Leveraging Domain-Specific Software Architectures for Classifying Cloud Service Abstractions

T.S. Mohan\textsuperscript{1} \hspace{1cm} Nenad Medvidovic\textsuperscript{2} \hspace{1cm} Chris A. Mattmann\textsuperscript{2,3}

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Have We Really Understood the Cloud Yet?

- Plethora of Definitions – Hype?
  - Range of Technologies and business models
- What really clicks in the Cloud?
  - Pay per use – no capex only opex!
  - Meet seasonal loads – elasticity – scalability up and down
  - Simplified uniform abstractions
- Service offerings and Vendors
  - Large players – Azure, AppEngine, AWS, etc
  - Small niche players – variety of cloud enablers for the varied enterprises.
- Value add? Where and How? Sustainable?
- Key Issues and Challenges for sustained usage
  - Applying / Leveraging CAP (Consistency, Availability & Performance)
  - Security (or is it?) – The dilemma of storing and using Confidential Data
  - Interoperability and portability
  - Variable seasonal Cloud Services Pricing
  - Multi-tenancy and reputation sharing
The Users Dilemma – Migrating into the Cloud…..

**IaaS**
- IT Folks
- **Abstract Compute / Storage / Bandwidth Resources**
- Amazon Web Services – EC2, S3, SDB, CDN, CloudWatch

**PaaS**
- Programmers
- **Abstracted Programming Platform with encapsulated infrastructure**
- Google Apps Engine (Java/Python); Microsoft Azure (.NET)

**SaaS**
- Architects & Users
- **Application with encapsulated infrastructure & platform**
- Salesforce.com; Hotmail;Gmail; Yahoo Mail; Facebook; Twitter
### Cloud Application Deployment & Consumption Models

<table>
<thead>
<tr>
<th>Public Clouds</th>
<th>Hybrid Clouds</th>
<th>Private Clouds</th>
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Leverage what……?

• At what level of the cloud services .. Combinations of IaaS, PaaS and SaaS.
• What costs model ? Factoring in variable pricing risks....
• What configurations and deployments? Interoperability? Portability?

Can we apply the principles and discipline of Software Engineering when using Cloud services?
Domain Specific Software Architectures

• A domain-specific software architecture (DSSA) comprises:
  • a reference architecture, which describes a general computational framework for a significant domain of applications;
  • a component library, which contains reusable chunks of domain expertise; and
  • an application configuration method for selecting and configuring components within the architecture to meet particular application requirements.

• A Reference architecture is the set of principal design decisions that are simultaneously applicable to multiple related systems, typically within an application domain, with explicitly defined points of variation.
Leveraging Studies from the World of Grid Technologies

<table>
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<tr>
<th>Technology</th>
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DSSA for Grid Computing

---- Capturing Service Component Interactions
Migrating to the Cloud – The Issues and Challenges

The overall Migration Steps:

• Evaluate & Assess
• Pilot for the right level of migration
• Rearchitect, Redesign and Reimplement part or all of the components – The Hybrid design
• Leverage platform advantages
• Leverage Cloud Services Eco-Systems
• Test and Validate – including the pricing dimensions
• Refactor, Refine and Re-Iterate

Distributed System Fallacies
And the Promise of the Cloud

- Full Network Reliability
- Zero Network Latency
- Infinite Bandwidth
- Secure Network
- No Topology changes
- Centralized Administration
- Zero Transport Costs
- Homogeneous Networks & Systems

Challenges in Cloud Technologies

- Security
- Performance Monitoring
- Consistent & Robust Service abstractions
- Meta Scheduling
- Energy efficient load balancing
- Scale management
- SLA & QoS Architectures
- Interoperability & Portability
- Green IT
Classifying Cloud Service Abstractions

Given

-- public cloud services operational opacity
-- fewer open source packages available for setting up one’s own private ‘cloud’,

the key DSSA driven cloud service abstractions are:

• Domain Specific Application services abstraction
• Platform Runtime Collective services abstraction
• Runtime Collective services abstraction
• Resource services abstraction
• Fabric services abstraction

--- Encompasses Functionality and API from Grid DSSA

Work in progress: Study of several applications – structural, service component interactions, service abstraction interactions for each of the conventional cloud offerings: IaaS, PaaS and SaaS.
Domain Specific Software Architectures models for Cloud Service Abstractions

IaaS
- User Application
- Runtime Collective Service Abstractions
- Resources Service Abstractions
- Fabric Service Abstractions

PaaS
- User Application
- Platform Runtime Collective Service Abstractions
- Resources Service Abstractions
- Fabric Service Abstractions

SaaS
- User Application
- Domain Specific Application Service Abstractions
- Runtime Collective Service Abstractions
- Resources Service Abstractions
- Fabric Service Abstractions
Leveraging the Cloud DSSA – The Best Practices for Hybrid Clouds

Key Challenges in taking an existing application into the Cloud Hybrid mode:

- Rearchitect, Redesign, Reimplement as necessary
- Issues: Interoperability, Portability, Security and Variable Pricing

Hybrid Cloud Migration and Deployments options for an application

Private Data Center & Private Cloud

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<tr>
<th>Sequential</th>
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<th>PaaS</th>
<th>SaaS</th>
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Public Cloud Offerings

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Thank you!!

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