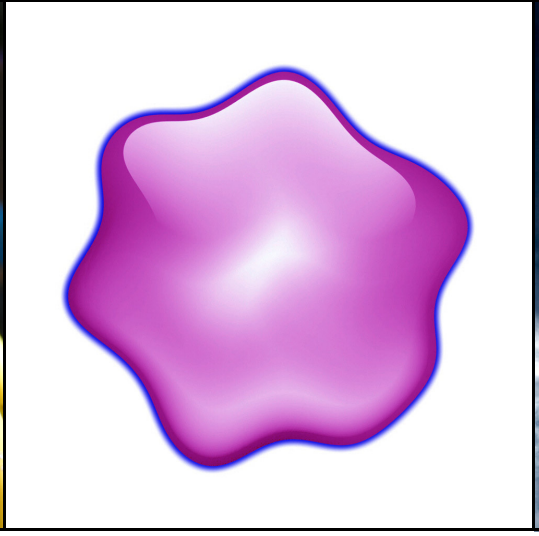


ALBEDO Net.Storm

the Path to Excellence

NetStorm generates those perturbances typical of IP and Carrier Ethernet to test applications, devices and protocols that should be tolerant with packet delay, jitter, loss, duplication, reordering, error and bandwidth variations.

Testing has become an important topic during the IP convergence, because of the diversity of underlying technologies, and the adaptive behavior of applications. NetStorm facilitates the verification of new applications, services and nodes through emulation of the real nature of IP networks. NetStorm enables engineers to model and modify arbitrary performance dynamics including *packet delay, jitter, bandwidth limitations, congestion, packet loss, errors and duplication* on live IP packets.

There are increasing requirements of QoS guarantees from multiplay in public and private IP networks that may eventually provide paths in the inter-domain network with QoS attibutes.Testing the behavior of applications, devices or services is such paths or isolating applications in a lab can be simplified with NetStorm that can shape and manage up to 16 independent flows of traffic with predefined QoS.The emulated test environment resembles actual traffic profile as observed on the real network.

WAN emulation

NetStorm is a tool for developers debugging new IP equipment, acceptance test laboratories, design and configuration of unified Ethernet/IP networks, QoS/QoE test, HDTV, IPTV, VoIP, Internet radio, Video Streaming, VPN data, High Speed Internet, Satellite and Undersea traffic applications. All of them that may suffer the network conditions found on the Internet and enterprise.

“Net.Storm is Network Emulator capable to manage full Gbit stream with an accuracy better than 1ms”

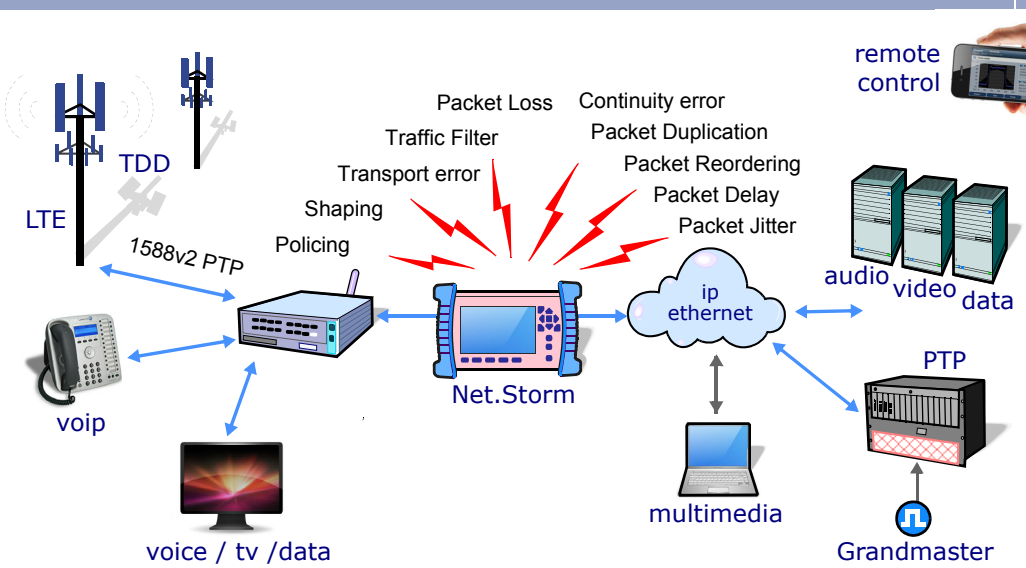
This tool is being used by big operators, acceptance labs and universities to test Multiplay applications including Critical Data Access, Internet, VoIP, IMS, and IPTV and the associated nodes such as routers, VoIP hand sets, VoIP PBXs, set-top boxes and VoD servers.

ALBEDO Telecom

NETSTORM.en

The IP Dimension

Historically, the process followed to accept a device, test a protocol or troubleshoot an application has always been an important task. However, when the new solution is based on the IP protocol stack, then a formal verification of the solution becomes essential.



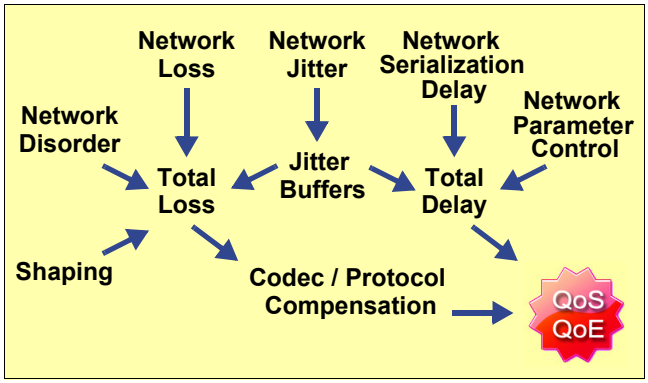
IP networks are now everywhere can be very diverse and are capable of carrying any type of traffic. However, IP connections can vary significantly in bandwidth, latency, error and loss rates, and often are asymmetric. Moreover, QoS dynamics can fluctuate widely because of the congestion in peak hours, failures and routing.

QoS demands

The demands that applications make of networks vary widely as well, often relying on near-real-time characteristics that differ fundamentally from the best-effort delivery typically provided by current networks. As a consequence, applications and protocols increasingly employ adaptive mechanisms to make more intelligent use of available network resources. However, these too present new testing challenges as the correct behaviour of adaptive STB's cannot be defined statically or often even in any simple deterministic fashion; and adaptive protocols at different levels or in different systems may interact poorly with each other in ways not easily detectable while testing in isolation.

NetStorm

ALBEDO Telecom has designed Net.Storm to address this growing diversity of network hardware and software and to provide a controlled, reproducible environment for testing nodes, protocols and terminals used in the new IP applications. Net.Storm is a simple, fast, hardware based Ethernet/IP network emulator that provides the ability to generate common network effects such as packet loss, duplication, delay, congestion, packet errors and bandwidth limitations.



It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviours up to 1 Gbps rates with accuracy always better than 1 ms. Operating at the Ethernet layer, Net.Storm can emulate the critical end-to-end performance characteristics imposed by core routers and carrier switches and by any underlying network technology.

Hardware Performance

Net.Storm is inserted between two Ethernet segments in pass through mode while operating in bidirectional packet transfer mode. The emulation settings can be defined independently for 16 separate flows that can be filtered by several criteria including MAC, IP, TCP/UDP or User Mask.

The result is a realistic and 100% controlled simulation of those conditions obtained of actual WAN networks that have been detected as if live. The same conditions are able to be reproduce in order to observe the behaviour of applications such as VoIP, IPTV, VoD; nodes such us gateways, routers or set top boxes; and protocols such as SIP, MEGACO, H.323; and critical links and access networks.

Key Features

The overall QoE depends not only on the packet loss or jitter time pattern but also on the content, the en-coding and de-jitter buffering strategies. With Net.Storm, all of these impairments and more can be generated to address reliable performance verification.

- High performance appropriate for TV head-end, Video servers or Massive VoIP calls.
- Configurable, either deterministic or random, time delays can be inserted in every filter
- FEC errors, IP checksum errors
- Users can place errors within IP protocols or edit the Ethernet/IP fields.
- Impairments ITU-T Y.1541.
- Detailed event log window with per flow viewing of the events.
- Disordering.

Net.Storm has the ability to replicate complex network dynamic by means of modifying Bandwidth and QoS parameters. Net.Storm is an invaluable tool for IP equipment manufacturers, R&D departments, Network Operators, ISP and Triple Play service providers that test and verify a wide variety of projects.

CUSTOMERS

- 1588v2 (PTP) set up, generation of PDV, Delay, Loss
- Asymmetric delays
- IP Protocol developers
- Triple Play service providers
- R&D, Universities, Labs
- VoIP, IPTV, HSI designers
- Megaco, H.323, SIP testing
- Satellite delay emulation
- Submarine links
- HD Television test

KEY FEATURES

- Hardware (FPGA) based
- Up to 15 user defined filters
- MAC, IP, TCP, UDP... filters
- Full Gigabit performance
- Hand-held battery operated
- Real traffic conditions
- Advanced traffic statistics
- CLI though SSH/Telnet
- Touchscreen, mouse, VNC
- SNMP / MIB support

BENEFITS

- Carrier-class device
- Ideal for developers
- Verify 100% the stability of network nodes and terminals
- Check the tolerance of services to QoS degradation
- Assured Service and SLA
- Minimize investment risks
- Easy identification of degradation sources

Applications

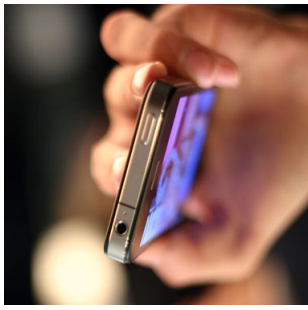
The network convergence has produced a new generation of sophisticated devices and applications supported by Ethernet/IP networks. NetStorm facilitates a methodology to verify these solutions to quickly ship products or certify networks and applications making sure they are capable and tolerant enough to provide good Quality of Experience.

- **Network Design**. Verification and debugging of Ethernet and IP networks, in both telecom and enterprise.
- **IP Applications Design**: Including Internet access, Voice over IP, Fax over IP, Gaming, Streaming audio and video, IPTV, VoD, and real/time services.
- **Approval and Acceptance Tests**: Required to certify the behaviour of IP equipment including Phones, Fax, Gateways, Set-Top-Box, IMS core, Application servers, Gateways, ADSL/VDSL/FTTx routers, and PLCs.
- **IEEE 188v2 PTP**. Generation of impairments to test the synchronization quality achieved between master/slave clocks.
- **QoS level verification** in Intranet or Internet environment to configure terminals, gateways and routers.
- **Laboratories**. Generation of controlled QoS on different flows defined by the user to emulate and repeat network impairments in the lab.
- **Emulation network conditions** found on the Internet and enterprise networks (LAN, MAN, WAN): latency, jitter, packet loss, packet reordering, bandwidth limitations, to test IP applications, services and products sensitive to various real conditions.
- **Protocol testing** used by Multiplay Application such as H.323, SIP, MPEG2, MPEG4, and VC1.

Universal Network Emulation

Developers of IP solutions find Net.Storm will assist debug and test new features. Moreover, it facilitates the execution of Performance & Acceptance Tests, while evaluating the behaviour of IP equipment in real Enterprise or Metropolitan Networks. Engineers will be able to easily simulate exactly the same conditions found on the Internet, Corporate and Telecom networks, including Satellite and Submarine links with important delays and limited bandwidth.

Benefits



Net.Storm is an inexpensive hardware based tool, which can emulate numerous complex performance scenarios. To get a better emulation approach, up to 16 independent flows are tuneable with packet delay distributions, congestion, packet loss, bandwidth limitation and packet reordering / duplication.

Net.Storm can evaluate the stability of switches and routers under static or dynamic traffic load conditions over minutes, hours or days. Net.Storm is an intuitive, low cost architecture, which minimizes the risk of launching new products that could cause issues after installation and, as a result, will certainly improve your long term customer relations.

Minimize Risk

Characterize and troubleshoot functional performance and tolerance of new network functionality in the development lab and before deployment into the operational network to minimize your investment risks.

Evaluate key performance parameters such as per-flow QoS, fail-over time or Access Control List (ACL) filtering performance. Perform comparative analysis of devices or services with deterministic traffic during product development cycles or vendor comparisons.

Networking Features	
Interfaces	• Dual RJ-45 port for electrical connection 10/100/1000BASE-T; PoE detection and PoE transparency • 2 x SFPs ports: 10BASE-T, 100BASE-TX, 100BASE-FX, 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX and 1000BASE-BX • Autonegotiation: Bit rate at 10, 100, and 1000 Mbit/s, Disable autonegotiation and direct set up • EtherType II (DIX v.2), IEEE 802.3, IEEE 802.1Q, and IEEE 802.1ad • IEEE 802.2–LLC1 and IEEE 802.3–SNAP • IPv4 and IPv6 support
Filters	• Traffic impairments can be defined over max. 32 traffic flows (16Tx, 16Rx) defined by means of filters • User-defined filters at IP, UDP and TCP headers including agnostic filters defined by 16-bit masks and user defined offset • Independent filtering criteria at each flow; Independent statistics for each configured filter
Ethernet Filters	• Ethernet flow: MAC origin, destination, group of address based on defined masks • Ethernet type and selection mask • VLAN and selection mask; CoS and selection mask
IP Filters	• IP address origin, destination, and masks. • Protocol encapsulated in the IP packet (TCP, UDP, Telnet, FTP, etc.) • Traffic flow selection based on DSCP with optional DSCP filters • Field contents at TCP/UDP layer port with optional port filters
Results	• Auto-negotiation results including current bit rate, duplex mode, Ethernet interface • SFP presence, vendor, and part number • Frame counts: Ethernet, and IEEE 802.1Q (VLAN), control frames; Unicast, Multicast and Broadcast • Basic error analysis: FCS errors, undersized frames, oversized frames, fragments, jabbers • Frame size counts: 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518 bytes; Byte counts: Port A (Tx / Rx) and Port B (Tx / Rx)

Event Insertion	
Events Insertion	• Independent event insertion in every single flow identified in the main stream. • Events: Frame loss, delay, frame duplication, errored frames. • Maximum process time caused by event insertion: 10 µs
Delay	• Single delay insertion [0ms - 60s] • Uniform distribution: minimum delay (Tmin) and maximum delay (Tmax) [0ms - 60s] • Random delays with exponential distribution: defined with a Mean (ms) and a Minimum delay (ms)
Jitter	• Deterministic or random jitter using uniform and exponential distribution • Uniform distribution: minimum delay (Tmin) and maximum delay (Tmax) • Exponential distribution: minimum delay (Tmin) and average delay (Tavg)
Loss	• Deterministic loss: unique, burst, periodical burst • Single loss insertion;; Constant loss defined by a probability • Burst Loss defined by time start / duration [0 - 30min], or first frame / number of loss packets [0 - 32,737 packets] • Periodic Burst Loss defined by time start / duration, or first frame / number of loss packets / separation between bursts [0 - 30min] • Random loss defined by a probability [0.00% - 99.99%] • Random loss defined by the two-state model of Gilbert-Elliot
Duplication	• Traffic duplication defined by deterministic and random events • Deterministic duplication defined by time or frame number • Random duplication defined by event probability [0.00% - 99.99%]
Error	• Single error insertion • Constant error insertion defined by a probability [0.00% - 99.99%]
Traffic Shaping	• Shaping filter for bandwidth control. Based on token bucket algorithm (a) sustainable rate (frames/s), (b) depth (frames) • Not conforming frames are delayed.
Traffic Policing	• Policing filter for bandwidth control. Based on token bucket algorithm (a) sustainable rate (frames/s), (b) depth (frames) • Not conforming frames are dropped
Results	• Auto-negotiation results including current bit rate, duplex mode, Ethernet interface • SFP presence, vendor, and part number • Frame counts: Ethernet, and IEEE 802.1Q (VLAN), control frames; Unicast, Multicast and Broadcast • Basic error analysis: FCS errors, undersized frames, oversized frames, fragments, jabbers • Frame size counts: 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518 bytes; Byte counts: Port A (Tx / Rx) and Port B (Tx / Rx)

Operation and Management	
Performance	• Full Duplex operation at 1 Gbit/s or 1,5 Mframes/s in each direction • Accuracy better than 10^{-6} secs. at 1 Gbit/s • Performance and accuracy 100% independent of the line bit rate

Ergonomics	
Instrument	• Touchscreen 480 x 272 TFT • Mouse, USB & Ethernet ports • 1.0 kg, 223 x 144 x 65mm; IP-54 • Soft LEDS All events at a glance • Rechargeable Batteries continuous working up to 12 hours continuous operation • AC Power Adapter Input: 100 ~ 240 V AC, 50/60 Hz • Operating Temperature 0°C ~ 50° C, Storage Temperature -20°C ~ 70°C, Humidity 5% ~ 95%; IP rating 54 • SNMP, MIB support and VNC remote control