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Using the PNE Network Emulator to test E&M and TDM Replacement Products

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Many of our customers are faced with the "disappearing E&M line blues" as telephone companies withdraw their leased E&M line offerings from the marketplace. They are replacing those with digital lines, typically T1 or packet switched networks (basically ethernet). In some cases TDM networks are being replaced with packet switched networks.

We used PNE to analyze a few TDM and E&M replacement products to help those customers, and in some cases the equipment manufacturers, better characterize the performance of new circuit transport via real world ethernet connections.

The test setup is simple. Two CPE end products are connected via the PNE ethernet ports. Traffic is passed through those CPE products and the ethernet network between them. The tests are straight forward. TDM traffic was generated using a T-Berd, E&M traffic was generated using modems. The results are sometimes surprising, sometimes as expected.

TDM (T1) Product Tests.

Test 1: Dropped packets for T1 transport emulation: With jitter buffers and jitter tolerance set at manufacturer's recommended values, we configured the PNE to drop one packet per each thousand packets. MFRA's product always generated an error.

Test 2: Duplicate packets for T1 transport emulation: Same equipment as above, and we duplicated one packet per hundred. It always generated an error. We then lowered the error rate to one packet duplication per thousand. Same thing… the hit always generated an error.

Test 3: Out of order packets for T1 transport emulation: One packet out of order per thousand packets. No error was generated, but when we raised it to any number greater than one out of order packet per thousand, there was an error generated.

Test 4: Packet jitter: Jitter didn't cause a problem up to 20 msec. But, since the jitter buffer setting was 24, we know there will be problems with jitter values near 24 msec or greater.

E&M Product Tests

We used a 202T FSK modem over an emulated E&M channel. RFC 5087 – Time Division Multiplexing over IP (TDMoIP) provides various ways for a manufacturer to handle packet switched network real-world problems. It allows for either configurable or dynamically adjusted jitter buffers, and requires a lost packet processing method.

Test 1: Out of Order Packets: We discovered that the CPE E&M tunnel device does not tolerate any out of order packets.

Test 2: Duplicate Packets: It was more tolerant of duplicate packets. The link worked with ten packets duplicated per hundred packets transmitted.

Test 3: Packet Jitter: The unit under test automatically adjusts its jitter buffer to compensate for network jitter. When the jitter value is changed very quickly, a single error was generated, and then error free operation resumed. When we bumped the jitter from 30 msec up to 600 msec, then back down to 30 msec, again there was a single error with each jump, but it's obvious that the jitter buffer is elastic and grows and shrinks as necessary.

And a Product Verification

While this one is a bit self-serving, we'll mention one more test suite we recently performed. We tested two of our AVA-E low bit-rate VOIP boxes. The AVA-E configuration was typical..

Interfaces configured to FXS to FXS–PLAR the P25 3600 bps voice CODEC. Jitter buffer is 40 msec.

For the test, timing was set for 3 msec latency, 100 msec jitter, and random jitter. We tested for typical Internet problems such as drop one packet per thousand, duplicate one packet per thousand, and move three packets per second out of order.

We found no perceptible impact on the voice traffic. Of course, we attribute this to good design work. But, buffering in the network interface engine and CODEC choice are the primary reasons that network imperfections didn't affect the end to end traffic in this robust product.

PNE Testing Two AVA-E VOIP Units

Conclusions

PNE enables you to learn things about your ethernet products that aren't readily apparent. With a low entry cost, it's convenient to characterize how YOUR installation will operate on a less than perfect real world network. This appliance provides a solid methodology for comparing alternate products as well as learning how your installation will work in the real world. By measuring the actual network path characteristics using the ETTA ethernet transport analyzer and configuring the PNE appropriately, you can test your proposed equipment installation on the bench using the PNE with repeatable measurements.

About the PNE

The PNE (Packet Ethernet Network Emulator) is available from Data Comm for Business, Inc (DCB) either directly or through resellers such as Graybar or Anixter. At only $995, and with a small desktop footprint, there should be one on each technician's test bench.

Read the PNE data sheet at https://www.dcbnet.com/datasheet/pneds.html
More information about testing is in the ETTA manual at https://www.dcbnet.com/manuals/pene.pdf

A companion product ETTA, the ethernet performance test set, is used to characterize an existing network. Read the ETTA data sheet at https://www.dcbnet.com/datasheet/ettads.html