Application Note

End-to-end RFC 2544 testing of Ethernet lines

CMA 3000

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INTRODUCTION

In many cases it is important to test the performance of the link end to end when service providers deploy Ethernet links. Hereby the service provider ensures efficient turn-up and error free operation and gets the highest customer satisfaction. The Internet Engineering Task Force (IETF) RFC 2544 "Benchmarking Methodology for Network Interconnect Devices" defines tests that describe the performance characteristics of a network interconnecting device. These tests can be used for deploying and commissioning the Ethernet links. Often these tests are done using one test instrument that sends a test signal to a far-end destination, where the test signal is returned to the test instrument by some means of a "reflector" or "loop back". This test configuration makes the instrument test both the outgoing and incoming side of the link, which may be sufficient if both sides of the link provide the same bandwidth and the results show that the performance is OK.

Unsymmetrical links like xDSL provide different line rates in the two directions. Typically the downlink line rate is significantly higher than the uplink line rate. If you need to verify the traffic capacity of throughput of such links the result will reflect the capacity of the link side with the lowest line rate (i.e. the uplink line rate) if you test using "reflector" or "loop back". To get information for both the low and the high speed side of the link you need to send a test signal from an instrument at one end of the link to an instrument at the other end of the link and vice versa to test traffic capacity of both sides on the link. The two test instruments have to cooperate, because the tests described in RFC 2544 require that the receiver of a test signal must know the contents of the transmitted test signal in details.

In case you test a symmetrical link, which is not performing OK, it is important to find out if both or only one of the directions is performing badly. In this case you also need to test the link with two instruments to get separate results for the two sides of the link.

1.0 RFC 2544 test with the CMA 3000

The CMA 3000 Ethernet options include an automated RFC 2544 test application. In one of its test modes the RFC 2544 test application allows two CMA 3000s to perform throughput, frame loss and burstability tests in a master-slave constellation. The user sets up the test in the master CMA 3000. When the test is started, the master CMA 3000 transfers the necessary setup information to the far end slave CMA 3000. The information is transferred through the line that is under test. Once the test is completed, the slave CMA 3000 transfers the test results back to the master CMA 3000, so the user can read the results for both directions of the link on the master CMA 3000. If needed the user can initiate a new test without having to access the remote slave CMA 3000 directly. The dual-port capability of the CMA 3000 allows the user to test two links simultaneously.

Figure 1 End-to-end RFC 2544 testing using two 3000's

The test mode, which allows two CMA 3000 units to cooperate to perform an RFC2544 test, is called the "end-to-end" test. The unit that initiates the test is the master instrument while the other unit is the slave instrument. Control information is sent from the master instrument on port A; if port A is turned off, port B is used. When the test is started on the master CMA 3000, the unit will contact the slave instrument using the IP address of the slave unit. When the slave instrument receives the communication on a port with a matching IP address, the test will begin.

2.0 Setup of slave instrument

To set up the slave instrument, first the Ethernet interface needs to be activated. In this case, an electrical interface with auto negotiation is selected. Port A is used in this example – port B is disabled by setting it to Off.
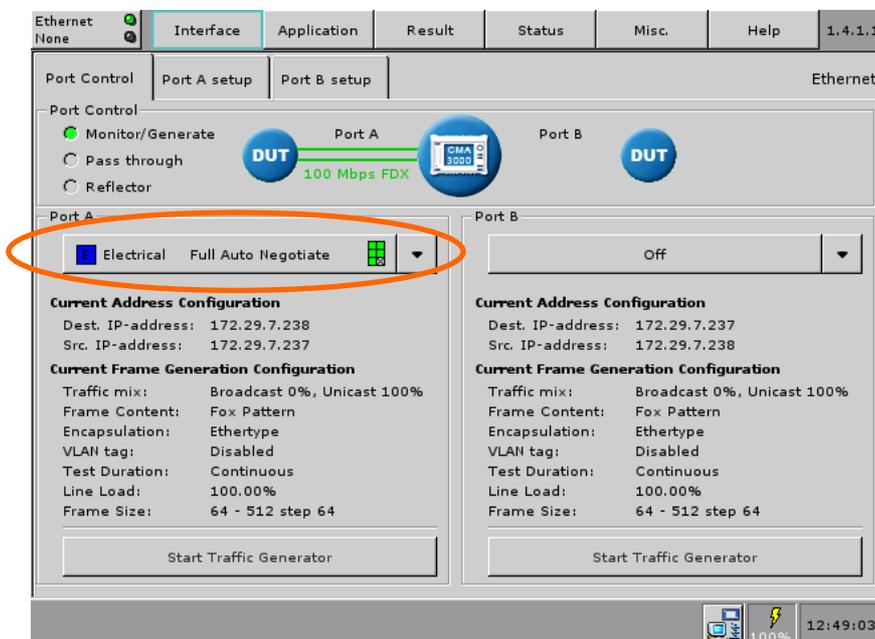
Figure 2 The Interface/Ethernet/Port Control page, where the Ethernet interface is activated.

Two more pages have to be set correctly in the slave instrument to make the test work. In the first page, the IP and MAC addresses are set up.
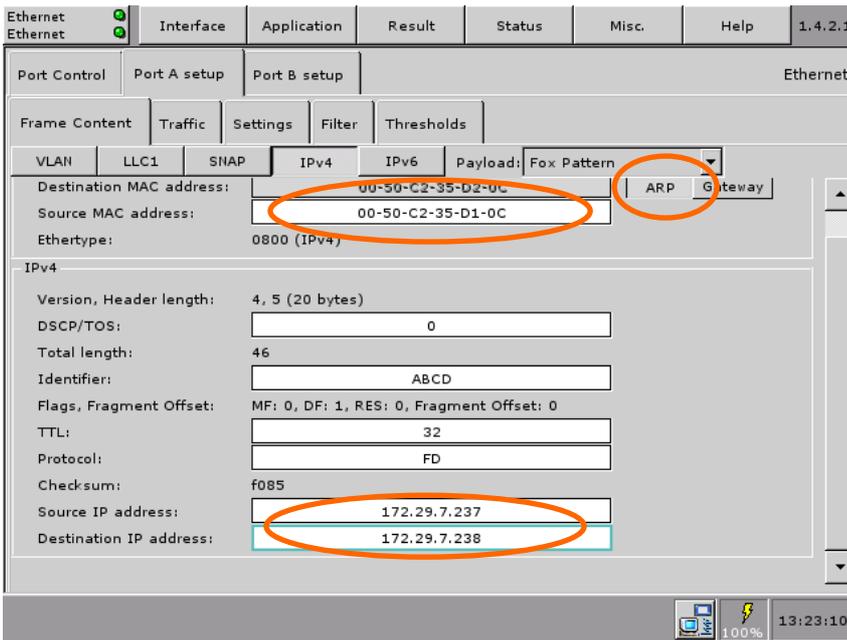
Figure 3 Setting of addresses for the Slave CMA 3000

It is important to set the address of the slave instrument: Source address/IP address and MAC address. The MAC address should be set to the ports default address (this comes as a choice in the setup dialog that appears when the MAC address field is pressed).

Destination address/IP address should be the IP address of the Master CMA 3000. However if that is not known at the time of the setup of the slave instrument, this can be handled from the master instrument (see later). For Destination MAC address it is recommended to click the ARP box, which will make the instrument request the MAC address from the device it is directly communicating with. Otherwise the user will have to identify this address and enter it manually.
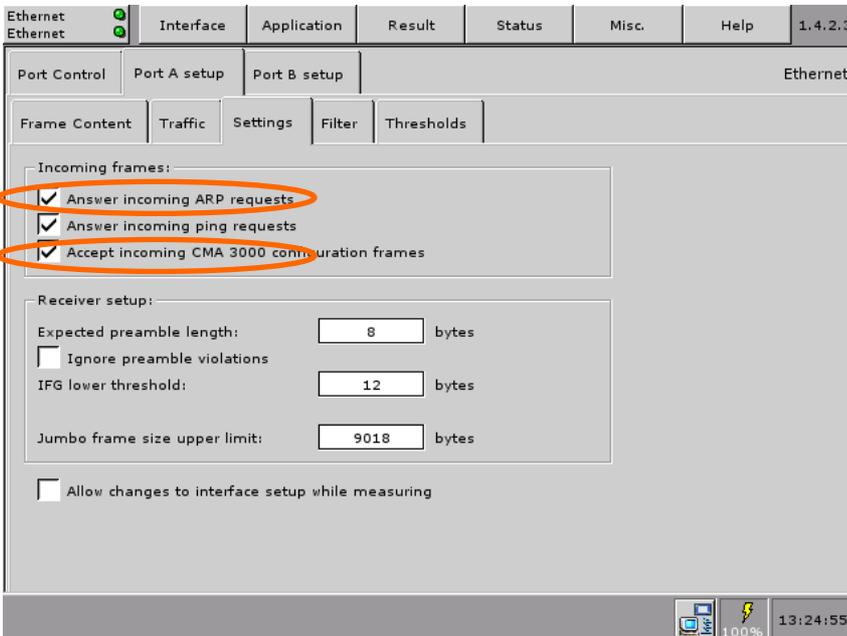
Figure 4 Other general settings of the Slave CMA 3000

In the port A Settings page the "Answer incoming ARP requests" box must be checked. This will allow the instrument to communicate its MAC address to the device it is directly connected to. Also the "Accept incoming CMA 3000 configuration frames" box must be checked. This ensures that the slave CMA 3000 can communicate with the master CMA 3000.

3.0 Setup of master instrument

To set up the master instrument, first the Ethernet interface needs to be activated. In this case, an electrical interface with auto negotiation is selected. Port A is used in this example.
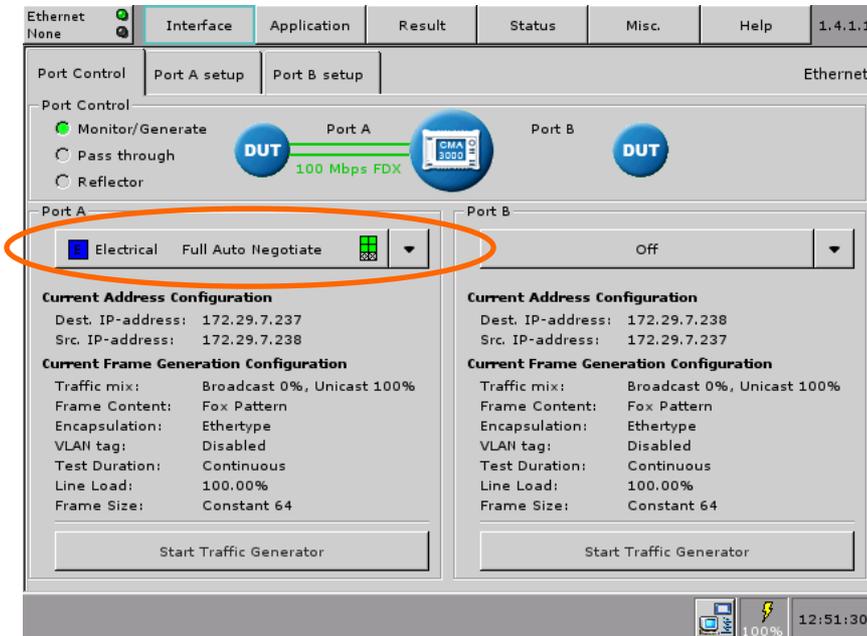
Figure 5 The Interface/Ethernet/Port Control page, where the Ethernet interface is activated.
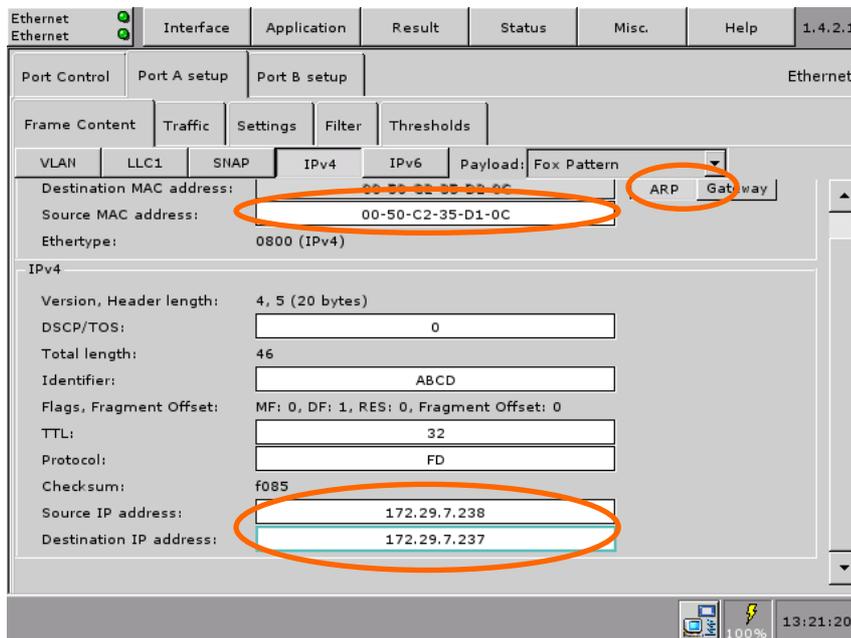
Figure 6 Setting of addresses for the Master CMA 3000

It is necessary to set the address of the master instrument: Source address/IP address and MAC address. The MAC address should be set to the ports default address (this comes as a choice in the setup dialog that appears when the MAC address field is pressed). Destination address/IP address is the IP address of the slave CMA 3000. For Destination MAC address it is recommended to click the ARP box, which will make the instrument request the MAC address from the device it is directly communicating with. Otherwise the user will have to identify this address and enter it manually.
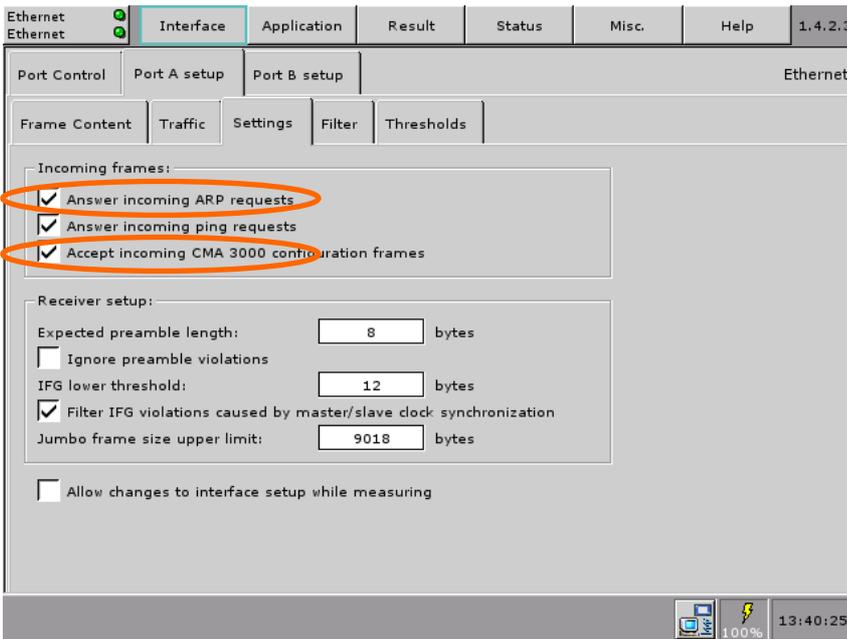
Figure 7 Other general settings of the Master CMA 3000

In the port A Settings page the "Answer incoming ARP requests" box must be checked. This will allow the instrument to communicate its MAC address to the device it is directly connected to. Also the "Accept incoming CMA 3000 configuration frames" box must be checked. This ensures that the master CMA 3000 can communicate with the slave CMA 3000.

The rest of the test setup and the test itself are done in the Application/RFC2544 pages of the master CMA 3000.
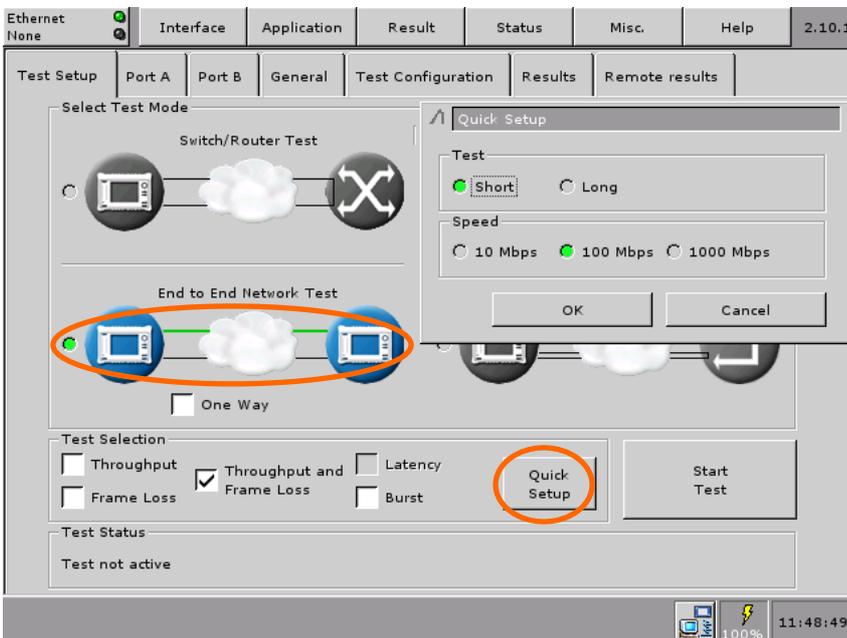
Figure 8 RFC 2544 Test Setup page of the Master CMA 3000

In the test setup page the End to End network test is selected and the needed tests can be chosen by checking the boxes in the Test Selection part of the page. The user can also choose a predefined either short or long test activated by clicking the Quick Setup key. In this case a short test is selected, which sets the instruments to do a combined Throughput and Frame Loss test.

By default a test is done from Master to Slave and from Slave to Master simultaneously. However, in some cases (f.inst. when testing half duplex connections) it can be relevant to test only one of the directions at the time. In that case the user must check the "One Way" box. The direction of the test (from master to slave or from slave to master instrument) is defined in the "General" page.

The detailed configuration of the Throughput and Frame Loss test can be seen in the Test Configuration page. This test use a short, a medium and a long size frame, together with a selection of line loads to test the throughput and frame loss at different loads. The test configured as shown below takes approx. 10 minutes to complete.
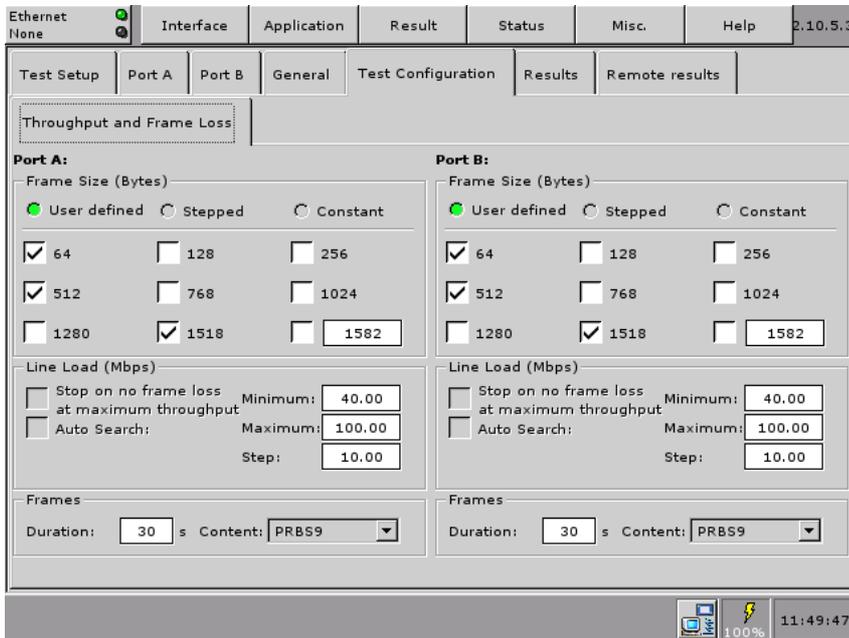
Figure 9 Detailed setup of Throughput test on the Master CMA 3000
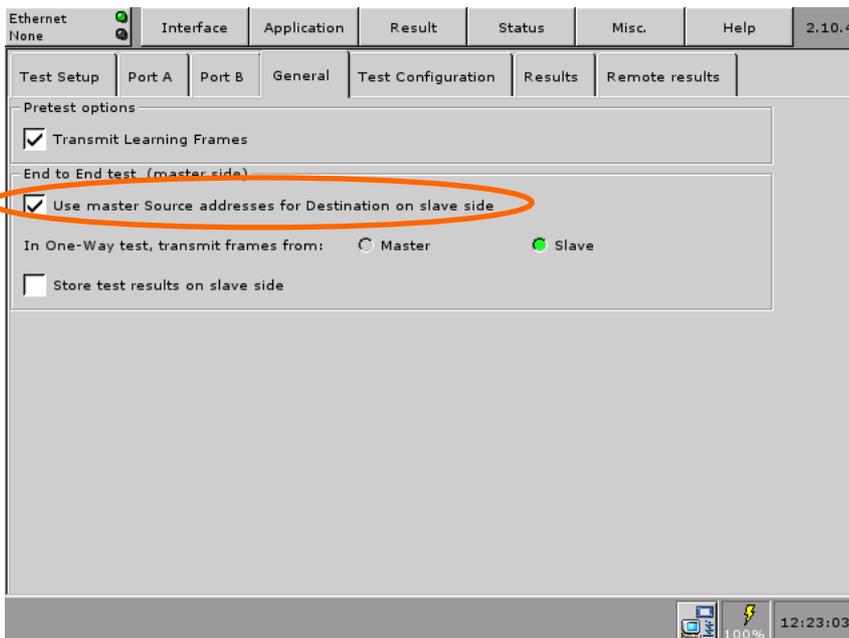
Figure 10 RFC 2544 General setup page of the Master CMA 3000

By checking the "Use master Source addresses for Destination on slave side" the master instrument will, when the test starts, inform the slave instrument to use the source IP address in the incoming CMA 3000 configuration frame (i.e. the address of the master CMA 3000)

In case the test is terminated due to a break of the communication between the two instruments the slave instrument will not be able to transfer test results to the master instrument at the end of the test. To be able to see the slave instruments results anyway, the user can choose to always store the test results in the slave instrument by checking "Store test results on slave side"; then the test results from the slave instrument can be inspected here if they were not transferred to the master instrument

4.0 Start the test

The test is started by pressing Start Test soft key in the RFC 2544 Test setup page of the master CMA 3000. At that time the RFC2544 test setup is transferred from the master to the slave CMA 3000. During the test an indicator on the taps of the test result pages will indicate what test that currently is active. The state of the test and estimated time to complete the test can be seen in the Test Status part of the Test Setup page on the master instrument.
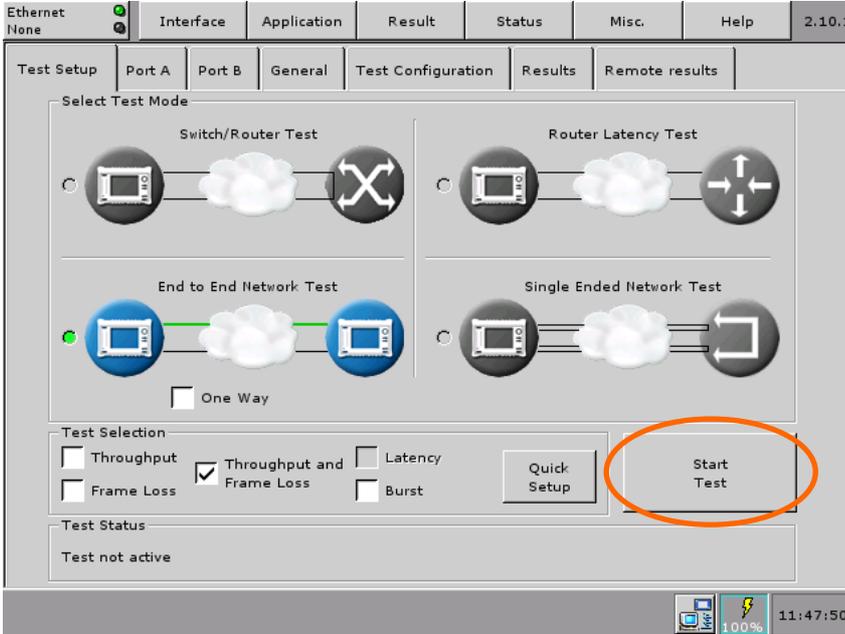
Figure 11 Start the test in the RFC 2544 Test setup page of the Master CMA 3000
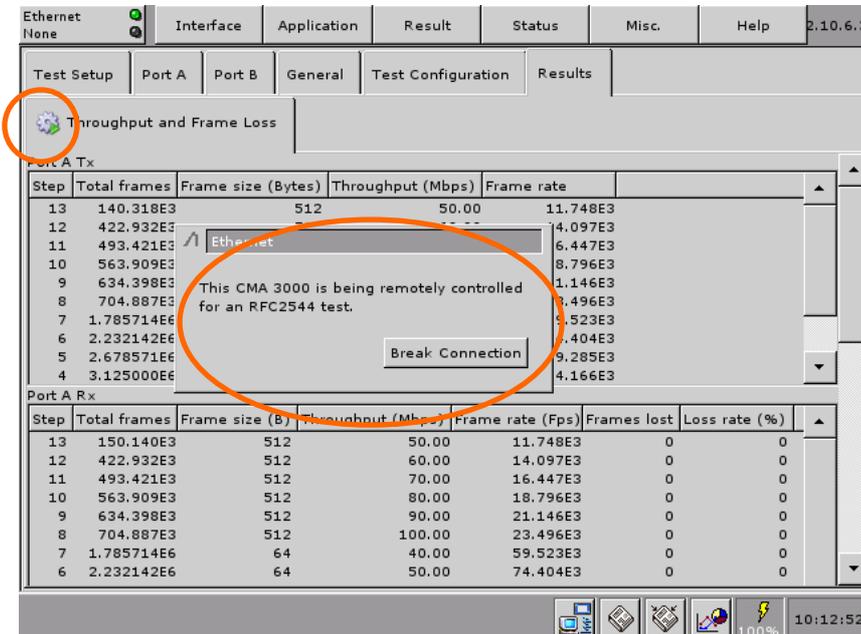
Figure 12 A pop-up on the slave CMA 3000 shows it is remotely controlled during the test. An icon on result page taps indicates the active test

When the test is started on the master CMA 3000, a popup will appear on the slave instrument, stating that the unit is being remotely controlled and providing a 'break connection' button. The popup will disappear when the test is completed or stopped on the Master.

5.0 End of the test

When the test is completed, the test results are transferred from the slave to the master CMA 3000 where they appear alongside the RFC2544 results sub-tap under the name RFC2544 remote results. As for the other RFC 2544 test modes, the user can see the results in a tabular format or as graphs. In the master instrument the results from both instruments are stored in the memory for analysis at a later time. The user can from the master CMA 3000 also get the results from both instruments as files in pdf format. The pdf reports can be output to a memory stick inserted in one of the USB ports of the master CMA 3000 or transferred directly to a PC if the master CMA 3000 is equipped with the FrontSim option. Finally the reports can be output to a HP USB printer.

Figure 13 Test results in tabular form on the master CMA 3000
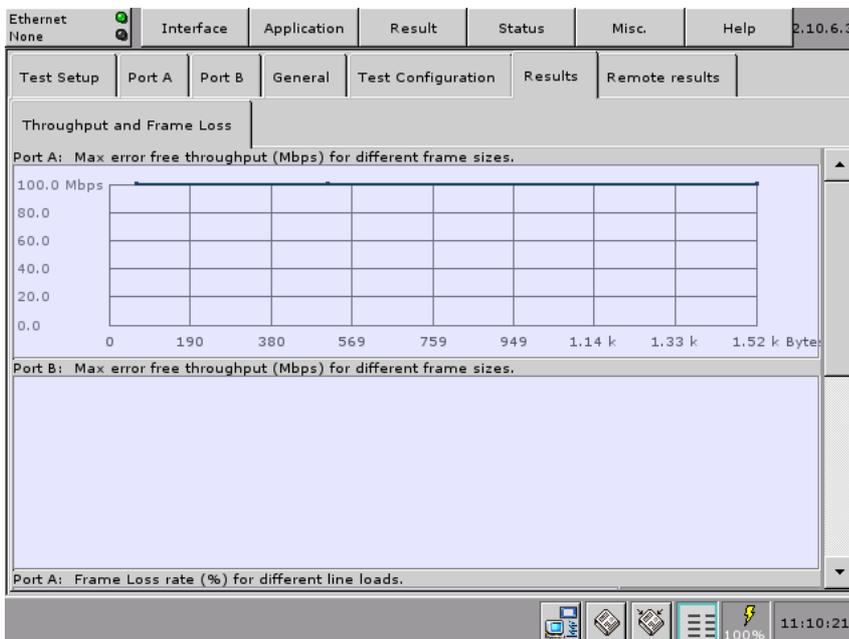
Figure 14 Graphical test results on the master CMA 3000

RFC2544: Throughput & Frame Loss Results

Started: 2006-12-08.10:08:59, Stopped: 2006/12/08 10:22:06

Port A: Max error free throughput (Mbps) for different frame sizes.

Port A: Frame Loss rate (%) for different line loads.
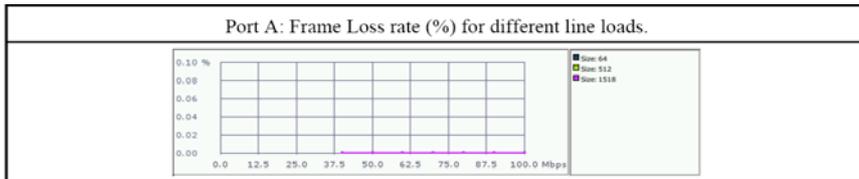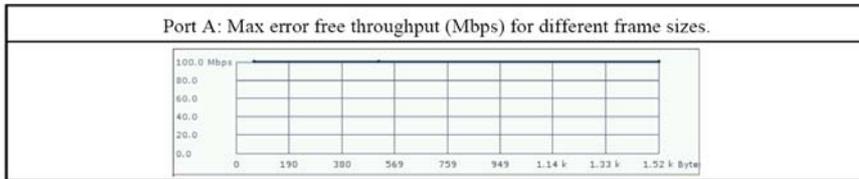
Port A Tx	Total frames	Frame size (Bytes)	Throughput (Mbps)	Frame rate
Step: 21	97.529E3	1.518E3	40.00	3.250E3
Step: 20	121.911E3	1.518E3	50.00	4.063E3
Step: 19	146.293E3	1.518E3	60.00	4.876E3
Step: 18	170.676E3	1.518E3	70.00	5.689E3
Step: 17	195.058E3	1.518E3	80.00	6.501E3
Step: 16	219.440E3	1.518E3	90.00	7.314E3
Step: 15	243.823E3	1.518E3	100.00	8.127E3
Step: 14	281.954E3	512	40.00	9.398E3
Step: 13	352.443E3	512	50.00	11.748E3
Step: 12	422.932E3	512	60.00	14.097E3
Step: 11	493.421E3	512	70.00	16.447E3
Step: 10	563.909E3	512	80.00	18.796E3
Step: 9	634.398E3	512	90.00	21.146E3
Step: 8	704.887E3	512	100.00	23.496E3
Step: 7	1.785714E6	64	40.00	59.523E3
Step: 6	2.232142E6	64	50.00	74.404E3

Figure 15 A part of the pdf report the CMA 3000 can generate of the end-to-end test as documentation of the test results

Notes

The test described in this application note was made with two CMA 3000s running SW version 3.10

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