The Recommended Testing Process for PacketCable™ Voice Service at a Customer Premises

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The current generation of cable systems supports voice, video, and data services. Video and data services have been deployed for many years, and a variety of tests have been developed to reduce the number of repeat truck rolls and to increase customer satisfaction.

Now, many cable providers are adding voice service in order to become triple-play providers. It is important to note that voice service requires a level of quality above traditional data and video services.

This document is intended as a discussion of the tests available to field technicians for testing PacketCable™ voice service, including the pros and cons of each test. For voice service, traditional testing alone is not sufficient to troubleshoot the VoIP service and to confirm that a customer can place and receive calls on the network. In the case of voice service, a test device with a built-in Multimedia Terminal Adaptor (MTA) is required to perform the necessary quality tests.

WARNING

Using a test device to emulate a cable modem with an external MTA is not the same as the tests described in this application note.

An external MTA will often connect to another VoIP provider (such as Vonage®) and will not verify the MTA registration process, proving that a dial tone can be provided by the cable network. Any test performed with an external MTA to another VoIP provider is not a valid turn-up test.

The Testing Process

The following tests are available to a technician during the turn-up of voice service at a home or business. The tests are performed in the following order:

Step 1: Data Testing

- Range and register the cable modem (CM) with the Cable Modem Termination System (CMTS)
- Ping, packet loss, and throughput

Step 2: MTA Registration Testing

- Register the CM and the MTA on the network and obtain a dial tone

Step 3: End-to-End Call Quality Testing

- Place and receive a call on the network with a built-in MTA test device
- Place and receive a call using the customer's phone to confirm the customer's MTA

STEP 1: Data Testing

Data testing is still an important step in the turn-up of voice service since VoIP packets travel the same path as Internet packets. Therefore, the quality of the DOCSIS® data network directly affects voice quality.

Range and Register the CM with the CMTS:

The first step of data testing includes ranging and registration. A test device with a built-in CM verifies the physical RF connectivity RESULTS such as receive level, downstream MER, and upstream transmit level. Technicians must ensure that there are enough margins in the RF parameters. The test device can also verify all of the servers by registering with the CMTS. If properly registered, the test device receives an IP address and performs IP testing such as ping, packet loss, and throughput.

Ping, Packet Loss, and Throughput:

The ping test is a very common test used for turning up Internet services over cable systems. The ping test allows the technician to confirm basic connectivity and capture a number of basic statistics about the link. For Internet services, the ping test is able to provide the following information:

Connectivity – The technician is able to obtain a valid IP address and register with the CMTS. This test is performed on the Internet service when it is initially turned up.

Basic Last Mile Statistics – The technician is able to capture basic statistics between the CMTS and the edge test device. These statistics include round trip delay (latency) and lost packets. These statistics offer a basic measure of the Internet link quality. This test is performed on the Internet service when it is initially turned up.

Overall Upstream/Downstream Data Rate – The technician is able to determine the maximum upstream and downstream data rates (throughput). This test is performed on the Internet service when it is initially turned up.

The ping test provides the technician with a lot of information. Most of the information would have been obtained when the customer's cable modem was initially installed. It is acceptable, though, to recheck this information when adding voice service. However, data testing alone does not confirm the overall network's ability to handle the new voice traffic.

PROS: Data testing checks RF parameters and basic Internet service and confirms speed and quality.

CONS: Data testing does not provide voice analysis or proof of call manager registration. Data testing does not confirm that the service will offer the customer a dial tone or that the quality of the voice calls will be acceptable.

STEP 2: MTA Registration Testing

Register the CM and the MTA on the network and obtain a dial tone:

In order for a phone to obtain a dial tone, the CM and the MTA must be able to go through the CM's range and registration process as well as a more complex MTA registration process. Both the CM and MTA registration processes are very complex. Appendix A and Appendix B list the possible errors and events that may occur during these registration processes.

The MTA must register with its Call Management Servers (CMS) in addition to the CMTS and the security server. If any step of the MTA registration process fails, the end user will be able to use the Internet, but they will not be able to make any phone calls.

In order to confirm MTA registration on the network, the technician's test device must have a built-in CM and MTA that can register with the CMTS and the local CMS. If the registration fails at any point, the technician can monitor the network to determine if the Internet and voice servers are not working properly, indicating that the customer's service cannot be fully turned up.

If a dial tone is present, the technician can be confident that the entire registration process described above was successful and that the customer's MTA is functioning properly.

Note: The test device MUST have a built-in MTA to fully test the registration process and to verify a dial tone from the cable operator's network.

PROS: MTA registration testing confirms that the customer will be able to register with the voice portion of the network and that a dial tone is present.

CONS: There is no voice quality metric at this point. The network voice priority settings are not confirmed and the end user may have call quality issues forcing a second truck roll.

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STEP 3: End-to-End Call Quality Testing

The next step in the testing process is to confirm that service is available and that the quality of the service is acceptable. These tasks are accomplished by placing an actual call on the network with the test device. Placing the phone call will confirm signaling translation (provided by the signaling gateway) and will verify voice quality.

Place and receive a call on the network with a built-in MTA test device:

Signaling – In order to confirm that the signaling gateway (SG) is working properly, the technician must place two separate calls, an on-net call and an off-net call. The on-net call is from the test device to another phone within the cable provider's VoIP cloud. The off-net call is from the test device to the Public Switched Telephone Network (PSTN). These two calls will confirm that the CMS is correctly recognizing the voice and is routing all of the signaling (digits) to the SG. They also confirm that the signaling digits are being handled properly.

Call Quality – During either of the above calls, the technician will verify the voice quality. If the registration process has occurred properly, the CM and MTA will reserve bandwidth for the voice traffic through the entire cable provider's network. Voice, therefore, has a higher quality of service (QoS) than data. Monitoring the test call and confirming the voice quality will demonstrate that the appropriate bandwidth has been reserved and that the link has the ability to handle the voice.

There are many parameters that dictate call quality. These parameters include voice packet loss, voice packet jitter, and voice packet delay. Several methods have been developed that measure jitter, loss, and delay information and assign a pass/fail indicator. The two most commonly used voice quality metrics are Mean Opinion Score (MOS) and R Value (see inset). The test device automatically calculates both of these values, allowing the technician to verify that the voice quality is at the appropriate level.

PROS: The voice service has been fully tested. Both provisioning and the ability of the network to carry the voice have been verified.

CONS: The customer's set top box (MTA) has not been verified yet.

Place and receive a call using the customer's phone to confirm the customer's MTA:

The final step in the voice service testing process is to place and receive calls via the customer's MTA. To accomplish these tasks, the technician uses any analog phone or butt-set to place a call on the customer's equipment. The technician then uses a non-VoIP phone to call the customer. The successful completion of this call demonstrates a fully functioning outbound call service.

PROS: This is the final step in the procedure of turning up a VoIP service. The successful completion of this step (as well as the steps above) allows the technician to leave the customer's premises with a fully turned-up service.

CONS: None. The service is functioning properly.

Summary

Technicians following the described 3-step testing process, including data testing, MTA registration testing, and call quality testing, will eliminate unnecessary service calls by closing out VoIP service turn-up/service work orders with the confidence that the quality of service will meet the customer's expectations.

Voice Quality Metrics

MOS (Mean Opinion Score): MOS ratings range from 0 (bad) to 5 (perfect). A phone call on a traditional PTSN has a maximum MOS rating of 4.2. Any MOS rating above 3.5 is considered acceptable.

R Value: R Values, specifically designed for VoIP, have a range of 0 (bad) to 100 (perfect). A phone call on a traditional PSTN has a maximum R Value of 94. A VoIP call, with an R Value above 72, is considered acceptable.

Appendix A

Possible Errors and Events during Cable Modem (DOCSIS®) Registration

- CM failed to acquire the QAM lock.
- CM failed to acquire the FEC lock.
- Downstream scan process failed.
- Downstream scan process was stopped.
- Downstream frequency lost.
- No upstream channel descriptor.
- Bad upstream channel descriptor.
- Downstream signal error.
- This may not be a DOCSIS® channel.
- CMTS did not return a range response.
- CMTS stopped responding before ranging was complete.
- CMTS has requested a change in the downstream signal.
- CMTS has aborted ranging.
- CMTS requested an upstream signal level that is above the range of this instrument.
- CMTS requested an upstream signal level that is below the range of this instrument.
- DHCP server provided missing or invalid IP parameters.
- DHCP server is not responding.
- Configuration file has not been found on the server.
- TFTP server is not responding.
- TFTP protocol failure.
- Error retrieving the configuration file from the server.
- Error parsing the configuration file.
- CMTS did not respond to the registration request.
- Registration with the CMTS failed.
- Received an authentication failure from the CMTS.
- Traffic encryption failure.
- Received a traffic encryption failure from the CMTS.
- Class of service failure.
- Received a class of service failure from the CMTS.

Appendix B

Possible Errors and Events during MTA Registration

- DHCP server provided missing or invalid IP parameters for the MTA.
- DHCP server is not responding to the MTA.
- MTA could not obtain an IP address from the DHCP server.
- MTA DNS error.
- Downstream signal lost the QAM lock.
- MTA could not retrieve the SNMP engine ID.
- MTA could not resolve the SNMP Mgr FQDN.
- MTA could not send the SNMP Enroll Inform.
- MTA did not receive the name of the MTA configuration file via SNMP.
- MTA configuration file not found.
- MTA TFTP server is not responding.
- Error retrieving the MTA configuration file from the server.
- Error retrieving the MTA configuration file from the server.
- Error parsing the MTA configuration file.
- Error hashing the MTA configuration file.
- Error decrypting the MTA configuration file.
- MTA could not resolve the FQDN of the TFTP server to an IP address.
- Name of the configuration file is not in a valid URL format.
- MTA could not resolve the IP of the TFTP server.
- MTA timed out during the TFTP process.
- MTA has failed the provisioning process.
- MTA has failed the Kerberos security process.
- MTA failed to generate AS request reply keys.
- MTA failed to generate AP request reply keys.
- MTA failed to generate AP request due to wrong key version.
- MTA failed to generate keys for IPSEC.

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