跨雲端運算之服務管理
Service Management for Future Inter-Cloud Computing Systems

周立德 教授

國立中央大學資訊工程學系

URL: *http://www.csie.ncu.edu.tw/~cld*

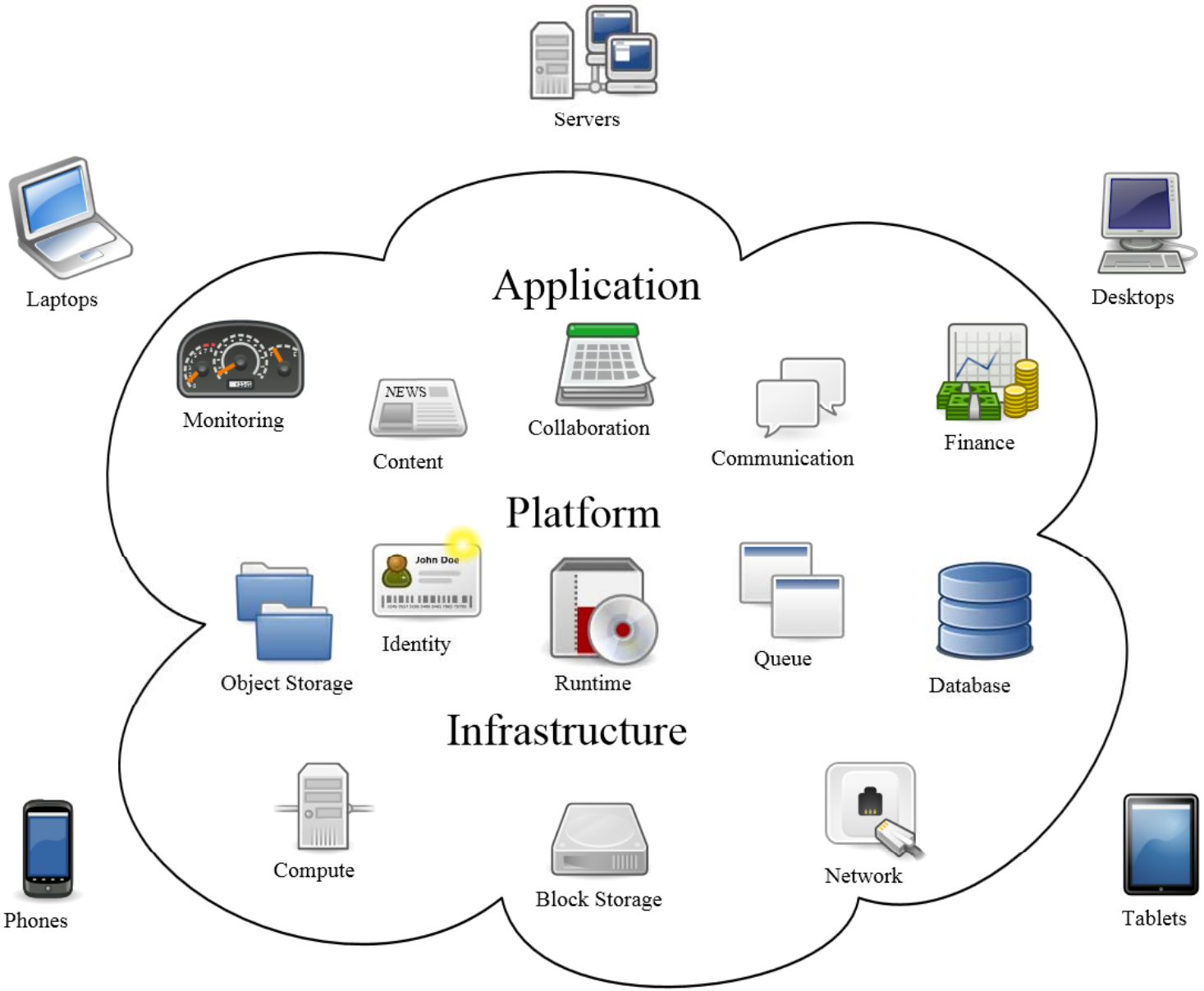
Email: *cld@csie.ncu.edu.tw*

Outline

- Cloud Computing
- Service Management
- Service Level Agreement
- Interoperability of Cloud Computing
- P2P-Based Inter-Cloud Mechanism
- NetFPGA-Based Service Gateway
- Conclusions

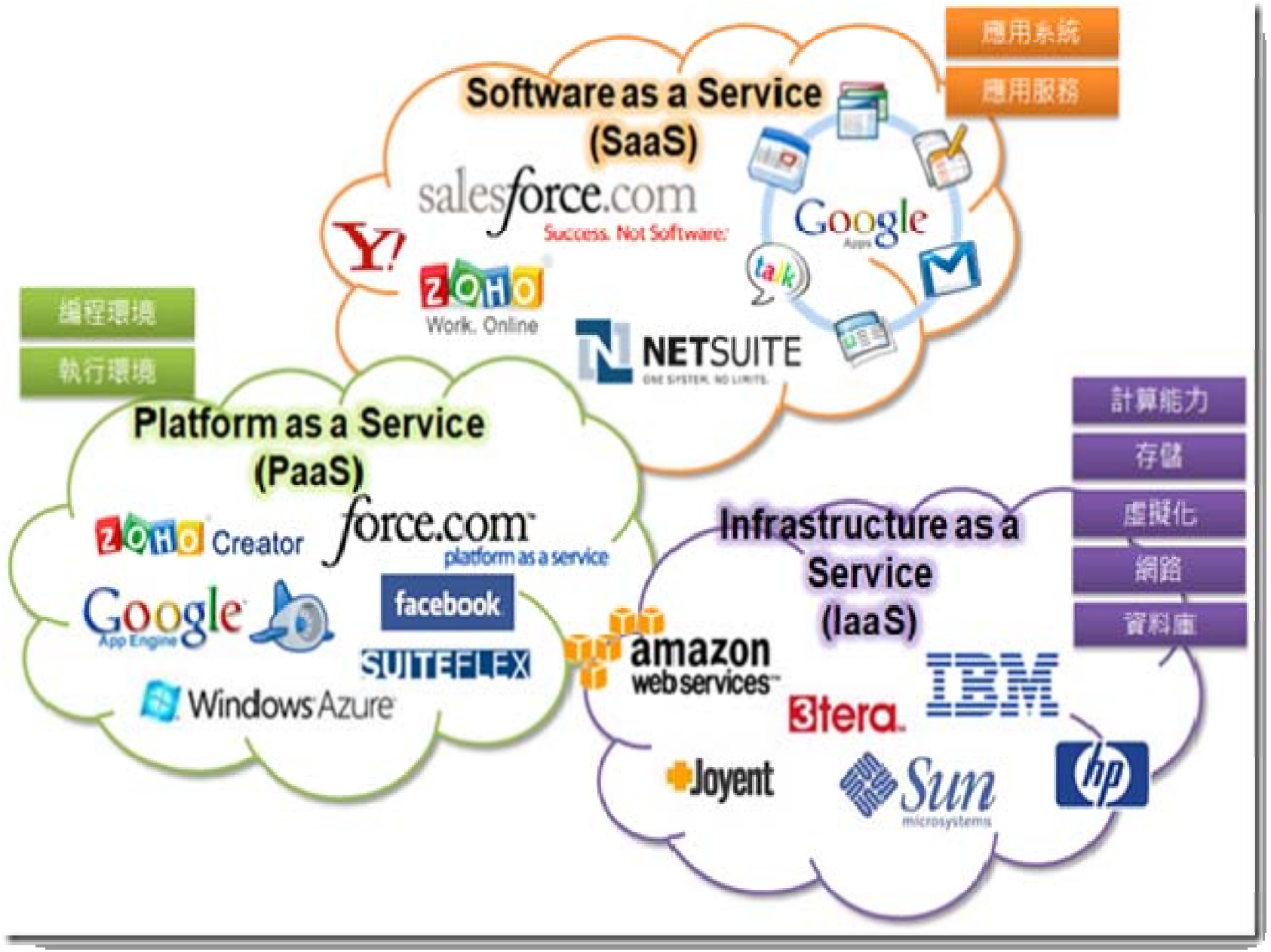
Cloud Computing

- Advantages of cloud computing :
  - Virtualization
  - Scalability and elasticity
  - Reliability
  - Reduced cost
  - Pay as you go
- XaaS (Everything as a Service)
  - Provide services at three different levels in SaaS, PaaS and IaaS
- Public cloud, Private cloud and Hybrid



Cloud Computing

Source: Wiki



Source: Trend Micro

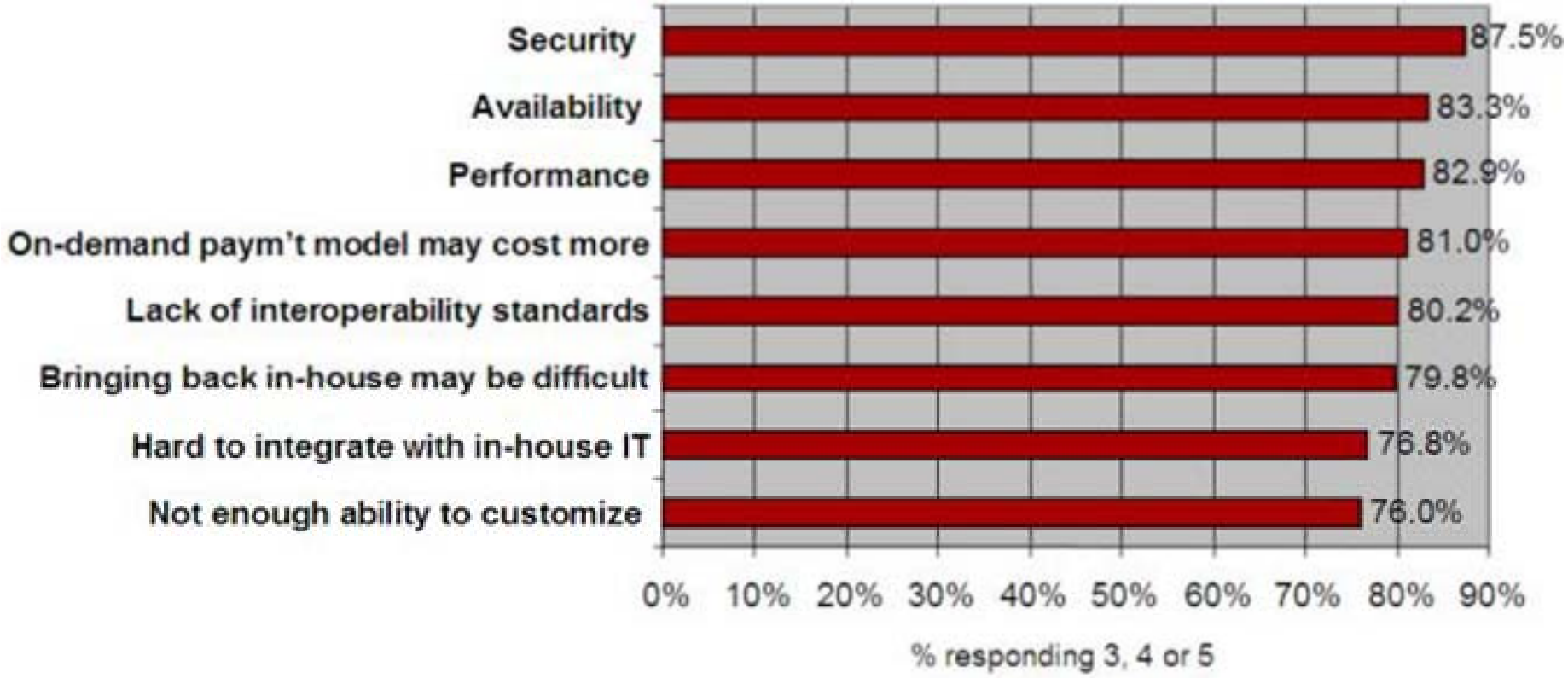
Ten Obstacles to Cloud Computing

	Obstacle
1	Availability of Service
2	Data Lock-In
3	Data Confidentiality and Auditability
4	Data Transfer Bottlenecks
5	Performance Unpredictability
6	Scalable Storage
7	Bugs in Large Distributed Systems
8	Scaling Quickly
9	Reputation Fate Sharing
10	Software Licensing

Source: "Above the Clouds: A Berkeley View of Cloud Computing," *Tech. Report No. UCB/EECS-2009-28*

Q: Rate the challenges/issues of the 'cloud'/on-demand model

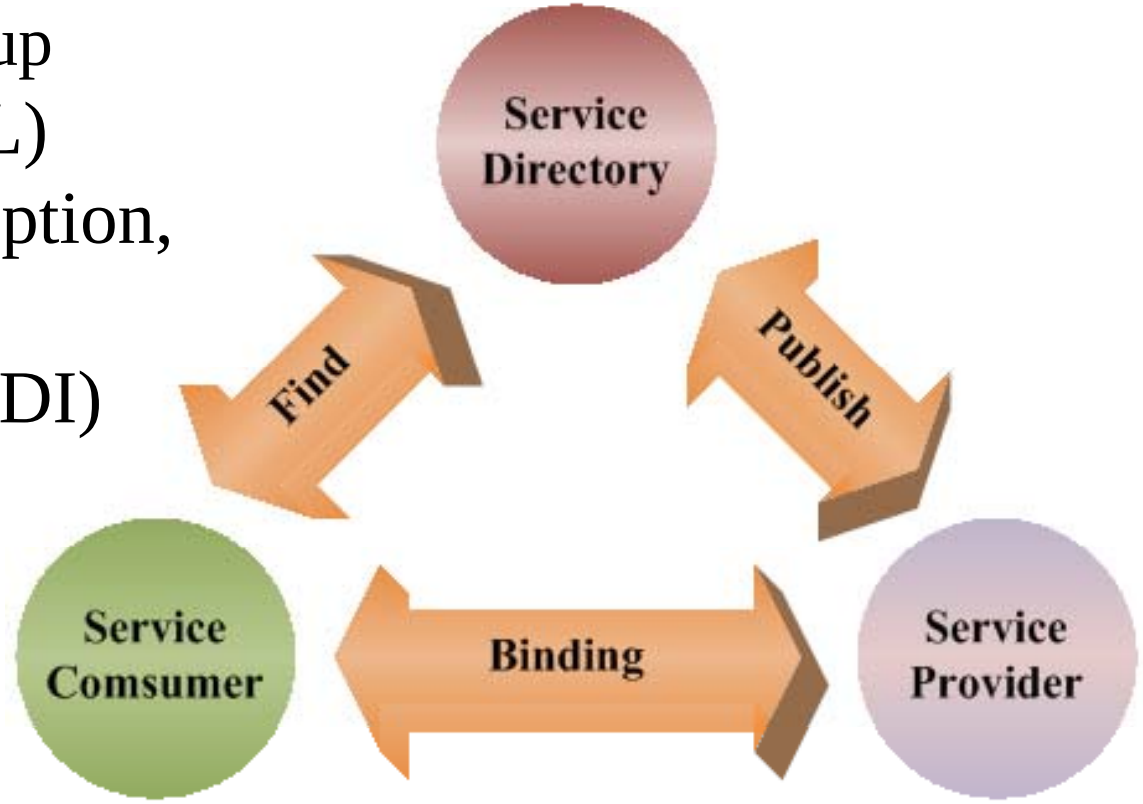
(Scale: 1 = Not at all concerned 5 = Very concerned)

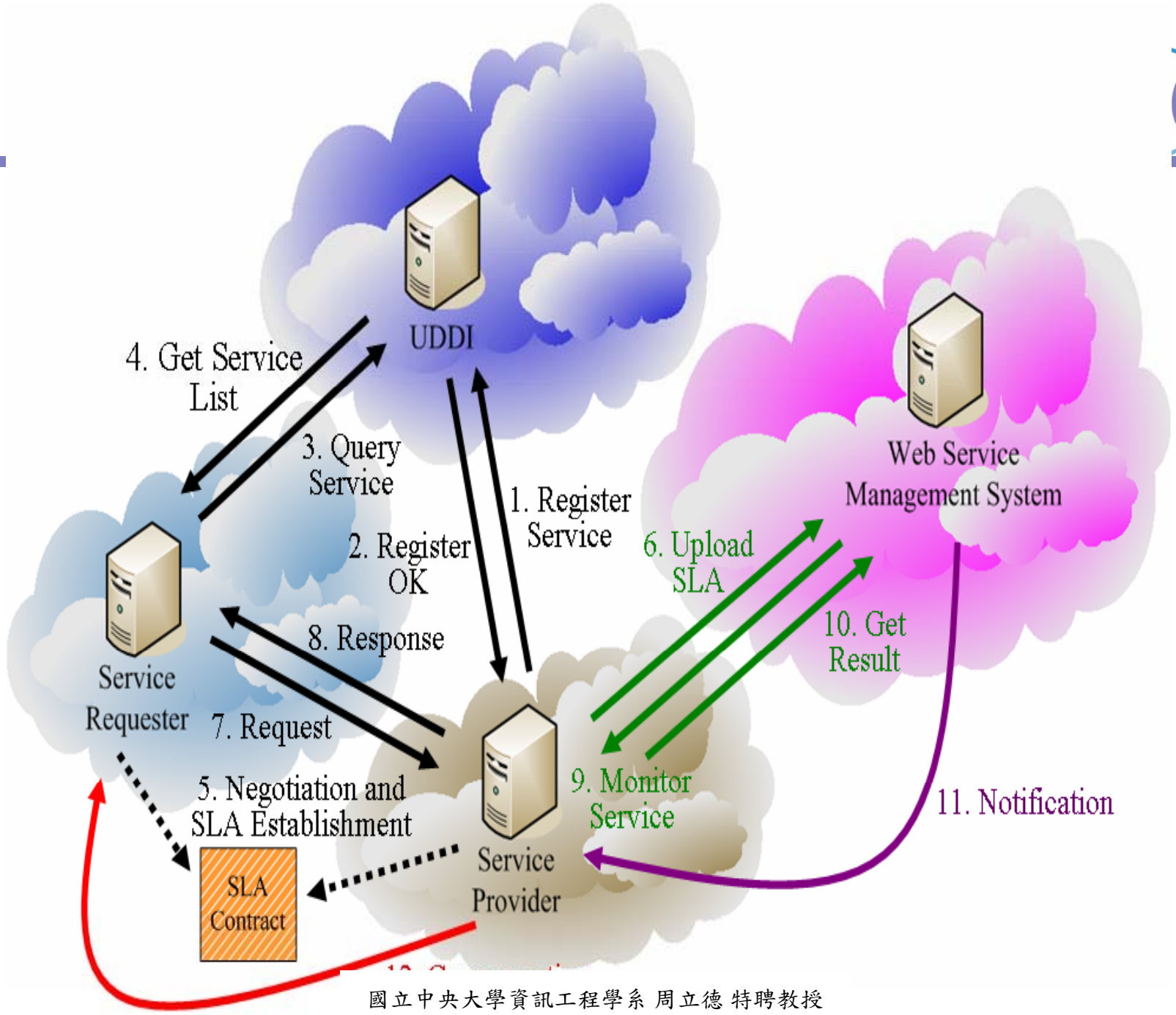


Source: IDC Enterprise Panel, 3Q09, n = 263

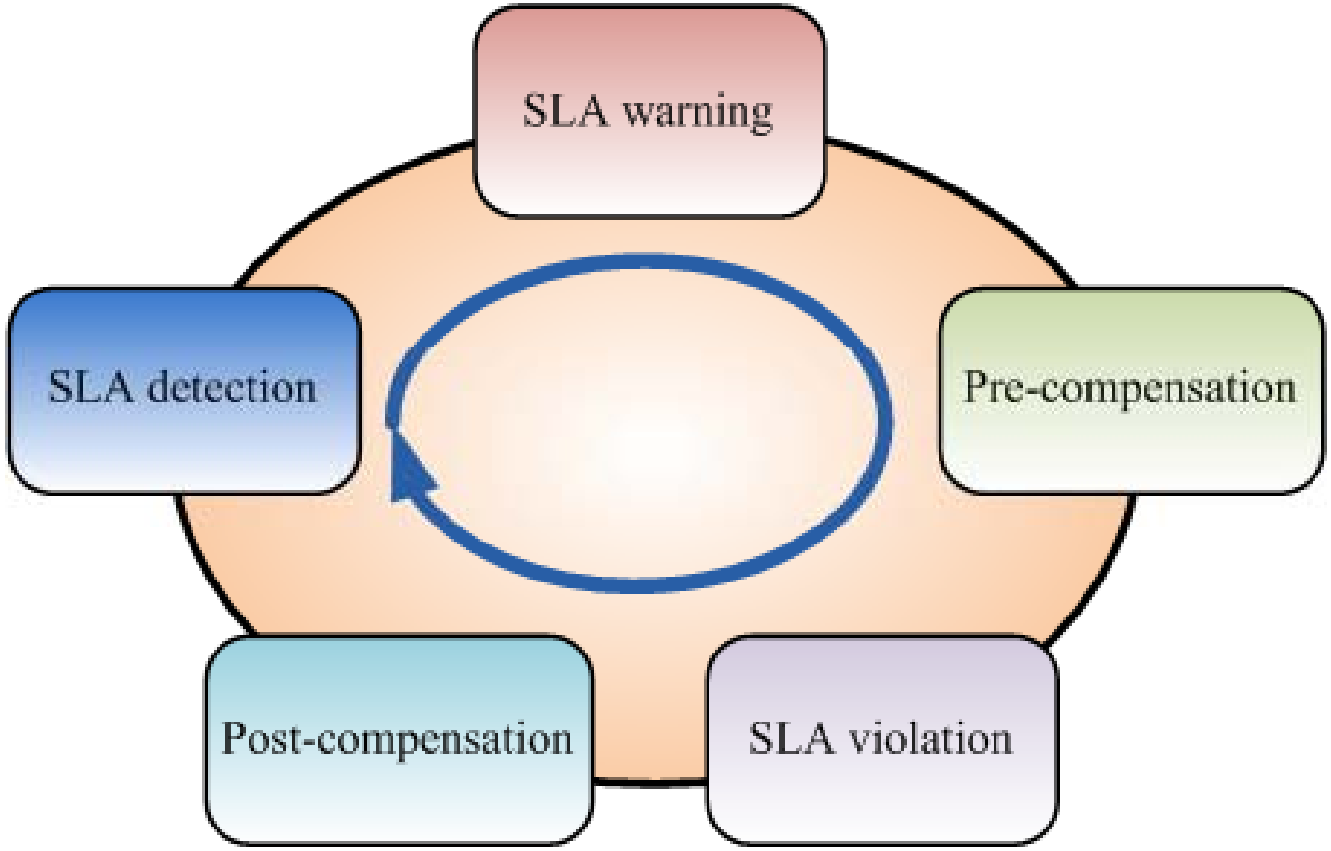
Service Management

- Service-Oriented Architecture (SOA)
  - Simple Object Access Protocol (SOAP)
  - Web Service Description Language (WSDL)
  - eXtensible Markup Language (XML)
  - Universal Description, Discovery, and Integration (UDDI)




UDDI
4. Get Service List
3. Query Service
1. Register Service
2. Register OK
Web Service Management System
6. Upload SLA
10. Get Result
8. Response
Service Requester
7. Request
9. Monitor Service
11. Notification
5. Negotiation and SLA Establishment
SLA Contract
Service Provider

Service Management (cont.)



Service Management (cont.)

- Cloud service management
  - How to manage these services and guarantee the quality of service (QoS) of Cloud services?
  - Reliability, performance and service capabilities of Cloud services resources determine the QoS of upper-level application system

Cloud Service Management

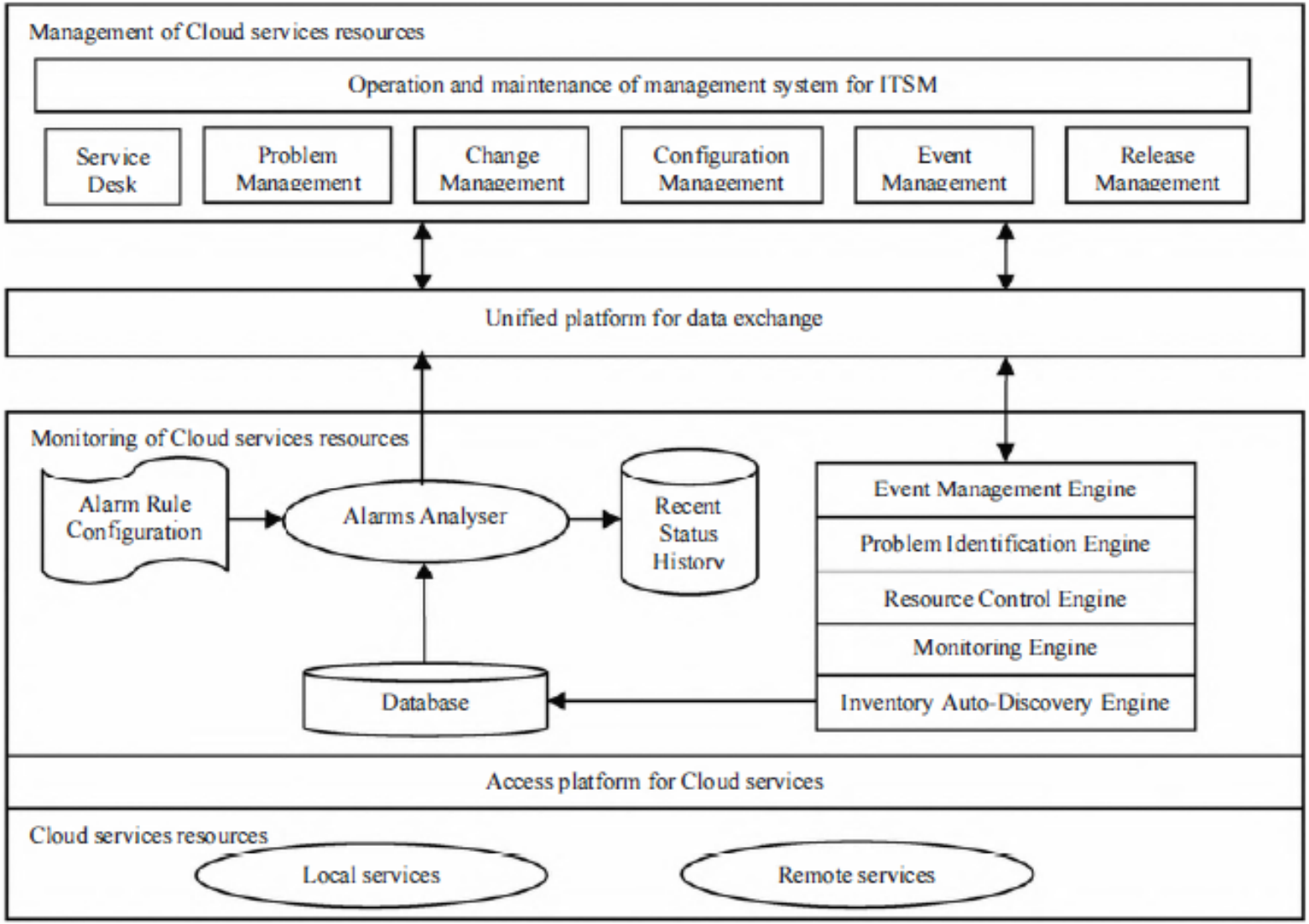


Figure 1. Architecture model of management and monitoring on Cloud services resources.

Source: "An architecture model of management and monitoring on Cloud services resources,"ICACTE 2010

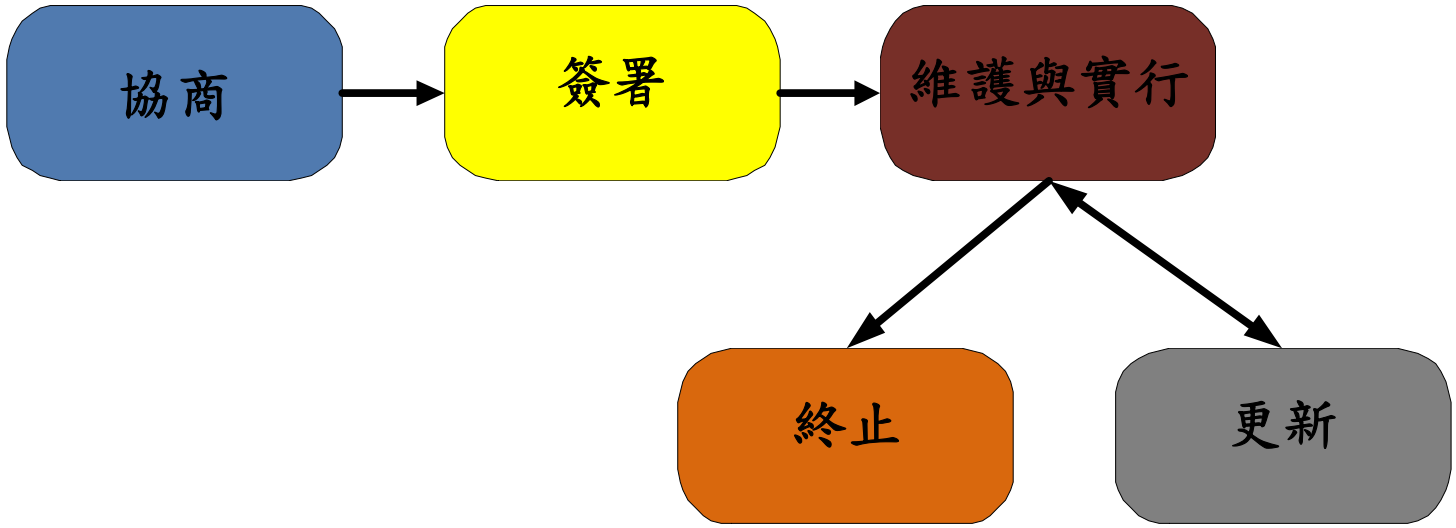
Service Level Agreement (SLA)

- 重要服務中斷時顧客的損失
  - 經紀業務 $200K per minute
  - 製造業 $50K - $100K per minute
  - 銷售業 $20K - $100K per minute
- 一種雙方(客戶–業者 或 業者–業者)所協商出的一種契約
- 服務提供者及顧客之間雙方同意的約定，裡面定義了服務目標及雙方的預期及責任

Source: http://www.wareprise.com/

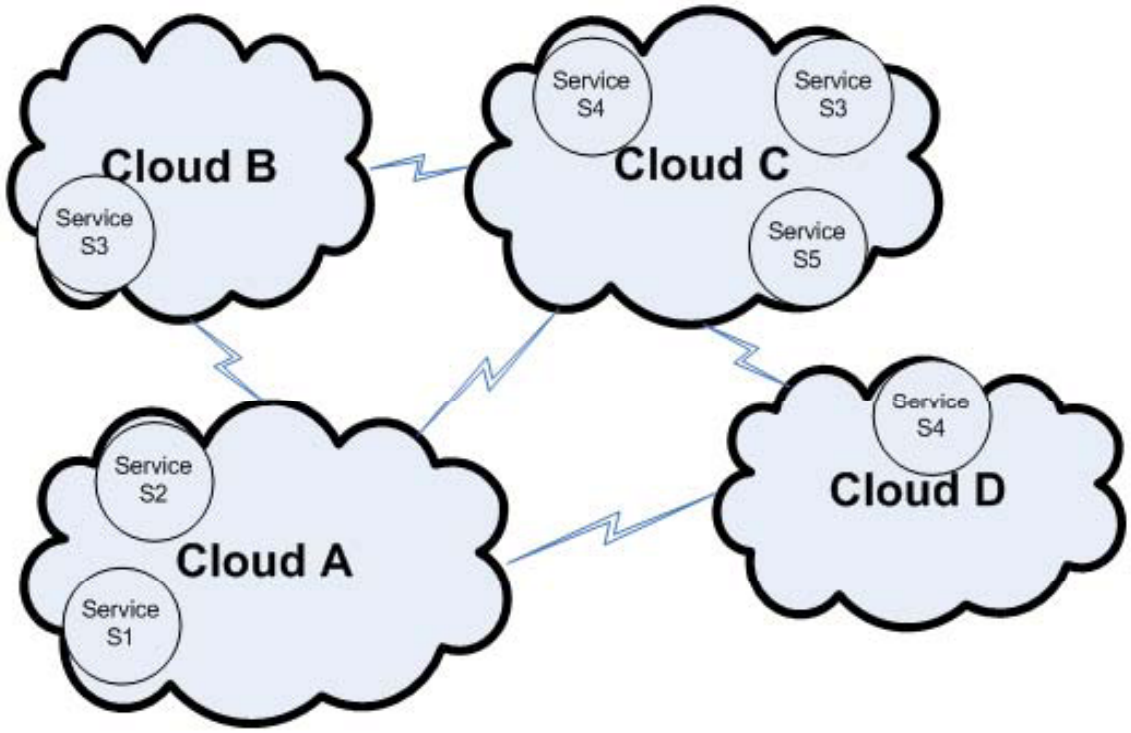
SLA (cont.)

- SLA 的內容包括
  - 服務內容說明
  - 服務申裝、停用、變更之方式與流程
  - 服務品質參數與指標
  - 服務品質稽核方式
  - 維護方式
  - 服務障礙之申告方式
  - 服務障礙之處理方式
  - 申訴管道及流程
  - 計費方式
  - 罰則



Multiple-Cloud Environment

- The computing cloud services are accessible from anywhere.
- Deployment of business services use multiple clouds.
- The services usually do not have mechanism to monitor business service level performance.



Source: "Policy-based event-driven services-oriented architecture for cloud services operation & management," IEEE ICCC 200

Study Issues

- Interoperability
- Security
- Migration/cloning control
- Standards
- Transparency to enable manageability
- Service quality monitoring

Study Issues (cont.)

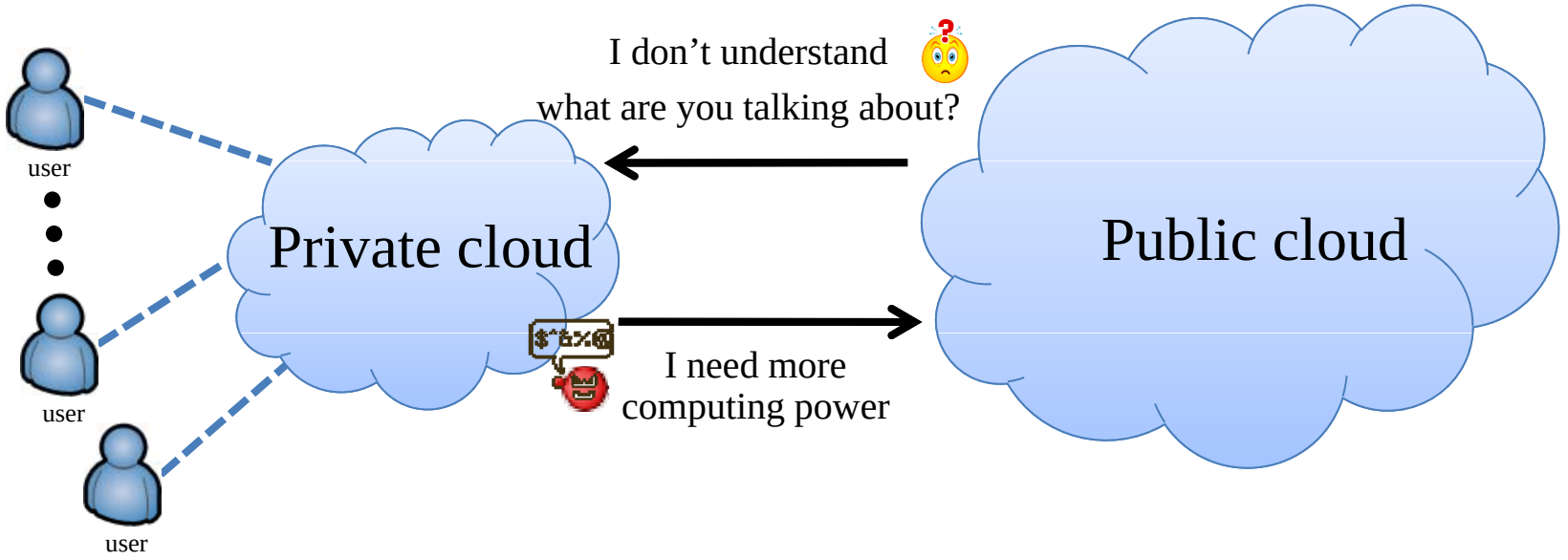
- Cloud service publication
- Cloud service discovery
- Cloud resource allocation
- Inter-cloud service sharing
- Inter-cloud service dispatch
- Inter-cloud service management

Interoperability of Cloud Computing

- Users can exchange resources or data from different public/private cloud by some mechanisms
- Importance of Interoperability
  - Users will have more resources to choose from different cloud services providers
  - Users or enterprise's private cloud can find more resources when they suddenly need more computing power or data
- Two steps to solute the Interoperability problem
  - Find the resource
  - Transfer , exchange data or image migration

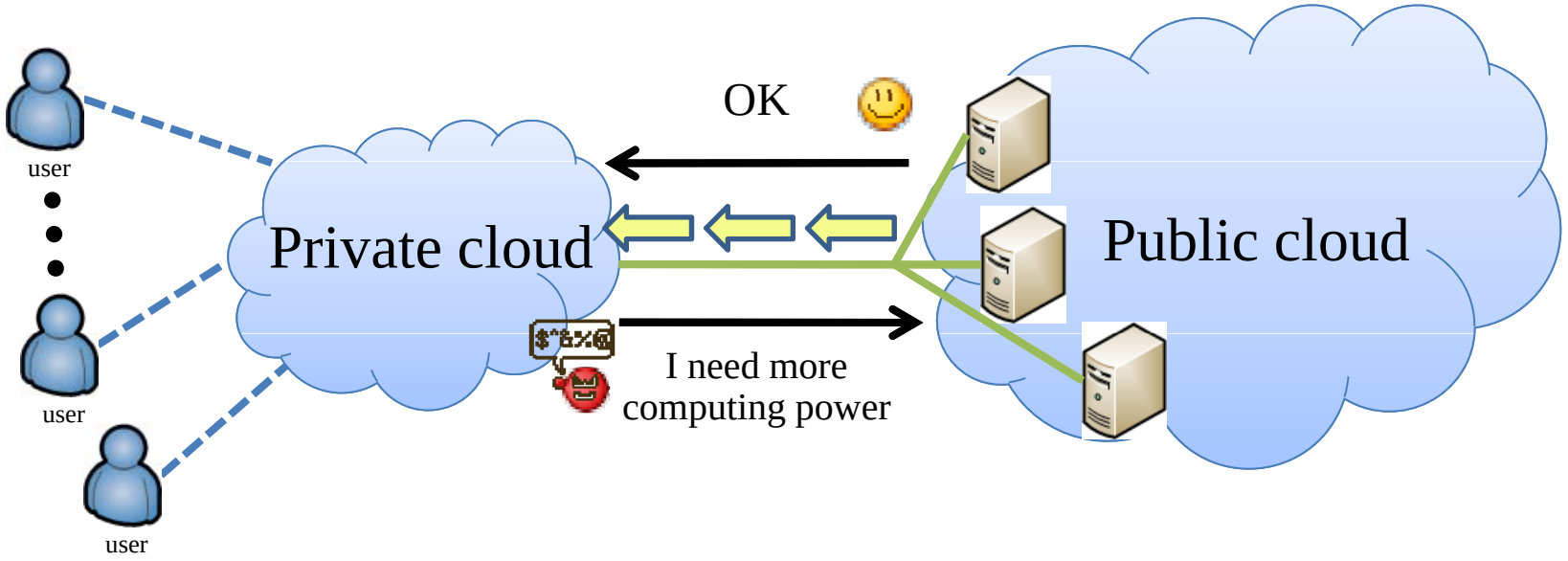
Interoperability of Cloud Computing

- Portability and interoperability are also difficult between different public/private clouds
- It lacks some query mechanisms to search different public/private clouds' resources in application layer

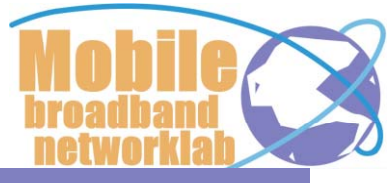


Interoperability of Cloud Computing (cont.)

- Solve interoperability problems in cloud computing
- Maintain the consistency of the virtual and physical network in cloud environment



Organizations for Cloud Interoperability



- Open Stack
  - http://www.openstack.org/

- Open Data Center Alliance (ODCA)
  - http://www.opendatacenteralliance.org/

- Open Cloud Computing Interface (OCCI)
  - http://occi-wg.org/

Solutions of Interoperability

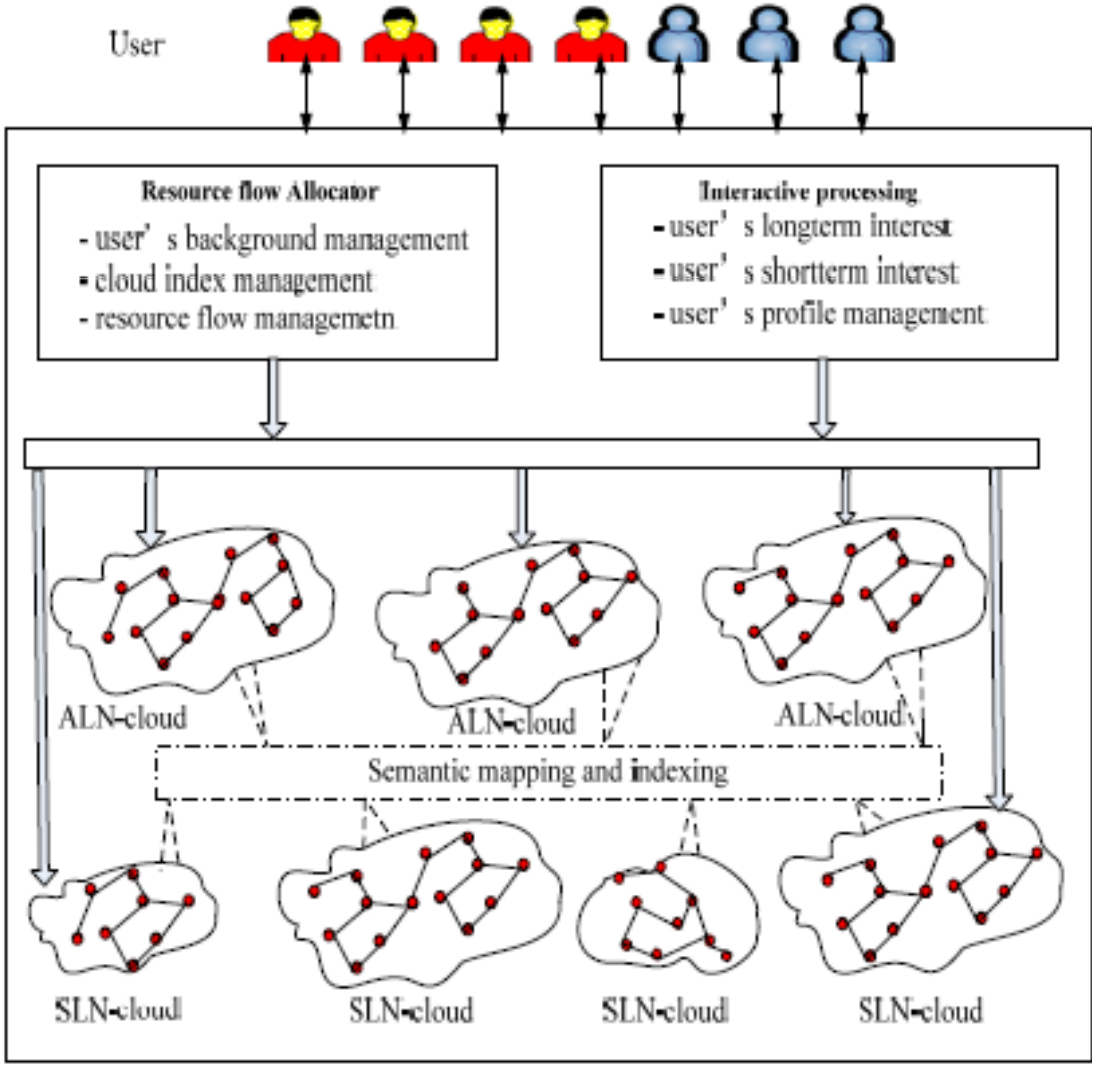
- Interoperability on SaaS
  - Users or cloud service providers query resources to each other by application or mechanism
  - Google app engine URL
  - Peer to Peer
- Interoperability on PaaS
  - Using standard API to communicate with other cloud
  - Microsoft SQL azure
  - Amazon Web Services APIs
  - Open Cloud Computing Interface (Occi)

Solutions of Interoperability (cont.)

- Interoperability on IaaS
  - Using pre-defined communication protocol to achieve computing power or Image migration
  - ODCA Open Virtualization Format (OVF)
  - Amazon Machine Image (AMI)
  - Open Stack

Semantic Cloud based on SLN and ALN

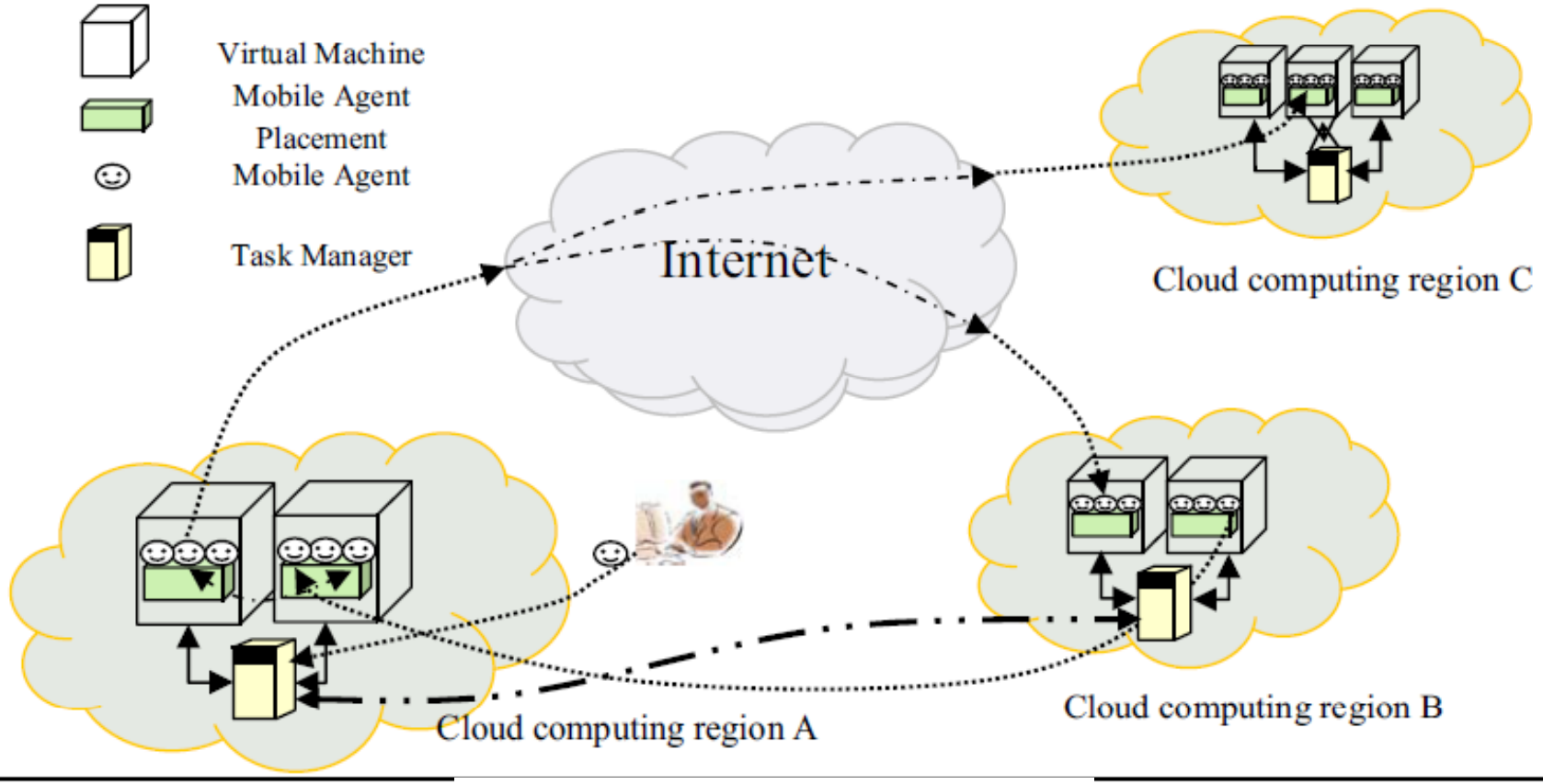
- Provide a semantic layer for cloud computing with:
  - Similarity Link Network (SLN)
  - Association Link Network (ALN)
- Users browse and search resources by similar flows in SLN



Source: 2009 International Conference on Semantics, Knowledge and Grid

Mobile Agent Based Open Cloud Computing Federation

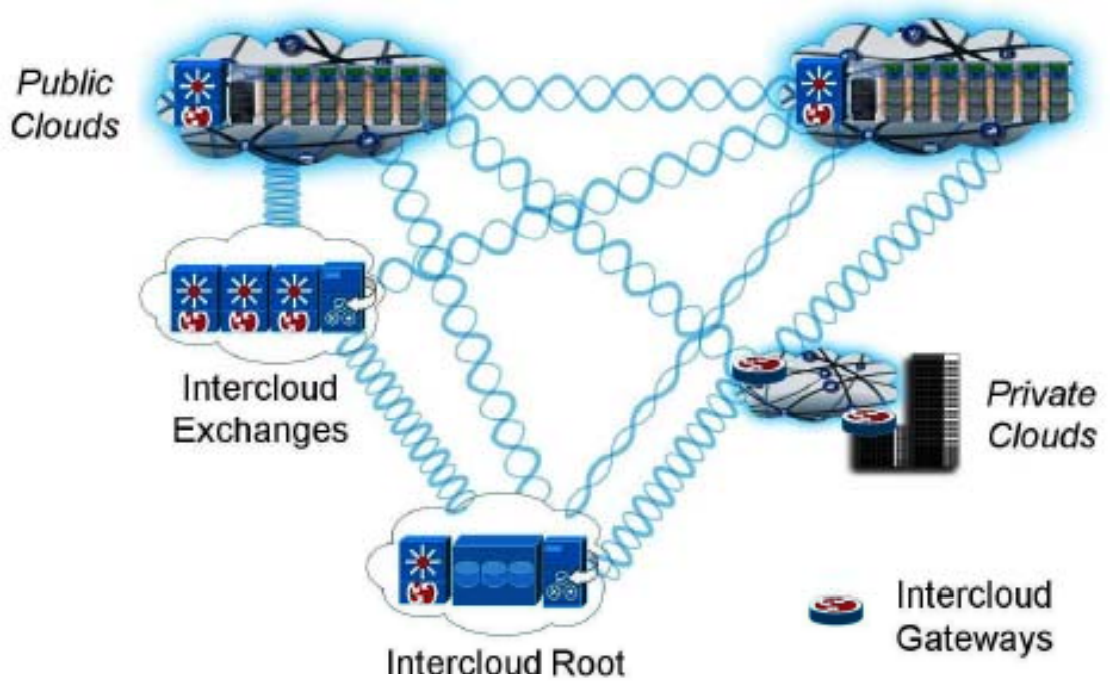
- Realization of Open Cloud Computing Federation Based on Mobile Agent (MABOCCF)



Source: IEEE ICIS 2009

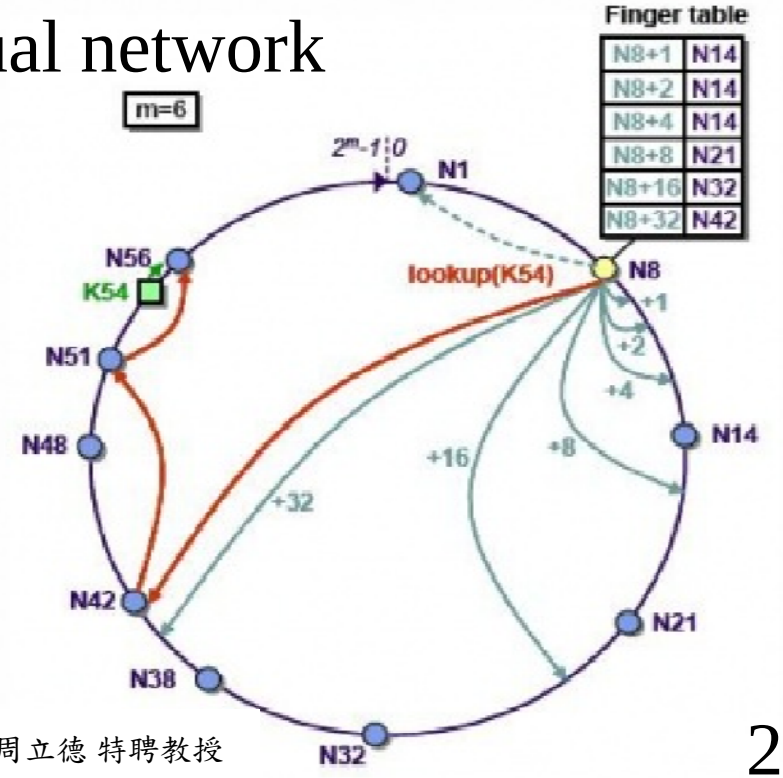
Inter-Cloud Directory and Exchange Protocol

- Solve the Cloud Computing interoperability using XMPP and RDF
  - XMPP: Extensible Messaging and Presence Protocol
  - RDF: Resource Description Framework
- Use RDF to record users' data, and adopt XMPP to exchange information



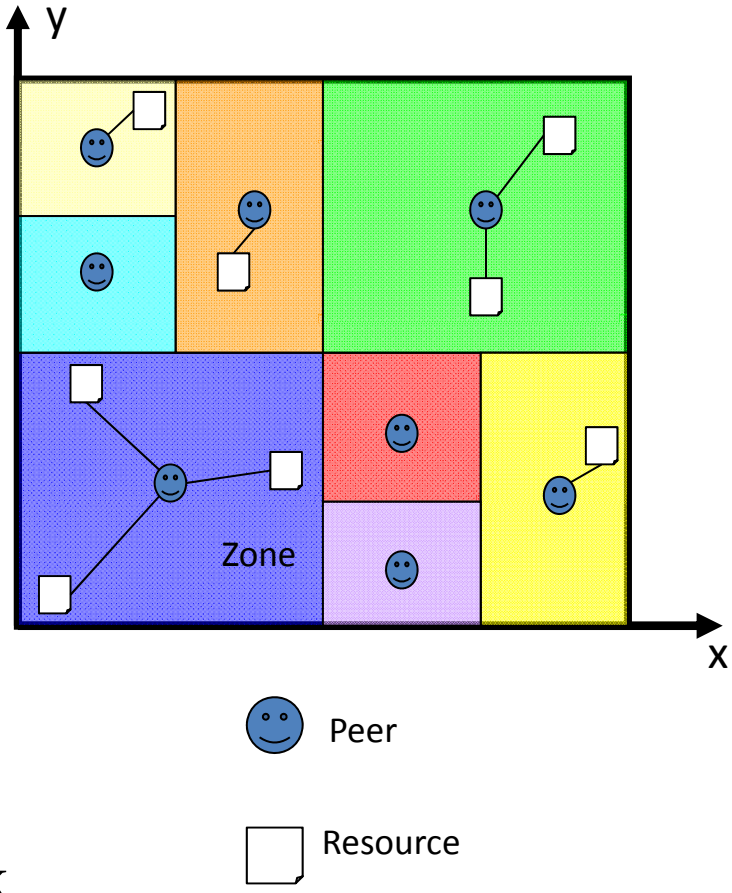
P2P-Based Inter-Cloud Mechanism

- Distributed Hash Table (DHT)
  - DHT is a class of peer-to-peer network that provides a lookup service similar to a hash table
  - Nodes uniformly distributed across *key* space
  - Nodes form an *overlay* virtual network
  - Nodes maintain list of neighbors in routing table
  - Decoupled from physical network topology
  - E.g. : Chord, Pastry, CAN



P2P-Based Inter-Cloud Mechanism (cont.)

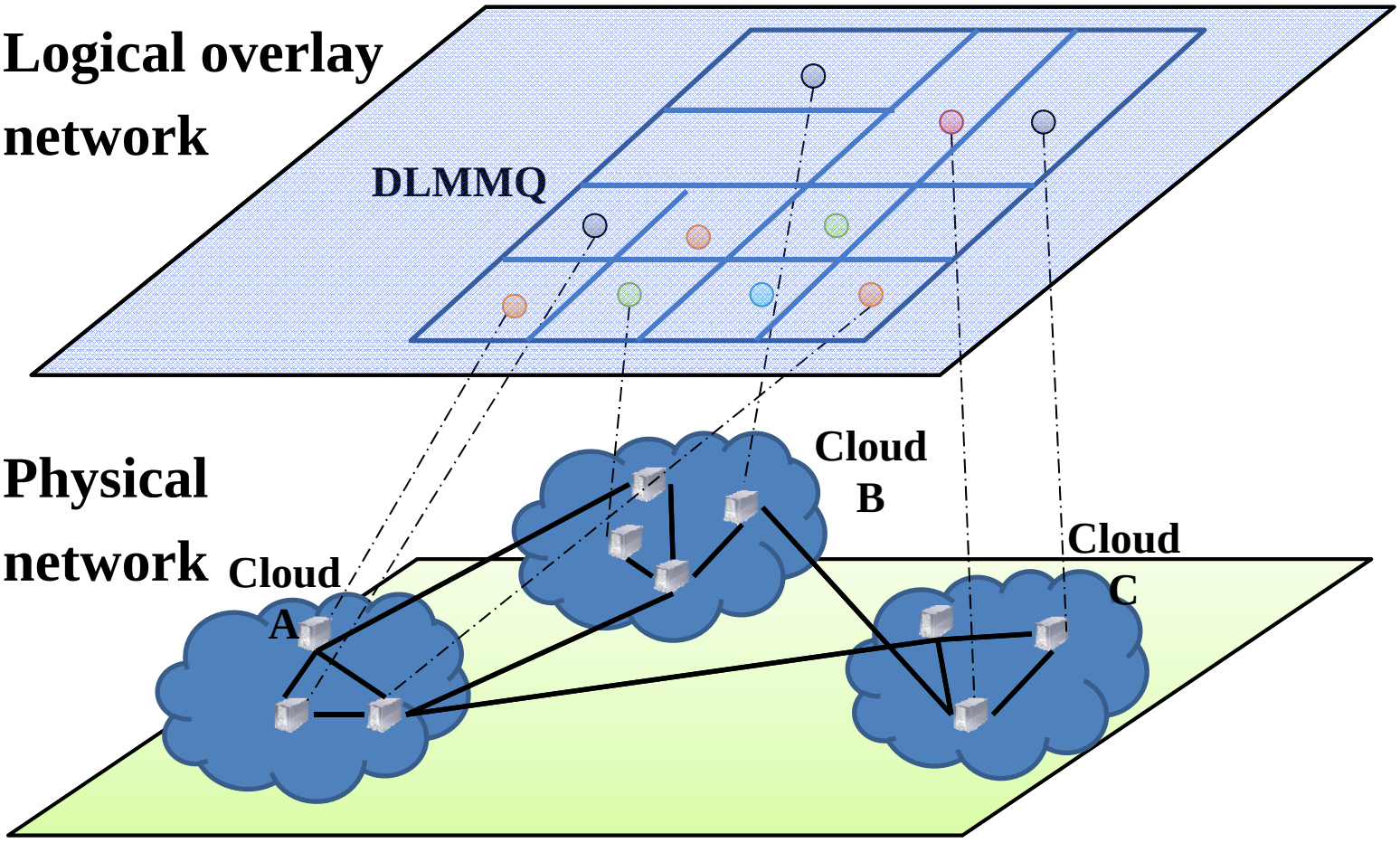
- Content Addressable Network (CAN)
  - Using a d-dimensional virtual space for routing and object location
  - Every peer is responsible for the objects that are hashed into its zone and neighbor information
  - d-dimensional virtual space is partitioned into several zones ,and each of that zone is maintained by a peer
  - Relevant problem between DHT virtual network and physical network in CAN



P2P-Based Inter-Cloud Mechanism (cont.)

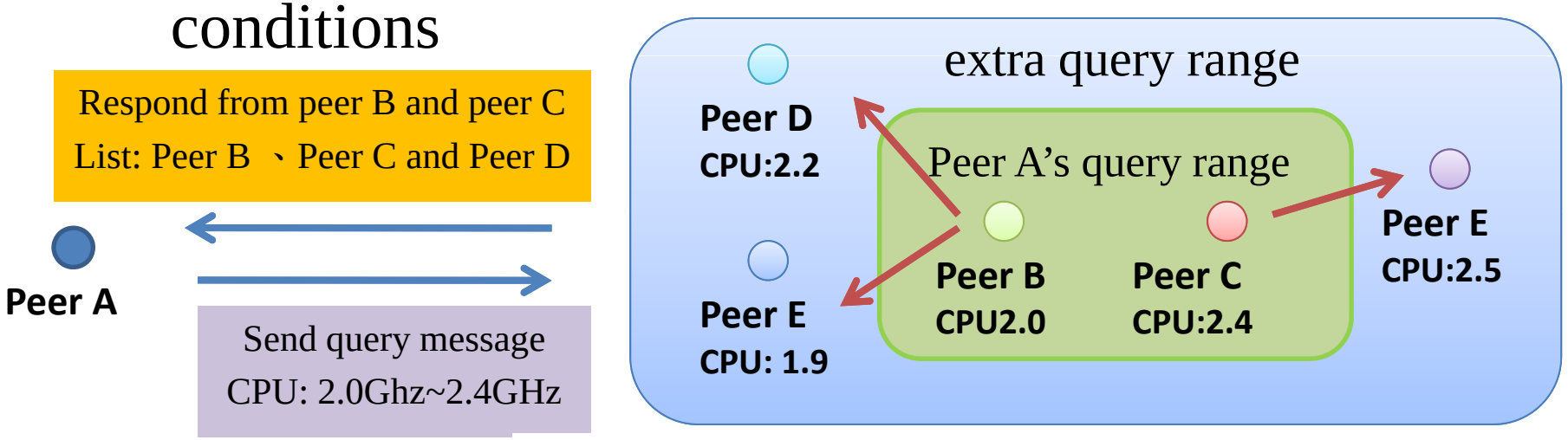
- DHT-based Mechanism for Multi-attribute Range Query (DMMRQ)
  - Location-aware Join Mechanism (LJM)
    - According to Peer's resource and location condition to maps a key, and then hashes into *d*-dimensional victual space
  - Multi-attribute Query Mechanism (MQM)
    - Query some resources with one or more attribute conditions
    - The MQM can not only look for match resource, but also find the nearest resource as possible as it can

P2P-Based Inter-Cloud Mechanism (cont.)



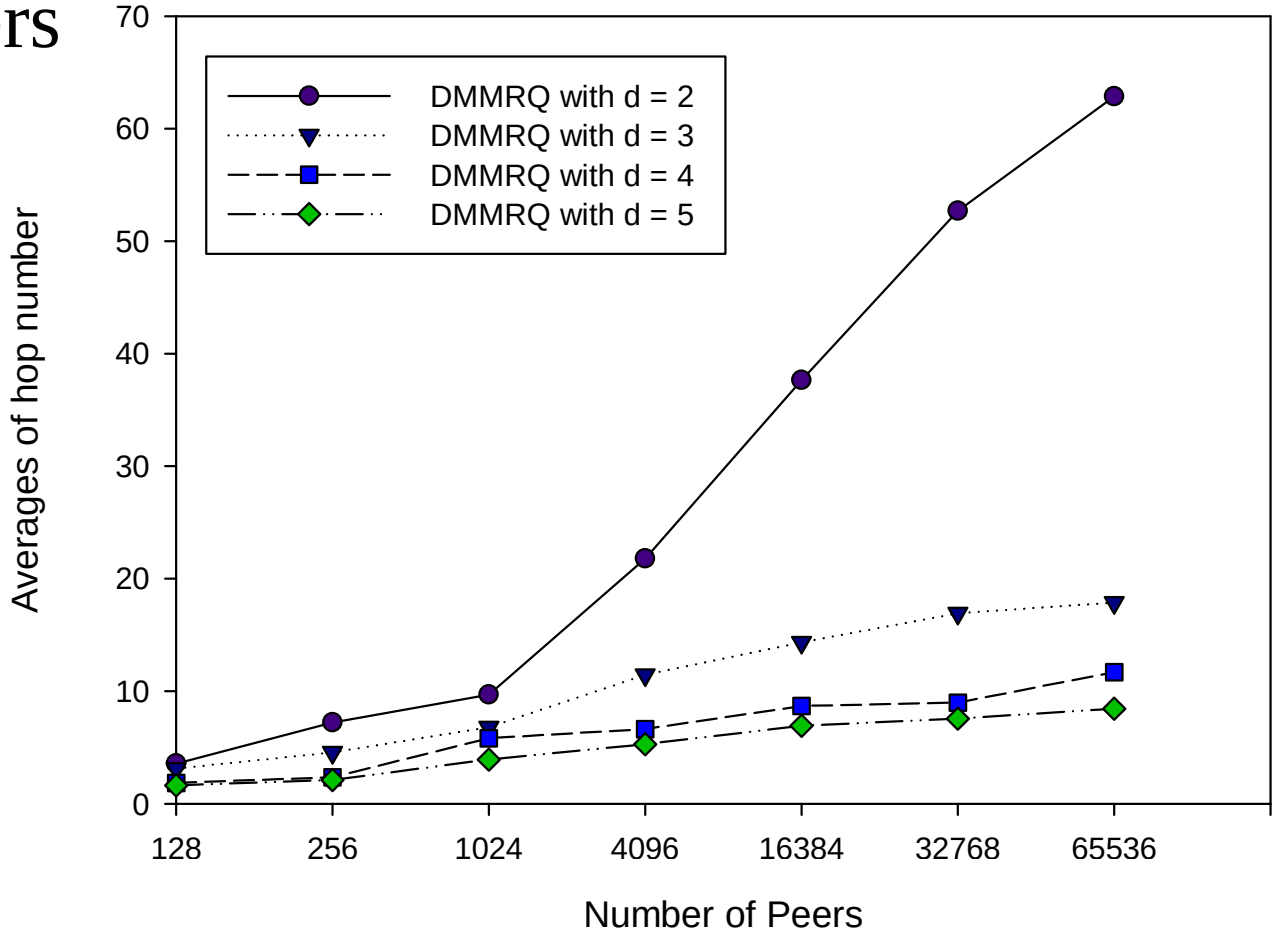
P2P-Based Inter-Cloud Mechanism (cont.)

- Multi-attribute query
  - When a peer searches information in the Cloud
  - Peer not only gets the peer's information about who maintains the area in the range
  - Peer gets the peer's **Neighbor information** and **Virtualization Group** that conform to queries conditions



P2P-Based Inter-Cloud Mechanism (cont.)

- The relationship between dimension and peer numbers



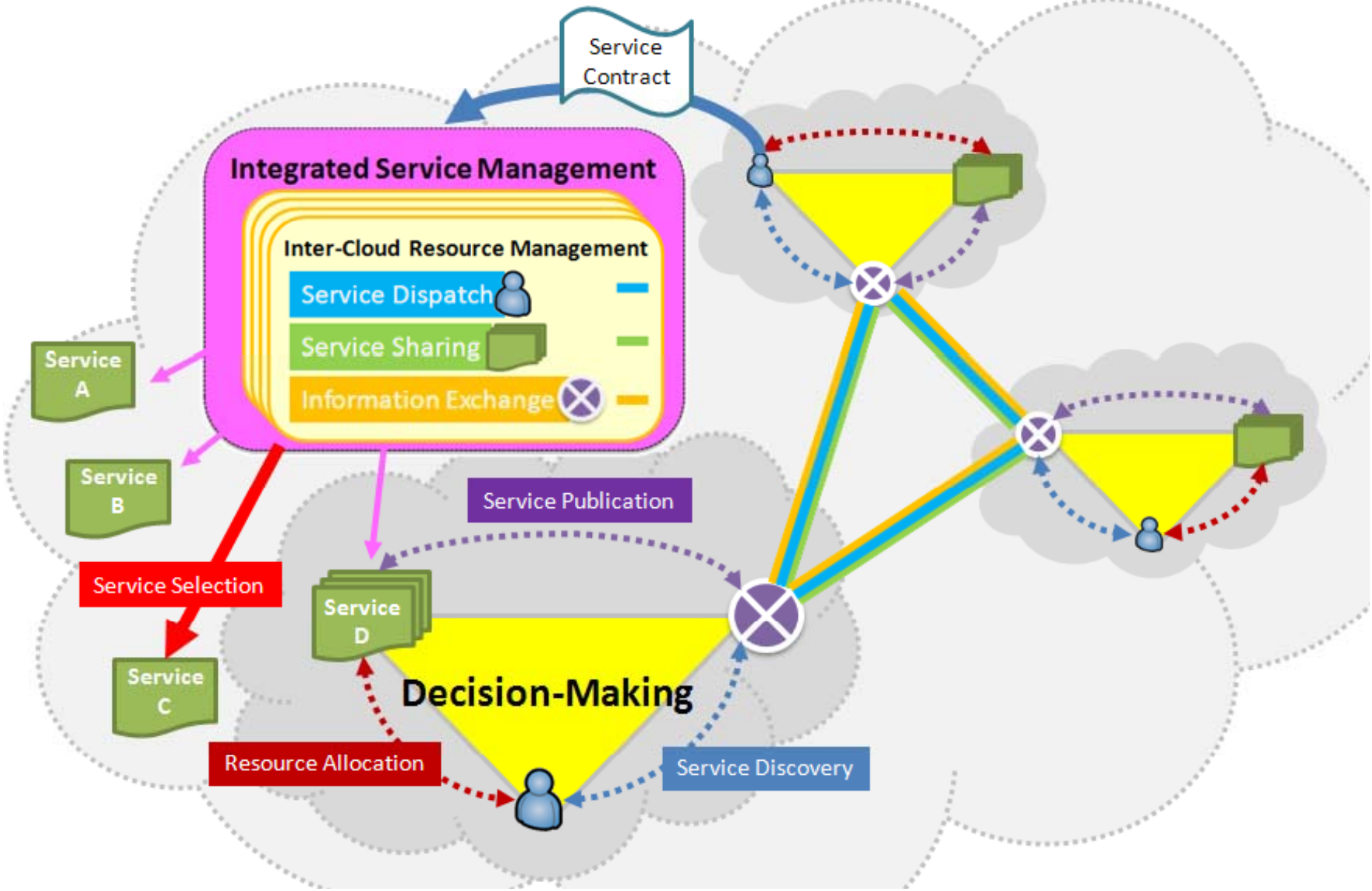
NetFPGA-Based Service Gateway

- NetFPGA
  - A reusable, flexible, opening hardware platform implemented by Stanford University based on FPGA for education
  - More and more projects distributed on the Internet
    - Openflow, RCP router, NIC, etc…
- OpenFlow
  - A software that builds logical network to run experimental protocols
  - OpenFlow connects to controller – NOX
    - Decide which flows to admit
    - Decide the transmission path of packets

NetFPGA-Based Service Gateway (cont.)

- NetFPGA can be adopted to serve as a service gateway for inter-cloud system
  - Feature of network virtualization
  - Improve the SLA achievement on virtual networks
  - Reuse network resources effectively
  - Design a SLA-Oriented mechanism

NetFPGA-Based Service Gateway (cont.)



Conclusions

- Interoperability and service management of cloud computing are getting important.
- P2P-based inter-cloud mechanism is proposed for resource query, multi-attribute range query and locality requirement.
- NetFPGA is a good candidate for service gateway in the multi-cloud environment.
- Political issues for inter-cloud computing should be considered.

Thank You for Your Attention!!

Q & A