



Executive Summary

Coriant is applying its 35 years of experience and expertise in Tier 1 optical networking to deliver disaggregated, modular and open optical networking solutions.

Coriant today announced the evolution of its Groove G30 platform into a fully disaggregated open-line system (OLS). The high density, 1RU Groove G30 platform began shipping for data center interconnect (DCI) applications in Q2-2016. In Q1-2017, Coriant will make additional pluggable modules and configurations available to support industry leading densities for optical layer mux/demux and amplification for coherent and direct-detect wavelengths from Coriant and third-party transmission sources.

With native support for YANG modeling, NETCONF/RESTCONF protocols and open APIs, Groove configurations can be consistently managed and controlled, thus minimizing OPEX. The modular, pluggable architecture also minimizes start-up costs and creates a pay-as-you-go CAPEX model, matching incremental pluggable modules to services and bandwidth demands. Service providers considering a migration toward an open-line system or looking to minimize rack space will want to consider the high-density Coriant Groove™ OLS solution.

Key Findings

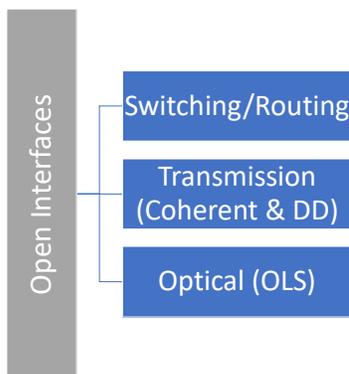
- Leveraging the Coriant Pluggable Optical Layer and the high-density 1RU modular Groove G30 DCI platform, Coriant launches a high-density open line system.
- At one-third the rack space of competitive alternatives, the Groove G30 OLS saves CAPEX and OPEX.
- Advances in miniaturization and packaging enable pluggable mux/demux and amplifiers for the Groove G30 OLS.
- Common YANG modeling and open programmatic interfaces across Groove G30 use-cases speed integration and enable management and control by CSP or third-party software.

Changing Optical Networks

It is no secret that increasing bandwidth demands and the rise of the data center are having profound impacts on optical networking. We see it in the accelerating migration of long-haul and metro DWDM networks to 100G and 200G+ wavelengths. We witness it in communication service providers' (CSPs) software-defined-networking (SDN) and network function virtualization (NFV) trials and deployments. We also see it in the increasing number of open source software and open hardware collaborations such as the Facebook sponsored Telecom Infra Project.

Although there are varying perspectives regarding the functional division of a disaggregated network, ACG Research has taken a position that the optical network can be divided into three hierarchical functions or layers: the optical layer, the transmission layer and switching/routing.

The optical layer supports functions such as wavelength multiplexing, wavelength switching, amplification and fiber compensation. The transmission layer sits hierarchically above the optical layer and is where baud rates, transmission modulation formats and forward error correction codes are assigned. Digital signal processing plays a key role in implementing 100G+ coherent transmission functionality. Above the transmission layer is packet switching and routing where individual packets are directed and manipulated. Vendors can disaggregate (or combine) all three of these layers as appropriate for their solutions and for their customers.



With disaggregation, each layer can evolve independently and be independently optimized for performance and cost.

Modular by Design

The Coriant Groove™ OLS leverages Coriant's Pluggable Optical Layer technology and is architected to support open disaggregation, including at the optical layer.

To achieve industry leading OLS density and flexibility, Coriant has developed several advances. Through advanced miniaturization and the use of multi-fiber push-on (MPO) connectorization with quad MPO-to-LC cabling, the Groove G30 can support mux/demux of 96 x 200 Gb/s wavelengths or 19.2 Tb/s of multiplexed traffic in one-half rack unit (two of four slots).

Coriant has made significant advances in the packaging and miniaturization of programmable EDFA amplifiers. Three pluggable OFP2 packaged pre-amps or booster-amps can be populated in one-half rack unit (two of four slots). The OFP2 package is similar but slightly longer than the more familiar industry MSA CFP2 package used in pluggable optics. Coriant is introducing its OFP2 EDFA packaging design to the industry to encourage other EDFA vendors to utilize a common high-density package for EDFAs.

The high-density mux/demux and EDFA pluggable designs combine to support up to 96 200Gb/s wavelengths over a fiber pair in 1RU. This configuration is one-third the rack space of competitive alternatives. In addition to potential CAPEX savings, reduced rack space also saves OPEX. ACG estimates that an average, fully populated seven-foot rack costs thousands of dollars per month and 10s of thousands of dollars per year to maintain and operate.¹

The Coriant Groove™ OLS has anticipated future technology enhancements and use-cases, including the ability to mux/demux and amplify coherent wavelengths with modulation rates up to 1.2 Tb/s with 64QAM/63GBaud dual 600 Gb/s carriers. The initial release of the OLS product also provides optical mux/demux and amplification support for direct detect wavelengths such as PAM4. Tunable dispersion compensation modules (TDCM) for direct detect will be added in subsequent releases of the Groove G30 in 2017. As new breakthrough technologies become available, the modular, pluggable design of the platform means that it is upgradeable without a forklift—simply

replace existing modules and insert the new ones as the technology becomes available.

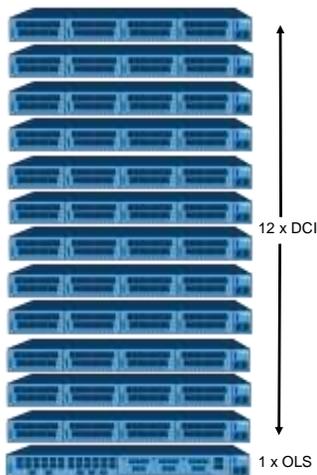
Flexible Configurations

The initial application for the Groove G30 is for coherent DWDM transmission for data center interconnect applications. In this configuration, the product is utilized as a disaggregated transmission platform (muxponder), delivering 1.6 Tb/s of coherent DWDM line-side capacity with 8x200 G (16 QAM) wavelengths and 1.6 Tb/s of client-side bandwidth with up to 16x100 G SFP+ clients.

The second application for the Coriant Groove™ OLS is as a disaggregated OLS. Wavelengths can originate from Coriant or any DWDM compliant transmission equipment. The Groove G30 OLS supports coherent DWDM or direct-detect PAM4 wavelengths for mux/demux and amplification.



The DCI transmission and OLS capabilities of the Coriant Groove™ Open Line Solution can be combined to create high-density stackable solutions. For example, 96 carriers originating from 12 Groove G30 DCI elements can be multiplexed and amplified with a single Groove G30 OLS node. Components of the stackable solution can be deployed simultaneously or incrementally as DWDM capacity is required.



The modular Groove G30 design means that future configurations are also possible as new technologies and pluggable modules become available. With the addition of pluggable TDCMs in 2017, CSPs can eliminate external dispersion compensation and deliver mux/demux, pre-amp, booster amp and dispersion compensation for up to 80 PAM4 wavelengths in a single 1RU Groove G30 OLS node.

Open Programmable Architecture

The drive for open optical architectures also means a move away from closed, per-vendor, per-product management and control systems. Open interfaces enable 3rd parties, including the CSPs, to deliver control and application software to dynamically program the network. Common, open, programmatic interfaces across Groove G30 applications has several benefits:

- 1) Utilizing a common modeling language such as YANG to describe the Groove G30 enables the creation of a unified networking view across multiple products and vendors. Open northbound interfaces and protocols, including NETCONF and RESTCONF, further abstract the network and enable the use of a diverse and emerging set of real-time controls and applications.
- 2) Support for SNMP, a command line interface and a Web GUI by the Groove G30 platform enables connections to legacy management and OSS systems and aids service providers in transition.
- 3) CSPs can simplify the management and control software hierarchy with fewer servers, reducing CAPEX and OPEX. Many CSPs are integrating Groove G30 directly with their management, control and application software and do not plan to deploy an intermediate SDN controller or management system.
- 4) Coriant also exposes integrated hardware and software functions of the Groove G30 OLS to external control and application software. Communication service providers can automate and customize service assurance and resiliency behaviors of the Groove G30 OLS by utilizing the open interfaces for the optical channel monitoring function, the optical supervisory channel function and optical time domain reflectometry fiber measurement functions.

Industry Collaboration

Coriant is collaborating with the industry to advance disaggregated optical networks:

- 1) Key participant in the SDN POC testing led by the OIF in 2014. Actively involved in the new round of OIF SDN interoperability testing occurring in 2016.
- 2) Active member of the Open Networking Foundation and has made numerous contributions to the OpenFlow specification including OF1.5.
- 3) Member of the Facebook Telecom Infra Project; will contribute to white-box architectures.

Market Adoption

Since delivery of the Groove G30 DCI platform in Q2-2016, Coriant has conducted 23 field trials, been selected in 10 customer wins and created a pipeline of more than 35 field trials. Announcements include SwissIX Internet Exchange using the Groove G30 to scale its core network interconnections in Switzerland and Europe. Japan's Internet Multi-Feed is using the Groove G30 DCI application to scale its backbone network with 200Gb/s, 16QAM wavelengths. The Supercomputing 2016 SCinet is also utilizing the Groove G30 DCI platform at its conference in November 2016.

Conclusion

Coriant is applying its 35 years of experience and expertise in Tier 1 optical networking to the development of disaggregated, modular and open optical networking solutions.

The Coriant Groove™ OLS disaggregation platform has been extended beyond coherent transmission to support disaggregation of the optical layer as an open-line system.

The modular, pluggable design minimizes startup costs and CAPEX in a pay-as-you-grow manner. Support for YANG modeling and open programmatic interfaces speeds integration and enables management and control by CSP or third-party software. With common modeling and abstraction across all Groove G30 use-cases, service providers can minimize OPEX as integration with one use-case virtually eliminates the integration costs with follow-on applications.

SPs migrating toward an open-line system or looking to minimize CAPEX and rack space will want to consider the modular Coriant Groove G30 platform.



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Source:

1. ACG, Multiple Business Case Analyses, 2015 to 2016.

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