ThP4 **2:45pm**

Experimental demonstration of MOSAIC: a multiwavelength optical subcarrier multiplexed controlled network

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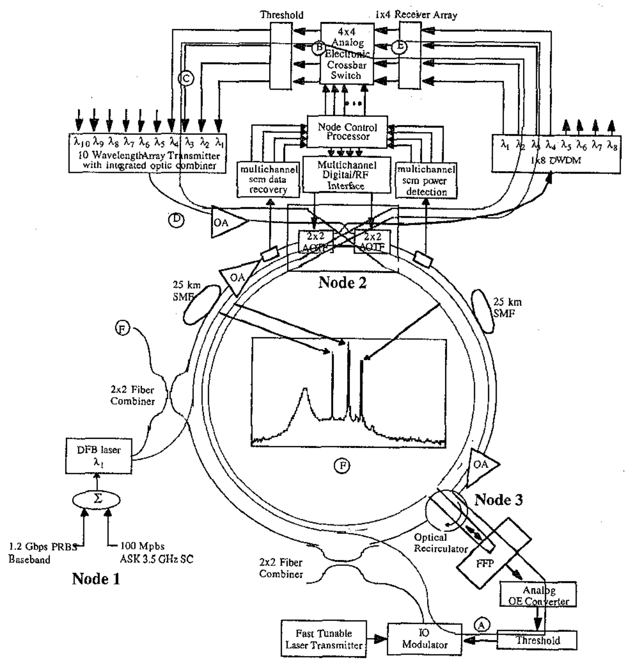
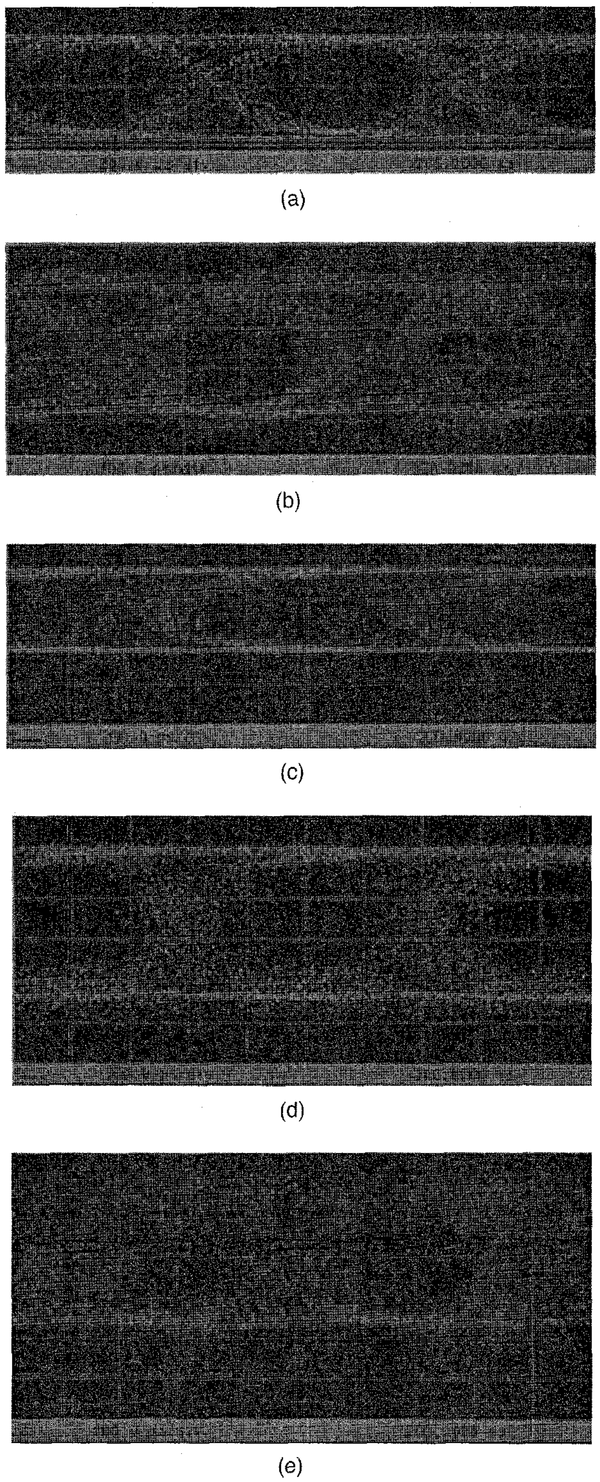
Reconfigurable wavelength-division multiplexing (WDM) add/drop fiber transport networks have the potential to satisfy the demands of future broadband communications applications. Second generation networks must be able to set up and maintain lightpaths that support the optical network layer. Lightpaths using multichannel optical switching and optoelectronic-optical (OEO) switching with wavelength translation can enhance performance and scalability.[1] Over the last several years, several WDM transport network testbed demonstrations have been reported.[2]

In this paper, we believe we present for the first time, results on the demonstration of our MOSAIC network. MOSAIC is a reconfigurable add/drop multiwavelength network that may be connected in a ring or bus fashion and digitally transparent *lightpaths* over multiple links and wavelengths.

A three-node, 50-km WDM ring network with a multichannel add-drop multiplexer (ADM) and a single channel tunable ADM was demonstrated as shown in Fig. 1. The multichannel ADM consists of (I) a WDM optical crossconnect (OXC), (II) an optoelectronic-optical cross-connect (OEOXC), (III) WDM multiplexer/demultiplexers and (IV) a node control processor. The OXC utilizes a 2 × 2 dilated AOTF switch[3] constructed with two 2 × 2 switches from Pirelli Cavi S.p.A and a multichannel digital-to-RF interface. Each wavelength is encoded with a unique subcarrier supporting 10 Mbp data for channel identification, remote node control and channel equalization. The OXC incorporates a multichannel SCM digital receiver to detect the presence of SCM channels at the ADM input and recover control data to configure the OXC and OEOXC. A second multichannel SCM circuit is used to measure the relative RF subcarrier power in all channels and is used



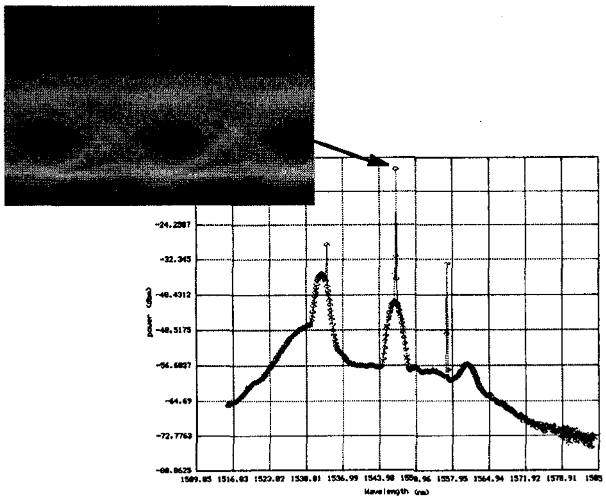
ThP4 Fig. 1. Three node network demonstration with transparent lightpath indicate by light gray line. Eye diagrams measured at points A-E are shown in Fig. 2.



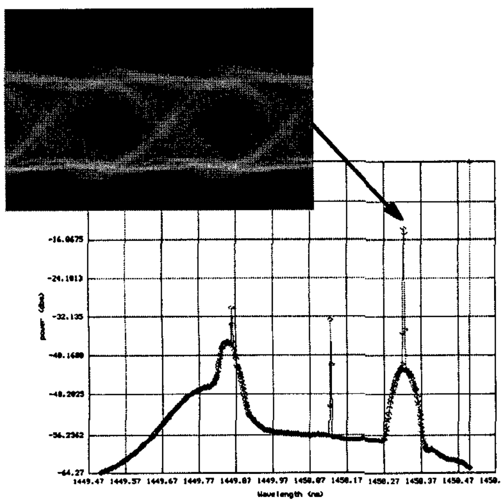
ThP4 Fig. 2. Recovered eye diagrams. (a) after first OEO wavelength translation and 2R regeneration, (b) after first pass through analog switch, (c) after second 2R regeneration, (d) after second OEO translation and (e) after three ring traversals, two 2R regenerations with OEO wavelength translation and 4 optical bypasses.

to control the AOTFs for channel equalization. The OEOXC contains four photoreceivers that currently support data rates up to 1.2 Gbps, a 4 × 4 analog electronic crossbar switch that supports data rates up to 5 Gbps, a threshold circuit array and a multiwavelength transmitter that supports 10 wavelengths at data rates up to 2.5 Gbps per wavelength with a subcarrier signal on four wavelengths.[4] An arrayed grating router is used to separate wavelengths that enter the multichannel ADM. The fixed- wavelength-drop/tunable-wavelength-add ADM with 2R OEO regeneration and wavelength translation is based on a recirculator, fiber Fabry-Peroy filter (FFP) and a fast tunable wavelength transmitter[5] with external modulator.

A circuit switched *lightpath*, digitally transparent up to 1.2 Gbps, was established as indicated in Fig. 1 by the light gray line. The lightpath was added at node #1 on $\lambda_1 = 1545.55$ nm, then optically bypassed by the OXC at node #2 and OEO bypassed at node #3 with 2R regeneration and OEO wavelength translation to $\lambda_2 = 1533.80$ nm. The lightpath continues through node #1 and is OEO bypassed at node #2 using the AOTF switch and OEOXC to wavelength translate to $\lambda_3 = 1560.60$ nm. The λ_3 segment of the lightpath is routed back to the network, optically bypassed at nodes #3 and #1 and is finally dropped at node #2.



(a)



(b)

ThP4 Fig. 3. Remote configuration of multichannel ADM node #2 with two different configurations transmitted on subcarrier channel from node #1(a) Shows add port optical spectrum for state 1 and detected eye diagram and (b) is for state 2.

The measured eye diagram at several points along the lightpath are shown in Fig. 2. Figure 2(a) illustrates jitter accumulation with 2R regeneration and reduction of ASE noise while Fig. 2(b) illustrates ASE accumulation due to the optical amplification. Figure 2(e) shows the recovered eye diagram at the lightpath termination with a measured end-to-end $BER^{-9} < 10$.

The remote node configuration results are shown in Fig. 3. Two different control data patterns were transmitted from the source node at λ_1 on a 10 Mbps ASK modulated 3.5 GHz subcarrier, then received, decoded and processed at node #2. Figures 3(a) and 3(b) show the optical spectrum and detected eye diagrams at the network add port for node #2 for the two different control patterns. The states were set to add one of four wavelengths with channel rejection better than 25 dB and a measured BER better than 10^{-9}. The reconfiguration time was measured to be better than 5 μs limited by the AOTF switching time.

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ThP5 3:00pm

All-optical access node using a novel self-synchronization scheme

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We demonstrate all-optical serial processing for a 100-Gbit/s access node using a novel self-synchronization scheme, which utilizes gain saturation in a semiconductor laser amplifier (SLA) followed by self-phase modulation (SPM) in an optical fiber. The contrast ratio for the header processor is 10:1 and for the demultiplexer is 20:1. Previous demonstrations of self-synchronization have involved specialized marker pulses with different wavelength,[1] polarization,[2] intensity,[3] or bit-period.[4] Our design avoids the complexity of generating and propagating these marker pulses because all pulses in the frame can be identical.

Figure 1 shows the experimental setup of the access node. An erbium-doped fiber laser ($\lambda = 1535$ nm, $\tau = 1.5$ ps) and a fixed word encoder is used to generate the 100-Gbit/s '10111000' data packet where '101' is the header and '11000' is the payload. The self-synchronization unit consists of an InGaAsP SLA, a 250-m fiber with a zero-dispersion wavelength at 1529 nm, and a filter at 1542.5 nm with a bandwidth of 2.3 nm. We use a low-birefringence nonlinear optical loop mirror (NOLM) XOR gate to recognize the header and a $LiNbO_3$ modulator to route the packets. The demultiplexer is a two-wavelength NOLM.

Figure 2 shows the results of the self-synchronization unit. Using an input energy of ~2pJ/pulse to saturate the SLA gain, we obtain more than 2:1 intensity difference between the first and the remaining bits in the frame [Fig. 2(b)]. This intensity difference is further enhanced to 17 dB by filtering the