PTT Call Flow

Introduction to PTT

PTT traffic in the Spectralink system utilizes a proprietary technology to create a one-to-many call. In order to accomplish this multicast is used to ensure that only one instance of the session must be generated by the transmitting handset. Multicast allows for a single stream of traffic to be duplicated and sent to multiple clients. This process allows for much less overhead and makes use of existing network technologies. In this design the phone can rely on the network to deliver the packet to each device that has subscribed to the multicast stream.

Multicast

There are some limitations to multicast that every network administrator should be aware of before developing a multicast network. Likely the biggest limitation of multicast is how the network regards the traffic. A multicast packet is largely considered to be just like a broadcast and often gets the same treatment. This is frequently the case in networks that don't have multicast networking fully configured to support all the available features. Multicast packets will always be destined for a multicast group address. In the case of Spectralink devices that multicast group address will always be 224.0.1.116. The client transmitting the multicast stream directs its traffic to this group address and then other clients can subscribe to the group to receive the traffic. However, by default network devices, like switches, will simply forward multicast out all ports, hence treating it like a broadcast. This behavior is in place because the switch isn't aware of which clients want to receive the stream so it will simply forward the traffic. Newer managed switches have implemented new features that allow them to "snoop". The switches can recognize the multicast messages from the clients that wish to join a particular multicast group and so they are able to generate a table of which ports should receive traffic for specific multicast groups. The benefit to this behavior is that the switch no longer must flood the traffic out all ports which will reduce overhead in the network.

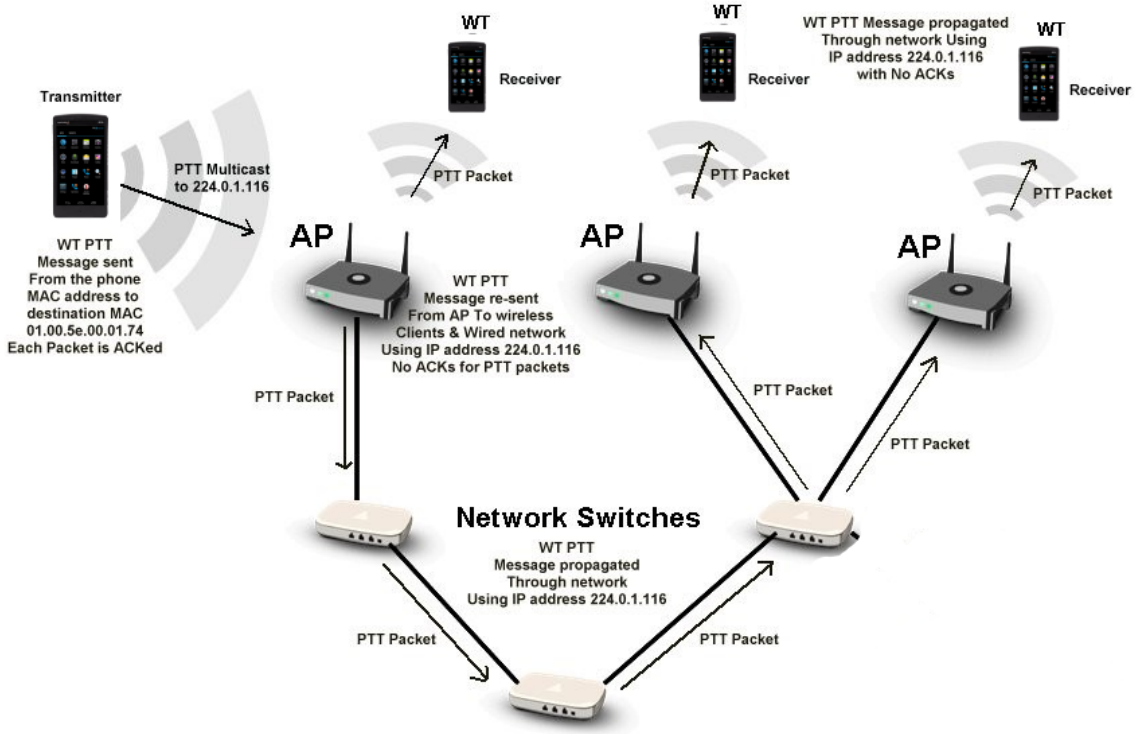
Another limitation of multicast once again relates to multicast being treated like broadcast traffic. Since routers in the network split up broadcast domains, they will also segregate multicast traffic. What this really means is that a router will not forward any multicast traffic from one subnet or network to another subnet or network. It is possible to work around this limitation as most all network routers can be configured to support multicast routing. Multicast routing allows the router to receive multicast traffic on one network and pass that traffic to a different network. The configuration of multicast routing varies by manufacturer so be sure and check with your network hardware manufacturer on how best to configure your network for multicast routing. When configuring multicast on your network you'll want to be sure and set the multicast mode to dense. There are two different modes which multicast can operate in, dense mode and sparse mode. But the Spectralink products use only dense mode.

PTT in Practice

In the 802.11 world each packet between a phone and AP or from the AP to the phone much be acknowledge. When a phone transmits multicast push-to-talk packets the access point will ACK each packet from the phone so that the handset knows the packet has been received.

When a phone transmits push-to-talk the AP that first received the multicast traffic from the transmitting handset will need to retransmit those packets back out the AP's radio interface because there may be handsets associate to that AP that will need to receive this traffic. When the AP retransmits the packets, it will take the transmitting phone's original packet and change the sequence number in the packets. Any phone that receives the multicast packets from the AP will also not acknowledge the packets because they are considered broadcast packets and in 802.11 broadcast packets are not acknowledged.

The AP that received the multicast packets will also send the packets out the Ethernet interface of the AP. The packets will be propagated through the network and depending on the switch types and their configuration the switches may flood the multicast traffic out all ports or simply forward it out ports that it has heard join requests for the multicast group. The packets will pass between switches and they will remain on the network they were generated on. If the packets encounter a router, they will be forwarded only onto the same network they were received by the router on and will not be forwarded to any other network unless otherwise configured to do so, but we'll discuss that in a later.



Take a look at this diagram for a visual description of the packet flow described above.

Once the packets have reached other AP's on the network the multicast traffic will be buffered, and the AP will flag the Traffic Indication Map (TIM) for each client the traffic is destined for. When those clients come out of power save mode, they will begin to receive the multicast stream. The packets will have the same sequence numbers as the packets from the original transmitting phone. This is because the AP's did not receive the multicast traffic on the radio interface and so they do not need to change the sequence number of the packets. The phones will receive the multicast packets in a burst of as many as 10 packets at a time and will be able to immediately begin buffering the audio payload in the packets into the jitter buffer of the phone so it can be played.

This process is continued throughout the PTT session and utilizes just as much bandwidth as a normal voice call. Keep in mind that because the multicast traffic is treated much like a broadcast in 802.11 there are no retries so if the phone misses one of the multicast packets there is the potential for audio loss. Because of this it is never possible have audio quality in a PTT session as good as you would receive in a normal voice call. There is a higher likelihood of occasional choppy audio or small gaps in PTT, particularly while roaming, but overall the audio quality will be quite good.

Multicast Routing

The topic of multicast routing is somewhat complex and is very dependent on the network manufacturer. Cisco implements multicast routing different from Nortel and so on so be sure and check with your manufacturer for the particulars of how to configure multicast routing.

In general, multicast routing will allow for multicast traffic to be available to multiple networks with a signal source. An example of why one would configure multicast routing might be a site using push-to-talk, but they have phones on two distinct subnets or networks. But even with this router boundary they need to have the PTT traffic from one subnet delivered to phones in the other subnet. This is very easy to configure on most routers and will allow all multicast traffic to traverse the router between those two subnets. On many routers it is possible to restrict the multicast traffic to specific multicast groups or even to specific devices but that's beyond the scope of this document.

Another aspect of why you may need multicast routing is related to how many wireless controllers operate. Because controllers and AP's communicate via a secure tunnel using a protocol known as CAPWAP, the traffic between the two is often sent over a management VLAN. The client traffic is encapsulated across this tunnel to the controller where it can then be placed onto the appropriate VLAN. In many situations the traffic must first be routed from the management VLAN to its destination VLAN. This would mean that your PTT traffic would have to traverse a router boundary. If you didn't enable multicast routing between the management VLAN that the controller sits on and the VLAN the phones use the multicast traffic would get dropped at the router interface of the management VLAN. But, by enabling multicast routing on the router and then

enabling IP PIM sparse or dense mode, note that Spectralink PTT is a dense mode multicast application, any traffic received from the management VLAN that is multicast will be allowed to traverse the router boundary onto the voice VLAN. You can use access control lists to limit multicast traffic if you need to as well. Many environments have other multicast traffic for things like IPTV and they don't want that traffic getting mixed in or being sent to their AP's. You'll need to decide which multicast groups you want and which you don't. Every router vendor has several useful multicast routing commands to allow you to control and see what's happening with your multicast traffic these days. It's not as evil as it once was and isn't just another broadcast packet anymore.

Handset Compatibility Notes

Be aware that PTT is backwards compatible with prior Spectralink product models. However, there are some configuration changes that are required in order to make the prior 8030 handsets interoperate with all newer handset models. Newer handsets utilize the G.722 audio codec for high definition audio while the 8030 handsets only support G.711MuLaw. Additionally, the legacy 8030 handsets only supported up to 8 channels while the newer handsets can support up to 25 channels. This means that you would be unable to communicate with the legacy phones on any channel above channel 8 on the newer models. The Spectralink 8030 handset and all its OEM equivalent models, including the Avaya 3645, Nortel 6120 and NEC MH150 all offer similar support for PTT. If you're using the Spectralink 84-Series, 87-Series or Versity handsets you'll notice that you now can change the multicast group and ports used for PTT. Changing these values would further prevent backwards compatibility with the legacy 80-Series handsets.

Troubleshooting Tips

The following are some common troubleshooting tips that might help you with solving why PTT might not be working in your environment. Some of these are things that we at Spectralink have learned over time and others are just good things to verify while troubleshooting a challenging problem.

1. PTT is not enabled via the handset's User Interface.
2. Incorrect AP configuration – ensure recommended settings are set correctly, but especially the DTIM setting. (usually the case if not all phones on the same AP wake up or wake up together) DTIM will usually be set to 1 but reference the VIEW guide for your AP model for the recommended setting.
3. IP Multicast being filtered by the AP (ensure IP filtering is disabled)
4. "Peer" mode being blocked by the AP configuration (The AP stops two clients from exchanging packets via the AP – this is a new security feature employed in many wireless controller products and AP's focused on the wireless hotspot environment that prevent clients from communicate with each other through the same AP. Also known as Peer-to-Peer Blocking.
5. IP Multicast not enabled in the Network Switch layer. (IP multicast addresses are used for the PTT streams - see below)
6. IGMP Snooping settings in the WLAN/switching layer affecting packet delivery – this has proved to be vendor dependent and often tricky to pin down, e.g.

- It was identified that disabling IGMP on Cisco Catalyst 6500 core switches enabled packet delivery even though IGMP is still enabled in the edge switches. Packet delivery was blocked with IGMP enabled on the 6500. Configuring the 6500 to participate in the multicast group will prevent it from being pruned.
- Extreme Summit 300 and Alpine 3804 series switches were found to stop passing multicast packets after some amount of time.
- It was identified that the Alpine switch has an "IGMP snooping timer" that was at a default setting of 260 seconds. So, after 260 seconds it would remove or prune the multicast address from its group membership list and stop passing multicast packets. The work around was to set the IGMP snooping timer to the max value (68 years).

Spectralink uses the multicast group address 224.0.1.116 for PTT. All this communication is done via UDP over port 5001-5025 (different ports for different channels), and we use port 5454 for legacy Netlink inter-Gateway discovery. Spectralink legacy infrastructure products will respond to IGMP membership packets on 224.0.0.1 when received.

Conclusion

As with any network deployment it is always important to consider the design and development necessary to make the system operate as expected. Many network administrators effectively use multicast to their advantage but many more view multicasts as a deviant traffic type and try to prevent it. It's always best to understand the nature of the traffic and learn to control it in the best way possible. The push-to-talk traffic generated by Spectralink handsets is a perfect example of a valuable tool that can be implemented in a safe and effective manner simply by understanding and designing the network appropriately.

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Contact Information

US Location
+1 800-775-5330

Spectralink Corporation
2560 55th Street
Boulder, CO 80301
USA

info@spectralink.com

Denmark Location
+45 7560 2850

Spectralink Europe ApS
Bygholm Soepark 21 E Stuen
8700 Horsens
Denmark

infoemea@spectralink.com

UK Location
+44 (0) 20 3284 1536

Spectralink Europe UK
329 Bracknell, Doncastle Road
Bracknell, Berkshire, RG12 8PE
United Kingdom

infoemea@spectralink.com