IBM Transformation:
Major IT Virtualization Initiative

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IBM Virtualization – Enterprise Data Center Journey

Agenda

- IBM IT Infrastructure Transformation
- Enterprise Virtualization and Progress
- Program Model and Workload Selection
- Business Case and Benefits
- Lessons Learned/Critical Success Factors

Project ‘Big Green’

Double compute capacity with no increase in consumption or impact by 2010

Major proof point for Project Big Green

IBM’S PROJECT BIG GREEN SPURS GLOBAL SHIFT TO LINUX ON MAINFRAME

ARMONK, NY, August 1, 2007

IBM to reallocate $1 billion each year

- To accelerate “green” technologies and services
- To offer a roadmap for clients to address the IT energy crisis while leveraging IBM hardware, software, services, research, and financing teams
- To create a global “green” team of almost 1,000 energy efficiency specialists from across IBM

Re-affirming a long standing IBM commitment

- Energy conservation efforts from 1990 – 2005 have resulted in a 40% reduction in CO2 emissions and a quarter billion dollars of energy savings
- Annually invest $100M in infrastructure to support remanufacturing and recycling best practices

- *IBM will consolidate and virtualize thousands of servers onto approximately 30 IBM System z™ mainframes*
- *Substantial savings expected in multiple dimensions: energy, software and system support costs*
- *The consolidated environment will use 80% less energy and 85% less floor space*
- *This transformation is enabled by the System z sophisticated virtualization capability*

IBM's own transformation experience

IBM IT Transformation

- ✓ *IBM's IT transformation continues: our own IT investments over the past 5 years have delivered a cumulative benefit yield of $4.1B*

Data Center Efficiencies Achieved

- ✓ *Consolidation of infrastructure, applications*
- ✓ *Enterprise architecture optimization*
- ✓ *Global resource deployment, Globally Integrated Enterprise*

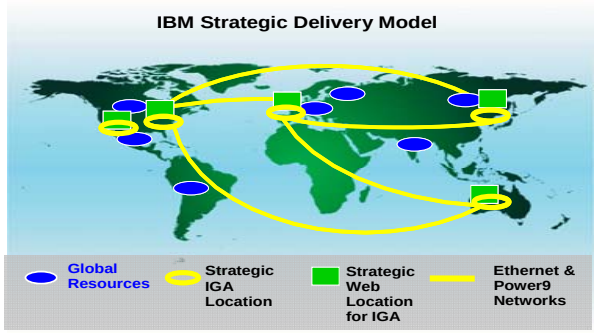
Next Level of Infrastructure Challenge

- ✓ *Floor space challenges in key facilities*
- ✓ *Underutilized assets in outdated Web infrastructure*
- ✓ *Continued infrastructure cost pressure*
- ✓ *Increase % IT spending to transformation initiatives*

The New Enterprise Data Center

- ✓ *Project Big Green: 2X existing capacity, no increase in consumption or impact by 2010*
- ✓ *Highly virtualized and pooled resources, compelling results*

	1997	Today
CIOs	**128**	**1**
Host data centers	**155**	**7**
Web hosting centers	**80**	**5**
Network	**31**	**1**
Applications	**15,000**	**4,700**



Stages of Adoption: IBM Journey

Simplified

Drives IT efficiency

- Physical consolidation of data centers, networks and applications
- Simple like-for-like server and storage virtualization
- Service tools, energy facilities mgmt

Shared

Rapid deployment of new infrastructure and services

- Significant progress toward highly virtualized environment to enable pooled System z, x, Power Systems, and storage
- Green production and advanced data center facilities
- Shared service delivery model

Dynamic

Highly responsive and business goal driven

- IBM Research “Cloud”
- Business-driven service management pilots
- Globally Integrated Enterprise

Enterprise Business Value – Expectations

Business case

- **Early modeling identified significant potential for savings**
- **TCO virtualization assessment as cross-IBM effort**
- **Leverage IBM technology and capabilities**

Energy savings

- **Annual energy usage to be reduced by 80%**
- **Total floor space to be reduced by 85%**
  - 11,045 square feet for distributed solution
  - 1,643 square feet for System z solution

Quality service

- **Leverage maturity of System z - availability, resiliency**
- **Reduce complexity, centralize service mgmt**
- **Dynamic allocation of compute power, provisioning**

Comparison of Annual Energy Usage for Workloads

	Distributed Solution		System z Solution	
	Kilowatt hours (K)	**Cost* ($K)**	**Kilowatt hours (K)**	**Cost* ($K)**
Power	24,000	$2,400	4,796	$479
Cooling**	14,400	$1,440	2,877	$287
Total Energy	38,400	$3,840	7,673	$767

* Electrical cost calculated at rate of .10 per kW ** Cooling is 60% of power cost

Virtualization Benefits are Significant; Migration Management is Key

Expected Benefits of Virtualization

- **Substantial savings in multiple dimensions: energy, software and system support costs**
- **80% less energy, 85% less floor space for consolidated environment**
- **Improved inventory hygiene, including application to server mapping**
- **Dramatically faster provisioning**
- **Improved security and resiliency**
- **Higher quality through reduced complexity, increased stability and availability**

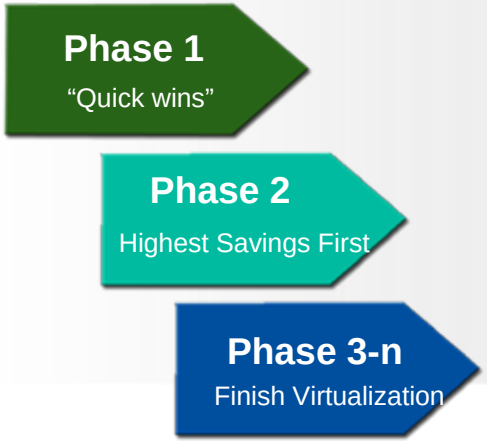
Large Scale Migration Challenges Exist

- **Decision-making: Integrating Enterprise and Business Unit view**
- **Mindset/Culture related to distributed and mainframe worlds**
- **Workload selection - multidimensional nature of selection process**
- **Dated inventory records that are not centrally maintained**
- **Detailed data required for internal business case**
- **Project and program complexity – integrating multiple priorities**

Clients are able to leverage IBM experience and capabilities to accelerate value

IBM System z Linux Virtualization Progress

- **Established phased approach**
  - Migrated initial servers from early ‘wave’ teams
  - Thousands of servers inventoried
  - Decommission pipeline of hundreds of servers for reuse or removal
- **Comprehensive project plan and management system in place**
  - Integrated business priorities with transformational objectives
  - ‘Work in progress’ approach to maximize server migrations
  - Pipeline, process, technical, finance and communications support

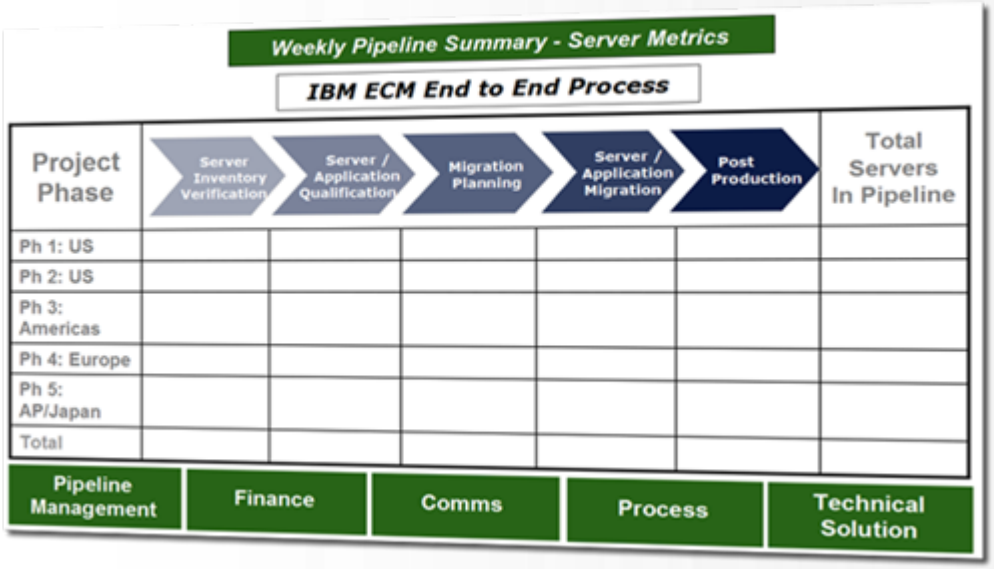


- **Benefits are on track with expectations**
  - Migration management key
  - Business case is compelling
  - Using System z10 technology, the number of machines could be cut by about half, with greater savings in energy, floor space, software and support costs
- **Technical solution, education plan and operational plan developed**
  - Built upon IBM prior consolidation/simplification efforts, utilizing IBM offerings and capabilities
- **IBM experience is driving Time to Value initiatives, integrated into IBM capabilities**
- **Highest level of support from IBM senior executive team**

IBM is Using a ‘Work in Process' Approach to Manage the Migration

Management Approach and Reporting

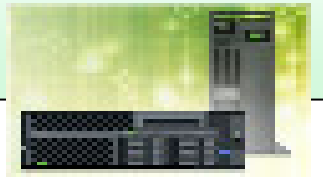
- Process approach borrowed from factory line management
- Metrics for each process and sub-process
- Quality measured with process fallout – tracked by cause
- Daily status calls for issue resolution
- Weekly status reporting for CIO and management team



Enterprise Approach to Workload Migration

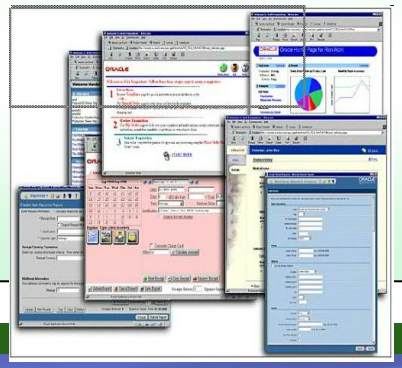
Location View
Boulder
Poughkeepsie
Portsmouth
Raleigh
Rochester
Southbury

Environment View
Managed 'Offerings'
Development
Intranet
BU Environments



Migration Candidates Sourcing

Application View
Business Unit Partnership

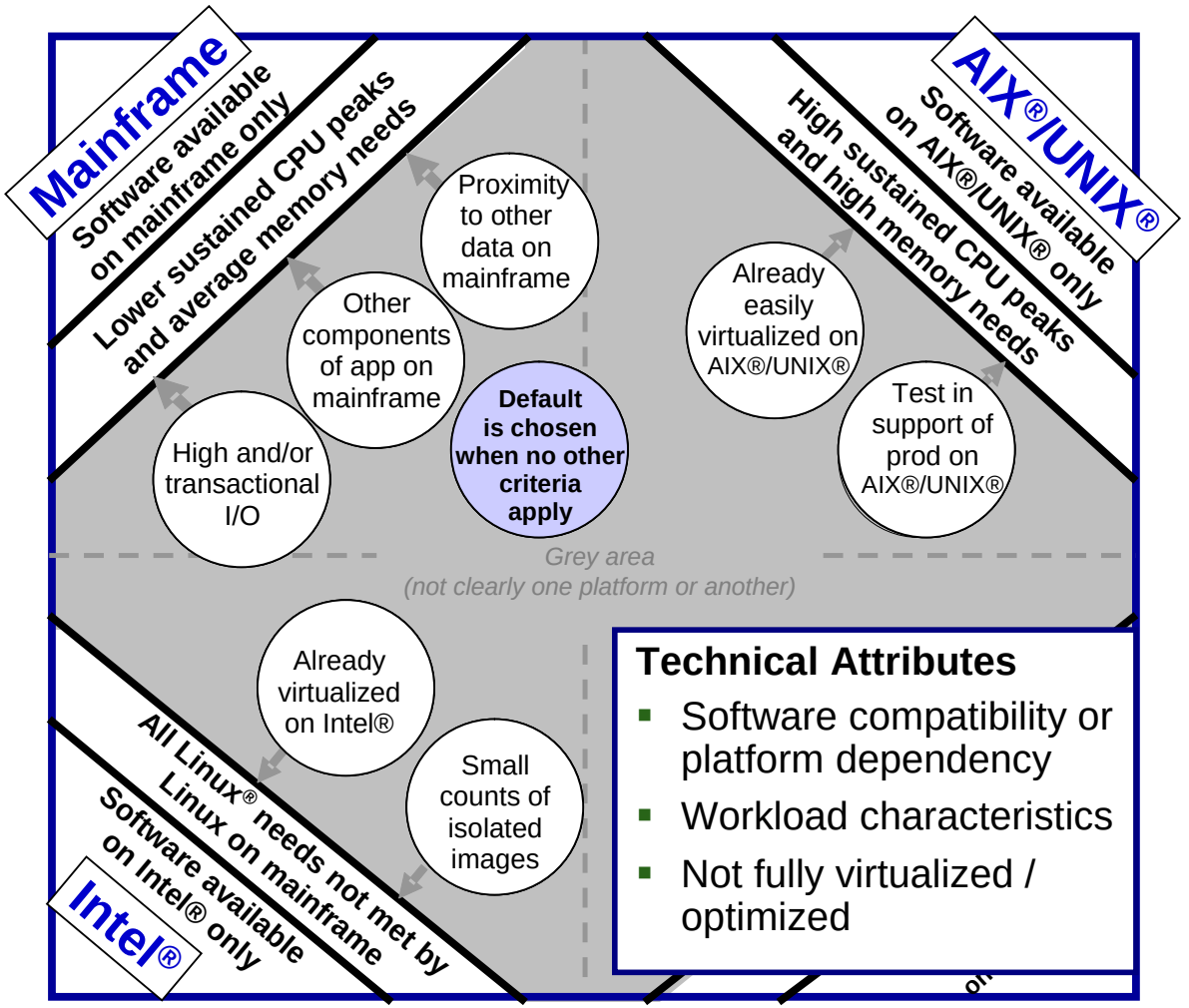


Technology View
Domino
Email
Static Web
DB2
Linux on x86

Each Workload is Evaluated for Suitability Based on Technical Attributes

Priority Workloads for Consolidation:

- WebSphere® applications
- Domino® Applications
- Selected tools: Tivoli®, WebSphere® and internally developed
- WebSphere MQ
- DB2® Universal Database™



Business critical applications, such as IBM's intranet portal, are successfully moving to System z Linux

Business Challenge

- Employees rely on IBM's intranet portal, the On Demand Workplace, for access to critical business applications. With up to 1.3 million views daily (and growing), it was critical to reduce server sprawl, operating costs and energy footprint while maintaining performance, resiliency and growth.

Solution

- Move the On Demand Workplace development and production environments from distributed to virtualized IBM System z Linux environment.

Benefits

- Reduce data center footprint, realize additional savings from reduction in energy use and staff needed to manage the environment.

Virtualization and consolidation can help reduce the total data center footprint and associated energy use while improving the efficiency of the energy that is used.

– The Enterprise of the Future, Implications for the CIO IBM 2008

Business Case Leveraged RACE Tool, Iterative Approach

Utilized RACE commercial modeling tool

- Foundation for internal business case, constructed specific environmental variables

. Created financial plan for "known universe"

- Identified relevant sample (5-10%) of most likely servers to be migrated and gathered financial profile information for each

Engaged SME's within IBM

- Provided business case assumptions (i.e. depreciation/maintenance), modified as appropriate

Iterative Process

- Continuously engaged with core SME's to ensure most current information

Project Metrics

- Weekly report of migrated servers and their disposition status (reuse or disposal using GARS*) and Energy Certificate status
- Working to incorporate actuals into the Business Case such that we can refresh our assumptions

**IBM Global Asset Recovery Services*

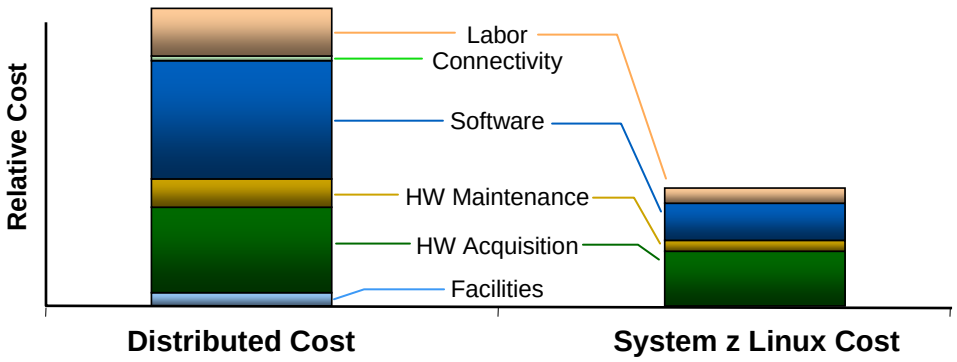
TCO: A Range of IT Cost Factors – Often Not Considered

- *Availability*
  - High availability
  - Hours of operation
- *Backup / Restore / Site Recovery*
  - Backup
  - Disaster Scenario
  - Restore
  - Effort for Complete Site Recovery
  - SAN effort
- *Infrastructure Cost*
  - Space
  - Power
  - Network Infrastructure
  - Storage Infrastructure
  - Initial Hardware Costs
  - Software Costs
  - Maintenance Costs
- *Additional development/implementation*
  - Investment for one platform – reproduction for others
- *Controlling and Accounting*
  - Analyzing the systems
  - Cost
- *Operations Effort*
  - Monitoring, Operating
  - Problem Determination
  - Server Management Tools
  - Integrated Server Management – Enterprise Wide
- *Security*
  - Authentication / Authorization
  - User Administration
  - Data Security
  - Server and OS Security
  - RACF vs. other solutions
- *Deployment and Support*
  - System Programming
    - Keeping consistent OS and SW Level
    - Database Effort
  - Middleware
    - SW Maintenance
    - SW Distribution (across firewall)
  - Application
    - Technology Upgrade
    - System Release change without interrupts
- *Operating Concept*
  - Development of an operating procedure
  - Feasibility of the developed procedure
  - Automation
- *Resource Utilization and Performance*
  - Mixed Workload / Batch
  - Resource Sharing
    - shared nothing vs. shared everything
  - Parallel Sysplex vs. Other Concepts
  - Response Time
  - Performance Management
  - Peak handling / scalability
- *Integration*
  - Integrated Functionality vs. Functionality to be implemented (possibly with 3rd party tools)
  - Balanced System
  - Integration of / into Standards
- *Further Availability Aspects*
  - Planned outages
  - Unplanned outages
  - Automated Take Over
  - Uninterrupted Take Over (especially for DB)
  - Workload Management across physical borders
  - Business continuity
  - Availability effects for other applications / projects
  - End User Service
  - End User Productivity
  - Virtualization
- *Skills and Resources*
  - Personnel Education
  - Availability of Resources

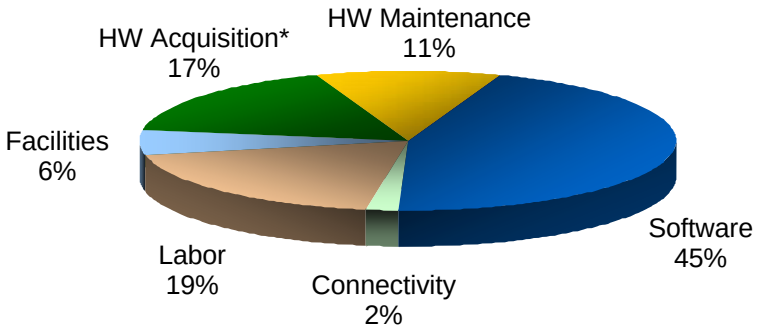
Routinely Assessed Cost Factors

Client View of TCO Comparison for Similar Distributed Workload vs. System z Linux results in Potential 60-75% Gross Costs Savings / 5 yrs

Operating Cost: Distributed vs. Mainframe



Potential Savings: Categories as a % of Gross Savings



* HW Acquisition compares server/disk refresh of distributed environment to the cost of acquiring new mainframes/storage

Dramatic Simplification

Unit	Distributed	System z Linux	% Reduction
Software Licenses	26,700	1,800	93%
Ports	31,300	960	97%
Cables	19,500	700	96%
Physical Network Connections	15,700	7,000	55%

Results will vary based on several factors including # of servers and work load types

Decommission Process Overview

Server available as a result of virtualization efforts

Server Ready

Check for technical viability and asset value to determine if h/w is a redeployment candidate

If redeployed

Request completed to coordinate shipping and update property control

If not redeployed

Complete Machine List Database and ship to GARS*

Apply to Neuwing for energy efficiency certificates

Tracking tool is updated to reflect disposition of the assets in the project

Capture savings in business plan and business case

****IBM Global Asset Recovery Services***

In addition to compelling savings, by virtualizing distributed workload onto System z Linux, ECM operational benefits are being realized

From application owner perspective …

- Speed: Rapidly clone environment - hours vs. days vs. weeks
- On demand resources: Add system resources (memory, cpu) as needed
- Scalable growth: I/O intensive workloads and cyclical applications
- Enable new business models: Significantly reduced need for dedicated development and test servers

From infrastructure owner perspective…

- System stability: Server reboot/recycling greatly reduced
- Simplification: Less hardware and related features to manage
- Improved change management: Significantly less security patches to apply
- Increased agility: Managed change during freeze windows

Infrastructure Transformation – Lessons Learned

Preparation

- Enlist a Senior Executive Sponsor for enterprise view
- Motivate Business Units through benefits and incentives
- Build business case and gather data – financial, inventory

Start-Up

- Start with small number of servers and build enterprise view
- Run ops while transforming w/strong PM, dedicated team
- Define reference architecture for ‘to be’ environment

Execution

- Integrate waves and resources, leverage existing processes
- Enterprise criteria, shared strategy, communicate real-time
- Drive cultural change needed to support transformation

Critical Success Factors

- **Sponsor with an enterprise view**
- **Strategic investment for migration**
- **Clear goals, dedicated team, inclusive leadership for execution of migration**
- **Leveraging talent and capability across all of IBM to drive rapid results**

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Domino*	**POWER5**	**System z9**	**zSeries***
GARS	**Power Systems**	**System z10**	**z/VM***
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