

Update on Intercloud Efforts

David Bernstein
Special CTO and Vice President
Software and Applications Division
Americas R&D Center

Agenda

- **What is the Concept of an “Intercloud”**
- **Why is an Intercloud Important, and to Whom**
- **Intercloud Specific Workgroups**
- **Intercloud Architectural Elements**
- **Intercloud Technologies and Research Round Up**

Intercloud Awareness Rises

GovIT: Blog Feed Post

Cloud Federation and the Intercloud

Advances in federation are good news for companies considering a move to the cloud no longer need to be custom

BY ELLEN RUBIN

ARTICLE

JANUARY 25, 2010 09:30 AM EST

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5th International Cloud Ex

Last week's post explored federated enterprises to move workloads and external clouds according to requirements. Advances in federated

companies considering a move to the cloud since they need to be custom projects and applications no longer coupled to a particular cloud.

To follow up, there's been lots of discussion recently about "Intercloud," a direction for cloud computing that ties in with much of our work at Cloud

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TECHNOLOGY BLOG

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We have the internet: now we need the intercloud, says Vint Cerf

With "cloud computing" growing in importance, Google's Vint Cerf thinks it's time to start working on "intercloud" standards and protocols so your data doesn't get trapped in one



The 'Intercloud' and the Future of Computing

DevCentral > Weblogs > Lori MacVittie - Two Different S

Pursuit of Intercloud is Practical not P

posted on Friday, January 08, 2010 3:56 AM

Kicking off the new year (and a new decade) with a lively discussion of interclouds is always a good thing. Fred Cummins over at HP and caught the eye of several of us for whom Intercloud is the year by declaring the concept of Intercloud "not yet

"If this elastic mesh is provided by a single cloud provider, then it is simply a different spin on cloud computing. If it is a mesh of independent cloud providers, sharing workloads, then it is a vision that is not worth concern within the next decade. [emphasis added]"

I'm going to have to disagree with Fred for two reasons. The first is based on the rate of change and innovation in technology in the last decade that certainly points to the next decade being just as disruptive. Consider that in the year 2000, most of the web as it exists today – Web 2.0, APIs, integration, collaboration, video, user-generated content – didn't exist. From a technology perspective virtualization wasn't even a twinkle in the infrastructure world, well, we were just beginning to explore the advantages of moving software solutions to hardware and hadn't fully managed to integrate infrastructure solutions let alone anything else.

The rate of change in technology makes a "decade" in real time more like a century in technology-time, as far as innovation and use of new technology goes. So to say that the vision of Intercloud isn't worth concern for a decade isn't realistic. It is imminently more practical to consider where we want to be in ten years and head in that direction than it is to stand pat and let our options essentially stagnate.

The second reason I'm going to disagree with Fred is on the basis that Intercloud is not an "exclusive or" concept. We

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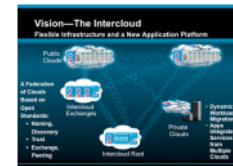
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vorherige News nächste News

07.04.2010, 10:00

Intercloud: Internet der Zukunft wird sichtbar

Wie sieht das Netz der Zukunft aus? Experten glauben: Statt aus einem „Netzwerk der Netzwerke“ wird es aus einer „Cloud von Clouds“ bestehen.



Die im US-Blog [High Scalability](#) zusammengefasste Diskussion basiert auf der Annahme, dass sich unabhängig voneinander existierende Cloud-Umgebungen verbinden wollen – und dass sie künftig nahtlos zusammenarbeiten sollen.

Cisco-Intercloud: Entwurf fürs Internet der Zukunft.

Dies soll so einfach geschehen können wie heute Netzwerke mit dem Internet verknüpft werden können. Die dazu benötigte Technologie bezeichnen die Experten als „Intercloud“: eine verwobene, internationale Cloud aus Cloud-Angeboten.

Fragen zu Datenschutz und Funktionen

Der von vielen als „Vater des Internet“ bezeichnete Vinton Cerf sagt in einem [Beitrag auf dem Google Research Blog](#), die Zeit für die Intercloud sei gekommen. Allerdings gebe es noch viele

Business IT Buzz Blog

Prakash Kannoth

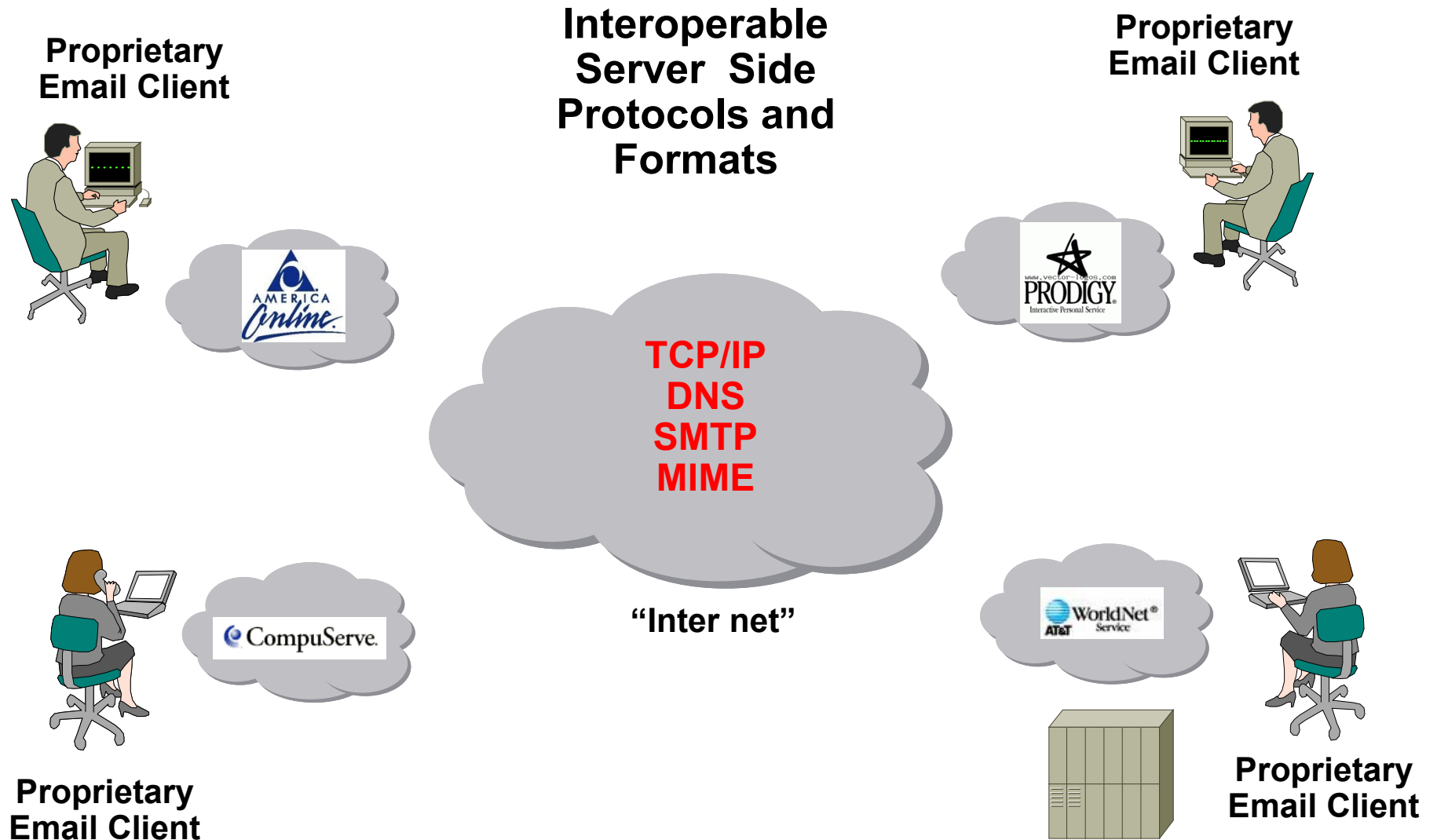
Private Cloud , Public Cloud and Inter-Cloud



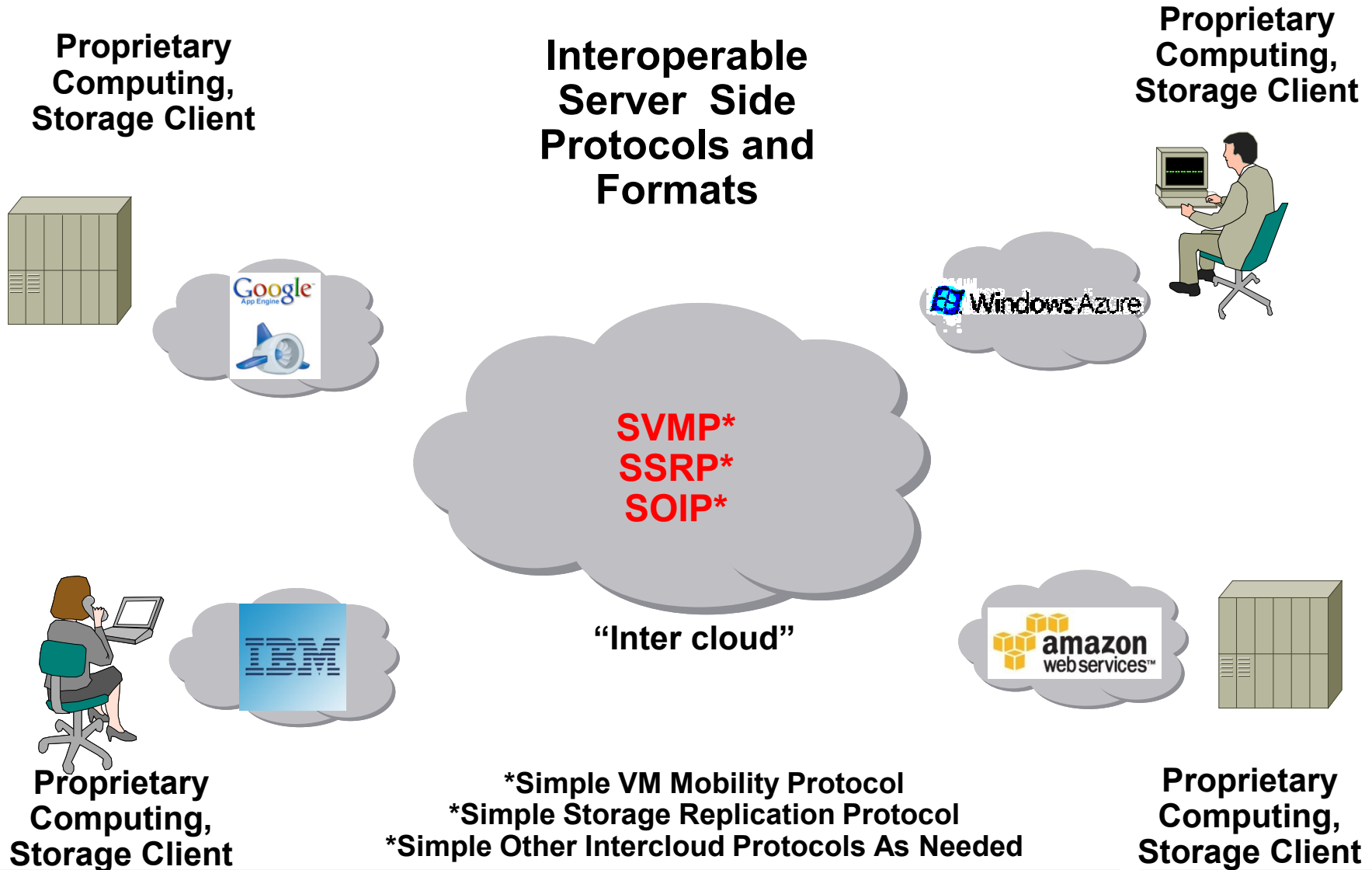
By Prakash Kannoth on April 16, 2009 3:05 PM 2

Lately, my big question for IT professionals is: do you really care about private, public or Inter-Cloud right now? I'm sure you understand what private and public clouds are, so what is Inter-Cloud? Inter-Cloud is a new term coined by Cisco and it's defined by Cisco as "Bringing Cloud Providers together and allowing them to inter connect each other; this creates a Inter-Cloud." Here is a [link](#) to a Cisco video about this vision recorded in December 2008. Recently Cisco started promoting this term and Inter-Cloud Vision to bloggers, analysts and users around last December and early January this year. If you are following [David Smith's blog](#) at Gartner you must have noticed an interesting blog conversation between David and James Houghton. To really understand Cisco's vision you have to read this comment posted by James

Cloud to Cloud, Email for Example – A big breakthrough



We Need A Profound Breakthrough, Again



It Really is a Déjà Vu – But Don't worry, it won't Last



"I'm seeing a possibility of inter-cloud problems mirroring the Internet problems we had thirty or forty years ago,", Vint Cerf, Vice President and Chief Internet Evangelist for Google

Carriers Mobility drive will accelerate adoption of Cloud Computing as a back end

Open Handhelds



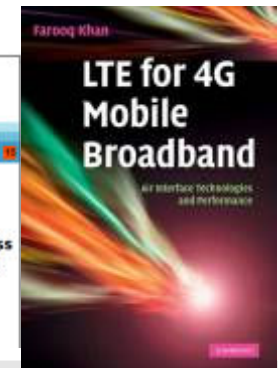
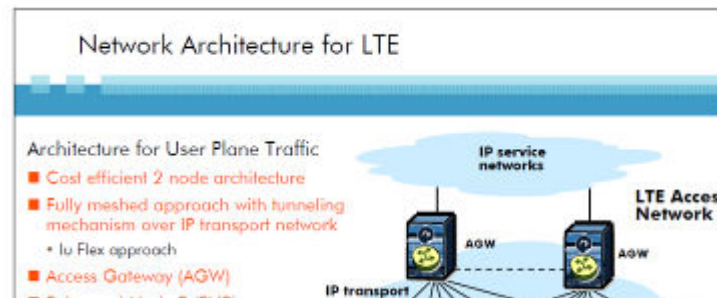
Netbooks



Open Wireless Networks



4G/LTE – All IP network design for Wireless

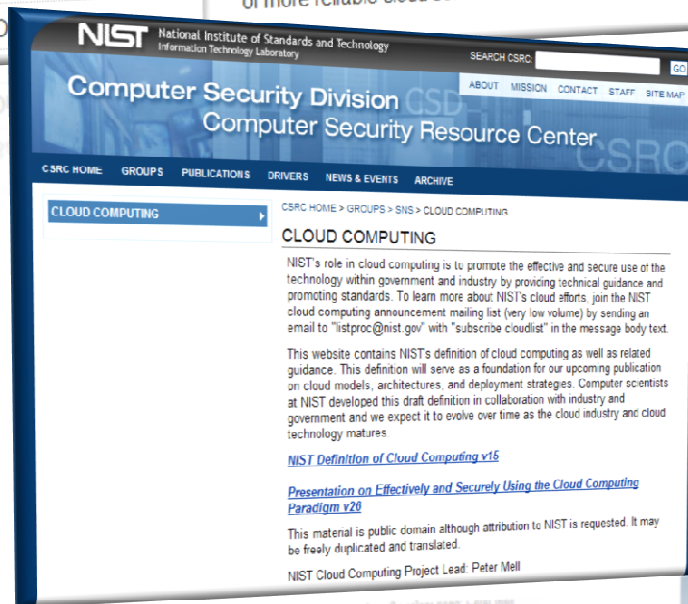
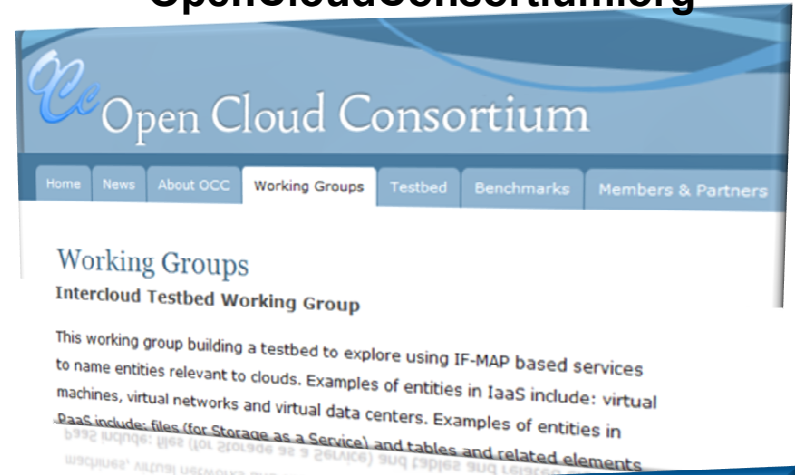


Focused, Intercloud Working Groups

GICTF.org



OpenCloudConsortium.org



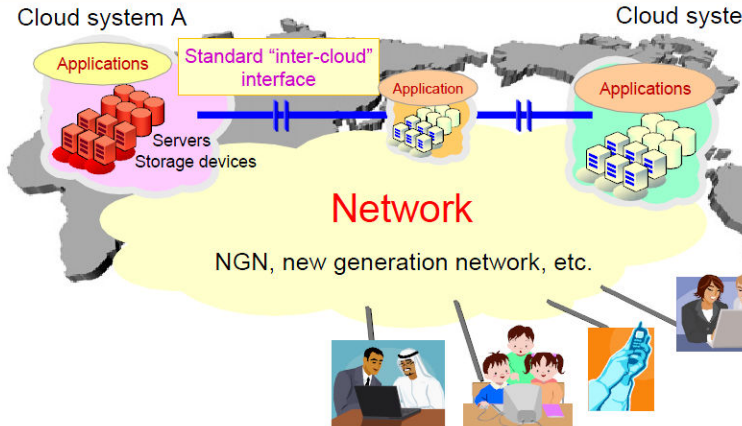
<http://csrc.nist.gov/groups/SNS/cloud-computing/>

[Intercloud.org](http://intercloud.org)

GICTF: A technology forum for the “Inter-cloud” era

Promotes the global standardization of inter-cloud system interfaces through collaboration between academia, government and industry

Established on July 17



Global Inter-Cloud Technology Forum (GICTF)

■ Main activities:

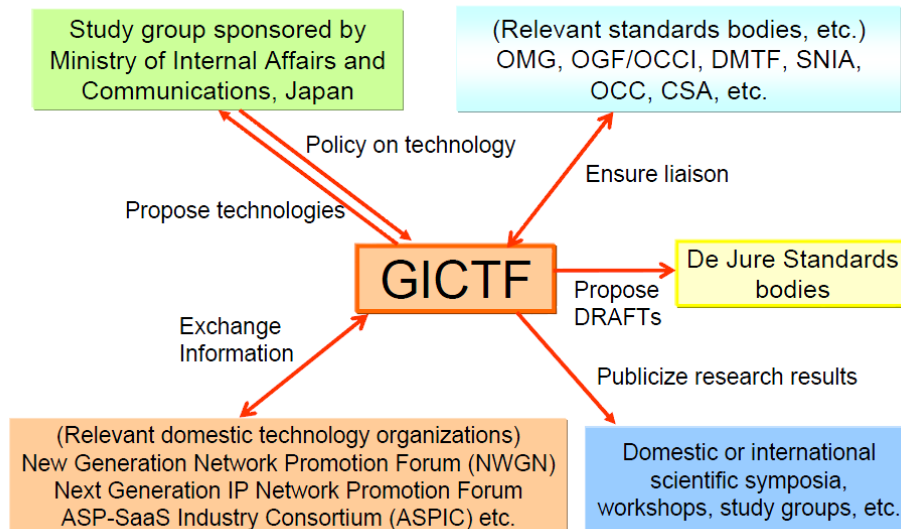
- Identify technical needs for secure cloud federation applicable to e-Government, etc.
- Develop a standard set of specifications for cloud federation, and propose it to relevant overseas standards bodies
- Raise awareness of users

■ Membership (as of November 2009)

- 44 enterprises: NTT, KDDI, NEC, Hitachi, Fujitsu, Toshiba Solutions, IBM, Sun, Oracle, Cisco, RICOH, CTC, and others
- Independent administrative institution, National laboratory
- University professors, etc.

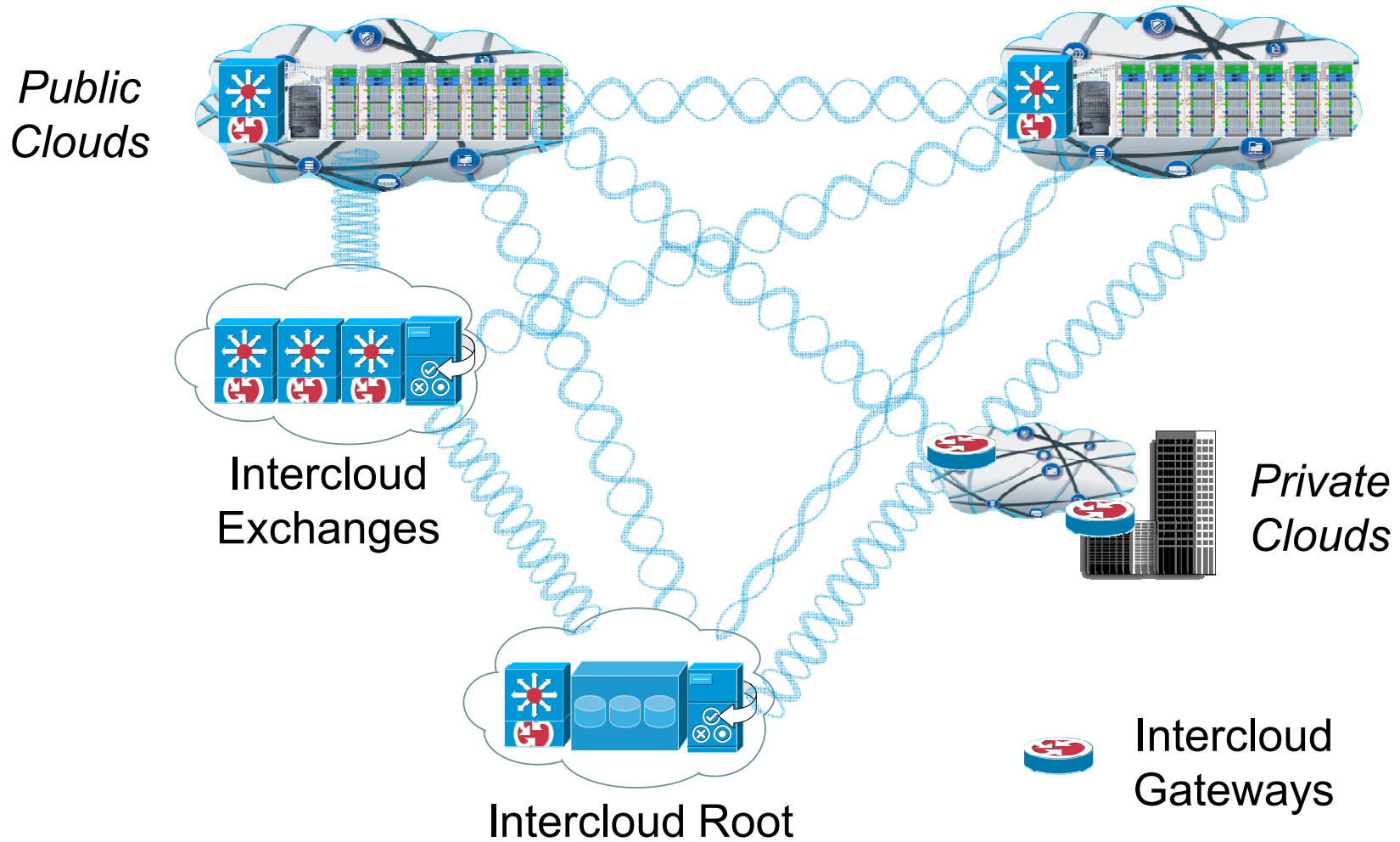
Liaison between GICTF and other related bodies

Ministry of Internal Affairs and Communications of Japan

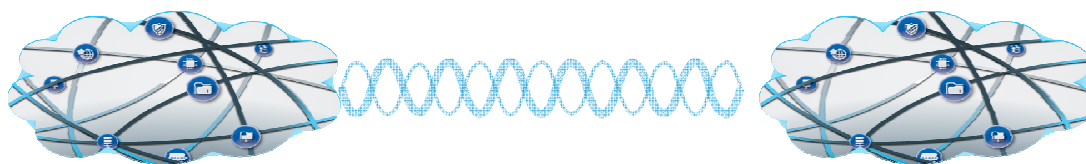


So What is the Intercloud

A set of protocols and root services for Cloud to Cloud interoperability



Dynamic Workload Migration – Simple VM Mobility



Cloud 1 / Cloud 2 transport
→ **XMPP**

Cloud 1 finds Cloud 2
→ **Naming, Presence**

Cloud 1 trusts Cloud 2
→ **Certificates, Trust**

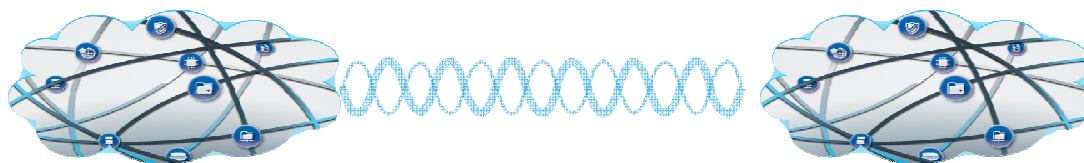
Cloud 1/2 negotiate
→ **Policy, Entitlement, Security, Metering**

Cloud 1 sets up Cloud 2
→ **Placement, Deployment, Format, Motion**

Cloud 1 sends to Cloud 2
→ **Transfer, Management**

VM Runs in Cloud 2
→ **Addressing, VLAN, WWN, Filesystem**

Dynamic Workload Federation – Generalized Service Access



Cloud 1 / Cloud 2 transport
→ XMPP

Cloud 1 finds Cloud 2
→ Naming, Presence

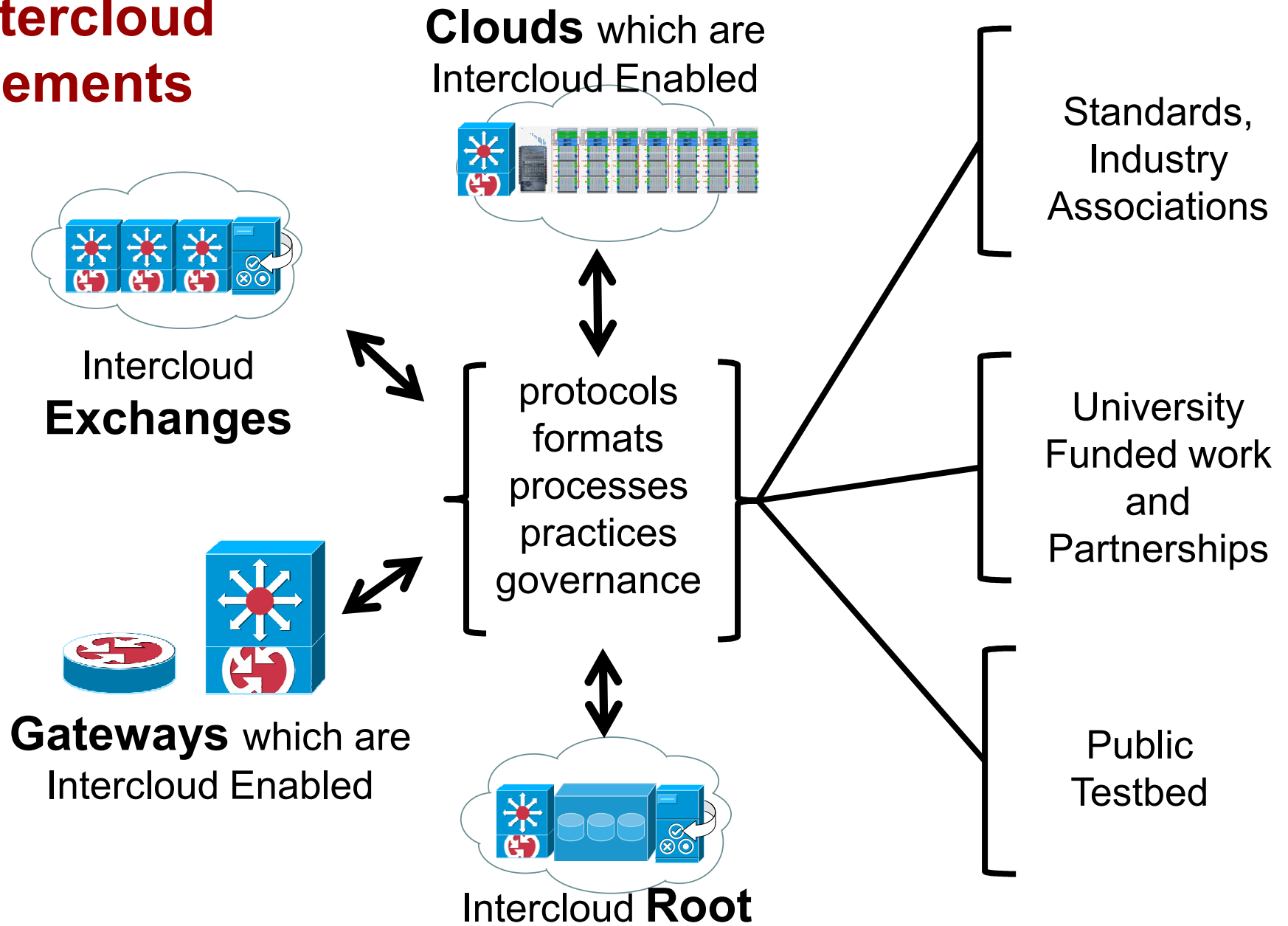
Cloud 1 trusts Cloud 2
→ Certificates, Trust

Cloud 1 queries Cloud 2 for Services
→ RDF/SPARQL

Cloud 1 selects; receives protocols, interface
→ Web Services; REST API

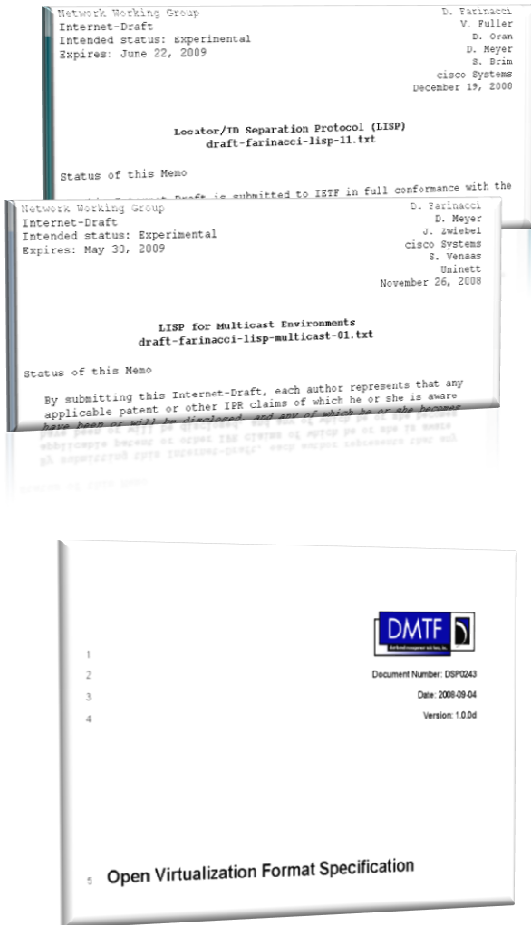
Cloud 1 calls services in Cloud 2
→ Metering, SLAs

Intercloud Elements



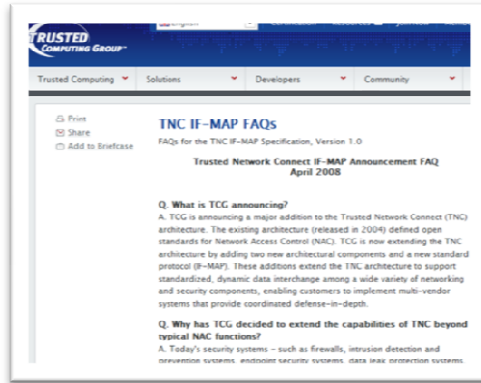
Technologies

Addressing: IETF LISP

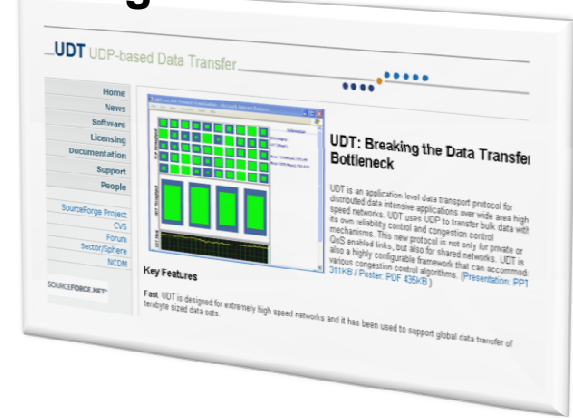


Virtual Machines: DMTF OVF

Distributed Storage Acceleration - opencloudconsortium.org, udt.sourceforge.net



NAC: IF-MAP from Trusted Computing Group



```
<iq type='result'
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  to='romoo@montague.net/orchard'
  id='info1'>
  <query xmlns='http://jabber.org/protocol/disco#info'>
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    category='conference'
    type='text'
    name='Play-Specific Chatrooms'/?>
  <identity
    category='directory'
    type='chatroom'
    name='Play-Specific Chatrooms'/?>
  <feature var='http://jabber.org/protocol/disco#info'/?>
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  <feature var='jabber:iq:version'/?>
  </query>
</iq>
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Conversations: XMPP.org

Blueprint for the Intercloud – Protocols and Formats for Cloud Computing Interoperability

David Bernstein Erik Ludvigson Krishna Sankar Steve Diamond Monique Morrow
Cisco Systems, Inc.
[daberns, eludvigs, ksankar, stdiamond, mmorrow]@cisco.com

Abstract

Cloud Computing is a term applied to large, hosted datacenters, usually geographically distributed, which offer various computational services on a "utility" basis. Most typically the configuration and provisioning of these datacenters, as far as the services for the subscribers go, is highly automated. Additionally, the hypervisor based virtualizes these services. The concept of service provider or even clouds operated by another that is limited to use case. Cloud explicitly references There is no implicit and Use cases for interoper progress around inter-cloud enabling those use cases, a

For the purposes of this paper, we define Cloud Computing as a datacenter which:

1. Implements a pool of computing resources and services which are shared amongst subscribers.
2. Charges for resources and services using an "as used" metered and/or capacity based model.

InterCloud: Utility-Oriented Federation of Cloud Computing Environments for Scaling of Application Services

Rajkumar Buyya^{1,2}, Rajiv Ranjan³, Rodrigo N. Calheiros¹

¹ Cloud Computing and Distributed Systems (CLOUDS) Laboratory
Department of Computer Science and Software Engineering
The University of Melbourne, Australia

² Manjrasoft Pty Ltd, Australia

³ School of Computer Science and Engineering
The University of New South Wales, Sydney, Australia

Abstract

Cloud computing providers have geographical locations over the Internet customers around the world. How mechanisms and policies for dynamic different Cloud-based data centers in hosting application services to achieve computing providers are unable to consuming their services, hence the load and distribution of services must counter this problem. We advocate environment (InterCloud) that facilitate provisioning of application services, variable workload, resource and network computing environment that support capabilities (VMs, services, storage, an in service demands.

This paper presents vision, InterCloud for utility-oriented federated proposed InterCloud environment support vendor clouds. We have validated our performance evaluation study using the that federated Cloud computing no significant performance gains as regular dynamic workload scenarios.

1. Introduction

Cloud Computing has become an important type of datacenter anyone: an enterprise, government.



Figure 1. A Cloud datacenter. We list several make a large data

The First International Workshop on Cloud Computing Interoperability and Services (InterCloud 2010)

<http://intercloud.cloudcom.org>

Organised in cooperation with the [Cloud Computing Association](#)

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June 28 - July 2, 2010

Le CENTRE DE CONGRÈS de CAEN
Caen, Normandy, France

Submission Deadline: February 15, 2010

SCOPE AND OBJECTIVES

"Cloud" is a common metaphor for an Internet accessible infrastructure, hiding most of the implementation and deployment details of the system from users. Cloud computing delivers IT-related capabilities as services over the Internet, allowing resources to be managed and accessed at an Internet scale. Cloud computing has been envisaged to

Using XMPP as a transport in Intercloud Protocols

David Bernstein
Huawei Technologies, USA
dbernstein@huawei.com

Deepak Vij
Cloud Strategy Partners, LLC
deepak@cloudstrategypartners.com

Abstract

Cloud Computing is a term applied to large, hosted datacenters, usually geographically distributed, which offer various computational services on a "utility" basis. Most typically the configuration and provisioning of these datacenters, as far as the services for the subscribers go, is highly automated, to the point of the service being delivered within seconds of the subscriber request. Additionally, the datacenters typically use hypervisor based virtualization as a technique to deliver these services. The concept of a cloud operated by one service provider or enterprise interoperating with a clouds operated by another is a powerful idea. So far that is limited to use cases where code running on one cloud explicitly references a service on another cloud. There is no implicit and transparent interoperability. This interoperability should be more than cloud to cloud, it should embody 1-to-many and many-building a layered set of protocols to solve this interoperability challenge protocols such as HTTP are not suitable beyond 1-to-1 models, mechanisms have been proposed, including XMPP. This paper invest protocols and concludes that logically it is a perfectly suited choice.

1. Introduction

Cloud Computing has emerged recently as a label for a particular type of one or more datacenters, most often, multiple. For the purposes of this paper, we define Cloud Computing as a logical single datacenter, which:

1. May be hosted by anyone: an enterprise, a service provider, or a government.
2. Implement a pool of computing resources and services which are shared amongst subscribers.

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Determining Service Trustworthiness in Intercloud Computing Environments

Jamal Abaway
Denkim University
School of Information Technology
jenal@denkim.edu.au

Abstract—Deployment of applications and scientific workflows that require resources from multiple distributed platforms are fueling the federation of autonomous Clouds to create Cyberinfrastructure environments. As the scope of federated cloud computing enlarges to ubiquitous and pervasive computing, there will be a need to assess and maintain the trustworthiness of the cloud computing entities. In this paper, we present a fully distributed framework that enables interested parties determine the trustworthiness of federated cloud computing entities.

Index Terms— Cloud computing, Grid computing, reputation, inter-Grid.

Introduction

Advances in systems such as hardware, networking, middleware and increasing ubiquity of Virtual Machine (VM) technologies have led to an emergence of new globally routed computing platforms such as Grid computing [8, 9, 11, 12] and cloud computing [16, 17] that provides ware, computing resources and storage as a service for fee accessible from anywhere via the Internet. Although these generations distributed computing platforms have been used for various applications, they generally follow specific treatments of their user communities.

In this paper, we refer to Grid-based distributed computing public cloud computing whereas distributed computing aided by Google, Amazon, Microsoft and others that we workloads to be deployed and scaled-out quickly with the rapid provisioning of virtual machines or physical lines as private cloud computing. For example, Amazon's Elastic Compute Cloud (EC2) [16] allows users to deploy services on demand on Amazon's infrastructure and pay only for computing, storage and network resources they use. Generally, existing clouds are specific to each owner and sure of the entrance of other clouds. As a result, there is little any resource and service sharing between them. In this paper, we refer to the logical federation of autonomous computing clouds for the purpose of exchanging resources (compute, messaging etc) in a uniform/untied way as inter-cloud computing. There are ample benefits for interconnecting computing clouds in a uniform way while respecting their autonomy. For example, the federated clouds will enable users to solve large-scale computational and data intensive problems in science, research, and commerce. These benefits have inspired

Deepak Vij
Cloud Strategy Partners, LLC
3260 Nipoma Court
San Jose, CA 95135
deepak@cloudstrategypartners.com

International Conference on Internet Computing, Las Vegas, NV, Jul 12-15 2010
IEEE in Computer Science, Computer Engineering, and Applied Computing
Cloud Computing", "Intercloud", "Semantic Web", "RDF", "Ontology"

4. Are usually geographically distributed, in a manner which is transparent to the subscriber (unless they explicitly ask for visibility of that).
5. Are automated in that the provisioning and configuration (and de-configuration and un-provisioning) of resources and services occur on a "self service" basis, usually programmatic request of the subscriber, occur in an automated way with no human operator assistance, and are delivered in one or two orders of seconds.
6. Resources and services are delivered virtually, that is, although they may appear to be physical (servers, storage, network, etc) they are not physically present at the subscriber's location.

2009 10th International Symposium on Pervasive Systems, Algorithms, and Networks

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Jamal Abaway
Denkim University
School of Information Technology
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research in creating mechanisms and protocols for interlinking existing Grids across multi-site in a coordinated manner [2, 12, 18]. Although there are values for federating autonomous clouds, the open and dynamic nature of these systems coupled with the independent capacity planning and provisioning of resources to users within each system makes resource sharing in inter-cloud computing environment a challenging task. Issues such as standardization of network protocols and the mechanism that would allow them to interwork such as the interfaces through which cloud systems internetwork with each other as well as enabling the provisioning of reliable cloud services are needed to fully realize inter-cloud computing. Specifically, since inter-cloud computing constitutes collaboration between independently owned autonomous clouds, there is a need for policies and mechanisms for these clouds to peer with each other and for admission control when accepting requests originated from other clouds. We also need mechanisms for selecting trustworthy clouds to peer with and outsource applications for execution or data for storage.

In this paper, we focus on the problem of how to determine service trustworthiness in inter-cloud computing environments. Policies and mechanisms for peering Grids and for admission control have been discussed in [2]. Although, it has been clearly shown that an assurance of a higher degree of trust relationship is required to attain efficient resource allocation and utilization [6], to the best of our knowledge, the problem of how to determine service trustworthiness in inter-cloud computing environments has not been addressed previously. In this paper, we present a fully distributed framework that enables interested parties to determine the trustworthiness of inter-cloud computing entities. The proposed trust framework is a reputation-based trust management system that enables a service requester to obtain service trustworthiness. The proposed trust management framework model enables users to select high-quality cloud services through determining the trustworthiness of a given resource for the purpose of executing their jobs, thereby satisfying clients' quality-of-service (QoS) requirements. The rest of the paper is organized as follows. The background and related work are discussed in Section 2. We also discuss the problem of trustworthy resource selection and provisioning in inter-cloud computing environments. In Section 3, the architecture of the Inter-Cloud computing and the proposed trust framework model are discussed. We discuss the representation of reputation and how the reputation is built. We also discuss how reputation is updated as well as how the ratings of others are considered and integrated. In Section 4,

Next Intercloud Activity

The screenshot shows the NIST Information Technology Laboratory website. The header includes the NIST logo, navigation links for NIST Time, NIST Home, About NIST, Contact Us, and A-Z Site Index, and a search bar. Below the header is a blue navigation bar with links for About ITL, Publications, Topic/Subject Areas, Products/Services, News/Multimedia, and Programs/Projects. The main content area features the title "Cloud Computing Forum & Workshop" and a "SHARE" button with social media icons. The page is divided into two columns. The left column contains sections for Purpose, Agenda (Preliminary), and Related Project(s). The right column contains a Details section with information on Start Date, End Date, Location, Audience, Format, Sponsor(s), and Registration.

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Cloud Computing Forum & Workshop

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Purpose:
The Federal Chief Information Officer is charged with improving performance and lowering the cost of government operations by leveraging cloud computing.

The Federal CIO has asked the National Institute of Standards and Technology (NIST) to lead federal efforts on standards for data portability, cloud interoperability, and security.

NIST's mission, as a non-regulatory federal agency within the U.S. Department of Commerce, is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

The goal of this event is to initiate engagement with industry to collaboratively develop standards and explore solutions for cloud interoperability, portability, and security.

Agenda:
Preliminary
8:00 - 9:00 Coffee Reception
9:00 - 11:45 Cloud Computing Forum
1:30 - 4:00 Cloud Computing Workshops (parallel tracks)

Related Project(s):
Cloud Computing

Details:
Start Date: Thursday, May 20, 2010
End Date: Thursday, May 20, 2010
Location: Department of Commerce, Herbert C. Hoover Building, 14th St. & Constitution Ave., NW, Washington, DC 20230
Audience: Industry, Government, Other
Format: Workshop
Sponsor(s):
Federal Chief Information Officer, Office of Management and Budget
Federal CIO Council
National Institute of Standards and Technology

Registration:
Online registration
Registration Contact:
Teresa Vicente, NIST, email: teresa.vicente@nist.gov

<http://www.nist.gov/itl/cloud.cfm>

Thank You

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