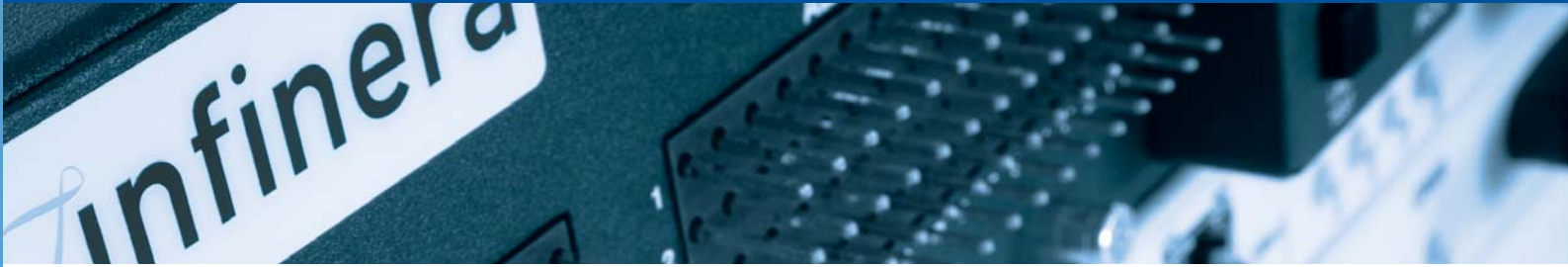


Infinera Case Study: Transatlantic Submarine Transmission



Infinera Demonstrates Trans-oceanic Submarine Solution on Transatlantic Link

Trans-oceanic submarine links represent one of the most demanding applications for an optical transmission system. Reach and capacity are the two dominant requirements, and in the past they have tended to overshadow the other common requirements for optical transmission systems. But as the transmission market becomes increasingly competitive, the need for greater efficiency is now becoming very significant. In this case study we examine how the Infinera submarine solution was adapted to meet the unique requirements of submarine transmission and deliver greater bandwidth capacity, while continuing to deliver one of the most advanced optical network feature sets in the industry.

Infinera was invited to participate in a field trial on the network of a carrier with an existing transatlantic link using a third party terminal and optical amplifier chain. Like most submarine systems, the amplifier chain cannot operate over the whole C-band. With demand for transatlantic services growing rapidly, the service provider needed to explore alternatives for adding capacity rapidly. The pre-existing submarine system supplier had discussed the possibility of migrating to 40Gb/s transponders, but these are typically very expensive, with extremely long delivery times (6-12 months), and require a complex and time-consuming installation process. A trial system from the pre-existing supplier took three months to reach a state that could be tested.

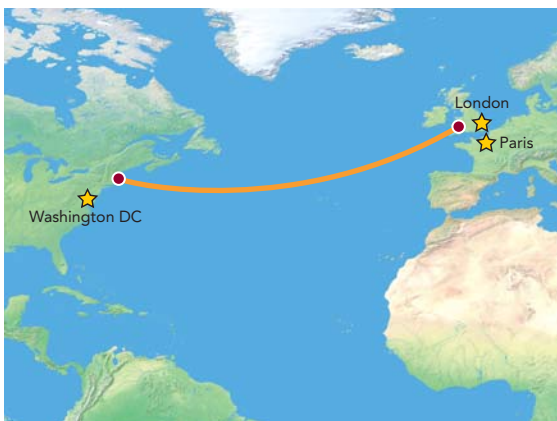


Figure 1. The Infinera field trial successfully demonstrated a doubling of capacity over this transatlantic link of more than 6,000 km.

Photonic Integration for Submarine Systems

The Infinera submarine solution is based on the Infinera Submarine Line Module (SLM), a version of Infinera's DLM line module implemented with Infinera's second generation high performance photonic integrated circuit (PIC). These PICs are built with an integrated semiconductor optical amplifier (SOA) to provide enhanced reach and enable trans-oceanic submarine network links.

There were four major objectives in this field trial of the Infinera submarine solution:

- Complete a full soak-test transmission across a transatlantic link of more than 6,000 km (See Figure 1).
- Demonstrate that the Infinera system could double network capacity.
- Operate over the existing third party amp chain.
- Install and commission the pilot link in the shortest possible time.

Infinera's Submarine Solution

The Infinera DTN leads the market for terrestrial long-haul capacity deployment (Source: Ovum), but it had not previously been deployed over the distances required for a transatlantic transmission — especially over an “alien” amplifier chain. Deployment of an Infinera submarine solution at the land-based cable-landing stations enables a service provider to increase subsea capacity significantly without the enormous expense of building a whole new submarine network. In addition, the submarine solution is fully compatible with the market-leading terrestrial DTN system.



Figure 2. The legacy submarine system in this trial required 8 bays of equipment, including transponders, dispersion compensation, and amplifiers to support 24 10Gb/s channels. The Infinera submarine solution required just one bay to support the field trial, increasing capacity with an 87% reduction in space consumption. Infinera's innovative DCM3 full-band compensation module was a key contributor to the space efficiency.

Rapid Network Deployment Capability

The first goal was to demonstrate that the rapid deployment features of Infinera terrestrial systems could also be achieved over a transatlantic link. A critical aspect of this step was to make use of new dispersion management technology, allowing the entire SLM waveband dispersion to be managed in one step, using a single Infinera DCM3 card. This contrasts with the per-wavelength dispersion management used by traditional submarine systems. The DCM3 solution can be commissioned in hours, rather than days or weeks, and consumes a fraction of the rack space required by the traditional dispersion management solution. Infinera increased capacity on the link yet reduced the space required by 87%. The improved density of the Infinera solution is due firstly to Infinera's photonic integrated circuits, which integrate ten 10Gb/s DWDM channels onto a single pair of chips, enabling the Infinera DTN system to support 80 channels in a single bay. Secondly, the new DCM3 solution provides dramatic space savings over the traditional fiber-based dispersion solution. The end result was that the entire transatlantic pilot (commissioning and testing) was completed in only 5 days. This compares with the three months a traditional system needed for a similar pilot test.

Rapid Service Activation

Once deployed, the Infinera submarine solution enables new services to be added in as little as a few minutes. In contrast, on traditional submarine DWDM systems, each new service requires a lengthy design and commissioning process, which often takes six to twelve months. The speed of Infinera's service activation is due to Infinera's unique Bandwidth Virtualization™ architecture, where the raw capacity is pre-deployed and Infinera software is used to enable any of a range of services to be quickly deployed over that capacity.

Increasing Capacity

The pre-existing solution on this transatlantic link could support only 31 channels for bandwidth of 310Gb/s. Over the very limited bandpass of the transatlantic amp chain, the Infinera submarine solution demonstrated successful transmission of 88 channels or 880Gb/s — more than doubling the capacity of the pre-existing terminal system with no changes to the subsea optical amplifiers. Over the course of the test, the Infinera system was able to exceed the link specification set by the service provider.

New Service Opportunities

While traditional submarine equipment has excellent reach and reliability, it often lacks support for more modern client service types, such as Gigabit Ethernet or 10GbE. The Infinera DTN as SLTE can support Infinera's full range of client interfaces.

Digital Optical Network Meets Submarine

In the past, submarine networks had to trade capacity and flexibility for high reach and high reliability. Now that PIC-based Digital Optical Network technology has been proven for the submarine market, these service providers are able to enjoy :

- Dramatically reduced equipment lead times. Days or weeks, rather than 6-12 months.
- Rapid deployment of new capacity. When the new equipment arrives, it can be deployed in days, rather than weeks.
- Typically a doubling of available capacity by moving to 25GHz channel spacing — even over the existing subsea infrastructure.

For more information, visit us at www.infinera.com, or contact an Infinera representative at the contact details below.



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