



Evolving the metro network

Metro optical network infrastructure for the cloud generation



Where network infrastructure and metro strategy meet

Metro networks are experiencing a dramatic change. The accelerating demand for broadband services on mobile devices, new applications such as video on-demand and online gaming, and the increasing number of data centers in the metro area are all dramatically changing metro network demands. Increased capacity will also be essential, as will full support of coherent modulation formats and a flexible optical layer to make the metro network ready for future service evolution and software-defined networking. But current metro networks are not ready for this challenge. Network operators need to rethink their metro networks and the technology they use while also remaining competitive and profitable.

A flexible optical layer is key

The mid-term benefits of ROADMs are clear. However, their cost on day one is prohibitive for metro networks and has forced operators to install fixed OADM in their networks instead. With our extended ADVA FSP 3000 OLS solution, you now have a flexible optical layer with common equipment costs in the range of fixed OADM technology – a new solution that not only focuses on cost but also addresses the specific operational requirements of metro networks.

Making OTN scalable

The adoption of optical transport network (OTN) technology plays a key role in making your metro network an open and programmable platform. By deploying traditional OTN cross-connect technology, however, your metro network does not have a seamless upgrade path to higher capacities. Our FSP 3000 OpenFabric™ technology helps you modernize your metro network without OTN capacity lock-in, focusing on the sweet spot with optimum scalability, agility and efficiency. Moreover, FSP 3000 OpenFabric™ maximizes revenue generation and ROI by supporting a variety of traditional and new transport services, accelerating services availability and improving operational efficiency.

Time-sensitive transport

With increased 4G and 5G radio access network (RAN) capacities and the resulting need for precise synchronization, it's now essential to build transport networks that are capable of transporting high-speed, time-sensitive mobile fronthaul and backhaul traffic. Whether provided as a wholesale transport service to a mobile network operator or deployed as infrastructure serving a packet-switched or routed mobile backhaul service, our FSP 3000 time sensitive transport technology ensures that your data is forwarded with maximum integrity of your timing information carried.

Operational benefits through automation

Our FSP 3000 also provides significant operational benefits. These benefits go beyond those associated with traditional ROADMs and OTN cross-connects. It provides stand-alone set-up procedures that reduce to a minimum the number of truck rolls, on-site adjustments and the overall provisioning time needed when a change in network configuration occurs. Our FSP 3000 technology delivers agile, flexible and highly scalable networks with automated end-to-end provisioning: the perfect foundation for your software-defined network.



**Our FSP 3000 is the perfect solution to
develop a flexible and cost-efficient metro optical layer**

The ADVA FSP 3000 offers more

Our FSP 3000 OLS has expanded to address metro network transformation at metro economics. It provides all the benefits of a reconfigurable optical layer with just an incremental cost in comparison with fixed OADM deployments, a much more compact design with lowest power consumption, and much simpler operation and provisioning processes through automation compared with traditional reconfigurable wavelength switches. It also provides an optical layer ready to support flex-grid and high constellation formats – a must for transmitting speeds beyond 100Gbit/s and an ideal foundation for software-defined metro networks.

Avoiding high first-in costs

The new FSP 3000 metro OLS is optimized to meet all metro network demands at lowest cost. The innovative technology behind it complements traditional multi-degree ROADMs and avoids high first-in costs while enabling a flexible solution ready for tomorrow's needs. Footprint, configuration and cabling efforts are reduced to a minimum by the maximum consolidation of key functions. What's more, our compact 2-degree MicroROADM™ technology is ideal for efficient deployment in space-constrained metro points of presence and local exchanges.

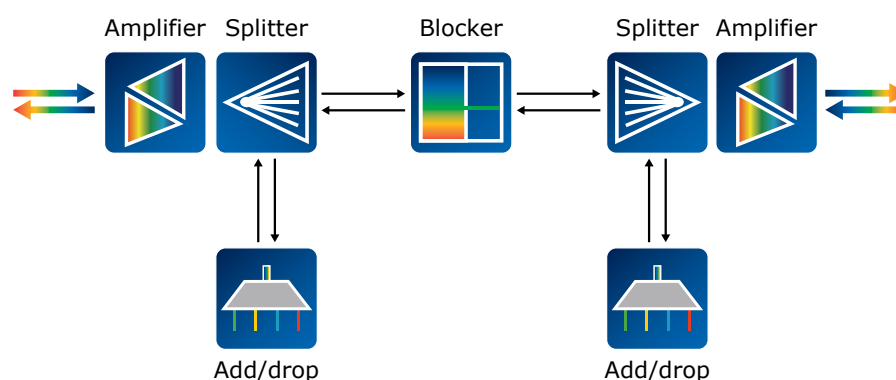
Making configuration and cabling simpler

Another relevant aspect of metro nodes is complexity. Very modular transport systems that adapt to a very broad set of configurations translate into lots of modules and optical cables and also lengthy commissioning and provisioning procedures. When looking at typical metro applications, configurations are very similar and ultimate optical performance is not the key issue. Automated set-up procedures as well as automated fiber impairment compensation mechanisms make our FSP 3000 management and operation child's play.

Operational simplicity with the ADVA FSP 3000

1. Guided fiber installation and ROADM commissioning
2. Automated performance monitoring and fault management for improved availability
3. Automated power leveling of pass-through channels and span equalization for fully remote operation
4. Self-tuned dispersion compensation for simplified operation of coherent and direct detect wavelengths
5. Support of a flexible channel grid and speeds beyond 100Gbit/s for highest network capacity

“Superior performance with maximum simplicity and lowest cost”



Ultra-compact and cost-effective 2-degree-ROADM architecture

OTN scalability through OpenFabric™

The majority of services in the metro are still 10Gbit/s and below. Moving to coherent-only transmission at 100Gbit/s or above delivers significant benefits, so there is an increasing need to aggregate lower speed services onto high-speed wavelengths. With OTN grooming, fewer of your valuable wavelengths are consumed, which results in much greater efficiency. Your network will scale for a longer period of time without running into wavelength blocking scenarios and, ultimately, less DWDM capacity needs to be added to your network, eliminating the cost of leasing and lighting new fibers.

Universal switching with OpenFabric™ technology

Our FSP 3000 OpenFabric™ is an entirely new OTN switch design concept, optimized for metro network capacities and simplified operations. While traditional OTN switch architectures utilize active electrical backplanes and switch fabric adapters integrated with interface cards, OpenFabric™ comes with a standardized and flexible open frontplane. No longer do fixed slot capacity assignments and proprietary fabric adapters of a closed system lock you out from technology innovation cycles. No longer does stranded switching capacity impact the efficiency of your network. OpenFabric™ allows any service – for any mix of OTN, Ethernet, Fibre Channel or other optical services – to be connected to your switching matrix directly or via standard, OTN-based multiplexing transponders. You can now utilize standard interface technology as needed in a pay-as-you-grow approach for low initial costs.

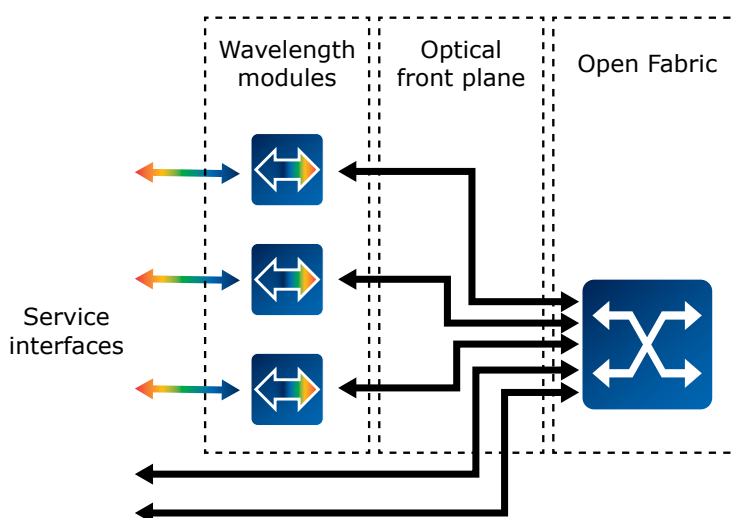
Complemented by distributed OTN switching

Distributed, fabric-less switching is ideal for metro aggregation of sub-10Gbit/s and 10Gbit/s traffic into 100Gbit/s and above transport wavelengths. It is also ideal for small node aggregation applications and hybrid configurations where ROADM and OTN switching are combined within a single shelf. Complementing OpenFabric™ with transponder-based ODU and ODU-flex switching enables optimal aggregation efficiency with any-to-any, mix and match of clients and uplinks.

Together with the innovative FSP 3000 metro OLS technology, our FSP 3000 OpenFabric™ provides you with a flexible and economical metro transport solution.

Service assurance at lowest cost

Performing protection and restoration purely on the wavelength layer can take minutes as lasers need to retune and amplifiers need to rebalance. Switching network capacity with OpenFabric™ enables fast shared protection and restoration schemes at the OTN layer. Switching on the electrical layer can be done in tens of milliseconds, significantly lowering the cost of enabling your network to survive multiple failures.



OpenFabric™ functional architecture

Time-sensitive transport

The evolution of RAN technologies makes precise and robust delivery of time synchronization essential for profitable mobile services with high availability. Poor synchronization of the radio access network infrastructure has a direct impact on quality of experience as well as on the efficient use of spectrum resources. The IEEE 1588-2008 Precision Time Protocol (PTP) has been chosen by the industry to distribute timing with sub-microsecond accuracy over packet networks. The effectiveness of RAN technologies such as LTE-TDD, CoMP, eMBMS and eCIC heavily depends on aligning cells precisely in absolute time.

A new challenge for the optical network

Since the PTP algorithm is a two-way time transfer protocol, where time information is exchanged between master and slave clocks, path asymmetries are one of the major impairments for precise time recovery. In particular, dynamic asymmetries cause significant timing errors, since they are not constant in time and cannot be predicted.

When PTP is transported over traditional OTN/DWDM networks, dynamic asymmetries are mainly caused by OTN switches and reconfigurable optical add/drop multiplexers (ROADMs), due to the switching and multiplexing of signals in the electrical and optical domains. This significantly minimizes time accuracy in the order of microseconds, which can cause critical issues for new technologies such as LTE Advanced or coming 5G.

Optical timing channel (OTC)

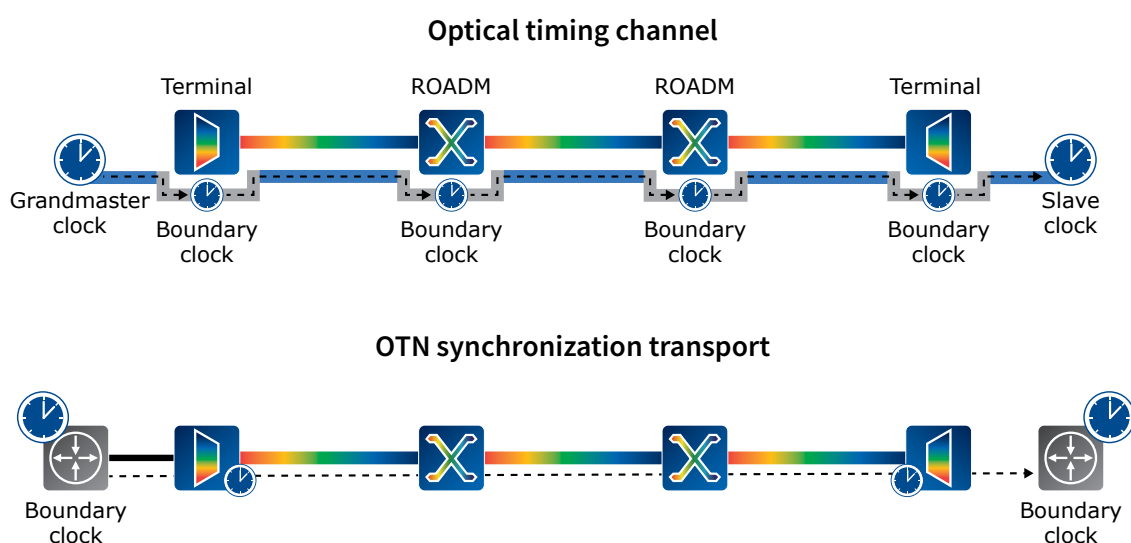
Our optical timing channel is a robust and field-proven alternative to the native transparent transport of PTP over OTN and WDM networks. PTP signaling is transported over a dedicated wavelength without OTN framing and that bypasses the elements that cause asymmetries. PTP

signals are regenerated at each intermediate site with our OSA 5400 family scalable grandmasters featuring boundary clock class D functionality.

With that and the automatic measurement and compensation of static link asymmetries, our OTC solution achieves the highest levels of timing accuracy when transporting PTP over flexible fiber optical networks.

OTN synchronization transport

Another alternative for transporting PTP signals without impacting the integrity of the timing information is leveraging buffer-controlled OTN mapping. Unlike with conventional OTN mapping and aggregation implementations, the FSP 3000 buffer control constantly monitors and averages out buffer fill levels. Dynamic node delays and consequently latency asymmetries are therefore minimized, enabling slave clocks to recover timing signals with the intended level of accuracy. Latency variations caused by resetting nodes in your network are eliminated by pre-defined buffer fill levels at cold start – a unique function of our OTN transport solution. With our FSP 3000 you can now effectively offer time-sensitive front- and backhaul services to your wholesale customers.



Precise timing distribution over DWDM/OTN networks

A new era of operational efficiency

There is a fair amount of effort that goes into building or extending your metro optical network, not to mention the tight timeline. It is critical that your network is up and running early in the build process and new services can be added quickly. Without it, there is no connectivity and services provisioned on top of your optical network cannot be activated. Fully automated setup procedures are a mandatory prerequisite for a software-defined network (SDN). Transforming operator business by network virtualization and dynamic resource allocation under the supervision of a centralized control system can only be achieved when building on an agile, flexible and highly scalable optical network with automated end-to-end provisioning.

Not touching anything ... almost

Our FSP 3000 is a plug-and-play solution. Upon power-up and IP configuration, the system will automatically set up DCN connectivity in the network and start probing next-neighbor node distances, in order to tune dispersion compensation for all direct detection channels to the set points. Furthermore, set points for line amplification will also be tuned and the system will lock into a working mode which provides a continuous span equalization. Fiber loss transients will be automatically compensated via EDFA pump power.

Open for SDN control

Do you want to be ready to move to a programmable software-defined optical network? Our FSP 3000 is the most cost-effective foundation for software-defined metro network evolution. With an open hardware and software design, our FSP 3000 is prepared for multi-layer optimization based on service availability, economics and your policies. Now, you can efficiently meet current metro demands while preparing for the big change. Bandwidth provisioning becomes more agile and much faster, while your network utilization improves dramatically.

Compactness meets simplicity

Inserting a node in a ring is usually one of the most disruptive actions, since it requires significant power leveling and dispersion compensation adjustments. With our FSP 3000 managing these adjustments automatically, as well as the function to provision the node which is about to be inserted into a pass-through mode, network augmentation can be accomplished in much shorter time and with significantly fewer manual steps. Manual cabling, power levelling and dispersion compensation adjustments in the new and adjacent nodes are no longer required.



Metro optical networks are at the heart of the internet

There is no doubt that the world of data centers, which provides the foundation of the internet, has gone through a radical change over the last few years with the massive growth in cloud services. In order to support this change, metro optical networks now need to become flexible infrastructures optimized for 100Gbit/s and above. They constitute vehicles interconnecting enterprises, radio access networks and broadband access points with an increasing number of data centers and carrier hotels in the metro at high capacity, incorporating elements of SDN technology.

Leading in the metro with the ADVA FSP 3000

The unique combination of our innovative flexible optical layer for metro networks, OpenFabric™ universal service switching and TrueTime™ time-sensitive transport technology provides you a significant advantage when evolving your metro optical networks with our FSP 3000. Our solution is designed for maximum efficiency:

- Compactness – fitting into any metro environment
- Low latency – when every nanosecond counts
- Time-sensitivity – timing at highest precision
- Scalability – pay-as-you-grow flexibility
- Efficiency – simplicity comes as standard
- Eco friendliness – sustainability is essential

Our FSP 3000 offers the ultimate deployment flexibility to evolve any metro network to the 100Gbit/s-and-above-services era using either a coexistence or fully coherent evolution approach.

Adding value to your metro applications

1. More efficient linear add/drop configurations
2. Simplified ring-based metro access network deployments
3. Cost-reduced meshed metro networks composed of two- and multi-degree nodes
4. Dynamic cloud data center interconnect infrastructure
5. Time-sensitive mobile front- and backhaul connectivity

Connecting the internet

In summary, several major trends are driving the need for carriers to evolve their existing metro optical networks into scalable infrastructures. And it is those trends that create more and more demand for high-capacity metro data center interconnect transport between cloud hosting and content delivery facilities. It's time to recognize that the combination of a flexible and operationally efficient optical infrastructure plus data center interconnect is how today's internet gets connected in the metro.





Leading with a flexible and cost-efficient metro optical layer

For more information

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About ADVA Optical Networking

ADVA Optical Networking is a company founded on innovation and driven to help our customers succeed. For over two decades our technology has empowered networks across the globe. We're continually developing breakthrough hardware and software that leads the networking industry and creates new business opportunities. It's these open connectivity solutions that enable our customers to deliver the cloud and mobile services that are vital to today's society and for imagining new tomorrows. Together, we're building a truly connected and sustainable future. For more information on how we can help you, please visit us at: www.adva.com.