Cloud Computing Architecture and Strategy

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Agenda

- **Introduction**

- **Cloud Computing Reference Architecture**
  - Cloud Computing Management Platform
  - Selected Management Areas

- **Hybrid Clouds**

- **Customer Projects**

- **Standardization Efforts**

- **Summary**

- **References**
The world is getting smarter...

In 2001, there were 60 million transistors for every human on the planet ...

... by 2010 there will be 1 billion transistors per human...

... each costing 1/10 millionth of a cent.

In 2005 there were 1.3 billion RFID tags in circulation...

... by 2010 there will be 33 billion.

One billion camera phones were sold in 2007, up from 450 million in 2006 ...

Worldwide mobile telephone subscriptions reached 3.3 billion in 2007

An estimated 2 billion people will be on the Web by 2011 ...

... and a trillion connected objects – cars, appliances, cameras, roadways, pipelines – comprising the "Internet of Things."
Cloud Computing: The next step in the evolution of IT

   - Optimized for sharing, industrial strength, systems management, …
   - Managed by central IT organization
   - Back office applications involving transactions, shared data bases, …
   - Mainframes, supercomputers, minicomputers, …

2. Client/Server: 1985 –
   - Optimized for low costs, simplicity, flexibility, …
   - Distributed management across multiple departments and organizations
   - Large numbers of PC-based applications
   - PC-based clients and servers, Unix, Linux, …

   - New consumption and delivery model
   - Optimized for massive scalability, delivery of services, …
   - Centralized model, hybrid service acquisition models
   - Supports huge numbers of mobile devices and sensors
   - Internet technology-based architecture

Just like introducing the Client/Server model impacted almost everything we did in IT (operation IT, developing applications, …), Cloud computing has severe impact on the IT industry
Cloud Computing...

The Industrialization of IT...

Virtualization + Automation + Standardization + Self Service = Reduced Cost

...leverages virtualization, automation, standardization and self service to free up operational budget for new investment

Agility + Business & IT Alignment + Service Flexibility + Industry Standards = Optimized Business

... allowing you to optimize new investments for direct business benefits
Cloud Computing Layers

**Infrastructure-as-a-Service**
- Shared virtualized, dynamic provisioning

**Platform-as-a-Service**
- Database
- Development Tooling

**Application-as-a-Service**
- Middleware
- Web 2.0 Application Runtime
- Java Runtime

**Business Process-as-a-Service**
- Collaboration
- Industry Applications

Examples
- Fidelity.com
- Salesforce
- Google
- Amazon Web Services

Industry-specific Processes
- Employee Benefits Mgmt.
- Procurement

Business Travel
- CRM/ERP/HR

Financials

Employees

Benefits Mgmt.

Industry-specific
Processes

Procurement

Business Travel
Cloud Computing Delivery Models

Flexible Delivery Models

Public ...
Service provider owned and managed. Access by subscription

Private ...
Privately owned and managed. Access limited to client and its partner network.

Hybrid ...
Access to client, partner network, and third party

Cloud Computing Model

Cloud Services

... Standardization, capital preservation, flexibility and time to deploy

... Customization, efficiency, availability, resiliency, security and privacy

ORGANIZATION ➔ CULTURE ➔ GOVERNANCE
What’s so different about cloud-like Service Management? – Changes in orders of magnitude

<table>
<thead>
<tr>
<th>Capability</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server/Storage Utilization</td>
<td>10-20%</td>
<td>70-90%</td>
</tr>
<tr>
<td>Self service</td>
<td>None</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Provisioning</td>
<td>Weeks</td>
<td>Minutes</td>
</tr>
<tr>
<td>Change Management</td>
<td>Months</td>
<td>Days/Hours</td>
</tr>
<tr>
<td>Release Management</td>
<td>Weeks</td>
<td>Minutes</td>
</tr>
<tr>
<td>Metering/Billing</td>
<td>Fixed cost model</td>
<td>Granular</td>
</tr>
<tr>
<td>Payback period for new services</td>
<td>Years</td>
<td>Months</td>
</tr>
</tbody>
</table>

Traditional Service Management

Cloud-like Service Management
Lifecycle of a Cloud Service

Service Subscription & Instantiation

Service Offering Creation & Registration

Service Catalog Manager

Cloud Service Definition

Cloud Management Platform
Common Resource Pools

Cloud Service

Offering

Subscription & Instantiation

Production

Termination

Subscriber (e.g. Line of Business)

Administrator / SLM

Service Operation

Service Instance Termination

IBM / ISV / IT Dept

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- **Summary**
- **References**
Overview – Cloud Computing Reference Architecture

1. The IBM Cloud Computing Reference Architecture (CC RA) is structured in a modular fashion (similar to the SOA Reference Model)
   - On its highest level of abstraction, it defines a base set of architectural elements, which are refined to the next level of detail
   - This modular approach allows refinement of the CC RA architectural elements independent from each other by the respective SMEs.

2. The IBM Common Cloud Management Platform Reference Architecture (CCMP RA) is the reference architecture for the CCMP being one fundamental architectural elements of the IBM CC RA.
Cloud Computing Reference Architecture (CC RA) – Overview

Cloud Services
IT capability provided to Cloud Service Consumer

(Virtualized) Infrastructure – Server, Storage, Network, Facilities
Infrastructure for hosting Cloud Services and Common Cloud Management Platform

Common Cloud Management Platform

BSS – Business Support Services
Business-level functionality for management of Cloud Services

OSS – Operational Support Services
Operational-level functionality for management of Cloud Services

Security & Resiliency
Cloud Services
IT capability provided to Cloud Service Consumer

(Virtualized) Infrastructure – Server, Storage, Network, Facilities
Infrastructure for hosting Cloud Services and Common Cloud Management Platform

Common Cloud Management Platform

BSS
Business Support Services
- Offering Mgmt
- Order Mgmt
- General accounting
- Contract & agreement Mgmt

Customer Mgmt
- Entitlement Mgmt
- Invoicing
- Opportunity to Order
- Service Offering Catalog

Pricing & Rating
- Subscriber Mgmt
- Peering & Settlement
- Service Offering Catalog

OSS
Operational Support Services
- Service Templates
- Service Request Management
- Provisioning
- Monitoring & Event Management

Change & Configuration Management
- Incident & Problem Management
- IT Asset & License Management
- Virtualization Mgmt

Service Delivery Catalog
- Service Automation Management
- Image Lifecycle Management
- IT Service Level Management
- Capacity & Performance Management

Common Cloud Management Platform RA - Details
Virtualized Resource Management
- Deploy cloud services on virtualized resources
- Manage virtual resources

Service Automation Management
- Interpret and execute build- and management plans
- Orchestrate management componentry

Image Management
- Design, build, and manage images for cloud services

Heat and Power Management
- Control energy consumption

Security
- Design for multi-tenancy
- Protect assets through isolation, integrity, image-risk, and compliance management

Usage Metering and Accounting
- Flexible support of delivery models
Typical Cloud Management Platform Middleware Stack

**Workloads**
- Service measurement
- Service reporting
- Usage accounting
- Auditing and controls

**Tivoli Service Automation Layer**
- Automate process of instantiating and managing a distributed IT environment.

**Virtualized Infrastructure Layer**
- Virtualized resources
- Virtualized aggregation
- Physical infrastructure

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- **Web, Collaboration and Infrastructure**
  - Technology
    - Highly Threaded
    - Throughput-oriented
    - Scale Out Capable
    - Lower Quality of Service

- **Analytics and High Performance Computing**
  - Technology
    - Compute intensive
    - High I/O Bandwidth
    - High Memory Bandwidth
    - Floating point
    - Scale Out Capable

- **Transaction Processing and Database**
  - Technology
    - Scale
    - High Transaction Rates
    - High Quality of Service
    - Handle Peak Workloads
    - Resiliency and Security

- **Business Applications**
  - Technology
    - Scale
    - High Quality of Service
    - Large Memory Footprint
    - Responsive Infrastructure

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**Tivoli Monitoring**
- TSA M v7.2
  - Web 2.0
    - User Interface
  - Service Request Mgr
  - Service Automation Mgr
  - TPM Provisioning Mgr
  - Tivoli Process Automation Engine
    - Orchestration workflows
  - Image Library
  - Workflows

**TUAM**
- Usage Reports
- Billing Reports

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**Virtualized Infrastructure Layer**
- x86
  - VM
    - Hypervisor (KVM, VMware, Xen)
    - Storage
    - Network
  - ... VM
  - Storage
  - Network

- **System p / SUN**
  - HMC
  - NIM
  - Hypervisor (PowerVM)
  - VM Partition
  - VM Partition
  - Storage
  - Network

- **System z**
  - HMC
  - Hypervisor (zVM)
  - VM Partition
  - VM Partition
  - Storage
  - Network
Traditional Data Center Management vs. “Cloud-like” Management

The overall objective of Cloud-managed data centers is to **automate any type of task or situation** (by reducing manual intervention) for **increasing flexibility** and **reducing operational expenses**.

### Core Metrics

<table>
<thead>
<tr>
<th>Core Metrics</th>
<th>Traditionally managed Data Center</th>
<th>“Cloud-managed” data center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admin/Server ratio → Costs</td>
<td>1:50 – 1:100</td>
<td>1:100’s – 1:1000’s</td>
</tr>
<tr>
<td>Time to provide new service instances &amp; changing them → Flexibility</td>
<td>Days / weeks</td>
<td>Hours / minutes / seconds</td>
</tr>
</tbody>
</table>

### Core Disciplines

- IT Management approach
- Administration Tasks
- Problem handling
- Service Consumer <-> Service Provider interaction

For Cloud-like efficiencies and flexibility, it is not sufficient to have the right technology, but to also use it in the right way!
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Hybrid Cloud Management, Security and Integration

- From the Enterprise Client’s perspective:
  - **Management of workloads running off-premise on clouds**
    - Management of software applications and services (monitoring, events, availability, performance)
    - Service Request Management (governance of service provisioning)
    - Dashboard for service visibility
  - **Security for Hybrids**
    - Control security and resilience of services (identity management, compliance, isolation)
  - **Integration of applications & data**
    - On-premise to off-premise business application connectivity & governance
    - Information exchange and data integration across the enterprise and clouds
  - **Application and Workload migration workbench**
    - Tools to support the migration of workloads to the cloud

*Initial focus for 'Hybrid Cloud':* 'Provide clients the ability to manage and integrate workloads and resources on a cloud with their existing processes, management and business systems.'
IBM + Cast Iron combines enterprise level scalability and support with rapid on & off premise application integration

**Today**
- Separate technologies to manage application integration requirements
- Fragmented infrastructure/device sprawl
- Duplicate integration processes

**IBM + Cast Iron**
- Single, integrated platform for on- to on-, on- to off-, and off- to off-premise application integration
- Uniform infrastructure
- Shared application integration processes

### On-Premise Applications

**Packaged Apps**
- SAP
- PeopleSoft
- JD Edwards
- SIEBEL

**Technologies**
- WebSphere
- DB2
- MySQL
- SQL Server
- .NET
- Databases, Web services, Messaging, App Servers, ...

### Off-Premise outside the Enterprise

**Public Clouds**
- Netsuite
- Salesforce
- Taleo
- Amazon Web Services
- Google

**BPO**
- UPS
- IBM
- ADP
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Emerging Customer Patterns

Self Service Provisioning
Compelling entry-point into Cloud Computing, particularly for Development/Test environments,

Cloud Service Delivery Platform
Very active with CSP’s, Telco’s. High Competition

Analytics
Heavy interest in Health & Pharma, emerging in FSS

Application / Platform Service
Advanced enterprises looking for the “big bang” of Cloud, with focus on increasing & optimizing existing infrastructure utilization
Self Service Delivery Project – Financial Customer

Low-cost, low-touch self-enablement server provisioning system that leverages automation around virtualized server and storage infrastructure

**Primary Focus Areas**

- **Improve Efficiency**
- **Improve Quality**

**Supporting Capability**

- **Self-service portal with automated provisioning**
  Move from traditional high touch provisioning model to a self-service, full-lifecycle, reservation model with automated provisioning

- **Management of the full lifecycle of a server**
  Systems can be reserved, provisioned and de-provisioned based on schedule and capacity

- **Image management**
  Temporarily restore servers for further testing

- **Policy management and governance**
  Consistency of server provisioning and configuration. Flexibility and control over request/approval workflows, resource assignment, utilization and capacity, and cost allocation

**Key Metrics**

- time to market
- consistency
- flexibility
- server/admin ratio
- systems utilization
- systems capacity
- time to market
- flexibility
- systems capacity
- consistency
- visibility and control
- systems capacity

**SupportingCapability**

- AIX LPARs on IBM p5/6
- Linux and Windows images on x86
IBM Tivoli Development Cloud

Business Background

- IBM Tivoli Development Services (TDS) organization provides IT services for Tivoli and other organizations in IBM Software Group and Research
- IT Footprint had expanded to 24 labs through growth and acquisitions, creating inefficiencies and increased expense
- Plan to exploit Tivoli capabilities to:
  - More effectively manage resources and IT services in the cloud
  - Innovate new business services through process transformation

Cloud Business Benefit

- Transformed business and IT processes
- Improved competitiveness through faster time to value and enhanced productivity
- Avoided $4.8M in capital expense and $3.1M in operational expense in 2009 through consolidation, virtualization and automation
- Consolidated 5 of 24 labs, reduced physical space by 8% and built capacity for 1200 virtual machines.

Solution Overview

- IBM Tivoli Development Cloud implemented with Tivoli Service Automation Manager, Tivoli Provisioning Manager, IBM Tivoli Monitoring, Storage Productivity Center, OMNIbus, Tivoli Business Service Manager, Tivoli Data Warehouse, Tivoli Performance Analyzer
- Infrastructure includes KVM, VMWare and Hyper-V based virtualized images on IBM System X hardware
SKT’s vision of Cloud Computing

Cloud Computing platform needs to be deployed that enables mobile content providers and business partners with a mobile service idea to develop, test and commercialize new services quickly and easily.

**Business Needs**

“Strengthen the Competitiveness of the SKT Internet Service & Create new business opportunities for Platform service“

- Create new service offerings
- Respond to changes quickly

- New business service idea
- Event/Marketing strategy changeover

**Speed:** Provide resources quickly

**Agility:** Quickly respond to changes in IT resource demand

- Development & Production system Infra
- Cloud Service Platform

**Project Objective**

- Provide Better and flexible service to users (CP/BP), enabling self-service request and delivering services more rapidly
- To leverage CP/BP who has a new business service ideas
- Reduce cost for operations & management and for new investment

- Improve time to market – react to deliver a new IT service quickly, decrease time to deploy systems for new service offerings

- Lower development cost – increase resource utilization and reduce labor costs

- Find new revenue/profit streams thru embrace a new business service ideas of CP/BP quickly.
United States Air Force Mission Oriented Cloud Architecture

Business Background

• The United States Air Force (USAF) provides aerial, space and cyber warfare for the United States Armed Forces. The USAF consists of 10 major commands, 100 military bases, and 700,000 personal worldwide.

Solution Overview

• Demonstration of a security focused cloud computing architecture that can manage, monitor and secure the information flowing through the Air Force network.
• Advanced analytic processing from InfoSphere Streams coupled via sensors, monitors, and other detection devices.
• Automated mission prioritized capacity management.
• Real-time situational awareness of the cloud environment.
• Policy based security compliance reporting and enforcement.
• IBM hardware – System x, BladeCenter, DataPower, ISS Proventia.
• IBM software – Tivoli, Rational, WebSphere and InfoSphere.

Business Benefit

• IBM will provide research, design and demonstration a secure cloud computing infrastructure for the USAF.
• IBM is helping the USAF understand how to manage, monitor, and secure the information flowing through the USAF, Department of Defense and other intelligence agency networks.
• IBM will demonstrate an unprecedented level of security, network resiliency to the USAF networks.
• The resulting architecture will provide the USAF with an advanced level of “Situational Awareness” by implementing sensors, monitors, detection devices, security policy management, compliance management, and advanced analytic stream processing.
• The new cloud architecture will reduce the time it takes to respond to cyber threats by leveraging automated mission prioritized workload and capacity management systems.
IBM Technology Adopter’s Portal (IBM TAP)

**Without Cloud**

- 100% New Development
- Software Costs
- Power Costs
- Labor Costs
- HW Costs

**With Cloud**

- Liberation funding for new development
- Deployment
- Software Costs
- Power Costs
- Labor Costs
- HW Costs

**Strategic Change Capacity**

- Hardware, labor & power savings reduced annual cost of operation by 83.8%

**Business Case Results**

- Innovation Cloud for 100,000 Subscribers
- Reduced Capital Expenditure
  - Reduce from 488 servers to 55
- Reduced Operations Expenditure
  - Reduce from 15 admins to 2
- Additional Benefits:
  - Enhanced customer service
  - Less idle time
  - More efficient use of energy
  - Acceleration of innovation projects
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Service Definitions and Service Instances

**Service Definition**
including a topology model for the services, and build- and management plans

**Service Instances**
created from template definitions in a Service Definition, representing one deployed service

**Tivoli Service Automation Manager**

**Service Definition**

**Service Instance Test 2**

**Service Instance Test 1**

**Automation assets**

**Automation Assets**
leveraged by build- and management plans, e.g. OVF images, TPM workflows, scripts, ...

**Instantiation**
of services from a Service Definition, parameterized through user input filling in point of variability of the Service Definition

**Data Center Resources**
Test 1
Test 2
Service Definition Overview

- **Service Definition** provides a model for managing Cloud Services throughout their **complete lifecycle**:
  - Initial Deployment of a service instance
  - Operational management of a service instance (e.g. modify capacity, patch management, upgrades, incident and problem management, etc.)
  - Termination of a service instance

- **Service Topology Template**:
  - Structural model of a service, i.e. its **components** and their **relationships**
  - Includes **operations** that can be invoked on service components as the basis for instrumentation

- **Build- and Management Plans**:
  - Process model of how to **set up, manage and terminate** a service
  - Plans are represented in BPMN

- **Interfaces describing the CRUD operations that can be executed on Cloud Service Definitions and Cloud Service Instances**
  - For **orchestration** of the service, and for **creation and management of composed services** (Hybrid Clouds)
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Summary

- Cloud Computing is a disruptive change to the way IT services are delivered… it is about shifting to the third compute model in the evolution of IT

- Service Lifecycle Management based on a Dynamic Infrastructure is the foundation for managing Clouds

- A solid Cloud Computing Architecture is required to successfully and economically manage Clouds
  - Open standards based architecture for the buildout of private, public and hybrid Clouds
  - Management of IaaS-, PaaS- and SaaS Clouds
  - Build for seamless integration into existing customers environment

- The Journey to Cloud requires an integrated and orchestrated approach

- Customers are adopting Cloud Computing today
  - Adoption often starts in the Development- and Test Environments

- The Benefits of Cloud Computing are real!
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Thank you!

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