How to Select the Proper Split Ratio on 10G Fiber-Optic Links

Introduction

Passive fiber-optic splitters are the preferred tool for monitoring fiber-optic communication links, both because of their reliability and their relatively low cost. In a properly configured monitoring setup, you can count on a passive fiber-optic splitter for reliable delivery of the received optical signal to both the main signal path (the link) and the splitter path's connected tools without concern for packet loss.

Passive fiber-optic splitters work by diverting a portion of the optical signal to a "splitter path" for analysis tools while leaving the remaining light for the link itself. Successful deployment of a passive fiber-optic splitter requires that the total amount of the optical power budget diverted to splitters and any other components in the optical path does not exceed the tolerances of the link itself. This document provides some background facts and guidelines that will help you select the proper split ratio for your 10G fiber-optic links.

Optical Power Budget

Sufficient signal strength is the key to assuring error-free communication on a fiber-optic link. The link must deliver a distortion-free signal that is strong enough to meet the minimum receive sensitivity of the receiver. Signal strength and quality are dependent on fiber-path attenuation, signal speed, and clean fiber connectors (poorly cleaned fibers are one of the most common sources of errors in fiber-based data centers).

The IEEE Ethernet standard specifies both the minimum transmitter output power for different transceiver types, as well as the minimum receiver sensitivity. **The difference between these two values is the link optical power budget.**

Splitter Signal Path Attenuation

When a light signal enters a fiber splitter, it is split into two or more output beams, losing some of its strength. For the purpose of this discussion we will limit the splitters to *1x2* – one input to two outputs.

The typical signal loss introduced by different split ratios is summarized in the table below:

Split Ratio	Main Path Nominal Loss	Splitter Path Nominal Loss
50/50 Main/Split	3.5 dB	3.5 dB
70/30 Main/Split	2.0 dB	6.0 dB

Power Budget and Post-Splitter Power Margins for 10G Ethernet Fiber-Optic Links

Link Type				
Link Speed	*10G Ethernet*	*10G Ethernet*	*10G Ethernet*	*10G Ethernet*
Fiber Type	*Multi-Mode*	*Multi-Mode*	*Single-Mode*	*Single-Mode*
Wavelength (nm)	*850*	*850*	*1310*	*1550*
Transceiver type	*SFP+, SR*	*XFP, SR*	*SFP+, LR*	*SFP+, ER*
IEEE Transceiver Specification				
Minimum Tx Power (dBm)	-7.3	-7.3	-5.2	-1.7
Minimum Rx Sensitivity (dBm)	-11.1	-9.9	-12.6	-11.3
Optical Power Budget	3.8	2.6	7.4	9.6
Typical 50/50 1x2 Splitter Loss / Path Margin				
Main Path	3.5 / 0.3	3.5 / -0.9*	3.5 / 3.9	3.5 / 6.1
Splitter Path	3.5 / 0.3	3.5 / -0.9*	3.5 / 3.9	3.5 / 6.1
Typical 70/30 1x2 Splitter Loss / Path Margin				
Main Path	2.0 / 1.8	2.0 / 0.6	2.0 / 5.4	2.0 / 7.6
Splitter Path	6.0 / -2.2*	6.0 / -3.4*	6.0 / 1.4	6.0 / 3.6
**** Negative value indicates insufficient optical margin.***				

SFP+ LRM transceivers are not shown because they are not commonly used.

Recommendation
As shown in the table above, a 50/50 split ratio consistently provides sufficient optical power margin to ensure 10G Ethernet link stability on multi-mode fiber (except when using XFP transceivers), while the 70/30 split ratio does not. Because of this, Gigamon recommends using 50/50 ratio splitters for 10G Multimode Ethernet links – they are compatible with 10G transceivers that meet the minimum IEEE specifications.

In the real world, transceivers typically provide an additional 2 to 4 dBm of margin above and beyond the specified standards values, thus allowing their actual link budget to exceed the margins shown in the table above by the same typical amount. Because of this, the 70/30 split ratio may work for 10G MM SFP+ links in typical cases. However, transceiver manufacturers do not guarantee their devices to the typical values. Therefore users must measure the light values at the egress points of the splitters to validate that the light levels at each of the transceiver's Rx inputs meets the minimum Rx sensitivity levels and that they are sufficient to assure reliable operation over the expected life of the links. Because laser outputs and fiber connections may degrade over time, users are advised to seek the advice of qualified fiber-optic experts before using 70/30 deployments on 10G Multi-Mode SFP+ links.