Managing Your Voice Network

The WLSE allows you to display voice call information for devices in your network, manage voice settings and set up voice notifications. Using the WLSE VoWLAN features, you can:

Table 15-1 Voice Features

Feature	For More Information, See
Enable radio management for VoWLAN on your network and assign voice configuration settings	Enabling VoWLAN, page 15-6
Display and update voice-related faults.	Monitoring Your Voice Network, page 15-7
Display voice-related information for an AP, a floor, or the entire network.	Generating Voice Reports, page 15-8

Related Topics

- Understanding Radio Management for VoWLAN, page 15-1
- Guidelines for Using Voice, page 15-5

Understanding Radio Management for VoWLAN

The following topics explain some basic voice fundamentals and how WLSE has implemented these features:

- Understanding Call Admission Control, page 15-1
- Understanding Roaming, page 15-3
- Understanding Voice Packet Latency, Jitter, and Loss, page 15-3
- Voice Capacity Planning, page 15-5

Understanding Call Admission Control

A WLAN provides differentiated services for voice, best-effort data, and other traffic. For these differentiated services to provide sufficient quality of service (QoS) for voice packets, only a certain amount of voice bandwidth can be serviced or admitted. If the amount of voice traffic is increased

beyond this limit, the QoS of all calls will suffer. The Call Admission Control (CAC) function allocates this bandwidth to client devices on a first-come, first-served basis. However, it also maintains a small reserve so mobile phone clients can roam into a BSS, even if the BSS would otherwise be at full capacity.

One of the key aspects when considering the network capacity of a WLAN is that it is a *shared* medium, and therefore radio contention among various client devices is limited when compared to that of a wired LAN. This affects the overall throughput of packet processing and transportation, especially for the voice traffic, which requires timely delivery when other types of packets such as data are competing for the medium.

When transmitted over a WLAN IP network, the requirements of voice and data are very different:

	Voice	Data
Packet Flow	Steady/Consistent	Bursts
Packet Delay	Sensitive	Insensitive
Packet Loss	Sensitive	Insensitive
Bandwidth Contention	On demand (UDP)	As much as allowed (TCP)
Mobility	Delay sensitive	Delay insensitive

With the growing demand and broader deployment of voice application on WLAN, the issues of packet latency and packet loss become more important. The WLSE provides voice-related measurements on APs and clients that help isolate where the network bottleneck problems or impairments such as interference are introduced.

Radio management for VoWLAN on the WLSE consists of two components: radio coverage and radio diagnostics.

- **Radio coverage**:
  - Ensures that there is sufficient signal strength everywhere the handset will be used.

    To ensure good radio coverage, the coverage predictions made by WLSE must be based on site survey measurements—otherwise there is not sufficient confidence to reliably predict coverage.
  - Ensures that there is sufficient overlap in radio coverage provided by adjacent APs so that a client roaming from one BSS to another has sufficient signal strength.

    Radio management predicts call capacity on an AP basis to give the network administrator a prediction of overall network call capacity.
  - Predicting the voice capacity of the network and individual APs.
- **Radio diagnostics** are used to troubleshoot problems (in particular, audio problems) encountered by handset users. Diagnostic information helps the network administrator decide whether the problem is in the WLAN or in the wired infrastructure. The WLSE:
  - Receives and displays aggregated WLAN instrumentation metrics and traffic specification metrics.

    The traffic stream metrics measurements are collected by the APs and their associated clients, aggregated by the WDS, and archived and displayed at the WLSE. The WLSE can also enable or disable traffic stream metrics collection on a global or AP basis.
  - Provides network troubleshooting by reporting WLAN instrumentation networks on a network and AP basis.

WLAN instrumentation metrics help network administrators diagnose problems on the VoWLAN. In particular, this data provides an administrator with the ability to determine whether a problem (which is most likely reported by end users as poor audio quality) is caused by an impairment on the WLAN. There are only a few impairments caused by the WLAN that impact audio quality. By observing these metrics, a network administrator can determine whether they are within normal limits or out-of-range for WLAN operation, and which APs and their corresponding service areas are affected by interference.

Understanding Roaming

Roaming is the ability to move from one AP coverage area to another without interruption in service or loss in connectivity. There are two types of roaming:

- Layer 2 roaming occurs when a WLAN device (such as a Cisco 7920 phone) moves far enough that its radio associates with a different AP. During Layer 2 roaming, the original and the new AP offer coverage for the same IP subnet, so the device's IP address is still valid after the roam.
- Layer 3 roaming occurs when a client moves from an AP that covers one IP subnet to an AP that covers another IP subnet. At that point, the client no longer has an IP address and default gateway that are valid within the new IP subnet. Because the client's IP address and default gateway are no longer valid, its existing data sessions or voice calls fail because the remote client can no longer reach the local client.

To maintain robust audio quality during roaming, the radio design for the WLAN must provide for sufficient BSS overlap. When a handset approaches the edge of a BSS during a call, it must have sufficient coverage overlap to the adjacent cell so that radio coverage is maintained while the handset is making the decision to roam. If there is insufficient overlap, there will be an audio gap when the handset roams. Typically handsets will continually scan the APs in the neighbor list to stay associated with the best AP.

Roaming delay is the time it takes for roaming to complete, depending on the duration of:

- The scanning process—Determining which neighboring APs have sufficient received signal level (RSL) and capacity. Typically this is a continuous background process that does not impact roaming time. *Roaming time* is the time the last downstream voice packet is received on the old AP to the time the first downstream voice packet is received on the new AP. Roaming time is measured by the client and reported to the AP.
- The 802.1x authentication process.
- The 802.11 association process.

Understanding Voice Packet Latency, Jitter, and Loss

Voice packets (also known as media or RTP packets) are time sensitive. If they are delivered too late to a receiver's playout buffer, which briefly stores packets prior to the voice decoder converting the packet to audio, the buffer runs dry and must employ a packet loss concealment algorithm to mitigate the effect of the lost or delayed packet. If packets suffer too much jitter while traversing the network or WLAN, they will be of no use. If the packets are delayed too long while traversing the end-to-end network, the quality of the conversation will degrade.

All SWAN components measure and report traffic stream metrics; the APs and clients measure them, the APs collect the measurements and send them to WLSE through WDS, and the WLSE displays and archives them and raises faults if they exceed certain configurable thresholds. By studying packet latency, jitter, and loss, a network administrator can isolate the source of bad voice quality.

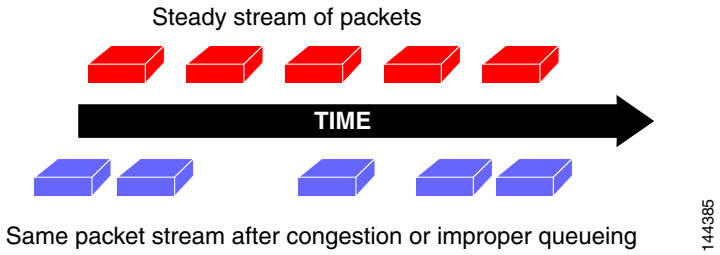
Packet Latency (Delay)

Packet latency is the time it takes for a packet (a unit of data, in this case voice data) to cross a network connection from sender to receiver. Packet delays on WLAN are usually caused by excessive data traffic volume traversing on APs and clients or by congested radio on the air. If end-to-end delay is too high, the two parties will have a tendency to double talk.

When packet delay is measured, the AP indicates whether the client is using U-APSD (unsolicited automatic power save delivery). Although the U-APSD feature provides a dramatic improvement in talk time for battery-powered handsets, the jitter performance can be quite different when compared to normal packet delivery.

Packet Jitter

Jitter is a variation in the latency of received packets. At the sending side, packets are sent, spaced evenly apart, in a continuous stream. Jitter results when a packet gets queued or delayed somewhere in the circuit, where there was no delay or queueing for other packets. Due to network congestion, improper queuing, or configuration errors, the delay between each packet can vary instead of remaining constant.



The DSPs inside the router can make up for some jitter, but can be overcome by excessive jitter. This results in poor voice quality.

Packet Loss

Packet loss, which is measured on the uplink and downlink, takes into account:

- Queue management. This may happen on either the uplink or the downlink, but might be more likely to happen on the downlink, where packets cannot be delivered to a specific client. In this case, the AP might discard packets to prevent its queues from overflowing.
- Maximum retry count. Maximum retry count is reached, for example, under congested conditions or due to foreign interference.
- Because VoWLAN is using the unlicensed spectrum, there is no way to prevent foreign interference, but fault notifications generated by WLSE will enable a network administrator to know when foreign interference is occurring.
- Packet age-out mechanism. To make sure it does not add significant delay for voice traffic, the AP drops a voice packet if it is already too old. It also drops the oldest voice packet in the queue when it detects voice traffic congestion.

  If there is too much packet loss for voice packets, the audio codecs are unable to adequately conceal the packet loss, resulting in reduced audio quality.
- Radio Management (RM) events. The WLAN continuously employs an RM function to scan for rogue APs, perform self healing, and other related functions. APs must momentarily stop traffic on their serving channel to scan other channels to support these tasks.

Voice Capacity Planning

After sufficient radio coverage and BSS overlap have been set by the RPG, the network administrator needs to know the number of calls each AP is capable of handling. Voice capacity prediction is based on analyzing the amount of BSS overlap from co-channel APs in conjunction with the knowledge of the basic call capacity of the AP on a clear channel. To the extent that APs overlap, the voice capacity between these APs is shared. The degree of overlap is quite different between the 2.4-GHz and 5-GHz bands. AP coverage overlap can be caused by APs on the same floor or by APs on a different floor of the building. Overlap from APs on different floors is expected to be much greater in the 2.4-GHz band.

WLSE provides two ways to specify a usage limit for voice traffic:

- A global limit that applies to all APs; the network administrator can use this limit to ensure that a certain percentage of the WLAN is reserved for mission-critical data traffic.
- An AP-specific limit. The lower value of the two limits should be pushed to each AP during configuration. The AP-specific limit can be used to:
  - Fine tune the network during the planning phase.

    Example 1: Some APs are in disadvantaged locations (prone to interference) and require a lower capacity limit to maintain good audio quality. For example, there might be a 2.4-GHz AP servicing a lunchroom that has a microwave oven, or a hospital with legacy frequency-hopping APs that limit call capacity.

    Example 2: The radio frequency planning tool identifies that two APs have overlapping coverage and one of the APs primarily services a conference room while the other primarily services cubicles. In this situation, the network administrator may might to apply most of the channel's capacity to the AP servicing the conference room.
  - Fine tune the network during troubleshooting. Some APs might have too high a delay or packet loss during operation. If the network administrator is unable to locate any problem interference or other bug, reducing the call limit could help solve the user compliant.

Guidelines for Using Voice

Prerequisites

Before you can use WLSE to manage voice traffic over your WLAN, you must:

1. Configure your network for radio management (see Configuring Your Network for Radio Management, page 11-5). If your network is not properly configured, *none of the Voice functions will work*.
2. Define the location elements (buildings and floors) and place the APs on the floor images. This step is optional, but will help you get the best results from the Location Manager displays. For more information, see:
   - Entering Building Information, page 13-4
   - Adding Floors to Location Manager, page 13-9
   - Adding Devices to Floors, page 13-14
3. Optional (but necessary to accurately locate rogue APs): Perform an AP Radio Scan on all APs on the specified floor (see Using AP Radio Scans to Collect RM Data, page 13-43).
4. Be sure Radio Monitoring is enabled on all APs (for both serving and non-serving channels) on the specified floor (see Starting Radio Monitoring, page 12-4).

Note Radio Monitoring is enabled by default; if it has been disabled, you must re-enable it.

5. Set policies to enable voice management (see Enabling VoWLAN, page 15-6).

Tips

- Use the *roaming count* value to diagnose problems in a client roaming algorithm or the network design that cause the client to micro-roam between two APs (ping-pong quickly back and forth).
- When compared to normal packet delivery, the jitter performance might be quite different for clients using U-APSD (unsolicited automatic power save delivery).
- Before a voice handset can have reliable audio quality, there must be sufficient signal strength (RSSI or RSL) wherever a user will go in the enterprise. For network administrators to have confidence in the radio coverage, a site survey must be performed and the data imported into WLSE. Then, as the RPG (radio parameter generation) program adjusts the transmitter power levels and performs channel assignments, the coverage levels will be correct. It is important the antenna gain of the radio used for site survey be accounted for when the site survey data is imported as it is likely to be higher than that of the voice handset.
- Due to the interaction between the desired capacity and the required level of radio coverage, the network administrator must have some knowledge of the desired capacity when setting the coverage level requirements. For example, VoWLAN operation based on 24-Mbps results in greater capacity than 6-Mbps but reduced radio coverage. The trade-off between capacity and radio coverage is different in each deployment as well as between 2.4-GHz and 5-GHz bands.
- Radio coverage is *not* static. Enterprise users routinely change their environment by doing things such as adding walls or shelves. Radio coverage will need to be reevaluated after these occurrences and the affected area might need to be resurveyed.

Enabling VoWLAN

Use the procedures in this section to enable voice management on the WLSE.

Note Your login determines whether you can use this option.

Before You Begin

Satisfy the prerequisites for running voice monitoring (see Guidelines for Using Voice, page 15-5).

Procedure

Step 1 To enable CAC and Traffic Stream metrics in the APs and generate the default voice settings, select **Configure > Templates**, create a new template or edit an existing template, then select **Voice Express**. Enter the required information (see Configuring Voice Express, page 5-14), then push the new configuration to the devices.

Step 2 Enable voice bandwidth faults.

To enable voice bandwidth faults on a device or group of devices, select **Faults > Manage Fault Settings**. Select the fault setting you want to edit from the Existing Fault settings table, click **Edit**, then select **Radio-802.11a Thresholds > Voice Bandwidth**. For more information about this feature, see Setting Voice Bandwidth Threshold, page 3-41.

Step 3 Enable QoS status faults.

To enable voice quality of service (QoS) status faults on a device or group of devices, select **Faults > Manage Fault Settings**. Select the fault setting you want to edit from the Existing Fault settings table, click **Edit**, then select **Radio-802.11a Thresholds > Voice QoS Status**. For more information about this feature, see Setting Voice QoS Status Threshold, page 3-42.

Step 4 Assign voice QoS settings.

To configure the voice QoS settings, select **Faults > Voice QoS Settings**. You can assign the following Voice QoS settings:

- Downstream Delay with U-ASPD not used
- Downstream Delay with U-ASPD used
- Upstream Delay
- Downstream Packet Loss Rate
- Upstream Packet Loss Rate
- Roaming Time

For more information about this feature, see Assigning Voice QoS Fault Settings, page 3-54.

Step 5 Define voice fault notification targets.

When a fault is detected, the WLSE can send automated notifications in the form of SNMP traps, syslog messages, and email alerts. You can specify multiple recipients for each notification type, and choose to deliver the message using either a plain text or XML format.

To create fault notification targets for Voice traps, syslog messages, and emails, select **Faults > Notification Settings.** For more information about this feature, see Notification Settings, page 3-56.

Related Topics

Monitoring Your Voice Network, page 15-7

Monitoring Your Voice Network

Select **Faults > Voice Summary** to display all voice fault information. Voice faults will not appear in this table until the fault has been enabled. For more information about this feature, see Viewing the Status of the VoWLAN, page 3-53.

Generating Voice Reports

The **Reports > Voice** option displays voice call information about the devices in your network. This information can be shown for an AP, a single floor, or the entire network. You can view, export, and email the reports. Using this option, you can view the following types of current reports:

- Group Reports:
  - AP Group Call Summary: Current, page 10-24
  - AP Group Metrics Summary: Current, page 10-25
- Access Point Reports:
  - AP Detail: Current, page 10-27
  - AP Detail: Last Hour, page 10-29
  - Voice Queuing Delay, page 10-30
  - Voice Packet Loss, page 10-31
  - Voice Roaming, page 10-33
  - Bandwidth In Use, page 10-34
  - Voice Streams In Progress, page 10-35
  - Rejected Voice Streams, page 10-36
- Wireless Clients:
  - Voice Client Detail: Last Hour, page 10-43

For more information about these reports, see Displaying Voice Reports, page 10-24 and Displaying Wireless Client Reports, page 10-37.