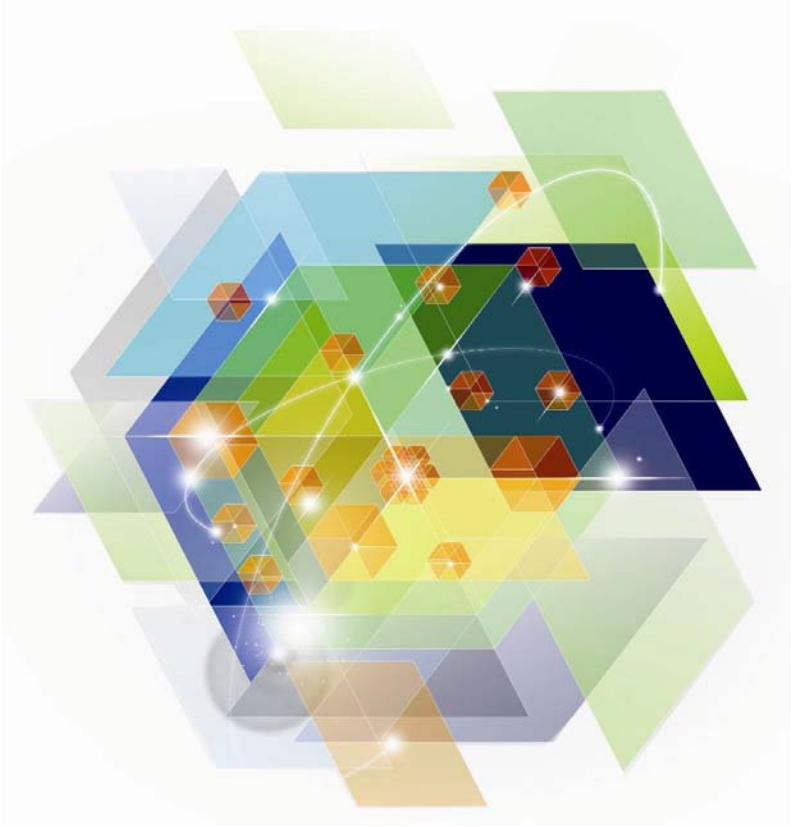
# Analyzing IT Value and Cost Considerations – Maximizing The Value of Your Mainframe



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

April 2012

# Smarter Computing

## Strategies to achieve breakthrough reductions in IT cost

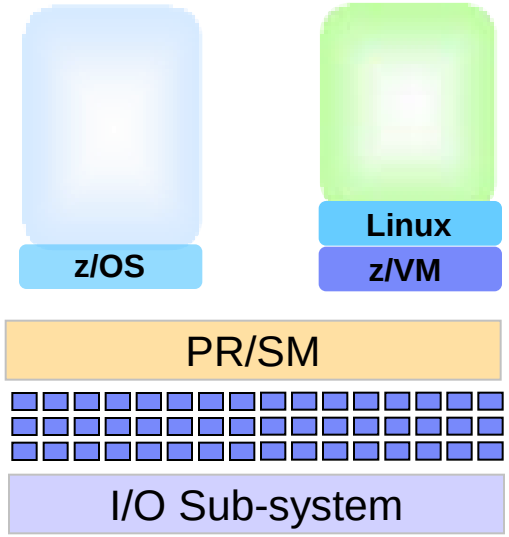
**Ascertain true elements of cost:**

**Hardware/Software/Maintenance**
**Networking**
**Energy**
**Labor**
**Storage**

**New metric for the age of Smarter Computing**

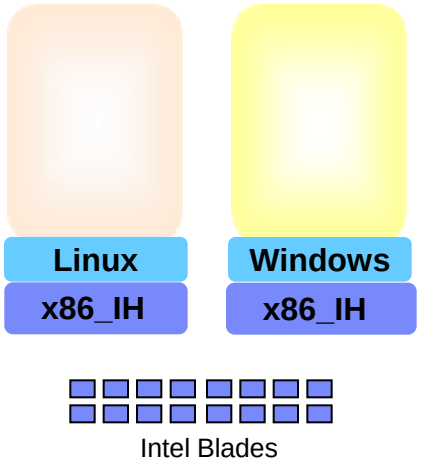
**COST PER WORKLOAD**

# A Closer Look At Fit-For-Purpose Workload Assignment



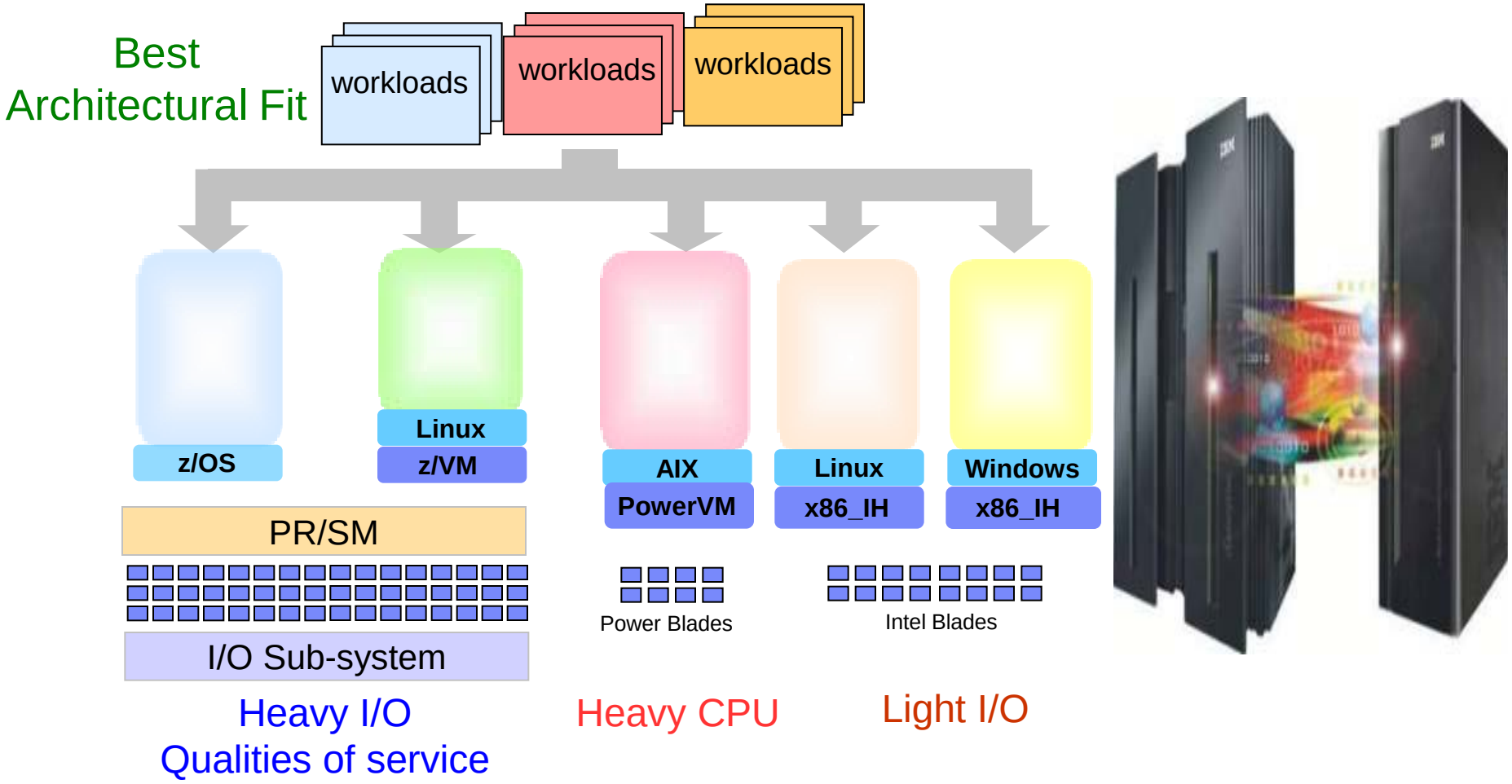

- Scale up to 80 cores in a frame (z/OS clusters with sysplex)
- Dedicated I/O sub-system
- Superior qualities of service


- Scales to 8 cores per blade
- 4 fast processing threads per core
- Floating point accelerators




- Scales to 16 cores per blade
- 2 fast processing threads per core
- Commodity I/O
- Modest qualities of service

# Workload Characteristics Influence The Best Fit Deployment Decision




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

# Deploying Stand Alone Workloads With Heavy CPU Requirements

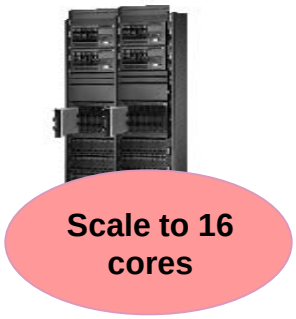
***Benchmark to determine which platform provides the lowest TCA over 3 years***

Heavy CPU workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 8 core Nehalem servers**

Online banking workloads, each driving **460** transactions per second with light I/O

2 workloads per Intel blade




Virtualized on Intel
16 core HX5 Blade
**$200,055** per workload

**Best Fit**

1 workload per POWER7 blade

PowerVM on PS701
8 core POWER7 Blade
**$216,658** per workload

10 workloads per 32-way z/VM

z/VM on z196 CPC
32 IFLs
**$328,477** per workload

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

# Deploying Stand Alone Workloads With Light CPU Requirements

***Benchmark to determine which platform provides the lowest TCA over 3 years***

Light workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 4 core "older" Intel**

Online banking workloads, each driving **22** transactions per second with moderate I/O

47 workloads per Intel blade

Virtualized on Intel
16 core HX5 Blade
**$8,165** per workload

28 workload per POWER7 blade

**Fast low cost threads**

PowerVM on PS701
8 core POWER7 Blade
**$7,738** per workload

**Best Fit**

155 workloads per 32-way z/VM

z/VM on z196 CPC
32 IFLs

**$21,192** per workload

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

# Deploying Stand Alone Workloads With Heavy I/O Requirements

***Benchmark to determine which platform provides the lowest TCA over 3 years***

Heavy I/O workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 4 core "Older" Intel**

Online banking workloads, each driving **22** transactions per second, with **1 MB I/O per transaction**

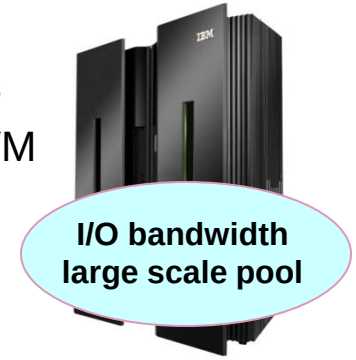
1 workload per Intel blade

Virtualized on Intel
16 core HX5 Blade
**$400,109** per workload

1 workload per POWER7 blade

PowerVM on PS701
8 core POWER7 Blade
**$216,658** per workload

40 workloads per 32-way z/VM




z/VM on z196 CPC
32 IFLs
**$82,119** per workload
**Best Fit**

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

# Benchmarks Show System z And z/OS Are Optimized For Batch Processing

| Intel x3550 | Power PS701 | Linux on z | z/OS |
|---|---|---|---|
| 12 processors 128 GB RAM DS8300  | 8 processors 128 GB RAM DS8300  | 8 processors 128 GB RAM DS8800  | 8 processors 128 GB RAM DS8800  |
| Sorting Average CPU 89% | Sorting Average CPU 92% | Sorting Average CPU 90% | Sorting Average CPU 72% |
| **SORT** *Job: Sort a 3 GB transaction file – Repetitions: 300* | | | |
| Total Time (secs) | 7,680 | 6,900 | 2,590 | 644 |
| Concurrency | 12 | 20 | 18 | 45 |
| Rate (MB/sec) | 240 | 280 | 746.2 | 3,000 |
| **MERGE** *Job: Merge 30 sorted files into a 90 GB master file – Repetitions: 10* | | | |
| Total Time (secs) | 11,709 | 7,920 | 2,799 | 558 |
| Concurrency | 10 | 10 | 10 | 10 |
| Rate (MB/sec) | 157 | 244 | 690.5 | 3,460 |

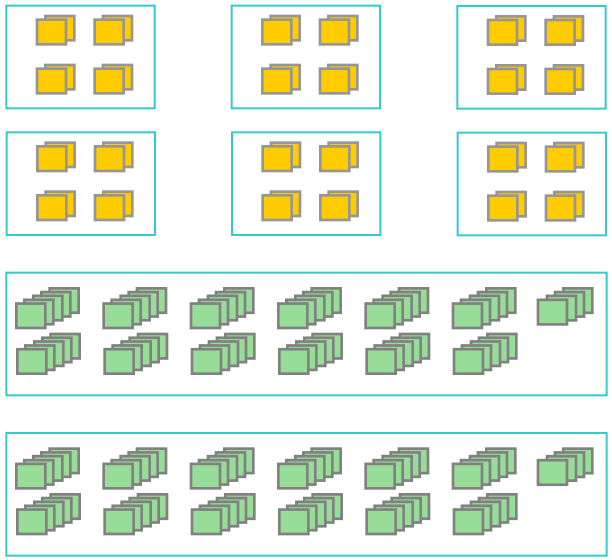
## Results:

1. **Running same software, x86 batch window is 3.6x greater than System z**
2. **On System z, Linux batch window is 4.5x greater than z/OS**
3. **Off-loading batch from z/OS to x86 leads to as much as 16x increase in batch window**

Source: Internal IBM study

# Core Proliferation for a Mid-sized Offload Project

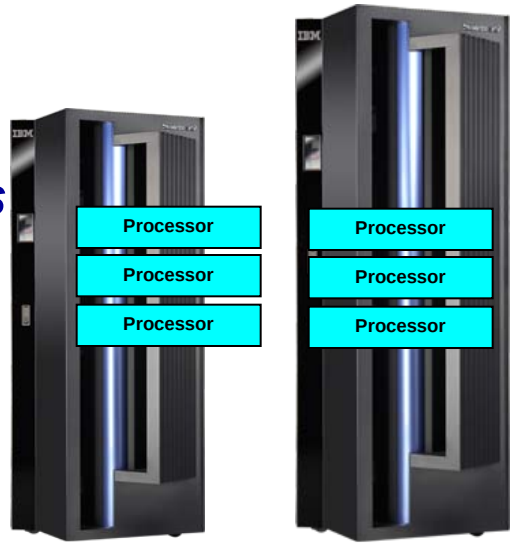
6x 8-way Production / Dev
2x 64-way Production / Dev
Application/MQ/DB2/Dev partitions



**$25.4M TCO (5yr)**

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

***6 processors***
*(1,660 MIPS)*




***176 distributed processors***
*(800,072 Performance units)*

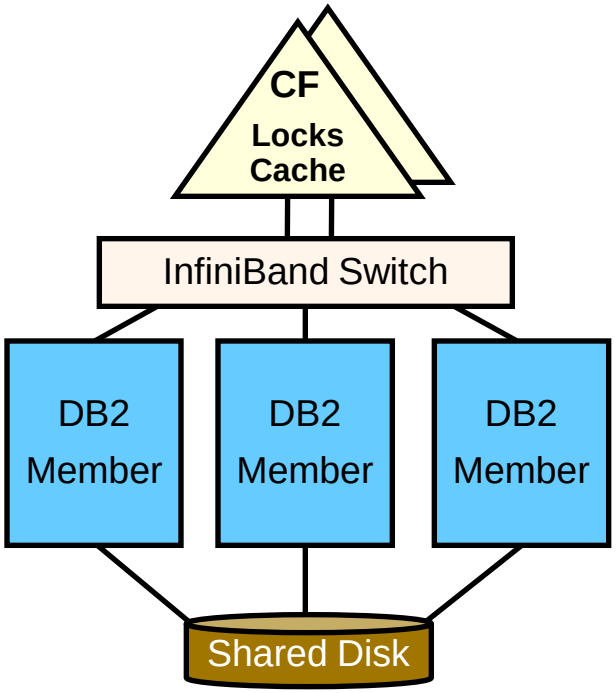
**$17.9M TCO (5yr)**

**482 Performance Units per MIPS**

# Clusters Grow Database Processing Power Beyond Single Server Solutions

## DB2 for z/OS

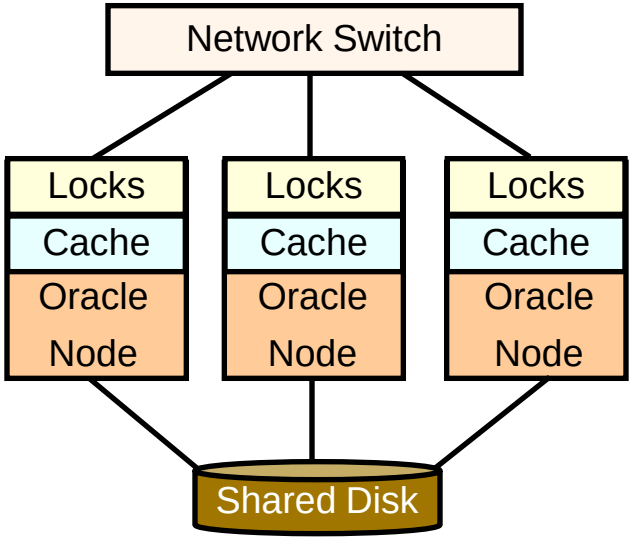
Centralized Coupling Facility Design




Efficient lock and buffer management achieve near linear scalability

## Oracle RAC

Distributed Design




Inefficient distributed locking and buffer management limits scaling

# ISAS 9700 + IDAA Delivers

*5X Performance At 25% The Unit Cost*

## Competitor

**Quarter Rack**

**Unit Cost** (3yr TCA)
**$97/RpH**

| | |
|---|---|
| RpH (Reports/Hour) | 29,572 |
| Exadata V2 (HW+SW+Storage) | $2.9M |

## ISAS 9700

DB2 (ISAS 9700)

12 GP+12 zIIP

**Unit Cost** (3yr TCA)
**$62/RpH**

| | |
|---|---|
| RpH (Reports/Hour) | 57,904 |
| ISAS 9700 (HW+SW+Storage) | $3.6M |

## ISAS 9700 + IDAA

DB2 (ISAS 9700)

z/OS 5 GP+5 zIIP

Netezza TwinFin 12

**Unit Cost** (3yr TCA)
**$24/RpH**

| | |
|---|---|
| RpH (Reports/Hour) | 154,893 |
| ISAS 9700 10-cores (HW+SW+Storage) | $1.5M |
| NZ TF12 (HW+SW+Storage) | $2.1M |

Source: IBM Competitive Project Office
Customer Study running 161,166 concurrent operational reports.
Results will vary based on customer workload profiles/characteristics.

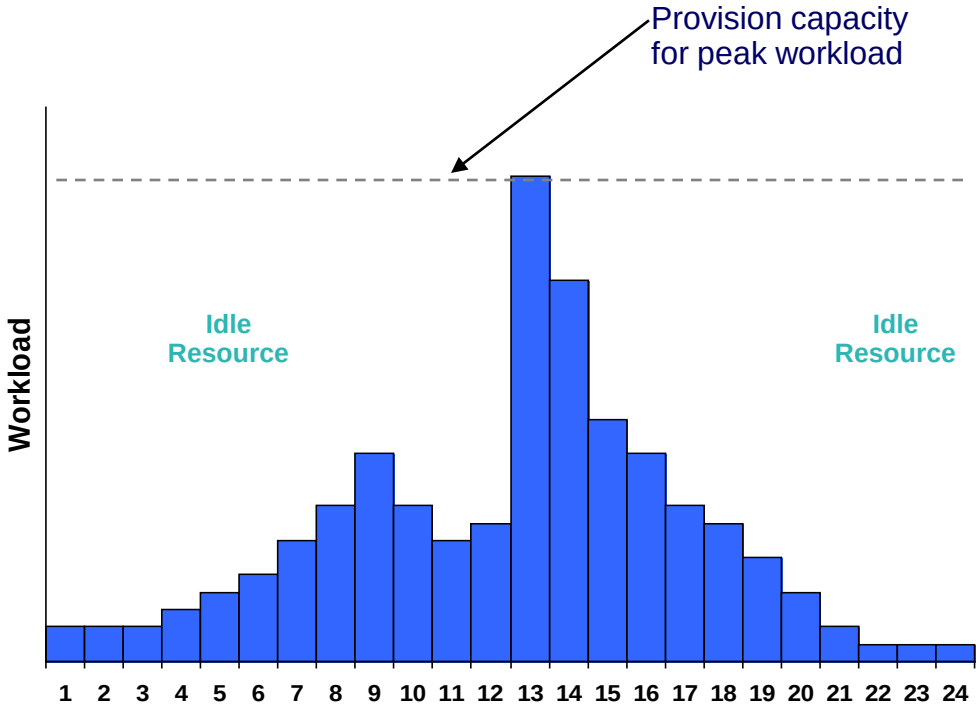
# Utilization of Distributed Servers & Storage

Typical utilization of:

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

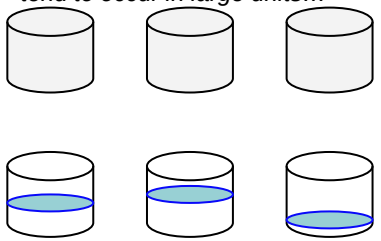
Server dedicated to one application

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

*Application specific storage allocations tend to occur in large units…*



*resulting typically in single digit utilization*

# 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**

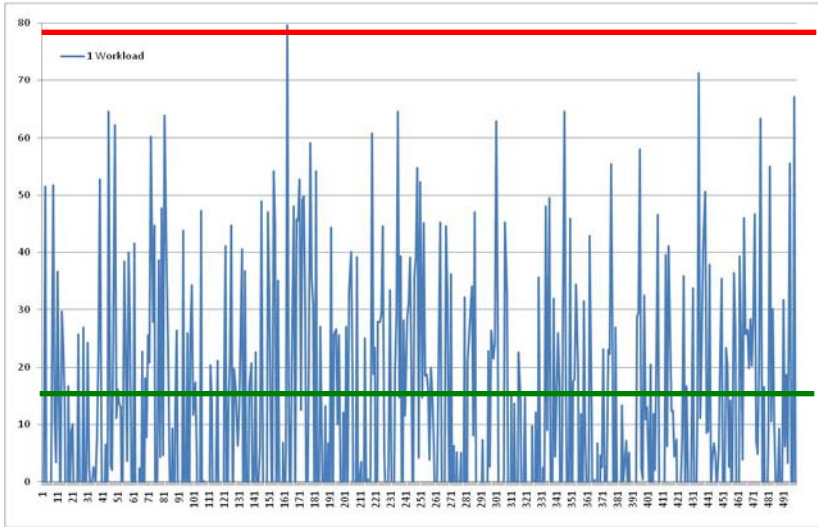
**Legacy workloads on XEON 2.5-2.8GHz Servers**

Normal probability distribution

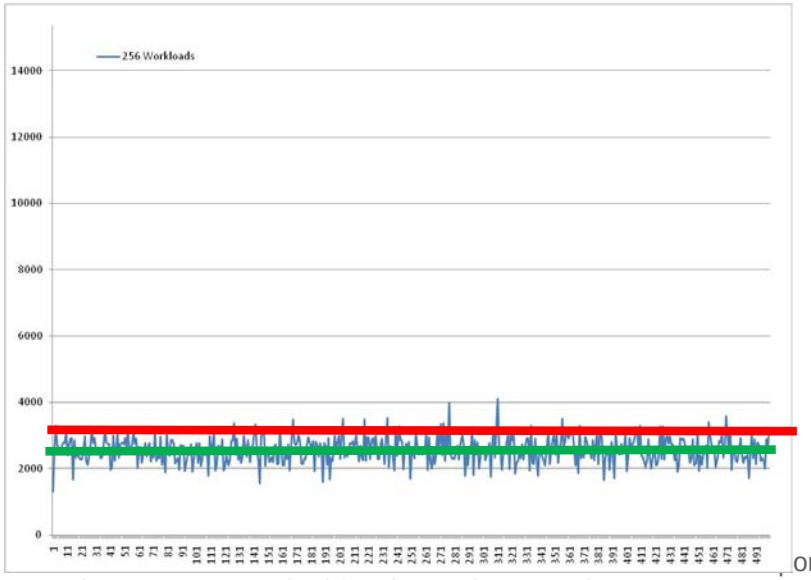
# New Workload Scenarios – Beware Benchmarks

- **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

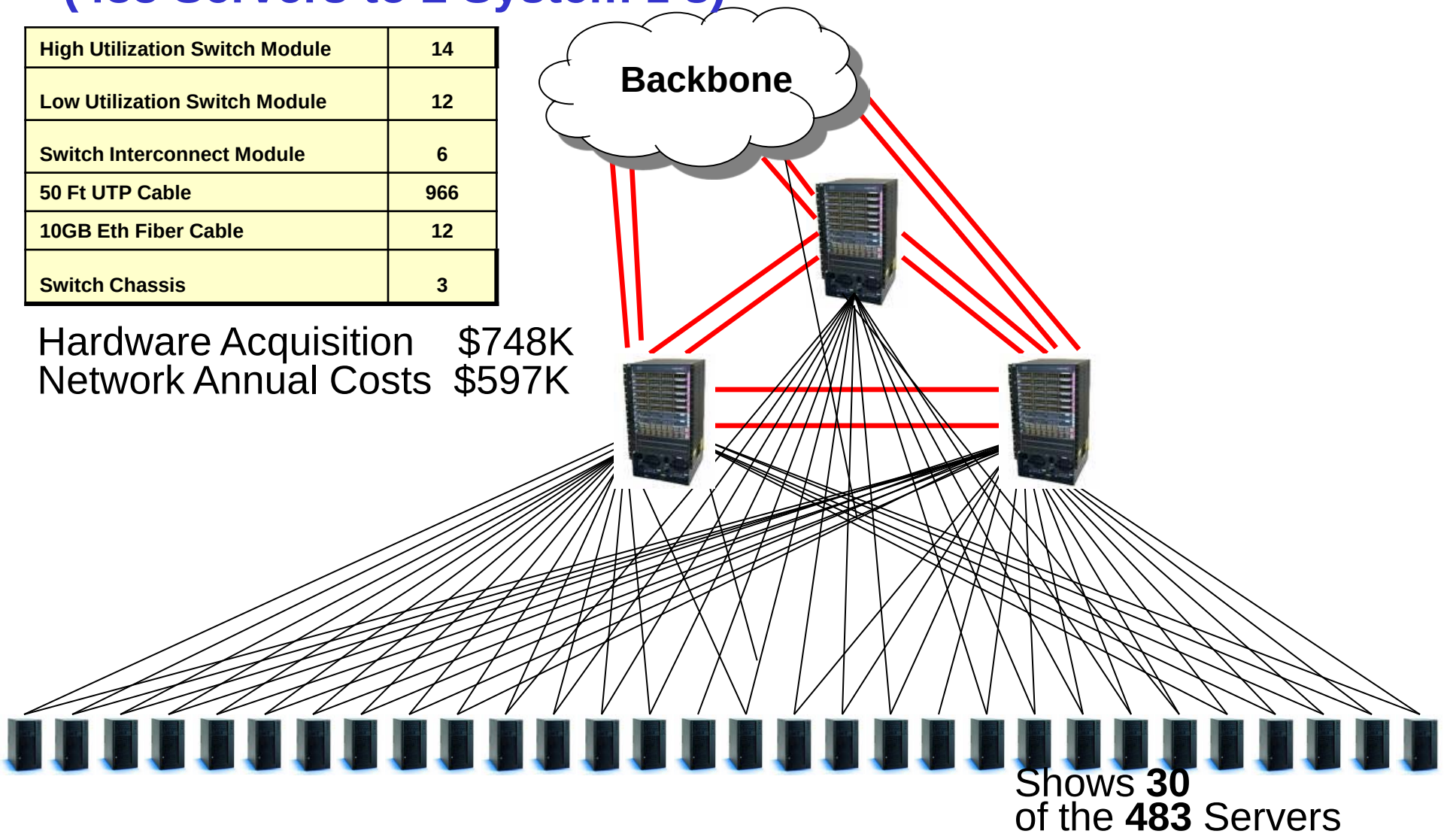



* If we add one more workload to a pool of 256 consolidated workloads the computing resource required for the pool goes up by 1.00047 * Mean

# 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

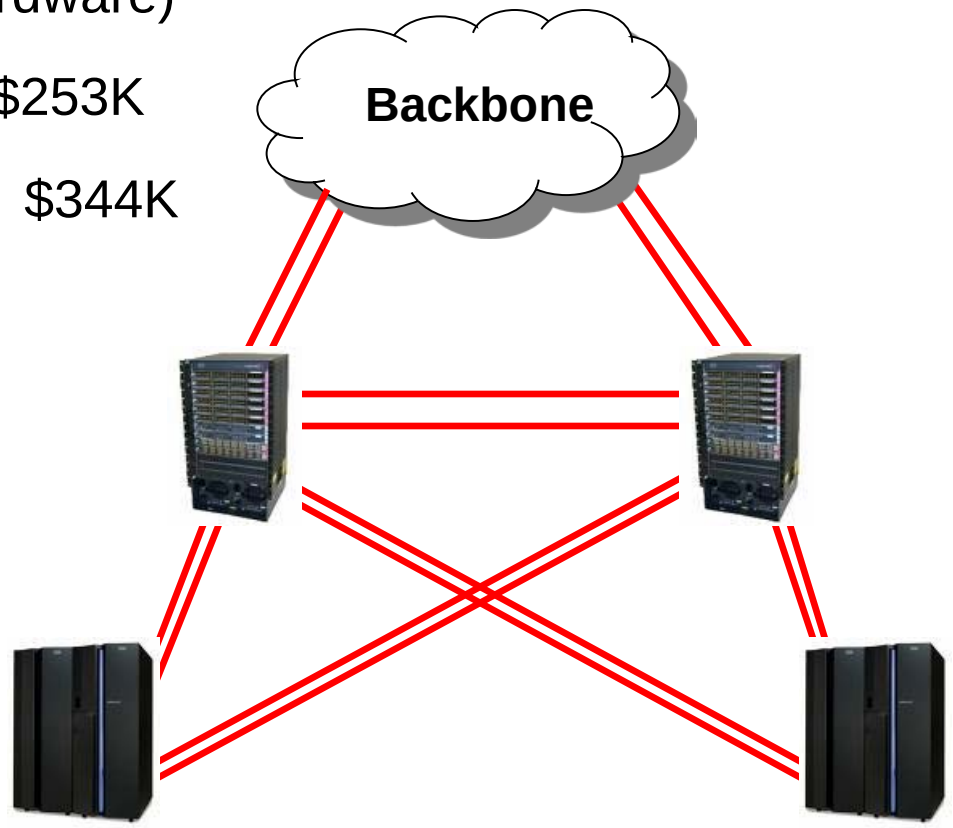


# Case Study: Network Costs – After Consolidation (483 Servers to 2 System z's)

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

After Network Annual Cost $253K

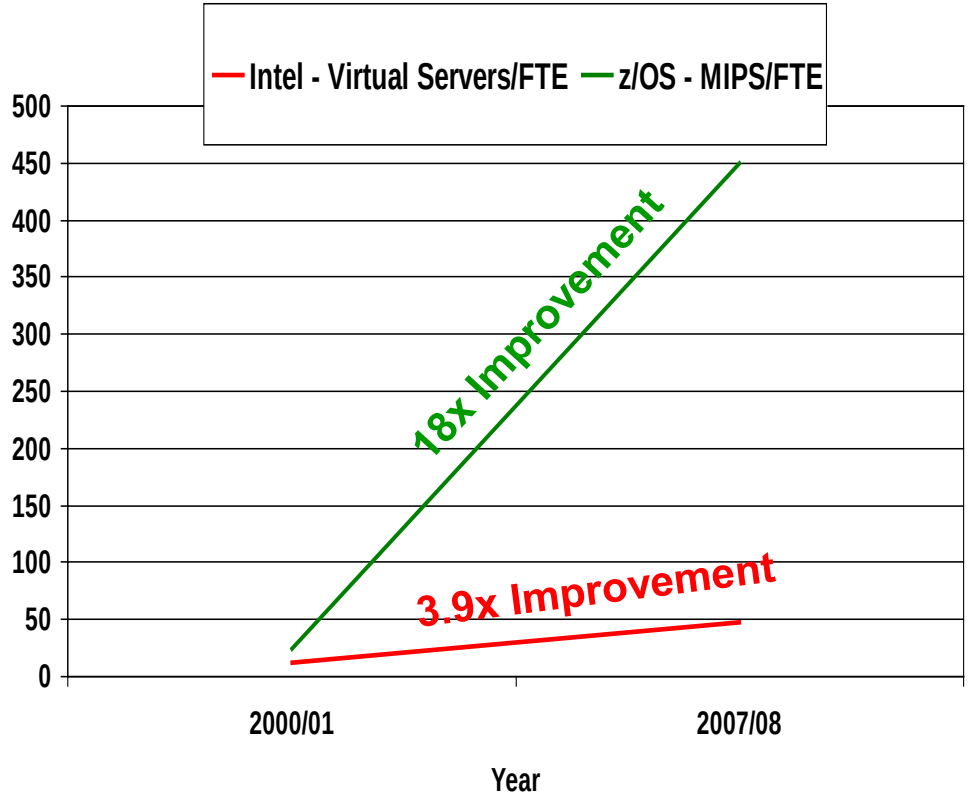
Network Annual Cost Savings $344K



# Why Does Core Proliferation Happen?

- **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
  - As a result, full DR is rarely implemented
- **Processing comparisons**
  - Language expansion (CICS/COBOL path lengths are highly optimized)
  - Networking drives up cycles spent on protocols
  - Mainframe has dedicated processors for I/O operations, distributed does not
  - Converting classic file systems to relational results in up to 3x expansion
  - Zero network traffic on mainframe reduces computation (and latency)

# 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

# Accumulated Field Data For Labor Costs

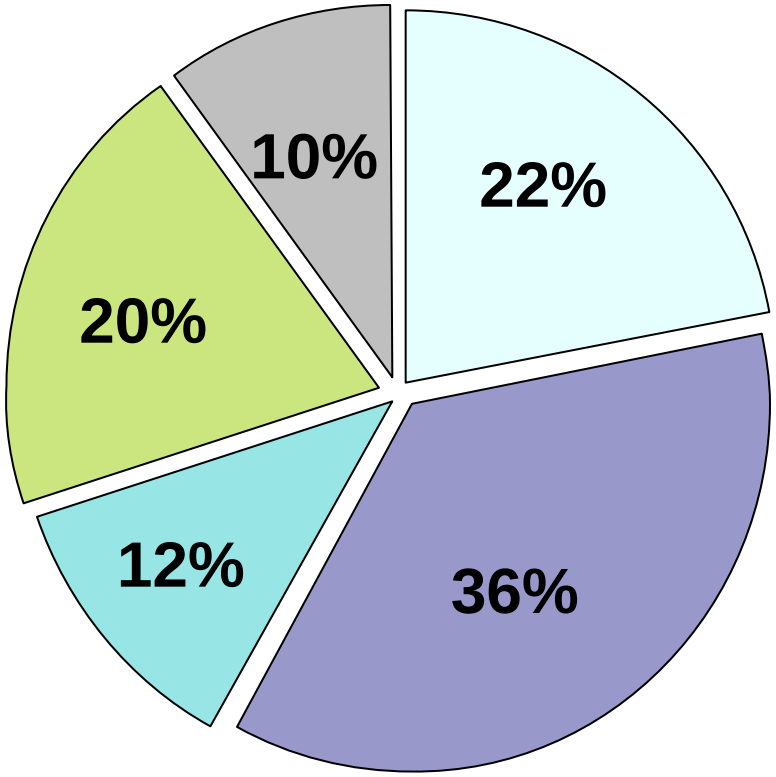
- **Average of quoted infrastructure labor costs**
  - **30.7** servers per FTE (dedicated Intel servers)
    - **67.8** hours per year per server for hardware and software tasks
  - **52.5** Virtual Machines per FTE (virtualized Intel servers)
    - **39.6** hours per year per Virtual Machine for software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

# Five Key IT Processes For Infrastructure Administration

## Time spent on each activity

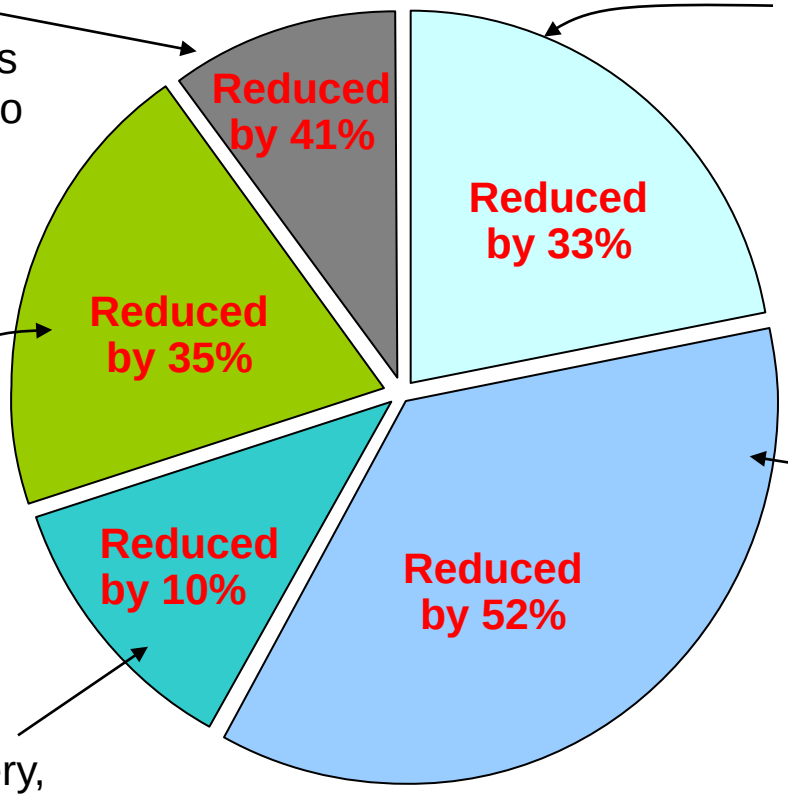



- **Deployment Management**
  - *Hardware set-up and software deployment*
- **Incident/Capacity Management**
  - *Monitor and respond automatically*
- **Asset Management**
  - *Hardware and software asset tracking*
- **Security Management**
  - *Access control*
- **Change Management**
  - *Hardware and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

Allocation based on customer data from IBM study

# zManager 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

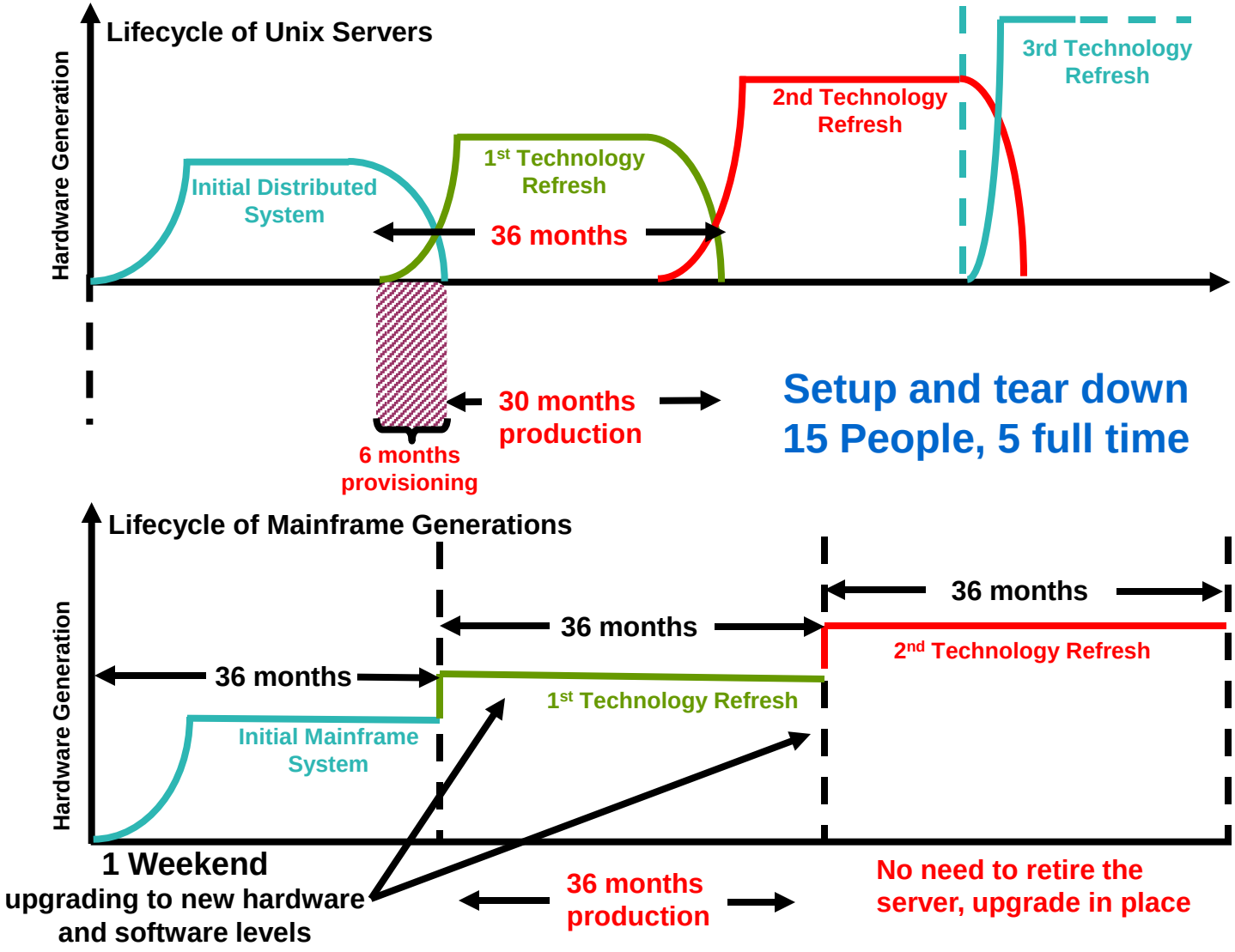
**Deployment Management**
Automatic setup and configuration of the hypervisor and out-of-the-box networks

**Security Management**
Centralized fine-grain administrator access control

**Incident/Capacity Management**
Automation to isolate and fix issues

**Asset Management**
Automated discovery, entitlement management

# New York Financial Services Company – Useful Lifetime Of 36 Month Lease




Observed at a large financial service customer

In each 36 month lease there are only 30 months production use

Setup and tear-down time costs 25% more. Plus . . . 41 hours of FTE setup and tear down labor per server = $3,075

Weekend upgrades performed by IBM

Capacity on demand pricing

# 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 | | |

# Case Study – Consolidate 880 Standalone Workloads And Integrate 44 Hybrid Workloads On zEnterprise

- **Standalone distributed workload profile is a mix of**
  - **784 light**
  - **56 heavy CPU**
  - **40 heavy I/O**
- **Hybrid workload profile is a mix of**
  - **24 Web front-end workloads to CICS on z/OS**
  - **20 SAP application workloads with DB2 on z/OS**
- **What is the most cost effective way to consolidate/deploy all these workloads?**

**Sun Fire X4170**

**zEnterprise**

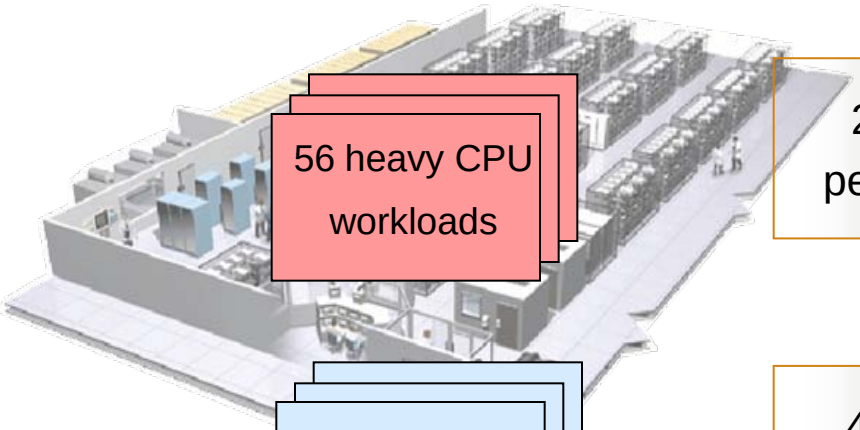
# What Is Best Fit For 880 Standalone Workloads On zEnterprise?

784 light workloads

28 workloads per POWER7 blade

**28**

IBM POWER7 blades




2 workloads per HX5 blade

**28**

IBM HX5 Blades

40 heavy I/O workloads

40 workloads per 32 IFLs

**1**

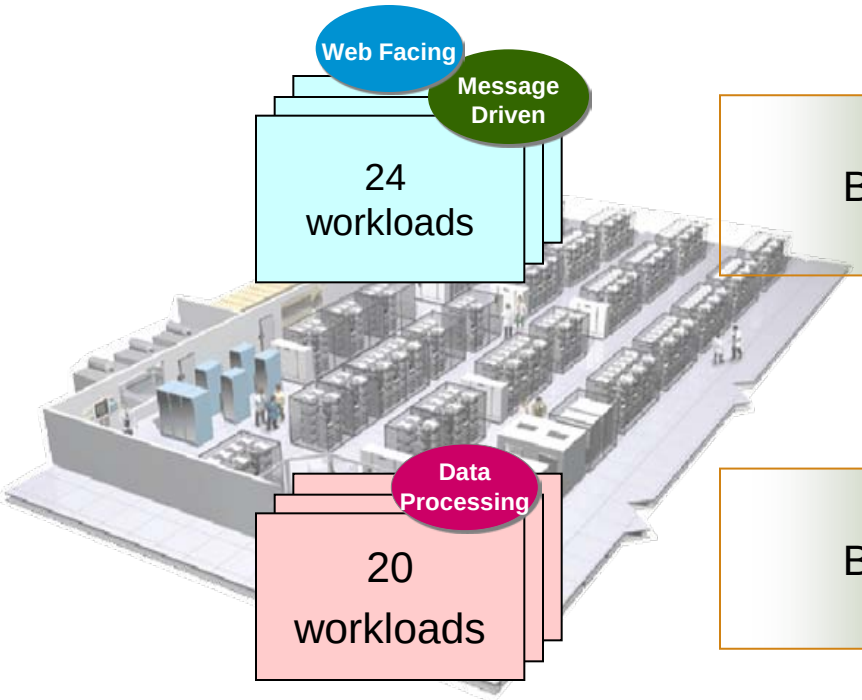
z196 CPC

32 IFLs

Best fit assignments

Server configurations are based on consolidation ratios derived from IBM internal studies. Projected Sun Fire X4470 2.0GHz 2ch/16co from x3550 2.66GHz 2ch/12co measurements. Prices are in US currency, prices will vary by country

# What Is Best Fit For 44 Hybrid Workloads On zEnterprise?




Best Fit

Best Fit

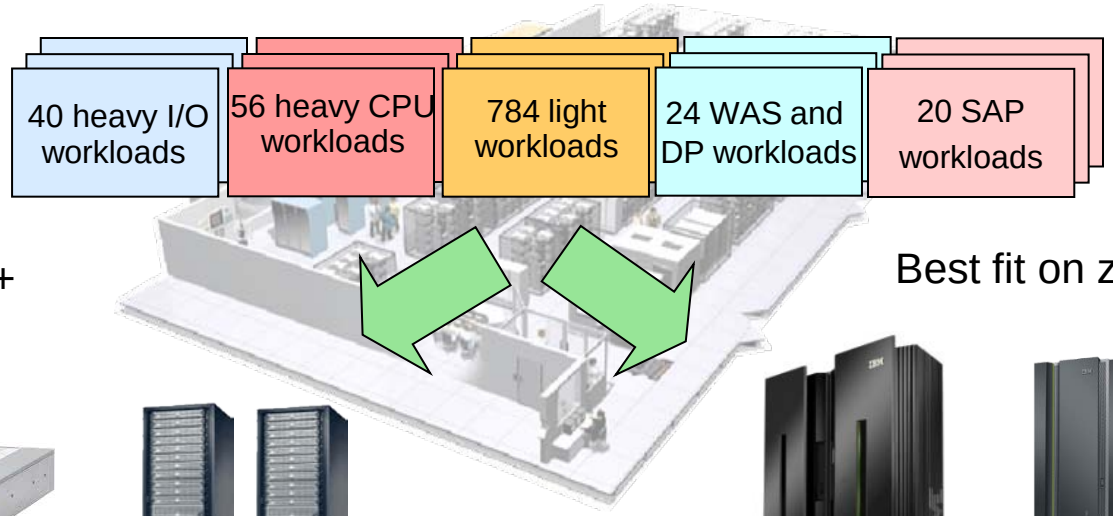
**24** IBM POWER7 blades

**2** DataPower XI50z blades

**23** IBM POWER7 blades

CICS and DB2 components are Best Fit on z/OS

# Compare Server Hardware And Software Cost Of Acquisition




Deployed on Sun + HP servers

**123 Sun Fire X4170**

1476 cores

**183 servers**

**2,060 cores**

**$46.0M** **Total**

**3yr TCA HW+SW**



**24 Sun Fire X4170**

**34 Sun T4-1**

560 cores

**2 DL380**

24 cores

Best fit on zEnterprise



**z196**

32 IFLs

**106 servers**
**1,080 cores**

**$26.1M** **Total**

**3yr TCA HW+SW**

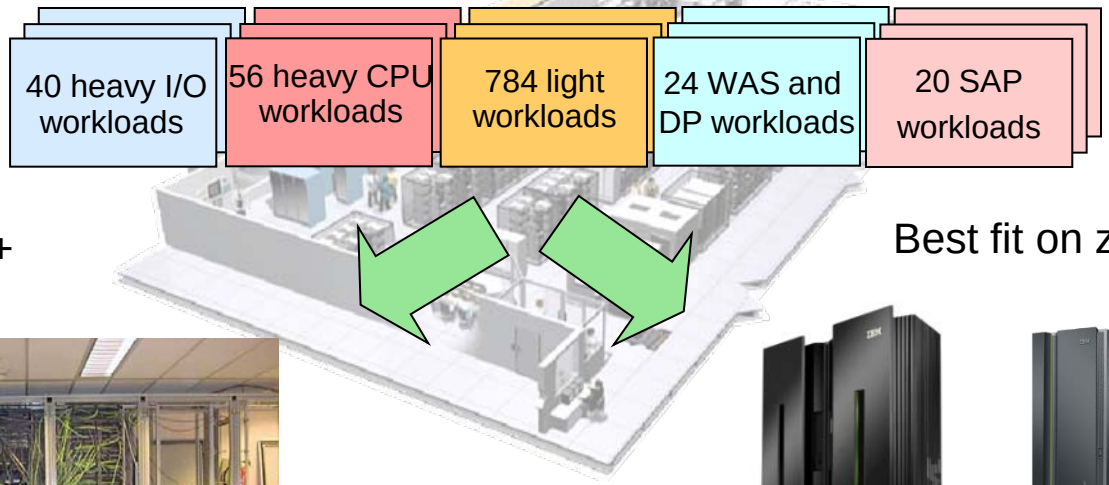
**105 Blades**

1,048 cores

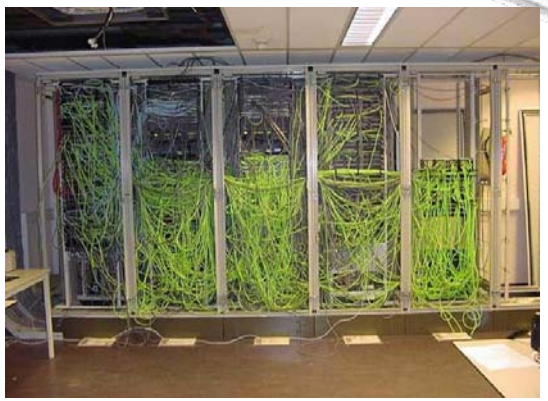
**43% less**

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

# Compare Network Cost Of Acquisition




Deployed on Sun + HP servers



Additional network parts

37 switches

814 cables

740 adapters

**1,591** total network parts

**$0.45M** **Total**

Best fit on zEnterprise

Additional network parts

1 switch

10 cables

10 adapters

**21** total network parts

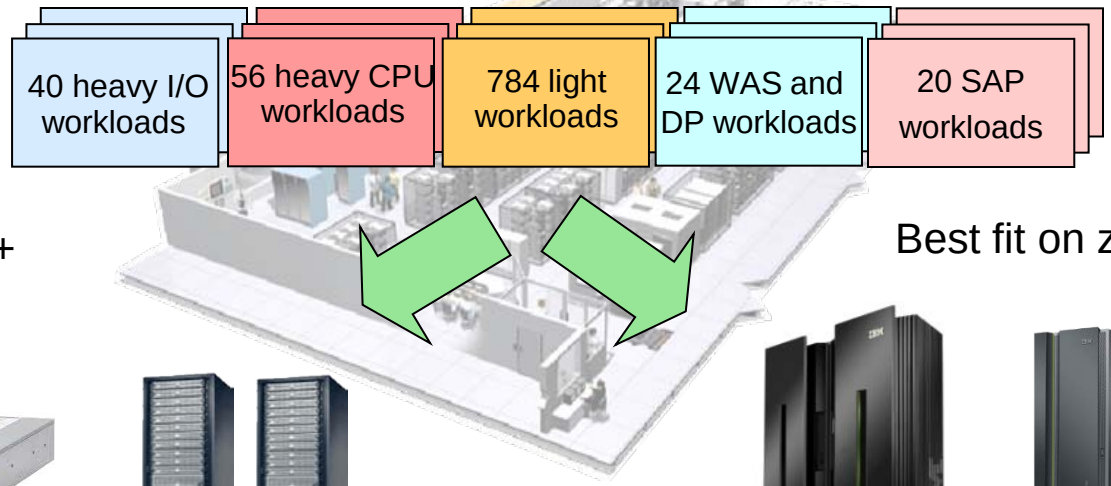
**$0.03M** **Total**

**94% less**

Network configuration is based on IBM internal studies.

Prices are in US currency, prices will vary by country

# Compare Power Consumption




Deployed on Sun + HP servers

183 servers

**124.1 kW**

**$0.33M** **Total**

3 years
@ $0.10 per kWh

Best fit on zEnterprise

106 servers

**53.4 kW**

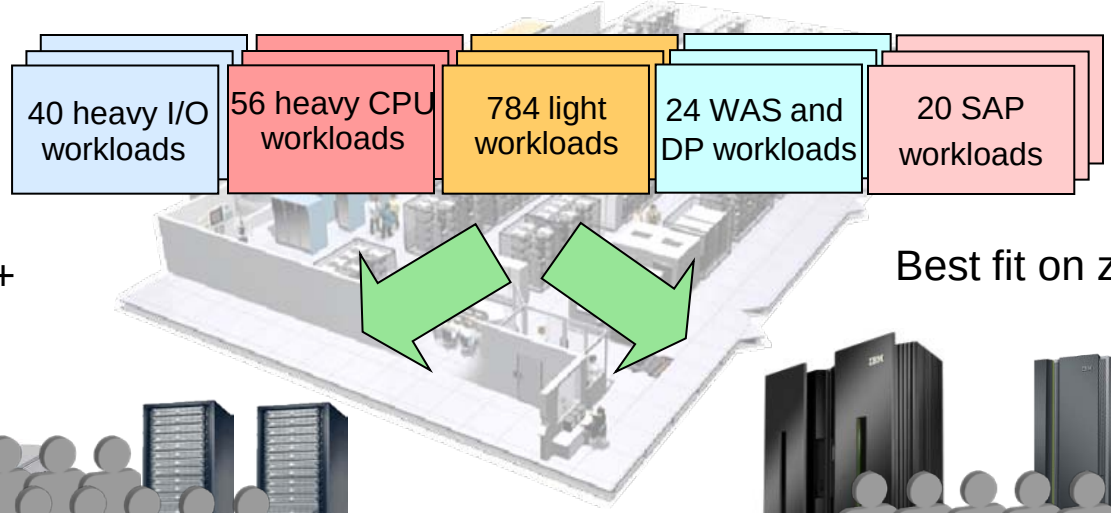
**$0.14M** **Total**

3 years
@ $0.10 per kWh

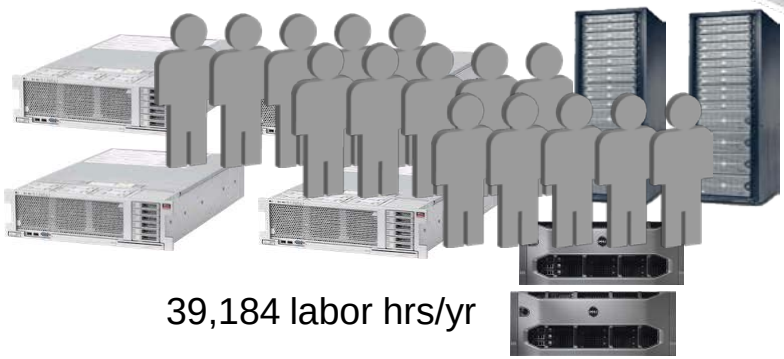
**57% less**

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

# Compare Server Infrastructure Labor Costs




Deployed on Sun + HP servers



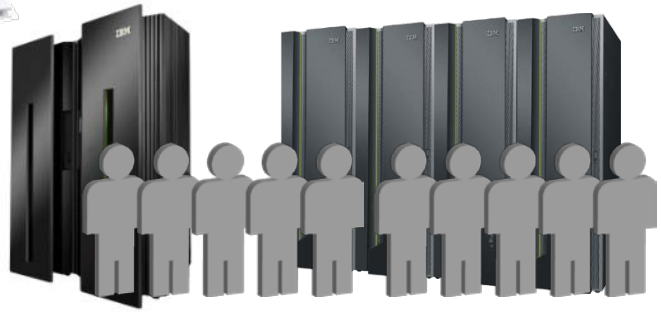
39,184 labor hrs/yr

**18.83** administrators

**$9.02M** **Total**

3 years
@ $159,600/yr

Best fit on zEnterprise



26,441 labor hrs/yr

**12.71** administrators

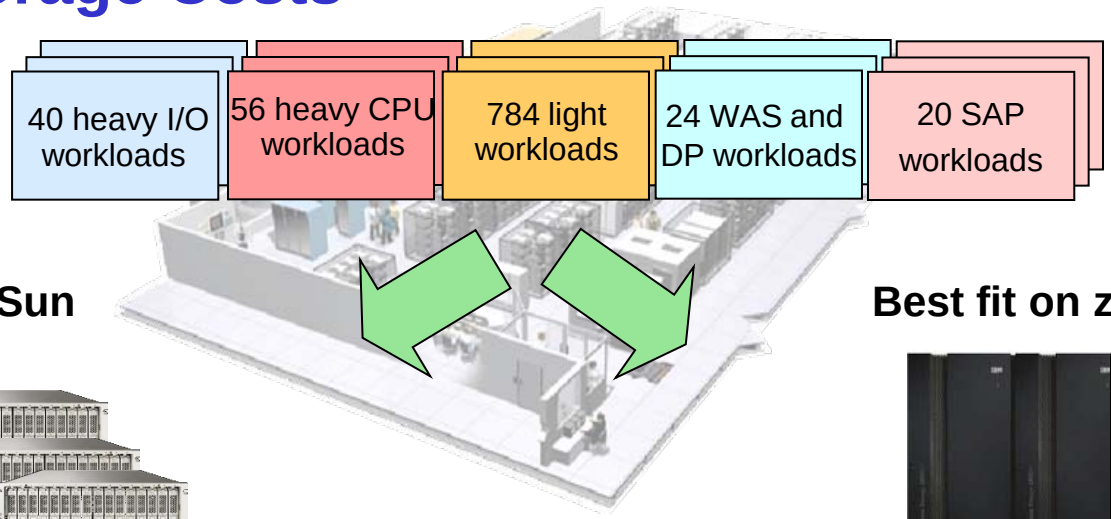
**$6.09M** **Total**

3 years
@ $159,600/yr

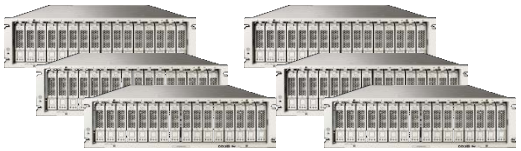
**32% less**

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

# Compare Storage Costs




## Deployed on Sun



Sun Storage 6180 Array  Sun F5100 Storage Flash Array

**232.8TB** embedded storage
36.57% utilization
70 points of admin

**$8.58M** TCO(3 years)

## Best fit on zEnterprise

Incremental add on DS8800

**143.04TB** provisioned storage
59.52% utilization
1 points of admin

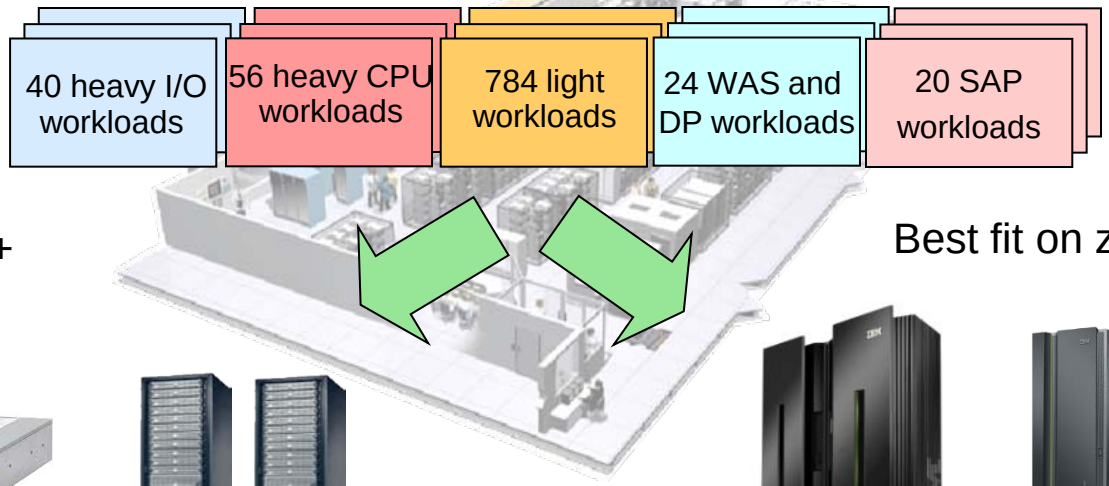
**$4.6M** TCO (3 years)

**45% less**

75GB/240GB active storage required per workload

Storage configuration is based on IBM internal studies.
Prices are in US currency, prices will vary by country

# Compare Total Cost Of Ownership




Deployed on Sun + HP servers

**183 servers**

**2,060 cores**

**$64.38M Total**

**or $70K per workload**

**3yr TCO**

Best fit on zEnterprise

106 servers

1,080 cores

**$36.96M Total**

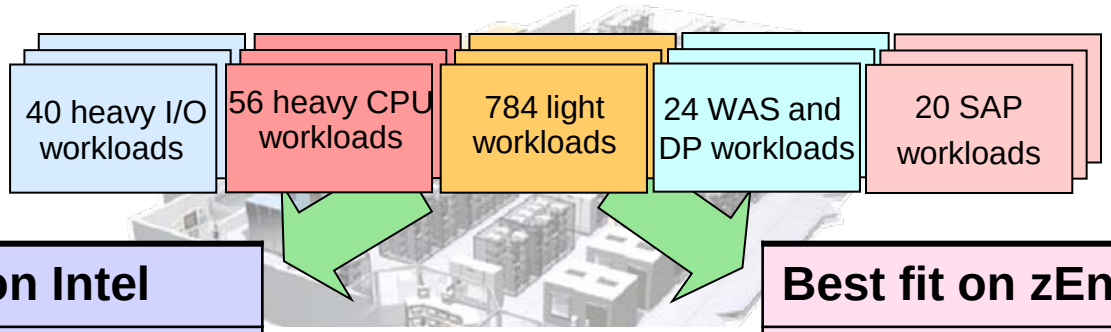
**or $40K per workload**

**3yr TCO**

**43% less**

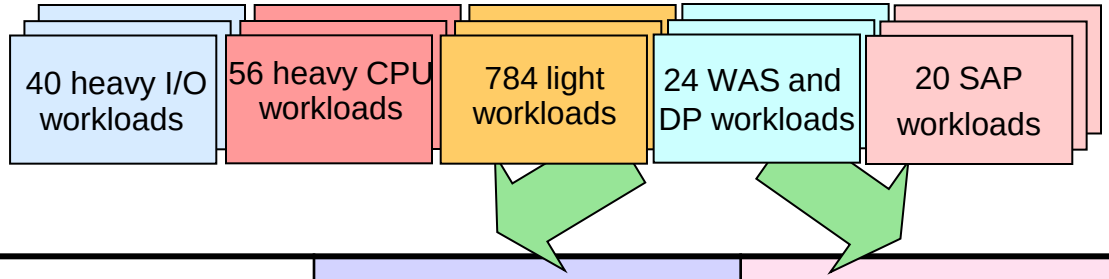
Server configurations are based on consolidation ratios derived from IBM internal studies. Prices are in US currency, prices will vary by country

# Fewer Parts to Assemble and Manage




| Deployed on Intel | | Best fit on zEnterprise |
|---|---|---|
| 183 | Servers | 1 z196 + 1 zBX (with 105 blades total) |
| 1592 | Network (parts) | 21 |
| 124 | Power (KW) | 53 |
| 19 | Administrators | 13 |
| 70 | Storage points | 1 |

# The Savings Are Cumulative



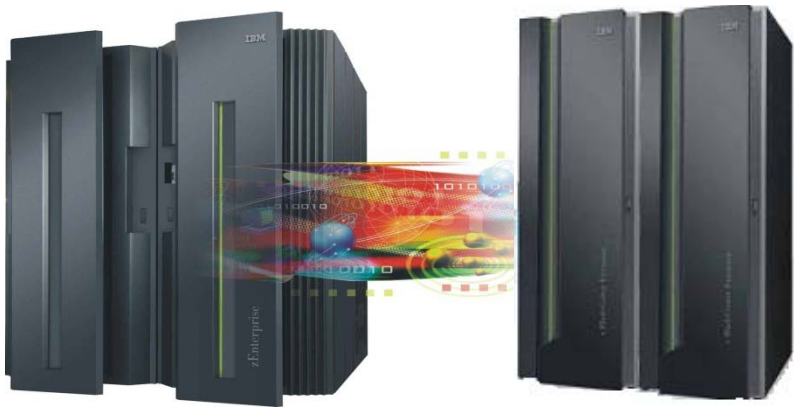

| Three Year Cost Of | Deployed on Intel | Best fit on zEnterprise |
|---|---|---|
| Servers | $46.0M | $26.1M |
| Network | $0.45M | $0.03M |
| Power | $0.33M | $0.14M |
| Labor | $9.02M | $6.09M |
| Storage | $8.58M | $4.6M |
| **Total** | **$64.38M** | **$36.96M** |
| **Total cost per workload** | **$70K** | **$40K** |

**43% less**

Results may vary based on customer workload profiles/characteristics. Prices are in US currency. Prices will vary by country

# Summary

- **Cost per workload is the key metric for the new IT economics**
  - Mainframe cost per work goes down as workload increases



- **Fit for purpose reduces cost of acquisition per workload**

- **zEnterprise's integrated management reduces cost per workload with extreme automation for simplicity**

# Thank you

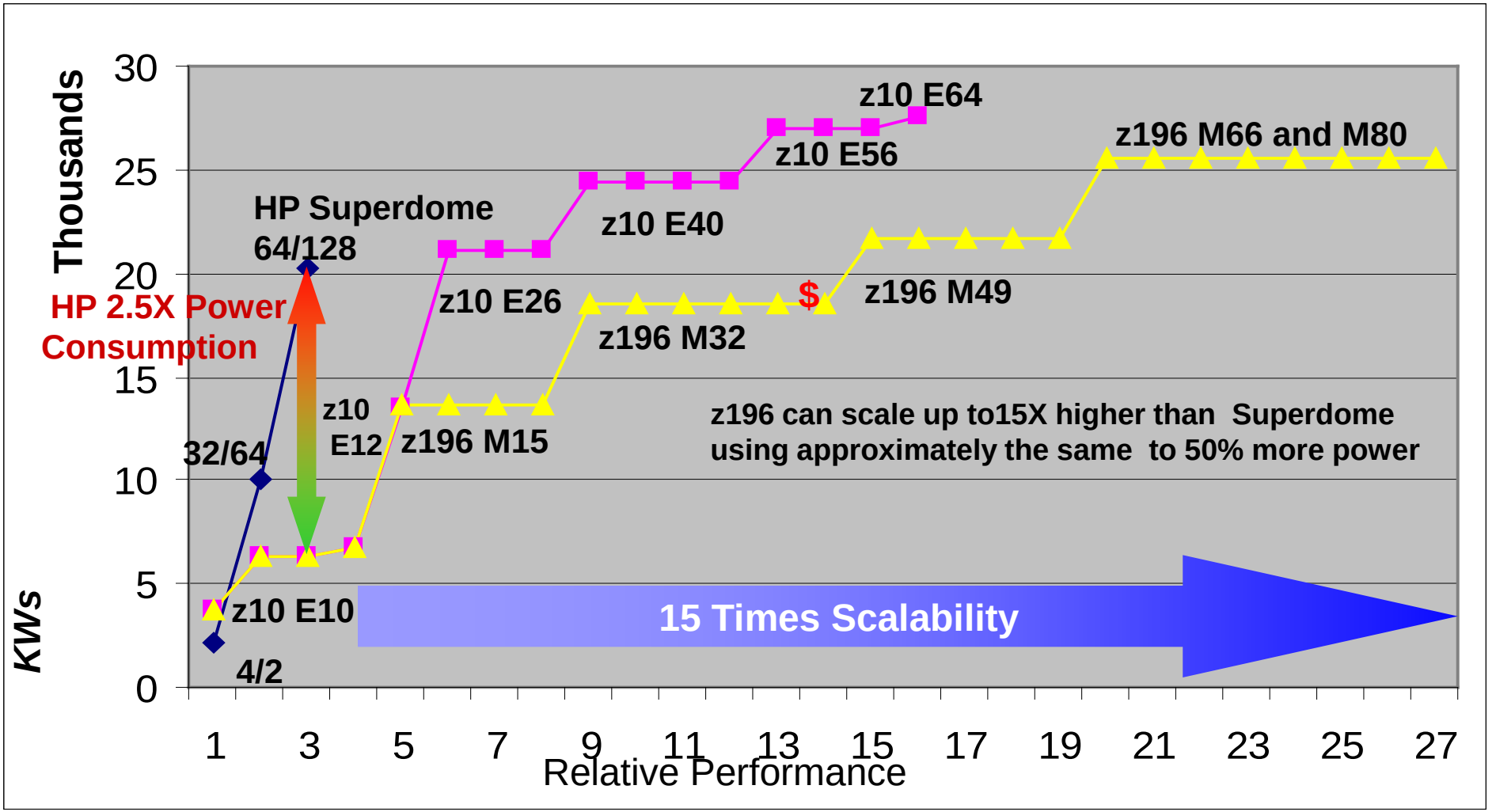
# Surveys Confirm Mainframes Are Lowest Cost For Core Business Workloads

| Industry | Measure | Average IT Cost of Goods | Mainframe Biased | Server Biased | % Improvement |
|---|---|---|---|---|---|
| Bank | Per Teller Transaction | $0.31 | $0.12 | $0.35 | -66% |
| Mortgage | Per Approved Loan | $263.67 | $98.38 | $290.80 | -66% |
| Credit Card | Per Transaction | $0.16 | $0.10 | $0.18 | -44% |
| Railroads | Per Ton Mile | $0.0014 | $0.0012 | $0.0018 | -33% |
| Armed Service | Per Person | $8,036 | $6,871 | $9,839 | -30% |
| Automotive | Per Vehicle | $333 | $275 | $370 | -26% |
| Retail | Per Store (Door) | $494,818 | $421,346 | $560,300 | -25% |
| Utilities | Per MegaWatt Hour | $2.63 | $2.21 | $2.94 | -25% |
| Hospitals | Per Bed per Day | $64.30 | $54.4 | $71.7 | -24% |
| Oil & Gas | Per Barrel of Oil | $2.10 | $1.78 | $2.32 | -23% |
| Consulting | Per Consultant | $53,060 | $48,900 | $62,344 | -22% |
| Trucking | Per Road Mile | $0.177 | $0.155 | $0.194 | -20% |
| Airlines | Per Passenger Mile | $0.007 | $0.0061 | $0.0076 | -20% |
| Chemicals | Per Patent | $57,717 | $55,800 | $59,552 | -6% |
| Web Sites | Per Search | $0.042 | $0.046 | $0.041 | 12% |

**Most businesses running core workloads on mainframes had 6% to 66% lower IT costs per good than those using distributed servers**

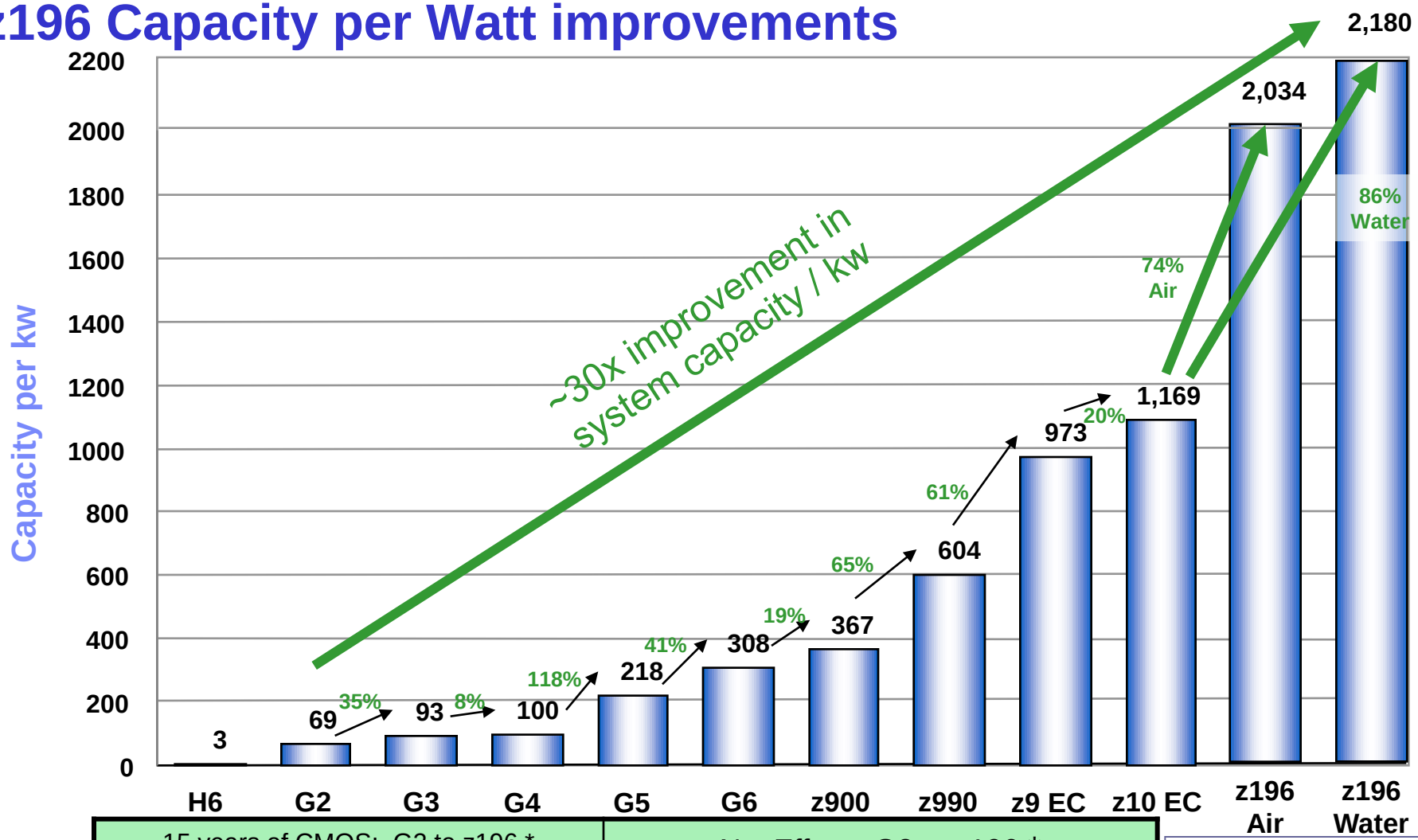
From Rubin Worldwide analysis of customer data and Gartner Research IT costs

# Mainframe Scales 2.5 to 15X Superdome More Performance / Watt




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.

# z196 Capacity per Watt improvements

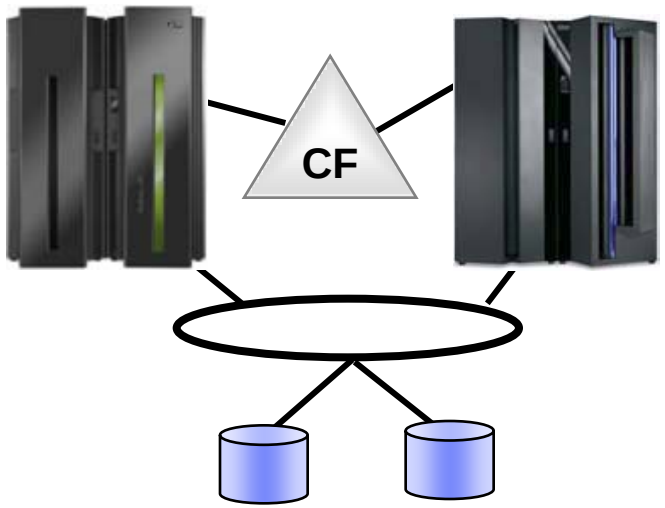



| 15 years of CMOS: G2 to z196 * | | Net Effect: G2 to z196 * | |
|---|---|---|---|
| **Power Increase:** | 17% **per year** | **Performance increased by:** | 300x |
| **Performance increase:** | 46% **per year** | Performance / kWatt increased by: | 30x |
| **Power density** | 13% **per year** | **Performance / sq ft increased by:** | 190x |

Note: Capacity/kWatt assumes hot room, max plugged I/O power, max memory power and all engines turned on. Real world max capacity system is about 3/4 of this.

# z/OS Sysplex - Optimized For Efficient Clustering

- **Specialized hardware - Coupling Facility**
  - Dedicated processor with specialized microcode to coordinate shared resources
  - High speed inter-connect to clustered systems
  - Hardware invalidation of local cache copies
  - Special machine instructions
- **Exploited by IMS, CICS, DB2, MQ, and other middleware on z/OS for transaction processing scale**




**Data Sharing**

A single 80-way zEnterprise delivers 52,286 transaction processing MIPs. Up to 32 of these can be clustered in a parallel sysplex, delivering ultimate scalability and availability.