An intelligent optical aggregation layer: what, why and how

Author and Author Affiliation: Pieter Panis, network engineer at Belnet

Keywords: Optical Transport Network, Aggregation, Ethernet, Bandwidth Optimization, 100G.

Abstract:

Until August 2014 the Belnet network consisted of a hybrid architecture, built up by only 2 layers: an optical DWDM layer (built on 2000km of fibres) and an IP layer.

In June 2012, Belnet started with an RFI for the replacement of their optical platform. At the same time Belnet realized that also the IP layer needed to be upgraded in the coming years. A scenario migrating the DWDM and IP layer in a big bang scenario was soon considered to be too complex and therefore too risky for Belnet 's customers. It was therefore decided to go for a 2-phased approach, first changing the DWDM layer in 2014, and then changing the IP layer in 2015.

The RFI process for the replacement started in June 2012, and although the RFI process for the new IP network would only start in 2013, the Belnet network department already realized early in the process that the technology choice for a new optical platform would have a direct impact on the development and effectiveness of a future IP network. Therefore the scope of the RFI was extended towards the development of a vision for a Next Generation Belnet Network, including the IP layer. That vision resulted in a technology choice for the optical layer splitting it into 3 sub-layers: a DWDM layer, an OTN layer, and a packet layer, all integrated into one optical platform. The sum of those 3 sub-layers was being named the "**intelligent optical aggregation layer**", on which a new IP layer could be built in the most efficient way.

Based on this vision, the project was kicked off and a public tender was released in June 2013. Based an extensive evaluation a vendor was selected in January 2014, and in September 2014 all traffic was migrated to the new optical platform. But this was only the first step in the migration. The optical platform currently integrates only 2 sub-layers out of 3, namely the DWDM and the OTN layer. The integration of the 3rd sub-layer, namely the packet layer, is the 2nd step of the migration, foreseen for the 1st half of 2015, facilitating the migration to a new IP platform in 2nd half of 2015 as the 3rd step.

1st step: new optical platform: As mentioned above, the currently rolled-out new optical platform integrates DWDM and OTN in one platform. The DWDM layer is based on **100G** coherent technology, in combination with WSS technology, enabling the transport of 100G channels purely optically throughout the Belnet network, making Belnet ready for future bandwidth requirements. Currently the 100G lambdas are used to transport 1G and 10G Ethernet services aggregated by OTN switches located in each PoP of the Belnet network. Such de-coupling of client signals from the implemented nx100G capacity has several advantages: it enables a pre-provisioned network where clients can be connected just by introducing or activating additional XFPs or SFPs, resulting in **faster delivery times**; it enables Belnet to flexibly configure and re-configure the end-to-end routing, resulting in **more efficient operations**; it also allows to **optimize the bandwidth** and therefore the cost by aggregating multiple client signals into one or more 100G lambdas. Such architecture also has some disadvantages: higher initial power consumption and a need for proper capacity management. The integration of OTN and DWDM into one layer can therefore be called an "**optical aggregation layer**".

2nd step: integration of packet layer: in order to make the optical platform also "intelligent" we decided to integrate packet layer functionality. The reason for such "intelligent optical aggregation layer" is Belnet 's intention to evolve **from a centralized to a distributed network model**.

Today's Belnet hybrid network is based on a centralized model, whereby all IP traffic from Access PoPs passes via two central sites where the Core PoPs are located. In a new distributed model there will be no difference anymore between "Core" and "Access". This has several advantages: points of interconnection to IP transit providers or internet exchanges can be chosen more freely, which should increase the availability of the connectivity to the external world; in combination with extra mesh, the network becomes **more resilient against local or regional outages**; ability to create direct paths between any 2 PoPs, **decreasing latency**; a distributed model can more efficiently **support evolving customer requirements** that are a result of the changing customer landscape (centralization via "Associaties" and "Académies").

Next topic of discussion was how to build such distributed network: on IP level or on a lower layer. Using the IP layer for aggregation in all sites would have a too high cost impact. Therefore Belnet chose to create such aggregation function in layer 2, integrated in the optical platform, thereby off-loading the transit traffic in the IP routers, using its IP interfaces only for local add/drop. Integrating such layer 2 aggregation feature in the Optical platform allows to further optimize the bandwidth usage in ODU containers and therefore the number of 100G lambdas needed.

The Core functionality, previously handled by the centrally located huge IP routers, is now handled by the packet layer functionality integrated in the optical platform. The reasons why the packet feature make the "optical aggregation layer" also **"intelligent"** are multiple: the fact that the packet layer functionality allows for statistical multiplexing, **further optimizing the bandwidth**; **any-to-any** connectivity capability with **limited number of IP ports** and without related bandwidth explosion.

Belnet is currently in the process of choosing the transport mechanism to implement the layer 2 functionalities - Ethernet Switching (G.8032 + Ethernet OAM), MPLS-TP, … - and the architecture (e.g. which PoPs in which rings). This will be further analyzed and decided upon in the 1st quarter of 2015. The implementation of this functionality, converting the Broadband IP services from ODU based to packet based, will be done in the 2nd quarter of 2015.

3rd step: new IP layer: once the "intelligent optical aggregation layer" has been successfully implemented on the current IP layer, Belnet will go to the 3rd and final step: the implementation of the new IP layer parallel to the current IP layer, but using the same "intelligent optical aggregation layer". This is planned in the 2nd half on 2015.

Vitae:

Pieter Panis, Pieter.panis@belnet.be, +32 2 790 3333

Pieter has a broad experience in transmission. After obtaining a masters degree in telecoms in 1995, he started working as transmission design engineer for one of the first European carrier's carrier. In 2000 Pieter joined a start-up dark fibre provider, first in operations and then as pre-sales helping the company to become a major telecom player in the Netherlands. Fascinated by DWDM, he joined Alcatel-Lucent in 2004, designing networks for several European NRENs and world-wide carriers, and became a product manager for their DWDM flagship. He joined Belnet in 2011 as network engineer and project managed Belnet's new optical network.