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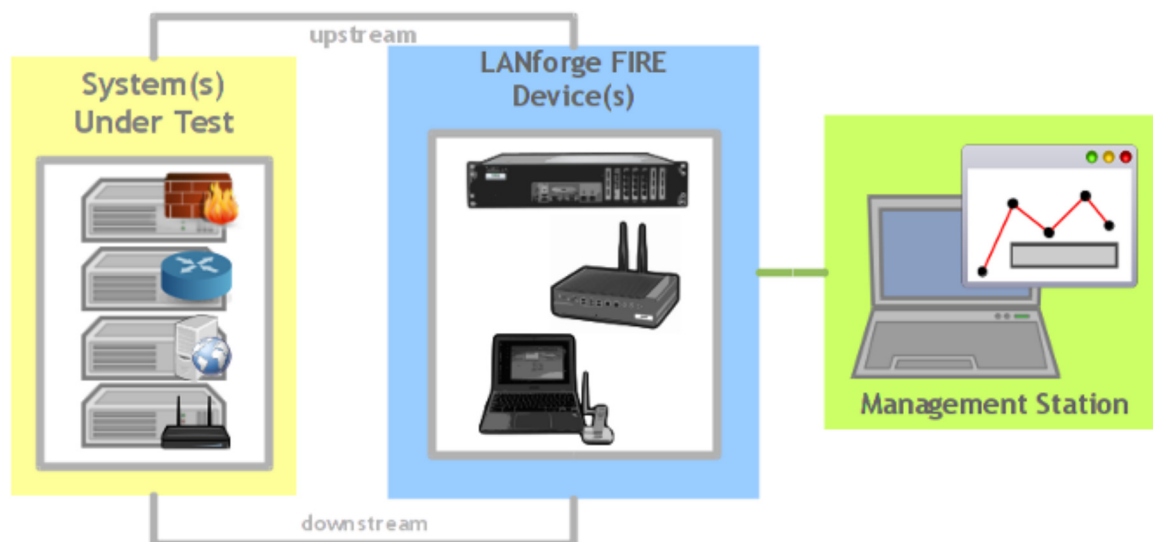+1 360 380 1618 [PST, GMT -8]

Network Testing and Emulation Solutions

# LANforge FIRE
# Stateful Network Traffic Generator



LANforge supports Linux, Microsoft Windows and Solaris operating systems. LANforge on Linux is still the most precise, featureful and highest performing option.

## 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 1200 WiFi stations 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 50,000+ 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
    - PPP: Supports PPPoE interfaces
    - Layer 3: Armageddon accellerated 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 (6 Gbps+ bi-directional, 3 streams, 24k byte PDUs, 1500 MTU, 10G, to self, some drops)
    - Layer 3: UDP/IPv6 (6 Gbps+ bi-directional, 3 streams, 24k byte PDUs, 1500 MTU, 10G, to self, some drops)
    - Layer 3: IGMP Multicast UDP (500+ receivers)
    - Layer 3: IGMP Multicast UDP over IPv6 (500+ receivers)
    - Layer 3: Stateful TCP/IP (9.8Gbps+ on wire, 9.3Gbps goodput, bi-directional with 24K byte writes, 30 streams, 1500 MTU, 10G, to self)
    - Layer 3: Stateful TCP/IPv6 (9.8Gbps+ on wire, 9.1Gbps goodput, bi-directional with 24K byte writes, 30 streams, 1500 MTU, 10G, to self)
    - Layer 3: Stateful SCTP/IP (850Mbps, bi-directional, 3 streams. No hardware offload exists, CPU bound.)
    - Layer 3: Stateful SCTP/IPv6 (850Mbps, bi-directional, 3 streams. No hardware offload exists, CPU bound. Requires global-scope IPv6 addresses.
    - Layer 4: FTP
    - Layer 4: SFTP
    - 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
    - Layer 4: TFTP (1400+ concurrent connections, ~1Gbps throughput)
    - Layer 4: TELNET
    - Layer 4: DNS (Used and Reported by most Layer 4 traffic types)
    - Layer 4: PING (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 50,000 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, TELNET, 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 PPPoE, including automated creation and deletion of the PPP interfaces

- Supports 802.11a/b/g/n/AC 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/AC 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 a/b/g/n radio, and up to 64 per /a/b/g/n/AC radio.
- Each radio can run on only a single frequency at a time. So, all stations on a radio 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, /AC) or be told to use the best option available.
- For 802.11n and AC, 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 (PSK) and related wpa_supplicant authentication methods supported.
- Advanced authentication support includes: 802.1x, 802.11u, HotSpot 2.0, EAP-TLS, EAP-TTLS with MSCHAPv2, EAP-SIM, EAP-AKA, etc.
- Supported standards include: 802.11r (OTA and over DS), 802.11w
- 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 an 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.

# 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 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. | HTML PDF |
| 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. | HTML PDF |
| VoIP Call Generator: CT505-30 | Generate up to 30 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. | HTML PDF |
| 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. | HTML PDF |
| 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. | HTML PDF |

# LANforge ICE
# WAN/Network Emulator
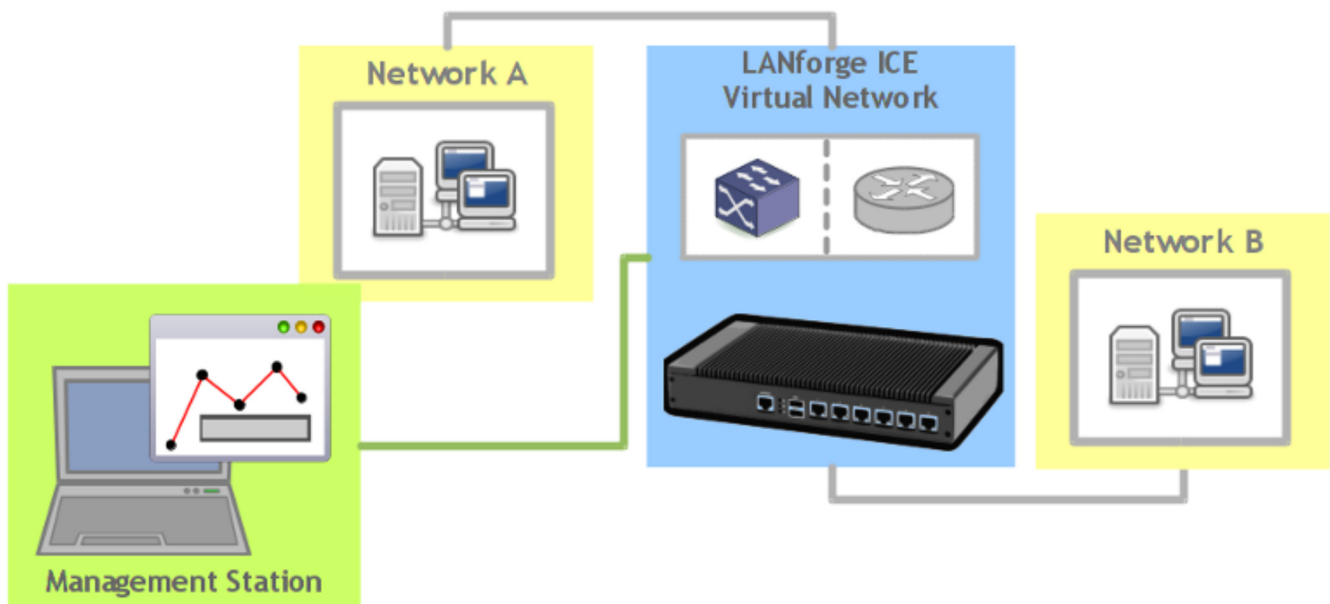


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LANforge ICE is a network emulator. It can add impairments in a controlled and reproducible manner to aid in testing applications and network equipment that must operate over a network. LANforge supports many impairments: latency, bandwidth, jitter, packet loss, packet reordering and more. It can act as a layer-2 pass-through device for easy insertion into the system under test. It also supports 802.1Q VLANs, router emulation, bridges and other network elements for more advanced emulation needs. Emulation speeds range from 10bps to 5Gbps, and some systems support more than 48 concurrent emulations.

Some users may want to simulate an entire LAN or WAN network. LANforge ICE supports this with it's Netsmith feature. Netsmith is a click-and-drag virtual network builder. It supports Bridges (switches) including spanning tree protocol, as well as OSPF, BGP, RIP and multicast routers. IPv4 and IPv6 routing protocols are supported, and the bridge will handle any Ethernet frame. LANforge is running real router and bridge software, so it can exchange messages with external equipment to populate routes and set up spanning trees. A screenshot from a Netsmith virtual router & emulation setup is found here.

## LANforge ICE Use Cases

- Verify applications can run over WAN (wide area network) before migrating applications to remote data center. For a small cost up front, serious problems can be found in the lab before the customer sees them. Typical impairments would be delay (latency), bandwidth constraint, jitter and packet loss. Corruptions, packet reordering and complete link loss can also be applied.

- Affordably test multi-player games and other interactive real-time group applications. 48-port systems are available for around $1000 per port. Impairments include packet loss, delay, jitter, bandwidth constraint, and NAT (network address translation) emulation.

- Test streaming media CODECs and network stacks in a controllable manner. LANforge can emulate delay, jitter, packet loss, packet duplication, packet reordering and corruptions. All of these must be handled for streaming media based on UDP, for instance.

- Test LAN (local area network, typically Ethernet) based applications for adverse network conditions. LANs are

normally fast and clean, but that just makes it harder to test for rare network problems. LANforge can drop, reorder, duplicate and corrupt packets. It can also generate realistic background traffic with the LANforge FIRE feature set.

- Verify data-replication services can function properly over degraded networks. LANforge can drop, reorder, and corrupt packets.
- Verify WAN accelerators and other data-compression tools provide the advertised improvements for your particular data flows. LANforge can limit bandwidth, add delay, and display actual throughput.
- Simulate large complicated networks. LANforge supports virtual routers, switches, multi-hop networks and more. Protocols supported include spanning-tree for switches and OSPF, BGP, RIP, IGMP, an PIM (Multicast) for routers.
- Do specific application testing by impairing only a certain subset of packets using the WanPath feature. Filters can be applied to almost any type of packet, including ARP, SIP, DNS, etc.

## Standard Features

- General purpose WAN and Network impairment emulator: Validates stability and functionality of devices and programs over a wide variety of network conditions.
- Able to simulate DS1, DS3, OC-3, OC-12, OC-24, OC-48, GigE, DSL, CableModem, Satellite links and other rate-limited networks, from 10bps up to 5 Gbps speeds (full duplex).
- Can modify various network attributes including: network-speed, latency, jitter, packet-loss, packet-reordering, and packet-duplication.

## Advanced Features

- Supports Packet corruptions, including bit-flips, bit-transposes and byte-overwrites.
- Supports WanPath feature to allow configuration of specific behaviour between different IP subnets or MAC addresses using a single pair of physical interfaces. *
- WanPaths can also impair packets based on an arbitary filter that is created using the powerful and well documented tcpdump filter syntax. *
- Supports WAN emulation across virtual 802.1Q VLAN interfaces for more efficient use of valuable physical network interfaces.
- Supports routed and bridged mode for more flexibility in how your configure your network and LANforge ICE. Virtual routers can be configured with the Netsmith tool. Supported routing protocols include: static, OSPF, RIP, OLSR, BGP, and Multicast (PIM, IGMP). Most protocols support both IPv4 and IPv6. LANforge ICE on Windows and Solaris supports only bridged mode currently.
- Supports 'WAN-Playback' allowing one to capture the characteristics of a live WAN and later have LANforge ICE emulate those captured characteristics. The playback file is in XML format, and can be easily created by hand or with scripts. The LANforge ICEcap tool can be used to probe networks and automatically create the XML playback file.
- 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.

## Deployment Options

- Rackmount systems are available for lab environments.

- All-in-one Netbooks, Laptops, small and silent appliances are also available.

- Implements a modular architecture that supports clustering and allows you to leverage your existing LANforge investment as your need for capacity increases.

- Ethernet hardware bypass option allows LANforge to be deployed in networks with high availability requirements.

- Additional RAM, storage and other upgrades are available.

## 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 ICEcap Network Probe Feature Highlights

- The LANforge ICEcap tool can probe a network and save the probed latency, packet loss and other values to an XML file that can be replayed by the LANforge ICE WAN emulator. This allows for realistic WAN emulations based on real-world networks.

- LANforge ICEcap currently supports Linux and Windows.

## LANforge ICE Systems

LANforge ICE is often customized to a customer's speficications. In particular all of the LANforge FIRE Network Traffic Generation feature set is available. Some standard systems are listed below, but please contact sales@candelatech.com to discuss your requirements in detail and for a customized quote.

| | | |
|---|---|---|
| Appliance: CT920 | One network appliance supporting 0-45 Mbps WAN emulation. A separate machine running the LANforge GUI manages the appliance. | HTML PDF |
| Appliance: CT922 | One network appliance supporting 0-155 Mbps WAN emulation. A separate machine running the LANforge GUI manages the appliance. | HTML PDF |
| Gigabit Rackmount: CT963 | A 1U rackmount appliance supporting 0-1 Gbps WAN emulation that is managed locally or with a separate machine. (GigE Fibre interface available.) | HTML PDF |
| 10 Gigabit: CT966 | A 1U 64-bit rackmount appliance supporting 0-5 Gbps WAN emulation that is managed locally or with a separate machine. 12 GB RAM included to support higher latencies. Dual port 10 Gigabit Fibre NIC installed. (10 GigE copper interfaces available.) | HTML PDF |
| 48-WAN Emulator: CT970-48 | A 1U high-end rackmount appliance and one managed ethernet switch combined to support 48 unique WAN emulations. May be managed locally or with a separate machine. Great for testing MMOG and game testing in QA test houses! | HTML PDF |

## More LANforge ICE Resources

- Videos
- LANforge GUI Users Guide
- Common configurations and prices

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# 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. More functionality and improved performance may be ported to Windows in the future, so please ask if there are features that are of particular interest to you.

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
- LANforge ICE WAN emulator is supported up to at least 10 Mbps
- 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/AC client emulation.
- Virtual interfaces (802.1Q, MAC-VLANs)
- Virtual routers and routed mode for LANforge ICE WAN emulator.
- 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.

# Additional Feature Upgrades

Unless otherwise noted in the product description, 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 over the included package requires a license.

- Armageddon: Each pair of ports requires a license if not already included.

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