



APPOSITE
TECHNOLOGIES

Best Practices for Measuring Application Performance over Satellite Networks

Put applications to the ultimate test with a highly repeatable and cost-effective methodology

With demand for connectivity at an all-time high, providers, enterprises and government agencies all stand to benefit from greater use of satellite communications. Diverse new applications range from monitoring soldiers' vital statistics in the field to collecting data from remote oil rigs to keeping up with today's most pressing IT trends:

The Internet of Things (IoT). Gartner analyst Bill Menezes said, "A lot of IoT devices are going to be in locations that don't lend themselves to easy access from a terrestrial network. If there are 20 billion endpoints out there, most of which need some type of wireless connectivity . . . a fair amount of those are going to be in a use case where satellite is the best way of delivering that connectivity."

Mobile hotspots. Today's users expect to be able to access email from cruise liners, remote travel destinations, and other areas where broadband network infrastructures are underdeveloped. Tony Pallone, writer/editor for IEEE GlobalSpec, writes: "Satellite technology has the potential to be a strong player in IoT connectivity, along with 'connecting the unconnected'.¹

An obvious choice for "anywhere, anytime" access, satellite communications (satcom) offers an ideal way to supplement coverage—provided performance meets the demands of today's challenging applications and service can be made affordable to businesses and consumers alike.

¹ <https://news.itu.int/satellite-communications-trends/>

THE TRENDS UNLOCKING OPPORTUNITY

A new generation of satellite technology is emerging to address rising demand. Satellite Today writes, "Evolving customer needs and requirements in 2018 have led to the need for fast-paced innovation from manufacturers and operators alike."²

Enabling innovations include:

Low Earth Orbit (LEO) satellites. Defined by NASA as the first 100 to 200 miles of space above the planet, LEO constellations work together closer to the ground to overcome a major limitation of geosynchronous (GEO) satellite systems: high latency. The emergence of LEO will unlock profitable new markets requiring low-latency broadband with reliable connectivity. Early examples include SpaceX's plan to build its Starlink constellation comprised of some 12,000 satellites.

High-throughput satellites (HTS). BIS Research expects the market for this new generation of satellites that promises to transmit up to 20 times more data than conventional satellites to reach \$7.31 billion by 2023. Early initiatives include the Telstar 19 Vantage HTS launched by SpaceX.³

So, what still stands in the way?

Latency. Rain. Cost. And perhaps, lingering perceptions that satellite networks are too slow, susceptible, and expensive. Satellite networks have traditionally been prone to high latency and a higher likelihood of dropping packets that can severely detract from voice, video, and many data services.

But according to Pallone, "As satellite technology continues to expand into the connectivity landscape, perceptions of it being prohibitively expensive, plagued by high latency and having limited bandwidth are starting to shift."⁴ Outdated objections to the use of satellite can be overcome in one simple step: proving they can deliver a high-quality experience with intended applications.

Whether you plan to employ satcom to roll out Internet access at sea or life-and-death homeland security, measuring and optimizing application performance in your lab beforehand proves absolutely essential. Here again, the industry must close the viability gap by making testing itself easy, affordable, and ubiquitous.

ENTER WAN EMULATION FROM APPOSITE TECHNOLOGIES



² <https://www.satellitoday.com/business/2018/12/20/a-year-of-evolution-top-5-satellite-trends-in-2018/>

³ <https://www.satellitoday.com/business/2018/12/20/a-year-of-evolution-top-5-satellite-trends-in-2018/>

⁴ <https://news.itu.int/satellite-communications-trends/>

CONNECT WITH CONFIDENCE: NETROPY WAN EMULATION

Latency and packet loss can have as great, if not even greater impact on application performance via satellite networks than link bandwidth. Applications that have not been designed and proven to run well over a satellite network are far more likely to fail. But challenges unique to testing satellite remain:

Satellite time is expensive. For starters, just booking time to test applications can cost up to \$1,000. Testing on live satellite links can cost up to a dollar per minute, placing the average cost to test new applications somewhere around \$100,000. Regression and performance testing should obviously continue as networks evolve and upgrades become available—a costly proposition that detracts from profitability throughout the application life cycle.

Networks are extremely dynamic. Even if you could afford to thoroughly test using the live network, replicating conditions proves nearly impossible. Conditions vary dramatically from one moment to the next along with subtle or dramatic shifts in usage, network conditions, or the weather.

Practical testing needs to be fast, repeatable, and deterministic allowing users to replicate good, bad, and fluctuating conditions on satellite links.

Performance testing must be holistic. Satellite technology may be part of larger, heterogenous communication systems that include wireless, wired and other types of communication networks that all need to work seamlessly to deliver a great user experience.

Wide area network (WAN) emulators from Apposite Technologies can be used to quickly measure and troubleshoot application performance—before and after you deploy. Apposite’s Netropy WAN Emulators replicate all popular IP-based networks, including satellite, terrestrial, Internet, wireless, line-of-site, and other types of IP networks.

Unlike satellite simulators used to test communications hardware, WAN emulators are purpose-built to measure application performance. Stress-testing applications against challenging real-world conditions accelerates deployment, eliminates surprises, and improves quality and efficiency as the network or business evolves.

USE WAN EMULATION TO:

Simulate changes in the weather

The effects of interference from rain and snow can cause wireless and satellite links to deteriorate from a normal to a degraded state, then eventually recover. Netropy equips users to emulate this process, modeling and benchmarking performance under normal conditions, then degrading to various states and specifying transitions between them. Periodic degradation with gradual or abrupt recovery also can be modeled easily.

Speed time to market

Configure tests in minutes to identify and address performance issues. Leverage automation and easy-to-use APIs to accelerate testing during design, quality assurance (QA), deployment and operation.

Choose the right applications

Performance issues often arise from poor application design and choosing the wrong protocols. Properly designed applications may work well in satellite environments regardless of bandwidth, latency, and loss conditions.

Use Netropy to evaluate applications from different vendors and the performance of challenging services like voice and videoconferencing before you roll them out.

Reduce cost

Avoid purchasing expensive satellite time by testing on emulated networks in the lab. Centralized testing also reduces the need to dispatch technicians to remote locations.

Bridge the gap between cross-functional teams

In operation, emulation can act as the referee when users complain, allowing you to easily isolate the source of issues to the network or application. By way of example, an oil company may have customers in geographically dispersed locations or stationed at offshore rigs. The telecommunications team might be responsible for the satellite network while IT remains accountable for application performance.

Emulation makes it easy for the teams to work together—quickly—to decide which architectures best support

mutual goals and to troubleshoot performance when issues arise.

Avoid risk

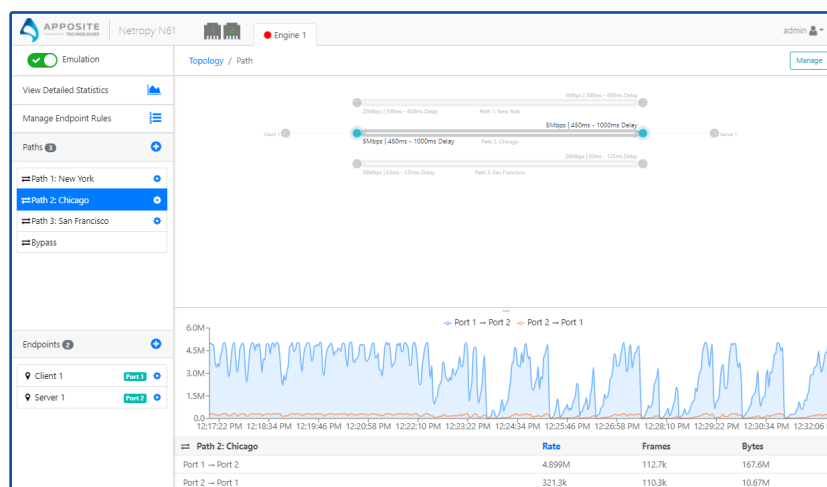
For certain applications, failure to perform can result in a loss of revenues and reputation, and even fines or liability. Mobile or web-based government, retail, and healthcare transactions rank among those subject to the greatest risk. One famous example, the launch of the beleaguered Obamacare site actually landed providers in front of the U.S. Congress.

HOW TO TEST APPLICATION PERFORMANCE USING WAN EMULATION

Apposite's high-precision network emulators are architected to deliver the ultimate user experience for your design, QA, and IT teams. Replicating IP networks and modeling conditions with Netropy lets users:

- Simulate bandwidth, latency, jitter, bit errors, and other network impairments
- Add background traffic to create realistic congestion
- Model varying quality of service (QoS) on the network
- Simulate multiple links simultaneously causing packets to be fragmented, duplicated, or reordered
- Record live network conditions for use in lab testing
- Run "what-if" scenarios such as an increase or decrease in bandwidth

Simply run your actual devices and applications over an emulated network configured to match your exact conditions to see how applications ranging from Windows file sharing to VoIP to media and military applications perform.



How It Works

Netropy emulators feature Ethernet ports used to connect client and server networks with traffic passing between the two appearing as if it had traversed a satellite link.

Simply attach a client device to one port on the WAN emulator and a server to a second to replicate entire networks on both sides. Use Apposite's highly graphical UI to specify link conditions and run applications over the simulated network to measure results.

The Fastest Path to Action

Performance problems may stem from a combination of factors including: application design, protocols, bandwidth constraints, latency and loss conditions, and other factors. Netropy lets users isolate, model, and address the source of potential issues before users feel the impact.

Think “Ecosystem.”

Make sure your vendors are testing, but do not assume that all testing falls to them. Hardware, software, and applications all must be evaluated under realistic conditions to ensure a seamless user and operational experience. Leading network operators, device manufacturers, government agencies, and large enterprises already use Netropy to ensure performance across IP-based networks.

WHY APPOSITE?

The gold standard in network emulation, Netropy’s high-performance testing lets users emulate even the most complex and challenging networks. Simulate up to 15 separate links on each pair of ports and individually control to introduce impairments such as bandwidth constraints, latency, jitter, and loss at speeds up to 100 Gbps.

Highlights include:

Run tests within minutes. Netropy emulators are quick to install, intuitive to configure, and easy to operate with the Apposite GUI providing the responsiveness of an application with the convenience of a standard web browser.

Conduct comprehensive satellite testing. Netropy simulates a full range of satellite links allowing users to specify conditions and impairments across traditional GEO, emerging LEO, and medium earth orbit (MEO) satellite networks.

Leverage the Gilbert-Elliott model. Satellite performance varies greatly depending on the atmospheric conditions. Apposite supports the Gilbert–Elliott model, a simple channel model widely used for describing burst error patterns in transmission channels. This approach enables flexible replication of link conditions and simulation of digital error performance on communications links.

Support for Gilbert-Elliott proves critical to simulating fast-changing weather conditions and the impact of subtle shifts. Modeling bit error rate loss and burstable loss aids in scripting the effect of atmospheric conditions.

testing to new levels. Where traditional replication focuses on Layer 1 of the OSI

network model (emulating power, signals, waveforms), WAN emulation addresses layers 2 and 3 to measure and fine-tune IP networking and the user experience.

Minimize cost. Pricing for WAN emulators starts at around \$2,000 and testing in the lab eliminates the exorbitant costs of using live links. Devices are easy for new users from all teams to learn without costly, time-consuming training. The same Netropy system can be used to test performance on any IP-based wired or wireless network to extend investment value.

About Apposite Technologies

Apposite Technologies makes WAN emulation easy by offering professional-quality network emulation tools at affordable prices. Apposite’s award-winning Netropy and Linktropy 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. Netropy and Linktropy WAN emulators are widely deployed by leading enterprises, application and equipment developers, telecoms carriers, and government and military organizations around the world. Apposite Technologies – WAN Emulation Made Easy



APPOSITE
TECHNOLOGIES

17835 Ventura Blvd Suite 211, Los Angeles, CA 91316 USA

TEL: 1.310.477.9955 | info@apposite-tech.com

www.apposite-tech.com

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