

# Is Fiber In Your Future?

ENGINEERING | *Facility Design*

by Paul Berger

Up until recently, most television plants have been constructed using coaxial cable and copper wire to interconnect the television equipment. This technology has served the standard definition television plants quite well. It can be used to transport both analog and digital composite and component signals as well as audio, communications and control. However, the advent of high definition television with its 1.485 Gbps transport stream requires us to revisit interconnect technology. Coaxial cable is satisfactory for short runs between co-located equipment, but distance limitations soon become a major obstacle for the television facility designer.

With the transition to HD, engineers are now confronted with the dilemma of how to plan and implement a facility that will support production needs both today and in the future. Fortunately, as television technology advanced, fiber optics has developed into a practical alternative to the traditional coaxial cable/copper wire interfacing technology. Surprisingly, costs for the fiber optic cables and terminations are now competitive and, in most cases, even lower than the equivalent copper wire and coaxial cable installation.

**CONSTRUCTING A FIBER OPTIC TRANSMISSION SYSTEM** The basic fiber optic relay systems consist of the following:

- **Transmitter:** Converts electrical signals into light signals generally using the common wavelengths of 850 nm, 1,310 nm and 1,550 nm.

- **Optical fiber:** Conducts the light signals from point to point.

- **Optical regenerator:** Boosts the light signal (for long distance applications).

- **Optical receiver:** Receives the light signals and converts back to electrical signals.

However, to construct a cost-effective fiber optic transmission system the designer requires some additional "tools" beyond the basics listed above. In the simplest case, the fiber optic transmission system can be realized in a fashion analogous to the wire and coaxial cable system. That is, replace each coaxial cable and copper wire pair with one fiber per signal. Even with this simplistic approach, a fiber optic system offers many advantages:

- Optical fibers can be drawn to smaller diameters.

- Space required in cable trays and conduits is greatly reduced.

- There is less signal degradation with optical fiber than in copper wire.

- Distance limitations of wired networks are almost eliminated.

- Light signals from one fiber do not interfere with those of other fibers in the same cable—crosstalk is completely eliminated.

- Since optical fibers are nonconductive, ground loops are nonexistent.

**In most cases the cost of relocating an entire plant is far greater than the cost of operating from multiple locations.**

- If armored multi-fiber cable is used, the fiber is well protected and can be employed in almost any portion of the plant without regard to the potential for cable damage.

- Use of multi-strand fiber cable saves cost, since it avoids pulling multiple wires and coaxial cable, which is one of the most expensive, labor-intensive tasks in a construction project.

- *Passive* optical multiplexing and *bi-directional* signal transfer without the need for sophisticated electronic networks to mix and separate signals is realizable.

## EXAMPLE FIBER OPTIC TRANSMISSION SYSTEM FOR BROADCAST APPLICATIONS

With the continued growth of broadcast television over the years, it is quite common for a broadcast operation to be distributed among multiple locations. This is particularly true for the major networks and large station groups, which are often located in the heart of a city with limited room for onsite growth.

Having outgrown the existing facility, the only expansion options are to relocate

### THE BOTTOM LINE

With television physical plants transitioning from a standard definition infrastructure to one supporting high definition, the ability of existing coaxial cable and copper wiring to support long uncompressed HD cable runs is called into question. Today, fiber optics has developed into a practical alternative to the traditional coaxial cable/copper wire interfacing technology. Surprisingly, costs for fiber optic cables and terminations are now competitive and, in most cases, even lower than the equivalent copper wire and coaxial cable installation.

the broadcast plant or expand the operation into nearby "remote" locations. In most cases the cost of relocating an entire plant is far greater than the cost of operating from multiple locations.

However in many cases, particularly in the case of news or "live" programming, the "remote" operation requires tight integration with the main broadcast plant. In the past, this requirement presented an almost insurmountable obstacle to the use of "remote" studios for live news broadcasts.

Now with the availability of dark fiber within a city or industrial campus, a remote studio (RS) can easily be interconnected with the main broadcast center (MBC) and operate just as if it's located in the main plant.

For the television engineer who is tasked with the project of designing a system for interconnecting the MBC and RS, the problem can be broken down into a number of relatively simple steps.

**First:** Identify sources that can supply the dark fiber needed to connect the main and remote plants. In general, this would include two completely diverse paths and two separate entrances to each of the MBC and RS buildings. Diversity is needed to provide the high reliability connectivity that television operations normally require.

**Second:** Create a list of signals, which must be transported between locations. At this point, the needs of both the broadcast operations group and the IT activity must be considered. For the example being studied the broadcast operations people have requested the following:

- Four HD-SDI signals from RS to MBC
- Eight SDI signals from MBC to RS
- Three 10/100 Ethernet paths between MBC & RS
- Reference analog black burst signal from MBC to RS
- One signaling GPI in each direction
- Six RS-422 for machine control
- Six bi-directional analog audio paths
- Encoded HD signal from RS to MBC

The Business group that is supported by the IT department requires:

- One gigabit Ethernet link

- Provision for expansion to second (backup) gigabit Ethernet link

**Third:** Identify the fiber optic modules and system configuration which will best support the required connectivity. Although there are several manufacturers of fiber optic equipment, I've found only one manufacturer that offers the broad range of optical modules needed to handle all these diverse requirements—Evertz.

With a single source for all the optical modules, a system can be designed using only one type of frame. This means that

the number of spares can be minimized since power supplies and many other modules are interchangeable.

Because components age and system problems may arise, it is very useful to have the ability to non-intrusively monitor system status. This is even more important when operating a fiber optic transmission system.

When disconnecting fibers for maintenance, troubleshooting or system expansion, it is possible for dust and dirt to migrate into connectors and interfere with signal paths. Also, the ability to monitor

# 3 Gb/s Routing

HD/SD Multi-Format Routers - from 32x32 up to 576x576



Xenon  
EQX

• Quartz offers powerful and highly flexible 'Signal Processing' routers essential to your broadcast, production or AV facility

• The Xenon is available in 4RU or 8RU with matrix sizes ranging from 32x32 to 128x128

• The EQX routing platform can handle up to 576x576 in a single frame

**Find out how Quartz's Xenon routers can power your operation - call now for a demonstration!**

**The Leaders in HDTV and now the Leaders in Routing & Master Control**

**Visit us at NAB - Booth #1713**

Processors / Monitoring & Control / Fiber / Master Control & Branding / Time Code / Distribution & Conversion / Routing / Management Software

1-877-995-3700 • [www.evertz.com](http://www.evertz.com)

**evertz.**

laser light levels over time allows the user to do preventive maintenance by replacing units whose output has fallen below the minimum operating threshold.

For these reasons it is desirable to use SNMP-enabled modules within the system. Use of Evertz VistaLink-enabled modules provides non-intrusive control, monitoring and preventive maintenance capability, which is a fundamental building block of a reliable fiber optic system.

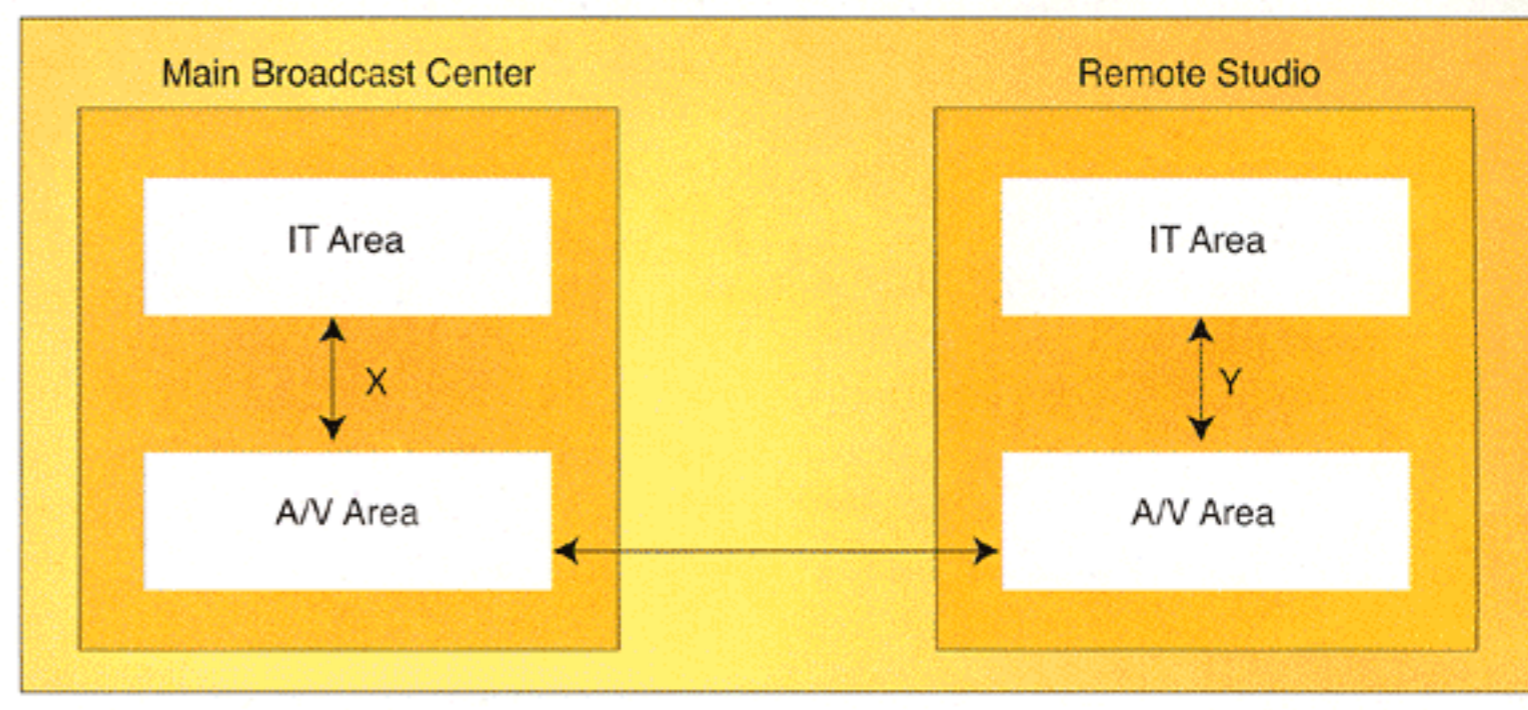
**Fourth:** Develop the system architecture. Figure 1 shows a simplified diagram of the interconnections between the MBC and the RS. Note that X and Y represent the fiber paths between the A/V area and the IT area respectively.

For reliability, diverse paths are used to link the MBC and RS. To keep costs down these paths have been reduced to one fiber per path. By using an optical splitter (7705DS) and a 2 x 1 optical bypass protection switch (7707BPX), in the event of a failure on the main path, the system will automatically switch over to the backup path.

A total of nine wavelengths are needed within the A/V area at each location. To minimize cost, coarse wavelength division multiplexing (CWDM) is used in the A/V area. A combination of 7705CWDM-M8 and 7705CWDM-LB-M8 in the MBC and 7705CWDM-D8 and 7705CWDM-LB-D8 in the RS are used to combine/separate the wavelengths at each location.

This configuration supports a total of 16 CWDM wavelengths of which nine are needed for the A/V area and two are required for the gigabit Ethernet link with two spares

#### Main Broadcast Center & Remote Studio Fiber Optic Link System Overview



reserved for future IT area additions.

Since almost all of the wavelengths are accounted for, an adjustment must be made to provide additional wavelength capacity for future needs. Accordingly, the architecture can be modified to incorporate dense wavelength division multiplexing (DWDM) in the IT area. A detailed block diagram for the system can be generated from the Fiber Optic Product Selector Guide and calculated loss budget figures using the Optical Budget Calculator found on the Evertz website ([www.evertz.com](http://www.evertz.com)).

Using Evertz's fiber optic product line, a practical link for almost any conceivable signal type or group of signals can be easily implemented.

Supported video formats include both analog video (NTSC and PAL) and digital video (SD, HD, DVB-ASI, SDTI and SMPTE 310M).

Audio formats include both analog audio and AES/EBU audio.

Control formats include bi-directional

RS-232, RS-422 and GPI/GPO.

Datacom formats include single and multiple bi-directional Ethernet (10/100 BaseT), gigabit Ethernet, Fiber Channel and other network transport protocols.

Other formats include SONET/SDH, DS3, T1/E1/J1, L-Band and 70/140Mhz I/F signals. Using VistaLink-enabled modules provides the user with advanced features such as preemptive warnings and onboard signal and level monitoring through SNMP.

If in the future, as the need for SD or analog signal paths diminishes, HD-capable modules can be substituted for these existing modules without rebuilding the link. HD modules can easily be installed without impacting the system except for the exchange of modules.

Distance limitations of traditional cable networks are of no concern as long as the link parameters remain unchanged.

*Paul Berger runs Paul Berger Television Consulting, LLC.*