



Enabling Grids for E-scienceE

# Agreement signalling and network service provisioning for Grids

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Information Society



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## Enabling Grids for E-science (EGEE)

- large project funded by the European Union
- Aims:
  - Grid middleware development
  - seamless integration of other e-Science Grid activities to one infrastructure
  - Operation and management of a world-scale Grid infrastructure supporting various communities:
    - *Particle Physics*
    - *Bioinformatics*
    - *Astronomy*
    - *Chemistry*
    - *Geophysics*
    - *and other disciplines*



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# User application and Grid middleware requirements

## Guaranteed average bandwidth

- Bulk data transfer in High Energy Physics

## Guaranteed constant bandwidth

- Electronic Very Long Baseline Interferometry

## Latency

- User applications:
  - **Visualization** applications
  - Control of remote Grid-enabled **instruments**
- Grid control and management plane:
  - Archiving and publishing of **Grid monitoring and accounting** information
  - **File catalogue services** and, in general, database queries
  - Access to client proxy **certificates**
  - .. and in general **Grid control and management**

## IP packet delay variation

- Medical imaging, visualization, video/voice-based applications
- Electronic Very Long Baseline Interferometry

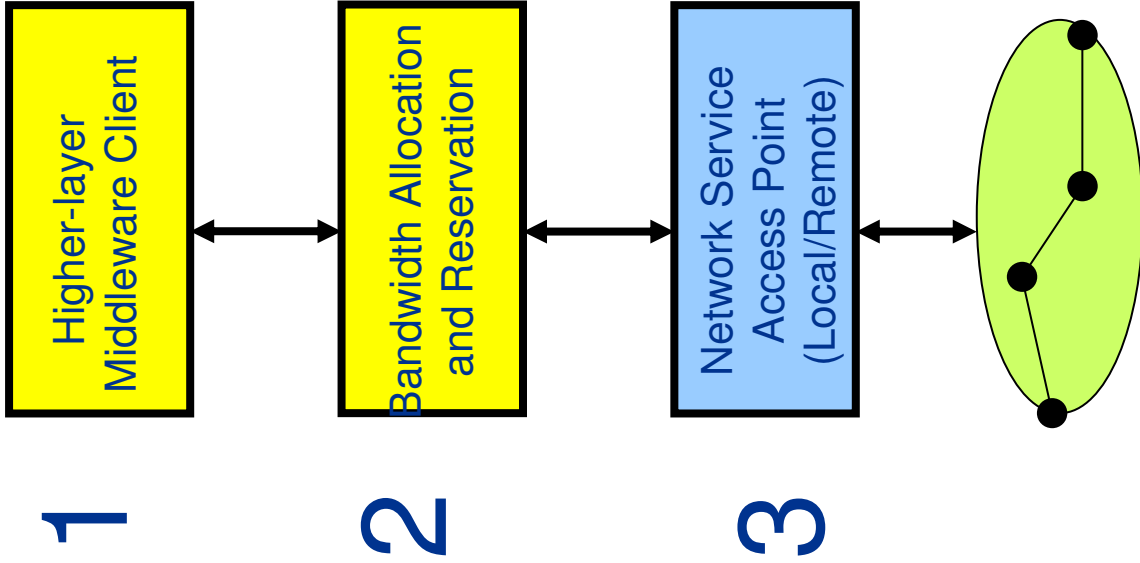
- ***Guaranteed Deadline File Transfer***
  - Guaranteed delivery of a given volume of data to a destination within a specified time-window
  - Average bandwidth guarantee
- ***Virtual Leased Line***
  - Fix guaranteed bandwidth for a certain amount of time

## Define and implement a general and extensible

### Grid network service architecture:

- enabling **advance reservation** of a *specific transport service* between two network endpoints
- supporting the signalling of **Service Level Agreements** according to the GGF guidelines
- exposing a **Web services interface**
- based on the concept of **network virtualization**
- **transparently** relying on various **network control and management** techniques and protocols supported by National Research Networks and the pan-European Research and Education network (GEANT2)

# Architecture components

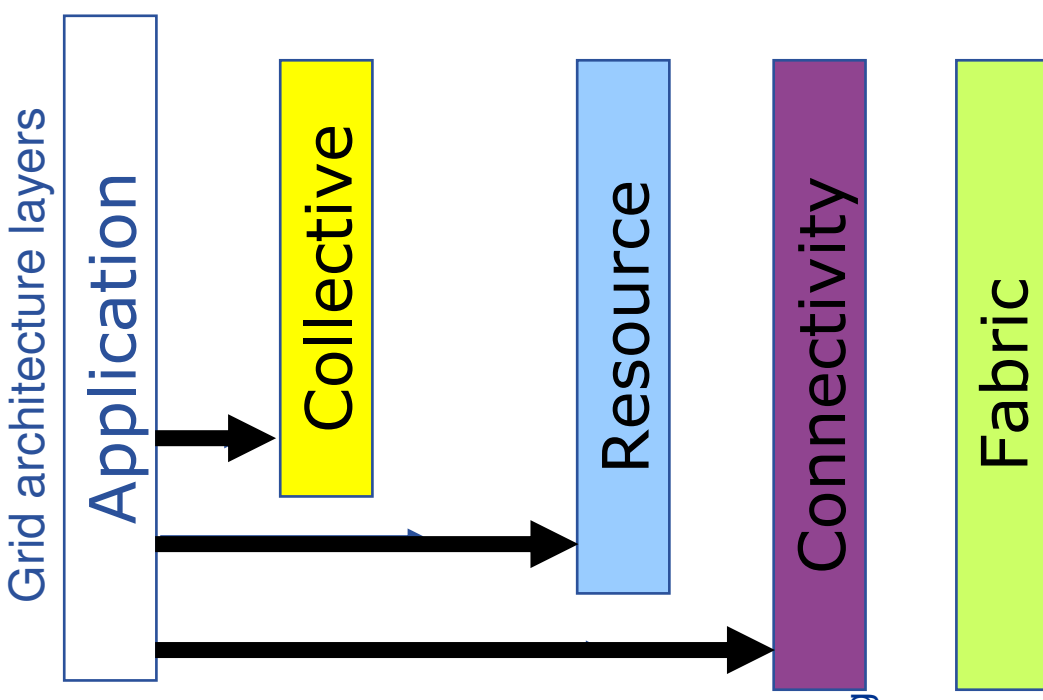


Grid mw (or user Application)

- Translation of XML SLA parameters
- Communication with local and remote NSAPs

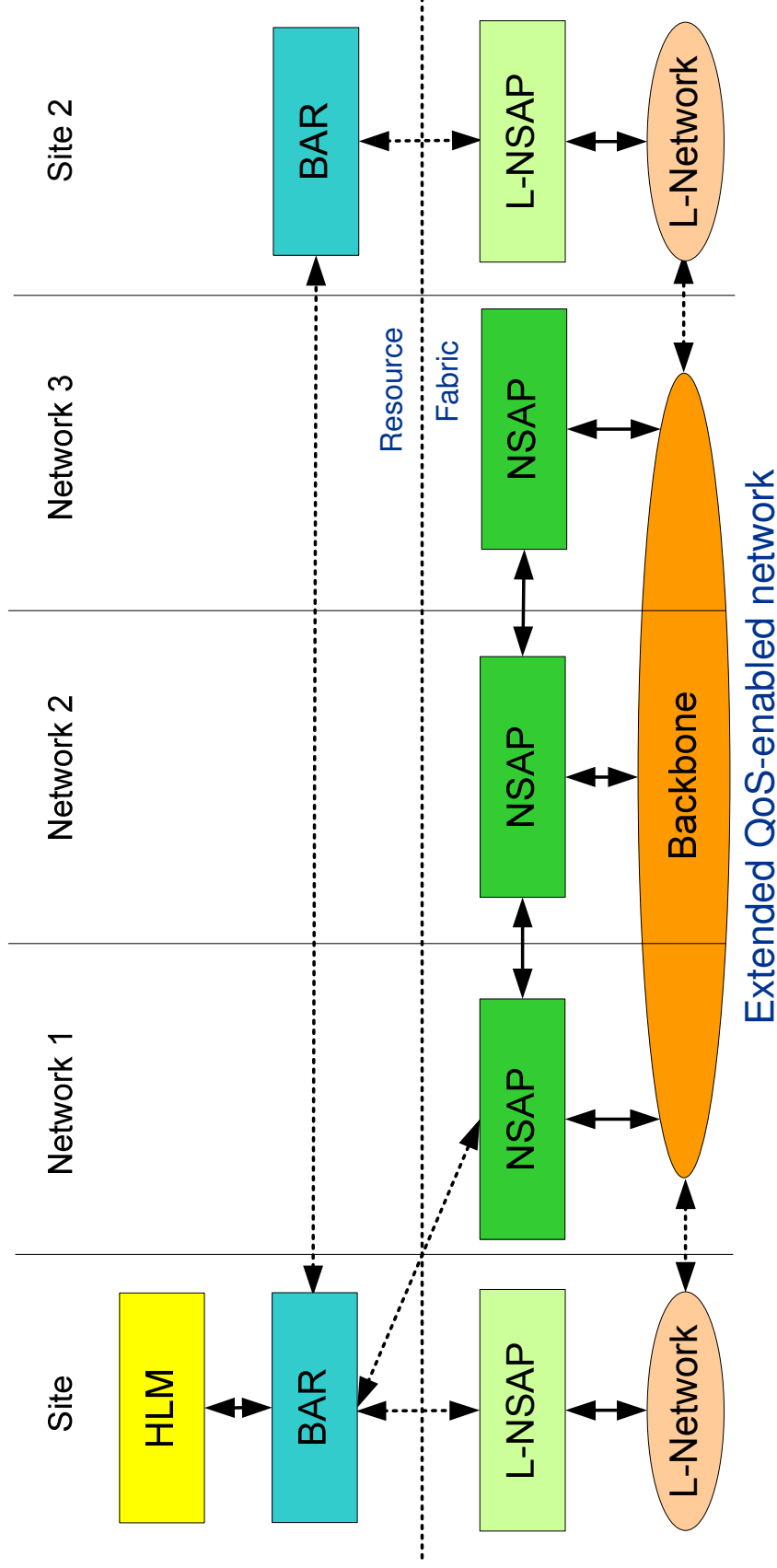
- Admission control
- Configuration of network equipment

- L-NSAP: policing and marking of ingress traffic



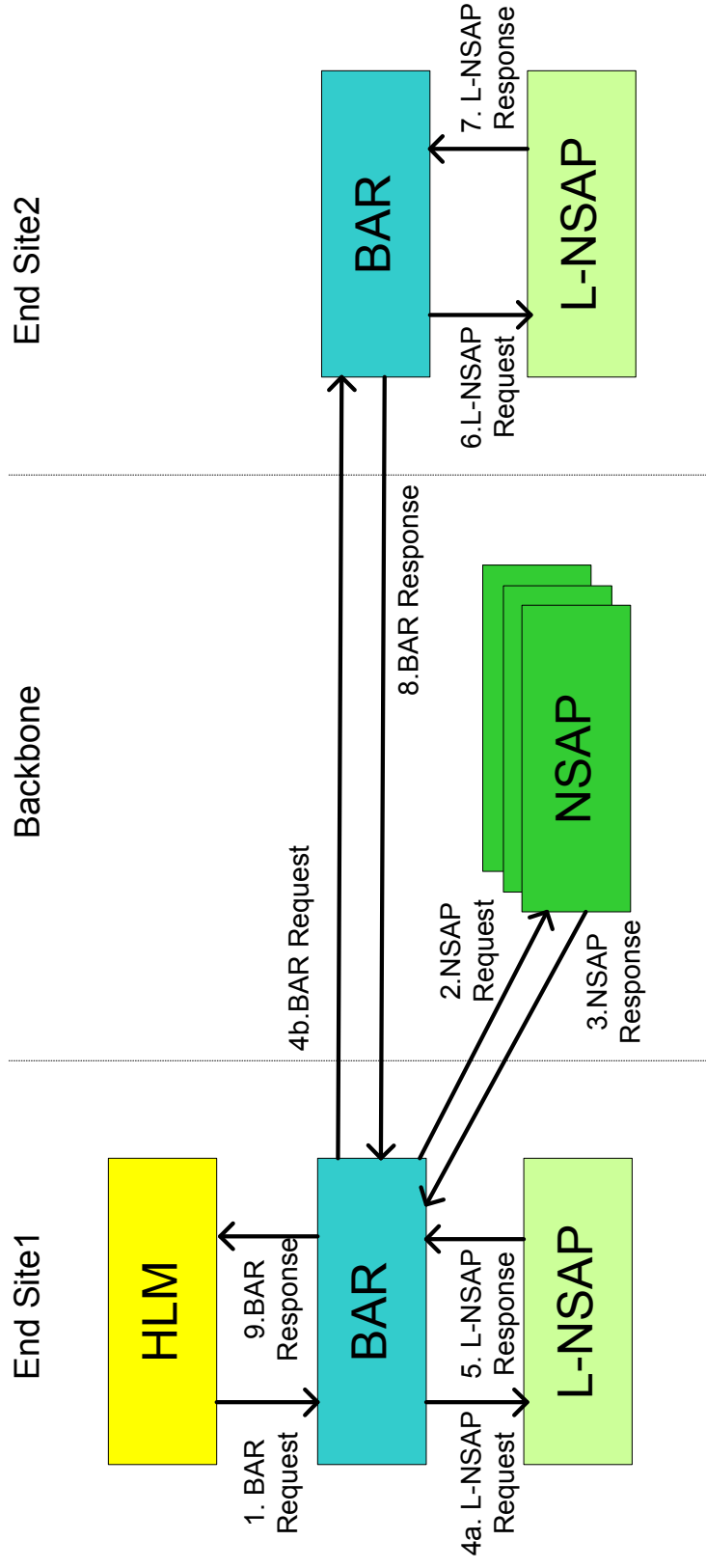
## Components:

- HLM: Higher Layer Middleware client
- BAR: Bandwidth Allocation and Reservation
- NSAP: Network Service Access Point (GEANT2)
- L-NSAP: Local Network Service Access Point



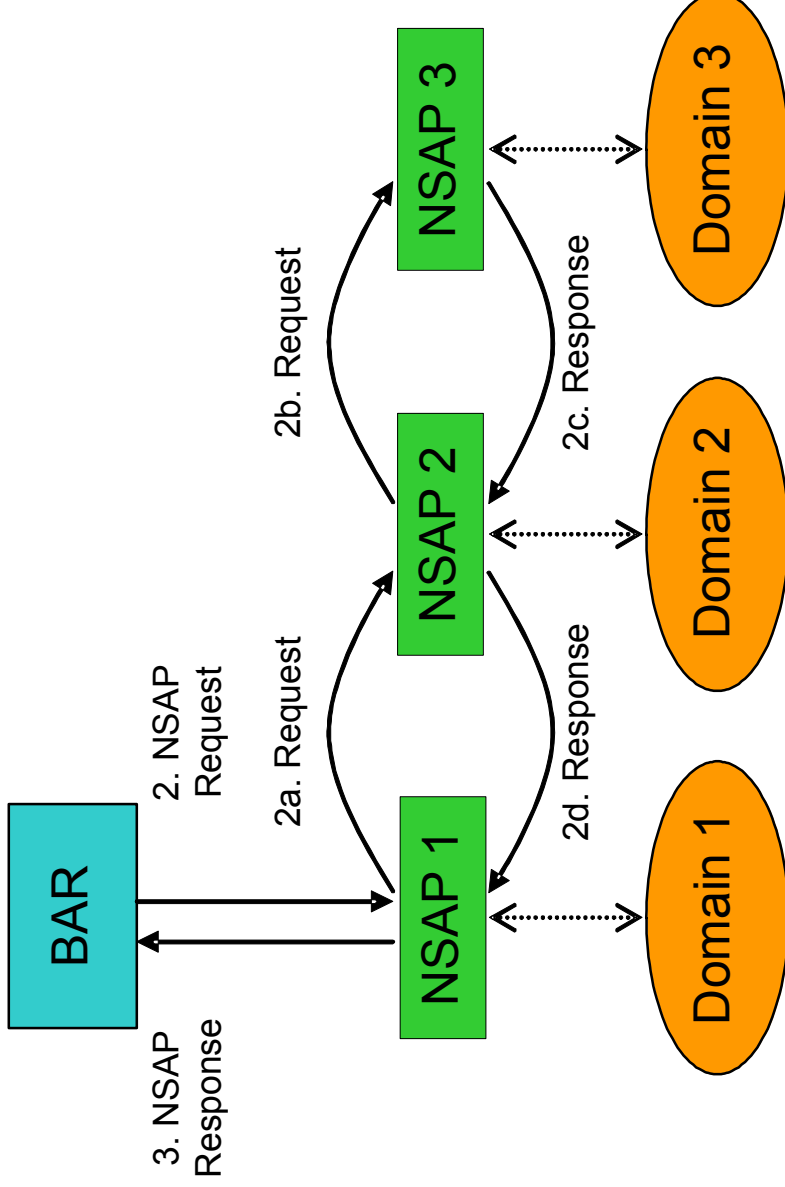
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- **Today**
  - **Differentiated Services**
    - Expedited Forwarding PHB
    - Premium IP
      - *Quantitative guarantees over bandwidth*
      - *Qualitative guarantees over one-way delay, packet-loss and IP packet delay variation*
    - Manual configuration, 2 days for provisioning
    - Restricted set of NRN early adopters forseen
- **Future**
  - Automatic Differentiated Services configuration
  - Manual SDH circuit switching

- **BAR integration in the Grid requires:**
  - Support of SLA signalling → WS-Agreement
    - BAR → Network Agreement Service
  - Full interoperability with Grid scheduling services
    - the gLite Workload Management System (WMS)
  - PKI-based authentication and authorization
    - Virtual Organization Membership Service
    - retrieval and renewal of proxy certificates
    - local authorization
  - Publishing of BAR profile (interface, capabilities, etc) into the Grid information system
    - (monitoring and accounting)

- **WS-Agreement defines a language and a protocol for**
  - *Advertising* the capabilities of providers
  - *Checking compliance* to pre-defined templates
  - *Creating agreements* based on creatonal offers
- **Agreement Layer:**
  - Agreement initiator vs agreement responder
  - *Responder: advertising, creation, delegation of provisioning, monitoring* of agreements
- **Service Layer**
  - Service consumer vs service provider
  - is an *resource-specific* layer of a provided service



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# Network Agreement Service

- **Functionality:**
  - Interacts with *one or more service providers*
  - *Translates* high-level service description terms (from initiator) to low level service-specific terms
  - Advertises the Service Provider capabilities through *agreement templates*. *The template is an XML document* that describes the contract skeleton.
  - Handles the agreement *negotiation* (agreement offer attributes from the initiator are tuned during the negotiation phase)
  - Provides information about: *status* of the agreement negotiation process and *attributes* of a specific agreement instance
- **Benefits:**
  1. It *hides the complexity* of the service providers' interfaces from the agreement initiator (the client).
  2. It exposes *a single operation* which can be used independently of the nature of the agreement type (*createAgreement*).
  3. *Scalability*: new Service Providers can be easily integrated by advertising the corresponding templates (clients can be notified when new templates are added).

## Collective

Agreement  
Initiator

(on behalf of  
service consumer)

Agreement Offer

Grid scheduling service:  
the Workload Manager System

- Internal task queue and re-submission
- Agreement and service provider discovery
- Resource scheduling algorithms

## Collective

Agreement Offer\_1

Network  
Agreement Service  
(BAR)

Agreement Offer\_n-1

Storage Space  
Agreement Service

Agreement Offer\_n

Computing  
Agreement Service

## Resource

Network Service  
Access Points

Storage Element

Storage Element

- **Problem: given an agreement offer including**
  1. Resource requirements
  2. Resource preferences (optional)
  3. Service functionality

*find Agreement Services that support service functionality (3) and can (indirectly) do reservation on resource instances satisfying (1) and (2)*
- **Matchmaking finds a list of resources:**
  - on which user is authorised to do reservation and
  - satisfying resource requirements (1), preferences (2), and supporting (3)
- **find Agreement Services:**
  - authorized to talk to the resources in the list identified above
  - Supporting the corresponding allocation and reservation service provider interfaces

- **BAR:**
  - interactions between a BAR client, a BAR web service and a limited functionality NSAP web service
  - Grid transport service invocation, query and cancel
  - basic security mechanism between a client and a BAR service.
  - But: the prototype does not demonstrate:
    - A fully functional NSAP reserving IP Premium services → GEANT2
    - usage of the L-NSAP service
- **Agreement service:**
  - based on WS-Agreement XML Schema Definitions (GGF, GRAAP WG)
  - gSOAP 2.7.0
  - Storage Space reservation: agreement service tested with ased on SRM v 2.1

- [1] EGEE Middleware Architecture; EGEE Deliverable DJRA1.1 (<http://edms.cern.ch/document/476451>)
- [2] End to End Specification for Bandwidth Allocation and Reservation (<http://edms.cern.ch/document/593453>)
- [3] BAR Prototype (<http://egee.epcc.ed.ac.uk:38080/barclient/>)
- [4] Specification of interfaces for bandwidth reservation service, EGEE Deliverable DJRA4.1, May 2005 (<http://edms.cern.ch/document/501154>)
- [5] The Grid Resource Allocation and Agreement Protocol Working Group; Global Grid Forum (<https://forge.gridforum.org/projects/graap-wg>)
- [6] gLite Allocation and Reservation Architecture, EGEE JRA1 technical report (<http://edms.cern.ch/document/508055>)