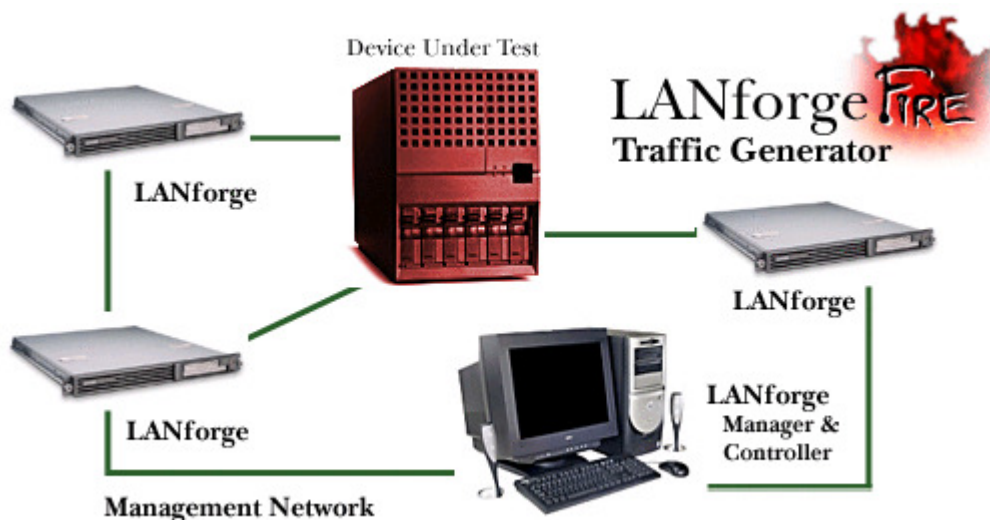




Network Testing and Emulation Solutions

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## LANforge-FIRE Stateful Network Traffic Generator



## LANforge FIRE Stateful Network Traffic Generator

LANforge FIRE generates and receives various network protocols. It is used to create load on a network under test. It reports statistics such as packets sent and received, latency, packet-loss and many other network characteristics. LANforge supports real protocols and stateful TCP connections, so it can generate load against web servers, VOIP gateways, firewalls, load-balancers and many other network components. LANforge can virtualize network adapters and wifi station interfaces. It can also act as a router or group of routers supporting OSPF, RIP, BGP and Multicast (PIM, IGMP). LANforge supports IPv4 and IPv6.

The LANforge system consists of a single manager process, and one or more traffic generator machines (resources). The resources are connected to the manager over a management network. Devices under test are connected to the non-management ports of LANforge systems. If needed, LANforge can also generate traffic on the management network.

The LANforge GUI may run on the LANforge machines or on the customer's PCs. The GUI should connect to the manager machine. Multiple GUIs can be used concurrently.

## LANforge FIRE Use Cases

- Validate network equipment for throughput, stability and performance, at up to 10Gbps speeds. All supported protocols can be used concurrently for a very realistic traffic mix.
- 24 and 48-port modules especially cost-effective for testing many slower systems, such as DSL, Cable-Modem, and Satellite modems.
- WiFIRE models can emulate up to 400 WiFi clients per chassis for testing access points and other wireless infrastructure.
- VOIP Call generation can be used to load SIP gateways and other VOIP infrastructure. It can report various statistics, including PESQ quality scores.
- HTTP, HTTPS, FTP and similar load generation can be used to test web servers, load balancers, and related equipment.
- LANforge can support 30,000+ concurrent stateful TCP connections, so it can be used to test firewalls, routers, and other equipment that pays close attention to higher level protocols.

## LANforge FIRE Protocols & Connections

- Supports real-world protocols: (Benchmarked on high-end Candela Technologies-supplied hardware)
  - Layer 2: Raw-Ethernet (225 Mbps+ bi-directional on GigE)
  - PPP: Supports PPP and multi-link PPP over T1/E1 interfaces at full line speed
  - Layer 3: Armageddon accelerated UDP/IP (9.99 Gbps+ with 1514 byte frames on 10 GE; 990 Mbps, 81,800 pps on GigE; both symmetrical and bidirectional, sending to self (2 ports)) \*
  - Layer 3: UDP/IP (1.8 Gbps+ bi-directional, 3 streams, 1472 byte PDUs, 1500 MTU, 10G, to self)
  - Layer 3: UDP/IPv6 (1.8 Gbps+ bi-directional, 3 streams, 1440 byte PDUs, 1500 MTU, 10G, to self)
  - Layer 3: IGMP Multicast UDP (500+ receivers)
  - Layer 3: IGMP Multicast UDP over IPv6 (500+ receivers)
  - Layer 3: Stateful TCP/IP (6.4Gbps+ bi-directional with 24K byte writes, 4 streams, 1500 MTU, 10G, to self)
  - Layer 3: Stateful TCP/IPv6 (7.2Gbps+ bi-directional with 24K byte writes, 4 streams, 1500 MTU, 10G, to self)
  - Layer 4: FTP (200 Mbps+, bi-directional, per processor)
  - Layer 4: SFTP (not benchmarked)
  - Layer 4: HTTP (9 Gbps+ download, 65,000+/13,000+ Requests per Second, 6,000+ concurrent connections)
  - Layer 4: HTTPS (1 Gbps+ download)
  - Layer 4: SCP (not benchmarked)
  - Layer 4: TFTP (1400+ concurrent connections, ~1Gbps throughput)
  - Layer 4: SMTP (not benchmarked)
  - Layer 4: TELNET (not benchmarked)
  - Layer 4: IMAP (not benchmarked)
  - Layer 4: DNS (Used and Reported by most Layer 4 traffic types)
  - Layer 4: PING (not benchmarked, via integrated script)
  - Layer 4: VoIP Call Generator (SIP, RTP, RTCP, PESQ/MOS), 1000+ calls per machine. \*
  - File-IO: NFS 17+Gbps (dual 10G NICs, mostly reading), 1000+ virtual clients.
- Supports over 30,000 concurrent TCP connections on a single high-end machine with appropriate licenses. Base license includes 1000 concurrent connections. Supports around 2000 concurrent Layer 4, UDP and other connection types. \*
- Supports real-world compliance with ARP protocol.
- Supports ToS (QoS) settings for TCP/IP and UDP/IP connections.
- Utilizes [libcurl](#) for FTP, SFTP, TFTP, SCP, SMTP, TELNET, IMAP, HTTP and HTTPS (SSL) protocols.
- Supports file system test endpoints (can be used for NFS, NFSv4, SMB, and iSCSI file systems too!). Can emulate 1000+ CIFS and/or NFS clients with unique mount points, IPs, MACs, etc \*
- Supports custom and command-line programs, like nmap and ping.
- Custom packet builder interface allows hand crafting of headers and payloads. Headers supported at Layer 2 include ARP, SNAP/LLC, 802.1Q, 802.1QinQ and MPLS. Some Layer 3 protocol headers supported include IP, IPX, UDP, TCP, ICMP, IGMP, IP-ENCAP, RDP, IPinIP and IPv6 protocols.
- Uses publicly available Linux, Windows and Solaris networking stack for increased standards compliance.
- Supports 20 or more physical data-generating Ethernet ports per 2U LANforge chassis.
- Emulates over 2000 unique machines with one physical interface with the MAC-VLAN feature! \*
- Supports over 2000 802.1Q VLANs. \*
- Supports PPP-over-T1/E1 and PPPoE, including automated creation and deletion of the PPP interfaces
- Supports 802.11a/b/g/n with WiFIRE feature set (see below.)

## LANforge FIRE Reporting

- Comprehensive traffic reports include: Packet Transmit rate, Packet Receive rate, Packet Receive Drop %, Transmit Bytes, Receive Bytes, Latency, various Ethernet driver level counters, and much more.
- Supports generation of reports that are ready to be imported into your favorite spread-sheet.
- Allows packet sniffing and network protocol decoding with the integrated [Wireshark](#) protocol sniffer.

## Management & Platform Support

- Comprehensive management information detailing all aspects of the LANforge system including machine statistics, test cases, and Ethernet port statistics.
- The LANforge Management GUI manages the LANforge systems and may be run locally on the LANforge system or over the network.
- The GUI can manage multiple units, tests, and testers simultaneously.
- The GUI is supported on Linux, Windows, Solaris, and other operating systems.
- Supports scriptable command line interface (telnet) which can be used to automate test scenarios. Perl libraries and example scripts are also provided!
- LANforge testing software supported on Linux, Microsoft Windows and Solaris.

- Automatic discovery of LANforge systems simplifies maintenance of LANforge test equipment.
- The modular architecture that allows you to leverage your existing LANforge investment as your need for capacity increases.
- LANforge FIRE feature set may be combined with LANforge ICE to provide background traffic for more realistic testing.

## LANforge VoIP/RTP Call Generator Feature Highlights

- SIP protocol used for call management. \*
  - SIP/UDP supported.
  - Can use directed mode, where VoIP phones call directly to themselves.
  - Can also use Gateway mode where the VoIP phones register with a SIP gateway.
  - SIP authentication is supported.
- RTP protocol used for streaming media transport, and supports the following CODECS. More codecs may be supported in the future.
  - G.711u: 64kbps data stream, 50 packets per second
  - G.729a: 8kbps data stream, 50 packets per second
  - Speex: 16kbps data stream, 50 packets per second (Linux ONLY)
  - G.726-16: 16kbps data stream, 50 packets per second
  - G.726-24: 24kbps data stream, 50 packets per second
  - G.726-32: 32kbps data stream, 50 packets per second
  - G.726-40: 40kbps data stream, 50 packets per second
  - NONE: A messaging-only configuration is now supported
- Supports PESQ automated voice quality testing.
- RTCP protocol used for streaming media statistics
- Each LANforge VoIP/RTP endpoint can play from a wav file and record to a separate wav file. Almost any sound file can be converted to the correct wav file format with tools bundled with LANforge. Sample voice files are included.
- Support for 1000 or more emulated VoIP phones per machine (hardware dependent).
- LANforge VoIP/RTP endpoints can call other LANforge endpoints or third party SIP phones like Cisco and Grandstream. Third party phones can also call LANforge endpoints and hear the WAV file being played.

## LANforge WiFIRE 802.11a/b/g/n Stateful Traffic Generator

- Useful for testing Wireless Access Points and deployments.
- Can emulate up to 200 802.11a/b/g/n wireless client stations (Virtual STAs) per radio.
- Each radio can run on only a single frequency at a time. So, all stations must be able to connect to an AP on the same channel.
- Each Virtual STA can be associated with a particular Access Point (AP).
- Each Virtual STA can be set to a specific protocol (/a, /b, /g /n) or be told to use the best option available.
- For 802.11n, HT-40 can be disabled.
- For all protocols, the rates can be specified or left auto.
- AMPDU density and factor can be modified for 802.11n stations.
- Each Virtual STA has unique MAC address, IP address and routing table.
- 128bit WEP, WPA, WPA2 and related wpa\_supplicant authentication methods supported.
- Supports all LANforge FIRE stateful traffic generation features, including HTTP, TCP, UDP, TCPv6, UDPv6, VOIP (SIP, RTP) \* and more.
- Supports bridge mode where wired Ethernet traffic can connect to the wired port on the LANforge and have their traffic sent onto the wireless network. This allows third-party traffic generators to be used. Each MAC address is associated with a single WiFi station in LANforge. With release 5.2.2, traffic can be bridged by IP address as well.

## LANforge NetReplay & Backtrack Feature Highlights

- Using a combination of the LANforge FIRE traffic generation and LANforge ICE network emulation, LANforge supports capture and replay of Ethernet packet streams.
- Capture protocol can be converted to standard 'libpcap' format for use with other tools such as Wireshark and tcpdump.
- Capture has been benchmarked at 1Gbps bi-directional on high-end hardware using 6TB RAID configuration.

## Virtual Network Builder

LANforge Netsmith is a drag-and-drop virtual network builder. It can support virtual routers, emulated network links, bridges (switches), virtual and physical interfaces, and more. When using routers, it supports static, OSPF, BGP, Multicast (IGMP, PIM) and other protocols for IPv4 and IPv6. LANforge FIRE stateful traffic generating connections and LANforge ICE network emulations are easily placed in the virtual networks. The virtual routers can connect to external routers and other network elements for easy

integration into your network.

- Emulates networks of arbitrary complexity using real-world routing protocols by integrating with the **XORP** router daemon.
- Supports IPv4 and IPv6 static routing.
- Supports IPv4 and IPv6 OSPF routing.
- Supports IPv4 and IPv6 multicast routing.
- Supports basic RIP, OLSR, and BGP routing protocol features.
- Supports Ethernet bridges (switches), including spanning tree protocol (STP).
- The virtual interfaces are 'real', so you can configure them like normal network interfaces and use sniffers and other tools on the individual interfaces.
- Virtual router interconnections can be associated with LANforge ICE network emulations.
- Interfaces can be associated with LANforge FIRE stateful traffic generation connections.
- See the **LANforge FIRE** and **LANforge ICE** and cookbook for examples of how Netsmith works.

## LANforge FIRE Systems

LANforge FIRE is often customized to a customer's specifications. In particular all of the **LANforge ICE** Network Emulation feature set is available. Some standard systems are listed below, but please contact [sales@candelatech.com](mailto:sales@candelatech.com) to discuss your requirements in detail and for a customized quote.

Gigabit in a Box: CT502-1G	Simulate up to 250 ethernet devices with unique MAC, IP Address and routing table over 6 physical ports with gigabit traffic generation. Excellent for testing routers and firewalls that monitor traffic flows.	<a href="#">HTML</a> <a href="#">PDF</a>
802.11a/b/g/n WiFi: CT521-400	Simulate up to 400 802.11a/b/g/n Wireless Stations in one small system (200 per radio). Each Virtual Station device has it's own IP address, IP port space, MAC address and routing table. Excellent for testing Access Points and other WiFi networks.	<a href="#">HTML</a> <a href="#">PDF</a>
VoIP Call Generator: CT506	Generate up to 140 concurrent SIP calls with RTP. Excellent for testing SIP gateways, routers and QoS configurations. Includes optional PESQ module that provides automated perceptive quality scoring for the individual calls.	<a href="#">HTML</a> <a href="#">PDF</a>
10 Gigabit Generator: CT503-10G	Generate and receive 10 Gbps of traffic with a single system. The CT503-10G is configured with two 10 Gigabit Fiber interfaces. This system is excellent for testing multi-port high-speed networks.	<a href="#">HTML</a> <a href="#">PDF</a>
48-port Last-Mile Traffic Generator: CT570	Generate and receive up to 2 Gbps of traffic across 48 10/100 ethernet interfaces utilizing a single LANforge machine and a 48-port managed ethernet switch. This system is excellent for testing DSL, Cable Modem, and other networks with a large number of lower-speed network devices.	<a href="#">HTML</a> <a href="#">PDF</a>

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# LANforge-FIRE Related Screen Shots

## Layer 3 (Ethernet, UDP, TCP) Connections

LANforge Manager Version(5.2.4)

Control Reporting Tear-Off Help

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Resource Mgr Serial Spans PPP-Links Event Log Alerts Port Mgr Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Collision-Domains File-IO

Rpt Timer: fast (1 s) Go Test Manager all Select All Start Stop Quiesce Clear

View all Display Create Modify Delete

**Cross Connects for Selected Test Manager**

Name	Type	State	Pkt Tx A->B	Pkt Tx A<-B	Rate A->B	Rate A<-B	Rx Drop ...	Rx Drop ...	Drop Pkts A	Drop Pkts B	Latency	Rpt
sta-sta-t1	LF/TCP	Stopped	0	0	0	0	0	0	0	0	0	0
sta-sta-t2	LF/TCP	Stopped	0	0	0	0	0	0	0	0	0	0
sta-sta-u1	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0
sta-udp-s	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0
tcp-d-001	LF/TCP	Stopped	0	0	0	0	0	0	0	0	0	0
udp-0001	LF/UDP	Run	2,244	56	383,983	9,582	0	0	0	0	3	
udp-0002	LF/UDP	Run	2,244	56	383,988	9,582	0	0.045	0	1	5	
udp-0003	LF/UDP	Run	2,244	56	383,988	9,582	0	0.045	0	1	8	
udp-0004	LF/UDP	Run	2,244	56	383,988	9,582	0	0.045	0	1	10	
udp-0005	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0
udp-0006	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0
udp-0007	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0
udp-0008	LF/UDP	Stopped	0	0	0	0	0	0	0	0	0	0

Logged in to: 192.168.100.195:4002 as: Admin

## Layer 3 Create/Modify Screen

Create/Modify Cross Connect

Cross Connect Information

CX Name: tcp6-nrml CX Type: LANforge / TCP6 Report Timer: fast (1 s) Quiesce: 3 Test Manager default\_tm

**TX Endpoint (endpoint A)**

Endp Name: tcp6-nrml-A Shelf: 1 Resource: 1 (lec2010-ath9k-1) Port: 10 (rddVR0)

Pld Pattern: Increasing IP Addr: AUTO Min IP Port: AUTO Max IP Port: Same

Min Tx Rate: 10M (10 Mbps) Max Tx Rate: Same Min Pkt Size: TCP P1d (1,460 B) Max Pkt Size: Same

IP ToS: Best Effort (0) Pkts To Send: Infinite TTL: 32

Min Duration: Forever Max Duration: Same Min Recon: 0 (0 ms) Max Recon: Same

Multi-Conn: Normal (0) Filename: Dest MAC: b2 e3 d9 eb 14 f4

Checksum  UnManaged  Rcv Mcast  Replay File  Loop  Dest Mac

**RX Endpoint (endpoint B)**

Endp Name: tcp6-nrml-B Shelf: 1 Resource: 1 (lec2010-ath9k-1) Port: 15 (rddVR5)

Pld Pattern: Increasing IP Addr: AUTO Min IP Port: AUTO Max IP Port: Same

Min Tx Rate: 10M (10 Mbps) Max Tx Rate: Same Min Pkt Size: TCP P1d (1,460 B) Max Pkt Size: Same

IP ToS: Best Effort (0) Pkts To Send: Infinite TTL: 32

Min Duration: Forever Max Duration: Same Min Recon: 0 (0 ms) Max Recon: Same

Multi-Conn: Normal (0) Filename: Dest MAC: 4e aa 68 16 1c 9d

Checksum  UnManaged  Rcv Mcast  Replay File  Loop  Dest Mac

## LANforge on Microsoft Windows

LANforge supports Microsoft Windows operating systems, but Linux is still the preferred platform for advanced features and higher stability, performance and precision.

Some features currently supported on Windows:

- Layer 2: Raw-Ethernet
- Layer 3: IPv4: UDP, TCP, Custom UDP, Custom TCP
- Layer 3: IPv6: UDP, TCP (XP only, not available on Vista currently)
- Layer 4+: HTTP, HTTPS (SSL), FTP, VoIP (SIP, RTP), File-IO (CIFS, etc.)
- Display of interface (adapter) related statistics and settings
- Custom packet builder interface allows hand crafting of headers and payloads. Headers supported at Layer 2 include ARP, SNAP/LLC, 802.1Q, 802.1QinQ and MPLS. Some Layer 3 protocol headers supported include IP, IPX, UDP, TCP, ICMP, IGMP, IP-ENCAP, RDP and IPinIP.
- For detailed information on specific features, please contact Candela Technologies or your sales representative

Some features currently **NOT** supported on Windows:

- Layer 3: IPv6 on Vista (Supported on XP)
- Armageddon UDP packet generator
- PPPoE, PPP/T1
- LANforge WiFIRE 802.11a/b/g/n client emulation.
- Virtual interfaces (802.1Q, MAC-VLANs)
- Virtual routers.
- Configuration of interfaces (adapters) through LANforge. You can configure the interfaces through the normal Windows tools instead.
- For detailed information on specific features, please contact [Candela Technologies](#) or your sales representative.

## LANforge on Solaris

LANforge support for Solaris operating systems has returned, but Linux is still the preferred platform for advanced features and higher stability, performance, and precision.

Some features currently supported on Solaris:

- Layer 2: Raw-Ethernet
- Layer 3: UDP, TCP, Custom UDP, Custom TCP, IPv6 (TCP, UDP)
- Layer 4+: HTTP, HTTPS (SSL), IGMP, FTP, File-IO (NFS, etc.)
- Display of interface (adapter) related statistics and settings
- Configuration of interfaces (adapters) through LANforge (no DHCP though).
- Custom packet builder interface allows hand crafting of headers and payloads. Headers supported at Layer 2 include ARP, SNAP/LLC, 802.1Q, 802.1QinQ and MPLS. Some Layer 3 protocol headers supported include IP, IPX, UDP, TCP, ICMP, IGMP, IP-ENCAP, RDP and IPinIP.
- For detailed information on specific features, please contact Candela Technologies or your sales representative

Some features currently **NOT** supported on Solaris:

- Configuring ports to use DHCP from LANforge.
- Armageddon UDP packet generator
- PPPoE, PPP/T1
- LANforge WiFIRE 802.11a/b/g/n client emulation.
- Virtual interfaces (802.1Q, MAC-VLANs)
- Virtual routers.
- For detailed information on specific features, please contact [Candela Technologies](#) or your sales representative.

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## Feature Upgrades

Unless otherwise noted, these features usually cost extra:

- WanPaths (LANforge-ICE feature set)
- Virtual Interfaces: MAC-VLANs, 802.1Q VLANs, WiFi stations, etc
- FIRE Connections: Base FIRE license includes 1000 active connections.
- LANforge-ICE Network Emulation.
- VOIP: Each concurrent call requires a license.
- Armageddon: Each pair of ports requires a license.

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