

Get a Better Understanding of Fiber Optic Taps

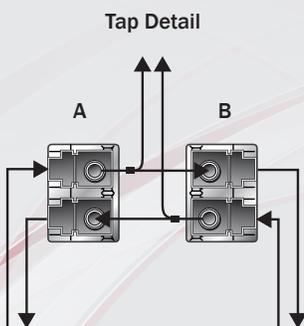
Technical Brief

APCON passive and managed taps bring enterprise-grade failsafe network monitoring hardware to your intelligent data traffic management system

Taps are a basic building block of network monitoring. By allowing network managers to “listen in” on all network traffic between switches, routers, and other features on the network landscape, taps allow network managers to observe the packets moving through the network without disturbing those packets. In general, taps deliver full-duplex monitoring with 100 percent network traffic visibility, including layer 1 and 2 errors for comprehensive troubleshooting. Conversely, SPAN or Mirror ports often drop malformed packets, obscuring errors.

TAP or Tap

As you read materials available on the Internet and from tap vendors, you’ll notice that in many cases the word “TAP” is rendered entirely in capital letters. TAP is often used as an acronym for Test Access Port, but since the term “tap” has been used for decades to describe the same practice applied to analog telephone lines (and long before that with water pipes), it’s likely that this is simply a convenience.



HOW TAPS ARE USED

Typically, a Network Manager wants to monitor the traffic that passes between Point A and Point B on a network. Point A and Point B may be any devices – a router and a switch, a server and a client, or any other network devices. The only requirement is that the two points must be connected to each other directly. The Network Manager may then choose to insert a tap in the connection link between those points.

Any tap designed to monitor one network connection generally comes with three or four ports. Two of those ports are labeled “Network” ports, and these are dedicated to the cables connecting Point A to Point B. This is known as the primary or “pass-through” link. The one or two remaining ports carry a read-only copy of the primary traffic. These ports are called “Monitor” ports.

SIMPLEX TAPS

In the case of a half-duplex (also called Simplex) tap, there are four ports. One Monitor port carries a copy of all traffic emanating from Point A and intended for Point B, and the other carries a copy of the traffic transmitted from Point B intended for Point A. To use the tap, the two monitor ports are connected to a pair of network ports on the monitoring device. The ports on the monitoring device are then joined using channel bonding to re-integrate the data stream so the device can analyze the conversation between Points A and B.

DUPLEX TAPS

In the case of a full duplex tap such as APCONTAP, there are three ports, and the single Monitor port carries the integrated traffic from both pass-through ports. No channel bonding is required at the monitoring device.

There are exceptions, but this is how the vast majority of taps are cabled and used. We’ll look at some of the exceptions below, but it’s important to understand how taps work right from the beginning.

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COPPER AND FIBER OPTIC TAPS

Taps are available for all standard network connections used today, including twisted pair copper network cables and a variety of fiber optic cables. With twisted pair copper taps, the traffic signal is received at the tap and passed through to the primary link connection. The traffic signal is either split using passive wiring or replicated using powered circuitry and passed out through the monitor ports on the tap.

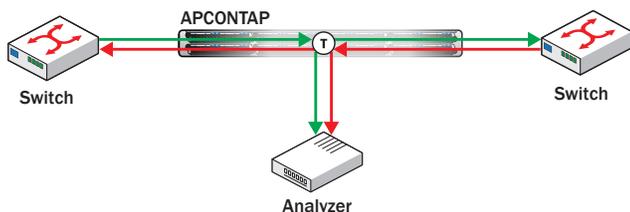
However, most data centers large enough to be considering taps rather than simply using mirror or SPAN ports for monitoring are also large enough to be using fiber optics for their primary network links. Fiber provides a much higher data rate capability than copper – 10G is popular today, with 40G and 100G on the way – and so it's the basis of most high-volume data center architecture.

Most fiber optic taps are made by splicing a second strand of fiber into each strand on the primary link connection, bleeding off a percentage of the light towards a monitor port.

FIBER OPTIC TAP DESIGNS

The next topic to understand is the distinction between various fiber optic tap designs. The terminology is critical in understanding the capabilities and risks of each design.

APCONTAP Passive Tap – A tap is called passive when it does not affect link traffic in any way. These devices are also known as Split or Splitter taps. A passive tap is simply a prism that splits off some light signal for the monitor port at a given ratio relative to the signal remaining for the pass-through port. Advantages of passive taps include the fact that because the tap has no address on the network, it cannot be hacked. Also, as a passive device, the tap is not subject to power failures or logic control failures. Disadvantages include the fact that a passive tap has no means of recording events such as the connection or disconnection of recording devices, and there is no provision for remote management and monitoring capabilities such as SNMP. APCONTAP falls into the category of passive taps.

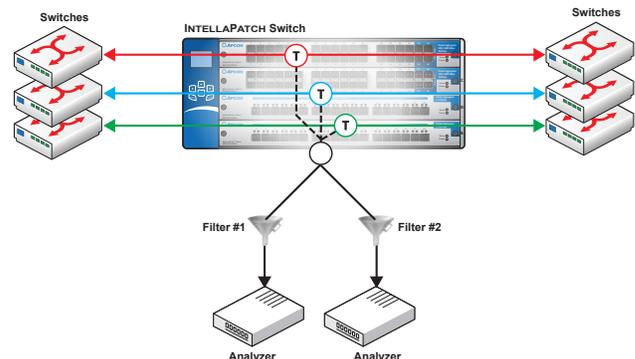


With a passive, unpowered tap such as APCONTAP, network traffic is split off for analysis without disturbing the inline traffic.

Active Tap – An active tap is designed to allow the network monitoring device to add packets back into the main pass-through network connection. Usually this capability is there to allow an Intrusion Detection System (IDS) to reset a TCP connection when unauthorized activity is detected.

Adaptive Tap – An adaptive tap is powered, as its function is to convert the data from one format or data rate to another. The pass-through link may be unpowered and failsafe, but any link on which the data has been manipulated in any way must be powered.

APCON INTELLAFLEX Aggregation Tap – Aggregation taps use a particular design that is more properly called “Channel Bonding.” In this design, a powered tap collects signal from both pass-through link inputs and then directs those two signals to a single output. In other words, an aggregated tap combines the Tx and Rx sides of a full duplex link into a single monitor output port on the switch. With these taps, you run a near-certain risk of packet loss during spikes in network activity. This happens because if you are tapping a 1G duplex connection, you have two simplex channels that may approach 1G apiece for 2G of total traffic at peak use. If your recording or analysis device can manage only 1G, you're sure to lose packets during periods of high activity. Because of their name, these channel bonded taps are often confused with packet aggregation switches, but they are fundamentally different in their operation. When you use a packet aggregation switch such as an APCON INTELLAFLEX™ solution to implement an aggregation tap, packet loss is not at risk.



APCON switches provide aggregation tap capabilities, along with filtering to monitor 10G tap links with 1G tools.

Filterable Tap – Filterable taps are active taps designed to tap a 10G (or higher) pass-through link, and then filter the data and convert the data transmission rate down to 1G, 10G or any lower data rate output. Obviously, a fully-loaded 10G link will overwhelm a 1G connection, so the data must be filtered to pass only the desired packets. This type of tap is useful when only particular data is of interest, such as packets from a particular address, or packets of a particular application. If the data stream is still too large, a load balancing device may be used to distribute the load among several monitoring devices. APCON INTELLAFLEX packet aggregation switch solutions are capable of converting data rates, filtering, and load balancing to several devices for this purpose.

APCON INTELLATAP® Managed Tap – Managed taps such as APCON's INTELLATAP require electrical power to operate. This tap design often does not use electricity to power the

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primary pass-through link connection, but rather to facilitate the collection and storage of statistics and diagnostic data on the primary link. Managed taps generally respond to SNMP commands. Some managed taps measure incoming signal levels, so an SNMP trap may be generated if additional taps or devices are attached to the link.

Regeneration Tap – this is a specialized design that is intended to tap a link and generate multiple identical outputs. The tap is powered and reads the data into the electronics, then retransmits the signal through multiple output channels. The problem with this design is that if the signal is already degraded or there is noise on the line, then the errors and noise may be regenerated and amplified along with the intended signal.

FIBER OPTIC TAP SPLIT RATIOS

Fiber optic taps are designed to bleed off light from the primary pass-through link. A tap can be designed to split off more or less light as needed for the particular installation circumstances. The percentage of light left in the pass-through link versus the percentage tapped off for the monitoring link is known as the split ratio. Split ratios are generally available from 50:50 up to 95:5 distribution. At first glance, the 50:50 ratio often appears to be the best option, but that's not always the case.

Several factors influence the optimal split ratio for any tap. To understand the decision factors, you should first review the basics of fiber optic communications. A light source at one end of the fiber generates a signal that travels down the fiber and emerges from the opposite end to be interpreted by an optically sensitive receiver that converts the light pulses to electrical signals. The electrical signals are then available to the receiving device for further processing. Simple enough, right?

Yet while you're considering the fiber optic chain, remember that the system loses light signal strength over connections and distance. There are many measurements of light strength, but in the case of network fiber optics, light is measured in decibels (dB), like sound. The decibel is used because it's a good unit to measure signal losses within a closed system. Decibels tell you the relationship between the original signal strength and the received signal strength. That's why every form of fiber network (or copper wire, for that matter) has a maximum distance over which it will work.

Every connection that breaks the fiber between the light source and the receiver causes a little bit of light to be lost. Furthermore, light tends to travel in a straight line. We can force light to curve around through the fiber optic cable, but the light will be bouncing off the walls of the cable as it makes the turn. Every bounce loses a little bit of light until you get to the receiver, where you hope you have enough light left to read the signal.

So, what does this have to do with your tap? Simply put, if you've already lost 70% of the required signal strength to transmit data reliably, a 50:50 tap placed in the line could easily render your primary link inoperative. If the path to your monitoring device is short and direct, you might need to maintain more light on your primary link to keep both signals readable. At the edge of readability, you'll experience network performance degradation due to retries and errors even if the link does not fail completely.

Conversely, if the tap does not split off enough light, the monitor link will fail to deliver enough light for the monitoring appliance to register an accurate signal. Low light levels on the monitor link can lead to false conclusions of data errors on the network link, or there may not be enough light for the appliance to register any signal at all.

APCONTAP Light Level Losses				
Product	Optical Fiber	Split Ratio	Pass Through Light Loss	TAP Light Loss
ACI-0500-550	850nm 50µm MMF	50/50	-3.9 dB	-3.9 dB
ACI-0500-560	850nm 50µm MMF	60/40	-3.0 dB	-4.9 dB
ACI-0500-570	850nm 50µm MMF	70/30	-2.3 dB	-6.2 dB
ACI-0500-650	850nm 62.5µm MMF	50/50	-4.1 dB	-4.1 dB
ACI-0500-660	850nm 62.5µm MMF	60/40	-3.3 dB	-5.2 dB
ACI-0500-670	850nm 62.5µm MMF	70/30	-2.7 dB	-6.6 dB
ACI-0500-950	1310/1550nm 9µm SMF	50/50	-3.57 dB	-3.57 dB
ACI-0500-960	1310/1550nm 9µm SMF	60/40	-2.72 dB	-4.64 dB
ACI-0500-970	1310/1550nm 9µm SMF	70/30	-2.00 dB	-6.05 dB

NOTE: This table shows approximate losses resulting from the split ratio in the optical fiber only. Connector insertion losses are not included in these figures and can vary substantially (up to about -1.5 dB) from unit to unit.

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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 50 countries depend on APCON network infrastructure solutions. Customers include Global Fortune 500 companies, banks and financial services institutions, telecommunication service providers, government and military, and computer equipment manufacturers.

Contact Us

Please email sales@apcon.com if you have any questions

The trick, obviously, is to find the split ratio at which both the primary pass-through link and the monitor link can both function reliably. The first thing to do is measure the light level at every connection with an Optical Power Meter, and use a Visual Fault Locator to pinpoint breaks and sharp bends in cables and faulty connectors. You may find that a particular cable is losing more light than others, or a particular connection is faulty, and repairing those connections can have a profound effect on your signal propagation.

There is no objectively correct answer on optical split ratios – it depends on the architecture of the particular network and the efficiency of the various elements (including the signal generator) in the connection. Thus, network architects and administrators have some homework to do – how much light is being generated to begin with and what is the loss rate over the fiber optic cable and through each connection? How much light is available at the end of the chain and how much does the receiver need to register the signal reliably?

Do the research and you will discover the split ratio you need, and how far the primary connections can stretch before too much signal is lost. Note that this calculation may yield a very different result for each optical connection on your network!

APCON INTELLATAP – EMBEDDED MANAGED TAP

While most taps in use are external to any other piece of network hardware, there are distinct advantages to embedding the tap technology into a network monitoring switch. Like most modern data center hardware, monitoring switches tend to be made of removable blades inserted in a switch chassis. By placing a series of taps onto a blade and integrating the blade into the network monitoring switch chassis, INTELLATAP allows you to multicast data streams to various ports on the switch.

In the embedded design used in INTELLATAP, the monitor data is passed from the tap blade through the switch fabric to one or more output ports on a different blade. The pass-through links are cabled to the front of the tapping blade, and may be failsafe passive connections.

APCON switches typically feature one-to-many and many-to-many port aggregation capabilities, along with advanced packet filtering and data rate conversion. These features allow the monitoring switch to collect inputs from taps, SPAN or mirror ports, and other sources and then filter and deliver customized data streams to the various monitoring devices in use on the network.

THE BOTTOM LINE ON OPTICAL FIBER TAPS

The configurability of optical fiber tap devices makes the technology indispensable to any comprehensive network monitoring plan. Whether you choose passive, managed, active, or embedded, you need to understand tap design and functionality to make the best choice to meet your monitoring needs.