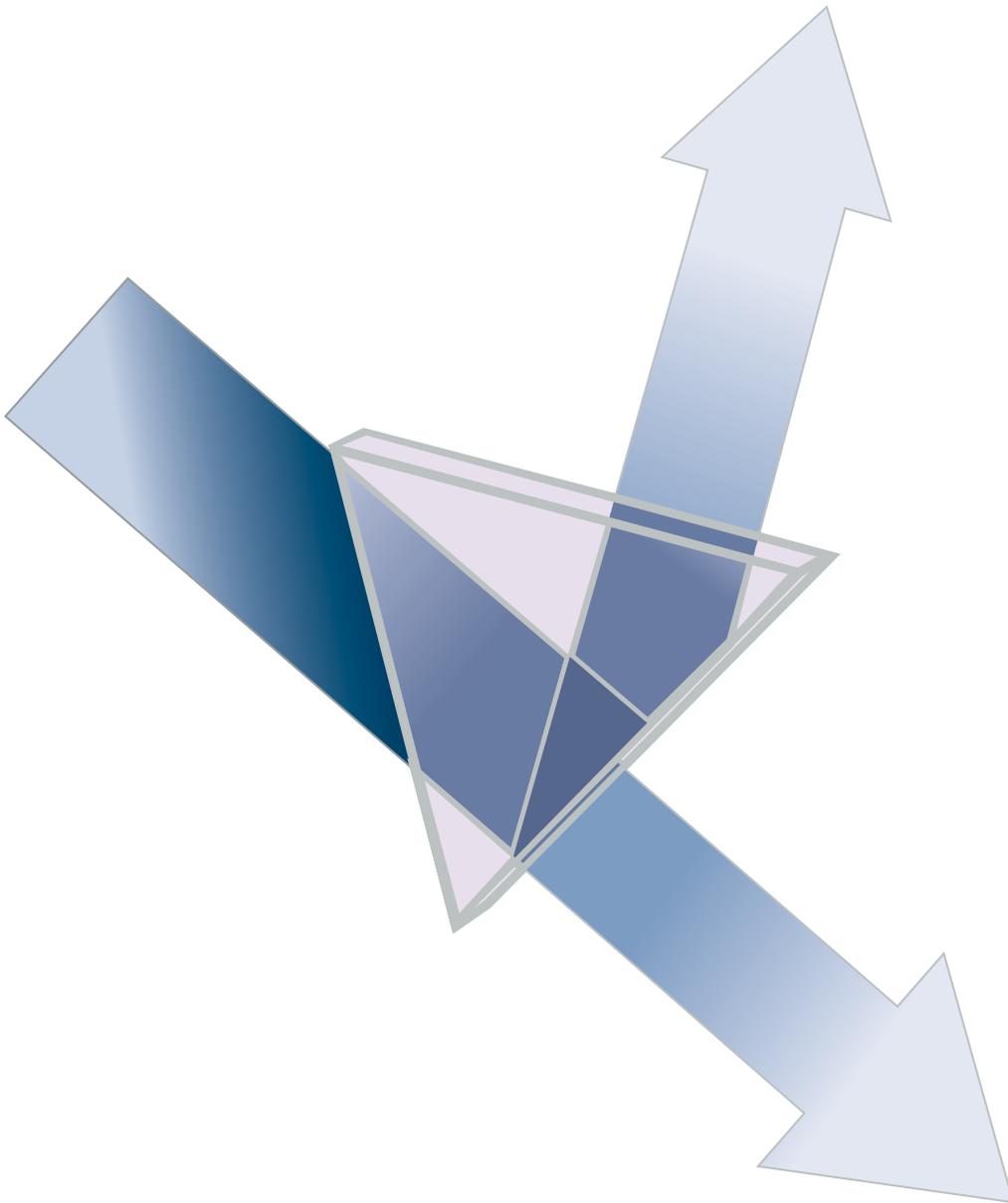


Optical Signal Attenuation and Network Performance

Network administrators who manage optical links have the added challenge of dealing with signal attenuation—the rate at which light dissipates over a network. Attenuation is caused by a number of factors and can affect both network performance and the ability to analyze the network. This paper explains what signal attenuation is, what causes it, and how it affects a network.



Introduction

Excessive signal attenuation can cause link failure. However, understanding signal levels, selecting the right split ratio on devices, and carefully managing the location of repeaters can prevent problems. This white paper defines attenuation, explains how it's affected by fiber and other optical elements on a network, and how it can be efficiently managed.

Attenuation

Attenuation is the reduction of signal strength during transmission. Greater signal loss equals higher attenuation. A signal can lose intensity, or experience increased attenuation, with each surface or medium it traverses.

Optical signal strength is measured in decibels (dB) and is based on a logarithmic scale. If a signal attenuates too much, the destination device cannot identify it, or worse, it may not even reach the destination. This is why some optical links depend on repeaters, which amplify the signal.

Many factors contribute to the attenuation rate of signals including devices such as **Test Access Ports (TAP)** and transmission through **optical cables**.

TAPs

TAPs are used to provide access to the data streams passing through a high-speed, full-duplex network link (typically between a switch and device of interest). They guarantee complete data transfer to a monitoring device for accurate analysis. An optical TAP optically splits the full-duplex signal into two signals. One signal maintains the network link, while the other is simultaneously passed to the analysis or monitoring appliance. As with all devices inserted into an optical link, one side effect of TAP usage is signal attenuation.

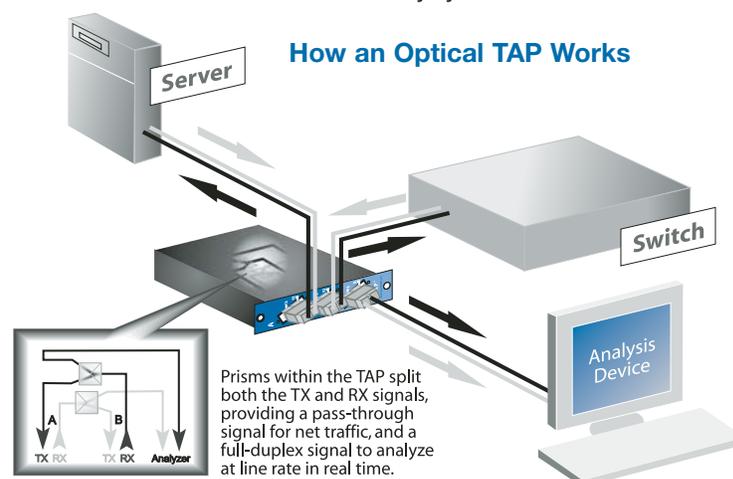


An optical TAP contributes to signal attenuation, but typically not enough to make a significant difference on the network.

A TAP attenuates the signal for two reasons:

- 1) A portion of the signal strength is "siphoned off" and sent to the analyzer. How much of the signal strength is redirected for analysis depends on the split ratio of the TAP.
- 2) The connections and internal TAP cables absorb and refract a portion of the signal.

An optical split ratio must be designated on each TAP. In most cases, a 50/50 split ratio is ideal, providing sufficient light to the network and monitoring device. However, there may be special cases that require a network administrator to designate an alternative ratio in order to meet signal power needs. For example, if a TAP is cabled close to the analyzer NIC (network interface card), and the link under test requires a long cable run, you may want to provide more power back to the network than the monitoring device. However, it may be more appropriate to implement a repeater on that segment. If you do choose an alternate ratio, keep in mind that the signal has to be strong enough for it to be interpreted at the destination. Table 1 shows an example of attenuation caused by a TAP at different split ratios. The rate of TAP attenuation can vary by TAP manufacturer.



Optical Cables

Optical cables also contribute to signal attenuation. As light travels through an optical cable, some of its energy gets dispersed and absorbed by the cable. The attenuation rate varies depending on the cable type used.

Depending on your gigabit transmission technology, you may be required to use a specific cable type. Examples include single-mode (for ZX or LX gigabit) and multimode (for LX or SX gigabit). Multimode cable has a larger core diameter than single-mode cable, resulting in greater light dispersion. Unless the cable run is extremely long, the signal attenuation for both cable types will be negligible. However, multimode cable does cause higher signal attenuation than single-mode cable. Check with the cable manufacturer to determine specific attenuation rates.

TAP Split ratio	Attenuation	
	Single-mode	Multimode
50/50	4.0/4.0 dB	4.4/4.4 dB
60/40	2.9/5.0 dB	3.6/5.6 dB
70/30	2.3/6.2 dB	3.0/6.9 dB
80/20	1.7/8.0 dB	2.4/8.8 dB
90/10	1.2/11.4 dB	1.9/11.9 dB

Table 1

Managing Signal Attenuation

Managing signal attenuation is critical for running a network at optimal performance. A problem arises when a signal is attenuated so much that the destination can't interpret the signal or the signal fails in route. Repeaters can help, but they can become costly and inconvenient to implement. In general, unless a signal has to travel a long distance, there should not be a problem. The most efficient and cost-conscious way to manage attenuation is to measure signal levels throughout the network and place repeaters only when and where they are needed.

To determine if a light signal is at an acceptable level at any point on a network, it's helpful to use an optical power meter. Optical power meters measure signal power at a port, helping you determine whether a device is receiving a strong enough signal and thereby identifying if repeaters need to be placed. The meters are typically inexpensive and are offered from a number of vendors.

Conclusion

Signals naturally lose intensity over distance, but factors such as network devices and cable mode can contribute to increased attenuation. For a network to run effectively and efficiently, attenuation must be taken into consideration to ensure the signal will reach its destinations at a powerful enough strength to be successfully interpreted.