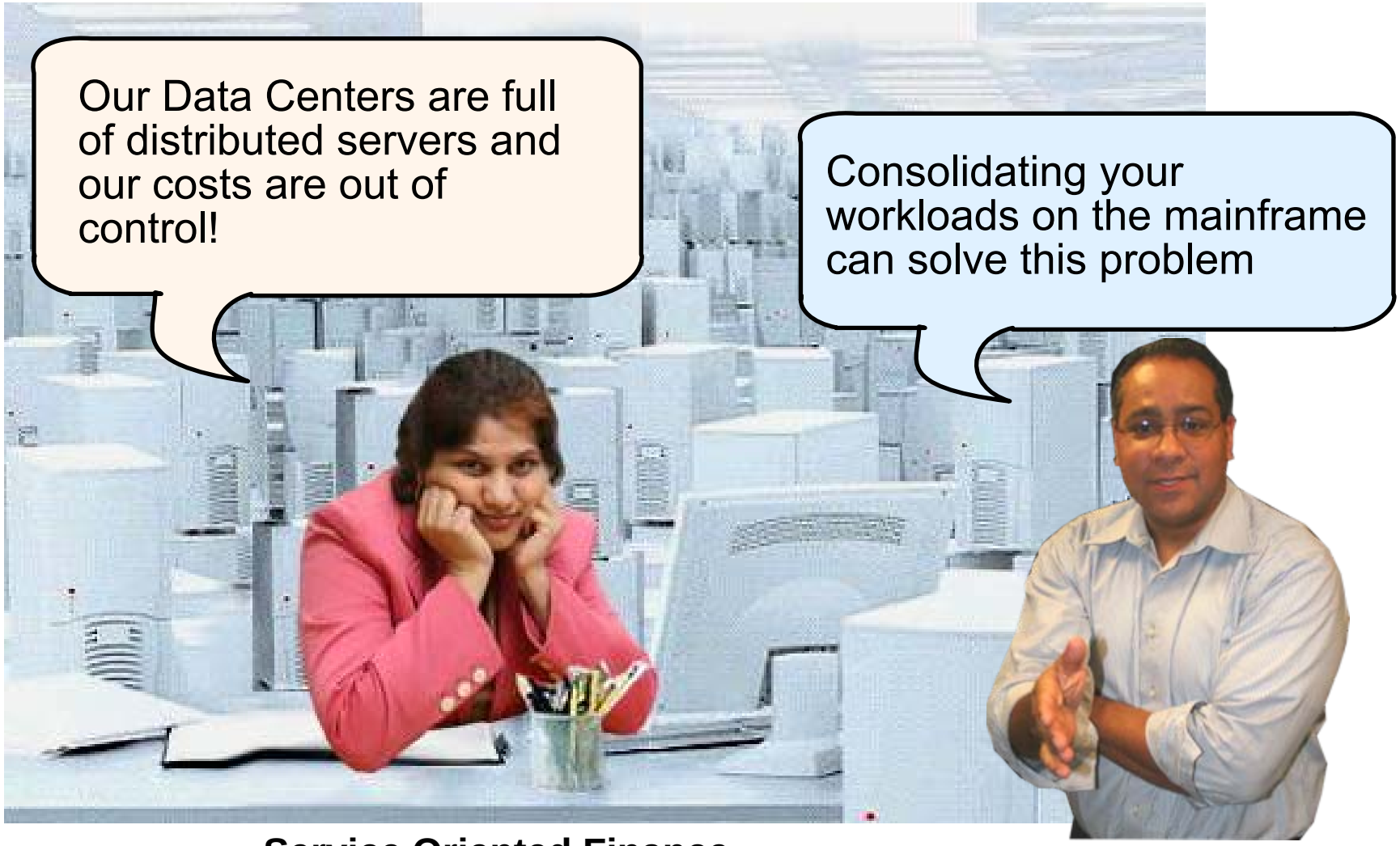
Extending Your Mainframe For More Business Value

Consolidate Workloads
To Reduce Costs

Distributed Server Sprawl

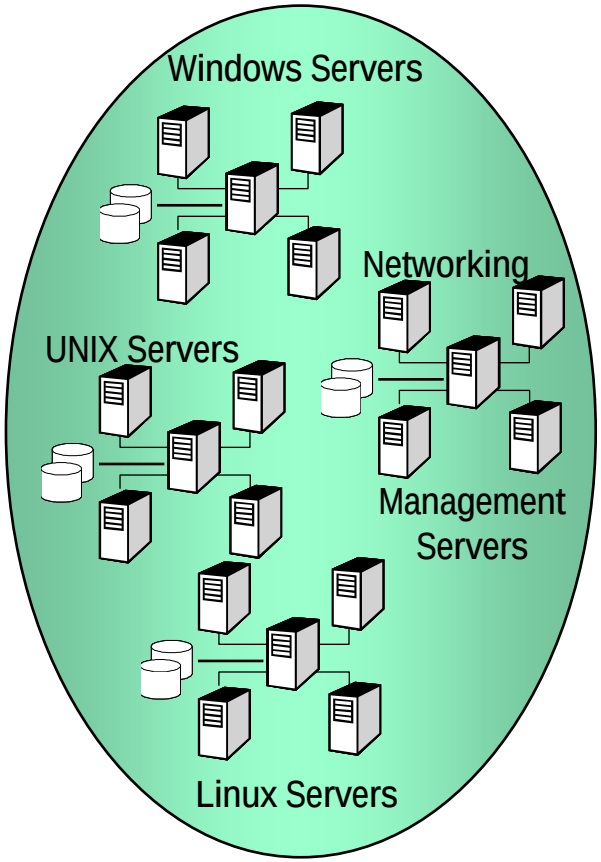


Service Oriented Finance CIO

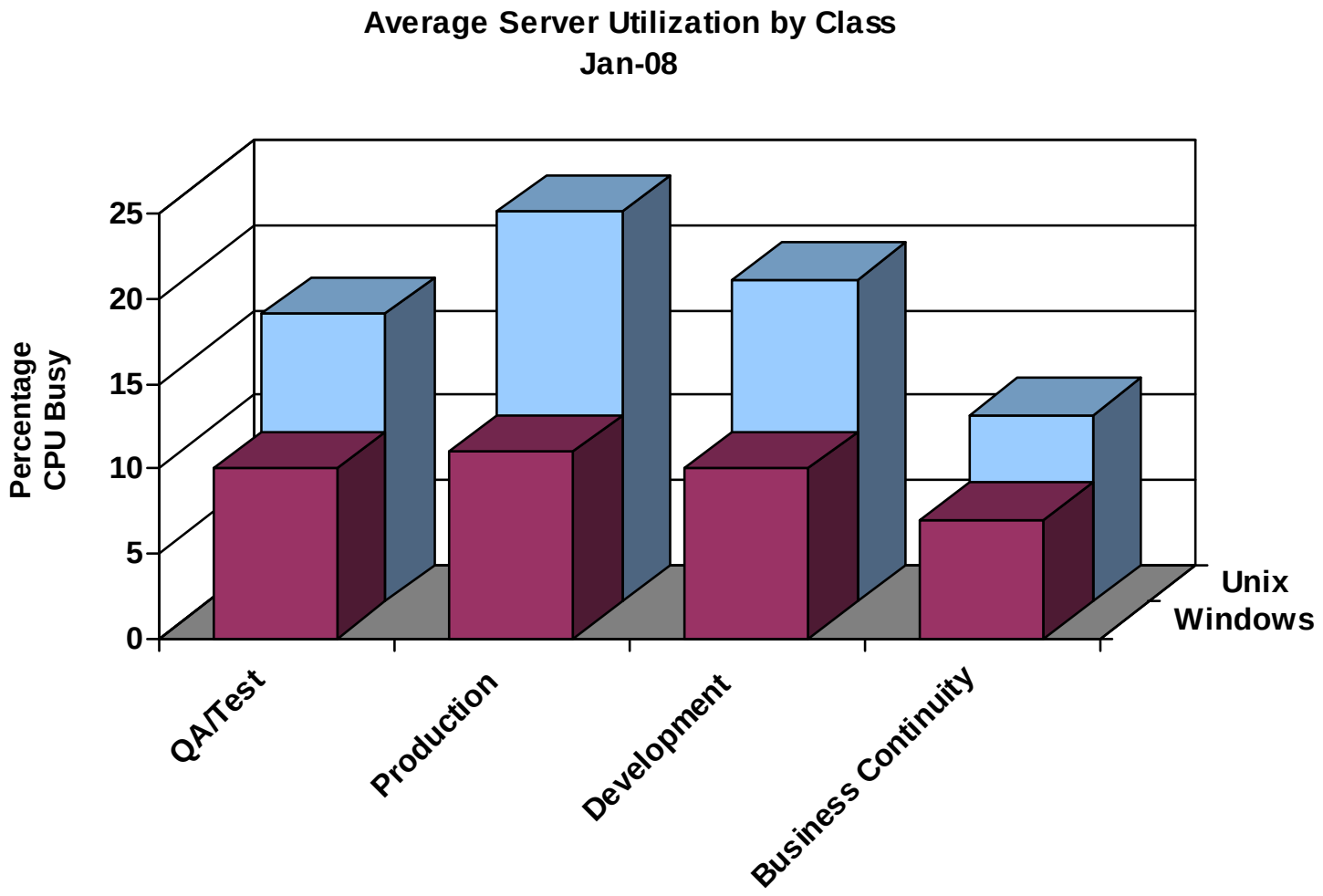
IBM

Distributed Server Sprawl Uses...

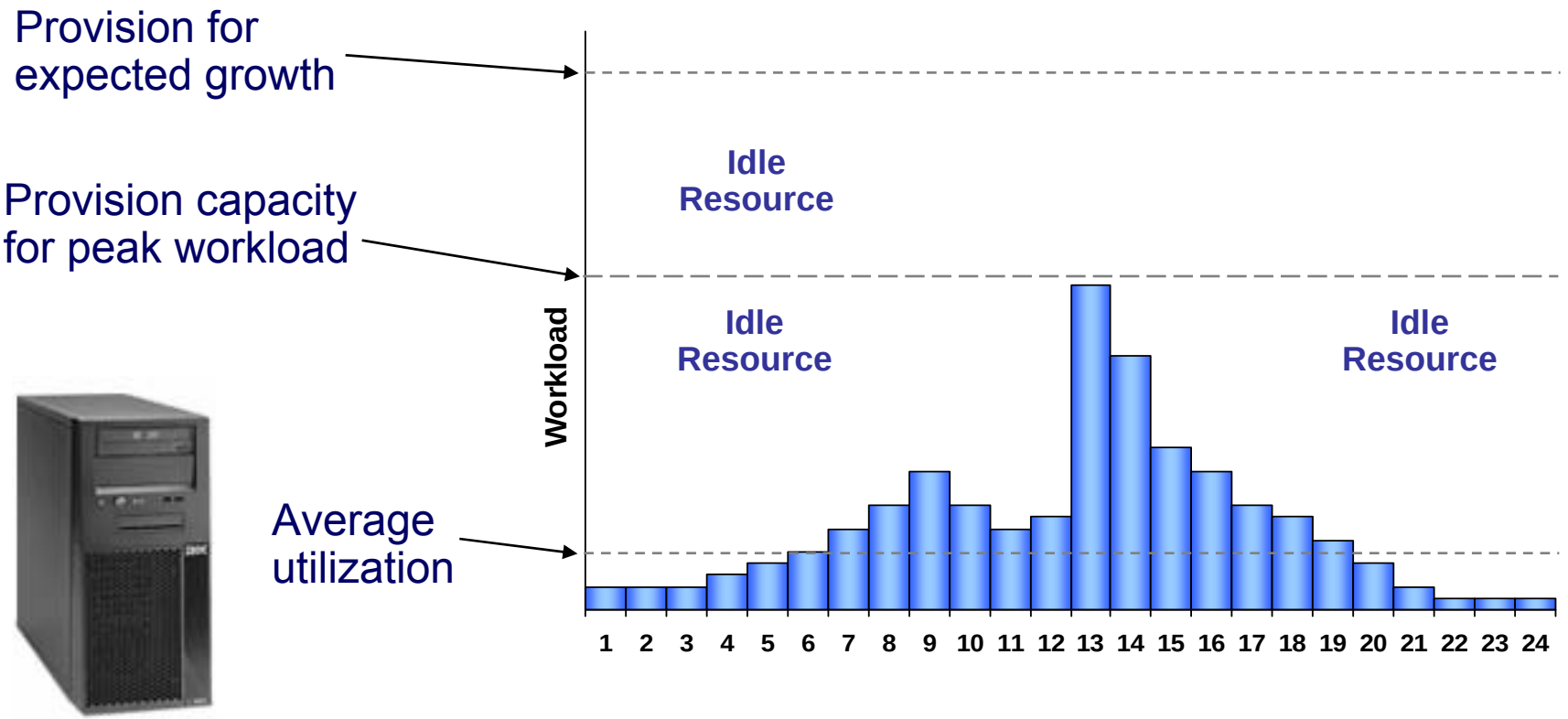
- Lots of hardware
  - Lots of floorspace
  - Lots of power
  - Lots of networking
- Lots of software licenses
- Lots of people to manage the systems
- **Consequences**
  - Low Utilization of Hardware Resources
  - Complexity
  - Increased time to respond to business requirements
  - Difficulty integrating information from various systems



Server Utilization At A Large Financial Institution



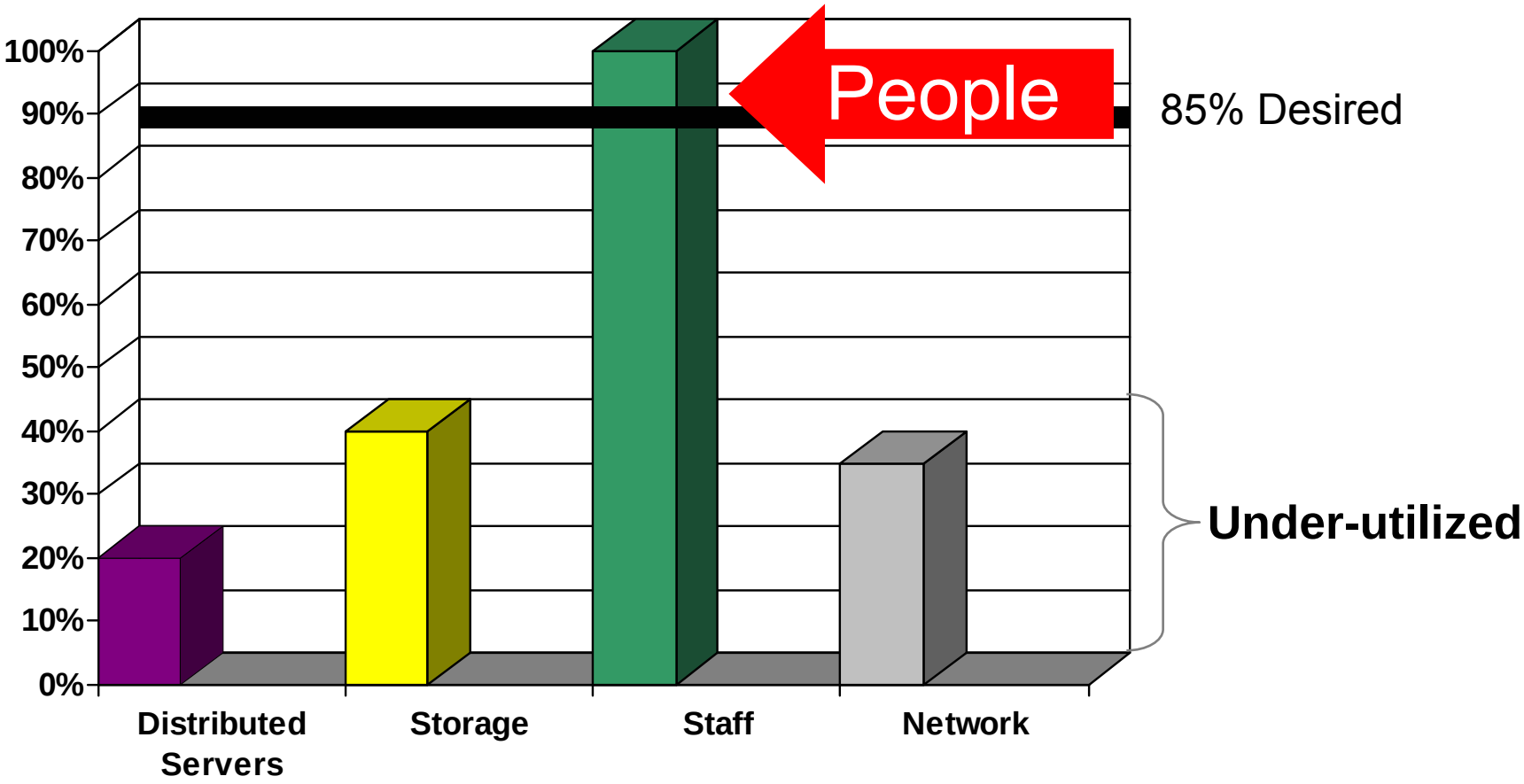
Utilization Of Distributed Servers



Server dedicated to one application

- Typical utilization of Windows Servers <5%
- Typical utilization of UNIX Servers 15 – 20%
- Typical utilization of System z Servers 70 – 100%

Distributed Result: Only One Resource Is Highly Utilized!



Sources: IBM & Industry Studies

IBM Consolidation Experience: Annual Costs Per Distributed Server

Annual Operations Cost Per Server
(Averaged over 3,917 Distributed Servers)

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

Service Oriented Finance CIO

The largest cost component was labor for administration 7.8 servers per headcount @ $160K/yr/headcount

Economics Of Consolidation

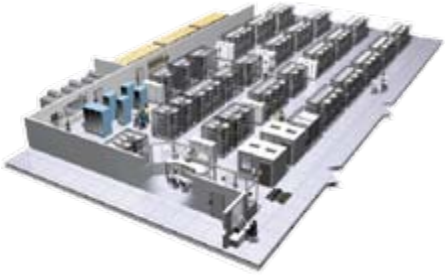
- Consolidating workload means running multiple workloads on the mainframe at the same time
- Consolidation achieves greater utilization of assets which minimizes cost per unit of work
- Same principal was applied by Henry Ford at the dawn of the industry era
  - It still applies today
- Workload consolidation on a mainframe squeezes out cost to achieve maximum efficiency
  - And return on investment

Economics Are Driving Data Centers To A New Model

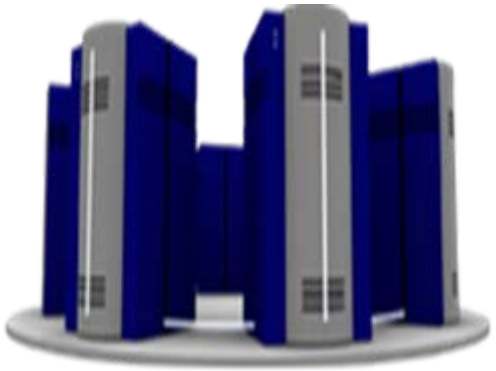
Economy of scale
Squeeze out cost
Resource sharing
Structured management

Bifurcation of service delivery

Data Center



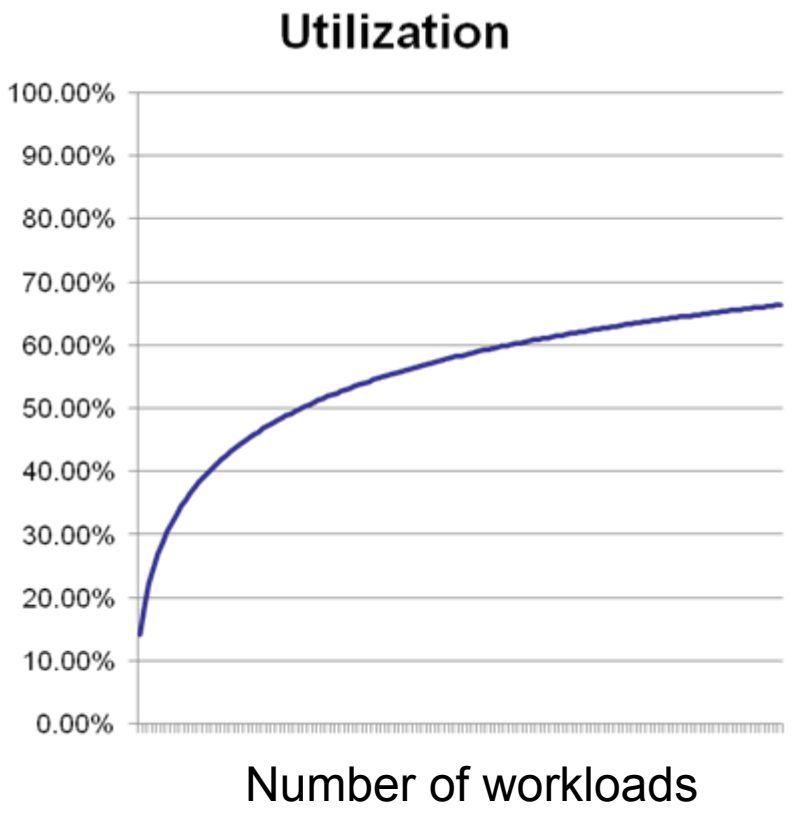
Scale Out
Mixed Environment



Dedicated resource
Unstructured management

Also, Improving Predictability In Demand Improves Efficiency Of Resource Utilization

- When the number of workloads is small
  - To guarantee that work will complete within “specified” time requires more excess capacity
- When the number of workloads is large
  - Combination of arriving workloads is more statistically predictable
  - Higher predictability means lower excess capacity required to meet the specified response times



- When many applications are brought from single application servers to a centralized server, wasted utilization can be squeezed out of the datacenter

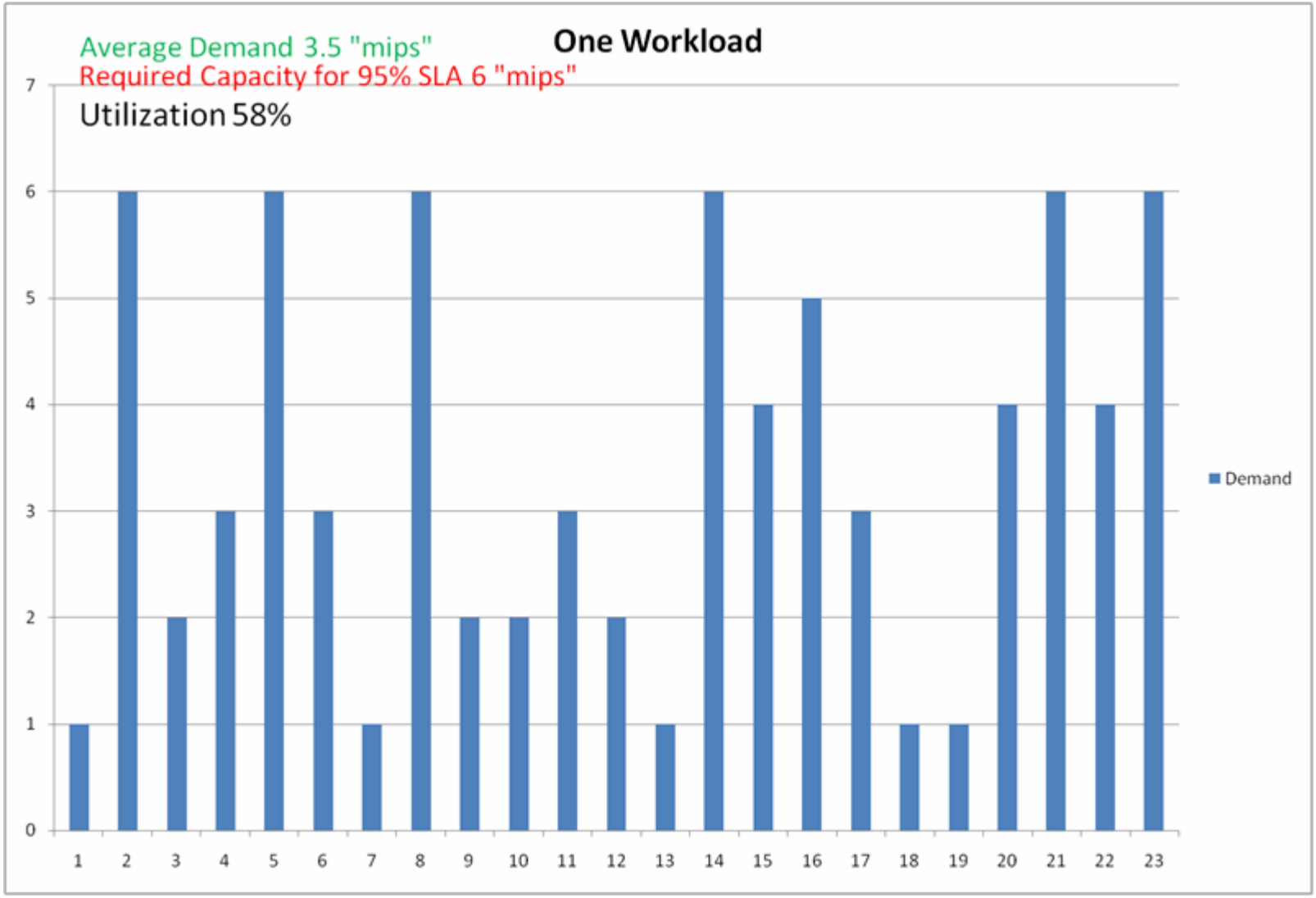
An Experiment Shows How Combining Workloads On A Shared Server Statistically Improves Utilization

- Group 1
  - Take 1 die and roll it 10 times. Count the number of times you get a 1, 2, 3, …. 6
  - Plot your results on a histogram

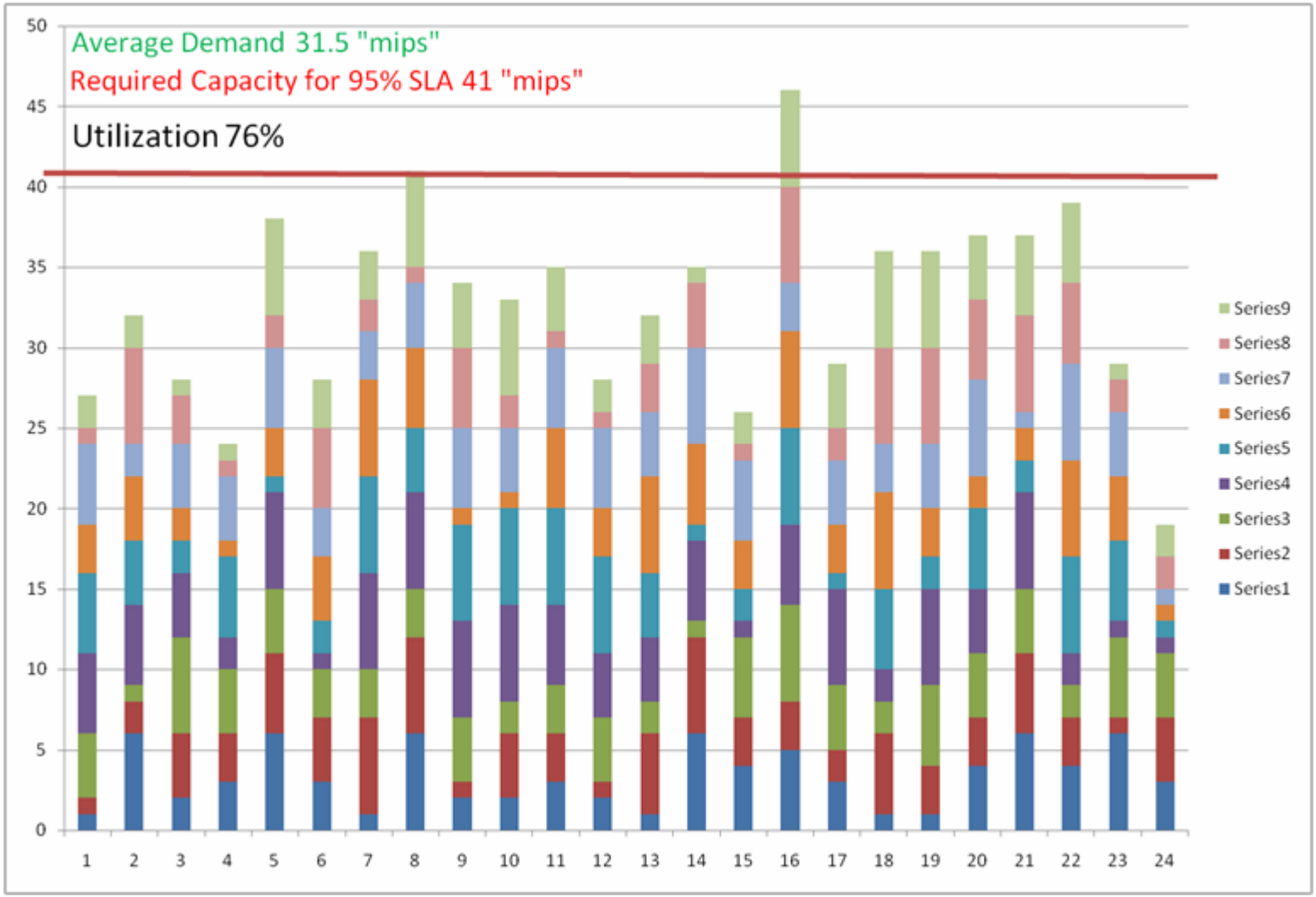
- Group 2
  - Take 9 dice and roll them 10 times. On each roll get the total value on the 10 dice. Count the number of times you get a 9,10, 11, 12, …., 30, 31, … 54.
  - Plot your results on a histogram.

- What do we see about the "predictability" of the result of a "roll"? (Let's roll the dice with a computer.)

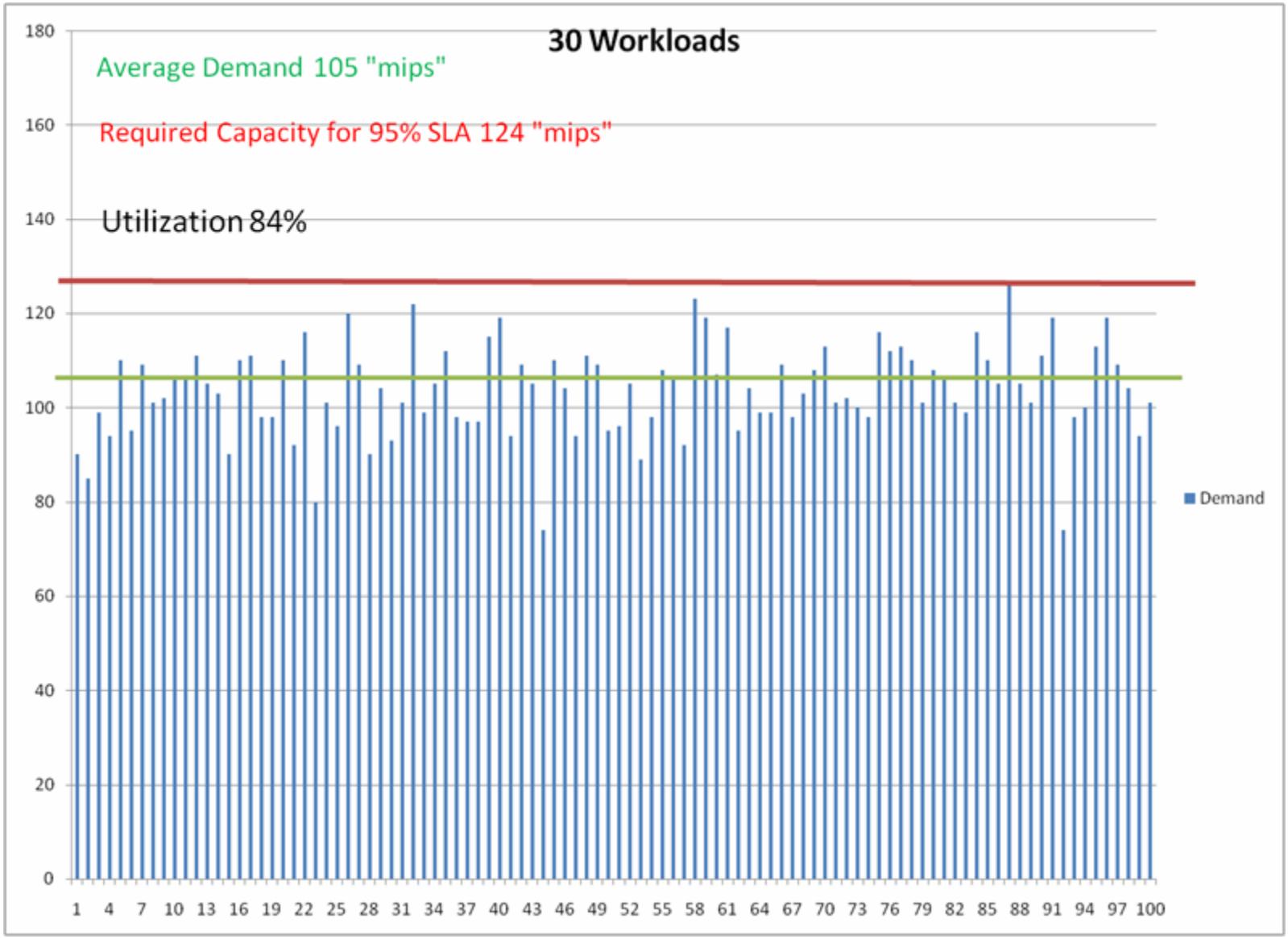
After Rolling 1 Die (1 Workload) The Distribution Would Look Like This



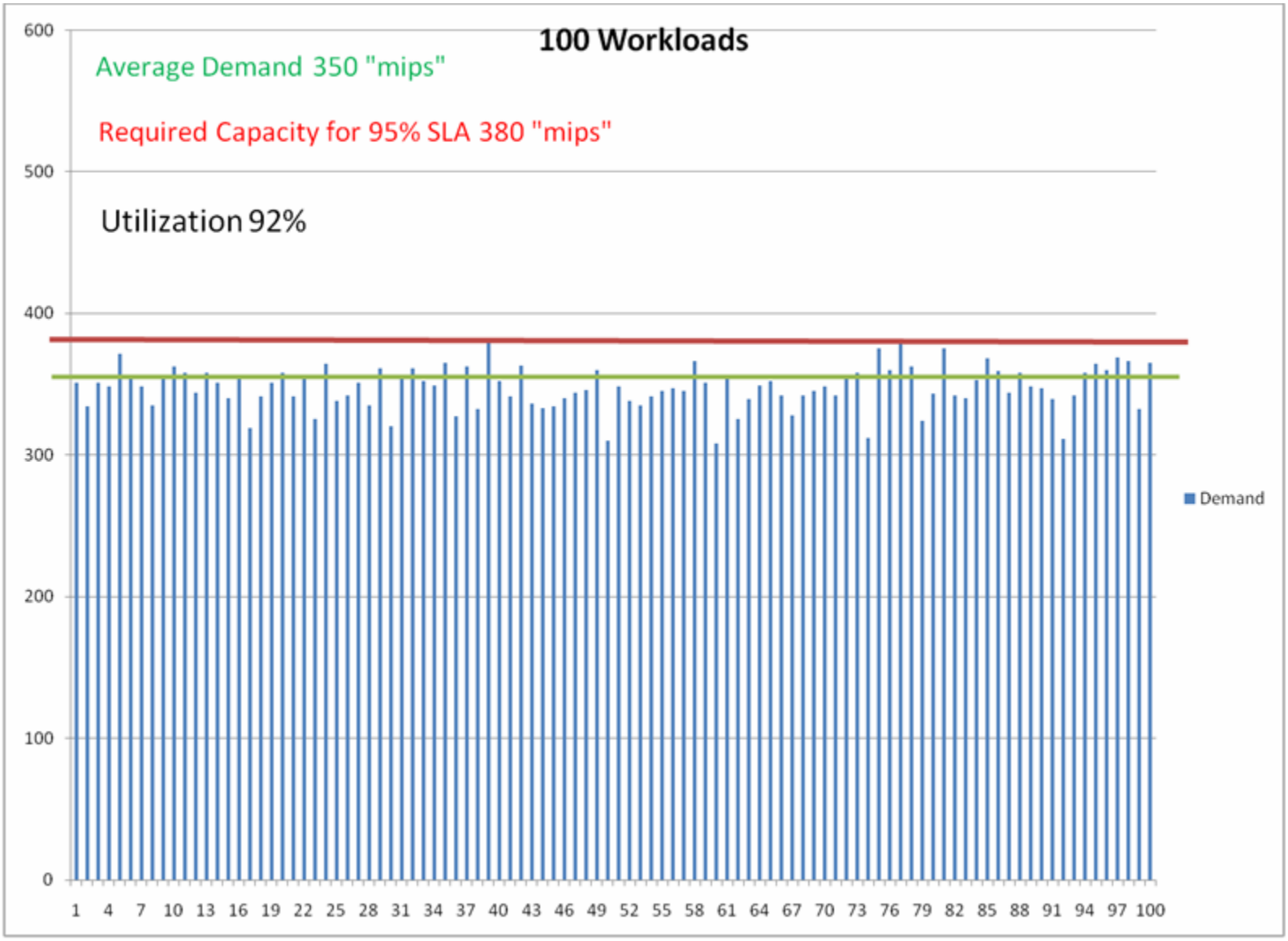
After Rolling 9 Dice (9 Workloads) The Distribution Would Look Like This



After Rolling 30 Dice (30 Workloads) The Distribution Would Look Like This



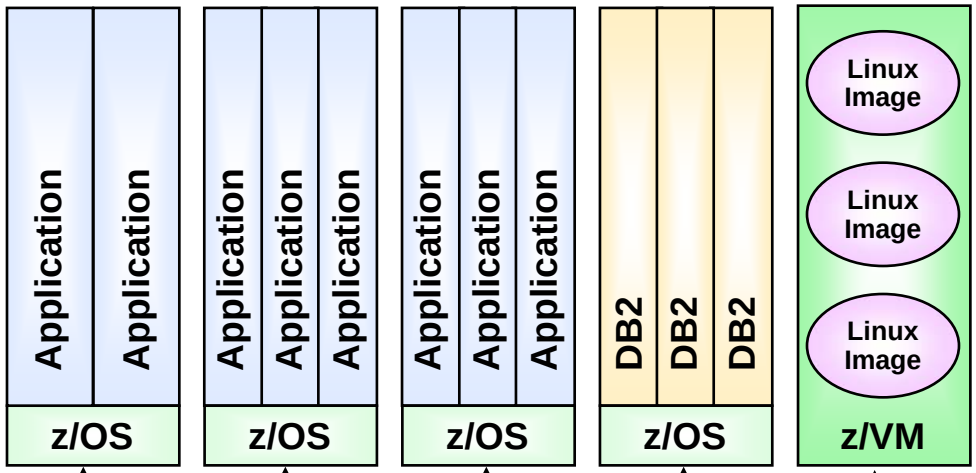
After Rolling 100 Dice (100 Workloads) The Distribution Would Look Like This



Extreme Virtualization In System z

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

Workload Manager allocates resources as needed by service classes



Internal networking via secure high speed Hipersockets

PR/SM and Intelligent Resource Director dynamically allocate 64 processors to partitions

Shared access to all disk data and to external networks

z/VM supports 1000's of virtualized images

Eligible workload automatically dispatched to zIIP and zAAP specialty processors

Multiple Workloads On A Single Server Requires Business Oriented Workload Management

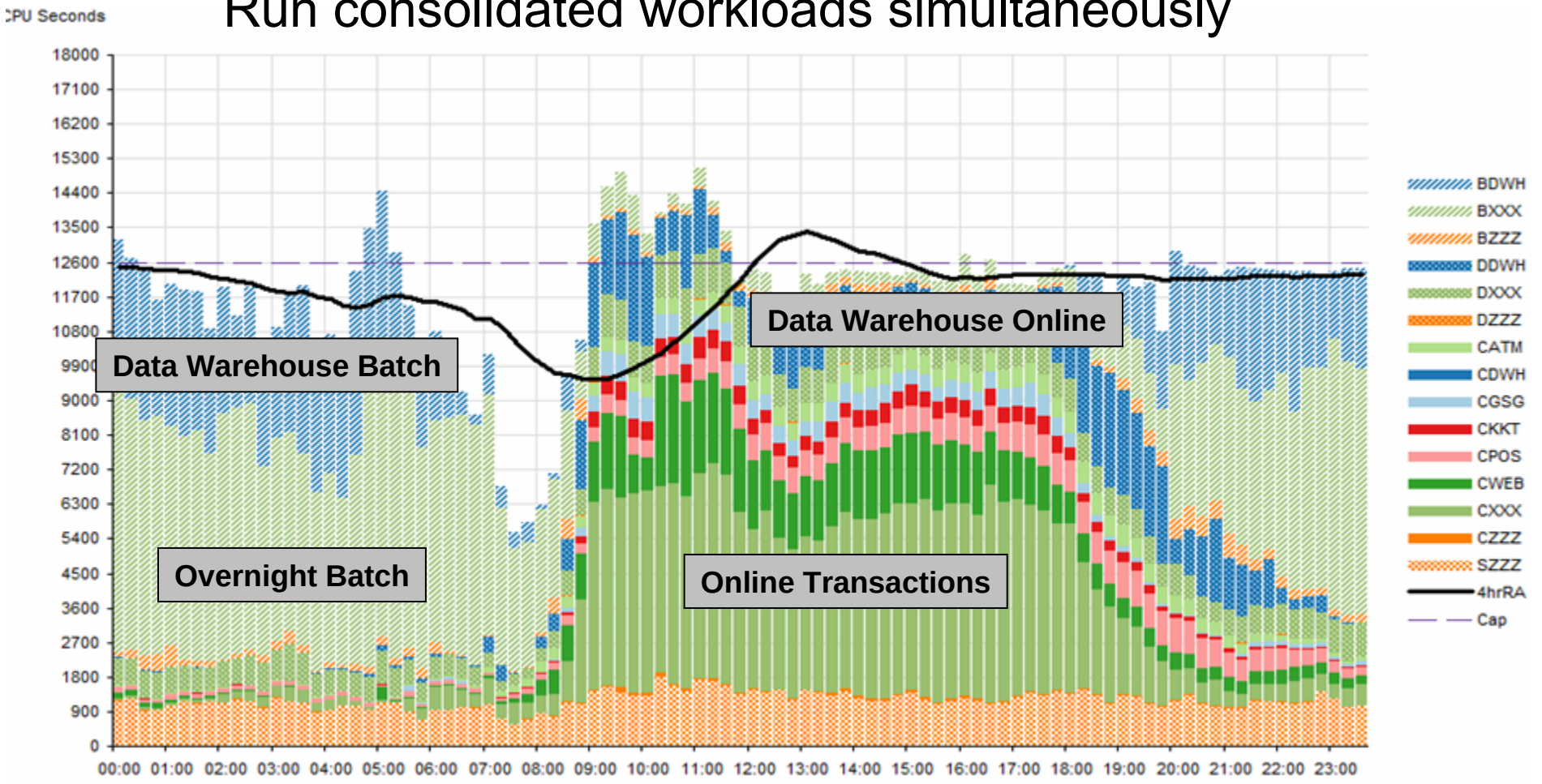
- Mainframe hardware provides:
  - Hypervisor assigns processor resources to logical partitions
  - Intelligent Resource Director supervises this assignment
  - Virtualized I/O Subsystem
- z/OS provides:
  - Workload Manager assigns resources within a z/OS image according to service level agreements
  - Also performs this function across a cluster of z/OS images
- z/VM provides:
  - Virtual Machine Resource Manager
  - Complete mainframe virtualization (including memory)
- All of these facilities provide
  - Business workload oriented goal or velocity definitions
  - Autonomic and continuous management to those definitions

Other Workload Management Solutions Lack Business Goals and Dynamic Flexibility

- For example, HP-UX workload manager
  - Marketing description looks like it is referring to z/OS WLM!
    - "…a goal based policy engine…"
  - In fact, HP's WLM uses static relationships based on the IT environment, not related to business goals
  - Can adjust share/number of CPUs available to a workload but only via static relationships:
    - "3 cpu-shares per connected user with a minimum of x, maximum of y"
  - Can only hard code memory and disk bandwidth shares
    - Dynamic changes not possible so only useful for hard-caps
- No sign of z/OS WLM business goals like:
  - Application X will achieve <2s response time for 95% of users during US Eastern business hours, <5s at other times

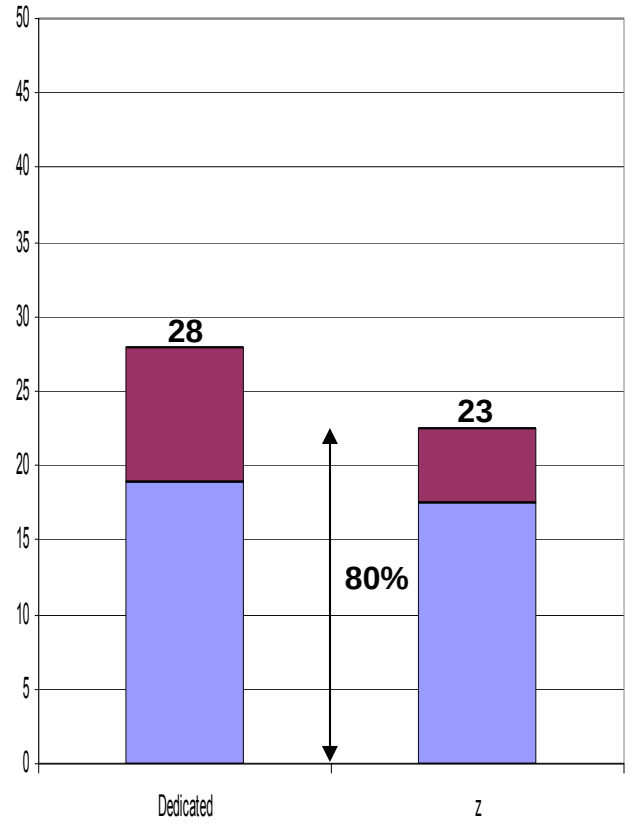
The Real World Result – High Utilization On A Mainframe Via Workload Layering

Run consolidated workloads simultaneously

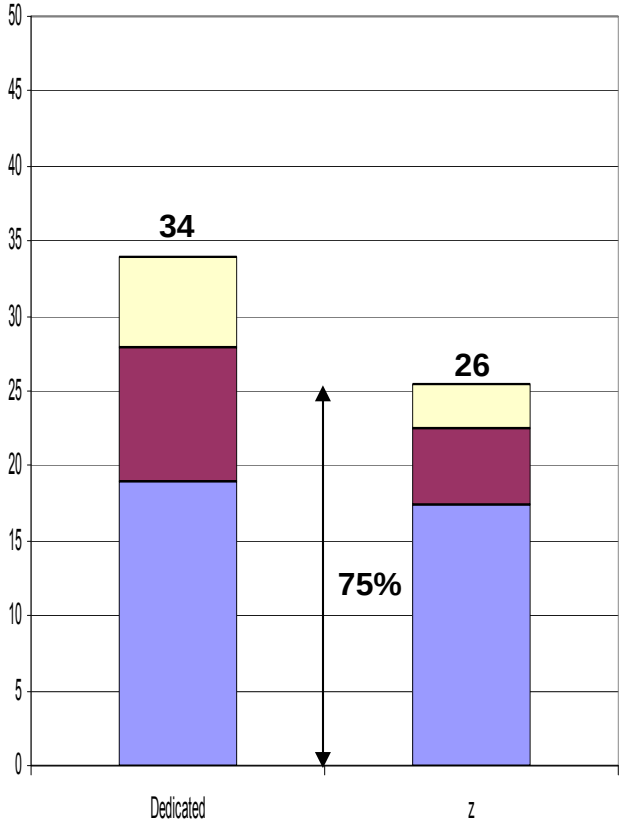


Workload of a highly utilized (>90%) mainframe - Illustration of 4-hour rolling average, and softcap
Full daily operational mix of batch, data warehouse and OLTP transaction from ATM, Web, PoS etc

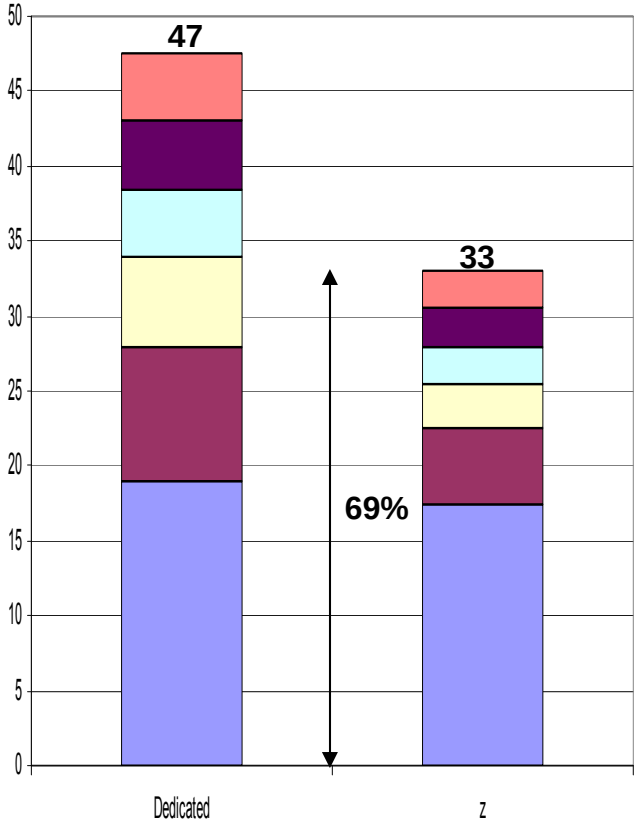
The Importance of the Mainframes 'Workload Layering' Capability to TCO



2 Core Applications
Core Banking, then Credit Card
z is ~80% of total dedicated cost



3 Core Applications
Core Banking, Credit Card, DW
z is ~75% of total dedicated cost



6 Core Applications
Core Banking, Credit Card, DW
then 3 JavaEE/DBMS apps
z is ~69% of total dedicated cost

Adding more core applications to z platform reduces both cost and complexity

Example Workloads That Can Be Consolidated On A Mainframe

What	Where	Specialty Processor	How
Growth of Existing Mainframe Workload	z/OS	--	Capacity on demand
New CICS or IMS Applications	z/OS	--	Develop
Data Warehouse	z/OS	zIIP	Deploy
SAP Database Server	z/OS	zIIP	Deploy
WebSphere Application Server	z/OS	zAAP	Deploy
WebSphere Portal Server	z/OS	zAAP	Deploy
WebSphere Process Server	z/OS	zAAP	Deploy
.NET Applications	z/OS	zAAP	Mainsoft
Domino	z/OS	--	Deploy

More Example Workloads That Can Be Consolidated On A Mainframe

What	Where	Specialty Processor	How
Linux Applications	Linux on z/VM	IFL	Recompile
Linux Middleware - IBM Brands (DB2, WebSphere, Lotus, Rational, Tivoli) - Oracle Database - etc.	Linux on z/VM	IFL	Rehost
Linux Packaged Applications - SAP - Oracle - etc.	Linux on z/VM	IFL	Rehost
.NET Applications	Linux on z/VM	IFL	Mono, Mainsoft
Open Solaris Applications	Open Solaris on z/VM	IFL	Sine Nomine

Linux On z/VM

We've seen some examples of incremental growth on z/OS

- Extend new access channels with WebSphere
- New data workloads with DB2
- Business insight with DB2 and Information Server
- Communications backbone with IBM Enterprise Service Bus

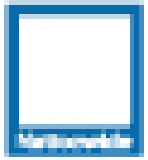
Now let's look at some examples of roll-up consolidation to Linux on z/VM

Nationwide On Your Side™ Saves $16+ Million With Linux On System z

- ***Problems:***
  - High TCO including data center power and floor space scarcity
    - New facility would cost $10M+
  - Long server provisioning process

- ***Solution:***
  - **350** servers virtualized with **15** z990 IFLs – **23 to 1 consolidation**
    - 12 mission critical applications with 100,000+ users/day
  - 50% reduction in Web hosting monthly costs
  - 80% reduction in floor space and power conservation
  - 50% reduction in hardware and OS support efforts
    - Significant savings on middleware costs
  - Significantly faster provisioning speed (months → days)
  - Mainframe high availability and disaster recovery

Vastly improved TCO, Speed & Simplification



Nationwide®
On Your Side™

Saves $16+ Million With Linux On System z

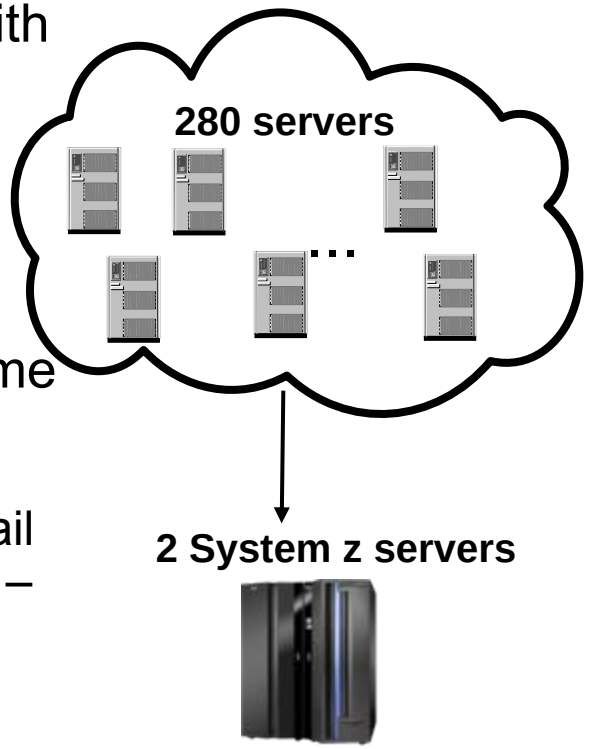
Update (February 2008):

- $16M savings realized a year earlier than planned
  - In 2 years not 3
- Up to 18 mission critical applications
  - Added more WebSphere, Portal, and DB2
- Upgraded from z990 to z9 IFL's
- **483** virtual servers with 1,350 JVM's running on **34** z9 IFL's
  - So, workloads that would have required **1,350** physical servers are running on **34** z9 IFL's – **40 to 1 consolidation**

Improved TCO, Speed and Simplification

Hannaford Supermarket Chain Goes Real Time With System z

- Northeastern United States supermarket chain with sister chains in the Southeast US
- Reduced costs, while improving inventory management, customer and partner satisfaction
- Consolidated **~280** store servers on to a mainframe
  - z/OS inventory system links to computer-assisted ordering system
  - zLinux runs 35 applications used by corporate, retail and vendor partners on 100 virtual servers (**4** IFLs – **25:1** consolidation)
  - Significant labor, hw, sw, environmental savings



"The only way we'd consider consolidating critical data from hundreds of servers onto one system was by choosing an IBM mainframe for its legendary reliability and availability,"

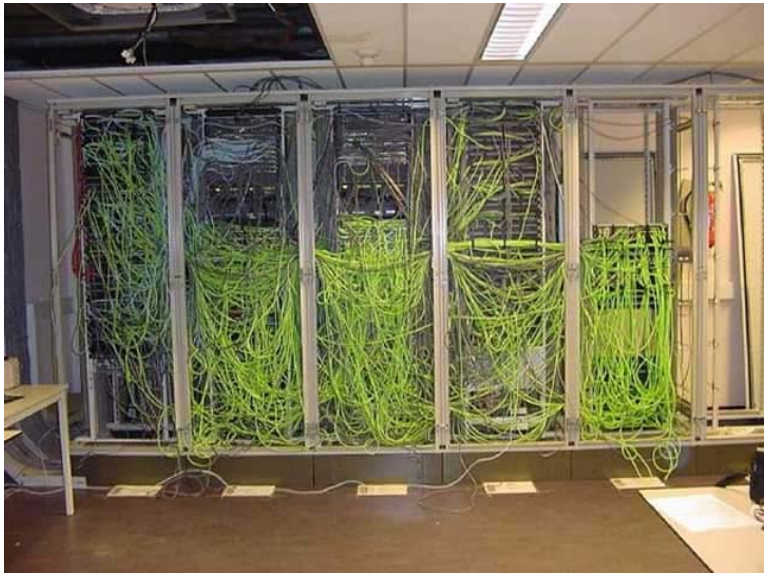
Bill Homa, senior vice president and CIO of Hannaford

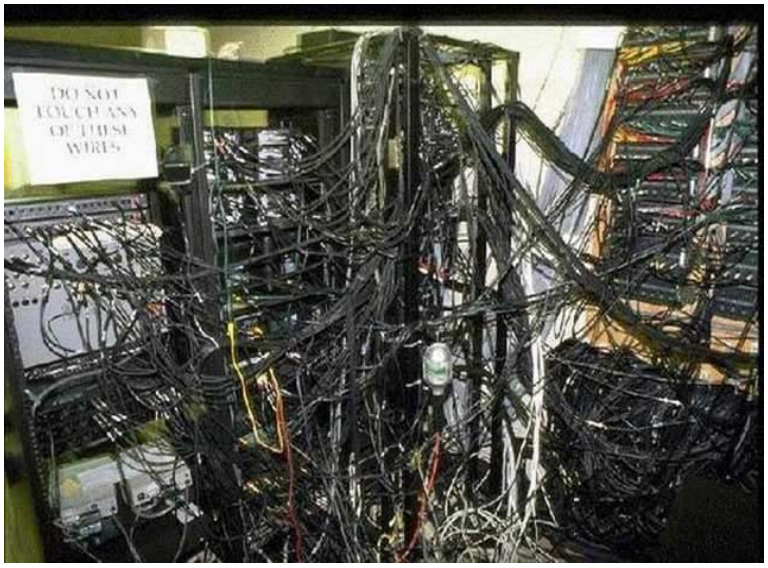
More on Hannaford: http://www-03.ibm.com/systems/z/testimonials/customer.html

Case Study: Québec Government Runs Oracle At IFL Prices

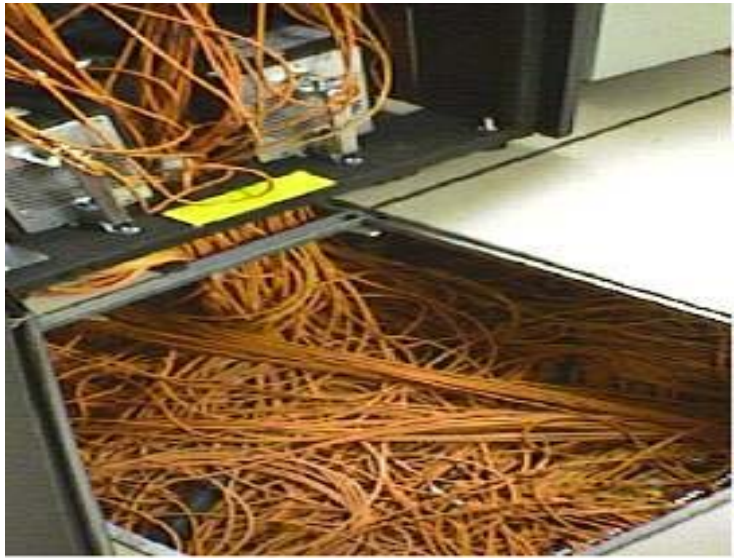
- Running **292** server instances on a z9-EC with **5** IFL's
  - 200 Oracle, 80 WebSphere, 12 WebSphere messaging
  - Reduced cost of hardware and software by 30%
    - Saved $800,000 in licensing cost in the first year
  - Used RACF for consistent security
  - Each administrator can manage 100 consolidated Linux images (up from 30)
  - Easy migration
    - Create new Linux server in 30 min (vs. 1 week – 3 months)
    - Clone Oracle DB instance in 30-45 min (vs. 10 – 14 hours)
  - Inherited benefits of z platform – workload management, availability, disaster recovery, I/O bandwidth

Network Sprawl Is Another Legacy Of Unconsolidated Servers





- Unconsolidated servers lead to high maintenance cabling
- Raised floors cleanup the appearance on the rack
  - Have the same issues, just buried under the floor

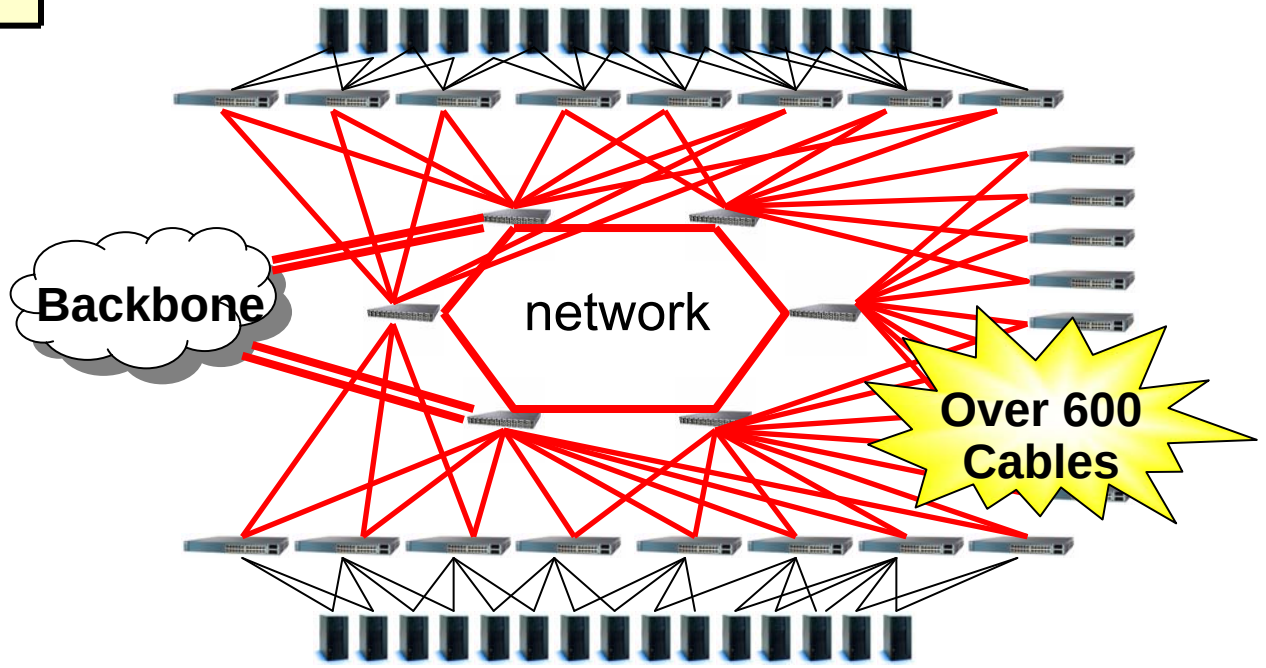


Even When Done Right, It Is Hard To Service

- Even when properly organized administrators have to deal with a large number of cables
  - A single rack can have over 100 cables
- One misplaced connector or label can cause havoc in the whole network
- Once cables are strapped together, it is very hard to make changes

Case Study: Network Before Consolidation (292 Servers To 1 System z10)

3560E-24TD	8
3560E-24TD	17
3560E-12D	6
50 Ft UTP Cable	584
10GB Eth Fiber Cable	60

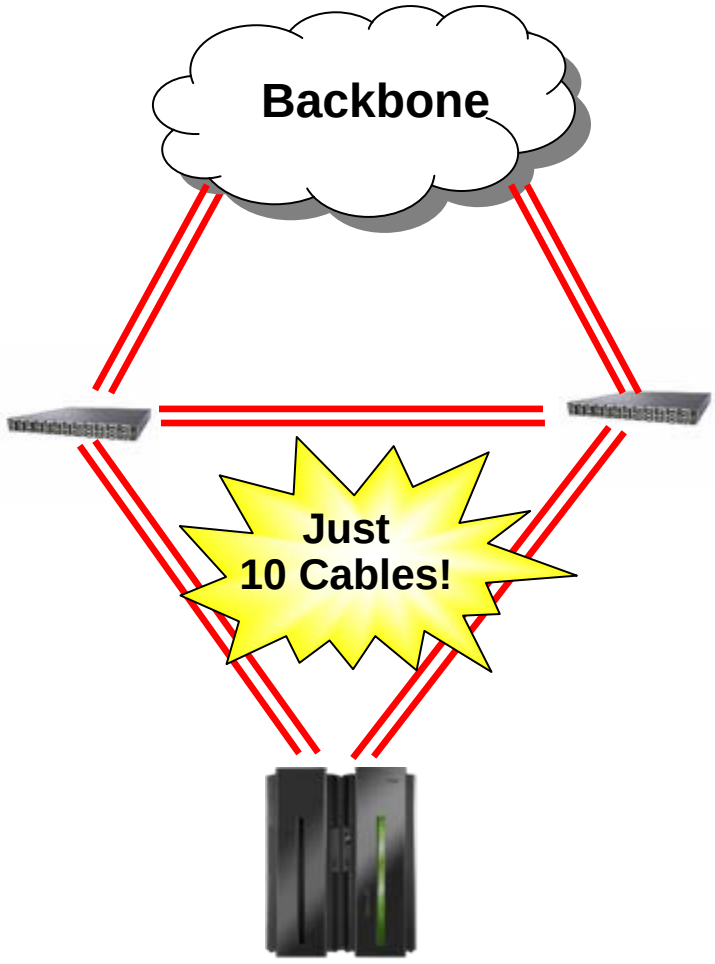


The diagram only shows **30** of **292** servers

Case Study: Network After Consolidation (292 Servers To 1 System z10)

Easier to manage & troubleshoot

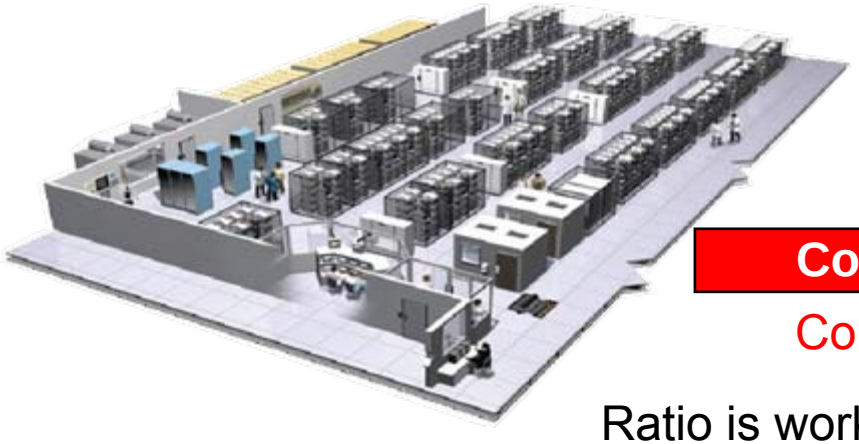
Better performance



Benefits Of Consolidation On The Mainframe

- Less hardware
- Fewer software licenses
- Less costly to manage
- Consumes less power and floor space
- Responsiveness to the business via faster provisioning
- Inherit the benefits of the mainframe platform
  - High reliability
  - I/O bandwidth
  - Consistent security
  - Systematic disaster recovery
- Lower annual costs!

How Many IFLs Will Be Required?



Consolidation

Cores to cores

Ratio is workload dependent

	Some recent examples:
Major Brokerage House	112 to 1 (z9)
A Major US Bank	37 to 1 (z9)
Hannaford	25 to 1 (z9)
Nationwide	40 to 1 (z9)
Major Brokerage House	90 to 1 (z9)

IBM Internal Project To Consolidate Over 3,000 Servers

- IBM expects substantial operational annual savings by consolidating 3,917 distributed servers to about 30 mainframes
  - 86% savings in system administration cost
  - 85% savings in floor space
  - 81% savings in power
  - 57% savings in network management
- $81M savings per year including
  - Operational savings above
  - Hardware and software maintenance

Mainframe Labor Costs Per MIP Declining

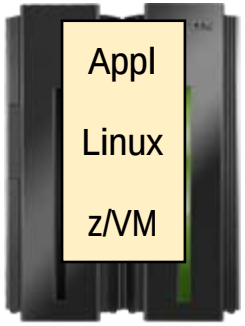
- IBM Survey five years ago, average MIPS per person
  - **50** for z/OS
- Typical MIPS per person today
  - **150 to 700** for z/OS (1,300 to 2,000 for zLinux)
- A major bank went from 128 MIPS/person to 597 MIPS/person in 8 years with no extra people
- Gartner showed the MIPS/person doubling in 3 years at another site
- An outsourcer stated they doubled MIPS with only 20% increase in headcount

Case Study: Consolidate On Mainframe vs. Keeping Dedicated Servers

Existing Mainframe

Existing processors:
4 general purpose

Add 1 LPAR for Oracle Server Consolidation



Add three processors:
3 IFLs

Or maintain existing 292 server farm for Oracle data servers

3 year TCO $9.06M

Annual operating cost $0.67M

Breakeven in first year

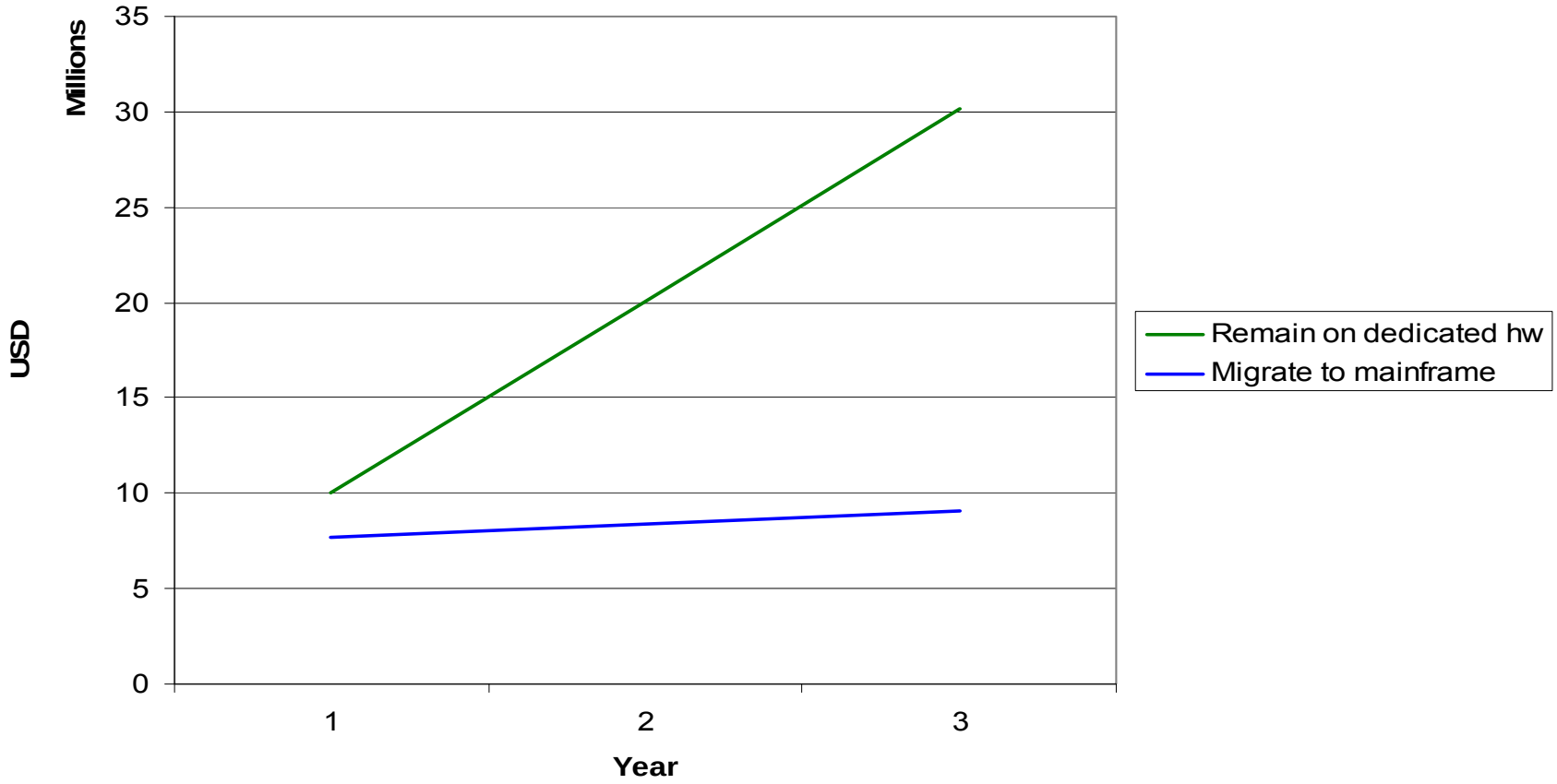
3 year TCO $30.13M

Annual operating cost $10.04 M

Case Study: Consolidate On Mainframe vs. Keeping Dedicated Servers

- **Rehosting Risks**
  - Minimal migration to/from Linux
  - Leverage existing Linux expertise for new hardware platform

70% TCO reduction!



292 Oracle DBs to 3 IFLs on Existing Mainframe

DEMO: Fast Linux Provisioning

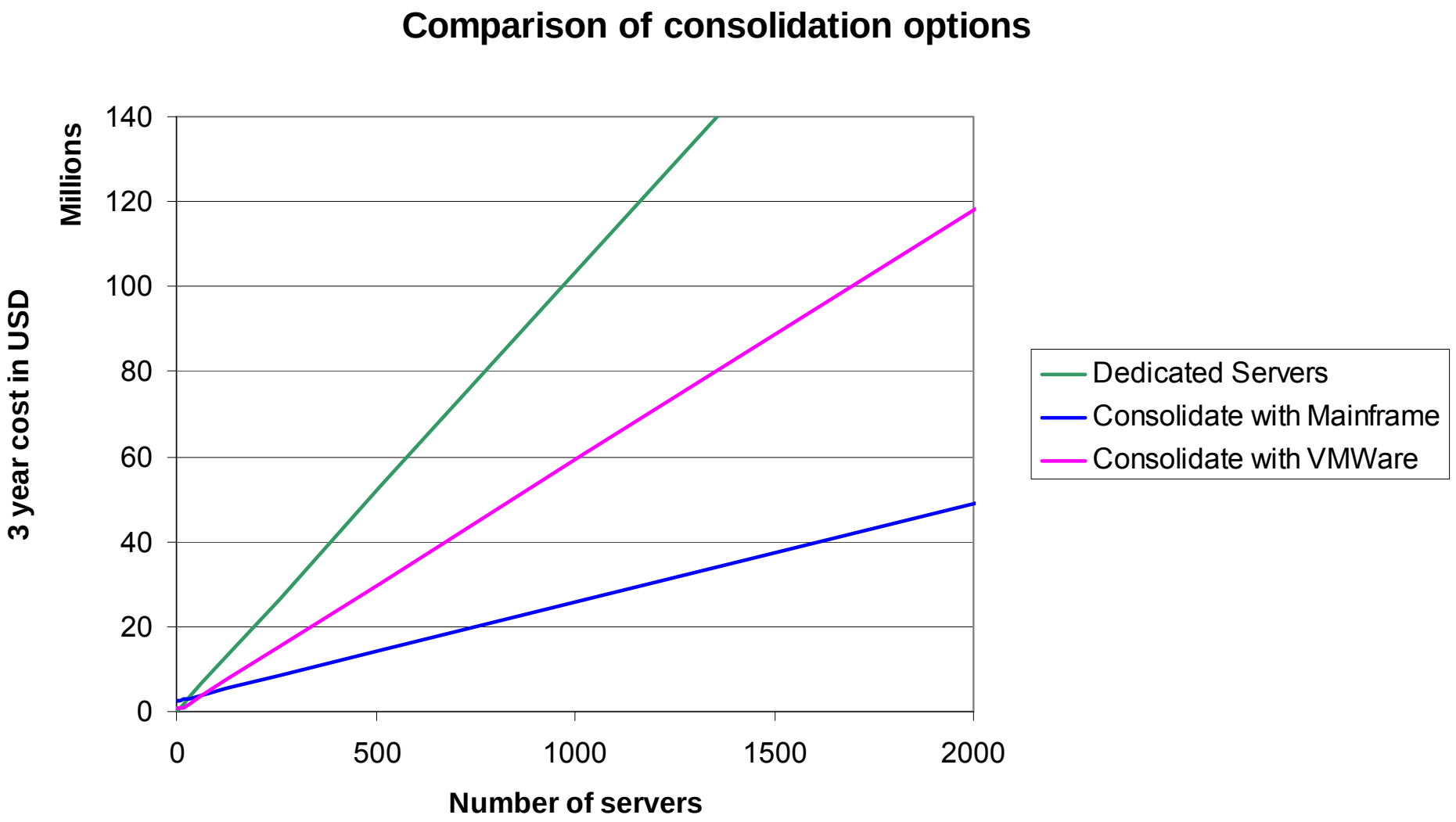
- Another benefit of virtualization is speed of provisioning
  - No additional resources required, no purchase necessary!
- Coupled with standardization, reduces complexity
- Need a new machine? Let's see how fast we can get one...

What About Using VMWare On Intel?

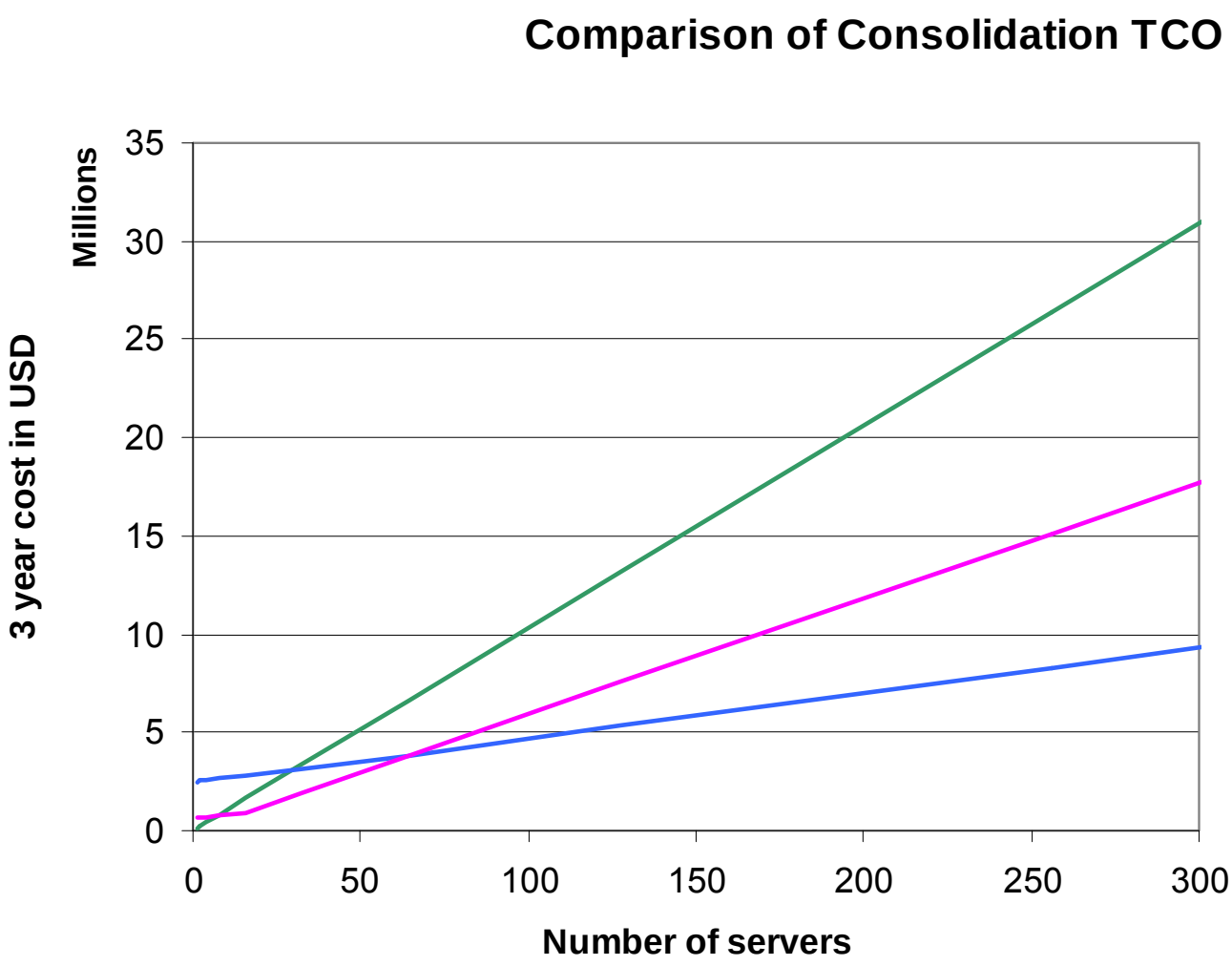
- VMWare lacks the consolidation efficiency of z/VM
- Less efficient use of memory and storage
- Less efficient use of processors
- Not fully supported with enterprise software

	z/VM	VMWare
Maximum memory per virtual Linux server	**More than 256GB**	16GB
Maximum CPU's per virtual Linux server	**Up to 64**	Up to 4
Maximum "Active virtual memory" supported	**Up to 8TB**	16,384MB
Maximum virtual CPU's per core	**Thousands**	Up to 8
Maximum real memory	**Up to 256GB**	Up to 64GB
Maximum virtual servers per machine	**Thousands**	128
Call Oracle for support if you have a database problem?	**Yes**	No - unsupported

Result: Consolidation on z/VM Saves the Most Money



Cost of Different Linux Consolidation Solutions (Zoom on 0-300 Servers)



- 292 servers:

  70% TCO reduction on mainframe

  Only 41% on VMWare

Do YOU Need To Consolidate?

- I/T department whose budget is consumed by operating cost?
- Contemplating new data centers due to power or floor space constraints?
- Need a systematic site failover plan for **all** applications and data?
- Quality of service issues?
- Lots of UNIX or Linux servers?
- Lots of small database servers scattered around (including Oracle)?

Service Oriented Finance Did A Roll-up Consolidation Of Linux Servers

Service Oriented Finance CIO