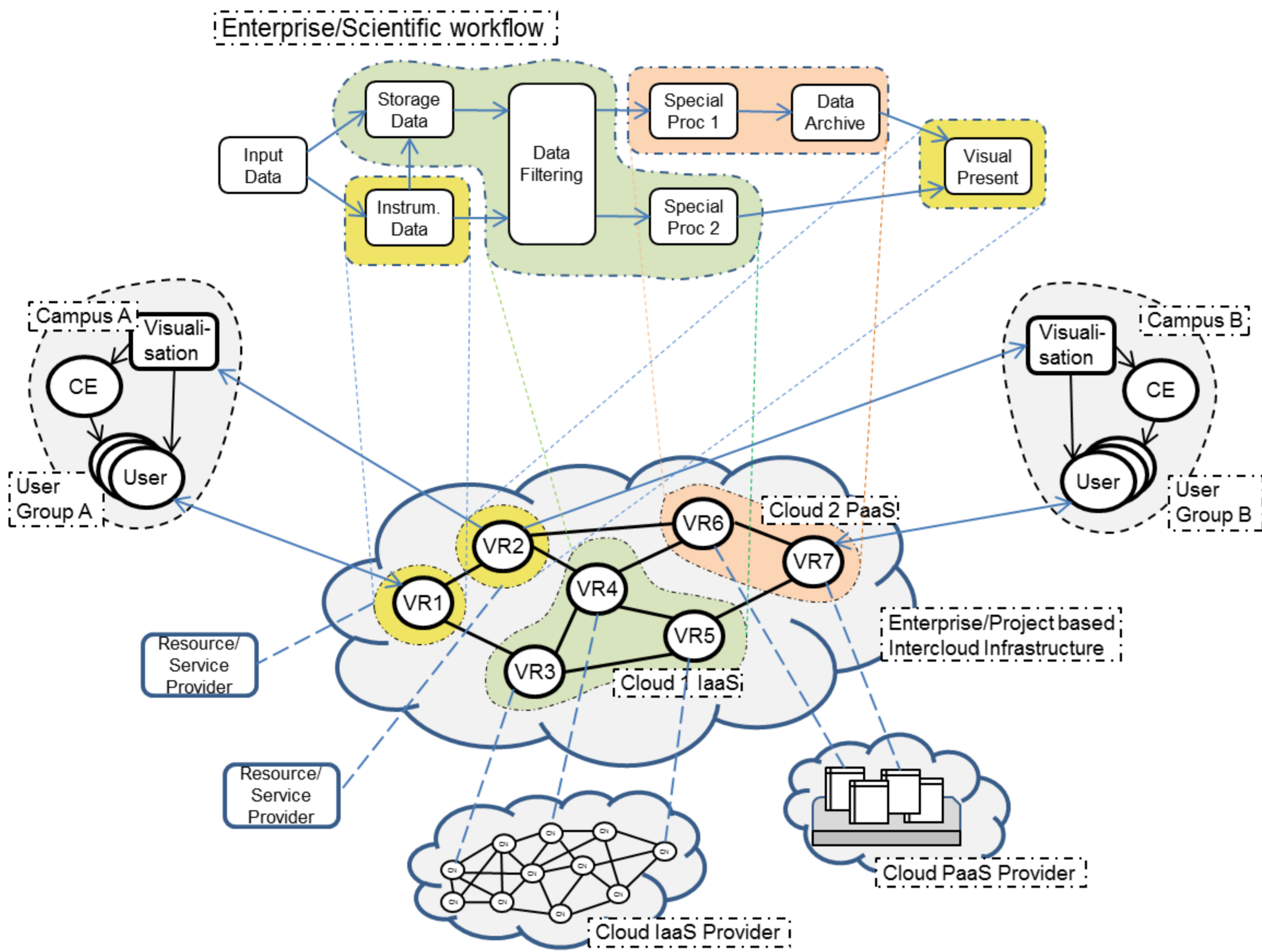


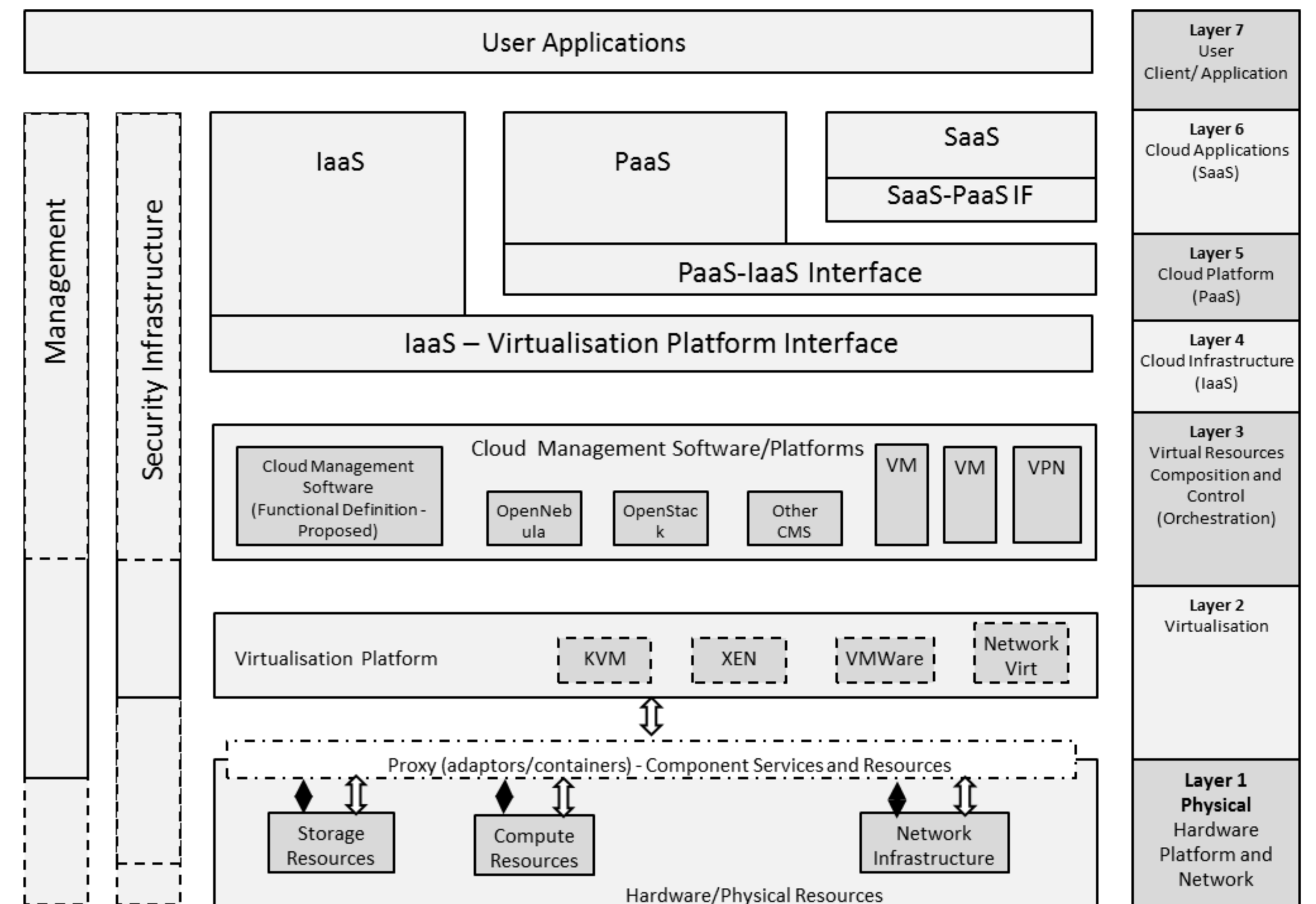
Inter-Cloud Architecture for Interoperability and Integration

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Intercloud Infrastructure/Services Provisioning (General use case: Enterprise/Scientific Workflow deployment on heterogeneous cloud infrastructure)



Multi-layer Cloud Service Models (CSM)



Cloud Services Model Layers

- Layer 1 - Physical platform (PC hardware, network, and network infrastructure)
- Layer 2 - Cloud virtualisation layer (e.g. represented by VMware, Xen or KVM as virtualisation platforms)
- Layer 3 - Cloud virtual resources composition and orchestration layer that is represented by the Cloud Management Software (such as OpenNebula, OpenStack, or others)
- Layer 4 - IaaS provided as infrastructure or used for hosting cloud platforms or applications
- Layer 5 - PaaS provided as a service or used as a platform for hosting cloud applications
- Layer 6 - SaaS (or cloud applications) as a top cloud layer that represents cloud applications
- Layer 7 - User client or application

CSM is compatible with the NIST Cloud Computing Reference Architecture (CCRA, NIST SP 800-282)

General requirements to Intercloud Architecture (ICA)

- ICA should address the interoperability and integration issues in the current and emerging heterogeneous multi-domain and multi-provider clouds, in particular:
- ICA should support communication between cloud applications and services belonging to different service layers (vertical integration), between cloud domains and heterogeneous platforms (horizontal integration).
- ICA should provide a possibility that applications could control infrastructure and related supporting services at different service layers to achieve run-time optimization (Intercloud control and management functions).
- ICA should support cloud services/infrastructures provisioning on-demand and their lifecycle management, including composition, deployment, operation, and monitoring, involving resources and services from multiple providers.

The Intercloud Architecture components

- Multi-layer Cloud Services Model (CSM)** for vertical cloud services interaction, integration and compatibility that defines both relations between cloud service models (such as IaaS, PaaS, SaaS) and other required functional layers and components of the general cloud based services infrastructure.
- Intercloud Control and Management Plane (ICMP)** for Intercloud applications/infrastructure control and management, including inter-applications signaling, synchronization and session management, configuration, monitoring, run time infrastructure optimization including VM migration, resources scaling, and jobs/objects routing.
- Intercloud Federation Framework (ICFF)** to allow independent clouds and related infrastructure components federation of independently managed cloud based infrastructure components belonging to different cloud providers and/or administrative domains; this should support federation at the level of services, business applications, semantics, and namespaces, assuming necessary gateway or federation services.
- Intercloud Operation Framework (ICOF)** includes functionalities to support multi-provider infrastructure operation including business workflow, SLA management, accounting. ICOF defines the basic roles, actors and their relations in sense of resources operation, management and ownership. ICOF requires support from and interacts with both ICMP and ICFF.

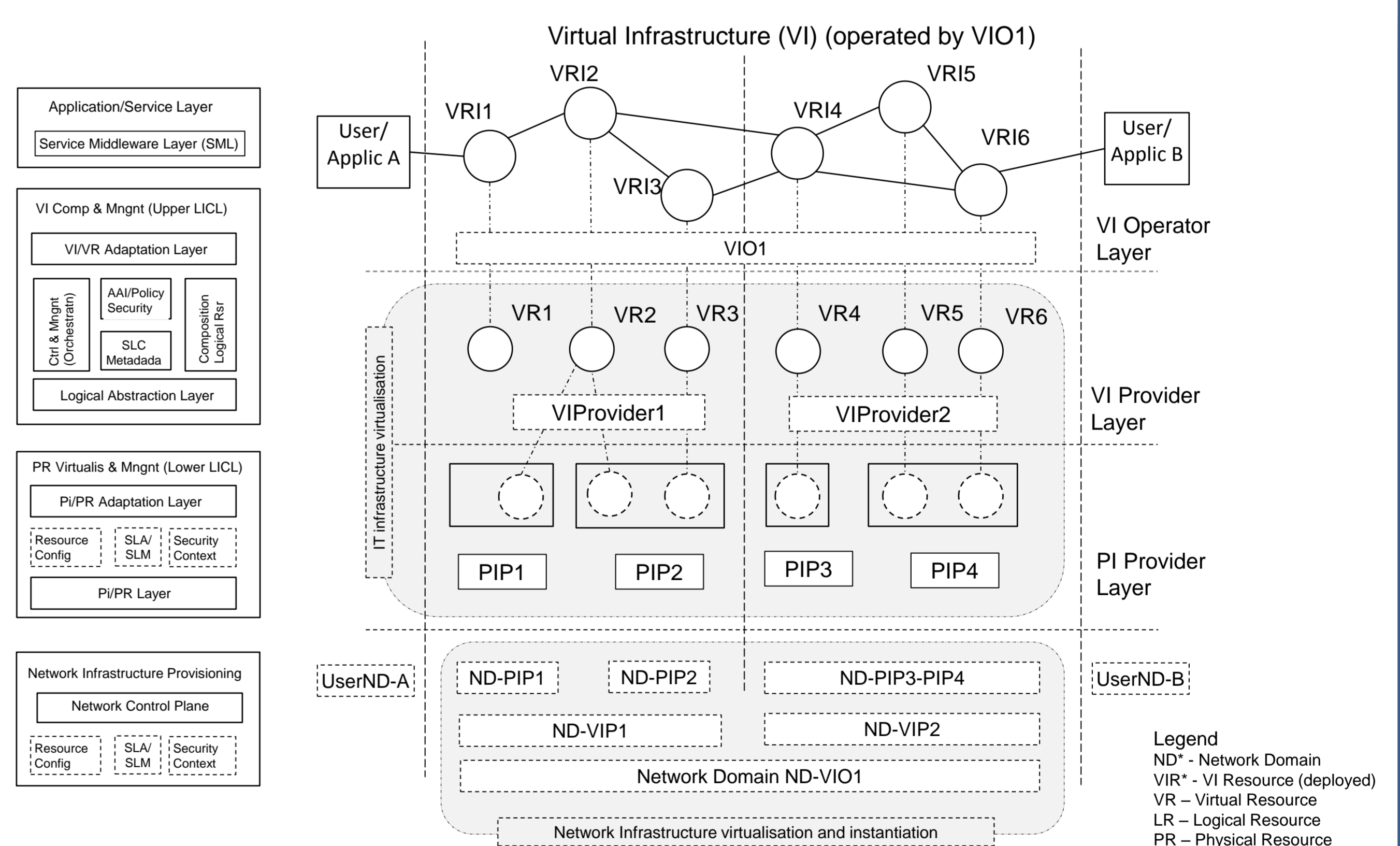
Basic Use Cases for Intercloud Interoperability and Integration

- Use Case 1: Enterprise IT infrastructure migration to cloud and its evolution**
 - Integration of the cloud based components and legacy infrastructure
 - Evolution from general cloud infrastructure services to specialised proprietary cloud platform services
- Use Case 2: Large project-oriented scientific infrastructures including dedicated transport network infrastructure that need to be provisioned on-demand**
- Use Case 3: IT infrastructure disaster recovery that should include both data and supporting infrastructure backup and recovery on possibly new computer/cloud platform**

Contributing Projects

GEYSERS – Generalised Architecture for Infrastructure services - <http://www.geysers.eu/>
 GEANT3 JRA3 Task 3 – Composable services (GEMBus) - <http://www.geant.net/>
 COMMIT P20 - e-Infrastructure and virtualization for e-Science applications – [hNp://www.commit-nl.nl](http://www.commit-nl.nl)

Abstract Model for Infrastructure Services Provisioning



Virtual Infrastructure Composition and Management (VICM) Layer

VICM includes the following layers and components

- Logical Abstraction Layer and the VI/VR Adaptation Layer facing correspondingly lower PIP and upper Application layer
- VICM middleware - defined by CSA and implemented as GEMBus (as extended ESB platform for multi-domain applications)
- VI Composition Service supporting ISMF
- VI Control and Management plane supporting SDF workflow

Main actors involved into provisioning process

- Physical Infrastructure Provider (PIP)
 - Can also be a Cloud resources provider
- Virtual Infrastructure Provider (VIP)
- Virtual Infrastructure Operator (VIO)
 - Optionally inter-VIP network connectivity for VIO can be provided by Virtual Network Infrastructure Provider (VNIP)

Related links

Intercloud Architecture Framework for Interoperability and Integration, Draft version 0.3, 11 May 2012. SNE Technical Report. <http://staff.science.uva.nl/~demch/worksinprogress/sne2012-techreport-12-05-intercloud-architecture-draft03.pdf>
 Generic Cloud IaaS Architecture, Release 1, 15 April 2011. SNE Technical Report. <http://staff.science.uva.nl/~demch/worksinprogress/sne2011-techreport-2011-03-clouds-iaas-architecture-release1.pdf>
 On-Demand Infrastructure Services Provisioning Best Practices, Draft Version 0.3, 23 April 2012 (OGF ISOD-RG Deliverable) <https://forge.ogf.org/sf/go/doc16435?nav=1>
 NIST SP 500-292, Cloud Computing Reference Architecture, v1.0. http://collaborate.nist.gov/twiki-cloud-computing/pub/CloudComputing/ReferenceArchitectureTaxonomy/NIST_SP_500-292_-_090611.pdf

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