



TELECOM INFRA
PROJECT

How TIP's Open Optical Group is driving forward disaggregated transport network solutions.

How TIP's Open Optical Group is driving forward disaggregated transport network solutions.

The Open Optical & Packet Transport (OOPT) group is a project group within Telecom Infra Project that defines open technologies, architectures and interfaces in Optical and IP Networking.

Its goal is to accelerate innovation in optical and IP networks and it has defined specifications for network elements including optical transponders, line systems, IP access devices and disaggregated routers. It has also developed network simulation and planning tools, as well as defining open operating architectures and OS for the control and management of those elements.

All of its work is led by operator requirements, meaning that vendors know that any solutions they develop using the TIP frameworks and blueprints will meet specific operator use cases, and therefore will be commercially viable.

The importance of transport networks, and the OOPT

One of Groups within TIP that has driven the largest volume of commercially deployed solutions is the OOPT group, perhaps most notably with its Disaggregated Cell Site Gateway (DCSG) but also with a host of other solutions.

TIP's Chair Santiago Tenorio paid tribute to the work of the OOPT group as he launched the TIP Summit conference stream at Fyuz22. He said, "One of TIP's core missions is driving the adoption of disaggregated technology at scale.

"OOPT has really been on a tear providing solutions for backhaul and other use cases. It is reaching a high level of commercial deployment and we are adopting robust solutions from that group."

Juan Carlos Garcia, SVP Technology Innovation and Ecosystem, Telefónica, and TIP member, said, "We are very active in open transport and fixed broadband. In IP and Optical disaggregation we are in many projects that are already going into commercial operation and are showing technical maturity in the field.

"As far back as 2019 we had the first trials of Cassini terminals in an inline optical line system. We have also done a lot of work in pushing a key project – MUST - looking at the separation of the control and user plane in transport network. That's been an example of collaboration in TIP where it has been very easy to launch a Group within weeks and months, prepare a roadmap and deliver with a pragmatic approach."

Diego Marí Moretón, Manager Connectivity Technologies & Ecosystems, Meta, introducing a track of sessions on the Group's work said, "OOPT has set the standard on how the industry should work together to define the future of connectivity. We have a strong foundation with cultures and co-leads that give us that energy and vision.

"We know fixed networks and transport networks are fundamental to connectivity, so when the TIP journey started it was clear we had to do something about them as well as access networks, because transport solutions were single vendor, monolithic.

"Why is this so important? We all see that transport networks are taken for granted, only noticed when they stop working. But they are at the core of connectivity. You can have fantastic WiFi, base stations, a central core in the middle but unless you have something to connect those, nothing is going to work. That is the fundamental purpose of transport networks – to connect the different components you have in the network.

"But initially the supply chain was very limited, and we don't like that because when you have a limited number of players innovation doesn't happen as fast as it should. So we started our

mission in OOPT to bring more people and companies into the mix, to grow networks in a way that fulfills customer demands."

As well as fostering more innovation, the group saw that operators had a need to reduce the TCO across installation, commissioning and integrating transport networks with their own OSS. One of TIP's key principles is that technologies need to be fully open and disaggregated. So it divided this TCO and operational problem into layers, starting with basic disaggregation of software and hardware.

The main advantage of HW-SW separation is to be able to combine solutions from different suppliers at your own will. Interoperability and integration with SDN/management systems was also seen as fundamental, so all solutions must have a requirement to offer open and standard APIs.

Marí Moretón said, "We now have 10+ sub groups running different tracks and we are very proud of this journey. We have more than 50 commercial deployments that we have incubated over the years, across multiple operators, and 100,000 devices that we have deployed in networks around the world. We couldn't have achieved that without the community we have built."



Figure 1: OOPT Project Group Structure

In the last two years the OOPT group published 32 deliverables, which form detailed technical requirements for hardware, software and interfaces that the industry can use as a reference, knowing that they are completely operator-driven and vendor-neutral. A requirement has not been baked or influenced by any of a vendor's competitors. As proof of that, 43 TIP badges and ribbons have been awarded to OOPT vendor products and solutions by the TIP Test and Validation framework.

In addition,

- a total of 27 solutions have been listed in TIP Exchange from the various OOPT subgroups, including 4 new DCSG (Disaggregated Cell Site Gateway) and the first 3 DDDBR (Distributed Disaggregated Backbone Router) listings

- More than 45 trials and deployments, from 35 different operators, across 27 countries.
- New commercial DCSG deployments across North America (uGrid) & Europe (Kazakhtelecom) with IP Infusion and Ufispac
- Turk Telekom announced a DCSG field trial
- NTT completed world ultra-low latency video-transmission with OOPT Galileo Optical Transponder
- In 2022, TIP demonstrated the first Phoenix compliant solution available in the market with NTT, Fujitsu, NEC and Wistron running on the Goldstone open source operating system



Figure 2: OOPT deployment map, 2022

As that journey continues, TIP's OOPT members do not want the pace of innovation to slow, and now the paradigm has been established it is becoming the de facto model for solution development.

Here are some of the key recent and upcoming developments and products that you will see emerging from the work of the OOPT Group.

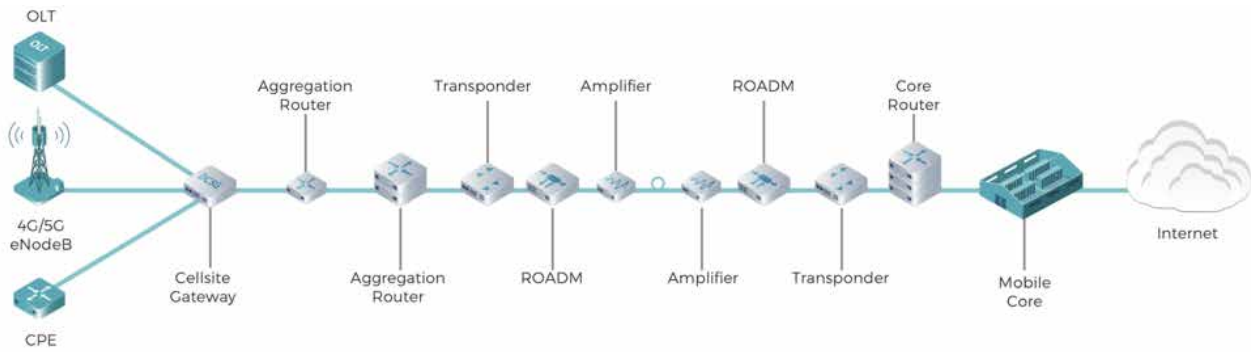


Figure 3: OOPT Product portfolio

DCSG Disaggregated Cell Site Gateway

One of the OOPT's foundational Groups, the DCSG has just received further commercial validation from Vodafone, with the announcement in Q4 2022 that Vodafone Turkey will begin rolling out DCSGs at its base station sites.

The DCSG is a 1RU router that sits at the cell site, supporting Layer-2, Layer-3 and MPLS features with native time synchronization protocols such as IEEE-1588 v2 and Synchronous Ethernet for the mobile base stations.

In 2022 there were new hardware models available, with 15 vendor product SKUs now accredited with Tip badges. Recent new solutions include a 2-in-1 DSCG and virtual DIU from Ceragon, which forms a radio-aware DSCG in 2022 based on COTS hardware with NOS integration from IP Infusion. The product is helping one European operator replace split mount solutions with an all in one outdoor solution. Adva, Edgecore, Infinera and UfiSpace also have commercial solutions available.

MUST Mandatory Use Case Requirements for SDN for Transport:

MUST enables the separation of control and data plane in the network, adopting SDN principles in the transport network. **The objective is to define a common SDN architecture and open and standard interfaces between the control and management layer.**

MUST is developing a common set of interfaces for management of the devices, developing the data models for the use cases that operators need. It is focussing on mobile aggregation and backhauling, such as L3 VPN and discovery, but is evolving beyond that.

Although slightly disrupted by the pandemic, there were several live trials and pilots from 2020 onwards, with some commercial deployments started in South Africa and Romania. There have also been more vendors coming into the ecosystem.

Recently the group has been producing new updates and test release requirements, including work on API development with vendors.

Vodafone in particular has onboarded DCSG internal processes like benchmarking, scouting suppliers of hardware and software, making sure it has a proper list of vendors and they are delivering requirements.

Johan Hjortås, Head of Transport Network strategy and architecture, Telia Company, said, "We defined the architecture a couple of years ago which would become the common

umbrella. **The ambition is that TIP products follow the MUST specifications, so we can facilitate integration of all TIP products with open interfaces.**"

Jose-Antonio Gomez, Senior Optical & SDN Transport Architect, Vodafone, said at FYUZ that it is fundamental to have proper integration of management and control of the network.

Gomez said, "We have a solution with disaggregated suppliers for HW and SW that can be interchanged, and a number of vendors already with badges, thousands of devices already deployed around the world."

"A focus on automation is very fundamental for us, not only for DCSG - we are asking DCSG to support the same as the SDN controller providers.

Juan Carlos Garcia, SVP Technology Innovation and Ecosystem, Telefónica, said, "MUST is providing us with the possibility to have a simple computing fabric and also enable integration with systems on top."

The next work of the group is to move beyond requirements documentation to test solutions for IP and Optical that can support SDN. Four detailed technical requirements evaluation (dTRD) processes closed responses in November, and a TIP Test plan will be approved before the end of 2022, before TIP Test & Validation events take place in H1 2023. Over 20 products are under evaluation.

M.U.S.T. – Mandatory Use Case Requirements for SDN Transport

Timeline

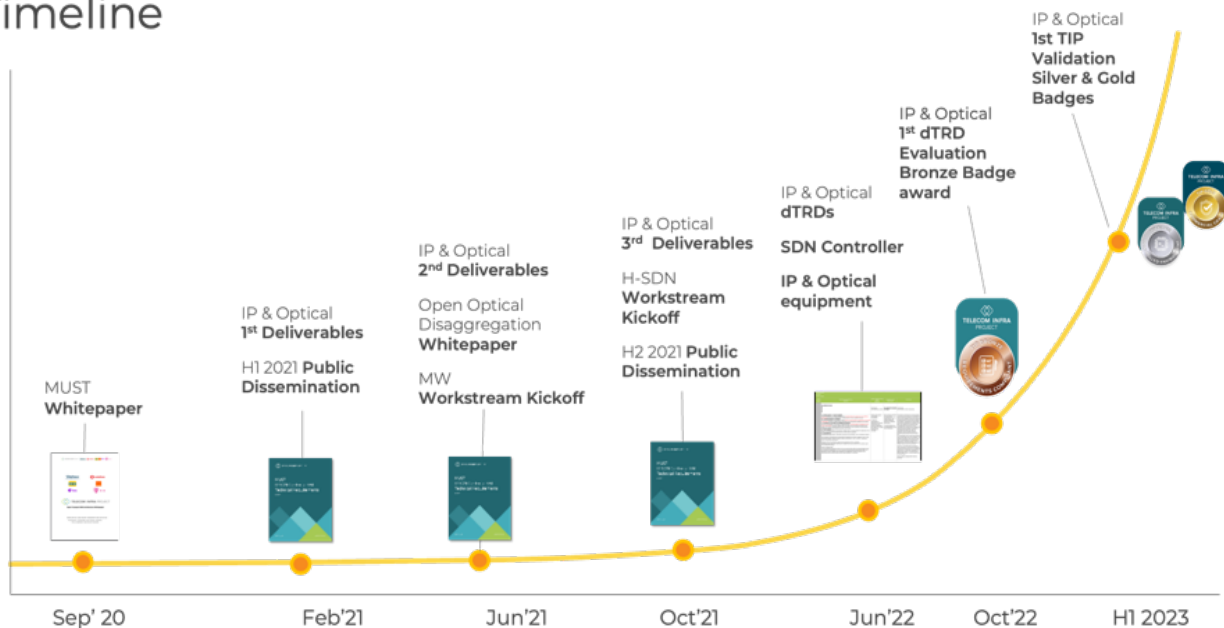


Figure 4: MUST timeline

DOS Disaggregated Optical System

The DOS is a white box open transponder/muxponder, with the first product being Phoenix - a 400G white box that is already part of a big deployment in South Africa.

The Phoenix product went through the requirements process in June 2022, with different SKUs for 100 - 400G client interfaces, third-party pluggable interoperability and MUST Optical SDN compliance.

It has been in lab and field trials in 2022 with Gold Data in the Americas, NTT in Japan and TeraCo in South Africa. NEC and Wistron won the first badges in October 2022, and TUP Test & Validation events are planned for H1 2023.

Telia's Hjortås said, "We are very happy with progress - now already there are a couple of ribbons to Wistron and NEC and then we will enter the Phoenix validation phase next year."

DOR Disaggregated Open Routers

We have seen that the DCSG is the oldest product in the TIP portfolio. With that product, TIP started small, covering a cell site with a small router. Now it is going bigger, to a disaggregated backbone router that covers the functionalities of an active router. The first product to come from this group is the Distributed Disaggregated Backbone Router (DDBR) which is a high scale router consisting of a cluster of white box switches deployed in a Leaf and Spine Architecture to act as a single network entity.

One benefit is that it can provide disjointed innovation paths for hardware and NOS vendors to provide operations deployment agility.

KDDI, Turkcell, Telefonica and Vodafone are all involved in producing requirements. Turkcell deployed the DDBR product on the production network as a first TIP deployment in Q3 2022, and KDDI produced a further operator-tested ribbon in Q4. Vendors in the group include Delta, Drivenets and UfiSpace.

González de Dios, Optical and IP Transport Network Expert, Telefónica said "We have designed the leaf and spine architecture for the router, and we have been very busy testing these solutions. There are also a couple of solutions that have been tested both in Turkcell and kddi, that have been awarded an operator-tested ribbon, which means that is an operator we can trust that has done that work. And now we think it is ready to be tested with the rest of the community."

Next up for DDBR is to focus on other flavors of router. The P-router is done, but the group decided to focus on PE functionalities, to cover the whole set of potential routers in a network. The Group will soon launch the new detailed technical requirements of the DDBR PE flavor, and will start testing, field trials next year, followed by the launch of an RFI. End-to-end solution testing could occur before the end of 2023.

DOS Disaggregated Optical Systems

TIP demonstrated the first Phoenix e2e setup in collaboration with Wistron, NEC, Fujitsu, Lumentum and NTT at OFC 2022. Phoenix is the first open and disaggregated transponder that supports 400G and 600G transmission. Incubated by the DOS subgroup, Phoenix will help operators evolve their 100G networks into high capacity links that support continuous traffic growth.

NTT has developed the first-ever ultra-low latency video-transmission technology capable of transmitting and receiving uncompressed 8K120p video*1 in the SMPTE ST 2110*2 over

optical paths. SDI*3 signals are directly collected by the TIP OOPT Galileo optical transponder and can be sent out into a large-capacity optical path in uncompressed SMPTE ST 2110, enabling long-distance and ultra-low latency video transmission. Furthermore, direct mapping of 8K120p video from SDI to SMPTE ST 2110 using SMPTE RP 2110-23, a method for dividing video data into multiple streams, achieves a delay of less than 1 ms between the video input at transmission and video output at the receiving end.

MANTRA Metaverse Ready Architecture for Transport Networks

MANTRA was formerly known as the CANDI subgroup, but was full-rebranded early this year to explore IP over WDM new transport architectures alternatives enabled by new-generation routers equipped with 400G (and beyond) coherent optical transceivers and multi-vendor optical Open Line Systems with third-party alien wavelength management capabilities.

TIP has seen groups focussed on solutions but this group was focussed to evolve new architectures, to explore new possibilities for emerging technology.

The focus of the Group starts with the IPoWDM initiative - targeting a plug and play model for 400G pluggable transceivers in QSFP-DD form factor, that is interoperable through standards such as OpenZr, OpenROADM and Open Zr+, as well as common implementation agreements such as TIP TAI.

The disaggregated architecture, based on standard APIs, will allow third-party Open

Optical Terminals to be deployed over brownfield Open Live Systems – with the idea being to take any router, plug in the pluggable and make it work over the available transport. MANTRA is focussing on the APIs to make that work, leveraging MUST, to specify how to interact with an open transponder, how to read information.

The aim is to eliminate vendor lock-in, and enable enhanced network planning and create a new business opportunity by generating capex savings with a reduced footprint, as well as reducing network investment in redundant capacity.

Moving forward, MANTRA will focus on incubating transport technologies to build the foundation for metaverse-ready transport networks in more cost-efficient ways

MANTRA disseminated a white paper in mid-2022, and is now conducting a survey with vendors, working towards a Proof of Concept in 2023.

PSE Physical Simulation Environment

PSE is producing software for optical network planning. Project group members include Cisco, Facebook, Juniper, Microsoft, Orange, Politecnico di Torino and Telia Company.

PSE is an open source tool that is able to calculate physical impairments. One pain point of optical networks is that this has been the secret sauce of vendors. For an operator to have a view of all physical impairments it needed to go with the vendor tool, like a black box. The PSE subgroup wanted to open that up, to one open tool that can know the performance of a system

PSE has produced the model and software and is now working with TIP's TAI (Transponder Abstraction Interface), OpenROADM, IETF and with TIP's MUST to ensure information that is required for physical simulations is available through their interfaces. This is an example of how TIP subgroups are linked together – as with MUST and the disaggregated router groups.

In the roadmap for 2023 is next generation readiness, with 800G connectivity.

NOS Network Operating System

Goldstone is a reference open-source Network Operating System and is one of TIP's oldest products. It is mainly aimed at accelerating the adoption of disaggregated networking in different deployments. It began with disaggregated packet optical transponders with extension into others as well. Major contributors have been PalC Networks, NTT and Wistron. It supports features like Rich line monitoring

by using TAI, 16QAM 200G/QPSK 100G mode and provides easy onboarding of third party application containers thanks to Kubernetes based architecture

It has been involved in production deployments since Aug 2019, with support from Wistron and NTT Electronics. Now it is working in disaggregated packet optical boxes.

Summary Adoption

Industry maturity and collaboration with organizations like TIP OOPT project group is easing adoption by driving consistency across vendor solutions with standard interfaces and data models. TIP OOPT recently initiated its badge evaluation process to demonstrate compliance and interoperability.

We are encouraged to see momentum rapidly building behind our Disaggregated Cell Site Gateway (DCSG) solutions with a number of trials and deployments announced across multiple regions from multiple mobile operators and ISPs.