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*A Furukawa Company*

**Your Optical Fiber Solutions Partner™**

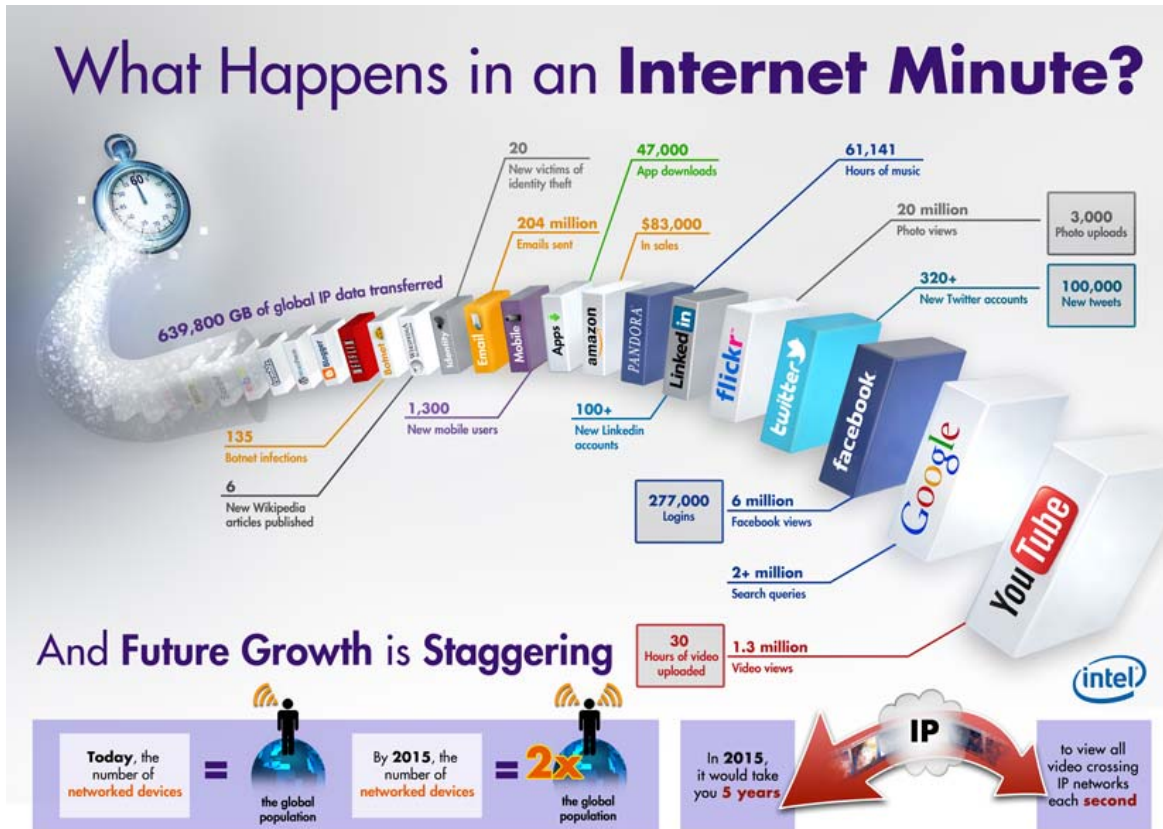
# **TeraWave Fiber**

## ***Fiber for the Long Haul™***

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# Long Haul Network Capacity Reaching Limits

## Advanced Fibers Can Help Enable Cost Effective Capacity Growth



Backbone bandwidth demand growing 40% - 100% each year.

Growth driven by

- More video
- Higher definition video
- Software downloads
- Double the number of networked devices in the next 2 years.

New fiber overbuilds and Greenfield builds should use bandwidth scalable, cost effective fibers.

## **Next generation long haul networks are reaching the limits of standard SM Fiber**

***Advanced fibers can help overcome these limits***

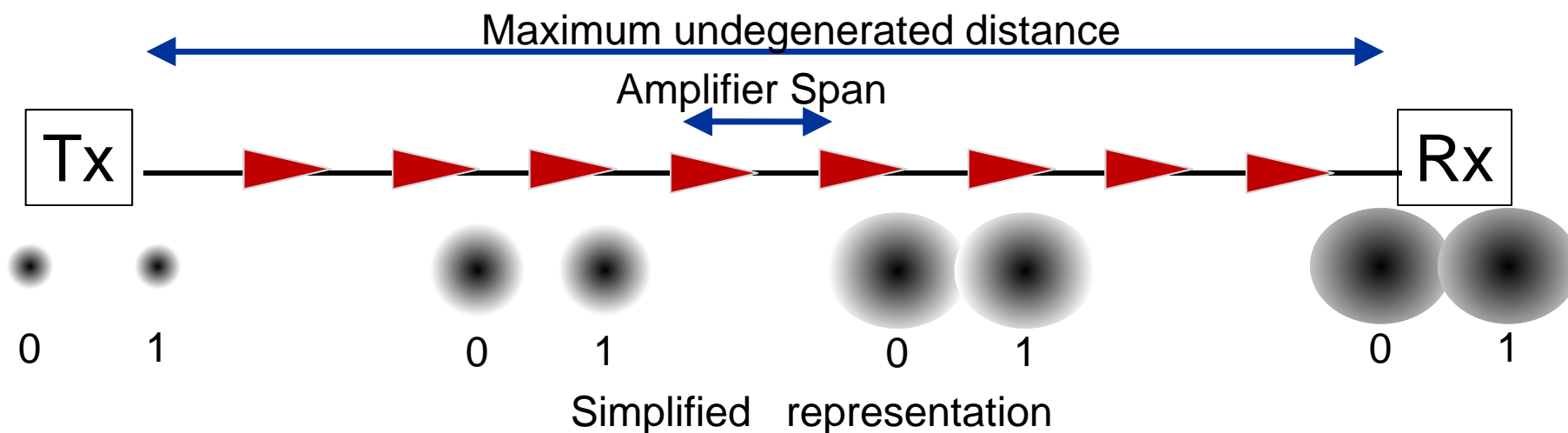


- **Capacity will need to be increased to meet growing bandwidth demand.**
- **100G adoption is growing fast and 400G is next, and both use sophisticated noise-sensitive encoding schemes with coherent detection.**
- **OFS TeraWave fiber uses Optimized Large Effective Area Technology to reduce amplifier noise and extend optical reach.**
- **TeraWave fiber can reduce system cost by avoiding \$Ms in signal regeneration, compared to conventional G.652D and ULL G.652 SM fibers.**

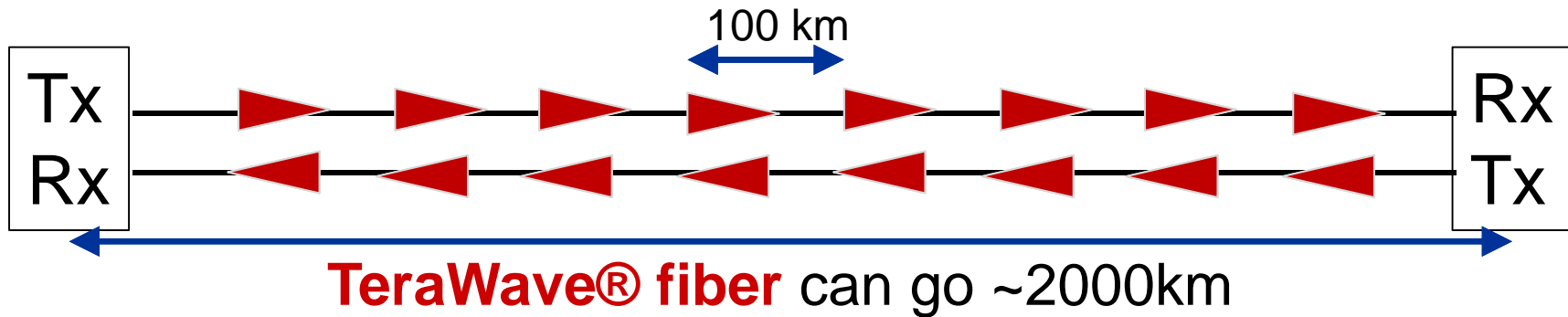
## What is Signal Regeneration?

*The short answer is – expensive*

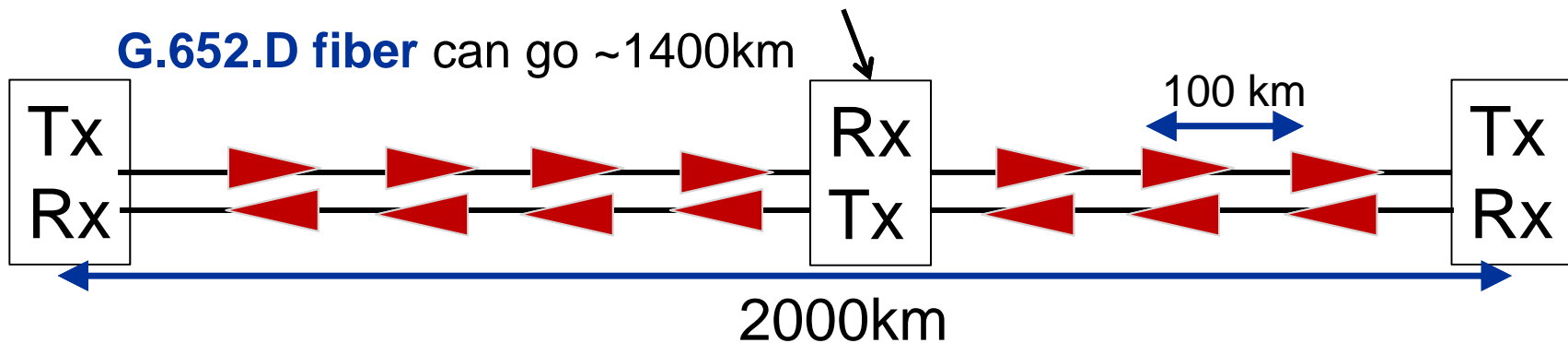
- Each amplifier adds noise to the optical signal.
- Transmission through fiber adds non-linear noise to the optical signal.
- Once the accumulated noise gets too large through many spans the signal must be regenerated to avoid bit errors.
- A regenerator is a receiver followed by a transmitter that together remove the amplifier noise – one regenerator for each wavelength of the fiber.
- Carriers want to avoid regeneration as it can cost \$Ms per fiber
  - ~\$50K per wavelength. and each fiber can carry 80 or more wavelengths!



**TeraWave fiber exceeds the reach of conventional G.652.D fiber by 40% to avoid expensive regeneration at 400G\***



### Expensive Regeneration



\* Estimated reach for network with 100km spans with Hybrid Raman-EDFA

## How do we improve regeneration distances to help reduce system cost?

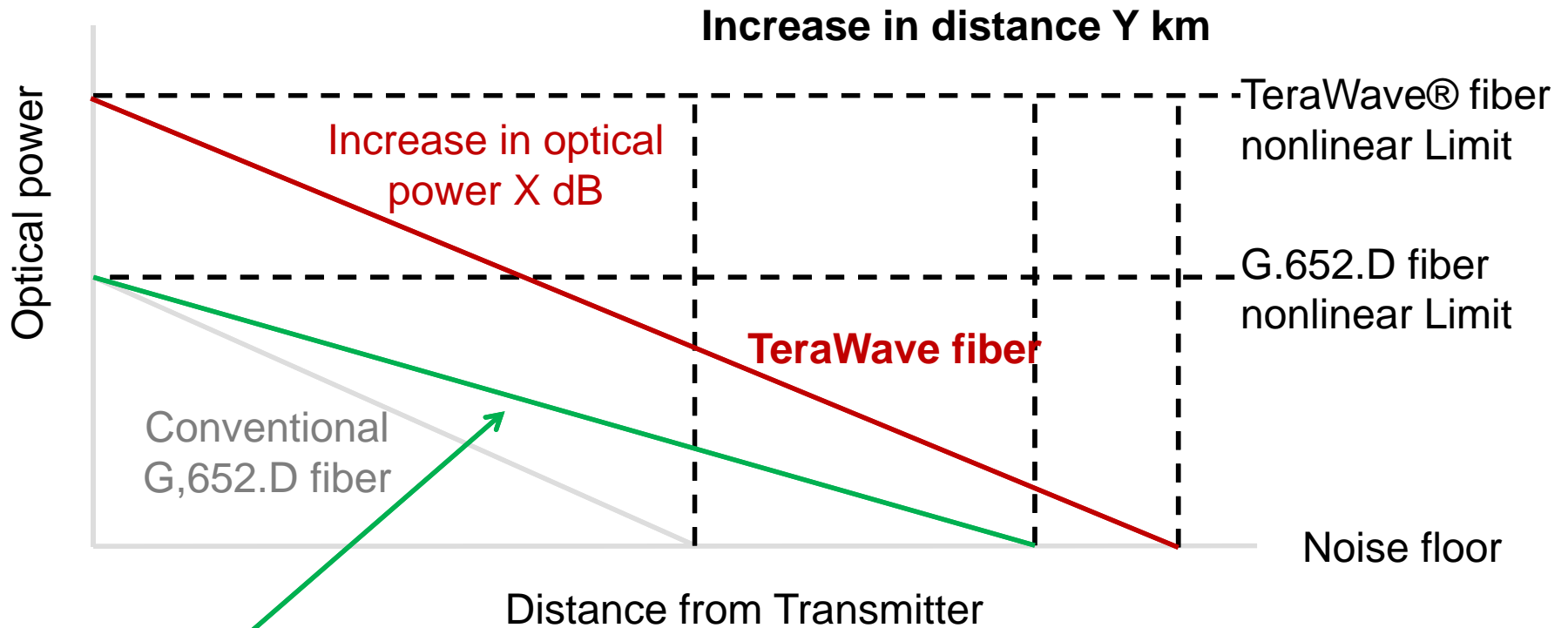


- **Improving the signal to noise ratio (OSNR) in the system increases system reach**
- **Closer amplifier (hut) spacing and Raman amplification are two ways to improve OSNR**
- **Advanced optical fibers can improve OSNR. Two approaches will be considered:**
  - Lower loss G.652 fibers such as ULL
  - Optimized large effective area G.654.B fibers such as TeraWave® fiber

# How far can I send a signal in an optical fiber? Farther with Terawave fiber



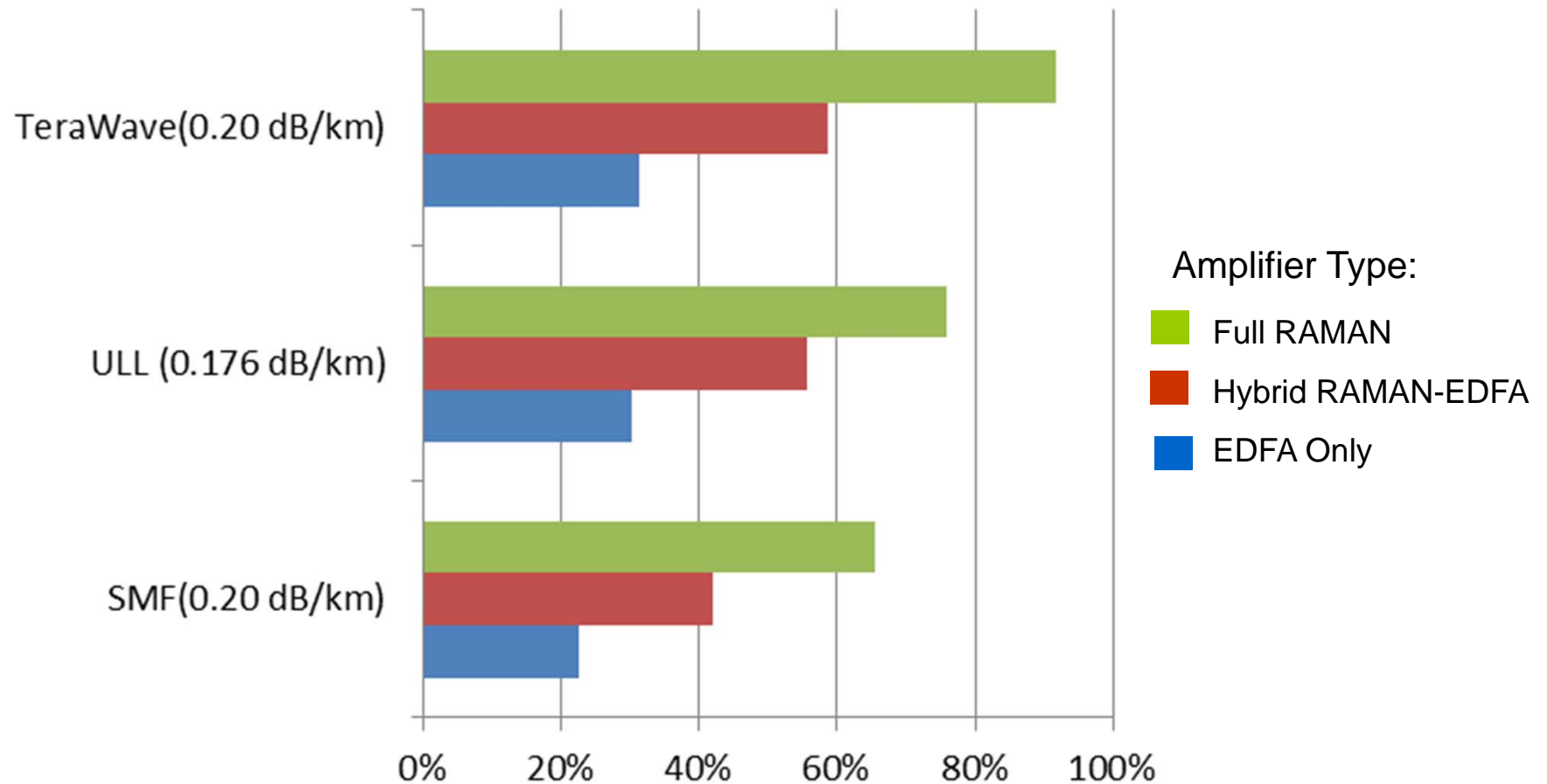
Single span, EDFA shown case shown. Even greater improvement with RAMAN.



G,652ULL type fiber with lower link attenuation by X dB

**TeraWave fiber's Optimized Large Effective Area provides more benefit than ultra low loss**

# TeraWave fiber link results in less noise for greater reach without regeneration at 400 Gb/s



**Relative 400G reach referenced to std SMF at 100 Gb/s using Erbium Amplifiers**



## Summary

- **Longhaul network capacity will need to be increased to meet growing bandwidth demand, increasing by 40 % or more per year.**
- **100G adoption is growing fast and 400G is next, and both use sophisticated noise-sensitive encoding schemes with coherent detection.**
- **OFS TeraWave fiber uses Optimized Large Effective Area Technology to reduce amplifier noise and extend optical reach.**
- **TeraWave fiber can reduce system cost by avoiding \$Ms in signal regeneration, compared to conventional G.652D and ULL G.652 SM fibers.**
- **TeraWave fiber is recommended for long haul overbuilds and greenfield long haul networks.**

# TeraWave® Fiber – Fiber for the Long Haul™



**More fiber will be deployed**

*And that fiber should be optimized  
for 100 and 400 G*