Topic: **Cloud Computing Architecture**

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Paper survey

• **CCOA: Cloud Computing Open Architecture**
  2009 IEEE International Conference on Web Services

• **Service-Oriented Cloud Computing Architecture**
  2010 Seventh International Conference on Information Technology

• **Next Generation Cloud Computing Architecture**
  Enabling real-time dynamism for shared distributed physical infrastructure
  2010 Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises
CCOA : Cloud Computing Open Architecture

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Outline

- Introduction
- CCOA: 7 principles
- Case Studies of CCOA
- Related Work and Discussions
- Conclusions
Introduction

• Cloud Computing provides environments to enable resource sharing in terms of scalable infrastructures, middleware and application development platforms, and value-added business applications.
  — Infrastructure resources
  — Software resources
  — Application resources
  — Business processes
Introduction

• Two key enabling technologies:
  • **SOA (Service-Oriented Architecture)**
    – It is the evolution of a system or software architecture for addressing componentization, reusability, extensibility, and flexibility.
  • **Virtualization technology**
    – Handle how images of the operating systems, middleware, and applications are pro-created and allocated to the right physical machines.
CCOA : 7 principles

1. Integrated Ecosystem Management for Cloud
2. Virtualization for Cloud Infrastructure
3. Service-Orientation for Common Reusable Services
4. Extensible Provisioning and Subscription for Cloud
5. Configurable Enablement for Cloud Offerings
6. Unified Information Representation and Exchange Framework
7. Cloud Quality and Governance
7 Principles

1. Integrated Ecosystem Management for Cloud
   — It includes all involved services and solutions vendors, partners, and end users to provide or consumer shared resources.

2. Virtualization for Cloud Infrastructure
   — The Cloud IT Infrastructure Management module covers software image management, hardware virtualization, and legacy application packaging.

3. Service-Orientation for Common Reusable Services
   — Cloud Horizontal and Vertical Business.
7 Principles

4. Extensible Provisioning and Subscription for Cloud
   — Handle service providers provisioning process and service consumers’ subscription process.

5. Configurable Enablement for Cloud Offerings
   — IaaS, PaaS, SaaS, BPaaS

6. Unified Information Representation and Exchange Framework
   — The messages exchanged among cloud clients, partners and vendors.
7 Principles

7. Cloud Quality and Governance

— It is responsible for the identification and definition of quality indicators for Cloud Computing environment
— A set of normative guidance to govern the design, deployment, operation, and management of the cloud offerings.
Cloud Computing Open Architecture Overview Diagram
Case Studies of CCOA

• Infrastructure Cloud
  — Build a **private cloud** to offer service requesters a pay-to-use model to provide servers with a selected set of reinstalled software packages.

• Business Cloud
  — Employ a **public cloud** to demonstrate the usage of CCOA to enable business cloud offerings.
Instantiate CCOA for an Infrastructure Cloud

• **The Cloud Ecosystem (Module 1)**
  — Cloud Ecosystem Management (1A)
  — Cloud Vendor Dashboard (1B)
  — Cloud Partner Dashboard (1C)
  — Cloud Client Dashboard (1D)

• **The Virtualization module (Module 2)**
  — Including a large number of servers, data centers, and supporting software packages such as WebSphere Application Server (WAS), DB2 database, and LDAP.
Figures

Cloud Vendor Dashboard

Cloud Client Dashboard
Instantiate CCOA for an Infrastructure Cloud

• **The Service-Orientation module (Module 3)**
  — Horizontal business services.

• **The Cloud Core module (Module 4)**
  — Service provisioning (ServiceP), Service de-provisioning (ServiceDeP), and contract change including contract extension and contract termination.

• **The Cloud Offering module (Module 5)**
  — Offering management service & Server provisioning offering
Instantiate CCOA for an Infrastructure Cloud

• The Cloud Information Architecture module (Module 6)
  — Define data structures for subscription orders, contracts, SLAs, project information, and business scenarios.

• The Cloud Quality and Governance module (Module 7)
  — Monitoring Service, license management service.

• The overall productivity, reusability, cost –effectiveness are reflected in the design of the Cloud solution architecture based on CCOA’s seven principles.
Business Cloud

Cloud Client Dashboard
(Amazon’s AMK Portal, CPB Portal)

Cloud Offerings: Business Solutions
(Copyright Detection Service of Cloud Publishing Business)

Cloud Provisioning Service
Cloud Subscription Service

Cloud Horizontal Business Services
Cloud Vertical Business

Cloud IT Infrastructure Management

Cloud Vendor Dashboard

Cloud Ecosystem

Cloud Information Architecture
Cloud Quality and Governance
Cloud Ecosystem Management

Virtualization: Hardware and Software:

Mainframe
Cloud Core Infrastructure

Data Center
Servers
Related Work and Discussions

• Issues
  – Profiling framework
  – Provisioning and Subscription processes
  – Batch requests handling and monitoring

• Two major costs
  – Maintenance service fee
  – Energy consumption cost
Conclusions

• The Cloud Computing Open Architecture (CCOA) based on seven architectural principles and ten architectural modules, by integrating the power of service-oriented architecture (SOA) and virtualization technology of hardware and software.

• The case studies and analysis have shown that the proposed CCOA is an extensible and configurable architecture.
Service-Oriented Cloud Computing Architecture

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Outline

• Introduction
• A Hierarchical View of Cloud Computing
• Issues with Current Clouds
• Service-Oriented Cloud Computing Architecture
Introduction

• Attempts to establish the connections between SOA and cloud computing issues.
• Proposes a Service Oriented Cloud Computing Architecture.
A Hierarchical View of Cloud Computing

- **Data Centers**: provides the hardware the clouds run on
- **IaaS**: virtualizes computing power, storage and network connectivity of the data centers
- **PaaS**: provides a set of services
- **SaaS**: provides applications as services on demand
Issues with Current Clouds

- Users are often tied with one cloud provider
- Computing components are tightly coupled
- Lack of SLA supports
- Lack of Multi-tenancy supports
  1. Resource sharing
  2. Security isolation
  3. Customization
- Lack of Flexibility for User Interface
Service Oriented Cloud Computing

[Diagram showing the Service Oriented Cloud Computing (SOCCA) architecture with various layers and components, including workflow templates, service registries, storage brokers, computing brokers, cloud ontology mapping layers, and virtual images in different clouds.]
Multi-tenancy Architecture

• Multiple Application Instance
  better isolation among different tenants

• Single Application Instance
  not scale as well as the latter

• Single Application Instance and Multiple Service Instances
Consumer-Centric Service-Oriented Architecture

Figure 1: CCSOA Architecture
CCSOA

1. An application builder develops an application template
2. The application template is registered
3. Provider subscribed to the application registry
4. Automatic matching between the requested and registered application templates.
5. Find an application template
6. Submits it to an application template
7. Service broker will notify the application builder
8. Builder test and evaluate the service
9. Service into the target application.
Global Software Enterprise

Figure 1. GSE broker architecture
Conclusions

• It proposed a service-oriented cloud computing architecture
• Support easy application migration from one cloud to another and service redeployment to different clouds
• Promote an open platform on which open standards
Next generation Cloud Computing Architecture

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Outline

• Introduction
• Variety of virtualization
• Systems Management Infrastructure
• PROPOSED ARCHITECTURE MODEL
• PROOF OF CONCEPT
Introduction

- Computer can no longer be thought of in terms of the physical enclosure
- Cloud ideally comprises a pool of physical compute resources
Server Operating Systems and Virtualization

- Server virtualization is the spark that is now driving the transformation of the IT infrastructure from the traditional server-centric computing architecture to a network-centric.

- Capacity utilization of servers can be increased

- Power consumption can be dramatically reduced
yet to full potential of virtualization

• Traditional server-centric operating systems were not designed to manage shared distributed resources.

• Current hypervisors do not provide adequate separation between application management and physical resource management.

• Server virtualization does not yet enable sharing of distributed resources.
Storage Networks & Virtualization

• Use Fibre Channel (FC) protocol and Fibre Channel-based Storage Area Networks (SAN) which provided high speed storage connectivity.
Network Virtualization

• Almost become necessary to eliminate the mess of cables.

• Needed to multiple HBAs and NICs for each application with a single high speed Ethernet connection and a virtual switch.
Systems Management Infrastructure

- Present day management systems are not cut out to enable the real-time dynamic infrastructure needed for cloud computing.

- Human system administrators do not lend themselves to enabling real-time dynamism
- Policy-based management is not really automation
- Virtualization compounds management complexity
PROPOSED ARCHITECTURE MODEL

• The next generation architecture for cloud computing must completely *decouple* physical resources management from virtual resource management.

• Provide the capability to *mediate* between applications and resources in real-time.
Next Generation Cloud Computing Infrastructure
Cloud Computing Infrastructure

• Infrastructure Service Fabric:
  Distributed Services Mediation:
  — This is a FCAPS based
  Virtual Resource Mediation Layer:
  — enhance the throughput and capacity

• Distributed Services Assurance Platform:
  — creation of FCAPS-managed virtual servers
Cloud Computing Infrastructure

- Distributed Services Delivery Platform: workflow engine that executes the application

- Distributed Services Creation Platform: provides the tools that developers will use to create applications defined as collection of services

- Legacy Integration Services Mediation: provides integration and support for existing or legacy application
PROOF OF CONCEPT

• Resource provisioning based on an application Profile
• FCAPS-based dynamic service mediation
Conclusion

• Describe the truly dynamic cloud computing infrastructure.
• It can be organized on demand into a dynamic logical entity.
Question

• On CCOA’s seven principles, which principle includes all involved services and solutions vendors, partners, and clients to provide or consumer shared resources?
  (A) Virtualization for Cloud Infrastructure
  (B) Configurable Enablement for Cloud Offerings
  (C) Integrated Ecosystem Management for Cloud
  (D) Service-Orientation for Common Reusable Services
  (E) Cloud Quality and Governance
Answer

(A) Virtualization for Cloud Infrastructure
(B) Configurable Enablement for Cloud Offerings
(C) Integrated Ecosystem Management for Cloud
(D) Service-Orientation for Common Reusable Services
(E) Cloud Quality and Governance