



Enabling Grids for
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Advance Reservation Overview and Dependencies: Information Services Data Management Network Element (JRA4)



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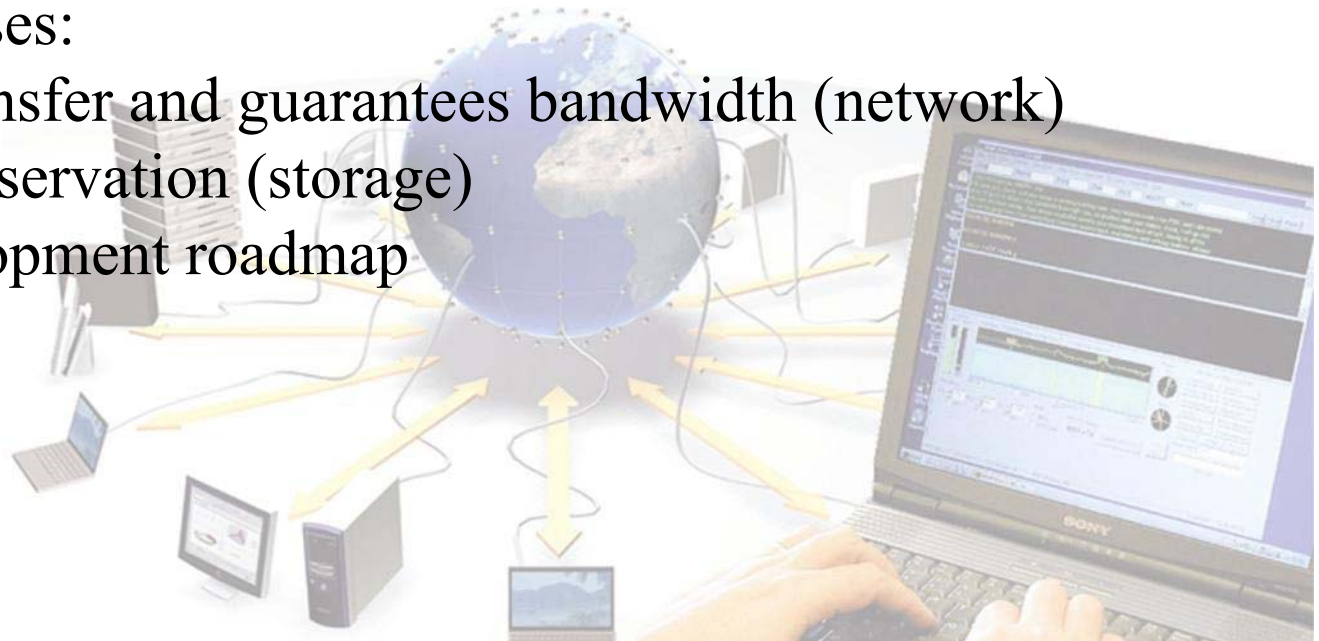




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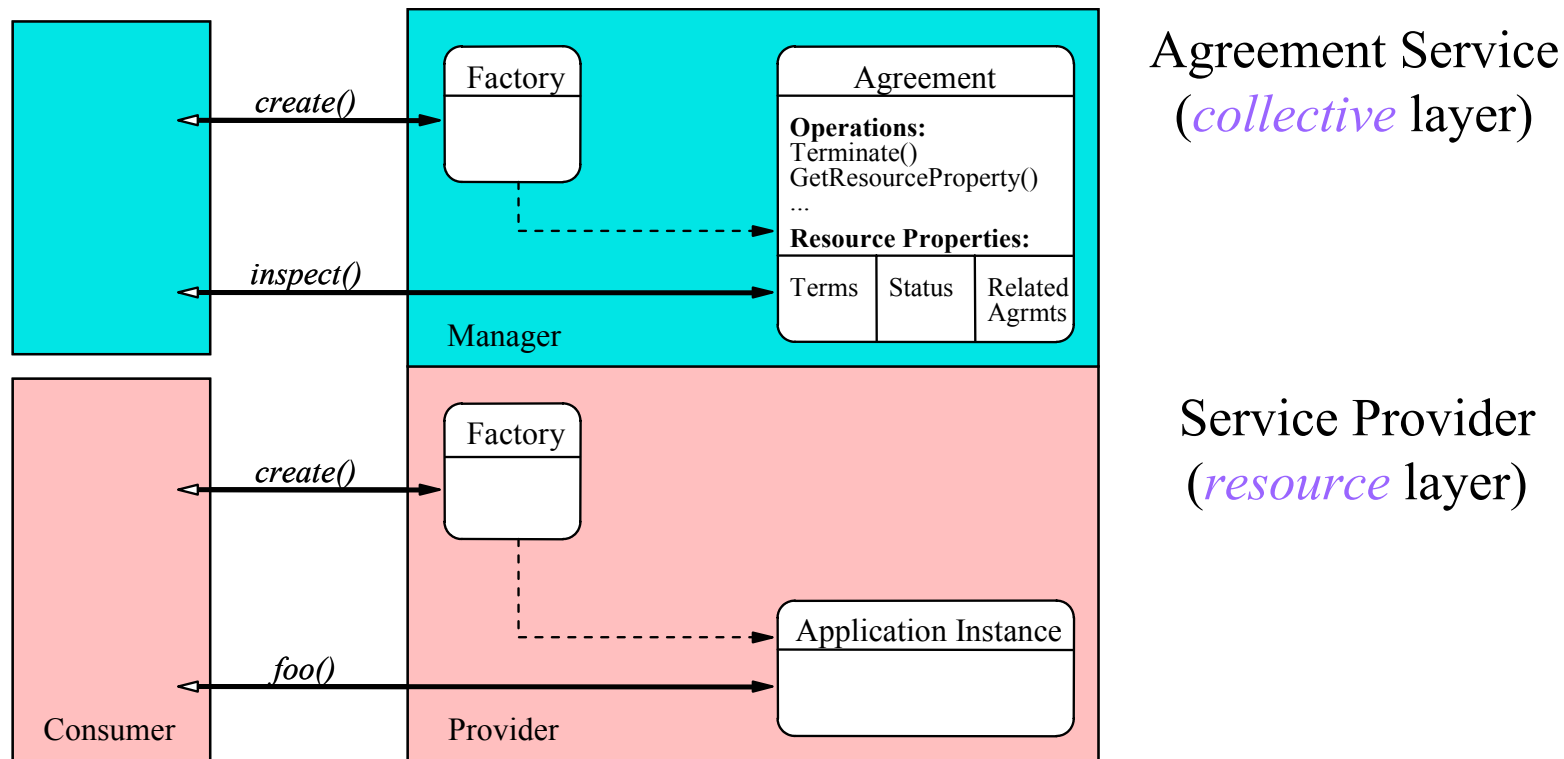
PART I

- *Architecture overview*
- Two use cases:
 - . Bulk transfer and guarantees bandwidth (network)
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Agreement Services and Service Providers (GGF GRAAP WG)

WS-Agreement Conceptual Layered Service Model



Service Provider

- **One** Service Provider instance per “resource” instance (e.g. CE and SE).
- It **manages resource availability** information over time through a local “slot table”
- It **enforces** resource reservation through resource-specific interfaces/for example:
 - Network → the set of agents responsible of configuring switches/routers on a given path
 - Storage → srmReserveSpace / srmReleaseSpace
- The **Service Provider interface** may be non-standard (and no Web Service interface required).
- Information about **resource usage** needs to be returned – deirectly or through a companion monitoring service to the agreement initiator or to the Information Service.

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
 - **Attributes** of a specific agreement instance
 - **Initiators:**
 - the user
 - the Workload Management System
- **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** – AgreementFactory port type).
 3. **Scalability:** new Service Providers can be easily integrated by advertising the corresponding templates (clients can be notified when new templates are added).
 4. **No need of a-priori knowledge** about services available to users.

Co-Allocation Agreement Service

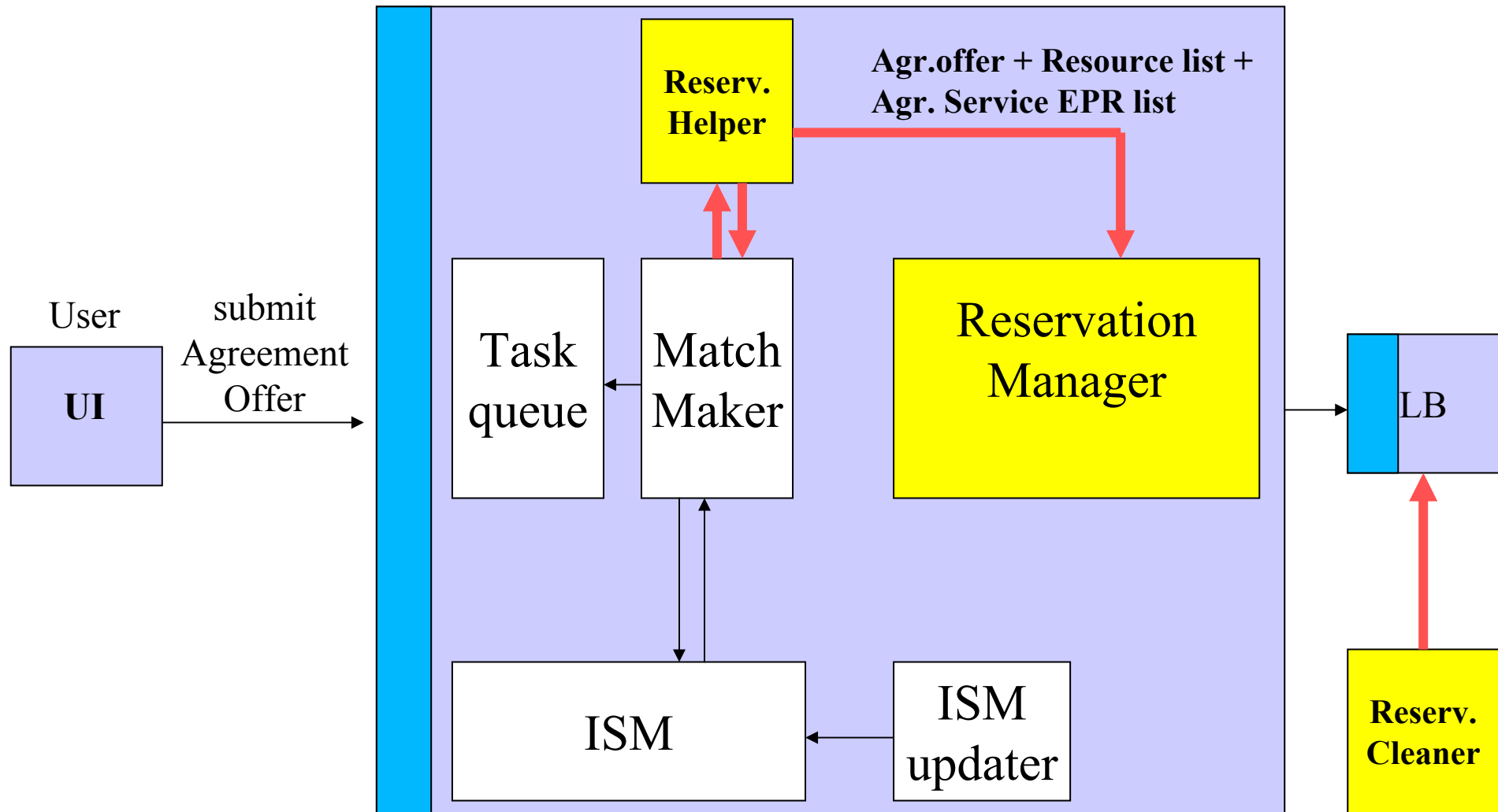
- Co-Allocation Agreement: a composition of dependent “atomic” agreements. Several types of dependency are possible:
 - Temporal: resources from different agreements need to be allocated in the same time interval;
 - Resource identity: resources allocated by different agreement need to satisfy some properties (e.g. Space is reserved on SE_i, computing is reserved on CE_j, and SE_i and CE_j are close to each other).
- Atomic transaction
- All or nothing

- Not currently addressed by the GRAAP WG at the GGF

(Co-)Allocation and the WMS (1/2)

- **Reservation Manager**: a proposed component of the WMS; it should handle:
 - Simple agreements (to start with)
 - Compound agreements (next in development roadmap)
- **Why integrated in the WMS?**
 - Agreement offer submission: **similar to job submission**
 - Agreement **status**: information from Logging and Bookkeeping
 - Agreement Service **discovery**: a list of Agreement Services is tried (more powerful than submission to a single Agreement Service)
 - based on **matchmaking library**
 - takes advantage of the **ISM**
 - Agreement offers can be **re-submitted** periodically in case of failure

(Co-)Allocation and the WMS (2/2)



 Web Service interface

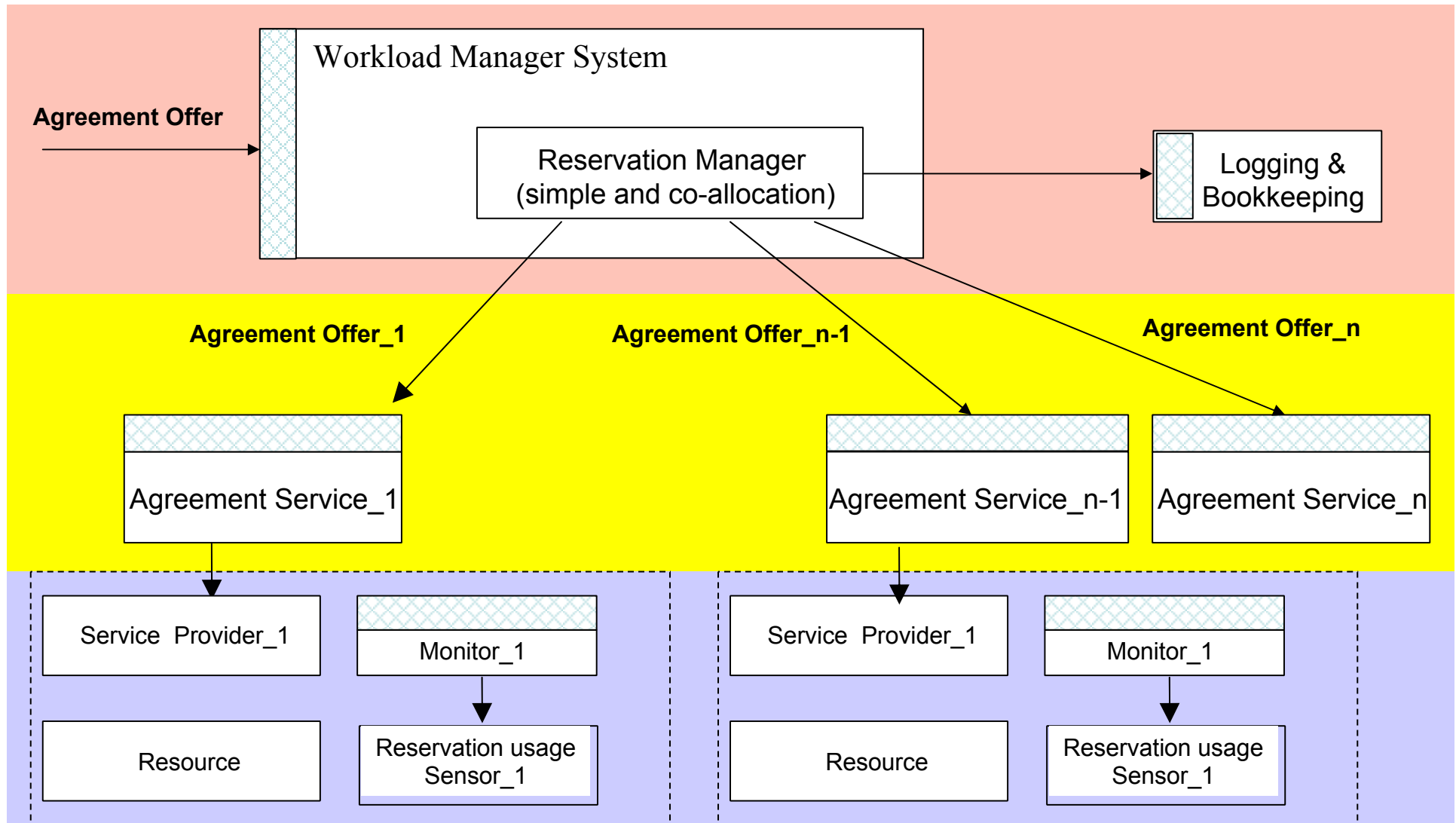
Agreement Service Discovery

- 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
 - Supporting their service provider interfaces

The Overall Picture





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Network: Bulk Transfer and Virtual Leased Line



- Services specified in Deliverable DJRA4.1 “*Specification of Interfaces for bandwidth Reservation Service*”
- **Bulk Transfer**: file transfer by deadline; input parameters: file size, transfer end time
- **Virtual Leased Line**: guaranteed bandwidth; input parameters: bandwidth, start time, end time

Use case 1: Virtual Leased Line Service (1/2)

- Step 1: WMS receives an agreement offer (JDL) from
 - user U_i from Virtual Organization VO_i,
 - bandwidth = 1 Gbit/s
 - From Source S (in source domain D_{tx}) to destination D (destination domain D_{rx})
 - Service functionality = “VirtualLeasedLine”
 - Start time = t1
 - End time = t2

requirements

```
[
  Type = "allocation";
  ServiceCategory =
    "NetworkElement";
  Functionality =
    "VirtualLeasedLine";
  StartTime = t1;
  EndTime = t2;
  AverageBandwidth = 1; # Gbit/s
]
{
  SourceDomain = "D_tx";
  Source = "S";
  DestinationDomain = "D_rx";
  Destination = "D";
}
```

Use case 1: Virtual Leased Line Service

(2/2)

- **Step 2:** the matchmaker looks for Network Elements offering connectivity from S/D_tx to destination D /D_rx and service provider of type “VirtualLeasedLine”
- **Step 3:** for each NE, the corresponding service provider interface is extracted;
- **Step 4:** for each service provider interface from step 3, the matchmaker library is invoked to find agreement services with compatible interface (*agreementService.ServiceProviderInterface*) and authorized to interact with that service provider
- **Step 5:** an agreement offer is sent (augmented by the corresponding Service Provider URI) to each agreement service from Step 4

Use case 2: Storage Space Reservation (1/2)

- Step 1: WMS receives an agreement offer (JDL) from
 - user U_i from Virtual Organization VO_i,
 - Storage space = 40 Gbyte
 - ServiceCategory = "StorageElement"
 - Functionality = "SpaceManagement"
 - StartNow = TRUE;
 - EndInfinite = TRUE;
 - SpaceSize = 40; # GByte
 - StorageTransferProtocol = "gridftp";

```
requirement {  
  [  
    Type = "allocation";  
    ServiceCategory =  
      "StorageElement";  
    Functionality =  
      "SpaceManagement";  
    StartNow = TRUE;  
    EndInfinite = TRUE;  
    SpaceSize = 40; # Gbyte  
  ]  
}
```


Use case 2: Storage Space Reservation (2/2)

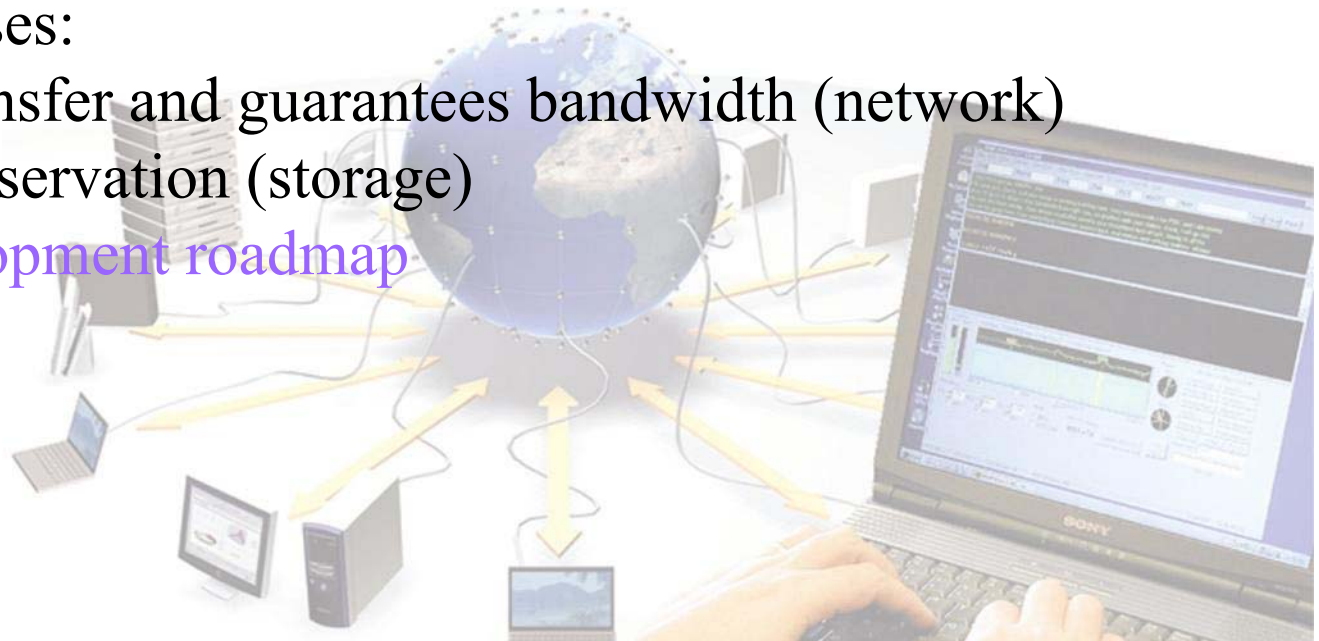
- **Step 2:** the matchmaker looks for Storage Elements with Storage Transfer Protocol equal to “gridftp” and service provider of type “SpaceManagement”
- **Step 3:** for each SE, the corresponding service provider interface is extracted;
- **Step 4:** for each service provider interface from step 3, the matchmaker library is invoked to find agreement services with compatible interface (*agreementService.ServiceProviderInterface*) and authorized to interact with that service provider
- **Step 5:** an agreement offer is sent (augmented by the corresponding Service Provider URI) to each agreement service from Step 4



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Development Roadmap

- requestAd: it has to include common attributes for advance reservation and an initial set of resource-specific attributes:
 - Network:
 - Bulk Transfer Service
 - Guaranteed Bandwidth Service
 - Storage:
 - srmReserveSpace
- edg_job_submit: to be extended in order to handle type alloc/coalloc
- Helper for advance reservation
- Handling of SE, NE and Agreement Service ClassAD in ISM
- Submission of advance reservation (through resource-specific Agreement Service)
- Binding
- Reservation cleaner (Logging and Bookkeeping)



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PART II

- Grid Information Service:
 - . Extensions for existing schemas
 - . New schemas
- Data Management:
What support for storage reservation?



Extensions: Computing and Storage Element

```
[ Entity          = "StorageElement";  
  Name           = "auniqueID"; # URI del servizio  
  ServiceCategory = "StorageElement"; ???  
  
  [ Entity = "Service";  
    Name = "http://storm:5000";#URI del servizio  
    Functionality = "SpaceManagement";  
    Interface = "http://www.cnaf.infn.it/storm_wsdl"; ]  
  
  [ Entity = "Service";  
    Name = "gridftp://sdfds:5000";#URI del servizio  
    Functionality = "FileTransfer";  
    Interface = "http://www.ggf.org/gridftp.spec"; ]  
  
  [ Entity = "Service";  
    Name = "rfio://sdfds:5000";#URI del servizio  
    Functionality = "FileAccess";  
    Interface      = "http://www.cern.ch/rfio.spec"; ]  
  
  [ Entity          = "StorageArea";  
    Name            = "foo";  
    AvailableSpace = ""; ]  
]
```

1. CE and SE are containers of resource-specific services → hierarchy
2. Each service has a name, **functionality** and **interface**:
→ *functionality*: service provider discovery
→ *interface*: Agreement Service discovery

Network Element Schema (to be discussed in Den Haag)

```
[ Entity = "NetworkElement";  
  Name = "uniqueID"; # URI del servizio  
  
  [ Entity = "Service";  
    Name = "http://xxx:5000"; #URI of service  
    Functionality = "VirtualLeasedLine";  
    Interface = "http://yyy/jra4.wsdl"; ]  
  
  [ Entity = "Service";  
    Name = "http://zzz:5001"; #URI of service  
    Functionality = "ConnectivityMonitoring";  
    Interface = "http://kkk/connMon.wsdl"; ]  
  
  [ Entity = "NetworkPath";  
    Name = "http://jjj";#URI del servizio  
    Functionality = "Connectivity";  
    Interface = "http://lll/networkpath.wsdl";  
    SourceDomain = "S";  
    DestinationDomain = "D"; ]  
  
  [ Entity = "PerformanceMonitor";  
    Name =  
    Interface =  
    ... ]  
]
```

- The Network Element:
 - The projection of a set of services
 - Also includes information about the physical resource (e.g. characteristics of a network path such as source and destination) → needed for service provider discovery
 - Service functionality and service interface is needed for Agreement Service discovery

Agreement Service Schema

```
[  
Entity = "AgreementService";  
  ServiceName      = "http://iii";  
  ServiceCategory = "AgreementService";  
  Interface = "http://jjj.wsdl"  
  ServiceProviderInterface =  
    {"http://xxx/jra4.wsdl"}  
]
```

- Abstracts the Agreement Service
- The Agreement Service has an **interface** of its own (e.g. As specified in WS-Agreement)
- Its capabilities are represented with a **list of Service Provider interfaces** which the Agreement Service can support



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 - `srmReserveSpace`





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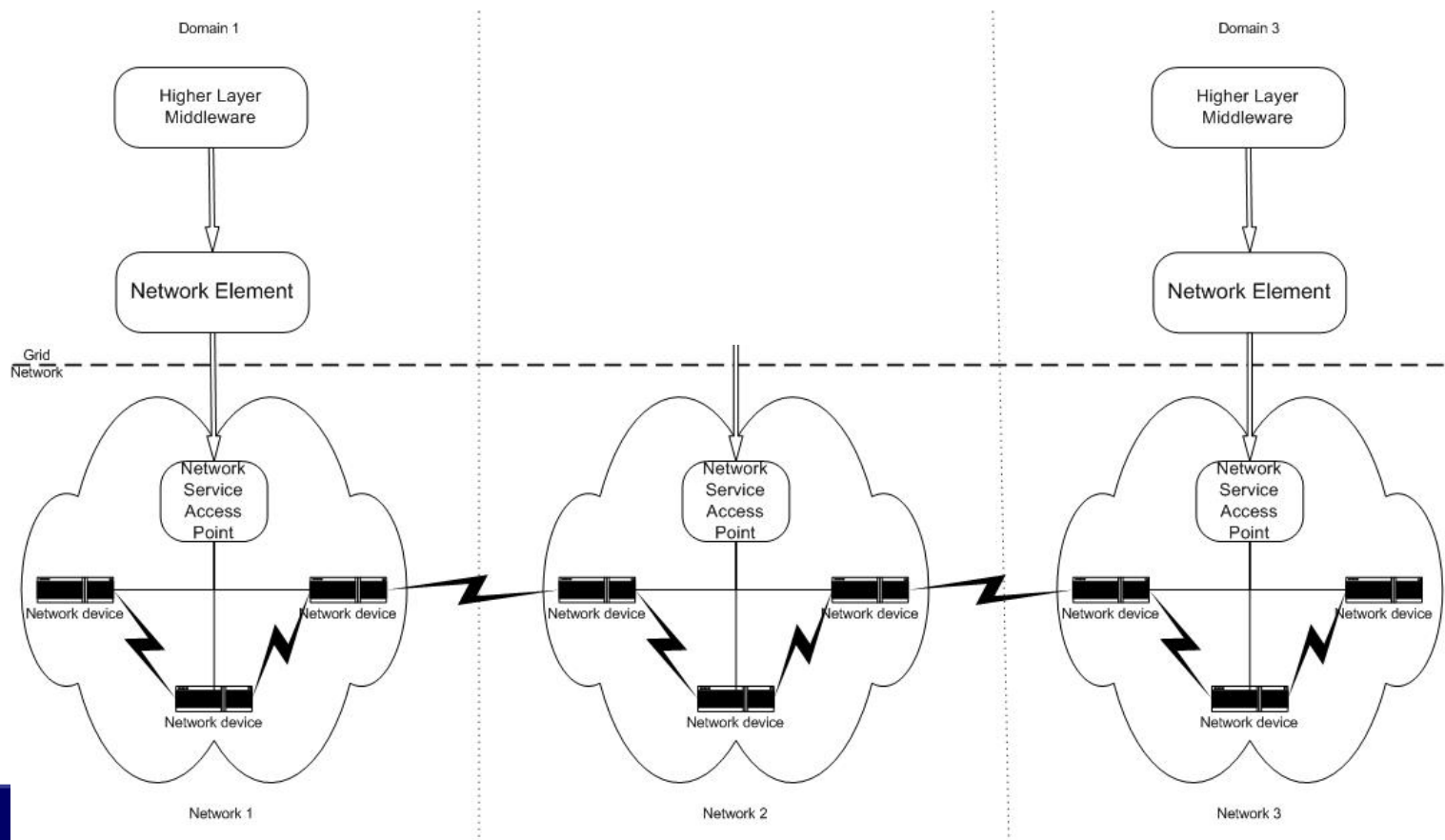
PART III

- DJRA4.1: “Specification of interfaces for bandwidth reservation service”: overview and issues



Quoting from DJRA4.1

“The Network Element should be seen as *a set of services* rather than a single component in the architecture . It provides *user-oriented* network services to the Higher Layer Middleware by abstracting the physical network services. Specifically it will *allow reservation* of network bandwidth and the definition of the desired network QoS. This may *involve mapping* the the higher level service requests into network specific service requests.”



- Notion of NE still too vague
 - “A set of user-oriented services”: *ok, but which ones?*
 - A **NE schema** abstracting the NE missing → needed for Agreement Service discovery
- Notion of NE different from CE and SE
 - *No notion of “physical (fabric) capabilities” (in picture NE does not include physical resources)! → discovery based on resource requirements not possible*
 - *The NE does not include the allocation Service Provider (for bandwidth allocation – see picture), but it should.*
 - “it will allow reservation”: *does it include the “Agreement Service” layer? It shouldn’t, as the Agreement Service is collective, it must be capable of interacting with various Service Providers.*
 - *Monitoring missing (while for example it is part of the CE as described in the EGEE Middleware Architecture deliverable)*
- Monitoring interface: *not specified, but needed*
- NE interface: *mixes all the parameters needed for any type of service (bulk and virtual leased line), without clarifying what is mandatory, and when.*

Network Element according to JRA1-proposal

- NE: A collection of services including:
 - **Virtual Leased Line first-hop Service Provider** (if other Service Providers on the path to destination are invoked by the first-hop Service Provider; otherwise, a set of Service Providers)
 - **Bulk Transfer first-hop Service Provider** (same assumption as above)
 - **Connectivity**: offers information about fabric capabilities (if the NE corresponds to a path either end-to-end or domain-to-domain), for example: source/destination, services available from source to destination, performance
 - **Network performance monitoring**
 - **Resource usage monitoring**
 - (apparently under the responsibility of the GN2 project...)
- The Network Agreement Service (responsibility of JRA4)
 - Its functionality **is not part of the NE**
 - It **translates** user service description terms into low-level network parameters
 - Can support a number of **different service provider interfaces** (e.g. Based on Diffserv, GMPLS, MPLS, RSVP, etc.)
 - Can support **negotiation**
 - Provides **information about agreements**