

WaveCAST™ Network Guide

FOR CONSULTANTS AND IT PROFESSIONALS



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Description

A WaveCAST System is built with any Wi-Fi audio streaming Williams AV product. This includes the WaveCAST, WaveCAST EIGHT, FM + and IR + hardware devices.

A typical WaveCAST system consists of the following segments: Audio Source, WaveCAST Server, Router/DHCP Server, IP Network (including Wi-Fi), and receiving device (end point).

WaveCAST receives live audio from sources such as TVs, cable receivers, satellite receivers, microphones, sound systems, etc. WaveCAST then encodes the audio onto an IP Network so the encoded audio can be sent through the Wi-Fi network to smartphones or tablets, as well as the WaveCAST Receiver.

Understanding Live Audio Streaming

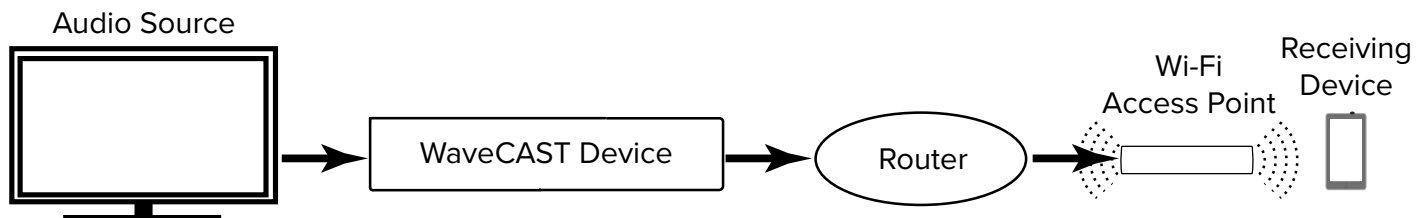
Online streaming services like Netflix, YouTube, Pandora and Spotify work differently than a live streaming system like the WaveCAST.

Both online streaming and live streaming transmit data with packets. Packets are one snippet of a larger piece of information such as an audio file. A streaming system takes the packets it receives and puts them back together into a large piece of content for the user.

In order to optimize the experience, online streaming services buffer hundreds of packets before the user actually sees or hears them. This can be done because the content is stored. If a packet is missed, it is re-requested and inserted back into the stream. This maintains a consistent uninterrupted flow of the data.

Live audio streaming works differently. In order to avoid lip-sync delay, these systems only buffer 2-3 packets ahead of when the audio is heard by the user. A packet that was missed (a "drop-out") cannot be recovered. There is virtually no storage of packets nor time to re-request the packet. However, with network optimization, the performance can be extremely good. This document covers the necessary parameters to optimize the network for best performance.

How it Works



Audio is taken from the source (TV's, cable, satellite, live sound systems, etc.) and brought into the WaveCAST Server via analog or Dante connections. The WaveCAST system encodes and broadcasts the audio over the IP network. The Wi-Fi Network may consist of Wireless Local Area Network (LAN) Controllers, Router/DHCP Server, and/or Wi-Fi Access Points (APs). Enterprise level Wi-Fi APs are sometimes controlled by WLAN controllers.

Unicast vs Multicast

Unicast data streams create and send an individual copy of the data directly to each individual user. For example, if the audience includes 30 people, 30 copies of the data being streamed will be created. Unicast streams are easier to set up on a network, but are more data intensive due to the amount of copies that may be needed.

Multicast data streams send one copy of the data to a central location, such as a switch. The central location is then accessed by any users, who are then sent the data. Multiple copies of the data are not created. Since there is only one copy of the data, the data can be sent to far more users with far less network usage than a unicast stream. However, networks that support multicast are more intensive to set up and require equipment that supports multicast data streams.

Dante™ Audio Requirements

Dante versions of WaveCAST systems have a dedicated RJ-45 port on the rear panel. Most audio setting will need to be adjusted in the Dante Controller software, provided by Audinate.

If Dante audio is being used, a 48 KHz sample rate is the only one supported. A 44.1 sample rate is not supported.

A Note on Mobile Devices

Some mobile devices, like smartphones, are programmed to drop Wi-Fi connections that do not provide access to the internet. While the WaveCAST system will work without an internet connection, mobile devices will see there is no internet connection, disconnect from the network and switch to using a data network. The audio from the WaveCAST network will then be unavailable.

Putting the device in Airplane Mode or disabling cell data can resolve this issue if an internet connection cannot be provided over the same network as the WaveCAST Audio.

You may also try the following settings adjustments:

- Enable Network Permissions for the Wavecast App
- Disable Private IP Addressing
- Disable Random MAC address
- Reopen the app or reboot the device

Standard WaveCAST System Network Requirements

- A WaveCAST System is configured to receive a DHCP address from a DHCP server on the existing network. A DHCP server is required for managing traffic for users using mobile phones.
- A separate or isolated LAN, subnet, or VLAN for audio streaming is recommended.
- The WaveCAST system can be configured to use a static IP address in the device settings, if required (see full user manual for details).
- Multicast is required on multiple-channel units, like the WaveCAST EIGHT. Unicast is not available.
- Both unicast and multicast modes are available on single-channel units. The mode must be selected by the user in the WaveCAST system settings (see the full user manual for details). Approximately 30Kbps of bandwidth are used (depending on audio source and frequency response) per device. This bandwidth measurement is per stream in Unicast mode and per channel in Multicast mode.
- Unicast mode can support up to 45 users.
- Multicast mode can support up to 1,500 users. The maximum amount of users may be limited by network hardware, configuration and/or DHCP server. For Multicast, consumer-grade routers do not work well, enterprise-grade routers and access points are recommended.
- End points must be able to communicate with the WaveCAST system. We recommend that the WaveCAST system and the end points are on the same subnet.
- Time to Live (TTL) is the number of switch hops that can occur before a packet is considered dead. TTL is selectable in the WaveCAST system settings (see the full user manual for details). In most cases, Williams AV recommend keeping the default TTL value of 1. However, if the endpoint resides on a different VLAN than the WaveCAST system, or access to the network requires switch hopping, it may be necessary to adjust the TTL to a higher value.
- Likewise, the end points must not be isolated from the WaveCAST system. In a guest Wi-Fi environment, it is usual to have the SSID connections isolated from one another and from the LAN. The Wi-Fi connections will need to have access to the WaveCAST and vice versa. This can be accomplished either by creating acceptable routes from the Wi-Fi to the WaveCAST system, or by making the SSID non isolated from the LAN that the WaveCAST is located on.
- UDP protocol and UDP Broadcast are used for device discovery and for multiple WaveCAST server sync/communication.
Note: If UDP Broadcasts are disabled, users still can connect to the device from the WaveCAST Receiver app via IP Address.

Port Information

The following ports are required to be open for the WaveCAST system to work: 80, 3300, 3301, 3302 and 3303.

The server control commands on the mobile app are received by the WaveCAST system on UDP port 3300 and replies are sent back to UDP port 3301. These are used for UDP discovery.

The server transmits audio from UDP port 3302 to UDP port 3303 in both Unicast and Multicast mode. The WaveCAST App checks in on these ports.

The web control interface is accessed on port 80 and will need to be available for setting adjustments.

Unicast Network Requirements

- A DHCP server (*required to manage traffic for mobile devices*)
- Bandwidth requirements are approximately 30kBS (*depending on audio source and frequency response*) per device, per stream in Unicast.
- Unicast supports up to 45 users. *Maximum users may be limited by network hardware, configuration and/or DHCP server. The FM + (FM T55) and WaveCAST (WF T5) support Unicast or Multicast; The WaveCAST EIGHT (WF T8) and IR + (IR M1) are Multicast Only.*
- UDP Protocol, UDP Broadcast, and UDP Discovery allowed.
- QoS set to voice or higher (*as is typically done in VOIP systems*)
- Port 80, 3300, 3301, 3302, 3303 open
- Network Security/Firewalls/Switch configured to pass audio streams
- Optimize environmental conditions for Wi-Fi
- Reduce 2.4 GHz interference with Access Points (APs) (*check the environment with Wi-Fi Analyzer or similar App*)
- Reduce AP channel hopping (*fixed channels recommended*)
- Wi-Fi site survey recommended prior to new installs
- Minimize switch hops if possible. If switch hops are required, TTL can be set in the web interface.
- Separate or isolated LAN, subnet, or VLAN for audio streaming is recommended
- 5 GHz APs recommended. 2.4 GHz often suffers from interference depending on the environment.
- Networks ideally should have access to internet. If internet is not present, some devices will attempt to switch to cell data and disconnect from Wi-Fi. If internet cannot be made available, users may need to switch to Airplane mode or disable cell data on their mobile device to use WaveCAST.

Multicast Network Requirements

Follow the Unicast Network Requirements, but also:

- Bandwidth requirements are approximately 30kBS (*depending on audio source and frequency response*) per device per channel in Multicast.
- Multicast supports up to 1500 users. *Maximum users may be limited by network hardware, configuration and/or DHCP server. The FM + (FM T55) and WaveCAST (WF T5) support Unicast or Multicast; The WaveCAST EIGHT (WF T8) and IR + (IR M1) are Multicast Only.*
- For Multicast, enterprise-grade routers and APs are recommended.
- Internet Group Management Protocol (IGMP) support
- IGMP Snooping enabled
- Quality of Service (QoS) set to voice or higher (as is typically done in VOIP systems)
- Protocol Independent Multicasting (PIM) (if being used)

Multicast Details

- The WaveCAST Receiver App (the end point) discovers if there is a WaveCAST system on the network by sending a broadcast packet and listening for a response on the multicast address.
- The broadcast uses the broadcast IP Address of the subnet that the endpoints (receiving device) are on. For example, if the subnet has the address range of 192.168.128.XXX, the broadcast address is 192.168.128.255.
- The multicast group range must be kept available and allowed on the network. The default Multicast address range is 239.168.0.12 - 239.168.0.127. The user may set a custom Multicast address for each channel in the web interface.
- When the WaveCAST App selects a channel, the server begins to stream the audio on that channel to the device (if not already doing so). The access point should be configured to support multicast. Refer to the AP/Wi-Fi manufacturer's documentation.
- The network should support: IGMP, IGMP Snooping, PIM, and Multicast.
- The network and SSID should also be configured for Voice or Premium QoS, (or other priority QoS depending on Manufacturer). The WaveCAST system uses similar settings as most VOIP configurations, and DSCP .46 or EF for QoS classification.

Considerations for an Interference-Free Network

- Since the WaveCAST system uses Wi-Fi as its medium for transmission, care should be taken to minimize obstructions between the access point and user devices. The more numerous or significant the obstructions, the less consistent the performance will be.
- Access points are critical to optimal performance of the user experience. There must be adequate Wi-Fi coverage to accommodate the space where users are expected to use the WaveCAST Receiver App.
- Network security settings, including firewalls and switch configurations, must be configured to pass audio streams
- User density must also be considered as different access points will allow different amounts of maximum client connections. The Wi-Fi network must be able to accommodate all users within the space with adequate bandwidth.
- Signal strength should be kept strong in all areas required; no less than -80 dBm is recommended. Signal strength is also impacted a great deal by frequency and co-channel interference. Interference mitigation is critical. A site survey may be useful in diagnosing or discovering interference issues.
- Channel hopping by the access points can cause quick audio interruptions. Configure access points to use a fixed channel. Independent networks should be separated by at least 2 channels.
- Increase the minimum allowed connection rate. Using the 5 GHz band only may improve performance due to less network interference, but this will also eliminate devices that are only capable of utilizing the 2.4 GHz band or devices unable to recognize the higher channel frequencies within the 5 GHz band.
- Keep in mind, encryption uses bandwidth and reduces the number of successful connections substantially in a Wi-Fi environment and must be taken into account.
- If any of the network parameters cannot be configured on the enterprise network, an independent or segregated network may be an option.

Specifications

Router	Ports	Information
Operating System	End Point (receiving device)	Apple iOS 9.1 or newer Android 6.0 or newer Blackberry/Windows currently not supported
Bandwidth	Initial App Connect(i)	Background = 128 Kb per device
	Audio	Wired Bandwidth for Unicast = 30 Kbps per user Wired Bandwidth for Multicast = 30 Kbps per configured channel Wi-Fi Bandwidth for both Unicast and Multicast = 30 Kbps per user

ⁱ After connecting to the WaveCAST network, when the WaveCAST Receiver App is launched there is an initial connection that will download background content to the device. This initial connection happens once per device per session.

ⁱⁱ Connected channels are any channel that has at least one device actively playing the channel (joined to the Multicast Group). It does not matter how many devices are joined to a particular channel, it is connected if one or many devices are joined.

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