

## **CT521c-3ax4 Economy LANforge WiFIRE 802.11a/b/g/n/AC/AX 3 radio WiFi Traffic Generator Supporting 57 Virtual STA Interfaces**

The CT521c-3ax4 wireless traffic generator is an excellent choice for testing Access Points and other WiFi networks. The 4x4 MTK7915 /AX (a/b/g/n/ac/AX) chipset NICs can support 19 virtual stations per radio. Each of the Virtual Stations has its own IP address, IP port space, MAC address and routing table. The Virtual Stations can be assigned to communicate to a particular Access Point, use a particular SSID, and Open or WPA/WPA2 authentication assigned. More advanced 802.1X authentication is also included. Each radio can be configured independently of the other. Transmit power and channel/frequency is configured on a per-radio basis. Most other settings are configurable per virtual station.

**There are three MTK7915 /a/b/g/n/AC/AX 2.4/5Ghz WiFi radios per CT521c-3ax4 and multiple LANforge systems can be clustered together for even more realistic radio interference patterns and increased traffic generation capability.**

All virtual stations on the same radio must be on the same frequency, but as long as the protocol supports that frequency, the multiple protocols can be used concurrently. For instance, if the radio is configured for a 2.4Ghz channel, the stations can be /b, /g, /n, or /ax. If the radio is on a 5Ghz channel, the stations can be /a, /n, ac, or ax. The bandwidth can be configured for all protocols.

The Virtual Stations may be configured with all of the virtual interfaces on the same subnet, or different subnets, depending on the testing requirements. When used with something like VoIP, it allows all of the VoIP calls to use the standard IP ports (with one call per virtual interface).

The CT521c-3ax4 has no fans and is silent. It has 12 antenna. It will fit into a small travel bag or briefcase for easy portability. The system should be managed with the LANforge-GUI software installed on a laptop or PC. The CT521c-3ax4 can also be managed over a serial console in text mode. Maximum throughput for the CT521c-3ax4 is about 1Gbps and is bound by the relatively weak CPU. For faster systems, consider the CT522, CT523c, and CT525 chassis.

Performance reports:

TBD





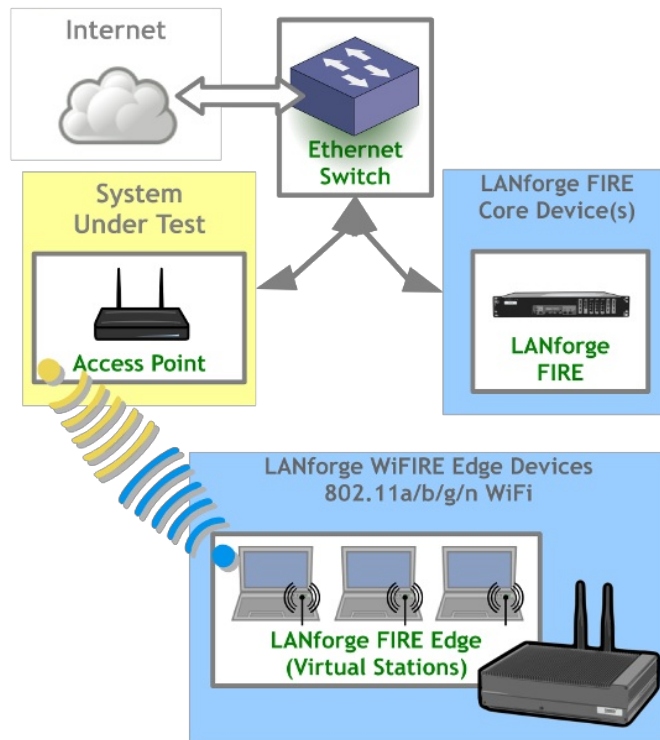
NOTE: This product may have a different hardware configuration than the system pictured above.  
Refer to your official quote for details.

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## Example Network Diagram



## LANforge WiFIRE Virtual Station Traffic Generator



LANforge WiFIRE supports 802.11 Virtual Stations and Access Points\*. To the System Under Test, it appears as if there are multiple PCs sitting inside the LANforge system generating independent traffic streams over Wireless NICs.

Many Virtual Station interfaces are supported per LANforge WiFIRE machine. LANforge can send traffic from one physical interface on the local machine to another interface on that same machine. Each physical and virtual interface can be configured on the same, or on different IP subnets.

In the configuration on the left, the LANforge FIRE Core can be one physical Ethernet interface and act as the server. The LANforge FIRE Edge can be the Virtual Station interfaces configured on the WiFi radio. Both interfaces can be on the same machine or multiple LANforge machines can be clustered together for increased traffic generation capacity.

\* All system support 802.11 a/b/g/n.  
Some systems support 802.11ac as well.

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### Quick Start Guide

1. Connect Management Ethernet port to Management network or management PC. If connecting directly to a PC, an Ethernet cross-over cable should be used.
2. Connect eth1 wired Ethernet interface to wired Ethernet interface on the AP or network under test. This usually is considered the 'server' side of the network.
3. The Client side of the network will be the Virtual Stations configured on the CT521c-3ax4 WiFi NIC(s).
4. Connect power to standard US or European AC power source. If using external battery pack, then connect to that instead. Click button to power on the unit.
5. The CT521c-3ax4 should now boot. If DHCP is enabled on the Management network, the CT521c-3ax4 will automatically acquire an IP address. If DHCP is not available, the IP address will be set to **192.168.1.101**.
6. Install the LANforge-GUI on a separate management PC or Laptop, or use VNC or remote-desktop programs to access the LANforge system directly. Windows, MAC-OS and Linux GUIs are supported: Select the correct one from the web page served from the LANforge system and install it.
7. Start the LANforge-GUI on the management PC and click the 'Discover' button. It should find the

CT521c-3ax4 appliance and add the IP address to the drop-down box in the Connect widget. Press 'Connect' and you will be connected to the CT521c-3ax4.

8. Select the Port Mgr tab in the GUI. Double-click on the device called 'wiphy0'. This is the Radio device, and should be configured for the correct, channel, country-code, etc. Next, select one or more of the Virtual Station interfaces and click 'Modify'. Enter the correct IP address information, SSID and WPA/WPA2 password (if Enabled). After applying these changes, the Virtual Station interface should associate with the AP and be ready to send traffic. You may create up to 57 Virtual Station interfaces per CT521c-3ax4 with the 'Create' button.
9. Once the interfaces are configured correctly, you can click on the Layer 3, VOIP/RTP and other LANforge-FIRE related GUI tabs and configure/modify/start/stop particular traffic patterns that utilize the virtual stations and wired Ethernet interface. In most cases, you will want one of the FIRE endpoints to be on the wired interface and the other to be on the WiFi Virtual Station interface. It is also valid to generate traffic between two Virtual Station interfaces. The GUI Chamber View window provides some automated test suites. Contact support if you have suggestions for improvements.
10. Any GUI modifications take place immediately after you click 'Submit' or 'OK'.

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## LANforge WiFIRE Related Images

### Virtual Station Configuration Screen

The screenshot shows the 'sta2003 (jedway1) Configure Settings' window. The 'Port Status Information' section at the top indicates 'Current: LINK-UP GRO Authorized' and 'Driver Info: Port Type: WIFI-STA Parent: wiphy0'. The 'Port Configurables' section has tabs for 'Standard Configuration', 'Advanced Configuration', 'Misc Configuration', 'Corruptions', and 'Custom WiFi'. The 'Standard Configuration' tab is active, showing 'General Interface Settings' and 'WiFi Settings'.

**General Interface Settings:**

- Enable:** ☐ Set IF Down, ☐ Set MAC, ☐ Set TX Q Len, ☐ Set MTU, ☐ Set Offload, ☐ Set PROMISC
- Services:** ☐ HTTP, ☐ FTP, ☐ RADIUS
- Low Level:** ☐ PROMISC, ☒ TSO Enabled, ☐ UFO Enabled, ☒ GSO Enabled, ☐ LRO Enabled, ☒ GRO Enabled
- General Interface Settings:**
  - ☐ Down, ☐ Aux-Mgt
  - ☐ DHCP-IPv6, ☒ DHCP Release, DHCP Vendor ID: None
  - ☒ DHCP-IPv4, Secondary-IPs, DHCP Client ID: None
  - DNS Servers: BLANK, Peer IP: NA
  - IP Address: 0.0.0.0, Global IPv6: AUTO
  - IP Mask: 0.0.0.0, Link IPv6: AUTO
  - Gateway IP: 0.0.0.0, IPv6 GW: AUTO
  - Alias: , MTU: 1500
  - MAC Addr: 04:f0:21:5e:2a:ab, TX Q Len: 1000
  - Rpt Timer: fast (3 s), WiFi Bridge: NONE

**WiFi Settings:**

- SSID: jedway2-wpa2-2000, AP: DEFAULT
- Key/Phrase: jedway2-wpa2-2000, Mode: 802.11abgn-AC
- Freq/Channel: 5260/52, Rate: OS Default
- ☐ WPA, ☒ WPA2, ☐ OSEN, ☐ WEP
- ☐ Disable HT40, ☐ Enable VHT160, ☐ Disable SGI

Buttons at the bottom: Print, Display, Probe, Display Scan, Sync, Apply, OK, Cancel.

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

LANforge Manager Version(5.2.13)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Attenuators File-IO Layer-4 Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr Messages

Status Layer-3 L3 Endps WanLinks

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

View 0 - 200 Display Create Modify Delete

Cross Connects for Selected Test Manager

Name	Type	State	Pkt Rx A → B	Pkt Rx A ← B	Rate A → B	Rate A ← B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts B	Avg RTT
xcdx-1	LF/UDP	Run	17,294	17,549	9,998,239	9,997,437	0	0	0	0	1
xcdx-10	LF/UDP	Run	17,377	17,716	9,997,632	9,996,340	0	0	0	0	0
xcdx-2	LF/UDP	Run	17,548	17,802	9,997,351	9,996,964	0	0	0	0	0
xcdx-3	LF/UDP	Run	17,633	17,802	9,997,891	9,996,964	0	0	0	0	0
xcdx-4	LF/UDP	Run	17,633	17,802	9,997,891	9,996,964	0	0	0	0	1
xcdx-5	LF/UDP	Run	17,718	17,036	9,997,947	9,992,326	0	0	0	0	1
xcdx-6	LF/UDP	Run	17,718	17,044	9,997,947	9,997,018	0	0	0	0	1
xcdx-7	LF/UDP	Run	17,718	17,044	9,997,947	9,997,018	0	0	0	0	1
xcdx-8	LF/UDP	Run	17,718	17,044	9,997,947	9,997,516	0	0	0	0	1

Logged in to: 192.168.100.26:4002 as: Admin

## Layer 3 Create/Modify Screen

udp-se - Create/Modify Cross Connect

Display Sync Batch-Create Apply OK Cancel

**1** Cross-Connect

CX Name: udp-se

CX Type: LANforge / UDP

Endpoint A	Endpoint B
Resource: 1 (brent-6port)	1 (brent-6port)
Port: 1 (eth0)	2 (eth1)
Min Tx Rate: New Modem (56 Kbps)	New Modem (56 Kbps)
Max Tx Rate: Same	Same
Min PDU Size: AUTO	AUTO
Max PDU Size: Same	Same
IP ToS: Best Effort (0)	Best Effort (0)
Pkts To Send: Infinite	Infinite

**2** Cross-Connect

Report Timer: default (5 s)

Endpoint A	Endpoint B
Pld Pattern: increasing	increasing
Min IP Port: AUTO	AUTO
Max IP Port: Same	Same
Min Duration: Forever	Forever
Max Duration: Same	Same
Min Reconn: 0 (0 ms)	0 (0 ms)
Max Reconn: Same	Same
Multi-Conn: Normal (0)	Normal (0)
Script	Script
Thresholds	Thresholds

**3** Cross-Connect

Test Manager: default\_tm

Quiesce: 3 (3 sec)

Endpoint A	Endpoint B
IP Addr: AUTO	AUTO
<input type="checkbox"/> Replay File	<input type="checkbox"/> Replay File
<input type="checkbox"/> Loop	<input type="checkbox"/> Loop
<input checked="" type="checkbox"/> Dest Mac	<input checked="" type="checkbox"/> Dest Mac
Filename:	
Dest MAC: <custom>	<custom>

**4** Cross-Connect

Endpoint A	Endpoint B
Snd Buff Size: OS Default	OS Default
Rcv Buff Size: OS Default	OS Default
Send Bad FCS: zero (0%)	zero (0%)
Src MAC: 00:00:00:00:00:00	00:00:00:00:00:00
<input type="checkbox"/> Use-Proxy	<input type="checkbox"/> Use-Proxy
Proxy Addr: 0.0.0.0	0.0.0.0
Proxy Port: 0	0
Socket Priority: 0	0
Payload	Payload

**5** Cross-Connect

Endpoint A	Endpoint B
Conn Timeout: 10s (10 s)	10s (10 s)
TCP MSS: OS Default	OS Default
<input type="checkbox"/> Do Checksum	<input type="checkbox"/> Do Checksum
<input type="checkbox"/> UnManaged	<input type="checkbox"/> UnManaged
<input type="checkbox"/> Duration Quiesce	<input type="checkbox"/> Duration Quiesce
<input type="checkbox"/> Quiesce-After-Range	<input type="checkbox"/> Quiesce-After-Range
<input type="checkbox"/> TCP_NODELAY	<input type="checkbox"/> TCP_NODELAY
<input type="checkbox"/> Concurrent IP Adrs	<input type="checkbox"/> Concurrent IP Adrs
<input type="checkbox"/> Clear-Port-On-Start	<input type="checkbox"/> Clear-Port-On-Start
<input type="checkbox"/> Linear-IP-Ports	<input type="checkbox"/> Linear-IP-Ports
Endp Name: udp-se-A	udp-se-B

## Software Features

- Supports real-world protocols:
  - Layer 2: Raw-Ethernet.
  - 802.1Q VLANs.
  - PPPoE: Integrated PPPoE support.
  - Layer 3: IPv4, IPv6, UDP/IP, IGMP Multicast UDP, TCP/IP.
  - Layer 4-7: FTP, HTTP, HTTPS, TFTP, SFTP, SCP
  - 802.11a/b/g/n/AX Wireless Station (up to 57 per machine).
  - Layer 4-7: TELNET, PING, DNS, SMTP, NMAP (via add-on script).
  - File-IO: NFSv3, NFSv4, CIFS, iSCSI.
- Supports up to 1000 concurrent TCP connections with base license package.
- The CT521c-3ax4 is able to push up to about 1Gbps through an AP, depending on the protocols mix, wireless mode and environment, and speed of the network under test. Supports at least 20 VoIP (SIP, RTP) calls if appropriate licenses are purchased. This system is CPU limited, but the affordable price makes it easier to afford multiple units to spread around the network-under-test for greater combined throughput. Consider the CT522, CT523c, and CT525 for more powerful systems. (
 

**Performance results: TBD)**
- Supports real-world compliance with ARP protocol.
- Supports ToS (QoS) settings for TCP/IP and UDP/IP connections.



6. Uses publicly available Linux and Windows network stacks for increased standards compliance.
7. Utilizes **libcurl** for FTP, HTTP and HTTPS (SSL), TFTP and SCP protocols.
8. Supports file system test endpoints (NFS, CIFS, and iSCSI file systems, tool). File system mounts can use the virtual interface feature for advanced testing of file server applications.
9. Supports custom command-line programs, such as telnet, SMTP, and ping.
10. Comprehensive traffic reports include: Packet Transmit Rate, Packet Receive Rate, Packet Drop %, Transmit Bytes, Receive Bytes, Latency, Jitter, various Ethernet driver level counters, and much more.
11. Supports generation of reports that are ready to be imported into your favorite spread-sheet.
12. Allows packet sniffing and network protocol decoding with the integrated **Wireshark** protocol sniffer.
13. GUI runs as Java application on Linux, MAC and Microsoft Operating Systems (among others).
14. GUI can run remotely, even over low-bandwidth links to accommodate the needs of the users.
15. Central management application can manage multiple units, tests, and testers simultaneously.
16. Includes easy built-in scripting for iterating through rates and packet sizes, with automated reporting. Also supports scriptable command line interface (telnet) which can be used to automate test scenarios. Perl libraries and example scripts are provided!
17. Automatic discovery of LANforge data generators simplifies configuration of LANforge test equipment.
18. LANforge traffic generation/management software is supported on Linux and MS Windows.

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## Hardware Specification

1. Affordable Appliance with no fans.
2. Operating System: Fedora Linux with customized 64-bit Linux kernel.
3. Three 1Gbps Ethernet ports, room for three wifi NICs
4. Intel Atom E3845 quad-core 1.9Ghz processor.
5. RJ45 Serial console (115200 8 N 1) for console management & initial configuration.
6. 4 GB RAM.
7. 60+ GB Solid State mSata storage Drive.
8. Larger storage drives available.
9. 12v 5AMP external power supply (brick).
10. Weight: 2 lbs
11. Dimensions: 8 x 8 x 2 inches    Metric: 200 x 200 x 60 mm.
12. Operating Temperature: -20 ~ 45°C.
13. Certification: CE Emission, FCC Class A, RoHS

List Price: \$12,500    List Price with 1 Year support (17%): \$14,625

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## 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.
- **WiFi RF Attenuator**: Adjust WiFi signal strength in a controllable manner.
- **RF Noise generator**: Generate modulated WiFi RF noise.
- **RF Noise / Radar Simulator**: Simulate RADAR pulses and other non-modulated RF noise.
- **SMA RF Cable Bundle**: Used to cable LANforge WiFIRE radios to device-under-test.
- LANforge-ICE Network Emulation.
- VOIP: Each concurrent call over the included package requires a license.
- **VoIP-Mobile Audio Quality Testing using POLQA/PESQ**.
- **Mobile-Mobile Audio Quality Testing using POLQA/PESQ**.
- Armageddon: Each pair of ports requires a license if not already included.
- **RF Chambers for WiFi testing**.
- External battery pack: 12+ hours for CT520, CT523, CT92X and other platforms.

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