OGF25 - Catania - 3rd of March 2009

NML-WG

VXDL: Virtual eXecution Infrastructures Description Language

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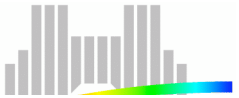
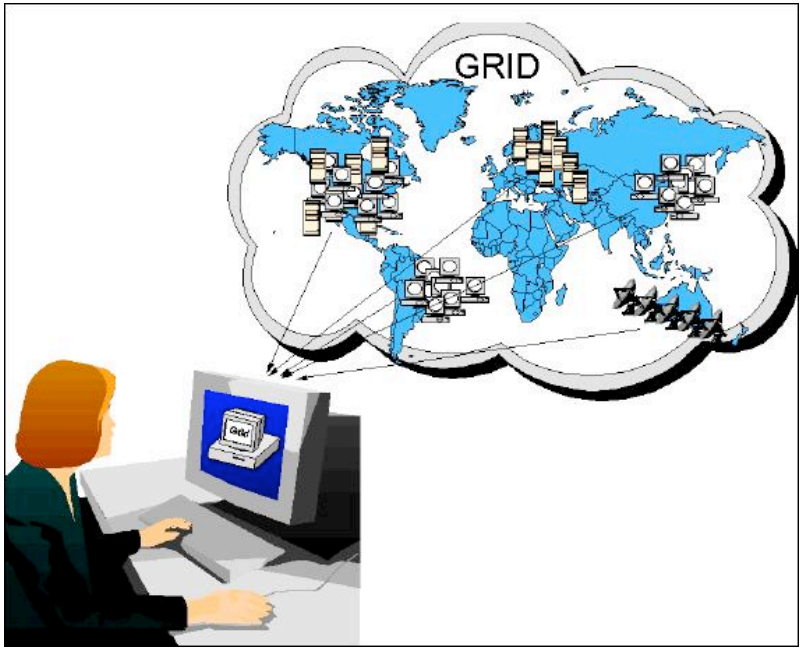
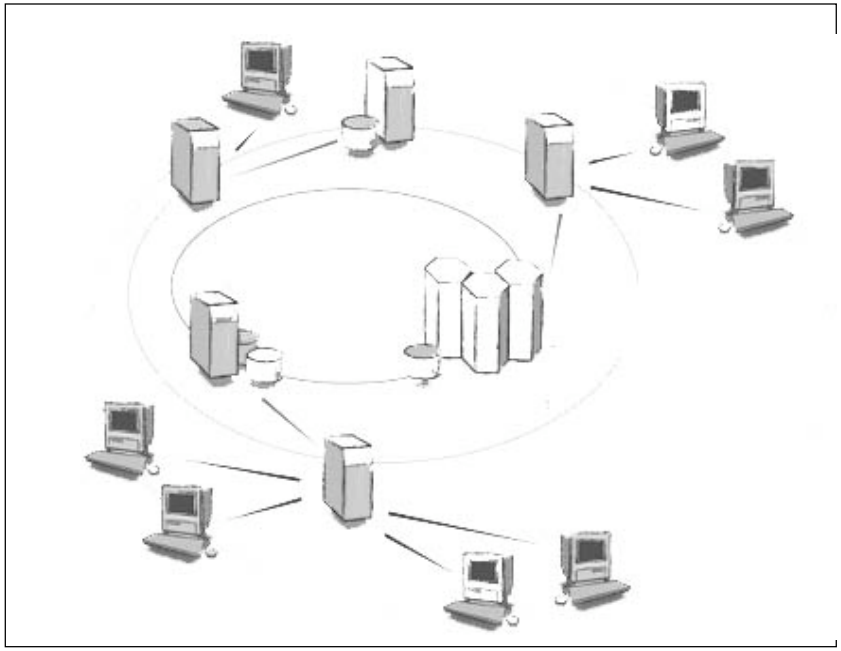
RESO – Optimized Protocols and Software for High Performance Networks

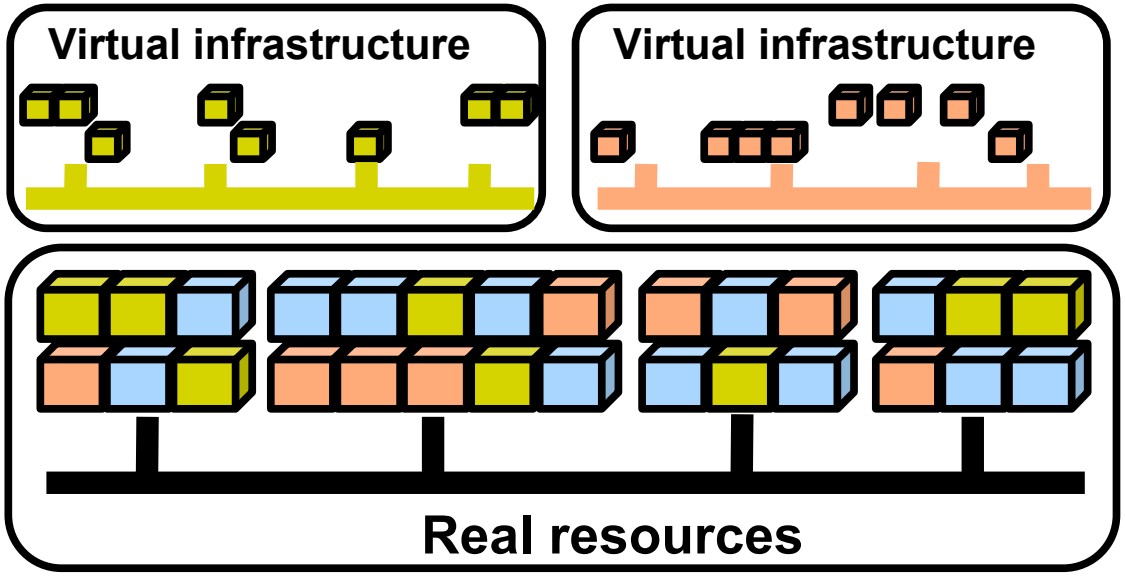

Introduction: Virtualized Infrastructures

- There are many currently projects/users seeking a private and custumized infrastructure utilization
- Virtualized Infrastructure is a concept emerging from Virtual Networks, Virtualization and Infrastructure as a Service waves





Virtual Infrastructures concept



- Virtualization
  - Computational resources: virtual machines monitors: Xen, vServer, VMWare, UML
  - Network: Abstraction and sharing of the communication channels and network devices
- Related work
  - VINI, CABO, VGrADS, GLambda, Reservoir, Manticore, HIPCAL, CARRIOCAS,

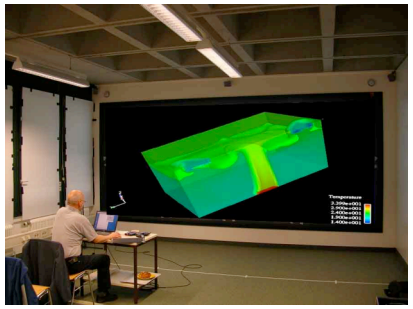
Background 1
ANR HIPCAL project (2007-2010)

- HIPCAL introduces and studies a new paradigm for controlling distributed resources based on **joined network** and **operating system virtualization** and cryptographic identification and network resource reservation:
  - To increase application **portability, performance prediction, security**
  - To provide **a software framework** enabling the creation and management of
  - **Virtual Private Execution Infrastructures : VPXI**
- **Applications to biomedical and genomic applications.**
- **Validation** at different scales on **Grid5000**.
- Demonstrate that applications perform efficiently with more **security, predictability and transparence**.

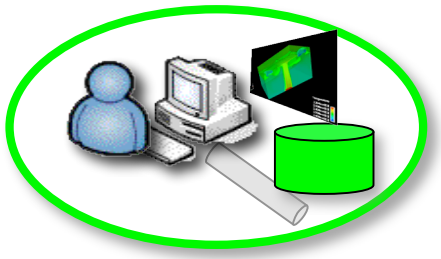
CARRIOCAS project (2006-2009)

Orchestrating dynamic network service deliveries over ultrahigh capacity optical networks

- To research, design and implement an ultra-high bit rate network, reconfigurable according to grid applications connectivity requirements
  - ***Transmission capacity 40Gbit/s per wavelength***
  - **Enhanced application-network interactions**
  - Guaranteed network service deliveries in function of Application QoS requirements.



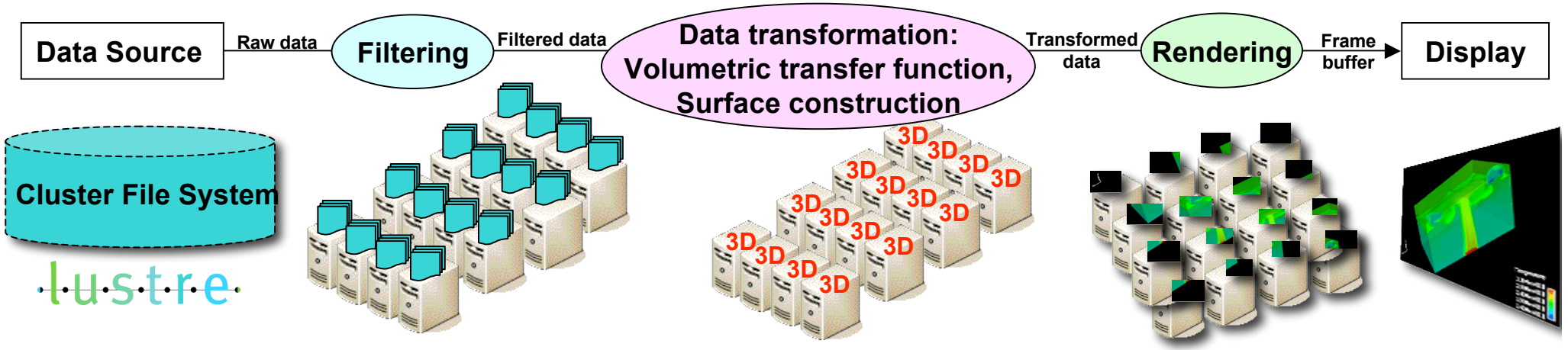
- To develop new **Services** & **Usages**
  - collaborative engineering on virtual prototypes
  - Computing Intensive Simulation Applications
  - Interactive visualization



- To specify new business models of services integrating IT access and connectivity

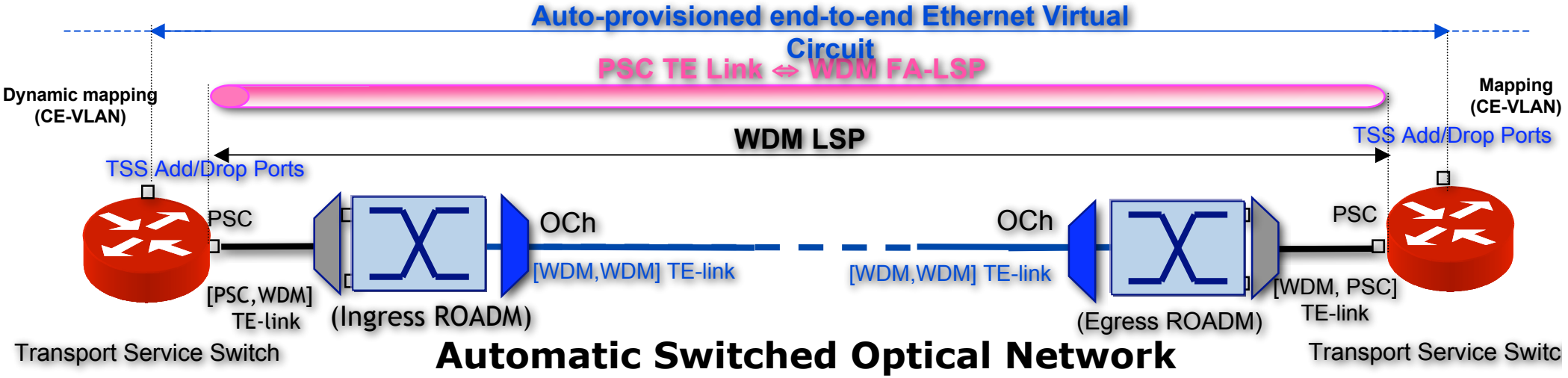
CARRIOCAS example

- Visualization pipeline

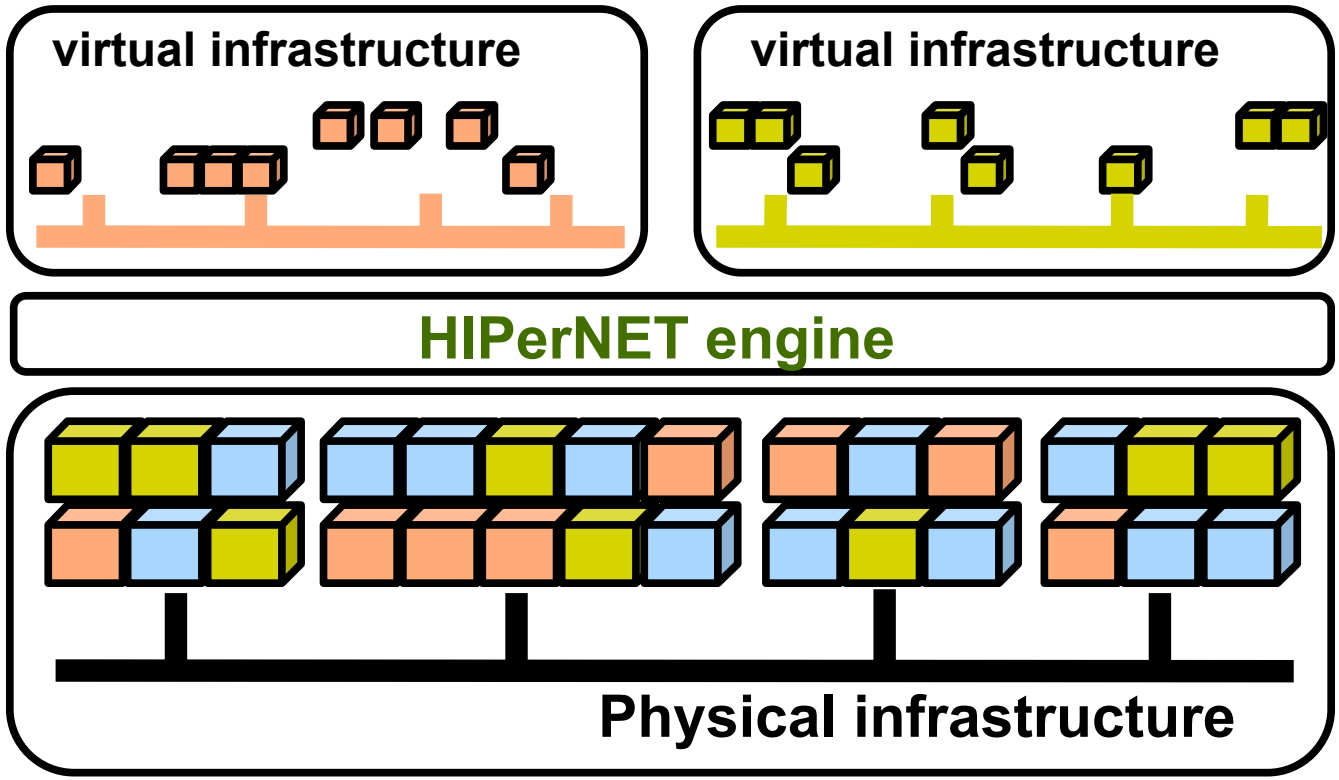


- 24 Mpixels x 32 bits x 30 images/s x 2 for stereo = **46,08 Gb/s**
- Low latency requirements for interactivity

- One Data flows can be mapped on one EVC allocated on dedicated WDM

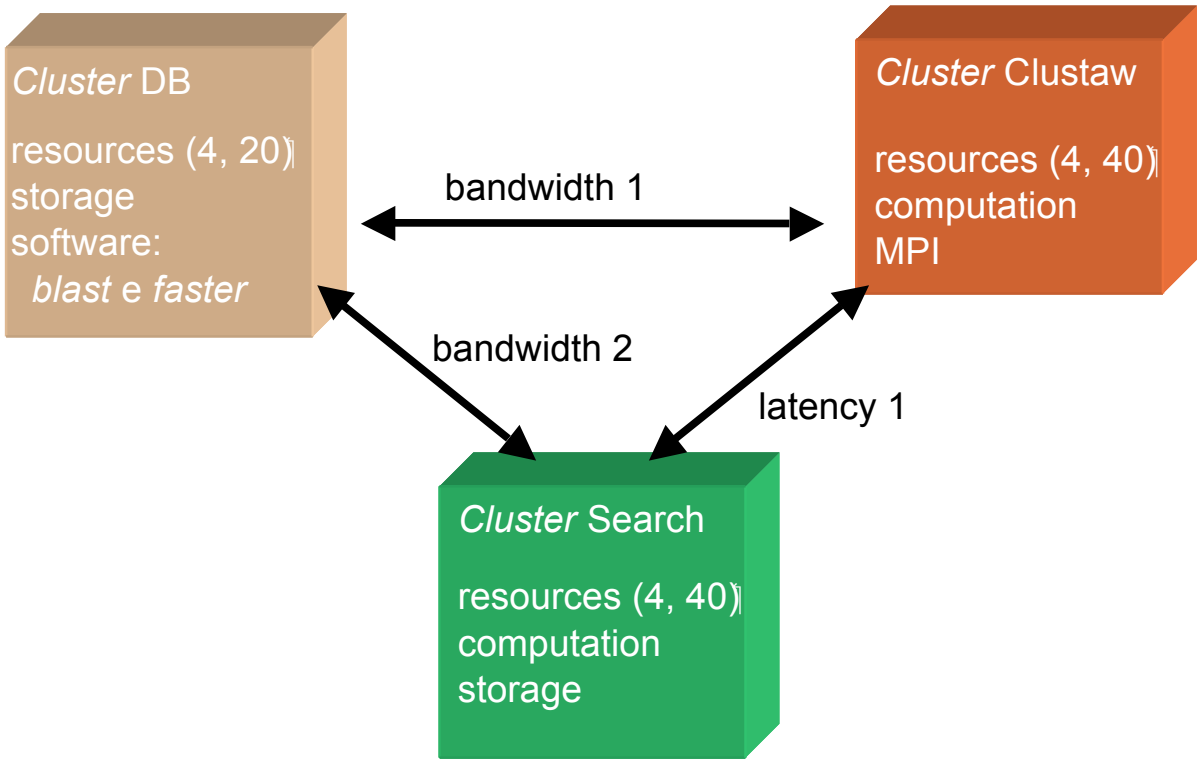


HIPerNET software (from L3 virt.)
SRV software (from L1virt.)



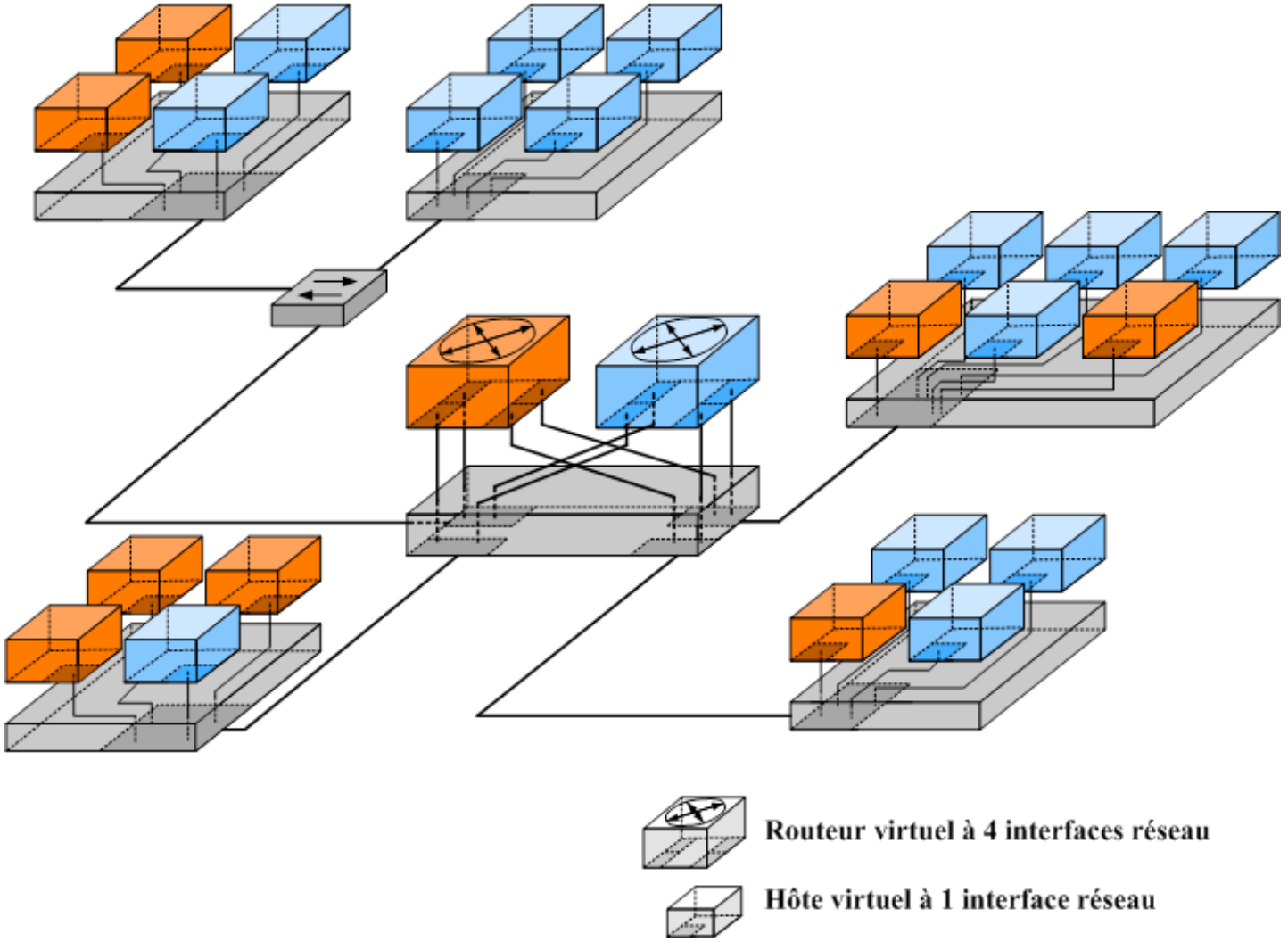
Virtual Infrastructure description

- Applications have different requirements - Need to use infrastructures
- Engines need to allocate and manage resources for them
- There is a need for components description and parameterization



Virtual Infrastructure Description and Specification about recursive aggregation & interconnection

Virtual Infrastructure with virtual router



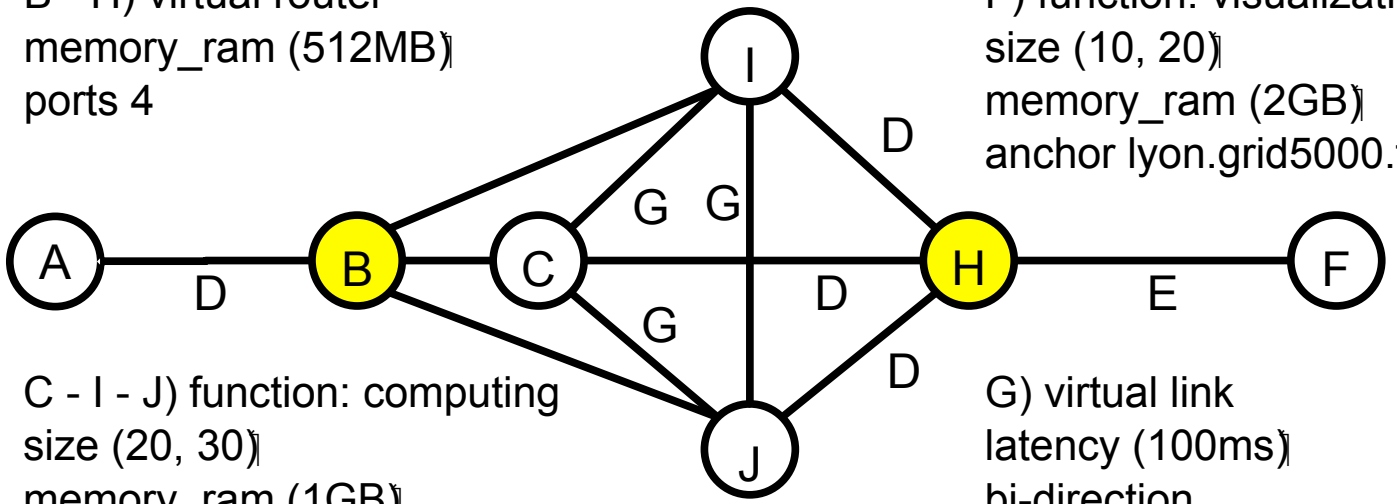
Virtual Infrastructure definition

A) function: storage
size (10, 20)
hd_size (30GB, 60GB)

E) virtual link
bandwidth (2Gbps, 3Gbps)
uni-direction
between [(H port 4,F)]

B - H) virtual router
memory_ram (512MB)
ports 4

F) function: visualization
size (10, 20)
memory_ram (2GB)
anchor lyon.grid5000.fr



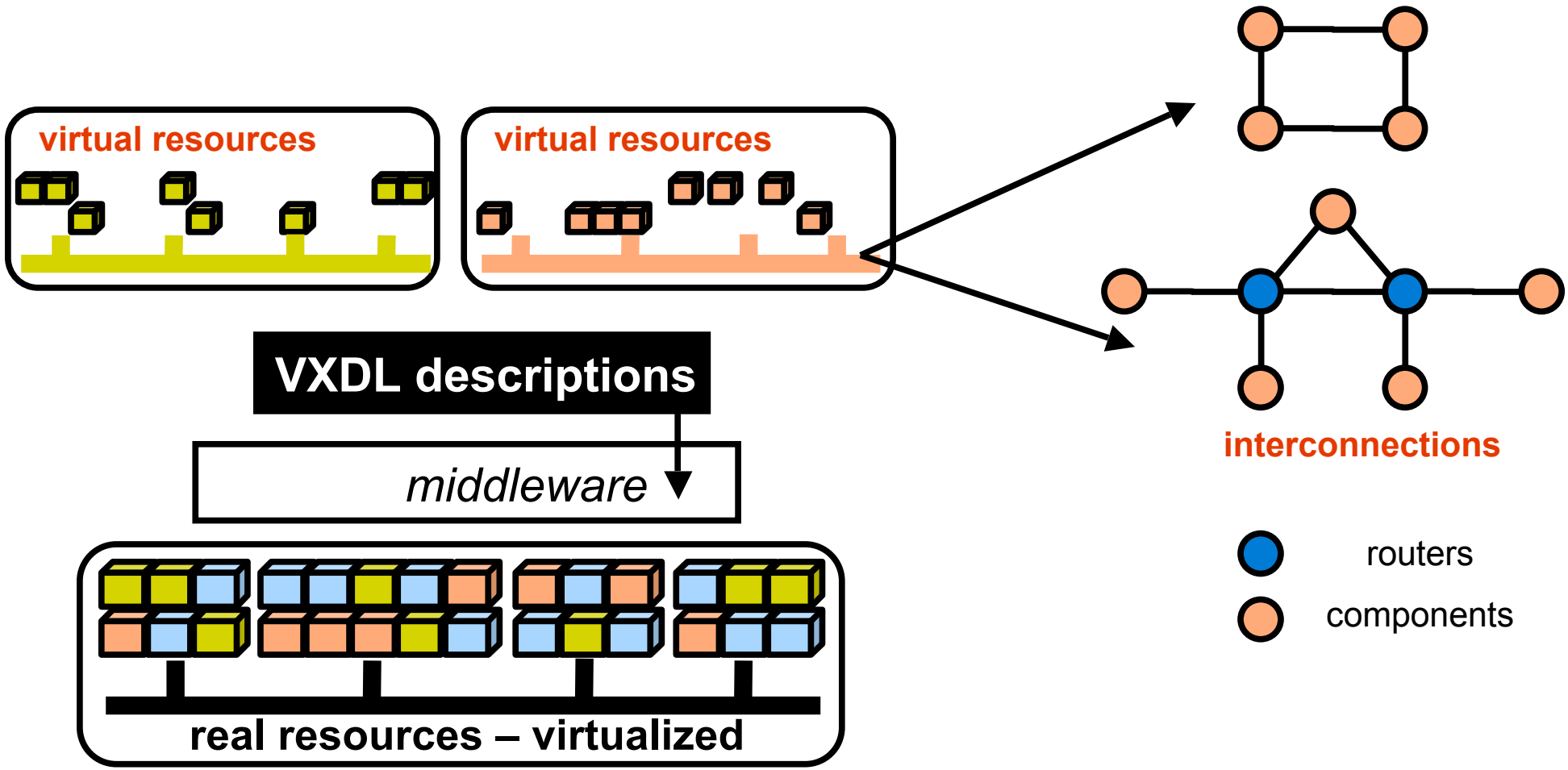
C - I - J) function: computing
size (20, 30)
memory_ram (1GB)

G) virtual link
latency (100ms)
bi-direction
between [(C,I), (I,J), (C,J)}

D) virtual link
bandwidth (1Gbps, 2Gbps)
uni-direction
between [(A, B port 1), (I, H port 1), (J, H port 2), (C, H port 3)]

VXDL

VXDL: Virtual **eXecution Infrastructure** Description Language



VXDL: grammar

I) Description of computational resources

II) Description of network topologies

III) Description of an execution timeline

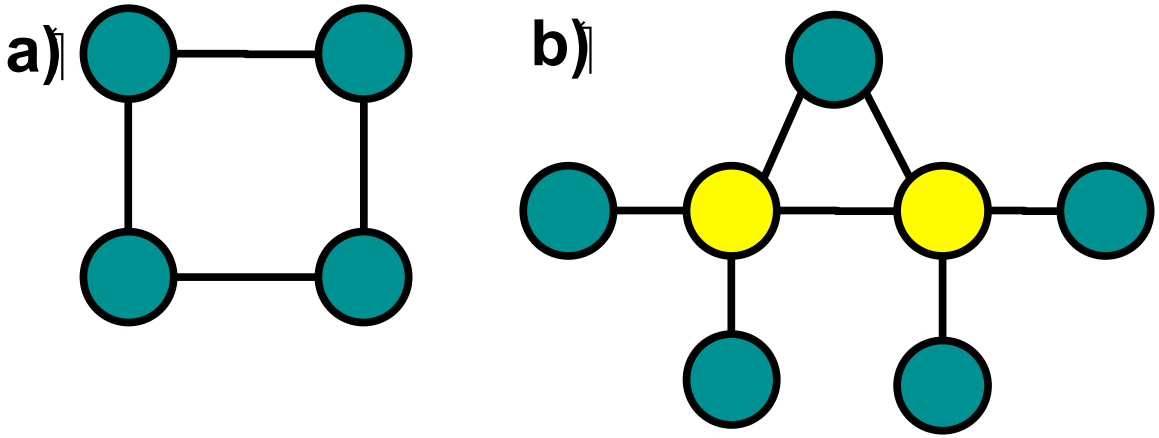
VXI : virtual infrastructure

- A virtual infrastructure (VXI) is defined as:
  - (optional) A list of individual resources and groups;
    - For each resource an elementary function assigned (single component or a Group attribute)
    - (optional) Applications and tools to be deployed on each component (operating systems and programming tools, for example);
    - Expression of physical constraints
      - anchor= @PHY
      - #VM/PHYM
  - (optional) Network topology and characterization of the links in terms of QoS metrics (bdw, latency…); (work in progress in NML-WG)
  - (optional) The executing timeline of the application (for co-scheduling).

VXDL: grammar

I) Description of computational resources

II) Description of network topologies

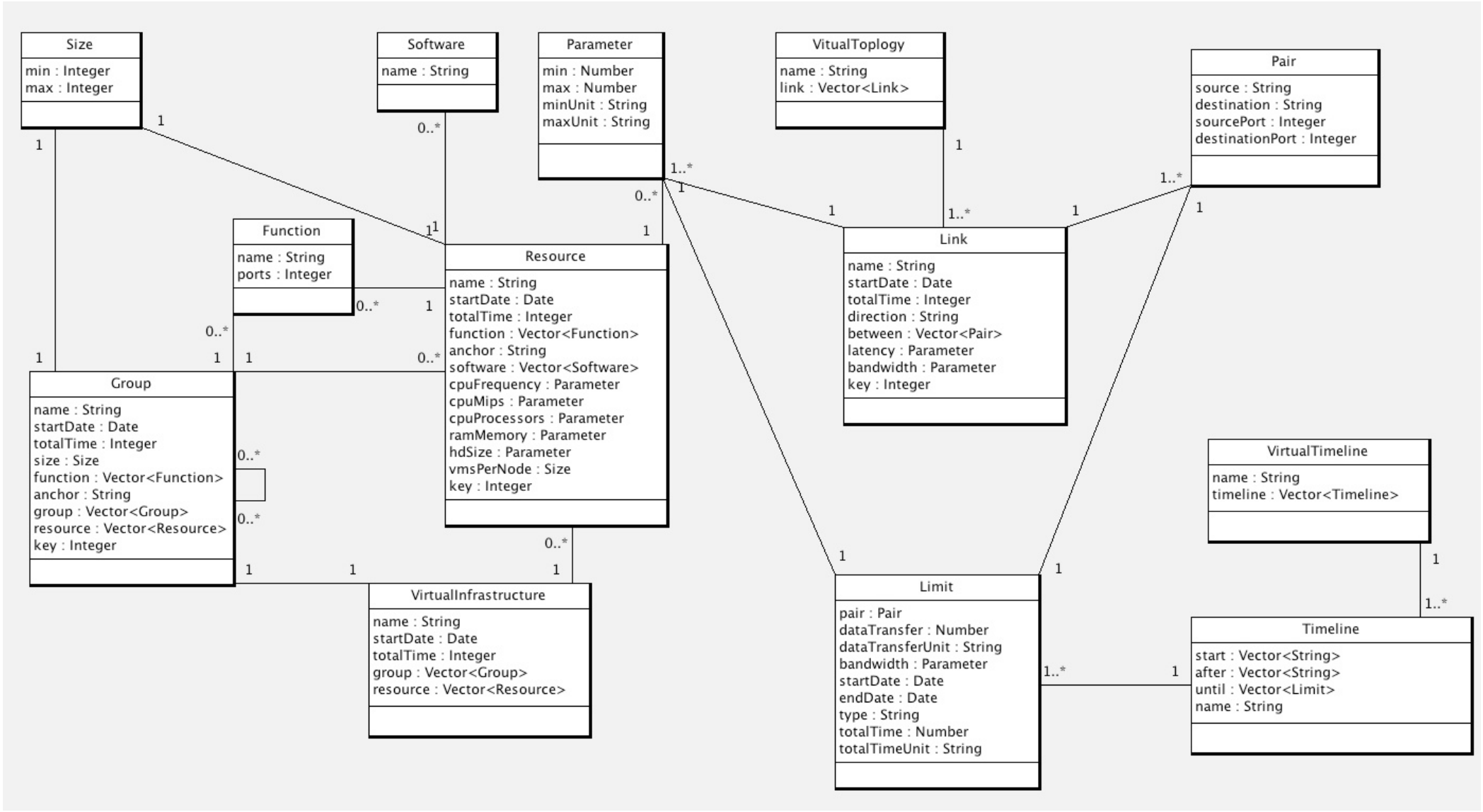


III) Description of an execution timeline

Network topology specification in VXDL (grammar)

```
["virtual topology" <name> "{" <links> "}"]
<links> ::= (<link>)+
<link> ::= "link" "(" <name> ")"
       "{" <link-parameters> "}"
<link-parameters> ::= <link-parameter>
       ("," <link-parameter>)*
<link-parameter> ::= "bandwidth" <value> |
   "latency" <value> |  "direction" <direction> |
   "between" "[" <components-links> "]"
<direction> ::= "uni" | "bi"
<components-links> ::= <pair> ("," <pair>)*
<pair> ::= "(" <component> "," <component> ")"
<component> ::= <name> | <name> "port" <number>
```

VXDL schema



http://perso.ens-lyon.fr/guilherme.koslovski/vxdl/

VXDL: grammar

I) Description of computational resources

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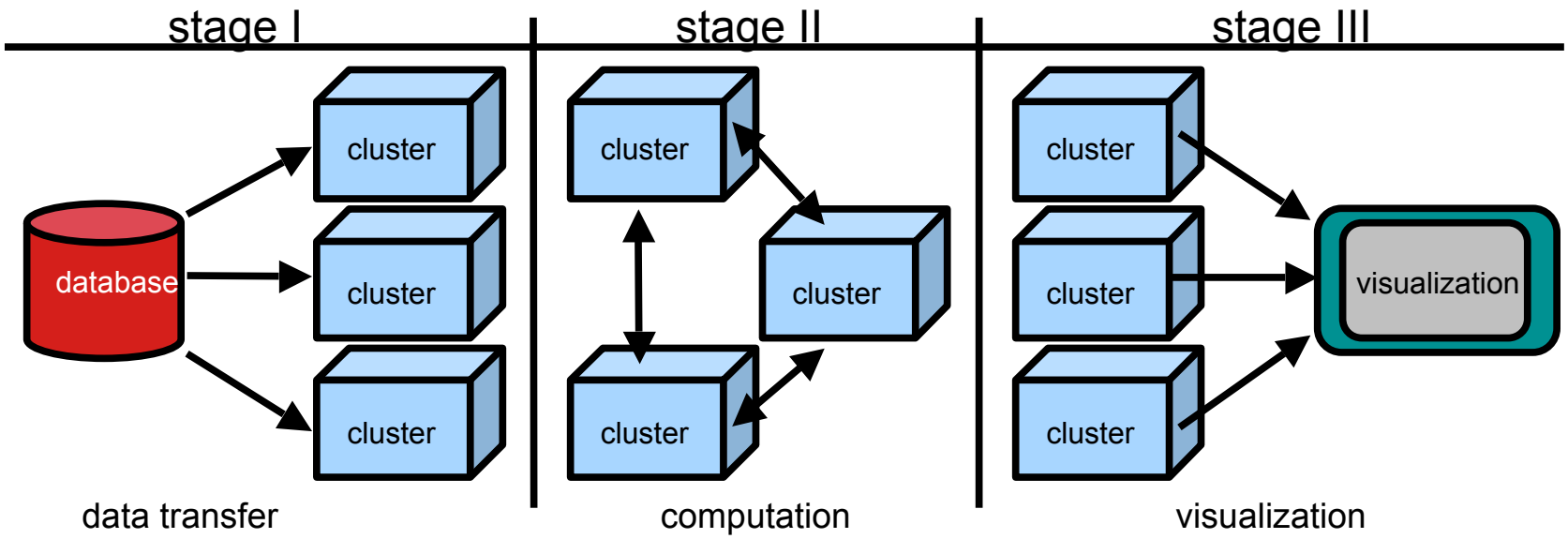
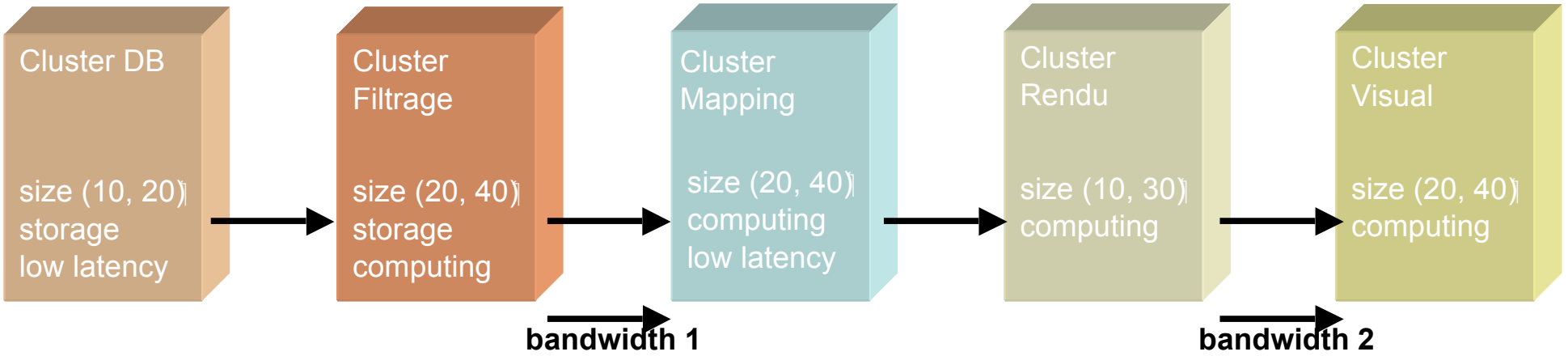


VXDL: example

- VISUPIPE:
  - Used to view images in real time. CARRIOCAS project
  - Network topology interfere directly in the performance



VXDL description of VISUPIPE application

```
<?xml version="1.0"?>
<vxdl:description xmlns:vxdl="http://perso.ens-lyon.fr/
guilherme.koslovski/vxdl#">
  <vxdl:virtualInfrastructure>
    <vxdl:name>VISUPIPE example</vxdl:name>
    <vxdl:startDate>2009-02-01 10:00:00</vxdl:startDate>
    <vxdl:totalTime>10</vxdl:totalTime>
    <vxdl:totalTimeUnit>hrs</vxdl:totalTimeUnit>
    <vxdl:group>
      <vxdl:name>Cluster Data Source</vxdl:name>
      <vxdl:size>
        <vxdl:min>10</vxdl:min>
        <vxdl:max>20</vxdl:max>
      </vxdl:size>
      <vxdl:resource>
        <vxdl:name>Nodes Cluster Data Source</vxdl:name>
        <vxdl:function>
          <vxdl:name>storage</vxdl:name>
        </vxdl:function>
        <vxdl:hdSize>
          <vxdl:min>30</vxdl:min>
          <vxdl:minUnit>GB</vxdl:minUnit>
        </vxdl:hdSize>
      </vxdl:resource>
    </vxdl:group>
    <vxdl:group>
      <vxdl:name>Cluster Filtering</vxdl:name>
      <vxdl:size>
        <vxdl:min>20</vxdl:min>
        <vxdl:max>30</vxdl:max>
      </vxdl:size>
      <vxdl:resource>
        <vxdl:name>Nodes Cluster Filtering</vxdl:name>
        <vxdl:function>
          <vxdl:name>computing</vxdl:name>
        </vxdl:function>
        <vxdl:cpuFrequency>
          <vxdl:min>2</vxdl:min>
          <vxdl:minUnit>GHz</vxdl:minUnit>
        </vxdl:cpuFrequency>
        <vxdl:software>
          <vxdl:name>debian</vxdl:name>
        </vxdl:software>
      </vxdl:resource>
    </vxdl:group>
    <vxdl:group>
      <vxdl:name>Cluster Data Transformation</vxdl:name>
      <vxdl:size>
        <vxdl:min>20</vxdl:min>
        <vxdl:max>40</vxdl:max>
      </vxdl:size>
      <vxdl:resource>
        <vxdl:name>Nodes Cluster Data Transformation</
vxdl:name>
        <vxdl:function>
          <vxdl:name>computing</vxdl:name>
        </vxdl:function>
        <vxdl:cpuFrequency>
```

```
    <vxdl:group>
      <vxdl:name>Cluster Data Source</vxdl:name>
      <vxdl:size>
        <vxdl:min>10</vxdl:min>
        <vxdl:max>20</vxdl:max>
      </vxdl:size>
      <vxdl:resource>
        <vxdl:name>Nodes Cluster Data Source</vxdl:name>
        <vxdl:function>
          <vxdl:name>storage</vxdl:name>
        </vxdl:function>
        <vxdl:hdSize>
          <vxdl:min>30</vxdl:min>
          <vxdl:minUnit>GB</vxdl:minUnit>
        </vxdl:hdSize>
      </vxdl:resource>
    </vxdl:group>
```

```
      <vxdl:name>Cluster Display</vxdl:name>
      <vxdl:size>
        <vxdl:min>20</vxdl:min>
        <vxdl:max>40</vxdl:max>
      </vxdl:size>
      <vxdl:resource>
        <vxdl:name>Nodes Cluster Display</vxdl:name>
        <vxdl:function>
          <vxdl:name>visualization</vxdl:name>
        </vxdl:function>
        <vxdl:ramMemory>
          <vxdl:min>3</vxdl:min>
          <vxdl:minUnit>GB</vxdl:minUnit>
        </vxdl:ramMemory>
```

VXDL description of VISUPIPE application

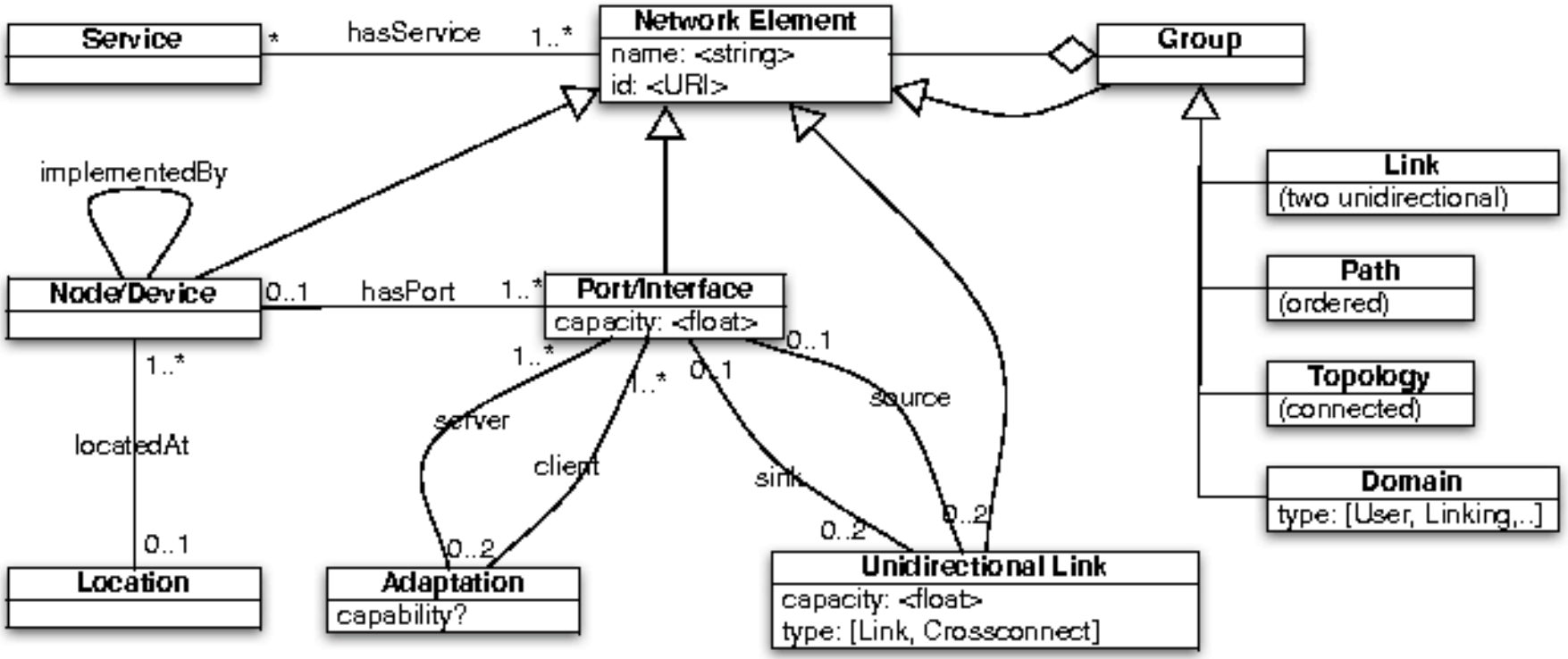
```
<vxdl:link>
    <vxdl:name>Raw Data</vxdl:name>
    <vxdl:bandwidth>
        <vxdl:min>38</vxdl:min>
        <vxdl:minUnit>Gbps</vxdl:minUnit>
    </vxdl:bandwidth>
    <vxdl:direction>uni</vxdl:direction>
    <vxdl:pair>
        <vxdl:source>Cluster Data Source</vxdl:source>
        <vxdl:destination>Cluster Filtering</vxdl:destination>
    </vxdl:pair>
</vxdl:link>
```

```
<vxdl:timeline>
    <vxdl:name>Time 4</vxdl:name>
    <vxdl:after>Time 3</vxdl:after>
    <vxdl:start>Frame buffer</vxdl:start>
    <vxdl:until>
        <vxdl:dataTransfer>500</vxdl:dataTransfer>
        <vxdl:dataTransferUnit>GB</vxdl:dataTransferUnit>
        <vxdl:pair>
            <vxdl:source>Cluster Rendering</vxdl:source>
            <vxdl:destination>Cluster Display</vxdl:destination>
        </vxdl:pair>
    </vxdl:until>
```

VXDL and NML elements

NML	VXDL
Group	*Group* description
Network Element	*Resource* description
Node	*Resource* description
Service / Device	*Resource* and/or *Group* parameters
Port / Interface	each *Pair* can identify source/destination ports
Location	*anchor* parameter for *Resources* and *Groups*
Adaptation	descriptive parameters?
Link	*Links* in a *Virtual Topology*
Path	a sequence of *Links*
Topology	a set of *Links* in a *Virtual Topology*
Domain	recursive *Group* definition

NML schema



NML schema using UML notation.
Extracted from https://forge.gridforum.org/sf/projects/nml-wg

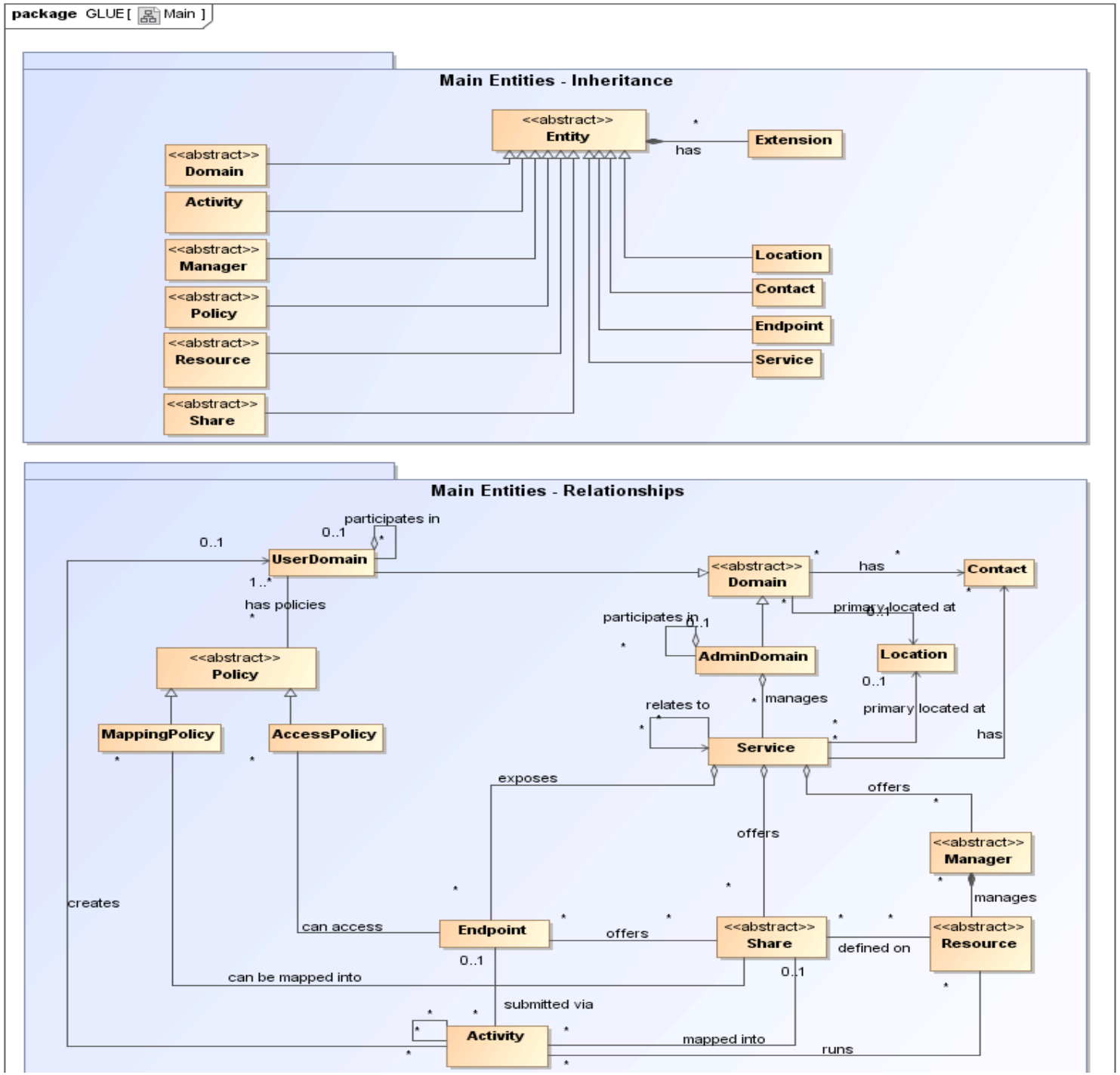
Related work

NDL - Network Description Language:

- collection of schemas (topology, layer, capability, domain and physical) used to represent a network infrastructure in different levels.
- in Resource Description Framework (**RDF**)(language for representing information)
- RDF (and NDL) explores a graph data model composed by a set of RDF triples (subject, object, predicate (property)).

CIM : Common Information Model Specification: a common set of objects and relationship among them. CIM architecture is based on UML concept and provide the language **CQL** (CIM Query Language) to select sets of properties from CIM object instances. CQL is a subset of SQL-92 with some extensions specific to CIM.

GLUE 2.0 : The GLUE specification is an information model for Grid entities described using the natural language and UML Class Diagrams. Rendering to concrete data models such XML Schema, LDAP Schema and SQL are also provided. Concentrate on end points, but also user, owner + integrates location, security & management aspects


package GLUE [Main]
Main Entities - Inheritance
<<abstract>>
Entity
has
Extension
<<abstract>>
Domain
Activity
<<abstract>>
Manager
<<abstract>>
Policy
<<abstract>>
Resource
<<abstract>>
Share
Location
Contact
Endpoint
Service
Main Entities - Relationships
participates in
0..1
UserDomain
1..*
has policies
<<abstract>>
Policy
MappingPolicy
AccessPolicy
<<abstract>>
Domain
has
Contact
primary located at
0..1
participates in
AdminDomain
Location
manages
relates to
Service
exposes
offers
offers
<<abstract>>
Manager
manages
creates
can access
Endpoint
offers
<<abstract>>
Share
defined on
<<abstract>>
Resource
0..1
can be mapped into
submitted via
Activity
mapped into
runs

References & Links

Pascale Vicat-Blanc Primet, Fabienne Anhalt, and Guilherme Koslovski.
Exploring the virtual infrastructure service concept in Grid'5000.
In **20th ITC Specialist Seminar on Network Virtualization**, Hoi An, Vietnam, May 2009.

Pascale Vicat-Blanc Primet, Jean-Patrick Gelas, Olivier Mornard, Guilherme Koslovski, Vincent Roca, Lionel Giraud, Johan Montagnat, and Tram Truong Huu.
A scalable security model for enabling Dynamic Virtual Private Execution Infrastructures on the Internet. In IEEE International Conference on Cluster Computing and the Grid **CCGrid2009**, Shanghai, May 2009. [bibtex-entry]

Guilherme Koslovski, Pascale Vicat-Blanc Primet, and Andrea Schwertner Charão
. VXDL: Virtual Resources and Interconnection Networks Description Language.
In **GridNets 2008**, Oct. 2008. [bibtex-entry]

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Questions?

- Do you think there is a place for VX concept in NML?
- Do we need a VXDL-WG in OGF?