Network Simulators for Solving Budget Problems
By Pankaj Shah

Until recently, the only way for IT professionals to evaluate enterprise management applications – either element managers, frameworks like HP OpenView NNM, or value-added applications – was to use it with their production network, or have an extensive multi-vendor hardware test lab. Using the mission-critical production network for testing is very risky, whereas a test lab can become very costly and can be time and space consuming. The equipment needs setup, maintenance and regular updating of devices and software releases. Current IT budget cuts require an alternative to the physical lab.
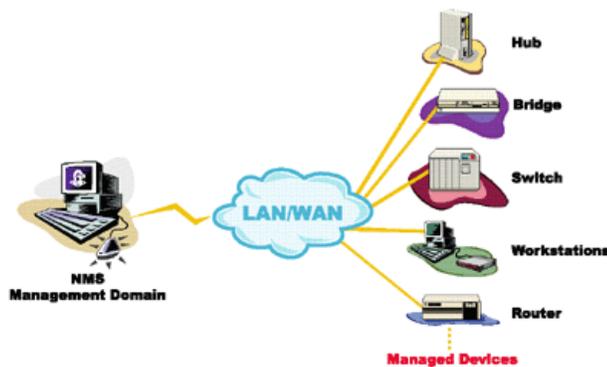
A typical scenario of a management application managing multiple devices over a LAN/WAN.

An Enterprise Management Solution — "Virtual Lab"

The use of a simulated "virtual" lab can eliminate the need for or expand the scope of an existing physical lab. Enterprises can enhance the lab environment by simulating scores of manageable devices, such as routers, hubs, switches, probes, workstations, cable modems and printers.
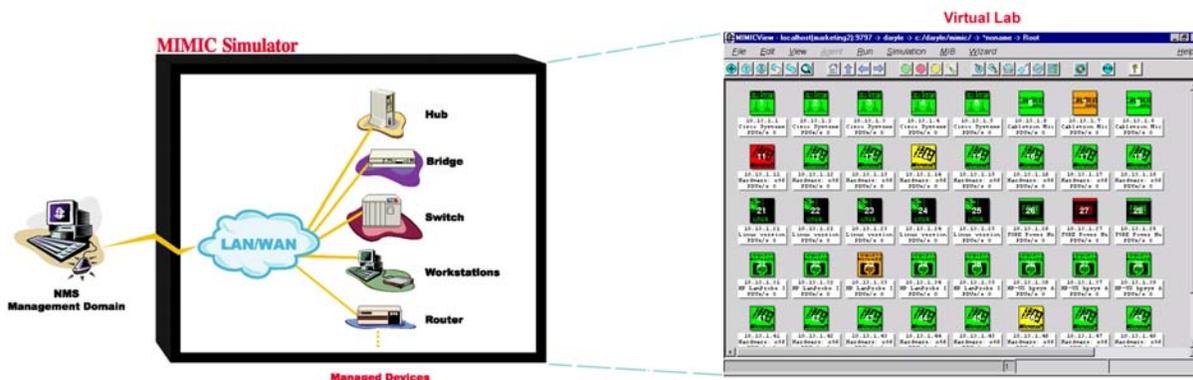
MIMIC Virtual Lab simulating thousands of devices from leading network management companies over a LAN/WAN.

A virtual lab combines many simulated devices and connections. In the real world, each manageable device contains an embedded software agent that accepts management commands through a standardized protocol. Device simulation in the context of a simulator means creating a software agent that is manageable in the same way as the real physical device would be, typically through multiple management protocols. A good management simulator needs to support protocols like SNMP, Telnet, DHCP and TFTP. Additionally, Cisco devices use IOS and many devices also use TL1 for management.

SNMP protocol simulation makes it possible to manage the device by getting and changing the information in the management information bases (MIBs). These MIBs can be public or private. Manipulating the MIBs helps in simulating any number and any type of resource within the device.

Telnet is a common way to manage high-end routers. The users can login to the device and configure it using a command line interface. For example, to manage a Cisco router, the user can give different IOS commands over a Telnet connection. The devices in the virtual lab can also be accessed using Telnet and IOS just like real devices.

With DHCP simulation, the devices can obtain their IP address dynamically from the DHCP server just like a real device. Devices can download their configuration information dynamically with TFTP simulation.

The virtual lab combines simulated devices with an interconnection exactly like a physical lab. You can then change the interconnections and topology. All these topologies and devices can be saved and replayed as needed. The management applications can interact with the simulations within the virtual lab just as they would with real-world devices.

Possible Ways to Create Simulations:

Record – The easiest way to create a simulation is by mimicking an existing device in your lab. The simulation recording proceeds just like many management discovery tools, sending out pings to find managed devices. For SNMP discovery, the recordings are the values in the MIB, including system name, type, number of interfaces, types of interfaces, different activities on each interface, etc.

Simulate – The information recorded by the recording tool can be used by the simulator as a starting point. The simulation can interpolate the values to create run-time values. The virtual device gets created in the same state as it was recorded, for example preserving the network connections by using the recorded routing tables or IP configuration tables.

Customize – Once the simulation is created, it is easy to modify the simulated network parameters like IP addresses, interfaces, packet rates, etc. by modifying the MIB

variables. For example, you can first create a device with 100 Ethernet and 50 ATM interfaces, and later on add or remove interfaces.

These tasks can be done graphically, or programmatically using built-in functions and by writing scripts using Java, C++, Tcl or Perl. You can also associate side effects to certain events. For example, if an interface of a router goes down, you can disconnect devices reached through that interface. You can also add delays to simulate long distance connections or drop packets to simulate faulty links.

If the simulator allows importing ready-made networks and devices, then you can short cut the initial steps of recording and customizing.

Operate – Once a device simulation is created and configured, you can start, stop, pause, and halt it – individually or in a group. Each device has its own IP address in any desired subnet. For example, you can create a topology with 192.3.100.*, 160.2.5.* and 193.9.200.* subnets.

It is easy to introduce dynamic changes into the simulation, such as enabling/disabling interfaces, increasing or decreasing packet rates, and changing the traffic pattern by simply changing MIB variables. An MIB browser/editor is useful in looking at the MIB and making changes. With a simulator you get the flexibility to concentrate on the MIBs of relevance in solving your specific problem.

A particular device can be simulated in any number of scenarios, just as in the real world. For example, you can simulate a lightly loaded or overburdened router by reducing or increasing input/output packet and error rates. You can make it a very faulty device by having it generate a trap storm.

Command line interfaces are more proprietary even than enterprise-specific MIBs. A Telnet recorder can generate an initial simulation from recording the command line conversation, but this will need more customization before being useful. The reason is that the semantic dependencies between different managed resources and management interfaces cannot be deduced purely by recording. The goal of the simulation is to have the management interfaces interact seamlessly. For example, changing some parameters via Telnet should impact the correct MIB objects, and vice versa.

A virtual lab overcomes the budget and resource constraints by allowing users to set up extensive labs with software. Enterprises can provide each IT professional, developer, tester, trainer and salesperson a private, virtual lab. The alleviation of the overhead and administrative headaches of physical equipment and an increase in efficiency are the end result. Therefore, the virtual lab's applications within an enterprise are virtually unlimited. Some of the most common applications include evaluation before deployment, disaster simulation, operator training and infrastructure planning.

Generally, in companies with a physical lab, there are multiple teams with different needs sharing the same lab. With a virtual lab, every member of the organization can have his or her own network on his or her own machine all the time. This results in significantly greater efficiencies within an enterprise.

On the other hand, just like a flight simulator cannot be used to fly passengers, a virtual lab cannot be deployed in the production network. Also, any simulation is going to have short-comings versus the real-thing: in this context this means that IOS commands may be missing, or commands may behave and look slightly different. Creating a virtual environment, with a physical lab or with a simulation is subject to a set of requirements. The goal of any simulation is to come as close as possible to achieving those requirements with minimal effort, whether it be for development, testing or training.

The implementation of a virtual lab within an enterprise — large or small — represents a significant value proposition. The bottom line for an enterprise is simple: simulation tools save both time and money by preventing network downtime.

Make vs. Buy

Make

While creating a physical lab, you need to consider the following:
1. Capital Expenses – for network infrastructure, devices, firewall, cabling and other test instruments like protocol analyzer, traffic generator, etc.
2. Lab space and fixture expense
3. Engineering labor cost – for setup and maintenance
4. Risks – of equipment, connector or cable failure, natural disasters, equipment misuse and network downtime
5. Sharing – how many people or group will share the lab
6. Updates – for new devices, software versions, etc.

Or Buy

You can buy a simulator product, which will not have any major lab capital expense or maintenance headaches. It is easy to share it or just keep it private, but the most important benefit is if you make a mistake you can restart. If you need to run the same tests frequently (regression tests), you don't need to worry about setting up the devices and connections. You can just save different network configurations and load them as needed.

Of course, once you have a physical lab, you can then use it for multiple purposes. For example, you can use the router to do the routing of your actual traffic, or use a PC for your accounting application. If you are going to use devices purely for the testing, evaluation or training purposes, then the virtual lab will be a solid alternative.

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