Virtualization based testbeds widely used for the creation of network environments needed to test protocols and applications. However, complexity of present networks and protocols arises the need of very complex network testbeds, made of tens or hundreds of virtual machines.

**Need for tools to support the design, deployment and management of large virtual network scenarios over clusters of servers**

Apart from large scale initiatives, none of the available tools (Netkit, MNL, Marianet, CORE) support distributed deployment or the diversity of virtual machine operating systems needed for complex testbeds.

**Virtual Networks User Mode Linux (VNUML)** is a general purpose open-source scenario-based management tool designed to help building virtual network testbeds automatically.

**EDIV: VNUML Distributed Deployment**

EDIV is a wrapper application to VNUML developed to allow the distributed deployment of virtual scenarios over clusters of servers.

**EDIV segments virtual scenarios into sub-scenarios deployed to the different servers, interconnecting them by means of VLANs. EDIV includes basic segmentation algorithms (R, RR, WRR) as well as an API to allow the development of new ones.**

**VNUML Operation Workflow**

VNUML made of two main components:

1. XML-based scenario specification language
2. Language interpreter

Three basic operations:

- **Scenario building:** virtual machines and networks created following the scenario topology in the user specification.
- **Command execution:** users can directly interact with virtual machines or automate the execution of commands.
- **Scenario releasing:** virtual machines and networks are released.

**Current version of VNX available:**

- libvirt support. Tested with Linux (Ubuntu, Fedora, CentOS), FreeBSD and Windows (XP and 7)
- Dynamips and Olive router emulation support
- Virtual machine individual management (start, stop, restart, reboot, suspend, etc.)
- OVF-Environment-like autoconfiguration and command execution support
- Plug-in architecture to add extensions to VNX
- Distributed deployment support (EDIV)
- Library of root filesystems available: Ubuntu, Fedora, CentOS, FreeBSD, etc

VNX is mostly written in Perl (around 25000 lines of code); Windows autocd daemon written in C++. Around 40% of VNUML code reused with minor modifications.

**Dynamic honeynets deployment**

In security research projects RECLAMO and Segur@, as part of the development of Automated Intrusion Response Systems (AIRS), VNX is being used as a tool to dynamically deploy virtual honeynets.

**Conclusions and Future Work**

Development continues, mainly focused on improving VNX functionalities, its robustness and completing the distributed version capabilities.

Future work includes:

- Complete and improve distributed support
- Dynamic scenarios (adding/deleting VMs and networks, machine migration, etc)
- Graphical user interface
- New virtual machine types (e.g. Android)
- Plug-in to control physical equipment
- Better network emulation capabilities

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