

# **RAINS**

## **Resource Aware Intelligent Network Services**

**ASCR Next-Generation Networks for Science (NGNS)**

**Principal Investigators' (PI) Meeting**

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# RAINS Motivation

- DOE Domain Science applications are not realizing benefits from the high performance advanced network infrastructures to the degree which they should
- A key problem is that compute, storage, and network resources are not “integrated” with each other or with domain application workflows
- That is, we have not solved the end-to-end problem in a multi-resource context
- A seamless, intuitive, and application focused integration of computation, storage, and networking is needed
- An infrastructure for topology and service awareness is needed
  - must span all the resources on an end-to-end, multi-domain basis

# RAINS Motivation

- For the wide area networks , i.e. ESnet and Internet2, we have topology and service awareness
  - via OSCARS and the perfSONAR Topology Service
- However, this only covers the wide area network topology
  - Does not describe the laboratory networks, regional networks, campus networks
  - Does not describe the resources (storage and compute) which are connected to these networks

# RAINS Overview

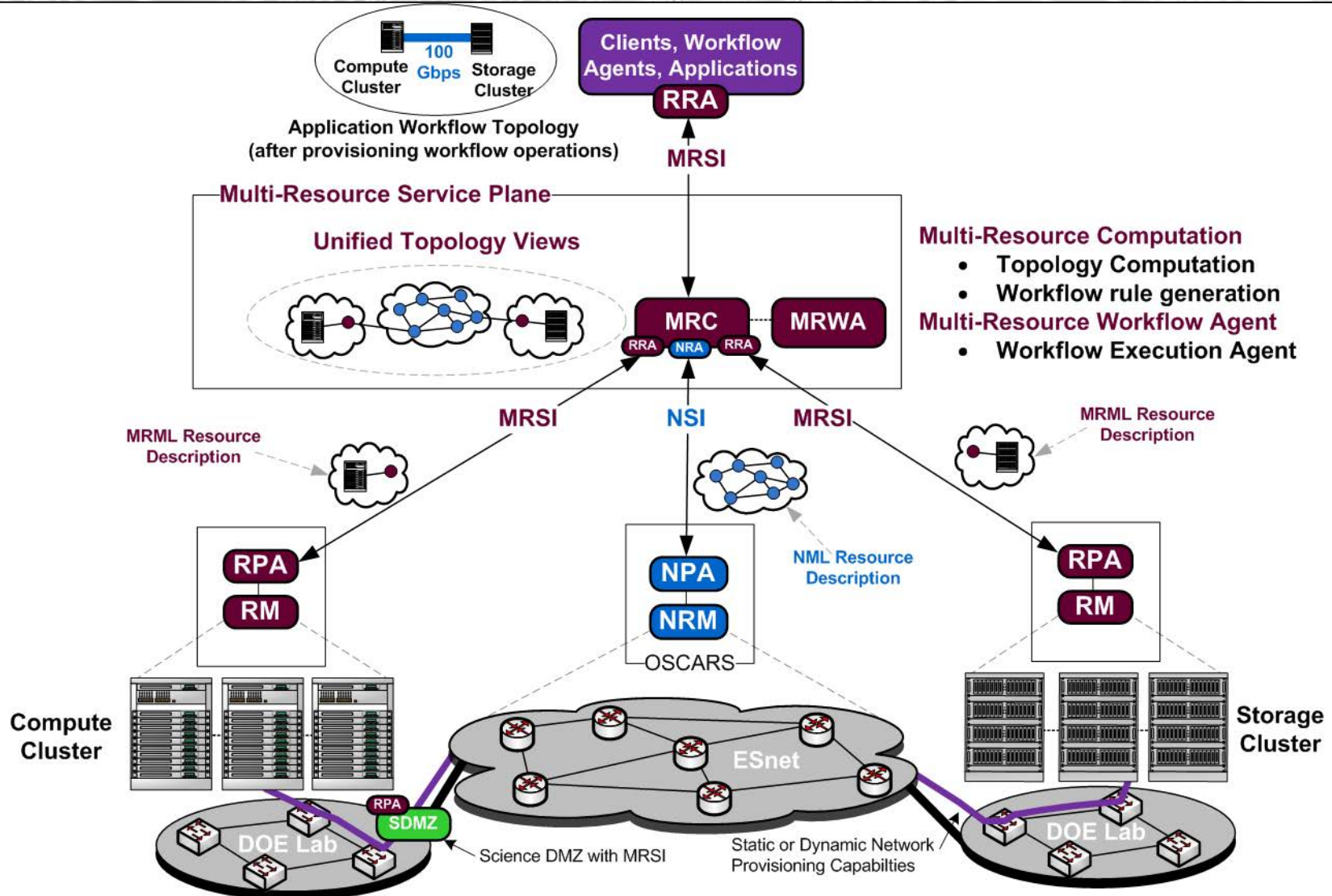
- The RAINS project is building on the Network Service Plane (NSP) as implemented by OSCARS, to construct a Multi-Resource Service Plane (MRSP)
- OSCARS is currently using a network topology description based on the NMWG Topology Schema and perfSONAR Topology service
- OSCARS is transitioning to the Network Markup Language (NML) schema, as part of move to the Network Service Interface (NSI) as the main API.
- RAINS is building on this and extending the NML to include multiple resource types (storage, compute, instrument), which we refer to as Multi-Resource Markup Language (MRML)

# RAINS Overview

- RAINS is focused on building an infrastructure and software package so that resource owners can describe their resources in a manner that is compatible with other resources and other resource owners (with abstraction features)
- Evaluating how to integrate this as extensions into the ESnet NSA/NSI/NML topology distribution service and the Document Distribution Service (DDS)
- RAINS is also implementing Intelligent Services based on these multi-resource topology descriptions
  - Allows applications to ask questions such as: What is possible? Where are specific resource types located? What are the five best options given these constraints?



# RAINS Multi-Resource Service Plane (MRSP)



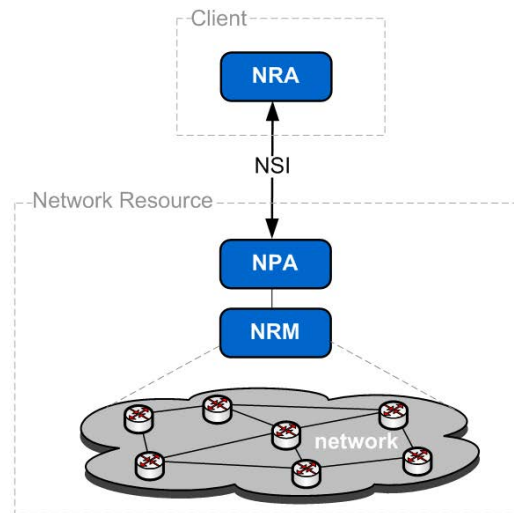
## DOE Lab and ESnet Network Resource Approach

- ESnet services such as OSCARS dynamic provisioning will be incorporated into the MRSP ecosystem
- DOE Lab networks may not have a dynamic provisioning capability. Planning to work to extend the lab ScienceDMZ connections and features to support the MRSP. This may include placement of a MRSI interface agent to "cover" the Science DMZ.

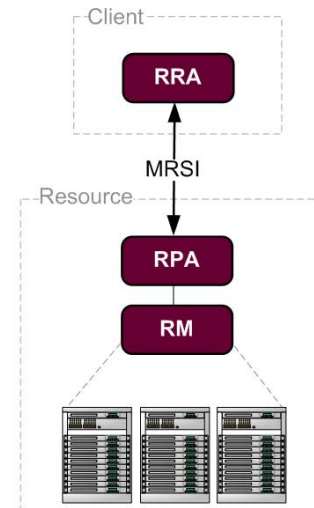
# Multi-Resource Service Interface (MRSI)

- Purpose:
  - Every MRSP participant acts as a service provider or a service requestor or both and is connected to the ecosystem through a set of services.
  - Through the MRSI, MRSP can provide common and open-standard mechanisms for requesting, querying and monitoring diverse types of resources
  - It also provides common mechanisms for security and policy management.

- Model:



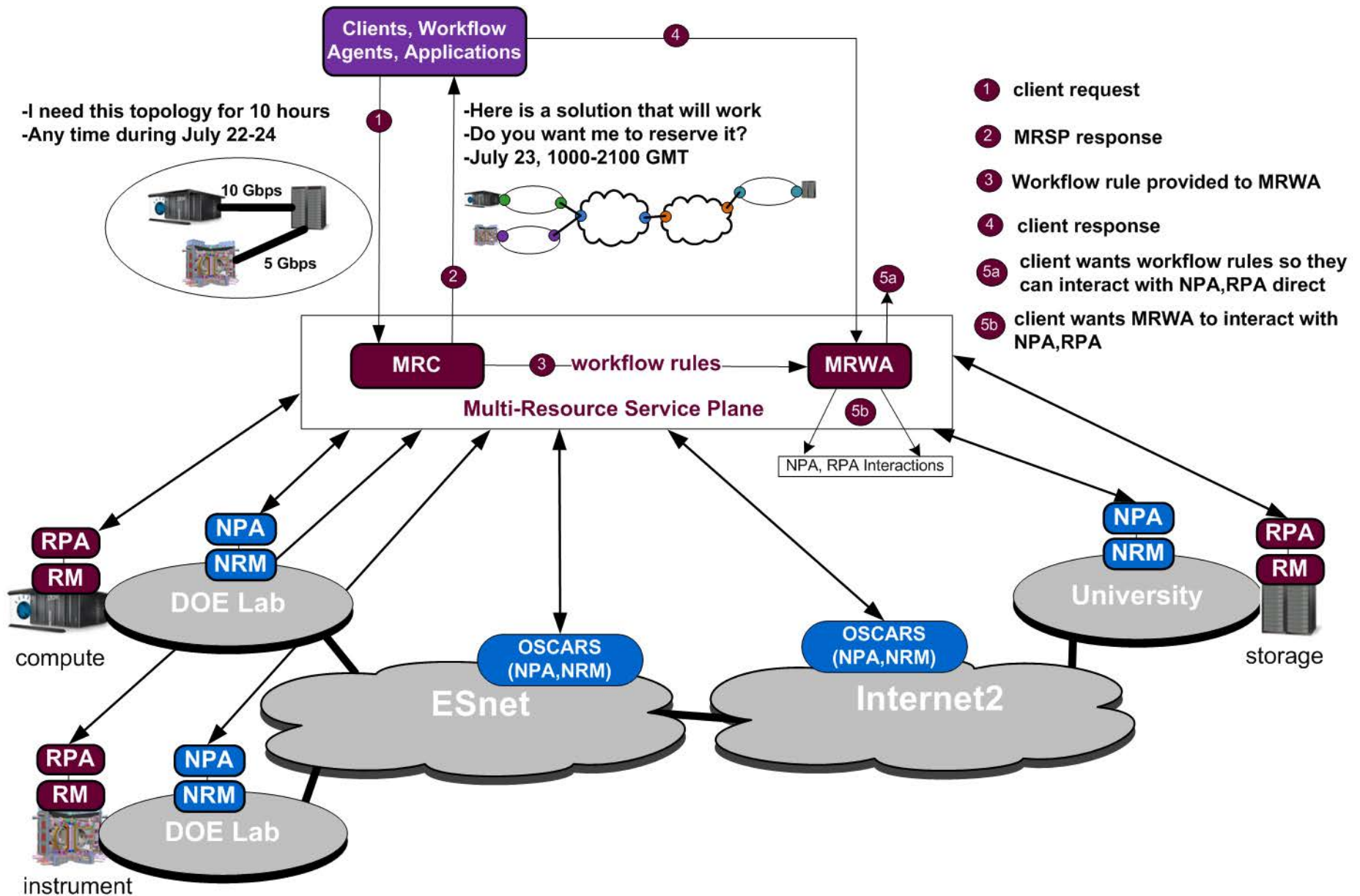
Network Service Interface Model  
NRA - Network Requester Agent  
NSI - Network Service Interface  
NPA - Network Provider Agent  
NRM - Network Resource Manager



Multi-Resource Service Interface Model  
RRA - Multi-Resource Requester Agent  
MRSI - Multi-Resource Service Interface  
RPA - Multi-Resource Provider Agent  
RM - Resource Manager

- Focus:
  - Make OSCARS an MRSI compatible resource provider agent (RPA).
  - Develop a new MRSI RPA to cover Magellan OpenStack clouds.
  - Wrap KBase or make Shock and AWE resource managers MRSI compatible.

# RAINS Multi-Resource Intelligent Services

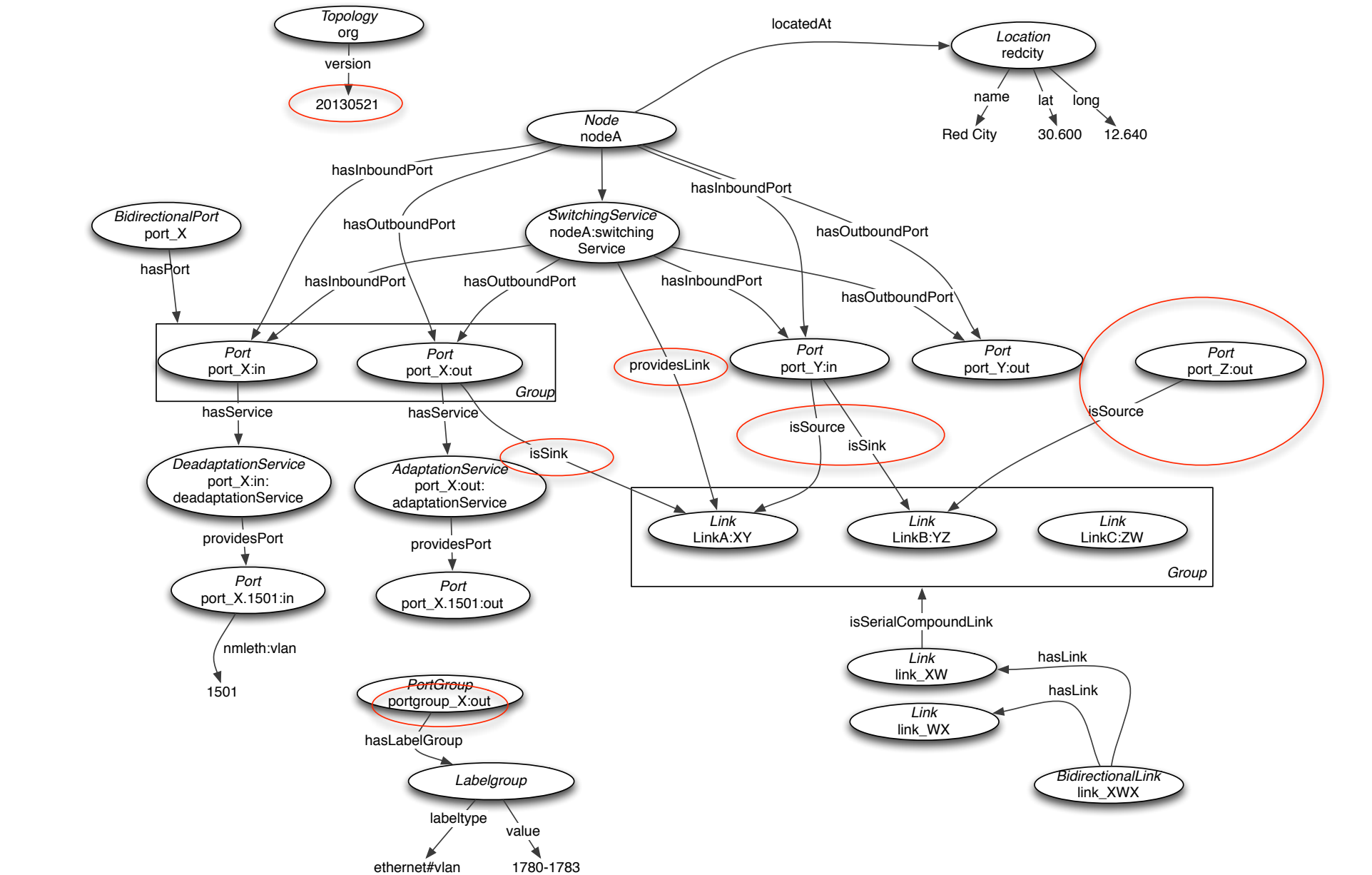




# RAINS Plans

- RAINS working on deploying Resource Manager (RM) agents with MRML capabilities based on the project participant resources:
  - MAX Regional Network and UMD campus ScienceDMZ
  - MAX Network Embedded Storage System (NES) which is a Ceph based high performance parallel file system
  - MAX OpenStack based compute infrastructure
  - ANL Science DMZ and Laboratory network
  - ANL Storage Systems
  - ANL Compute environment (Magellan Cluster)
- RAINS is also building a MRML capable Resource Manager (RM) for storage systems.
- RAINS includes a collaboration with KBASE (Biology Knowledgebase) as a demonstration use case

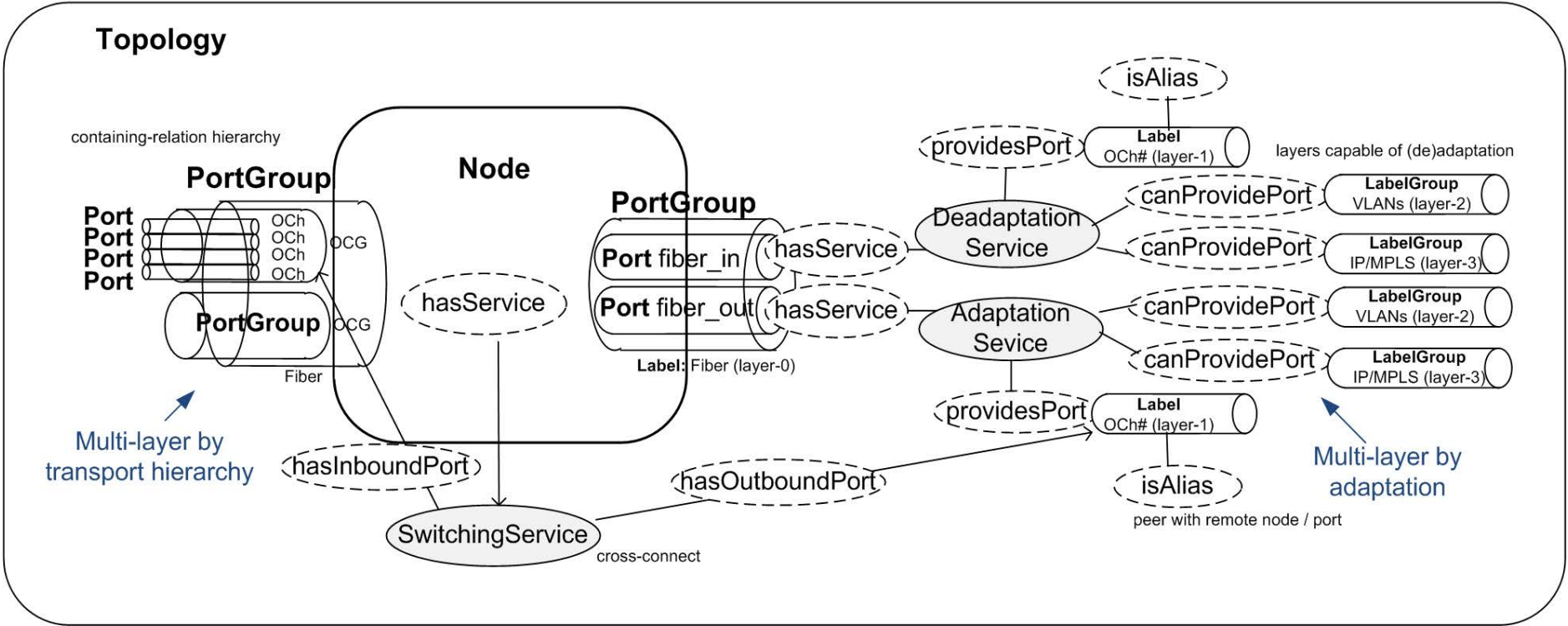
# NML Schema



# RAINS Multi-Resource Service Modeling

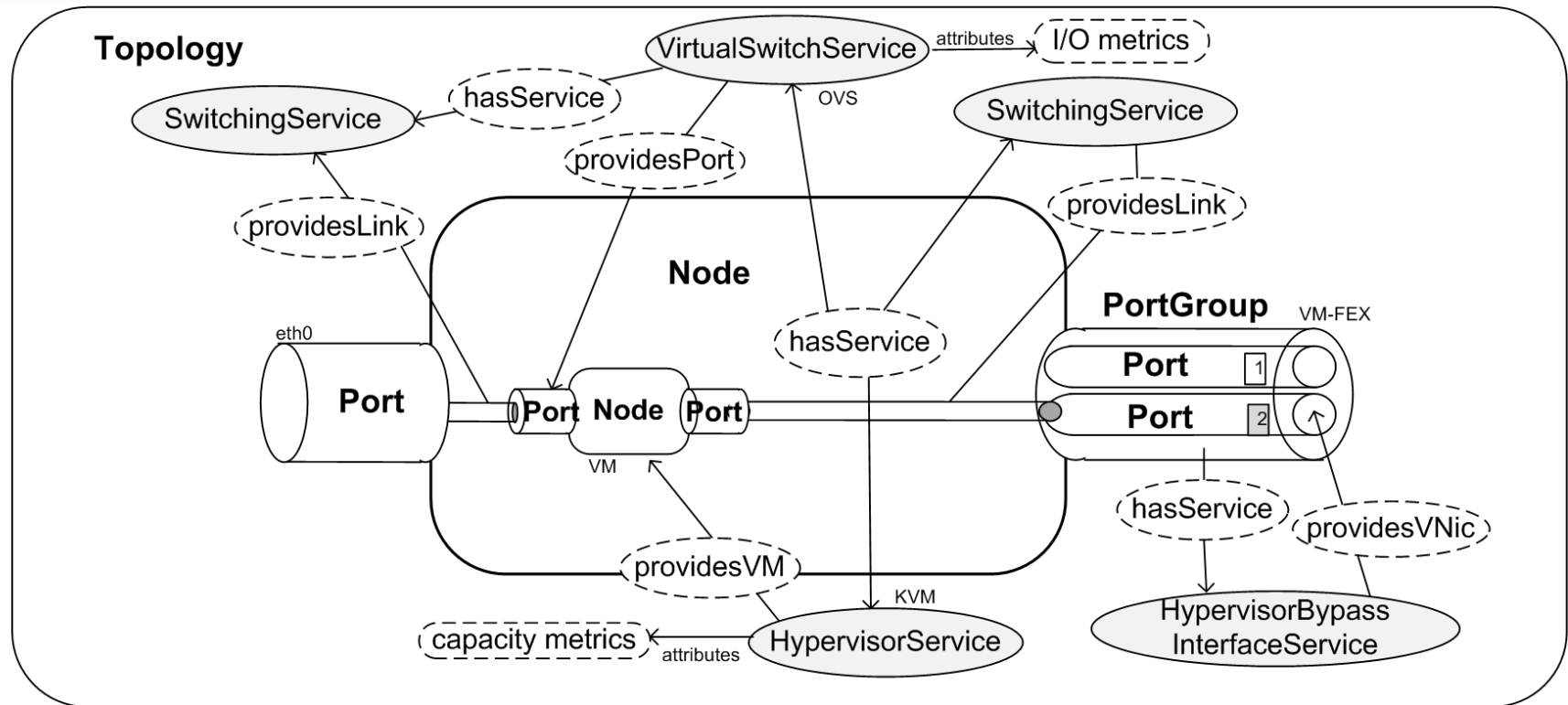
## NML-MRS Modeling

### Use Case 1: Multi-Layer Network



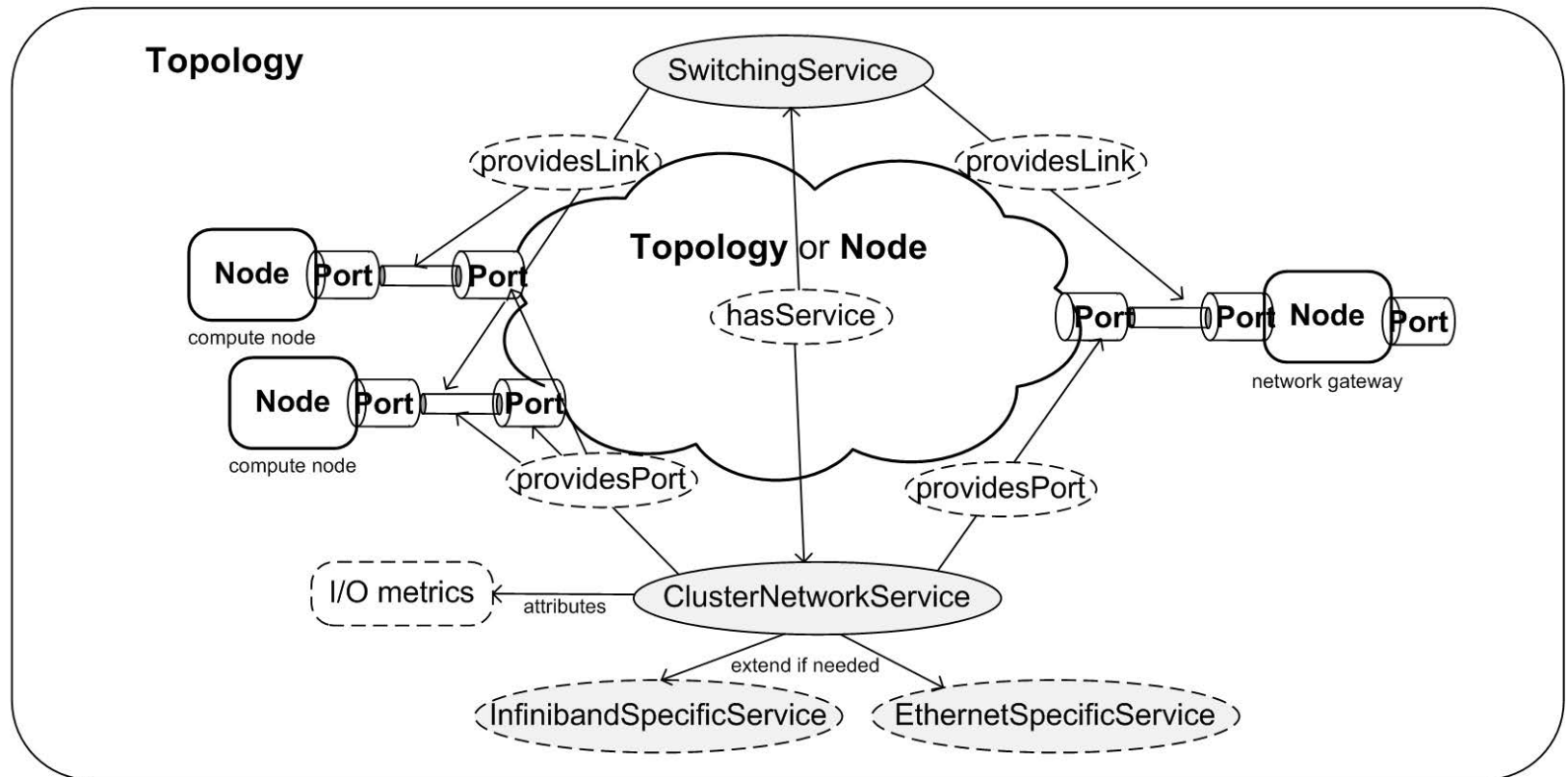
# RAINS Multi-Resource Service Modeling

NML-MRS Modeling  
Use Case 2: Cloud VM Host



# RAINS Multi-Resource Service Modeling

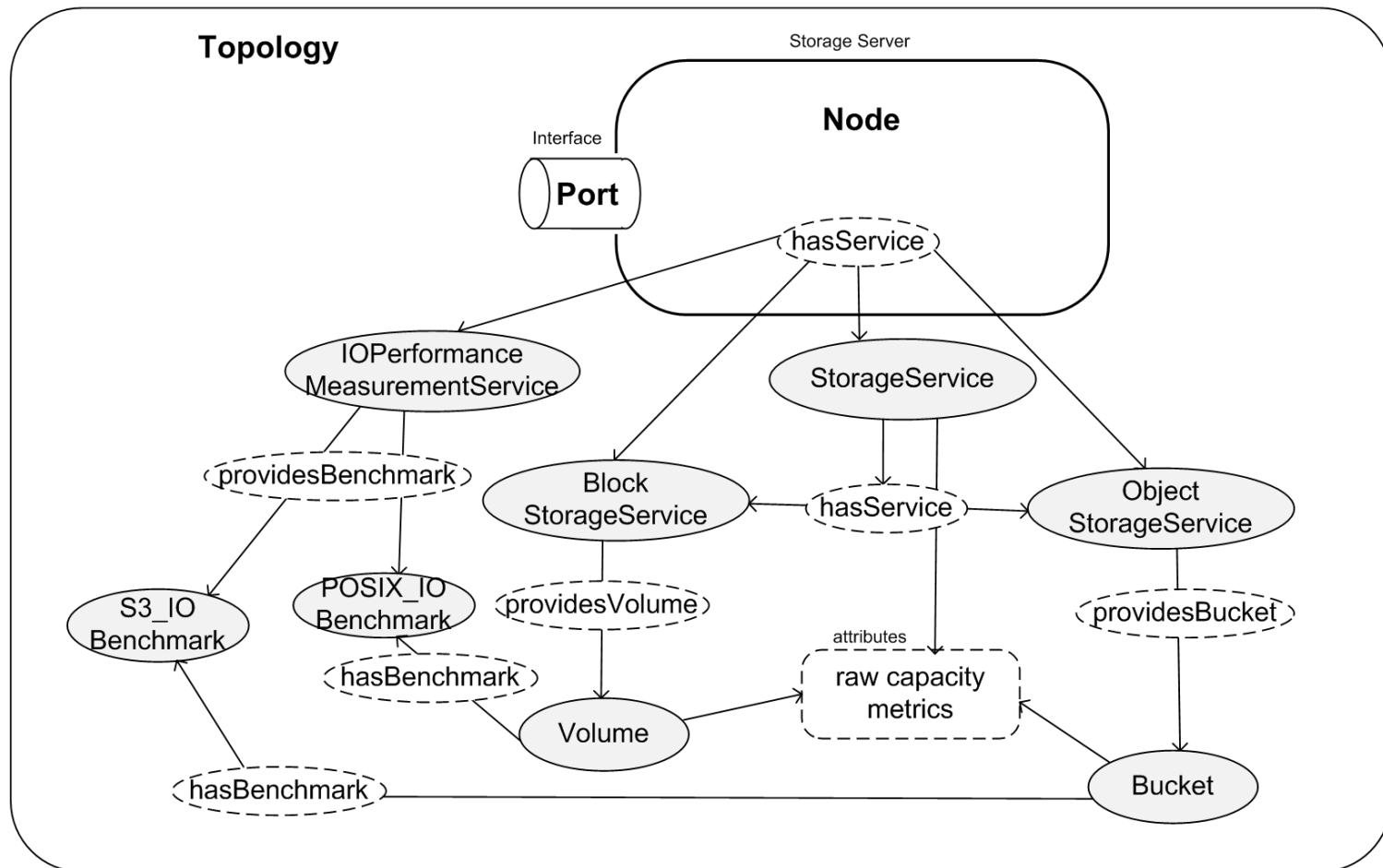
NML-MRS Modeling  
Use Case 3: HPC Cluster

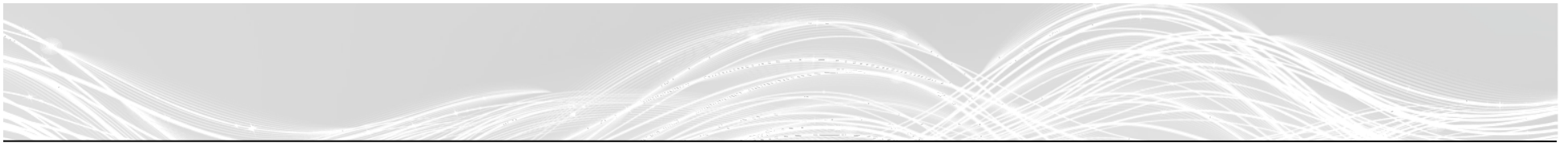




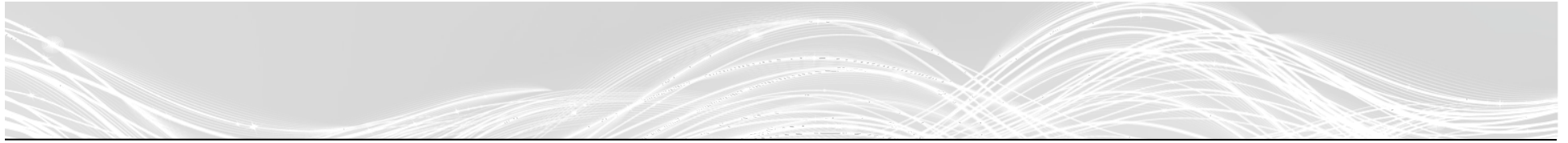
# RAINS Multi-Resource Service Modeling

NML-MRS Modeling  
Use Case 4: Networked Storage





- "What question does your research motivate you to now ask?"
  - How do we get the domain scientist application/workflow developers, the storage system builders, and compute system builders and the networking people to work more closely together?
  - How do we build bigger teams of people in the R&E community working on common and/or compatible technologies?



**Thanks**