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## Network Guide for Listen Everywhere

### Overview:

The Listen Everywhere (LE) System is designed to be used on pre-existing wireless networks and to be plug and play. However, it may be necessary to have an IT/Network Administrator assist with the initial setup. The purpose of this tech-note is to provide guidance when configuring a network where the LE system will be deployed.

### How It Works:

The LE system takes audio and streams it over Wi-Fi to connected Android and iOS smart-devices. This process has two phases: Discovery and Streaming. In the discovery phase the LE app on the smart-device seeks out the LE Server on the Wi-Fi network via mDNS. It then moves to the streaming phase, where audio is streamed unicast (UDP) from the LE server to the LE app on the connected smart-device.

### Network Requirements:

The network requirements can vary based on the number of simultaneous users the system will need to support. The most basic requirements are:

- Enterprise Grade Router. Consumer Grade routers do not always have the required features or configuration options. Contact Listen for more info on compatible routers
- Enterprise Grade Access Point(s), 802.11n or better (802.11ac is recommended)
- Multicast UDP (mDNS/Bonjour/Avahi) is enabled (see *Enabling Multicast UDP*)
- The data load is approximately 140 kbps per connected user. It is recommended that Listen Everywhere traffic only account for 20% of the total available bandwidth
- Internet connectivity to the LE server is required for initial customization and for some features to be available (See *Internet Connectivity*)

### Suggested Settings:

Though not required for the LE system to function, here are several suggested optimizations that can improve performance:

- Use either an open network (no encryption) or WPA2-AES encryption. Using encryption can lower the number of users that can connect to the Access Point and add latency to the LE system. TKIP encryption should not be used.
- Enable Quality of Service (QoS) on the network (see *Enabling QoS*)
- Do not use range extenders, mesh networks, or multi-hop networks. Doing so may add latency, noise, or cause dropouts

- Set the BSS Minrate to 12,000 (12 Mbps). This will disconnect clients from the network if their signal strength is too low, reducing strain on the AP
- Set Access Points to static channels (see *AP Channel Optimization*)

## **Internet Connectivity:**

An internet connection is not required for the LE system to function. However, the LE server must be able to reach the Cloud Manager (see *Ports and Services*) for the initial setup and for some features to function.

The following features are available without a persistent connection to the Cloud Manager:

- Audio streaming
- Theme settings (title, colors, images)\*
- Channel settings (names, images, gain, delay)\*
- Welcome ad (image or video)\*

The following features require a persistent connection to the Cloud Manager:

- Banner Ads
- Offers
- Documents
- Analytic reports
- Firmware updates
- Downloading log files

*\*Initial setup requires an internet connection and will then function without.*

## **Stand-Alone Networks:**

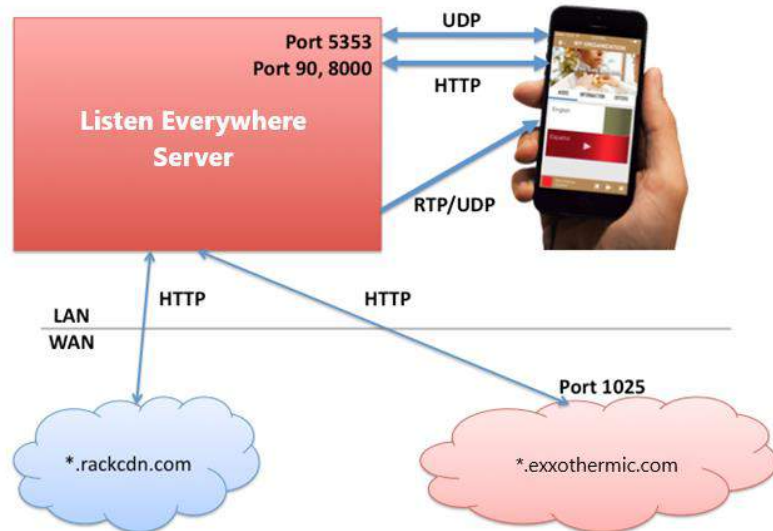
When a stand-alone network is desired, the LE server can function as the DHCP server. This setup does require that at least one Access Point be used. When the LE server is powered on, it checks for a connected DHCP server. If it doesn't find one within 5 minutes, it will become a DHCP server. No internet connectivity is available when in this mode.

The network setting when in DHCP mode are:

- Gateway: 172.30.0.1
- Netmask: 255.255.0.0
- Lease Time: 2 Hours

## Ports and Services:

- LAN ports and services
  - LE Server / Phone App Discovery:
    - The LE Server exposes an HTTP server on **port 8000**
    - The LE Server exposes a file server on **port 90** to download promotional media (e.g., images, labels, etc.). Protocol is HTTP
  - Audio Streaming:
    - The LE Server sends RTP packets using UDP to the apps over a range of ports
    - Mobile apps listen for UDP on **port 16384**
- WAN ports and services
  - The LE Server communicates with the Cloud Manager at **\*.exxothermic.com** (IP address: 108.166.110.178, but subject to change.) via **port 1025**. Protocol is HTTP
  - Media files are stored on **\*.rackcdn.com**. Protocol is HTTP



## Enabling Multicast UDP (mDNS/Bonjour/Avahi):

Multicast is used in the discovery process for the app and the server to connect via the “Scan” feature, which allows automatic connection when the app is opened.

To enable mDNS, perform the following:

- Add the following services to the allowed list in the Router/AP mDNS settings:
  - `_ExXothermic_tcp`
  - `_AsClient_ExXothermic_tcp`
- Open Port 5353
- Add the mDNS IP address to the allowed subnets list. 224.0.0.251 is the most common mDNS IP address, but it could be any of the 244.0.0.0/24 range

*Note: For specific assistance with Aruba APs: <https://www.listeneverywhere.com/aruba/>.*

*Note: For specific assistance with Cisco APs: <https://www.listeneverywhere.com/cisco/>*

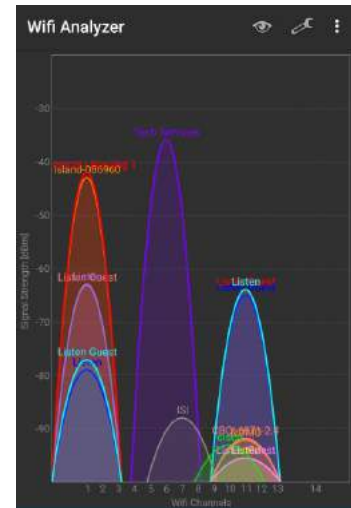
Multicast discovery may not be desired. In those cases, mDNS can be disabled and connections to the LE server can be made by entering the IP address or hostname (serial number) of the server into the app.

## AP Channel Optimization:

Many Access Points can automatically change channels to try and find one with less interference. This feature can cause audio drops each time the channel changes, as often as every 20 seconds. If it does not settle on a channel after 30-60 minutes, it may be best to choose a channel manually.

When manually setting channels, you should use a wi-fi signal analyzer.\* A wi-fi signal analyzer will provide a clear picture of the signal congestion in your space.

Channel width for 2.4GHz is very important. It should be set to 20MHz. Wider channels are more susceptible to interference.



\*For Android devices, we suggest the 'Wifi Analyzer' app. No comparable app is available for iOS.

## Enabling QoS (Quality of Service)

By default, the LE system uses QoS tags so that audio data can be prioritized over other data traffic on the network, which can provide improved audio quality. However, for this to function, it must be enabled on the network as well.

- Turn on WMM (Wireless Multimedia Extensions) in the Access Point
- Turn on QoS in Switch/Router

## Guest Networks:

Most Access Points have a 'guest network' option. This creates a network with tighter security settings. The settings can vary by manufacturer but will usually include client isolation, which prevents connected wireless devices from communicating with other devices on the network (such as smart-devices communicating with the LE server) and disables mDNS (Multicast DNS).

To bypass the client isolation, allowing wireless clients to connect to the Listen Everywhere server, you must add the Listen Everywhere server to the allowed address list (whitelist) for the Guest VLAN in the router configuration. Some routers require that this be done by IP address, and some by MAC address. The Listen Everywhere Server MAC address can be found on the serial number label on the unit and in the Cloud Manager. The IP address is also available in the Cloud Manager. The mDNS IP address must also be whitelisted (*see Enabling Multicast UDP*).

Note: Visit <https://www.listeneverywhere.com/guestnet/> for more details

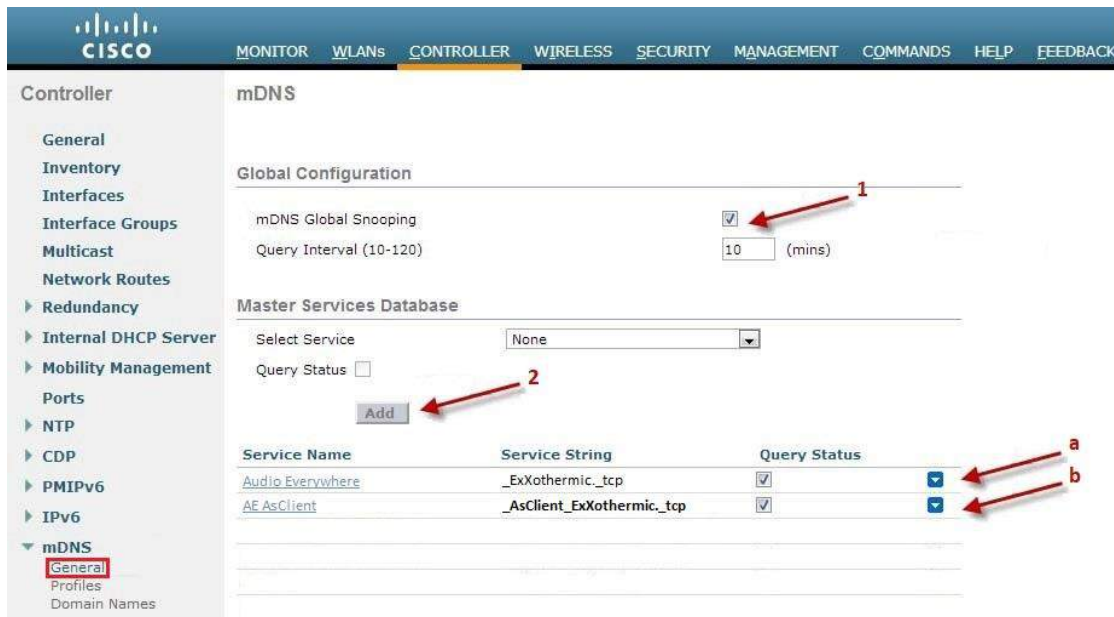
## Mesh Networks:

A mesh network is a type of network topology where each node in the network is connected to every other node. This network type can cause multicast discovery issues, increased latency, and audio dropouts. The use of Mesh Networks is not recommended.

### Cisco FlexConnect:

Cisco's Virtual Network Controller requires the use of FlexConnect, Cisco's version of a mesh network. It is not recommended, whenever possible. By default, only recognized mDNS services are allowed, such as from a brand-name printer. To allow the Listen Everywhere services you will need to go to CONTROLLER > mDNS > General in your Cisco Network Controller, then do the following:

1. Ensure mDNS Global Snooping is enabled
2. Add the following services to the Master Services Database
  - a. `_ExXothermic_tcp`
  - b. `_AsClient_ExXothermic_tcp`



Service Name	Service String	Query Status
Audio Everywhere	_ExXothermic_tcp	<input checked="" type="checkbox"/>
AE AsClient	_AsClient_ExXothermic_tcp	<input checked="" type="checkbox"/>

## Troubleshooting:

*The app on the smart-device will not connect to the LE server:*

- Verify that the smart-device is on the same network. Check the IP address of the smart-device and the IP address of the Listen Everywhere server to verify they are in the same IP range
- If it will connect by IP or hostname but not via the scan feature there is an issue with the Multicast settings (see *Enabling Multicast UDP*)

*Audio cuts out, has high latency, or excessive noise:*

- Wi-fi interference from other Wi-fi signals (see *AP Channel Optimization*)
- Bandwidth bottleneck at the Access Point
  - Is there enough bandwidth for the number of users? More capable or additional Access Points may need to be added.
  - Encryption lowers bandwidth. Consider disabling encryption, or make sure WPA2-AES is being used, as it has the lowest impact on bandwidth.
  - Enable QoS (see *Enabling QoS*)
- Check the audio source
  - Long cable runs from the audio source to the Listen Everywhere server should be balanced to avoid introducing interference
  - Is the audio being input at the nominal level? Input audio should be Line level, not Mic level

Please contact Listen Technologies with additional questions at [support@listentech.com](mailto:support@listentech.com) or 1-800-330-0891.