CUBRO
NETWORK VISIBILITY

THE FIRST STEP TO VISIBILITY NETWORK TAPS

WHITE PAPER

SEP 2018

TABLE OF CONTENTS

Introduction **3**
What is a Network TAP **3**
Advantages of a Network TAP **4**
Deciding which TAP to purchase **5**
Media Type and Connector Type 5
Fiber TAPs 6
Converter TAPs 9
Aggregation TAPs 9
Quality **9**
Conclusion **10**

Introduction

In order to achieve a 100% guaranteed view of all network traffic and fulfil today's access and visibility requirements, the network infrastructure must incorporate network TAPs (Test Access Points). Network Visibility solutions are only as good as the data that they receive; Network TAPs represent the foundation of an effective and reliable visibility infrastructure. The question that follows is, naturally, what exactly is a Network TAP and what does it offer that makes it a more effective data source than alternatives such as Port Mirroring and SPAN (Cisco's Switched Port Analyzer)?

What is a Network TAP

A Network Test Access Point is a relatively simple OSI Layer 1 device (simplicity equals reliability in this case) that connects directly inline with the cabling infrastructure and creates a copy of the traffic for monitoring purposes. They can be standalone devices or can be integrated into a visibility node. The copied traffic has no impact or interaction with the live network, and it is not possible to send traffic from a TAP's monitoring ports back into the live network stream. In fact, TAPs, except for Aggregation TAPs, are unmanaged devices and do not represent a risk of compromise as they cannot be enumerated in a network scan or remotely accessed (This speaks primarily to Cubro's TAP lineup).

With respect to fault tolerance, fiberoptic TAPs are completely passive devices requiring no power and completely fail-safe in operation. 10/100 copper TAPs require power only for the monitor ports while the live link remains passive and fail-safe. 10/100/1000 copper TAPs require some additional PHY level intelligence and, historically, relied on relays to fail open in the case of a power failure which could interrupt the link and require an auto-negotiation process between the two endpoints. Cubro has pioneered a new 10/100/1000 TAP architecture that reduces this problem and further enhances the reliability of 1 Gbps copper TAPs.

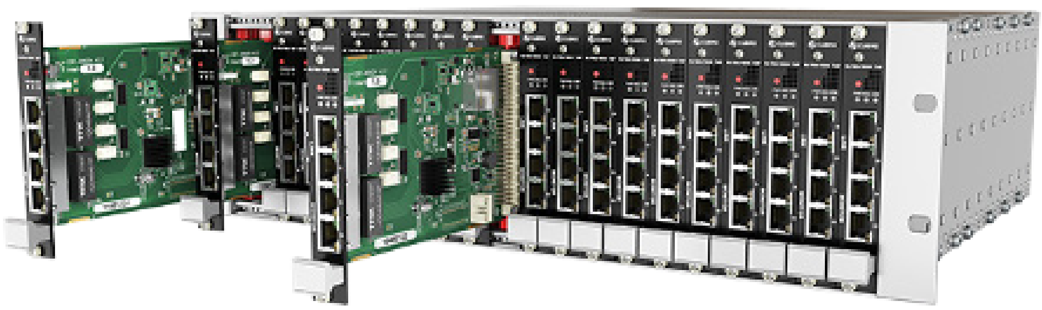
The way these devices operate is fundamentally different from a SPAN port because the Network TAP performs only a singular function and requires no processing capabilities to forward the copied traffic for monitoring. A SPAN is an ancillary function to the primary purpose of the switch. Performing that function requires additional processing resources and, by design, a switch will interrupt the traffic forwarding of the SPAN to protect its primary function of packet switching.

The TAP does not alter the traffic in any way or introduce any latency, furthermore, the copy is an exact duplicate of what is being carried on the link. In contrast to the way a SPAN works, the TAP does not require any configuration for traffic to be copied. Whereas a SPAN will drop errored or malformed frames a TAP will not. Additionally, a SPAN will alter the timing of the forwarded traffic such that it no longer reflects the reality of the network; a TAP is a precise reflection of what is on the wire.

A final consideration I will point out, and a very important one at that is the potential for over-subscription. In the case of full duplex links, the overall bandwidth of the link is actually twice the rated speed of the link i.e. a 1 Gbps link is comprised of up to 1 Gbps on the transmit (TX) side and up to 1 Gbps on the receive (RX) side and thus contains, potentially, 2 Gbps of traffic. If you send the traffic from a 1G full duplex link to a SPAN, then you are potentially directing up to 2 Gbps of data to be sent out on a port that can only handle 1 Gbps; that means a lot of lost packets. On a TAP there will be a separate monitor port for TX traffic and RX traffic.

In the case of a copper TAP that means the ports you are transmitting the copied traffic from, and likewise to, are capable of the same throughput as the live link. If a situation were to over-subscribe the links on a copper TAP, it would have already oversubscribed the live link, and the point becomes moot. An optical TAP cannot be oversubscribed in any case.

All these considerations taken together mean that a monitoring system that relies on SPAN ports for data feeds cannot be counted as 100% reliable; in the best-case scenario it doesn't completely reflect the network traffic accurately and in the worst-case scenario it can be missing vital information that is key to detecting a network issue.



Advantages of a Network TAP

In summary; here are some advantages of a Network TAP over port mirroring or SPAN:

- Passive; fail-safe
- Zero configuration
- Secure
- Exact duplicate of network traffic
- No added latency or altered timing
- Passes network errors in addition to good frames/packets
- Oversubscription not an issue

Deciding which TAP to purchase

Network TAPs (Test Access Points) are the absolute best way to gain access to network traffic, whether that be for network visibility solutions, network monitoring infrastructure, or network security auditing. It is common at a certain point in an organization's growth for it to be recognized that mirror ports and SPAN (Switch Port ANalyzer) ports, due to their many limitations, are no longer sufficient to provide traffic to monitoring and security tools. When it comes time to begin building a TAP infrastructure there are several details to consider. Some are simple and obvious, and others may be subtler and more nuanced. This article is intended to be a primer on the main points to consider when searching for Network TAPs for your environment. The information contained herein applies primarily to Cubro Network Visibility TAPs as these are the products I have the most first-hand knowledge of.

Network TAPs are the absolute best way to gain access to network traffic, whether that be for network visibility solutions, network monitoring infrastructure, or network security auditing.

Media Type and Connector Type

The first consideration for which TAP is best suited to environment is a fairly obvious one: Which media type do you intend to tap? Really, this is the difference between an electrical connection or a fiberoptic connection. On the electrical side we generally are talking about UTP (or perhaps STP cabling; it makes no difference for our purposes), although the use of DAC (Direct Attach Cabling) is relatively common as well. Fiberoptic cabling can be broken down into Single-Mode and Multi-Mode fiber and Multi-Mode fiber presents two possible core diameters to choose from.

Each of these media types will in turn necessitate a connector type on the TAP as well; fiber, again, having the most options. First let's address electrical connections and specifically UTP as it is the most common electrical media that a TAP will be used with. The category of UTP cabling doesn't really impact the decision of which TAP we will choose but would, of course, impact supported speeds and cable length. The speed of the link is a differentiating factor though.

Although it is not terribly common to encounter 10/100 links anymore it is important to point out that it is possible to have a completely passive electrical TAP (that requires power only for the monitor ports) at this speed. If you have 10/100 links in your environment the questions are whether it is more important to have a passive TAP that will not support 1G speeds or whether the option of upgrading the links without needing to replace the TAPs takes precedence.

10/100/1000 links are quite straightforward; you only have one choice. It is not possible to build a completely passive TAP for gigabit Ethernet over UTP; until now the industry approach has been to use relays to provide a fail-safe solution. This approach has not been problem-free though and instances where a link does not come back up or renegotiating a link after a failure takes an excessively long time are not rare. When I said you only had one choice earlier that is only partially true; in response to the number of issues with relay-based TAPs Cubro has designed a new type of 10/100/1000 TAP to drastically reduce these issues; adding a new, more reliable option to the mix.

A positive aspect of optical TAPs is that they are, with few exceptions, completely passive and fail-safe.

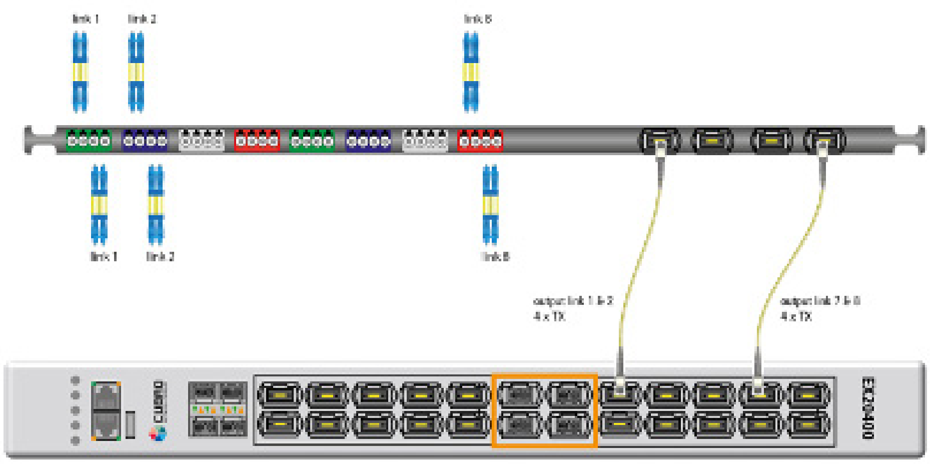
Fiber TAPs

A positive aspect of optical TAPs is that they are, with few exceptions, completely passive and fail-safe. Short of physical damage there is almost nothing that can cause a perfectly functioning optical TAP to bring down a live network link. A second positive aspect of optical TAPs is that they operate independently of link speed. Some vendors will test TAPs to certain speed standards and sort them into different SKUs, depending on their relative performance (Cubro does not take this approach; see “Quality” below), but nothing inherently limits an optical TAP to a certain speed apart from manufacturing tolerances.

As stated above, there are more options for fiber TAPs and more factors to account for when selecting the most appropriate one. The first, and most easily answered, is whether the link is Single-Mode or Multi-Mode. With respect to Multi-Mode fiber it is important to know whether the fiber has a core diameter of 62.5*µ* or 50*µ*. Multi-Mode TAPs are available with core diameters in both sizes and you will want to pair the TAP to the core size of the fiber in the link to avoid unpredictable light loss at the fiber couplers. 50*µ* is far more common these days than 62.5*µ* which was only used with OM1 fiber installs. OM1 fiber was the predominant fiber of the 80s and 90s however, so it can’t be said to be uncommon itself. A blue or lime green cable jacket is a dead giveaway of 50*µ* fiber but a word of caution: both OM1 and OM2 use an orange jacket while the former is 62.5*µ* and the latter is 50*µ*; be sure to check the cable markings carefully.

The second question, also easily answered, is the connector type needed. LC and MTP/MPO are by far the most common fiber connections these days and are, accordingly, the options that most TAP vendors focus on. When selecting the connector type there are instances where you can achieve very high port density with minimal rack space by employing MTP/MPO TAPs, along with patch panels and breakout cables, to TAP several LC links. Consider the following: Cubro's Optoslim form factor for optical TAPs employs a 1/3RU chassis which allows three units to be mounted in a 1RU space. This allows us to fit an industry-leading number of ports into a 1RU space while maintaining both customizability and very durable construction. The Optoslim TAPs are available with LC connectors supporting up to 8 links offering a potential of 24 LC links in a 1RU space. By contrast, an Optoslim TAP with MTP/MPO connectors can support up to 4 links of MTP cabling; up to 12 in a 1RU space. An MTP link supports four independent full-duplex fiber connections. By employing patch panels to wire our LC patch cables into the MTP TAPs we can support an incredible 48 links in a 1RU space, doubling the efficiency of our rack space!

Cubro's Optoslim form factor for optical TAPs employs a 1/3RU chassis which allows three units to be mounted in a 1RU space.



The third consideration is which split ratio to choose and to do this effectively requires understanding and knowing the light budget(s) of your optical links. This is unquestionably the most complex aspect of selecting an optical TAP, but it doesn't have to be daunting. The split ratio of a TAP denotes how much of the light of an optical link will be taken away from the live link and redirected to the monitor ports of the TAP. When we are talking about a 50/50 split ratio TAP, half of the light that exists on the link will be split off and sent to the monitor ports and, therefore, only half remains to be sent to the receiver on the live link. In an 80/20 split, only 20 percent of the light is sent to the monitor ports and, you guessed it, 80 percent remains en route to the receiver.

The Optoslim TAPs are available with LC connectors supporting up to 8 links offering a potential of 24 LC links in a 1RU space. By contrast, an Optoslim TAP with MTP/MPO connectors can support up to 4 links of MTP cabling; up to 12 in a 1RU space.

All Cubro TAPs are extensively tested before leaving the factory, included a detailed measurement of insertion loss for every port. These values are included on a print out with their respective TAP, so you will know the exact insertion loss of each port on the device.

To determine how, exactly, this impacts the link we wish to tap we first must determine the light budget of the link. Each transceiver has a launch power (sending power) and a receive sensitivity. For a given pair of transceivers on a link the difference between the launch power of the sender and the sensitivity of the receiver gives us the acceptable maximum power loss between the two transceivers that will still allow for a properly functioning link. The type of fiber used and the wavelength in use, in conjunction with the length of cable, the number of couplers, and the number of splices will all add up to some amount of power loss that we will need to deduct from the light budget between the two transceivers. Whatever figure remains is the allowable budget that we have for inserting a TAP into the link.

Corning has an excellent online light budget calculator than can be found here: http://www.corning.com/worldwide/en/products/communication-networks/resources/system-design-calculators/link-loss-budget-calculator.html

There are generally accepted values for TAPs and split ratios that provide a good starting place to determine which TAP is acceptable for a given budget. A 50/50 TAP is usually expected to have about 4.5dB of loss at the live link and at the monitor ports. When this value is deducted from our remaining light budget we can determine whether A) we do not exceed the maximum allowable loss that would prevent the live link from functioning and B) if we will have enough power at the monitor ports for some given length of cable and the transceiver receiving the monitor traffic. All Cubro TAPs are extensively tested before leaving the factory, included a detailed measurement of insertion loss for every port. These values are included on a print out with their respective TAP, so you will know the exact insertion loss of each port on the device.

That is hardly an exhaustive overview of calculating a light budget but conveys the general idea. Failure to appropriately take your light budget into consideration can make a perfectly constructed TAP appear to be faulty and lead to a frustrating and time-consuming troubleshooting process.

At Cubro Net-work Visibility every TAP is built with exacting attention to detail and every single unit is inspected and tested upon completion.

Converter TAPs

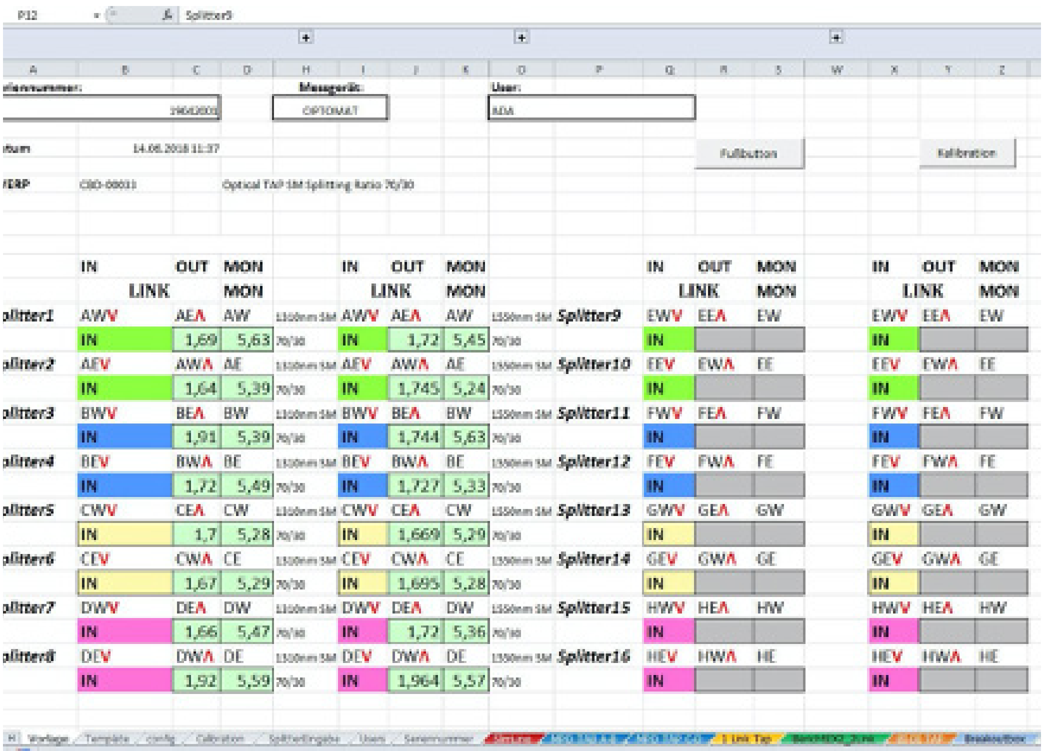
Converter TAPs are TAPs where the monitor ports are replaced with SFP or SFP+ cages and are available in both optical and electrical connections on the live link. These are useful when it is necessary to output the traffic from a fiber link to a device or tool that only has copper inputs or vice-versa. These TAPs require power for the SFP monitor ports in all cases (e.g. while an optical converter TAP will be passive at the live link side power will be needed for the monitor ports to be active) otherwise they function the same way as the other afore-mentioned TAPs.

Aggregation TAPs

Aggregation TAPs are useful when you simply want to aggregate se-veral live links together and output them to a single device or tool but don’t require the extra port density or filtering capabilities of a device like a Network Packet Broker. Aggregation TAPs are typically electrical TAPs. In the case of Cubro’s Aggregation TAPs they also function as a converter TAP for copper-based links and, in the event of a failure, will fail-open to preserve the live link.

Quality

One of the last but certainly not least important aspects of selecting the right TAP is not a matter of standards or specifications but rather of precision manufacturing and quality of the product. For a TAP to function optimally and have a long life span it needs to be constructed of the highest quality materials and rigorously tested before it ever reaches the customer.



tum 14.06.2018 11:37

/ERP CBO-00011 Optical TAP SM Splitting Ratio 70/30

	IN	OUT	MON		IN	OUT	MON			IN	OUT	MON	IN	OUT	MON
	LINK		MON		LINK		MON			LINK		MON	LINK		MON
plitter1	AWV	AEA	AW	1310nm SM	AWV	AEA	AW	1550nm SM	Splitter9	EWV	EEA	EW	EWV	EEA	EW
	IN	1,69	5,63	70/30	IN	1,72	5,45	70/30		IN			IN		
plitter2	AEV	AWA	AE	1310nm SM	AEV	AWA	AE	1550nm SM	Splitter10	EEV	EWA	EE	EEV	EWA	EE
	IN	1,64	5,39	70/30	IN	1,745	5,24	70/30		IN			IN		
plitter3	BWV	BEA	BW	1310nm SM	BWV	BEA	BW	1550nm SM	Splitter11	FWV	FEA	FW	FWV	FEA	FW
	IN	1,91	5,39	70/30	IN	1,744	5,63	70/30		IN			IN		
plitter4	BEV	BWA	BE	1310nm SM	BEV	BWA	BE	1550nm SM	Splitter12	FEV	FWA	FE	FEV	FWA	FE
	IN	1,72	5,49	70/30	IN	1,727	5,33	70/30		IN			IN		
plitter5	CWV	CEA	CW	1310nm SM	CWV	CEA	CW	1550nm SM	Splitter13	GWV	GEA	GW	GWV	GEA	GW
	IN	1,7	5,28	70/30	IN	1,669	5,29	70/30		IN			IN		
plitter6	CEV	CWA	CE	1310nm SM	CEV	CWA	CE	1550nm SM	Splitter14	GEV	GWA	GE	GEV	GWA	GE
	IN	1,67	5,29	70/30	IN	1,695	5,28	70/30		IN			IN		
plitter7	DWV	DEA	DW	1310nm SM	DWV	DEA	DW	1550nm SM	Splitter15	HWV	HEA	HW	HWV	HEA	HW
	IN	1,66	5,47	70/30	IN	1,72	5,36	70/30		IN			IN		
plitter8	DEV	DWA	DE	1310nm SM	DEV	DWA	DE	1550nm SM	Splitter16	HEV	HWA	HE	HEV	HWA	HE
	IN	1,92	5,59	70/30	IN	1,964	5,57	70/30		IN			IN		

At Cubro Network Visibility every TAP is built with exacting attention to detail and every single unit is inspected and tested upon completion. Each link of our fiber TAPs is examined and photographed using a precision microscope to ensure that no defects or contaminants are left on the fiber connector; this is critical for performance at higher bandwidths such as 100 Gbps. Speaking of bandwidth, every link of the optical TAP is also tested to handle speeds from 10 Mbps up to 100 Gbps. Currently, we are working on building a 400 Gbps testing solution as well.

Conclusion

Cubro rigorously tests every TAP to provide the highest quality while maintaining an affordable price point. Cubro TAPs remain resilient even in the event of a hardware failure. They are engineered to allow traffic to continue to pass along the live link even if the TAP itself stops functioning. Cubro TAPs do not introduce delay or alter the content and do not drop traffic regardless of the bandwidth of the link. This level of precision and quality assurance is at the heart of Cubro Network Visibility because building the best products we possibly can leads to high customer satisfaction and reliable network visibility products.