

Testing the Performance of Applications Over Wide Area Networks

An Apposite Technologies White Paper

Today's dispersed workforce requires responsive access to a wide variety of centrally managed applications. IT managers and network administrators therefore need to be able to predict, optimize, and troubleshoot how these applications perform over the wide-area network.

However, because application performance can be highly sensitive to bandwidth, latency, loss, and other WAN impairments, testing on the local network generally fails to identify critical issues that impact the end user experience.

Fortunately, a new generation of network simulation appliance makes it simple and affordable to test applications in the lab under real-world conditions, ensuring smooth roll-outs of new applications and helping to optimize the performance of existing applications.

The Need for Testing

Centrally hosted applications form the foundation of the operations of most enterprises, from VoIP and IP telephony, to file storage, e-mail, databases, order fulfillment, ERP, CRM, and a profusion of specialized client/server systems. But many of the employees and partners that depend on these applications are dispersed across regional and branch offices, or working from home or on the road, and connected to headquarters through a mish-mash of private lines and internet VPNs. And as any remote worker can attest, applications are rarely as responsive over the WAN as they are at headquarters. At a minimum, application performance issues cause frustration and reduce productivity, and at worst, render critical applications unusable.

The most obvious source of performance degradation is bandwidth bottlenecks, but this is certainly not the only cause. Latency, jitter, packet loss, congestion, and other impairments can all wreak havoc on throughput and responsiveness, and simply increasing WAN bandwidth may do little to improve performance.



Corporate IT managers are therefore confronted with the need to answer crucial questions such as:

- How responsive will the database, ERP, inventory, and order fulfillment systems be to users in branch offices?
- Will the sales team be able to use the CRM system from the road?
- How will VoIP sound between various sites across the world?
- Can a WAN accelerator improve performance and which one offers the greatest benefits for particular network conditions?
- Are wireless and satellite networks viable alternatives for remote users?
- How will the company's website and e-commerce system appear to customers?
- How much bandwidth is really needed to keep users happy and productive?

The Trouble with Live Networks

Network managers have traditionally taken two approaches to answer these questions: testing applications on the local network and limited testing on the production network. Both are clearly unsatisfactory.

While the impact of latency, jitter, and packet loss on real-time applications such as VoIP and IP video is obvious, their effects on data applications can be equally devastating. The interaction between these impairments and the chatty, transactional nature of HTTP, CIFS, and

other client/server communications can curtail throughput while degrading responsiveness.

For this reason, testing on the local network alone is insufficient, and inevitably leads to unexpected

problems during rollout, resulting in unhappy users and a rush to implement expensive and inefficient fixes.

But shipping equipment around the world and coordinating its testing on the production network is an expensive, time-consuming chore. Since testing is usually limited to off-peak hours between a few convenient sites, it frequently misses the problems that occur upon deployment under more typical conditions or between more far-flung locations.

Affordable WAN Simulation

A better solution is to recreate a range of typical and worst case scenarios to test applications in the lab. Until recently, however, emulating WAN links required test specialists with expensive, complex telecoms hardware that was hardly cost-effective for most IT departments.

Fortunately, a solution is now within easy reach with the Linktropy WAN emulator, a new generation of network simulator focused specifically on the needs of enterprise IT departments. By adapting commodity hardware with high-performance packet processing algorithms, Linktropy WAN emulators offer the precision of a high-end test tool in a cost-effective appliance. And by focusing on ease-of-use, Linktropy WAN emulators make it easy to test applications under a variety of real-world conditions with absolutely no training or special expertise.

Application Testing

Network conditions can affect applications in unexpected and surprising ways, and it is important to understand what to look for when testing performance. For example, large file transfers are primarily sensitive to link bandwidth, latency, and loss, and the most useful metric to observe is the throughput rate. In contrast, responsiveness is key to database and web-based applications, which can be highly sensitive to congestion and latency. For real-time applications, voice and video quality can be impacted by jitter, congestion, and other transient effects as well as link latency and bandwidth. The Linktropy WAN emulator makes it easy to assess the effects of any of these WAN impairments on application throughput, responsiveness, or quality.

Responsiveness

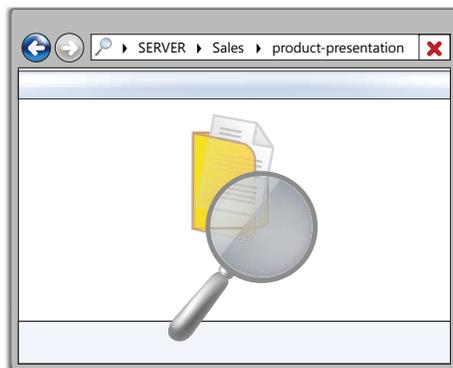
- ▶ Windows File Sharing (CIFS)
- ▶ Corporate Applications: Database, ERP, CRM
- ▶ Remote Access
- ▶ E-commerce and Web Applications

The corporate WAN should offer employees anywhere in the world easy access to the many applications and utilities they depend on. But in practice, congestion and latency can curtail the responsiveness of interactive applications such as Windows file sharing, email, databases, and web-based applications, causing user frustration and impairing employee productivity.

For example, CIFS, the Windows protocol for file sharing, requires a stream of messages back and forth to browse folders and move files. Consequently, even the small amount of latency between a telecommut-

er's home and a nearby office can cause sluggish performance when navigating a shared drive or adding an attachment to an email, while users across country or overseas are forced to waste minutes with even trivial tasks.

Similarly, the HTTP protocol of web applications transmits the dozens of objects



on each page one at a time, causing slow rendering over long-delay links regardless of the link rate. As corporate applications increasingly transition to web-based interfaces, it becomes ever more important to verify an acceptable level of responsiveness for remote users.

Many other important enterprise applications, including databases, ERP, CRM, billing and accounting systems, and remote access can also be chatty, making their responsiveness sensitive to any congestion or latency on the link.

Linktropy WAN emulators makes it easy to test the responsiveness of any application. With a Linktropy WAN emulator installed between a client and server, network administrators and application developers can experience the application just as end users see it.

[Continues on next page...](#)

Application Life-Cycle Testing

Network Design

Whether designing a new network, adding links to an existing network, or increasing bandwidth, it is important to understand the impact of network conditions on application performance.

Private networks, internet VPNs, satellite links, and wireless connectivity offer trade-offs in cost, performance, and convenience. Competing carriers may offer a range of latency, jitter, and bandwidth guarantees that vary with price.

The Linktropy WAN emulator makes it easy to simulate different link conditions and evaluate the trade-offs to make an informed decision.

Application Validation and Benchmarking

When deciding whether a particular application will meet corporate requirements, it is necessary to evaluate performance under a variety of real-world conditions.

Once the decision has been made to move forward with a particular application, the network manager needs to be able to benchmark the offerings of competing vendors.

The Linktropy WAN emulator assists this validation and benchmarking process by creating repeatable tests with real-world conditions. Emulation parameters can be saved and reloaded to re-run any test, while the Linktropy Recorder and Player features can capture and replay actual conditions of the live network.

Application Optimization

The performance of existing applications can often be improved with product updates or tuning of internal parameters. The Linktropy WAN emulator provides network managers with a convenient test bed to determine the impact of modifications to any application.

Troubleshooting

When remote users complain of application performance problems, the first challenge is to understand what they're seeing. The Linktropy WAN emulator replicates the user's network to help reproduce the reported problem in the lab. Once the problem is identified, fixes or workarounds can then be validated on the test network.

Throughput

- ▶ File Transfers
- ▶ Remote Backup and Disaster Recovery

FTP and other file transfer applications move inventory files, software updates, CAD drawings, media assets, print and production materials, and other essential files between sites. Minimizing the time required to complete the transfer of large files can mean the difference between success or failure of a project.

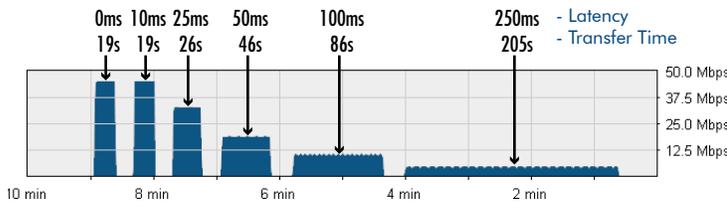
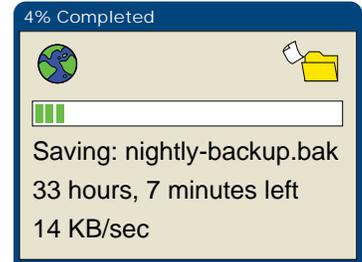
Similarly, data at remote offices need to be backed up regularly to a central facility, while centralized records have to be moved off-site for disaster recovery. In both steps,

bandwidth limitations or link latency can make it impossible to complete the process overnight.

The tremendous impact on throughput rates of even a small amount of latency or packet loss are clearly evident in the two screenshots of the Linktropy Monitor during a series of file transfers.

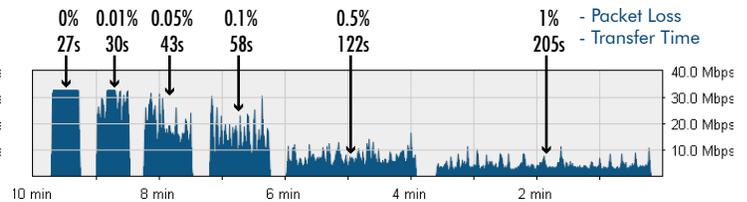
With a Linktropy WAN emulator installed between client and server, it is easy to measure the throughput and time to complete a transfer for any link conditions. The Linktropy WAN emulator can emulate links between headquarters, remote offices, and

back-up sites and answer what-if scenarios such as whether additional bandwidth actually reduces the transfer time and whether tweaks to the application or the use of a WAN accelerator can improve throughput.



As link latency increases from 0 ms to 250 ms, file transfer time increases from 19 seconds to 205 seconds.

100 MB file over 45 Mbps link using FTP



As packet loss rate increases from 0 to 1%, file transfer time increases from 27 seconds to 205 seconds.

100 MB file over 45 Mbps link with 25 ms round trip latency using FTP

Quality

- ▶ IP Video and IPTV
- ▶ VoIP

Real-time applications such as Voice over IP, IP video, and TelePresence, may look and sound great on the local network, but behave completely differently over the WAN. Not only are these rich media applications bandwidth-intensive, but their quality can be entirely dependent on the interaction between the product design and network conditions. Choosing the right codec for the situation can mean the difference between a crisp picture with clear sound, and a pixilated screen with garbled voice or even hangs, stalls, and dropped

connections. Products from different vendors can behave differently depending on the network conditions.

The Linktropy WAN emulator makes it easy to see and hear the effects of latency, jitter, congestion, and other network impairments on sound and video quality and evaluate the suitability of different systems for particular network conditions. With a Linktropy WAN emulator installed between the end nodes, network administrators and other decision makers can see and hear the end user experience prior to roll-out.



Apposite Technologies makes WAN emulation easy by offering high-precision network test tools with unmatched ease-of-use at unbeatable prices. Apposite's Linktropy and Netrophy WAN emulation appliances simulate bandwidth, latency, loss, congestion, and other network impairments with fine-grained precision to provide accurate simulations of any type of wide-area network.

Apposite Technologies – WAN Emulation Made Easy.

Application Testing with the Linktropy WAN Emulator

The Linktropy WAN emulator was specifically created to meet the needs of IT managers and network administrators for an easy-to-use, cost-effective network simulator. As a transparent Ethernet bridge, the Linktropy appliance is easy to install, and applications can be tested without the need for routers or any other WAN equipment.



To test a single application on an isolated network, simply plug in a client (or a network of clients) into one emulation port of the Linktropy unit, plug in the server (or a network of servers) into the other emulation port, and configure the link bandwidth, latency, loss rate and any other impairments through the browser-based interface.



Alternatively, the Linktropy device can be installed between the user's office PC and the corporate LAN. The office PC will then act as if it were located at a remote office, with full access to all corporate applications without the need for a separate lab or any special set-up.

The Linktropy WAN Emulator Simulates:

- ▶ Bandwidth
- ▶ Packet Loss
- ▶ Latency and Jitter
- ▶ Background traffic



INTERNET



WIRELESS



SATELLITE



TERRESTRIAL



Linktropy configuration window

Linktropy Models

Linktropy WAN emulators are available in three models to meet a range of testing needs:

- ▶ **Linktropy Mini2:** basic emulation up to 100 Mbps
- ▶ **Linktropy 5500:** links up to 1 Gbps
- ▶ **Linktropy 8500:** 4 links up to 1 Gbps each



For complex topologies or advanced emulation requirements, Apposite also offers the Netropy line of advanced network emulators.

Apposite Technologies, Inc.

11500 W. Olympic Blvd. Suite 510 | Los Angeles, CA 90064 USA | www.apposite-tech.com

Tel: 310.477.9955 | Toll-free: 866-WAN-SIM8 (866.926.7468) | Fax: 310.477.9956 | info@apposite-tech.com