# Improving network programmability with SDN and TAPI is indispensible for open optical network automation

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Network automation has been a key area of focus for operators to lower costs, improve network efficiency, improve customer experience and enable new revenue streams. Operators are now in the early stages of deploying automation in the optical domain and are adopting solutions for network operations as they move towards simplification, greater efficiency and increased reliability for their complex multi-vendor optical network operations. This requires operators to modernise their network management and automation solutions to maximise the efficiency, scalability and profitability of their optical network deployments.

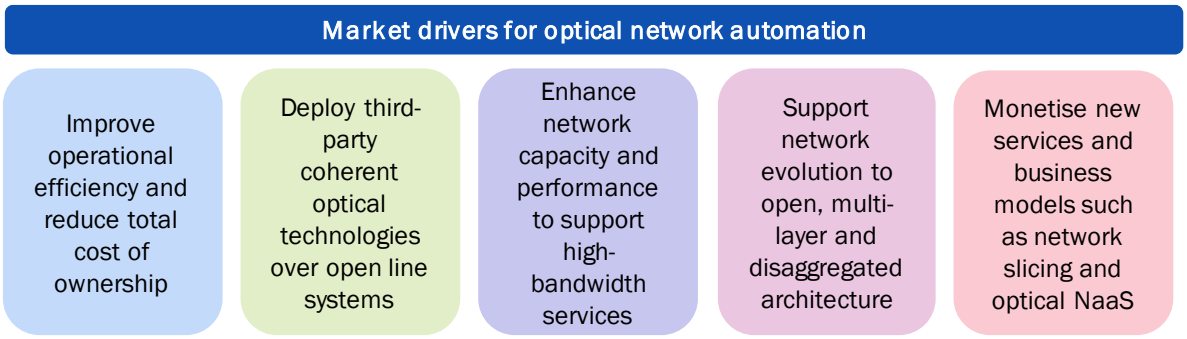
This article is based on our recent report *Automation strategies for multi-vendor, multi-domain optical networks*. It analyses the challenges and opportunities for deploying automation in an open optical networking architecture, offers information and insights that operators can draw upon when formulating their open optical networking strategies and includes profiles of leading vendors that offer optical networking automation solutions.

## The escalating demand for high-bandwidth applications is driving the need for high-capacity, efficient and reliable optical networks

The arrival of 5G, AR/VR, edge computing and other technologies has led to increasing pressure on operators to offer low-latency connectivity (<100ms) to support high-bandwidth applications and guarantee a seamless user experience. Furthermore, the increasing adoption of cloud-based services to support the massive volumes of data and workloads necessitates high-speed and reliable connections of 10Gbit/s to support the requirements. Dense wavelength-division multiplexing (DWDM), reconfigurable optical add-drop multiplexers (ROADMs) and coherent optical transmission technology are some of the new optical networking technologies that operators are adopting to increase the bandwidth of existing fibre networks.

Consequently, operators are seeking the best-of-breed solutions to meet consumer and enterprise demands for higher capacity and are breaking away from vendor silos to deploy multi-vendor network architecture. However, they are faced with several challenges in the management and configuration of equipment because traditional optical networks have been built on proprietary network management systems run by different vendors. Therefore, operators are evolving their optical networking architecture to be open and disaggregated to ensure seamless integration and end-to-end management and control of multi-vendor transponders, coherent pluggables and associated operations support systems (OSS).

*Figure 1: Market drivers for optical network automation*




Source: Analysys Mason

## SDN and TAPI are foundational for automating the management, control and configuration of open optical networks

One of the primary goals of software-defined networking (SDN) is to enable programmatic control of the network by abstracting the control plane from the data plane in network devices. The Open Networking Foundation is playing an active role in establishing SDN architecture standards for open optical network automation and developing Transport API (TAPI) to facilitate optical network automation. TAPI is currently the leading standard for northbound optical controllers and supports the Telecom Infra Project (TIP)'s Mandatory Use case requirements for SDN for Transport (MUST) in standardising interfaces to enable vendor-agnostic implementation across SDN controllers, orchestrators, management systems and OSS applications from different vendors. The convergence of control and management systems into a unified hierarchical SDN architecture will be a key enabler to automate and streamline the end-to-end management, multi-domain co-ordination and control of open optical networks.

Network disaggregation complements SDN by enabling network operators to select the best-of-breed and cost-effective solutions from a diverse ecosystem of vendors and enable better flexibility in deploying open optical network automation strategies. The TIP established the Open and Optical and Packet Transport (OOPT) project group to accelerate the development and deployment of open and disaggregated optical networks. It is a joint initiative consisting of over 15 network operators including Deutsche Telekom, MTN Group, Orange, Telefónica, Telia and Vodafone. It currently has achieved over 45 commercial trials and deployments from 35 operators across 27 countries. It has also published more than 32 documents on the technical requirements for hardware, software and interfaces, and use case definitions since 2021.

## Active collaboration is vital to ensure interoperability across multi-vendor optical network environments

The Optical Internetworking Forum (OIF) is leading the commercialisation of transport SDN by testing the multi-vendor interoperability of using TAPI and OpenConfig device APIs. At the European Conference on Optical Communication (ECOC) in 2023, OIF showcased the largest interoperability demonstration on 400G ZR+ optics, including Open ZR+ and OpenROADM applications, over a multi-span ROADM network. on Telefónica's network. Nearly 40 OIF members have participated in the demonstration, including Adva, Cisco, Ciena, Infinera and Nokia, with Telefónica as the hosting consulting network operator and LightRiver as the host for technology-specific pre-demonstration integration testing.

OIF followed a use case-driven approach for multi-vendor optical interoperability testing including the following.

- **Network discovery:** retrieval of network topology, resource availability and status required for inventory, traffic-engineering, or provisioning.
- **End-to-end provisioning:** control of creation, modification and deletion of connectivity services between two service end points at any network layer and export stateful information about the services deployed.
- **Inventory management:** retrieval of the relationship of logical network objects and their physical location in chassis, slots, ports, etc.
- **Maintenance:** support the deletion and modification of an already created service and notify of an error when a non-existing service is attempted to be removed.
- **Notifications:** notification of subscription to autonomous or on-demand information about network events and monitoring data, adds/deletes in the topology, connectivity, path computation elements and status changes.
- **Operations, administration and maintenance (OAM) performance monitoring:** ability to instantiate OAM monitoring points and to control fault and performance monitoring for network troubleshooting.
- **High-level features:** access to additional services such as network virtualisation/slicing and path computation services.

Operators and vendors need to work closely with industry organisations to adopt Open APIs, standardised interfaces and common data models in their open optical network automation journey. The implementation of artificial intelligence and machine learning with enhanced telemetry and data analytics will further enable better closed-loop automation. This will help to foster innovation among ecosystem players to develop solutions that are more flexible and scalable, and will ensure seamless integration, management and control of disaggregated, open optical networks.