

Testing minimum Inter Frame gap (IFG)



APPLICATION NOTE

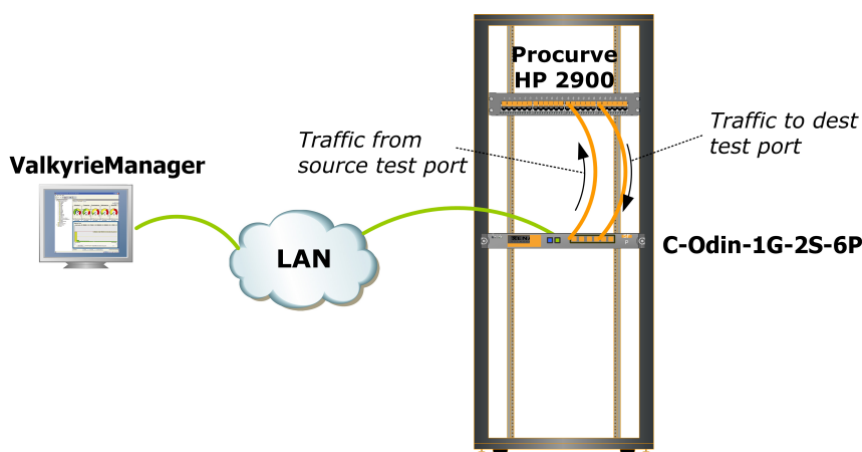
How to test the minimum IFG spacing.

The Teledyne LeCroy Xena testers can verify traffic forwarding performance, protocol scalability and services delivering capabilities of switching and routing devices across the enterprise, metro/edge and core.

The test engineer can use the Teledyne LeCroy Xena tester to examine the robustness and behavior of the Device-Under-Test (DUT) / Network under Test (NUT) when loaded with traffic patterns violating the IEEE defined minimum spacing between Ethernet packets. This application note uses an example test setup with a HP Procurve 2900 24G switch to illustrate how to stress test the minimum IFG spacing.

Test Setup

The test setup is shown in Figure 1. A source test port sends Ethernet frames through the device under test (DUT) while real-time performance statistics are measured by the Teledyne LeCroy Xena tester on the destination port. In this test the DUT is a HP Procurve 2900 24G (J9049A) Switch.



▪ Figure 1 Test setup with HP Procurve 2900 24G

Stress Testing Inter-Frame Gap (IFG)

The IEEE 802.3 defined minimum spacing between Ethernet frames is 20B when including the 8B packet preamble. The Teledyne LeCroy Xena testers can be used to verify the DUTs ability to support the minimum required IFG, and also to analyze the DUTs behavior when loaded with traffic patterns where the standard defined minimum IFG is violated. The following steps illustrate how the Teledyne LeCroy Xena tester can be used to analyze the DUTs behavior when presented with non-compliant inter-frame gap spacing between incoming packets.

Step 1: Select two test ports. Reserve a source and a destination port on the Teledyne LeCroy Xena tester. In this example, the source port is Chassis XB-2 / Module 7 / Port 3, and the destination port is Chassis XB-2 / Module 7 / Port 4. See Figure 2.

Step 2: Teach DUT the MAC address of the destination port. On the destination test port (Chassis XB-2 / Module 7 / Port 4), setup a traffic stream sending packets to the source port, so that the DUT device learns the MAC address of the destination port. Then start the traffic generation to send the traffic from the destination test port to the source test port to teach the DUT the addresses. Unlink the traffic Start on the destination port from the global Start button to ensure that traffic will keep running, so that the MAC learning table entries in the DUT do not expire. See Figure 3, and Figure 4.

Step 3: Define traffic on the source test port. On the source test port (Chassis XB-2 / Module 7 / Port 3), define a simple Ethernet stream with a fixed 64-byte packet length and 100% uniform traffic load. See Figure 5.

Step 4: Verify throughput with IFG = 19B. Any IEEE 802.3 compliant 1000 Mbps Ethernet port on the DUT must be able to handle a minimum IFG of 19B, meaning that the DUT is able to receive and process an incoming packet stream where all packets are just 19B apart (including preamble). However, the DUT will not be able to forward all packets to the Teledyne LeCroy Xena tester, because the DUT will always transmit using a standard compliant minimum IFG of 20B, and we should therefore expect that a percentage of the packets will be dropped inside the DUT.

When sending 64B-packets packets from the Teledyne LeCroy Xena tester and using an IFG of 19B, the expected number of transmitted packets per second can be calculated as $125,000,000 \text{ MBps} / (64\text{B}+19\text{B}) = 1,506,024 \text{ packet per second (pps)}$. See Figure 6.

The received number of 64B-packet from the tester is measured to be 1,488,089, and these packets are transmitted by the DUT using a standard minimum IFG of 20B (including preamble). Since the DUT in this traffic scenario is discarding packets due to the overload of the receiving DUT port, it is interesting to observe how this affects the IFG spacing on the transmitting DUT port and we can use a Rx IFG on the destination test port histogram for that purpose. The histogram shows that the DUT transmits 99% of the packets using an IFG of 20B, and that the remainder of the packet are transmitted with IFGs just above and below 20B, most likely as a result from the packet discard which the DUT must performs when its buffers overflow. See Figure 8.

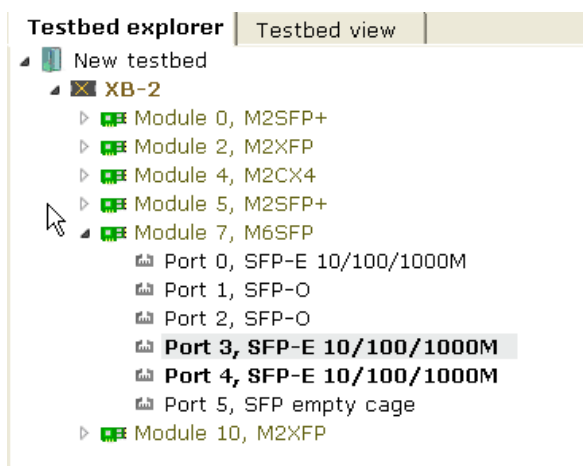
We can also deduct the nominal line rate clock frequency between the Teledyne LeCroy Xena tester and the DUT by doing a simple extrapolation. Theoretically, if the DUT was able to transmit with an IFG = 19B, then DUTs transmit rate would be $1,488,089 * 84\text{B} / 83\text{B} = 1,506,017 \text{ pps}$. When we compare this number to the number of packets transmitted by the Teledyne LeCroy Xena tester) when using a 19B IFG (which was 1,506,024 pps), we can calculate the difference in line rate clock frequency as $(1,506,024 - 1,506,017) / 1,506,024 = 4 \text{ ppm}$, or in other words, the line rate clock frequency of the Teledyne LeCroy Xena tester is 4 ppm higher than the line rate clock frequency of the DUT.

Step 5: Verify throughput with IFG = 18B.

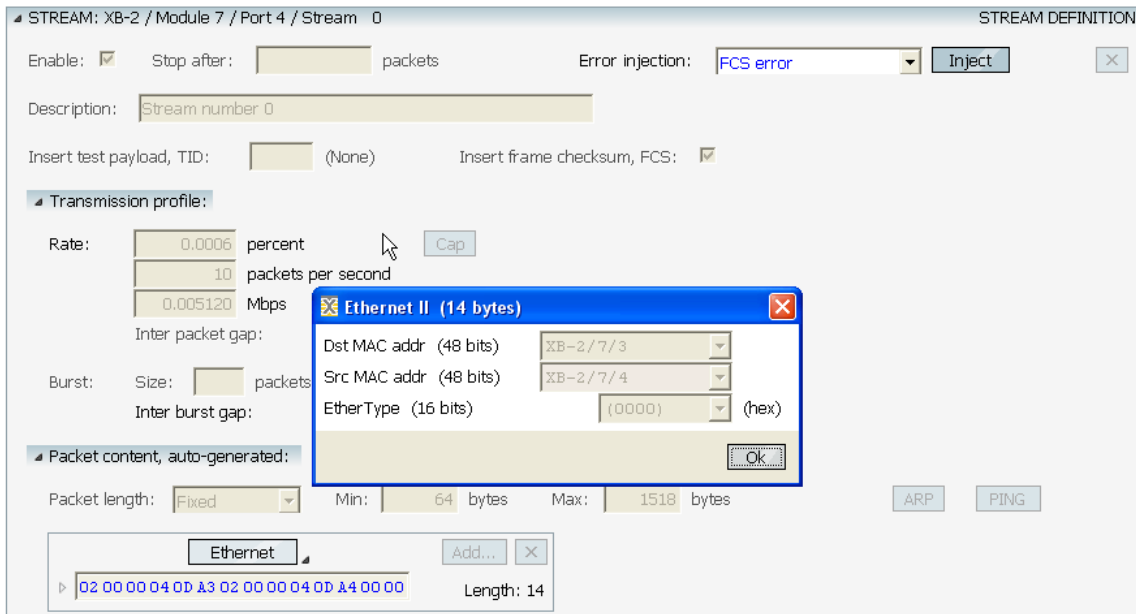
When the DUT receives a stream of packets spaced just 18B apart, we expect the DUT to identify this traffic pattern as non-standard compliant due to the violation of the minimum IFG spacing, and we can use the Teledyne LeCroy Xena tester to analyze the behavior of the DUT in this scenario.

The DUT basically stops forwarding traffic, with only one percent of the traffic received by the DUT being forwarded. The behavior of a network device when loaded with a non-standard IFG traffic pattern is typically implementation specified from vendor to vendor.

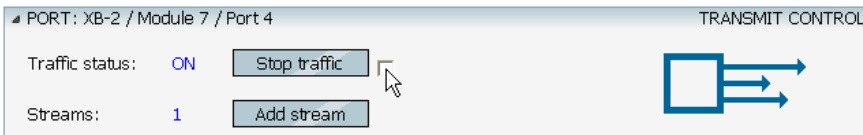
XenaManager screenshots for test steps 1 to 7



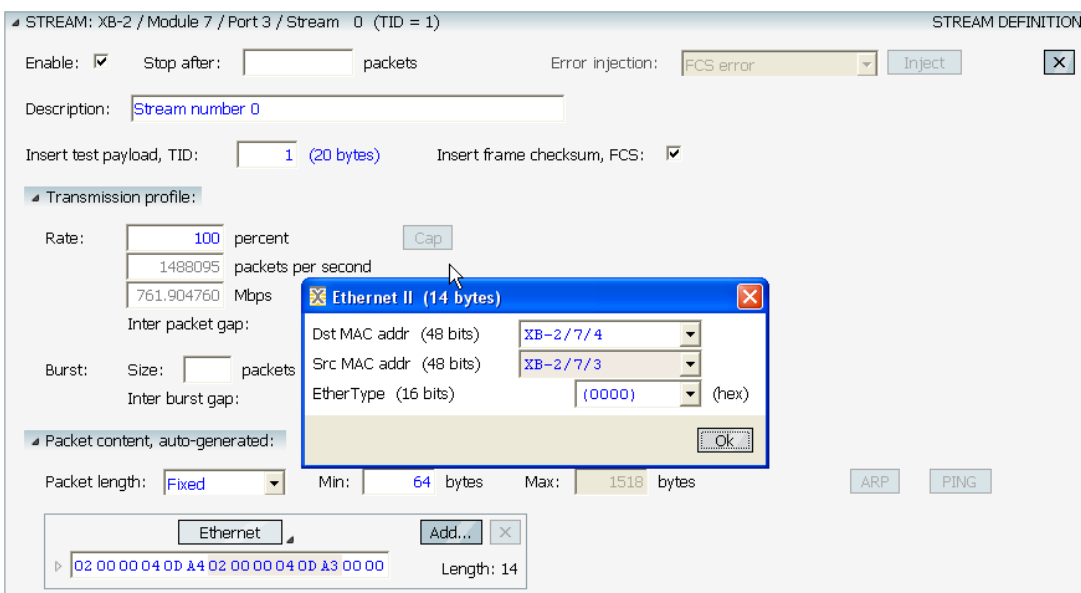
- Figure 2 Select two test ports ([step 1](#))



- Figure 3 Teach the DUT the MAC of the destination port ([step 2](#))



- Figure 4 Send the MAC address training packet forever, to avoid MAC learning table timeout ([step 2](#))



- Figure 5 setup traffic on the source test port ([step 3](#))

PORT: XB-2 / Module 7 / Port 3

Reserved by: MNI

Description:

Minimum inter-frame gap: bytes

MAC address:

MAC training:

React to pause frames:

PORT: XB-2 / Module 7 / Port 3 TRANSMIT STATISTICS

		Mbits/sec	Packets/sec	Bytes	Packets
Total traffic for port:	100%	771.084	1,506,024	10,230,638,272	159,853,723
Without test payload:	0%	0.000	0	0	0
Stream traffic:					
Stream 0 (TID = 1):	100%	771.084	1,506,024	10,230,639,552	159,853,743

Error injection:
 ARP and PING:
 Miscellaneous:

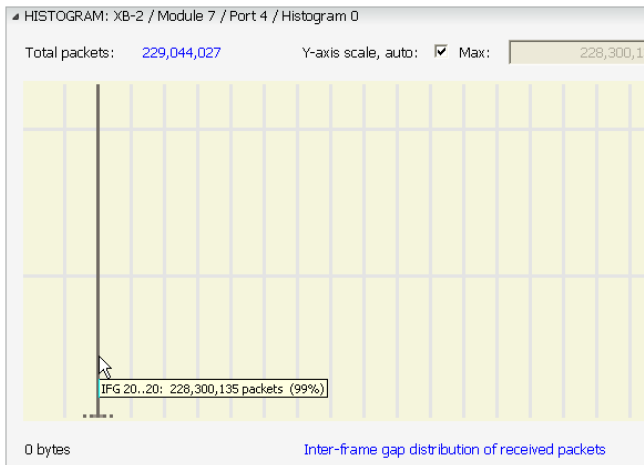
- Figure 6 Tester Tx rate when using 19B IFG and 64B-packets ([step 4](#))

PORT: XB-2 / Module 7 / Port 4 RECEIVE STATISTICS

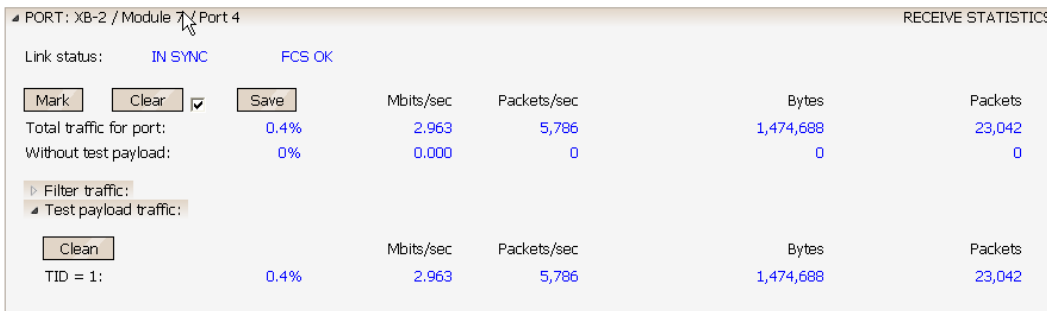
Link status: IN SYNC FCS OK

		Mbits/sec	Packets/sec	Bytes	Packets
Total traffic for port:	100%	761.901	1,488,089	968,725,632	15,136,338
Without test payload:	0%	0.000	0	0	0
Filter traffic:					
Test payload traffic:					
<input type="button" value="Clean"/>					
TID = 1:	100%	761.902	1,488,088	968,728,000	15,136,376

- Figure 7 DUT transmission rate ([step 4](#))



- Figure 8 DUT Tx IFG when in an overloaded state ([step 4](#))



PORT: XB-2 / Module 7 / Port 4 RECEIVE STATISTICS
Link status: IN SYNC FCS OK
Mark Clear Save
Mbits/sec Packets/sec Bytes Packets
Total traffic for port: 0.4% 2.963 5,786 1,474,688 23,042
Without test payload: 0% 0.000 0 0 0
Filter traffic:
Test payload traffic:
Clean
TID = 1: 0.4% 2.963 5,786 1,474,688 23,042

- Figure 9 Significant packet drop in the DUT with IFG = 18B ([step 5](#))