ribbon

Accelerate Your Network Transformation

Optical Freedom with Multi-Source Thin Transponders

Summary

Thin transponders are a new optical transport solution that blends flexibility with performance, enabling optical network operators to meet escalating traffic requirements efficiently.

Leveraging a new generation of small, energy-efficient 400G/800G ZR+ pluggable transceivers, thin transponders fulfill a middle ground of solutions between integrated transponders and IPoDWDM. They can serve regional and long-haul applications like integrated transponders but with significant advantages in cost, density, and power usage, at only a slight reduction in spectral efficiency. They also complement and interwork with IPoDWDM for layer 1 client aggregation and optical demarcation.

Ribbon offers a suite of slim transponder SLEDs for its Apollo 9408 high-density optical transport platform with transceiver sourcing from multiple vendors, delivering optical freedom of choice and supply chain resilience.

Coherent Transceiver Revolution and Applications

Figure 1 illustrates the recent revolution of 0dBm+ coherent transceivers, highlighting the two classes of capacity-reach optimized transceivers and power-cost optimized transceivers.

Until recently, the industry focused on capacity-reach optimized transceivers because, as shown in Figure 2, they addressed most optical transport applications. Transceiver manufacturers developed competing proprietary designs – all large, high-power modules or special pluggables, necessary to deliver the needed performance – that required integrating into transponder SLEDs or line cards.

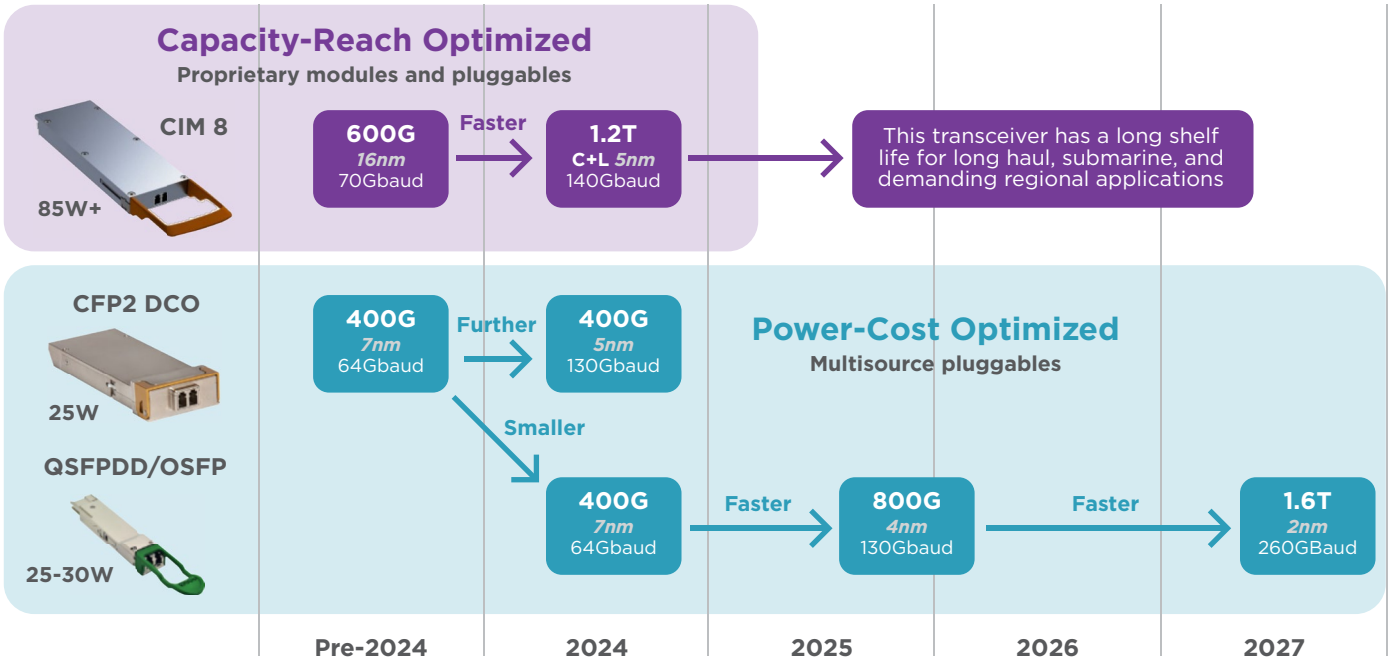

Figure 1 – Recent Evolution of Major Types of 0dBm+ Coherent Transceivers

In a major sea change, industry focus is now shifting rapidly to a new generation of standards-based, small pluggable power-cost optimized transceivers, using QSFP-DD as the dominant form factor.

This shift has two main drivers. The first is remarkable progress in underlying DSP technology, with designs scaling down from 16nm to 2nm, enabling the DSPs and associated transceivers to continually be smaller, more scalable (i.e. support higher baud rates and probabilistic constellation shaping), and be more power efficient. The second is a push for standards by webscale operators to create competition and economies of scale. This started with -10dBm ZR transceivers and evolved to 0dBm ZR+ transceivers which can be used in multi-hop optical wide area networks.

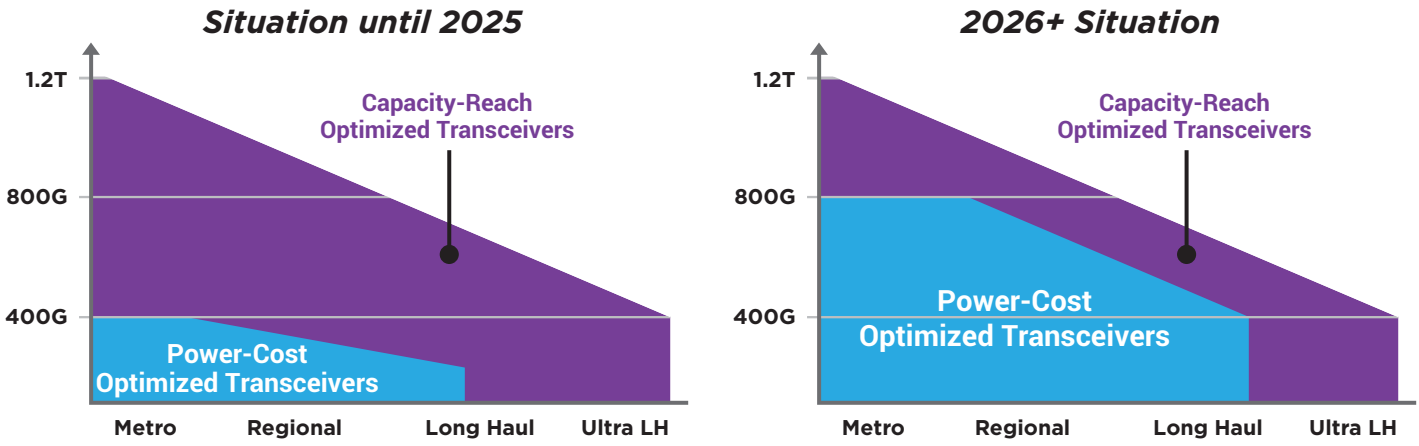

Figure 2 – Enlargement of Optical Transport Application Space of Power-Cost Optimized Transceivers

The introduction of 800G ZR+ transceivers is transforming the applications landscape. As illustrated on the right side of Figure 2, most requirements can now be met with power-cost optimized transceivers. However, capacity-reach optimized transceivers will remain essential for extended distance and intensive regional transport scenarios.

Impact on Optical Transport Solutions

Figure 3 shows three types of optical transport solution, that are compared in Table 1:

- **Integrated Transponders** – This is the traditional approach where large high power transceiver modules are integrated in the transponder card. (Note: in this document, transponders also refer to muxponders.)
- **Thin Transponders** – A new class of transponders which use small low power 0dBm ZR+ pluggable transceivers. These transponders provide a middle ground between integrated transponders and IPoDWDM.
- **IPoDWDM** – Started a few years ago, where routers directly use small low power pluggable transceivers. This began with -10dBm ZR pluggables and now also takes advantage of 0dBm ZR+ pluggables.

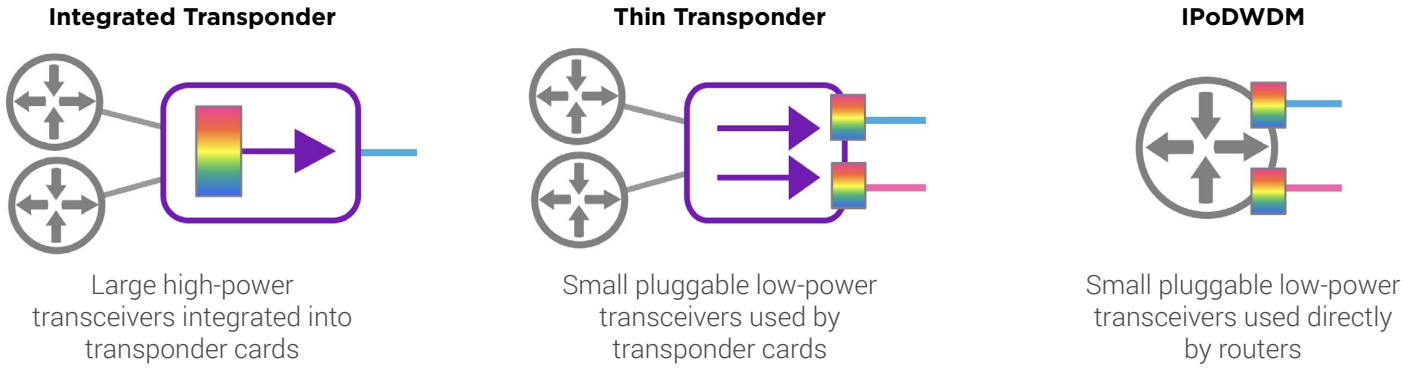

Figure 3 – Types of Optical Transport Solution

	Integrated "Thick" Transponders	Pluggable "Thin" Transponders	IPoDWDM
Description	Transponder/muxponder SLEDs based on integrating proprietary, high-power, coherent transceiver modules, optimized for capacity and reach.	Transponder/muxponder SLEDs based on standard, small form factor, pluggable coherent transceivers, optimized for cost and power.	Routers directly using standard, small form factor, pluggable coherent transceivers, optimized for cost and power.
Transceiver Examples (0dBM+)	Acacia CIM 8 - 400G to 1.2T - 5nm/140Gbaud - 85W	QSFP-DD 400GZR+ - 7nm/64Gbaud - 20-25 W QSFP-DD 800GZR+ - 4nm/130Gbaud - 25-30W - C band and L band	Same as used in thin transponders, and also using -10dBm ZR variants
Multi-vendor Optical Interoperability	No – Proprietary	Yes – based on OpenROADM	Yes
Apollo 9408 SLEDs (see details below)	MPJ1200_2	MPQ_8, FPQ_2, GPQ_2	Used in Ribbon NPT routers
Main Transport Applications	Long haul, ultra long haul, submarine	Metro, regional, long haul	IPoDWDM architectures, with reach same as thin transponders
Relative Cost	$$$	$$ **(about 30% less)**	$+ (cost of transceivers but no optical SLEDs)
Density	8T in 2RU (MPJ1200_2 using 1T wavelengths)	25.6 T in 2RU, **over 4x higher** (MPQ_8 using 800GZR+)	Not applicable for comparison
Spectral Efficiency (fiber capacity)	Maximum, operates closest to Shannon Limit	**10% lower**	Same as thin transponders
Layer 1 Clients Aggregation	Yes	Yes	No
IP Optical Domain Separation	Yes	Yes	No
Optical OAM	Maximum capabilities based on OTN	Moderate capabilities, including BER, Q-factor, and OSNR, with GPQ_2 supporting full OTN	Moderate capabilities, but with higher management complexity

Table 1 – Comparison of Optical Transport Solutions

There are several major takeaways from comparing these solutions:

1. Thin transponders, utilizing the new generation of 800G ZR+ pluggables, can fulfill regional and even long haul optical transport applications that previously relied on integrated transponders.
2. Thin transponders can meet this broader set of optical transport applications at about 30% lower cost and up to four times higher density than integrated transponders, with the compromise being about a 10% reduction in fiber capacity.
3. Thin transponders also provide benefits compared to IPoDWDM. They aggregate multiple high-speed ports onto a single wavelength with full throughput and zero latency, they provide a clean optical demarcation, and they simplify optical layer management. Thin transponders do add some cost due to a separate optical layer, but it should be noted that the largest and common costs of both solutions are the pluggable transceivers themselves.

Figure 4 illustrates some leading applications for thin transponders. The first is classical bookended aggregation of lower speed clients, with wide optical transport coverage. The second takes advantage of the ZR+ standard to aggregate 100G clients and transmit these as 400G or 800G wavelengths which are disaggregated at the far-end router. The third is a regenerator function for 400G clients.

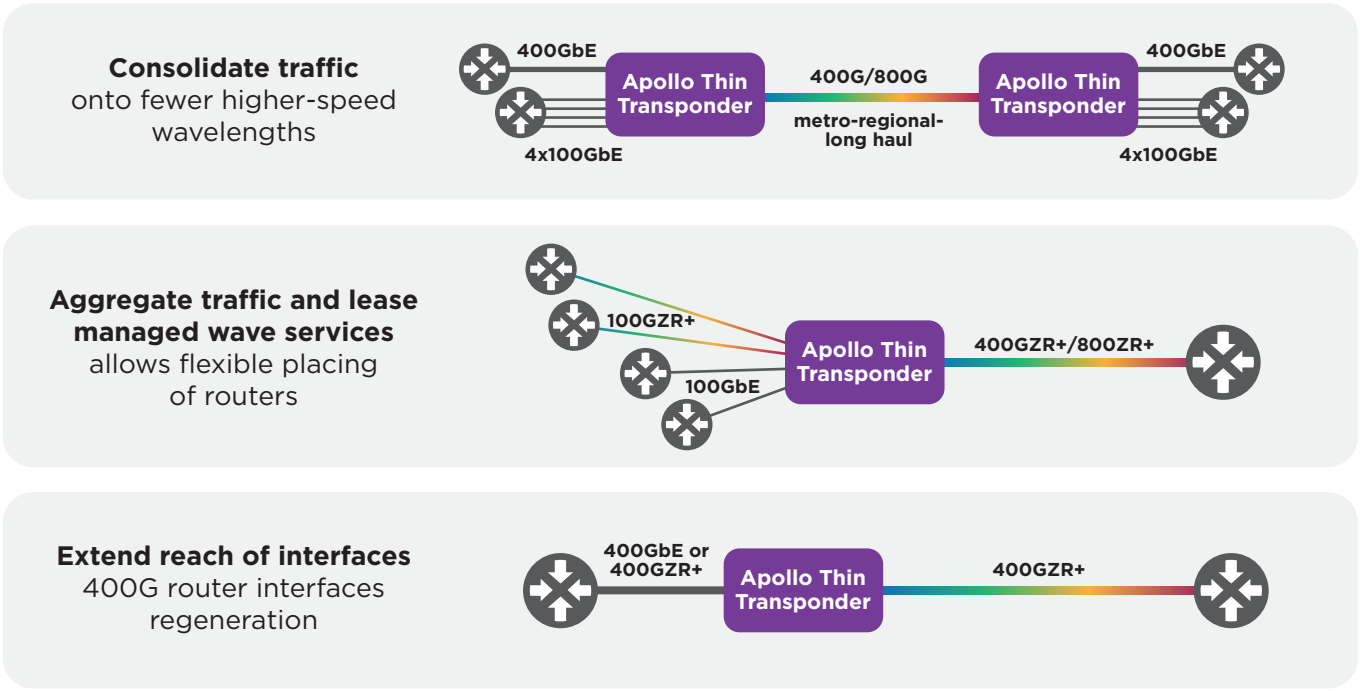

Figure 4 – Apollo Thin Transponder Applications

Apollo 9408 Transponder Solutions

The Apollo 9408 high density optical transport platform offers three thin transponder SLEDs and one integrated transponder sled to meet different market needs. These SLEDs are illustrated and summarized in Figure 5 and Table 2, respectfully.

Notably, Ribbon uses multiple transceiver vendors for its thin transponders. This offers choice to select the most suitable transceiver for different applications and adds supply chain reslilency to meet end-customer demands.

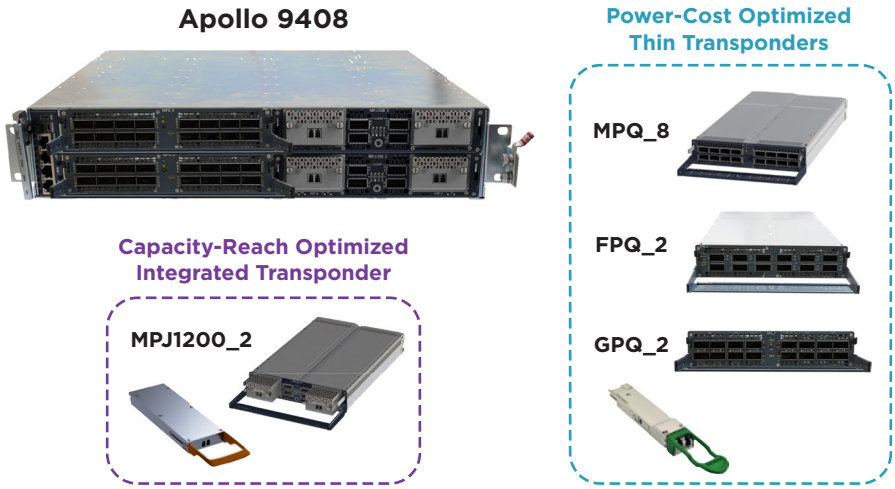

Figure 5 – Apollo 9408 High Density Optical Transport Transponder SLEDs

Apollo 9408 SLED	Availability	SLED General Description	Clients	Transceiver Technologies	Lines per SLED
Thin Transponders					
MPQ_8	GA	Cost-power optimized with maximum density	• 100GbE • 400GbE • 800GbE	QSFP-DD • 400G ZR+ • 800G ZR+	8
FPQ_2	GA	Cost-power optimized with LR4 support	• 400GbE • 100GbE LR4 • 100G ZR+	QSFP-DD • 400G ZR+ • 800G ZR+	2
GPQ_2	Q4'2026	Cost-power optimized with OTN capabilities	• 100GbE LR4 • 400GbE • OTU4 LR4 • 100G ZR+	QSFP-DD • 400G ZR+ • 800G ZR+	2
Integrated Transponder					
MPJ1200_2	GA	Capacity-reach optimized	• 100GbE LR1 • OTU4 LR1 • 400GbE • 800GbE	CIM 8	2

Table 2 – Apollo 9408 Transponder SLEDs

Summary

Thin transponders take advantage of a new generation of small, low power, ZR+ pluggable transceivers, and fulfill a wide middle ground of applications between integrated transponders and IPoDWDM.

Ribbon is leading the industry with the introduction of three thin transponder sled variants to fulfill different application needs. These save over 30% in cost over integrated transponders, with up to 4x better density.

Moreover, Ribbon leverages multiple 400G and 800G ZR+ vendors, providing both optical freedom of choice as well as supply chain resilience.

Contact Us Contact us to learn how Ribbon can optimize your optical transport networks

About Ribbon

Ribbon Communications (Nasdaq: RBBN) is a global provider of voice communications software, IP routing, and optical networking to mobile and wireline service providers, enterprises, critical infrastructure and defense sectors. We support our customers' Path to Autonomous Networks by leveraging the latest AIOps automation platforms and Agentic AI technologies, helping them deliver better customer experiences, reduce operational costs, and achieve sustainable growth. To learn more about Ribbon visit rbbn.com.