Fast, high capacity fiber transmission gets real for data centers

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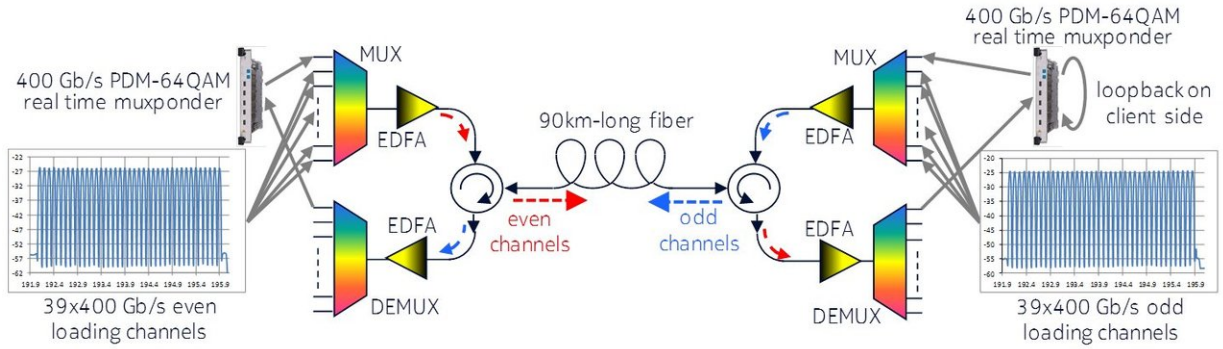

A bi-directional transmission set up with the same 90-kilometer fiber, where the even and odd 400 Gb/s channels, with the same 50 GHz grid spacing, transmit in opposite directions. Credit: Nokia

A cutting edge, "off-line" signal transmission mechanism, experimentally demonstrated just a few years ago, is now on-line as a real-time bidirectional transmission system. At OFC 2018, the single-most important annual event in optical communications, being held March 11-15 in San Diego California, a research team from Nokia will report the real-time, bi-directional transmission of 78 interleaved, 400 gigabit per second (Gb/s) channels with a 31.2 terabit per second (Tb/s) fiber capacity.

At twice the 200 Gb/s standard rate found in most applications, the C-

band signals were transmitted over a single, 90-kilometer-long single-mode fiber. Such a high transmission capacity and rate would offer a particularly attractive capacity bump to current data center interconnections, where nearby data centers are coupled together to form a single, larger center.

Fundamentally speaking, there are two ways to go about increasing a data center's capacity: either increase the number of (parallel) fibers through which the data travels, or increase how much data you transmit through existing fibers. While the use of additional fibers is a more straightforward approach (particularly for data centers which usually rent fibers to use), it is expensive both in price and power consumption.

Perhaps unsurprisingly, there is considerable interest in finding ways of increasing the transmission capacity of fibers already in use. As multiplexers (devices that combine multiple signals into one) and transponders become more sophisticated, so do the available signal encoding/decoding processes. Current standards for wavelength division multiplexed (WDM) signals, for instance, can combine up to 96 channels on C band.

The off-line proof-of-principle experiments first demonstrating the high capacity, error-free 400 Gb/s WDM transmission capitalized on a very high spectral efficiency to boost capacity in the fiber. While this is not the first real-time implementation of 400 Gb/s channels, it is the first to be successful with an impressive 8 bit per second-per hertz spectral efficiency.

"So far, three different companies have demonstrated a real-time 400 Gb/s transponder over the last three years, but we are the only ones reporting 400 Gb/s with such high spectral efficiency," said Thierry Zami, who will be presenting the team's work. "The spectral efficiency allows us to provide quite a large fiber capacity. So, in this case we claim

31.2 Tb/s, but in practice, without the limitations in terms of number of loading channels in our lab, we could have reached about 38 Tb/s over whole C band. This is really one of the innovative points."

In addition to using the real-time, commercially available transponders, the setup used components that are compliant with current network standards. After testing the unidirectional transmission configuration, Zami and his team wanted to further improve the resulting Q2 margins, which represent the signal to noise power ratio.

"It was important for us to maintain simple amplification, only based on erbium doped fiber amplifiers, and to use standard fibers," said Zami. "To increase the system margins observed with the unidirectional set up, we could have decided to make the same unidirectional experiment with slightly larger channel spacing, for instance. But we said, 'no' because we wanted to remain compliant as much as possible with the standard grid."

The team instead developed a bi-directional transmission set up with the same 90-kilometer fiber, where the even and odd 400 Gb/s channels, with the same 50 GHz grid spacing, transmit in opposite directions. For this configuration, they measured Q2 margins at least twice as large as for the unidirectional version. And because it employed two 100 GHz-spaced multiplexers to create the 50 GHz channel spacing, unlike the unidirectional system's individual 50 GHz multiplexer, it benefits from wider filtering to exhibit better tolerance to frequency detuning.

More information: Hear from the research team: 31.2-Tb/s real time bidirectional transmission of 78x400 Gb/s interleaved channels over C band of one 90-km SMF span (W1B.5), Wednesday, 14 March at 9:15 AM, Room 1B. , www.ofcconference.org/en-us/home