10:30am - 11:00am (Invited)
WK1

Construction and performance of a 576x576 single-stage OXC

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With the explosive growth in data communications, management of fiber networks becomes a crucial issue. Optical Cross-Connects (OXCs) are ideal for this application, if they satisfy several critical requirements: large fiber count, transparency (to allow future increase of bit rates), and low-loss performance.

One practical way to create such an OXC uses a single-stage, free-space design. In this design, an optical unit attached to each fiber creates an expanded beam, which is directed in space. A large number or such optical units can interconnect to form a large, transparent, low-loss OXC.

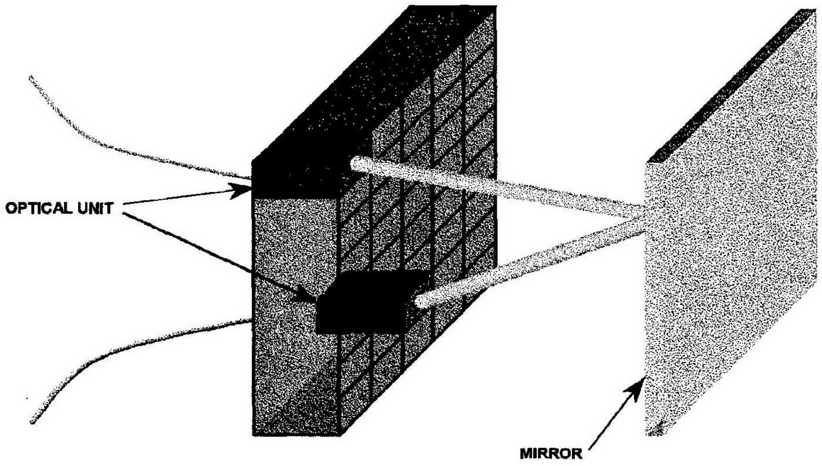

Figure 1: Directable Beams in Space

This basic free-space architecture is used in an existing commercial 72 x 72 multi-mode fiber cross-connect. Excellent performance has been demonstrated by these systems in the field. In this design, beam manipulation is performed with piezo-electric actuators, which move the fiber in two degrees of freedom.

In the new OXC under development, MEMS mirrors are used to direct the beams rather than the earlier piezo devices. The mirrors were developed by Texas Instruments, Incorporated. The mirrors are fabricated from silicon, and have an active area that measures 3 mm x 4 mm. The mirrors are magnetically actuated for rotation with two degrees of freedom. The mirrors have a precision surface

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that is gold-plated, resulting in diffraction-limited performance with a 3-mm diameter beam. Each mirror is hermetically sealed in a ceramic carrier with a glass window. Since the mirror is directing the expanded beam, the lens is always on-axis, allowing the use of a simple lens.

Four control LEDs surround each mirror, emitting short-wave infrared light at 880 nm. These control signals are used for servo control of the position of the MEMS mirrors. The LED signals are detected using a silicon-based detector mounted near the end of the communication fiber. A dichroic beam-splitter decouples the communication wavelength from the control wavelength; the communication beam is focussed on the fiber end, while the control signals arriving from the opposing unit are focussed on the servo detector.

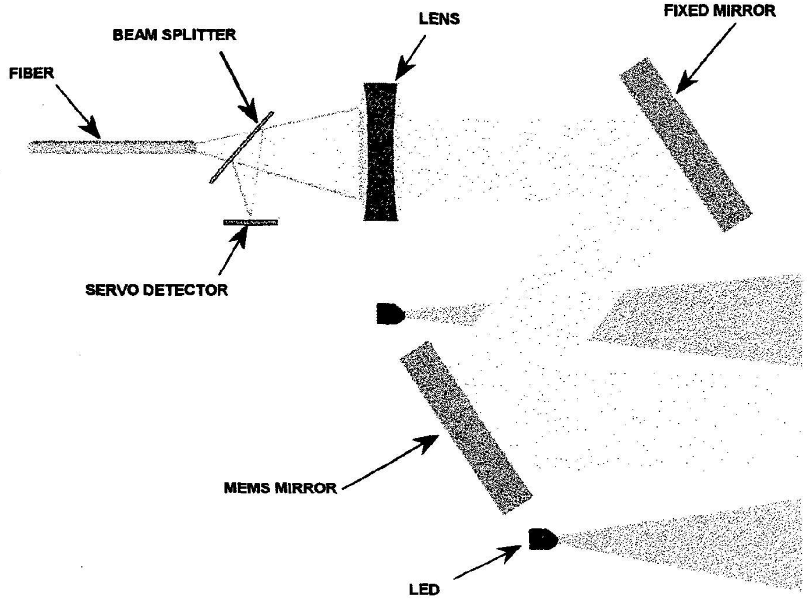

Figure 2: Optical Unit

Loss performance of 3-4 dB was measured for several optical units, well in line with the target specification of 6dB. These measurements were done at 1550 nm. The specified transmission window is 1260-1360 and 1500-1650 nm; at 1310 nm the loss performance was somewhat better than at 1550. The optics are being optimized to further improve performance for the 1500-1650 nm window. The target for polarization-dependent loss is less than 0.5 dB; it was measured at less then 0.4 dB. Optical improvements should reduce this figure further.

Cross talk was targeted to be -50 dB (optical) below the signal level. While switching, when a beam scans over other units not aimed at the scanning beam, the cross talk is doubled for a very short while. This is because most of the cross talk originates from scattering in the optics. The doubled cross talk was measured at -41.6 dB. From this measurement we extrapolate -80 dB optical cross talk, which translates to -160 dB when measured at the electrical level.