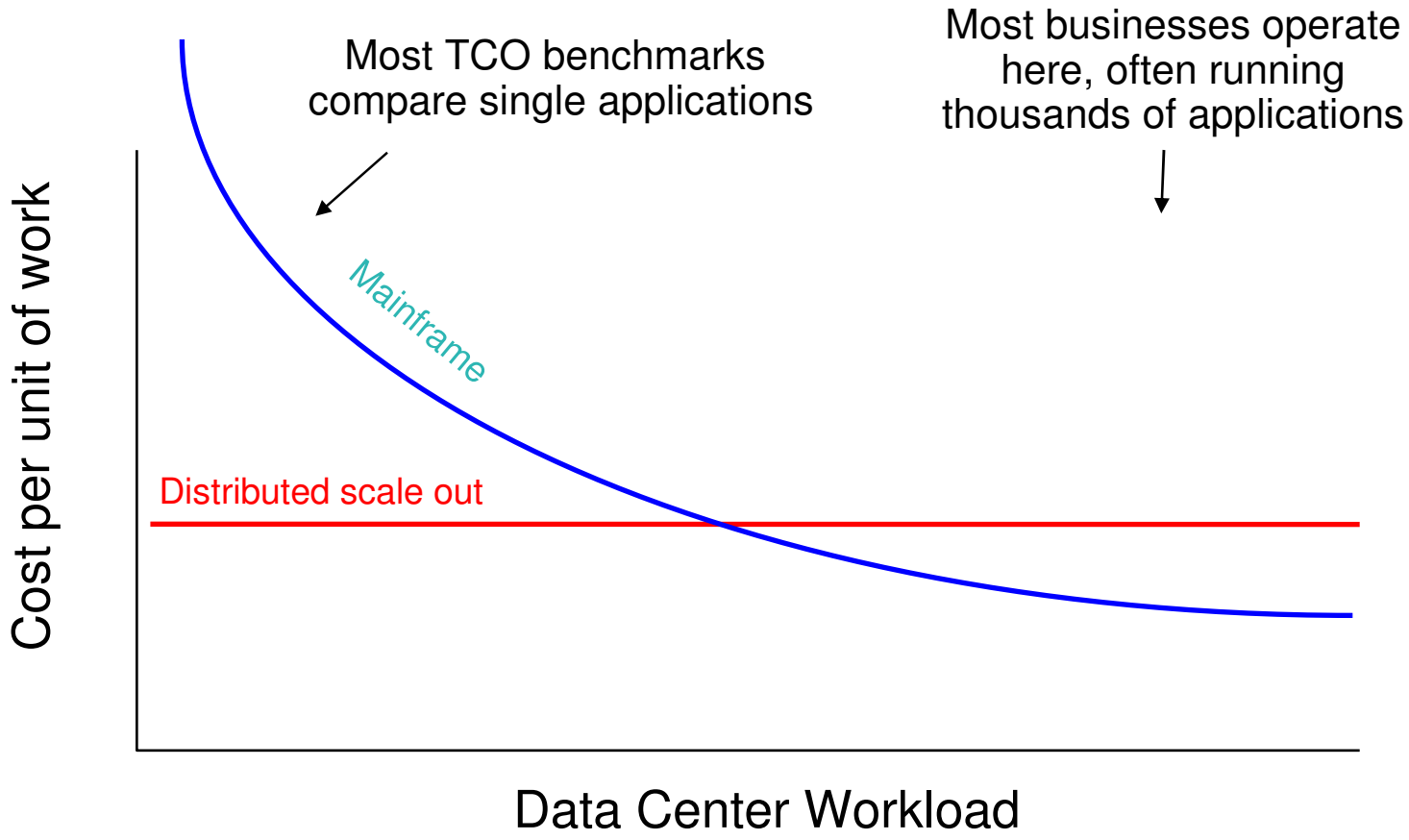
System z Premier Executive Event

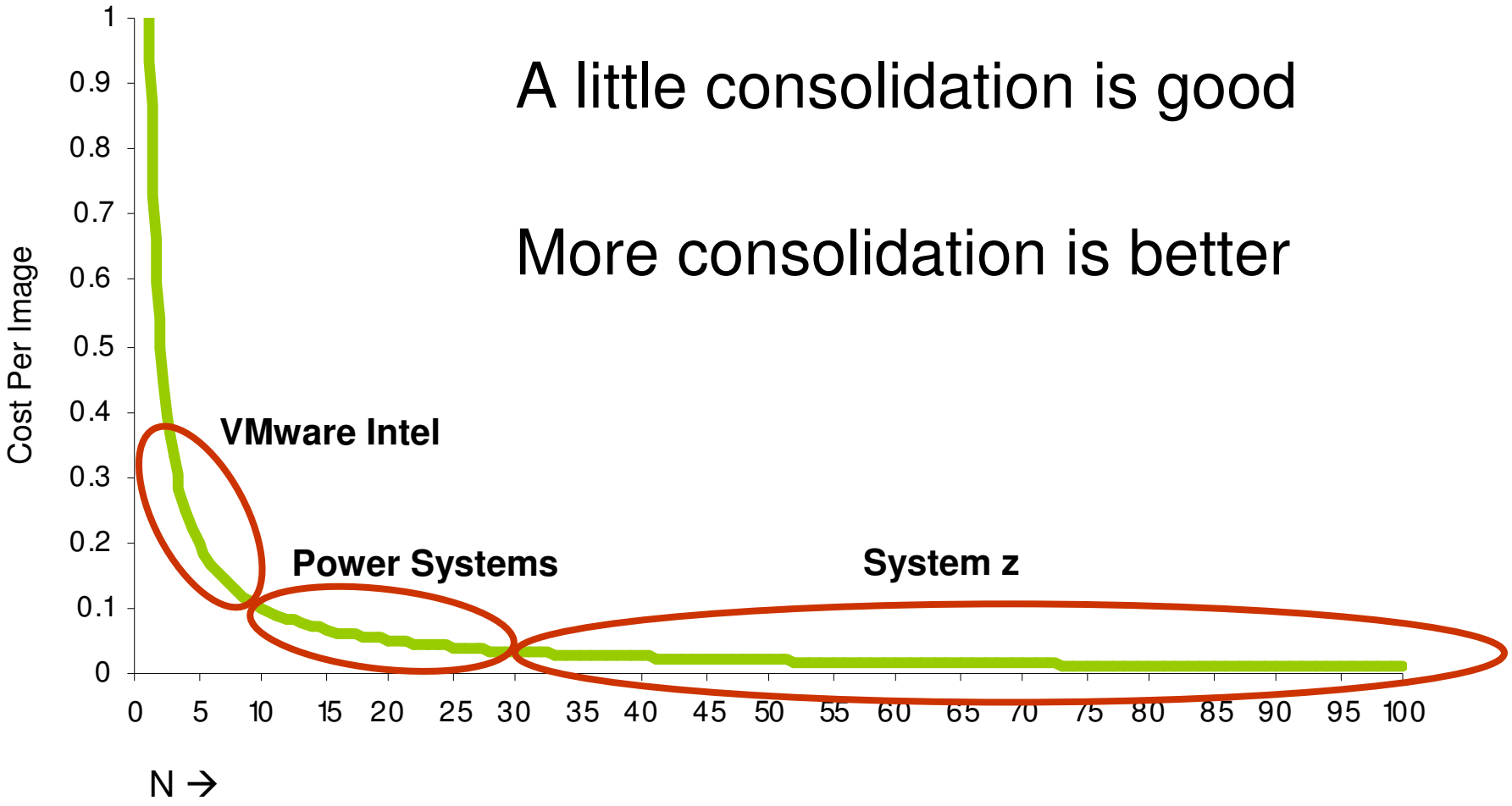
Analysis of IT Value and Cost Considerations

Ray Jones
Vice President,
Worldwide System z Software
IBM Software Group

Mainframe Cost/Unit of Work Decreases as Workload Increases



Observed Consolidation Ratios



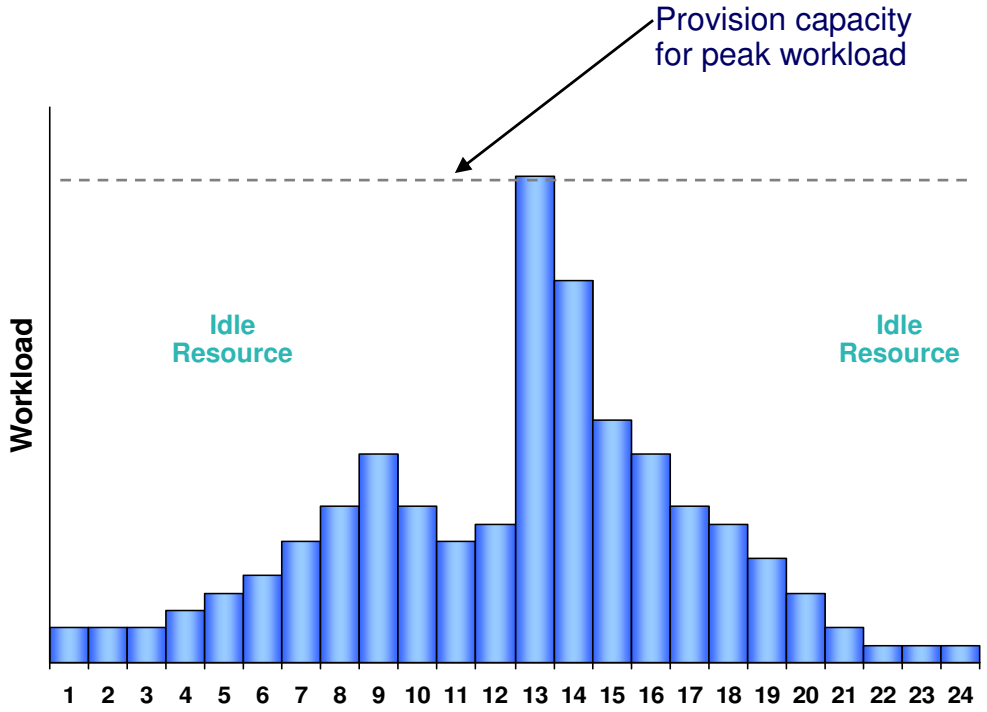
Utilization of Distributed Servers & Storage

Typical utilization of:

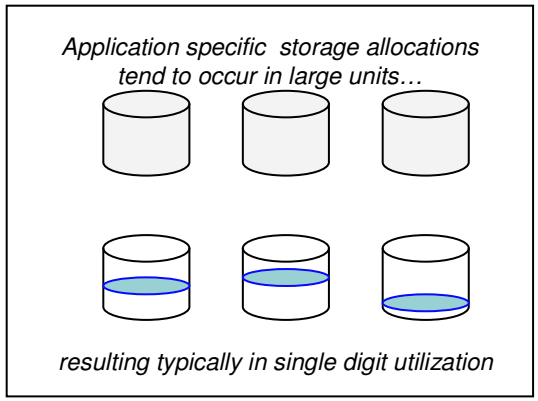
Windows Servers	5-10%
UNIX Servers	10-20%
System z Servers	85-100%

Server dedicated to one application

The cost of storage is typically three times more in distributed environments



- **Storage Allocation**
  - Application-specific resulting in over-allocations
  - Fine grained storage allocation mechanisms characteristic of mainframe storage are uncommon in distributed environments.
- **Storage Utilization**
  - Single digit utilization for distributed environments is not uncommon
  - Storage utilization of 80% + is typical for mainframe
- **Storage Management**
  - Data disaster recovery, synchronization, and transfer requirements add complexity and cost



What Is A Typical Value Of Sigma?

IBM Survey Of Workload Variability In 3200 Servers

Type Of Workload	Average Utilization	Peak Utilization	Sigma
Infrastructure	**6%**	**35%**	**2.5 * Mean**
Web Server	**4%**	**24%**	**2.5 * Mean**
Application	**4%**	**34%**	**3.75 * Mean**
Database	**5%**	**37%**	**3.25 * Mean**
Terminal	**6%**	**45%**	**3.25 * Mean**
E-Mail	**4%**	**34%**	**3.75 * Mean**

IBM System x™ Servers and VMware Virtual Machine Sizing Guide

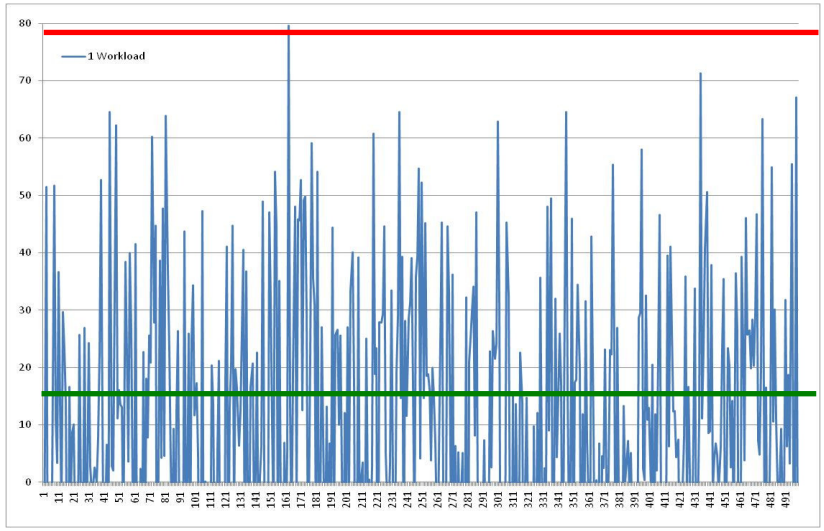
Legacy workloads on XEON 2.5-2.8GHz Servers

Normal probability distribution

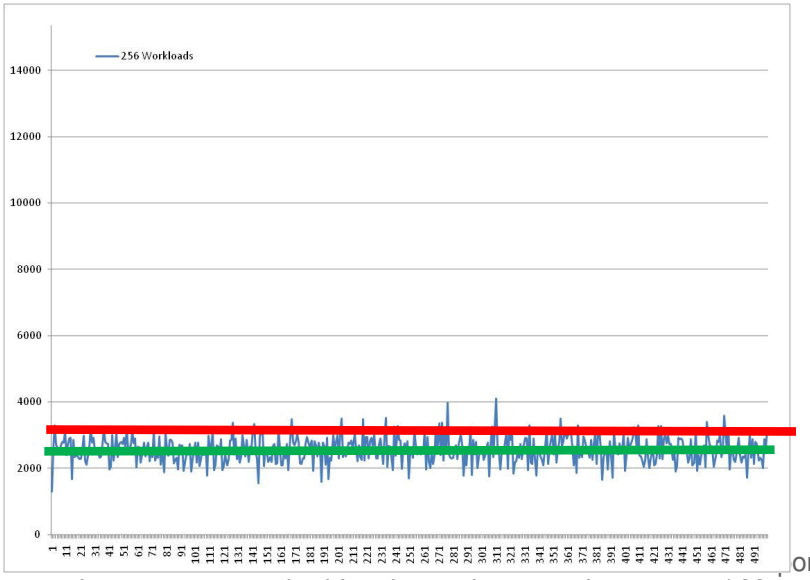
New Workload Scenarios – Beware Benchmarks

- **Stress test benchmarks have no variability!**
  - They drive the system under test to100% utilization with no variation
  - Comparing mean throughputs at 100% utilization doesn't give a realistic view of the resources required for deployment

Running a new workload with variability Sigma=2.5*Mean requires processing capacity equal to **6 times the Mean** workload demand



Adding a new workload to a pool of 256 existing workloads will require incremental processing capacity equal* to the **Mean** workload demand

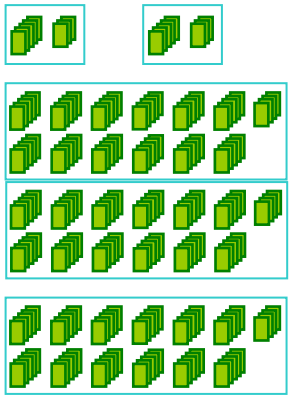


* If we add one more workload to a pool of 256 consolidated workloads the computing resource required for the pool goes up by 1.00047 * Mean

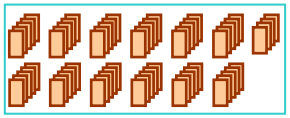
Compare The Processors Needed To Achieve 2,200 Transactions Per Second

Online Injector: 1 x HP RX7620

Temenos T24 Servers:
2 x HP RX7620
3 x HP 9000 Superdome

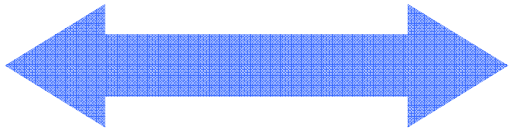


Oracle 10g: 1 x HP 9000 Superdome



5 processors

(3,906 MIPS)

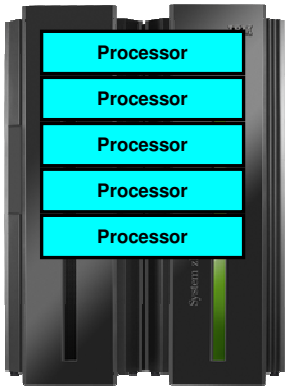


280 processors

(457,762 Performance Units)

$26.0M
TCA (3yr)

TCS BaNCS and DB2
1x z10 2097-705



$18.9M
TCA (3yr)

117 Performance Units per MIP

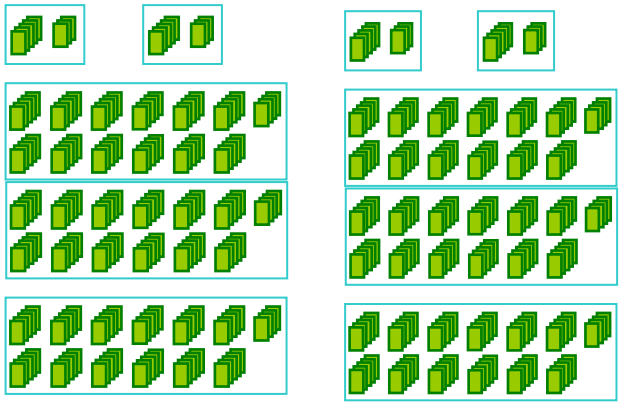
HP Integrity rx7620 - (10U) 1.5GHz 6MB (8ch/8co)

HP 9000 Superdomes - 32W 1GHz 32MB (32ch/64co)

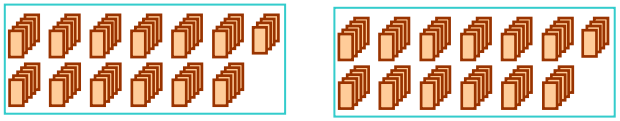
Compare The Processors Needed To Achieve 2,200 Transactions Per Second (with Dev/QA)

Online Injector: 2 x HP RX7620

Temenos T24 Servers:
4 x HP RX7620
6 x HP 9000 Superdome



Oracle 10g: 2 x HP 9000 Superdome



560 processors

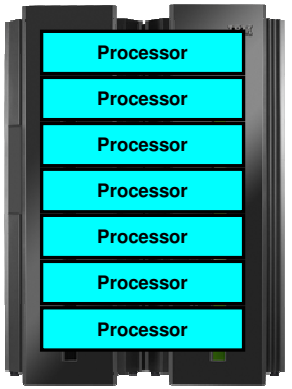
(915,524 Performance Units)

$59.2M
TCA (3yr)

7 processors

(4,906 MIPS)

TCS BaNCS and DB2
1x z10 2097-707



$22.7M
TCA (3yr)

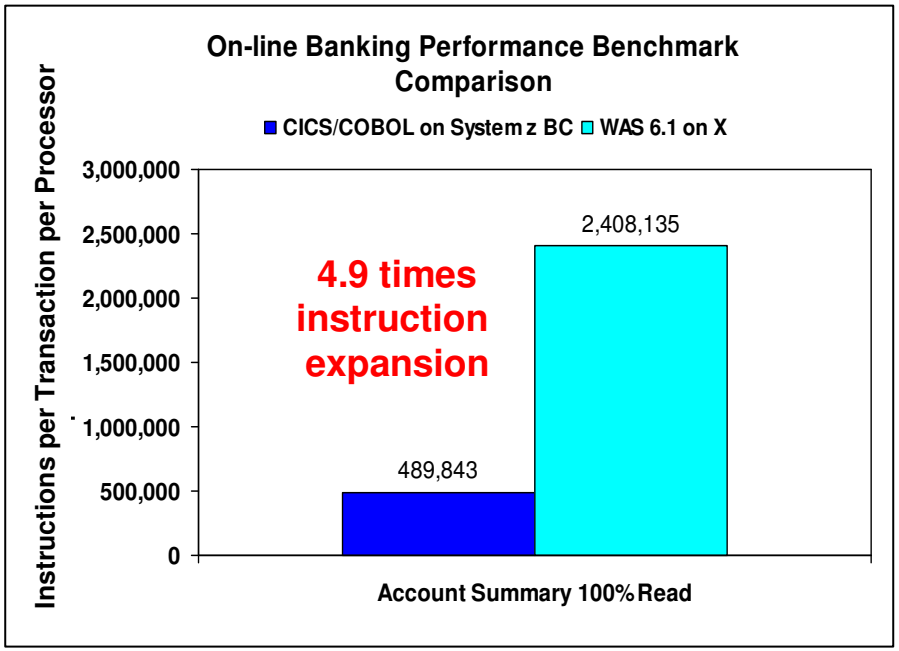
187 Performance Units per MIP

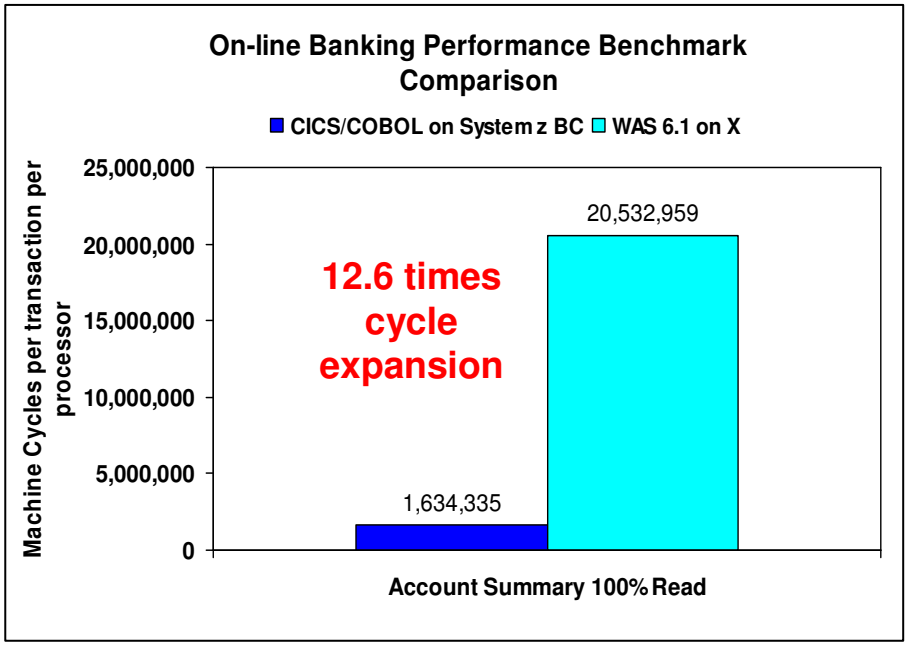
NOTE: Double Distributed Servers, add 1000 MIPS to System z for Dev/QA

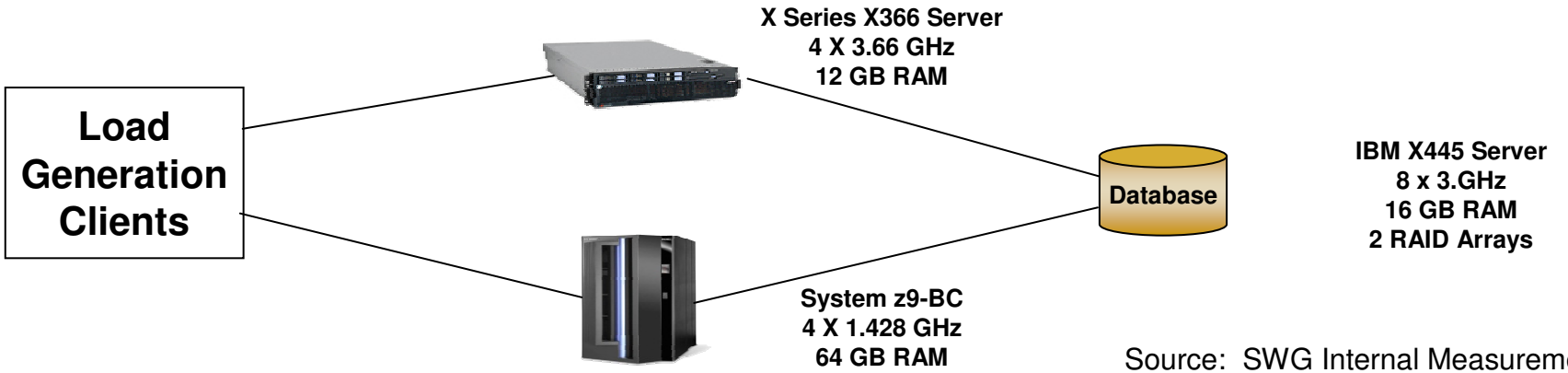
HP Integrity rx7620 - (10U) 1.5GHz 6MB (8ch/8co)

HP 9000 Superdomes - 32W 1GHz 32MB (32ch/64co)

Benchmark - Code Expansion When Moving From CICS/Cobol To Java On Wintel (Higher Is Worse)





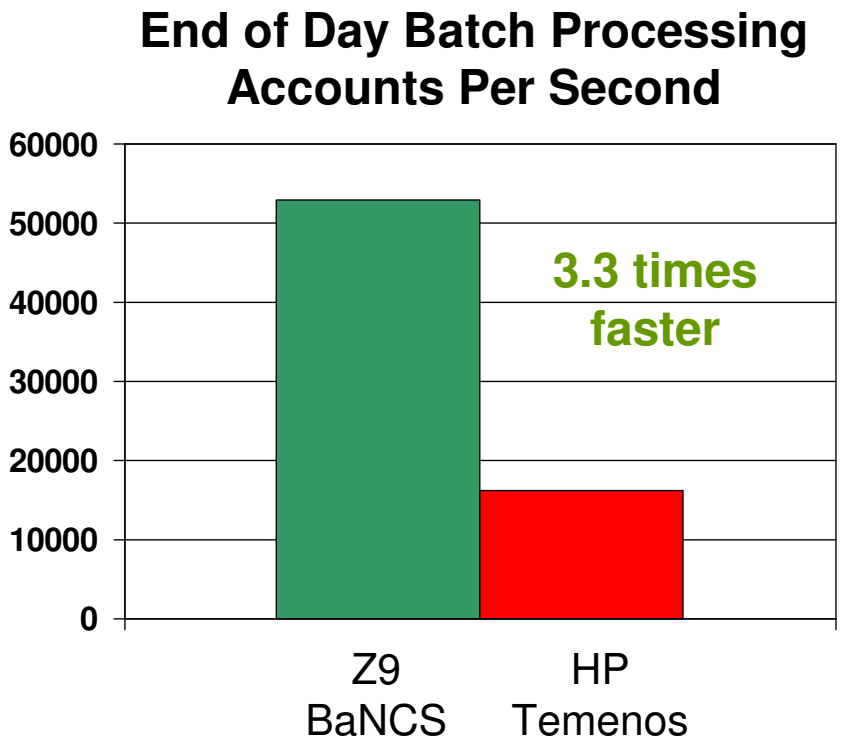


Source: SWG Internal Measurements

System z Batch Processing Performance

- Bank of China BMT*
  - **IBM System z9**
  - **TCS BaNCS (Cobol)**
  - **380** Million Accounts
  - End of Day processing – 175M accounts finished in 55 minutes (52,970 accounts/second)

- HP/Temenos BMT**
  - **HP Itanium**
  - **Temenos T24 (Java)**
  - **13** Million Accounts
  - End of Day processing finished in 13.33 minutes (16,250 accounts/second)

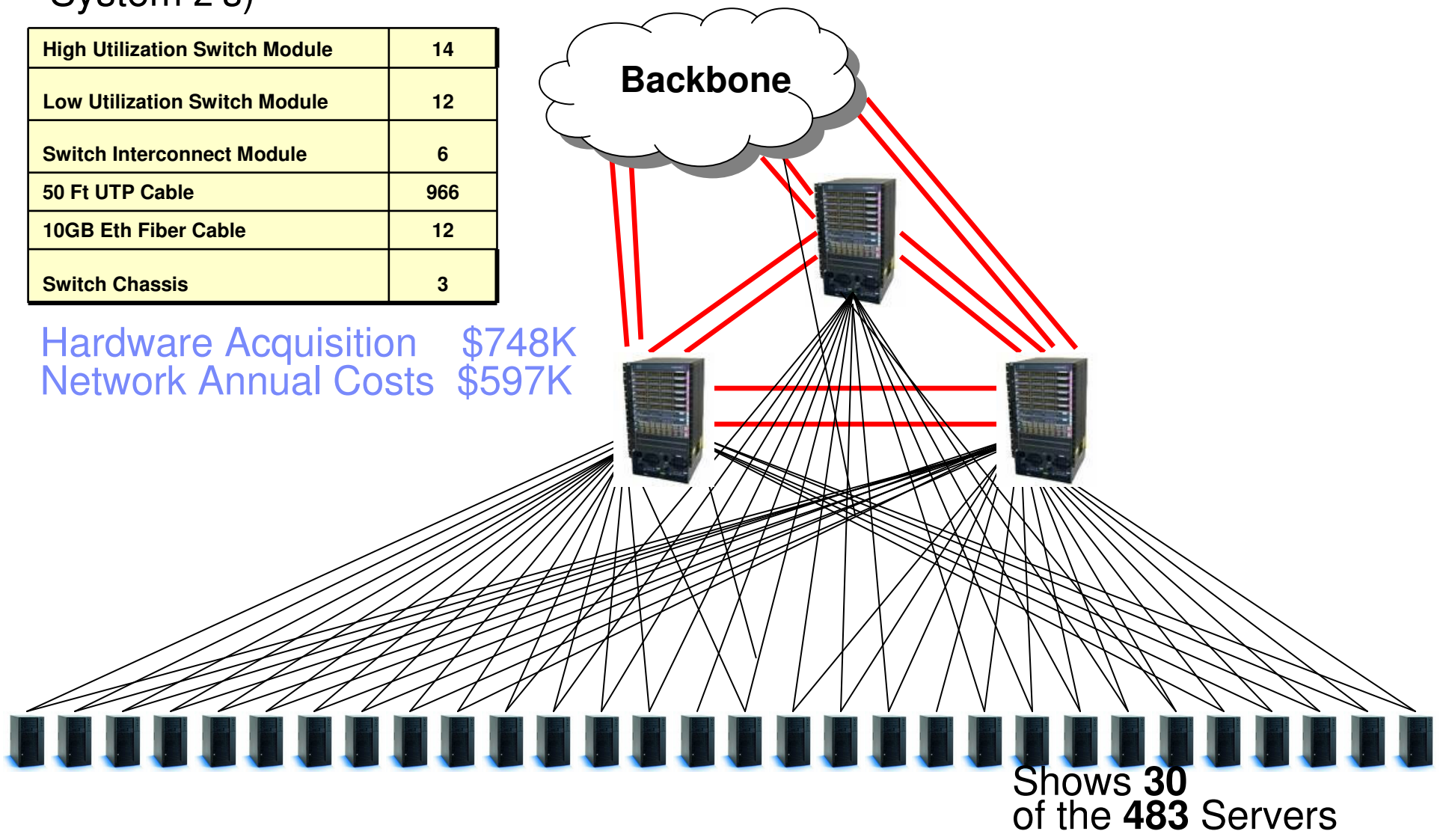


SOURCE:*http://www.enterprisenetworksandservers.com/monthly/art.php?2976 **Source**: InfoSizing FNS BANCS Scalability on IBM System z – Report Date: September 20, 2006
SOURCE:**TEMENOS BENCHMARKS; http://h71028.www7.hp.com/enterprise/downloads/TemenosBenchmark.pdf

Case Study: Network Costs –Before Consolidation (483 Servers to 2 System z's)

High Utilization Switch Module	14
Low Utilization Switch Module	12
Switch Interconnect Module	6
50 Ft UTP Cable	966
10GB Eth Fiber Cable	12
Switch Chassis	3

Hardware Acquisition $748K
Network Annual Costs $597K

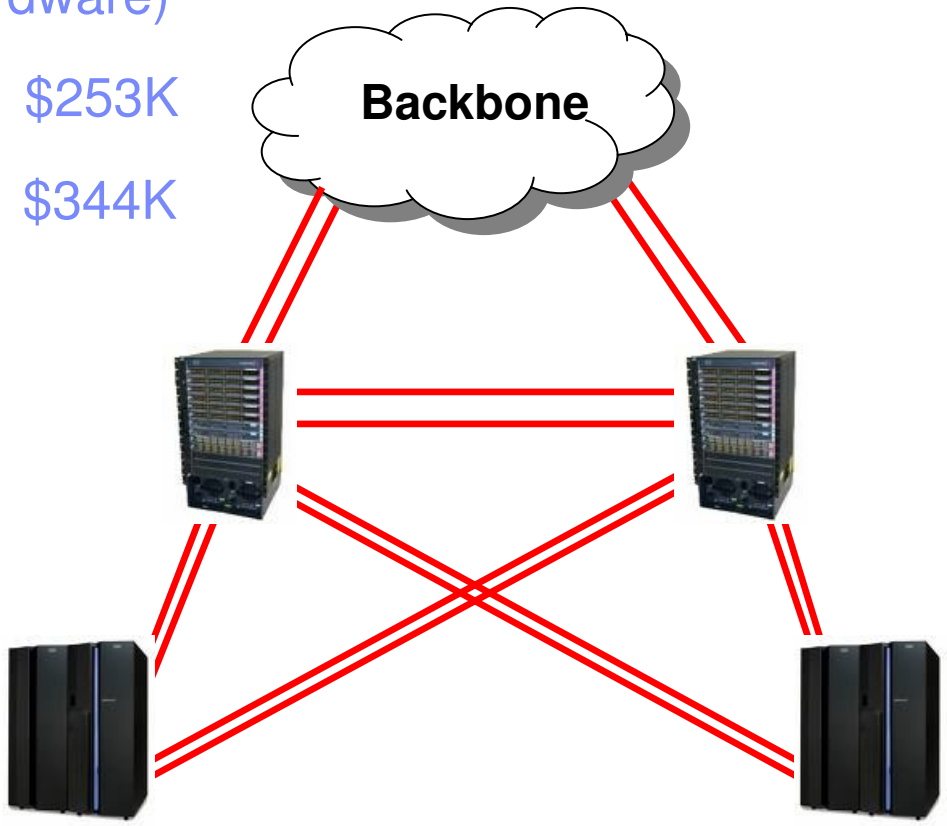


Case Study: Network Costs – After Consolidation (483 Servers to 2 System z's)

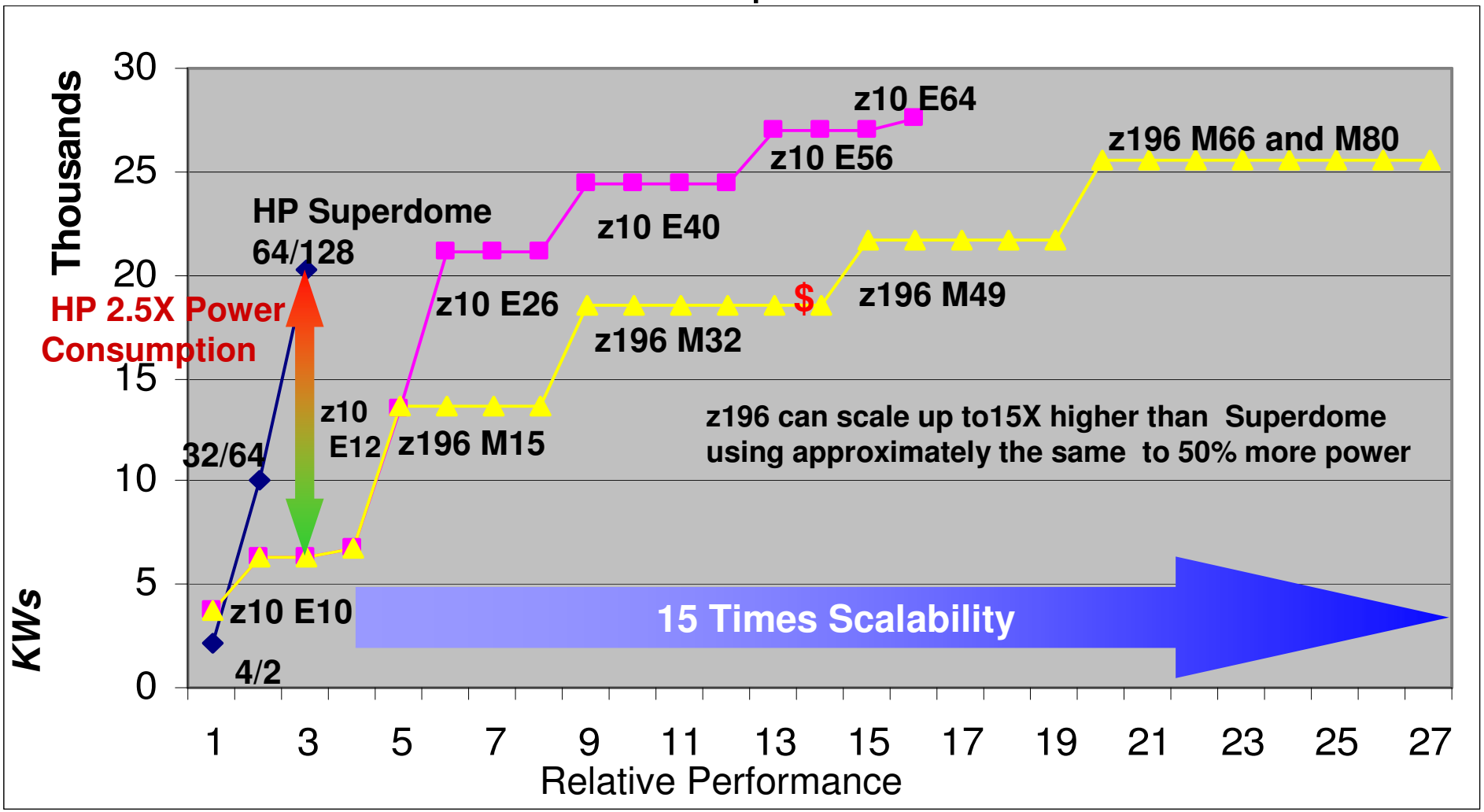
New Hardware Acquisition $0
(reuse some of old network hardware)

"After" Network Annual Cost $253K

Network Annual Cost Savings $344K

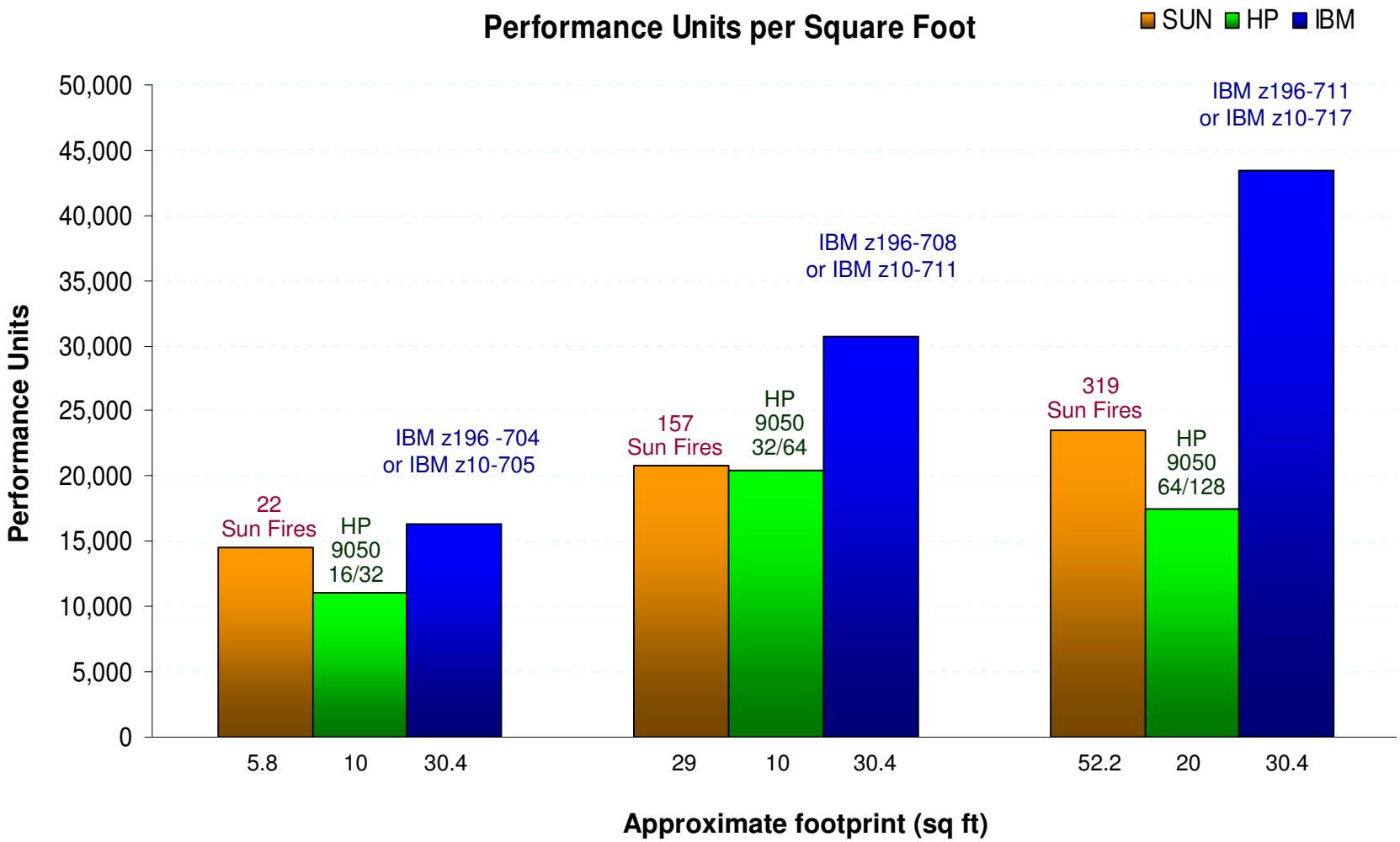


Mainframe Scales 2.5 to 15X Superdome



Notes: Performance as per Eagle TCO studies. Multiply by 2 for MIPS. HP performance based on 122 perf units / MIPS. z10 and z196 power is max value. It is very rare that any mainframe is even 80% of max. Typical mainframe power is less - approximately 60% of maximum as per field data. Mainframe Power scales by model or book package.

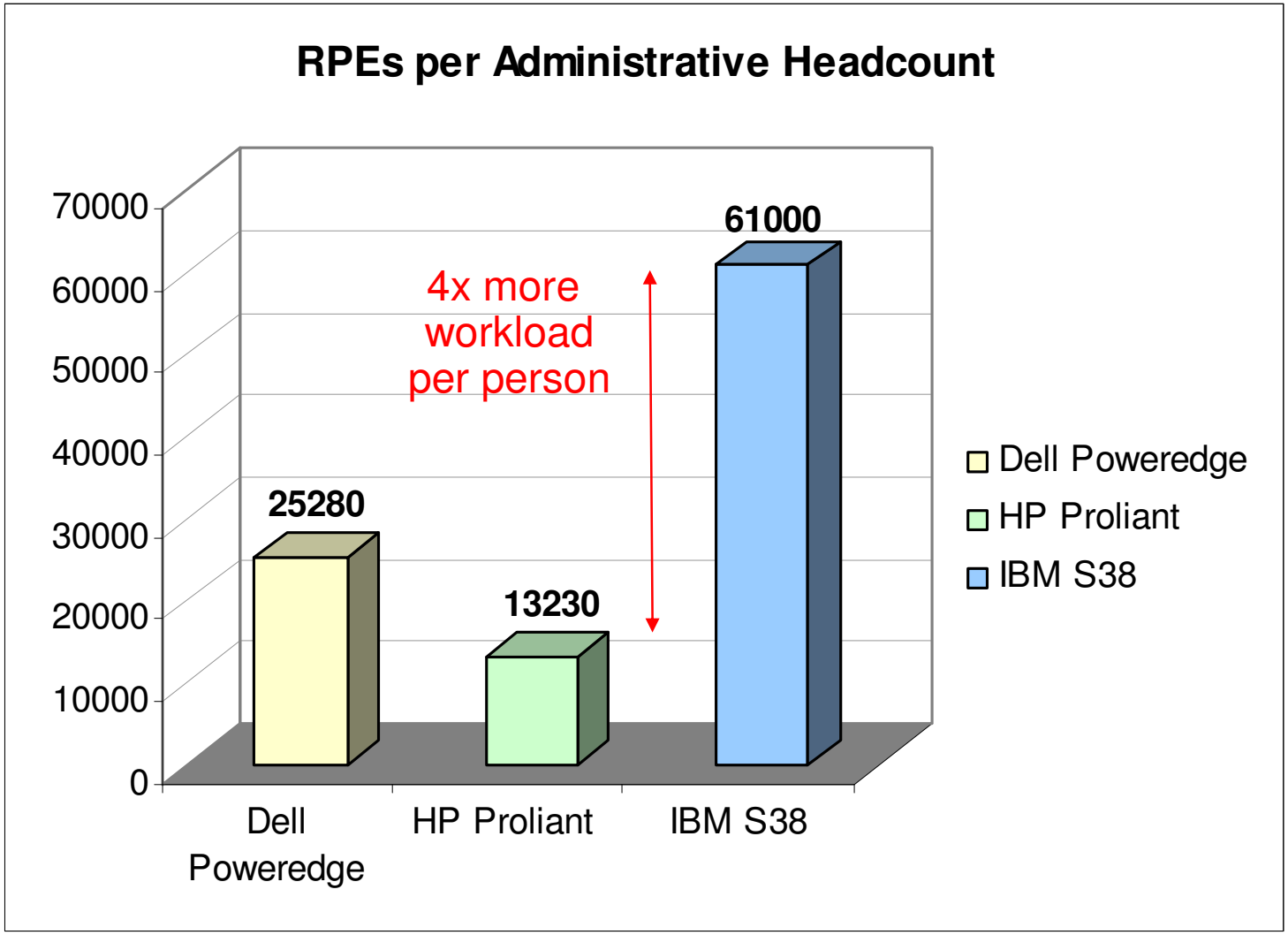
The Mainframe Also Delivers More Compute Power Per Footprint Unit



Based on 122 performance units per MIP

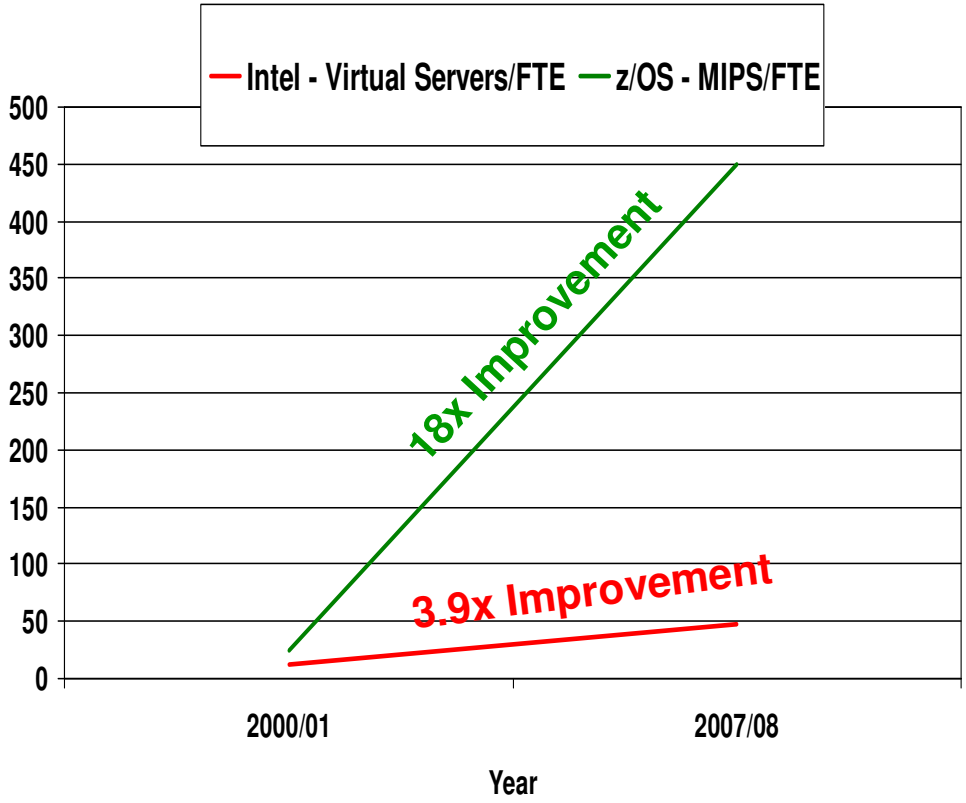
MainframeE10 EC and z196 footprint remains constant

Manage More Workload Per Headcount



Compared at 122 RPE's = 1 MIP

System z Labor Cost Trends Favor A Centralized Approach To Management



Large scale consolidation and structured management practices drive increases in labor productivity

Small scale consolidation achieves lesser gains

The more workloads you consolidate and manage with structured practices…
the lower the management labor cost

Source: IBM Scorpion Studies

Average Costs for Customers
System z vs distributed – Empirical Findings

Cost Ratios (z vs Distributed)

		z	Distributed	z vs distributed (%)
Rehosting	**5-Year TCO**	**$29,428,593**	**$51,965,131**	**56.63%**
	Software	$19,520,910	$17,484,548	111.65%
	Hardware	$7,183,032	$9,327,146	77.01%
	System Support Labor	$4,643,964	$8,255,061	56.26%
	Electricity	$40,840	$363,945	11.22%
	Space	$61,277	$225,078	27.22%
	Migration	$371,847	$7,067,787	5.26%
	DR	$1,009,618	$13,903,509	7.26%
Conslidation	**5-Year TCO**	**$9,739,125**	**$23,325,530**	**41.75%**
	Software	$2,579,985	$13,726,812	18.80%
	Hardware	$4,813,952	$5,425,007	88.74%
	System Support Labor	$1,100,500	$4,237,050	25.97%
	Electricity	$37,190	$271,895	13.68%
	Space	$236,542	$578,605	40.88%
	Migration	$2,297,676		
	DR			

Software costs on mainframe include production, batch and management

Software costs on distributed often do not include systems management software

Understand The Cost Components

Annual Operations Cost Per Server
(Averaged over 3917 Distributed Servers)

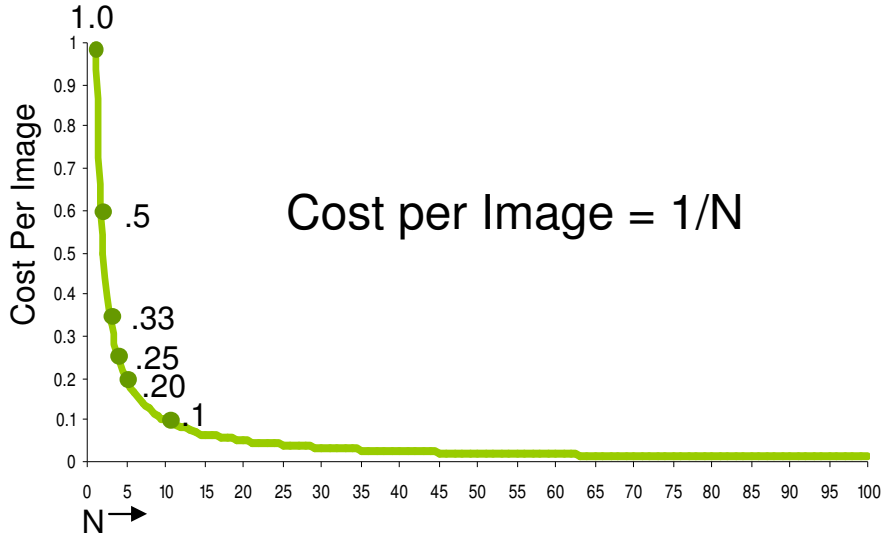
Power	**$731**
Floor Space	**$987**
Annual Server Maintenance	**$777**
Annual connectivity Maintenance	**$213**
Annual Disk Maintenance	**$203**
Annual Software support	**$10,153**
Annual Enterprise Network	**$1,024**
Annual Sysadmin	**$20,359**
Total Annual Costs	**$34,447**

The largest cost component was labor for administration
7.8 servers per headcount @ $159,800/yr/headcount

Source: IBM internal study

How Does Consolidation Reduce Costs?

- Costs shared by all “N” consolidated images
  - Hardware
  - Software
  - Power
  - Floor Space
  - Local Network Connectivity



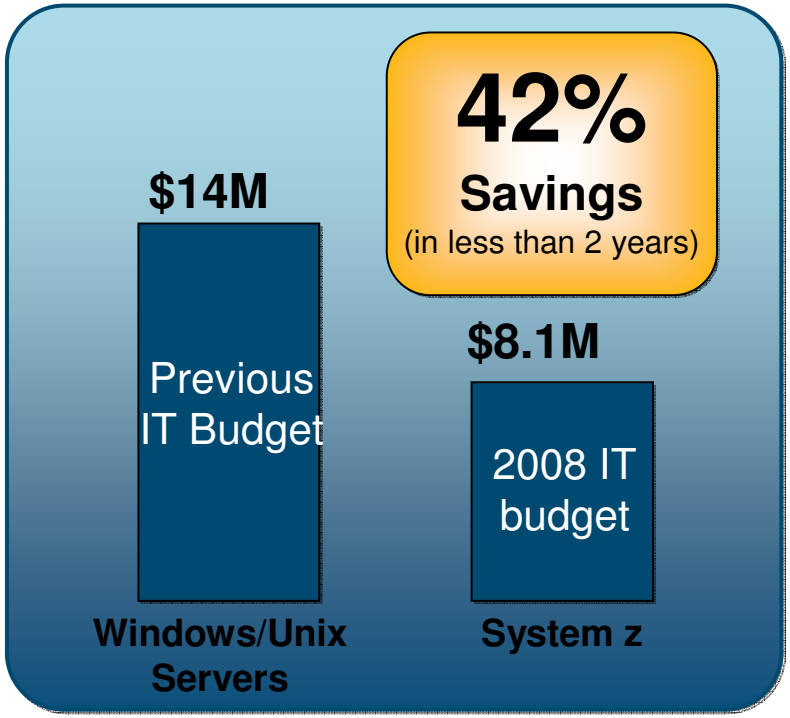
Cost per Image = 1/N

- Costs not shared by consolidated images
  - Migration cost per image — Fixed cost per image
  - Off premise network cost
  - Labor cost per image — Fixed cost per image, but typically less than unconsolidated labor cost

The more workloads you can consolidate, the lower the cost per image

Optimize deployment of applications and data

Deploying SAP database and application servers



Top three reasons for savings

- Software and hardware licensing costs dramatically reduced
- Software and hardware maintenance costs are significantly down
- Networking costs plunged, while infrastructure was drastically simplified

BALDOR $1.8 billion Electric motors manufacturer

Expected Benefits Realized: Availability and Performance

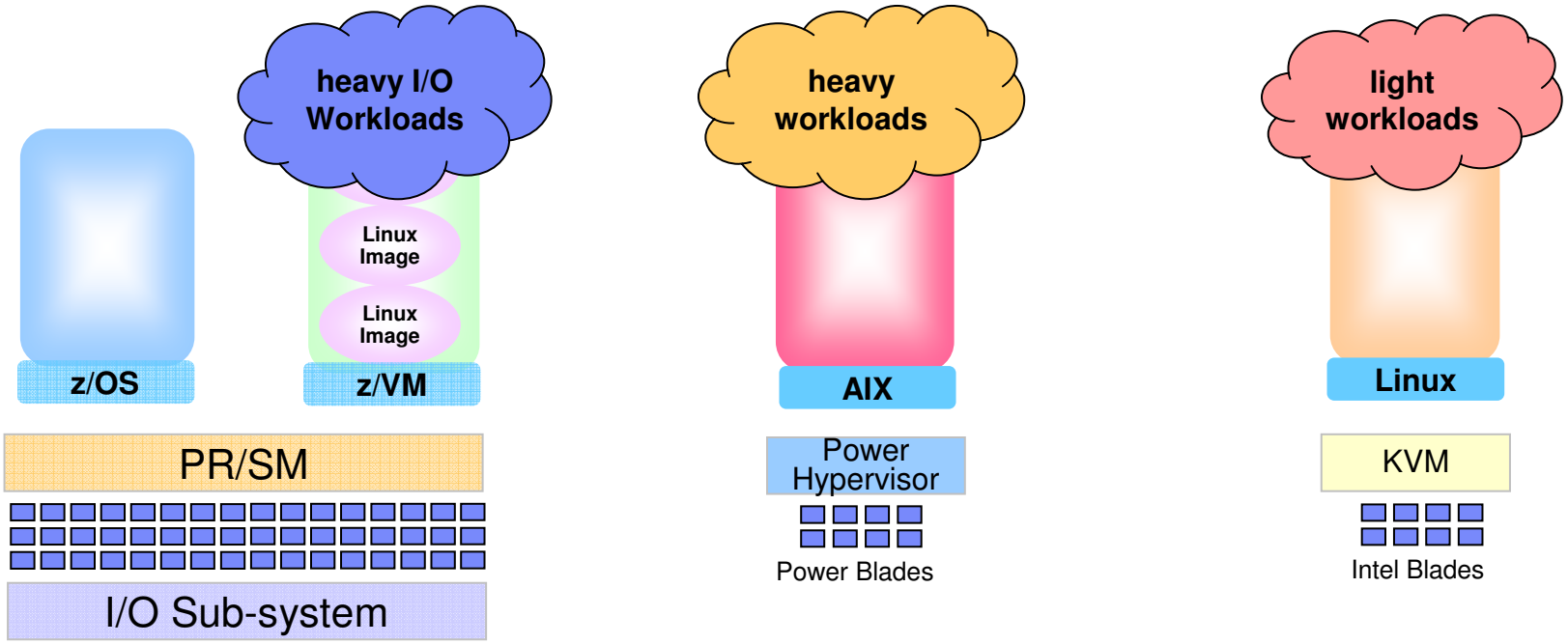
The System z decision was driven by expected benefits:

- **Reduced complexity**
- **High availability**
- **Ease of maintenance**
- **Dynamic Workload**
- **Good consistent application response time (SAP)**
- **zLinux for rich toolset, ease of use**

Additional Benefits Realized: Significant Cost Savings

- **+Reduced IT budget by 42% - in less than 2 years**
- **+Reduced floor space by 70%**
- **+Reduced software and hardware maintenance by more than 50%**
- **+Reduced power consumption by more than 60%**
- **+Reduced total TCO from 2% of sales to below 1% - and realized 1 year ahead of schedule**

zEnterprise Extends Cost Advantages To A Broad Range Of Workloads

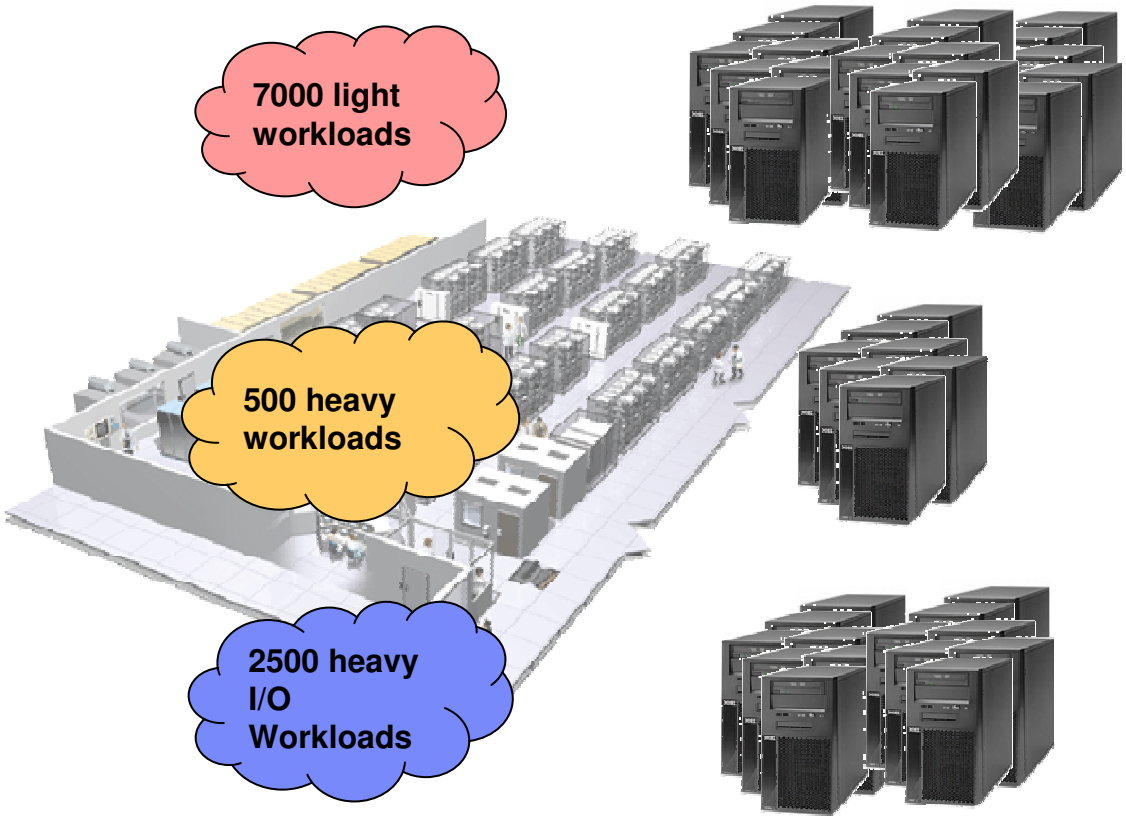


- Scale up to 80 cores in a frame (z/OS clusters with sysplex)
- Dedicated I/O Sub System
- Superior qualities of service

- Scales to 8 cores per blade
- Larger number of fast processing threads
- Floating point accelerators

- Scales to 8-12 cores per blade
- Fast processing threads
- Commodity I/O
- Modest qualities of service

Large Data Center – What Did It Cost To Deploy 10,000 Workloads On Virtualized Intel Servers?



Deployed on **875** Intel Xeon Servers using VMware
(8 cores each)

Deployed on **500** Intel Nehalem Servers
(8 cores each, non-virtualized)

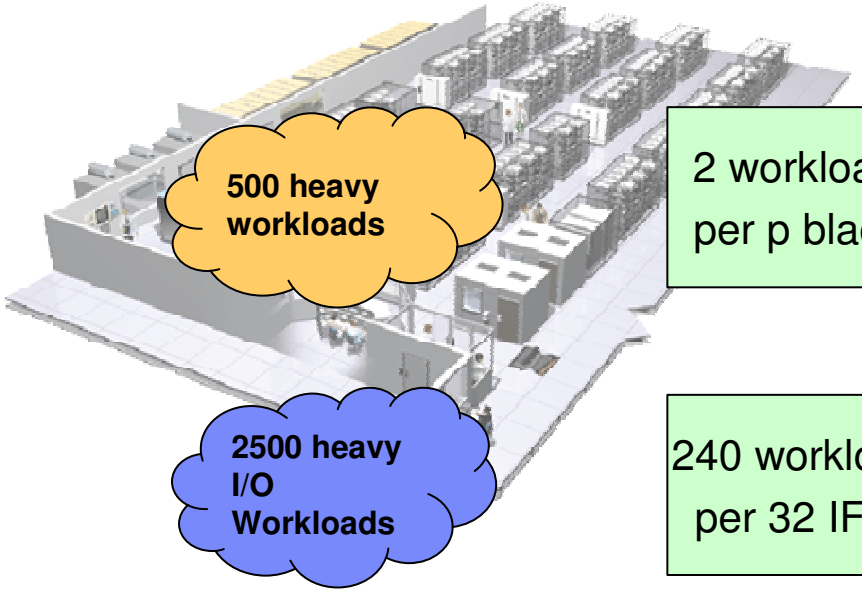
Deployed on **228** Intel Nehalem Servers using VMware
(8 cores each)

10,000 workloads

1603 servers

IBM analysis of a customer scenario with 10,000 distributed workloads. Deployment configuration is based on consolidation ratios derived from IBM internal studies.

Large Data Center – What Does It Cost To Deploy 10,000 Workloads On zEnterprise?



36 workloads per x blade

7 zBX racks 195 x blades total

2 workloads per p blade

9 zBX racks 250 p blades total

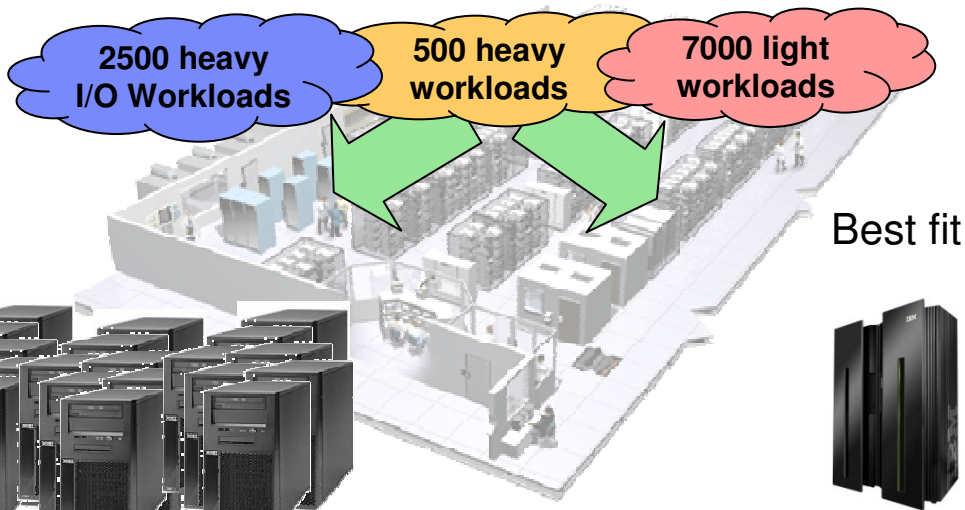
240 workloads per 32 IFLs

5 zEnterprise CPFs 334 IFL's

Best fit assignments

Configuration is based on consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way measurements. The zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics.

Compare Server Cost Of Acquisition



Deployed on Intel

1603 Intel Servers

$314M TCA (3 years)

Best fit on zEnterprise

21 Frames

445 blades

334 IFL's

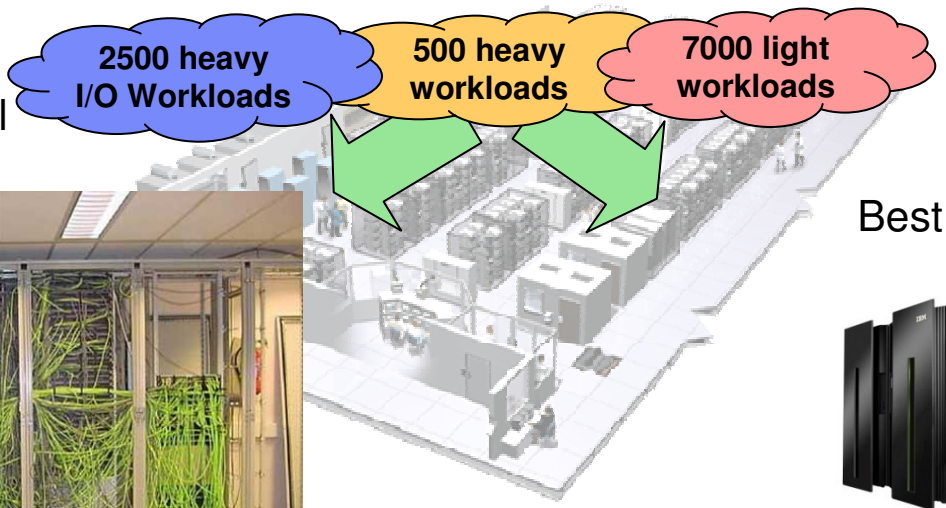
$138M TCA (3 years)

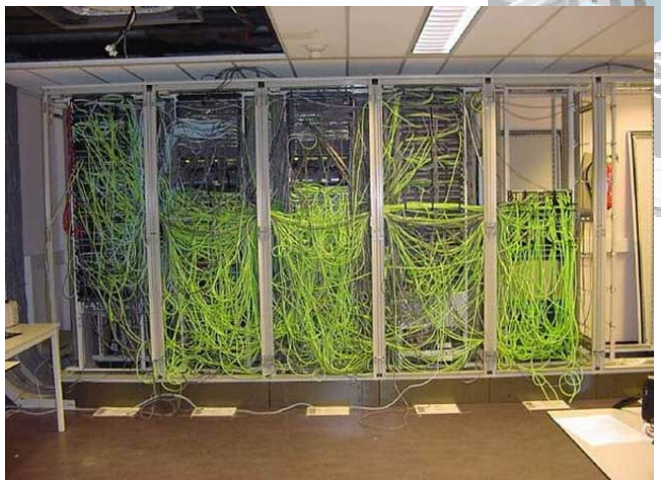
56% less

Server configurations are based on consolidation ratios derived from IBM internal studies. Prices are publicly available US list, prices will vary by country

Compare Network Cost Of Acquisition

Deployed on Intel





Additional network parts
- 313 switches
- 7038 cables
- 6412 adapters

13,763 total network parts

$3.8M TCA

Best fit on zEnterprise

Additional network parts
- 7 switches
- 142 cables
- 74 adapters

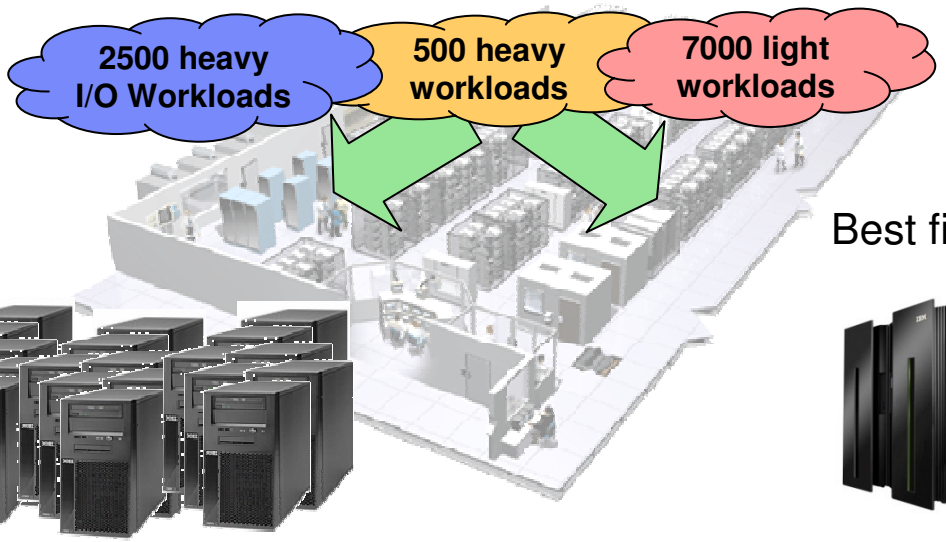
223 total network parts

$197K TCA

95% less

Network configuration is based on IBM internal studies.
Prices are publicly available US list, prices will vary by country

Compare Power Consumption



Deployed on Intel

Best fit on zEnterprise

1603 Servers

2131 kW

$5.6M

3 years@$0.10 per kWh

21 frames

419 kW

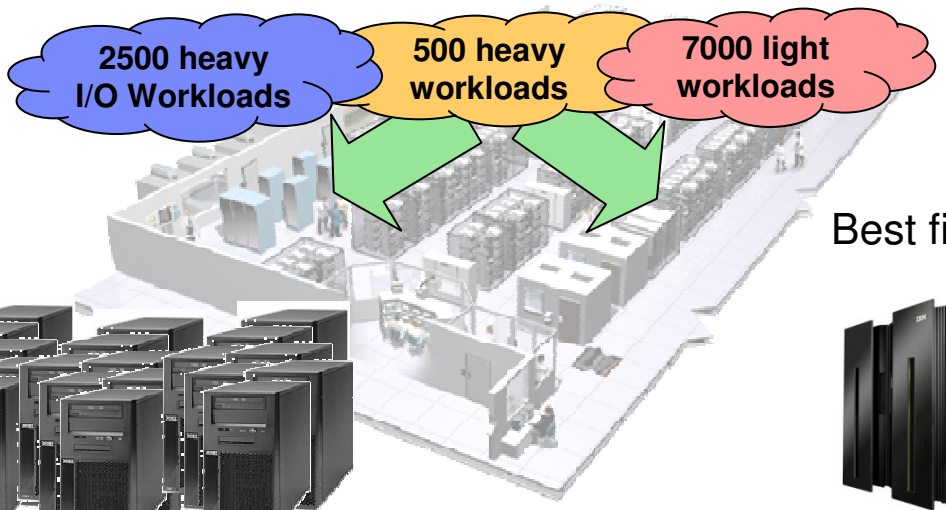
$1.1M

3 years@$0.10 per kWh

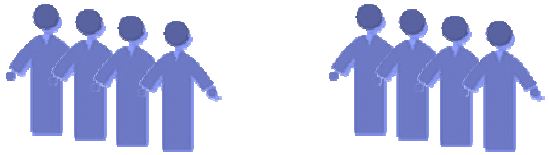
80% less

Server configuration based on IBM internal studies.
Calculations for Intel servers based on published power ratings and industry standard rates. Prices are publicly available US list, prices will vary by country

Compare Server Infrastructure Labor Cost



Deployed on Intel



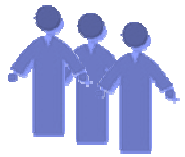
411,296 labor hours/yr

198 administrators

$94.8M

3 years @ $159,600/yr

Best fit on zEnterprise



156,606 labor hours/yr

76 administrators

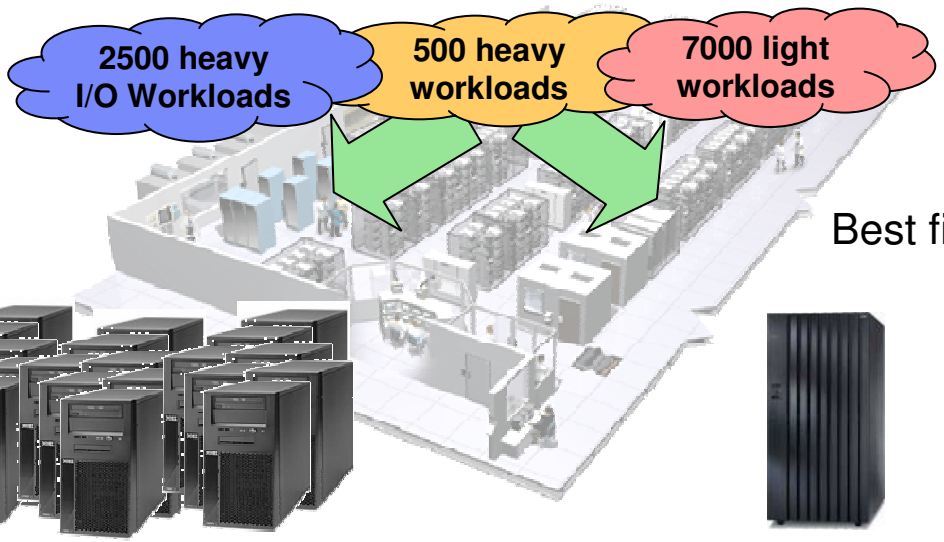
$36.4M

3 years @ $159,600/yr

62% less

Configuration based on IBM internal studies.
Labor model based on customer provided data from IBM studies
Labor rates will vary by country

Compare Storage Cost



Deployed on Intel

Best fit on zEnterprise

3 DS8700

6 XIV via SAN

1 SONAS

7.7 PB embedded storage
31% utilization
1603 points of admin

$211M TCO(3 years)

4.5 PB provisioned storage
53% utilization
10 points of admin

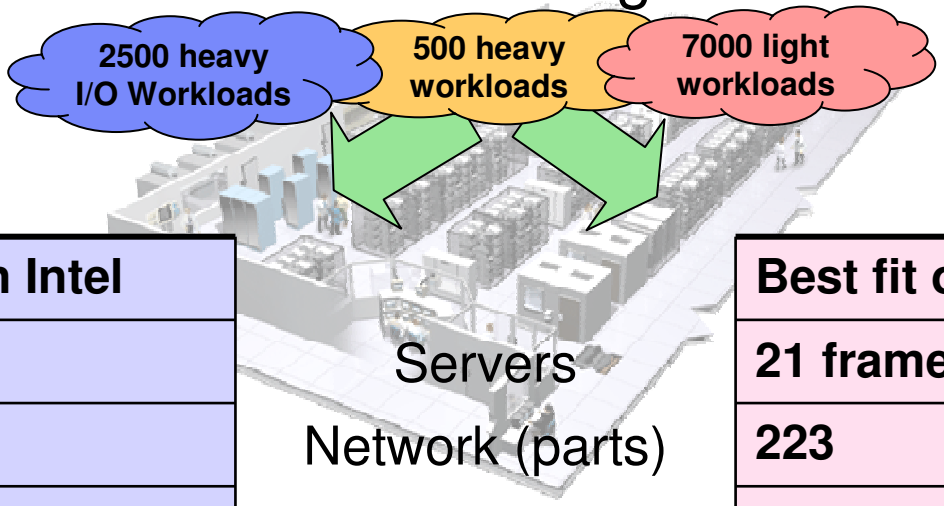
$108M TCO (3 years)

240GB active storage required per workload (2.4PB total)

49% less

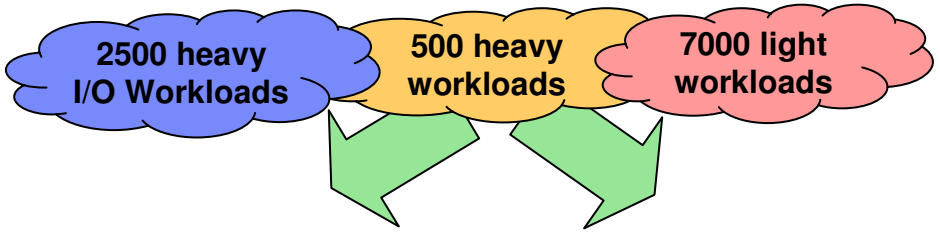
Storage configuration is based on IBM internal studies.
Prices are publicly available US list, prices will vary by country

Simplification –
Fewer Parts To Assemble And Manage



Deployed on Intel		Best fit on zEnterprise
1603	Servers	21 frames
13,763	Network (parts)	223
2131	Power (KW)	419
198	Administrators	76
1603	Storage admin points	10

The Savings Are Cumulative

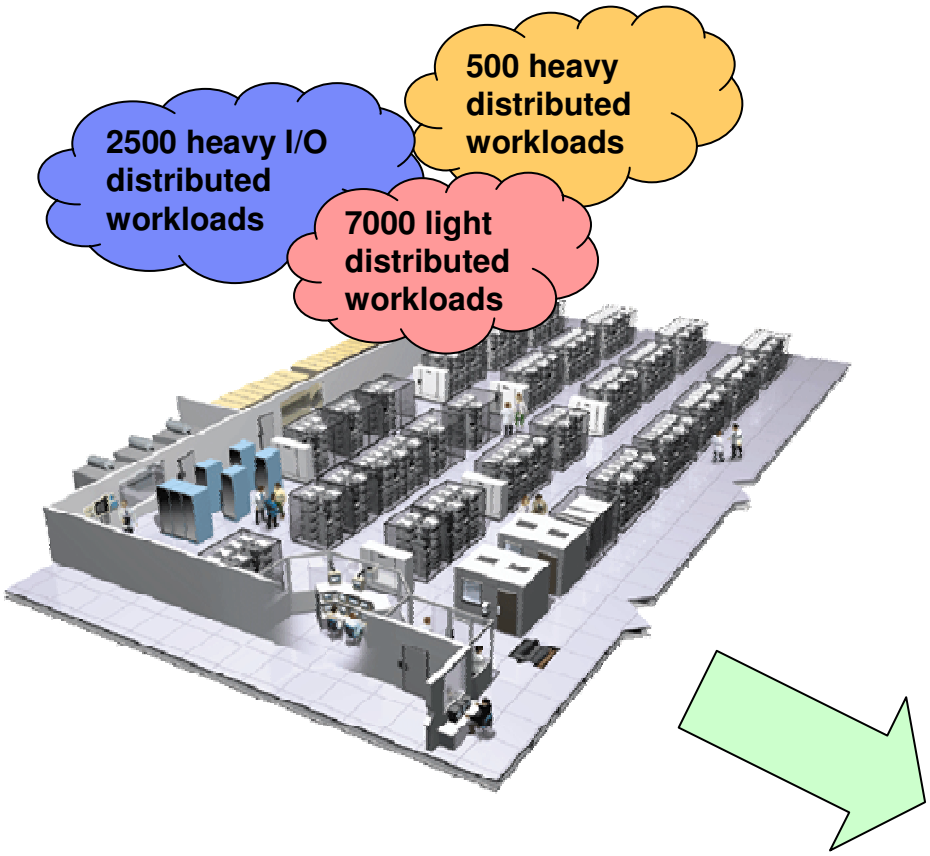


Three Year Cost Of	Deployed on Intel	Best fit on zEnterprise
Servers	**$314M**	**$138M**
Network	**$3.8M**	**$0.2M**
Power	**$5.6M**	**$1.1M**
Labor	**$94.8M**	**$36.4M**
Storage	**$211M**	**$108M**
Total	$629M	$284M
Total cost per workload	**$62K**	**$28K**

55% less

31 Results may vary based on customer workload profiles/characteristics. Prices based on publicly available US list prices. Prices may vary by

zEnterprise Is A Roadmap To The Data Center Of The Future



- **Lower cost per unit of work for large scale workloads**
- **Revolutionary cost reductions for smaller scale workloads**
- **Data center simplification**
- **Improve quality of service**
- **No other platform can match!**

Mainframe workloads
+
distributed workloads
best fit for cost

International Restaurant Chain Avoids High Cost Software

- **Existing environment of 1600 MIPS included high cost ISV system management software**
- **Competitor's proposal was only a partial offload**
  - Complete offload projected to cost 2.3x more
  - $56M vs $24M over 5 years
- **System management software costs more in the offload case**
  - Mainframe systems management
    - $2.0M Stream per year (48 products, mostly third party)
  - Distributed systems management
    - $2.6M Yearly Maintenance (26 products)
    - $13.3M One Time Charge
- **Better: Replace higher cost System z ISV software with lower cost IBM Software**

Typical System z Cost Comparison For Large Workloads

Configurations required to achieve 2,200 online banking transactions per second, production + dev/test/DR workloads

HP Servers

Oracle

560 processors

(915,524 Performance Units)

$49.5M*

TCA (5yr)

8 HP 9000 Superdomes - 32W 1GHz 32MB (32ch/64co)
6 HP Integrity rx7620 - (10U) 1.5GHz 6MB (8ch/8co)

IBM System z10

CICS/DB2

7 processors

(4,906 MIPS)

$24.9M

TCA (5yr)

z10 2097-707

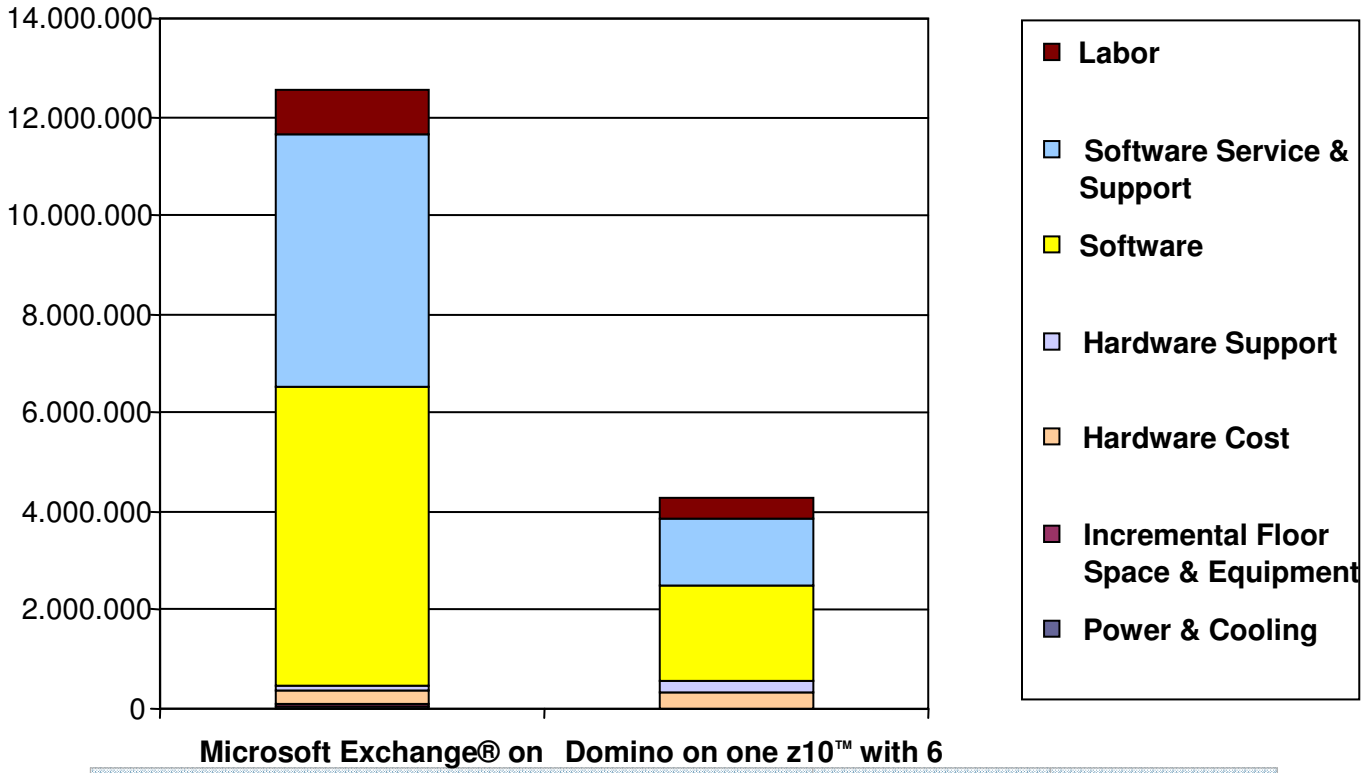
Based on IBM analysis of publicly available benchmarks
http://h71028.www7.hp.com/enterprise/downloads/TemenosBenchmark.pdf
IBM/FNS: http://www.enterprisenetworksandservers.com/monthly/art.php?2976
InfoSizing FNS BANCS Scalability on IBM System z
*Based on publicly available US list prices

Key Points:

Mainframe Costs	Distributed Costs
The cost of running incremental workload on the mainframe goes down as the total workload grows	The cost of running additional workload on distributed servers goes up more linearly
– Labor costs hold steady as workload grows	– Labor is now the highest cost element in distributed environments Administrative staff costs increase in proportion to the number of servers
– IBM pricing policies designed to favor the addition of more workload	– New workload requires additional servers and licenses
– Highly Efficient Power and Cooling – Small Footprint	– Energy and Space cost is more linear
– Lower software costs per transaction as workload grows – and PRA can lower ISV tool costs	– Cost of software licenses is more linear
– High Availability and Security Translate into low cost	– Fractionally less Availability and Security can drive Significant downstream costs
Customers have learned that mainframes deliver economies of scale, especially as the workload grows	**Result – scale out strategies do not deliver equivalent economies of scale as the workload grows**

This pricing discussion uses published list prices

Email, Calendaring, and Collaborative Application on System z is 1/3 the Cost of x86 and Saves $8M+ over 3 years

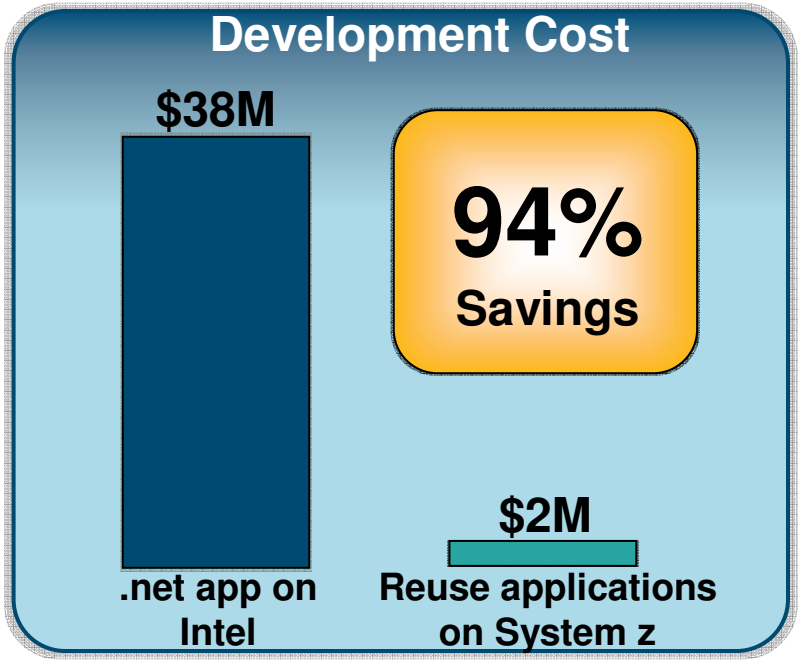


	TCO: 3 Years	Per User Cost
Microsoft Exchange on fourteen x86 Servers	$ 12,557,473	$ 1,046
Domino on one z10 BC™ with 6 IFLs	$ 4,286,997	$ 357
Savings with Domino on System z Linux	$ 8,270,476	$ 689

Assumes 12,000 users

Prices are in USD. Prices may vary in other countries.

3. Reuse applications and data



- **Complexity of recoding from scratch all the business processes into .net framework**
- **Speed of implementing System z solution was less than 29 days**
- **Additional employees to test and maintain .net application versus none for System z**

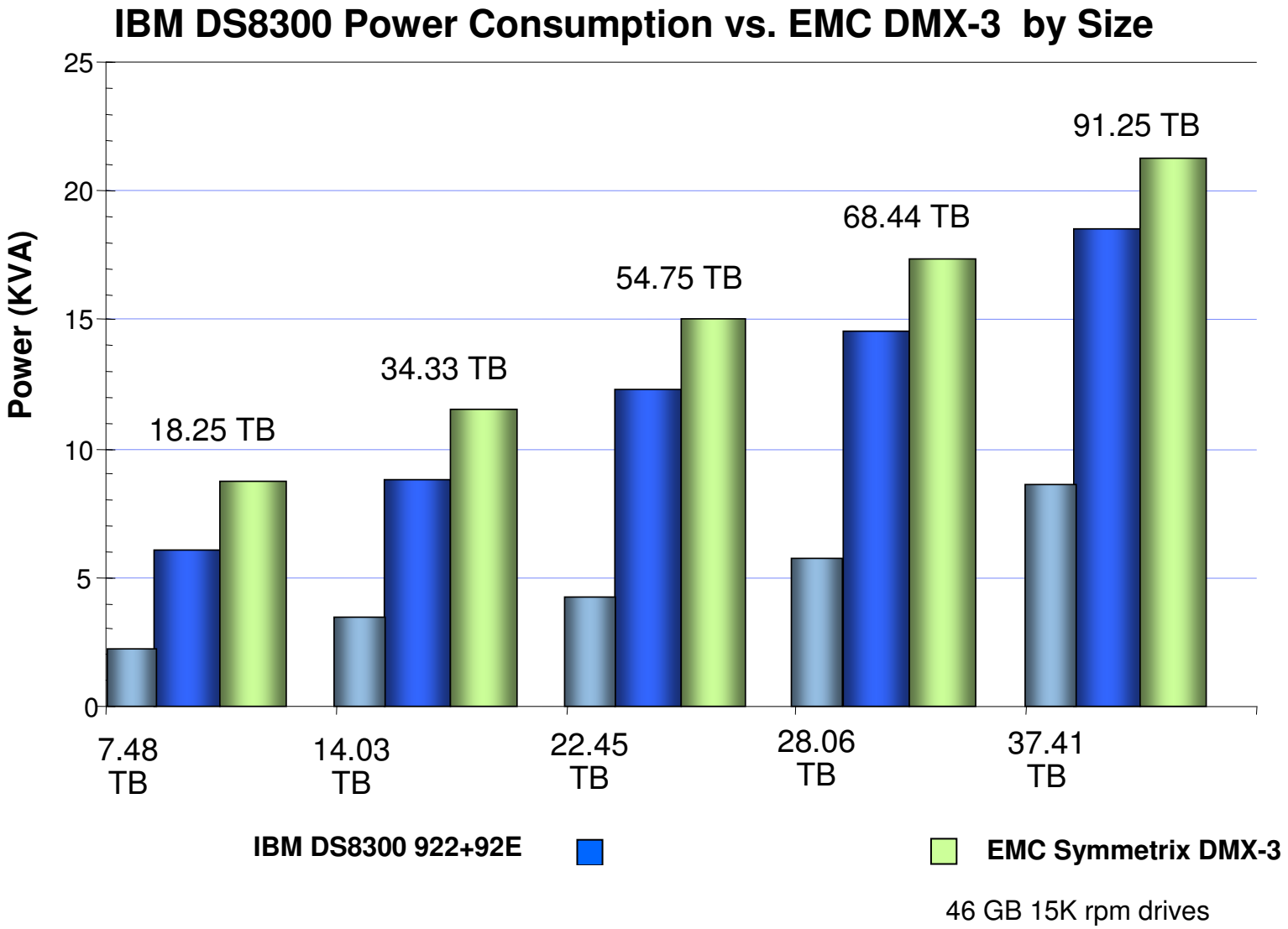
Additional benefits

Improved application functionality

Faster time to market

Quick implementation and reduced risk

IBM Storage Also Saves Energy Costs



Customer Survey – How Many People to Manage Servers?

# NT Servers	# People	Ratio (s/p)
1123	68	**16.5**
228	20	**14.4**
671	51	**13.1**
700	65	11.5
154	18	8.5
431	61	7.1
1460	304	4.8
293	79	**3.7**
132	54	**2.0**

# UNIX Servers	# People	Ratio (s/p)
706	99	**7.1**
273	52	5.2
69	15	4.6
187	56	3.3
170	51	3.3
85	28	**3.0**
82	32	**2.6**
349	134	**2.6**
117	50	**2.3**
52	52	**1.0**

Mainframe administration productivity surveys range 167-625 MIPS per headcount (500 is typical), so…

Source: IBM Scorpion Customer Studies NOTE: Figures for total administration cost

Storage Costs: DB2 Delivers More Storage Savings Than Oracle

- **DB2 for z/OS lowers TCO by reducing storage needed**
  - TPC-H Benchmark: DB2 compression of 62% vs 27% for Oracle RAC

- **Storage savings with DB2 vs. Oracle for a 10 TB data base**

	Oracle	DB2 for z/OS*
Storage System	**HP XP24000 Storage**	**IBM System Storage DS8100**
Overall database compression ratio (using TPC-H benchmark results)	**27%**	**62%**
For 10 TB uncompressed data storage needed	**7.3 TB of HP Storage**	**3.8 TB of IBM Storage**
Cost of storage (3 year TCA)	**$888,399 + $37,560 x 3** = $1,001,079	**$192,205 + $7,992 x 2**** = $208,189
With compression, storage for DB2 costs 79% less than for Oracle		

*DB2 for z/OS achieves similar compression ratios to those of DB2 for LUW
**IBM storage maintenance fee for the first year is included in the warranty

Let's Break Down the Elements of Cost

Total Cost of Ownership =

TCA – Hardware/Software/MA

+Networking

+ Environmentals

+ Labor

+ Peripherals

Impacted by Quality of Service

Expressed by Chargeback

The total cost requires a total picture of your I/T assets and expenses

Do The Math – z196 vs. 7 HP Superdomes $

- **HP Itanium 2 Superdome 9050 (64ch/128co)* consumes a maximum of 24,392 watts**
  - [24,392 X $.10 X (24 X 365)]/1000 = $21,367 per year for electricity
  - Need 7 for same performance as z196 M32
  - $149,569 per year

- **Mainframe with similar computing capacity - a System z196 731 machine with 6 I/O drawers cages using 18.5 kW (rated)***
  - (18,500 X $.10 X (24 X 365))/1000 = $16,206 per year
  -

- **Similar savings on cooling capacity**
  - Cost of cooling is about 60% additional
  - Superdome cooling $89,741 per year vs. Mainframe $9,724
  - Superdome total $239,310 per year vs. z196 total $25,930
  - Savings of mainframe power and cooling is $213,380 per year

- *18.5 KW as per IMPP. This is a max number and may be substantially less for typical configurations. Performance equivalence determined by IBM TCO study and use of LSPR MIPS
- z196 Cooling cost using water will be less than 60% of power. Measurements TBD. *These savings will improve.*