Intercloud Control and Management Plane with XMPP

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Outline

- General use cases for Intercloud Architecture
- Related standardisation initiatives: NIST, IETF, IEEE
- IEEE P2302 Draft Standard for Intercloud Interoperability and Federation (SIIF)
- Intercloud Architectural Framework (ICA/ICAF) components
  - Multi-layer/Layered Cloud Services Model (CSM)
  - Intercloud Control and Management Plane (ICCMP)
  - Intercloud Federation Framework (ICFF)
  - Intercloud Operations Framework (ICAF)
- XMPP based services for Intercloud services/infrastructure
  - XMPP overview
  - Current results (intermediate)
- Further research and standardisation contribution

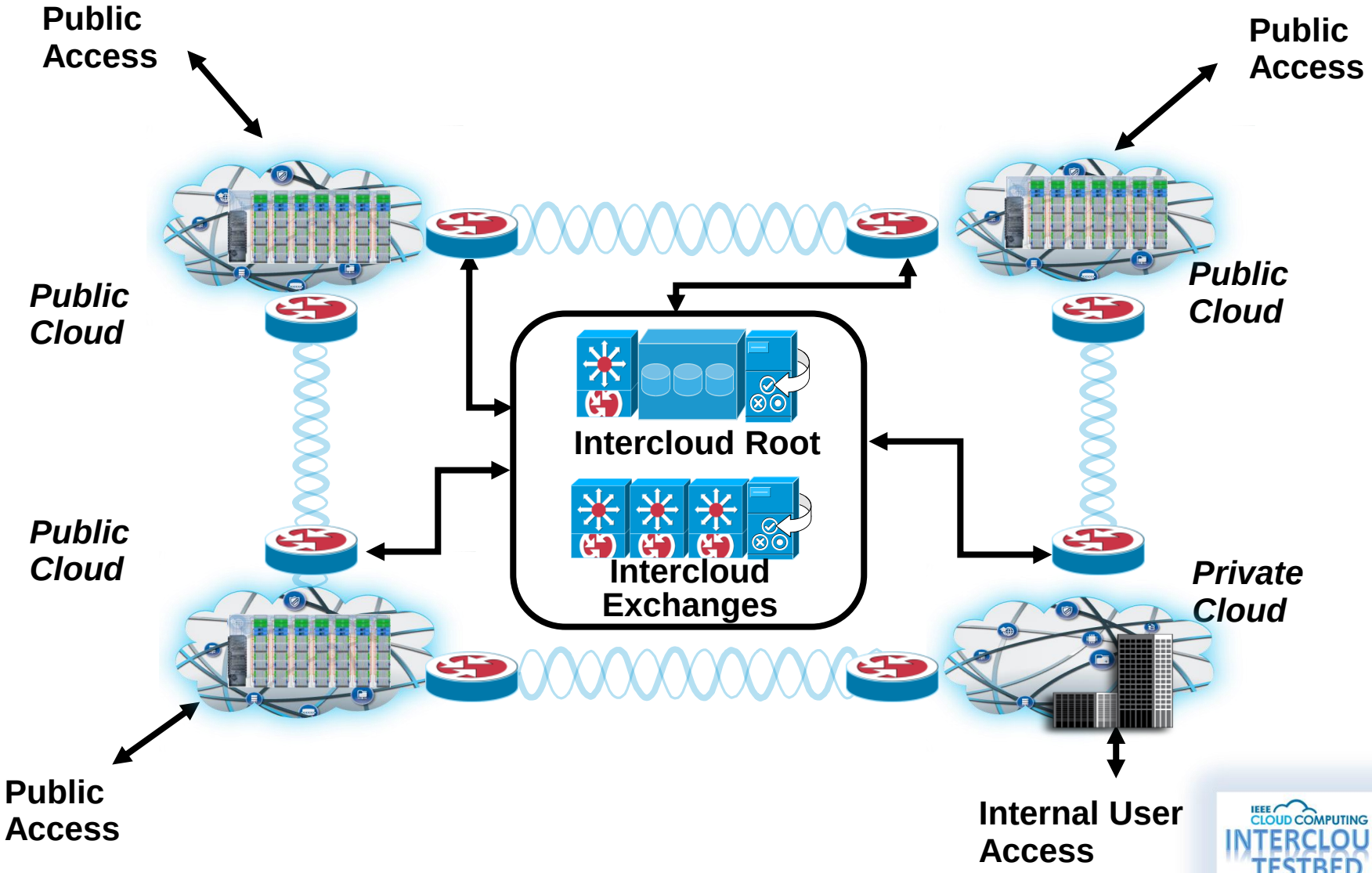
General use cases for Intercloud Architecture

- Clouds are evolving as a common way of provisioning infrastructure services on-demand
  - Intercloud is a demand for managing complexity and multi-cloud services and applications
- Intercloud Architecture Framework (ICAF) provides a framework to support provisioning of cloud based project oriented infrastructures on-demand and distributed virtualised applications mobility
  - Scientific Data e-Infrastructure for Big Data
  - Enterprise/campus cloud infrastructure evolution and migration/mobility
  - Infrastructure disaster recovery
    - Data require supporting infrastructure
- *ICAF intends to open Cloud market to more players and remove so-called “cloud curtain”*

Intercloud: Related standardisation activities

- NIST Cloud definition (NIST SP 800-145), and Cloud Computing Reference Architecture (CCRA), v1.0 (NIST SP 500-292)
- ITU-T Focus Group on Cloud: Technical Report (Part 1 to 7)
  http://www.itu.int/en/ITU-T/focusgroups/cloud/Documents/FG-coud-technical-report.zip
- IEEE - WGs on InterCloud issues and Cloud Profiles
  - IEEE ICWG/2302 WG - Intercloud WG (ICWG) Working Group
    http://standards.ieee.org/develop/wg/ICWG-2302_WG.html
- OGF ISOD-RG
  - BCP on existing on-demand network and cloud infrastructure resources provisioning systems (including GEYSERS)
- IETF Internet Drafts
  - Cloud Reference Framework. Internet Draft, by B. Khasnabish, J. Chu, S. Ma, Y. Meng, N. So, P. Unbehagen, M. Morrow, M. Hasan, Y. Demchenko
    http://tools.ietf.org/html/draft-khasnabish-cloud-reference-framework-08.txt

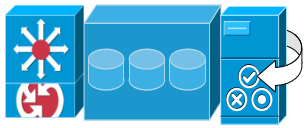
IEEE: Reference Intercloud Topology



IEEE: Reference Intercloud Components (capabilities and protocols)

- CS Namespace
- Conversational Substrate (XMPP)
- Transport/Services (Web Sockets)
- Trust/Identity

- Replication (BitTorrent)
- Semantic Directory (Ontology, RDF)



Intercloud Root

- CS Namespace
- Conversational Substrate (XMPP)
- Transport/Services (Web Sockets)
- Trust/Identity

- Replication (BitTorrent)
- Semantic Directory (Ontology, RDF)
- Auditing

Intercloud Exchanges

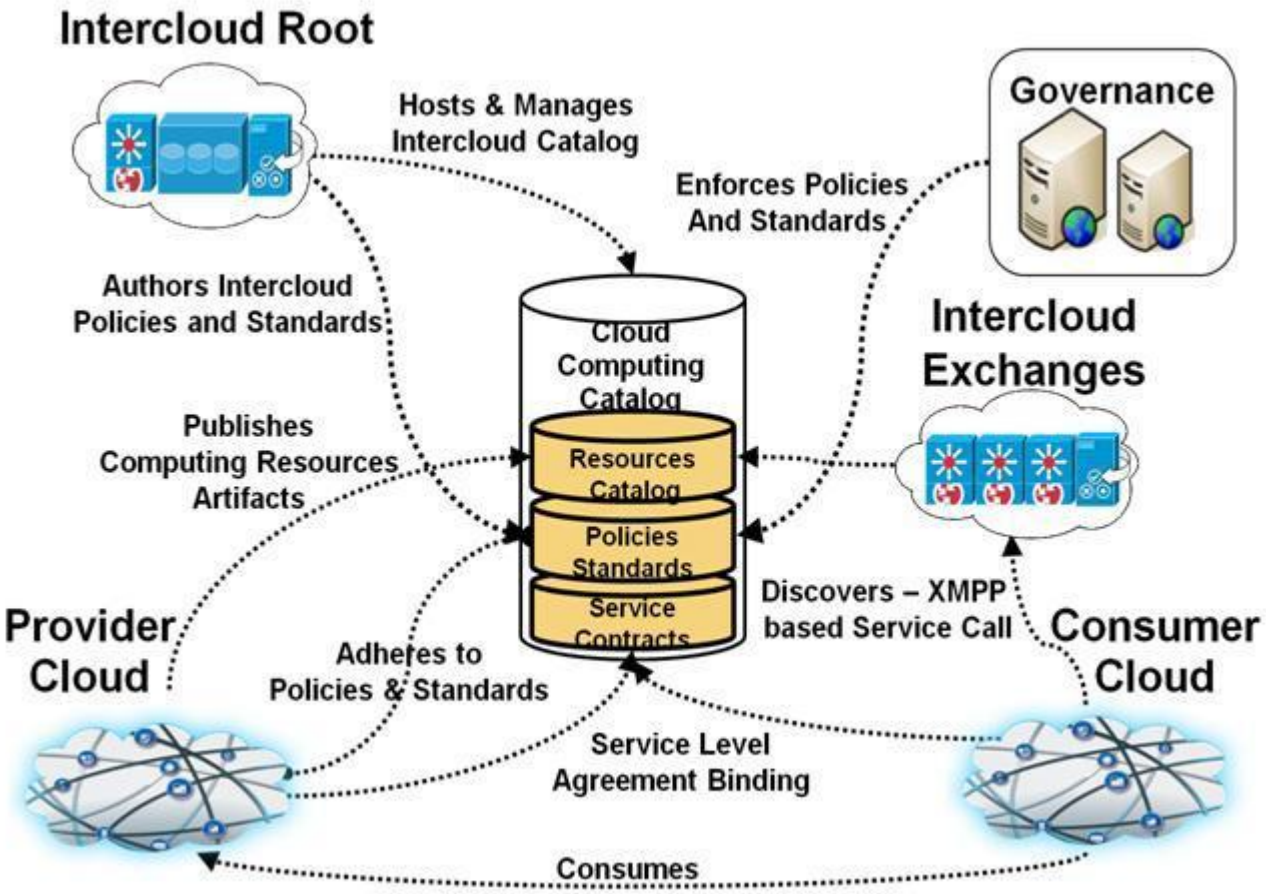
- CS Namespace
- Conversational Substrate (XMPP)
- Transport/Services (Web Sockets)
- Trust/Identity

- Federating API
- Federating Transport
- Federating Implementation

Intercloud Gateway

Ongoing: IEEE P2302 Draft Standard for Intercloud Interoperability and Federation (SIIF)

IEEE: Intercloud Root, Exchange, Catalog



Excerpt: IEEE P2302 Draft Standard for Intercloud Interoperability and Federation (SIIF)

I-Draft “Cloud Reference Framework” (Versions 0.3-0.8)

http://tools.ietf.org/html/draft-khasnabish-cloud-reference-framework-08.txt

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Version 0.3 – 29 June 2012
Version 0.4 – 27 December 2012
Version 0.5 – 3 July 2013
Version 0.6 – 4 January 2016
Version 0.7 – 7 October 2014
Version 0.8 – 9 April 2015

Intercloud Architecture - Requirements

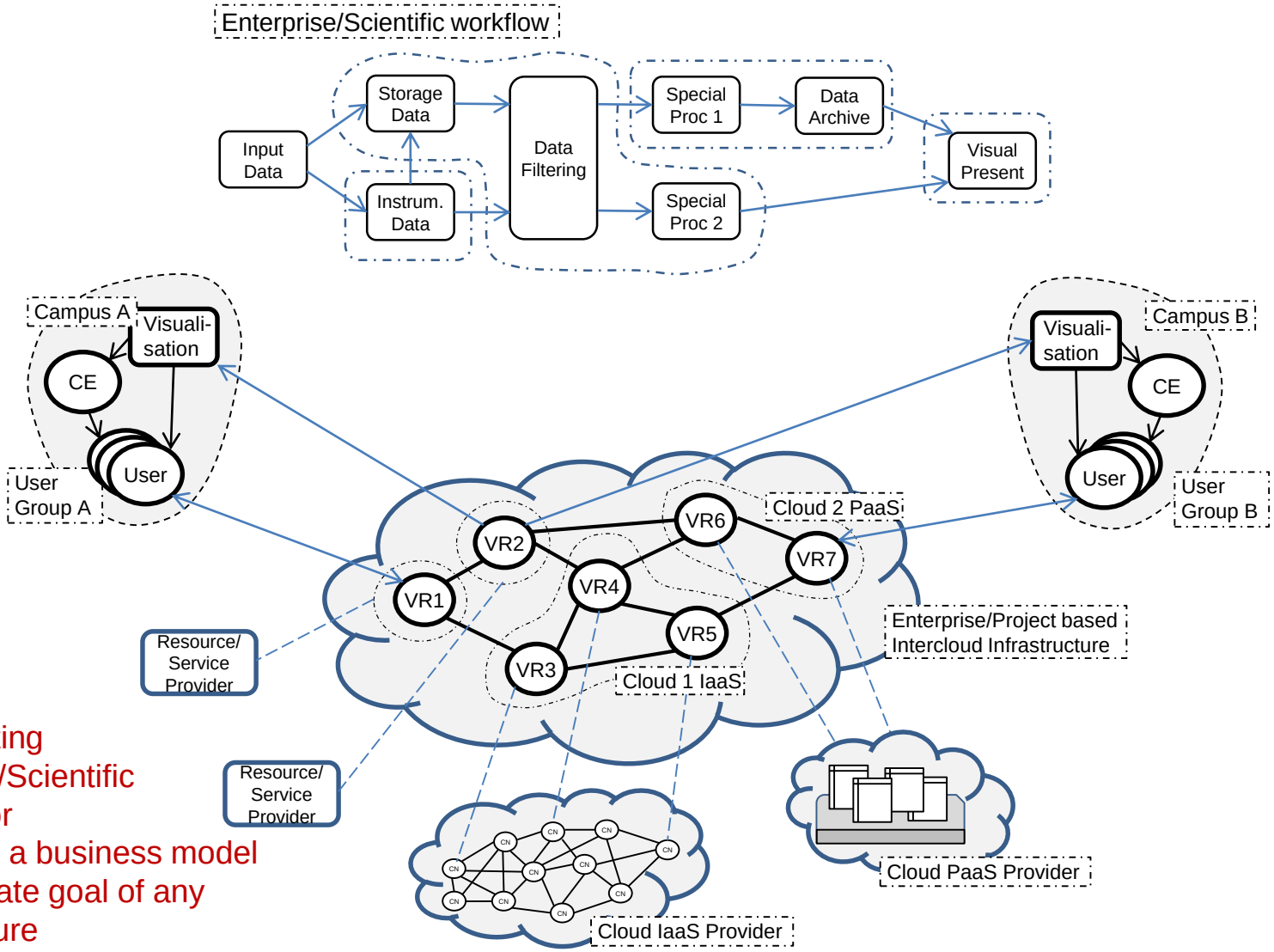
Intercloud Architecture (ICA) should address interoperability and integration of different cloud service platforms provided by multiple cloud providers, including integration with legacy campus/enterprise infrastructure

- Be compatible and provide multi-layer integration of existing cloud service models – IaaS, PaaS, SaaS and Apps clouds
- Facilitate interoperable and measurable intra-provider infrastructures
- Provide a framework for heterogeneous inter-cloud federation
- Support/provide Intercloud Control and Management Plane functionality for performance critical cloud services and network integration
- Support intra- and inter-cloud *network infrastructure* provisioning with controlled performance and QoS (as NaaS service model)
- Support existing Cloud Provider operational and business models and provide a basis for new forms of services provisioning and operation
  - Support *provider side federation (for resources sharing)* and *customer/broker side federation for multi-provider infrastructure integration*

InterCloud Architecture components

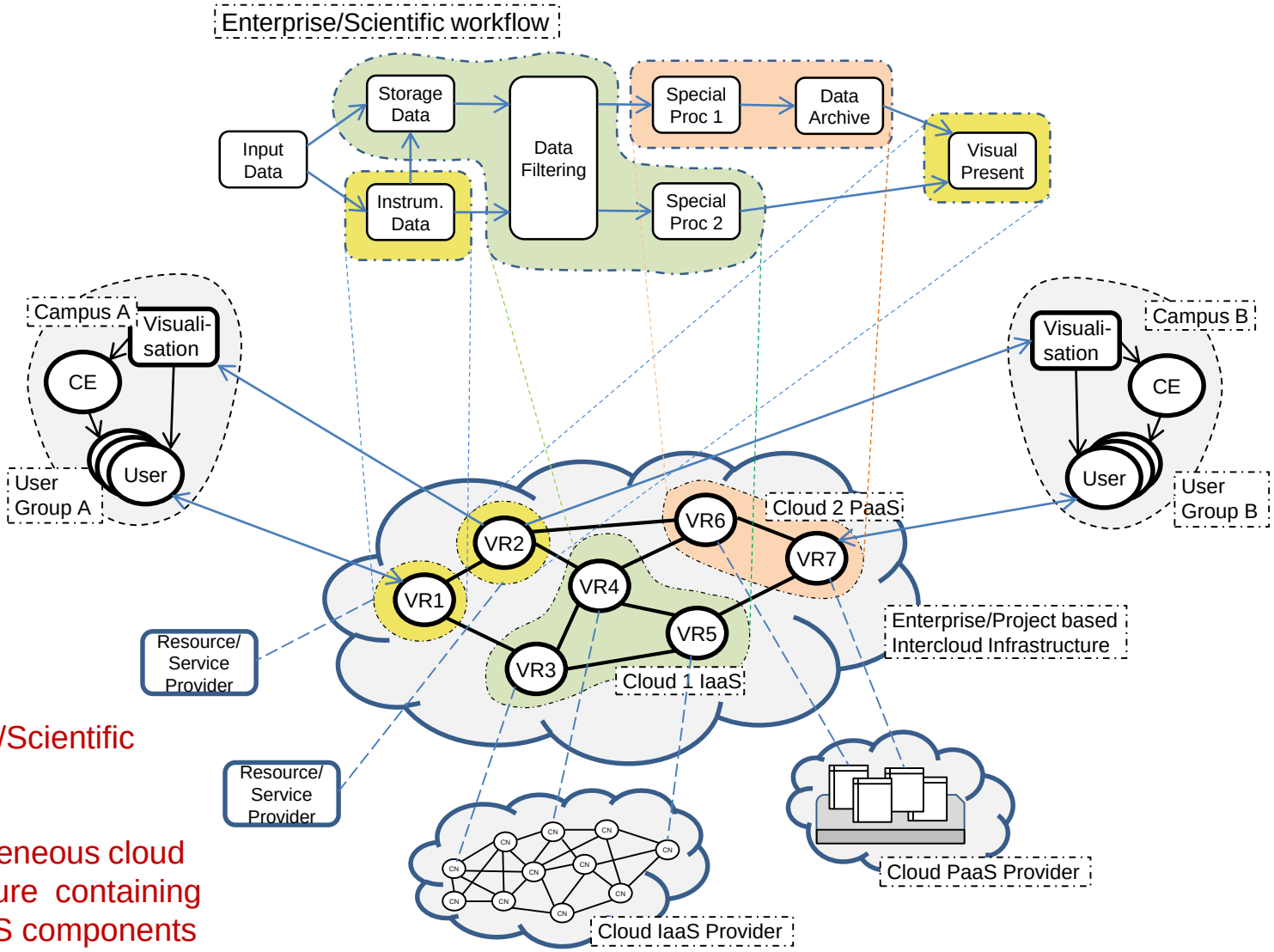
- Multi-layer Cloud Services Model (CSM)
  - Combines IaaS, PaaS, SaaS into multi-layer model with inter-layer interfaces
  - Including interfaces definition between cloud service layers and virtualisation platform
- InterCloud Control and Management Plane (ICCMP)
  - Allows signaling, monitoring, dynamic configuration and synchronisation of the distributed heterogeneous clouds
  - Including management interface from applications to network infrastructure and virtualisation platform
- InterCloud Federation Framework (ICFF)
  - Defines set of protocols and mechanisms to ensure heterogeneous clouds integration at service and business level
  - Addresses Identity Federation, federated network access, etc.
- InterCloud Operations and Management Framework (ICOMF)
  - RORA model: Resource, Ownership, Role, Action
    - RORA model provides basis for business processes definition, SLA and access control
  - Broker and federation operation
  - SLA Management
- InterCloud Security Framework (ICSF)

General use case for infrastructure provisioning: Workflow => Logical (Cloud) Infrastructure (1)



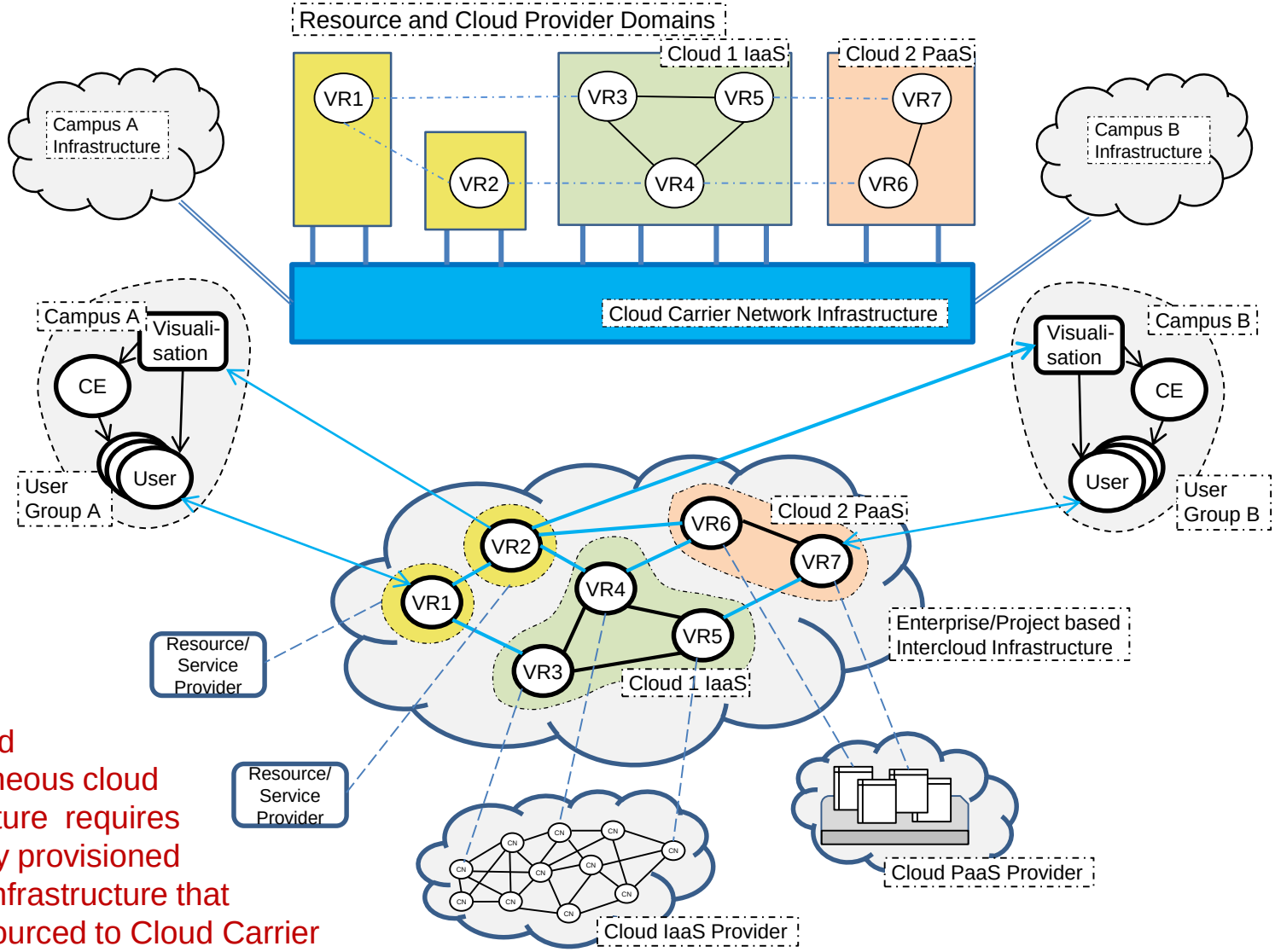
Implementing Enterprise/Scientific workflow or supporting a business model is an ultimate goal of any infrastructure

General use case for infrastructure provisioning: Workflow => Logical (Cloud) Infrastructure (2)



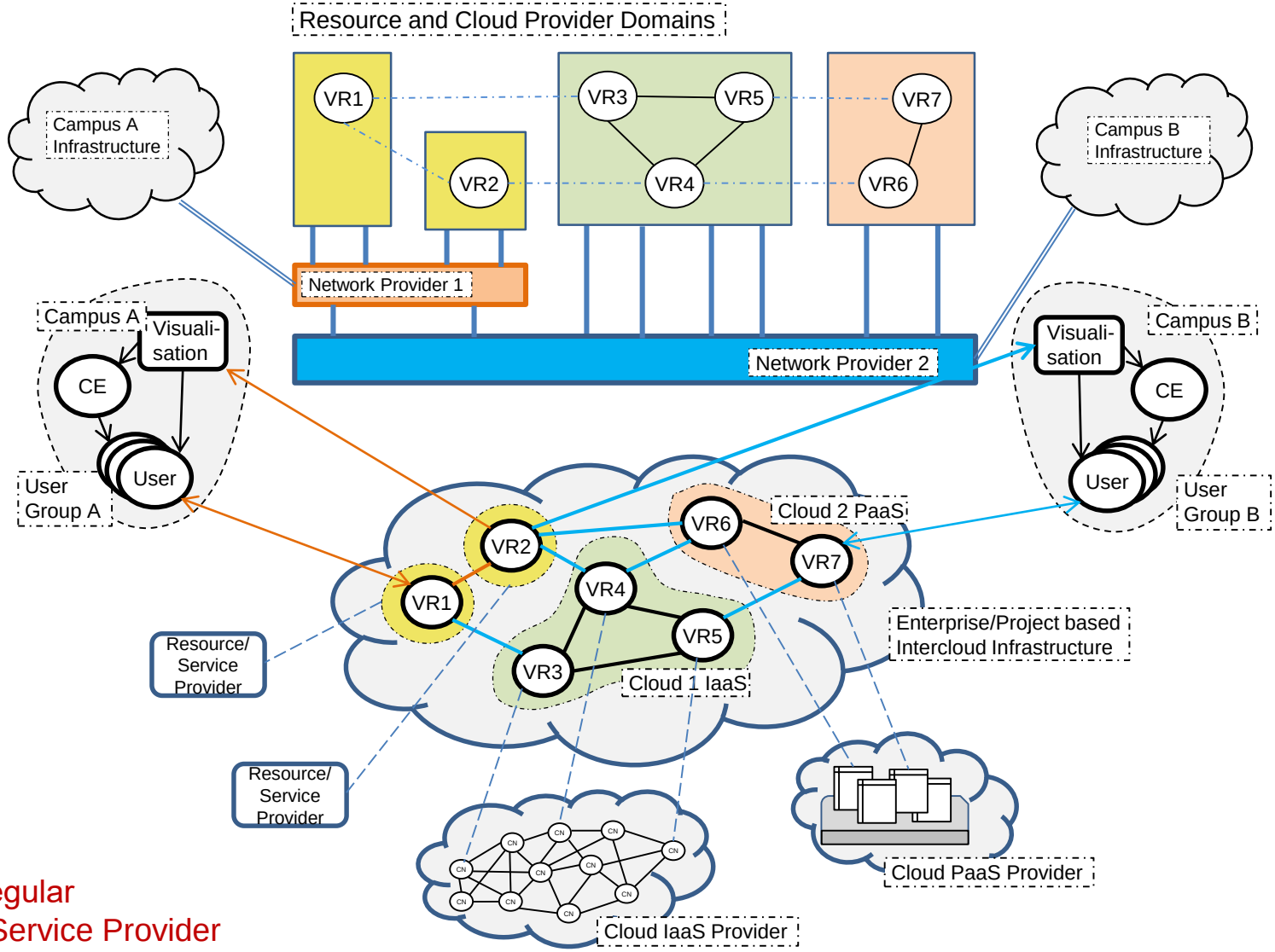
Enterprise/Scientific workflow
Is mapped
to heterogeneous cloud infrastructure containing IaaS, PaaS components

General use case for infrastructure provisioning: Logical Infrastructure => Network Infrastructure (1)

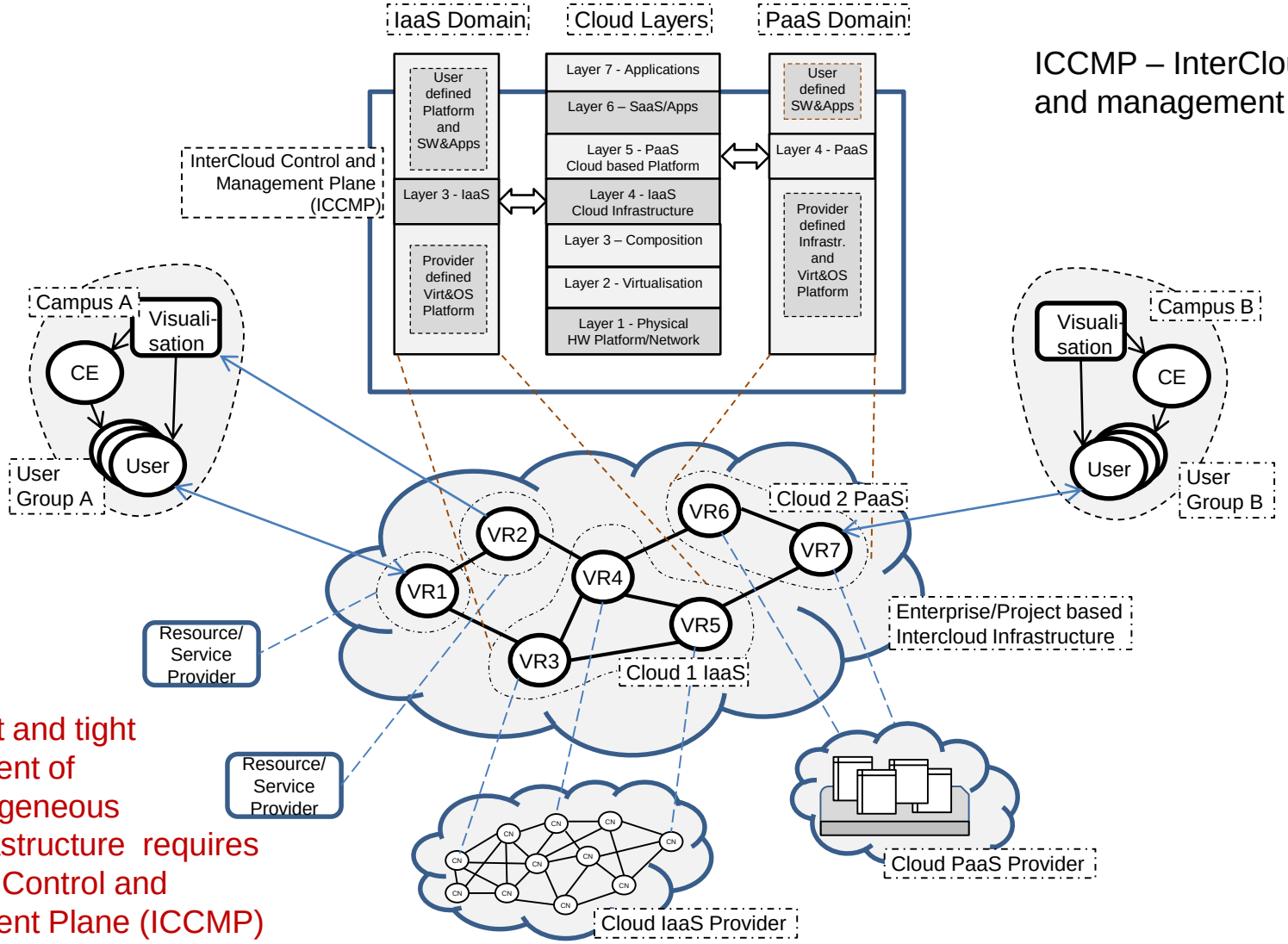


Distributed heterogeneous cloud infrastructure requires separately provisioned network infrastructure that Can outsourced to Cloud Carrier

General use case for infrastructure provisioning: Logical Infrastructure => Network Infrastructure (2)



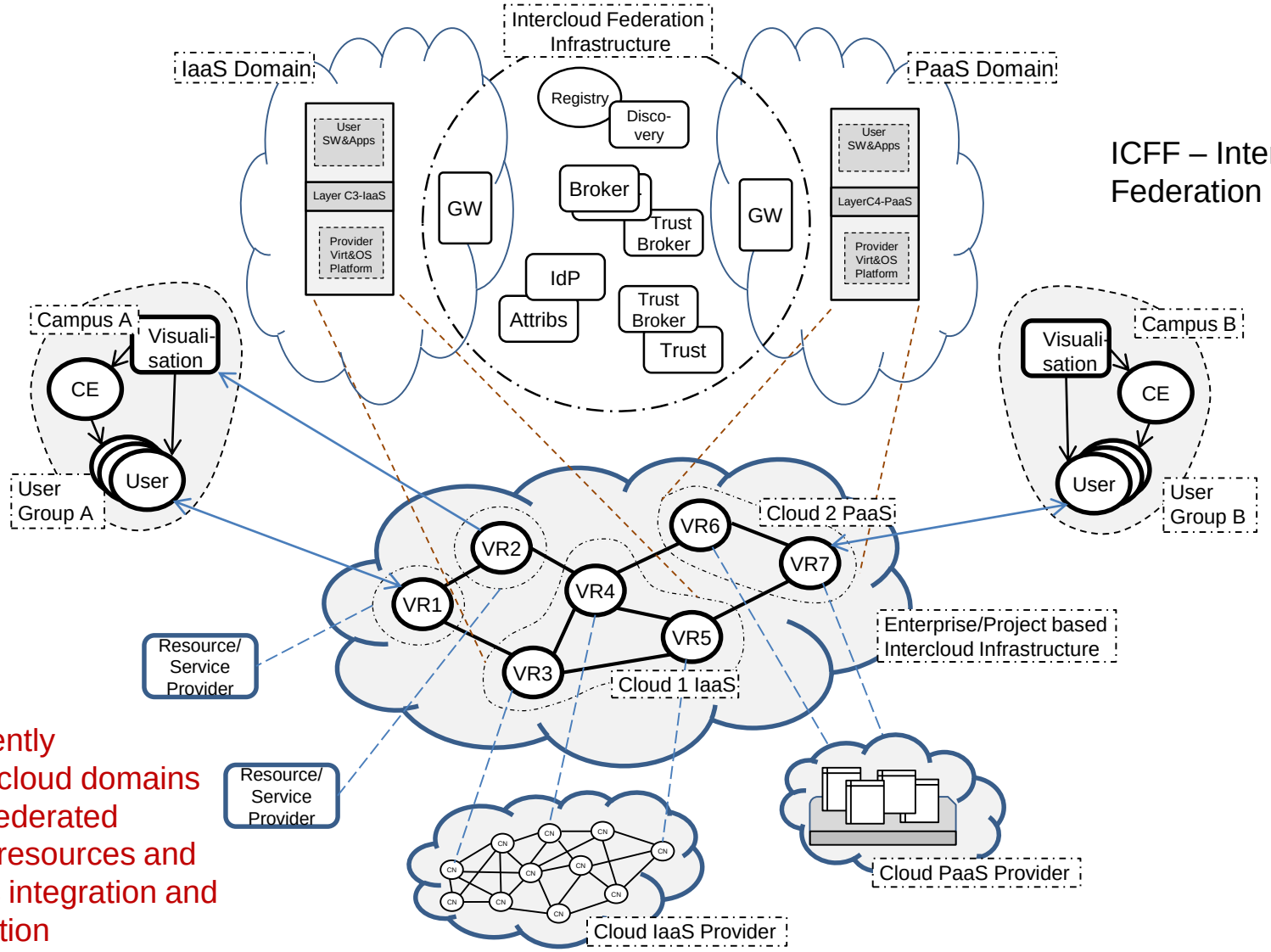
ICCMP - Intercloud Control and Management Plane



ICCMP – InterCloud Control and management Plane

Consistent and tight management of the heterogeneous cloud infrastructure requires Intercloud Control and Management Plane (ICCMP)

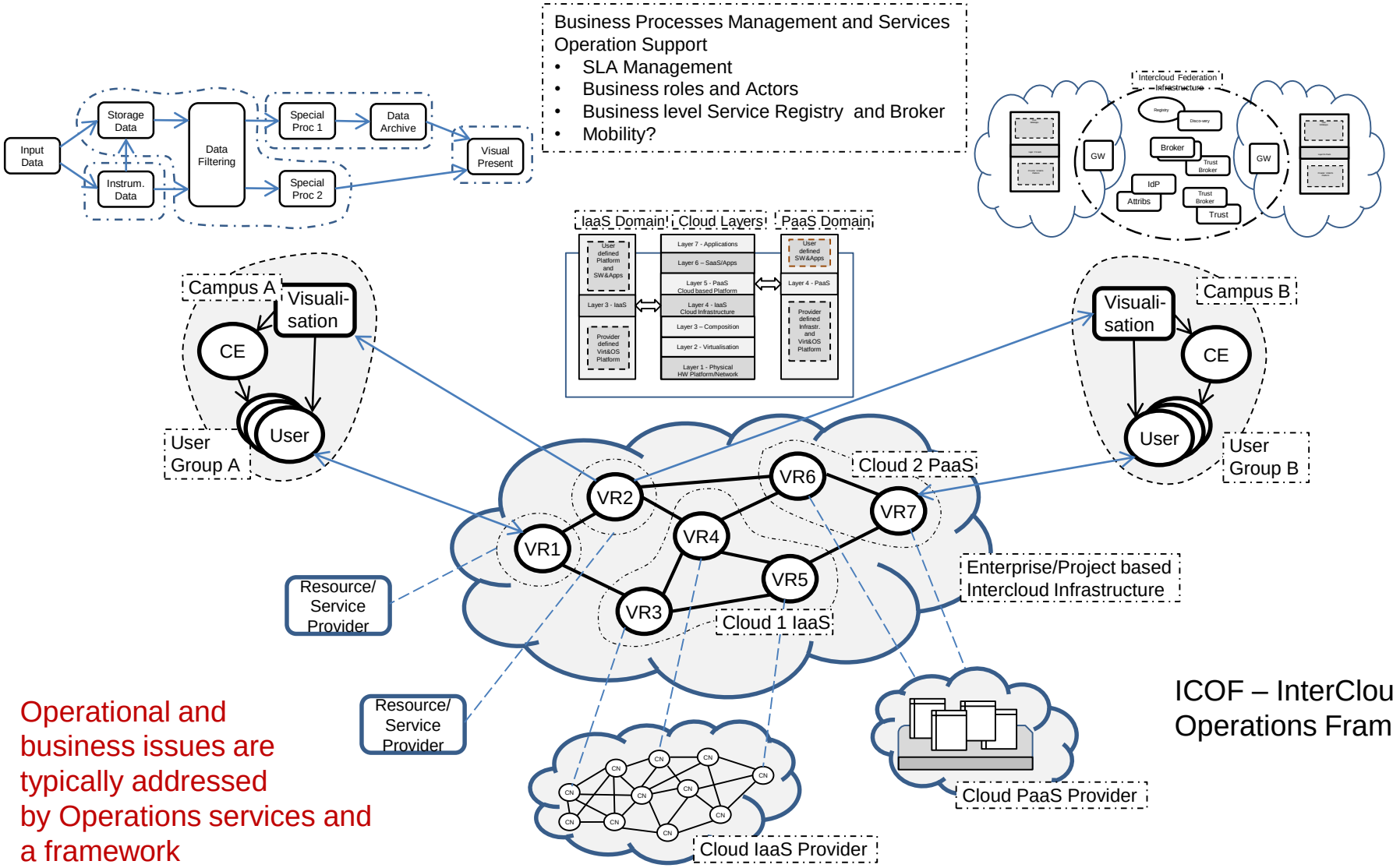
ICFF - Intercloud Federation Framework



ICFF – InterCloud Federation Framework

Independently managed cloud domains may use federated model for resources and processes integration and interoperation

ICOMF – Intercloud Control and Management Framework



Operational and business issues are typically addressed by Operations services and a framework

ICOF – InterCloud Operations Framework

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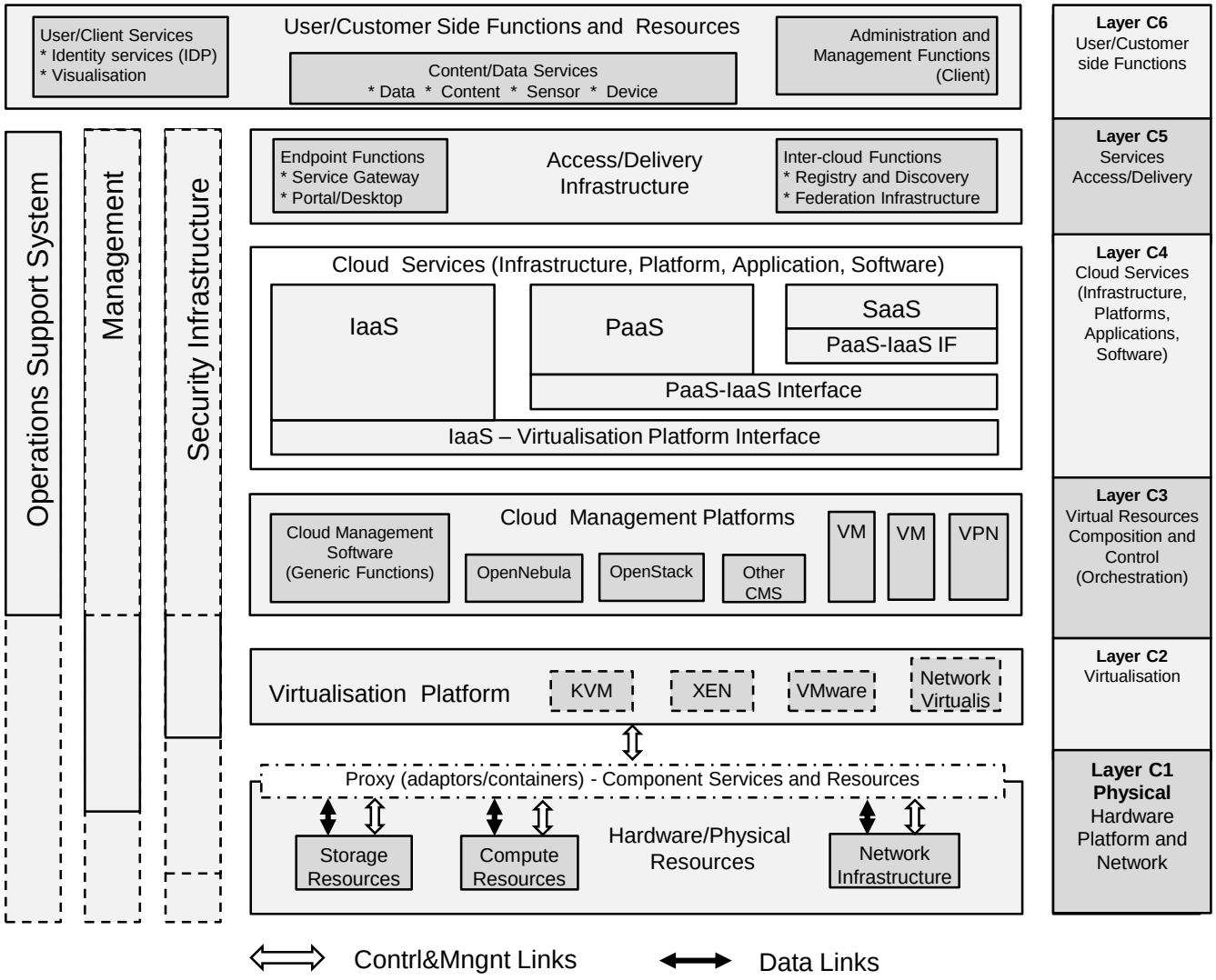
Multilayer Cloud Services Model (CSM)



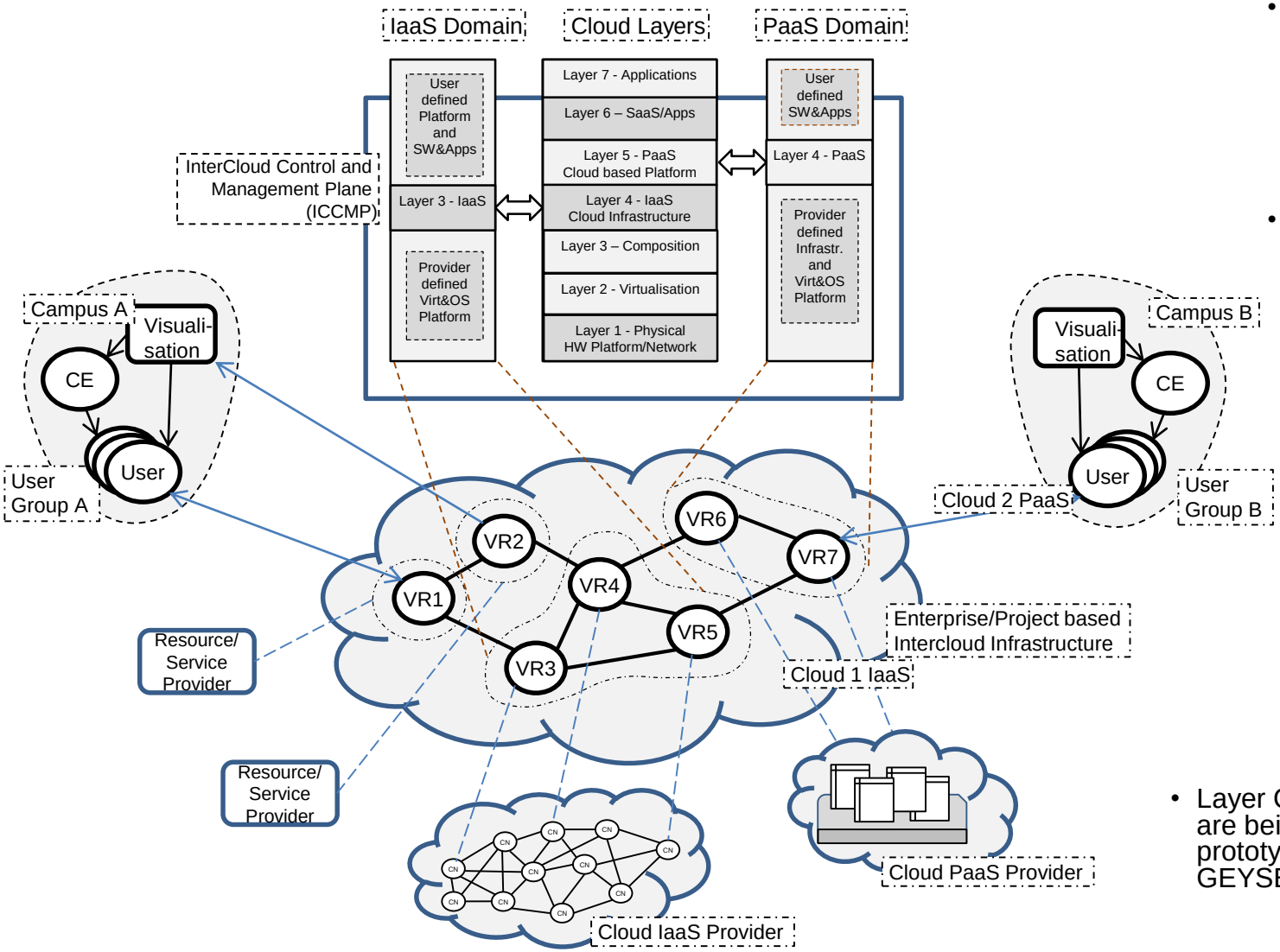
CSM layers

(C6) User/Customer side Functions
(C5) Services Access/Delivery
(C4) Cloud Services (Infrastructure, Platform, Applications)
(C3) Virtual Resources Composition and Orchestration
(C2) Virtualisation Layer
(C1) Hardware platform and dedicated network infrastructure

Control/ Mngnt Links

Data Links

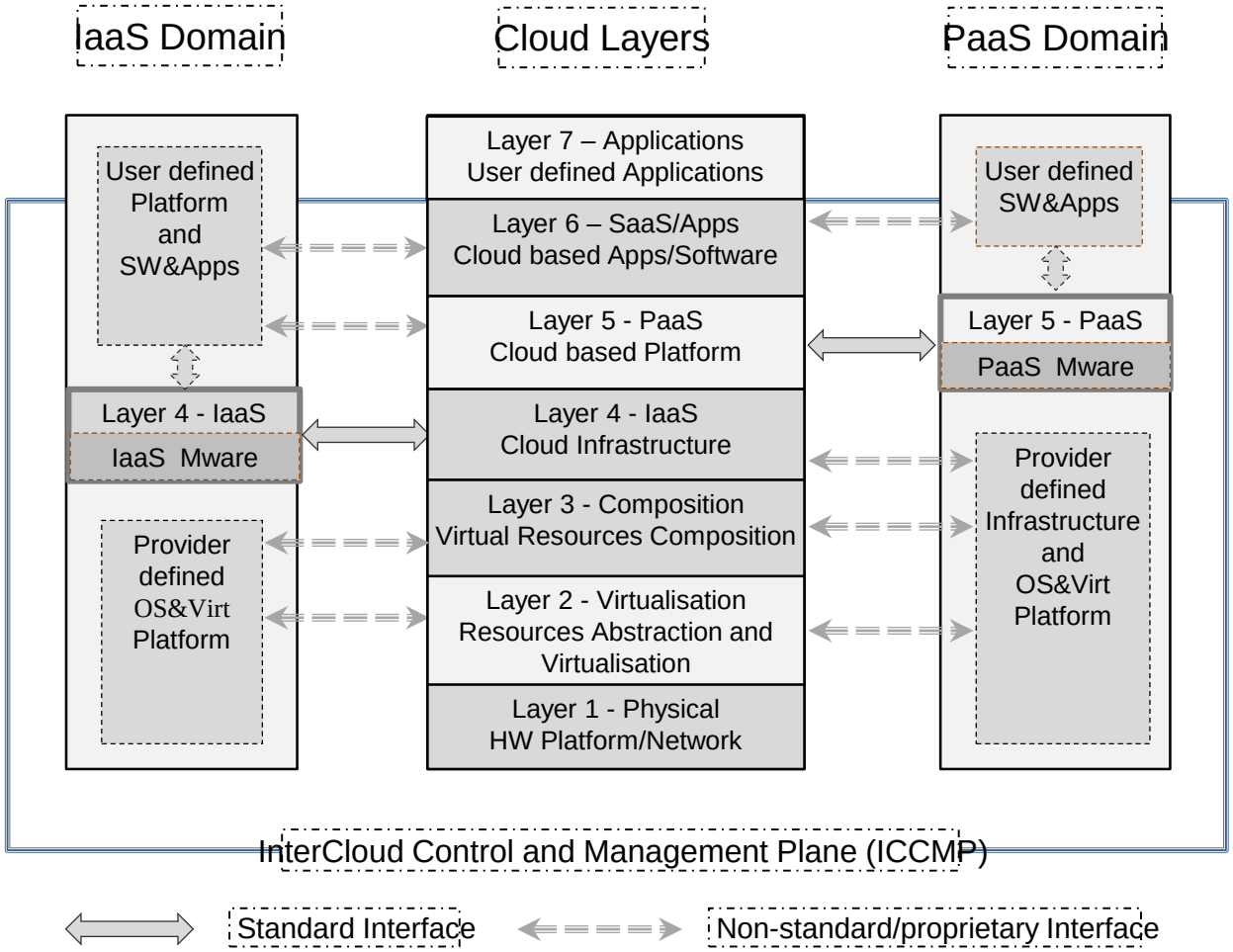
Intercloud Control and Management (1)



- Supports messages delivery/routing, signaling, monitoring, dynamic configuration and synchronisation between the distributed heterogeneous cloud instances
- Includes management interfaces from upper layers and applications to network infrastructure and virtualisation platform (virtualised resources

- Layer C1 - Layer C4 interfaces are being developed and prototyped in the framework of the GEYSERS project (2010-2013)

Intercloud Control and Management (2)



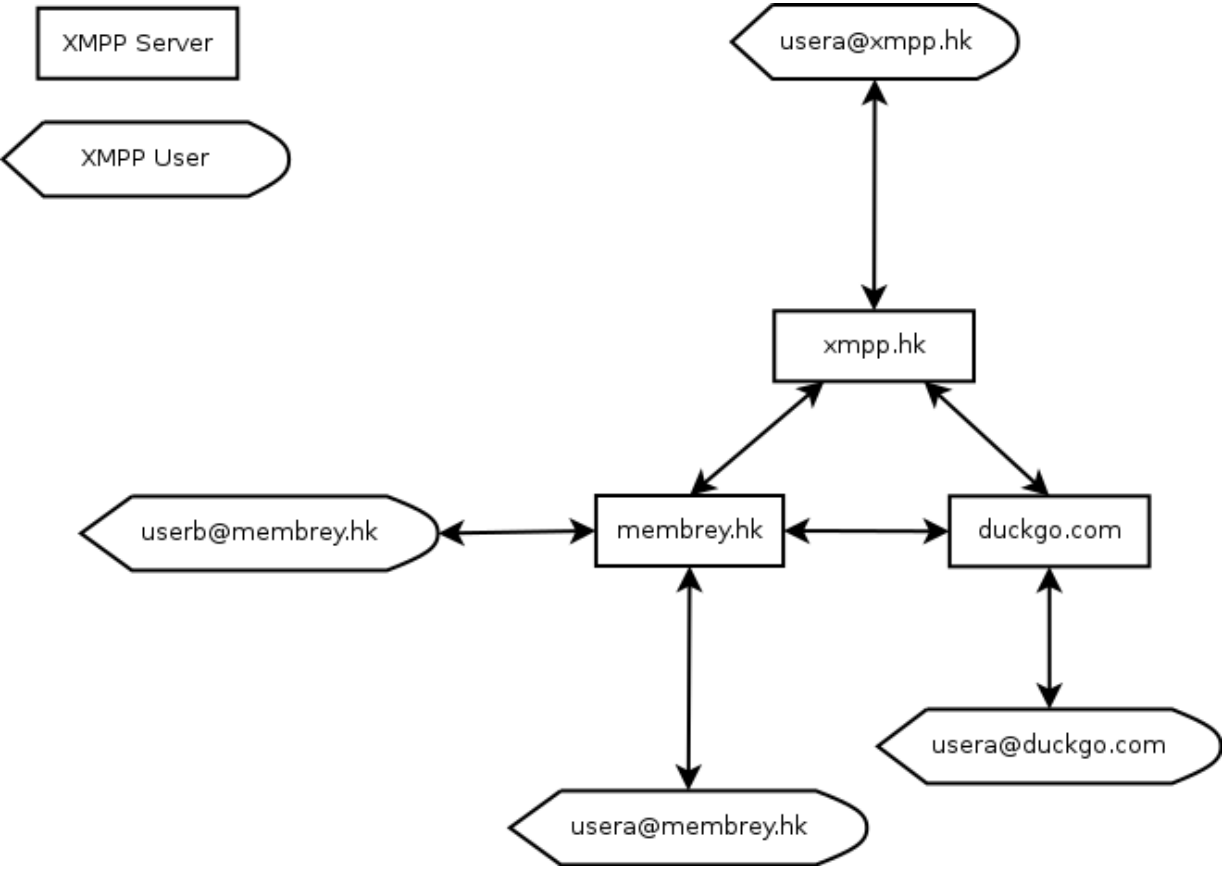
Intercloud Control and Management (3)

- Allows signaling, monitoring, dynamic configuration and synchronisation of the distributed heterogeneous clouds
- Including management interface from applications to network infrastructure and virtualisation platform
- Main functional components include
  - Cloud Resource Manager
  - Network Infrastructure Manager
- Possible ICCMP Interfaces include
  - Message routing
  - Signaling
  - Control
  - Management
  - Monitoring
  - Location

Research: Using XMPP for ICCMP

- XMPP Overview
- Raft protocol for consensus building in distributed cloud based infrastructures
- Works at the stage of Intercloud infrastructure configuration

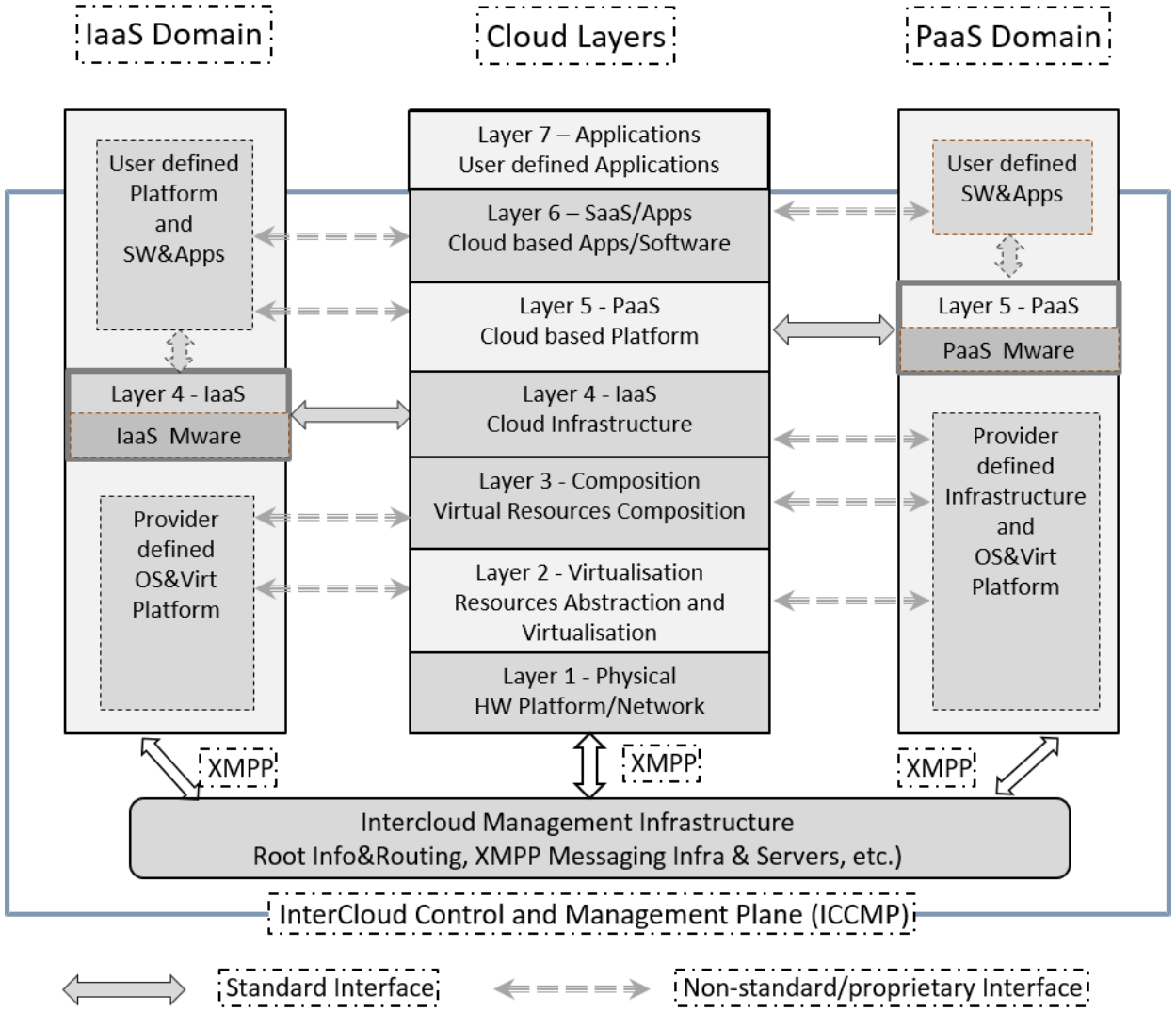
XMPP Architecture



XMPP Servers infrastructure
- Similar in architecture to SMTP

XMPP Services
- Presence
  - Could be used as a way of showing real time VM or Resource status
- Roster
  - Similar to a ‘friends list’ on most IM networks
- Notification
  - Unidirectional messaging Useful for mass notification of system alerts
- Service discovery
  - Determine what features other agents and nodes support

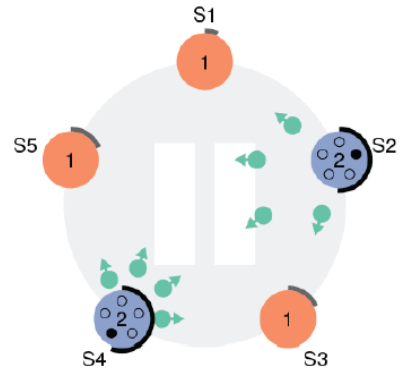
ICCMP Messaging over XMPP

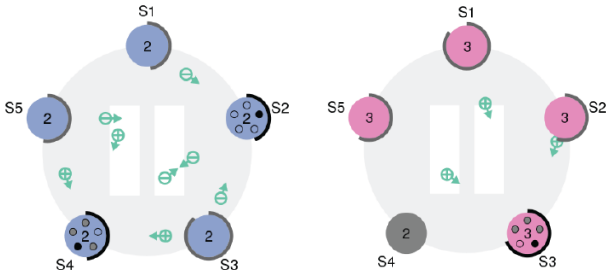


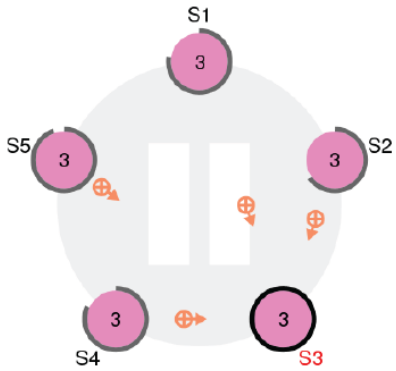
XMPP benefits

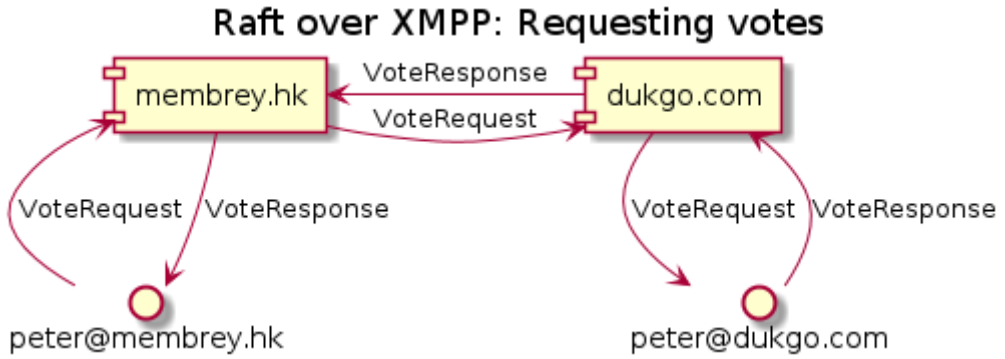
- Standard protocol
- Integrate/ bridge 2 Intercloud architectures

Raft Consensus Building Protocol over XMPP









XEP-0362: Raft over XMPP

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2015-08-11
Version 0.1

Status	Type	Short Name
perimental	Standards Track	NOT_YET_ASSIGNED

- Replaces complex PAXOS algorithm
- Using XMPP Extension Protocol (XEP)
- Primarily using delay/timeout
- Use for such applications as Hadoop based and distributed storage
- Tested with 5 nodes

Current Results: Use of XMPP for ICCMF

- Demonstrated that XMPP, can carry the sort of messages we would need for Intercloud
- Initial implementation for large scale data intensive infrastructures (distributed processing)
  - Infrastructure deployment and dynamic self-configuration (leader selection, consensus building)
- "XEP-0362: Raft over XMPP" which is now on the XSF standards track
  - HTML version is: https://xmpp.org/extensions/xep-0362.html

Summary and Future works

- The proposed ICAF is based on existing standards and proposes their integration and extension
  - Includes 5 components: CSM, ICCMP, ICFF, ICOMF, ICSF
    - Addresses cloud services/infrastructure lifecycle management
- Standardisation activity at IETF, IEEE
  - Partnering and integration between two intercloud architectures: IETF and IEEE
- First XMPP implementation for distributed data processing infrastructure deployed in cloud
- Future research and development primarily focused on inter-layer and inter-cloud interfaces definition
  - XMPP as a candidate messaging protocol

Questions and Discussion