IBM

The Modern Mainframe…
At the Heart of Your Business

Delivering Next Generation Solutions at the Lowest Cost

Key Points – Distributed Costs

■ The cost of running additional workload on distributed servers goes up linearly

▶ Labor is now the highest cost element in distributed environments
▶ Administrative staff costs increase in proportion to the number of servers
▶ New workload requires additional servers
▶ Cost of additional servers is linear
▶ Cost of software licenses is linear
▶ Electrical and air conditioning costs also increasing

■ **Result – scale out strategies do not reduce the cost per unit of work as the workload grows**

Owing to the nature of individual contracts, some details of this pricing discussion may be at variance with specific instances
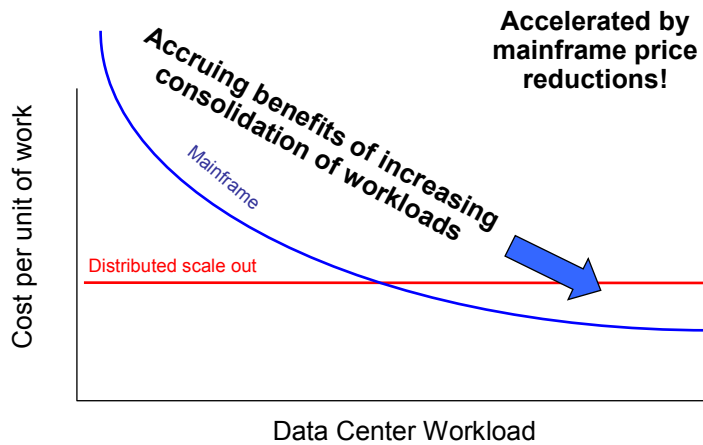
Key Points – Mainframe Costs

■ The cost of running incremental workload on the mainframe goes down as the total workload grows

▶ Labor costs hold steady as workload grows
▶ IBM pricing policies designed to favor the addition of more workload
▶ Special hardware pricing for new workload types
▶ Lower software costs per transaction as workload grows
▶ Lower electrical and air conditioning consumption than server farms
▶ Trade-in value is recoverable for growth customers

■ **Customers have learned that mainframes running high workloads are the most cost efficient platform**

Owing to the nature of individual contracts, some details of this pricing discussion may be at variance with specific instances

Mainframe Cost Per Unit of Work Goes Down as Workload Increases

Accrued benefits of increasing consolidation of workloads

Accelerated by mainframe price reductions!

Mainframe

Distributed scale out

Cost per unit of work

Data Center Workload

Let's Break Down the Elements of Cost

Total Cost of Acquisition =
Cost of hardware +
Cost of software +

Mainframe Hardware Cost is Decreasing

IBM Hardware price per MIP over time*

Hardware prices are one time charge

Price per MIP in $K

$600
$500
$400
$300
$200
$100
$0

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004

Year

$15
$10
$5
$0

1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
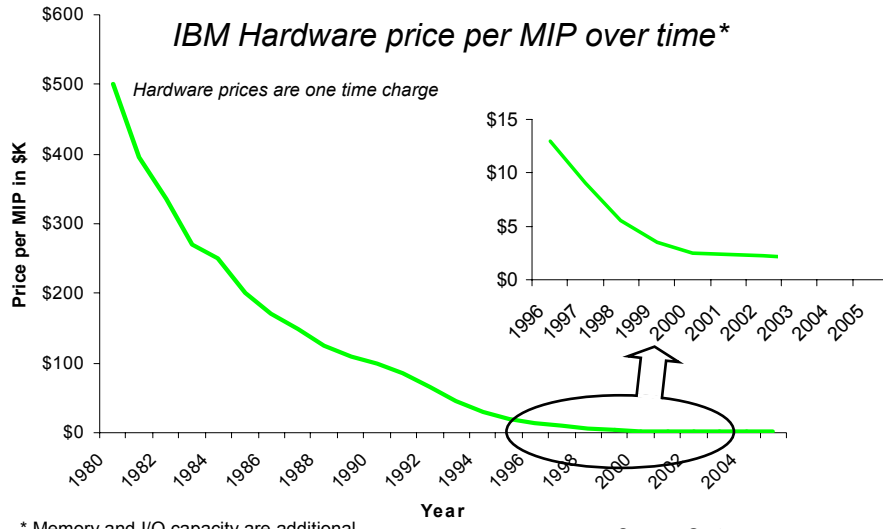
* Memory and I/O capacity are additional feature charges

Source: Gartner

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

9

IBM Software Price Per Transaction is Also Going Down

Software price per transaction

$0.00014
$0.00012
$0.00010
$0.00008
$0.00006
$0.00004
$0.00002
$0.00000

1Q'01 2Q'01 3Q'01 4Q'01 1Q'02 2Q'02 3Q'02 4Q'02 1Q'03 2Q'03 3Q'03 4Q'03 1Q'04 2Q'04 3Q'04 4Q'04 1Q'05 2Q'05 3Q'05 4Q'05
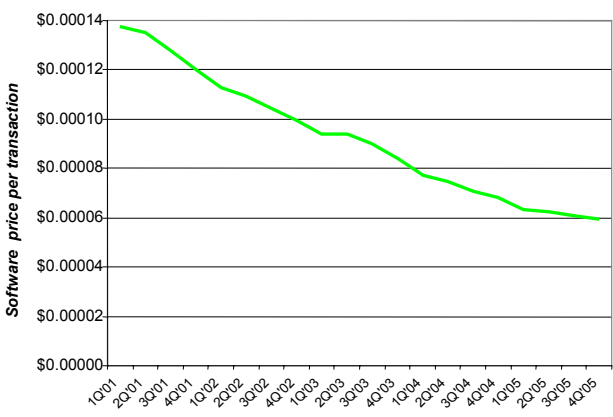
57% decrease in past 60 months

➢ *17% decrease per year*

What makes the price go down?

Pricing curves favor growth

Specialty processors (zAAPs, zIIPs, IFLs)

Technical pricing allowances

— Inflation-adjusted IBM software price per transaction

Source: IBM SWG Finance
Data is WW customer revenue only (not IGS)
Data includes specialty engines
'Highway conditions .. mileage may vary'

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

10

4

## Mainframe Hardware and Software Cost Reduction Features

- Hardware
  - ▶ Capacity on demand processors (free until you use)
  - ▶ Up to 336 I/O offload processors at feature prices
  - ▶ Specialty processors IFL, zIIP, and zAAP discounted 91%
  - ▶ Disaster recovery processors discounted 98%
  - ▶ Growing customers may upgrade installed MIPS without cost
  - ▶ IBM storage subsystems cost less than HP

- Software
  - ▶ MLC per incremental MIP goes down as system gets larger
  - ▶ No charge for software on zIIP and zAAP
  - ▶ One time charges are per processor for IFL (at Intel rate)
  - ▶ Sub-capacity pricing, Sysplex aggregation, technology dividend, zNALC
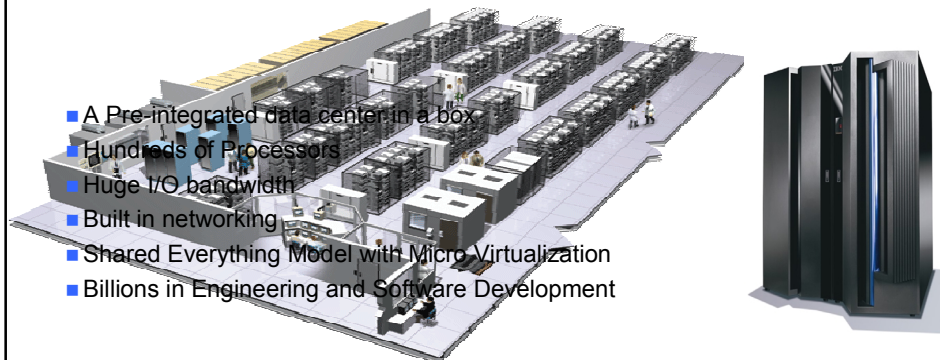
Data Center in a Box

- A Pre-integrated data center in a box
- Hundreds of Processors
- Huge I/O bandwidth
- Built in networking
- Shared Everything Model with Micro Virtualization
- Billions in Engineering and Software Development

- Building your own datacenter is costly and complex
- Install and configure hundreds of devices
- Networking
- Data Silos and Synchronization
- Power consumption
- Linear Staffing Costs
- Frequent Outages

Resulting in tremendous efficiencies

No extra charge for this deep pre-integration!

TCO Comparisons

Earlier today we saw that incremental growth on System z with zIIP costs less than HP/Oracle for
- ▶ Data Warehouse
- ▶ SAP Data Server

We also saw examples of Linux roll-up consolidation with IFL's reducing cost

Let's consider a web application that can exploit zAAP

IBM

Case Study: Consolidate New WebSphere Application on Mainframe

Existing Mainframe	*Existing Disaster Recovery Site*	*Add 3 LPARs for New Web Application w 820 GB storage*			*And Add Disaster Recovery w 820 GB storage*			
		Prod	Dev	QA	Prod	Dev	QA	
		900 MIPS additional workload						*3 year cost of acquisition $3.08M*

Existing processors: 2 general purpose

Existing processors: Pay for one general purpose processor for hot disaster switch over and one "dark" DR processor at $30K

Add two processors:
one zAAP
  510 MIPS WAS (85%)
one General Purpose
  300 DB2 MIPS
  90 WAS MIPS (15%)

Pay for Capacity Backup
two processors
$30K each

Or Add Superdome 9000 Servers w 1.5 TB storage

Prod   Dev and QA

16 Chip 32 Core   *16 Chip 32 Core*

And Add Disaster Recovery w 1.5 TB storage

Prod

16 Chip 32 Core

3 year cost of acquisition $5.31M

82,531 * *RPE's*   82,531 *RPE's*   82,531 *RPE's*

* Assume dev and QA = 25% of 900 MIPS total. Then production RPE's required = 900 x .75 x 122 = 82,350

WebSphere Application Server Incremental Cost Breakdown

Mainframe Incremental Hardware

OTC		ANNUAL	
1 GP Processor	$1,450,000	Processor Maintenance * (For year 2, 3)	$88,500
zAAP	$125,000		
2 DR Processors	$60,000		
IBM Storage (820x2GB)	$259,618	Storage Maintenance (For year 2, 3)	$12,856
TOTAL	**$1,894,618**	**TOTAL**	**$101,356 (year 2, 3)**

Mainframe Incremental Software

OTC		ANNUAL	
Utilities + WAS	$350,535	Utilities + WAS S&S	$56,608
		DB2 MLCx12	$77,280
		z/OS MLCx12	$38,568
		QMF MLCx12	$37,176
		Subtotal MLC x12	$153,024
TOTAL	**$350,535**	**TOTAL**	**$209,632**

Distributed Incremental Hardware

OTC		ANNUAL	
3 16x32 Itanium Superdome Servers	$1,451,817	Servers Maintenance (Prepaid in year 1 for 3 years)	$123,139
HP storage (1.5x2TB)	$401,220	Storage Maintenance	$22,226
TOTAL	**$1,853,037**	**TOTAL**	**$391,643 (year 1) $22,226 (year 2, 3)**

Distributed Incremental Software

OTC		ANNUAL	
Oracle EE & Utilities	$858,000	Oracle S&S	$188,760
WAS ND	$976,500	WS Maint (Year 2, 3)	$195,300
Unix	$98,397	Unix S&S	$44,242
		(prepaid in year 1 for 3 years)	
TOTAL	**$1,932,897**	**TOTAL**	**$321,486 (year 1) $384,060 (year 2, 3)**

* Mainframe Processor Maintenance includes the maintenance for general purpose processors and specialty engines

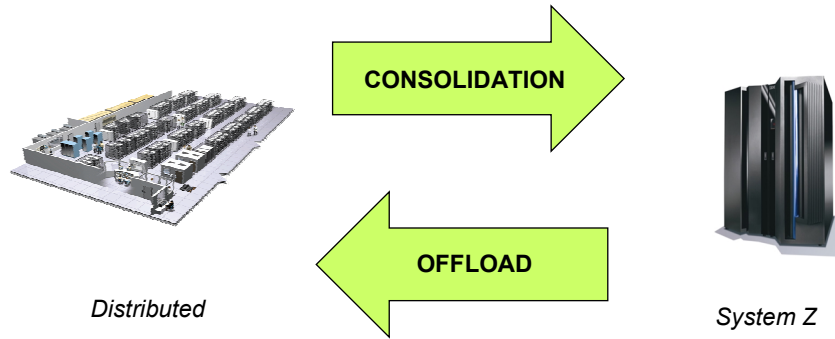10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt   15

Other Mainframe Deployment Options Can Reduce the Cost of the WebSphere Application Even Further

Note: Cost comparison only. Qualities of service and functional capabilities will vary depending on deployment choice

Disaster recovery and storage are included

Develop Web Application Create Database

Deployment Choices

	Case 1	Case 2	Case 3	Case 4
	WAS DB2 (z/OS) / (z/VM)	WAS (z/OS) / DB2 UDB (z/VM)	DB2 (z/OS) / WAS ND (z/VM)	WAS ND DB2 UDB (z/OS) / Linux z/VM
	85% zAAP 0% zIIP (no DRDA)	85% zAAP 100% IFL	40% zIIP DRDA 100% IFL	100% IFL
3 Year TCA for Production	$3.08M	$1.23M	$2.17M	$1.12M

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt   19

TCO Comparisons

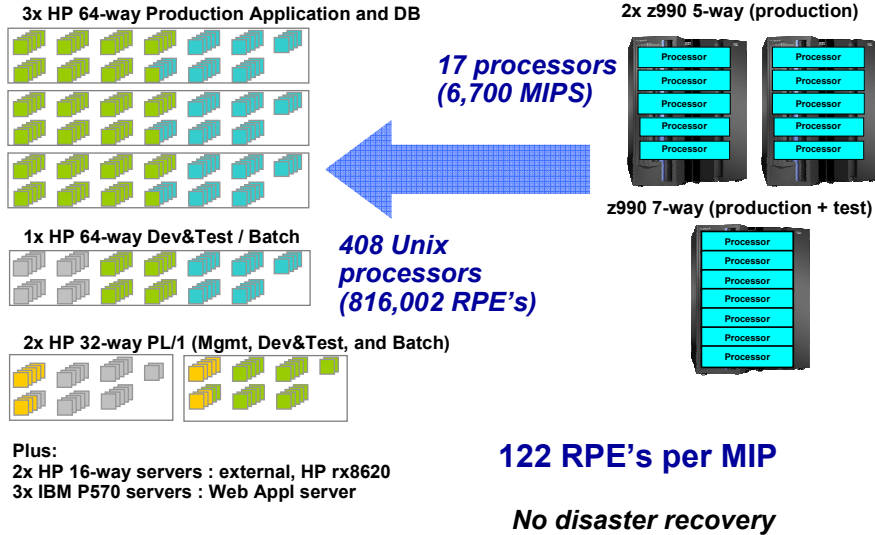CONSOLIDATION

OFFLOAD

Distributed

System Z
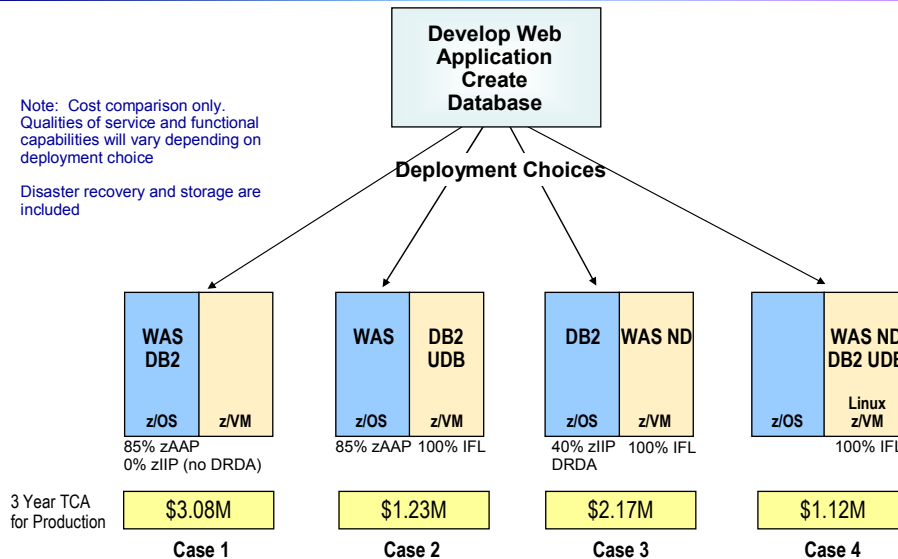
Tough Customer

The distributed servers run twice as fast as the mainframe processors, and they are cheap.

I don't believe your TCO comparison.

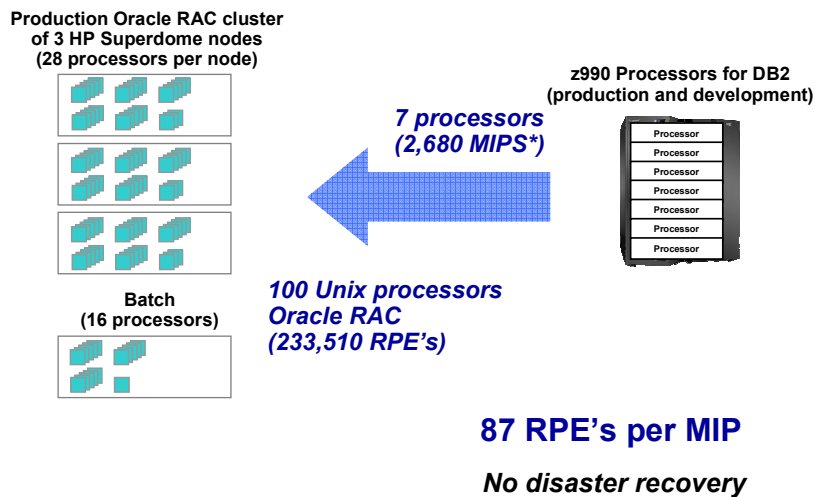**This Was a Real Project – Why Couldn't The Same Workload Be Done With 8½ Fast Processors?**

3x HP 64-way Production Application and DB

2x z990 5-way (production)

17 processors
(6,700 MIPS)

1x HP 64-way Dev&Test / Batch

z990 7-way (production + test)

408 Unix processors
(816,002 RPE's)

2x HP 32-way PL/1 (Mgmt, Dev&Test, and Batch)

Plus:
2x HP 16-way servers : external, HP rx8620
3x IBM P570 servers : Web Appl server

122 RPE's per MIP

No disaster recovery

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

23

Asia Pacific Financial Services Customer Offload Project – Database Only

Production Oracle RAC cluster
of 3 HP Superdome nodes
(28 processors per node)

z990 Processors for DB2
(production and development)

7 processors
(2,680 MIPS*)

Batch
(16 processors)

100 Unix processors
Oracle RAC
(233,510 RPE's)

87 RPE's per MIP

No disaster recovery
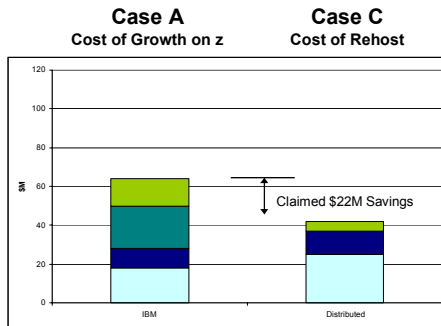
* DB2 is estimated to be 40% of total workload

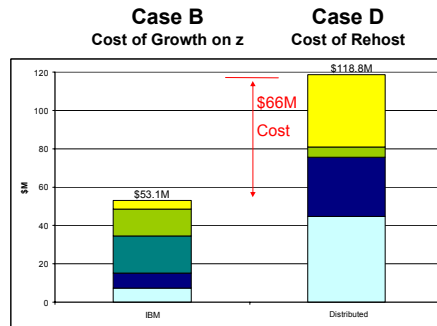10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

24

9

Did They Save Money by Offloading?

- Competitors told the customer they would save $22M over 4 years

- IBM analysis determined that the offload solution would actually cost $66M more than growing on z

Competitor's 4 Year Cost / Savings Prediction

Case A	Case C
Cost of Growth on z	Cost of Rehost

IBM Analysis

Case B	Case D
Cost of Growth on z	Cost of Rehost

Claimed $22M Savings

$118.8M

$66M Cost

$53.1M

Investment   Maint   MLC   Operations   Disaster Recovery

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

25

Lessons Learned About the Promises Made by the Competitors

- They **over-estimated** the mainframe costs
  - ▶ Over-provisioned too early — Δ$3.6M
  - ▶ Used highest hardware purchase & maintenance list prices — Δ$9.4M
  - ▶ Continued using older software; no sub-cap pricing — Δ$2.7M
  - **OVERESTIMATED BY Δ$15.7M**

- They **under-estimated** the offload costs
  - ▶ Forgot about mainframe coexistence during migration — Δ$9.5M
  - ▶ Forgot about high cost of power & cooling — Δ$1.1M
  - ▶ Forgot about the financing charges — Δ$2.5M
  - ▶ Added a test server — Δ$2.1M
  - ▶ Under-provisioned batch processing (15 % growth case) — Δ$6.3M
  - ▶ Failed to take into account technology updates — Δ$14.6M
  - ▶ Did not provide Disaster Recovery — Δ$40.6M
  - **UNDERESTIMATED BY Δ$76.7M**

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

26

Why Do Servers Proliferate in Offload Scenarios?

- The following considerations contribute to server proliferation

  - ▶ De-multiplexing of applications to dedicated servers
    - One application workload per server group
    - Low utilization due to peak-to-average and growth provisioning
    - Batch workload may stress I/O capabilities
    - Separate servers for production, failover, development/test, disaster recovery
  - ▶ Processing comparisons
    - Language expansion (CICS/COBOL path lengths are highly optimized)
    - Conversion factor (MIPS to RPE) worsens as I/O rates increase
    - Oracle RAC inefficiencies compared to DB2

- Other TCO considerations
  - ▶ 3 to 5 year lifetime for distributed servers requires repurchase
  - ▶ Dual environments during migration

Let's Consider The Other Elements of Cost

Total Cost of Ownership =

Cost of hardware +

Cost of software +

Environmentals +

Cost of labor +

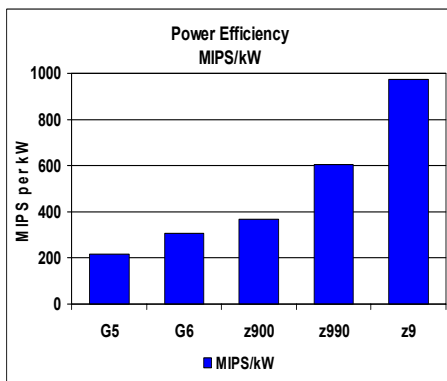Financial terms

Fast and Hot Distributed Servers

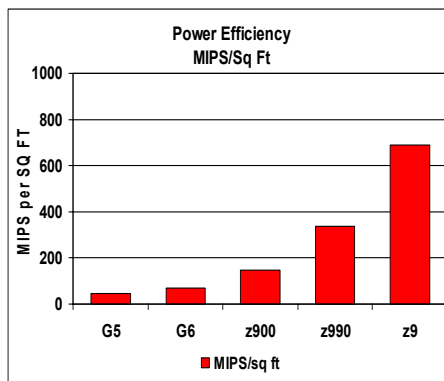**Managing power dissipation is limiting clock speed increases**

Clock Speed (MHz) vs year (1990–2010), with "2004 Frequency Extrapolation" shown.
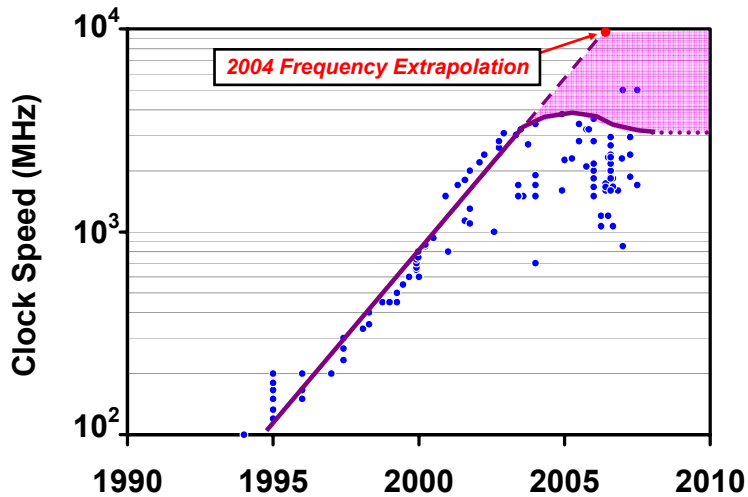
Mainframe Exhibits Increasing Power and Space Efficiencies with Each Generation

Power Efficiency MIPS/kW — bar chart (G5, G6, z900, z990, z9)

22% annual increase
in MIPS/kW

Power Efficiency MIPS/Sq Ft — bar chart (G5, G6, z900, z990, z9)

46% annual increase
in MIPS/square foot

Decreasing energy consumption per MIP   Decreasing square footage per MIP

Mainframe Consumes Less Power Than HP Superdome

WATTS (y-axis) vs. RPE (Workload Capacity) (x-axis)

HP Superdome
64 chips/128 cores

HP 4 Times More Power Consumption
6 Times Scalability

System z

IBM S08
IBM S18
IBM S28
IBM S38
IBM z9 S54
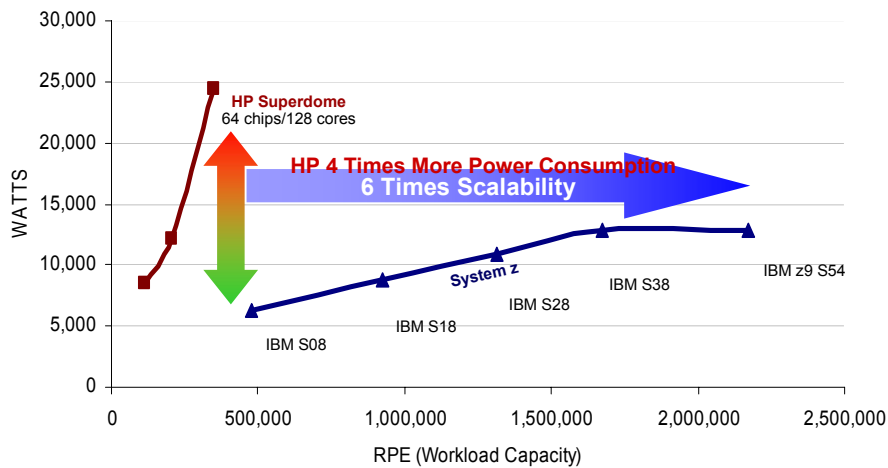
Source for HP Servers: Ideas International, Nov 06
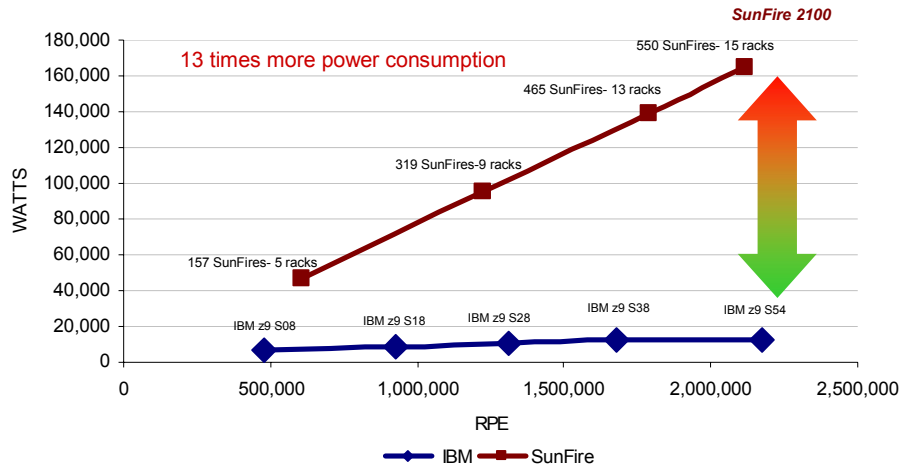Note: Uses equivalence ratio of 122 RPE's per MIP

Do the Math

- HP Itanium 2 Superdome 9050 (64ch/128co)* consumes a maximum of 24,392 watts
  - ▶ [24,392 X $.09 X (24 X 365)]/1000 = $19,230 per year for electricity

- Mainframe with similar computing capacity - a System z9 S08 machine using 6.3 kW
  - ▶ $4,967 per year for electricity

- Similar savings on cooling capacity
  - ▶ Cost of cooling is about 60% additional
  - ▶ Superdome total $30,768 per year vs. Mainframe $7947
  - ▶ Cost of mainframe power and cooling is $22,821 per year less than HP

*Rated at 350,041 RPE

Mainframe Consumes Less Power Than SunFire Server Farms

SunFire 2100

13 times more power consumption

550 SunFires- 15 racks

465 SunFires- 13 racks

319 SunFires-9 racks

157 SunFires- 5 racks

IBM z9 S08 IBM z9 S18 IBM z9 S28 IBM z9 S38 IBM z9 S54

WATTS (y-axis): 0 to 180,000

RPE (x-axis): 0 to 2,500,000

Legend: IBM — SunFire

Source for SunFire 2100 Servers: Ideas International, Nov 06   Note: Uses equivalence ratio of 122 RPE's per MIP

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt   34
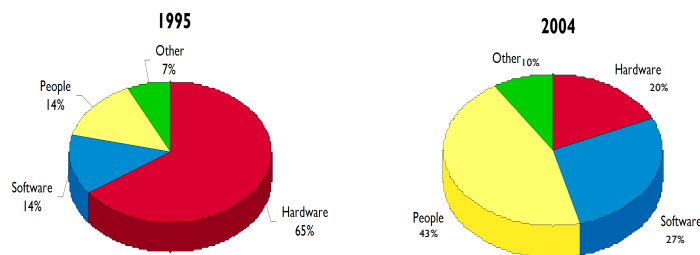

IBM Storage Also Saves Energy Costs

IBM DS8300 Power Consumption vs. EMC DMX-3 by Size

Power (KVA): 0 to 25

18.25 TB   34.33 TB   54.75 TB   68.44 TB   91.25 TB

7.48 TB   14.03 TB   22.45 TB   28.06 TB   37.41 TB   IBM TB after compression

IBM DS8300 922+92E ■   EMC Symmetrix DMX-3 ■
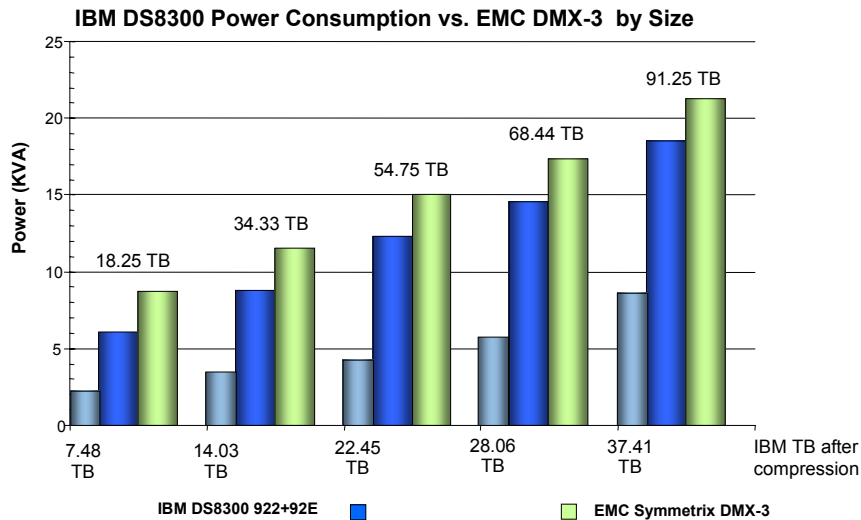
Study used 146 GB 15K rpm drives

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt   35
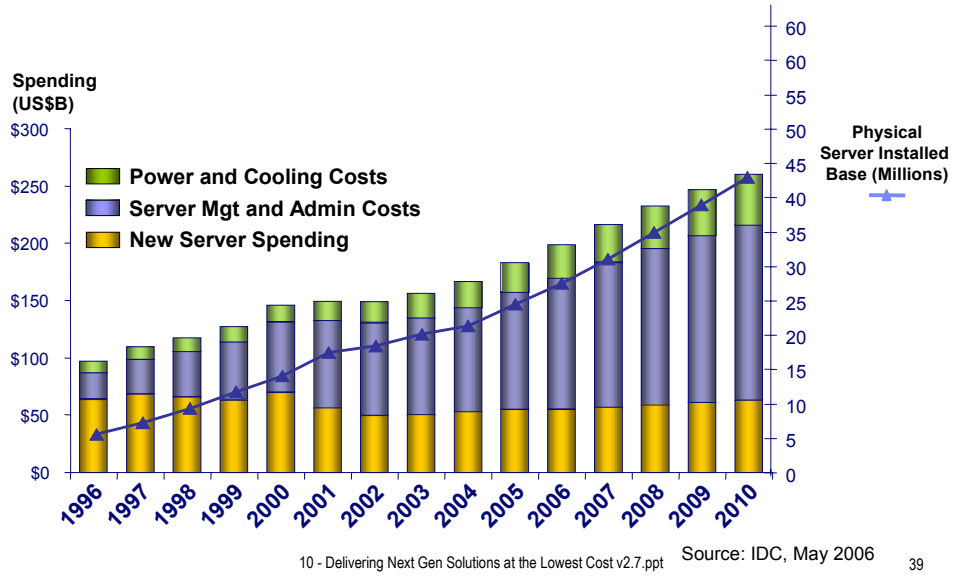
14

Power and Space Costs

- The cost of electricity to power and cool the servers
  - ▶ Electricity usage differences are large, but the costs are typically small in magnitude compared to other project costs

- The cost to re-arrange servers on the floor to take advantage of existing cooling vents
  - ▶ One customer spent $250K to place Superdomes near the vents

- The cost to upgrade cooling capacity

- The ultimate cost – build a new data center facility at $400 per square foot or more

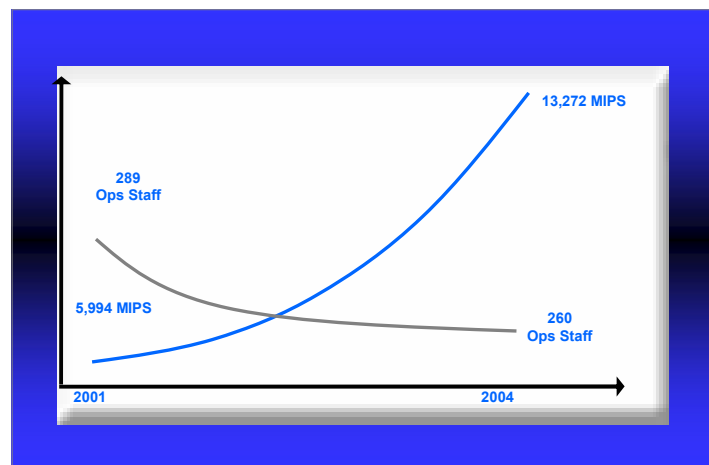## People Expense has Become the Dominant Component of TCO

1995

Other 7%

People 14%

Software 14%

Hardware 65%

2004

Other 10%

Hardware 20%

People 43%

Software 27%

Based on IBM Scorpion customer analyses

When Budgets Are Fixed, More Money for Labor Means Less for New Projects

Spending (US$B)

Legend:
- Power and Cooling Costs
- Server Mgt and Admin Costs
- New Server Spending

Physical Server Installed Base (Millions)

Years: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

Source: IDC, May 2006

39

Data Center Staffing Levels for System z Have Not Increased Despite Large Increase in MIPS

13,272 MIPS

289 Ops Staff

5,994 MIPS

260 Ops Staff

2001   2004

$$\frac{5,994}{289} = 21 \text{ MIPs/HC}$$ $$\frac{13,272}{260} = 51 \text{ MIPs/HC}$$

Source: Gartner

10 - Delivering Next Gen Solutions at the Lowest Cost v2.7.ppt

40

16

A Comparison of Labor Costs for Two Environments That Execute Roughly Equivalent Workloads

Topic	System z- 3,192 MIPS	900 Distributed Servers
Operations	$105K ……10% of 6 FTEs	none
Customer Engineers	$52K……. 0.3 FTEs $50K LAN charges $35K z- charges	$400K SUN charges $300K LAN charges $40K p- charges $100K HP charges
Systems Engineers	$551K ….. 3.15 FTEs	$5,250K…..30 FTEs (Operations in the Systems charge)
Security Admin	None	$600K
Total	$793K	$6,690K

Here, System z requires 1/8 the labor costs of the distributed environment

Previously discussed IBM Internal Consolidation Project also calculated a 1 to 8 ratio in admin costs
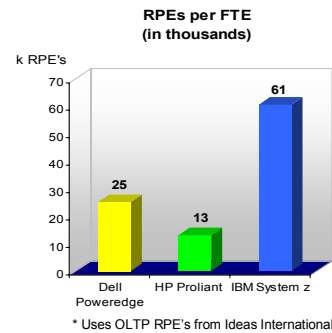
Source: IBM SWG Data Center

Mainframe Labor Is More Productive

- Mainframe efficiency means more workload per FTE (from a customer study)
  - ➢ RPEs managed/administrator on an IBM mainframe were 1.4x more than a Dell and 3.7x more than an HP Proliant (both x86)

- Another study shows mainframe Linux is quicker to provision
  - ➢ Internal study indicates initial installation/configuration labor for distributed Linux is 22% more than zLinux

22% higher on distributed Linux

RPEs per FTE (in thousands)

k RPE's

Dell Poweredge	25
HP Proliant	13
IBM System z	61

* Uses OLTP RPE's from Ideas International

Initial Hours per Server

| Initial Hours per Server	Distributed Linux	System z Linux
Acquire	18.9	18.9
Install	31.5	23.5
Configuring Users	4.5	2.5
Total	54.9	44.9

Trade-In Value Reduces Mainframe Net Present Value Costs

- Upgrade to next generation mainframe
  - ▶ Specialty processors are upgraded to next generation free of charge
  - ▶ Growing customers typically receive credit for existing MIPS investment when upgrading to new generation
  - ▶ Full trade-in value applied to upgrade and growth MIPS

- Upgrade to next generation distributed systems
  - ▶ Life time of 3 to 5 years
  - ▶ Must repurchase existing processor capacity plus any growth

- Long term TCO implications can be important

Conclusion: Total Mainframe Hardware, Software & Labor Costs Reduced by 62% in 5 Years
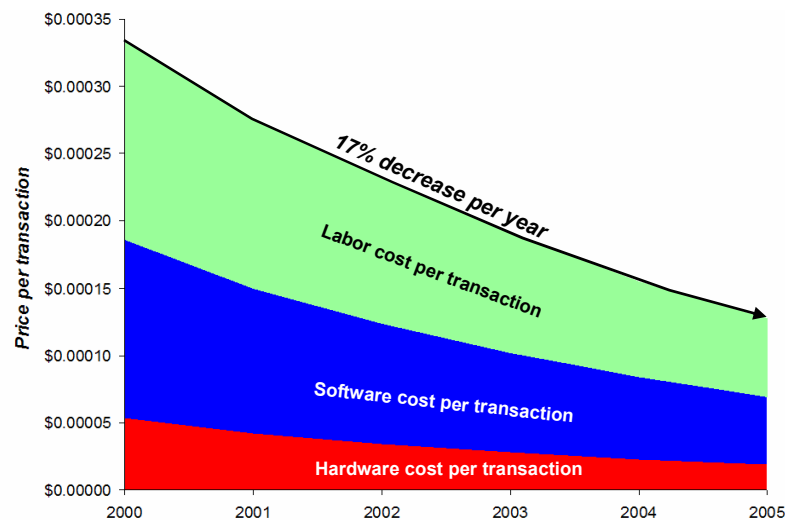
Tale of Two Customers

	Baldor	Welch's
Supplier	IBM	Dell
Moved From....	3 Mainframes and 8 Unix Servers	S/390 and AS/400
Moved to...	1 z990 System z Server	100 Intel Servers
Virtualization	z/VM	VMWare
Decision to Completion Time	Approximately 6 months	Started sometime before June 2005 "...project will continue into 2007"
IT Staff	Down to 38	50
IT Spending	1.2% of Sales (and still declining....now down to 0.9%)	About 2.5% of Sales
Max Power consumption	15.8 kW	48.4 kW

Three years ago, Baldor's IT director had investigated migrating to a Windows server environment with cluster fail-over. *"We thought we were going to save a ton of money,"* but the systems crashed all the time, he noted, and the idea was quickly abandoned.

"We have a very stringent requirement of being up all the time … Weighing heavily in support of the mainframe was its track record. There hadn't been any mainframe downtime since 1997"

Case Studies Summary

- Roll up consolidation of Linux servers onto System z saves big money

- Incremental Data Server on System z costs less than Oracle RAC on HP Superdome

- Incremental Data Warehouse workload on System z costs less than Oracle RAC on HP Superdome

- Incremental WebSphere workload on System z costs less than distributed deployment

- System z uses less power and requires fewer operational staff

Customer Objections

Your story makes sense, but my charge back for the mainframe is still much higher.

Data Center Cost Accounting

- Two terms used to describe data center cost accounting
  - ▶ IT cost accounting
    - − Assign costs to department budgets
  - ▶ Charge back policies
    - − Bill departments for IT resources used

- In this pitch we will use term "Charge Back" to refer to both

Charge Back Follies

- Bad charge back practices can create the false impression that the **mainframe costs too much**

  - Good practices allow business units to understand the economic impact of IT resource decisions

- Mainframe Charges are typically overstated
  - It's easy to assign unrecoverable cost to the mainframe
  - Unrelated allocation of corporate overhead
  - Disproportional allocation of data center overhead
  - System Programming teams that support specific business projects
  - Security support for all platforms and businesses…

When Good Charge Back Practices Are Applied

SAP Data Server With Disaster Recovery

- Costs on the mainframe over 3 years
  - 3 year incremental cost of acquisition $2.29M
  - 3 years labor (2 FTE's @ $120,000/yr times 3 years)* $0.72M
  - 3 year power cost ($0.09 per kw.hr)   negligible
  - Total cost for 3 years $3.01M
  - Monthly charge   Mainframe is half the cost $84,000

- Cost on the distributed system
  - 3 year cost of acquisition $4.51M
  - 3 years labor (3 FTE's @ $120,000/yr times 3 years)** $1.08M
  - 3 year power cost ($0.09 per kw.hr) $.018M
  - Total cost for 3 years $5.61M
  - Monthly charge $156,000

* One FTE per 500 MIPS   ** One FTE per 20 processors

When Bad Charge Back Practices Are Applied

SAP Data Server With Disaster Recovery

- Costs on the mainframe over 3 years
  - Use current cost/MIP figure of $188/month/MIP for existing hardware and software
  - 3 year hardware and software $188x966MIPS x36 months $6.54M
  - 3 years additional labor (2 FTE's @ $120,000/yr times 3 years)* $0.72M
  - Total cost for 3 years $7.26M
  - Monthly charge   Mainframe costs 10 times more $202,000

- Cost on the distributed system
  - 3 year cost of production server $0.73M
  - Disaster recovery allocated to general overhead   not charged
  - Cost of storage allocated to general overhead   not charged
  - Cost of software allocated to general overhead   not charged
  - Cost of labor allocated to general overhead   not charged
  - Additional electricity allocated to general overhead   not charged
  - Total cost for 3 years $0.73M
  - Monthly charge $20,000

     * One FTE per 500 MIPS   ** One FTE per 20 processors

Typical Evolution of Data Center Charge Back Practices

Early 90's	Mid 90's	2000+
Entire data center budget allocated to MIPS (cost/MIP = data center budget ÷ MIPS)	Cost of storage allocated by usage Cost of tape/slots allocated by usage Remaining data center budget allocated to MIPS	True mainframe costs allocated by usage
Distributed Server hardware is a capital expense (depreciation charged to user)	Distributed server hardware is a capital expense	All distributed costs allocated by usage

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

- Fully Loaded z/OS MIP Charge Back
- Single Sun 480 4X Server Charge Back
- z/Linux MIP Charge Back
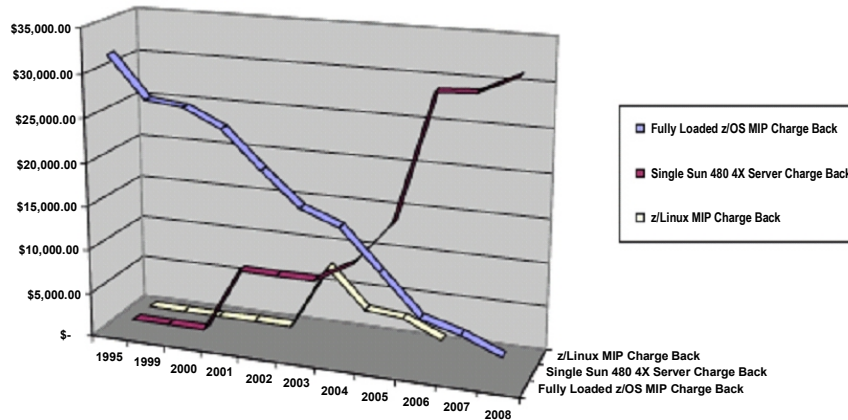
More Accurate Charge Back Can Correct Perceptions of Relative Costs

Data Center Cost Recovery Model

What Costs Need To Be Recovered?

How Are Costs Associated With Applications? (ATM, Credit Card, Commercial Loans, Mortgages)

Receive Recoveries From Departments

How are Applications Associated With Departments And Resources?

IBM Tivoli Usage and Accounting Manager (ITUAM)

Create Department Invoices

Determine Utilization
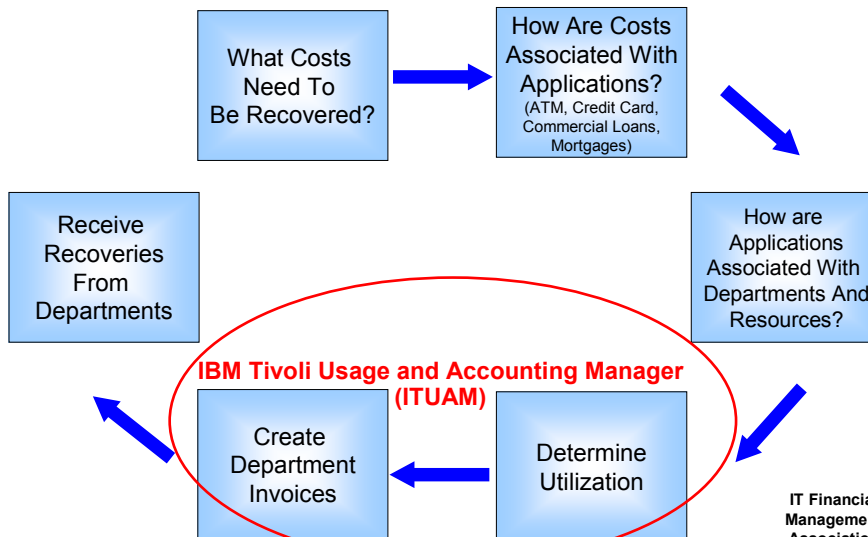
IT Financial Management Association ITFMA.COM

Charge Back Policies are Fixed

Now I'm paying the true cost for my mainframe applications