

A Fresh Look at the Mainframe

When the Mainframe Really IS the Lowest Cost Platform

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

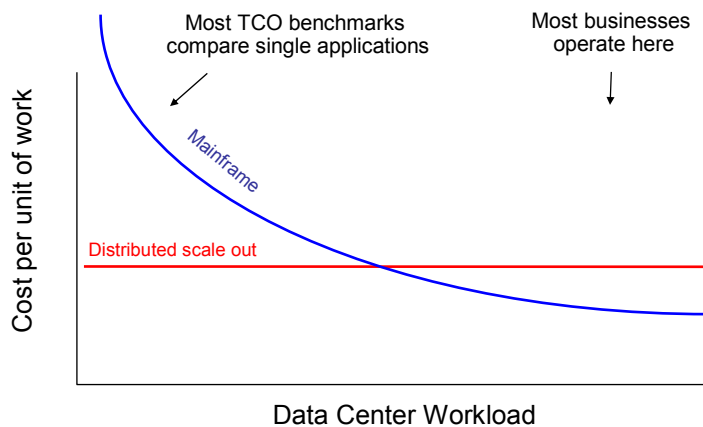
- The cost of running incremental workload on the mainframe goes down as the total workload grows
 - ▶ Labor costs hold steady as workload grows
 - ▶ IBM pricing policies designed to favor the addition of more workload
 - ▶ Special hardware pricing for new workload types
 - ▶ Lower software costs per 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

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Mainframe Cost Per Unit of Work Goes Down as Workload Increases



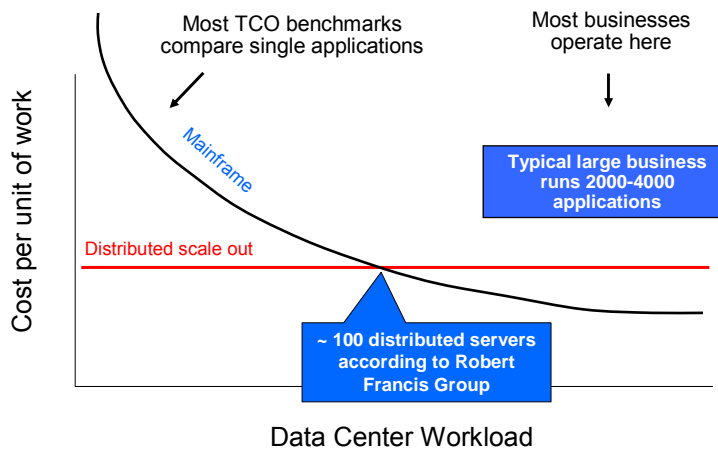
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	Servers	Reliability	Utilization	Staff
First move: Implemented distributed computing architecture that became too difficult to monitor, maintain, upgrade and scale	<ul style="list-style-type: none"> ■ 30+ Sun Solaris servers ■ 560+ Intel servers 	Un-acceptable	12%	24 people growing at 30% year
Next move: Consolidated back on the mainframe	z990	Much improved	84% with additional reserve capacity on-demand	Reduced to 8 people

Where is the Cross Over Point?

It depends on your environment ...



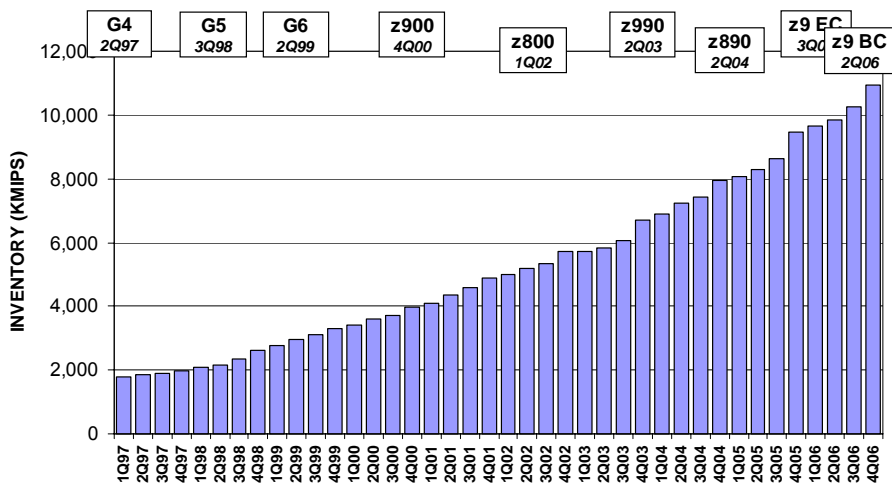
Here Are Some More Hints

- Growth by Large Customers
 - ▶ 95% of large mainframe customers (average installed MIPS from 13,000 to 15,000) have CAGR of installed MIPS by **21%** to **31%** since 2002
- Growth by mid size customers
 - ▶ 72% of mid size mainframe customers (average installed MIPS 1400) have CAGR of installed MIPS from **25%** to **34%** since 2002
- Growth by small customers
 - ▶ 70% of small mainframe customers (average installed MIPS 400 to 600) have CAGR of installed MIPS from **38%** to **50%** since 2002

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Mainframe Growth



CAGR 1997-2006 = 21%

Source: IBM STG Finance

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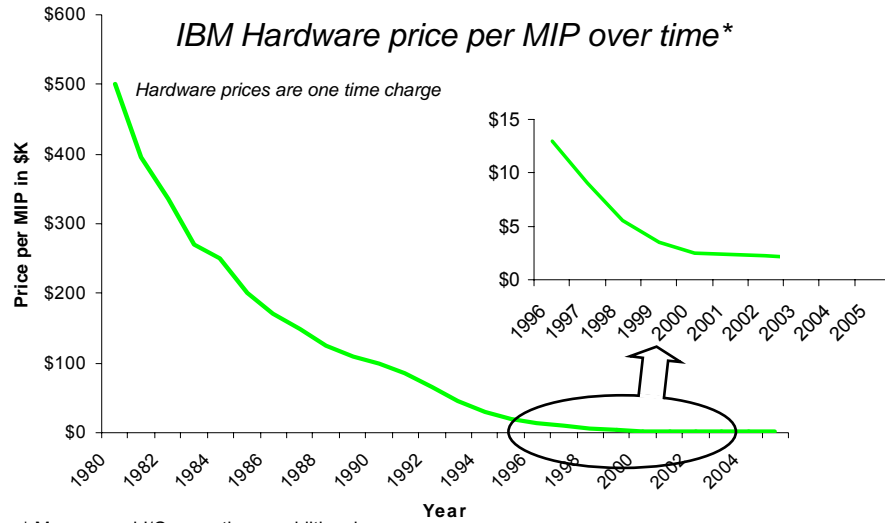
Let's Break Down the Elements of Cost

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

Let's Break Down the Elements of Cost

Total Cost of Ownership =
Cost of hardware +
Cost of software +
Environmentals +
Cost of labor +
Financial terms

Mainframe Hardware Cost is Decreasing

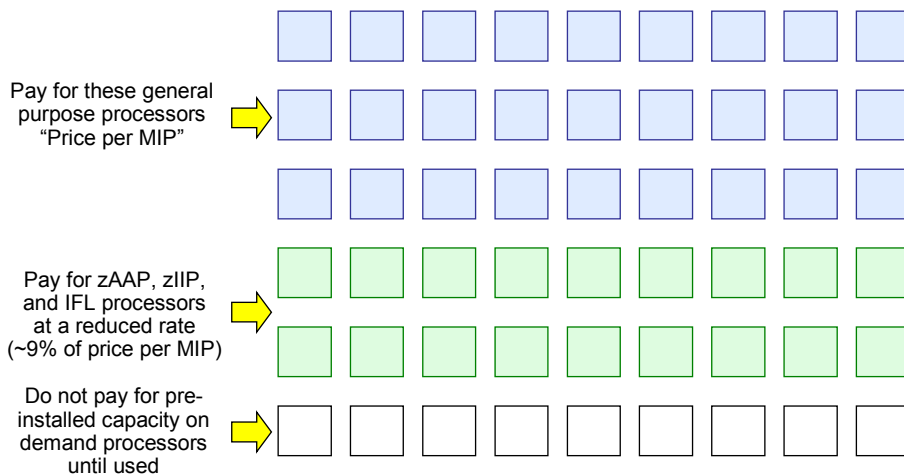


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“Price Per MIP” Does Not Tell The Whole Story

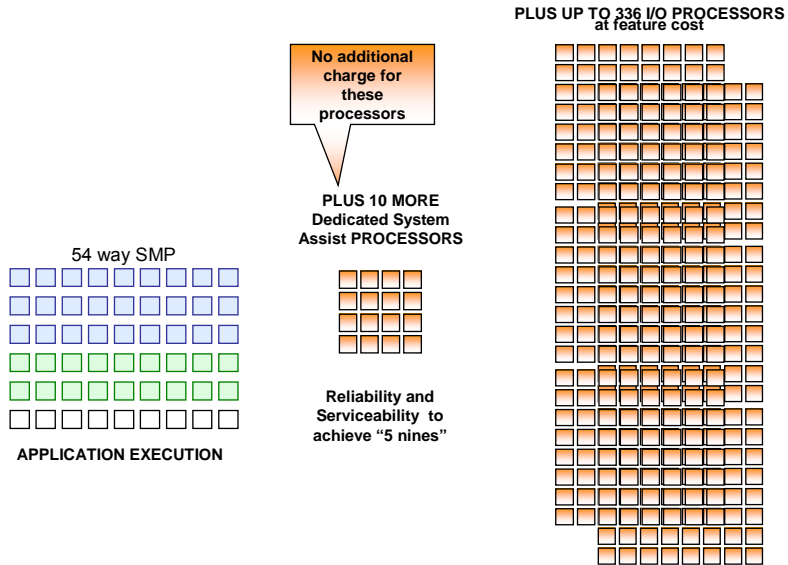
54 way SMP



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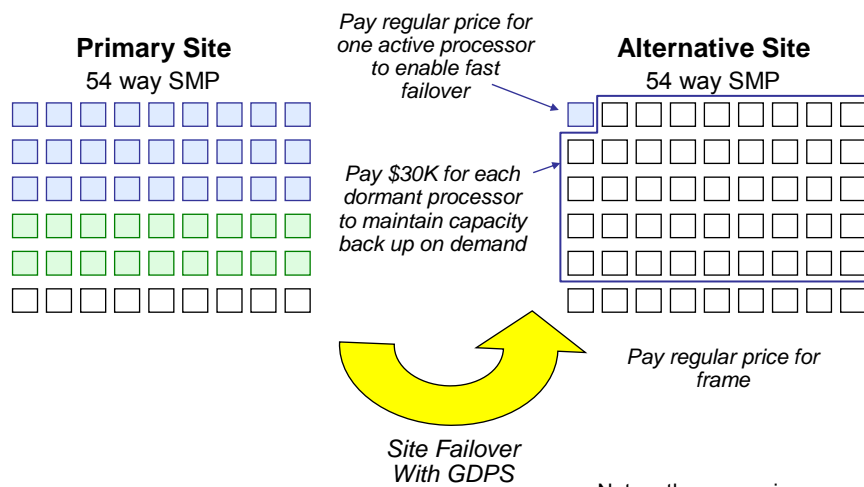
No Additional Charge For System Assist Processors and RAS Processors



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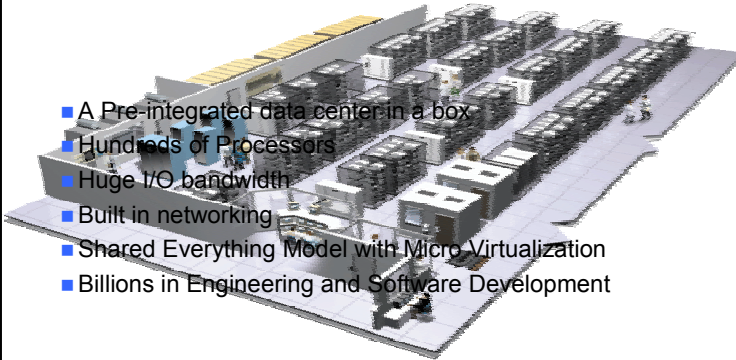
Disaster Recovery – Fast Failover For Less



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Datacenter in a Box

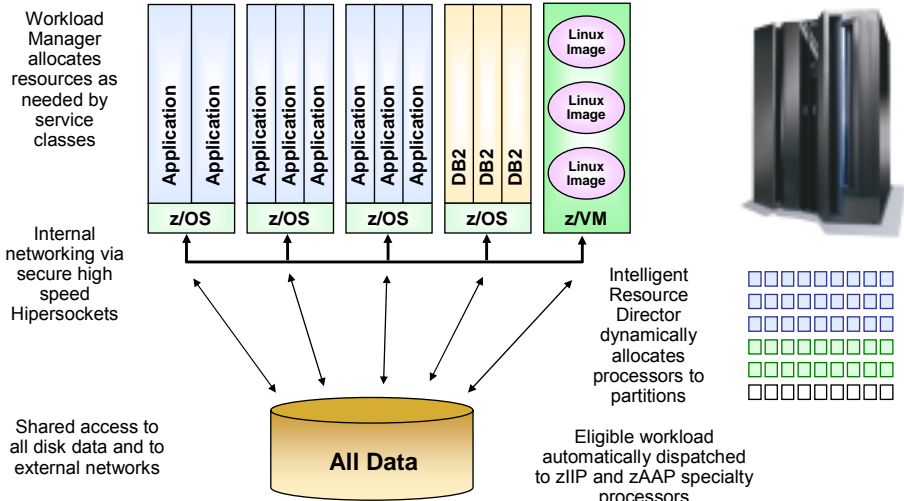


- A Pre-integrated data center in a box
- Hundreds of Processors
- Huge I/O bandwidth
- Built in networking
- Shared Everything Model with Micro-Virtualization
- Billions in Engineering and Software Development

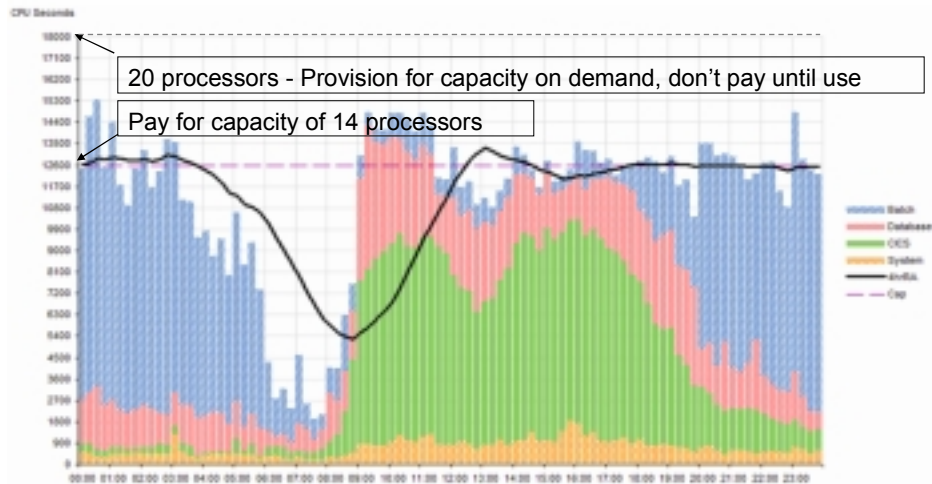
- Building your own datacenter is costly and complex
 - Install and configure hundreds of devices
 - Networking
 - Data Silos and Synchronization
 - Power consumption
 - Linear Staffing Costs
 - Frequent Outages
- Resulting in tremendous efficiencies**
- No extra charge for this deep pre-integration!**

Extreme Virtualization – How it Looks in z Architecture

Logical Partitions Share Processors, Common Cache Structures, and I/O



System z Virtualization, Workload Management, and Storage Bandwidth Achieve High Levels of Utilization



Note:

- Each bar represents the amount of CPU seconds used in 15 minutes (= 900 seconds) with 2 10-way machines
- The way Workload Management controls the workload 4-hour rolling average to the Cap "high-water mark"

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Distributed Systems Storage Utilization

▶ **The Total Cost of Storage is Typically Three Times More in Distributed Environments**

- Application specific data silos tend to over-allocate
- Storage utilization of 25-30% or less is typical in distributed environments
- Mainframe fine grained allocation and data sharing yield typical storage utilizations of 80% +
- Data copies are often used to separate "batch" style workloads from online
- Cheap disks cannot be used by high RAS workloads in distributed environments

▶ **Management Headaches**

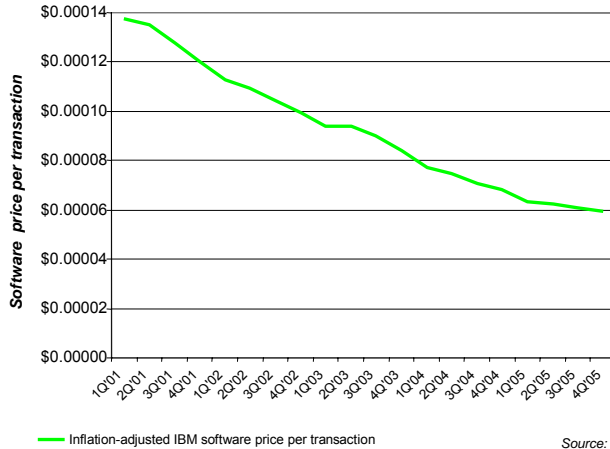
- Disaster recovery of separated data silos
- Synchronization, and transfer requirements

"Physically moving data" ranked highest in IT's "pain index" In an IBM Storage study of over 200 companies,

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IBM Software Price Per Transaction is Also Going Down



57% decrease in past 60 months

➤ 17% decrease per year

What makes the price go down?

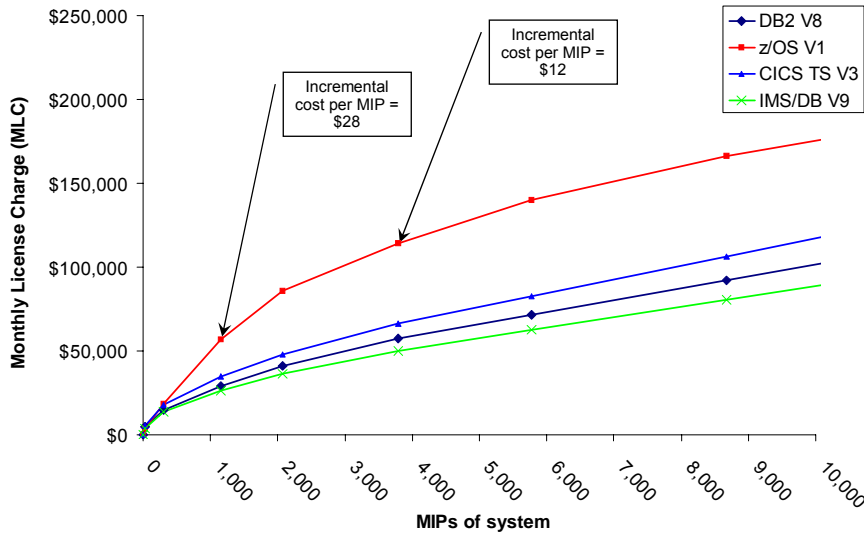
Pricing curves favor growth

Specialty processors (zAAPs, zIIPs, IFLs)

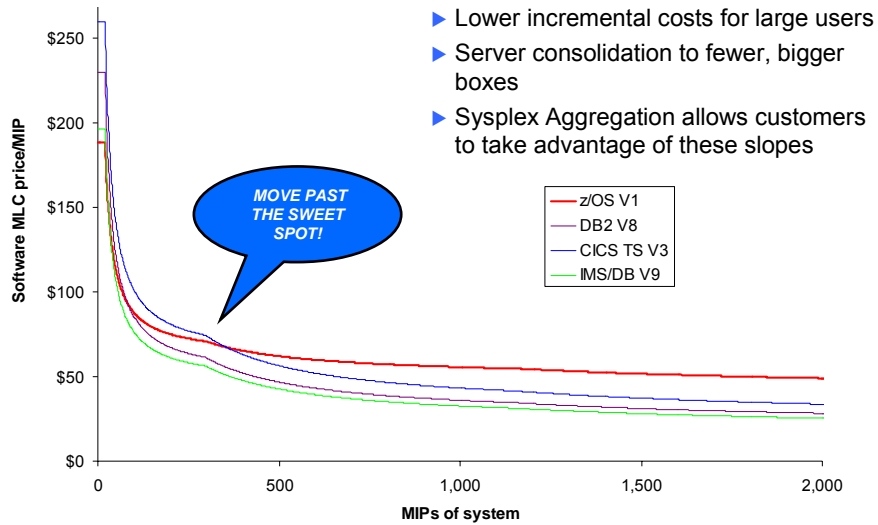
Technical pricing allowances

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

Software Pricing Curves Favor Growth



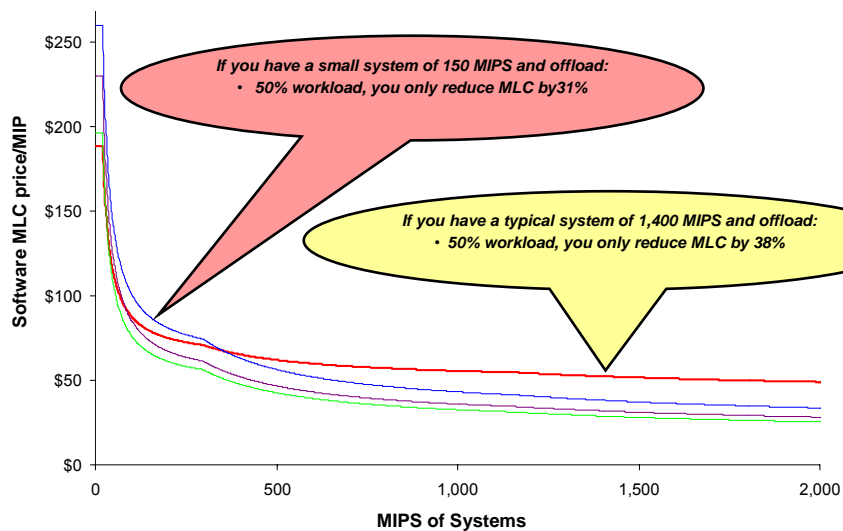
Overall Software Price Per MIP Decreases as System Size Increases



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Let's Consider How this Works in Reverse ... Lowest Cost MIPS are Offloaded First



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IBM Actually Charges on the Basis of MSUs (Millions of Service Units Per Hour)

- 1 MSU currently is equal to about 7.3 MIPS (for a z9 EC)

So...

- Software for a 580 MIPS machine will be charged at a rate of 81 MSU's

Various ratings online at:

MSUs <http://ibm.com/zseries/library/swpriceinfo/hardware.html>

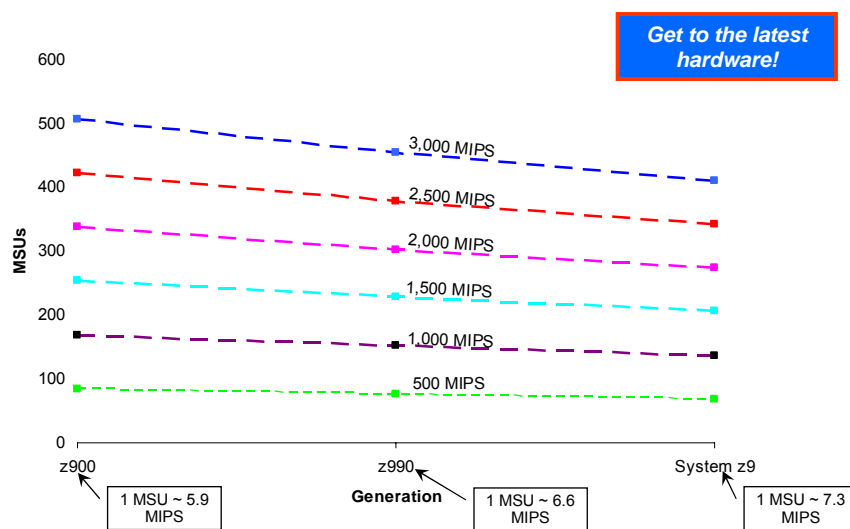
LSPR MIPS <http://ibm.com/zseries/lspr>

Hardware SRM Constants <http://ibm.com/zseries/srm>

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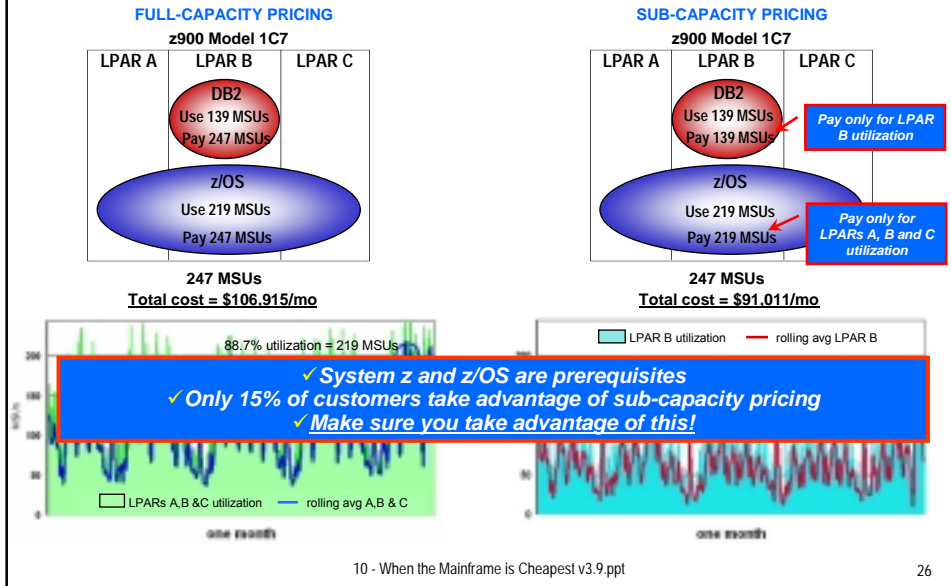
“Technology Dividend” = ~10% MSU Reduction Each Generation



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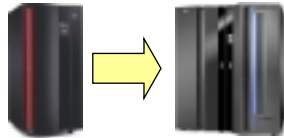
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Example of Sub-Capacity Pricing, Saving ~ \$16K MLC



Technology Dividend Helps Offset Software Upgrade Increases

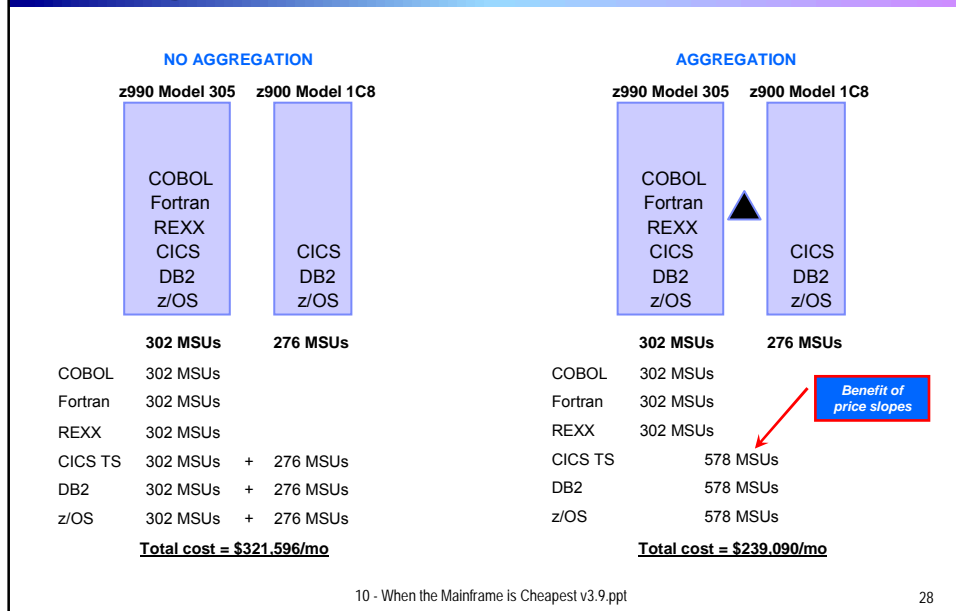
G5 S/390 processor
9672-R56
Purchased in 3Q98
Back level 4 generations
540 MIPS (5 CPU's)
93 MSU's



Upgrade to
current generation
z9 Enterprise Class
2094-701

	MLC		Tech Div and sub capacity	If No Tech Div
Database (-3 Generations)	\$15,378	DB2 UDB v6	DB2 UDB v9	\$19,866
Transaction Processing (-3 Generations)	\$14,733	CICS ESA v4	CICS TS v3.1	\$21,914
Operating System (-2 Generations)	\$46,485	OS/390 Base	z/OS VI Base	\$49,575
	\$76,596		\$69,560	\$92,872

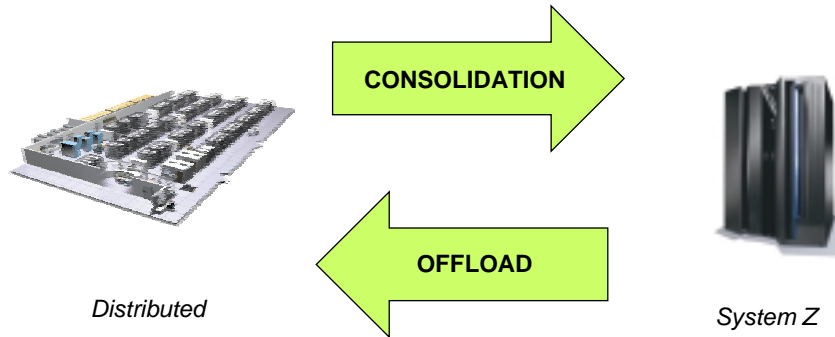
Example of Sysplex Aggregation, Saving >\$82K MLC



New! System z New Application Licensing Charge (zNALC)

- New pricing model to encourage running new applications on z/OS
- z/OS MLC is discounted 80-90% depending on machine/LPAR size
 - ▶ Examples:
 - System z Enterprise Class 710: \$35,899 for z/OS using zNALC compared to \$173,574 base price
 - System z Business Class S03: \$6,294 for z/OS using zNALC compared to \$44,707 base price
- Middleware can use normal sub-capacity pricing
- Application must run in a separate LPAR(s) from current workload
- Application must be certified by IBM as a qualifying application
 - ▶ Examples of qualifying applications WebSphere Application Server, Domino, SAP, Siebel, and PeopleSoft

TCO Comparisons

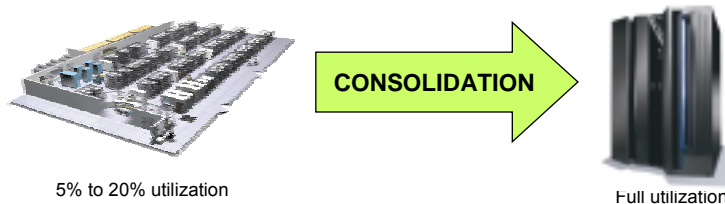


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The Economics of Workload Consolidation

- Distributed servers typically run at utilization levels in the range of 5% to 20%
 - ▶ Production servers, development servers, test servers
- Virtualization and workload management enable consolidation on the mainframe
 - ▶ Run multiple images on fewer processors
 - ▶ Achieve utilization levels of 85% or more
- Mainframe "specialty engines" further improve consolidation economics
 - ▶ WebSphere, Database, Linux



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zAAP and zIIP “Specialty Engines”

- Special assist processors
 - ▶ For Java workloads (zAAP)
 - ▶ For selected DB2 workloads (zIIP)
- Attractive pricing
 - ▶ Hardware is \$125K per processor one time charge
 - \$125K for a 580 MIP processor
 - ~ 9% of the normal price
 - ▶ No charge for IBM software running on zAAP/zIIP
 - ▶ Free upgrade to next generation!
- Requirements
 - ▶ z9-109 hardware platform
 - ▶ Latest service levels
 - ▶ zAAP/zIIP hardware feature
 - ▶ Max number of zAAPs =< number of general purpose processors
 - ▶ Max number of zIIPs =< number of general purpose processors



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How Much Workload is zAAP or zIIP- able?


- How much DB2 workload can typically be run on a zIIP?
 - ▶ DRDA Remote Access Protocol (**Database Server scenarios**)
 - Up to 55% of DRDA, 40% is typical
 - ▶ Parallel queries (**Data Warehouse scenario**)
 - Up to 80% of parallel queries
 - ▶ Most of **index maintenance** utilities
- How much Java workload can typically be run on a zAAP?
 - ▶ **WebSphere scenario**
 - Up to 85% of a WebSphere workload
- Offloads to specialty processors reduce software load and charges on general purpose processors
 - ▶ For sub capacity pricing, the offload must occur at a time that will reduce billable rolling average

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Example: Consolidate New Data Warehouse Application on Mainframe

Existing Mainframe



Existing processors:
2 general purpose

Existing Disaster Recovery Site



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

Add 1 LPAR for New Data Warehouse w 42 TB Storage

Prod

1954 MIPS additional workload

Add four processors:
3 zIIP's
1464 MIPS (75%)
1 General purpose
489 MIPS (25%)

And Add Disaster Recovery

Prod

Pay for Capacity Backup
4 processors
\$30K each

3 year cost of acquisition \$4.90M

Or add Superdome 9000 Server w 75 TB storage

Prod

26 Chip
52 Core

169,998 *
RPE's

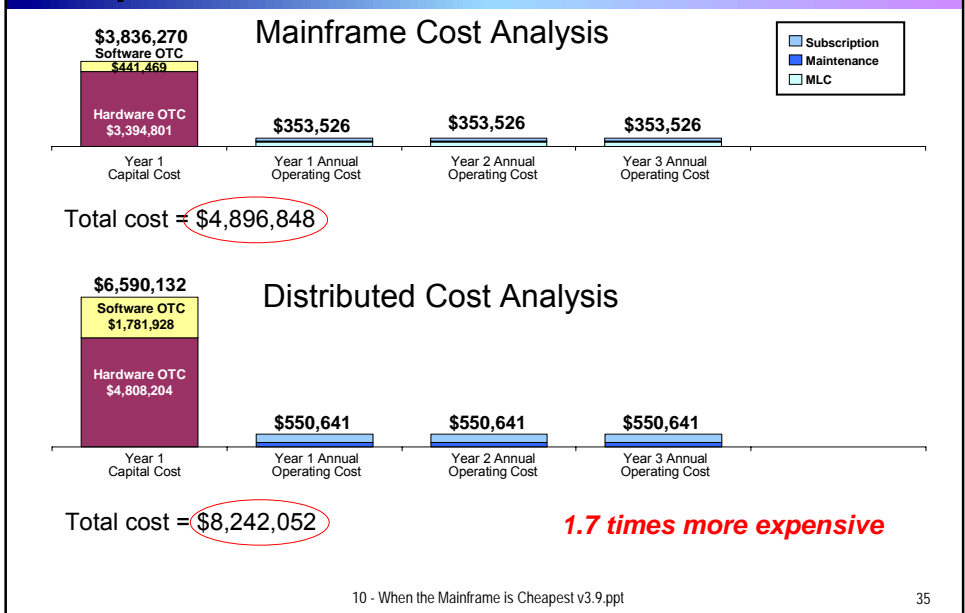
Disaster Recovery typically not considered

3 year cost of acquisition \$8.24M

* Production RPE's required = 1954 x 87 = 169,998

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zIIP Processors Lower the Cost of Acquisition



DB2 V9 Storage Compression Helped Reduce Storage Costs

- Customers using beta versions of DB2 9 reported 50–80% storage savings
- Typical storage cost savings
 - ▶ DB2 storage of 100 TB
 - ▶ 59% compression
 - ▶ $100 * .59 * \$35K/TB = \$2.03M$
- Oracle RAC software compression achieves 29%

"With DB2 9, we're seeing compression rates up to 83% on the data warehouse. The projected cost savings are more than \$2M initially with ongoing savings of \$500,000 a year."

Michael Henson
DB2 Unix Team Lead, SunTrust Bank, Inc.

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DB2 – Better Compression Ratio Than Oracle

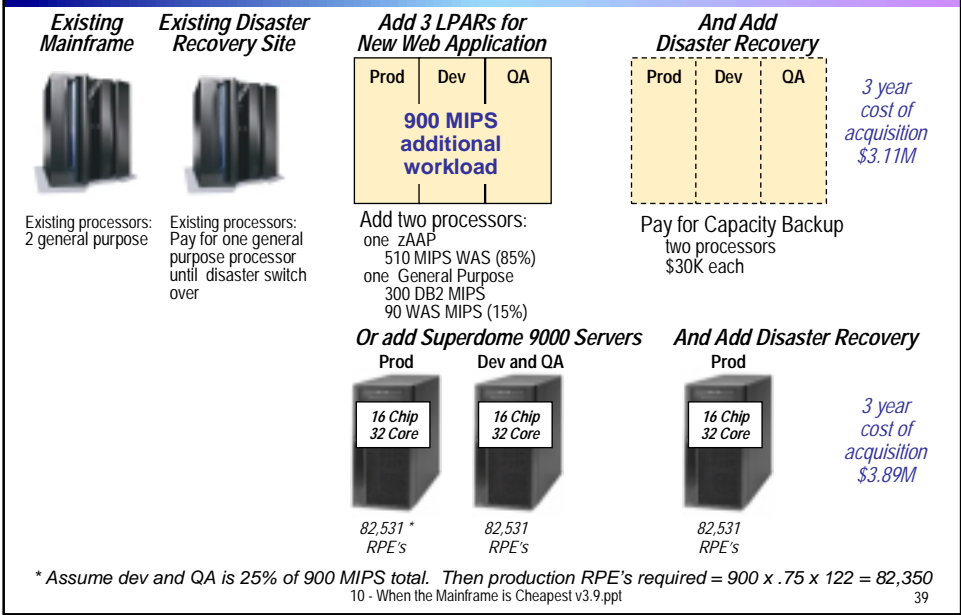
- TPC-H is a well known data warehouse benchmark
 - ▶ Each vendor uses the same tables and same data
 - ▶ Oracle published their compression rates for TPC-H tables at the VLDB conference in 2003
 - ▶ IBM ran the same tests on the same tables
- Test results

Table	Compression Ratio	
	Oracle	DB2
LINEITEM	38%	58% (1.5x better)
ORDERS	18%	60% (3x better)
Entire Database	29%	59% (2x better)

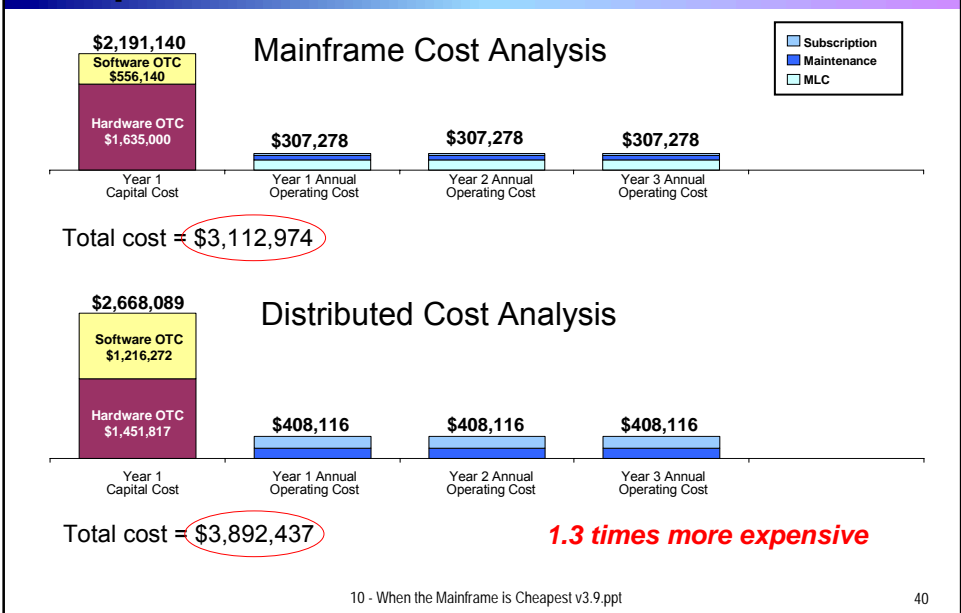
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Example: Consolidate New WebSphere Application on Mainframe

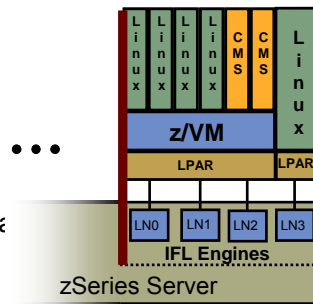


zAAP Processor Lowers the Cost of Acquisition



Integrated Facility for Linux (IFL) Makes Linux Consolidation Even More Attractive

- Linux Consolidation
 - ▶ Port multiple Linux systems to run as separate images under z/VM
 - ▶ Good economics due to typically low utilization of distributed servers
- Use of IFL engine reduces the price further
 - ▶ IFL specifically limited to Linux workloads
 - ▶ Hardware is \$125,000 per processor
 - ▶ IBM and some other vendors charge software licenses per one IFL processor (not per image)
- IFL Requirements
 - ▶ z9-109, z990, z900, z890 or z800 hardware platform
 - ▶ No z/OS requirements
 - ▶ No limit on the number of IFLs

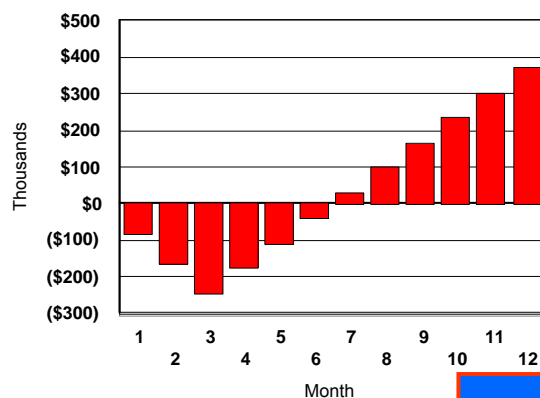


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Example: IGS US Consolidated 62 Distributed Images to zLinux Images on an IFL

UNIX to zLinux Cost Savings



(Costs Savings are driven primarily by \$89K monthly labor savings)

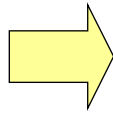
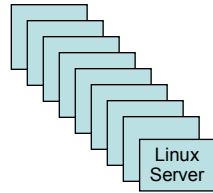
■ Cost Differential

- ✓ Broke-even after 6 months
- ✓ >\$2.5M saved in 3 years
- ✓ In Europe, €524K headcount saved in Year 1

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The Economics of Linux Workload Consolidation



62 Linux servers with low utilization

62 @ \$5,000 = \$310,000

Plus 62 middleware licenses

Plus \$6,500 x 62 = \$403,000/yr labor

One IFL processor with high utilization

1 @ \$125,000 = \$125,000

Plus one middleware license

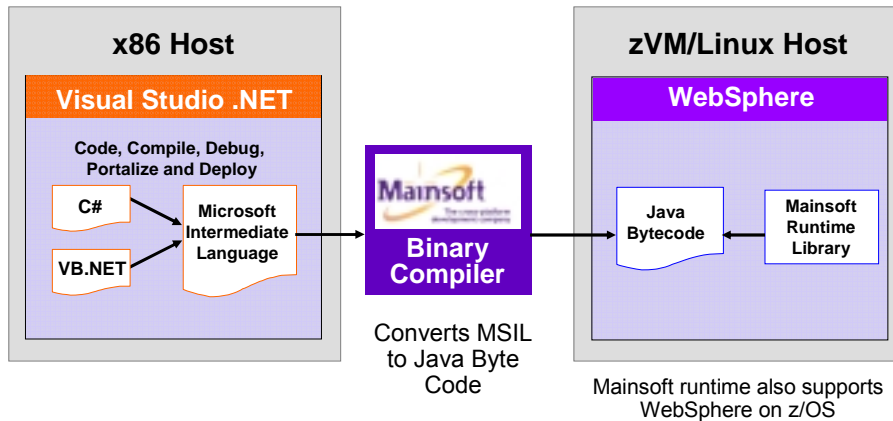
Little additional labor

Québec Government Runs Oracle at IFL Prices

- Consolidated 190 Oracle Databases (9i and 10g) onto a z9-EC with IFL's
 - ▶ Reduced cost of hardware and software by 30%
 - ▶ Better database loading performance due to higher I/O bandwidth
 - ▶ Each administrator could manage 100 database instances
 - ▶ Easy migration
 - One migration per day
 - Create new Linux server in 30 min (vs 1 week – 3 months)
 - Clone Oracle DB instance in 30-45 min (vs 10 – 14 hours)
 - Unload/load
 - ▶ Inherit benefits of z platform – workload management, availability, disaster recovery
 - ▶ Expect to migrate 200 more Oracle databases per year

NEW! Execute .NET Code on the Mainframe at IFL Prices

Visual MainWin for J2EE



Contact: Ron Johnsen – VP WW Sales, ronj@mainsoft.com USA 408 200 4023

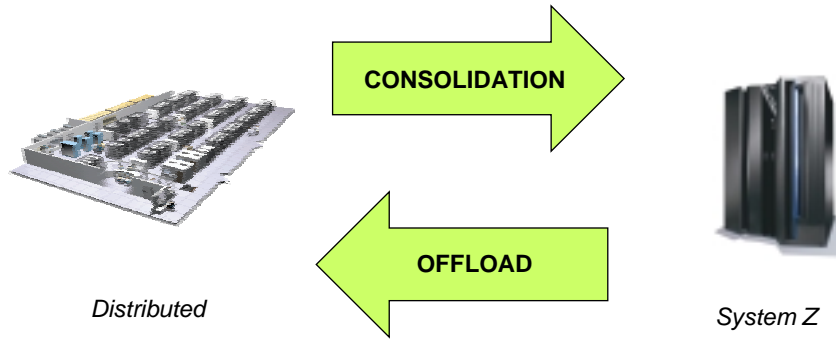
Replace Third Party Tools to Reduce Costs

- LabCorp
 - ▶ 35 products replaced - includes RMM, TWS, SCLM and DB tools and AD tools
 - ▶ About 700 MIPS
 - ▶ \$12M saved
- Putnam Investments
 - ▶ Over 20 products replaced at 2 sites - includes RACF, RMM, TWS, SCLM, SA390, GRS and DB2 Suite of tools
 - ▶ About 1500 MIPS
 - ▶ \$Millions saved
- Hennepin County
 - ▶ Products replaced - includes RACF, TWS, SA390, DB2PM, TDS
 - ▶ About 1100 MIPS
 - ▶ \$3M in savings
- Major automotive manufacturer
 - ▶ Doubled MIPS from 600 to 1200
 - ▶ Annual savings of \$1.8M
- Typically 30-50% lower run-rate after initial ROI period

A typical customer engagement replacing BMC tools

Original Product	IBM Replacement
Mainview for z/OS	IBM Tivoli OMEGAMON XE for z/OS
Mainview Stop X37	IBM Tivoli Allocation Optimizer
Mainview Explorer and Alarm Manager	IBM Tivoli OMEGAMON DE on z/OS
Mainview EasyHSM and StorageGuard	IBM Tivoli Storage Optimizer
Control-M & R	IBM Tivoli Workload Scheduler
Auto Operator	IBM Tivoli System Automation
Mainview for CICS	IBM Tivoli OMEGAMON XE for CICS / CICS PA
Mainview for DB2	IBM Tivoli OMEGAMON XE for DB2
Mainview for IMS	IBM Tivoli OMEGAMON XE for IMS
UltraOpt for IMS	IMS NETWORK COMPRESS FACILITY V1
Image Copy Plus for IMS	IMS HIGH PERFORMANCE IMAGE COPY
Unload Plus for IMS	IMS HIGH PERFORMANCE UNLOAD V1
Prefix Resolution Plus for IMS	IMS HIGH PERFORMANCE PREFIX RESOLUTION V3
Load Plus for IMS	IMS HIGH PERFORMANCE LOAD
Secondary Index Utility / EP	IMS INDEX BUILDER V2.3

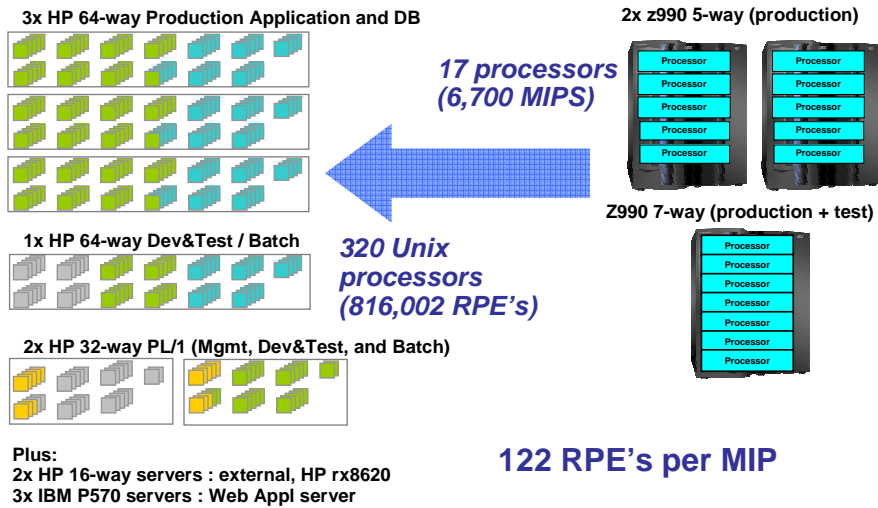
TCO Comparisons



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Asian Financial Services Customer Offload Project - Overall

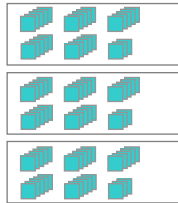


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Asia Pacific Financial Services Customer Offload Project – Database

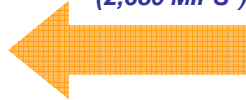
Production Oracle RAC cluster of 3 HP Superdome nodes (28 processors per node)



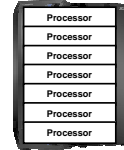
Batch (16 processors)



7 processors (2,680 MIPS*)



z990 Processors for DB2 (production and development)



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

87 RPE's per MIP

No disaster recovery

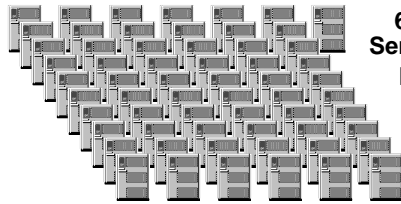
* DB2 is estimated to be 40% of total workload

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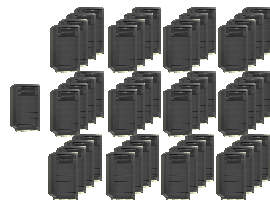
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European Banking Customer Study

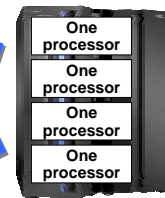
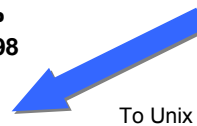
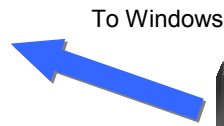
TCO Analysis to Offload CICS Transaction Workload



61 Windows Servers with 244 processors



49 System P LPARS with 98 processors



Conclusion: Same TCO with no benefit from additional migration cost

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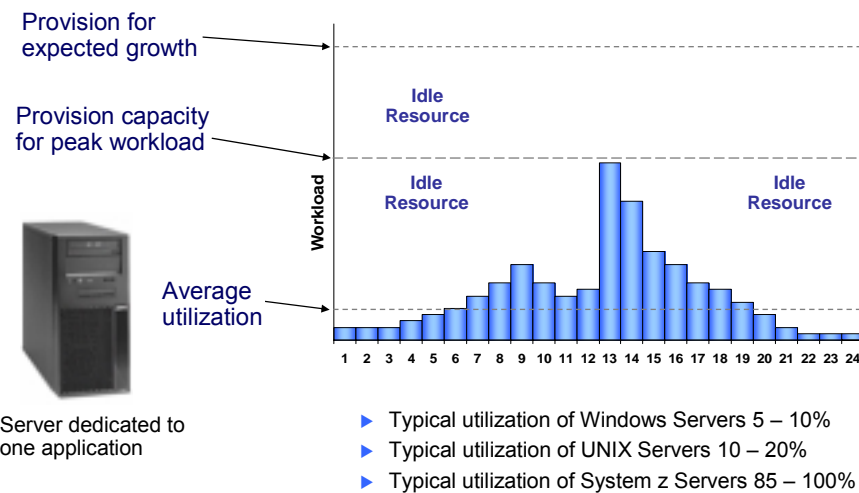
Why Do Servers Proliferate in Offload Scenarios?

- The following considerations contribute to server proliferation
 - ▶ De-multiplexing of applications to dedicated servers
 - One application workload per server group
 - Peak-to-average provisioning yields low utilization
 - Additional provision for expected growth in out years (no capacity on demand)
 - Batch workload may stress I/O capabilities
 - Separate servers for production, failover, development/test, disaster recovery
 - Infrastructure servers for systems management
 - ▶ Processing comparisons
 - Language expansion (CICS/COBOL path lengths are highly optimized)
 - Conversion factor (MIPS to TPM-C or 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
 - ▶ Partial offloads eliminate the lowest cost MIPS first

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Utilization of Distributed Servers



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Let's Consider The Other Elements of Cost

Total Cost of Ownership =
Cost of hardware +
Cost of software +
Environmentals +
Cost of labor +
Financial terms

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Distributed Power Costs Have Become a Major Issue

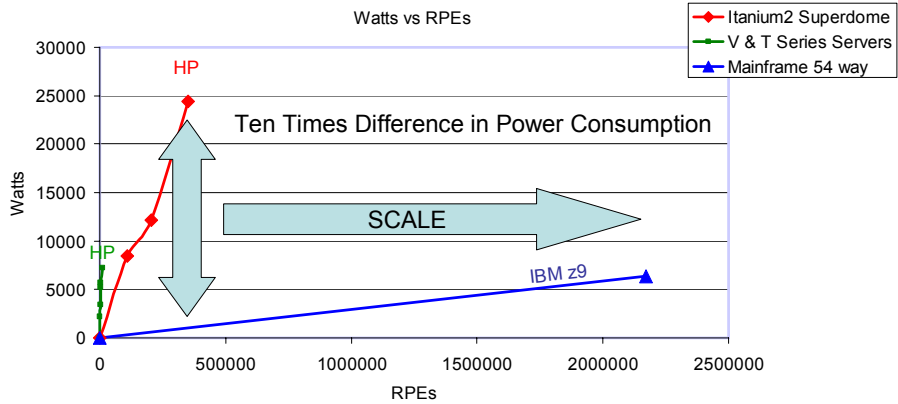
- According to the Wall Street Journal, distributed server farms can generate as much as **3,800** watts per square foot
 - ▶ In 1992 it was 250 watts/sq foot
 - ▶ By comparison, a System z9 consumes **107-312** watts per square foot – *one tenth or less the amount*
 - ▶ Turning on an IFL processor consumes 75 additional watts
 - ▶ Cooling cost is roughly an additional 60% of the power cost
- More than half of all serious outages are now caused by power problems*
 - ▶ Room temperatures averaging 92°F lead to erratic machine behavior
 - ▶ *“Power-related problems in 2005 will cause 4 of the 20 major failures, up from 2 of 20 last year”* (The Uptime Institute)

*Source: recent AFCOM survey of 200

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Mainframe Scale and Power Efficiency



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

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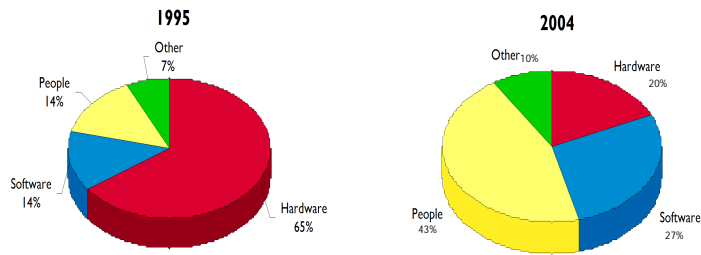
Do the Math

- HP Itanium 2 Superdome 9050 (64ch/128co) consumes a maximum of 24,382 watts
 - ▶ $24,382 \times .08 \times 24 \times 365 = \$17,087$ per year for electricity
- Mainframe with similar computing capacity consumes 2,500 watts
 - ▶ $\$1,752$ per year for electricity
 - ▶ Power cost is \$15,335 per year less
- Similar savings on cooling capacity
 - ▶ Cost of cooling is 60% to 80% the cost of power
 - ▶ Superdome total $\$27,339$ per year vs Mainframe $\$2,803$

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People Expense has Become the Dominant Component of TCO

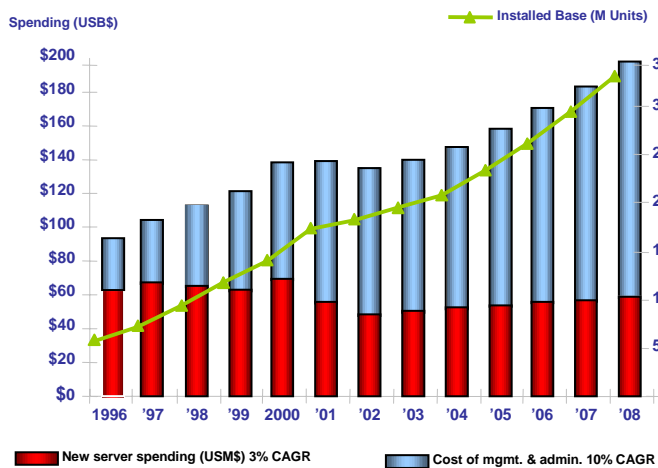


Based on IBM Scorpion customer analyses

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Since 2000, Labor Costs Have Exceeded the Cost of All Servers ... and are *Still* Growing



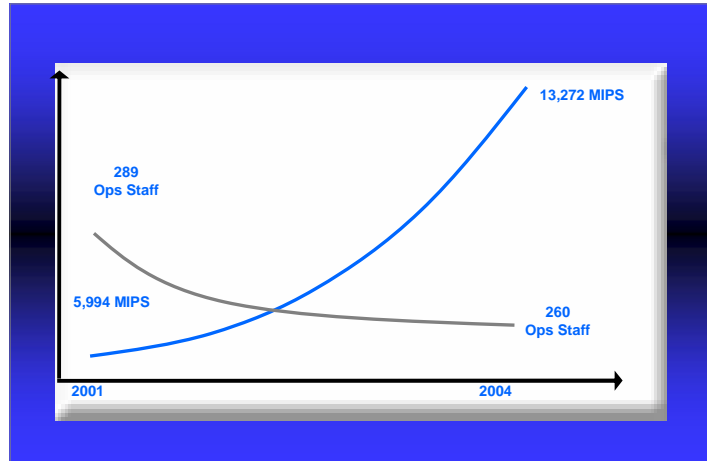
The cost of labor scales linearly with the number of distributed servers
Distributed scale-out is costly!

Source: IDC

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



$$\frac{5,994}{289} = 21 \text{ MIPS/HC}$$

$$\frac{13,272}{260} = 51 \text{ MIPS/HC}$$

Source: Gartner

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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	<u>\$793K</u>	<u>\$6,690K</u>

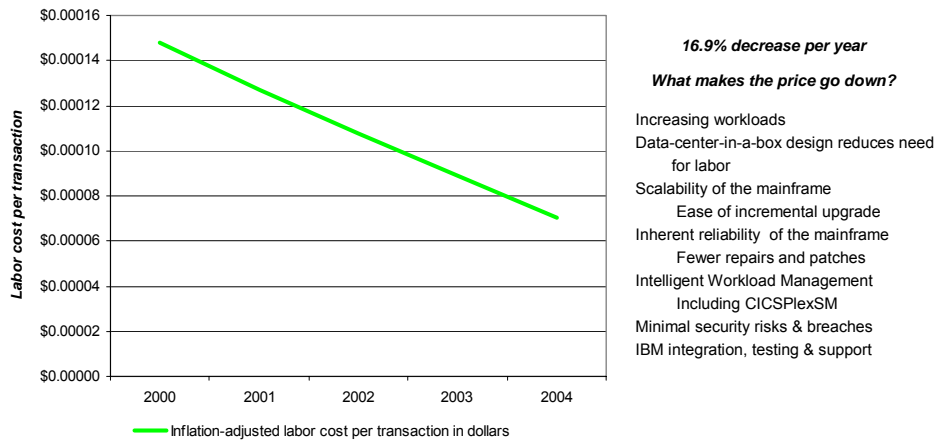
In this case, System z requires 1/8 the labor costs of the distributed environment

Source: IBM SWG Data Center

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Labor Cost Per Transaction on System z is Decreasing



Source: IBM Global Services UK

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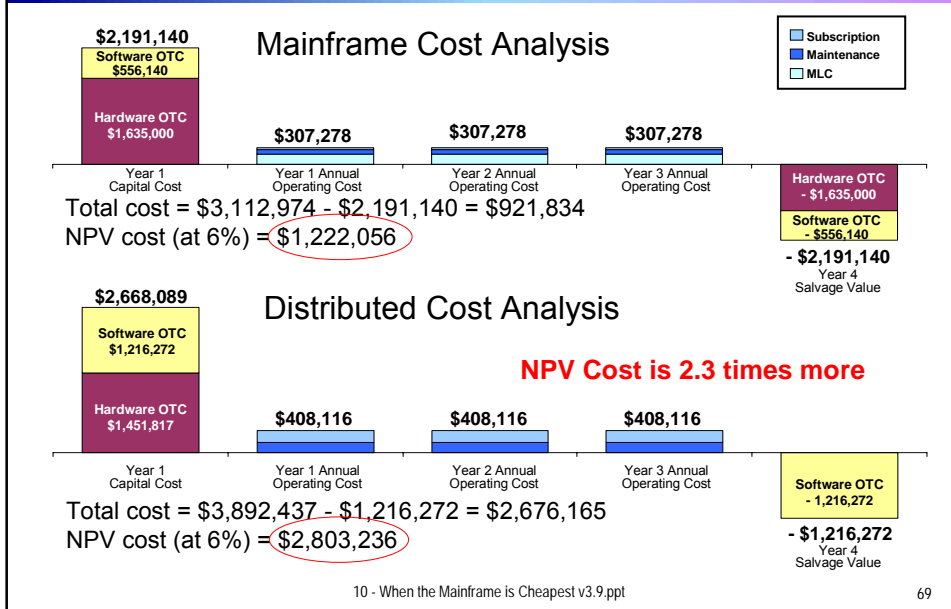
Trade-In Value Reduces Mainframe Net Present Value Costs

- 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

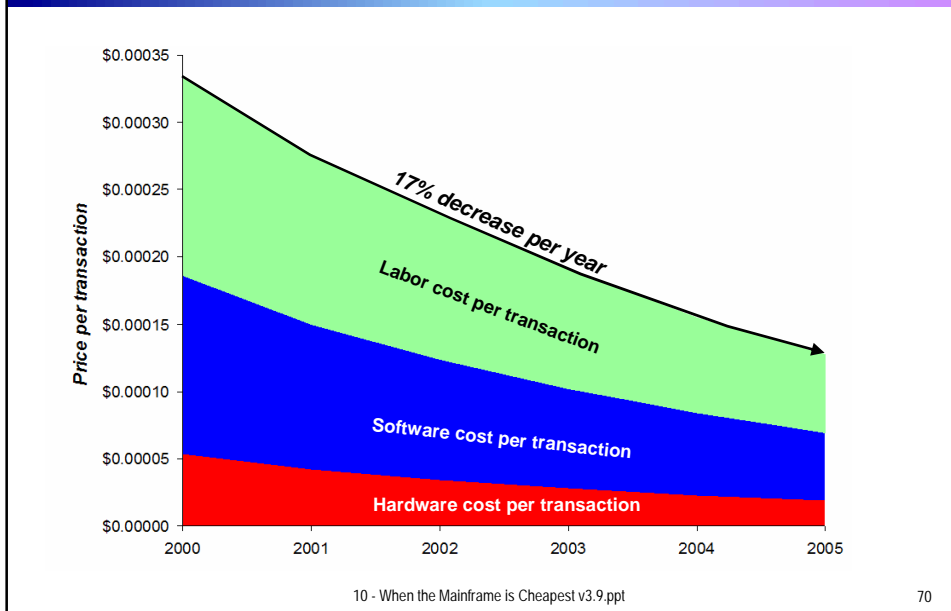
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Java Application Example Considering 100% Trade in on General Purpose Processor

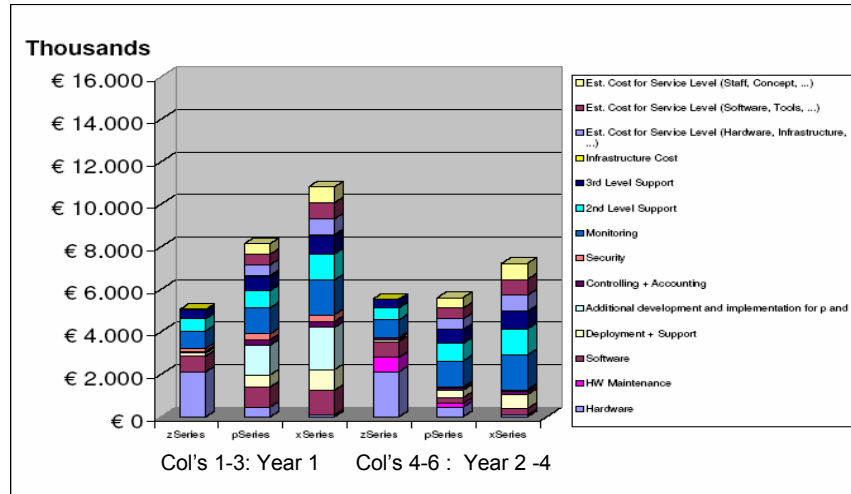


Conclusion: Total Mainframe Hardware, Software & Labor Costs Reduced by 62% in 5 Years



GAD TCO Study – a WebSphere Banking Example

Distributed servers have higher service, monitoring and support costs and cost more to develop and implement



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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.

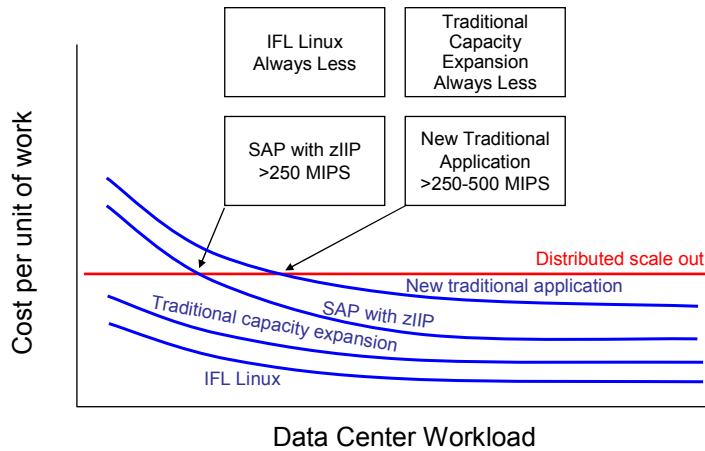
"We have a very stringent requirement of being up all the time ... Weighing heavily in support of the mainframe was its track record. There hadn't been any mainframe downtime since 1997"

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When Does 30% Incremental Workload Growth Cost Less?

3 Year TCO with HI-RAS requirement



Source: Eric Kutcher, McKinsey Analysis

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Summary

- The proper comparison between mainframe and distributed is not a single application benchmark
- The proper comparison is a distributed data center versus a mainframe, running high volume mixed workloads
- Under this comparison, mainframes have significant cost advantages

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How Customers Can Get the Lowest TCO on the Mainframe

1. Move past the “sweet-spot” to realize lower prices
 - ▶ Grow core-business MIPS
2. Use the latest technology and pricing models
 - ▶ Upgrade to System z
 - ▶ Utilize specialty processors
 - ▶ Utilize sysplex aggregation
 - ▶ Exploit sub-capacity pricing
 - ▶ Execute an ELA
3. Maximize utilization
 - ▶ Drive mainframes at 90+% utilization, 24 hours by 7 days
 - ▶ Consolidate workload onto System z
4. Minimize other costs
 - ▶ Minimize software tool costs
 - ▶ Minimize outages and security breaches...
5. Stop spiraling labor costs

