TROUBLESHOOTING WI-FI VOICE QUALITY ISSUES ON SOFTPHONE CLIENT

CWNE TECHNICAL ESSAY

JAMES JACKSON

PROBLEM:

Wireless clients utilizing a newly implemented Cisco Jabber Softphone solution were experiencing poor quality voice calls. Wired clients using the same softphone software reported no voice quality issues.

MY ROLE:

Network Analyst in charge of enterprise wireless infrastructure at an electrical utility

ANALYSIS AND TROUBLESHOOTING:

A well performing Voice over Internet Protocol (VOIP) network relies on properly configured Quality of Service (QoS) on the underlying wired network infrastructure. The enterprise I was employed at had a very well designed QoS configuration on the wired infrastructure with both proper queueing configured as well as port configurations that properly handled COS and DSCP markings. As preparation for the softphone deployment our network and systems administration staff had worked together to ensure that the Jabber softphone client and Windows PCs would mark outgoing voice traffic with a DSCP value of 46 (Expedited Forwarding) to ensure that voice traffic would have priority as it traversed the network.

With wired clients reporting no quality issues I was tasked with analyzing the wireless infrastructure to determine a possible cause for the reported issues. The first step was to setup packet captures at several different points in the network so that I could track changes to the voice related packets as they traversed end-to-end.

Captures were set at:

- Calling client (wireless laptop)
- Access Point
- Uplink between wireless controller and wired infrastructure
- Uplink to Cisco Call Manager
- Receiving client (wired desktop)

A test call was initiated, and the packets were analyzed with a particular focus on making sure the DSCP value in the packet was 46 (EF) throughout the whole conversation. Upon analysis it was discovered that despite the outgoing packet from the caller having the proper DSCP marking of 46, by the time it reached the WLC uplink it had been changed to 0 (Best Effort). The 0 marking was then maintained all the way through to the receiver. Outgoing packets from the receiver were marked 46 and maintained that marking all the way back to the calling client. This information indicated that something was causing the traffic to be reclassified upstream (caller to receiver) between egress from the client to egress from the wireless controller.

Focus was then turned to the AP packet capture where two items of concern were noted. First, the wireless frame received from the client had an 802.1e User Priority of 5 which

indicated Video priority traffic. The expected value was a User Priority of 6 for Voice. Second, it was noticed that the inner IP packet did have the expected DSCP value of 46. Next we looked at the packet as it was transmitted from the WLC to the upstream switch and noticed that the DSCP value was no longer 46, rather it had been overwritten. The existing QoS policies on the wired infrastructure saw the new value as an unexpected DSCP value and so by default it overwrote the value again with 0. We were able to verify this by analyzing the packet after entering the upstream switch and having the QoS policy applied.

At this point research was undertaken to determine if this behavior had been experienced and documented previously. Initial research found several articles referring to Microsoft Windows incorrectly applying User Priority on wireless frames when the IP packets were marked with a DSCP value of 46. The root cause of this behavior is that Windows machines will only look at the 3 most significant bits in the DSCP value. A DSCP value of 46 in binary translates to 00101110 or 101110 without the leading zeroes. Microsoft only uses the 101 (40) to determine the User Priority resulting in the wireless frame being assigned to the Video User Priority instead of the Voice category. Further research turned up the reason why we were seeing issues with DSCP marking upstream.

On Cisco Wireless Controllers there is a conversion of 802.11e UP values to the appropriate DSCP value (and vice versa) to maintain proper layer 2 and layer 3 QoS as traffic transits in both directions through the controller. In this case the VOIP packets that arrived at the controller from the AP with a DSCP value of 46 were having that value overwritten at the WLC due to the wireless frame having a User Priority of 5. With Cisco's mapping in place the VOIP packets were having their DSCP value overwritten to a value of 34 which maps to 802.11e UP of 5. The VOIP packets were then forwarded out of the WLC into the wired environment. Our QoS configuration was not configured to accept 34 as an expected DSCP value and so the upstream switch immediately overwrote the DSCP value once more with a value of 0. This resulted in the VOIP traffic having low priority as it transited the rest of wired network on its way to the receiver. Traffic initiated from the wired client did not experience any DSCP rewrites due to the fact that the controller in the downstream direction (i.e. from WLC to wireless client) could properly handle assigning 802.11e UP of 6 to traffic with DSCP marking of 46. Rewrites were also not seen as the traffic transited the wired infrastructure (which had properly configured QoS) before reaching the WLC.

RESOLUTION:

Cisco provides a couple of ways to fix DSCP rewrites. They have a custom UP to DSCP mapping option that allows the administrator to define exactly how they want values to map. This was going to be the solution I implemented until I learned about the second option. At the time of this incident Cisco had released code that allowed for inner DSCP markings to be trusted in the upstream direction. This setting, when enabled, allows packets to maintain their DSCP markings as they transit from client to AP to WLC into the wired infrastructure. Upon enabling this setting another test call was performed. This time the VOIP packets from the calling client (on wireless) maintained a DSCP value of 46 throughout the entire path to the receiving wired-in PC and the improvement in call quality was immediately noticeable.