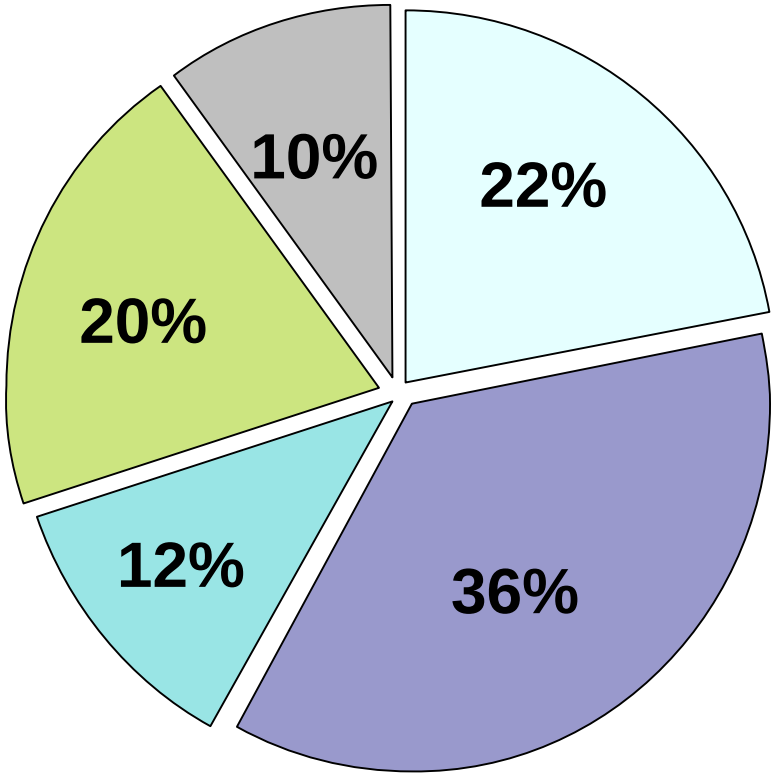
* Does not include DR planning and post-test debriefing

- Customer Recovery Time Objective (RTO) estimates:
  - Distributed ~ 48 hours to 60 hours
  - Mainframe ~ 2 hours

- Conclusion: Mainframe both simplifies and improves DR testing

Five Key IT Processes For Infrastructure Administration

Time spent on each activity



- **Deployment Management**
  - *Hardware set-up and software deployment*
- **Incident/Capacity Management**
  - *Monitor and respond automatically*
- **Asset Management**
  - *Hardware and software asset tracking*
- **Security Management**
  - *Access control*
- **Change Management**
  - *Hardware and software changes*

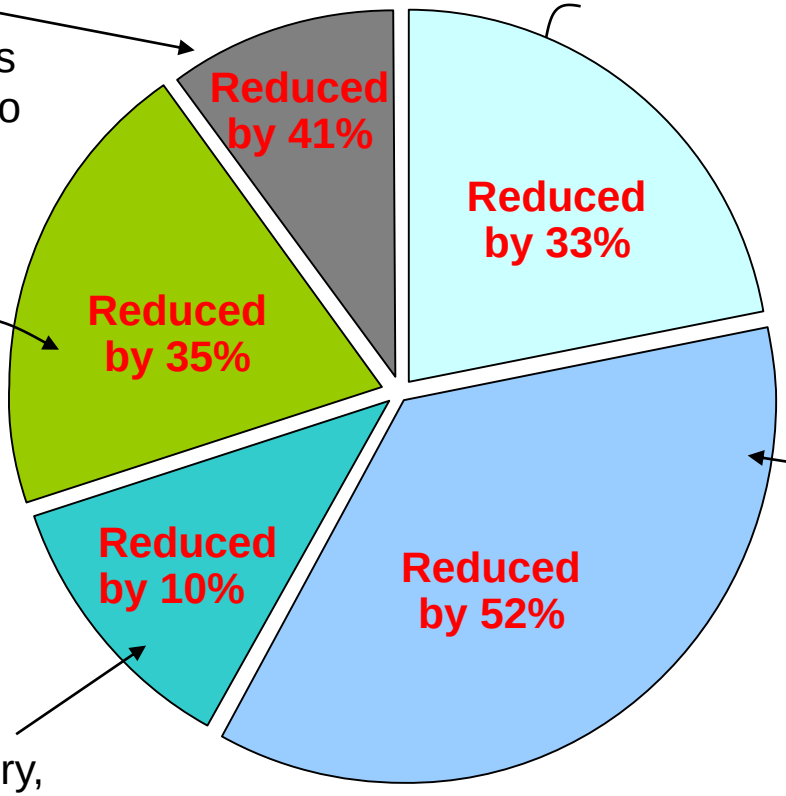
Allocation based on customer data from IBM study

Z System Labor Cost Reduction Benefits Case Study

5032 total hours per year reduced by 38% to 3111 hours per year

Change Management
Standardization of images and firmware, visibility into relationships among resources

Deployment Management
Automatic setup and configuration of the hypervisor and out-of-the-box networks



Security Management
Centralized fine-grain administrator access control

Incident/Capacity Management
Automation to isolate and fix issues

Asset Management
Automated discovery, entitlement management

Large Systems With Centralized Management Deliver Better Labor Productivity

Large US Insurance Company

HP Servers + ISV

Production Servers
HP 9000 Superdome RP4440
HP Integrity RX6600

Dev/Test Servers
HP 9000 Superdome RP5470
HP Integrity RX6600

Claims per year **327,652**

$0.12 per claim

$0.79 per claim

Mainframe support staff has 6.6x better productivity

IBM z Systems CICS/DB2

Total MIPS **11,302**

MIPS used for commercial claims processing prod/dev/test **2,418**

Claims per year **4,056,000**

Moving zOS Applications to x86 is Hard
State of Michigan is suing HP for Offload Project

- 2005 – HP/Michigan signed a $49M project to offload z Systems applications
- Project was supposed to take five years
- Not a single application has successfully moved

"We have no choice but to take HP to court to protect Michigan taxpayers.“

--- Ruth Johnson, Michigan Secretary of State

September 22nd, 2015

Ongoing rehosting project at US Retail company provides another example of the risks involved

Customer's stated objective:

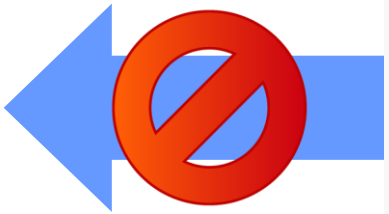
- Offload 3,500 MIPS with Micro Focus…
- $10M budget…
- 1 year schedule…

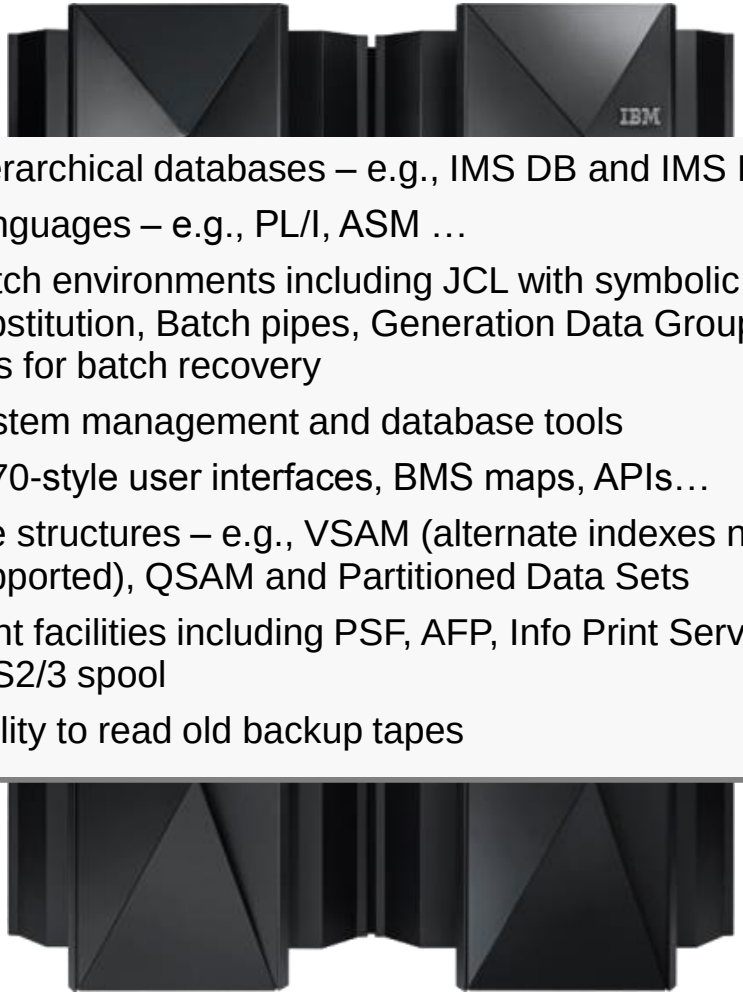
- **18 months later:**
  - $60M spent, but only 350 MIPS offloaded
  - Increased staff to cover over-run
  - Required additional hardware over initial prediction
  - Implemented manual steps to replace mainframe automation
  - Extended the dual-running period of the rehost…
  - Executive sponsor no longer employed…

Source: IBM Eagle Team

Replacement technologies are not always available for many mainframe functions

Rehosted platform

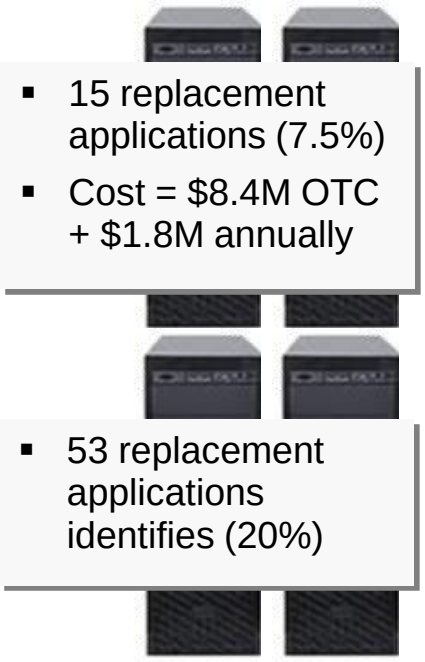




- Hierarchical databases – e.g., IMS DB and IMS DC
- Languages – e.g., PL/I, ASM …
- Batch environments including JCL with symbolic substitution, Batch pipes, Generation Data Group files for batch recovery
- System management and database tools
- 3270-style user interfaces, BMS maps, APIs…
- File structures – e.g., VSAM (alternate indexes not supported), QSAM and Partitioned Data Sets
- Print facilities including PSF, AFP, Info Print Server, JES2/3 spool
- Ability to read old backup tapes

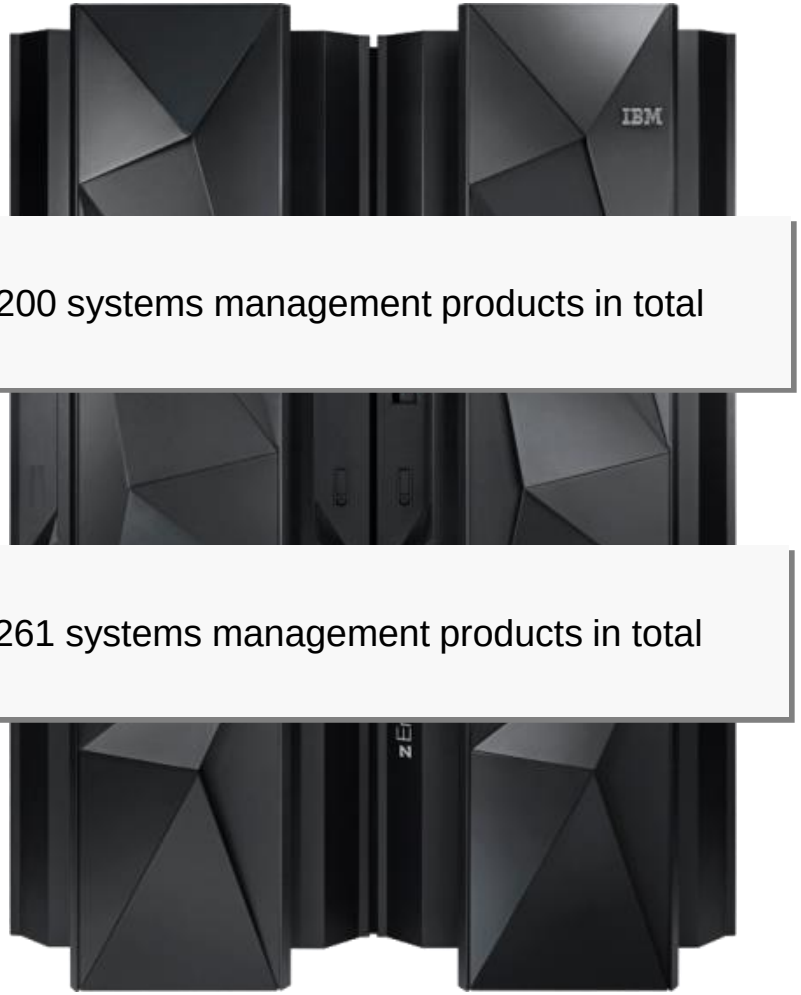
IT Economic studies for two US retailers highlight missing systems management functionality

Rehosted platform



- 15 replacement applications (7.5%)
- Cost = $8.4M OTC + $1.8M annually

- 53 replacement applications identifies (20%)



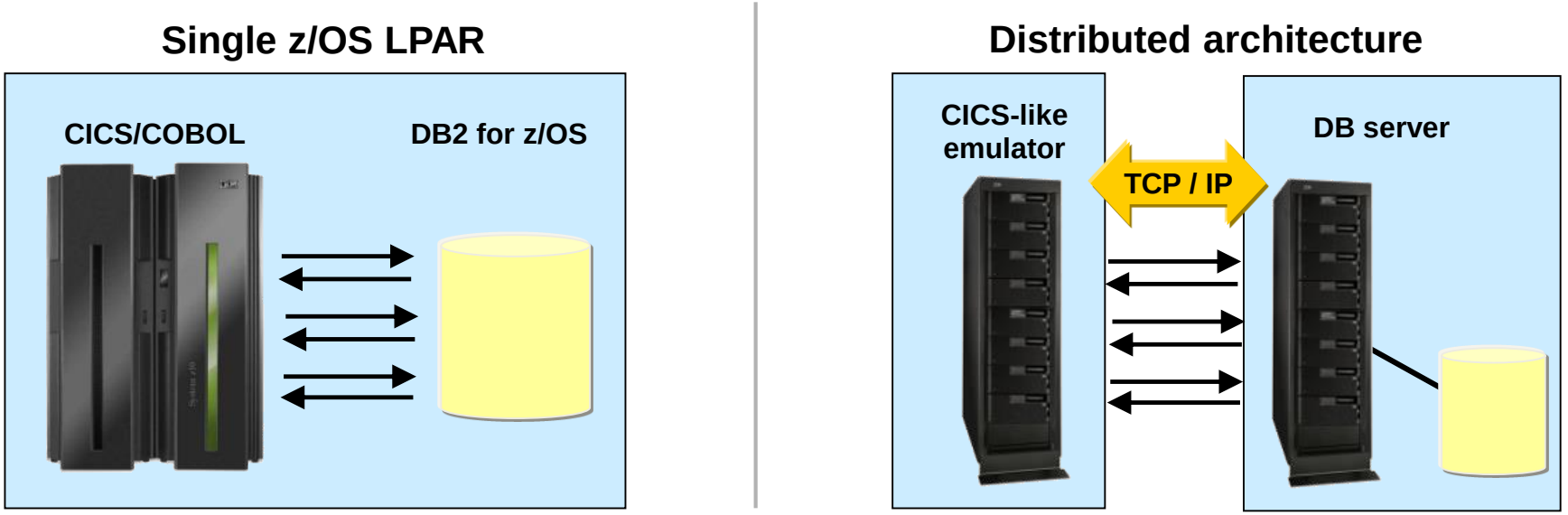
- 200 systems management products in total

- 261 systems management products in total

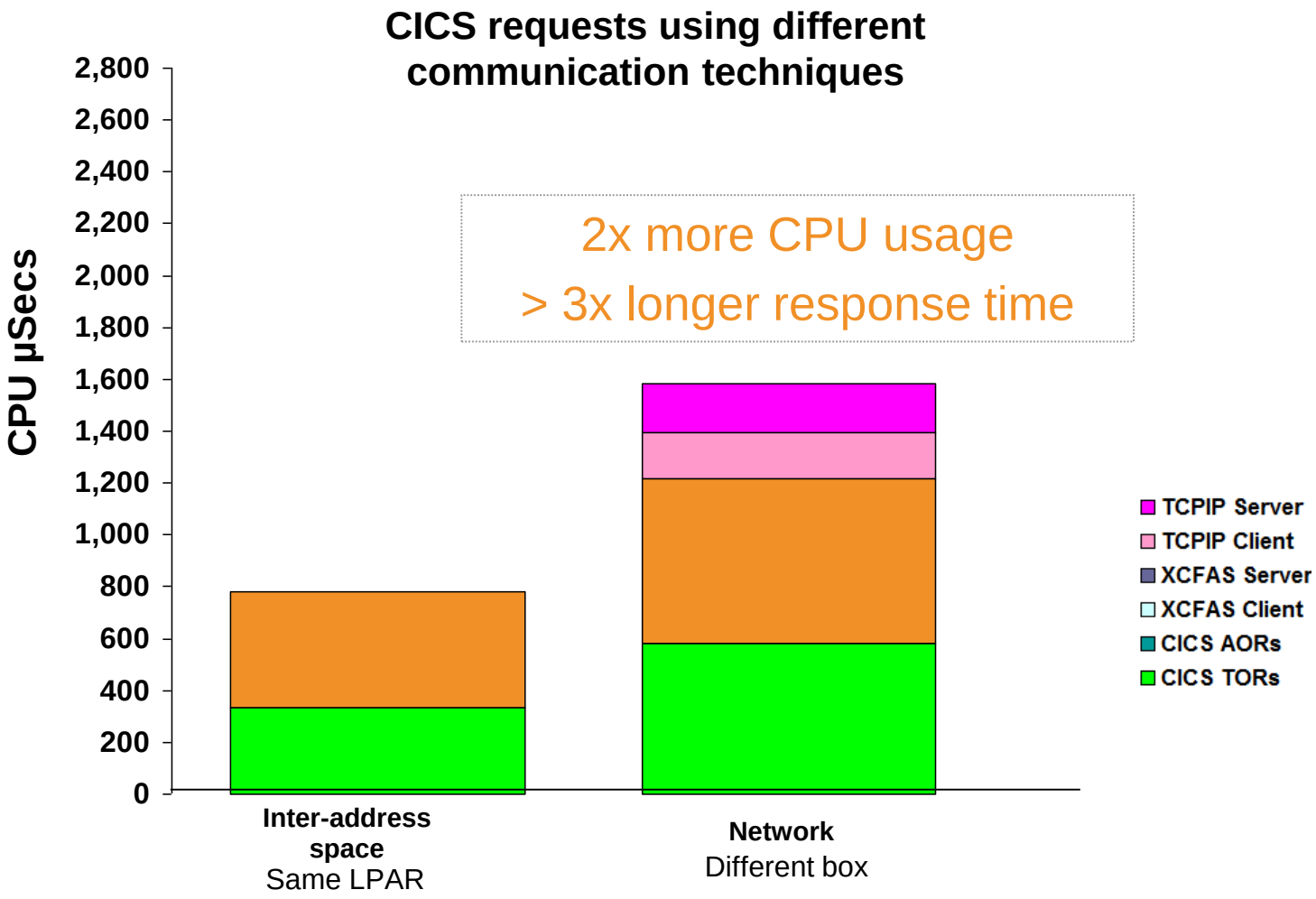
- Options?
  - Re-write applications to avoid usage
  - Write new code to perform the function
  - Add staff to manually perform the function

Some applications originally designed with co-located data are not good offload candidates

- Large insurance company rehosted portion of application as POC
  - Found TCP/IP stack consumed considerable CPU resource, and introduced security compromises and network latency
- European bank tried rehosting CICS workload to Linux while maintaining VSAM and DB2 data on System z
  - Induced latency resulted in CICS applications no longer meeting its SLA



Co-locating in the same address space is more efficient



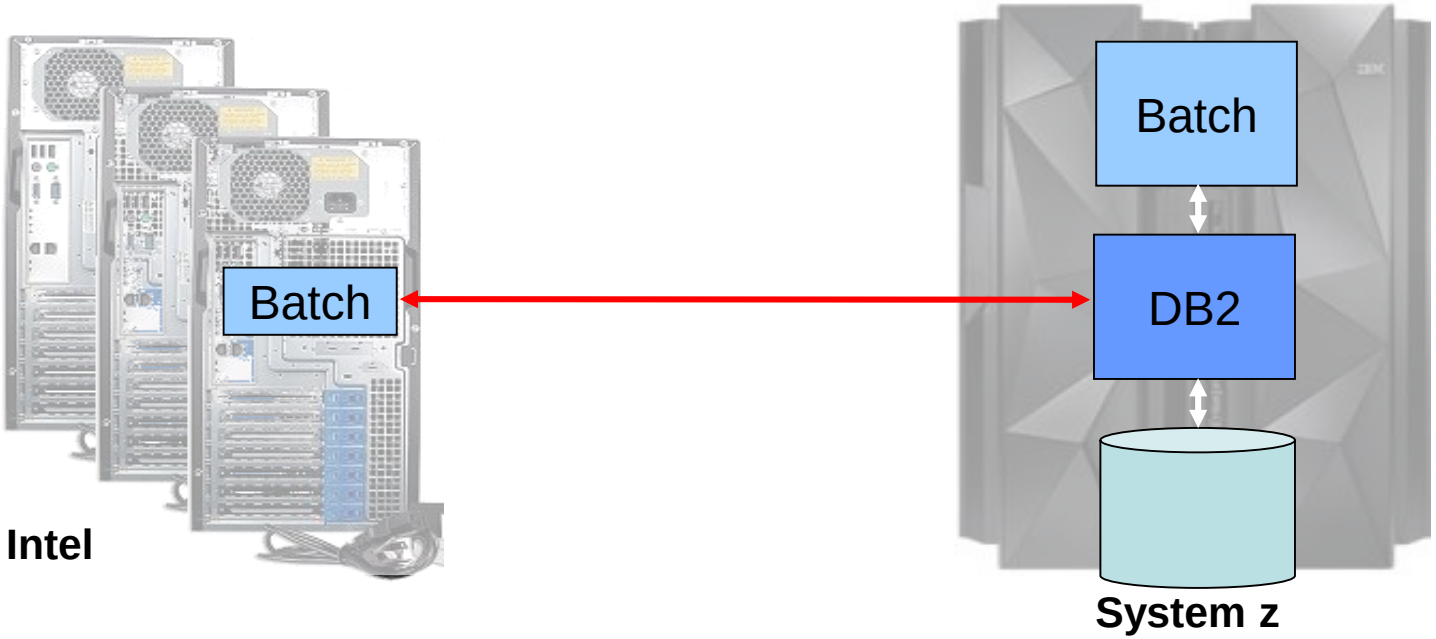
Source: http://hurgsa.ibm.com/projects/t/tp_performance/public_html/OS390CICS/reports/CICS%20TS%20V4.2%20Performance.ppt and email with z/OS Communications Server development team

Moving Batch applications off the mainframe can have serious consequences

- Additional DRDA processing doubled mainframe CPU usage even though the application was now running on Intel
- Additional network latency dramatically increased elapsed job time (10-25x)

Doubled Mainframe CPU usage

Elapsed job time grew 10-25 Xs



It Is Not Just Hard to Move Off – It Is Strategic to Move On

TCO: Understand The Complete Picture

Components

Hardware

Software

People

Network

Storage

Facilities

Environments

Production/Online Batch/Failover

Development

Test

QA

DR

Time

Qualities of Service such as availability, reliability, security and scalability

How Can an IT Economics Study Help?

An IT Economics study is **a business case** for your enterprise

- Built with your **information** and **costs**
- Specifically **tailored to your enterprise**
- Shows **your return on investment**
- Allows you to make a **financially based IT decision**

Do you…

- Want to do more with cloud?
- Need to simplify your IT environment?
- Want to grow your business but need to decide where to host the applications?
- Have more than 50 x86, HP-UX or Sun servers running Oracle or Weblogic?

Are you…

- Deploying workloads on Linux x86?
- Evaluating the best platform for Big Data?
- Running out of datacenter space?
- Using more than three platforms?
- Looking to reduce IT spend?

These are some **common scenarios** from which clients have **benefited** from an **IT Economics study.**

Use an **IT Economics study** to **build a business case for your IT strategy**

Five Steps for an IT Economics Study

An **IT Economics study** can be completed in a few weeks with minimal effort on your part. Studies involve these five steps:

1. Request a Study	2. Decide a Workshop Date	3. On-site Workshop	4. Data Analysis	5. On-site Study Presentation
• Ask your IBM Client Representative, business partner or contact the IBM Eagle Team at **eagletco@us.ibm.com**. • You will be contacted by a senior Eagle Consultant in your region.	• An IBM Eagle consultant coordinates a date to hold an on-site workshop with you. • This is typically a two hour meeting.	• Your IBM Eagle consultant will explain the study's methodologies, capture your objectives for the study and gather information about your IT environment. • The consultant share best and worst practices.	• Depending on the scope of the study, your IBM Eagle consultant may request additional data after the workshop. • Analysis and report preparation (performed off-site) are usually complete in three to four weeks.	• Your IBM Eagle consultant will meet with you to present findings and provide recommendations. • The consultant will answer questions and provide you with a final report with detailed analysis, an executive summary, and a business case

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https://www.ibm.com/partnerworld/iteconomics
IT Economics Practice

IT Economics Studies

Use a **business case** to make a **technically** and **financially based IT decision**

Cloud Assessment

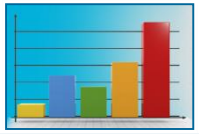
Perform a Health Check to find the right private, public or hybrid cloud solution
Examine workload size and activity, SLA and provisioning requirements, and instance costs

Analytics Assessment

Determine the most cost-effective infrastructure for analytics solutions
Exploit platform attributes and efficient storage solutions for Analytics and Big Data

Mobile Assessment

Mitigate high-volume, low-value mobile transaction costs
Evaluate the effects of throughput, response time and other KPIs in mobile topologies



Workload Placement Assessment

Consolidate, offload, and place new workloads on alternative platforms
Exploit and compare platform attributes to optimize workload performance and costs

Chargeback Analysis

Align chargeback policies to actual IT costs
Identify and overcome chargeback policies that drive adverse IT decisions

IT Best Practice Benchmarking

Compare actual IT environment with best practices in the IT industry
Improve forecast and actual spend

Available at **no-charge** to IBM clients and Business Partners

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IT Economics Practice

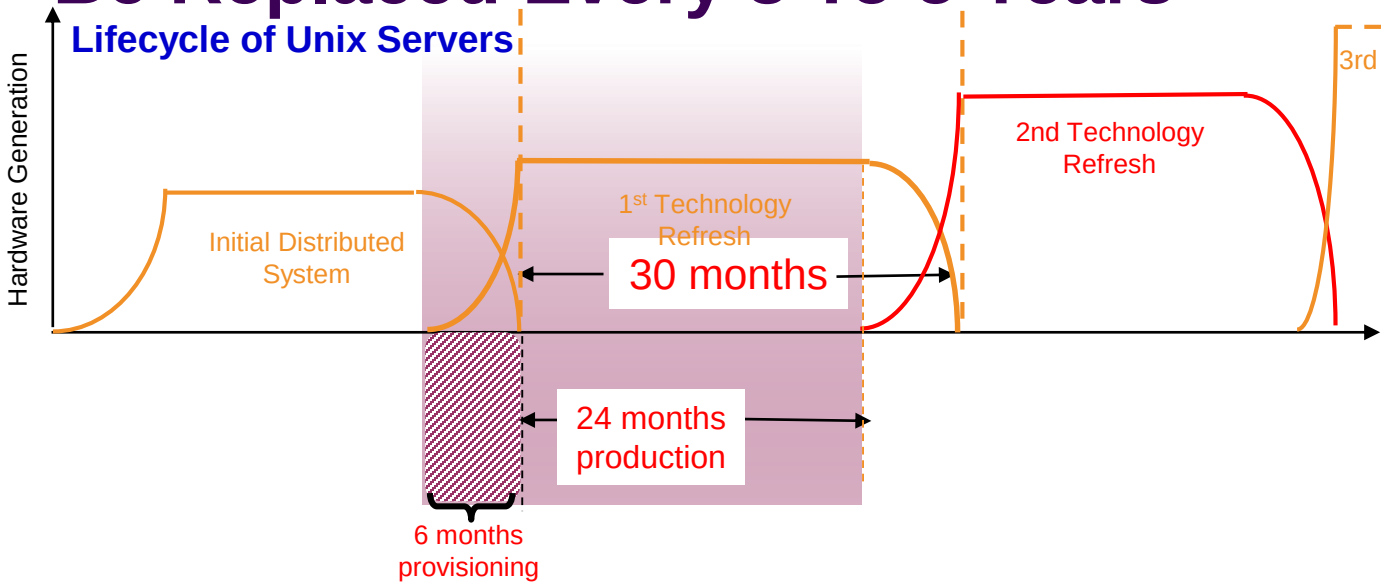
Thank you.

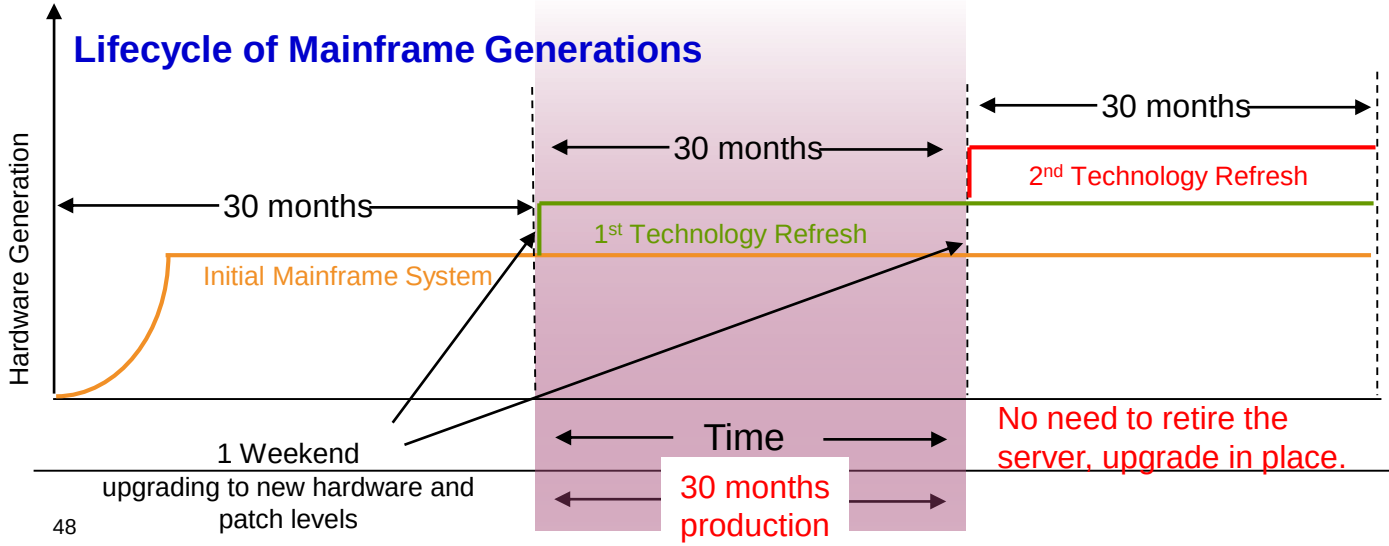
Cost Ratios in all TCO Studies

Average Cost Ratios (z vs Distributed)

		z	Distributed	z vs distributed (%)
Offload	**5-Year TCO**	**$16,351,122**	**$31,916,262**	**51.23%**
	Annual Operating Cost	$2,998,951	$4,405,510	68.07%
	Software	$10,932,610	$16,694,413	65.49%
	Hardware	$3,124,013	$3,732,322	83.70%
	System Support Labor	$3,257,810	$4,429,166	73.55%
	Electricity	$45,435	$206,930	21.96%
	Space	$59,199	$154,065	38.42%
	Migration	$438,082	$10,690,382	4.10%
	DR	$854,266	$2,683,652	31.83%
	Average MIPS	3,954		
	Total MIPS	217,452		
Consolidation	**5-Year TCO**	**$5,896,809**	**$10,371,020**	**56.86%**
	Annual Operating Cost	$716,184	$1,646,252	43.50%
	Software	$2,240,067	$6,689,261	33.49%
	Hardware	$2,150,371	$1,052,925	204.23%
	System Support Labor	$1,766,403	$2,395,693	73.73%
	Electricity	$129,249	$365,793	35.33%
	Space	$84,033	$205,860	40.82%
	Migration	$678,449	$0	
	DR	$354,735	$411,408	86.22%
	Average MIPS	10,821		
	Total MIPS	292,165		

Distributed Servers Need To Be Replaced Every 3 To 5 Years





Refresh is normally even worse than just re-purchasing existing capacity as this real customer demonstrates:

Non-mainframe systems must co-exist for months at a time while being refreshed, requiring space, power, licenses etc. In this case only 24 months of productive work is realized for each 30 month lease period and the leases overlap up to 6 months

The mainframe by contrast is upgraded over a weekend and is fully productive at all times

Resilient and intelligent I/O

- New FICON Express16S links reduce latency for workloads such as DB2
- ***Reduce up to 43% of DB2 write operations with IBM zHyperWrite*** – technology for DS8000 and z/OS for Metro Mirror environment
- First system to use a ***standards based approach for enabling Forward Error*** Correction for a complete end to end solution
- Clients with multi-site configurations can expect ***I/O service time improvement*** when writing data remotely which can ***benefit GDPS or TPC-R HyperSwap***
- ***Extend z/OS workload management policies into SAN fabric*** to manage the network congestion
- New Easy Tier API removes requirement from application/administrator to manage hardware resources

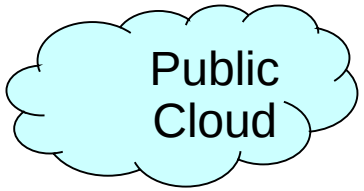
Optimized for enterprise-scale data from multiple platforms and devices

x86 and public cloud yield lower 3yr TCO

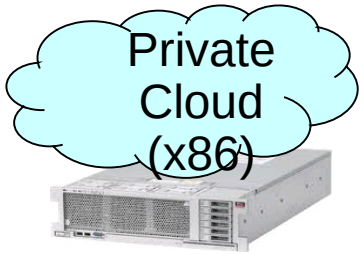
24 Web Workloads

24 VMs total

Compute-intensive web workloads
1 VMs per workload;
Each VM requiring 4GB memory; 20GB storage



24 instances
$0.91M (3yr TCO)



24 x86 cores
$0.61M (3yr TCO)

6 IFLs
$1.4M (3yr TCO)

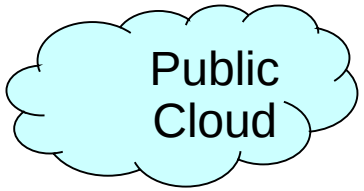
System configurations are based on equivalence ratios derived from IBM internal studies.
Average utilization of 24-core x86 system is assumed to be 60%; avg utilization of z13 with 6 IFLs is assumed to be 75%; transaction response time is the same on all platforms

Example: Compute intensive non-critical web workloads

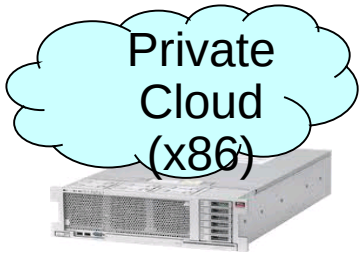
24 Web Workloads

24 VMs total

Compute-intensive web workloads
1 VMs per workload;
Each VM requiring 4GB memory; 20GB storage



24 instances (with total 48 vCPU)

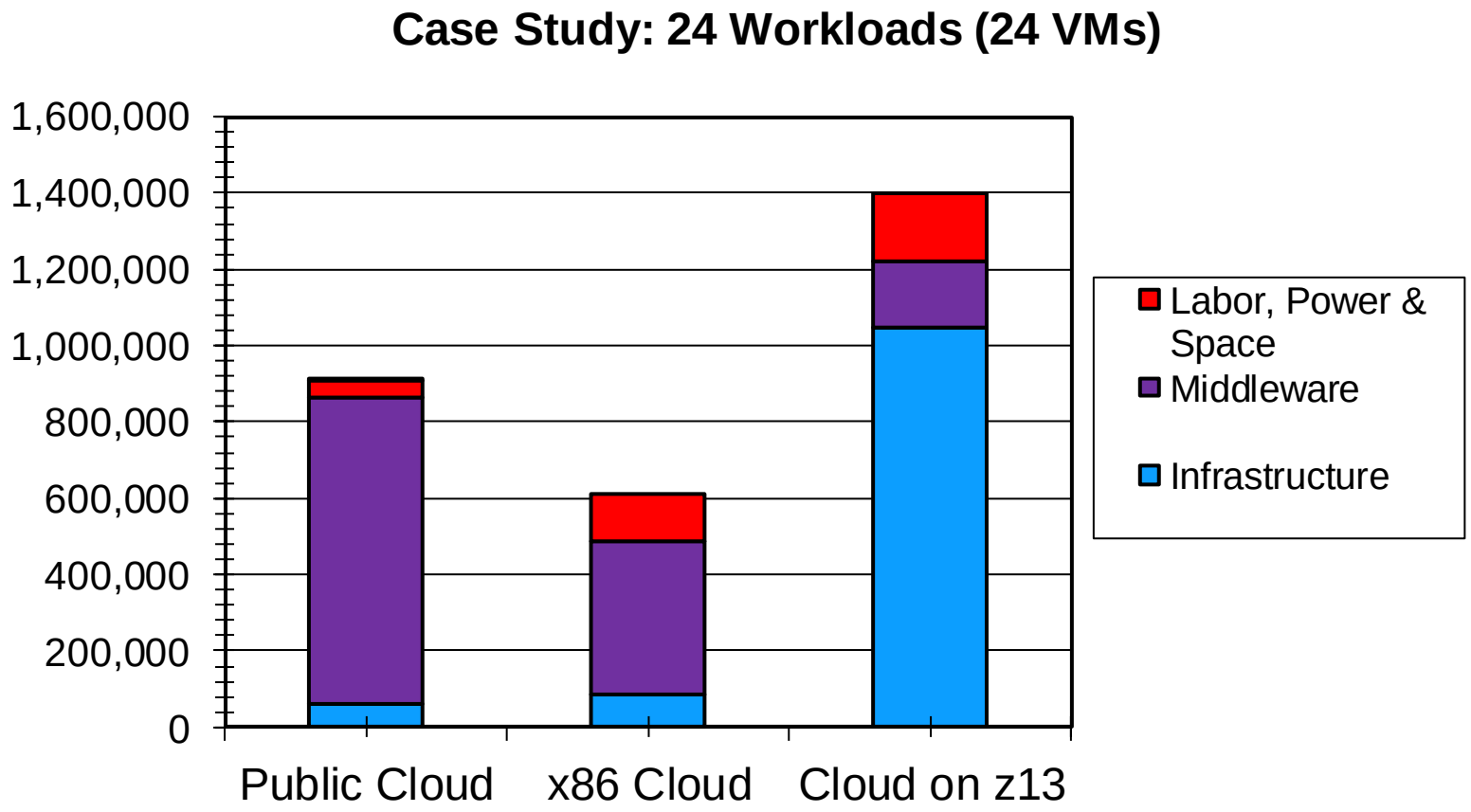


24 x86 cores

6 IFLs

System configurations are based on equivalence ratios derived from IBM internal studies.
Average utilization of 24-core x86 system is assumed to be 50%; avg utilization of z13 with 6 IFLs is assumed to be 75%; transaction response time is the same on all platforms

x86 and public cloud yield lower 3yr TCO

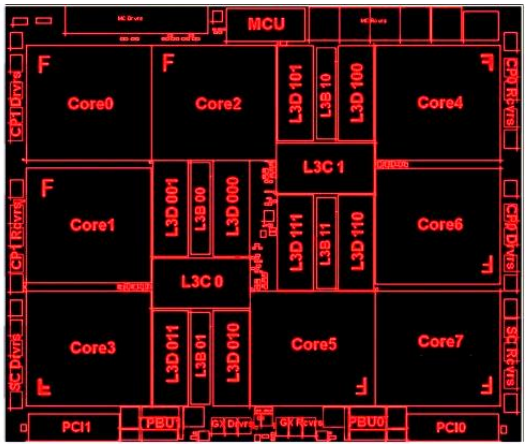


System configurations are based on equivalence ratios derived from IBM internal studies. Prices used are published US list prices as of 1/1/2015 for both IBM and competitors. Public cloud case includes costs of infrastructure (instances, data out, storage, free tier/reserved tier discounts), middleware and labor. z13 and x86 cases include costs of infrastructure (system, memory, storage, virtualization, OS, cloud mgmt), middleware, power, floor space and labor.

.

Designed for transaction processing and data serving

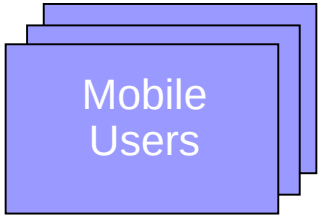
- New **8-core** Processor Design in **22nm Silicon Technology**
- ***Optimized Instruction Processing*** ***(***Out-of-Order Execution Pipeline, Relative-branch execution units, Software Prefetch Directives)
- Larger ***caches to optimize*** data serving environments
- ***Architecture Extensions*** (Transactional Execution, RDMA, Runtime Instrumentation) provide enhanced workload performance
- Substantial economies of scale with ***simultaneous multi-threading delivering more throughput*** for Linux and zIIP-eligible workloads
- ***Single Instruction Multiple Data (SIMD)*** improves performance of complex mathematical models
- Up to 2X ***improved cryptographic performance*** with enhanced Central Processor Assist for Cryptographic Functions (CPACF)
- ***Compress more data*** helping to save disk space and cut data transfer time with improved ***on chip hardware compression***

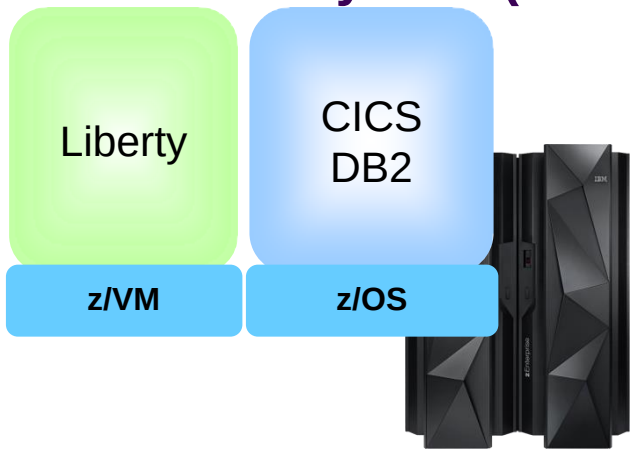


Plus 10 TB of memory to further improve performance

Oracle Coherence reduces TCA for read-only severe *sticky finger with think-time user* mobile workloads by 57% (forcing cache update)

Which platform provides the lowest TCA over 3 years?





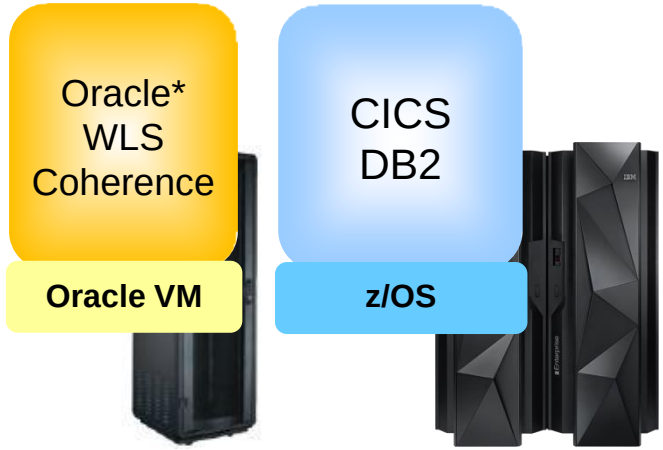
zEC12-705 + 3 IFLs

$21.8M (3 yr. TCA)
Prod

$28.5M (3 yr. TCA)
Prod+Dev/QA+DR

- **500 concurrent connections**
- **20 reads/session with 100ms think time (forcing a cache refresh)**
- **1 second cache invalidation (WXS scenario)**

Mobile read-only workload driving minimum throughput of **5,200** transactions per second and response time of 5ms



Exalogic X4-2 Rack **1/8th (24 cores pro-rated)** **zEC12-407**

$8.6M (3 yr. TCA)
Prod

$12.3M (3 yr. TCA)
Prod+Dev/QA+DR

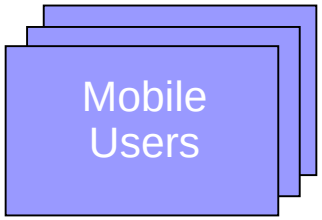
57% *lower cost!*

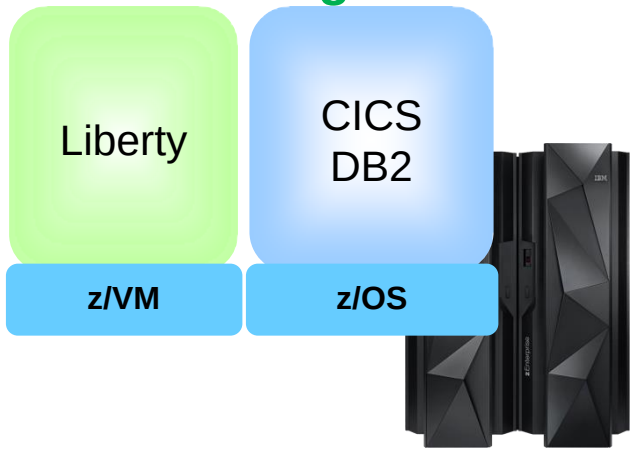
* Oracle Coherence performance projected from WXS Caching Test

WXS caching study for mobile workload - IBM Confidential

Oracle Coherence increases TCA by 5% for read-only moderate *sticky finger with think-time user* mobile workloads (forcing cache update) – using Mobile Workload Pricing

Which platform provides the lowest TCA over 3 years?





zEC12-703 + 3 IFLs

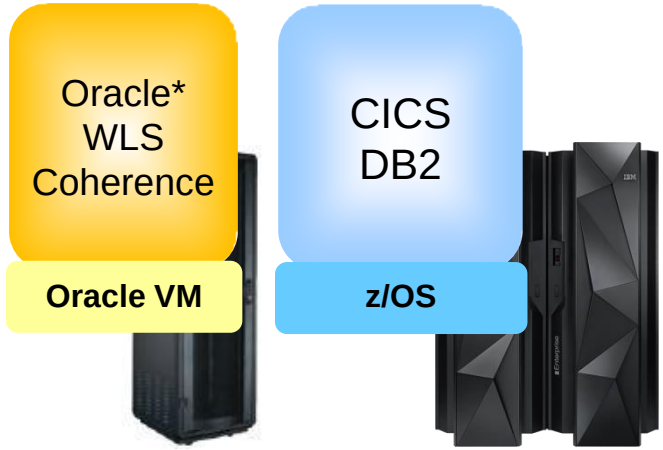
$8.5M (3 yr. TCA)
Prod

$11.2M (3 yr. TCA)
Prod+Dev/QA+DR

- **500 concurrent connections**
- **10 reads/session with 200ms think time (forcing a cache refresh)**
- **1 second cache invalidation (WXS scenario)**

Mobile read-only workload driving minimum throughput of **3400** transactions per second and response time of 2ms

* Oracle Coherence performance projected from WXS Caching Test



Exalogic X4-2
1/8th Rack
(18 cores pro-rated)

zEC12-407

$8.4M (3 yr. TCA)
Prod

$11.8M (3 yr. TCA)
Prod+Dev/QA+DR

5%
higher cost!

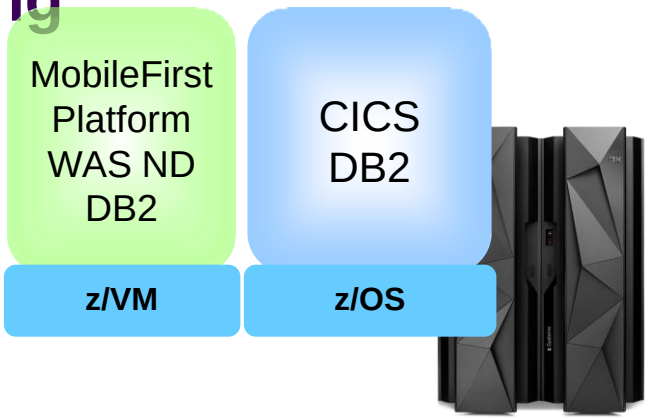
Replicating z Systems Mobile Workloads increases TCA by 66% versus co-locating MobileFirst Platform and using Mobile Workload Pricing

Which platform provides the lowest TCA over 3 years?

Mobile Users

- **500 concurrent connections**
- **70% do 1 read/session; 25% do 4 reads/session; 5% do 20 reads/session with 100ms think time**
- **1 second cache invalidation**

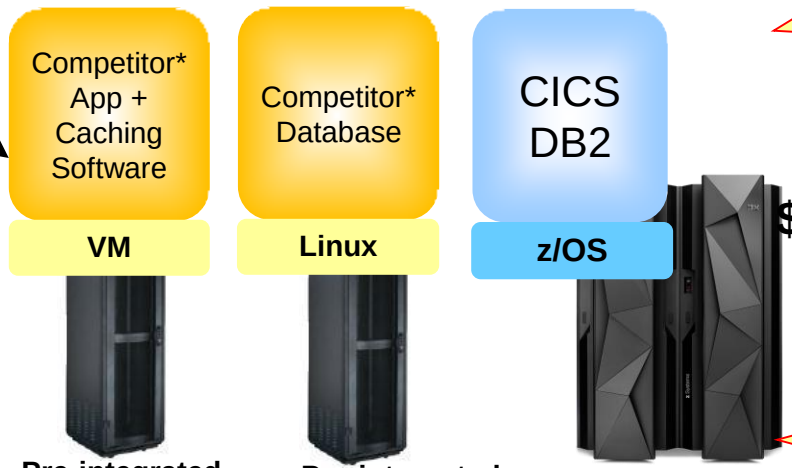
Mobile read-only workload driving minimum throughput of **6,300** transaction per second and response time of 12ms



z13-606 + 4 IFLs*

$11.2M (3 yr. TCA)
Prod + Dev/QA + DR
Mobile Workload Pricing

Estimated **40%** lower cost for systems compared



Pre-integrated Competitor* Eighth Unit (30 cores pro-rated)

Pre-integrated Competitor* Eighth Unit (24 cores)

z13-606

$18.6M (3 yr. TCA) Prod + Dev/QA + DR

Estimated **66%** higher cost for systems compared

* Competitor Caching and Database sizing estimated from WebSphere Extreme Scale Caching Test.
** Estimated performance, sizing and cost for z13 based on tests conducted on zEC12

This is based on an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Test involved executing a materially identical mobile transaction processing workload in a controlled laboratory environment with comparable tuning and sizing. Prices, where applicable, are based on US prices as of 12/31/2014 for both IBM and competitor. Price comparison based on 3 Year Total Cost of Acquisition (TCA) includes all HW, SW and 3 years of service & support. Sizing shown is for Production to which 30% is added for System z for Dev/QA and CBU pricing for DR and 2x for Distributed.

MobileFirst Platform on Linux on z System* is expected to provide lower front-end cost and better scalability than x86

At 50 concurrent users, z Systems provides better 3-year TCA

	MobileFirst Platform on Linux on z Systems*		MobileFirst Platform on x86	
# Concurrent Users	Front-end Cost per TPS	Response Time (ms)	Front-end Cost per TPS	Response time (ms)
10	$2,634	42	$2,074	50
30	$1,091	43	$1,066	54
50	$812	44	$964	62
100	$525	48	$770	68
200	$456	70	$636	95
400	$439	131	$693	205

16% better

37% better

Green = Better

* Estimated performance, sizing and cost for z13 based on tests conducted on zEC12

This is based on an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Test involved measuring throughput in transactions per second and response time for executing a materially identical mobile transaction processing workload in a controlled laboratory environment with comparable tuning and sizing. Prices, where applicable, are based on US prices as of 12/31/2014 for both IBM and competitor. Price comparison based on 3 Year Total Cost of Acquisition (TCA) includes all HW, SW and 3 years of service & support. Sizing shown is for Production to which 30% is added for System z for Dev/QA and CBU pricing for DR and 2x for Distributed.

Accumulated Field Data For Labor Costs

- Average of quoted infrastructure labor costs
  - **30.7** servers per FTE (dedicated Intel servers)
    - **67.8** hours per year per server for hardware and software tasks
  - **52.5** Virtual Machines per FTE (virtualized Intel servers)
    - **39.6** hours per year per Virtual Machine for software tasks and amortized hardware tasks
    - Typical 8 Virtual Machines per physical server

- Best fit data indicates
  - Hardware tasks are **32** hours per physical server per year
    - Assume this applies to Intel or Power servers
    - Internal IBM studies estimate 320 hours per IFL for zLinux scenarios
  - Software tasks are **36** hours per software image per year
    - Assume this applies to all distributed and zLinux software images

Labor model based on customer data from IBM studies