Press release

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New 20Gbit/s optical transmitter uses DQPSK modulator to double DWDM spectrum-packing efficiency and upgrade the capacity on installed links. The transmitter can double the operating distance on uncompensated SMF28 fibre when compared with OOK at the same bit rate.

Northampton, UK — Bookham Technology plc (LSE: BHM, Nasdaq: BKHM) will describe a new design of 20Gbit/s optical transmitter with high tolerance to chromatic and polarisation-mode distortion and with improved spectral efficiency at the Optical Fiber Communication Conference and Exposition (OFC) in March 2003.

Exploiting a new technique of differential quadrature phase-shift keying (DQPSK) and Bookham's unique integrated GaAs optical technology, the transmitters can operate at 20Gbit/s, providing parallel transmission of two Sonet OC-192 data streams on a single optical channel. This allows the potential to increase capacity whilst maintaining a standard 10Gbit/s interface. Since transmitting two bits per symbol inherently halves the optical spectral width compared to OOK, DQPSK increases spectral efficiency, potentially allowing 20Gbit/s transmission with 25GHz channel spacing. This is achieved without the need for polarisation interleaving/multiplexing to reduce cross-channel interaction. This is a particularly attractive proposition for carriers seeking to increase the capacity of installed long-haul point-to-point transmission systems using expensive dispersion-managed fibre.

Alternatively, under 10Gbit/s operation, the DQPSK transmitter can operate over spans of 250km on standard non-dispersion-compensated single-mode fibre, (SMF28). This compares with a typical span in metro networks of 120km achieved by conventional transmitters using on/off keying (OOK) at a similar optical signal/noise ratio (OSNR).

The key to the new device is Bookham's integration of an optical DQPSK encoder onto a single GaAs/AlGaAs chip. The encoder (Figure 1) comprises several Mach–Zehnder modulators (MZMs) arranged within a Mach–Zehnder superstructure. Each MZM is biased for minimum DC transmission and driven with a data signal at half the total bitrate. An optical phase difference of π/2 is maintained between the upper and lower branches to ensure quadrature addition of the optical fields on recombination. The design also adds a phase modulator (PM) after the recombiner. The PM can be driven with a sinusoidal clock signal to provide chirp on the DQPSK signal, and this additional chirp extends the transmission reach for non-dispersion-compensated fibre.

"Because of our underlying GaAs platform technology we can put a lot of functionality onto a single chip," says Robert Griffin, Senior Engineer, Bookham Technology, and lead author of the paper. "This is crucial because there are currently strong industry trends for high bitrates and long spans driving the development of complex modulation formats requiring multiple functions, and these generate needs for higher levels of component integration to enhance performance and to simplify implementation."

The 52 × 3.5mm GaAs/AlGaAs chip is co-packaged with a DFB laser to provide a high-performance small-footprint module (Figure 2). On the chip, the optical waveguides consist of ribs etched into the surface of a GaAs/AlGaAs slab-waveguide. The MZMs use a microwave slow-wave technique to achieve the RF/optical velocity match needed to achieve wide bandwidth with low drive voltage. The phase modulator at the output is a travelling-wave structure similar to the Mach–Zehnder electrodes. The Bookham design uniquely exploits the phenomenon of 2-photon absorption (TPA) in GaAs to provide performance monitors integrated monolithically on the chip after the recombine to avoid additional external components and any interruption and degradation of the optical path.

Notes for editors

(1) The Optical Fiber Communication Conference and Exposition (OFC) is one of the major events for the fibre-optics industry. OFC 2003 will be held in Atlanta, Georgia, USA, 23 – 28 March 2003. Details are available at www.ofcconference.com.

(2) The paper *Integrated DQPSK transmitter for dispersion-tolerant and dispersion-managed DWDM transmission* by R. A. Griffin, R. I. Johnstone, R. G. Walker, S. D. Wadsworth, A. C. Carter and M. J. Wale, will appear in the OFC 2003 Conference Proceedings.

(3) DQPSK encodes parallel signal bitstreams onto one of four possible optical phase states, thereby allowing each transmitted optical symbol to represent two bits. The widely used conventional OOK modulation transmits only one bit per optical symbol, and so is inherently less efficient in its use of optical bandwidth, a disadvantage in DWDM transmission, where many optical channels have to be packed closely together. The spectral shape of the OOK optical signal is also very vulnerable to the effects of fibre dispersion, and this severely limits the fibre spans over which OOK systems can operate unless special dispersion-managed fibres are used. Compared to OOK, DQPSK offers improved tolerance to chromatic dispersion and polarisation mode dispersion (PMD), together with increased spectral efficiency, while requiring the same OSNR for a given bitrate.

(4) Mach-Zehnder modulators (MZMs) comprise an optical Y-splitter and Y-combiner connected by two matched waveguides. They operate by producing a phase difference between the two optical signals in the waveguides; on recombination, the signals interfere, producing an amplitude variation in the output signal.

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Bookham Technology (LSE: BHM; NASDAQ: BKHM) is a global leader in the design, manufacture and marketing of optical components, modules, and subsystems. Bookham's disruptive technologies and broad product range allow it to deliver an extensive range of cost effective optical functionality. The company's components and subsystems are used in access, metropolitan and long-haul networks. In November 2002, Bookham acquired the optical components businesses from Nortel Networks. This followed the acquisition of Marconi's optical components business in February 2002. The company, whose securities are traded on NASDAQ and the London Stock Exchange, is headquartered in the UK, with manufacturing facilities in the UK, Canada, and Switzerland with offices in US, France, Italy, China and Japan, and employs approximately 2000 people worldwide.

More information on Bookham Technology is available at www.bookham.com