EU Brazil Cloud Connect

EU Brazil Cloud Computing for Science

KoM WP3 Task3.2 Overview and Next steps

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Task 3.2 Development of Security and Access Control Mechanisms in a Multi-cloud Federated Environment [M2-M24]

- Task leader: Yuri Demchenko (UvA)
  - Mechanisms to be developed should allow users to access all federated resources using their home institution account
  - Develop appropriate trust and identity management mechanisms

Task 3.2 Activity Details (from DoW)

- Design and implementation of federation mechanisms at the IaaS level that will allow cloud inter-provider federation
- Usage scenario: Independent private cloud providers (members of a federation) that share the same API can reserve/allocate part of their resources to be used in a communal pool of resources (aka distributed ***community cloud***) that can be used any user belonging to the federation.
  - Actually re-use/re-factor Grid VO model
- The mechanisms to be developed should enable federated access control and resource management
  - Authentication, authorization and auditing
  - Resource allocation prioritization - Control & signaling?
  - Support lightweight decentralized business models
    - Evaluate brokered federation operation and management
- Leverage the experience with similar systems, such as the JiT Cloud and OurGrid middleware whose development are led by UFCG

Task 3.2 interaction with other tasks

- Task 3.1 Operation and Support of the Production Infrastructure [M1-M24]
- Task 3.2 Development of Security and Access Control Mechanisms in a Multi-cloud Federated Environment [M2-M24]
- Task 3.3 Adaptation and Deployment of Cloud Federation Mechanism [M1-M24]
- Task 3.4 Exploitation of Shared Resources in an Opportunistic Federated Cloud [M1-M24]
- Task 3.5 Adaptation of CSGrid middleware [M1-M24]

- Task 3.2 will contribute with the security analysis and taxonomy [M2-M?]
- Task 3.2 expect to receive from other tasks use cases and scenarios [M?-M?]
- Task 3.2 jointly with other tasks will specify requirements and define security/access control policy [M?-M?]
- Security interface definition, to be implemented by applications
- Security mechanisms developments
- Security mechanisms integration

Interaction with other WPs

- Should be done via general WP3 interaction
  - WP3 <-> WP5 Use cases

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How to enable effective collaboration?

- Knowing involved people
- Planning work
- Interaction
- Common development platform

Deliverables and Milestones: Security Issues need to be addressed

- MS3.1: Infrastructure configured to allow access to users and developers of EUBrazilCC (M3)
  - All application users and system developers with access to a minimal part of the infrastructure that allows them to use it for their needs
- MS3.2 Deployment of opportunistic private cloud (M12)
  - Prototype able to connect desktops within a LAN to a private cloud in an opportunistic way
- MS3.3 Deployment of federation mechanisms (M16)
  - Prototype able to connect IaaS providers that share the same API using the Network of Favours incentive mechanism

- D3.1 Adaptation Requirements for CSGrid Middleware (M6)
- D3.2 Infrastructure Assessment Report (M12)
- D3.3 Prototype of the CSGrid Adaptation Mechanisms (M12)
- D3.4 Implementation of the Mechanisms to Federate Clouds and Exploit Shared Resources Opportunistically (M16)
- D3.5 Final Infrastructure Assessment Report (M24)

Initial Steps in Security Development

- Define what to protect
  - IaaS infrastructure or separate Compute, Storage, Network
  - Cloud applications
  - Collaborating user community
- Identify/specify used protocols
  - Cloud management protocols: OCCI, CDMI, OVF
  - Grid resources access and management: SE, CE , VOMS, SLCP
- Legacy security solutions and migration strategy
  - Grid on clouds vs native cloud solutions
  - VO based vs Cloud Identity Federation model
- Access control models and policy platform/profile
  - RBAC/ABAC, Identity Federation/Delegation, Security Token Service, Trust establishment and delegation

Federated Identity and Delegation in Clouds

- Existing federated identity schemes can be used to create consistent authentication between distributed computing resources (specifically cloud infrastructures) and a user/client
  - VOMS and (X509 Proxy Certificate or SAML VOMS credentials)
  - Shibboleth (with SAML assertions)
  - ABFAB and Moonshot project (Federated IdM and Trust Management)
  - CILogon and InCommon Federation (in US)
  - OpenID and similar services
- Identity Federation in clouds
  - EGI Identity Federation
  - OpenStack KeyStone Identity Broker/gateway
  - AWS Identity and Access Management (IAM)
- Traditional approach in clouds requires the Cloud Service Provider (CSP) to be involved into federation establishment
  - Need to limit CSP role to an initial Trusted Introducer
  - Avoid CSP role as (identity) broker or (authorisation) gateway

Federation in Grid and Clouds: Grid VO vs Cloud Virtual Infrastructure

- **Grid** federates resources and users by creating Virtual Organisations (VO)
  - VO membership is maintained by assigning VO membership attributes to VO resources and members
  - Resources remain under control of the Grid Resource Centers
  - Users remain members of their Home Organisations (HO)
    - AuthN happens at HO or Grid portal
    - To access VO resources, VO members need to obtain VOMS certificate
    - X.509 Proxy Certificate is used to AuthZ users/jobs at Grid resources
- **In clouds**, both resources and user accounts are created/provisioned on-demand as virtualised components/entities
  - User accounts/identities can be provisioned together with access rights to virtual resources

Cloud Federation – Scaling up and down

- Scalability is one of the main cloud feature
  - To be considered in the context of hybrid cloud service model
    - Cloud burst and outsourcing enterprise services to cloud
    - Cloud services migration and replication between CSP
- Scaling up
  - Identities provisioning
  - Populating sessions context
- Scaling down
  - Identity de-provisioning: Credentials revocation?
  - Sessions invalidation vs restarting
- Initiated by provider and by user/customer

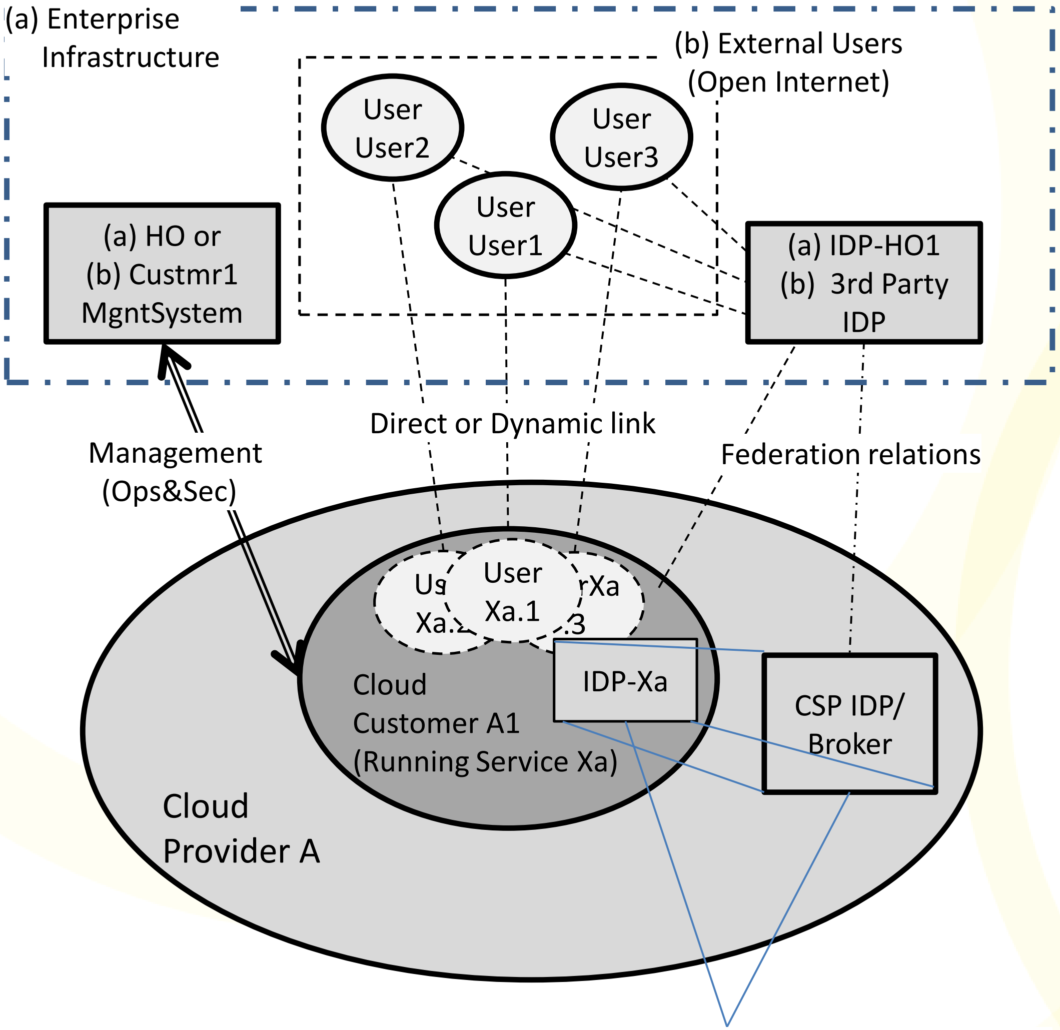
Discussion how to proceed

- Who is involved?
- Design and development team cooperation

Supporting material

- Federated Identity and delegation
  - Approach and tools
- Multi-tenant Access Control for Cloud Infrastructure Services
- GAAA-TK (Generic AAA Toolkit)
  - Security context and session management, delegation
  - Policy and attribute profiles
  - Policy management and evaluation
- Federation in clouds and Intercloud Federation Framework (ICFF)
  - Operational models and components
- Intercloud Architecture Framework (ICAF)
  - Multilayer Cloud Services Model (CSM)
  - ICCMP, ICFF, ICOMF, ICSF (Intercloud Security Framework)

Basic Cloud Federation model – Combined User side federation

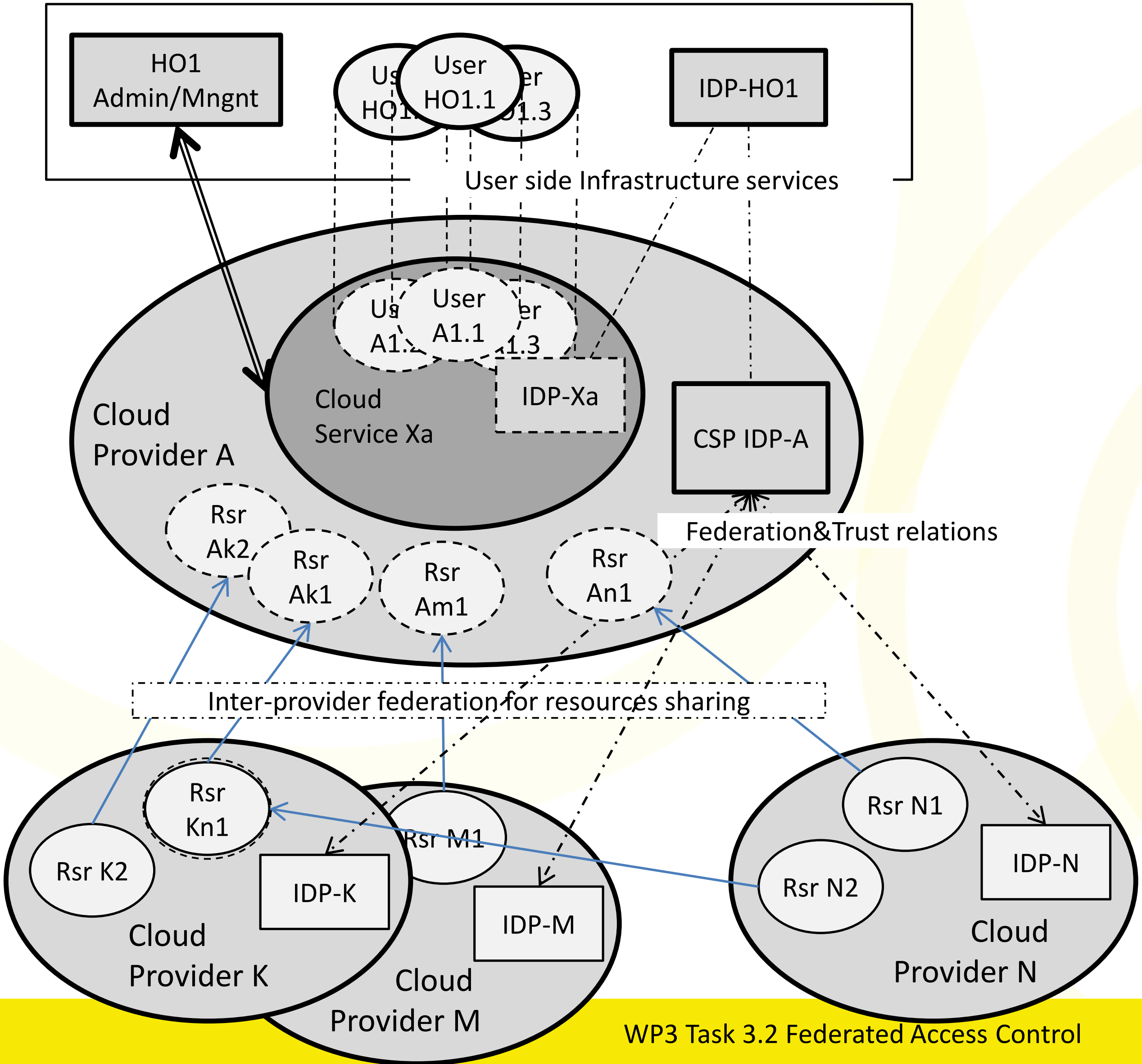

(a) Enterprise Infrastructure
(b) External Users (Open Internet)
User User2
User User3
User User1
(a) HO or (b) Custmr1 MgntSystem
(a) IDP-HO1 (b) 3rd Party IDP
Direct or Dynamic link
Federation relations
Management (Ops&Sec)
Us Xa.2
User Xa.1
rXa .3
IDP-Xa
CSP IDP/ Broker
Cloud Customer A1 (Running Service Xa)
Cloud Provider A

IDP-Xa can be implemented
as instantiated service of the CSP IDP

User side Federation

- Simple/basic scenario 2: Federating Home Organisation (HO) and Cloud Service Provider (CSP) domains
- Cloud based services created for external users (e.g. website) and managed by Customer 1
- Involved major actors and roles
  - CSP – Customer – User
  - IDP/Broker
- Cloud accounts A1.1-3 are provisioned for each user 1-3 from HO with 2 options
  - Individual accounts with new ID::pswd
  - Mapped/federated accounts that allows SSO/login with user HO ID::pswd
- Federated accounts may use Cloud IDP/Broker (e.g. KeyStone) or those IDP-Xa created for Service Xa

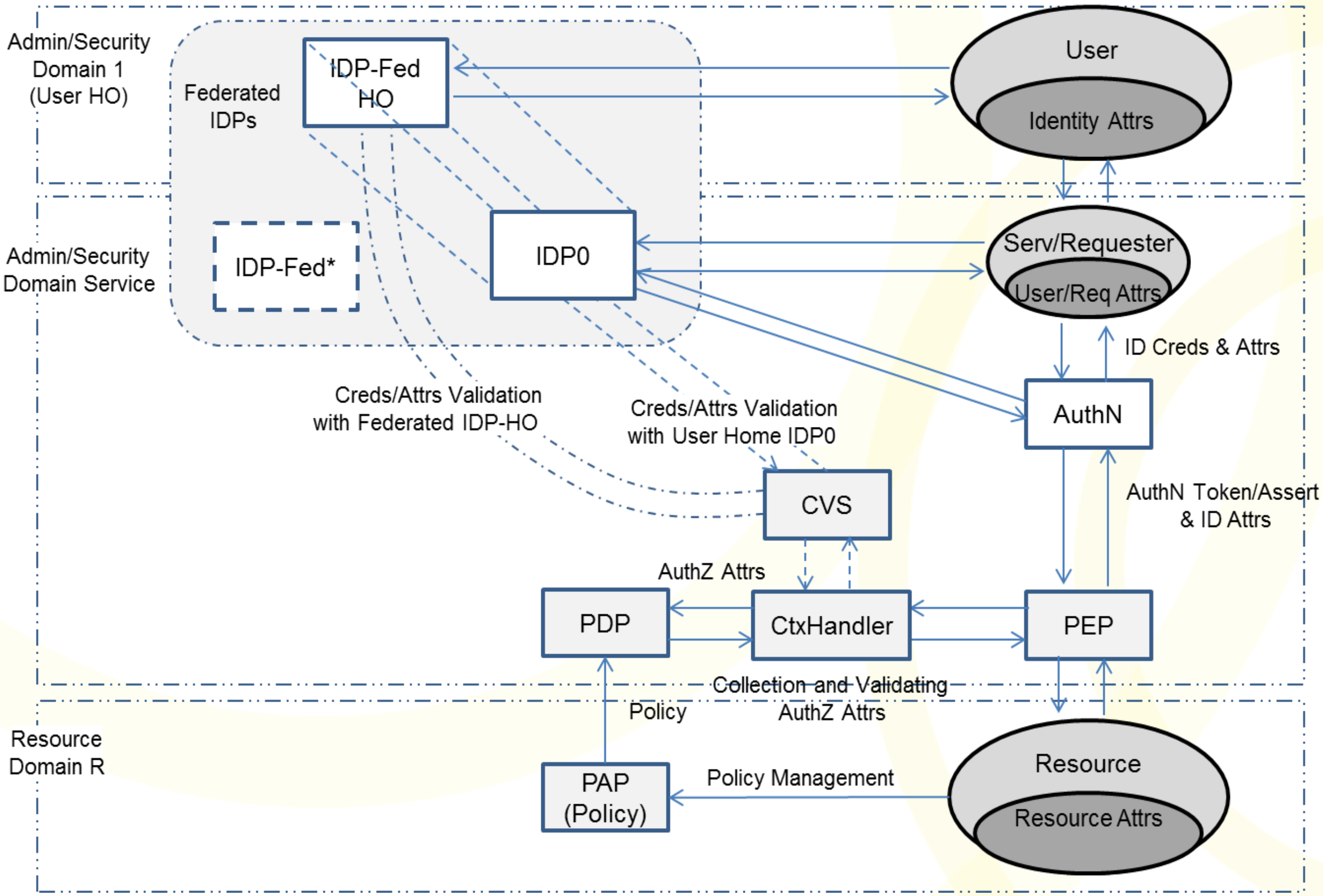
Basic Cloud Federation model – Federating CSP's/multi-provider cloud resources



- Cloud provider side federation for resources sharing
- Federation and Trust relations are established between CSP's via Identity management services, e.g. Identity Providers (IDP)
  - May be bilateral or via 3rd party/broker service
- Includes translation or brokering
  - Trust relations
  - Namespaces
  - Attributes semantics
  - Policies
- Inter-provider federation is transparent to customers/users

Provider side Federation

Authorisation in a Federated Cloud Environment

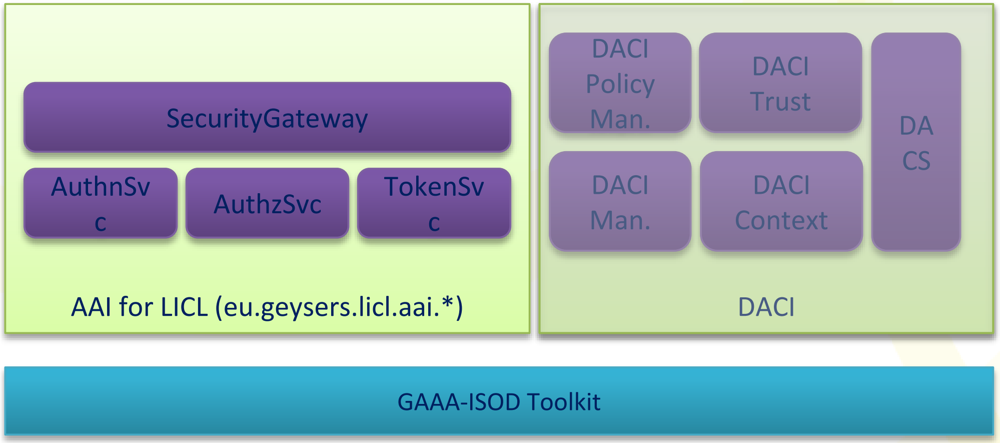

Admin/Security Domain 1 (User HO)
Federated IDPs
IDP-Fed HO
User
Identity Attrs
IDP-Fed*
IDP0
Serv/Requester
User/Req Attrs
Admin/Security Domain Service
ID Creds & Attrs
AuthN
Creds/Attrs Validation with Federated IDP-HO
Creds/Attrs Validation with User Home IDP0
CVS
AuthN Token/Assert & ID Attrs
AuthZ Attrs
PDP
CtxHandler
PEP
Collection and Validating AuthZ Attrs
Policy
Resource Domain R
PAP (Policy)
Policy Management
Resource
Resource Attrs

- PEP (Policy Enforcement Point)
- PDP (Policy Decision Point)
- PAP (Policy Authotity Point)
- CVS (Credentials Validation Service)

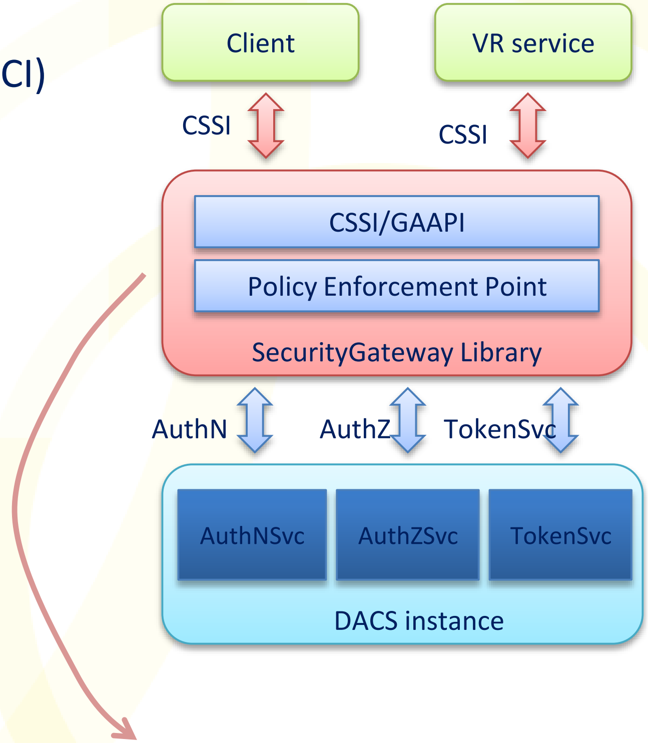
GAAA Authorisation Framework and GAAA Toolkit (GAAA-TK)

GEYSERS project Network+IT IaaS infrastructure provisioning Security Infrastructure

- Logical Infrastructure Composition Layer (LICL)
  - FUSE ESB env, OSGi bundles
  - Packages: AuthN/AuhZ and Dynamic Access Control Infra (DACI)
- Network Control Plane (NCP+)
  - AuthnSvc&AuthzSvc Web services
  - SecurityGateway library
- GAAA Toolkit Java Library provides core functionality
  - GAAA-ISOD profile (Infrastructure Services On Demand)

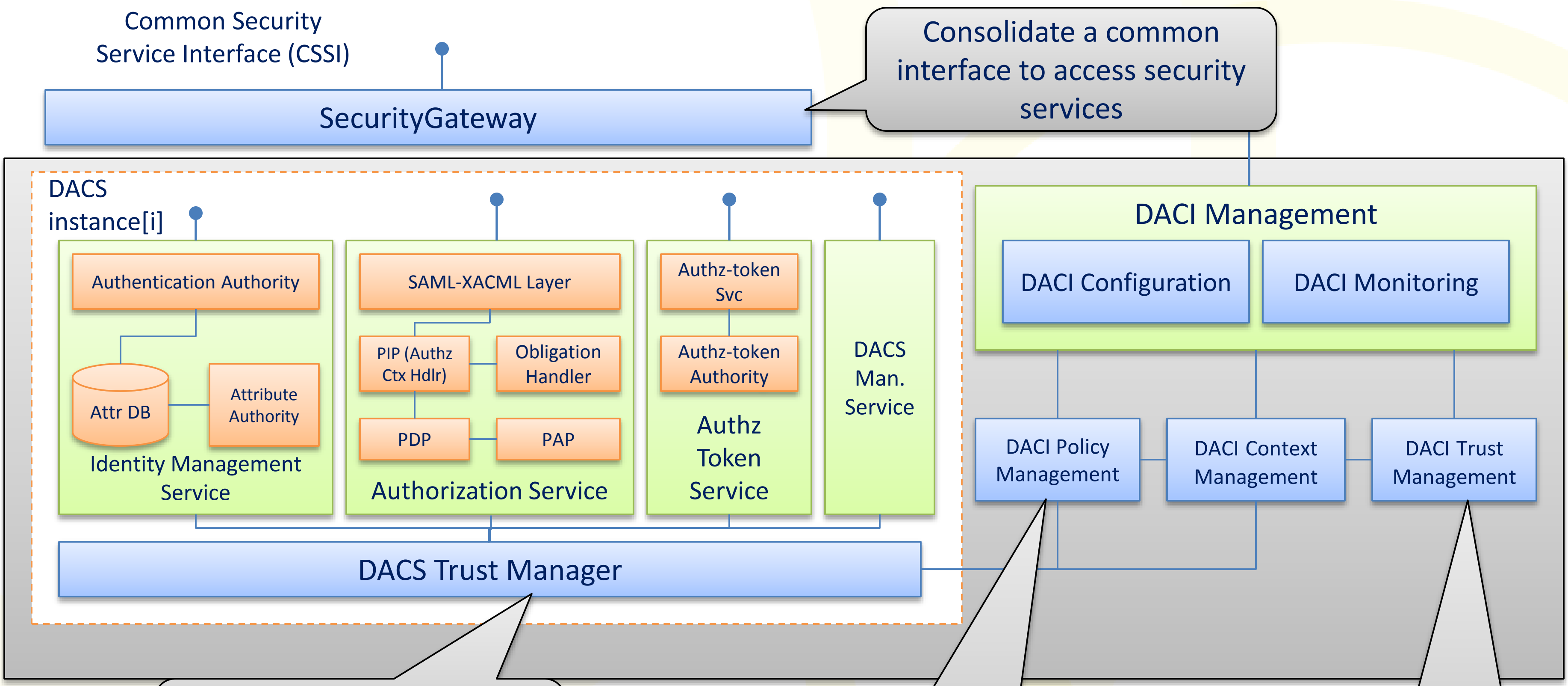


AAI Components



Integration
(via SecurityGateway)

Dynamic Access Control Infrastructure (DACI)



Consolidate a common interface to access security services

Provisioned on demand security services (DACS)

Update authz-policies upon reconfiguring Virtual Infrastructure

Dynamic Trust Establishment: DSA, Bootstrapping

DACI: Dynamic Access Control Infrastructure
DACS: Dynamic Access Control Services

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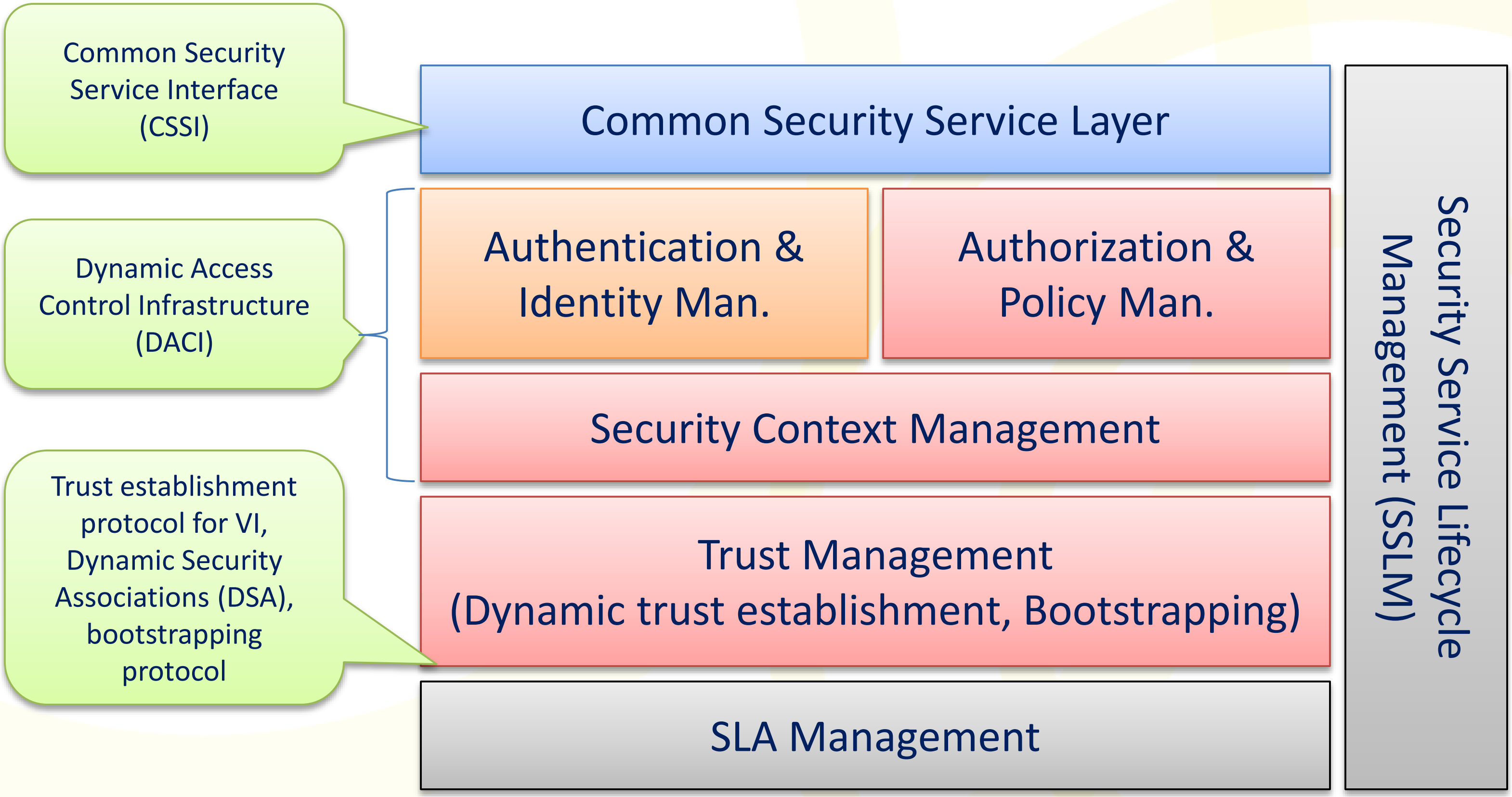
Security Services Reference Model


Common Security Service Interface (CSSI)
Dynamic Access Control Infrastructure (DACI)
Trust establishment protocol for VI, Dynamic Security Associations (DSA), bootstrapping protocol
Common Security Service Layer
Authentication & Identity Man.
Authorization & Policy Man.
Security Context Management
Trust Management (Dynamic trust establishment, Bootstrapping)
SLA Management
Security Service Lifecycle Management (SSLM)

Note: Integration with SLA management/negotiation is needed to ensure consistency

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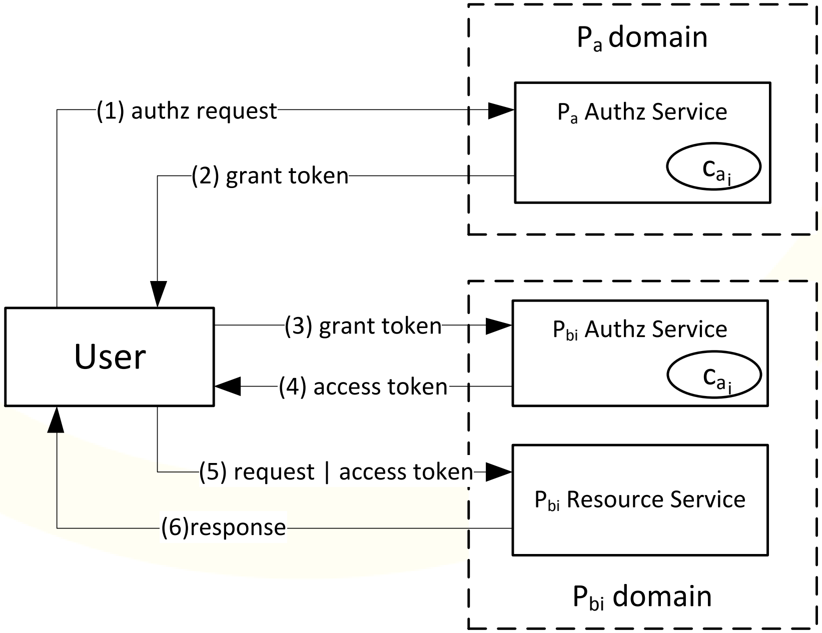
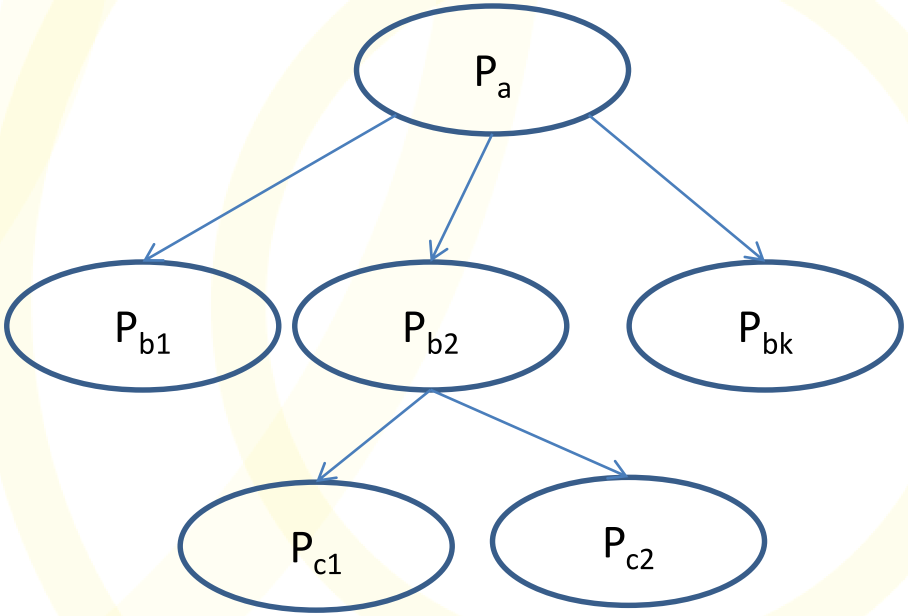
Multi-tenant Access Control for Cloud Infrastructure Services

System and Network Engineering

- Apply MT-AC in hierarchy
  - A high-level provider is a tenant of the low-level provider
  - Grant permissions -> Delegate granted permissions
  - Security context management using tokens as session credentials

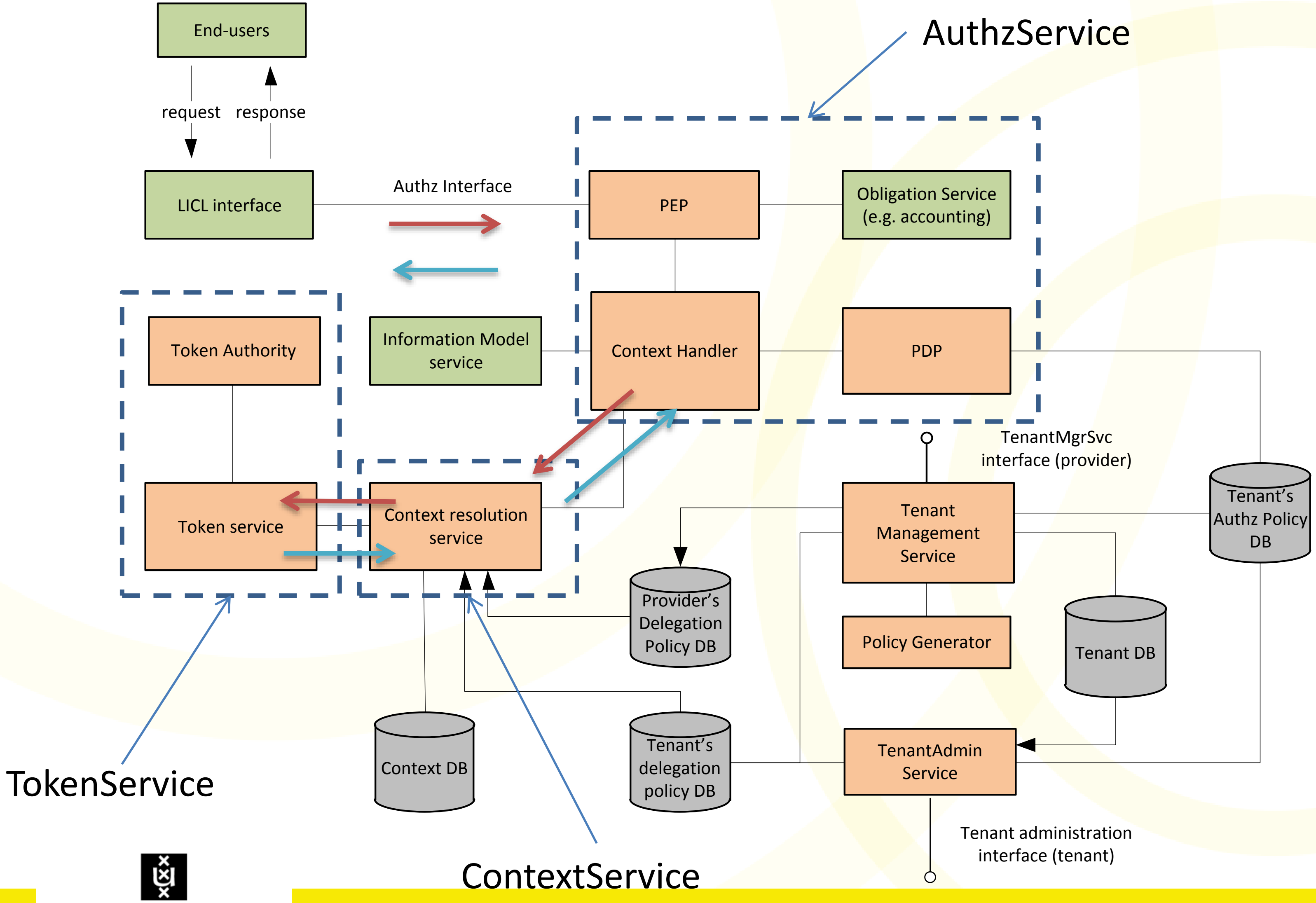


Exchanging tokens in Intercloud



MT-AC in hierarchy

GAAA-TK Implementation for complex infrastructure provisioning (GEYSERS project)


AuthzService
End-users
request
response
LICL interface
Authz Interface
PEP
Obligation Service (e.g. accounting)
Token Authority
Information Model service
Context Handler
PDP
TenantMgrSvc interface (provider)
Token service
Context resolution service
Tenant Management Service
Tenant's Authz Policy DB
Provider's Delegation Policy DB
Policy Generator
Tenant DB
Context DB
Tenant's delegation policy DB
TenantAdmin Service
TokenService
Tenant administration interface (tenant)
ContextService

InterCloud Architecture Framework (ICAF)

- 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 Framework (ICOF)
  - RORA model: Resource, Ownership, Role, Action
    - RORA model provides basis for business processes definition, SLA and access control
  - Broker and federation operation
- Intercloud Security Framework (ICSF)
  - Dynamic Security Infrastructure provisioning and protocols

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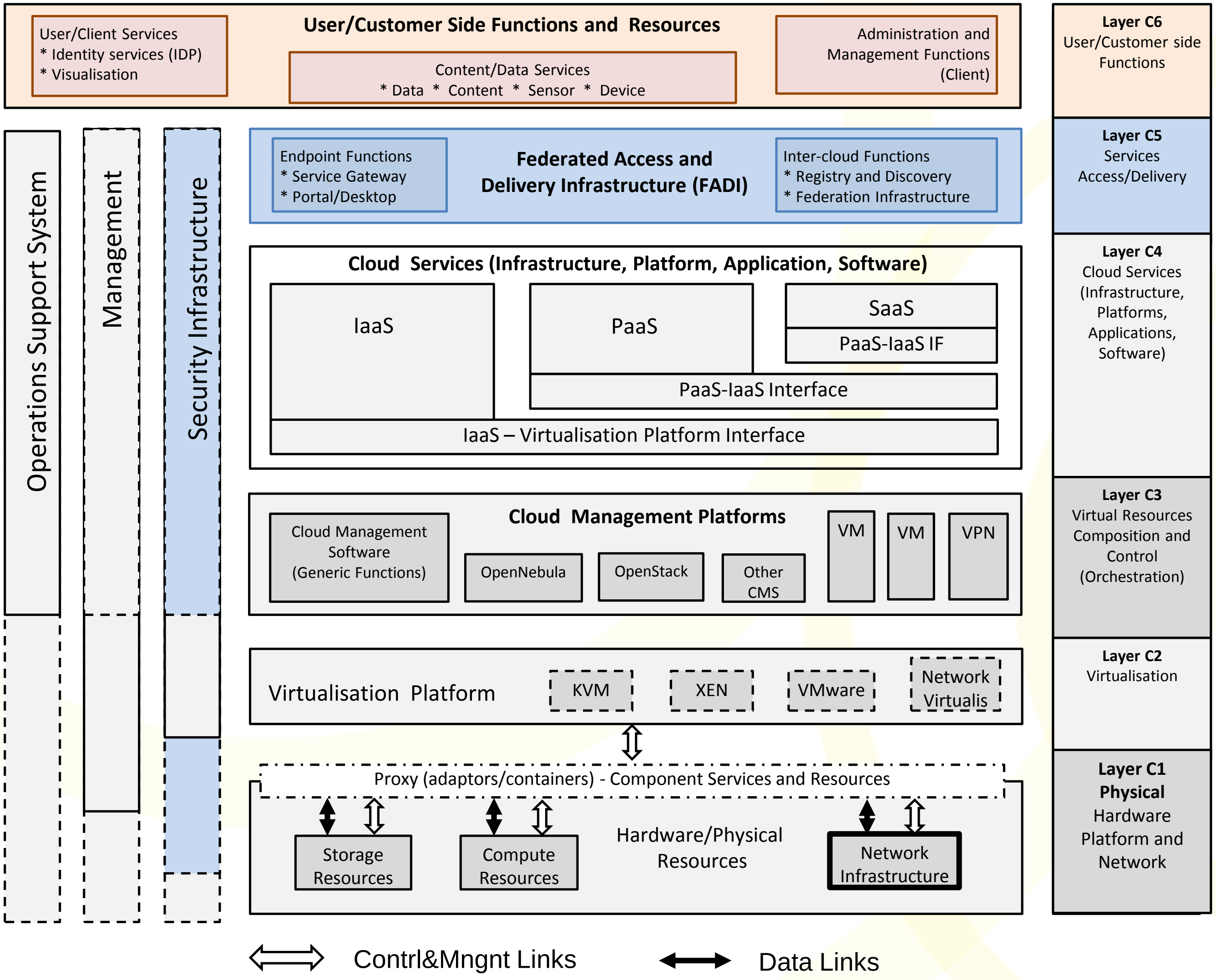
Multilayer Cloud Services Model (CSM)

http://www.ietf.org/id/draft-khasnabish-cloud-reference-framework-06.txt



User/Customer Side Functions and Resources
User/Client Services
* Identity services (IDP)
* Visualisation
Content/Data Services
* Data * Content * Sensor * Device
Administration and Management Functions (Client)
Operations Support System
Management
Security Infrastructure
Endpoint Functions
* Service Gateway
* Portal/Desktop
Federated Access and Delivery Infrastructure (FADI)
Inter-cloud Functions
* Registry and Discovery
* Federation Infrastructure
Cloud Services (Infrastructure, Platform, Application, Software)
IaaS
PaaS
SaaS
PaaS-IaaS IF
PaaS-IaaS Interface
IaaS – Virtualisation Platform Interface
Cloud Management Platforms
Cloud Management Software (Generic Functions)
OpenNebula
OpenStack
Other CMS
VM
VM
VPN
Virtualisation Platform
KVM
XEN
VMware
Network Virtualis
Proxy (adaptors/containers) - Component Services and Resources
Storage Resources
Compute Resources
Hardware/Physical Resources
Network Infrastructure
Contrl&Mngnt Links
Data Links
Layer C6
User/Customer side Functions
Layer C5
Services Access/Delivery
Layer C4
Cloud Services (Infrastructure, Platforms, Applications, Software)
Layer C3
Virtual Resources Composition and Control (Orchestration)
Layer C2
Virtualisation
Layer C1
Physical
Hardware Platform and Network

CSM layers

(C6) User/Customer side Functions

(C5) Intercloud Access and Delivery Infrastructure

(C4) Cloud Services (Infrastructure, Platform, Applications)

(C3) Virtual Resources Composition and Orchestration

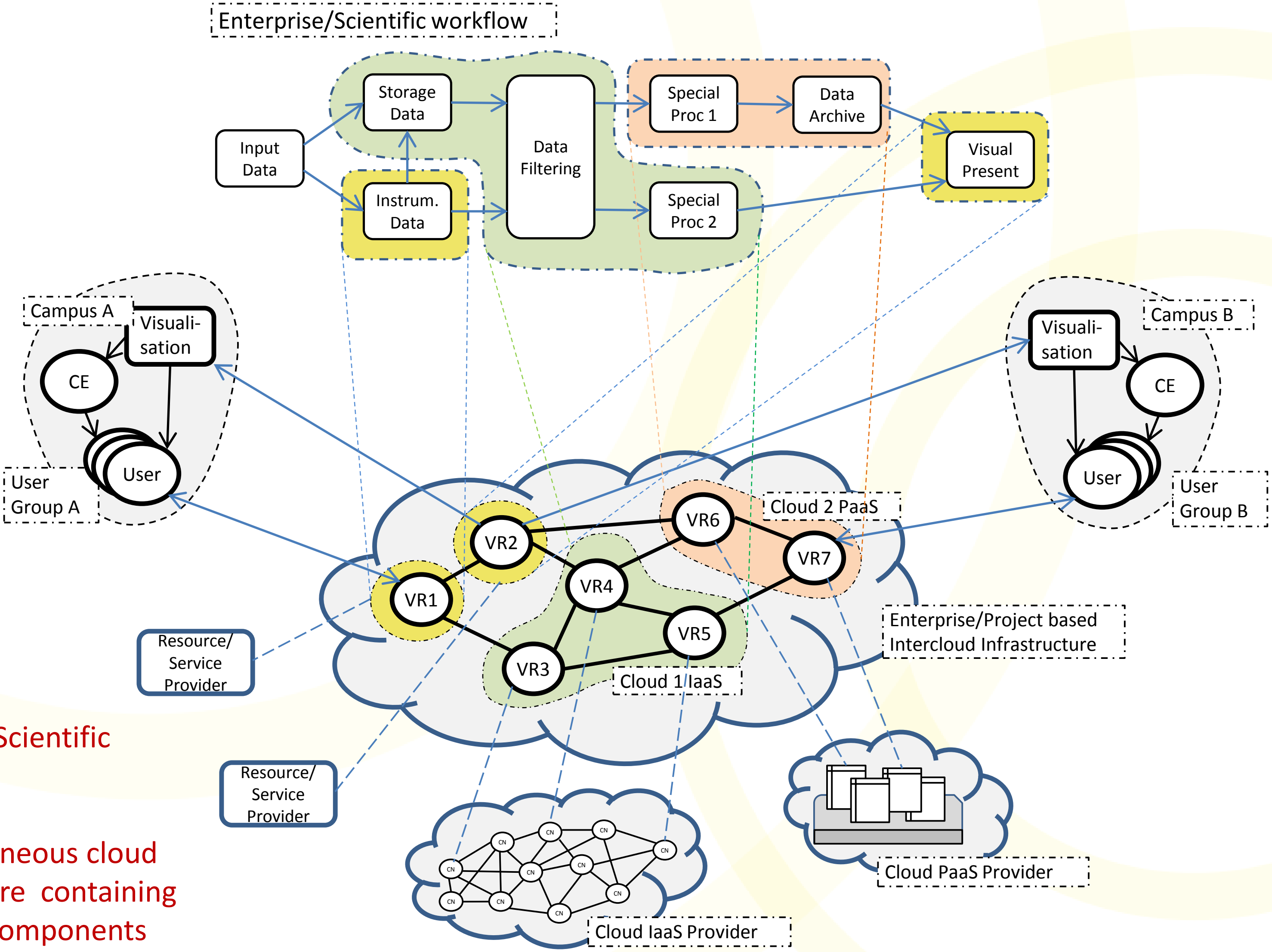
(C2) Virtualisation Layer

(C1) Hardware platform and dedicated network infrastructure

⇔ Control/ Mngnt Links

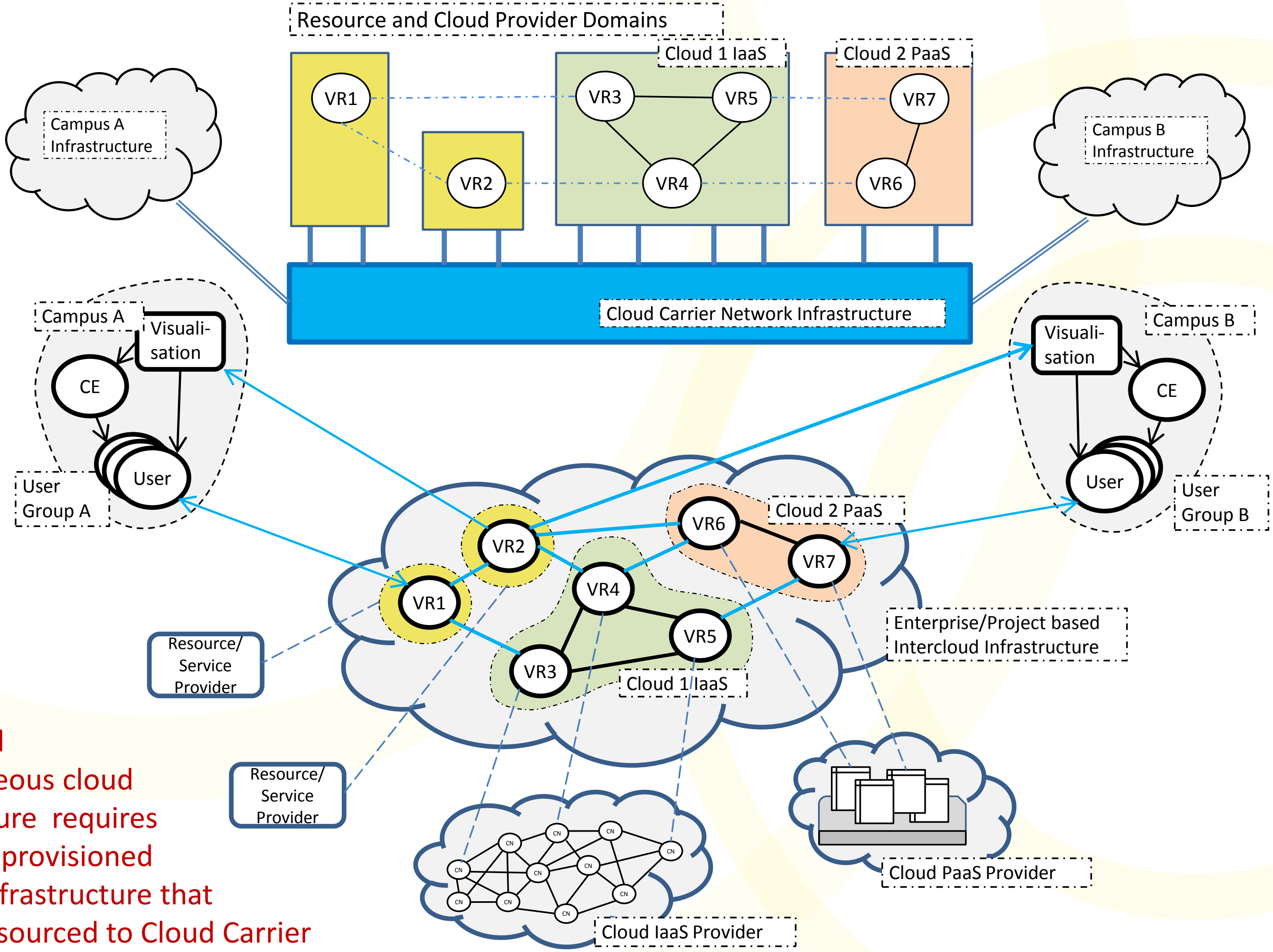
⟷ Data Links

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



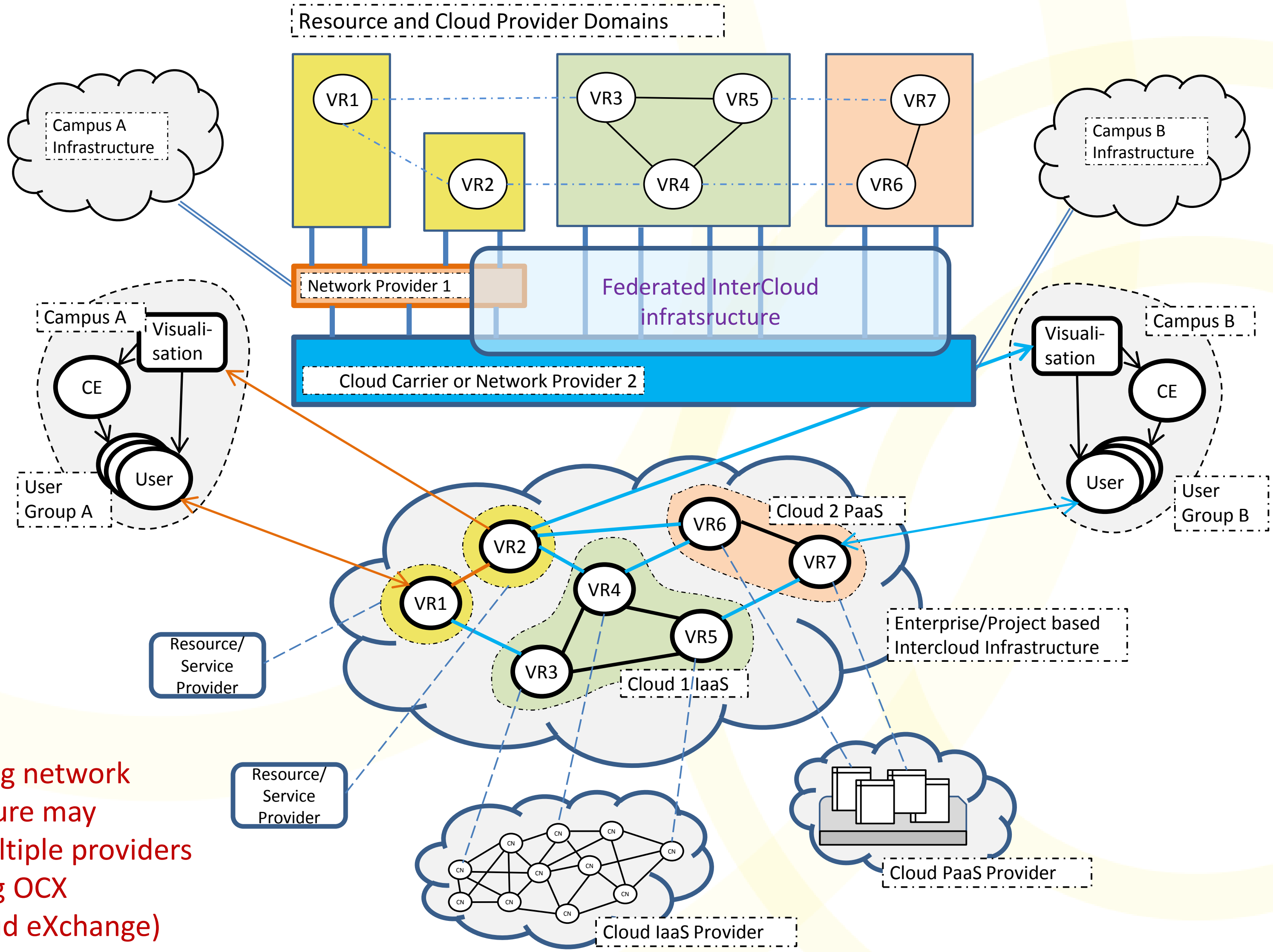
Enterprise/Scientific workflow
Is mapped
to heterogeneous cloud
infrastructure containing
IaaS, PaaS components

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



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

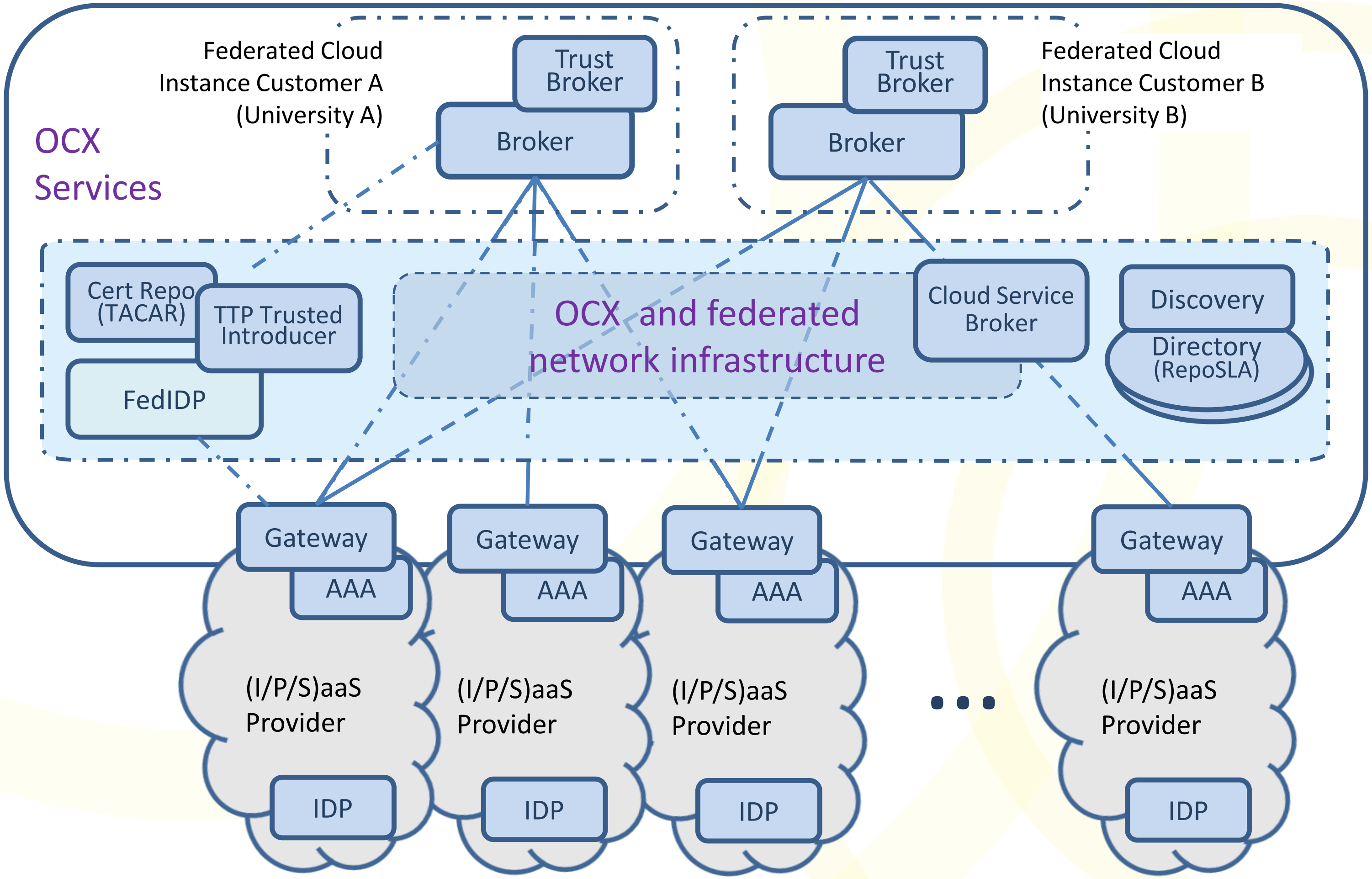
General use case for infrastructure provisioning: Logical Infrastructure => Network Infrastructure (2)



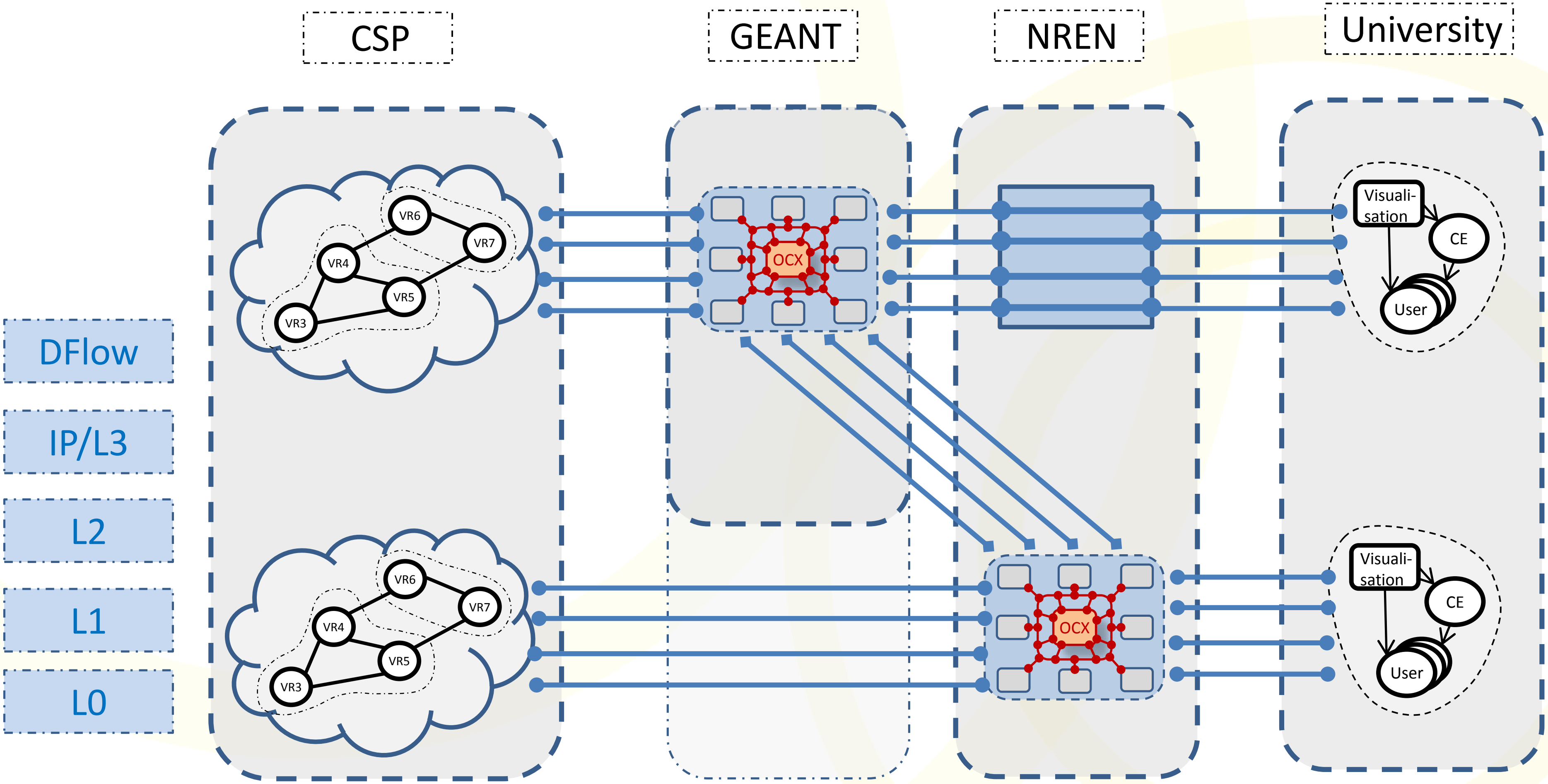
Provisioning network infrastructure may involve multiple providers

Introducing OCX (Open Cloud eXchange)

Intercloud Federation Infrastructure and Open Cloud eXchange (OCX)



OCX Hierarchical Topology Model


CSP
GEANT
NREN
University
DFlow
IP/L3
L2
L1
L0
VR6
VR7
VR4
VR5
VR3
OCX
Visuali-sation
CE
User
VR6
VR7
VR4
VR5
VR3
OCX
Visuali-sation
CE
User