

MEASURING NEXT AND FEXT

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The technological advancements in telecommunications over the last decade have increased the demand for more services and variety in service offerings. The evolution of digital subscriber line (DSL) technologies and the increase in bandwidth are some of the changes that have resulted from this technological advancement, yet this evolution also presents new testing challenges to service providers who are determined to ensure quality of service (QoS) to their customers. In order to ensure QoS, service providers must use effective approaches for measuring noise, which adversely affects the desired signal as it passes through the transmission path—resulting in a corrupted signal that can be misinterpreted by the receiver, which translates to errors in the digital bit stream.

NEXT (Near-End Crosstalk)

NEXT is defined as noise induced between adjacent pairs at the near-end of the link (i.e., at the end closest to the point of the signal origin), since this is the point where the outgoing downstream signal is at maximum strength and the incoming upstream signal is at minimum strength—signals can easily couple if the attenuation-to-crosstalk ratio (ACR) is not maintained at acceptable levels. For example, a modem is transmitted onto a pair and inducing signal into the receiver of an adjacent pair—whether on the exchange side or the customer side, NEXT will be prevalent.

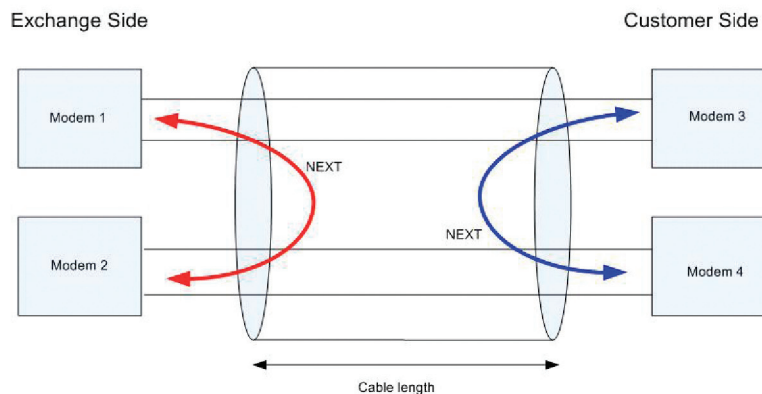


Figure 1. Near-end signal coupling or NEXT

Measuring NEXT

NEXT is measured by applying and measuring the signal transfer level at the same end. With the AXS-600 series or the CableSHARK, the PSD Noise test can be used to measure the amount of NEXT. Figure 2 illustrates NEXT measured at the exchange side, but the same could be done at the customer side by moving the unit down to that end. Note that the customer side modems have been removed from Figure 2 since they also generate signal onto the measured pair, which would add to the noise measurement.

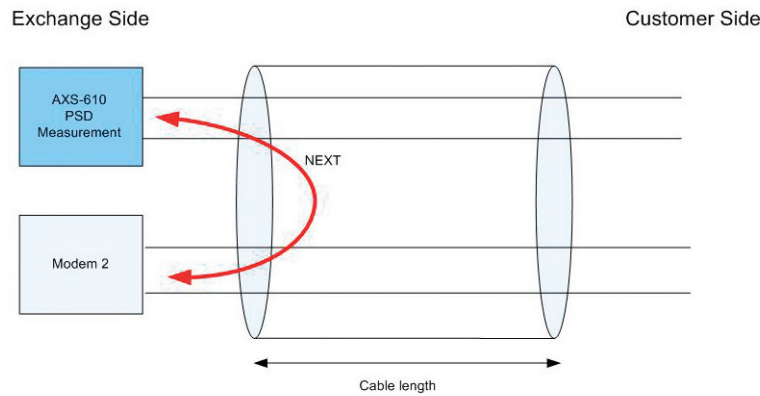


Figure 2. Measure NEXT using AXS-610 PSD analysis

FEXT (Far-End Crosstalk)

FEXT is defined as noise induced onto an adjacent pair by a transmitter on the near-end of pair 1 onto the receiver at the far-end of pair 2. FEXT should not adversely affect services at the customer premises, as the cables are successively smaller, containing fewer and fewer twisted pairs from the central office (CO) to the premises, so there are fewer opportunities for signals to experience co-interference—NEXT will always overpower FEXT in terms of power levels. On long loops, the FEXT signal becomes extremely attenuated.

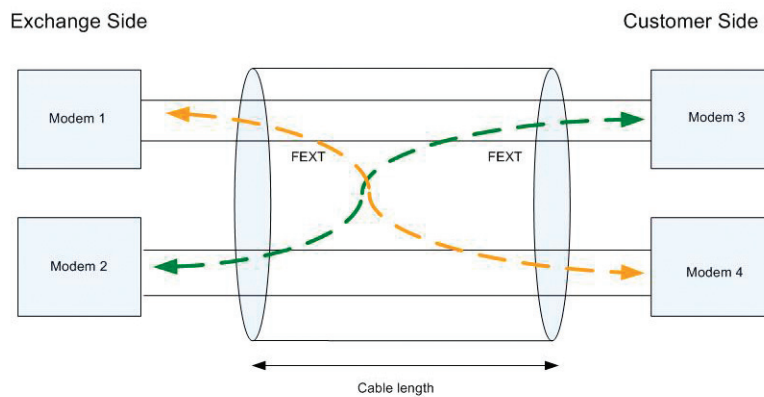


Figure 3. Far-end signal coupling or FEXT

Measuring FEXT

FEXT is measured by applying the disturbing signal on one pair at the near-end and measuring the signal transfer on the disturbed pair at the far-end. Two approaches can be used to measure FEXT:

1. Use the power spectral density (PSD) measurement and place a unit at both ends of the circuit. PSD is not measured FEXT in a 'true' sense, but this approach gives insight into how much noise is at the far-end—across a wide spectrum, including other noise sources as well which, is valuable data in addition to XTALK (crosstalk).
2. Using two AXS-610 30 MHz Copper Test Sets, use the first unit to send tone on pair no. 1 and use the second unit on pair no. 2 to receive tone, then compare the difference in power level.

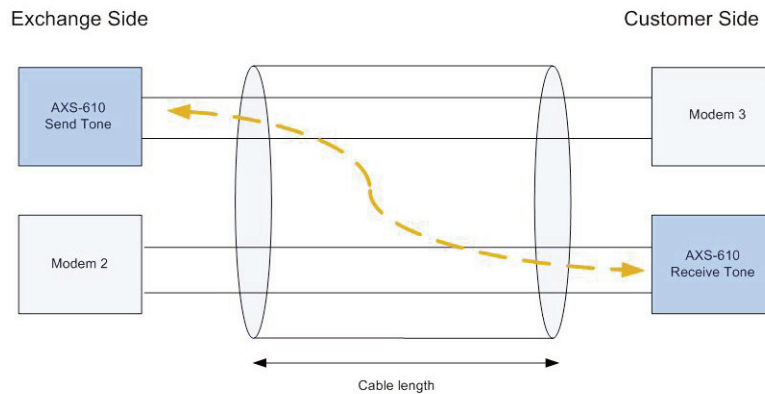


Figure 4. Measure FEXT with two AXS-610 test sets

The limit of using this approach is that you have to compete with NEXT. Therefore, provided that the send tone power level is high enough and using a unique frequency (different from that which the technology on the pair uses) and that the loop is short enough, a FEXT measurement may be obtained.

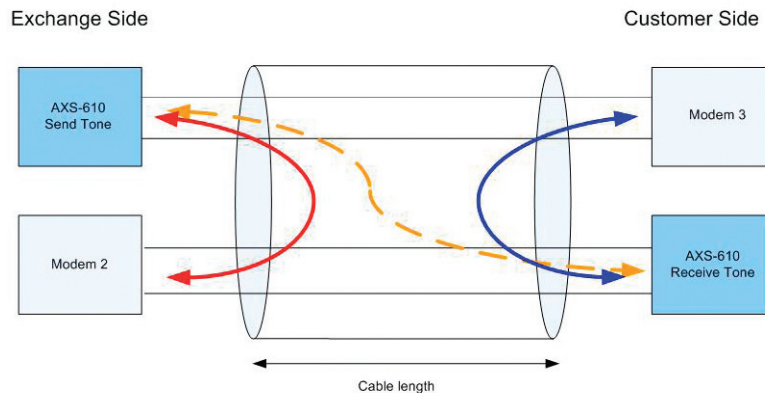


Figure 5. NEXT interferes with FEXT measurements

Conclusion

Due to the presence of crosstalk, the nature of NEXT and FEXT, asymmetrical services such as ADSL and the employment of higher frequencies to achieve higher data rates (especially in the downstream direction toward the customer), the effect of XTALK is more critical than ever, but especially NEXT. The asymmetrical, high-frequency output of services such as ADSL couple more easily onto adjacent pairs, but do not propagate as far down the wire, creating a greater NEXT versus FEXT. This has the effect of reducing SNR in the high-frequency, downstream transmitters, as well as near-end adjacent receivers (versus far-end receivers). This reduces the effect of FEXT, while challenging us to focus more on NEXT—and not only NEXT, but all noise sources that affect already critical SNR levels.

Modern, spectral analyzers (power spectral density) provide a wide and comprehensive picture of the total near-end noise situation, whether XTALK or foreign noise sources that reduce signal-to-noise ratio (SNR) and impact the ability to deliver promised data rates and new services. In view of modern, adaptable, power agile services, traditional NEXT/FEXT measurements are insufficient to guarantee QoS. Operators must understand not only the circuit quality but the environment around the circuit in order to reliably deploy modern high-bandwidth, high-frequency services required for video and triple-play.

Note: Wideband, spectral noise measurements are available on EXFO AXS-600 series and CableSHARK product lines.

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