

Active Network Approach to Grid Management

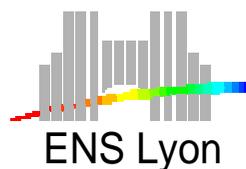
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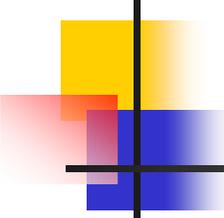
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EU IST project Context

French RNTL E-Toile and ACI Grid



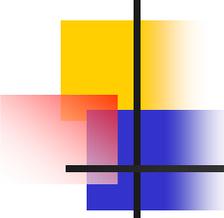


Outline



- Background
- Active Grid
- Tamanoir : Active Network Support
- Active Network for Grid management

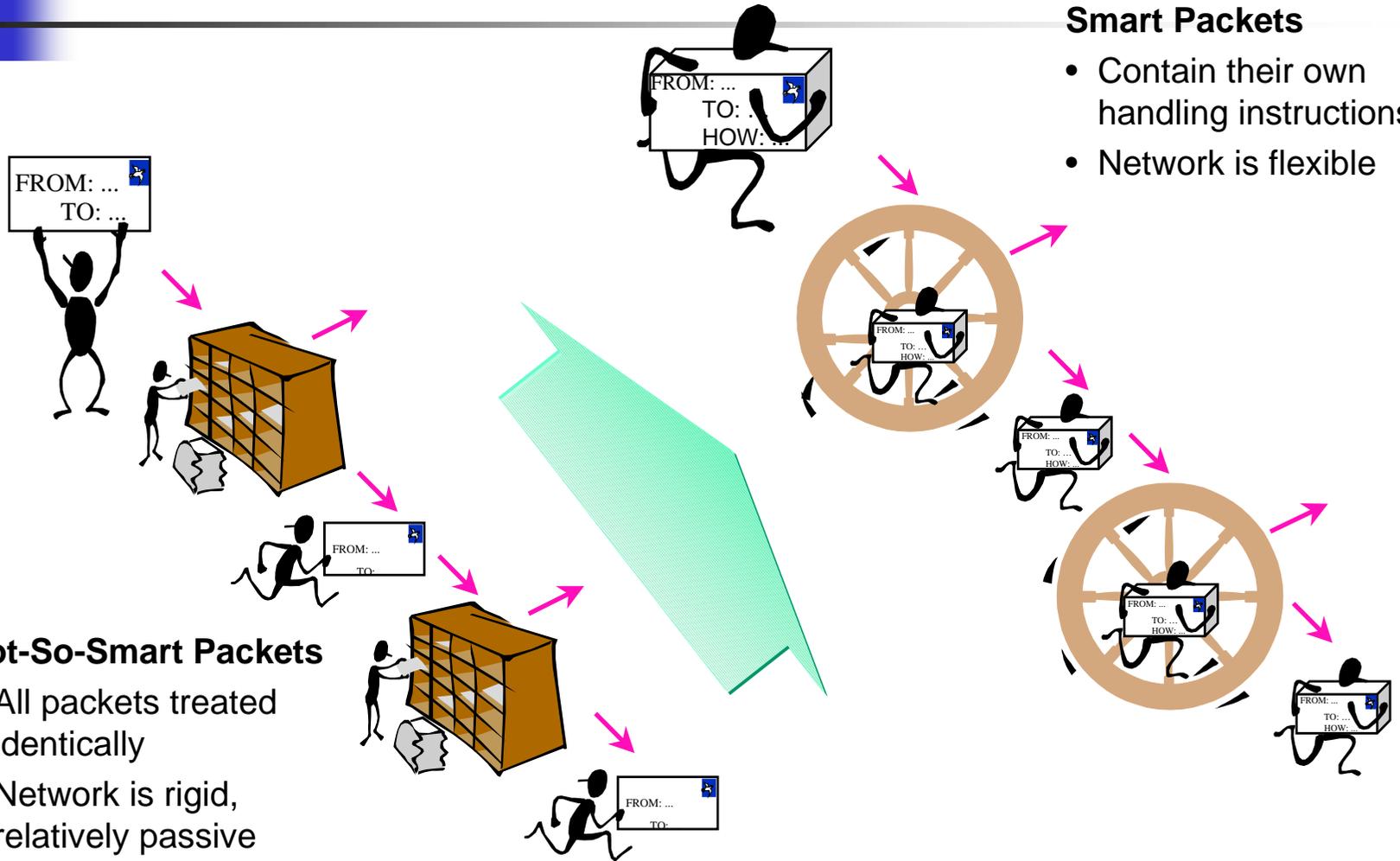
- Conclusions & Future Work



Background

- Large scale of Grid environment
- Grid rapid expansion (ressources and network)
- = > Grid management mechanisms to enable Grid Computing to adapt to various applications requirements.
- In a flexible and automated way (autonomic service)
- Grid administrator and Grid applications could benefit from advanced Grid network services

Active networks



Smart Packets

- Contain their own handling instructions
- Network is flexible

Not-So-Smart Packets

- All packets treated identically
- Network is rigid, relatively passive
- D. Tennenhouse slides

=> **Active nodes / routers**

Active Grid

« A more intelligent and dynamic network to support Grid middlewares and applications with adapted services. »

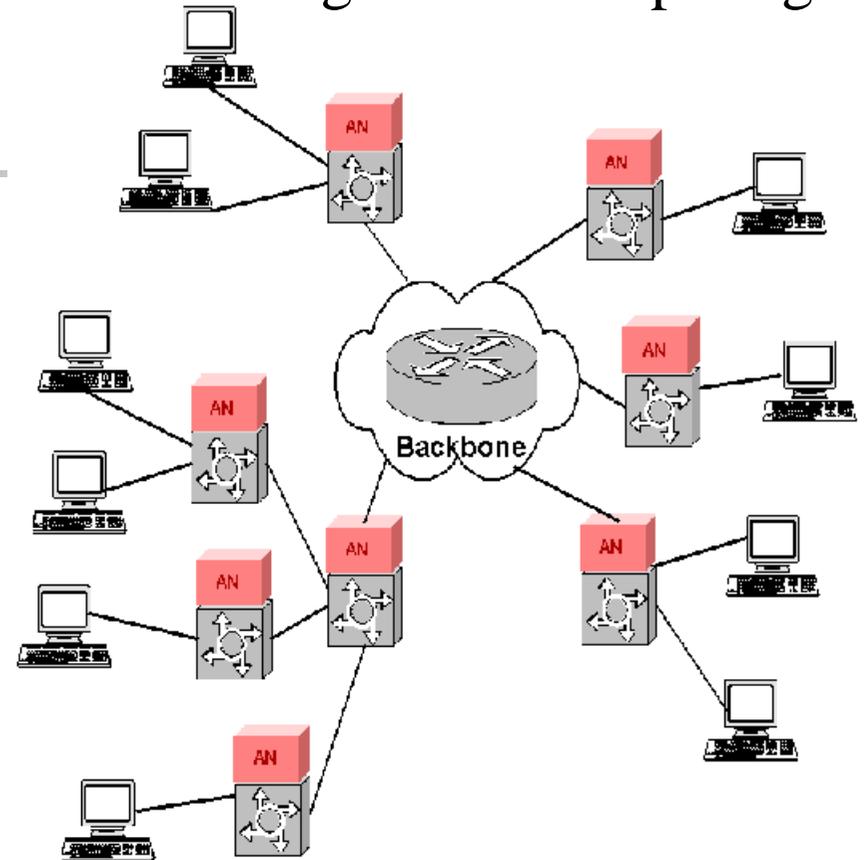
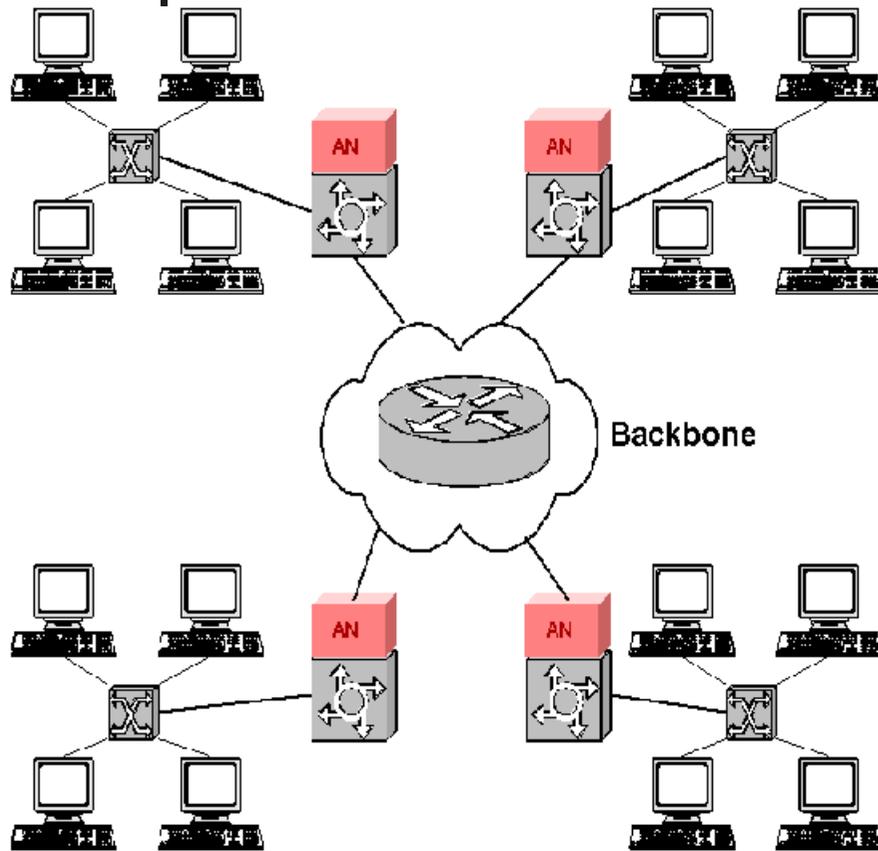
Grid management streams

- Middleware environment deployment
 - Heterogeneity, dynamic topology
 - Dynamic enrollment
 - Machine subscribing
- Application deployment
 - Collective communications : multicast, gather
 - Source deployment, results gathering
 - Fault tolerance
- Grid support
 - Monitoring, network sensors
 - Node data information

Grid applications streams

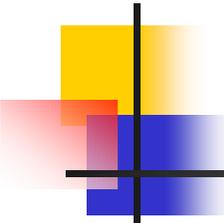
- Grid application input / output
 - Parameters
 - data
- WAN parallel processing
 - Communications between tasks
 - Point2point, global
 - QoS

Multi-cluster computing **Active Grid** Large scale computing



- AN : cluster head
- Manage data streams entering and leaving
- Local communications protocols
- Aggregate output streams

- AN associated with set of nodes
- AN hierarchies on different networks (heterogeneity point)
- Subscribing, results gathering, synchro, check pointing



Requirements for Grid Network Services

Meta cluster computing

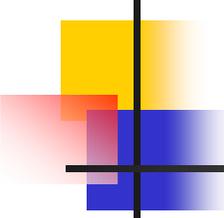
Set of parallel machines or clusters linked together.

- Grid environment deployment : OS heterogeneity support, dynamic topology reconfiguration, fault tolerance.
- Grid application management : multi- and gathercast communication for binaries deployment, parameters and collection of results of distributed tasks.
- Grid support : collection of data control, nodes synchro, node workload info.

■ Large scale computing

Thousand of connected machines

- Grid environment deployment : dynamic enrollment of unused machines.
- Grid application deployment : fault tolerance, check-pointing protocols.
- Grid Support : workload information of subscribed machines.



Why Active Networks for Grid?

Traditional method: Protocol-based

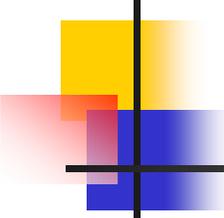
- ❑ Protocol is at each end of the peered layer.
- ❑ This mode of vertical integration impedes rapid Grid **service creation and deployment**.
- ❑ **Standardisation** for introducing protocols or new services is a time consuming effort with uncertain results.

Our method: Active services-based

- ❑ the actual code moves from place to place and executes **locally**, achieving:
 - lower latency, little need for remote interactions and highly flexible control.
- ❑ New environment can be set up by execution of active packets.
- ❑ *opening-up Grid architecture*



Tamanoir : An active network support for Grid
middleware services.



Active Networks Support

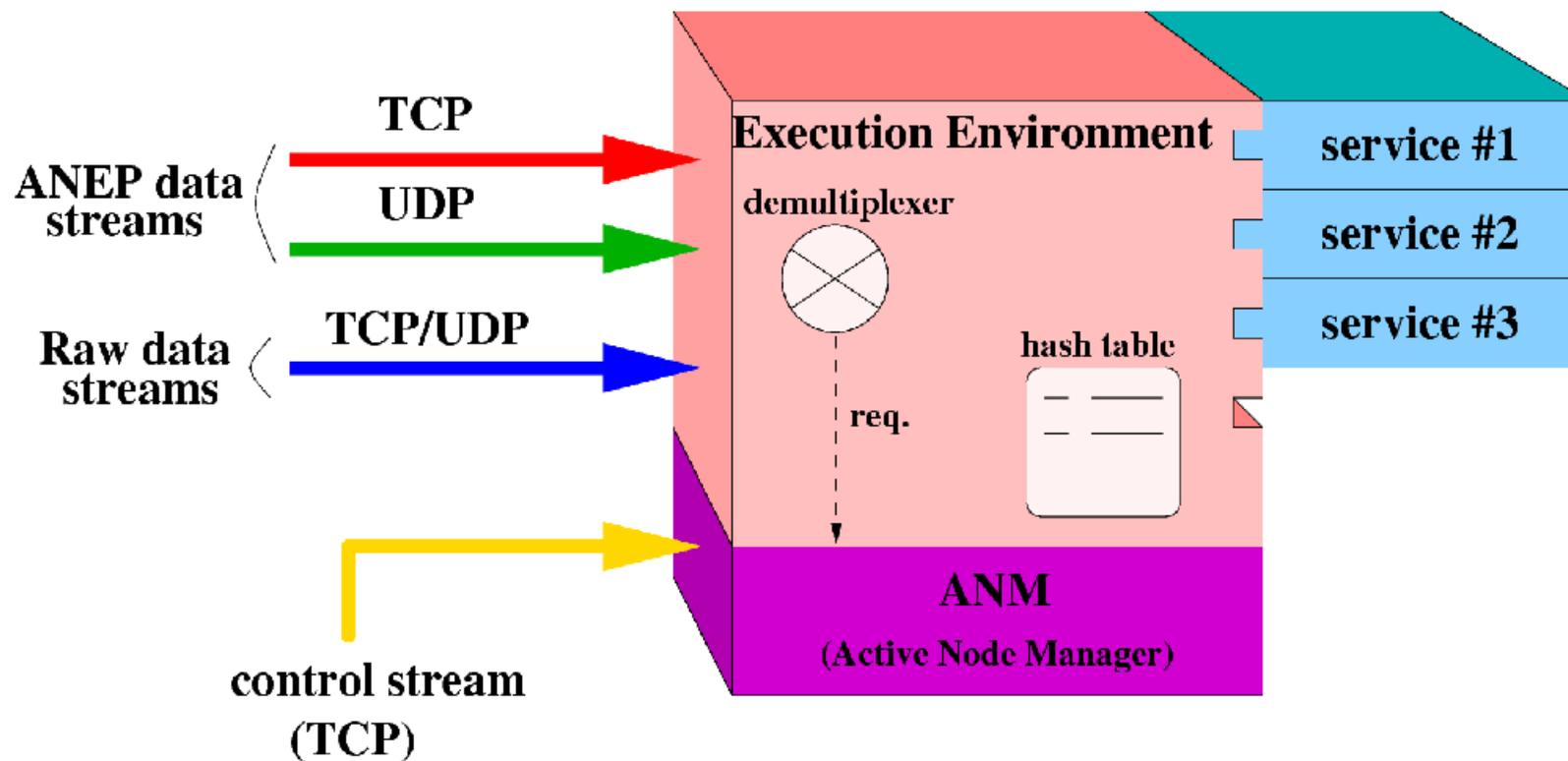
- Tamanoir : a complete software environment to deploy active routers and services.
- Handle different streams and applications in parallel.
- TCP and UDP support
- Provide a fast and performant Execution Environment.

Tamanoir EE

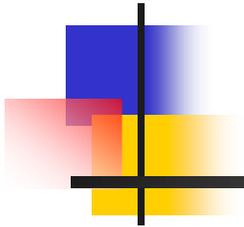
- Grid active services can be deployed on Tamanoir node on various level.
- kernel space (Netfilter)
- user space (Java)
- clustered architecture (LVS)

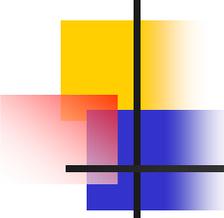


Tamanoir Active Node : TAN



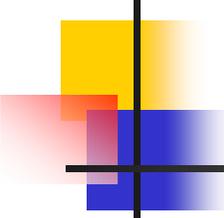
Active Network and Grid Management





Policy

- A way to guide a behavior of the network through high level declarative directives
- Ex: IF (sourceHost == host1) AND (destHost == host2) THEN ProvideGoldService();

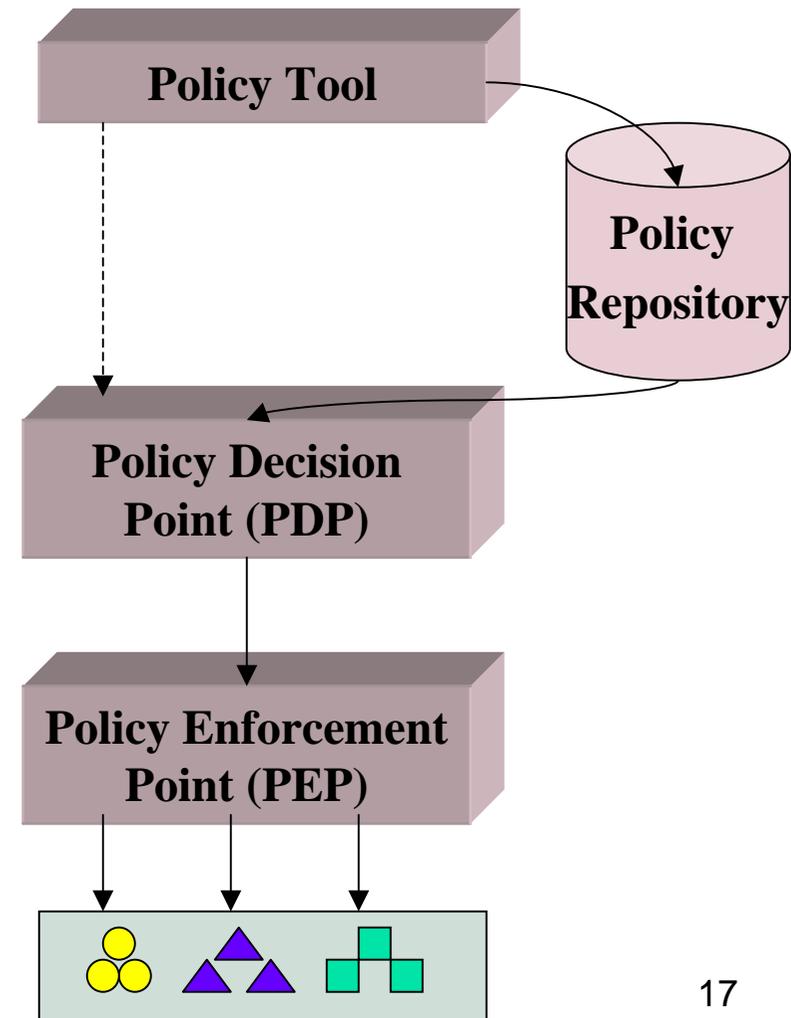


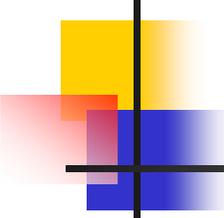
PBM (Policy Based Management)

- Allows control elements to be configured or scheduled on the fly
- Applies integrated management
 - System management
 - Network management
 - Service management
 - => To cooperate in Grid computing

Why Policy-Based “Grid” Management?

- Relieving network & service administrator from the burden of configuring every single Grid resource manually
- More flexible: administrator re-configures Grid by giving or changing policies
- More concerned about end2end management of Grid services





Why PBM+AN?

- PBM (Policy Based Management) is more suitable for the flexible and scalable management of Grid.
- AN (Active Network) speeds up the rapid creation and deployment of Network Grid services by introducing intelligence inside the network and other Grid resources.
- On one hand, active networks is a kind of enabling technology for
 - policy transit
 - policy downloading
 - Policy enforcement
- on the other hand, PBM also provides the management of AN themselves.

**Policy-based
Management**

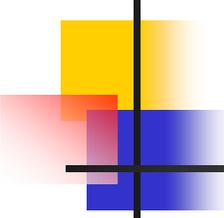
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**Active Networks
Technology**



**Novel Active Grid Mngt.
Architecture of:**

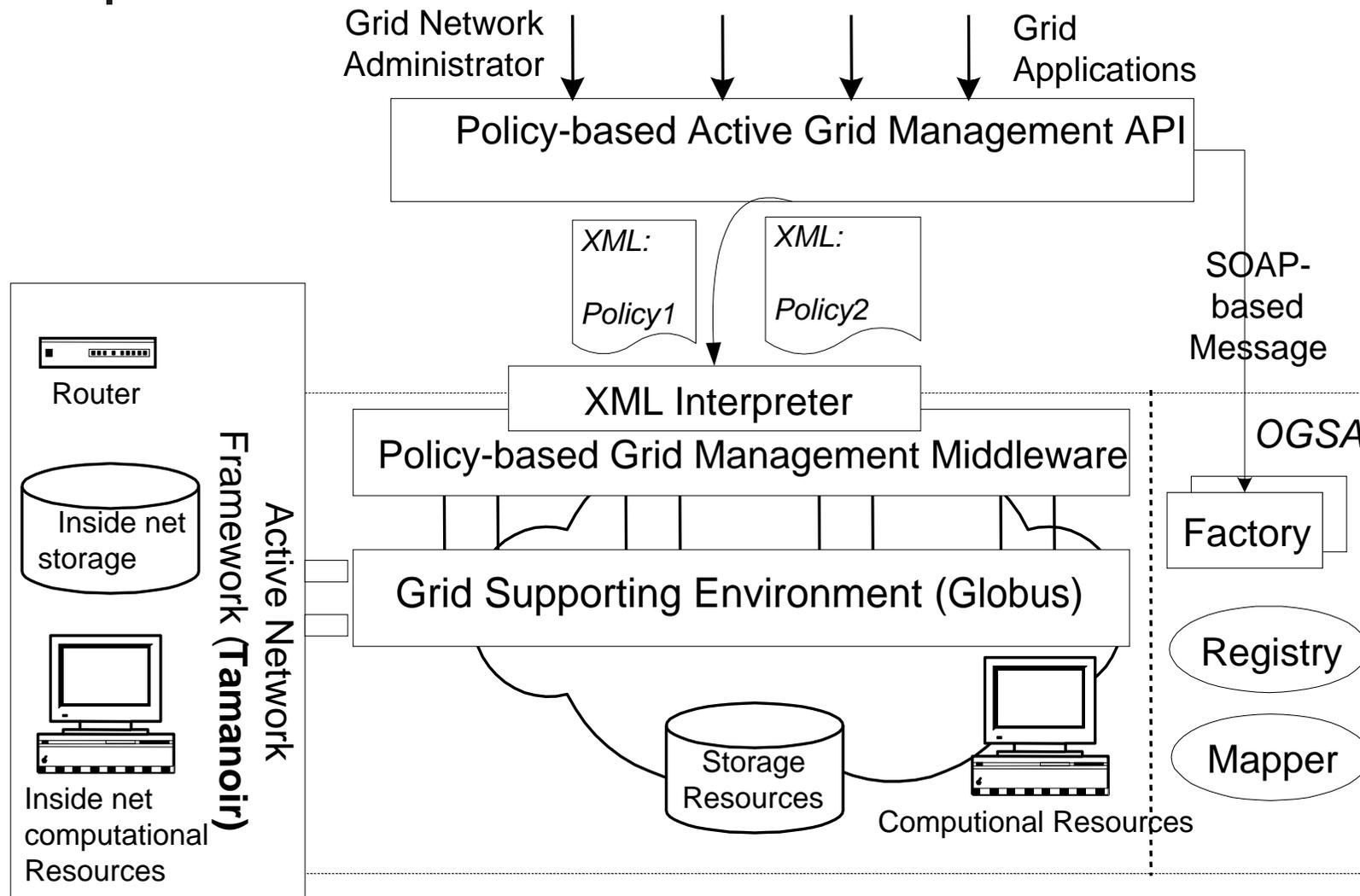
- Flexibility**
- Automation**
- Intelligence**



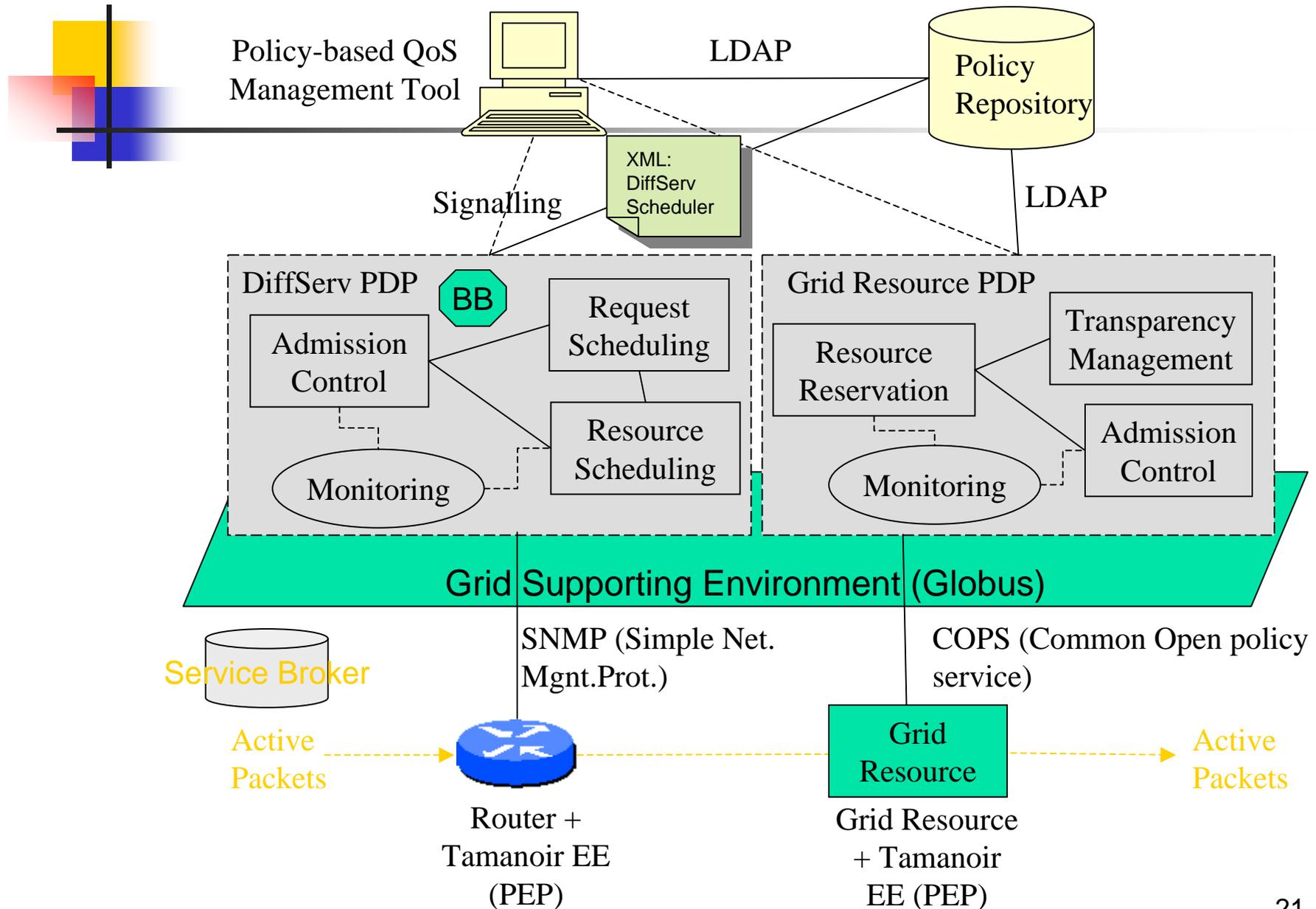
Architecture

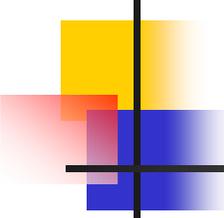
- OGSA (Open Grid Service Architecture): standard mechanism for creating, naming and discovering grid services.
- PBM + AN must fit in OGSA proposal.
- Active Grid architecture provides :
 - Mechanisms to dynamically adapt Grid networks elements to Grid services requirements
 - Grid resources management

Overall Active Grid Architecture



Middleware architecture



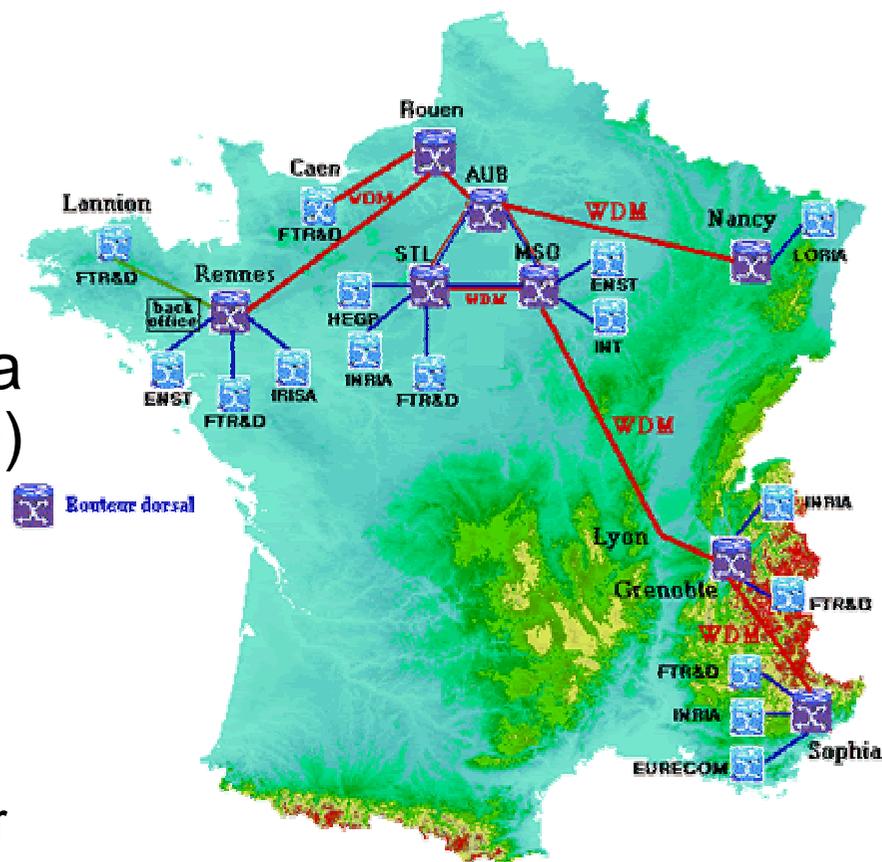


Conclusions

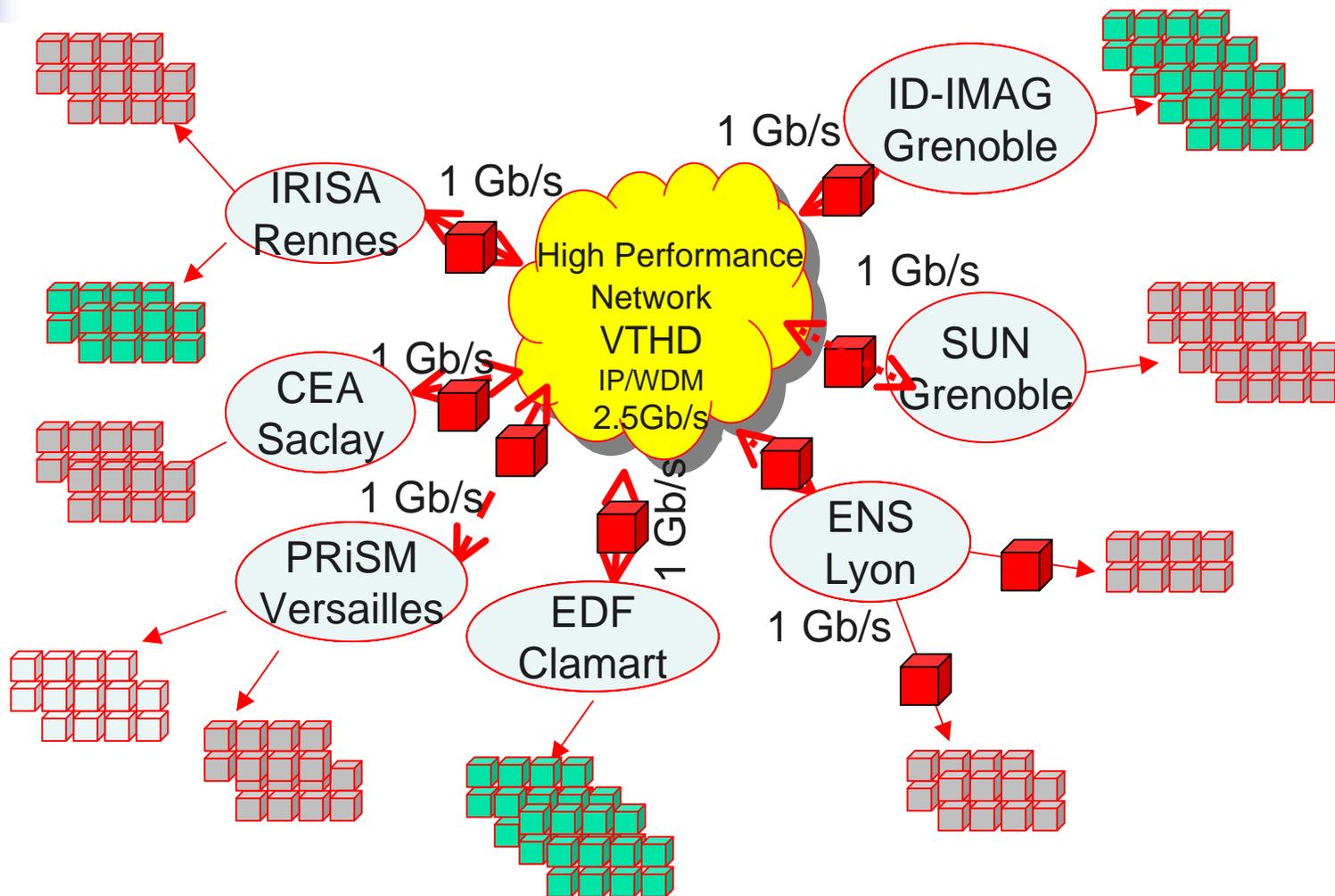
- ❑ Designed a Grid management system making use of the integration of **PBM** and **Active Networks** Technology.
- ❑ First step to fully design an Active Grid solution by focusing on management
- ❑ The whole system **scales** to the changing of the network requirement automatically and flexibly thanks to the inherent programmability of active networks and its intelligence empowered by policies
- ❑ Network Grid applications requirements also taken into account by providing advanced network services (reliable multicast, QoS...)

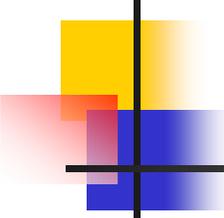
Tamanoir testbed around HP backbone

- RNRT VTHD project (Very high speed network) (<http://www.vthd.org>)
- Deploying high performance active node around wide area backbone (2.5 Gbit/s, 1 GEth)
- Supporting wide area applications (Grid and multimedia applications)
- Development of :
 - wide area visualization tools for active node management,
 - Distributed and P2P active traffic generator



Tamanoir Active Grid Support





Future Work

- **The design of a Policy-based Grid Description Language**
- **Integrate Tamanoir active service deployment with Globus middleware**

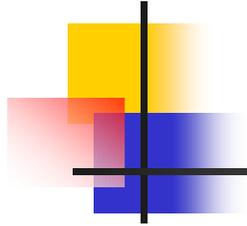
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Tamanoir page:

<http://www.ens-lyon.fr/~jpgelas/TAMANOIR>



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