Taurus Smart Cable Modules™: An Active + Smart Approach to 200/400/800GbE

Today's data center networks are primarily serviced by 25G/lane Ethernet technology; however, these networks are quickly moving to 50G and 100G/lane to allow hyperscalers to add additional servers and switches to their Clos Network topologies and support data-intensive workloads such as AI and Machine Learning. This rapid growth in Ethernet port speed is causing a new set of challenges for design complexity and serviceability of hyperscale architectures. In the past, passive Direct Attached Copper (DAC) cables have been sufficient for 25G/lane; however, as we move to 50G/lane or even 100G/lane Ethernet, this will be insufficient to meet the 3-meter reach needed for typical data center interconnects between top-of-rack (ToR) switches and servers or between spine and exit-leaf switches.

Cloud Service Providers (CSPs) and OEMs alike require cost-effective, reliable interconnects which are thin, bendable, and enable 3 meters in length or more (outlined here in Data Center Resource Disaggregation Drives Need for Cost-Effective 400/800-GbE Interconnects). While passive DAC cables are no longer an option, attempts to address these bottlenecks have been made by using active optical cables (AOCs) and copper-based, general-purpose active electrical cables (AECs). These solutions may be able to address some of the reach and speed requirements of hyperscale data centers, however, they come with their own set of limitations. AOCs can be expensive and power hungry while AECs do not have the system-wide visibility and management features needed to maintain a data center fleet running intelligent applications.

Why are Taurus Smart Cable Modules the right choice?

Taurus Smart Cable Modules™ (Taurus SCM™) are hardware modules (Figure 1) that make a general-purpose AEC smart. The Taurus SCM portfolio delivers advanced fleet management and deep diagnostic abilities that are critical to ensuring high reliability and up-time in data centers. Taurus SCMs enable a flexible supply chain of Smart Electrical Cables (SECs) that are compatible in leading cable vendor's assemblies. Taurus SCMs support 800G/400G/200G Ethernet port speeds (100G/50G/25G line rates) with the added capability of resolving rate mismatch between Network Interface Cards (NICs) and switches through aggregation and disaggregation gearbox capabilities. Taurus SCM enables these architectures using thin-gauge (30/32/34 AWG) copper cables up to 3-meters.
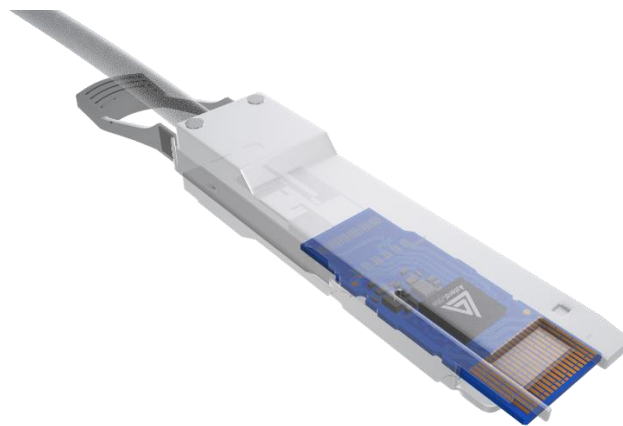

Figure 1: Taurus SCM fits inside leading cable vendors' assemblies for flexible supply chain support.

Unlike general-purpose AECs on the market, Taurus SCMs are a robust, easy-to-design solution with unmatched fleet management capabilities (see Table 1).

Table 1: Taurus Smart Cable Modules outperform general purpose AECs

	Parameter	Taurus Smart Cable Module	Other AEC
Robustness	**Ethernet Port Speed**	800G/400G/200G	400G/200G
	Low Latency	< 100ns	200ns
	Security	Prevents Malicious Attacks of unauthorized firmware loading, module diagnostics access, and configurations	No advanced security features
Easy System Design	**Gauge**	30 AWG (800G)	30 AWG (400G)
	# of Twinax Pairs	8 (400G)	16 (400G)
	Reach	3m (100G/lane)	5m (50G/lane)
	Flexible Supply Chain	Module compatible with multiple vendors for easy 2nd/3rd sourcing of active cable assembly	Single sourcing of active cable assembly
Fleet Management	**Quick Debug**	Self-test features support host-side loopback, end-to-end cable loopback; pseudo-random bit sequence (PRBS) generation and checking enable rapid troubleshooting	Limited debug features
	Deep Diagnostics	Cable-side and host-side SNR monitoring, adaptation parameters, junction temperature, and module voltage monitoring; interrupts to host are enabled whenever configurable limits are crossed; common APIs deployed across multiple cable vendors' solutions.	Limited diagnostics features

Applications for Taurus Smart Cable Modules

Taurus SCMs are purpose-built connectivity solutions for CSPs and OEMs to enable up to 100G/Lane Ethernet interconnects between servers, ToR switches, and spine switches. Figure 2 shows the two main use case categories for Taurus SCM:
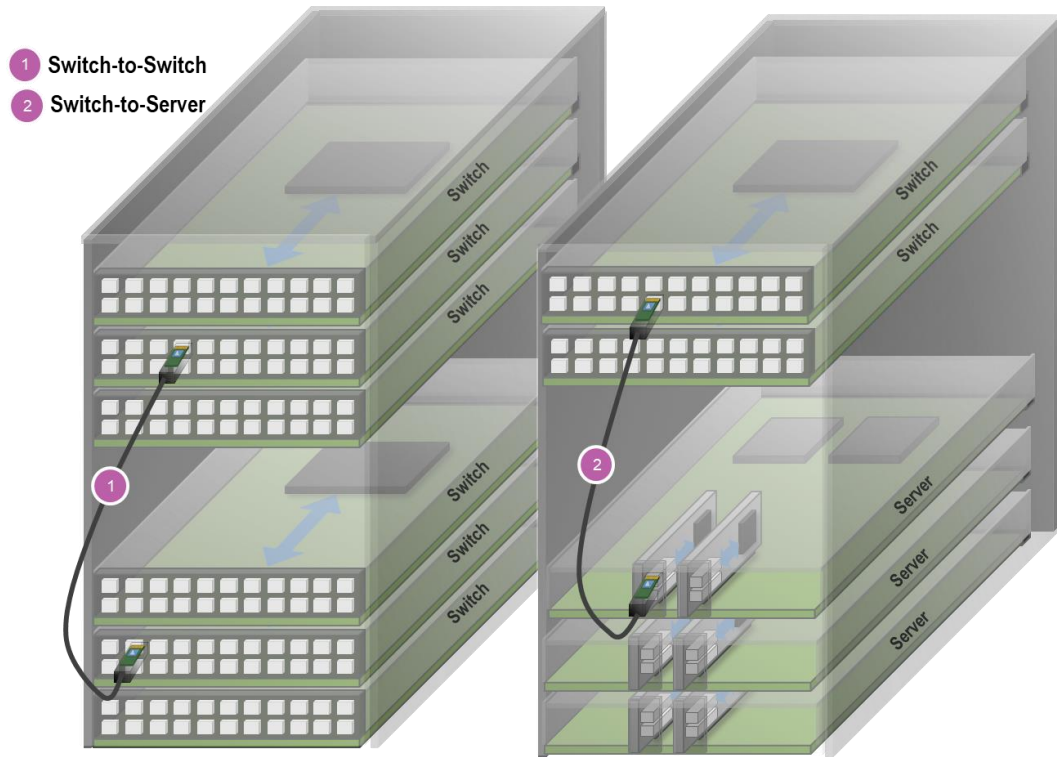
Figure 2 Taurus SCM portfolio overcomes performance bottlenecks in data center Switch-to-Switch and Switch-to-Server interconnects running up to 100G/Lane for 200/400/800 GbE

There are three cable types that are commonly adopted in the network architecture to achieve full bandwidth utilization and redundancy: Straight, Y, and X cables as seen in Figure 3. Taurus SCMs can support any of these cable configurations for switch-to-switch and switch-to-server connectivity.
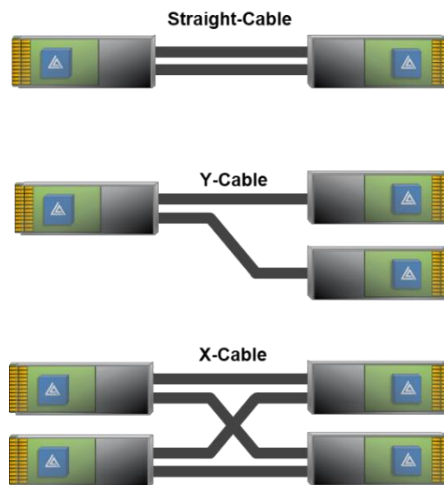

Figure 3 Taurus SCM portfolio supports three types of cable configurations

To overcome rate mismatch and fully utilize switch bandwidth during the transition from 200G ports to 400G and 800G ports, different cable configurations supporting various speeds at the two ends are needed. Qualified with leading cable vendors in both QSFP-DD and OSFP form factors, Taurus SCMs allow CSPs to apply a modular approach in designing and selecting the connectivity solutions within their rack.

Table 2 Common use cases and cable configurations of Taurus SCMs for switch-to-switch and switch-to-server applications

A-Side					B-Side		
Speed	Connector	Mode	Cable Type	Breakout	Speed	Connector	Application
800G	QSFP-DD800, OSFP	8x106G PAM4	Straight	1:1	800G	QSFP-DD800, OSFP	Switch-to-Switch
			Y	1:2	400G	QSFP-DD	Switch-to-Server
			Y	1:4	200G	QSFP56	Switch-to-Server
400G	QSFP-DD	8x53G PAM4	Straight	1:1	400G	QSFP-DD	Switch-to-Switch
			Y	1:2	200G	QSFP56	Switch-to-Server
			X	2:2	400G	QSFP-DD	Switch-to-Server
200G	QSFP56	4x53G PAM4	Straight	1:1	200G	QSFP56	Switch-to-Server
			X	2:2	200G	QSFP56	Switch-to-Server

Where to find Taurus Smart Cable Modules

For more information on Taurus SCMs, visit http://www.asteralabs.com/TaurusSCM

Conclusions

Data center networks are quickly moving to 50G and 100G/lane to allow hyperscalers to add additional servers and switches to their Clos Network topologies and support data-intensive workloads such as AI and Machine Learning. Cloud Service Providers (CSPs) and OEMs alike require cost-effective, reliable interconnects which are thin, bendable, and enable 3 meters in length or more. Taurus SCMs are purpose-built connectivity solutions for CSPs and OEMs to enable up to 100G/Lane Ethernet interconnects between servers, ToR switches, and spine switches.