Massive Consolidation:
Major IT Virtualization Initiative

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IBM Systems

IBM Virtualization – Enterprise Data Center Journey

Agenda

- **IBM Commitment/Announcement Highlights**
  - IBM Transformation and "Big Green"
  - Internal Infrastructure Challenge, Approach and Benefits
- **IBM Virtualization Update**
  - Virtualization Progress
  - Business Case Approach and Client View of Savings
  - Application and Workload Selection
  - Successful Techniques and Lessons Learned

Project ‘Big Green’

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

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

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 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*

IT Organizations are Challenged by Operational Issues

	Challenges
 ***Costs & Service Delivery***	Rising costs of systems and networking operations Explosion in volume of data and information Difficulty in deploying new applications and services
 ***Business Resiliency & Security***	Security of your assets & your clients' information Landslide of compliance requirements Systems and applications need to be available
 ***Energy Requirements***	Rising energy costs & rising energy demand Power & thermal issues inhibit operations Environmental compliance & governance mandates

IBM's Globally Integrated Enterprise Data Centers

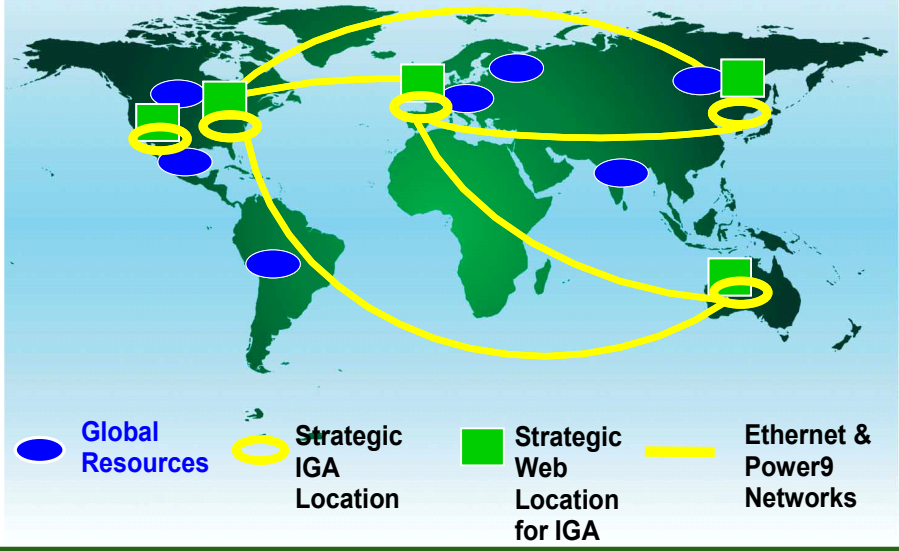
TECHNOLOGY

Data Center Efficiencies Achieved

- Consolidation of infrastructure, applications
- Enterprise architecture optimization
- Global resource deployment

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

IBM Strategic Delivery Model



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

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, Power Systems, System x and storage
- Green production and advanced data center facilities
- Shared service delivery model

Dynamic

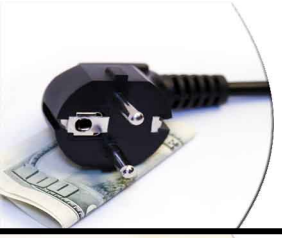
Highly responsive and business goal driven

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

Enterprise Business Value – Expectations

Business case

- Early modeling identified significant potential for savings through zLinux virtualization
- Performed TCO virtualization assessment on IBM portfolio as cross-IBM effort
  - System z, SW Migration Services, STG Lab Services, IBM Academy, ITO Migration Factory
- Identified substantial savings opportunity
  - Energy
  - Floor space
  - Labor
  - Software



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

- Leverages maturity of System z stack products - high availability, resiliency
- Reduces complexity and increases stability, centralizes service mgmt
- Potential for faster provisioning speed (months → days)
- Dynamic allocation of compute power
- Provides world-class security

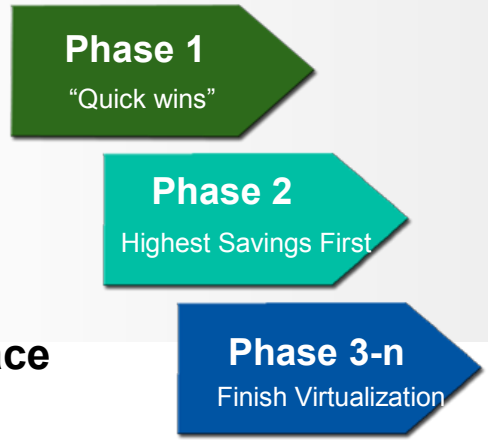
Comparison of Annual Energy Usage for Workloads

	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

IBM System z Linux Virtualization Progress

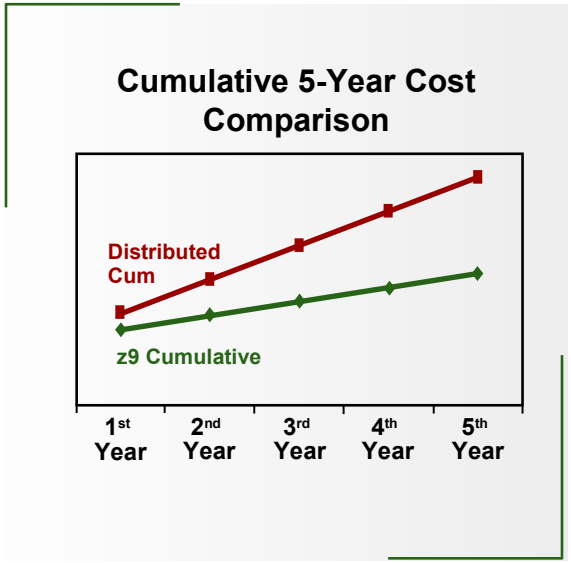
- **Established phased approach for quick wins**
- **Migrated initial servers from early 'wave' teams**
  - Thousands of servers inventoried
  - Multiple successful migrations delivering benefits as expected
  - Decommission pipeline of hundreds of servers for reuse or removal
- **Comprehensive project 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
- **Developed internal business case (RACE*)**
  - Created detailed cash flow and labor analysis, migration expense, iterated
- **Technical solution, education plan and operational plan developed**
  - Built upon IBM prior consolidation/simplification efforts, utilizing IBM offerings and capabilities
- **Highest level of support from IBM senior executive team**



*Formerly zRace

IBM System z Linux Virtualization Progress

- IBM implementing New Enterprise Data Center through achievements in
  - Server and storage virtualization
  - Energy efficiency and resiliency improvements
- 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
- Lessons Learned, including:
  - Enterprise strategy and sponsorship needed to drive business case and execution
  - Compelling business imperative accelerates execution and drives support
  - Enterprise view of migration managed by waves drives experience; savings for investment



- IBM experience is driving Time to Value initiatives, integrated into IBM capabilities
  - Dramatic reduction in labor through new processes supporting workload migrations
  - Fall in/out analysis, working with business units, to close gaps in workload pipeline
  - Piloting new testing strategy, processes & tools to automate

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*

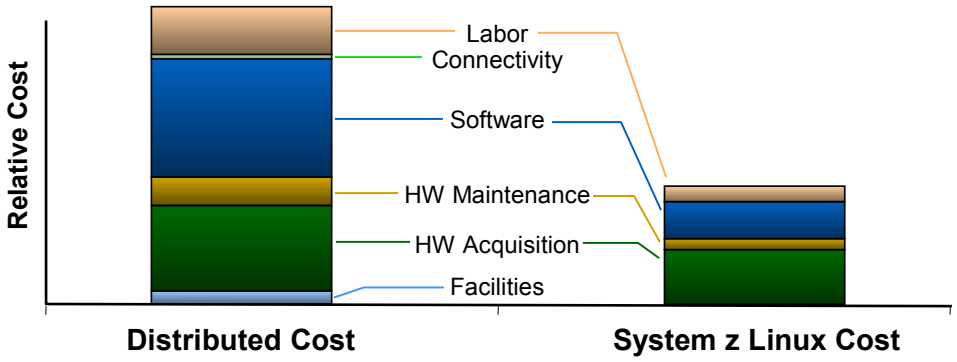
TCO: A Range of IT Cost Factors – Often Not Considered

- *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

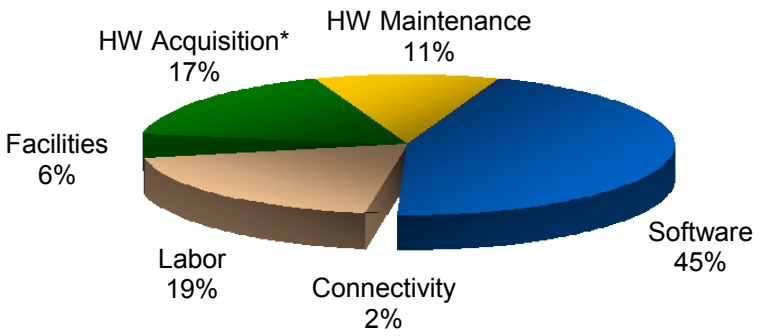
Routinely Assessed Cost Factors

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



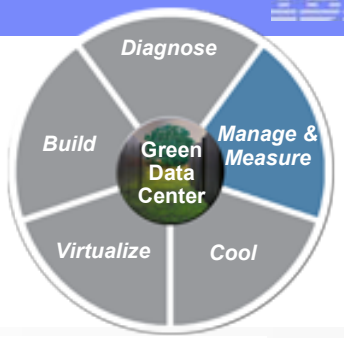
* HW Acquisition compares server/disk refresh of distributed environment to the cost of acquiring new mainframes/storage

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

Energy Efficiency Certificates Deliver Savings



By formally decommissioning servers, IBM is able to demonstrate energy savings and receive energy efficiency credits (EECs)

Client requirements

- Lower energy costs and achieve business benefit of Energy Efficiency
- Demonstrate Energy Efficiency Commitment

Solution

- Virtualized workloads onto System z platform and reduced energy consumption
- Hundreds of servers in pipeline to be redeployed, sent to GARS* and/or energy efficiency certificates issued
- IBM applied for EECs for eligible decommissioned servers to receive Energy Efficiency Credits
- GARS for asset reuse, recycling and/or reclamation

Benefits

- Quantifable energy reductions, tradable certificates
- Demonstrated commitment to energy efficiency

**IBM Global Asset Recovery Services*

The Next Level in Green Energy Markets

What is an Energy Efficiency Credit?

A Neuwing EEC (Energy Efficiency Credit) is a measured & verified Megawatt Hour (MWh) of Energy Savings i.e., Energy Efficiency

NEUWING ENERGY

EECs quantify, measure, verify, certify and monetize data center energy efficiency projects

November 2, 2007 Press Release

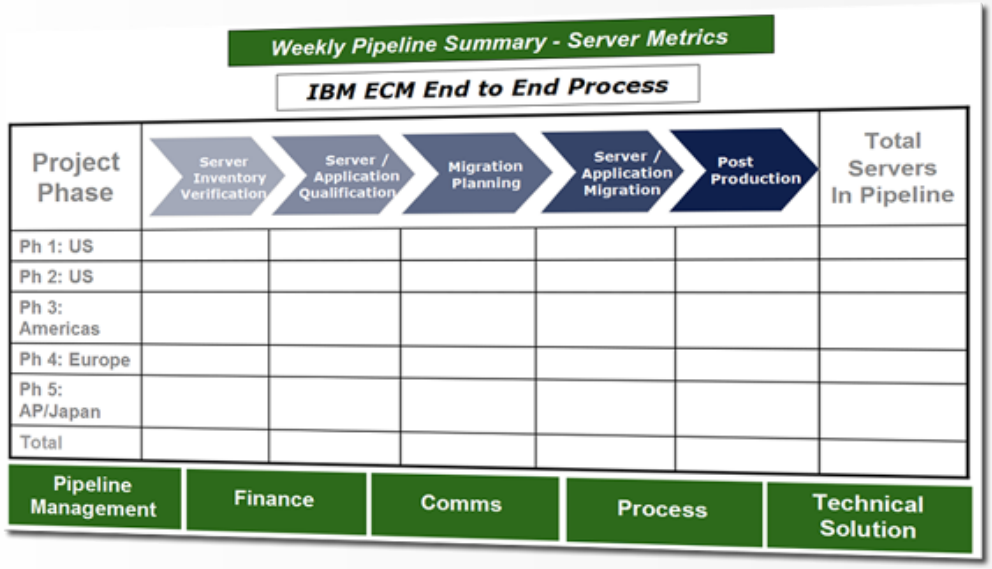
IBM Launches World's First Corporate-Led Energy Efficiency Certificate Program

In Conjunction With Neuwing Energy, Program Will Provide Clients Documentation and Third-Party Verification of the Energy Saving Results of Their Projects. ***Read more***

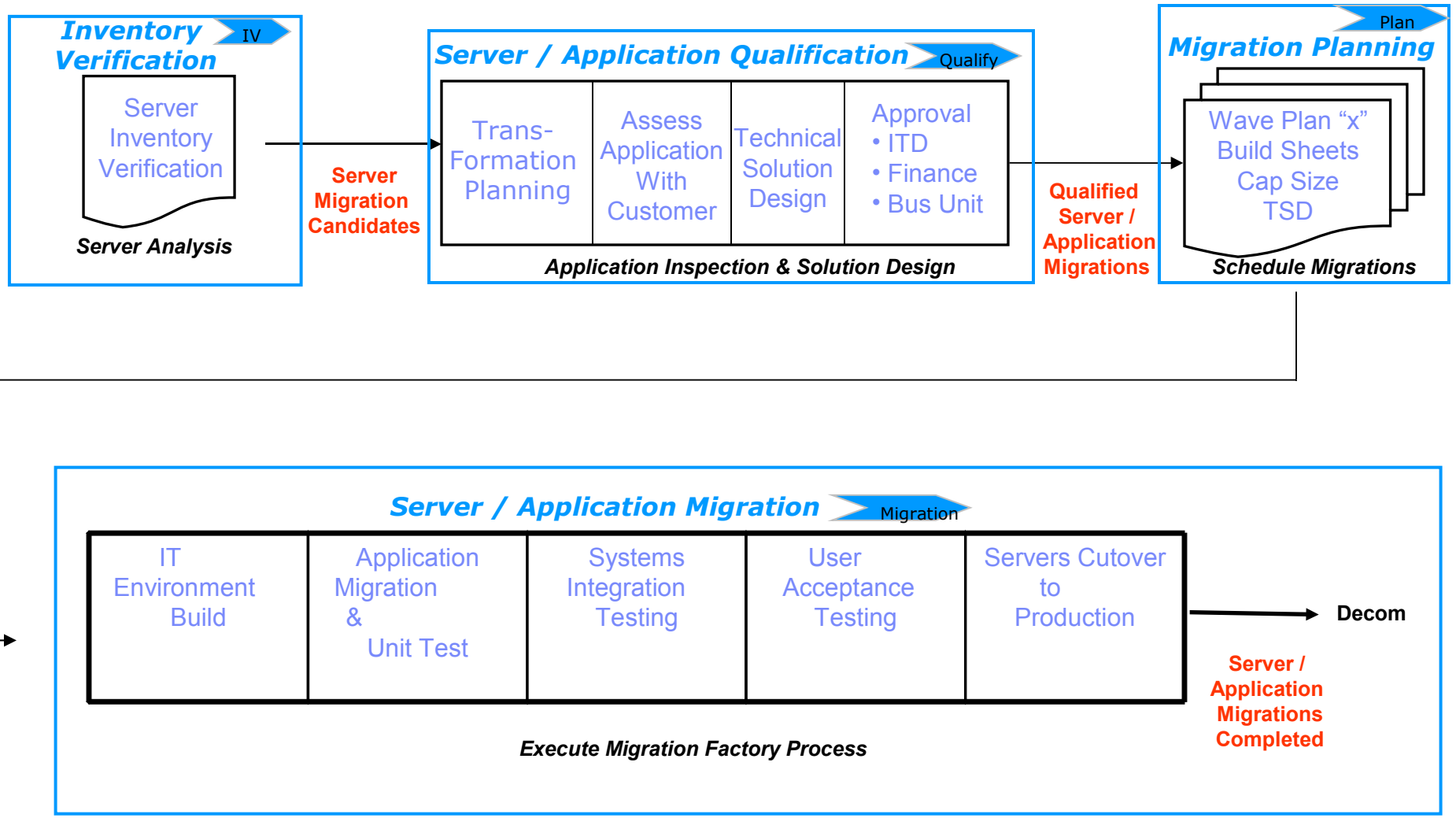
IBM is Using a ‘Work in Process' Approach to Manage the Migration

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



Migration Factory Process



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

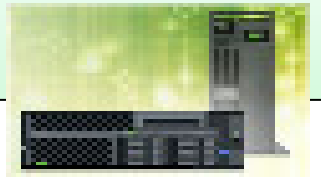
Capture savings in business plan and business case

**IBM Global Asset Recovery Services*

Enterprise Approach to Workload Migration

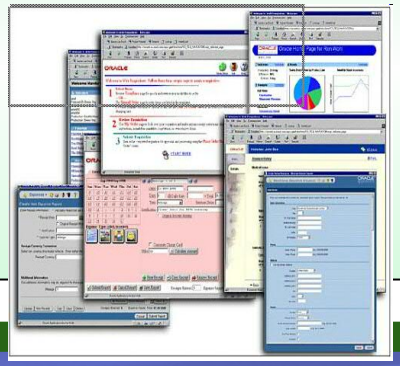
Location View
Boulder
Poughkeepsie
Portsmouth
Raleigh
Rochester
Southbury

Environment View
Managed 'Offerings'
Development
Intranet
BU Environments



Migration Candidates Sourcing

Application View
Business Unit Partnership

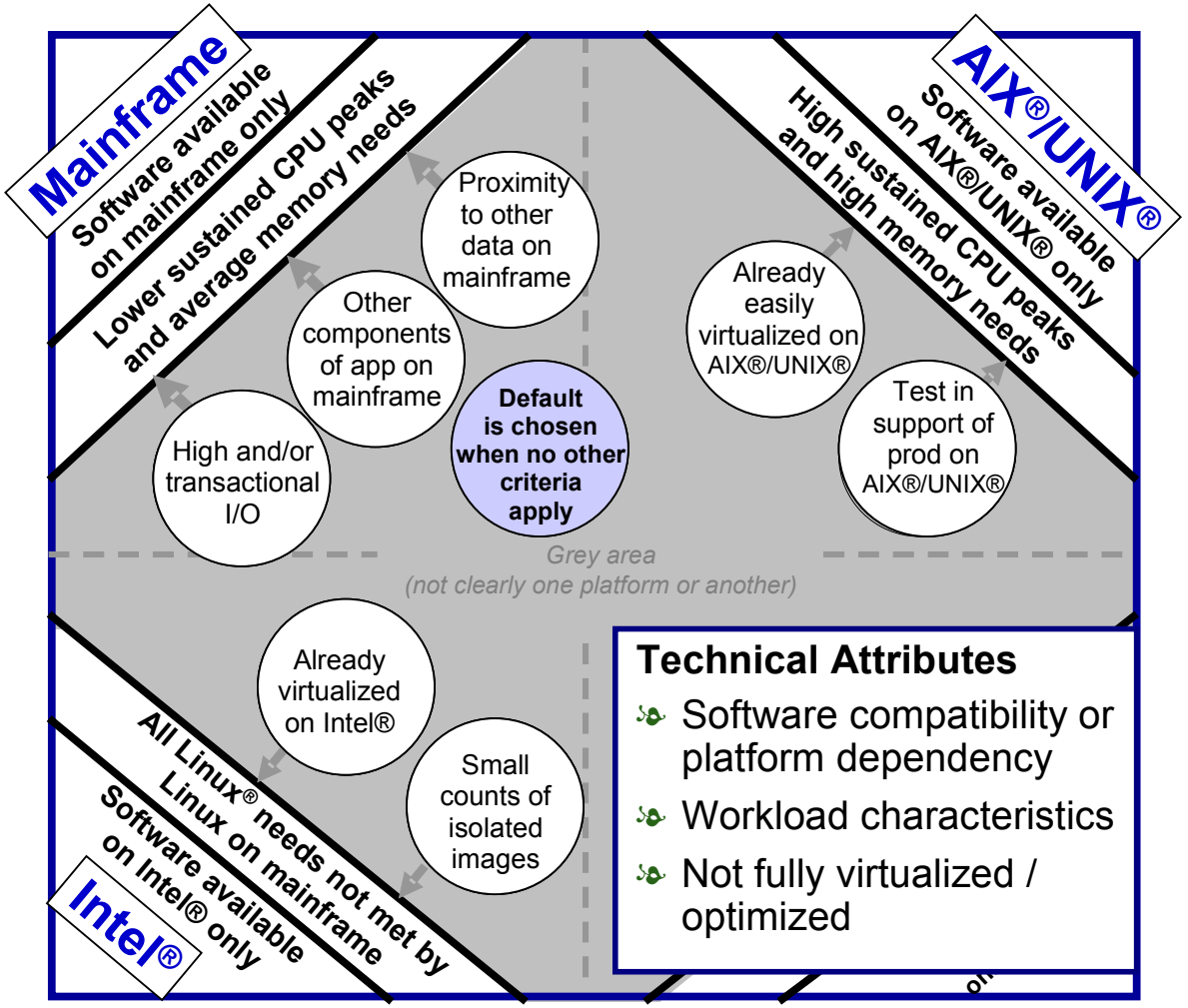


Technology View
Domino
Email
Static Web
DB2
Linux on x86

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™



Operationally, the goal is to minimize change while leveraging the capability of System z

The distributed and mainframe support teams collaborated with IBM's Design Center to develop the reference architecture and the basis for the operational approach

- **Approach:**
  - Adapt existing UNIX® team processes
  - Engage z team to operate System z and z/OS®
  - Broaden the VM/mainframe knowledge of the mid-range team through training, to assist in support of VM Hypervisor (z/VM®) and Linux
  - Use existing monitoring and operational tools, i.e.
    - Tivoli Monitoring and Enterprise Portal
    - VM Resource Manager
    - Monitor and Performance Toolkit
    - Administer Capacity, OS Provisioning and Software Distribution Tools

Successful Techniques – Preparing for Virtualization

Motivate business units	*Enlist a Senior Executive Sponsor* Sr. VP Linda Sanford, who manages Transformation for IBM is providing enterprise leadership, working with Business Unit Sr. VPs. *Build an "incentive" rates* Financial benefit provides good incentive for support and teaming in project execution. Reductions are being phased in during the project with differentiated rates.
Build the business case	*Start with a high level planning estimate* Initial estimates from RACE model were validated by the CFO through a detailed analysis of representative sample (5-10%) servers
Gather data	*Augment inventories with network tools* Local and central Configuration Management DB needed augmentation with network scans to gather configurations and application mapping.

Successful Techniques – Project Start-up

Start Small	*Migrate a small set of servers for a fast start* An initial Phase to immediately migrate a small number of servers worked well to build early experience.
Run operations while transforming	*Use a dedicated team* IBM's commercial migration practice is implementing most of the management and migration, minimizing the operational team's responsibility to Final Test, Environment Build and Cutover.
Manage complexity, monitor progress continuously	*Engage strong project management, end-to-end view* A structured management approach and broad, sustained sponsorship from the business units are critical. Process approach with clear handoffs will be monitored, measured and automated.
Define Reference Architecture	*Establish technical environment solution* Establish the "to be" environment solution and path into the environment utilizing a dedicated delivery team to enable the applications to be managed into the new environment.

Successful Techniques – Project Execution

Integrate view of waves, resources	*Leverage existing process and adapt to new environment* Applying a fast path approach to existing processes dramatically improved time, flexibility to modify based on new platform. Committing resources at wave launch across infrastructure, test, apps, is key.
Communicate real-time lessons	*Utilize internal collaboration tools* Stakeholder lessons learned communications needed real-time during project. Ensure linkage across cadence, wiki, process flow tools.
Create enterprise view of workload, server selection	*Establish enterprise criteria, shared strategy* An enterprise view of migration, managed in waves, drives experience and savings for investment. Workload selection considered across apps, infrastructure, common services and planning must include all CPU, I/O, storage and network demands.
Address cultural and organizational transformation	*Drive cultural change through communication, collaboration* Enterprise sponsorship and business unit support needed to drive business case and execution. Compelling business imperative accelerates execution and drives support. Training/support required.

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

Tell us Your Virtualization Story!

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DB2*	**IBM Business Partner Logo***	**System x**	**z10**
Db2 Universal Database	**IBM Logo***	**System z**	**z/OS***
Domino*	**POWER5**	**System z9**	**zSeries***
GARS	**Power Systems**	**System z10**	**z/VM***
HiperSockets	**System I**	**Tivoli***	

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Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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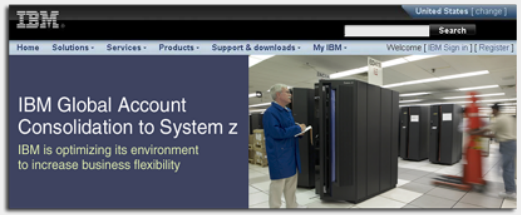
Backup

IBM Virtualization Announcement Highlights



August 2007

- *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*
- *Major proof point of IBM's 'Project Big Green' initiative*
- *The virtualized environment will use 80% less energy and 85% less floor space*
- *This transformation is enabled by the System z sophisticated virtualization capability*

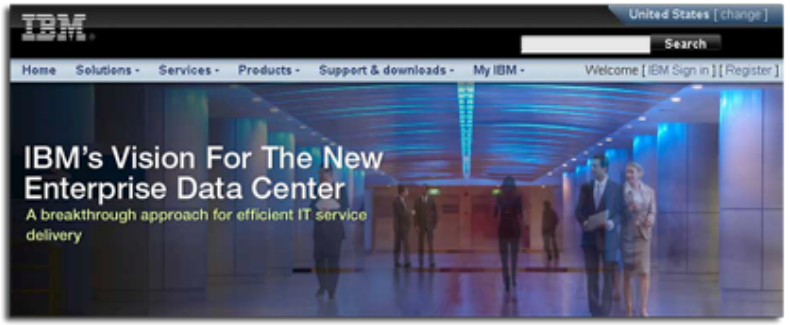
IBM System z10 EC Announcement Highlights

February 2008

By leveraging new System z10s . . .

- *Number of machines could be cut by about half*
- *Even greater savings in energy, floor space, software and support costs*

IBM's Vision For The New Enterprise Data Center



June 2008

IBM implementing New Enterprise Data Center through achievements in . . .

- *Server and storage virtualization*
- *Energy efficiency, resiliency improvements*
- *Utilizing IBM offerings and services capabilities*

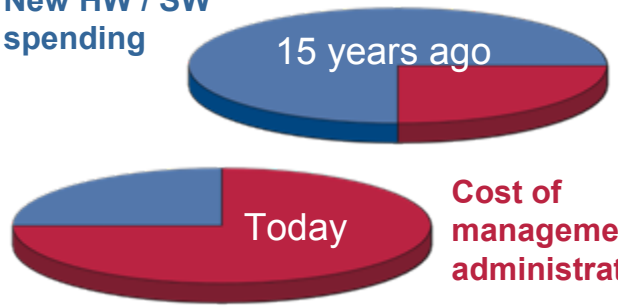
IBM Virtualization continues . . .

- *Built upon prior data center consolidations and application portfolio simplification cross-enterprise*
- *Significant progress including thousands of servers inventoried and multiple successful migrations delivering benefits as expected*
- *Client view of TCO savings* - 60-75% / 5 yrs*
- *Decommissioned pipeline of hundreds of servers for reuse, sent to IBM GARS** and/or issued energy efficiency certificates*
- *Additional virtualization leveraging System p, System x and storage across enterprise*

** Results will vary based on several factors including # of servers and work load types ** IBM Global Asset Recovery Services for reuse, recycling and/or reclamation*

Why System z Now?

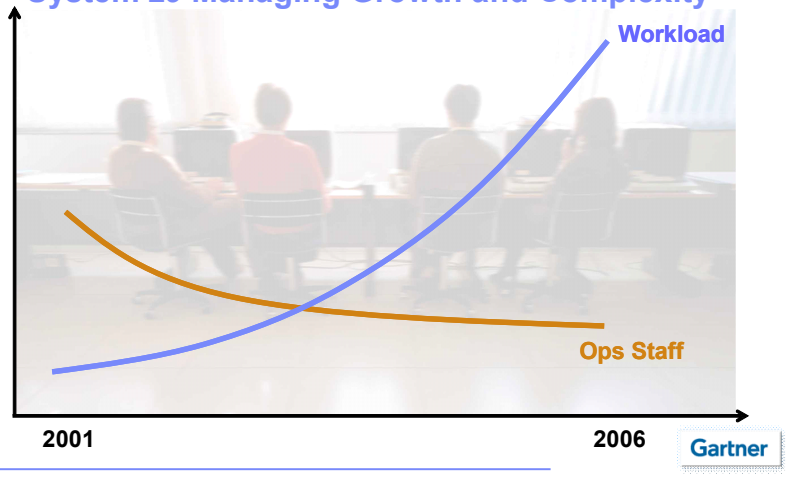
New HW / SW spending



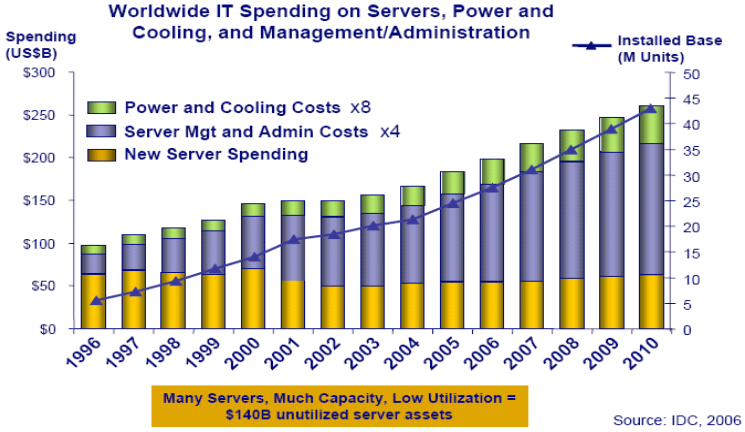
Cost of management & administration

Source: Tony Picardi, IDC
Economist.com: Make it simple. October 28th, 2004
From The Economist print edition

System z9 Managing Growth and Complexity

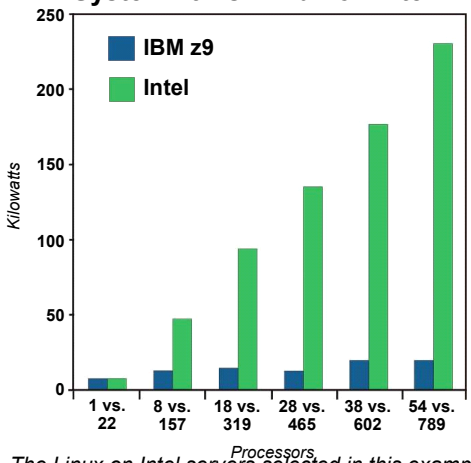


Worldwide Server Market:
Cost of Management Ramps Dramatically

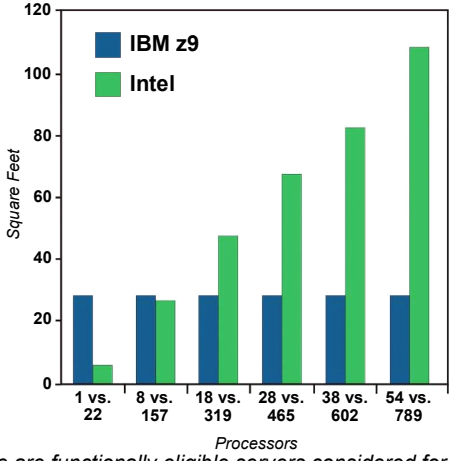


Source: IDC, 2006

POWER:
System z9 vs. Linux on Intel



SPACE:
System z9 vs. Linux on Intel

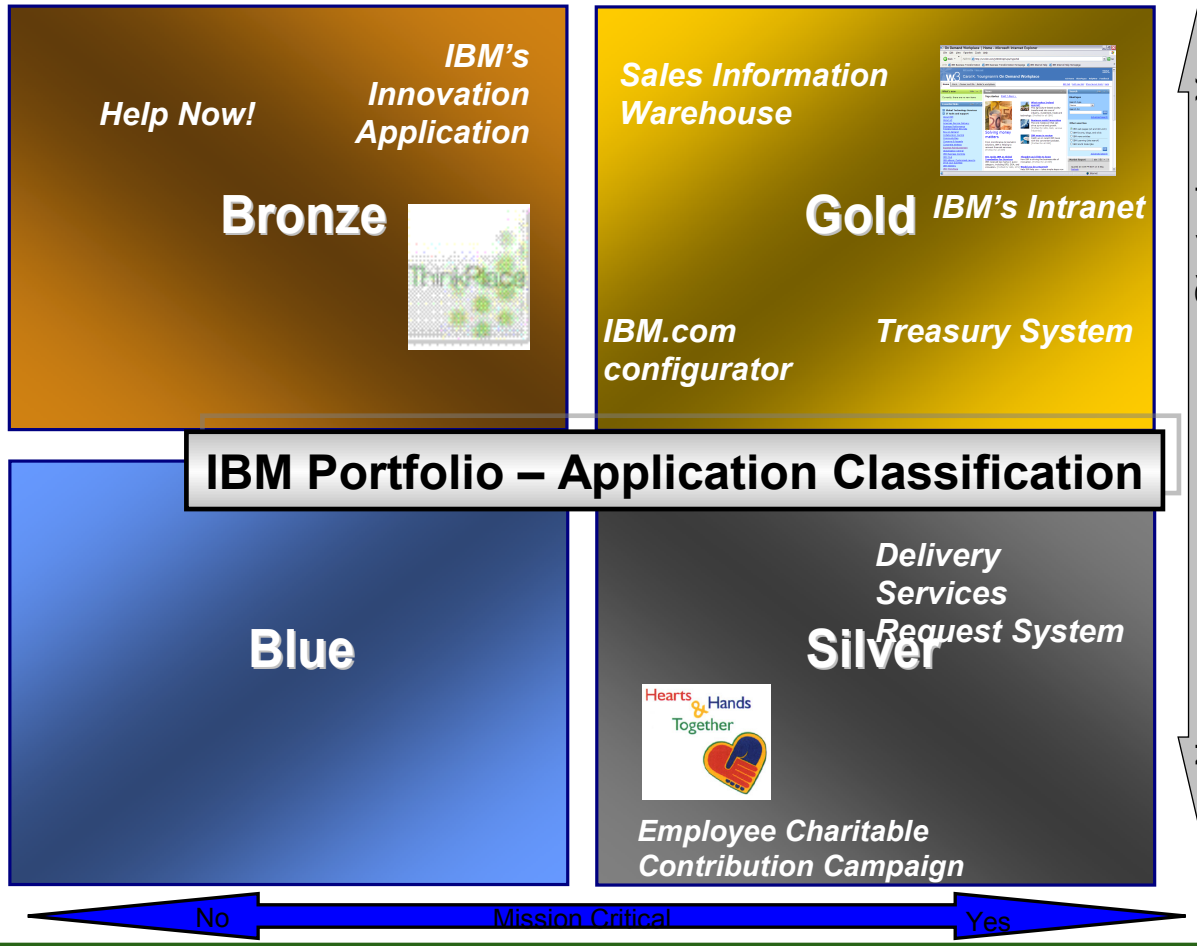


The Linux on Intel servers selected in this example are functionally eligible servers considered for consolidation to a System z running at low utilization such that the composite utilization is approximately 5%. The utilization rate assumed for System z EC is 90%. This is for illustration only, actual power and space reductions, if any, will vary according to the actual servers selected for consolidation.

Applications Moving to System z Tend to Be Strategic and Mission Critical

Application View

- Includes all business units, a cross-section of business functions
- Most are internally developed Web and Domino-based
- Tend to be complex with multiple servers and interfaces
- Almost 50% of initial applications are classified as “Gold”



Training Needs and Classes for Personnel Involved in System z Virtualization have Been Identified

- **IT Architects**
  - Broad based knowledge of Linux on System z solutions, VM and the underlying System z platform
- **Project Managers**
  - Sufficient knowledge of Linux on System z, VM, mainframe attributes, and migration scenarios to manage an ECM project
- **Server Build Personnel**
  - Understand the Linux on System z operating system; High level understanding of VM
- **Systems Administrators/Systems Operations Personnel**
  - Understand the unique attributes of Linux on System z and the VM/mainframe environment; Include Linux in base SA and systems operations education

A half day of general virtualization education for application owners and delivery personnel provides a high level view of virtualization, migration and Linux on System z