Precise distributed multiplexing of 200-Gb/s Nyquist-WDM using fiber frequency conversion

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Fraunhofer Heinrich Hertz Institute (HHI) and Fujitsu Laboratories Ltd. have achieved locally distributed wavelength-division multiplexing with exactly defined frequency spacing. Four Nyquist-shaped 25-GBd quadrature phase-shift keying (QPSK) modulation channels were successfully multiplexed to a 200-Gb/s super-channel. The researchers used optical frequency conversion in nonlinear fiber to realize nearly symbol rate spaced sub-channels.

The first public presentation of this work will be presented at the Optical Fiber Communications Conference (OFC) 2013 held in Anaheim on 21 March 2013.

Bandwidth explosion requires pushing next generation transmission systems to new capacity limits. The more capacity a fiber link can handle, the less fibers are needed to keep up with the increasing traffic demand. For this purpose high spectral efficiency, i.e. dense frequency packing of different wavelength channels, is essential.

Coherent-optical orthogonal frequency-division multiplexing (CO-OFDM) and Nyquist wavelength-division multiplexing (WDM) maximize the spectral efficiency by packing neighbouring channels at symbol rate spacing. These multiplexing schemes require frequency locking between all carriers at the transmitter to keep the exact frequency spacing and to avoid coherent crosstalk. In distributed multiplexing networks, such remote frequency locking raises a multitude of technical challenges.

To overcome these issues HHI and Fujitsu recently proposed and demonstrated a multiplexing scheme for distributed CO-OFDM which works with independent, free-running lasers and without the need for remote frequency locking.

The key idea is to exploit frequency conversion in a nonlinear fiber to assign locally defined exact frequency spacings to a global channel map. All contributing lasers are free-running while the proposed scheme does not depend on absolute emission frequencies. Therefore, all network nodes can operate independently.

Nyquist-pulse shaping was combined with the previously demonstrated distributed CO-OFDM scheme. The scheme provided a particular benefit of the inherently exact optical frequency alignment between the channels which allowed for narrow guard bands between channels. This would not have been possible without HHI's and Fujitsu's new multiplexing technique.

The researchers achieved distributed Nyquist-WDM of four 25-GBd channels carrying single-polarization QPSK at 26-GHz spacing, i.e. with only 4-% frequency guard band. They also emphasized that the scheme is inherently scalable towards even narrower guard bands, limited only by the steepness of the Nyquist spectra.

It is anticipated that this new technology can be applied to the multiplexing/addition optical node for huge numbers/capacity of data signal, which is a key technology for next-generation flexible photonic networks.

HHI and Fujitsu Laboratories will continue their research efforts to develop higher functionality in order to enable practical application of this new technology.

Provided by Fujitsu