Cloud Computing on the IBM System z mainframe

Andrea Greggo, Mainframe Cloud Initiative Leader
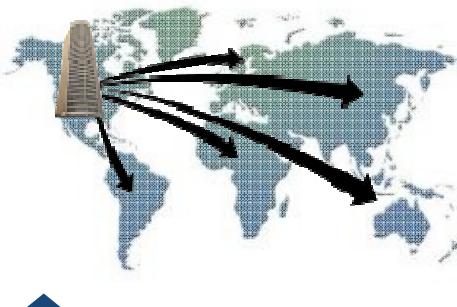
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Today's overarching realities – *21st Century Drivers of Change*

International Exporting

Proliferation of Devices

Business-to-business

21st Century

20th Century

The Globally Integrated Enterprise

Real-time Information Explosion

Business-to-consumer

eBay

amazon.com

Google

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Business innovation continues to accelerate –
Convergence of available technologies and a demanding marketplace
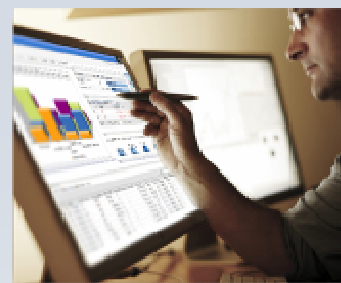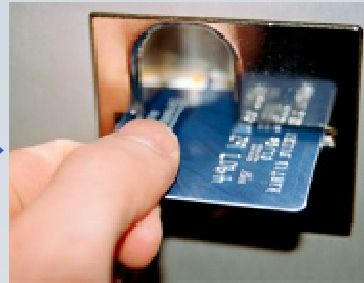
Branch Banking

Back-office automation and secure data processing

ATM

Secure online transaction processing

e-business

Connect existing IT infrastructure with the Web

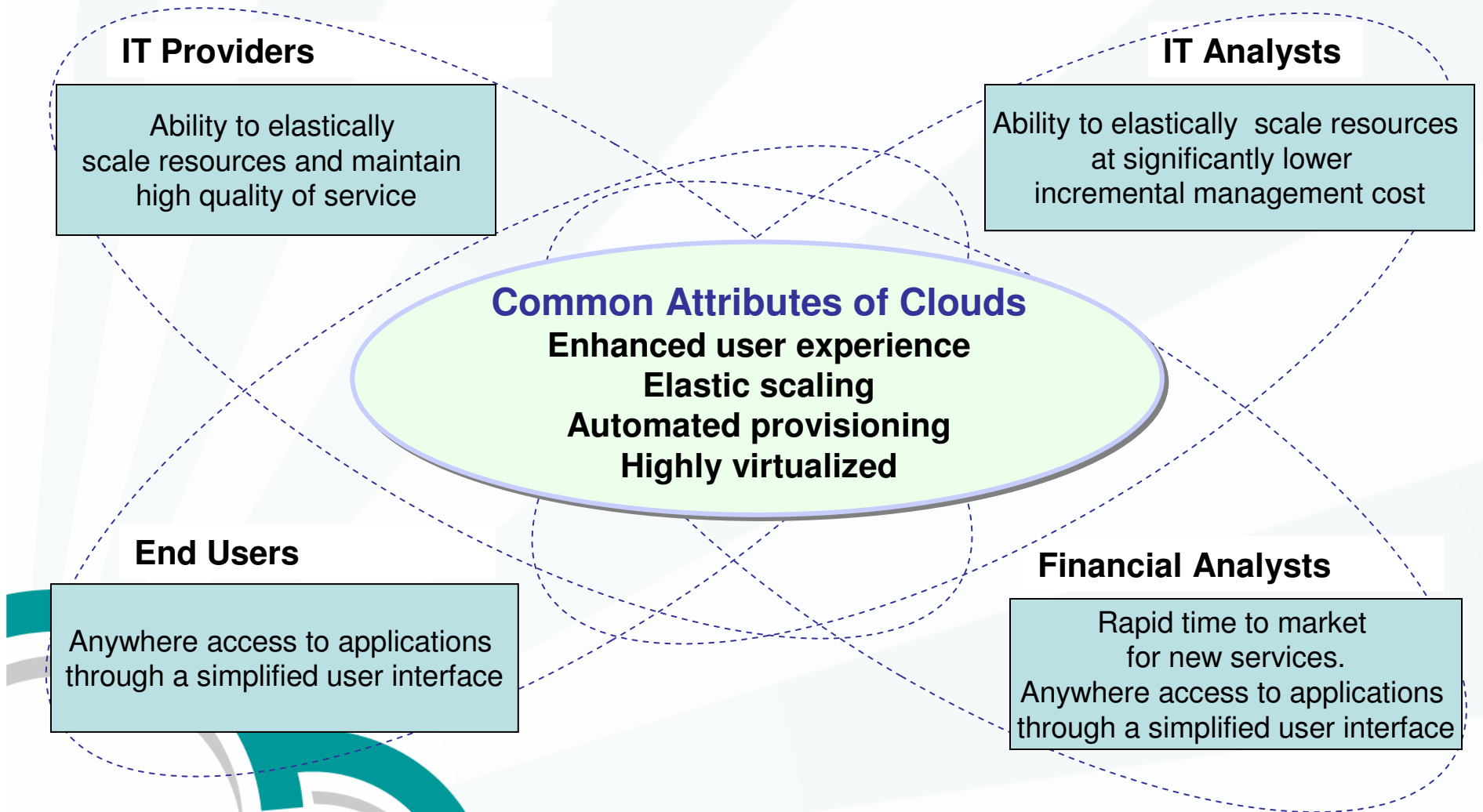### *Cloud*

An open, standards-based, dynamic infrastructure

1960s → *1970s* → *1990s* → *2010*

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Multiple Views of Cloud Computing in IT

IT Providers

Ability to elastically scale resources and maintain high quality of service

IT Analysts

Ability to elastically scale resources at significantly lower incremental management cost

Common Attributes of Clouds
Enhanced user experience
Elastic scaling
Automated provisioning
Highly virtualized

End Users

Anywhere access to applications through a simplified user interface

Financial Analysts

Rapid time to market for new services.
Anywhere access to applications through a simplified user interface

Source: IBM Corporate Strategy analysis of MI, PR, AR and VCG compilations
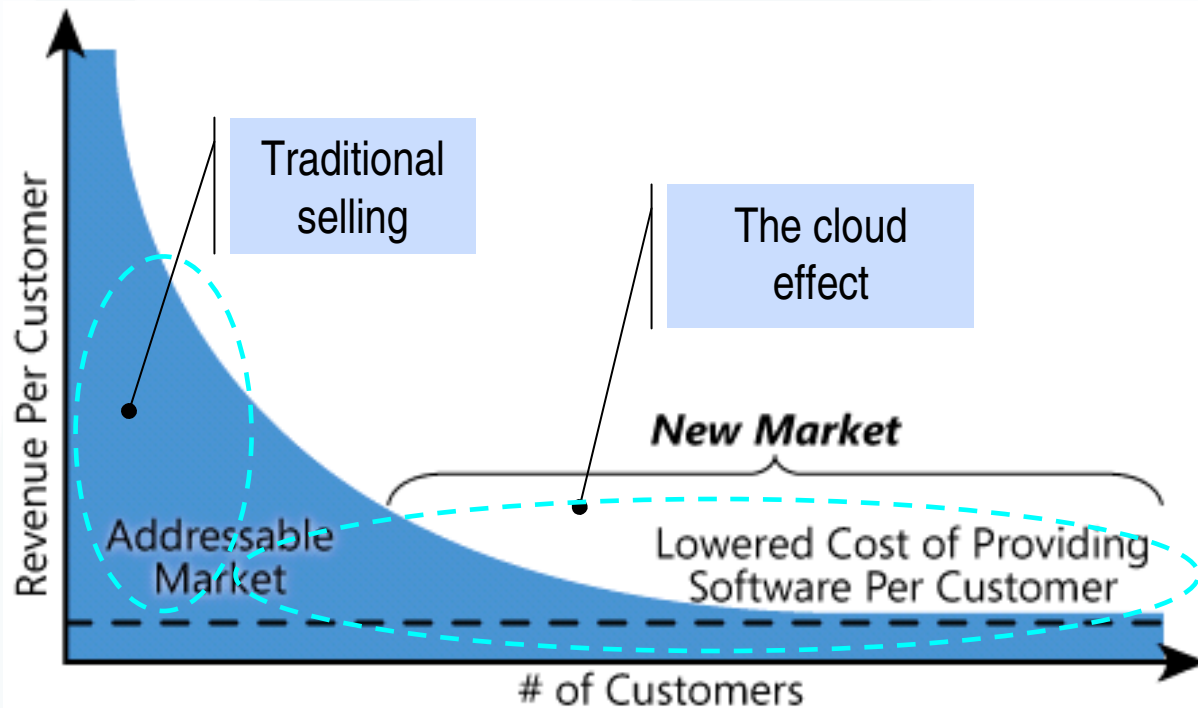
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Common attributes indicate a common definition

"An Elastically Scalable, Virtualized System That Is Rapidly Provisioned With Flexible Pricing Models"

Common Attribute	Details
Flexible pricing	Utility pricing, variable payments, pay-by-consumption and subscription models make pricing of IT services more flexible
Elastic scaling	Resources scale up and down by large factors as the demand changes
Rapid provisioning	IT and network capacity and capabilities are – ideally automatically – rapidly provisioned using Internet standards without transferring ownership of resources
Advanced virtualization	Virtualized desktops access pooled IT resources – servers, storage, network and applications – to provide a virtualized, cost efficient infrastructure

Source: IBM Corporate Strategy analysis of MI, PR, AR and VCG compilations

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The cloud market impact changes the way we sell

Traditional selling

The cloud effect

New Market

Revenue Per Customer

Addressable Market

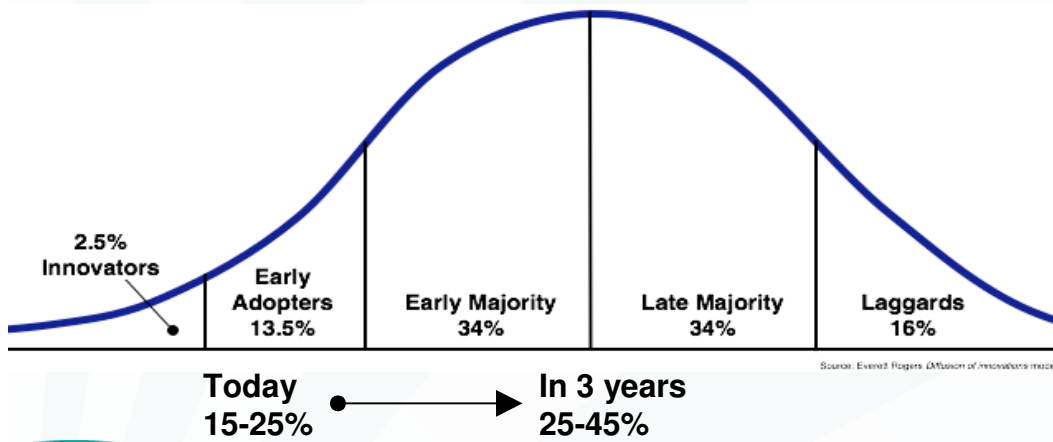Lowered Cost of Providing Software Per Customer

# of Customers

Cloud provides **a direct channel** to capture market demand and is offered on a **utility pricing** scheme that is **readily consumable**

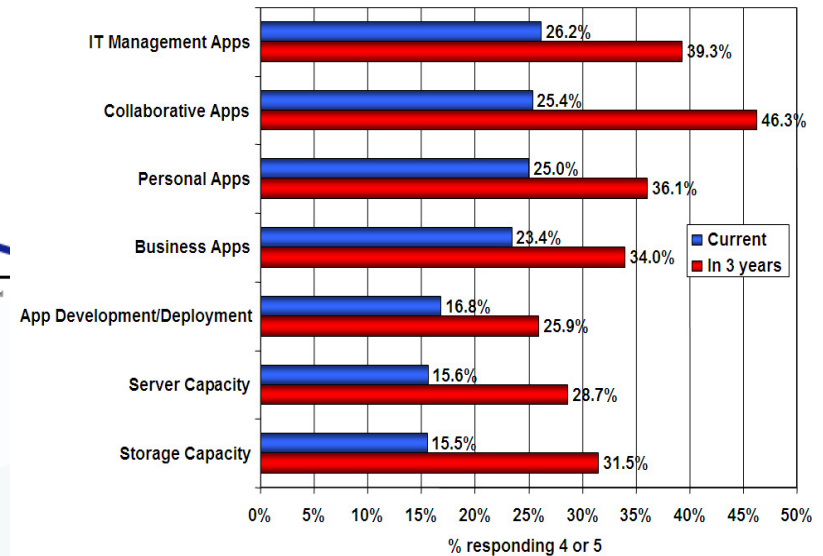**Operational efficiency** is the key to **cloud profitability** enabling hosters to service **significant volumes** of subscribed users with **low operating costs**

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The adoption of cloud computing in market

"For actual chasm crossing, applications have a huge advantage. That is because disruptive innovations are more likely to be championed by end users than by the technology professionals that operate the current infrastructure. Applications are what an end user sees… To accelerate the adoption of platforms, then, vendors must clothe them in applications clothing. That is, they must tie them directly to an application in order to gain the end-user sponsorship necessary to secure a beachhead."

2.5% Innovators

Early Adopters 13.5%

Early Majority 34%

Late Majority 34%

Laggards 16%

Source: Everett Rogers Diffusion of Innovations model

Today 15-25% → **In 3 years** 25-45%

Q: Current, future usage level of IT cloud services in your organization?
(1=none, 5=widespread)

	Current	In 3 years
IT Management Apps	26.2%	39.3%
Collaborative Apps	25.4%	46.3%
Personal Apps	25.0%	36.1%
Business Apps	23.4%	34.0%
App Development/Deployment	16.8%	25.9%
Server Capacity	15.6%	28.7%
Storage Capacity	15.5%	31.5%

% responding 4 or 5

Source: IDC Enterprise Panel, August 2008 n=244

IDC Analyze the Future

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A perspective on Clouds

Consumers are drawn to the cloud values:
- Low barriers – consumable & convenient
- Pay per usage business model

Consumers are concerned about clouds
- Security of Internet assets
- Availability of services

> Barb, we have to get this service. It has all the functionality we need, the costs are low, and we can get the results we need now!

> I don't know Jim … do you think it is safe to have our data out there?

Cloud providers face challenges:
- Profitability through efficiency – Lean IT
- Customer expectations are high & barriers to exit are low

> … even the free stuff is held to high standards!

Gmail outage causes blogger frenzy across North America

AUSTRALIANS may have missed it, but Google's Gmail service went down for an hour or two overnight.

The degree to which the company has become central to online life was highlighted when the outage became the most talked-about story of the day in North America.

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Cloud services require enterprise class QoS

Clouds are driven by consumers and feature:

- Low switching costs / lock-in for consumers
- Highly competitive market space with low barriers to entry
- A consumer friendly business model
- Internet offered business services

Clouds require enterprise class capabilities for:

- Security
- Availability
- Scalability

- Manageability
- Recoverability
- Agility
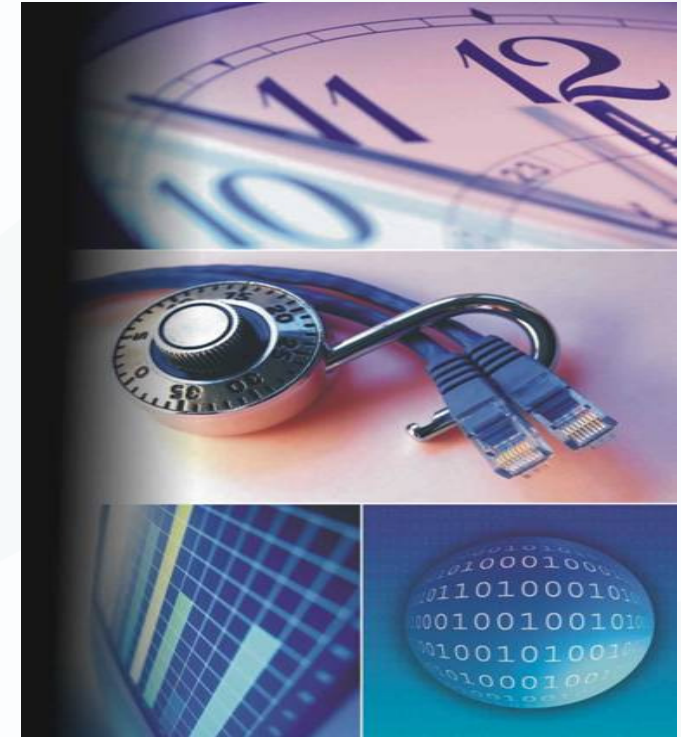
Providers of Cloud services require **operationally efficient** data center solutions to be profitable

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Cloud delivery spectrum

Focus on Clients and Customers

INNOVATIVE BUSINESS MODELS (with financial viability)

DATA CENTER INNOVATION

INNOVATIVE SERVICES

Service Integration

Service Integration

Enterprise IT

Enterprise Private Cloud

Hybrid Clouds

Public Clouds

The next frontier is Cloud integration

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The mainframe in the New Enterprise Data Center

Dynamic

Data Center

- Virtualized

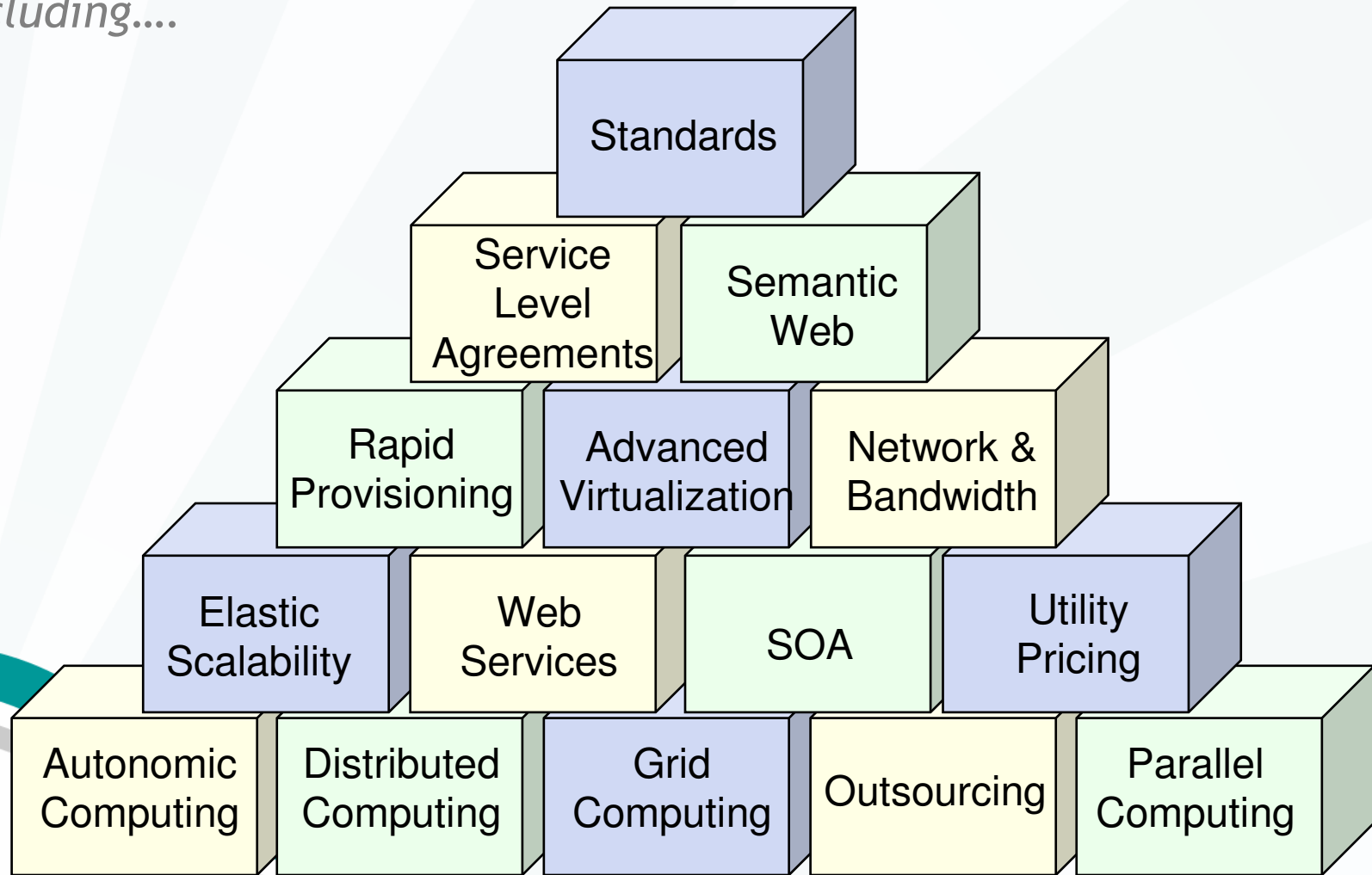- Real time integration of transactions, information & analytics

- Business-driven services

- Service oriented

Enterprise "private" clouds are the evolution of SOA

Mainframe is a hub for enterprise Clouds:

- Centralized control & management

- Consolidation of 100s - 1000s of diverse workloads

- Most efficient cost per compute power

- -Able (scalable, available, reliable)

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There Are A Number Of Building Blocks For Cloud Computing
Including....

Standards

Service Level Agreements

Semantic Web

Rapid Provisioning

Advanced Virtualization

Network & Bandwidth

Elastic Scalability

Web Services

SOA

Utility Pricing

Autonomic Computing

Distributed Computing

Grid Computing

Outsourcing

Parallel Computing

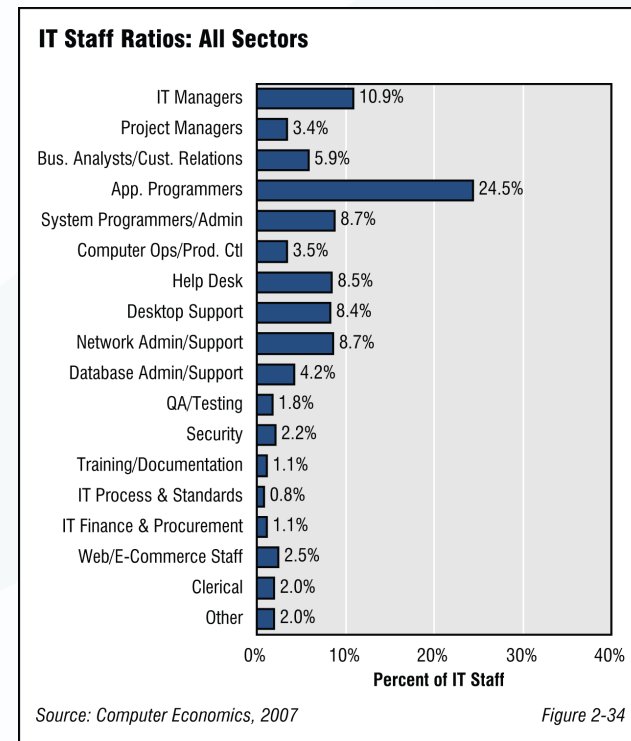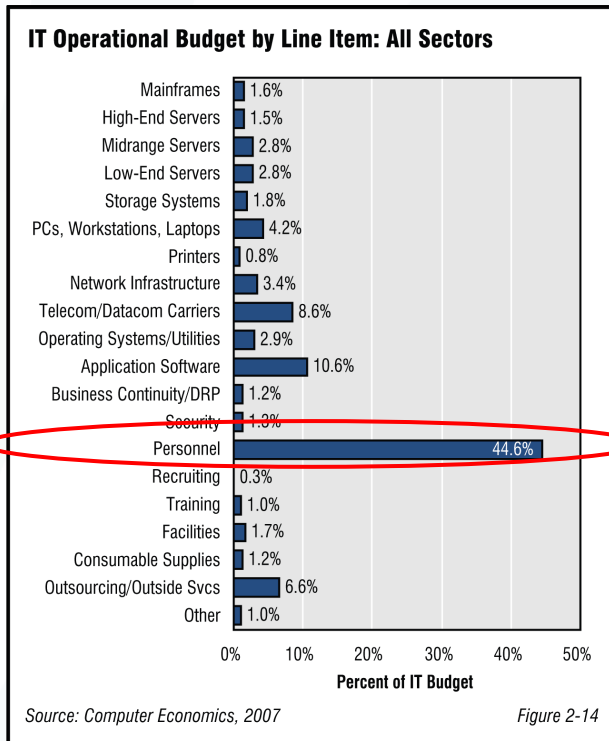Source: CHQ MI

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The mainframe as a foundation for Cloud offerings

"It's a mainframe model where things run together but in isolation. The issue is whether the machines will bear up under the load of diverse work or will they grind down and you'll need to provision another machine. You need reliability, security, auditing, privacy, data integrity, automation and full isolation. You need to have a lot of layers in the environment."* - *Steve Mills, SWG, interview with CNET when asked about Cloud Computing*

- Energy efficient
- Near-linear scalability
- Capacity management & upgrades on demand
- Delivers a specialized IT environment
- Virtualizes from the silicon to the app
- Enables transparent multi-tenancy of applications
- Improves performance
- Comprehensive industry-leading security
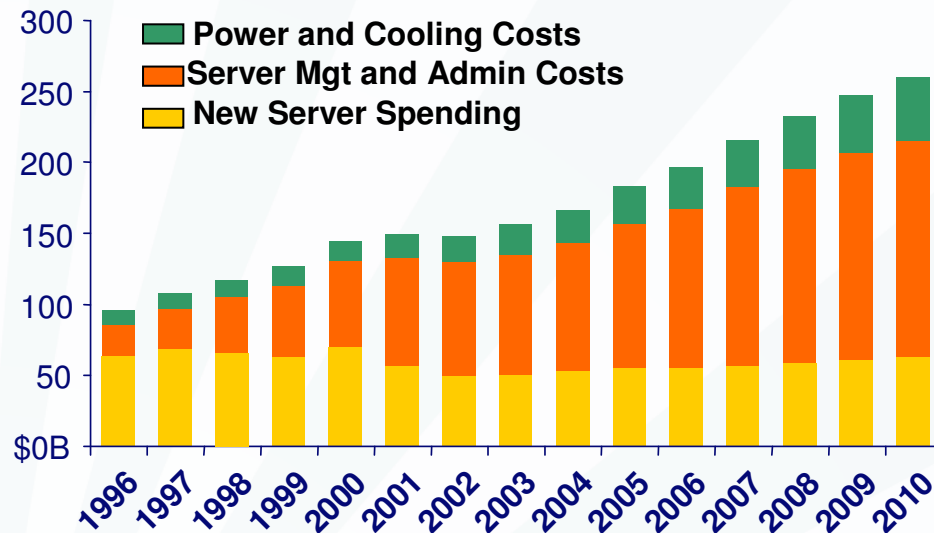- Enables seamless reliability
- Strong TCO

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The costs of IT Operations

IT Operational Budget by Line Item: All Sectors

Line Item	Percent of IT Budget
Mainframes	1.6%
High-End Servers	1.5%
Midrange Servers	2.8%
Low-End Servers	2.8%
Storage Systems	1.8%
PCs, Workstations, Laptops	4.2%
Printers	0.8%
Network Infrastructure	3.4%
Telecom/Datacom Carriers	8.6%
Operating Systems/Utilities	2.9%
Application Software	10.6%
Business Continuity/DRP	1.2%
Security	1.3%
Personnel	44.6%
Recruiting	0.3%
Training	1.0%
Facilities	1.7%
Consumable Supplies	1.2%
Outsourcing/Outside Svcs	6.6%
Other	1.0%

Source: Computer Economics, 2007   *Figure 2-14*

IT Staff Ratios: All Sectors

Staff	Percent of IT Staff
IT Managers	10.9%
Project Managers	3.4%
Bus. Analysts/Cust. Relations	5.9%
App. Programmers	24.5%
System Programmers/Admin	8.7%
Computer Ops/Prod. Ctl	3.5%
Help Desk	8.5%
Desktop Support	8.4%
Network Admin/Support	8.7%
Database Admin/Support	4.2%
QA/Testing	1.8%
Security	2.2%
Training/Documentation	1.1%
IT Process & Standards	0.8%
IT Finance & Procurement	1.1%
Web/E-Commerce Staff	2.5%
Clerical	2.0%
Other	2.0%

Source: Computer Economics, 2007   *Figure 2-34*

Personnel represents the largest percentage of operational costs in the enterprise

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The challenge for enterprises is to achieve operational efficiency

Global Annual IT Spending
Estimated US$B 1996-2010

Legend:
- **Power and Cooling Costs**
- **Server Mgt and Admin Costs**
- **New Server Spending**

Chart Y-axis: 300, 250, 200, 150, 100, 50, $0B
Chart X-axis: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010

Uncontrolled system management costs

Steady CAPEX spend: Not the key problem to address

> › Industry hypothesis is that clouds will be driven by scale. However to capitalize on this, providers must address the server management cost problem, not just CAPEX

Source: IBM Corporate Strategy analysis of IDC data, Sept. 2007

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Project 'Big Green'

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

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*

Think what we could do for you

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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
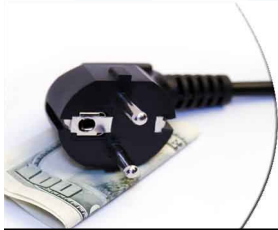
Energy savings

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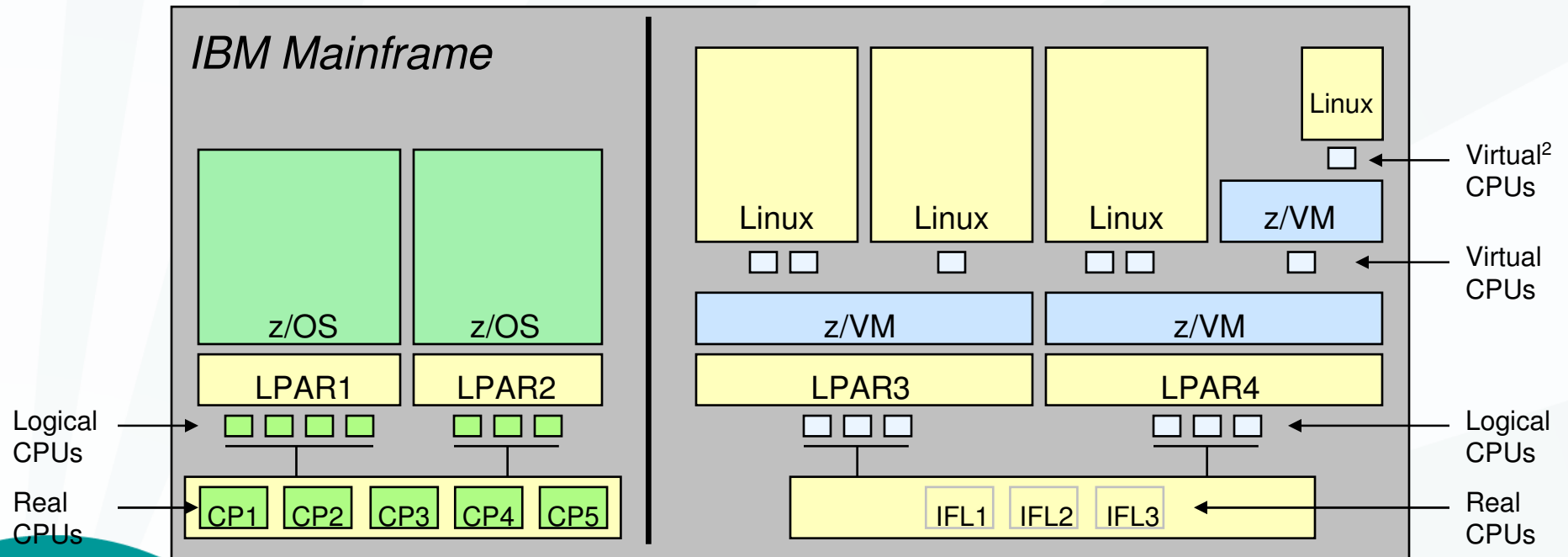 - 1,643 square feet for System z solution

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

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* El... ... ... per kW ** Cooling is 60% of power cost

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Virtualized from the silicon to the app

The core infrastructure of System z is multi-tenant by nature and highly efficient, resources (HW and SW) are shared and virtualized to ensure utilization up to 100% without degradation.

IBM Mainframe

			Linux
Linux	Linux	Linux	z/VM

Virtual[2] CPUs

Virtual CPUs

z/OS	z/OS	z/VM	z/VM
LPAR1	LPAR2	LPAR3	LPAR4

Logical CPUs

Real CPUs

| CP1 | CP2 | CP3 | CP4 | CP5 | | IFL1 | IFL2 | IFL3 |

Logical CPUs

Real CPUs

"... new virtualization product (z/VM 5.3) release can host more then 1,000 virtual images on a singe hypervisor - topping any virtualization solution in the industry."   *- Charles King, PUND-IT*

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Enabling transparent multi-tenancy of applications

*Linux Exploitation of z/VM Discontiguous Saved Segments (DCSS)*

Data-in-Memory technology
- Share a single, real memory location among multiple virtual machines
- High-performance data access

Shared program executables
- Program executables are stored in an execute-in-place file system, then loaded into a DCSS
- DCSS memory locations can reside outside the defined virtual machine configuration
- Access to file system is at memory speeds; executables are invoked directly out of the file system (no data movement required)
- Avoids duplication of virtual memory and data stored on disks
- Helps enhance overall system performance and scalability

Learn more:
"Using DCSS/XIP with Oracle 10g on Linux for System z"
www.redbooks.ibm.com/redpieces/abstracts/sg247285.html

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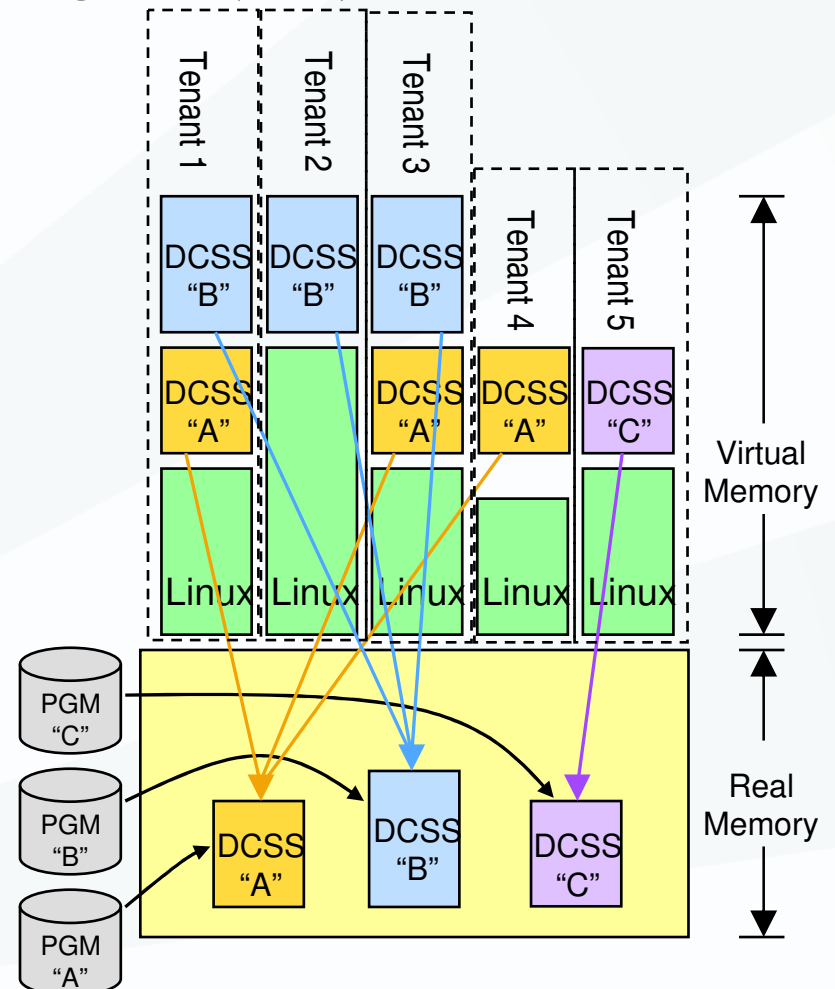
Enabling multi-tenancy with DB2 z/OS

Designing a multi-tenant database requires a decision on the degree of data separation among tenants, with Cloud data architecture ranging from separated tenant databases to shared databases and even shared database schema.

Separate DB design

- Each tenant has their own DB and set of tables
  - Enables flexibility & custom columns to support tenant
- Over time becomes costly and less manageable

Multi-tenant DB design

- Tenants share tables in a DB
  - Lesser data separation
- Less costly and more manageable
- Security precautions must be deployed
- Row level isolation of tenant data is achieved via views or security labels

A shared DB2 environment can be used to provide a cost effective, secure approach for supporting multi-tenant data for on demand software deployments

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Protecting sensitive data with DB2 for z/OS

Encryption over the internet
- Encryption for DRDA® communications
- DB2 V9: SSL encryption for sending documents

Encryption in the database
- Column level encryption
  - Enabled by the application itself
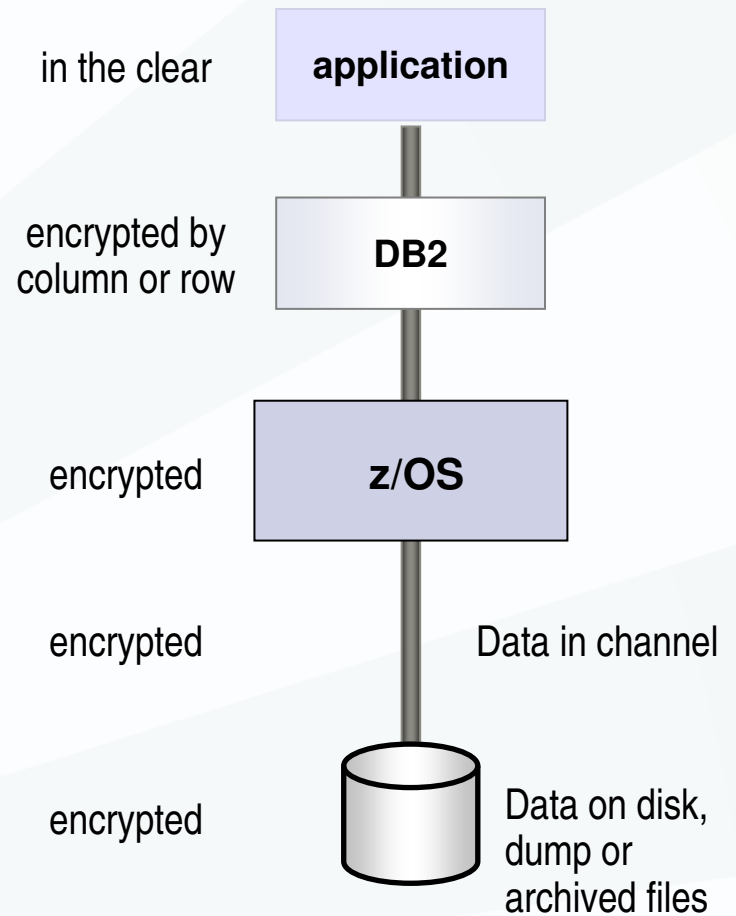- Row level encryption
  - IBM Encryption Tool for DB2

Row level access control using SAF security labels

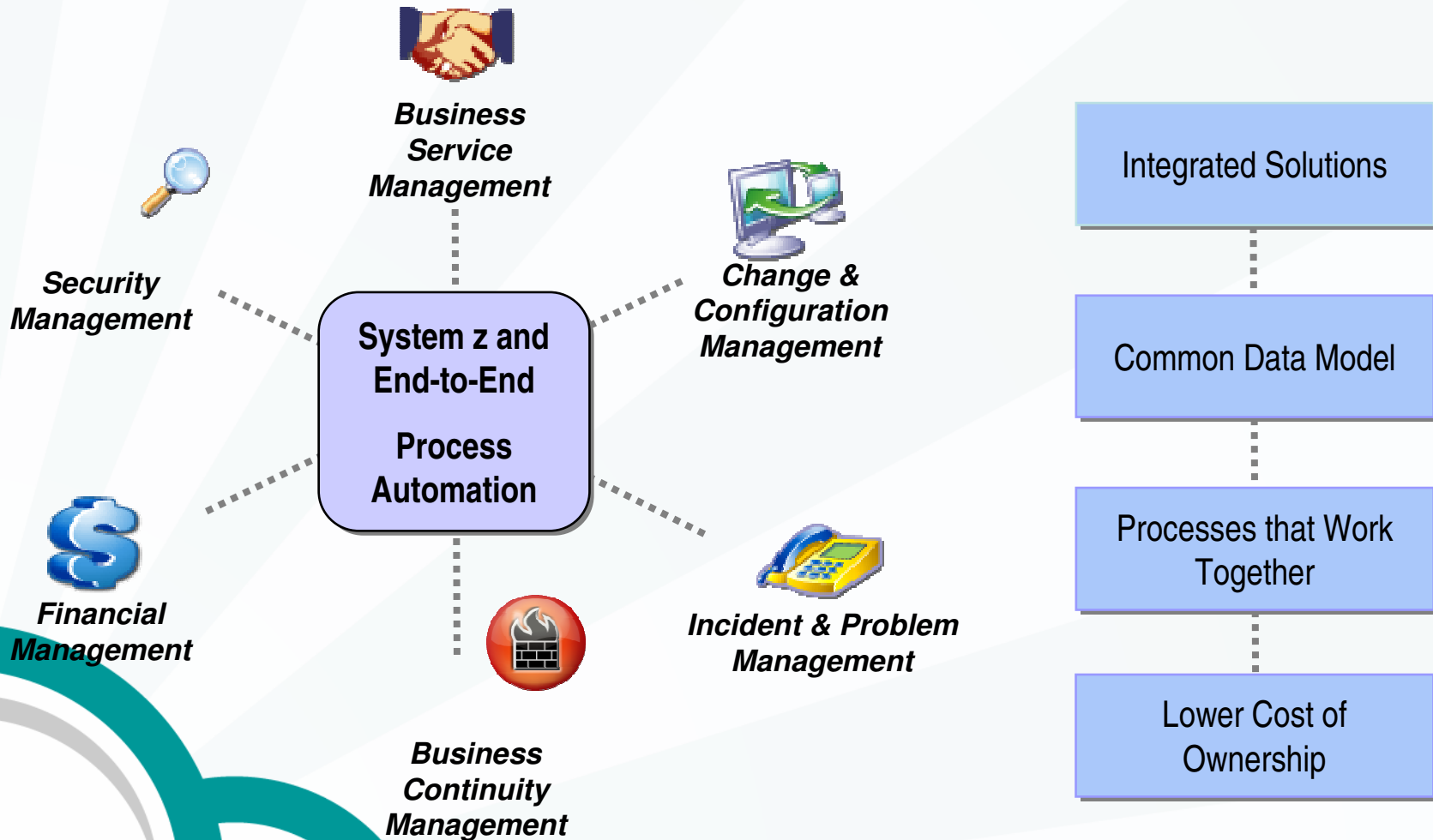**Tape encryption for backups and archive logs**

Contextual, application-aware data masking
- IBM Optim Data Privacy Solution

DB2 uses System z
encryption acceleration
& secure key processing

in the clear	**application**
encrypted by column or row	**DB2**
encrypted	**z/OS**
encrypted	Data in channel
encrypted	Data on disk, dump or archived files

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IBM Service Management from Tivoli Delivers a Single Process Automation Platform for Your Entire Business

Business Service Management

Security Management

System z and End-to-End

Process Automation

Change & Configuration Management

Financial Management

Business Continuity Management

Incident & Problem Management

Integrated Solutions

Common Data Model

Processes that Work Together

Lower Cost of Ownership

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Centralized control of Cloud Services with TSAM

Tivoli Service Automation Manager: GA 4Q08

Service Offering Subscription & Instantiation
• Specify parameters required for cloud service instantiation
• Select SLAs
• Automated Instantiation of cloud service (instance)
• Retrieve resources out of ensembles as needed

Service Offering Definition & Registration
• Definition of Service Offering as a constraint version of the Service Template
• Registration of Service Offering to Service Catalog
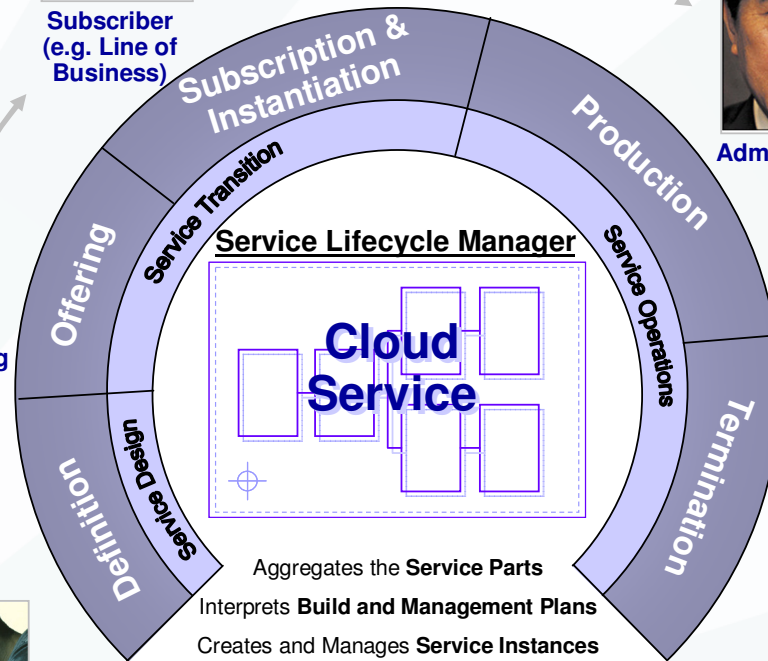• Preparation of environment for hosting the service

Service Template Definition
• Tool based creation of Service Template
• Service Template includes Service Topology + Build- and Management Plans
• Incl. SLAs, Ratings, Measurement Dir., etc.

Subscriber (e.g. Line of Business)

Service Catalog Manager

IBM / ISV / IT Dept

Administrator / SLM

• **Manual or SLM driven Execution of Management Plans leveraging Automation and Virtualization** to optimize and self-configure the underlying IT Infrastructure
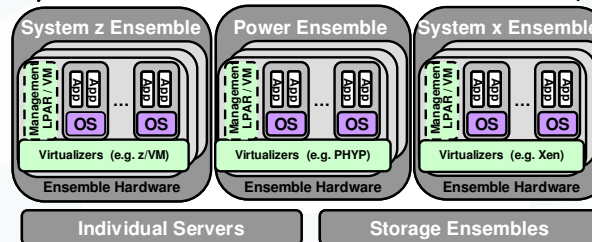• React to incidents and automate resolution
• Report of Cloud Service KPIs

Service Instance Termination Cloud Service gets destroyed and resources are returned back to ensembles / registries

Subscriber (e.g. Line of Business)

Subscription & Instantiation

Production

Service Transition

Service Operations

Offering

Termination

Definition

Service Design

Service Lifecycle Manager

Cloud Service

Aggregates the **Service Parts**

Interprets **Build and Management Plans**

Creates and Manages **Service Instances**

System z Ensemble — Management LPAR / VM — App OS / App OS — Virtualizers (e.g. z/VM) — Ensemble Hardware

Power Ensemble — Management LPAR / VM — App OS / App OS — Virtualizers (e.g. PHYP) — Ensemble Hardware

System x Ensemble — Management LPAR / VM — App OS / App OS — Virtualizers (e.g. Xen) — Ensemble Hardware

Individual Servers

Storage Ensembles

Basis for IBM Blue Cloud Ensemble Management

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The operational efficiency of the mainframe

• **Near-linear scalability**	up to 900,000+ concurrent users; TBs of data
• **"Mean Time Between Failure"**	measured in decades versus months
• **¼ network equipment costs**	virtual and physical connectivity
• **1/25th floor space**	400 sq. ft. versus 10,000 sq. ft
• **1/20 energy requirement**	$32/day versus $600/day
• **1/5 the administration**	< 5 people versus > 25 people
• **Highest average resource utilization**	Up to 100% versus < 15%
• **Capacity Management & upgrades**	On demand; in hours, not weeks/months
• **Security intrusion points**	Reduced by z architecture and # of access pts.
• **Higher concurrent workload**	hundreds of applications versus few

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A Cloud is a highly efficient datacenter with broad reach

Operational efficiency is enabled through user driven automation & intelligent IT capable of Internet scale elasticity ...

Reduce complexity with centralized management & EAL5 certified security

Built in elasticity for just in time capacity supporting massive scale, +900k users with TBs of data

Energy efficient consuming 80% less than distributed solutions

Availability for 24x7x365 with zero data loss disaster recovery

Virtualize "share everything" environment enables 100% utilization without degradation

The Future Runs on System z

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IBM cloud URLs

IBM Cloud landing site: http://www.ibm.com/ibm/cloud/

IBM & the resurrection of the mainframe – a CNET interview with Steve Mills: http://news.cnet.com/8301-13953_3-9933108-80.html

Transzap Deploys IBM Mainframe Running Like a Cloud
http://www.on-demandenterprise.com/topic/hardware/Transzap_Deploys_IBM_Mainframe_Running_Like_a_Cloud.html

Weak hypervisors push customers to mainframes
http://www.itnews.com.au/Feature/4835,weak-hypervisors-push-customers-to-mainframe-ibm-says.aspx

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