

TBONE: TestBed for all-Optical Networking

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INTRODUCTION

The TBONE project is an ARPA-sponsored three-year collaborative effort between MITRE, Optivision, and TASC. The objectives of the project are twofold: to implement and demonstrate a switched all-optical, multi-user image communications network in an applications environment, and to provide a testbed for developing and demonstrating optical network protocols, and other optical network technology. The testbed network will comprise two optical crossbar switches and two full-duplex single mode dark fiber links spanning the ~20km distance between TASC and MITRE. High performance workstations and image servers at the two sites will be linked by the network (see Figure 1).

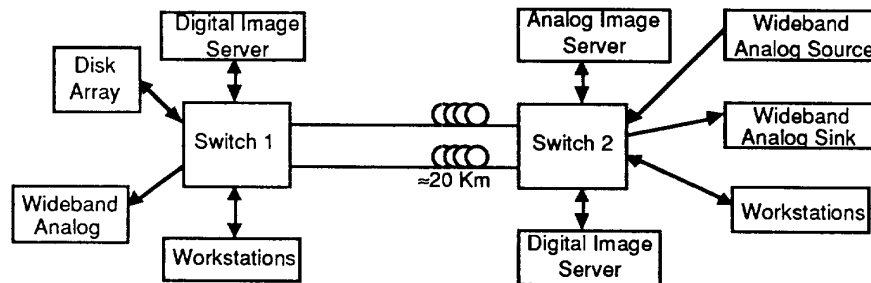


Figure 1. TBONE Baseline Network

In previous work, Optivision developed an 8x8 optical crossbar switch using semiconductor optical amplifiers (SOAs). MITRE has developed an all-optical LAN ("A-ONE") based on this switch, and has demonstrated network operation using an out-of-band control channel with high-speed digital and analog applications (see Figure 2). TASC has developed communications protocols, including a reliable multicast transport, for advanced imagery applications. The TBONE project will build on these capabilities.

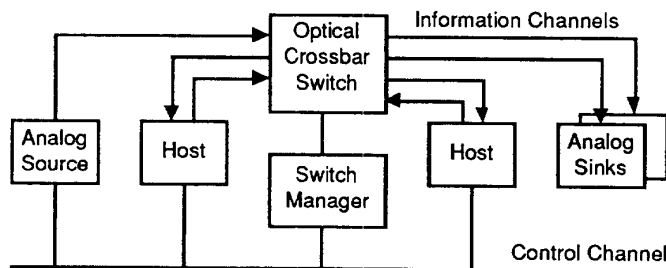


Figure 2. MITRE A-ONE Network

DEVELOPMENT STATUS

The TBONE project is focusing on four major activities:

- Design and implement a baseline optical network and demonstrate basic imagery applications
- Develop protocols for supporting real-time multicast of images
- Demonstrate the capability of the network to carry simultaneously both analog and digital traffic to provide integrated network services
- Develop new in-fiber out-of-band control methods and protocols designed specifically for all-optical networks

The TBONE project began in September 1993. Most work to date has concentrated on the first task above. The design of the network is complete, and installation is planned by 3Q94. Transmission tests for HIPPI communications over a two-switch laboratory configuration with 10 km of fiber plus a variable attenuator have recently been completed. Bit-error-rates of less than 10^{-12} have been demonstrated for an input optical power range of 0 to -10 dBm and with inter-switch losses up to 8 dB. Addition of an SOA-based link amplifier between the switches increases the allowable inter-switch link loss to 18 dB with the same error performance.

Designs for the initial in-band and out-of-band signaling approaches are in progress. The in-band signaling method supports HIPPI signals and uses a polling receiver approach developed by Optivision under ARPA SBIR sponsorship. The first out-of-band signaling approach will use a handshaking scheme, with coordination between the switch managers that are colocated with each switch; for expediency, a dedicated Ethernet will be used initially for the physical control channel. To achieve efficient high-speed transmission in an optical network, TBONE will use equipment that enables fast acquisition of HIPPI signals.

Design of the network and transport layer protocols necessary for both reliable and unreliable transport are underway. MITRE has developed a simple datagram transport protocol, and has an initial unicast implementation working across its all-optical LAN. TASC has implemented a Reliable Adaptive Multicast Protocol (RAMP) and has an initial version running on its internal LAN. These implementations are being integrated and improved for the TBONE network.

The presentation at the meeting will discuss the latest project status and system performance measurements.

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