Cloud Computing – An IT Paradigm Changer

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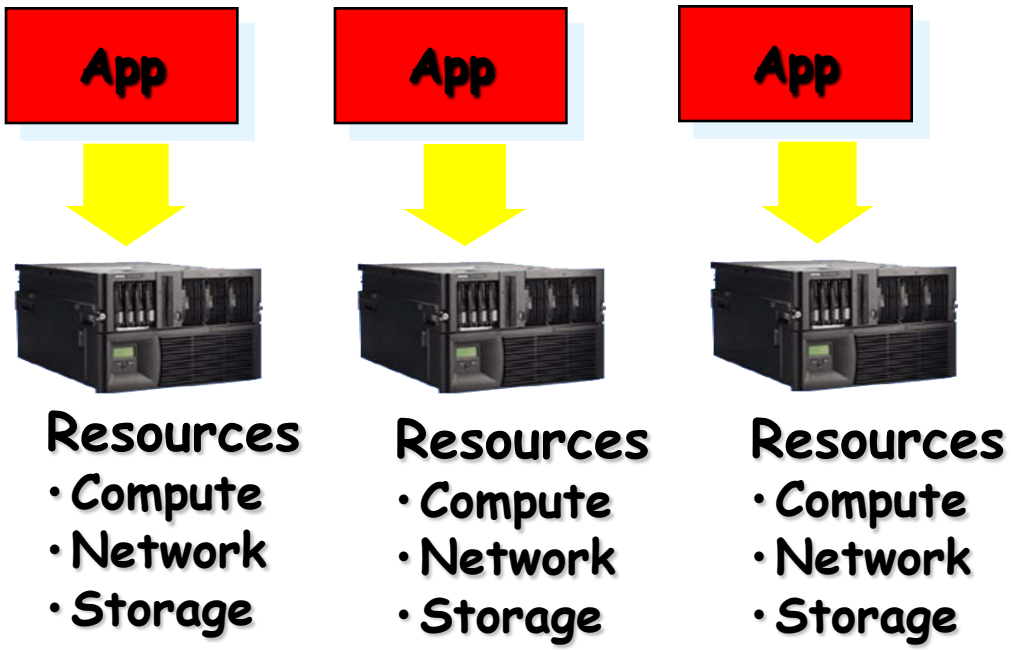
IT infrastructure reaching breaking point



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IT infrastructure reaching breaking point

Up to 85% Capacity remains idle

55¢/$1

70% on average is spent on maintaining infrastructures vs. adding new capabilities.

1.4X

Explosion of information driving 54% growth in storage shipments/year.

33%

33% of consumers notified of security breach terminate their relationship with companies they perceive as responsible.

$40B

Consumer industries lose ~$40B/year; 3.5% of sales due to supply chain inefficiencies.

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The Path to Clouds

Virtualization

Manageability

Standardizations

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… So what are Clouds?

- Clouds
  - Virtualized Autonomic Multi-tenant Utility Deployments
  - Provide capabilities as services
  - Services are accessible from anywhere
  - Accessing services is billable through usage
- Cloud Computing
  - A consumption and delivery model
  - End-user focused
  - Clients only see services

Industrialization of Delivery of IT Services

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… Key Clouds Attributes

High-Quality User Experience

- "Best in class" services
- Flexibility & choice
- Lower costs
- Enhanced security/reliability
- Rapidly Provisioned

Cloud Enables

- Self-service
- Sourcing options
- Economies-of-scale

Cloud Delivery Models

- Private, public and hybrid
- Industry sector specific
- Workload and/or programming model specific
- Any_Thing_You_Like_Cloud

Cloud Services

Changes in Consumption

- User provision
- Self service
- Tiered, flexible pricing

Changes in Delivery

- Standardized offerings
- Virtualized & automated

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Current Offered Services

Cloud Service Management Services	Examples
Business_Processes-as-a-service (BPaas)	Use provider's business app/services over network **E.g.,** Your CRM package does not manage load effectively
Software-as-a-Service (SaaS)	Use provider's applications over a network **E.g.,** Your email is hosted on exchange server in your office, but is slow ➔ outsource.
Platform-as-a-Service (PaaS)	Tools/Services & Middleware to deliver S/W app.; Deploy customer-created applications cloud. **E.g.,** Host 64GB files, make available to 50K users
Infrastructure-as-a-Service (IaaS)	Rent HW, system software, storage, network in cloud. **E.g.,** Need to run batch jobs, but do not have the infrastructure necessary to run it in timely manner

Cloud Computing drives business value

VIRTUALIZATION

STANDARDIZATION

AUTOMATION

Cost

Flexibility

… to free budget for new investment and speed deployment of new capabilities.

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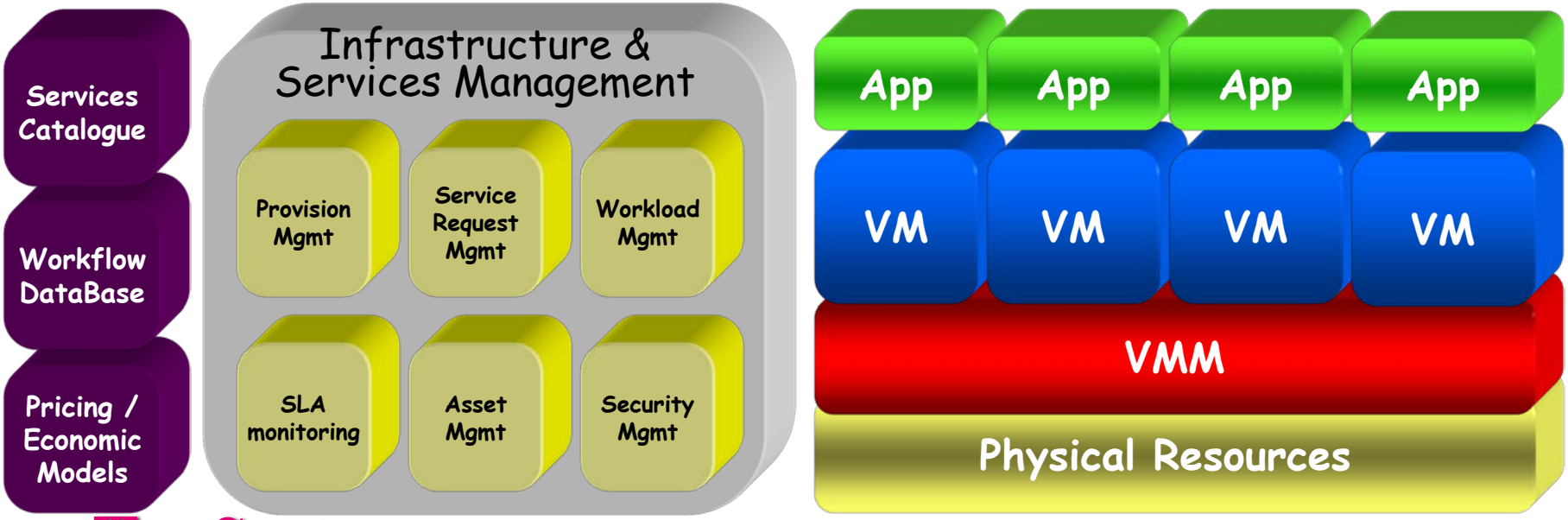
Architecture Overview

- Virtualized Pool of Compute & I/O resources
  - Applications/services running within virtual machines
- Autonomic services management
- Catalogues: offered services, images, workflows & utility models



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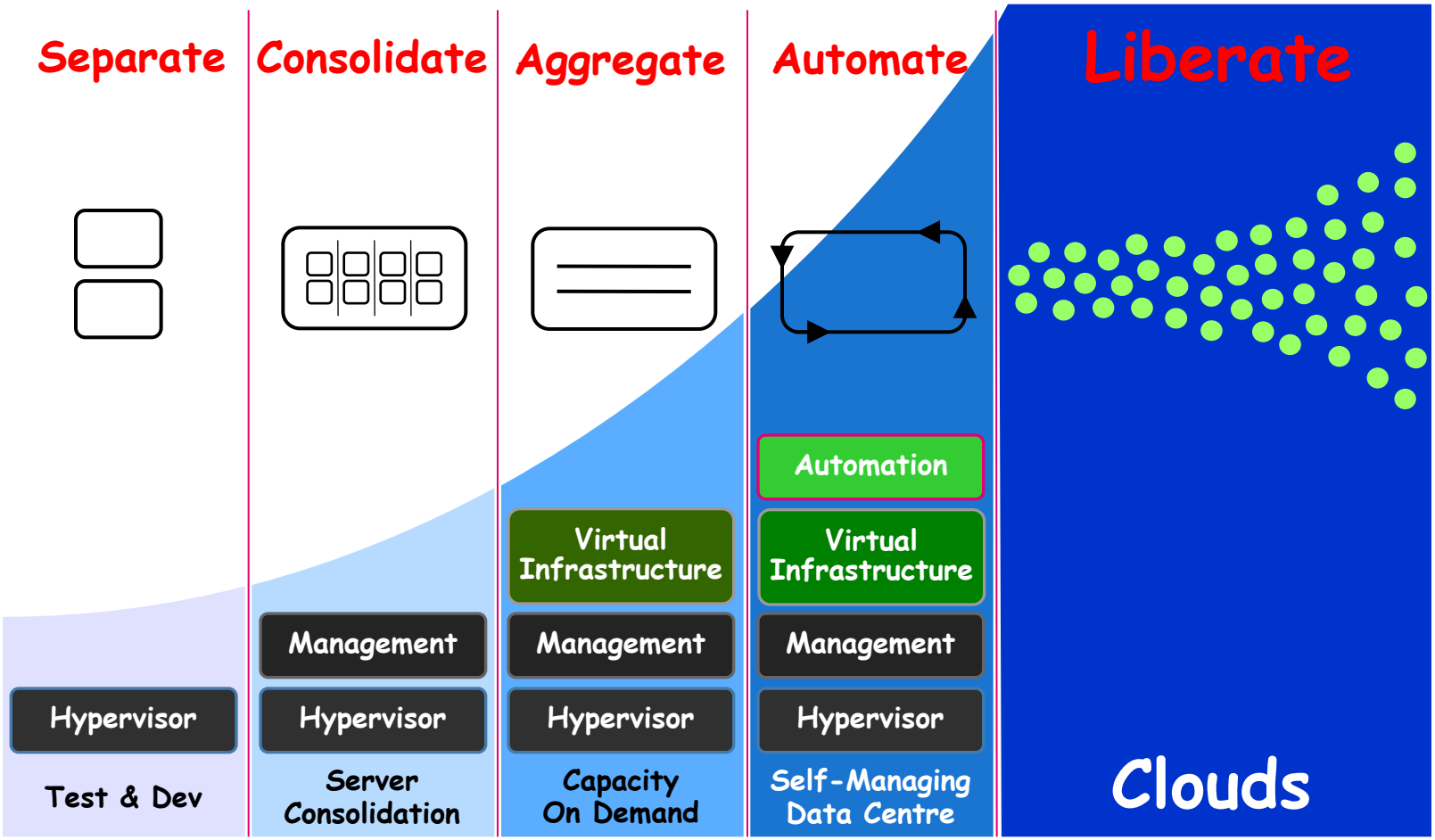
Virtualization - The Foundation of Clouds



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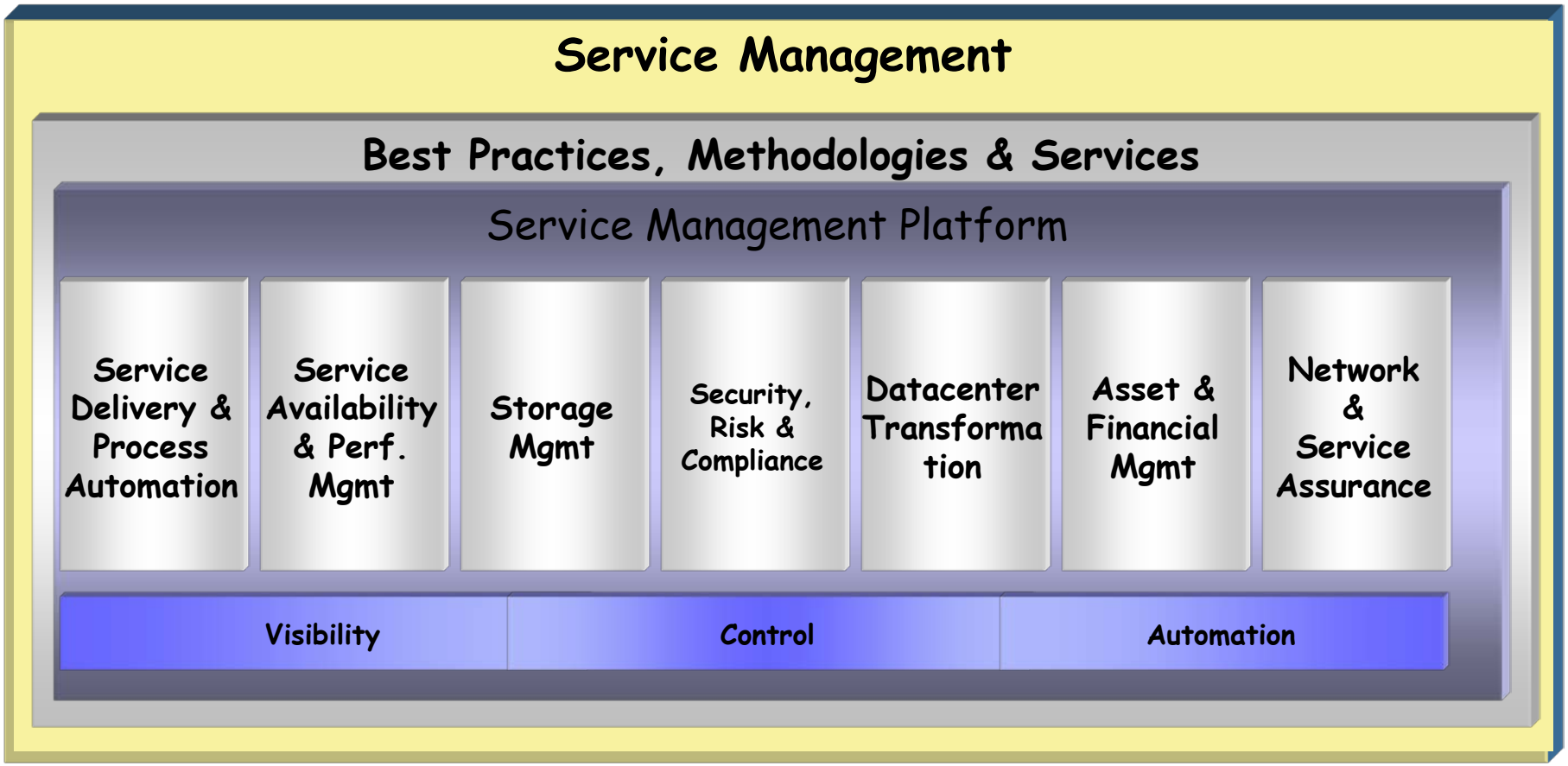
Manageability – Command & Control of Clouds

Service Mgmt provides mechanisms & S/W to assure quality service delivery & reduce infrastructure costs



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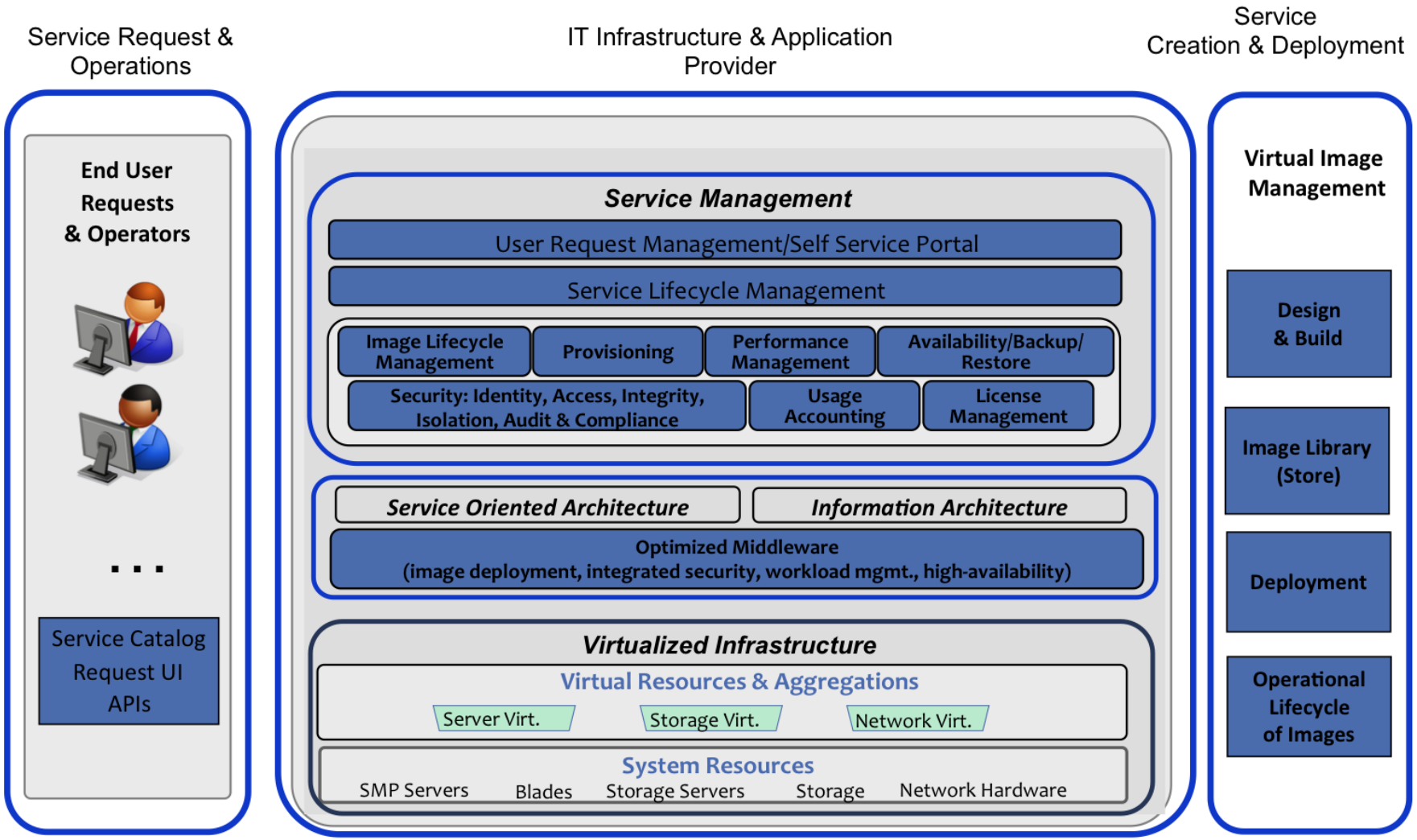
Service Management Model for Cloud Computing



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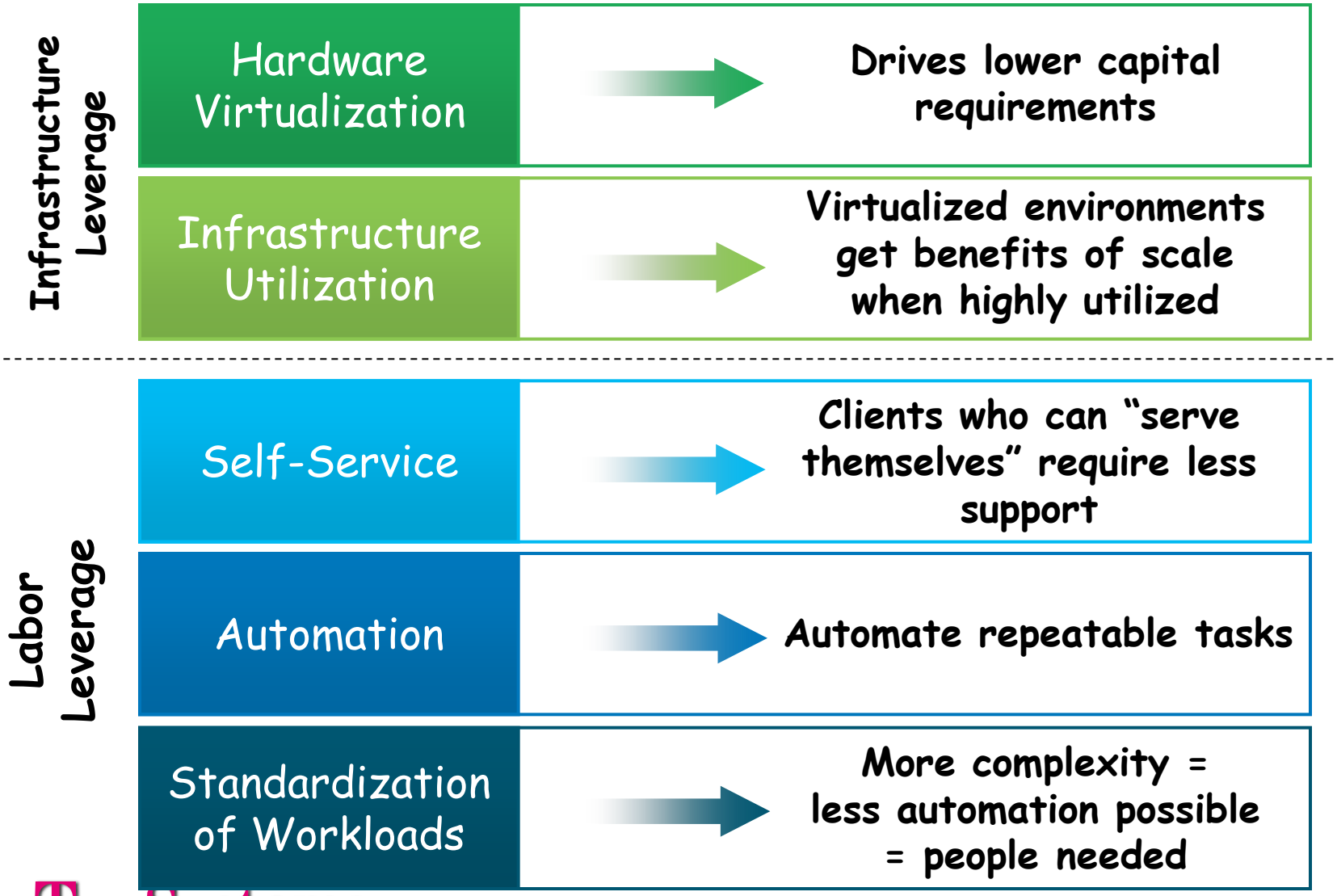
Elements that Drive Cloud Efficiency & Economics



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Differences: Cloud Computing & Traditional IT

	Traditional IT	Cloud Computing
Delivery Model	Buy assets & build delivery architecture	Buy external service
Interface Model	Internal network or intranet	Via Internet using standard Internet Protocols (IP, HTTP, HTML, etc.)
Business Model	Pay for fixed assets and administrative overhead	Pay directly based on usage or indirectly (e.g., subsidized by advertizing)
Technology Model	Single Tenant	Scalable, Elastic, Dynamic, & Multi-tenant

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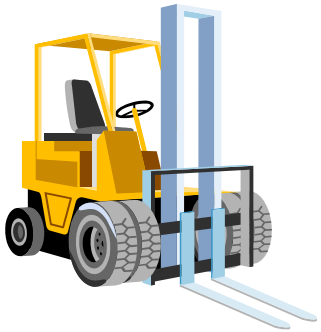
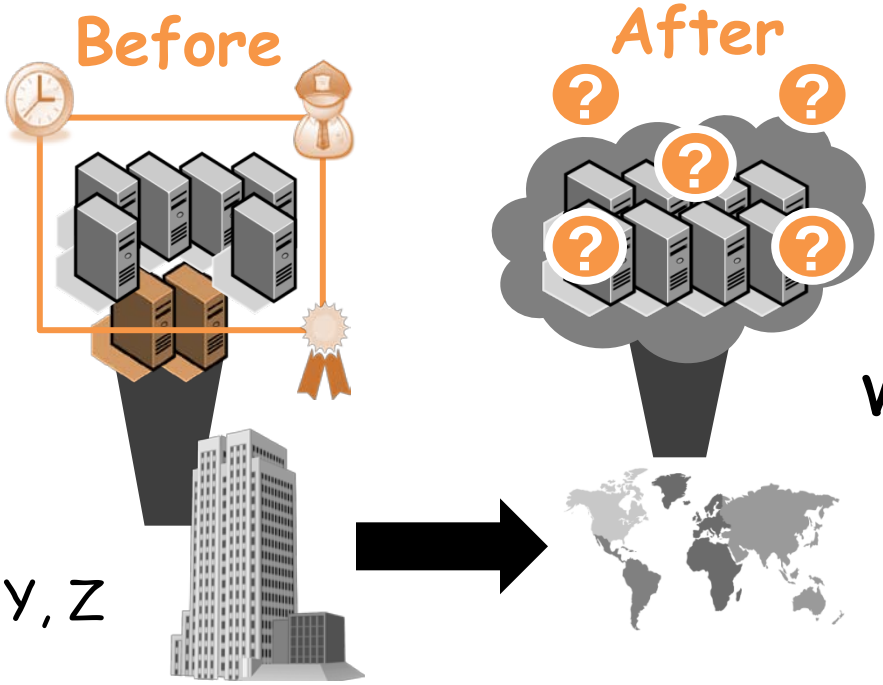
Challenges/Risks



- Availability of guaranteed service levels
- Security & regulatory compliance
  - … Data security, recovery, segregation, location; Investigative support; etc.
- Auditing Cloud to verify providers' claims
- Network connectivity – both performance & reliability
- Workload selection; effective exploitation of cloud capabilities
- Applications Scalability
- Integration of services between cloud offerings
- Interoperability among clouds, especially public clouds

Challenges/Risks - Security



We Have Control
Located at X
Stored in servers Y, Z
Backups in place
Sufficient ACL & Uptime
Happy Auditors
Engaged security team

Who Has Control?
Located where?
Stored where?
Who backs it up?
Who has access?
How resilient?
How do auditors observe?
How does security team engage?

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Workloads

Ready to Move (or Not to Move) to Public Clouds

Moving

- Single virtual appliance workloads
- Test & Pre-production systems
- Mature packaged offerings like e-mail, collaboration,..
- Software development environments
- Batch processing with limited security requirements
- Where latency is not issue
- Storage Solutions/StaaS
- Backup: Backup & Restore as a Service

Not Yet

- With sensitive data: Restricted to Enterprise
- Composed of multiple, co-dependent services, e.g. high throughput OLTP
- With high-levels of auditability & accountability: SOX, HIPPA, etc.
- Based on 3rd party SW that does not have virtualization or cloud-aware licensing strategy
- Require detailed chargeback or utilization measurement needed
- Require customization (customized SaaS)

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Workloads

When moving to external clouds: Workloads experience

- **Gain:**
  - High: small enterprise ERP/CRM/…
  - Little: loosely-coupled architectures/applications,..
- **Pain:**
  - High: numerical analysis with large data transfer,..
  - Little: development, web serving, collaboration, …

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Cloud Middleware

- Middleware written assuming static (permanent) machines ← Conventional Environments →
  - Even for simple virtualized environment (e.g., for server consolidation purposes)
    - Long running VMs with static IP addresses, host names, Elasticity limited to VMM capabilities; etc.
    - When shutdown VM (store back in persistent storage), it still ***exists*** → normal middleware still works. Restart VM image when needed.
- In Clouds
  - VM images get created; live for minutes/hours/etc. then collapse… nothing left (no states) → disappears forever.
    - You can purchase images that live for very long time; but you pay $$
  - Middleware must evolve with how virtualization is used in Clouds
    - VM disappearing forever on regular basis is a problem
    - Middleware to continuously discover resources/services
    - Can be done; but will be specific to cloud environment (IBM, Amazon,..) → No standards yet

Cloud Applications

- Take Enterprise Applications & move them to Clouds?
  - May be; but Unlikely
- Applications not Cloud Friendly: concerns
  - Enterprise applications' scalability is no match for scalability required for Clouds
  - Latencies in Clouds likely longer than latencies in enterprise
  - May need to deal with very large datasets in clouds
  - Licensing model may not work in the clouds

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Likely Evolution of Clouds

Current

1. Vendor offerings adopted primarily in single service nature;
2. Challenges will remain such as regulatory, security and performance to be gradually filled to broader acceptance.
3. Adoption by enterprises measured, focusing on non-core applications

Intermediate

1. Offerings increasingly appeal to specific industries;
2. Regulatory, security & SLA gaps in early offerings will be filled;
3. Vendors offering solutions to increase penetration of the cloud within enterprises.

Vision

1. Collection of offerings from multiple vendors;
2. Custom applications to be composites of off-the-shelf offerings in ecosystem mashed up to create new solutions;
3. Enterprise dynamically decide on resources to use based on current pricing & required SLAs.

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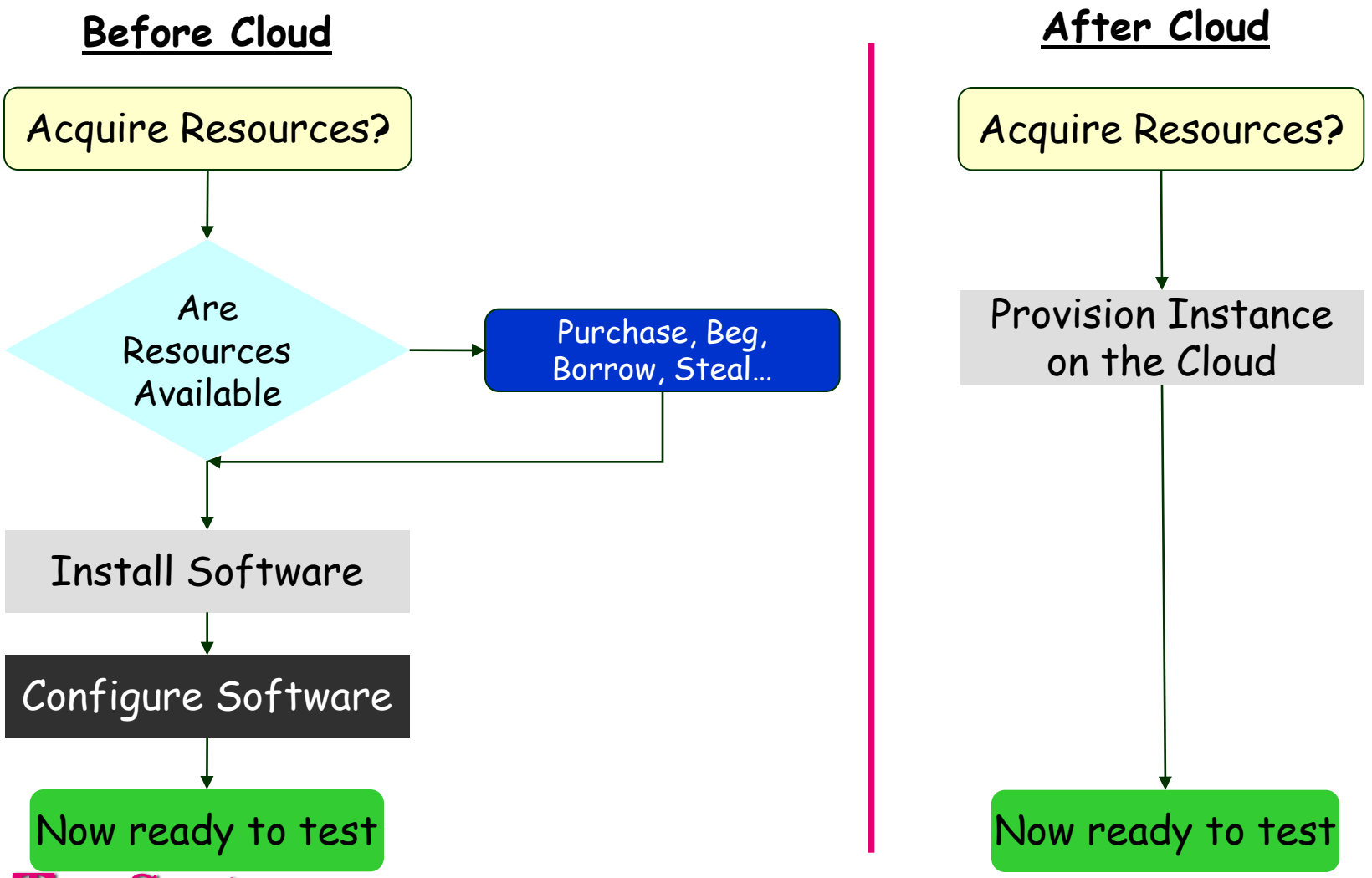
Test Clouds – An Example

IT Test Environments - Notoriously Inefficient

- 30% - 50% of all servers within a typical IT environment are dedicated to test.*
- Industry average utilization of test servers is around 5%
- IT staffs top challenge is finding available resources to perform tests to move new applications into production.
- 30% of defects caused by wrongly configured test environments
- Testing backlog is often very long
  - … also the single largest factor in delay of new SW deployments
- Test environments are seen as expensive and providing little real business value
- Too many different tools and skills needed

Traditional & Cloud-based Test Infrastructure



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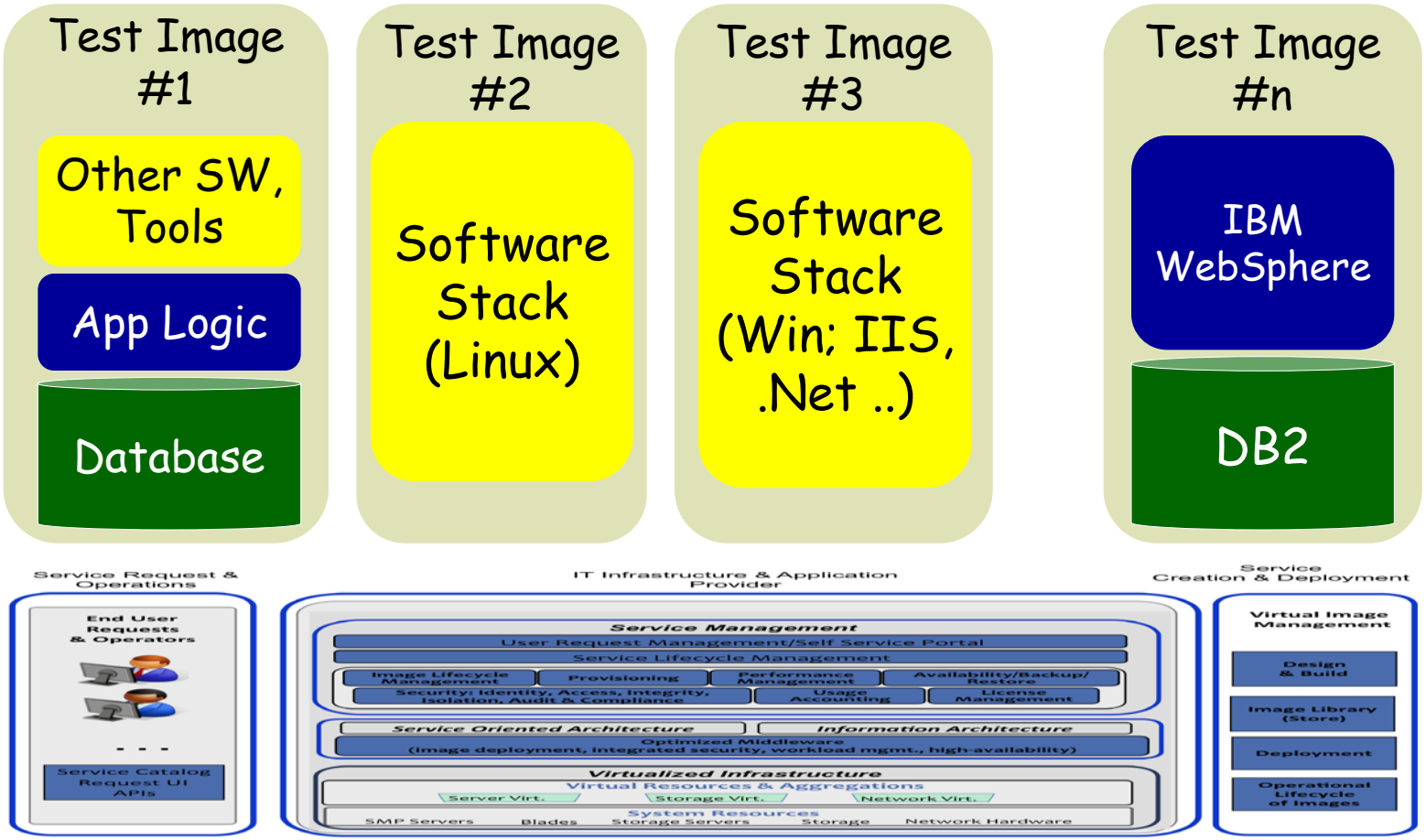
A Private Test Cloud – An Example



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SW Dev&test - Real improvements

Capability	From	To
Server/Storage Utilization	10-20%	70-90%
Self service	None	Unlimited
Test Provisioning	Weeks	Minutes
Change Management	Months	Days/Hours
Release Management	Weeks	Minutes
Metering/Billing	Fixed cost model	Term/value based
Payback period for new services	Years	Months

Cloud accelerates business value across a wide variety of domains.

Legacy ⟷ **Cloud enabled**

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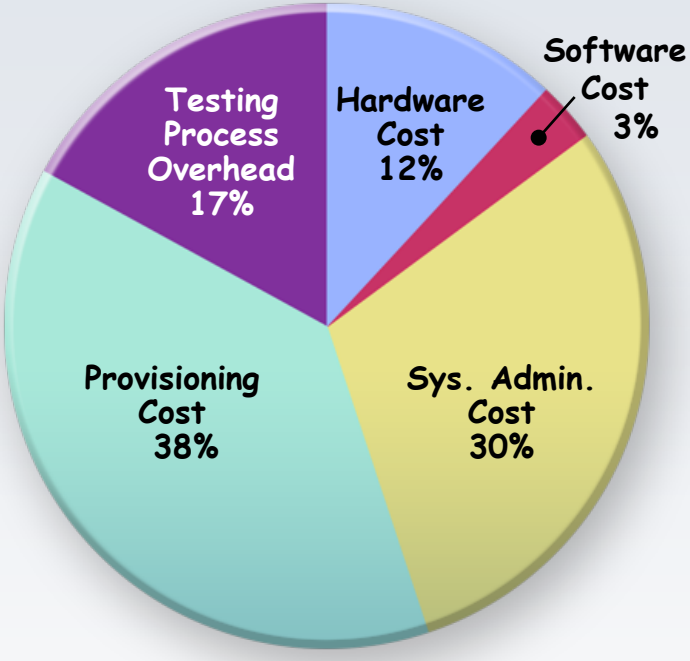
Test Cloud ROI Analysis - *Financial Institution*

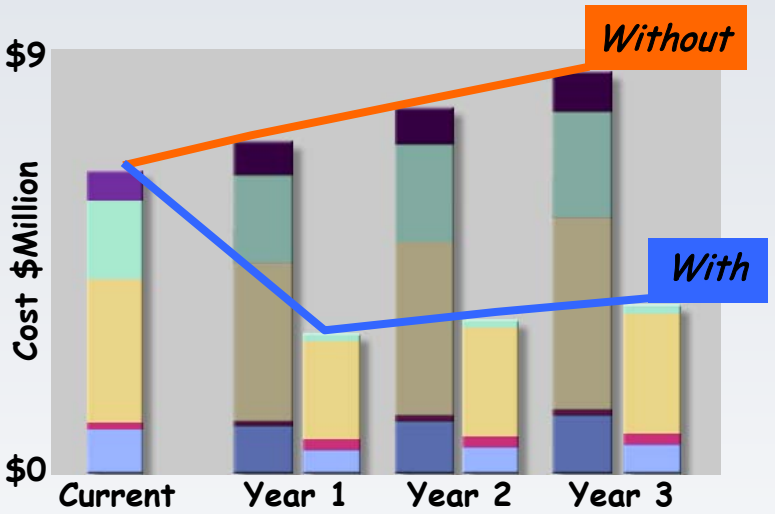
Saving by Category

1st Year After Cloud Transformation



Cost Structure

With and Without Cloud Transformation



Payback Period (Months)	2.85
Total Initial Investment for Test Cloud	$914,929.31
Net Present Value (NPV)	$7,949,228.81
Estimated ROI over 3 years	868.84%
Estimate average annual ROI	289.61%

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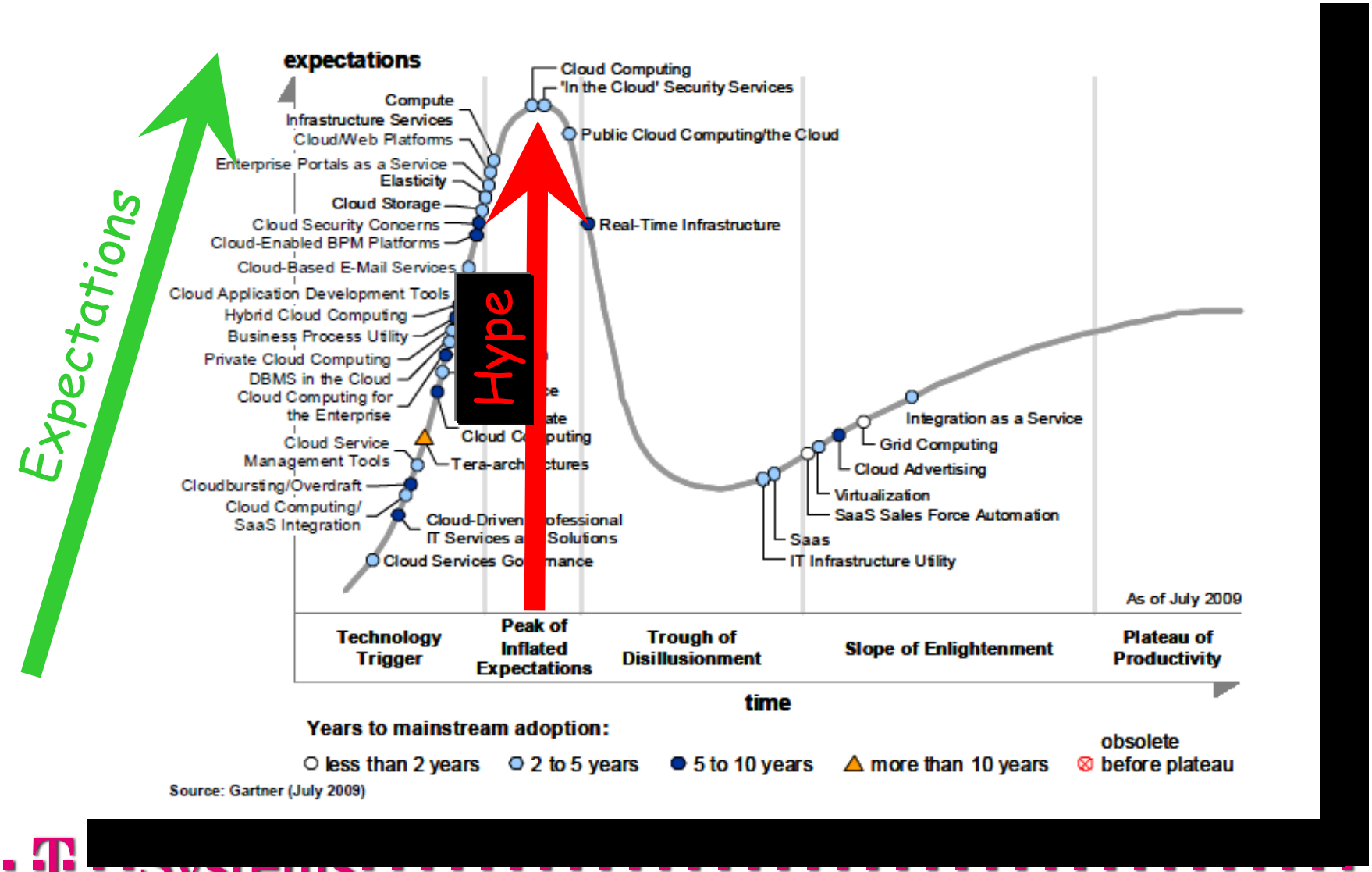
Gartner's Hype Cycle for Cloud Computing – July 2009



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Conclusions

- Cloud Computing is happening
  - … Still evolving requiring R&D
  - Considerable market growth & maturity over next 5 years
- Challenges exist
  - e.g., security, compliance, network availability, SLA guarantees, …
- Interoperability among public clouds
  - Standards & open source key for wide cloud adoption

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