Experiences with Transformation to Hybrid Cloud: A Case Study for a Large Financial Enterprise

Acknowledgments: Simon Kofkin-Hansen, Long Wang, Christopher Moss, Richard Smith, Theodor Razvan Ionescu (IBM)
Defining the Cloud Models
[The NIST Definition of Cloud Computing, 2011]

- **Private cloud**
  - cloud infrastructure provisioned for exclusive use by a single organization, comprising multiple consumers
  - owned, managed and operated by the organization, a third party or some combination of them
  - on or off premises

- **Public cloud**
  - cloud infrastructure provisioned for open use by the general public
  - owned, managed and operated by one or more organizations, a third party or some combination of them
  - on or off premises

- **Hybrid cloud**
  - composition of two or more cloud infrastructures (usually public and private) that remain unique entities
  - those infrastructures are bound together by technology that enables data and application portability
The Case for Dynamic Hybrid Cloud

Private Cloud & IT

Benefits:
- Fully customizable
- Robust management
- Secure by design

Public Cloud

Benefits:
- Low entry cost
- Pay-per-use
- Highly elastic

Dynamic Hybrid

When done properly, dynamic hybrid cloud can yield
- Best of both worlds
- Better outcomes

- Maximize return on existing IT investments
- Match workloads to best-fit infrastructure
- Hit the right balance of risk to speed
- Meet seasonal capacity without CapEx
- Add new capabilities quickly
The market opportunity for Hybrid Cloud is large

50% of enterprises will have hybrid clouds by 2017

Source: Gartner
A Case Study: Hy-Cloud – A Hybrid Cloud for Finances R Us (FRS)

- Hybrid Cloud for a large financial enterprise
  - Requirements and Challenges
  - Solution Approach
  - Lessons Learned

- Enterprise is Real; Names are Fictional. Let's call:
  - The Enterprise: Finances R Us (FRS)
  - Resulting Hybrid Cloud Infrastructure and Services: Hy-Cloud
Hy-Cloud Requirements

- Deliver an on-premise private cloud without introducing any negative performance, latency, or availability effects to existing environment.
- Utilize the already prevalent virtualization environment (VMWare ESXi) on which FRS had already sunk expenses.
- Deliver at least 50% improvement in service delivery SLAs through automation, orchestration, and workflow optimization.
- Rapid automated provisioning of VMs and workloads.
- Granular chargeback of resources consumed on a per-user, per-group, per-business-unit, and per-cost center basis.
- Integration with external public clouds: Amazon Web Services and Softlayer.
- Unified management of all resource environments.
- Single self-service portal for servicing all environments based on roles and entitlements.
- Integration with FRS’s existing service management tools (like ticketing, service desk, patching, monitoring, configuration management, change management, directory services, authentication services).
Each $P_k$ (where $k=0..12$) refers to a set of related use-case packages.
Cloud Adoption Use Case Packages for Hy-Cloud [IBM CCRA]

Each $P_k$ (where $k=0..12$) refers to a set of related use-case packages.
Incremental Approach to Higher Business Value via Cloud Adoption
[IBM CCRA 4.0]
Phases in Hy-Cloud Solution Design [IBM CCRA 4.0]

UNDERSTAND
- the client’s business and needs

EXPLORE
- options and approach

DEVELOP
- and agree to client solution

IMPLEMENT
- client solution

CONFIRM
- client value and experience

Understand Client -> Define Client Requirements -> Design Solution -> Detail Design to Define BOM -> Define Roadmap & First Project
Detailed Phases in Hy-Cloud Solution Design [IBM CCRA 4.0]

1. Business Drivers
   - Describe the key business drivers for the project, the KPIs or CSFs, and how they align with Cloud computing.

2. Business Process
   - Understanding the existing "As-is" process, and how this must change in order to meet the business drivers.

3. Current IT Environment
   - Understand the current environment where the Cloud will be deployed, what systems, technology, capacity, constraints.

4. Candidate Cloud Services
   - 12-step process to defining the services and the attributes of the candidate cloud services.

5. Use Cases & Actors
   - What are the functional requirements expected from the Cloud and who are the key actors. Expressed as Use Cases.

6. Non-Functional Requirements
   - NFRs should be defined to cover the volumes, capacity, scale, availability, security, operational and monitoring aspects of the Cloud.

7. System Context
   - The system context should define the boundary of the Cloud, and the integration with OSS/BSS systems.

8. Architecture Overview
   - Architecture overview diagram should define the high level components, their placement.

9. Architecture Decisions
   - Clearly documented decisions on key architectural points including the rationale for the decision.

10. Operational Model
    - Design and consider the components of the solution both at a physical and logical level.

11. Roadmap
    - Define the overall timeline, phases, and key milestones that will shape the plan and overall delivery.

12. Scope
    - Define the boundaries of the project, inclusions, exclusions, dependencies, and align phases with milestones in the roadmap.

Content provided by CCRA
- Business Drivers
- Use Cases and Actors
- Non-Functional requirements
- System Context
- Architecture Overview
- Architecture Decisions
- Operational Model
- Roadmap

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Hy-Cloud Overview and Key Characteristics

- Resources and cloud services spanning multiple infrastructures
  - VMWare-based on-premise management platform integrated with Amazon Web Services (AWS) endpoints
  - Orchestration and automation using vRealize Orchestrator and Chef

- Automated provisioning, deployment, and configuration of middleware patterns and operating systems

- Custom design for customer-specific “Day 2” operations automated by cloud service catalog and workflows
  - Customer-specific operations, e.g. “switch an application from Dev to Prod environment”, “start/stop a Oracle instance”, “patch SQL server instance”.
  - Customer-specific roles and responsibilities

- Integration with FRS’s existing environment and processes
  - Active Directory, Monitoring, Request/Ticketing, Backup, Configuration Database,...
Foundations of Hy-Cloud: Pattern-based Provisioning
[IBM CCRA]

- **Patterns (specifically, cloud-computing patterns)**
  - Logical descriptions of physical and virtual assets that comprise a cloud-computing solution
  - Useful in modeling multi-tiered application environments (e.g., SAP environment)
  - Useful in modeling complex middleware environments (e.g., cluster environment for developing J2EE apps)

- **Pattern-based provisioning**
  - prepares and supplies cloud-computing patterns within an IT environment and delivers them as a cloud service.
Foundations of Hy-Cloud: IBM Private Modular Cloud (PMC)

- Allows selection and modular assembly of hardware, software, features, and services
  - Reusable modular hardware, software, and services components
  - Start small and scale up quickly if and when needed

- Automated, fast deployment of private cloud using pattern-based approach
  - Automated provisioning and de-provisioning of OSes (minutes not weeks)
  - Automated provisioning and de-provisioning of workloads (minutes not months)
  - 200+ Application patterns (App, Middleware, and Database)

- Fully automated deployment and lifecycle management of cloud services

- Unified management of heterogeneous hybrid environments
  - Individualized self-service portal/dashboard
  - Automated provisioning
  - Automated capacity adjustments
  - Automated maintenance
  - “Day 2” operations: creating snapshots, de-provisioning machines, reboot, etc.
### System Context of Hy-Cloud

<table>
<thead>
<tr>
<th>Cloud Type</th>
<th>Manage-From</th>
<th>Manage-To</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-premise-Hybrid</td>
<td>On-premise</td>
<td>On-premise and AWS</td>
</tr>
</tbody>
</table>
Main Actors in a Typical Hybrid Cloud Scenario [IBM CCRA 4.0]

- Cloud Service Provider
- Cloud Service Consumer

- Business Manager
- Deployment Architect
- Transition Manager
- Service Manager
- Security & Risk Manager
- Operations Manager
- Operator
- Cloud Administrator
- Facilities Manager
- Customer Support & Care
- Offering Manager
- Service Component Developer
- Service Composer
- Consumer Business Manager
- Service Integrator
- Consumer Cloud Administrator
- Consumer End User

*Cloud Administrator* specialties:
Storage Admin., Network Admin., OS Admin., Virtualization Admin.
Hy-Cloud: Main Actors [IBM CCRA 4.0]

Cloud Service Creator (IBM)

Cloud Service Provider (FRS IT Division)

Cloud Service Consumer (FRS Business Units)

Business Manager
- Customer Account Manager, Business Office

Deployment Architect
- Cloud Service Consultant, Cloud Education Specialist

Transition Manager

Service Manager

Security & Risk Manager

Operations Manager

Offering Manager

Service Component Developer

Service Composer

Consumer Business Manager

Service Integrator

Consumer Cloud Administrator
- Tenant Administrator, Workload Administrator, Data Administrator, Security Administrator, Operator

Consumer End User

Cloud Administrator specialties:
- Storage Admin., Network Admin., OS Admin., Virtualization Admin.
Hy-Cloud: Simplified Conceptual Architecture

Examples of Cloud Orchestrator and Controller Engine:
- Apache CloudStack
- HP Eucalyptus
- IBM Cloud Orchestrator
- Oracle Enterprise Manager Cloud Control
- VMware vRealize

Examples of Virtual Infr. Manager
- HyperV, vCenter, XenCenter

*Endpoint* to interface different types of compute resources.

An endpoint could be associated with a cloud account or virtual infrastructure manager.

Possible to have multiple endpoints for the same cloud or virtual infrastructure.

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<tr>
<td>On-premise-Hybrid</td>
<td>On-premise Vmware based</td>
<td>On-premise, AWS, Softlayer</td>
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</tbody>
</table>
Steps in Building Hy-Cloud

1. Using automation scripts, install the cloud management stack.
2. Using IBM's pattern library as a starting point, build a library of PaaS patterns and service catalog.
3. Build Process Automation Workflows that will get invoked when users selects items from the service catalog.
Hy-Cloud Architecture – Service Catalog

- **IaaS Services**
  - base infrastructure provisioning services
  - e.g., Windows VM, Linux VM conforming to customer (i.e., FRS) specified security and deployment standards, integrated into FRS’s service management processes (e.g., backup and monitoring)
  - Day 2 operations, e.g., update lease time, change resources, restart VM

- **PaaS Services**
  - Provision and deploy middleware patterns (i.e., OS + middleware/application stack) into specified environments
  - E.g., MS SQL pattern conforming to customer (i.e., FRS) specified security and deployment standards, integrated into FRS’s service management processes (e.g., backup and monitoring)
  - Day 2 operations, e.g., create database, change logfile settings, create JDBC connections

- **Support Services**
  - Open ticket for specified infrastructure tasks (e.g., firewall update)
## Hy-Cloud Pattern Examples

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Software Components</th>
<th>Features / Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle</td>
<td>Oracle</td>
<td>Single Server Oracle or multiple server Oracle RAC installation.</td>
</tr>
<tr>
<td>SQL Server</td>
<td>SQL Server</td>
<td>Single Server or multiple server clustered installation.</td>
</tr>
<tr>
<td>Hybrid Linux Web</td>
<td>Apache, Tomcat</td>
<td>Single Server installation of Apache and Tomcat.</td>
</tr>
<tr>
<td>Multi-Tier Windows Web</td>
<td>IIS, .NET + IIS, HA Proxy</td>
<td>Multiple tier installation of IIS and .NET. The SQL Server installation in this pattern may be optional.</td>
</tr>
</tbody>
</table>
Different cloud platforms (VMware, AWS) have different rules or capabilities
- VM naming, agents for various capabilities, logon mechanisms, availability of endpoint plugins, etc.

Different cloud platforms require coordination of different types of workflows. Workflow interactions covering multiple platforms may be particularly challenging.

Credentials may be handled quite differently in different cloud platforms
- Customer Active Directory, Quest Authentication Service, VMware user accounts, AWS accounts, vRealize business groups, AWS security groups, …
Automation of “last mile” is demanded
- If VMs are provisioned in minutes but software deployment requires weeks, there is not much value in cloud provisioning
- Hy-Cloud supports automated deployment of software combinations via Chef-based Rapid Deployment Service

For the service catalog to be useful, it is important to identify common configurations of middleware patterns in customer applications
- Applications created by hundreds of developers in the customer for different environments (Dev, Staging, Prod, …)
- We designed an analytics engine to extract and analyze common configurations, and used those to guide pattern creation and customization

PaaS automation means automated deployment, configuration and inter-connection of a number of middleware
Gathering of customer-specific requirements is time-intensive and may involve interactions with many parts of the customer’s organization
- Interaction with multiple customer business units over many days may be needed to collect requirements covering
  - Deployment processes for a set of common operating systems and middleware
  - Clarification of roles, responsibilities, approval policies and processes
  - Determination of important post-provisioning operations (Day-2 operations)
  - Security requirements

Customer-specific requirements will affect design of service catalog, service workflows, and self-service portal
- Cloud service catalog access needs to be based on customer-specified roles and responsibilities
- Service workflows need to cover Day-2 operations
  - E.g. “switch a QA customer application to Prod”, “start/stop a Oracle instance”, “patch a system”, “add JVM memory for a Weblogic instance”, “build a deployment from spec”, “enable backup for VMs”, etc.
- Self-service portal needs to:
  - Support custom service catalog and Day-2 operations for multiple cloud platforms
  - Allow checking status of resources, components, and operations in multiple cloud platforms, through custom workflows
  - Accommodate customer’s special portal requirements (portal customization)
Many automated processes may require interacting with existing management tools in customer environment
- Provisioning, post-provision operations
- DNS, AD, ticketing, CMDB, backup, anti-virus, patching, monitoring, …

Integration requires thorough understanding of existing tools and processes

Integration requires buy-in from customer’s IT operations team
Hy-Cloud Summary

- Multiple cloud platforms (VMWare, AWS, Softlayer)
- Support for both on-premise and off-premise
- Emphasis on automation of “last mile” by using orchestration and pattern standardization
- Custom design for customer-specific entitlements, portal and post-provisioning operations
- Integration with customer’s existing environment, processes, and management tools
https://www.youtube.com/watch?v=8Nhued2B-cM
Epcot SCO Demo

https://www.youtube.com/watch?v=vkPU4Kd-yVU
IBM Private Modular Cloud Overview

DEMO
References

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- IBM Cloud Computing Reference Architecture (CCRA) 4.0
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  - Microsoft Cloud Design Patterns
  - www.cloudpatterns.org