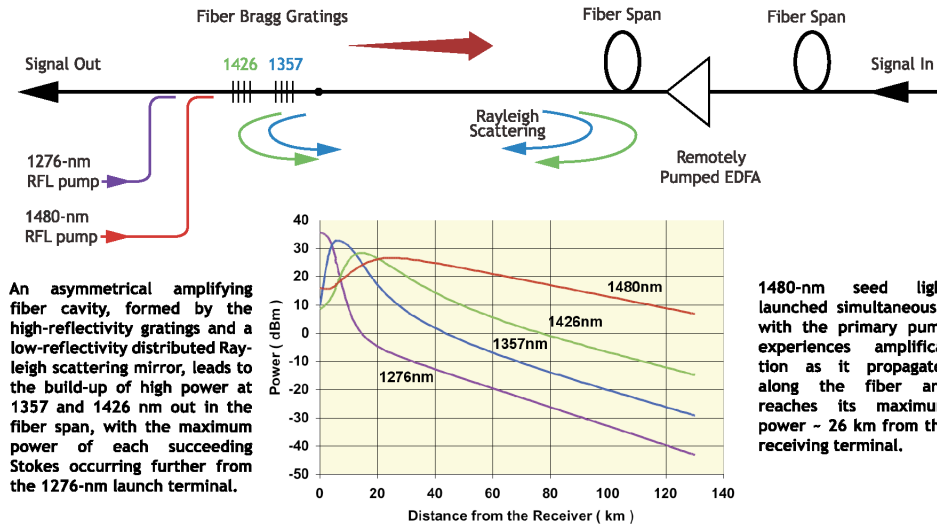


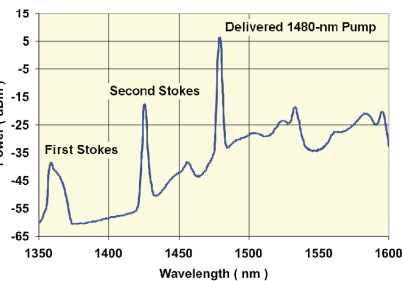
Cascaded Pump Delivery For Remotely Pumped Erbium Doped Fiber Amplifiers



Vladimir Karpov, Serguei Papernyi, Vladimir Ivanov, Wallace Clements (MPB Communications),
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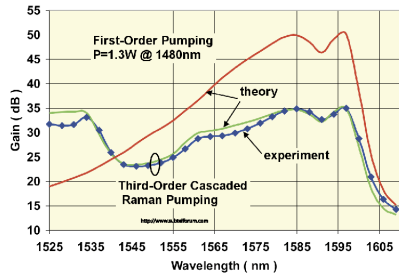


Third-Order Cascaded Raman Pumping: Primary Pump and Raman Stokes Evolution along Fiber Span.



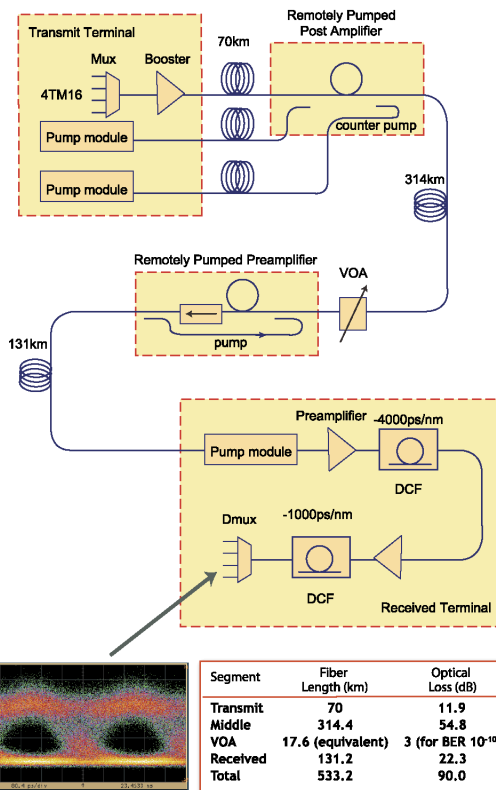
Optical Spectrum measured after the 131.2-km Span of Sumitomo Z Fiber pumped by the Third-Order Pumping Scheme.

Direct 1480-nm pumping at 1.3-W leads to a very high Raman gain, limiting the maximum launched power and ultimately the power delivered to a remote EDFA. On the other hand, the third-order pumping scheme allows the delivery of ~ 2.4-dB more power at a lower Raman gain.



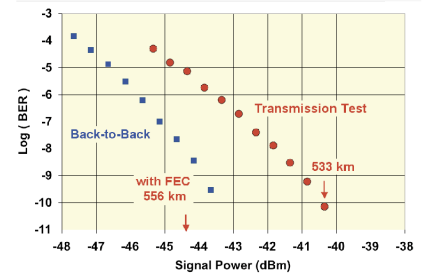
Raman On/Off Gain Spectra in 131 km of PSCF for first- and third-order pumping.

LONG SPAN TRANSMISSION TEST SET-UP WITH THIRD-ORDER RAMAN PUMPED REMOTE AMPLIFIERS

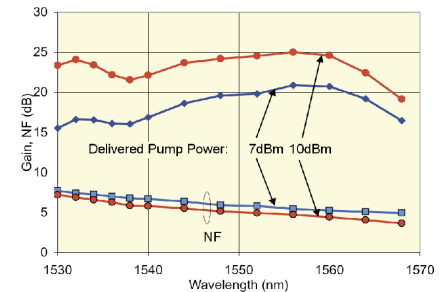


Summary

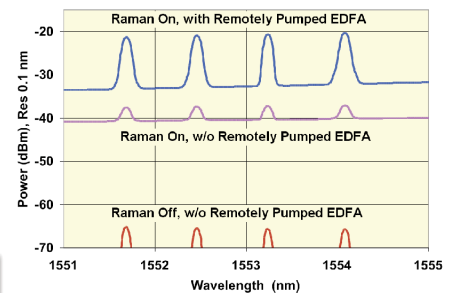
The third-order cascaded Raman pump scheme presented provides a 2.4-dB enhancement in the 1480-nm power delivered to remote optical amplifiers. This allows the span length between a remotely-pumped amplifier and its pump terminal to be increased by at least 12 km. Error-free transmission (with FEC) of 4 STM16 channels has been demonstrated in a PSCF (Sumitomo Z Fiber) span over a length equivalent to 556 km when both pre- and post-amplifiers were remotely pumped using the third-order cascaded Raman delivery scheme.



Bit Error Rate versus Signal Power at the Input of the Receiver's Pre-amplifier (back-to-back test) and at the Input of the Remote Pre-amplifier (transmission test).



Gain and Noise Figure of the Remotely Pumped EDFA measured when the Delivered 1480-nm Pump Power was 7dBm and 10 dBm.



Optical Spectra of WDM channels measured at the receiving terminal with Remotely Pumped EDFA and without EDFA when Cascaded Raman Pump was On and Off.