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Flexible Open Line Systems with the Dynamic Connectivity Platform (DCP)

A solution brief from Smartoptics

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With an open architecture the functionality of once monolithic optical transport systems can be disaggregated, using embedded transceivers, open line systems and SDN control, resulting in a much better price/performance. Smartoptics has therefore developed the **Dynamic Connectivity Platform (DCP)** for active open line systems of all types, may they be simple point-to-point links or advanced, ROADM-based, ring and mesh networks. To fit all the varying needs of an open line system, the DCP platform comes in three flavors – the DCP-M, the DCP-R and the DCP-F families – each optimized for a particular type of optical network.

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Disaggregated Networks and Open Line Systems

Until recently, all optical networks were built using dedicated, monolithic, optical transport systems originating from the telco world. However, an open architectural approach is increasingly being applied to optical networking, using embedded WDM, i.e. pluggable optics in standard switches, in combination with open, optical line systems including everything needed for the DWDM channels to be carried over longer distances (amplifiers, dispersion compensation, ROADMs etc.). A new breed of disaggregated network solutions has emerged, relying upon standardized hardware with embedded WDM capabilities and with the option of being steered from the same software defined networking (SDN) controllers as other parts of the network.

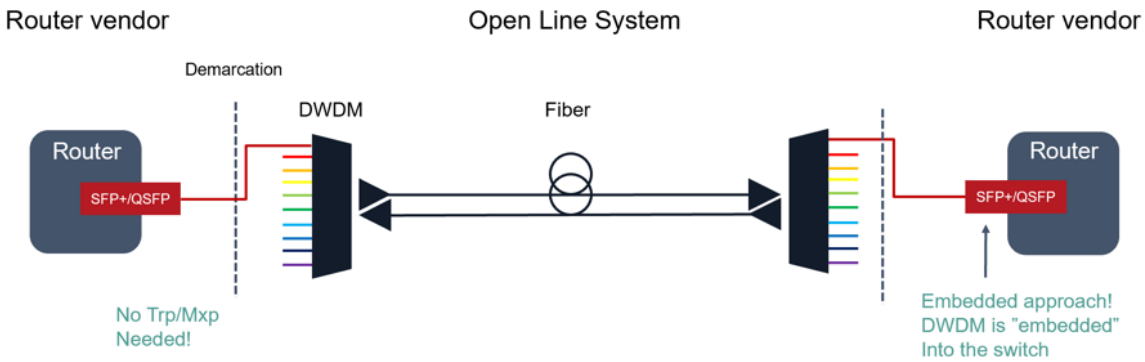

Figure 1. The Open Optical Networking Model

Open Line Systems are of interest both to enterprises for e.g. data center interconnect (DCI) applications and to more traditional telecom operators for metro access and metro/regional networks. The building practices, use of pluggable optics, SDN etc. originating from the enterprise data centers have laid the foundation for a new generation of optical networks, reaping the rewards of breakthroughs in DWDM and transceiver technology.

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The DCP Families

An open line system may be anything from a set of passive optical filters and a fiber to a complex, meshed ROADM network with multiple active elements. To meet the diverse requirements of active open line systems, Smartoptics has introduced the Dynamic Connectivity Platform (DCP) as a multipurpose basis, supporting the optical networking needs of both enterprises and operators.

The DCP platform comes in two building practices to provide flexibility for both small and large configurations and to cater for use in special situations. Management of all DCP platform products is either fully automatic (embedded) or controlled by use of either a command line interface or the REST/NetConf protocols, interfacing with standard SDN architectures as defined by the Open ROADM MSA.

The DCP products belong to three separate but closely related families, each optimized for a given network and customer situation:

The DCP-M Family for zero touch provisioning of point-to-point links with multiple traffic formats at speeds up to 400G, focusing on the lowest cost per transported bit. The DCP-M products have a fixed form factor chassis and each model is designed for a particular use case.

The DCP-R Family for any type of ROADM-based network topology with multiple traffic formats at speeds up to 400G, focusing on service reliability and wavelength manageability. The DCP-R products also have a fixed form factor chassis and each model is designed for a particular application.

The DCP-F Family, for configuration of all types of open line systems with a set of versatile, active, optical units that can be used on their own or extend the functionality of the DCP-M and DCP-R families and be used in active/passive optical ring applications. The DCP-F units have a uniquely high level of flexibility based on a building box concept with flexible optical modules that fit into a DCP-2 chassis.

Figure 2. The DCP-M/DCP-R chassis (top) and the DCP-2 chassis with a DCP-F-A22 amplifier and a DCP-F-R22 micro ROADM (bottom)

DCP-M

As a pioneer in open optical networking systems Smartoptics understands that you cannot engineer simplicity into a system that is designed for something completely different. That is why we have designed the highly automated DCP-M family of open line system products for multiplexing of DWDM signals, distance extension, open management protocols and ability to transport traffic from any combination of DWDM transceivers, transponders and muxponders in point-to-point configurations.

DCP-M provides everything required for an open line networking system – simple, reliable, and open for all protocol types.

For All Types of Point-to-Point Links

Using DCP-M is like using a passive multiplexer, but unlike a passive multiplexer it monitors the traffic, amplifies the signals for longer distances and can handle higher data rate protocols. This is because it has all the features usually reserved for the more complex DWDM platforms fully integrated into a simple plug and play 1U module. No separate passive mux, amplifier, management, dispersion compensation and traffic cards to configure. No messy wiring between modules. No additional knowledge or spares handling usually associated with the bigger systems. Instead, DCP-M provides everything required for an open line networking system – simple, reliable, and open for all protocol types.

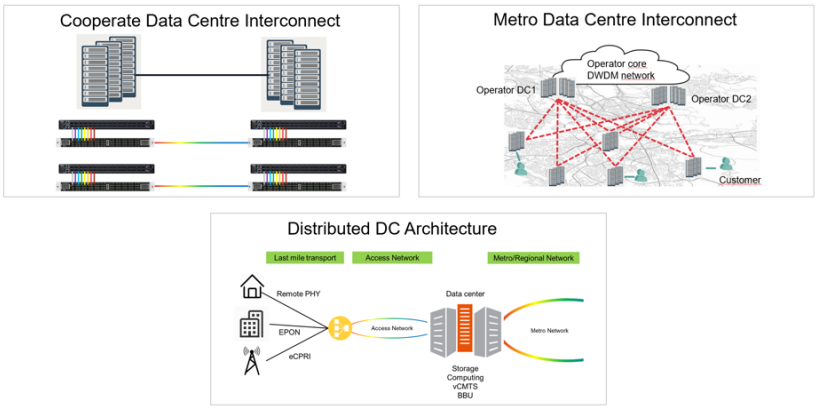

Figure 3. Typical applications for the DCP-M family

The DCP-M family is primarily used by enterprise and government customers as well as Internet exchanges and small operators in Data Centre Interconnect (DCI) and other point-to-point applications, carrying a mix of services at high capacity over medium distances.

DCP-M, Zero Touch Provisioning

DCP-M brings an unprecedented level of plug and play simplicity to DWDM networking, designed with ease of use in mind. Zero-touch optical configuration means the system sets itself up without any manual configuration in a GUI or CLI. Consequently, a minimum level of optical fiber knowledge is required to install the DCP-M. Power levels are automatically regulated on both sides when each channel is inserted — no manual setup required and a visual confirmation via LEDs shows that channel and line are set up correctly.

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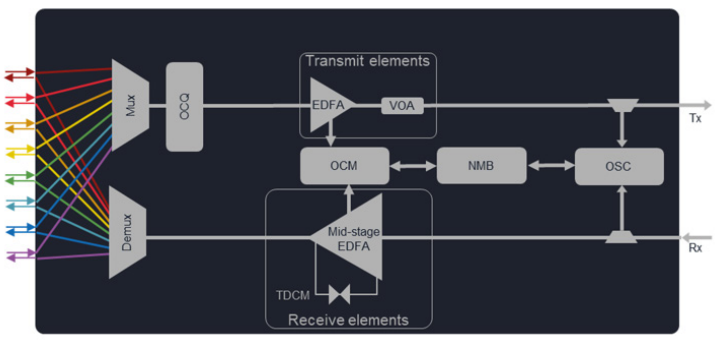

Figure 4. DCP-M block diagram

The DCP-M Family in Short

- Completely automatic optical setup, just like using a passive multiplexer
- Automatic fiber distance measurement and Dispersion Compensation setting
- Automatic modulation format detection
- Automatic client and line regulation
- Support for a mixture of up to 40 x PAM4 (Colorz), 400ZR OIF, NRZ & coherent wavelengths
- Scalable and cost effective datacom platform
- Modern management architecture based on REST/Netconf APIs or a CLI, when required
- Easily integrated into any network telemetry system
- The leading 1U Open Line System on the market for use with PAM4 transceivers

Figure 5. The DCP-M40-PAM4-ER multi-format 40 channel DWDM open line system

For use in short and medium reach point-to-point 100G applications with PAM4 modulation, DCP-M comes in four models. All models have the same basic features, making the operation and deployment remarkably similar irrespectively of the distances between sites required to be covered.

DCP-R

For the metro network, where wavelength manageability, capacity and reliability are at a premium, the Smartoptics DCP-R family of multi-degree ROADMs is the optimal choice. The DCP-R is a dedicated 1U per degree ROADM with FlexGrid, directionless, contention less and colorless capabilities. The ROADM, with integrated mux/demux for local add/drop, is designed for use with 100G PAM4 and 400ZR transceivers as well as with legacy 100G QPSK, 200G 16QAM, Ethernet and Fibre Channel traffic formats. The DCP-R-Metro ROADM comes in the same chassis as the well-known Smartoptics DCP-M family.

For All Types of ROADM-based Networks

The products in the DCP-R family can be deployed at all levels of the metro network, as well as in other applications where the flexibility and wavelength manageability of a ROADM is required. Applications range from 2-degree ROADM solutions for the metro access network up to 9- and 20-degree ROADM ring solutions for the metro/regional network as well as for meshed networks.

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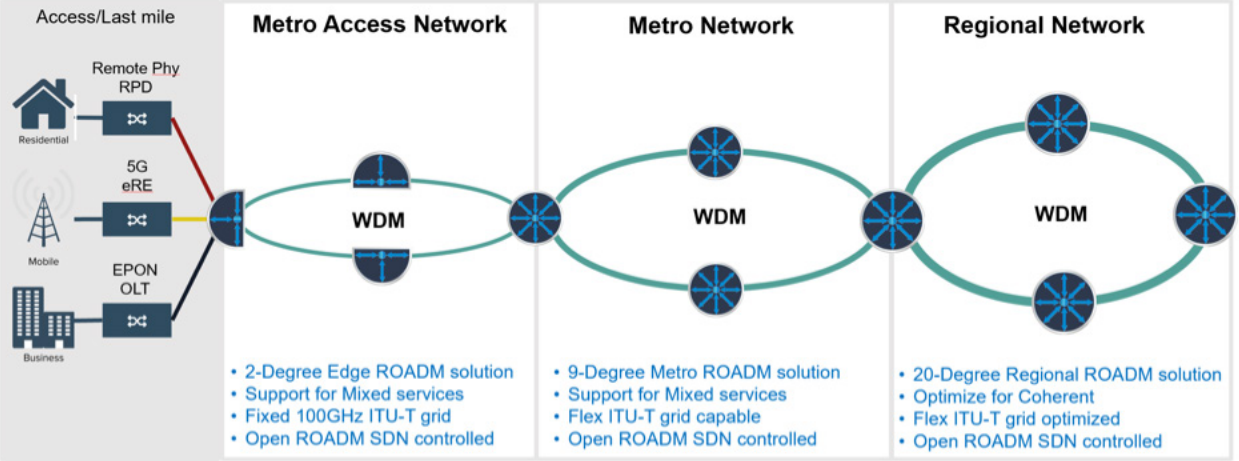

Figure 6. Typical applications for the DCP-R family

High Level of Automation and Openness

All members of the DCP-R family support a high level of automation and openness. The ROADMs are typically controlled through the NetConf protocol according to the principles outlined by the OpenROADM MSA architecture and with TransportPCE as the SDN controller. The configuration of the ROADMs is further simplified by the integrated automatic fiber distance measurement and dispersion compensation setting.

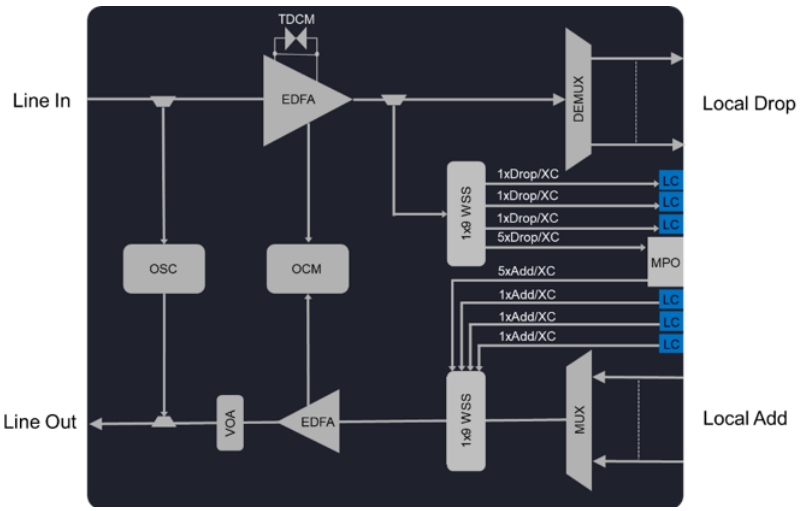

Figure 7. DCP-R block diagram

The DCP-R Family in Short

- Modern management architecture compliant with OpenROADM MSA
- Typically managed via the NetConf protocol
- Uses TransportPCE as an SDN controller
- Automatic detection of the optical characteristics of the fiber
- Support for a mixture of modulation formats such as PAM4 (Colorz), 400ZR OIF, NRZ & coherent wavelengths
- FlexGrid, directionless, contention less and colorless capabilities
- Optimized for ring and mesh network topologies with up to 20-degree ROADMs
- Flex ITU-T grid capable
- Scalable and cost effective datacom platform

DCP-F

For All Network Topologies

The DCP-F family members are designed for maximum configuration flexibility at the smallest possible footprint and for one signal direction per unit. Most of the topologies required in both point-to-point and metro networks can be achieved by simply combining one or more DCP-F units per site, if required supplemented with optional passive plug-in modules. You just interconnect the units and plug-in modules required for the site by patch cords at the front of the DCP-2 chassis to achieve the desired functionality.

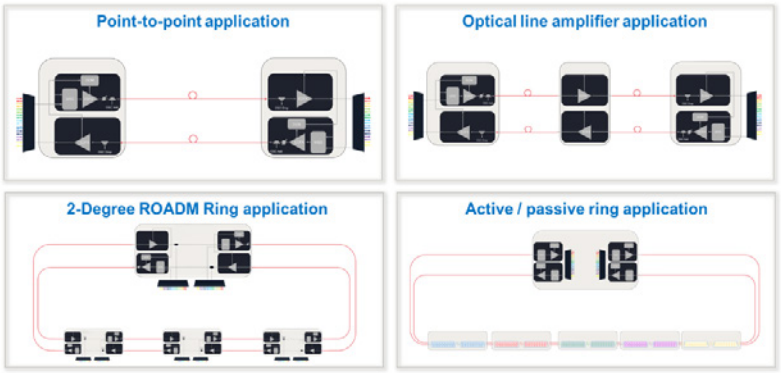

Figure 8. Examples of DCP-F applications

The DCP-F-R22 and DCP-F-A22

The first members of the DCP-F family are:

The **DCP-F-R22**, a compact 1x2 ROADM including equalizer, amplifier and monitor and with room for two Passive Plug-in Modules (PPM).

The **DCP-F-A22**, a dedicated EDFA amplifier with room for two Passive Plug-in Modules (PPM).

PPM for an Optical Surveillance Channel (OSCM) OADM

PPM for dispersion compensation

PPM for a passive optical coupler

2-degree ROADM with the DCP-F Family

As an example, a 2-degree ROADM, the standard building block of a metro access ring, can easily be configured by combing one DCP-F-A22 and one DCP-F-R22 for each signal direction, i.e. four active units. As shown in the figure below, two external passive multiplexors and two passive optical coupler plug-in modules is then all that is needed to implement a complete 2-degree ROADM.

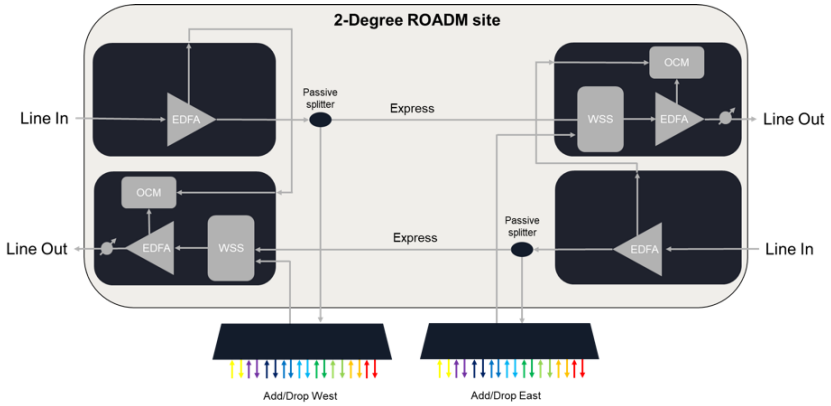

Figure 9. 2-degree ROADM

Active/Passive Applications with the DCP-F Family

For hybrid active/passive network configurations, Smartoptics also offers the versatile H-series passive optical networking platform which can be used as passive DWDM Mux/Demux and OADM together with the DCP families. Combining the aggregation capabilities of a passive optical network with the reconfigurability of the ROADMs can often result in the most economical metro access network with maintained flexibility and service reliability.

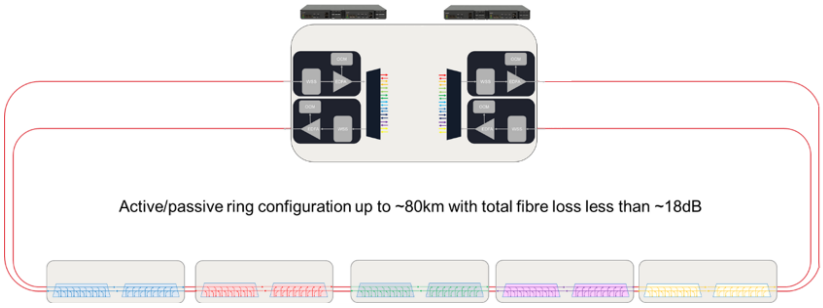

Figure 10. Active/Passive ring network with DCP-F and the H-series

The DCP-F Family in Short

- Maximum flexibility based on building block concept
- Configurable to support VOA, ROADM, OCM, OSC and dispersion compensation functionality
- Active units plugged directly into the DCP-2 chassis
- Integrated expansion field for optional passive plug-in modules (PPM) in each active unit
- Minimal footprint
- Typically managed via Command Line Interface (CLI)

Combining the DCP Families

The common basis of the Dynamic Connectivity Platform (DCP) allows the products from different DCP families to be mixed and matched for creation of the most cost-efficient open line system under the same management architecture.
The following figures show some of the myriad of open network topologies that easily can be configured by combining the members of the DCP families. There is always an open solution from Smartoptics to your optical network requirements.

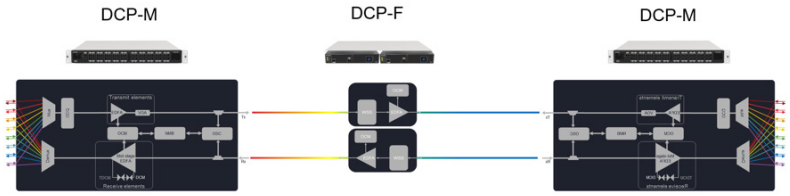

Figure 11. DCP-F-R22 used as a line amplifier for a point-to-point link

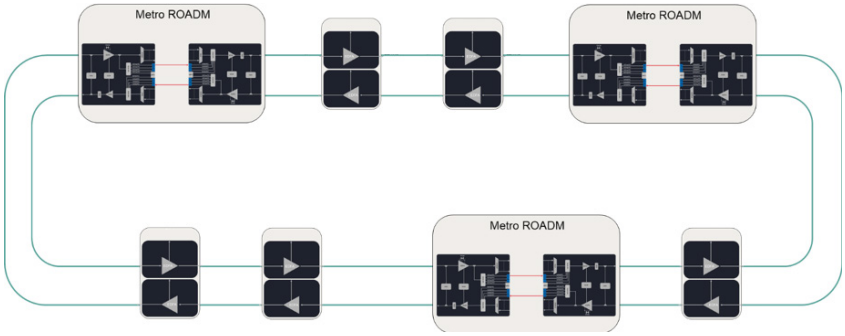

Figure 12. An optical ring using a combination of DCP-R and DCP-F products

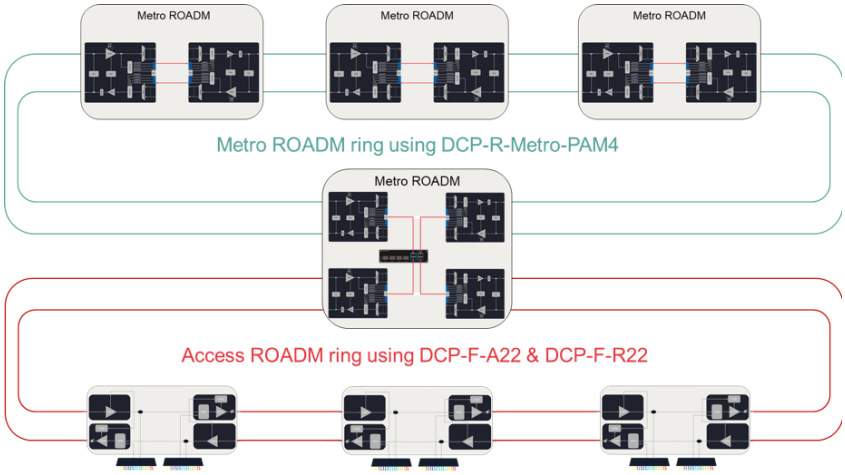

Figure 13. A two-tiered ring network using a combination of DCP-F-R22 ROADMs and DCP-R ROADMs

Network and Wavelength Management

Looking at the total life cycle cost of a communications network, the recurring operational and management expenses dominate. Capable network management tools and network equipment designed for cost efficient maintenance are vital to make the communication network investment profitable and the business case attractive.

Smartoptics is a pioneer in open optical networking systems and has paid significant attention to the management of the DCP families. The DCP-M family, primarily used in point-to-point networks for Data Center Interconnect (DCI), is optimized for zero-touch, fully self-configuring/regulating deployment, while the DCP-R and DCP-F families, often deployed in operator networks, are primarily designed to be externally managed. The external management can either be via a command line interface (CLI) or by using Software Defined Networking (SDN) principles based on the Open ROADM MSA initiative. The availability of zero-touch, CLI and SDN-based management for each individual DCP product is release dependent.

Capable network management tools and network equipment designed for cost efficient maintenance are vital to make the communication network investment profitable and the business case attractive.

About Smartoptics

Smartoptics provides innovative optical networking solutions and devices for the new era of open networking. Our customer base includes thousands of enterprises, governments, cloud providers, Internet exchanges as well as cable and telecom operators.

We have an open networking approach in everything we do which allows our customers to break unwanted vendor lock-in, remain flexible and minimize costs. Our solutions are used in metro and regional network applications that increasingly rely on data center services and specifications.

Smartoptics is a Scandinavian company founded in 2006. We partner with leading technology and network solution providers such as Brocade, Cisco, HPE and Dell EMC and have a global reach through more than 100 business partners.

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