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.

VNX: Virtual Networks over LinUX (VNX)

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

VNX is being extensively used in ETSIT-Telefónica and other research, education, and cooperation networks in Spain, such as the GÉANT network, for the creation of hybrid virtual scenarios.

VNX is written in C and Perl and uses the Linux standard API for management and the libvirt API, with the addition of a primitive to accommodate new virtualization platforms.

VNX project overall goal is the creation of a tool to deploy and manage virtual scenarios over a federated cluster environment made of dispersed nodes interconnected by means of layer 2/3 tunnels over Internet. Each node comprised of:

- Virtualization servers running different types of hypervisors
- Physical (non-virtual) equipment to allow the creation of hybrid virtual scenarios

Distributed Virtual Scenarios over Multi-host Linux Environments:

VNX project is a joint effort between Telefónica I+D, the Centre for the Development of Industrial Technology (CDTI) in Spain, and the Centre for the Development of Information Technology (CDTI) in Portugal, as part of the project 

VNX project: Distributed Virtual Environments for the Research and Education Community in Spain, that provides connectivity to international academic networks like the Portuguese FCCN and the European research network GEANT.

VNX has been chosen to build a model of the RedIRIS-NOVA infrastructure (same topology, metrics and links) to be used to define, implement and test new network features.

Networking laboratory for dynamic routing tests, resembling the topology of an ISP and involving 44 virtual devices as follows:

- 16 Cisco routers
- 6 Juniper routers
- 6 Linux/Quagga routers
- 12 end user computers
- 4 Servers (WinXP, FreeBSD, Ubuntu, Debian)

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, suspend, 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 autoconfig daemon written in C++. Around 40% of VNX code reused from minor modifications.

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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