

How to Get the Most Out of Your Optical Taps



Taps are central to any network monitoring architecture as they offer an uncensored view of all network traffic. Too often however, there is less time and attention spent on selecting and optimizing the network taps therefore businesses miss an opportunity to ensure their taps are a critical tool in the network visibility tool box.

Benefits

- Improve tap utilization across the network
- Maintain 100-percent network visibility
- Increase network security and performance

Further Reading

- APCON's technical brief on [choosing a tap or SPAN](#) explains the benefits for including taps in your data center monitoring strategy.
- APCON's technical brief on [the challenge of oversubscription](#) in growing network.

This paper details why selecting your tap's optical signal split ratio is critical to ensuring network performance and security analysis tools are not losing valuable data or leave the network with blind spots. It is intended to offer network architects guidance in understanding and calculating the optical budget for monitored links.

Let's take the case of an IT team at a major US-based e-commerce business. This team's objective is to support the business in doing all they can to set up and maintain security, and keep corporate data secure while supporting users. Ultimately their goal is to protect the company's revenue stream.

The IT team have installed a network monitoring architecture. The company has deployed taps in multiple data center locations to provide network traffic to packet inspection analysis tools such as Extrahop, IBM's Tealeaf®, and Netscout. These tools give the IT team insight into network's performance – meaning they can inspect, analyze and manage their customer's experience. This company also uses APCON's intelligent network monitoring switches to aggregate, filter, and load-balance packets on their way to the analysis tools.

Missing Data

The e-commerce business found that its network data analysis tools were receiving incomplete information. Intermittent portions of the network traffic were simply missing. This raised questions. Are the tools unable to keep up? Are the tool ports being oversubscribed?

The investigation revealed something unexpected: frames with CRC errors were being received from the network taps. The optical signal level they were mirroring was too low to be received without errors. The problem was the split ratio. Data loss can be avoided by selecting the right split ratio. The solution was to replace the taps. By selecting the right tap data loss can be avoided. The key is to understand the characteristics of your network before installing an optical tap in order to assure that the split ratio is appropriate for your network.

Tap Split Ratio

Passive optical taps use an internal prism to split the optical signal. Most of the signal is forwarded to the device at the other end of the link, but a portion of the signal is split off and sent to the monitor output, ultimately destined for the monitoring device. It is critical to choose a split ratio that delivers an acceptable signal level to the monitor output as well as to both ends of the link.

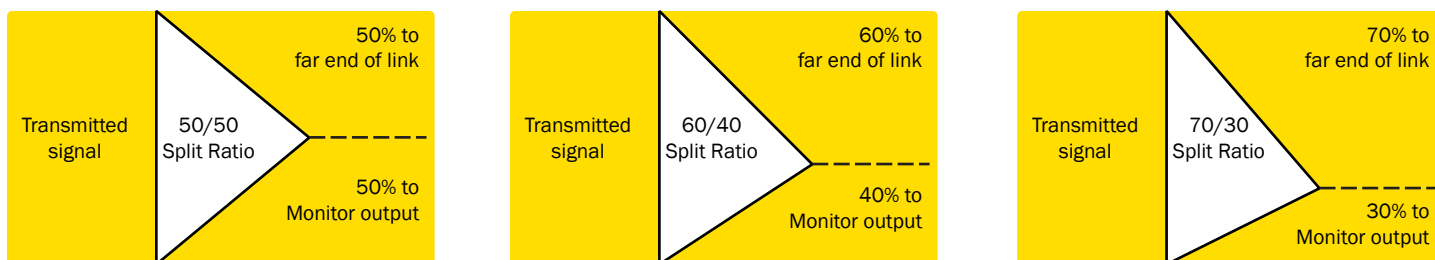


Figure 1. Common Split Ratios

Optical Budget

To choose the correct split ratio, you must understand the optical budget of the monitored link. In simple terms, the optical budget is the difference between transmit (or “launch”) power and receive sensitivity:

$$\text{Optical Budget} = \text{Launch Power} - \text{Receiver Sensitivity}$$

SFP, SFP+, and QSFP devices will vary in specified launch power and receive sensitivity ratings. For example, APCON uses the following 1G/10G dual-rate Multimode 850 SFP+:

Table 1. Specifications for typical APCON SFP+

APCON P/N	Finisar P/N	Average Launch Power		Receiver Sensitivity	
		1G	10G	1G	10G
ACI-0201-199-R	FTLX8571D3BCV	-9.5 to -1 dBm	-5 to -1 dBm	-17 dBm	-11.1 dBm

Therefore a link with the SFP+ shown in the table at both ends has an optical budget between 7.5 dB to 16 dB for 1G, and 6.1 to 10.1 for 10G.

To accurately calculate your optical budget, you should measure or query the SFP of the transmitting device to determine the actual launch power. In the following example, a commonly observed launch power of -2.25 dBm for both 1G and 10G will be used, along with the Receiver Sensitivity values shown in Table 1:

$$\text{Example optical budget (1G)} = (-2.25 \text{ dBm}) - (-17 \text{ dBm}) = 14.75 \text{ dB}$$

$$\text{Example optical budget (10G)} = (-2.25 \text{ dBm}) - (-11.1 \text{ dBm}) = 8.85 \text{ dB}$$

Link Attenuations

If the loss experienced over the link exceeds the optical budget, errors or a complete loss of signal will result. Connectors, splices, and cross-connect panels (typically equal to two connectors) all introduce significant attenuation into the link, as shown in Table 2.

Furthermore, the tap itself presents attenuation in the form of insertion loss. Table 3 shows the insertion loss to be expected from the various taps available from APCON.

Table 2. Loss from link components

Connector	Max: 0.75 dB* (Common: 0.5 dB)
Splice	Max: 0.3 dB* (Common: 0.1 dB)
Multimode 50µm fiber	3 db/km* (Common: Negligible)
Singlemode 9µm fiber	0.4 db/km* (Common: Negligible)

Table 3. Insertion Loss of APCON Taps

Product	Optical Fiber	Split Ratio	Pass Through Light Loss	Tap Light Loss
ACI-0500-550	Multimode, 850nm 50µm	50/50	-3.9 dB	-3.9 dB
ACI-0500-560	Multimode, 850nm 50µm	60/40	-3.0 dB	-4.9 dB
ACI-0500-570	Multimode, 850nm 50µm	70/30	-2.3 dB	-6.2 dB
ACI-0500-650	Multimode, 850nm 62.5µm	50/50	-4.1 dB	-4.1 dB
ACI-0500-660	Multimode, 850nm 62.5µm	60/40	-3.3 dB	-5.2 dB
ACI-0500-670	Multimode, 850nm 62.5µm	70/30	-2.7 dB	-6.6 dB
ACI-0500-750	Singlemode, 1310/1550nm 9µm	50/50	-3.57 dB	-3.57 dB
ACI-0500-760	Singlemode, 1310/1550nm 9µm	60/40	-2.72 dB	-4.64 dB
ACI-0500-770	Singlemode, 1310/1550nm 9µm	70/30	-2.00 dB	-6.05 dB

Example Calculation

Subtracting the various types of link loss (as listed in Table 2 and Table 3) from the optical budget must produce a positive result, or errors can occur:

- Optical budget
- Attenuation from all connectors on the link
- Attenuation from all splices on the link
- Attenuation from fiber loss
- Attenuation from taps on the link

- Positive value

NOTE: The following calculations assume an optical budget of 14.75 (established under Optical budget section) and commonly observed link attenuations (see Table 2 and Table 3).

Figure 2 illustrates a typical fiber link between two devices (West and East) that is currently not tapped. An example optical budget of 14.75 (that is for a 1G link) will be used. Subtracting the various attenuations in each direction from the

example optical budget produces a positive result, therefore no errors should be produced.

West-to-East:

$$14.75\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} = 12.75\text{ dB}$$

East-to-West:

$$14.75\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} = 12.75\text{ dB}$$

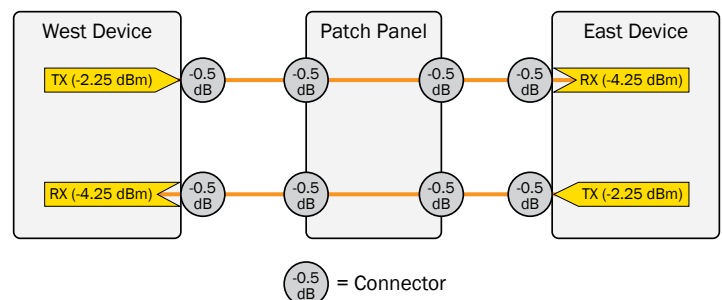


Figure 2. 1G Link with no tap installed

Figure 3 shows the same 1G link with 70/30 (Multimode, 50µm) tap between the Patch Panel and the East Device. In this case, an APCON switch is the monitoring device. It will

terminate the signal it receives from the tap, and transmit a regenerated signal to whatever tools need the data.

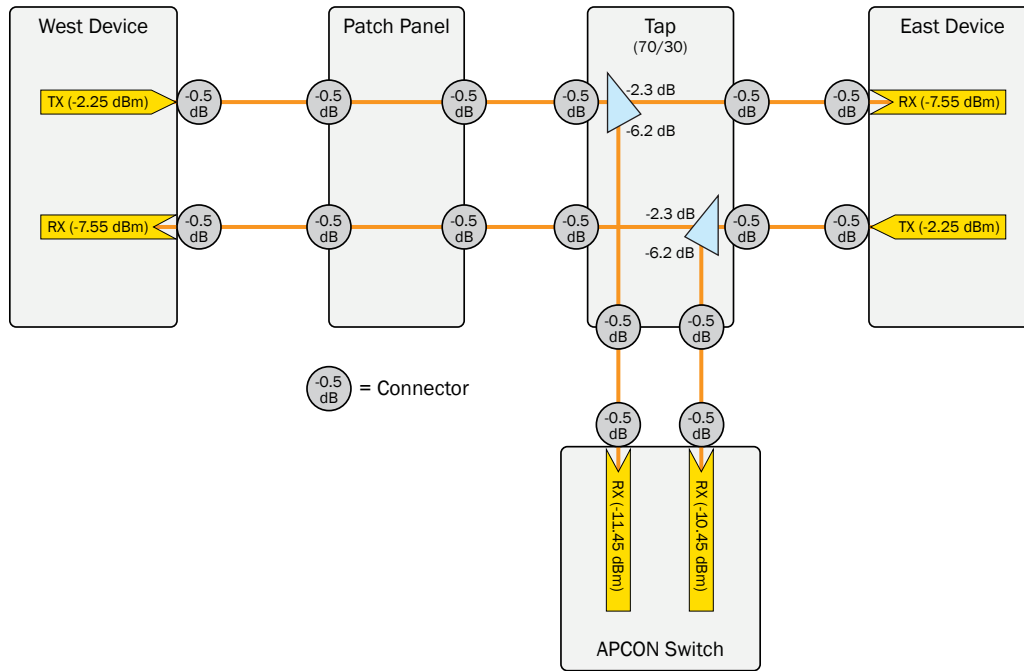


Figure 3. Optical budget for 1G link with 70/30 Multimode 50µm tap installed

With a tap installed, four budget calculations are required: two between the West and East devices, one between the West Device and the APCON switch, and one between the East Device and the APCON switch. If any calculation results in a negative value, receive errors will likely be encountered.

The calculations for Figure 3 are shown below. The positive results indicate that a 70/30 tap would be sufficient for the link as shown:

West-to-East:

$$14.75\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 2.3\text{dB} - 0.5\text{dB} - 0.5\text{dB} = 9.45\text{dB}$$

West-to-APCON:

$$14.75\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 0.5\text{dB} - 6.2\text{dB} - 0.5\text{dB} - 0.5\text{dB} = 5.55\text{dB}$$

East-to-West:

$$14.75\text{dB} - .5\text{dB} - .5\text{dB} - 2.3\text{dB} - .5\text{dB} - .5\text{dB} - .5\text{dB} - .5\text{dB} = 9.45\text{dB}$$

East-to-APCON:

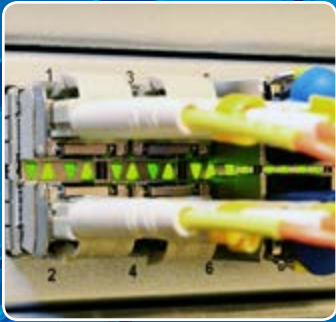
$$14.75\text{dB} - .5\text{dB} - .5\text{dB} - 6.2\text{dB} - .5\text{dB} - .5\text{dB} = 6.55\text{dB}$$

By offering taps with a range of split ratios, APCON can help you effectively monitor your traffic. Start by knowing the characteristics of your network before installing a tap. Use the calculations and examples in order to assure that the split ratio is appropriate for your network.

Troubleshooting an optical link

If you have link problems after installing a tap, don't forget to check the basics:

- If you're seeing a receive level less than -30dBm, the fiber is likely broken, unplugged, or reversed (TX connected to TX, RX connected to RX). To check for reversal, simply swap the fibers of the monitored link on one end of the tap, and re-check the receive levels.
- Examine the fibers for dirty or bad connectors.



ABOUT APCON

APCON develops innovative, scalable technology solutions to enhance network monitoring, support IT traffic analysis, and streamline IT network management and security. APCON is the industry leader for state-of-the-art IT data aggregation, filtering, and network switching products, as well as leading-edge management-software support. Organizations in over 40 countries depend on APCON network infrastructure solutions. Customers include Global Fortune 1000 companies, banks and financial services institutions, telecommunication service providers, government and military, and computer equipment manufacturers.

Contact Us

Please email sales@apcon.com or call 503-682-4050 if you have any questions.

APCON's Professional Services team can help you diagnose a link problem. You will be asked to provide the following information:

- Diagnostic XML of the affected chassis.
- The APCON port numbers associated with the problem links.
- Launch characteristics from the SFP's on your end devices.
- End to end cable specs (characteristics of fiber used).
- Number and type of splices in each run.
- Number and type of connectors in each run.
- Total length of each problematic run (please define length from end device(s) to tap and from tap to APCON).

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