The Reality of Rehosting: Understanding the Value of the Mainframe

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The Reality of Rehosting: Understanding the Value of Your Mainframe

An IBM® Redbooks® Point-of-View publication

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IBM Senior Analyst

Highlights

Moving applications from the mainframe to distributed environments often comes with the expectation of cost savings. However, studies reveal a conclusion that is counter to conventional wisdom:

► It could actually cost less to stay and grow on the mainframe than to move to

The first mainframe computers were introduced in the 1960s, and in the intervening years, the mainframe has become a mainstay for corporate businesses worldwide. Today, businesses trust their most mission-critical applications and data to the mainframe. Yet in recent years, some mainframe clients are attempting to move workloads off the mainframe (often referred to as *rehosting*) believing this will save them money. Typically, these clients have outdated hardware and software, smaller mainframe footprints, or perhaps a poor understanding of the true

Although some service pr
with cost savings, a caref
shows this claim in most
industry trends, such as s
constraints, and server sp

An incorrect assessment
migration costs, replacem
dual operations costs, and
a rehosting effort can

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IBM

Businesses trust their most mission-critical applications and data to the mainframe

70%
of top 500 System z
customers run CICS

67%
of top 500 System z
customers run CICS
<u>and</u> DB2

21 of top **25**
insurance organizations
use System z

23 of top **25**
retailers use System z

25 of top **25**
world's banks use System z

Today

IBM
zEC12

1964

IBM S/360

Source: IBM

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Yet, some mainframe clients are tempted to move workloads off the mainframe, allegedly to save money

z900
and
z/OS v1

… our hardware and
software are old…

*"…we're only
running 87
MIPS…"*

… our mainframe is
pretty small…

$$$$

… accounting is telling
me the mainframe is
expensive…

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The IBM Eagle team can help customers understand mainframe costs and value

- **Worldwide** team of senior technical IT staff

- **Free of Charge** Total Cost of Ownership (TCO) studies

  - Help customers evaluate the lowest cost option among alternative approaches

  - Includes a one day on-site visit and is **specifically tailored to a customer's enterprise**

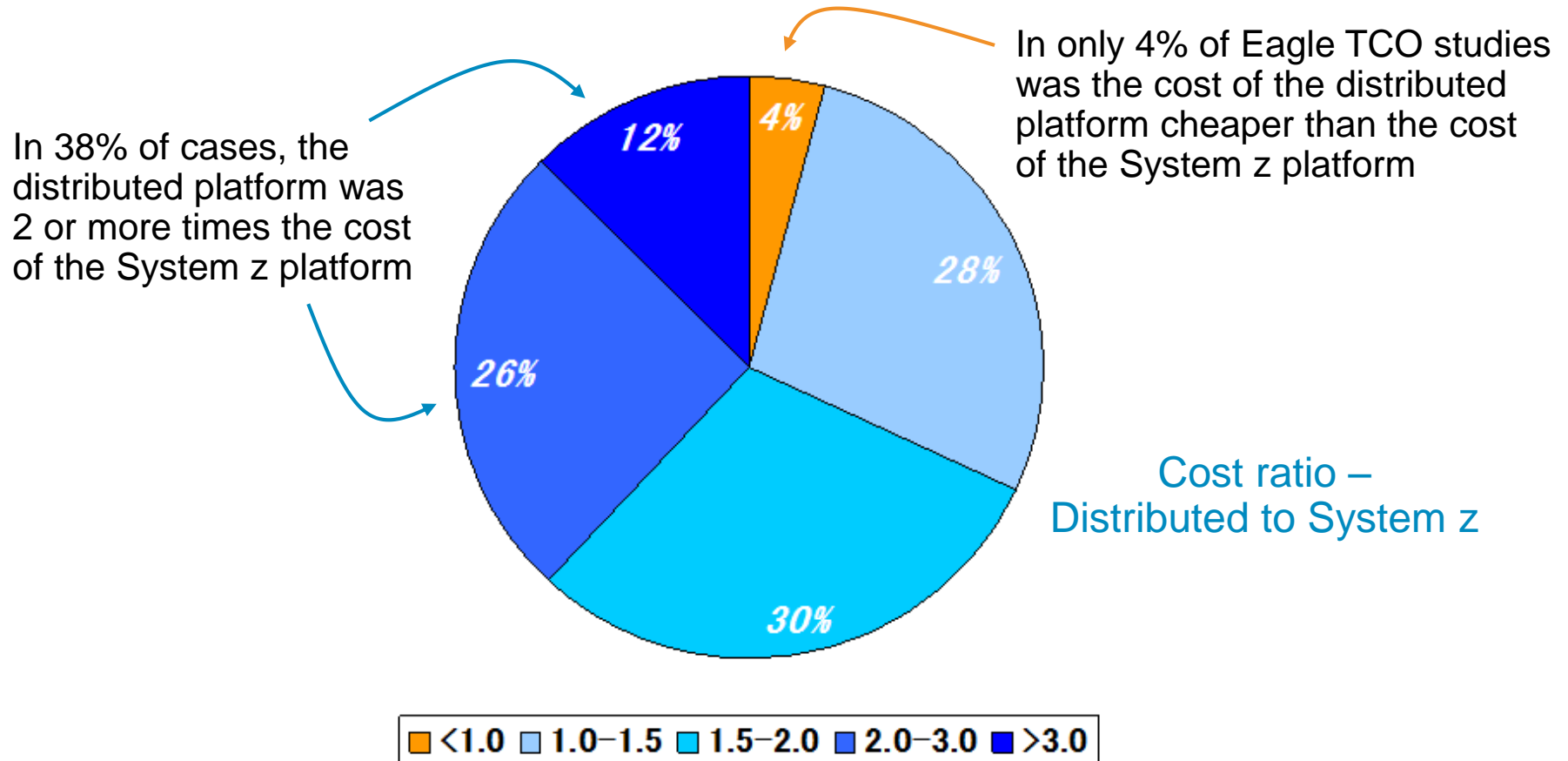- Over 300 customer studies since formation in 2007

- Contact: eagletco@us.ibm.com

Fit For Purpose Platform Selection

Enterprise Server Economics

Private Cloud Implementation

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Eagle team data shows that in 96% of mainframe rehosting cases, clients ultimately end up spending *more* for an offload

In only 4% of Eagle TCO studies was the cost of the distributed platform cheaper than the cost of the System z platform

In 38% of cases, the distributed platform was 2 or more times the cost of the System z platform

4%

12%

28%

26%

30%

Cost ratio – Distributed to System z

| <1.0 | 1.0–1.5 | 1.5–2.0 | 2.0–3.0 | >3.0 |

Sampling of 97 Eagle team TCO studies from 2007 - 2011

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Example: Moving transaction processing off System z rarely reduces cost

Eagle TCO study for a financial services customer:

4 HP Proliant DL 980 G7 servers

Production   Development

256 cores total
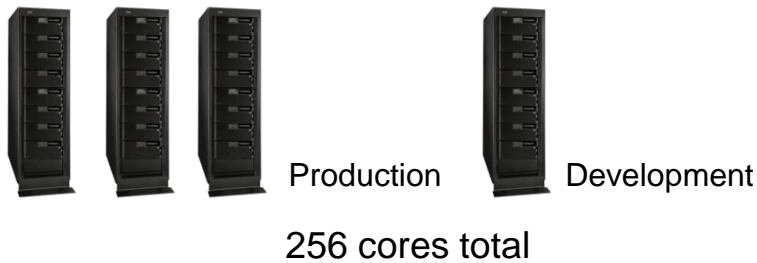
Hardware	$1.6M
Software	$80.6M
Labor (additional)	$8.3M
Power and cooling	$0.04M
Space	$0.08M
Disaster Recovery	$4.2M
Migration Labor	$24M
Parallel Mainframe costs	$31.5M
Total (5yr TCO)	**$150M**

System z z/OS Sysplex

2,800 MIPS

Hardware	$1.4M
Software	$49.7M
Labor	Baseline
Power and cooling	$0.03M
Space	$0.08M
Disaster recovery	$1.3M
Total (5yr TCO)	**$52M**

65% less cost!

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Rehosting costs are underestimated because of unrealistic equivalence data

From HP's "Mainframe Alternative Sizing" guide, published in 2012…

MIPS Level	z196 Models	Actual MIPS	z10 EC Models	z10 Actual MIPS	z10 BC Models	z10 BC Actual MIPS	z114 Models	z114 Actual MIPS	HP Cores Estimate	Total HP equivalent MIPS
1,000	2817-701	1,202	2097-701	889	2098-Z02	1250	2818-Z01	782	2	866
2,000	2817-702	2,272	2097-702	1,667	2098-Z03	1784	2818-Z03	2026	5	1,860
3,000	2817-703	3,311	2097-704	3,114	2098-Z05	2760	2818-Z05	3139	8	3,021

Can a 2-chip, quad-core x86-based Blade server really replace 3,000+ MIPS?

- Simple core comparisons are inherently inaccurate…
- Benchmarks can be deceiving…
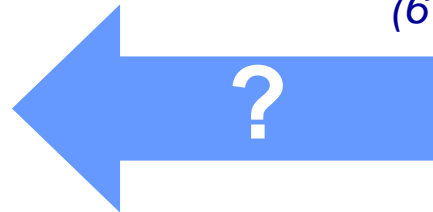- Real world use cases suggest this number is off by a factor of **10-20 times**

Eagle TCO study of a mid-sized workload demonstrates how HP's sizing guides are far from accurate

6x 8-way (x86) Production / Dev
2x 64-way (Unix) Production / Dev
      Application/MQ/DB2/Dev partitions

2x z900 3-way Production / Dev / QA / Test
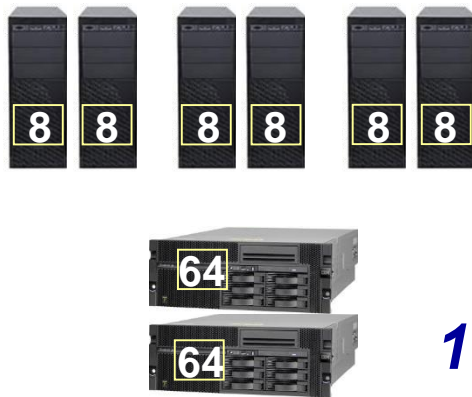
1,660 MIPS
(6 processors)

176 processors

$25.4M (5 yr. TCO)

29x more cores!

$17.9M (5 yr. TCO)

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Eagle TCO Study shows a pure Intel offload was not cost-effective…

3x HP DL580 (2ch/20co)
Production / Dev / Test
(2011 x86 technology)

z800 Production /
Dev / Test
(2002 mainframe technology)

499 MIPS
(2.1 processors)

60 processors

Despite a 9-year technology gap,
the Intel platform still required
29x more processors

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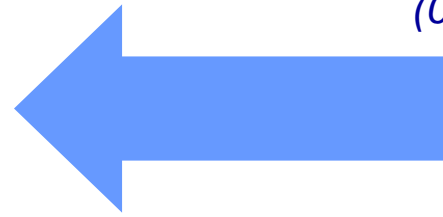© 2014 IBM Corporation

Eagle TCO study shows this small workload was *not* cheaper on the distributed platform

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

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

332 MIPS
(0.88 processors)

36 processors

$17.9M (4 yr. TCO)

*41x
more cores!*

$4.9M (4 yr. TCO)

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Eagle TCO study shows even this VERY small workload was not cheaper on the distributed platform

z890 Production / Test

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

88 MIPS
(0.24 processors)

8 processors

$8.1M (5 yr. TCO)

33x more cores!

$4.7M (5 yr. TCO)

Better understanding of mainframe workloads and the platform can prevent embarking on a bad rehosting experience

The value and advantages of the System z platform

- Perfect workload management

- Multiple environments on one platform

- Disaster Recovery

- …

Why some workloads are best fit on System z

- I/O-intensive workloads

- CICS/COBOL workloads

- "Chatty" workloads

- …

Note that this is not intended to list *all* the advantages of the System z platform, nor is it intended to list *all* workloads that are best fit on System z.

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System z is a highly efficient virtualized platform designed to benefit from statistical multiplexing of many workloads
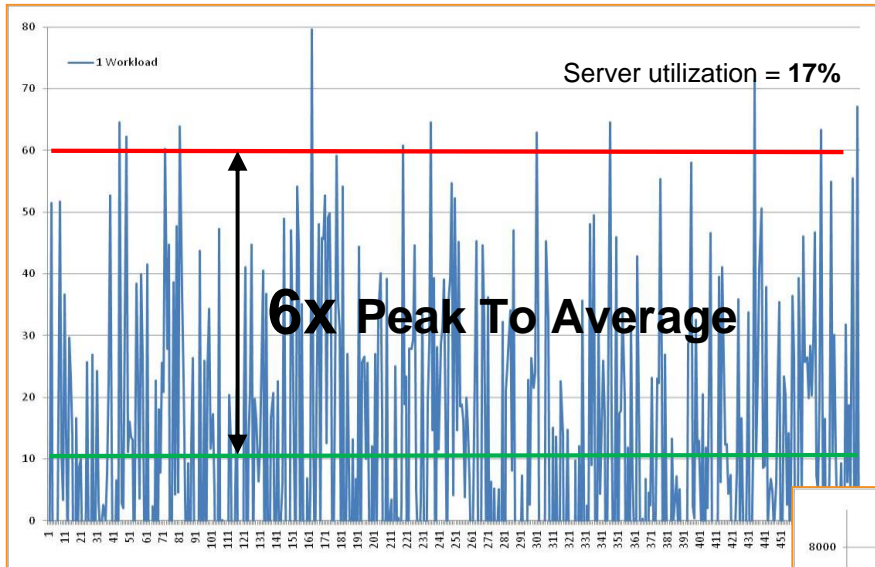

- Consolidating workloads with variance on a virtualized server reduces the overall variance (statistical multiplexing)

- Consequently, larger servers with capacity to run more workloads can be driven to higher average utilization levels without violating service level agreements

1 variable workload:
Machine capacity (red) =
6x average demand (green)

144 variable workloads:
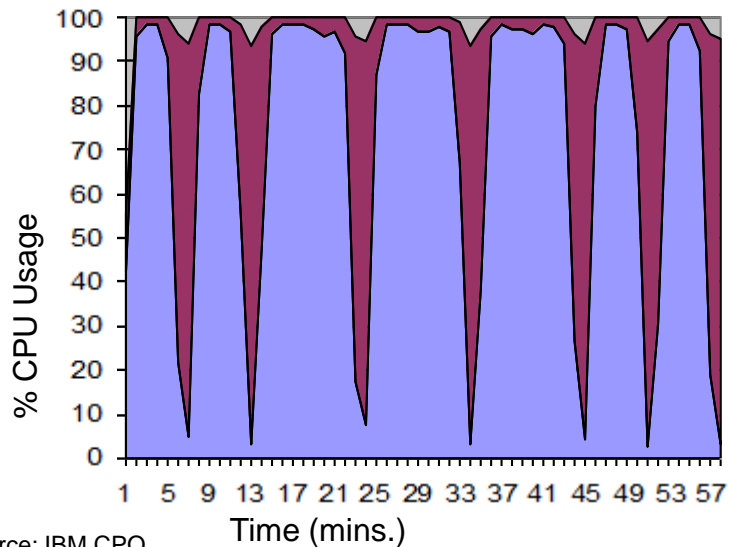Machine capacity (red) =
1.42x average demand (green)

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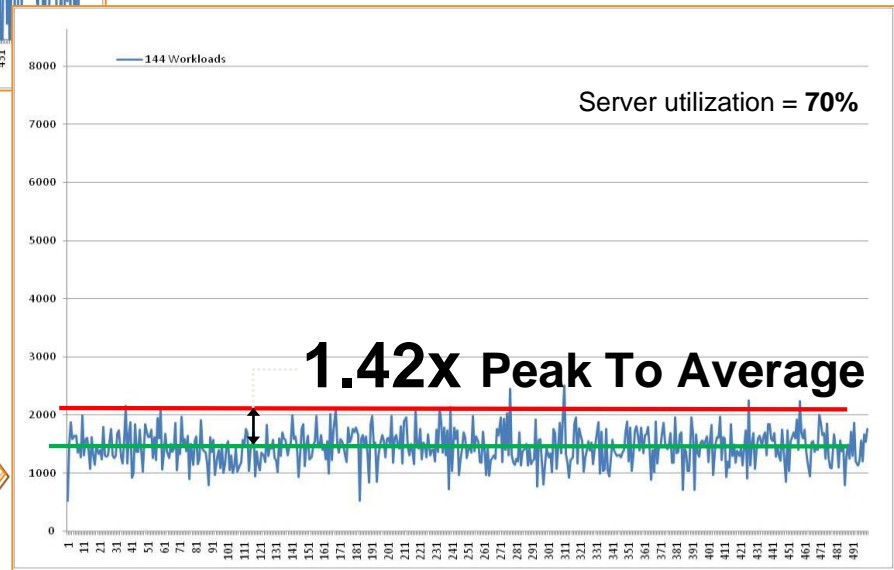
System z demonstrates perfect workload management…
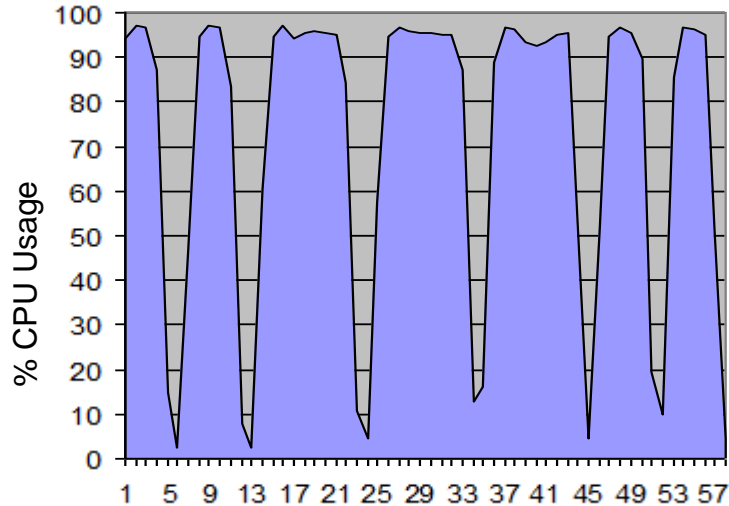
Demand curve for 10 high priority workloads running in 1 z/VM LPAR (PR/SM weight = 99)
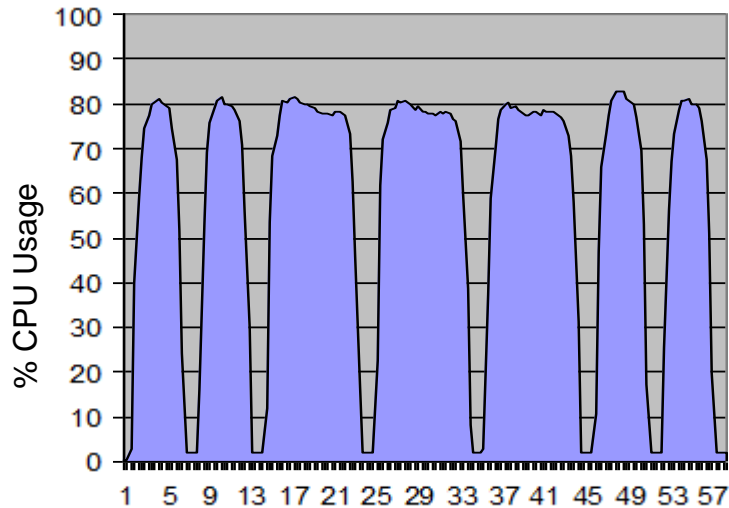
- **Workloads consume 72% of available CPU resources**

Demand curve when 14 low priority (PR/SM weight = 1) workloads are added in a second z/VM LPAR
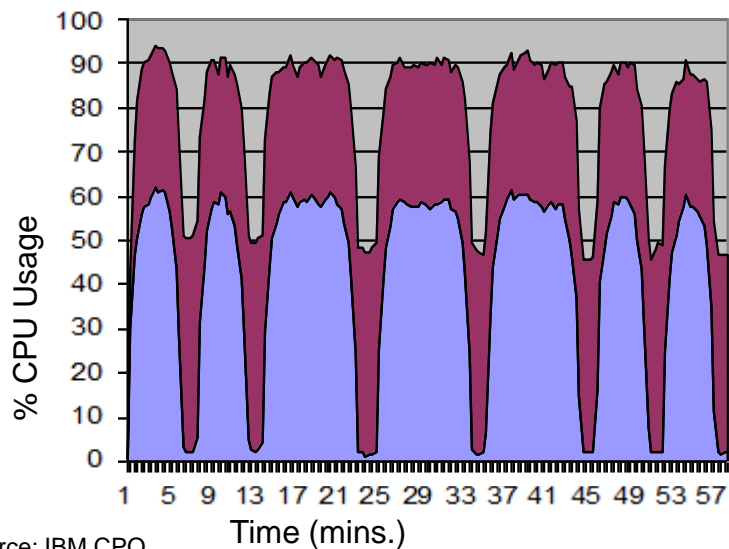
- **High priority workload throughput is maintained**

- **No response time degradation**

- **All but 2% of available CPU resources is used**

Source: IBM CPO

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…Unlike this common Intel hypervisor which demonstrates imperfect workload management

Demand curve for 10 high priority workloads running on a common Intel hypervisor (high share)

- **Workloads consume 58% of available CPU resources**

Demand curve when 14 low priority (low share) workloads are added

- **High priority workload throughput drops 31%**

- **Response time degrades 45%**

- **22% of available CPU resources is unused**

Source: IBM CPO

Time (mins.)

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Non-production environments require fewer resources on the mainframe

- Development and Test Capacity
  - Mainframe – Prod +20%
  - Distributed – a range, often Prod +200%

Production *QA* *Dev/Test*
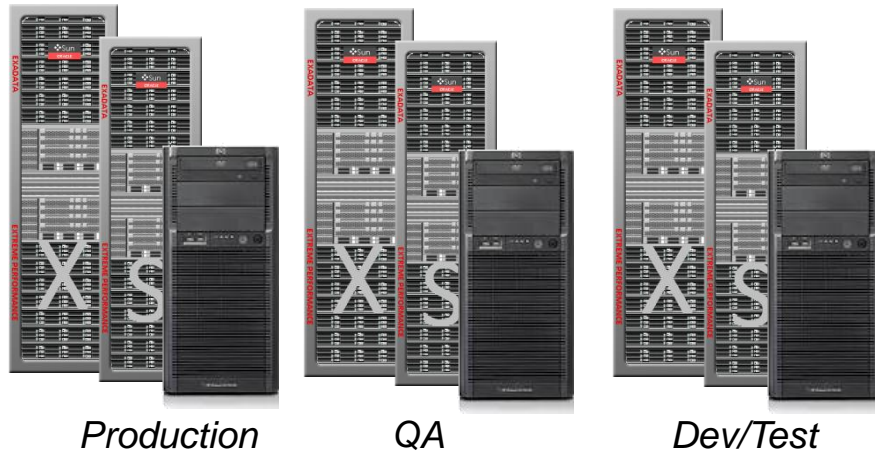
Mainframe Usage Profile

Dev / Test

QA

Production

24 hours

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Disaster Recovery on System z costs much less than on distributed servers

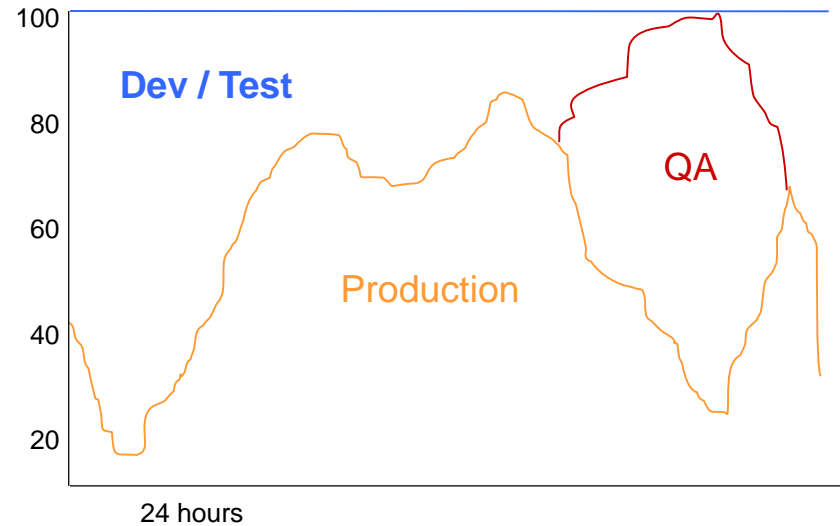**A large European insurance company with mixed distributed and System z environment:**

Disaster Recovery Cost as a percentage of Total Direct Costs:

System z – **3%**

Distributed – **21%**

Two mission-critical workloads on distributed servers had DR cost > 40% of total costs
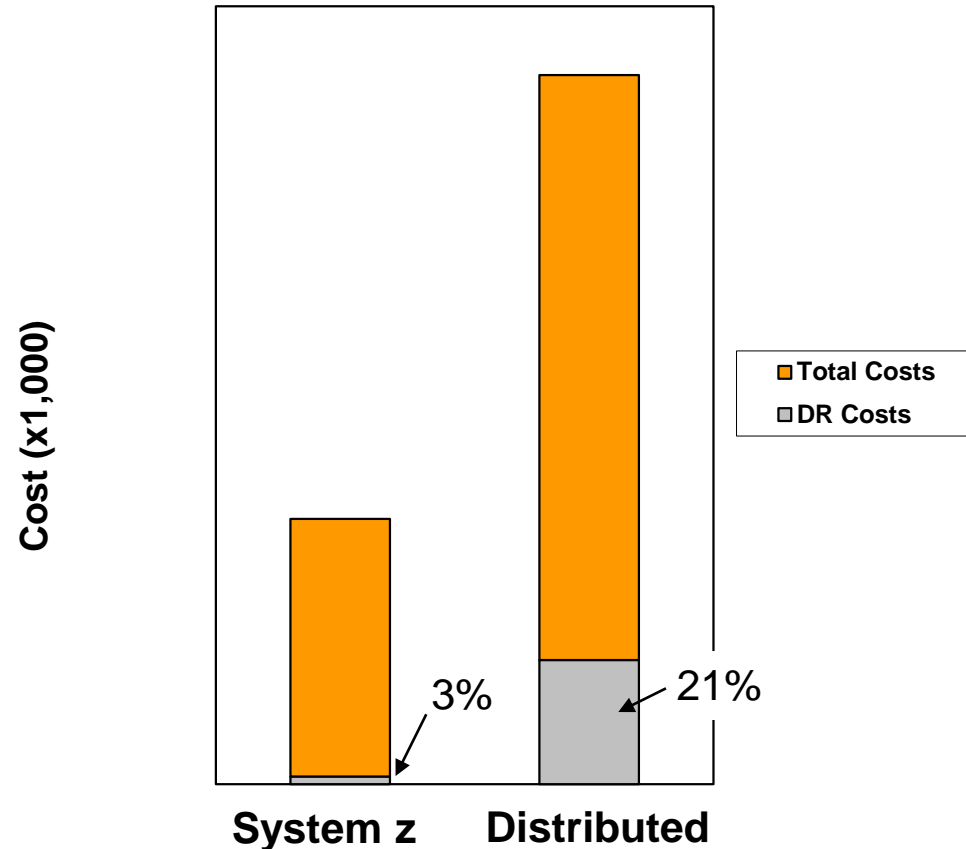
Cost (x1,000)

■ Total Costs
□ DR Costs

3%

21%

System z   **Distributed**

Source: IBM Eagle Team

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Better understanding of mainframe workloads and the platform can prevent embarking on a bad rehosting experience

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- …

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Dedicated I/O subsystem means System z is ideal for high bandwidth workloads

Capacity benchmark for Bank of China:
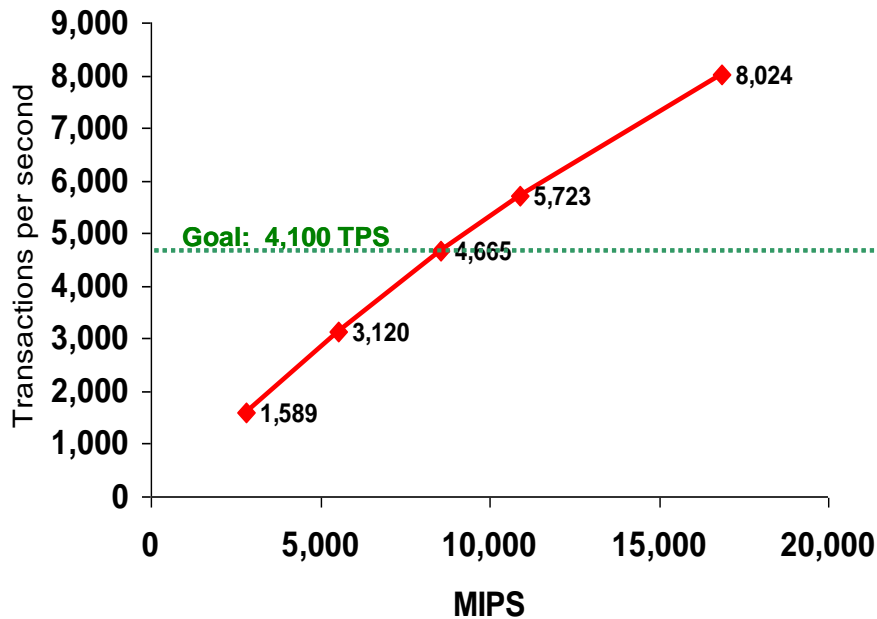
System z easily surpassed benchmark goal, and demonstrates near linear scalability
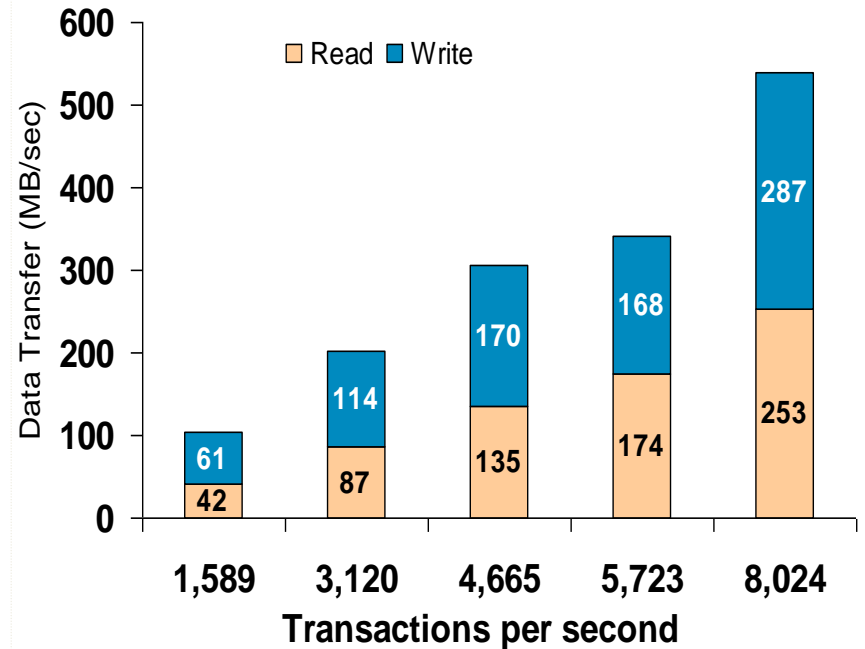
Reads and writes are well-balanced and scale linearly, demonstrating no constraints on I/O

Source: IBM CPO

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Comparison test demonstrates System z supports significantly more high I/O bandwidth workloads

Comparison of consolidation platforms
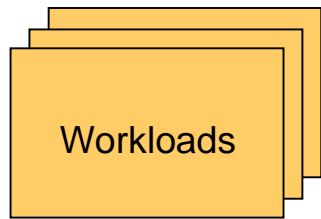
Workloads

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

1 workload per 16-core x86 blade

Virtualized on x86 16 core HX5 Blade

48 workloads per 32-way z/VM

Virtualized on z/VM on zEC12 32 IFLs

I/O bandwidth large scale pool

***24x** more workload density*

Source: IBM CPO

Customer data demonstrates consolidated Oracle database workloads benefit from System z's high I/O bandwidth

Which platform provides the lowest TCA over 3 years?
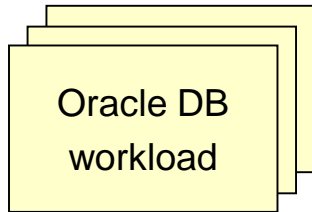
Oracle DB workload

Customer Database Workloads each supporting 18K tps

Oracle Enterprise Edition

Oracle Real Application Cluster

3 Oracle RAC clusters
4 server nodes per cluster

12 total HP DL580 servers
(192 cores)

$13.2M (3 yr. TCA)

3 Oracle RAC clusters
4 nodes per cluster

Each node is a Linux guest
zEC12 with 27 IFLs

$5.7M (3 yr. TCA)

1/2 the cost!

TCA includes hardware, software, maintenance, support and subscription.
Workload Equivalence derived from a proof-of-concept study conducted at a large Cooperative Bank.

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Eagle studies show some applications originally designed with co-located data are not good offload candidates

- Large insurance company rehosted portion of application as POC
  - Found TCP/IP stack consumed considerable CPU resource, and introduced security compromises and network latency

- European bank tried rehosting CICS workload to Linux while maintaining VSAM and DB2 data on System z
  - Induced latency resulted in CICS applications no longer meeting its SLA

Single z/OS LPAR

CICS/COBOL **DB2 for z/OS**
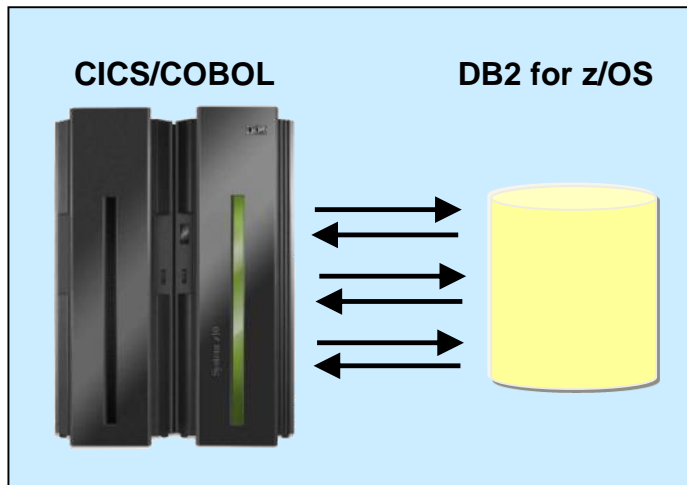
Distributed architecture

CICS-like emulator **DB server**

TCP / IP

Source: IBM Eagle Team

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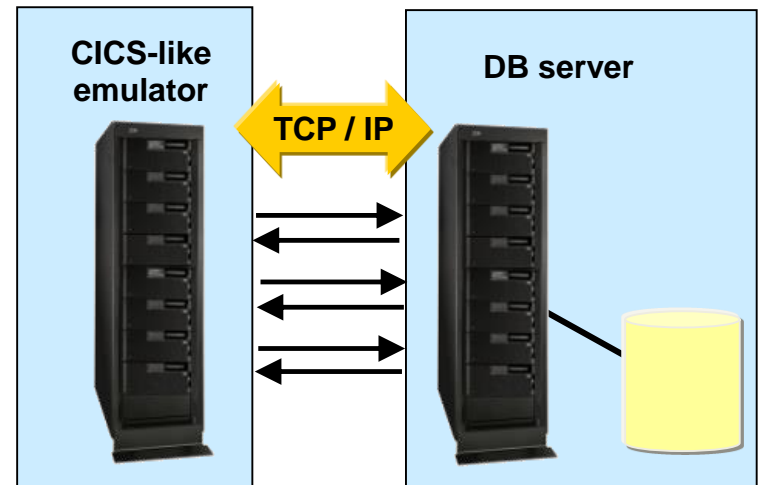
Before you start a rehosting project, make sure you have evaluated *all* the risks

Look for hidden costs like:
- Missing functionality
- Sub-optimized performance
- Risks of failure

The IBM Eagle Team

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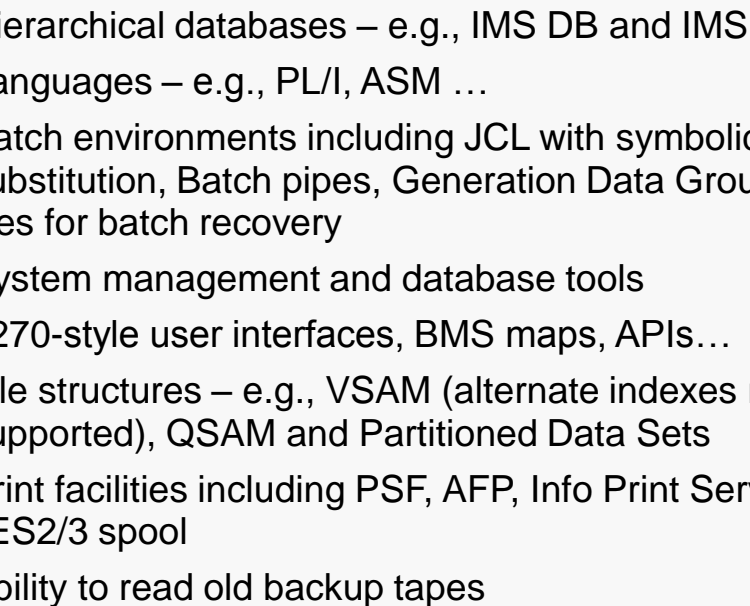
Replacement technologies are not always available for many mainframe functions

Rehosted platform
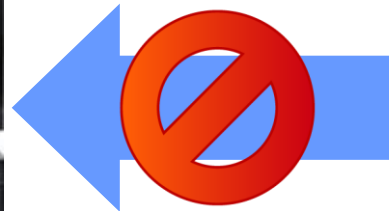
- Hierarchical databases – e.g., IMS DB and IMS DC
- Languages – e.g., PL/I, ASM …
- Batch environments including JCL with symbolic substitution, Batch pipes, Generation Data Group files for batch recovery
- System management and database tools
- 3270-style user interfaces, BMS maps, APIs…
- File structures – e.g., VSAM (alternate indexes not supported), QSAM and Partitioned Data Sets
- Print facilities including PSF, AFP, Info Print Server, JES2/3 spool
- Ability to read old backup tapes

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Eagle studies for two US retailers highlight missing systems management functionality

Rehosted platform

- 15 replacement applications (7.5%)
- Cost = $8.4M OTC + $1.8M annually

- 53 replacement applications identifies (20%)

- 200 systems management products in total

- 261 systems management products in total

- Options?
  – Re-write applications to avoid usage
  – Write new code to perform the function
  – Add staff to manually perform the function

Source: IBM Eagle Team

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Offloading CICS application results in suboptimal performance

- Offload project to move State of Montana Department of Motor Vehicles license registration system from CICS to Microsoft
  - Performed by Microsoft and Bearing Point
  - Cost of project $28.3M, 3 years late

	Response time
Before offload	Sub-second
After offload	30+ seconds

"Transferring titles is taking two to three hours instead 15 minutes."

One employee said she had never heard so many "four-letter words" from customers.

Source: http://spectrum.ieee.org/riskfactor/computing/it/montana-new-registration-and-licensing-system-still-having-hiccups

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Customer tests show IBM Enterprise COBOL performs better than competition

- IBM Enterprise COBOL on z/OS performed best

- Micro Focus COBOL is a COBOL interpreter, and code is over 4.5 times less efficient

- ACUCOBOL, a compiler acquired by Micro Focus, was 12 times less efficient

- Micro Focus functional differences required additional debugging

Performance Comparison Run Time

CPU time normalized to IBM Enterprise COBOL on z/OS

Lower is better

IBM Enterprise COBOL on z/OS	
Micro Focus COBOL compiler on Linux on z	
ACUCOBOL compiler on Linux on z	
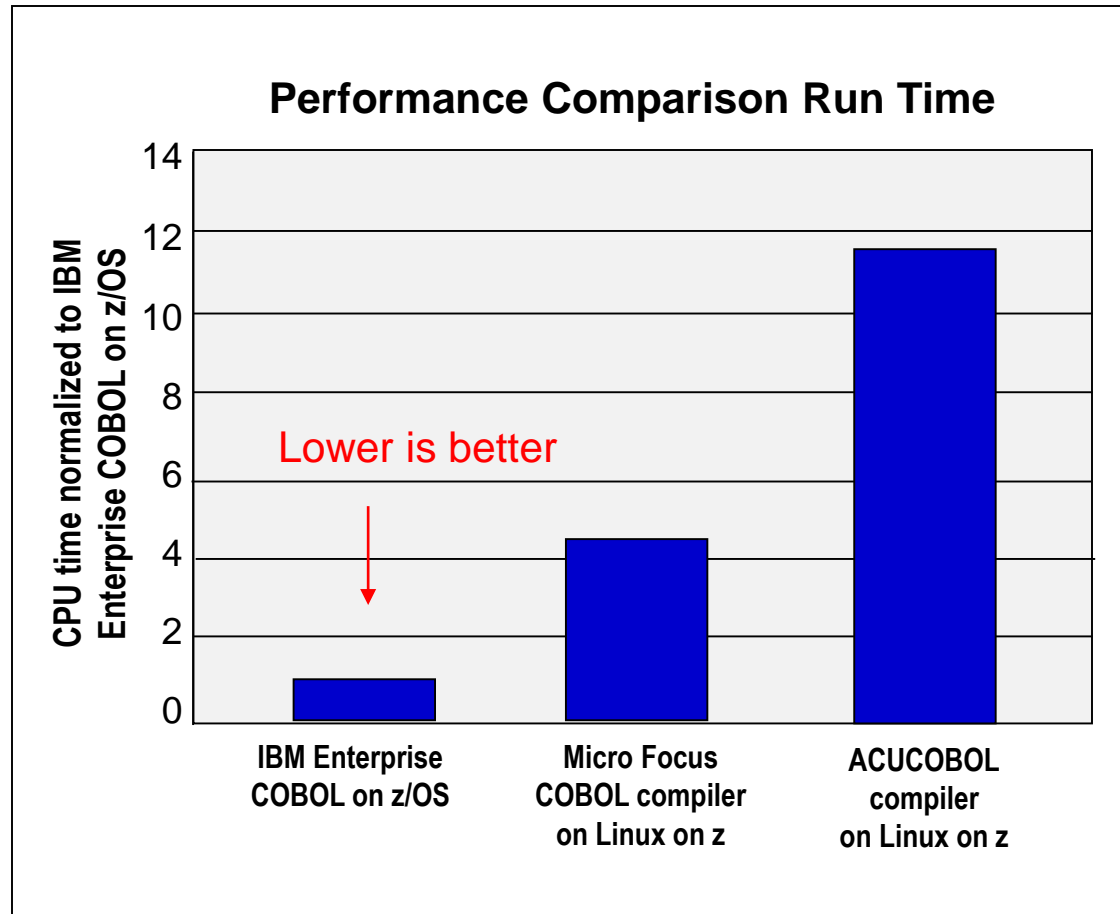
Different compilers may potentially lead to different COBOL behavior

IBM Enterprise COBOL

IBM COBOL for AIX

OpenCOBOL

Micro Focus COBOL

Veryant isCOBOL

ACUCOBOL

Netcobol

Unisys COBOL

zCOBOL

Tiny COBOL

Endian-ness

Array processing

Floating point representations

EBCDIC / ASCII conversion and collation

REWRITE operation

NULL address / pointer

Pointer manipulation

Truncation
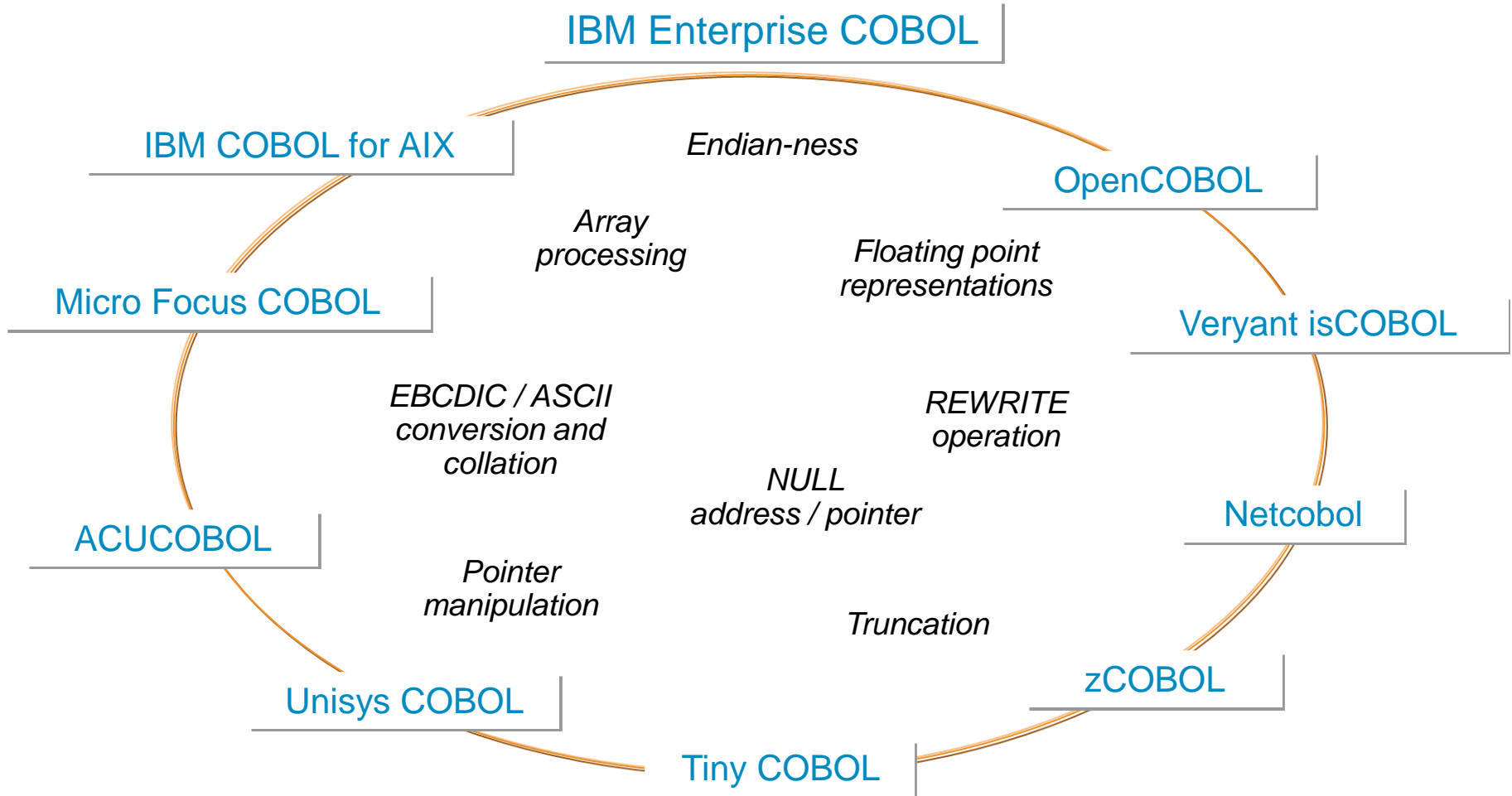
See http://download.oracle.com/docs/cd/E18050_01/artwb/docs11gr1/wbref/CobolConverter.html

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Code stability is at risk on some distributed platforms

- Mature System z software is very stable

- Distributed software is typically less so…

```
A problem has been detected and windows has been shut down to prevent damage
to your computer.

The problem seems to be caused by the following file: SPCMDCON.SYS

PAGE_FAULT_IN_NONPAGED_AREA

If this is the first time you've seen this Stop error screen,
restart your computer. If this screen appears again, follow
these steps:

Check to make sure any new hardware or software is properly installed.
If this is a new installation, ask your hardware or software manufacturer
for any windows updates you might need.

If problems continue, disable or remove any newly installed hardware
or software. Disable BIOS memory options such as caching or shadowing.
If you need to use Safe Mode to remove or disable components, restart
your computer, press F8 to select Advanced Startup Options, and then
select Safe Mode.

Technical information:

*** STOP: 0x00000050 (0xFD3094C2,0x00000001,0xFBFE7617,0x00000000)


***   SPCMDCON.SYS - Address FBFE7617 base at FBFE5000, DateStamp 3d6dd67c
```
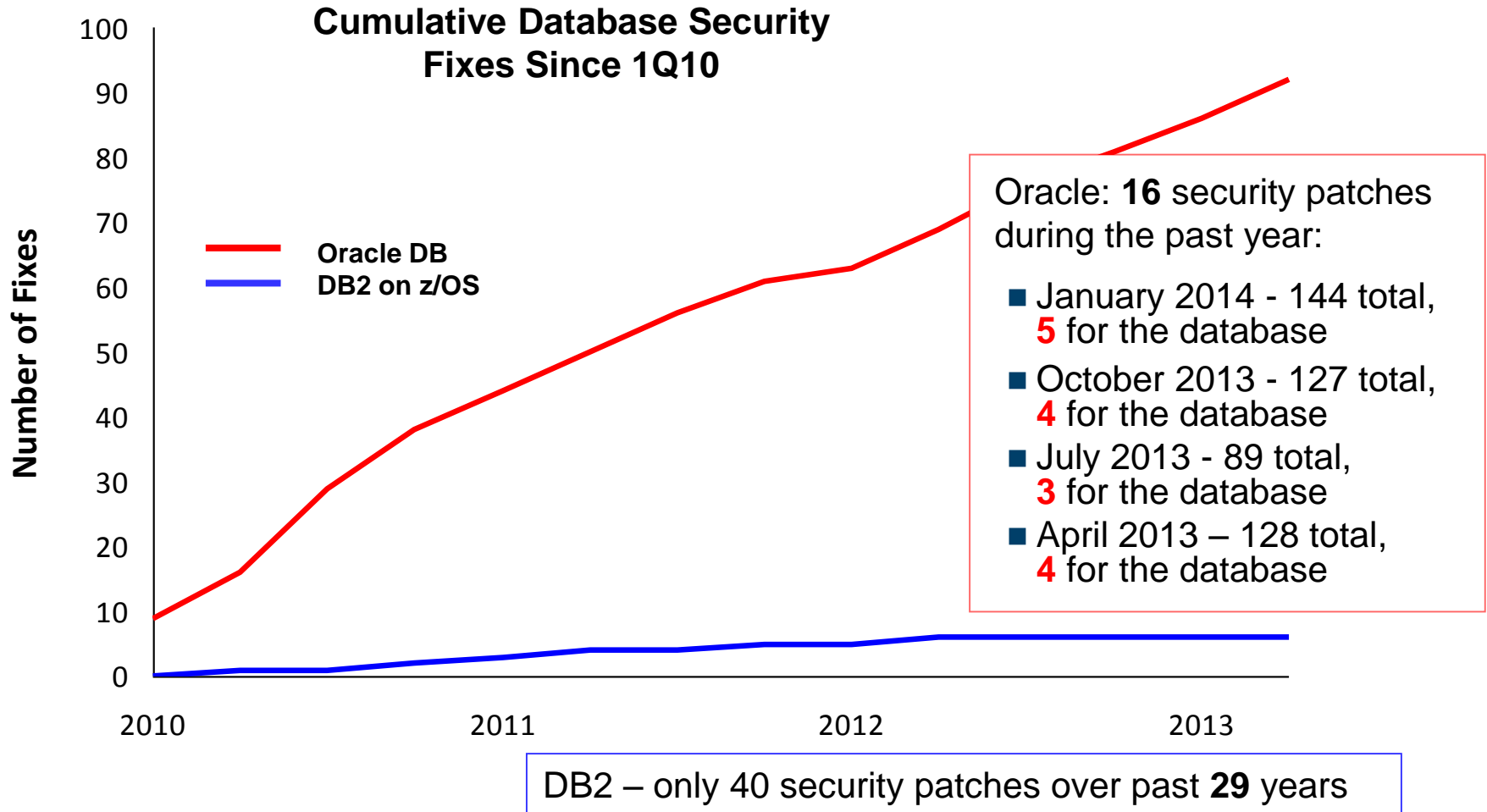
Familiar Microsoft "Blue Screen Of Death"

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IBM ⚛

Oracle patches far outnumber those for DB2 on z/OS

Cumulative Database Security Fixes Since 1Q10

Oracle: **16** security patches during the past year:

- January 2014 - 144 total, **5** for the database
- October 2013 - 127 total, **4** for the database
- July 2013 - 89 total, **3** for the database
- April 2013 – 128 total, **4** for the database

Legend:
- Oracle DB
- DB2 on z/OS

Y-axis: **Number of Fixes** (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)

X-axis: 2010, 2011, 2012, 2013

DB2 – only 40 security patches over past **29** years

Source: http://www.oracle.com/technetwork/topics/security

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In 2005, Canadian insurance company partnered with Micro Focus on a rehosting project…

Lombard Canada Ltd. wanted to replace their old mainframe

- 200 MIPS
- CICS, COBOL, VSAM, DB2

"We estimate this project will save us in excess of $1 million a year…"

**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
- Millions of dollars spent 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

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Asian bank project demonstrates another more recent example of failed rehosting

- 60 MIPS CICS/COBOL application plus additional 30 MIPS of Batch processing
  - 2.8M lines of COBOL code
  - 123K LOC in Assembler
  - 44K LOC of JCL

- IMS DB remained on System z

- **Two years later:**
  - Project abandoned after failing to complete development
  - $5.7M spent but unable to estimate eventual deployment costs
  - Team of 10 was disbanded and left the business – no one could describe the problems encountered
  - Management responsible was fired

Source: IBM Eagle Team

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Ongoing rehosting project at US Retail company provides another example of the risks involved

Customer's stated objective:
- Offload 3,500 MIPS with Micro Focus…
- $10M budget…
- 1 year schedule…

- **18 months later:**
  - $60M spent, but only 350 MIPS offloaded
  - Increased staff to cover over-run
  - Required additional hardware over initial prediction
  - Implemented manual steps to replace mainframe automation
  - Extended the dual-running period of the rehost…
  - Executive sponsor no longer employed…

Eagle team had advised against this offload…

Source: IBM Eagle Team

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Recent US government agency rehosting project also had to be abandoned

- 360 MIPS of CICS/COBOL for payroll and HR
  - 4M lines of COBOL code
  - Estimated 270K LOC needed to be changed

- Additional 30 MIPS of batch

- IMS DB to stay on System z

- Agency estimated a 5 year contract worth $80M to perform this offload

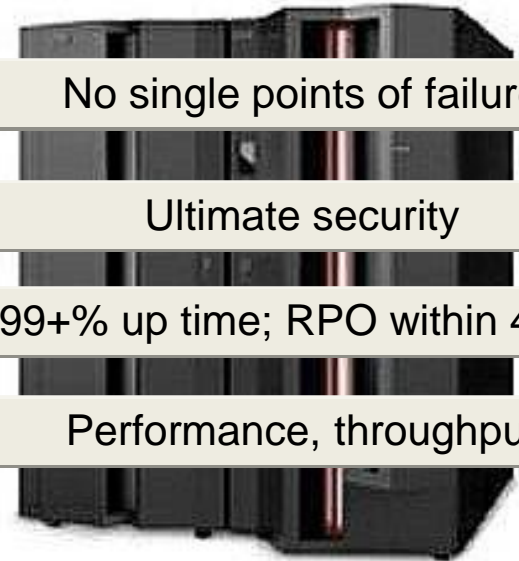- **Project abandoned** and manager responsible for the decision left

Source: IBM Eagle Team

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Can a rehosting vendor really meet your SLA requirements?

Distributed

Mainframe

Insist the solution includes the same levels of backup, availability and disaster recovery.

No single points of failure

Can the same levels and complexity be reached? What is the *cost*? How much testing will be involved?

Ultimate security

Is this attainable? Can this be *guaranteed*?

99+% up time; RPO within 4 hrs

How many *years* have you spent fine-tuning? Are you prepared to spend that again – maybe more – to reach the same levels?

Performance, throughput

Know the risks! Know the costs!

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What's next?

- **Re-examine your cost concerns; make sure chargebacks are accurate**
  - Read Forbes' (Dec 2013) It's 10 O'Clock -- Do You Know Where Your IT Costs Are?
    …Applying IT financial management is like deploying enterprise architecture or setting up enterprise standards: a horribly messy discussion but one that will imbue structure into everything you do in the coming years. It's time to stop and think about budget, value, and costs…

- **Examine the productivity of your mainframe compared to equivalent distributed platforms.**
  - Which generates more throughput in less time? Which gives you best cost per unit of work? Which has the lowest downtime and best security?

- **Ask IBM for an Eagle study… or a Portfolio Review and Analysis**

Remember:

> Examine all costs and all risks; understand what the ROI will be
>
> Consider upgrading the mainframe as a lower risk alternative

When talking to rehosting companies:

> Ask for references of customers who have completed similar migrations… Then talk to them!

The reality of rehosting: Understanding the value of the mainframe