The Arista 7130, a Better Way to Tap?

There are lots of reasons why organisations need to tap a feed and replicate it to a second (or third, or fourth…) endpoint. Here are some examples:

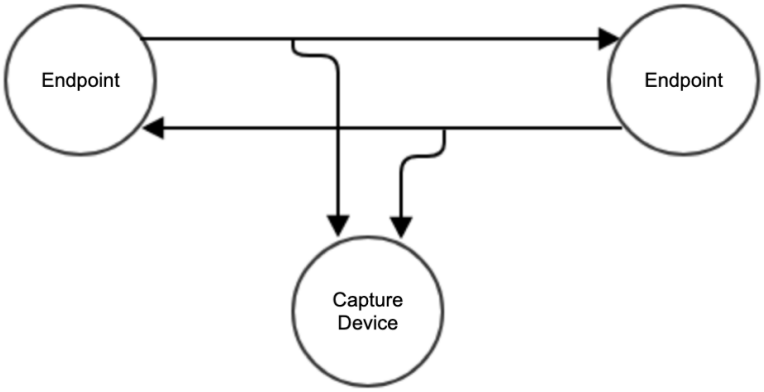
- Network forensics -- a record of packets can be examined after a network issue to understand the cause.
- Compliance requirements might necessitate a record of all data traversing the network for later audit.
- Security and intrusion detection can be performed out of band by replicating streams to a logging device.
- Media broadcast might benefit from recording all video feeds.

An example that's important for Arista customers is latency measurement in financial trading systems. In this scenario, taps can be used to replicate the input and output of a system to a packet capture and logging device, and thereby allow for an accurate analysis of the response time of the system.

An Introduction to Optical Taps

The traditional way to monitor a connection is using passive optical taps. These take an optical fiber, put it through a prism, a half silvered mirror or simply a Y-cable, and thereby split half of the light to each of two cables. It's a low-latency way to monitor the connection – you only incur the latency for the cable – and it's deterministic – the light takes the same amount of time to travel the length of the fiber/prism/mirror.

Of course, to do this, you need to be using optical fiber, and that introduces the big downside to using optical taps: cost. Say you wish to tap a set of 10G links in a rack, and the endpoints of those links are all SFP+ connectors. Instead of using low-cost Twinax copper cables, you are now required to cable the rack using fiber and you need to use fiber SFP+ modules. Each of these modules cost money. You also need to use two fiber SFP+ modules to receive the data – one module for each direction. On top of that you require two optical taps for each connection, which need to be mounted securely somewhere in the rack. All of this has an economic and operational cost.



Replacing Optical Taps with Arista 7130 Switches

The Arista 7130 is a much better alternative to optical tapping. The latency and determinism are about the same as using an optical tap, but at significantly lower total cost and improved signal reliability.

The 7130 devices regenerate each connection, so instead of degrading the signals as a passive optical solution does, the 7130 uses CDR to recover the signal and retransmit it. This means less errors in your packets and therefore less risk to the production data: the days of chasing down reliability problems introduced by the tapping infrastructure are gone.

You also get the ability to dynamically patch the connections, including which packet capture device is connected to which, finally you can leverage lower cost Twinax cables for a more economic solution than higher priced optical transceivers.

Other useful features include the ability to monitor the signal strength, implement loopbacks for testing, see the packet count and errors on each connection, sniff the lines using tcpdump, disconnect or reconnect ports, or use other features like the FPGAs integrated into some Arista 7130 devices.

Cost is a major advantage of using the 7130 for tapping (for a quote of the Arista 7130 devices, please get in touch with us at sales@arista.com). For the purpose of this paper, let's assume that the 7130 48-port Layer 1 device is being used, with a list price of 21,995 USD[1]. (We'll refer to it as the 7130-48).

The device can support tapping up to 12 bi-directional links, hence each bi-directional tap would work out to cost about $1,833, if it's fully utilised. You might not use every port, so the per-tap cost would increase as the utilisation is reduced.

It is true that the 7130 introduces an active device that could be seen as an extra point of failure. However, this additional risk can be eliminated/minimised.

1. The Arista 7130 fully regenerates the signal, resulting in much higher tolerances and better reliability when compared with passive optical taps which divide the signal power to multiple endpoints.
2. Arista hardware is designed for fault-tolerance, including redundant fans and power supply modules.
3. Standard network redundancy techniques can be applied to avoid a single-point-of-failure -- redundant paths should be tapped by redundant devices.

Given the above, there is a low likelihood of an event occurring that would not have also taken out the rest of the rack -- the most likely scenario being a complete power failure. Since the 7130 is often used to tap feeds to devices with which they are co-located, the additional failure point has not increased the risk of an outage in this failure mode.

Moreover, the 7130 avoids many of the issues that create issues in systems using passive optical taps:

1. Light levels are divided and reduced by splitting light in an optical tap, which can result in marginal signal levels and corrupted packets;
2. Passive optics are made out of fragile materials like glass. They are oddly shaped and are particularly vulnerable in large bundles in a datacenter environment.
3. The large numbers of fibers in a datacenter environment are complex to manage. 7130 provides LLDP for topology discovery, and L1 switching to allow for correction of any cabling issues.
4. Passive optics provide no feedback as to their operation -- it's not possible to monitor the operation of a passive optical device, aside from the quality of the received signals on the destination endpoints -- 7130 allows monitoring of all links.

In many ways, 7130-based tapping solutions can be considered more reliable than passive optics.

1 List prices as of November, 2020

Tapping Scenarios

Assumptions:

- Pricing for third-party devices is taken from a public online source (namely the CDW website);
- Pricing for Arista products is taken from Arista's November 2020 price list. All prices quoted are list price.

Scenario 1: Connecting Two Devices Intra-Rack

The first worked example is a scenario where two devices are connected together within the same rack using Twinax copper cables. The base cost to make 12 bi-directional connections between the endpoints is as follows:

Base (10G, 12 connections)	Number	Unit cost	Total Cost
Twinax cable (1m)*	12	$95	$1,140
Total			**$1,140**

** Arista list price November 2020*

To tap these connections using optical taps, it's necessary to use optics -- the cheapest intra-rack optics we can use are 10GBase-SRL (Light). Choosing some commercially available taps, the total hence cost might be:

SR tap (10G, 12 bidirectional taps)	Number	Unit Cost	Total Cost
Ixia FlexTap Chassis	1	$309.99	$309.99
Ixia FlexTap 10GbE SR Tap	12	$743.99	$8,927.88
10GBase-SRL SFP+ Module	48	$395	$18,960
10GBase-SR fiber (full duplex)	36	$15.99	$575.64
Total			**$28,773.51**
Cost to Tap ($28,773.51 - $1,140)			$27,633.51
Cost per unidirectional tap			**$1,151.40**

In this case, we pay an extra $27,633.51 to tap the 12 connections -- $1,151 per unidirectional tap.

Let's compare these scenarios with a similar setup using an Arista 7130-48 device and passive direct-attach Twinax cables:

7130 (10G, 12 bidirectional taps)	Number	Unit Cost (estimate)	Total Cost
1m Twinax cable	48	$95	$4,560
7130-48G3	1	$21,995	$21,995
Total			**$26,555**
Cost to Tap			$25,415
Cost per unidirectional tap			**$1,058.96**

To summarize, instead of paying $27,633.51 to tap the connections, as we would have using optics, we've paid $25,415.00, a saving of $2,218.51 or ~8%, while simultaneously utilising the full set of 7130 features, improving TCO and gaining reliability benefits. If the Arista 7130 48-port device is not fully utilised, the cost per port would naturally be higher.

Note, multiple taps from a single source can be made easily available in a 7130 simply by using an extra egress port for each extra tap. Taps can also be dynamically added or removed, since the Layer 1 forwarding rules are fully dynamic.

Scenario 2: Tapping WAN Links

The situation is exaggerated when tapping long-range links, since the optics required are much more expensive. In this case, we consider a series of taps placed between a local endpoint, and a WAN link running 10GBase-ER. We tap both directions.
Our base set of equipment to provide this connectivity is therefore 12x SFPs and 12x fibers (which connect to a patch panel presenting the WAN fiber).

Base (10G, 12 connections)	Number	Unit cost	Total Cost
1m Duplex Single mode fiber	12	$22.99	$275.88
10GBase-ER (40km) SFP	12	$2,495	$29,940
Total			**$30,215.88**

To tap these connections, we need to add Single Mode passive optical taps, as well as the 10GBase-ER SFPs required to receive the connections into a tap/agg switch. There are two extra SFPs required per bi-directional link (one to receive the copy of each direction's traffic). Note: It may be possible to find some cheaper, receive-only SFPs, for this purpose.

ER tap (10G, 12 bidirectional taps)	Number	Unit Cost	Total Cost
Ixia FlexTap Chassis	1	$309.99	$309.99
Ixia FlexTap 10GbE SM Tap	12	$636.99	$8,927.88
10GBase-ER SFP+ Module	36	$2,495	$89,820
1m Duplex Single mode fiber	36	$22.99	$827.64
Total			**$98,601.5**
Cost to Tap			$68,385.63
Cost per unidirectional tap			**$2,849.40**

Because of the cost of the long-range SFPs, the tapping solution is much more expensive than an intra-rack solution.

Consider the same tapping requirement, implemented using an Arista 7130-48G3 device. In this case, the number of optics stays the same -- these are connected to the Arista 7130 device. Traffic to the endpoint is carried from the 7130 using Twinax copper as converting between 10GBase-ER and Twinax copper is a capability of the Arista 7130. We don't require any further optics, since the egress traffic from the 7130 to the tap destinations is carried by Twinax copper -- each bi-directional tap is connected using a single 10GBase-ER SFP and three Twinax copper cables.

7130 (10G, 12 bidirectional taps)	Number	Unit Cost	Total Cost
1m Duplex Single mode fiber	12	$22.99	$275.88
10GBase-ER (40km) SFP	12	$2,495	$29,940
1m Twinax cable	36	$95	$3,420
7130-48G3	1	$21,995	$21,995
Total			**$55,630.88**
Cost to Tap			$25,415
Cost per unidirectional tap			**$1,058.96**

In this scenario, instead of paying $68,385.63 for optical taps and optics, we spend $25,415, a saving of $42,970.63, or 63%. Again, using Arista 7130 devices, we benefit from additional features and TCO improvements.

The savings are further exaggerated when more specialised optics are required -- e.g. in DWDM links.

Scenario 3: Connecting Two Vendor-Agnostic Devices Intra-Rack and Adding An Aggregation Switch

While replacing optical taps with Arista 7130 has a clear TCO benefit, this is further compounded when considering taps which feed a tap/aggregation device. This scenario considers a use case similar to that of scenario 1 -- tapping intra-rack Twinax copper. In this case, our fully utilised solution can tap 23 bi-directional connections. The lowest-cost case to implement this connectivity is therefore 23x Twinax cables (ignoring the endpoint devices which are the same cost whether tapped or not). In this example 1 m cables are being used.

Base (10G, 23 connections)	Number	Unit cost	Total Cost
Twinax cable (1 m)*	23	$95	$2,185
Total			**$2,185**

** Arista list price November 2020*

To tap and aggregate these intra-rack connections using optical taps, we replace the Twinax cables with optical SFPs at either end, three duplex fibers, the taps and an aggregation switch (in this case, we chose an Arista 7150, using its DANZ features). This will output a stream of packets to a capture or analytics device. Ignoring the cost of the downstream tools, we estimate the tapping equipment to be:

SR tap and aggregation (10G, 23 bidirectional taps)	Number	Unit Cost	Total Cost
Ixia FlexTap Chassis	1	$309.99	$309.99
Ixia FlexTap 10GbE SR Tap	23	$743.99	$17,111.77
10GBase-SRL SFP+ Module	92	$395	$36,340
10GBase-SR fiber (full duplex)	69	$15.99	$1,103.31
Arista 7150S (Aggregation switch)	1	$24,995	$24,995
Total			**$79,860.07**
Cost to Tap			$77,675.07
Cost per unidirectional tap			**$1,688.59**

Each unidirectional tap costs nearly $1,700.

Instead, we utilise an Arista 7130-48L device running the MetaWatch network application. The Arista 7130-48L, like all Arista 7130 devices, can switch at Layer 1-- implementing the taps in the same device as the best-in-class aggregation switch. Each connection only needs to pass through the 7130-48L.

In this case, we can use Twinax copper cables from each endpoint to the Arista 7130 and tap up to 23 connections. At least one of the front panel ports is needed as an output port.

7130L running MetaWatch (10G, 23 bidirectional taps)	Number	Unit Cost	Total Cost
1m Twinax cable	46	$95	$4,370
Arista 7130-48L	1	$39,995	$39,995
Total			**$44,365**
Cost to Tap			$42,180
Cost per unidirectional tap			**$916.96**

Instead of paying $1,689 per connection, as with using SRL optics, we've paid $917 -- a 46% saving, while providing a more capable and accurate aggregation switch.

Also worth comparing are the operational requirements. In the case of passive optics, we have added 1RU for the taps and 1RU for the aggregation switch but should also consider using rack units to manage the additional 69 cables that are required. In the case of the Arista 7130, a single rack unit is needed along with only one third of the additional cables.

Conclusion - What's the Best Way to Tap?

The Arista 7130 is superior to passive optics for tapping most applications.

The above analysis makes a number of assumptions: one important one is that a significant number of passive taps are being implemented and that the 7130 will be fully utilised. The cost savings diminish as the number of unused ports on the 7130 grows. For very small numbers of taps, it may be cheaper to use passive optics, however, the significant operational and reliability benefits of using a 7130 result in a lower TCO.

Footnotes:

- *At the time of writing the Arista 7130 supports 1G, 10G and 40G connections. Support for 25G and higher rates will be added in future hardware releases.*
- *The Arista 7130 is an exciting, enabling technology -- tapping everything efficiently and economically, providing new levels of network visibility.*
- *All Arista prices quoted are list prices as of November, 2020*

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