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American Fibertek Inc. White Paper:

Making the Fiber-To-IP Video Connection

As video surveillance technology continues the transition from analog to digital, a constant is the critical need for reliable transmission of the video signal. In the analog age, coaxial cable carried the signal from the camera dependably to the recording device or monitoring station. It is still widely used, although it has limitations, including limited transmission distance and signal degradation over long cable runs. The transition to digital video brings with it a change from widespread use of coax to the use of Cat-5/UTP cable and high-speed Ethernet connections using Internet protocol (IP) to send digitized video images. Wireless transmission methods have also found utility at various points on the analog-to-digital timeline, whether it was radio frequency or microwave transmission of analog signals or the so-called WiFi networks and vast third-generation wireless networks used today.

Fiber optics have had a role in video transmission for many years, starting in the days when analog video signals commonly traveled using amplitude modulation (AM) and frequency modulation (FM) across fiber optic cables. But that role is changing with the transition to digital. Now, fiber optics are capable of sending massive amounts of digital information across vast distances, securely and immune to electromagnetic interference. Fiber optic cables work alongside other connectivity media in the digital age, often providing the “backbone” of high-speed digital networks that deliver the bandwidth essential to video and security applications.

This white paper will cover important aspects of digital video connectivity, focusing on the role of technologies that make the critical connections in today's security and video surveillance systems. Fiber optics are just part of the picture, and networking of IP-based video is leading a path into greater connectivity and functionality for digital surveillance systems.

Video Over Fiber Optics

Fiber optics have several distinct advantages over other digital video transmission media, the most obvious being the ability to send data over longer distances than Cat-5 cabling. The IEEE 802.3ab standard limits each segment of a gigabit Ethernet over copper wiring to a distance of 100 meters (about 110 yards). Alternatively, gigabit Ethernet transmission over fiber optics can extend to dozens of miles. IEEE standards specify gigabit Ethernets using various cable fiber types and wavelengths of light that extend to distances up to 70 km (43 miles), thus expanding the reach of modern digital video systems to remote locations and increasing their functionality in a far-flung campus setting.

Fiber optics also provide better quality transmission with no electromagnetic interference. The core of fiber optic cable is glass instead of metal, which makes it immune to lightning strikes, short circuits, “cross talk” or other electrical problems. It is lightweight, is stable within a wide temperature range and has a long service life; for example, fiber optic cable that was installed 20 years ago is still in service. Fiber is also less easily tapped into or interfered with, which makes it a more secure means of transmitting data over long distances.

Fiber optic cable also offers extremely high bandwidth, and developing technology continues to increase the amount of data that can be transmitted by a single fiber, thus boosting the data capacity of an existing fiber optic infrastructure.

Fiber Optics History and Evolution

Research related to fiber optics technology dates back 100 years or so, but the availability of commercialized technology only dates back to the 1980s, when telecommunications companies began constructing massive systems using fiber optic cables. The core of a fiber-optic strand is clear glass surrounded by reflective cladding that keeps light traveling along the strand from escaping and redirects it along the fiber. This fiber strand is about the diameter of a human hair. Light pulses are used to transmit information along the fiber strand, in contrast to the electrical pulses that transmit information along copper lines. A transmitter or transceiver on one end of the fiber transforms electrical pulses from a copper line into light pulses that are beamed along the fiber strand until they are translated back into electronic

pulses at the receiving end. The terms singlemode and multimode refer to the diameter of the fiber and how light waves travel through the fiber; singlemode fiber core is smaller and uses light that travels a single path through the fiber to achieve a higher transmission rate. Singlemode fiber is less expensive than multimode, but singlemode converters are slightly more expensive than multimode versions. The technology takes advantage of sophisticated advances in lasers, semiconductor components and glass fiber purity for applications that include relaying audio, video and data signals. AFI (American Fibertek Inc.) traces its history back to 1984 as a manufacturer of fiber optic communication transmission systems for audio, video and data signals.

A consequence of the dot-com boom is the existence of a large amount of unused, “dark” fiber, some installed by telephone companies looking to expand their market. Millions of miles of fiber strands are installed throughout the world -- more than 90 million miles in the United States alone. Owners of fiber optic cables, such as railroads or power utilities, have often added additional fibers for lease to outside customers. Because installing fiber cables is expensive, often more fiber than currently needed is put in place for possible future use, especially in schools, hospitals and libraries or other campus settings. Fiber optic networks, often including dark fibers, are also likely to be available related to a customer's data system or telephone cabling system. This infrastructure can be leveraged as the backbone of a high-speed data network. Extension of fiber to new and remote locations is also necessary given the IEEE distance limitations on gigabit Ethernet.

Changing Along With Technology

Knowledge is power as it relates to fiber optic systems, and awareness of system operation is an important part of ensuring reliable transmission of the signal – even more so with today's digital systems. Historically, LED indicators have been used for power, data and video on transceivers to provide diagnostics in the form of a quick visual indication of system status. However, more complex and more critical systems suggest a need for more detailed monitoring of components. For example, AFI offers AFINETY, a password-protected web based monitoring system designed to monitor the fiber optic transceivers, the cameras, the sensors communicating over the fiber network and the network itself.

This need for monitoring the integrity of the network has led to the development of products

like AFI's Scout and Commander, designed specifically to address the Ethernet infrastructure. Scout supervises the critical concerns of com rooms and rack systems relative to intrusion, temperature/airflow/humidity extremes, and adverse voltage/frequency/power fluctuations. Commander provides these solutions with the addition of portflow™ in a layer 2 network switch. Both products also provide notification of impending failures to system administrators.

Role of Fiber in IP Video Surveillance

The advent of IP cameras has led to the development of a true digital video solution. A digital video system is also, by definition, a computer network. The capacity needs and data-rich nature of digitized video almost certainly require that it be a large computer network that takes full advantage of the very best the field of information technology has to offer. Large numbers of network cameras, expansive systems that cover wide geographic areas and advanced processing to help users make sense of hundreds of video feeds all point to the need for networking systems to tie it all together into a functioning whole. Responding to the need for additional bandwidth, 10 gigabit networks are becoming more common. The IEEE specification relies predominantly on fiber optics. As bandwidth needs and distance requirements increase, the role of fiber optics is a given. But even beyond fiber-based systems, the array of available products has expanded to encompass IP-based networking technologies that extend the capabilities of modern digital video systems.

For all its apparent complexity, a computer network is really a simple thing: a group of electronic devices and the links that connect them. Computer networks perform a critical mission in the security industry; therefore, the highest level of control and supervision must be achieved to keep the network functioning optimally. Supervising the components of the network is vital, whether it's the network infrastructure or the electronic devices – the cameras, switches, servers, etc. -- that are the nodes on the network. The security industry requires real-time assurance that the network is functioning correctly, and real-time information and diagnostics if an event requires action. Technology can ensure supervision of each component of the network, thus protecting the network's overall integrity. The important mission of corporate security demands continuous, dependable network functionality. Security is really about event management and control, and a secure enterprise is possible only if it is protected by a security system whose infrastructure is secure. For example, the

Video Network Enterprise Solution (V'nes) products from AFI are designed to provide system designers the tools necessary to monitor the network appliances and the network infrastructure itself. Another tool is V’nes “open path”, allowing the integration of V’nes components in IP, hybrid, and legacy analog systems. Taken together, V'nes is a video surveillance network solution that delivers control, management, infrastructure supervision and transmission capabilities specifically for professional security applications.

Technology And Fiber Expertise Lead The Way

Fiber optic technology offers the most efficient means of transmitting video in the digital environment, and the proliferation of video surveillance ensures its expanding role in security systems of the future. Today's security professionals need technology and expertise that extend beyond a specific product types. Fortunately, companies like AFI have evolved with transmission technologies and are expanding their expertise in solutions that address the specific communication methods employed in IP networks. Network switches, com room supervisory appliances and event management software systems have joined fiber optic media converters to ensure reliable, mission critical transmission solutions. Networks that work together dependably and observably are critical to the future of the security technology industry. By catering to the specific needs of security and digital video surveillance, they can empower integrators and users to make the all-important fiber-to-IP video connection.

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