zEnterprise – An Ideal Basis For Smarter Computing

TCO Lessons Learned From Customer Engagements

IBM Eagle Team Helps Customers Find The Lowest Cost Solution

- 8 senior technical IT staff performing TCO customer studies worldwide
- Over 250 TCO studies in the past 5 years

- Study categories
  - Offload System z workloads to distributed
  - Placement of new workloads (Fit for purpose)
  - Consolidate workloads to zLinux

- Contact us via Craig Bender (csbender@us.ibm.com)

- No charge

All the examples in this module are from actual customer studies

Typical Eagle TCO Study

Approach

- Establish scope of study – applications, platforms, etc.
- Gather information
- Build the cost model
- Review with customer and iterate as needed
- Produce final report

Process

- Meet with customer face-to-face to establish scope and gather information (1/2 day). **Kick off and set expectations.**
- Complete study (30 day target)

Methodology

To understand total costs, four dimensions of cost must be considered:

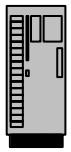
- Components
- Environment
- Time Factors
- Non-functional requirements and qualities of service

IT Solutions Require Many Cost Components

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

Components

Hardware



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

Software

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

People

FTE rate, in house vs. contract

Network

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

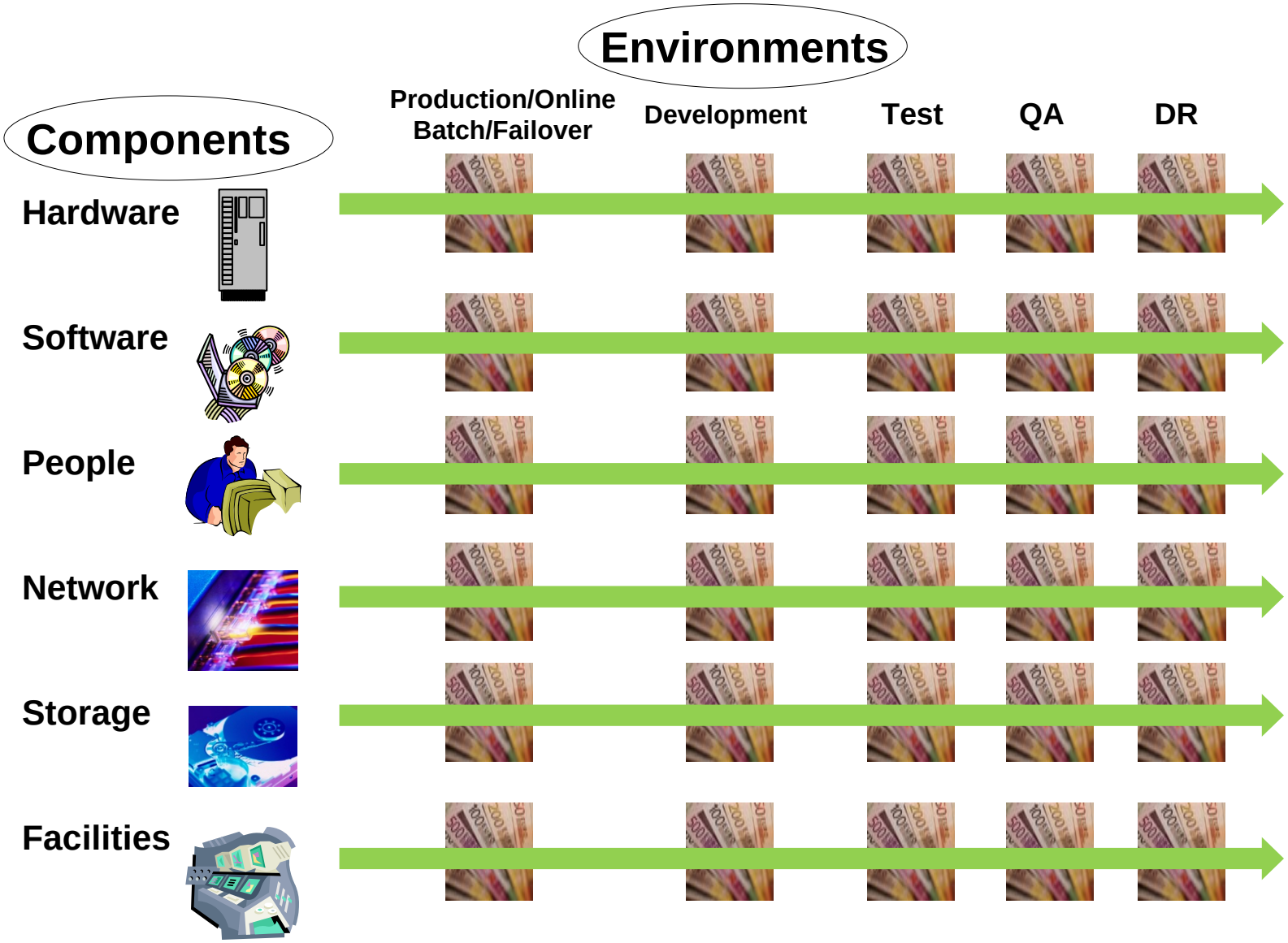
Storage

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

Facilities

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

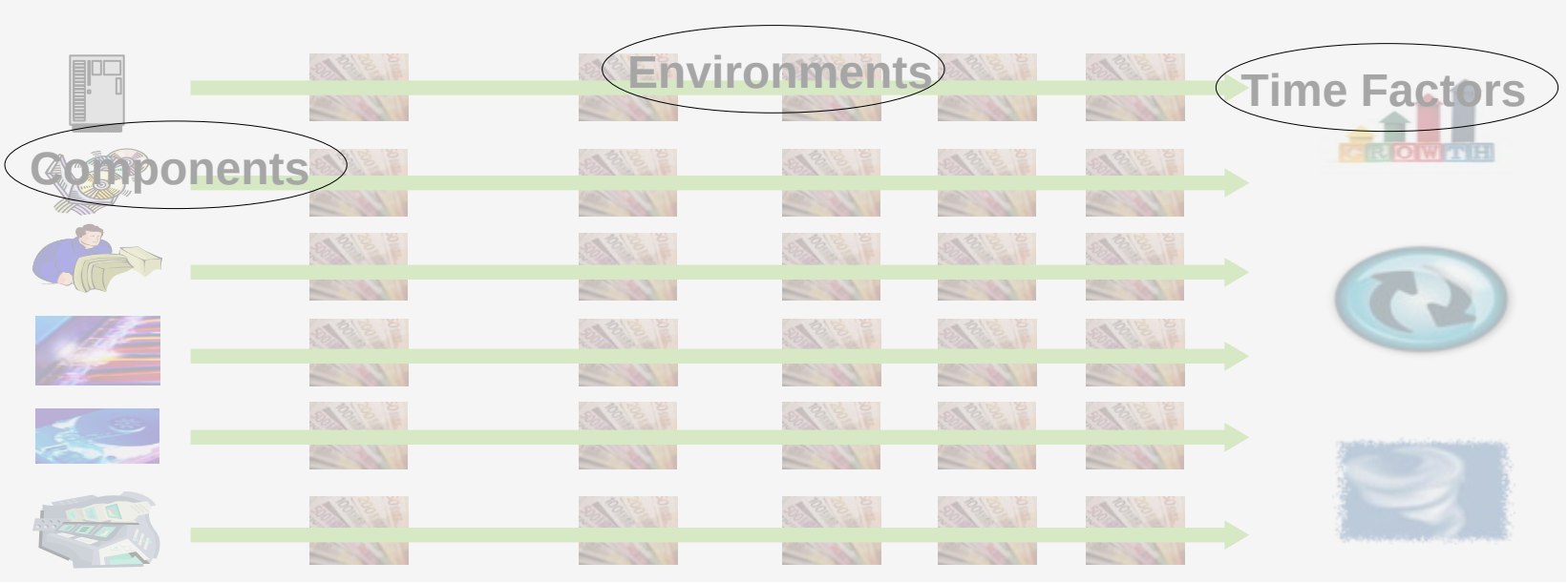
Environments Multiply Components



Time Factors Drive Growth And Cost

- Migration time and effort
- Organic growth of the business
  - Link a business metric to workload, and then use business inputs to drive the TCO case
    - UK utility company linked active service accounts to MIPS
- Planned business changes/growth
  - e.g. Change of access channel or adding a new internet accessible feature can double or triple a components workload
- Other periodic changes – hardware refresh or software remediation

Non-Functional Requirements Can Drive Additional Resource Requirements



Availability …Security …Resiliency …Scalability …

Qualities of Service, Non-Functional Requirements

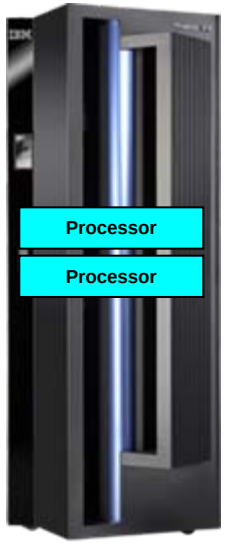
Understand The Complete Picture

…And then compare the alternatives
on a level playing field (e.g., available tools vs. labor)

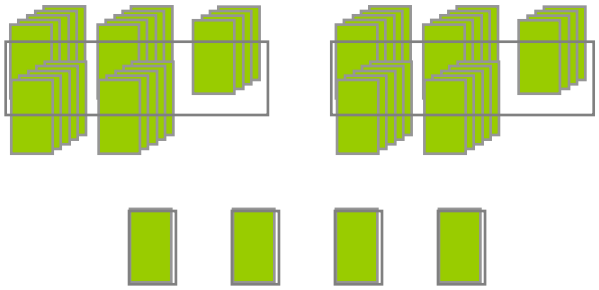
Size Alone Does Not Determine A Good Offload Candidate…

Example: Small offload project

z890 2-way Production / Dev / Test / Education
App, DB, Security, Print, Admin & Monitoring



2x 16-way Production / Dev / Test / Education
App, DB, Security, Print and Monitoring
4x 1-way Admin / Provisioning / Batch Scheduling



0.88 processors
(332 MIPS)

36 Unix processors
(222,292 Performance Units)

$17.9M TCO (4yr)

$4.9M TCO (4yr)

41x more cores

670 Performance Units per MIPS

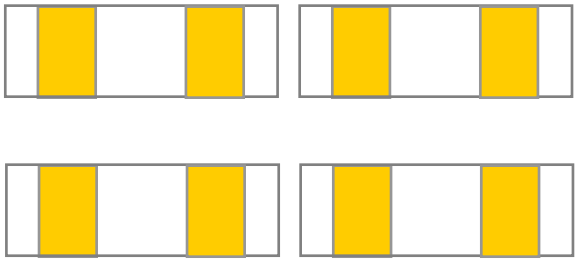
Plus:
2x HP SAN Servers (existing)
Many (existing) Windows servers

No Disaster Recovery

Size Alone Does Not Determine A Good Offload Candidate…

Example: Smaller offload project

4x p550 (1ch/2co)
Application and DB



0.24 processors
(88 MIPS)

1x z890
(production + test)

8 Unix processors
(43,884 Performance Units)

$8.1M TCO (5yr)

$4.7M TCO (5yr)

33x more cores

499 Performance Units per MIPS

Migration duration 3 years

Some Typical Eagle Studies Under 3,000 MIPS – Most Stayed On System z

Customer	z (MIPS)	distributed (PUs)	5-Year TCO z	5-Year TCO distributed	z/dist %
Average	**1,166**	**218,472**	**9,050,451**	**16,325,492**	
SA Government Agency	475	241,291	19,773,442	25,261,624	78.27%
German Financial	1,200	263,177	3,939,889	4,701,033	83.81%
NA Financial Services	2,526	308,144	3,456,611	5,939,476	58.20%
US utility company	456	163744	6,157,295	13,380,866	46.02%
European Insurance	904	171,062	13,019,980	15,877,484	82.00%
US Manufacturer	900	453,168	11,277,266	16,019,269	70.40%
Asian Bank	1,416	136,013	2,342,300	7,237,681	32.36%
US Retailer	1,700	215,124	3,543,154	8,951,851	39.58%
US County Government	88	43,884	4,717,394	8,108,668	58.18%
US Retailer	1,500	184,732	9,254,186	20,861,515	44.36%
AP bank	1,336	168,113	17,300,000	27,200,000	63.60%
AP bank	300	24,162	5,200,000	11,500,000	45.22%
US Manufacturer	1,917	261,040	4,758,313	7,350,216	64.74%
US Food Services	1,600	424,952	21,966,475	56,167,206	39.11%

Typical Decision Factors: Cost and Risk

References For Failed Offload Attempts Are Not Easy To Come By

Lombard Canada Ltd., one of the oldest property and casualty insurance operations in Canada, partnered with Micro Focus to replace old mainframe

- 200 MIPS
- CICS, COBOL, VSAM, DB2

"We estimate this project will save us in excess of $1 million a year, but more importantly, it will enable us to become more competitive in our industry both today and in the future." *

VP of IT
Lombard Canada Ltd.

BUT one year after starting, the project was abandoned

- System Integrator and Micro Focus did not have the skills
- Lombard spent millions on conversion with no results
- VP lost his position

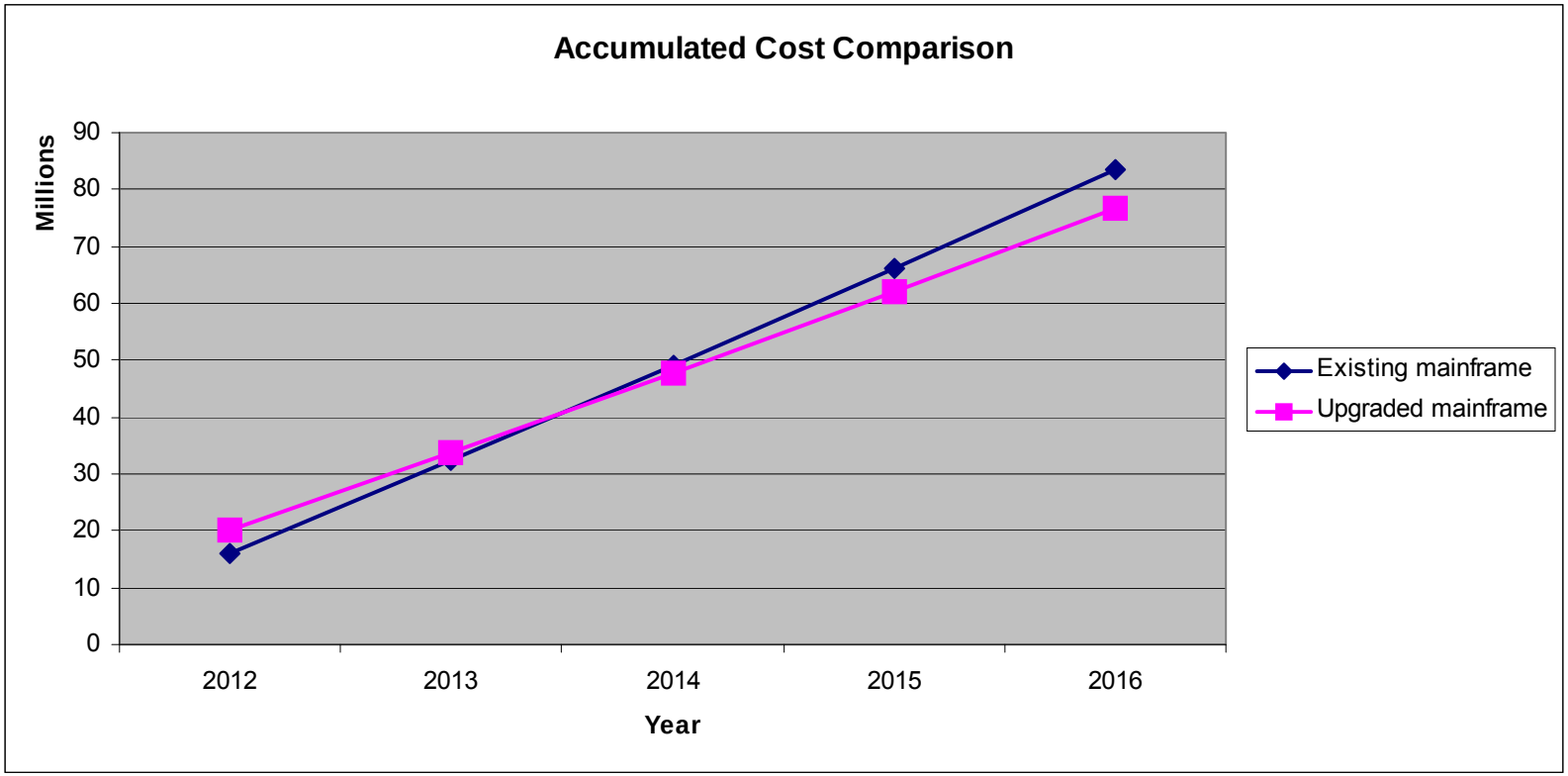
Today, Lombard continues as a System z customer, moving to z114

*Source: http://www.finextra.com/news/Announcement.aspx?pressreleaseid=4858

TCO Lessons Learned

- Always compare to an optimal System z environment
  - Currency reduces cost
  - Specialty processors revolutionize mainframe cost
  - Sub-capacity may produce free workloads
  - Replacing ISV software with IBM is a better deal
  - System z Linux consolidation is often a no-brainer
- Consider these additional platform cost differences
  - Cost of adding incremental workloads to System z is less than linear
  - New mainframe workloads have unbeatable price points via Solution Edition
  - Distributed servers need to be replaced every 3 to 5 years
  - Changing databases can have dramatic capacity impacts
  - Disaster Recovery can be more expensive than anticipated on distributed servers
  - Chatty applications are not good offload candidates
  - Customers often overlook significant tool replacement cost
  - Security breaches have high costs
  - High offload costs almost never pay back in operational savings
  - Late migration projects extend dual systems cost
  - Non-production environments require fewer resources on the mainframe
  - Mainframe cost per unit of work is much lower than distributed

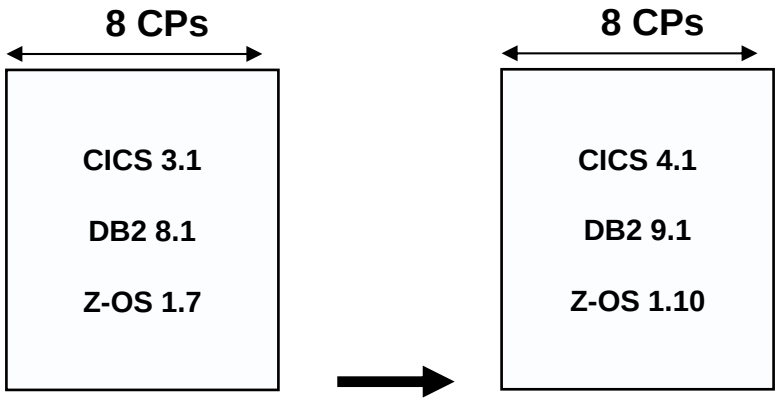
Currency Reduces Cost – Hardware



- Typical customer hardware refresh scenario
  - 2 generations, from z9 to z196
  - 2M investment pays back >1M savings every year – most cases positive in a 3 year period
  - Savings from increased capacity, reduced maintenance costs, and specialty processor offload
- Comparing latest technology servers to old mainframes is unfair but often done

Currency Reduces Cost – Software

CPO Comparison –
Only Software Changes:



System z — Same Hardware

1,560 tps — **2,330 tps**

Comments:

- Single LPAR configuration with CICS and DB2 collocated
- COBOL code recompiled with later COBOL compiler
- Later software (eg. DB2 v10) will be even better!

A similar example (European bank):

- z/OS 1.6 across tens of LPARs
  - Delayed upgrade for 9 months due to "cost of upgrade effort"
- Upgraded to z/OS 1.8
  - Reduced each LPAR's MIPS 5% mainly due to improvements in RMF/SMF code inside z/OS
- Monthly software cost savings paid for the upgrade effort almost immediately

Conclusion:
Keeping current saves money

Currency Reduces Cost – Tune Systems And Upgrade To Newer Compilers

- For core systems of record, raw throughput can affect the scalability of the whole organization

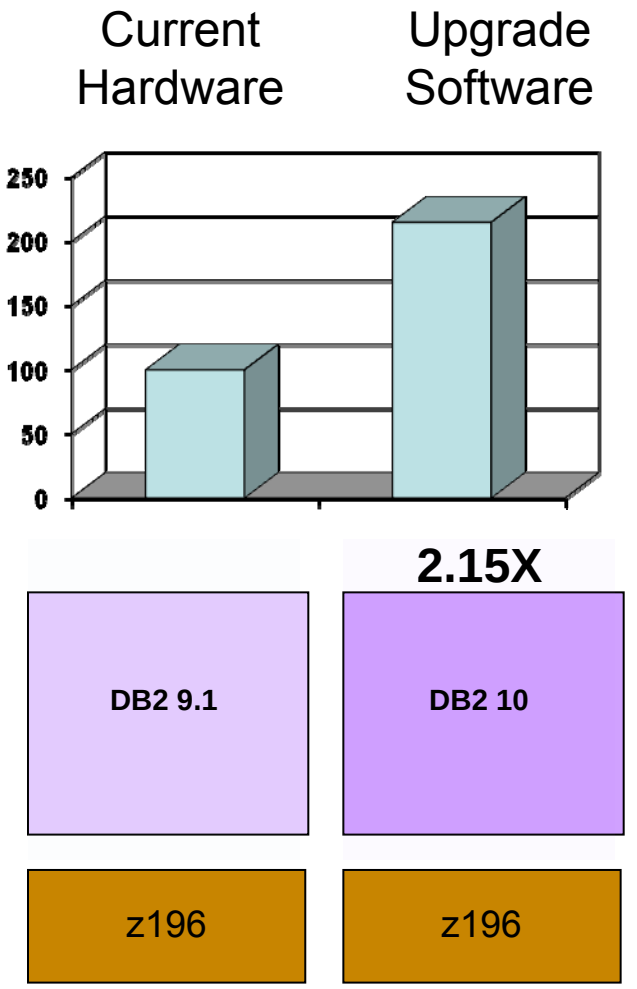
- IBM focus on tuning
  - Each release targets 5% reduction in middleware pathlength
  - Continued investment in compiler and JIT performance
  - Seek out more hardware/software optimization and offload opportunities

- DB2 v10 is a good example
  - Between 5% and 10% CPU reduction for traditional workloads
    - BMW Autos found 38% pathlength reduction for their heavy insert workload
  - 10x number of users by relieving memory constraints
  - IDAA appliance in zEnterprise for DB2 offloads, too

US Financial Company Doubles Performance After Upgrading To DB2 10 And Tuning

Tests showed **2.15x** boost in performance of business intelligence application

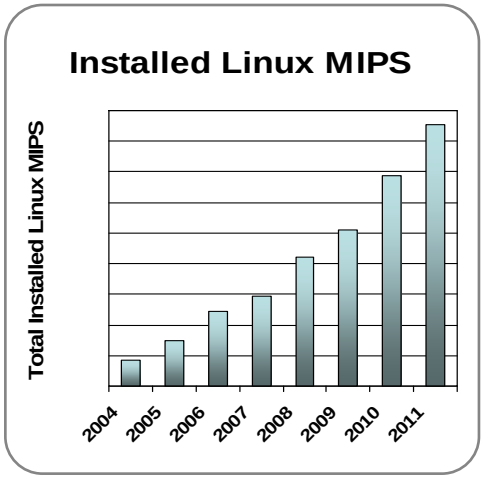
- First computed 42 operational BI reports serially
- Then database software upgraded to DB2 10
  - Performed tuning such as computing additional indexes, collecting additional statistics and pre-computing global Temp tables
- Results showed **54%** reduction in response time



Results may vary

Specialty Processors Revolutionize Mainframe Cost

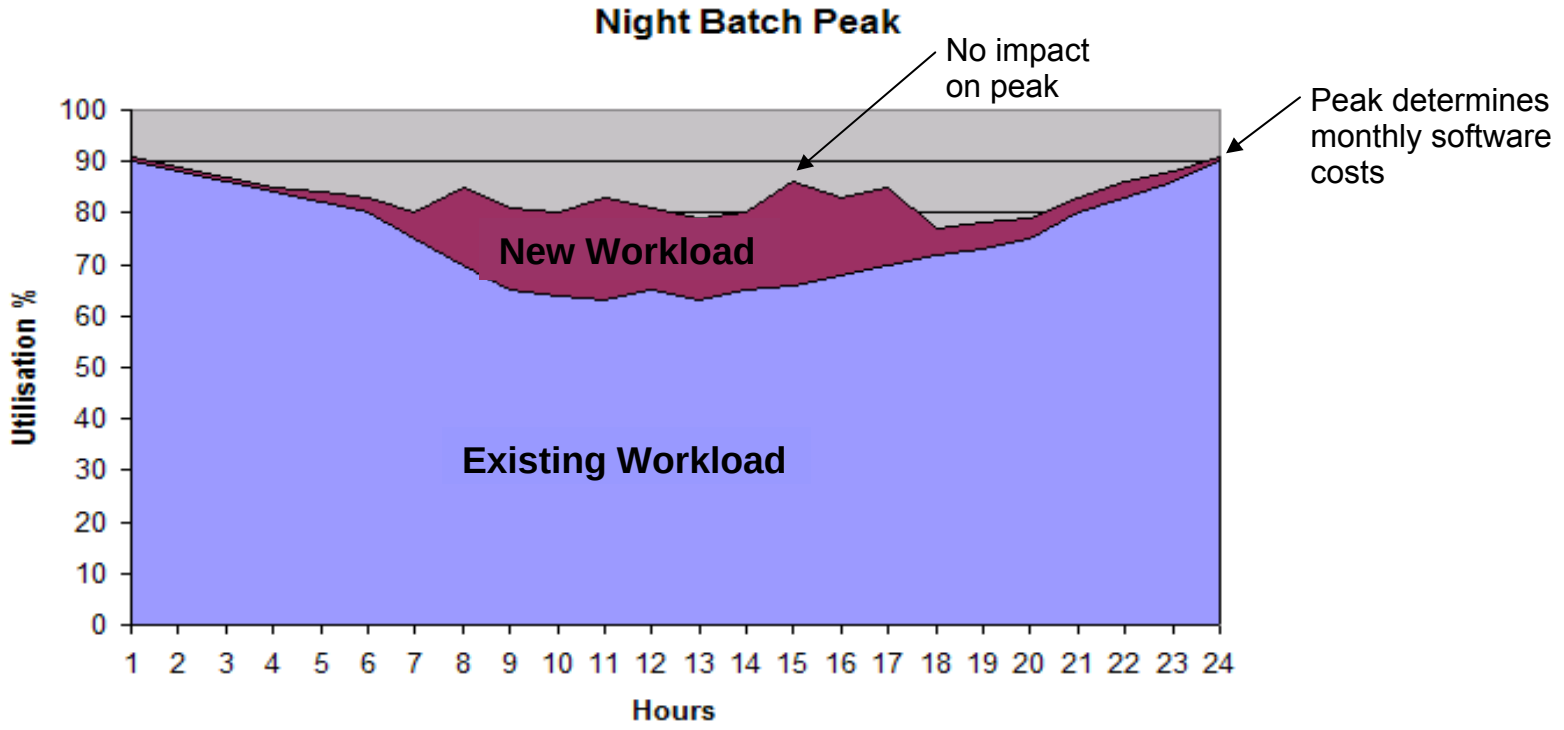
- Special assist processors for System z
  - For Java or XML workloads (zAAP)
  - For selected data, networking and security workloads (zIIP)
  - For Linux workloads (IFL)
- Attractive pricing
  - Hardware is from $35K per processor one time charge
    - Considerably less cost than a general purpose z/OS processor
  - No charge for IBM software running on zAAP/zIIP
  - IBM software on an IFL costs 120 PVU's (less than an Intel dual core)



Linux now 20% of all installed MIPS

- Cost impact of zAAP/zIIP depends on offload percentage
  - Between 40%-95% is customer experience
  - Tuned to task – for example, 3-5x pathlength expansion of Java countered with 80% offload to zAAP
- IFL processors have had a big impact on Enterprise Linux
  - 66 of the top 100 System z clients are running Linux on the mainframe
  - This is now the lowest cost place to run most IBM software
  - Fantastic UNIX-style workload consolidation option, or a good place to co-locate UNIX-style apps with z/OS data and services

Sub-Capacity May Produce Free Workloads



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

Replacing ISV Software With IBM Is A Better Deal

- Example: Medium-sized financial company in Europe
  - Started with a typical mixed software environment (left), matching our average profile
- Migrated ISV tooling to IBM tooling
  - Changed their software cost profile to that shown on the right

Average Profile (BEFORE)		
Weighted MIPS		8,800
Cost Per MIPS per Year		Profile
IBM Software	1,000.00	24.72%
		0.00%
ISV Software	1,540.00	38.07%
TOTAL SW	2,540.00	

Actuals (AFTER)		
Weighted MIPS		8,900
Cost Per MIPS per Year		Profile
IBM OTC	376.09	13.66%
IBM MLC	1,023.77	37.20%
ISV Software	136.09	4.94%
TOTAL SW	1,535.95	

- Results: IBM software costs are now slightly higher than the average customer…
  - But ISV software costs are dramatically lower – saving $1000/MIPS per year from their annual software bill

Replacing ISV Software With IBM Is Also A Better Deal Than Offloading

Example: Large US bank

	Customer's Mainframe Offload Estimate	**Eagle Team Analysis - Move To IBM Tooling**
Investment $, Period	$54M over 2 years	$3M over 1 year
Predicted Annual Cost Savings	$13M from year 3	$6M from year 2
5 Year TCO, Breakeven	$140M, year 7	$101M, year 2
Level Of Risk	Very High	Very Low

- Which would you choose?
  - A highly disruptive, risky and expensive project with distant payback under unlikely assumptions, OR…
  - A less disruptive, low risk and low cost project with instant payback

System z Linux Consolidation Is Often A No-Brainer

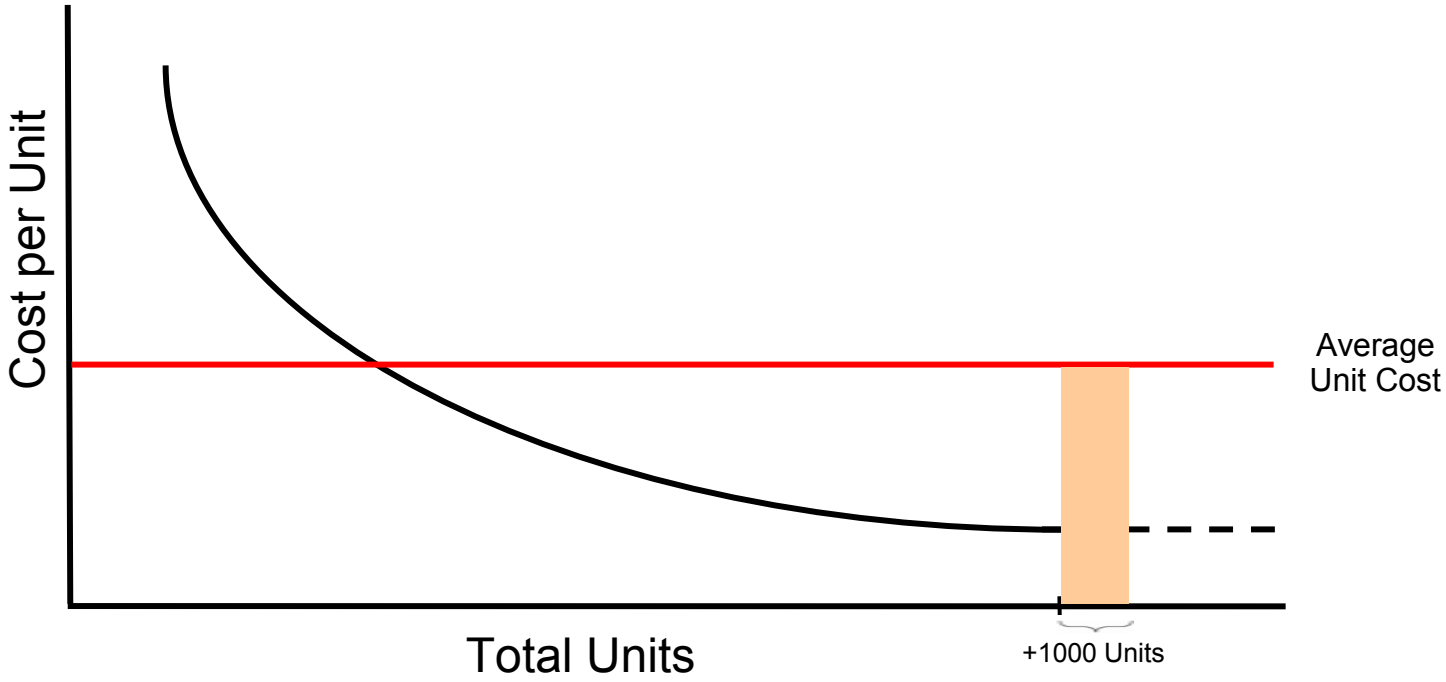
- Example: Large US/UK financial services company
  - Had a mixture of dedicated (Oracle) and virtualized (WAS products) environments on Intel
  - Scaling out rapidly – up to 172 images on 836 cores

	Refresh existing x86 servers	Consolidate on zLinux	Observation
Software	9.76M	3.70M	Software costs down 62%
Hardware	2.32M	5.22M	Hardware costs up 125%
Labor/Facilities	3.83M	0.69M	Charge to department down 82%
Migration	0.18M	0.41M	
Cost Avoidance	-	-0.61M	
Total	**16.1M**	**9.41M**	

- 5 Year Savings: 6.6M, with financing delivering savings in year 1 budget
- Achieve 26:1 core consolidation from virtualized x86 to zLinux
- 5 Year IBM Solution Edition pricing including two new mainframes in a pair of data centers
- Added benefit: Brought DR in house

Cost Of Adding Incremental Workloads To System z Is Less Than Linear

- Mainframes are priced to deliver a substantial economy of scale as they grow
- Doubling of capacity results in as little as a 30% cost growth for software on z/OS
- Average Cost is more than incremental cost
  - This is why chargebacks can be dangerous!



Cost Of Adding Incremental Workloads To System z Is Less Than Linear

- Example: European bank
  - Customer determined current mainframe and distributed WAS application costs were similar
  - Examined the incremental cost of adding one more large WAS application to each platform
  - The mainframe demonstrated a clear advantage

	Incremental Mainframe	Incremental Distributed
5 Year TCO	**1.29M** **(657K OTC, 42K Y1, 147K Y2-5)**	**1.56M** **(378K OTC, 192K Y1, 249K Y2-5)**

- Although moving existing WAS applications between platforms is unlikely, future WAS deployments will now be targeted to the mainframe

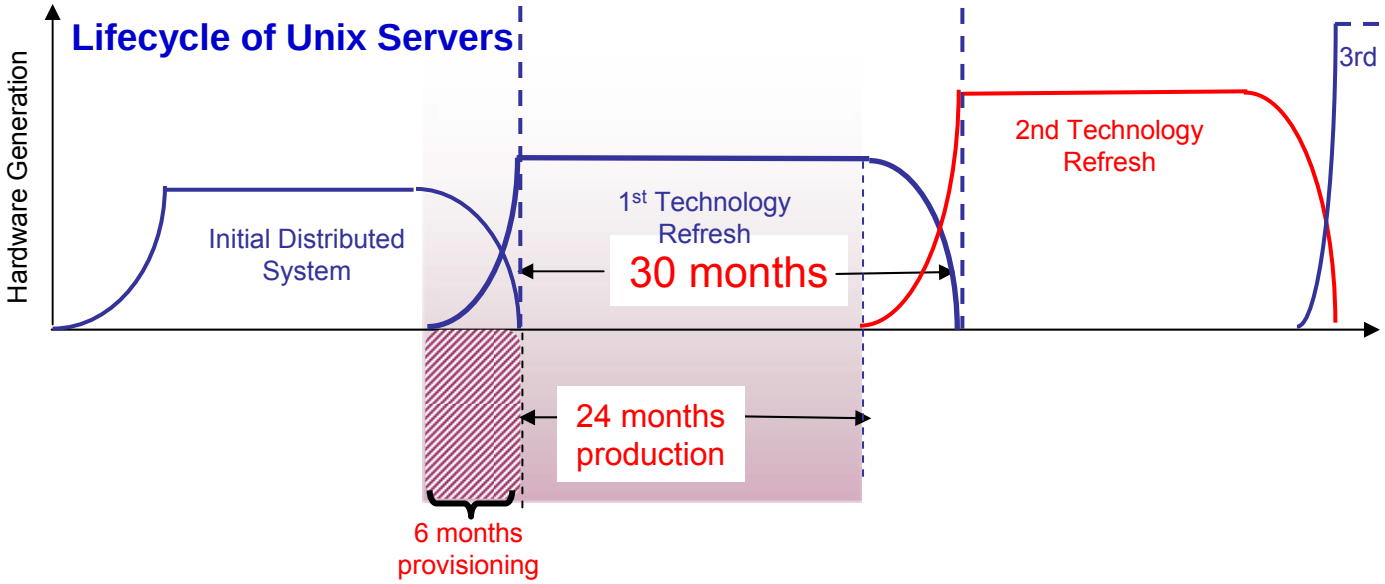
New Mainframe Workloads With Unbeatable Price Points Via Solution Edition

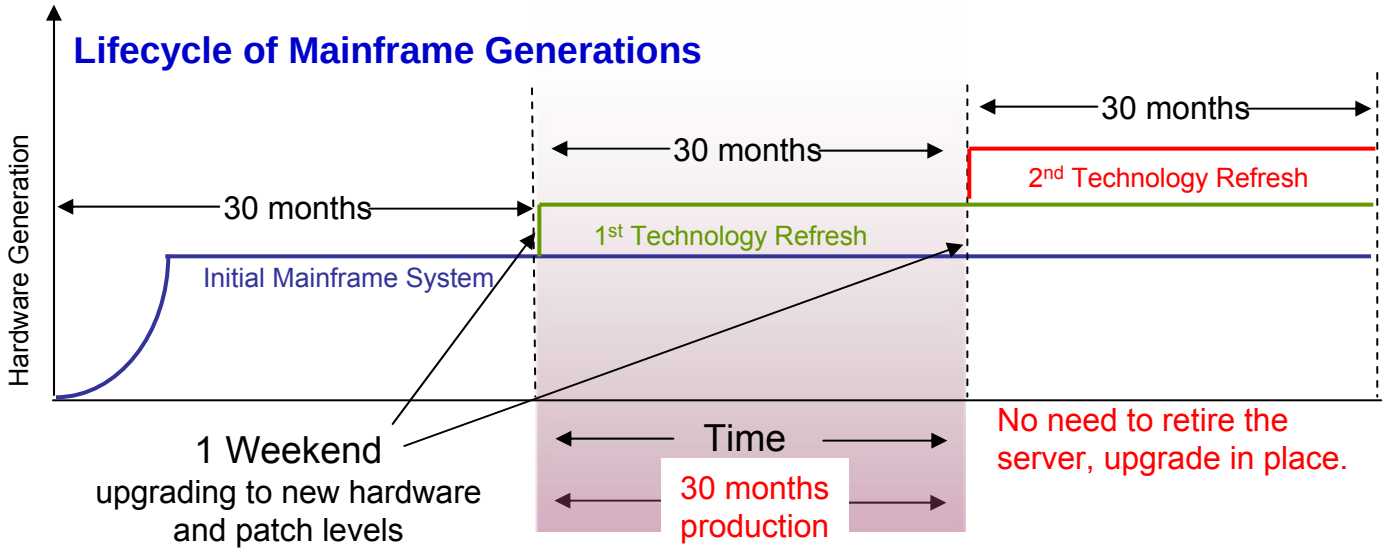
- Bundle of System z **hardware, software** and **maintenance**
  - 3 or 5 year **Best Price**
- Focus: new System z workload opportunities
  - Not for existing workloads
- Solution Editions usually include:
  - System z hardware (new footprint or incremental)
  - Prepaid hardware maintenance
  - Comprehensive middleware stack (including subscription and support)
  - Storage as an option for all Solution Editions
  - Services for some Solution Editions

Distributed Servers Need To Be Replaced Every 3 To 5 Years

- IT equipment refreshed 2 – 7 year intervals, normally 3 or 4 years
- Distributed servers re-purchased each time
  - Normally with some additional growth capacity (CPU, memory, I/O and other specialty cards like cryptographic offloads)
- With a growing mainframe, customers normally only have to purchase the additional (new) MIPS capacity
  - Existing MIPS are often carried over to the new hardware
  - Existing memory, I/O facilities and specialty processors / cards are also normally carried over to the new hardware
- Five year TCO studies show this effect, shorter periods do not

Distributed Servers Need To Be Replaced Every 3 To 5 Years





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

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

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

Changing Databases Can Have Dramatic Capacity Impacts

- Asian customer migrated large IMS DB to DB2
  - Capacity (MIPS) requirement for the database doubled (2x)
- European customer migrated IMS to Oracle RAC
  - Required a huge growth in processor cores
  - Reported a 3x storage requirement increase
- Small European customer migrated from IDMS to DB2, then decided to rehost off mainframe
  - Required 41x more core; broke our record for the highest MIPS-to-RPE ratio
  - Suggests mechanical conversion of code adds yet more overheads onto any existing overheads already in place
    - Badly written applications get worse still!
  - Application and data modernization in place are faster, safer and more efficient – and normally cheaper, too!

RPE are distributed performance units from Ideas International

Disaster Recovery Can Be More Expensive Than Anticipated On Distributed Servers

- Disaster Recovery costs include provisioning and testing
- Example: Major US company undertakes periodic DR testing
  - ~ 200 Distributed Servers (LinTel, Wintel, AIX, and HP-UX)
  - Compared to DR when same applications run on mainframe (using CBU)

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

* Does not include DR planning and post-test debriefing

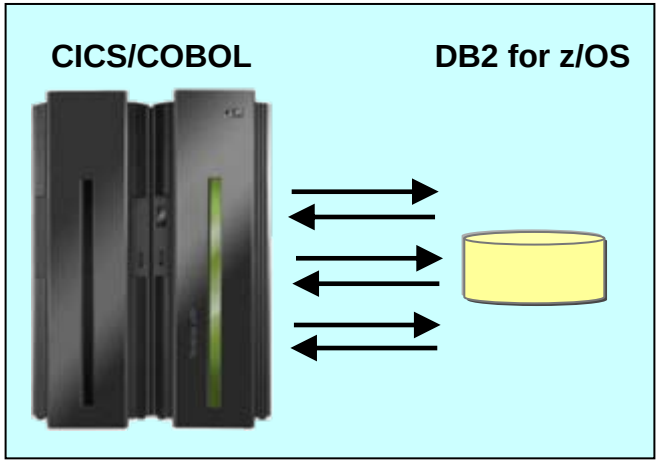
- Customer Recovery Time Objective (RTO) estimates:
  - Distributed ~ 48 hours to 60 hours
  - Mainframe ~ 20 minutes

- Conclusion: Mainframe both simplifies and improves DR testing

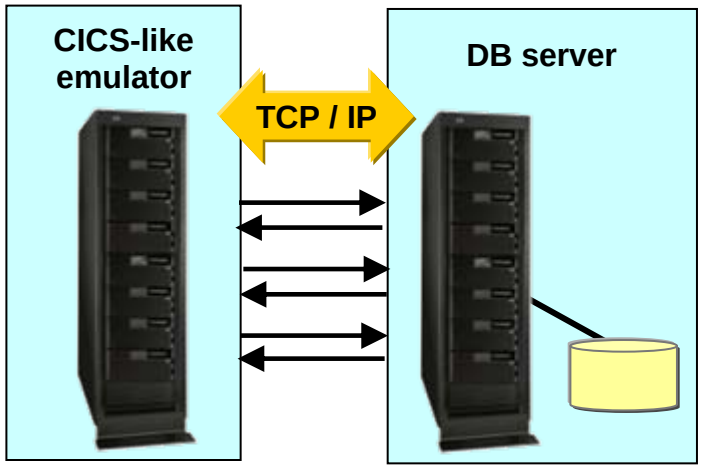
Chatty Applications Are Not Good Offload Candidates

- Many traditional applications are “chatty”
  - Tight integration between business logic and data; finely tuned
  - Frequent, unpredictable reads and/or updates of one or more data sources
- Moving these onto separate distributed servers introduces
  - More CPU overhead and resource requirements
  - Security risks (firewalls, etc.)
  - Latency due to the network

Single z/OS LPAR



Distributed architecture



Chatty Applications Are Not Good Offload Candidates (Example)

- Mid-sized European bank
  - Customer and offload vendor proposed a hybrid rehost
  - Move high MIPS CICS online workload to Linux on System z while retaining DB2 and some VSAM data on z/OS
- Application profile:
  - Most CICS application programs accessed VSAM and DB2 data
  - Individual programs had a “chatty” data access profile
  - CICS transactions typically execute <100ms
    - The mainframe component of an end-to-end user interaction accounts for no more than 20% of the total
- Conclusion: “Breaking apart” the CICS transaction programs induced latency impacts on the SLA

Customers Often Overlook Significant Tool Replacement Cost

- Customers often struggle to identify all the replacement tools and middleware they will need for an offload

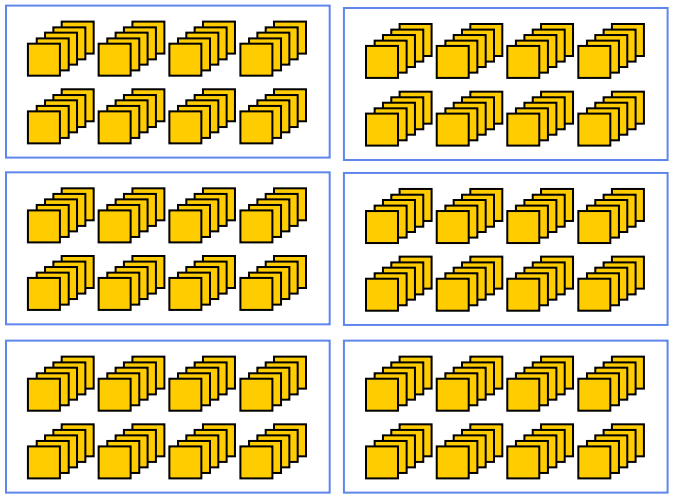
- Customer example: 261 total software tools products on z/OS
  - Only 53 products (20%) had near equivalents on distributed platform
  - How to account for 208 missing products? How to estimate cost?
    - Applications may be re-written to not need missing products
    - New code could be written to perform the function from scratch
    - Adding operations labor to manually do the function could be an option

- We extrapolated from the known products cost
- This proven to be good estimate a few years later

Another Example Of Software Costs Driven By Replacement Function And Core Proliferation

Typical Eagle TCO study for a US government agency

6x HX5 Xeon blades (4ch/40co)



2x z10 (Production, Dev, DR)

3.4 processors
(2,900 MIPS)

240 distributed processors
(1,532,640 Performance units)

$96.1M TCO (5yr)

$33.0M TCO (5yr)

480 Performance Units per MIPS

Not All Mainframe Management Software Could Be Replaced

Total **Distributed** Software Costs

$53.8M (5 yrs.)

Distributed Software Identified	Initial OTC	Maint. (per yr)
DB2	$4.50M	$0.99M
DB2 Recovery Expert	$1.58M	$0.35M
DB2 Optim Perf. Manager	$1.31M	$0.29M
DB2 Adv. Access Control	$1.23M	$0.27M
DB2 PureScale	$2.18M	$0.48M
IBM Optim DB Admin.	$0.66M	$0.15M
MQ	$0.82M	$0.18M
System Automation	$3.56M	$0.78M
Workload Scheduler	$0.78M	$0.17M
Access Manager	$0.51M	$0.11M
Micro Focus	$8.89M	$1.60M
Micro Focus Studio Ed.	$0.84M	$0.11M
Additional Products	$2.61M	$0.57M

Total **System z** Software Costs

$30.0M (5 yrs.)

44% less

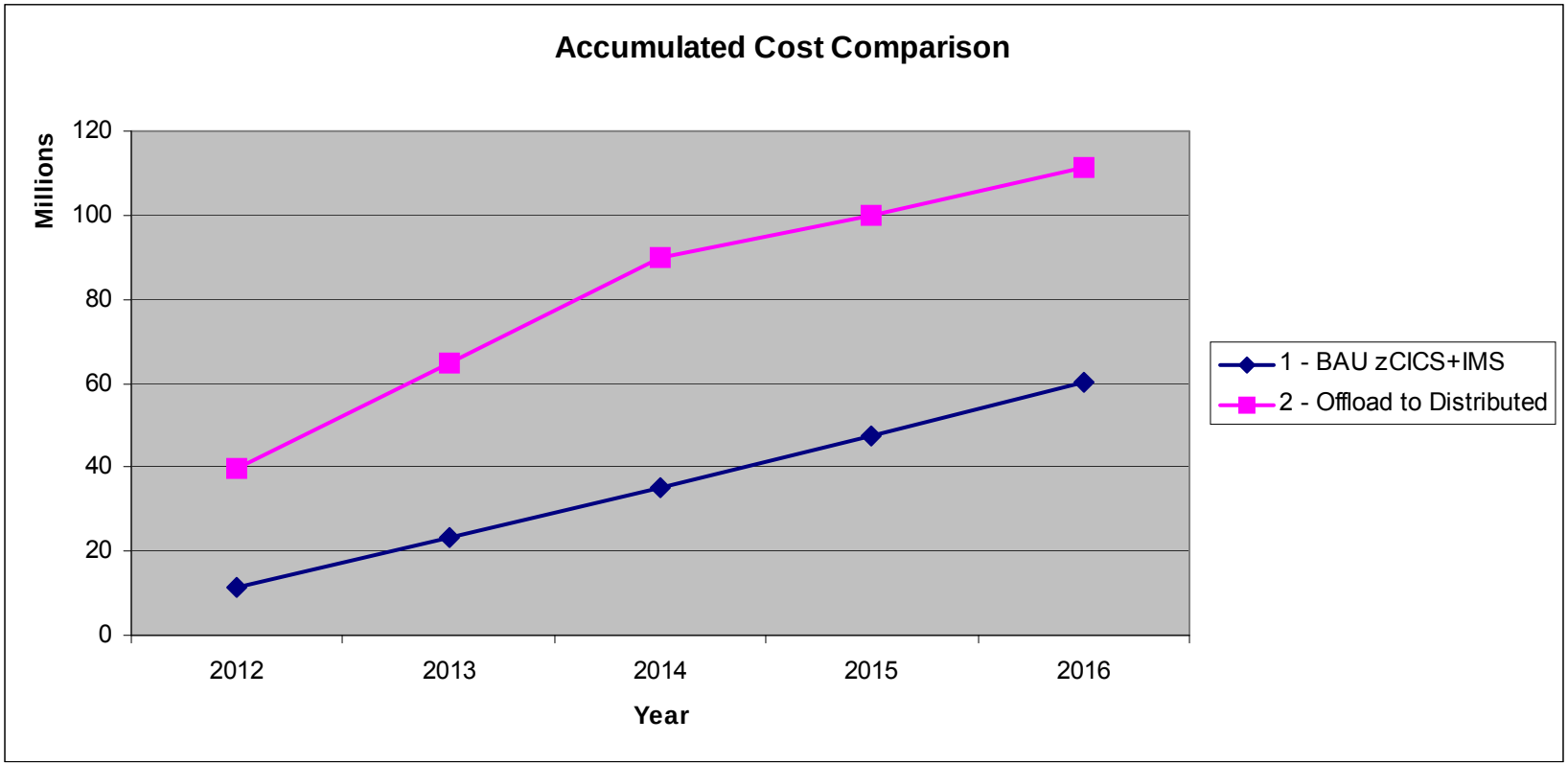
- Only 12 of 26 mainframe system management products available on distributed platform
- Of those, functionality not equivalent
  - Operations automation not as robust
  - Tape solution missing
  - Database tools missing
  - No RTM1 and RTM2
  - Lack of SMF and RMF
- Development costs for repair of missing functionality not included

Security Breaches Have High Costs

Example: Public US healthcare company

- Security breach was a result of theft of physical hard drives which contained customer and agent data (data, audio and video files)
  - Fifty-seven drives stolen from a data closet in a leased call center office
- Government regulations required:
  - Letters should be sent to customers and agents
  - Various local and national authorities needed to be notified
  - Fines can be levied (but weren't in this case)
- Security breach was conservatively estimated to cost $10M, including:
  - Diagnosing exposure
    - Approximately 700 people worked on identifying "what and who" was breached
  - Restoring lost files from backups
  - Phone calls from customers and documenting issues
  - Sending letters to customers and agents (~$2M estimated, >1M letters)
  - Replacement hardware (~$6M, switched to encrypted drives in all machines / SAN, requiring other hardware and software upgrades across the organization)
  - Credit monitoring (volunteered by the organization; not required by law)

High Offload Costs Almost Never Pay Back In Operational Savings



- Example: Existing older mainframe to new distributed platform
  - Typical mainframe offload cost profile with significant investment cost
  - Once migration completes, the operating cost is similar to the current mainframe – NO ROI!

Data based on European bank customer

Late Migration Projects Extend Dual Systems Cost

Example: Large US retail customer

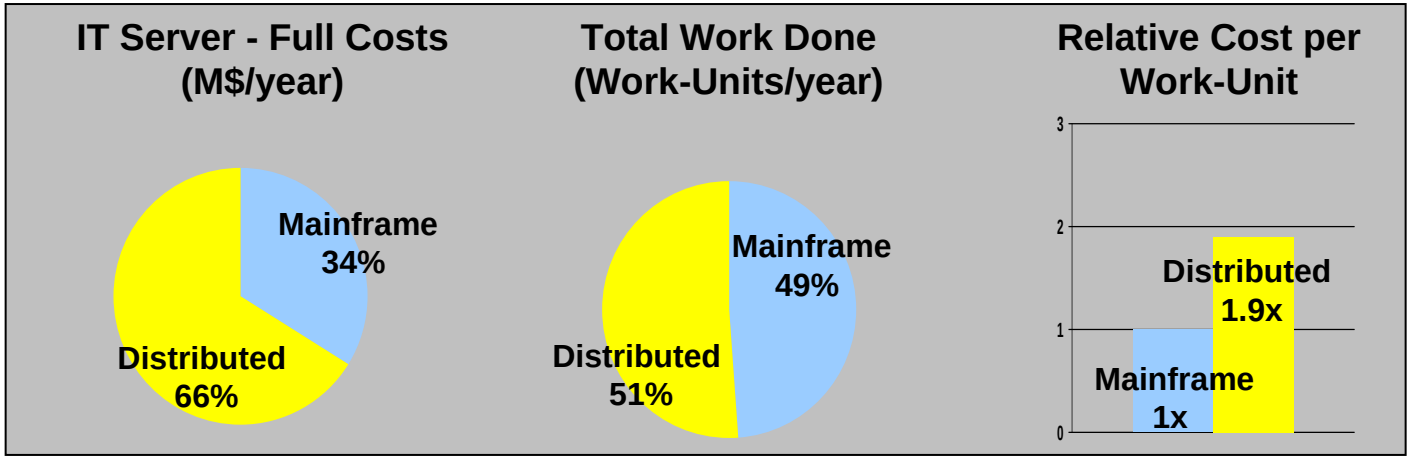
- Objective:
  - Offload 3,500 MIPS using Micro Focus
  - $10M budget and 1 year schedule
- Eagle Study advised against the offload; customer proceeded anyway
- Result:
  - 18 months later they had spent $25M and moved only a 10% of their MIPS
- Additional costs came from
  - Internal staff to cover the overrun
  - Substantial manual steps replaced mainframe automation
  - Needed many additional software products
  - Ended up acquiring additional distributed capacity over initial prediction (just to support the 10% they actually offloaded)
  - Extending the dual-running period of the rehost
- Executive sponsor lost their job

Non-Production And HA Environments Require Fewer Resources On The Mainframe

- Development and Test capacity
  - Centralized – Prod+25%
  - Distributed – a range, but around Prod+150%

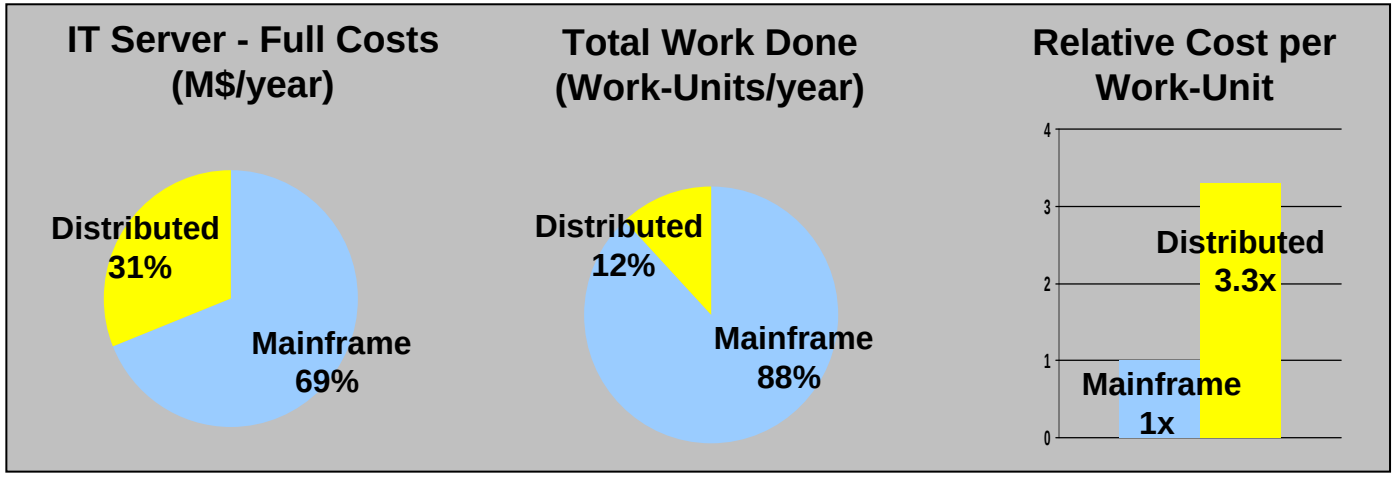
- High Availability mechanisms for Production
  - Dedicated active/active failover (Prod x 2.5)
  - N+1 clustered (Prod x 2 worst case)
  - Mainframe (usually Prod x 1, sometimes less!)
    - E.g., add LPARs without adding capacity or borrow/reuse MIPS from another time

Mainframe Cost Per Unit Of Work Much Lower Than Distributed



Case 1:
Very large retail bank
total of service delivery plus application development

Mainly UNIX distributed (>5000 servers)

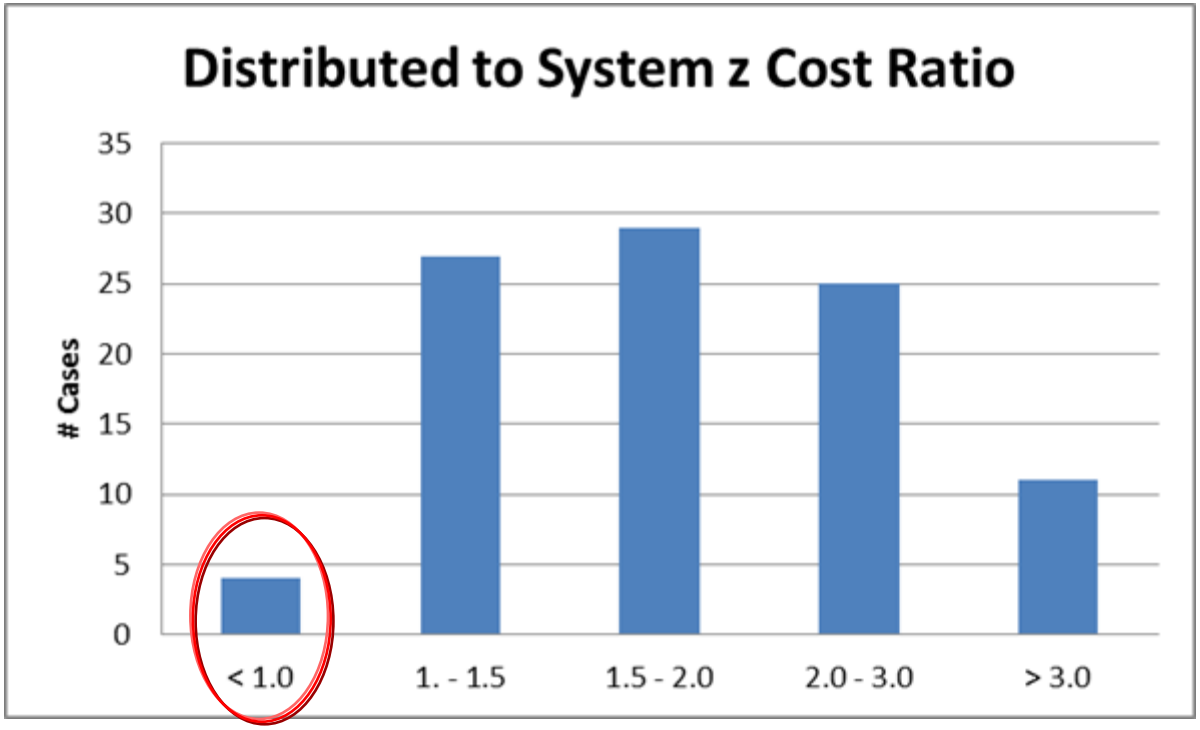


Case 2
Medium retail bank
service delivery only
Mainly mainframe
2500 mips, 13 M txns/day
Limited distributed servers
Windows + some UNIX
(~350 servers, 12% util'n)

Data from 3Q06 Scorpion studies

The distributed IT Total Cost/Work-Unit is approx. 2-3x Mainframe Cost/Work-Unit
The Mainframe typically does more work, Distributed has a lot of supporting infrastructure

Numerous TCO Studies Prove These Learned Lessons



- 97 total customer studies from 88 MIPS to 48,750 MIPS
- Average cost of distributed alternative was 2.2 times greater than System z
- Only 4 out of 97 studies showed lower costs on distributed