155 Mb/s ATM

Bit Error Rate Test

Fanny Mlinarsky

Overview

This test demonstrates how the characteristics of an ATM channel above 100 MHz affect the robustness of 155 Mb/s ATM network. A series of Bit Error Rate (BER) measurements were performed on two category 5 channels that have similar properties up to 100 MHz but differ above 100 MHz in that one of the channels has a defect at 124 MHz.

The channel with the defect above 100 MHz but that nevertheless passed the category 5 certification, exhibited BER of 9.6×10^{-8}, which significantly violates the maximum BER of 10^{-10} specified by the AF-PHY-0015.000 ATM Forum standard. By contrast, the channel with consistent behavior up to 155 MHz exhibited BER of 1.1×10^{-11}.

Test Set-up

The BER test was performed using two 155 Mb/s ATM physical layer evaluation boards connected to the Microwave Logic BER measurement system. The evaluation boards were supplied by the manufacturer of the physical layer device, a device that is incorporated into a number of existing 155 Mb/s products. The boards included standard magnetics and clock recovery. One board was connected to the pattern generator -- gigaBERT-660 Tx. The other board was connected to the BER analyzer -- gigaBERT-660 DRx.

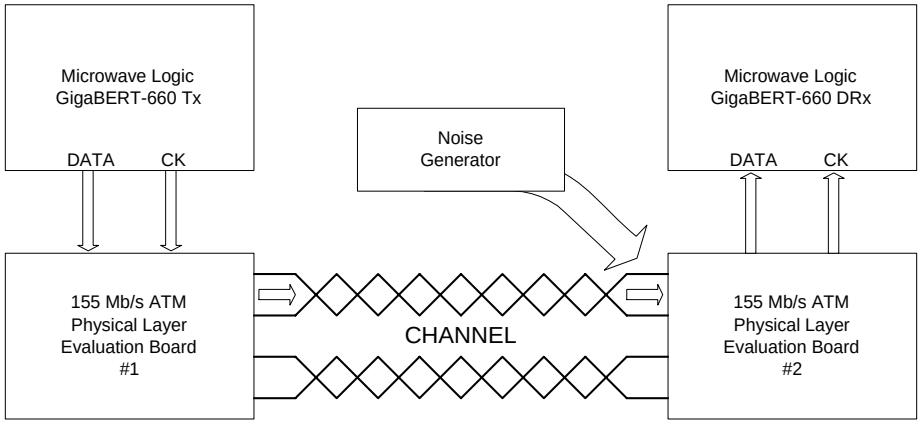

Figure 1: **Test setup**

The data was transmitted in one direction only and noise was added to the received signal. The noise source was a swept sine wave measuring 20 mV ptp[1]. The following 8 byte data pattern was constantly repeated:

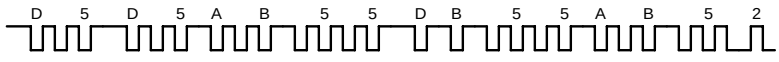

Figure 2: **Data pattern used in the BER test**

[1]Section 5.3.1 of the AF-PHY-0015.000 ATM Forum standard specifies maximum channel noise of 20 mV ptp.

As Figure 2 shows, the data pattern had very frequent transitions so that the clock recovery circuit worked exceptionally well and exhibited no measurable jitter. GigaBERT-660 DRx analyzed the received data pattern, counted the errors and computed the Bit Error Rate.

The two cables used in the test exhibit the following attenuation and NEXT characteristics:

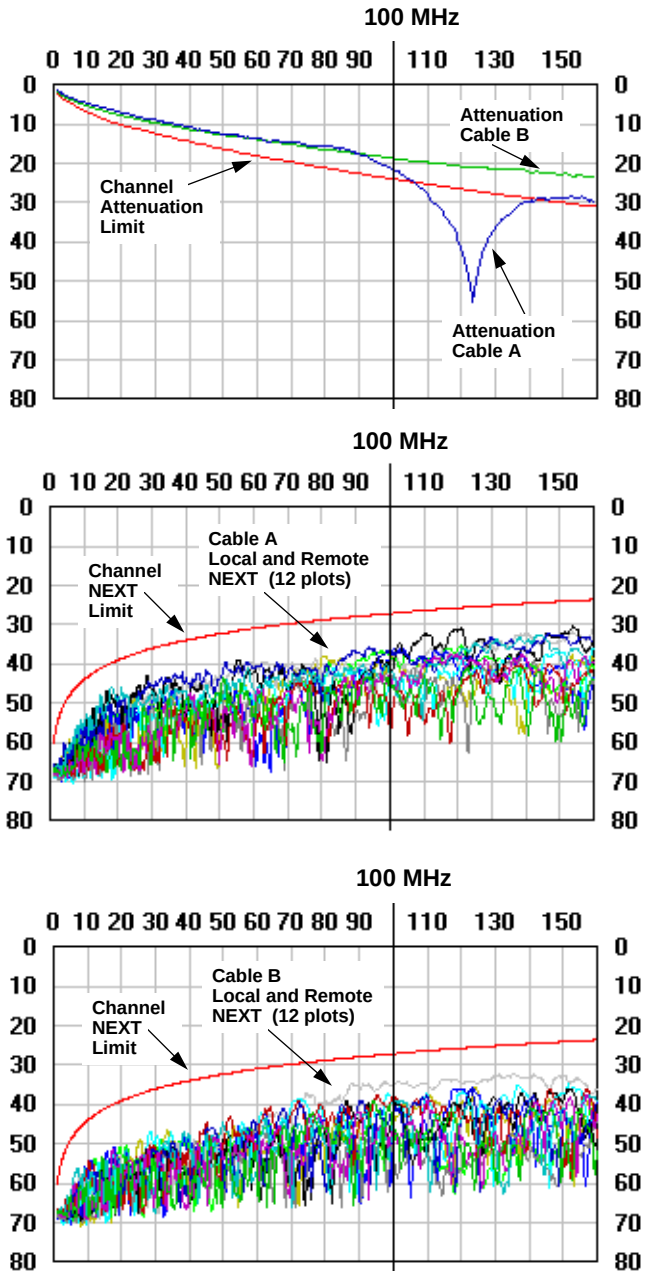

Figure 3: **Attenuation and NEXT properties of cables A and B used in the BER test**

Although cable A exhibits an abnormal attenuation response with a notch at about 124 MHz, it meets the category 5 limits for attenuation and NEXT with good margins. Cable B exhibits normal behavior all the way up to 160 MHz. The attenuation responses of the two cables are almost identical below 100 MHz. The NEXT responses are very similar up to 160 MHz.

Following is a photograph of the test setup:

Figure 4: **Photo of the test setup**

Test Procedure

Cables A and B were first characterized using the HP4195A analyzer and the WireScope 155. The measurements collected by the two instruments were in good agreement. Both cables passed the TSB-67 compliant category 5 certification. However, cable A failed the WireScope 155 extended frequency certification while cable B passed this test.

The BER tests were run over cables A and B. The BER test with each cable exhibited very repeatable and easily reproducible results. The data pattern and noise level remained the same throughout the duration of the test. The only variable in the test setup was the cable -- Cable A or Cable B.

Test Results

The BER performance figures shown below were obtained after a 12 hour test with each cable.

CABLE	TEST TIME	BER	Meets ATM Forum BER Spec? (10^{-10})
A	12 hours	9.6×10^{-8}	**NO**
B	12 hours	1.1×10^{-11}	**Yes**

Analysis of Results

The BER test described above is a very simple but powerful demonstration of the fact that ATM signal energy above 100 MHz is significant. This test demonstrates that a twisted pair channel can have flaws above 100 MHz, which are not detectable by a TSB-67 compliant category 5 certification, but which can nevertheless have devastating effects on the ATM network's BER performance.

The two cables used in the test appear to be very similar up to 100 MHz (Figure 3) and would not raise any concerns about the operation of the 155 Mb/s ATM network if extended frequency data was not available. However, our test demonstrates that these two cables would yield vastly different quality of service to the 155 Mb/s ATM users. Cable B, which behaves as expected over the extended frequency range, would maintain superior BER performance. Cable A, which has a flaw at 124 MHz, would violate the BER requirements of the ATM Forum standard by 2 orders of magnitude and would result in a significantly slower data throughput than cable B.

The test also demonstrates that it is possible for an installation to be certified as category 5 but still have defects that could render the BER performance of a 155 Mb/s ATM network non-compliant with the ATM Forum AF-PHY-0015.000 standard.

Conclusion

The BER test performed on the cables with and without defects above 100 MHz demonstrates that characterizing category 5 installations up to 100 MHz may not be sufficient to guarantee proper operation of twisted pair 155 Mb/s ATM networks.

The results of this test suggest that it is prudent to apply extended frequency field testing to the category 5 installations expected to carry 155 Mb/s ATM traffic.

753 Forest Street, Marlborough, MA 01752
♦ 800-418-7111 ♦ 508-786-9600
♦ 508-786-9700 Fax