
Delivering

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Unrepeated Systems Description

This document provides outline details of Xtera's unrepeated system solutions.

For more information:

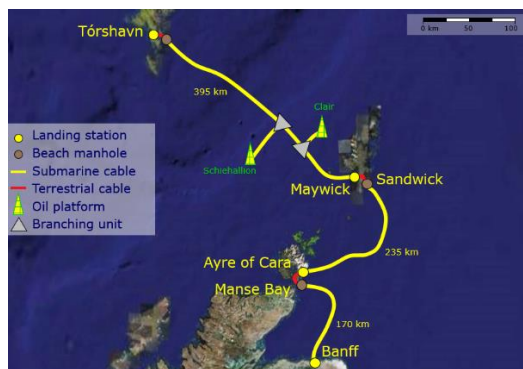
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The benefits

Unrepeated systems operate without submerged repeaters, power-feed equipment or grounding systems and therefore can use a smaller cable without high-voltage insulation and less copper than cables for repeated systems. These factors make unrepeated systems both less expensive, more reliable and simpler to manage. Xtera has been involved in extending the length and capacity of systems since 1999 and has worked on numerous unrepeated upgrades, and also new builds such as the Tamares North and SHEFA-2 systems. We have a particular interest in long or high-capacity systems, which are well suited to our Raman and Remotely Pumped Optical Amplifier (ROPA) Technology.



SHEFA-2



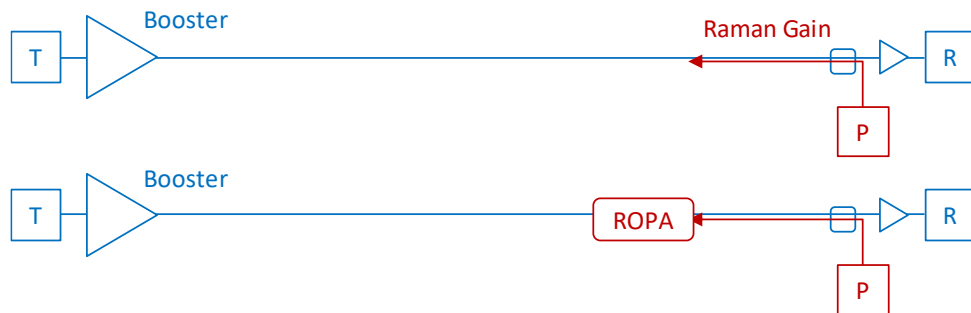
Tamares North

Technology

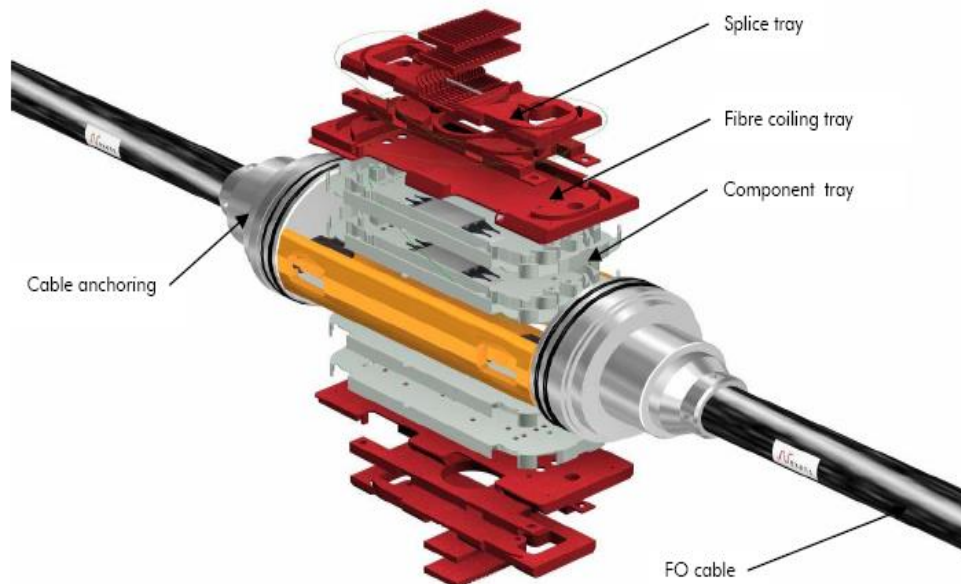
Longer spans are enabled by:

1. Lower loss fibre, where Xtera works with cable suppliers to select a loss which balances the cost with the required performance
2. Increasing the transmit optical power, which is ultimately limited by fibre non-linearity
3. Optical amplifier technologies such as Distributed Raman Amplification (DRA) and Remotely Pumped Optical Amplifier (ROPA), which become the key enablers once steps 1 and 2 have reached their limits

The Raman effect produces optical amplification in fibres where a "pump" light at the correct wavelength and power is injected into the line fibre. The following diagram shows Raman gain before the receiver, but it can also be applied at the transmitter, in both cases improving the overall optical signal-to-noise ratio (OSNR).



The OSNR can be further improved by using the residual Raman pump power at approximately 100 km into the fibre span to pump a Remote Optically-Pumped Amplifier (ROPA), as shown above. The ROPA contains Erbium-doped fibre within a submerged enclosure and effectively acts like an amplifier that is powered from the terminal. The figure below shows an exploded view of a subsea ROPA housing – ROPAs can also be used for long terrestrial spans.



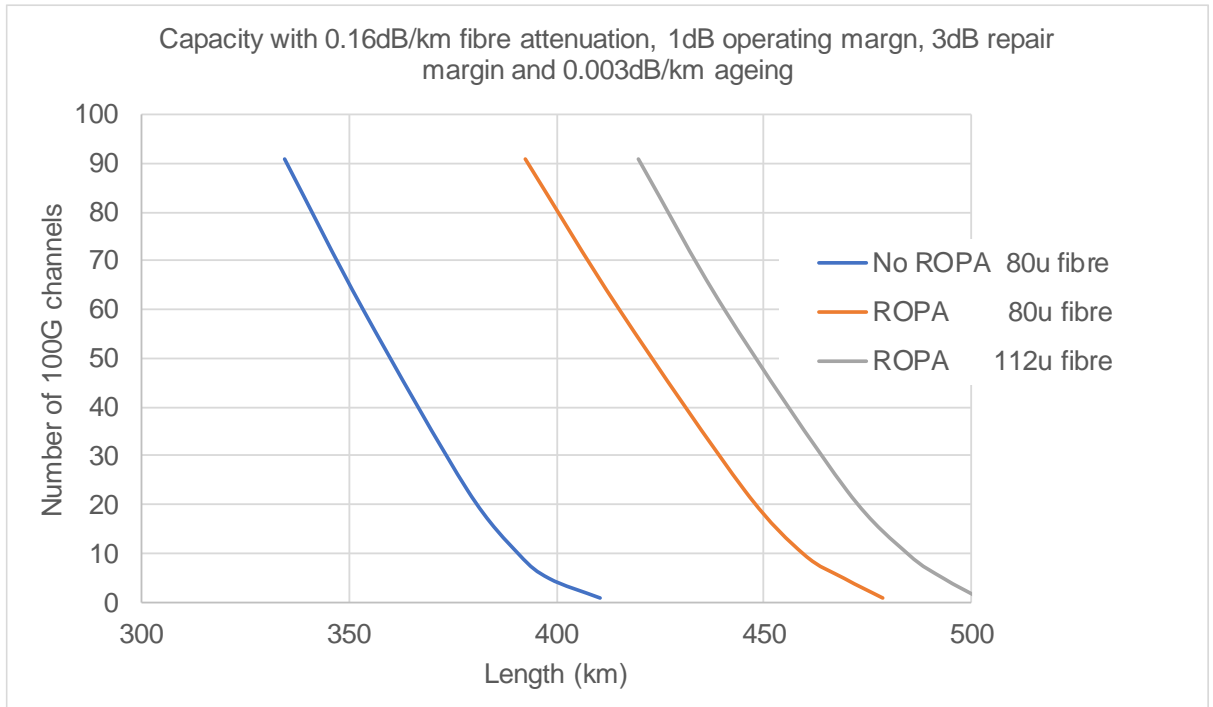
Both Raman and ROPA require very high-power pumps and a great deal of effort has gone into ensuring both safety – achieved by construction, interlocks and shutdown mechanisms – and reliability, coming from careful device selection and redundancy.

Getting the most from a DRA or ROPA requires a detailed understanding of the processes to ensure that power levels, wavelengths and ROPA position are optimised and Xtera has staff with many years of experience in this topic. Xtera also holds a number of key patents covering Raman technology.



Achievable spans

Xtera has demonstrated 100G transmission over more than 620 km in the laboratory and has produced real-world designs for systems significantly longer than 500 km. What is achievable depends on the type of fibre used and the repair and operating margins that are required; the following graph gives an approximate idea.



For simplicity, the graph shows only three configurations, but Xtera has a range of amplifiers with different power levels and bandwidths to allow us to tailor the system to suit your requirements. The example above uses a 50GHz spacing, with 37.5GHz Xtera can achieve up to 128 channels.

While the graph aims to show the upper end of what is possible, longer spans or higher capacity may well be achievable if even lower loss fibre or multi-fibre pumping is used, and we are continuously refining the technology, so please contact us if the graph suggests that your requirements are just out of reach.

We are used to collaboration and happy to work with other suppliers or to provide a full turnkey transmission or line solution. Xtera prides also itself on being able to work with customers to create tailored solutions and we would be happy to look at any particular case, so please contact us if you have a specific application.



Raman Amplifier modules

Our latest generation of Raman Amplifier units offer all the functionality required to enable long-span unrepeated systems, in a highly compact module.



Features and Benefits

- Compact 2RU design
- Co- (Fwd) or Counter- (Bkwd) propagating configuration
- Integrated gain and spectral shape measurement and control
- Integrated Loss-of-signal (LOS) detection and Auto-restart after repair
- Management interface to Xtera NMS
 - Open REST-based API for integration with 3rd Party management
- Industry-leading optical performance