Software solutions for Virtual Infrastructures provisioning and management

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Context (1): Infrastructure as a Service

- Convergence of computing and communication
- Expansion of cloud computing
- New models and tools are needed to help users & service providers to specify, configure, deploy, manage their virtual infrastructures and their applications
Context (2): Network virtualization

- Decouples the physical hardware from the service level
- M-to-N mapping (M “real” resources, N “virtual” resources)
- to deliver greater resource/infrastructure utilization and flexibility
- Solid basement for customized « network buildings »
- Parallel networks with customized routing, traffic engineering, protocols…
Virtual Infrastructures Framework

VPXI editor

VPXI admin

HIPerNet engine

HIPerNet software principle

HIPerNET engine: select, allocate, schedule nodes & channels
Virtual Infrastructures Software solutions

- IT & Network resource virtualisation
- VPXI: Virtual Private eXecution Infrastructure
- VXDL: Virtual Infrastructure description
- Time-aware Virtual Infrastructure Allocation
- Security model

Scenario description

- Execute a distributed application in a virtual infrastructure
- Application: NAS benchmark (version 3.3)
  - MPI
  - 7 applications: bt, cg, ep, is, lu, mg, sp
- Physical substrate: Grid’5000 platform
- Steps:
  - 1 – Create a substrate of virtualized resources
  - 2 – VPXIs specification
  - 3 – VPXIs allocation and deployment
  - 4 – Execution
G5K: large scale experimental facility (since 2005)

5000 cores, distributed over 9 sites in France
- Various types of servers

10 Gbps connections over RENATER network
- DWDM + 10GE in the core
- Different local network technologies

570 users
17 laboratories involved

See https://www.grid5000.fr

1) Bootstrap: virtualized substrate creation

Underlying physical ICT infrastructure

Virtualized substrate: VXspace
Virtual infrastructures: VPXI concept

We define a VPXI as a time-limited interconnection of virtual computing resources through a virtual private network.

Application-mapping principles

- application benchmark
- data input
- number of resources
- data dependency
- computing time
- modules serialization
- graph of resources
- network configuration
- resources location
- infrastructure configuration
2) VPXI specification

- VXDL language
- Specification of virtual resources sets
- Specification of virtual topology
- Specification of time line

Example:
- Specification of three VPXIs:
  - Same resource set & topology, different link rates

<table>
<thead>
<tr>
<th>VPXI</th>
<th>VN X – VR Y</th>
<th>VR 5 – VR 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPXI-3</td>
<td>100 Mbps</td>
<td>200 Mbps</td>
</tr>
<tr>
<td>VPXI-2</td>
<td>75 Mbps</td>
<td>150 Mbps</td>
</tr>
<tr>
<td>VPXI-1</td>
<td>50 Mbps</td>
<td>100 Mbps</td>
</tr>
</tbody>
</table>

3) Allocation and creation

- HiPerNet framework is a component-based software technology.
- Set of independent & replaceable modules to:
  - Parse VXDL requests
  - Allocate & schedule VPXIs
  - Control of VPXIs & Virtual resources
  - Manage users & security
4) VPXI deployment & configuration

- HiPerNET framework:
  - combines system and network virtualization
  - provisions and configures virtual resources
  - creates and manages VPXIs

5) VPXI & application deployment
6) Execution

Execution of NAS with different bandwidth setups

Conclusions

- **VXDL is a powerful language** to specify flexible and personalized virtual infrastructures (VPXIs)
- Execution using the modular HiPerNet framework is straightforward for our users. Resource virtualisation & dynamic reconfiguration complexity is hidden.
- Grid'5000 platform is a powerful physical underlying infrastructure for VPXI functionalities, performance's as well as scalability's experiments and demonstrations
- More features are being integrated in HiPerNet (security, OpenFlow interface, performance measurement, GUI...)
- VPXI can be applied to a large variety of usages (new services test and deployment, high throughput applications...)
- Collaboration and partnership: FP7 GEYSERS, FP7 SAIL, OrangeLabs, DocomoNTT, OpenFlow group
Annexe:
Some of our references on network virtualisation


