Grid optimized Network Control Plane

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Agenda

- Grid Application requirements on Carrier Networks
- Current practices:
  - The overlay case
  - Grids – Network Management interconnections
- Practical experiences:
  - ARGON and Meta-scheduler
- Levels of Grid Application - Network Control integration
- Standard Organization Synergy outlooks

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Grid Applications are Shared

- Grids are geographically distributed and connected by a wide-area network
- Grids are heterogeneous in many Resource aspects: computing, storage, sensor/instruments
- A collection of Grid services can "dynamically" be established and then leave the Grid
- Grid Application Servers are shared and accessed "on-demand" by a set of Grid session through Grid Middleware services

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Convergent Carrier Networks are Shared

- Network Infrastructure is a collection of switching technologies (regions): e.g. Ethernet Wavelength, SONET/SDH, IP/MPLS and others
- Network infrastructures is enabled to provide different Connectivity Services to its users
- Network infrastructure is shared between different class of application users
- Operational Network is able to reconfigure its connections with its control plane

Grid Application Requirements on the Connectivity

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Network Connectivity services for Grids should rely on:

- Multipoint Connectivity Services
  - A Grid session interconnect multiple resource end points
- Inter-Domain Traffic Engineering extensions
  - A Grid session can span several Administrative domains
- Multi-Switching Capability Connections
  - A Grid session can be transported by several network layers and/or cross several network regions
- Different Signaling options for Network Resources
  - In advance: scheduled bandwidth requests
  - Real-time: immediate bandwidth provisioning

Grid Application Requirements on the Network (con't)

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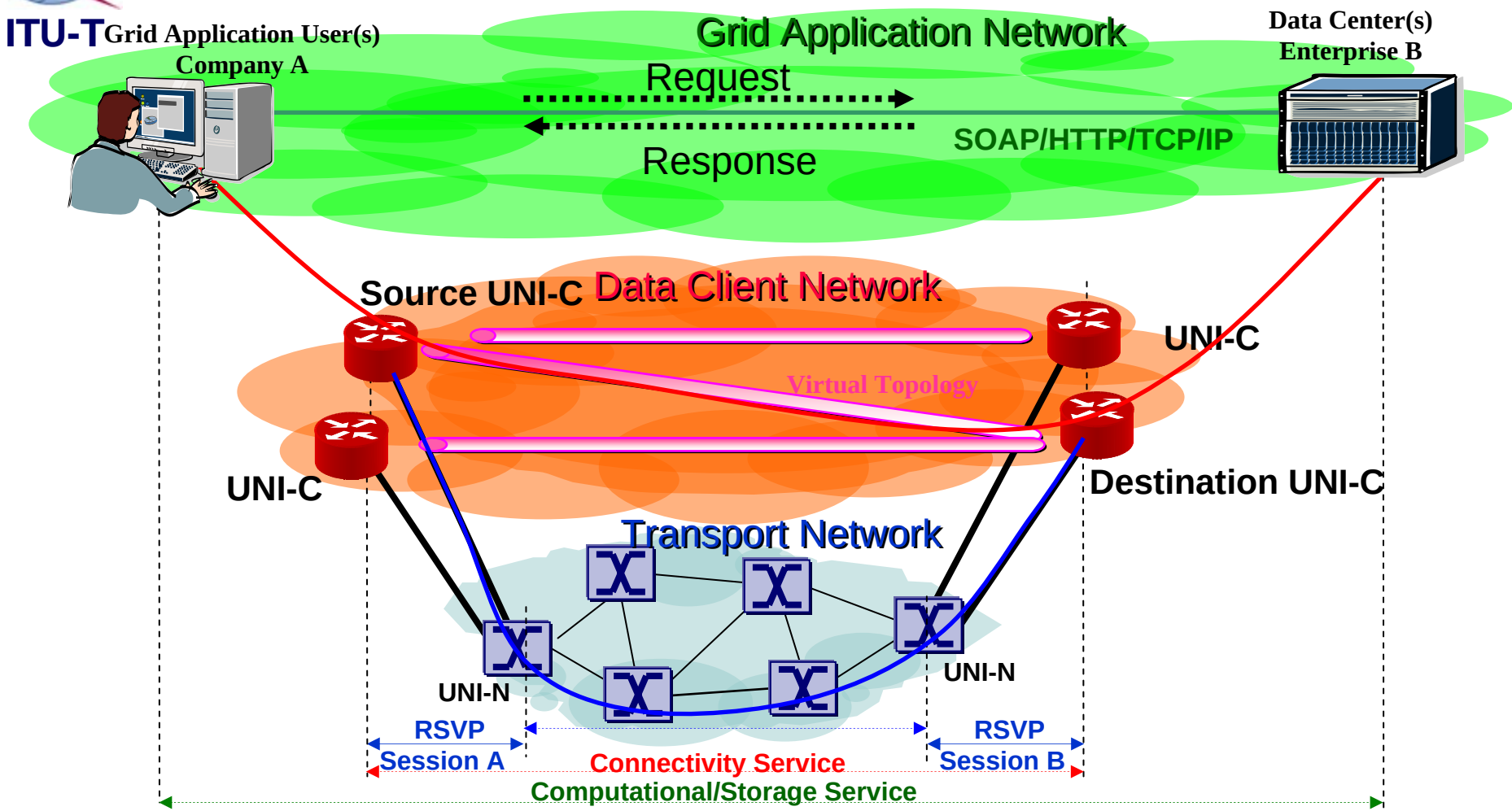
- In Most of the cases Grid applications are overlaid on the Network infrastructure and do not communicate their QoS requirements:
  - Dedicated resources or over-provisioning are required to sustain the highest value of QoS needed
  - Shared resources and no QoS (best-effort)
- Enhancements of Grid Application→Network control interactions are required to
  - Allow network control plane to deliver dynamically connectivity with the correct QoS values
  - Configure Network according to Grid application needs, (re)configuration should be fast, accurate and automatic
  - Orchestrate end-2-end Grid and Network resources

Overlay Model: No dynamic possible



- Application Users request Grid Services to the Servers through the Middleware Application triggering e.g. XML/HTTP/TCP/IP session(s)S

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Specifications for Grid applications to interact with its transport network

Specifications for more Grid → Network interactions:

- Control for resource discovery, resource selection and signaling is more uniform
- Virtualization for Grid and Network Resources:
  - To control the resources allocated during a Grid session
- Grid applications can provide directly their QoS requirements to shared controlled network
- End-to-end resource cross optimization is enabled:
  - end Grid resources: CPU, storage, instruments; and
  - network resources: bandwidth with QoS guarantees

Integrated Model: exploits the control functions

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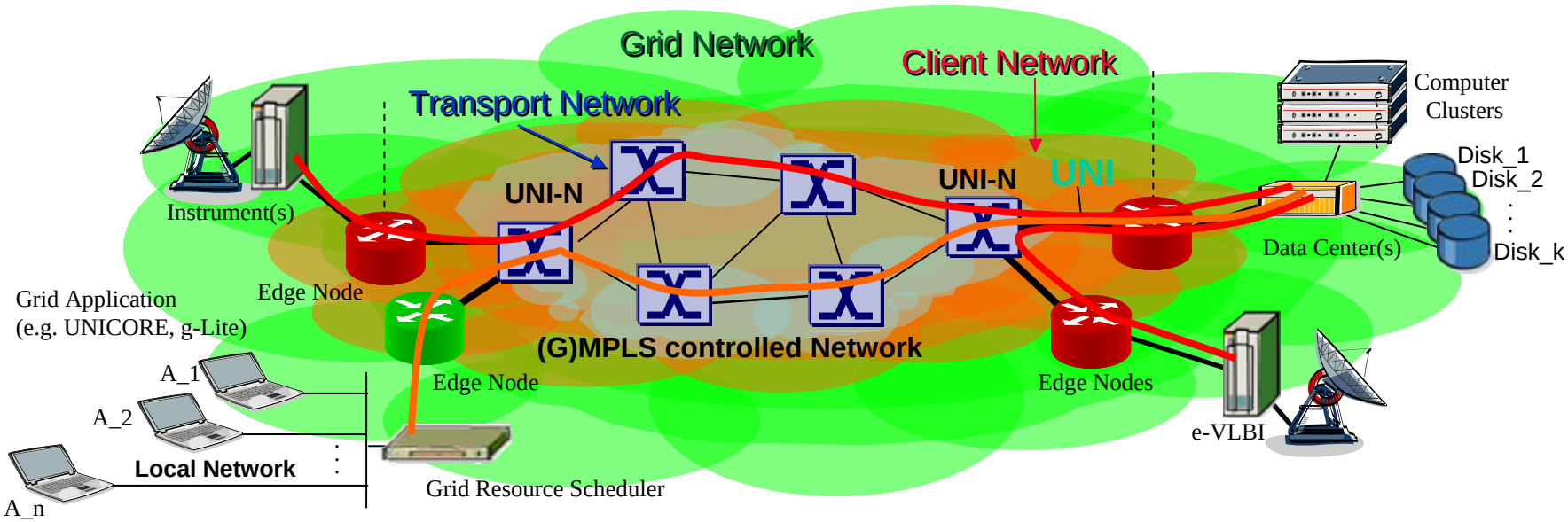
- Integrated (Grid+Network) Control relies on resource virtualization with combined resource discovery, selection and reservation
- Coupling Grid Sessions and Connections set-up/release enable efficient use of the resources at multiple sites
- Grid sessions express its bandwidth needs, and Network establishes very quickly an exclusive VPN



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Different levels of Grid Application / Network interactions

Compendium of architectures and functionality alternatives

- Level 0: Application - Network Resources are disjointedly controlled: no hook
  - End-Hosts solely drive the Grid applications operations on a full provisioned network
- Level 1: Management plane based system: Grid – NMS Middleware interactions: "Gateway" hook
  - Grid / Connection requests are centralized
- Level 2: Application Control functions – Network Control functions interactions:
  - Grid / Connection Controls are integrated and can be distributed
  - Cross-optimization between Grid and Network Resources enabled at each location and globally

«Application – Network hook» where ?

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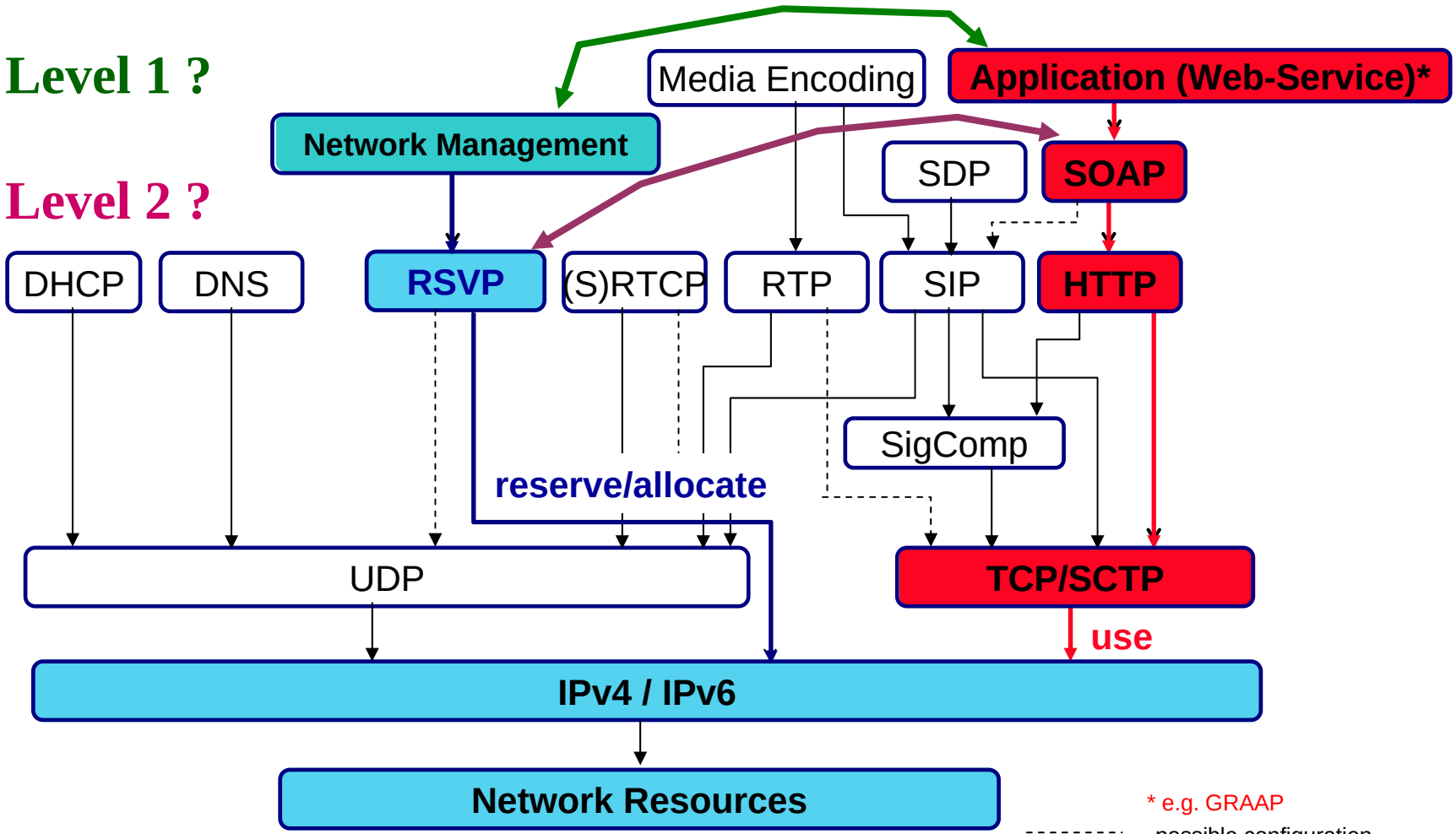
Level 0 ?

Level 1 ?

Level 2 ?



Level 1 example: ARGON - Network Architecture
Allocation and Reservation in Grid-enabled Optic Networks

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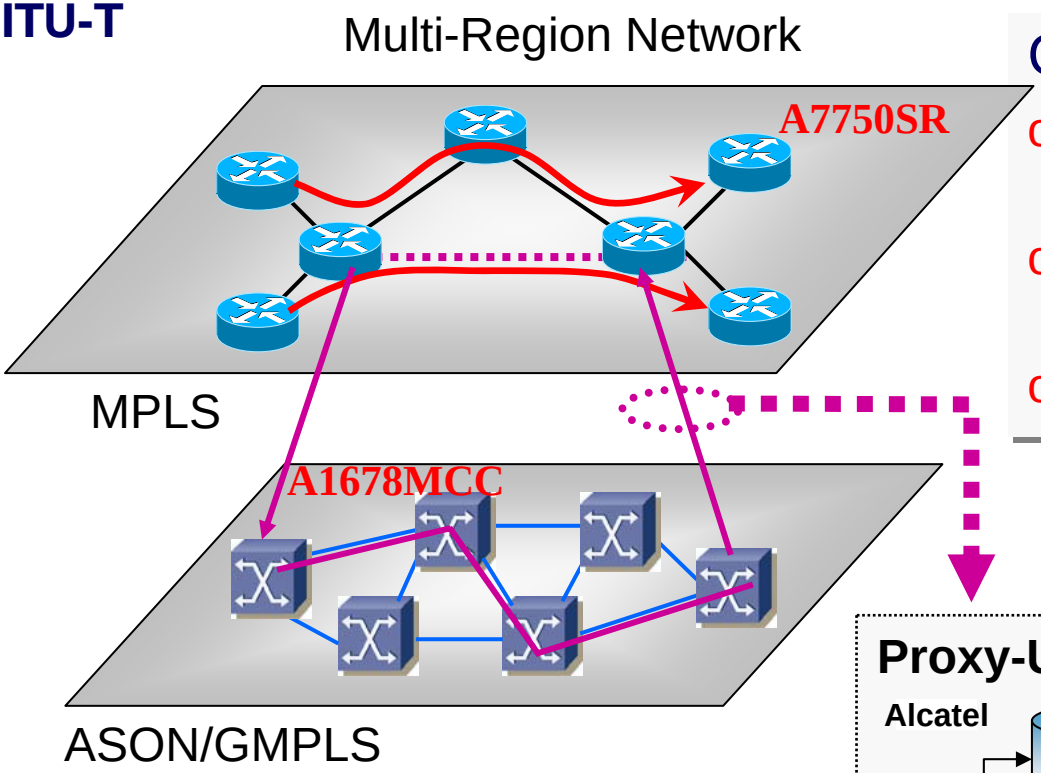
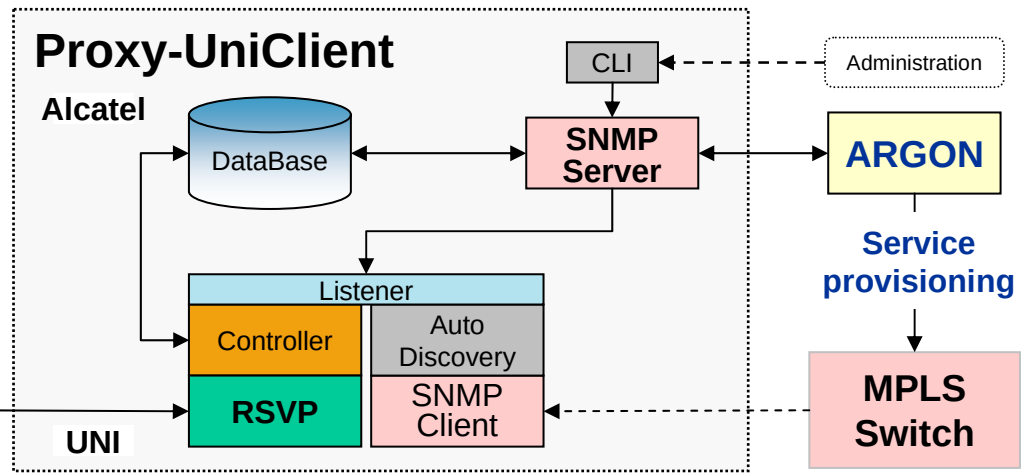


Overlay Model case:

- Optical domain is not visible to IP domain
- MPLS domain can not perform efficient TE (two Routing AS)
- GMPLS UNI signaling



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Level 1: Meta-Scheduling Service – Architecture

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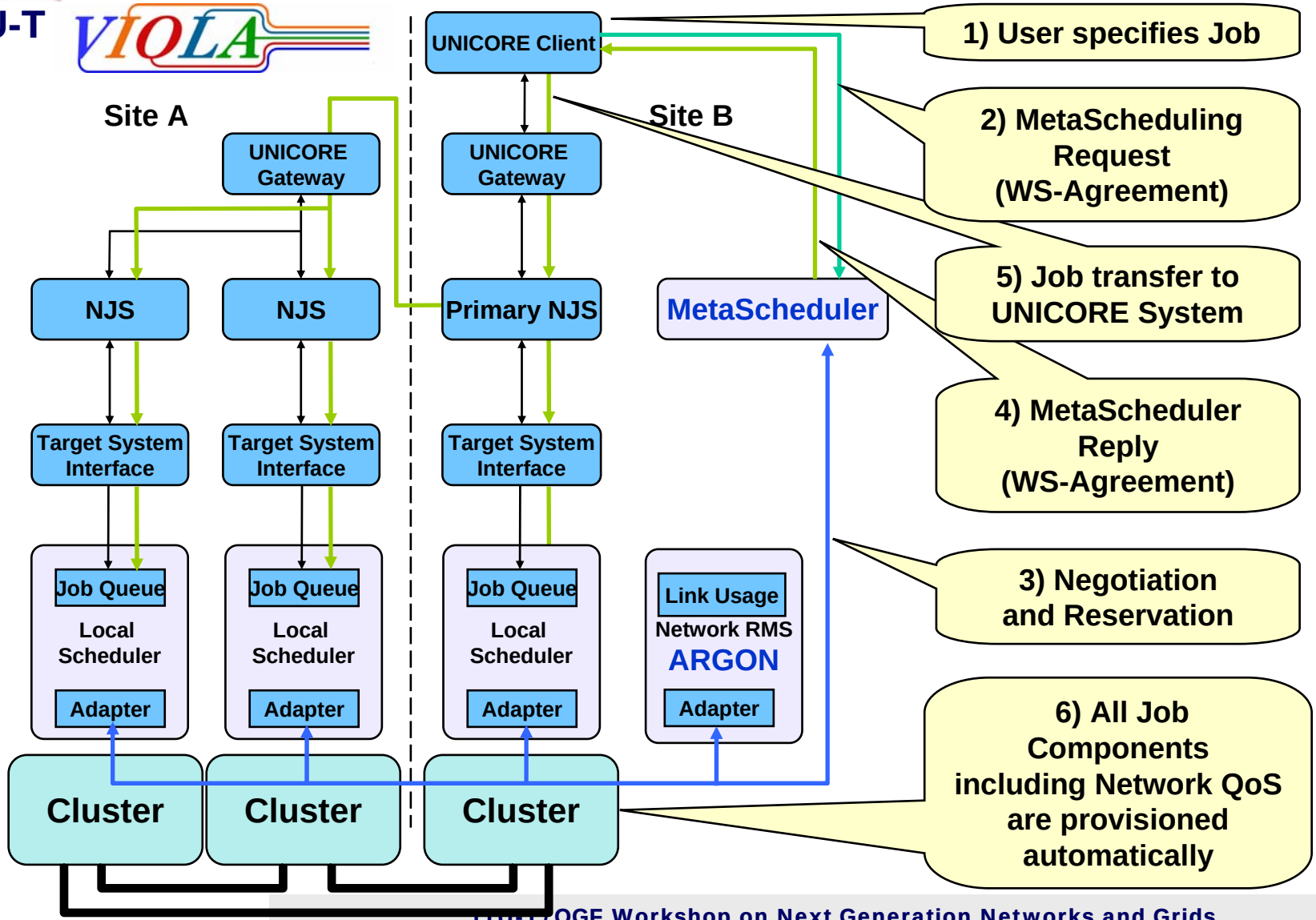

Level 1: Multi-Domain Connection Management

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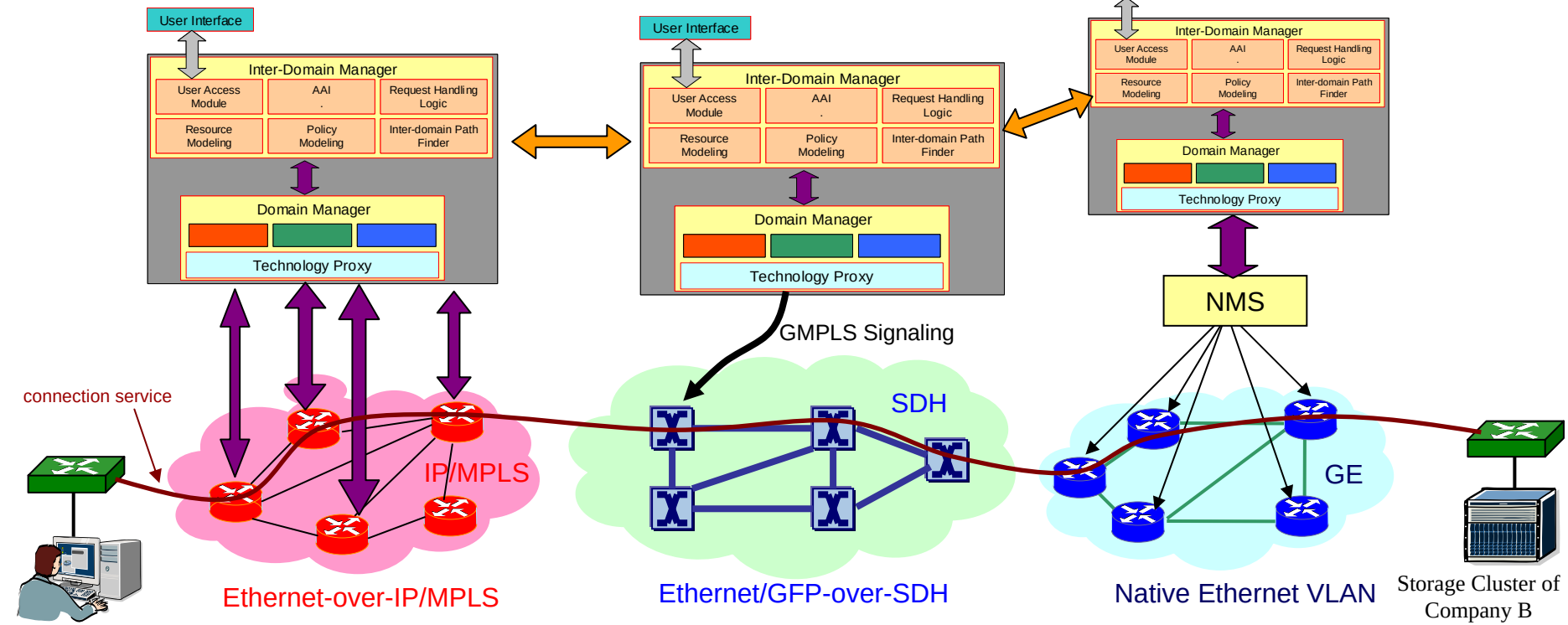
- Grid sessions span several Administrative Domains
- A set of automated procedures for non-technology specific inter-domain: AAA, Negotiation, Pricing can be required
- Connection signaling may not be uniform end-to-end precluding end-to-end controls



* From Geant2 / Afrodite Sevasti

Level 1 → 2: Grid Application / Network Resources Provisioning sequence

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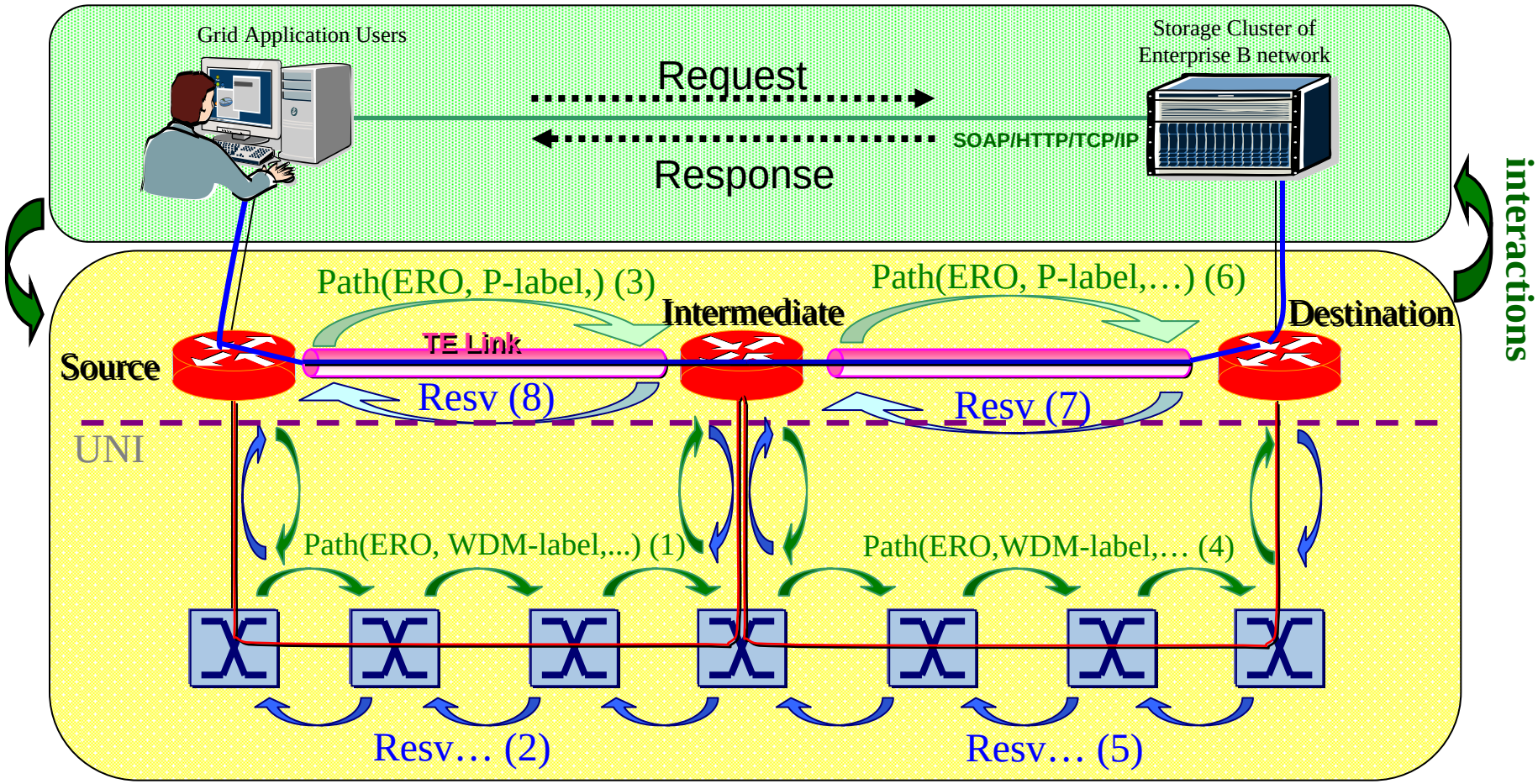
- Grid Application requests intercepted by the network controllers for delivering the connection with the exact QoS



Level 2: Grid Application Server Discovery

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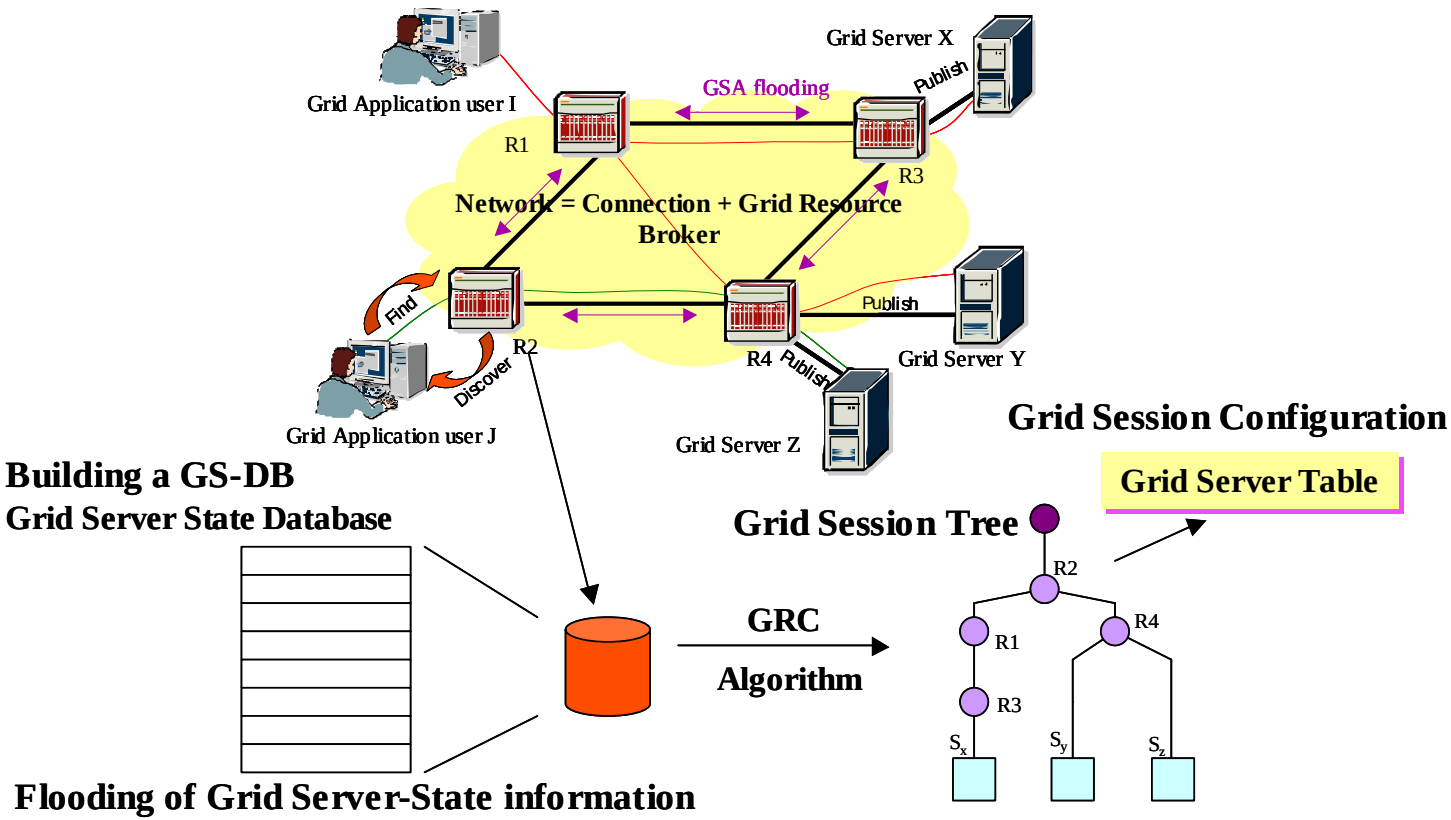
- Joint Resource Advertisements for Grid + Network
- Combination of Grid Application and Network protocol discovery



Level 2: Grid aware Network Resource Signaling

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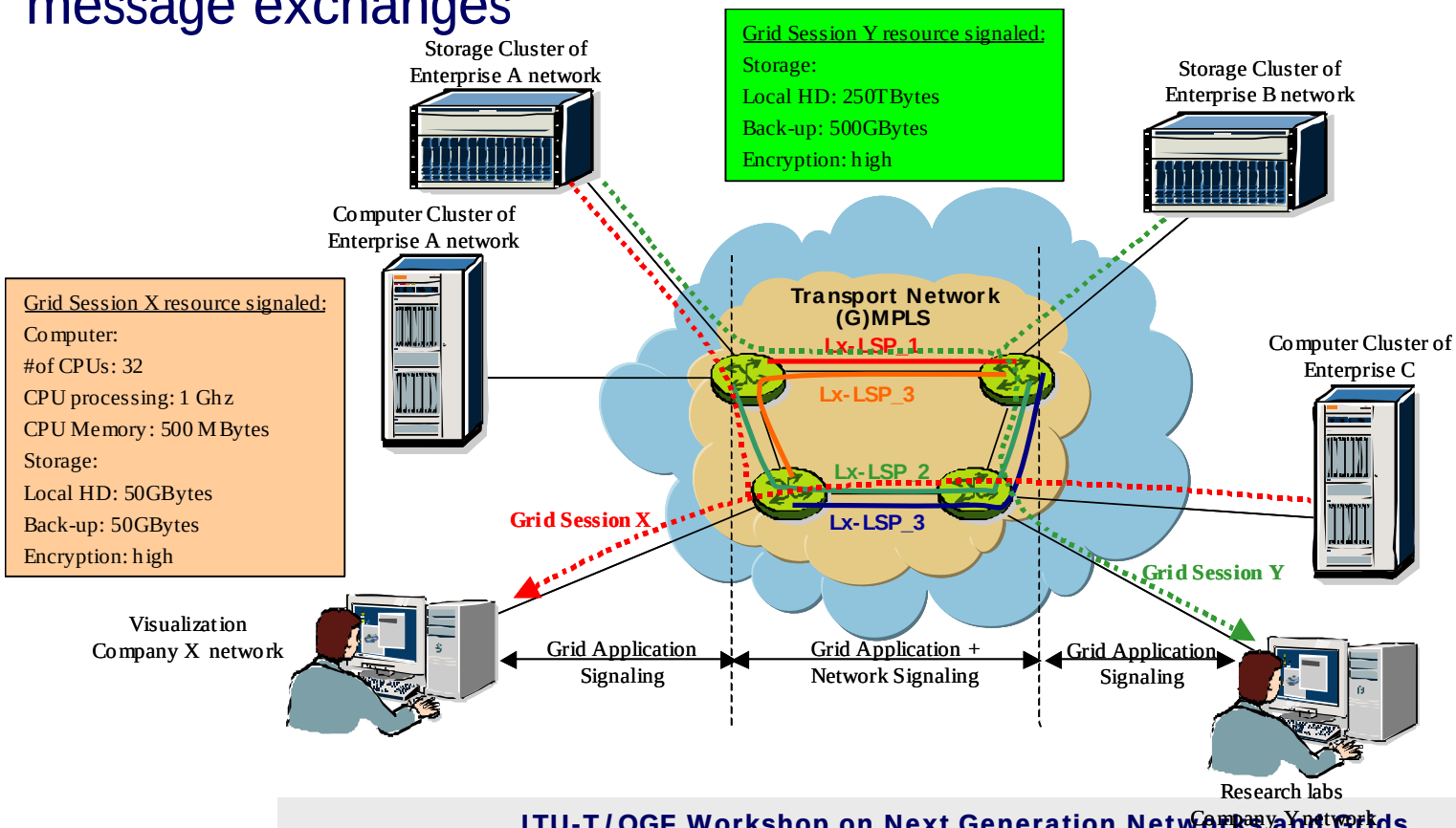
- Joint Signaling for Grid + Network Resource Reservation
- Combination of Grid Application and Network protocol signaling to accommodate Grid information Resource Request/Reserve message exchanges



Standards Organizations and Fora Working on Control Network Standards or Specifications

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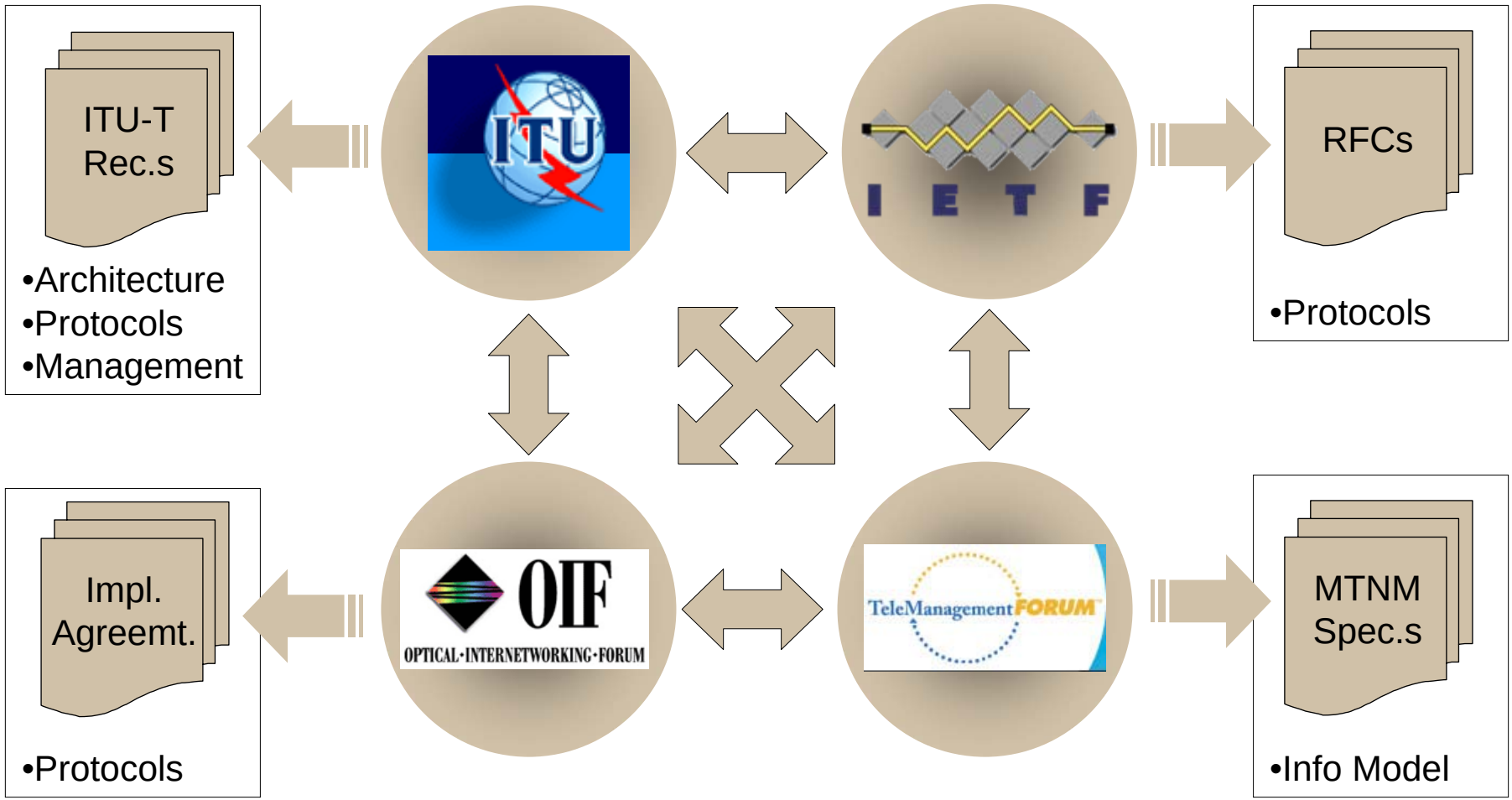

OGF: Open Grid Services Architecture and its Control functions

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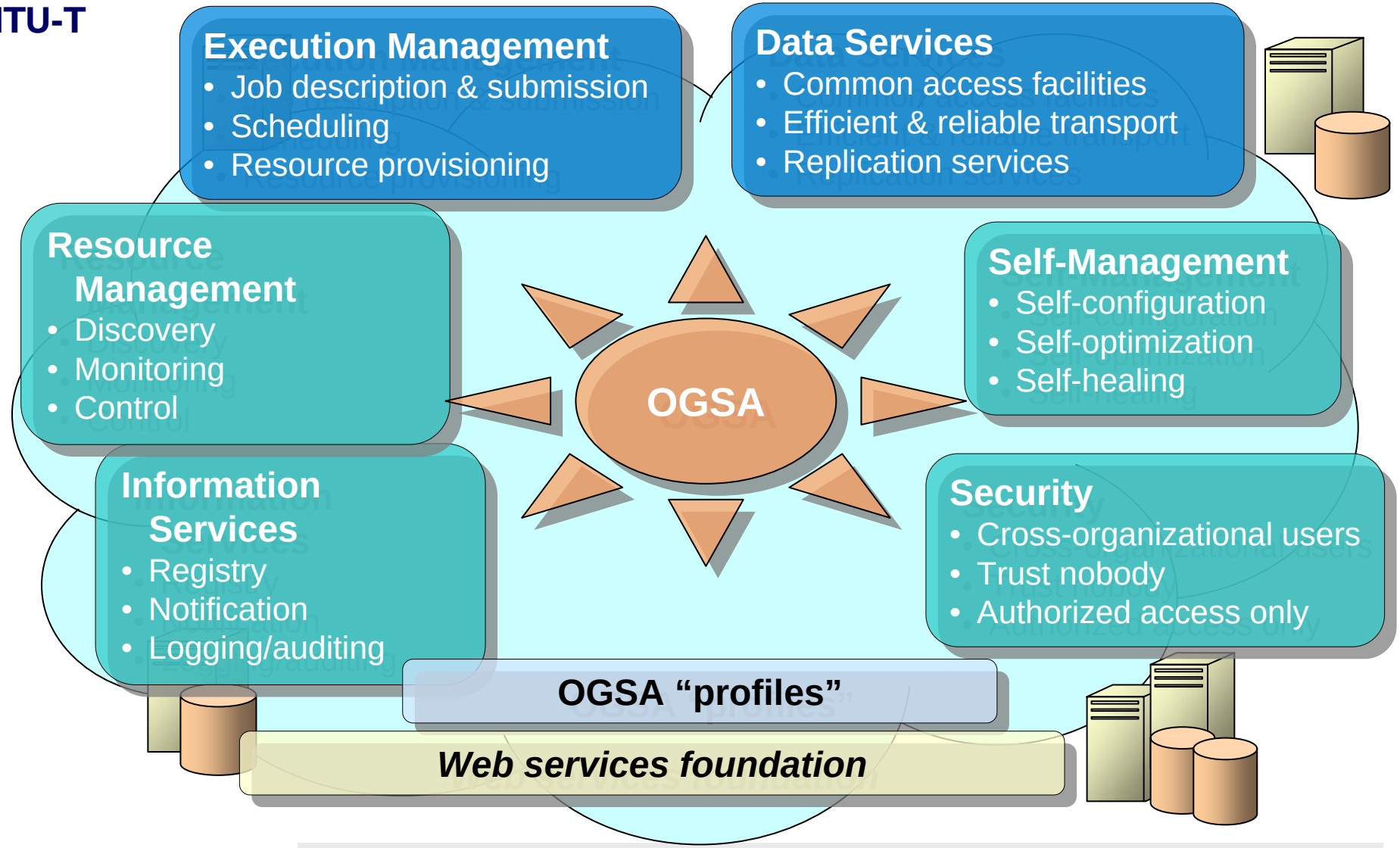

From: «OGF Standards Activity» - Steven Newhouse

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Any Level of Integration requires Synergies

- Control Integration raises Scalability issues
  - Performance associated messaging / processing have to be carefully analyzed for design
  - Grid Session Dynamic constraints are not uniform
- Integrated approach enables distributed Control capabilities for Grid Applications and Networks
  - Rapid, Flexible and Uniform
- Uniform Control enables richer interactions between the Network and the Grid applications
- Liaisons / Synergies between the Standard organizations are needed and will have to be established