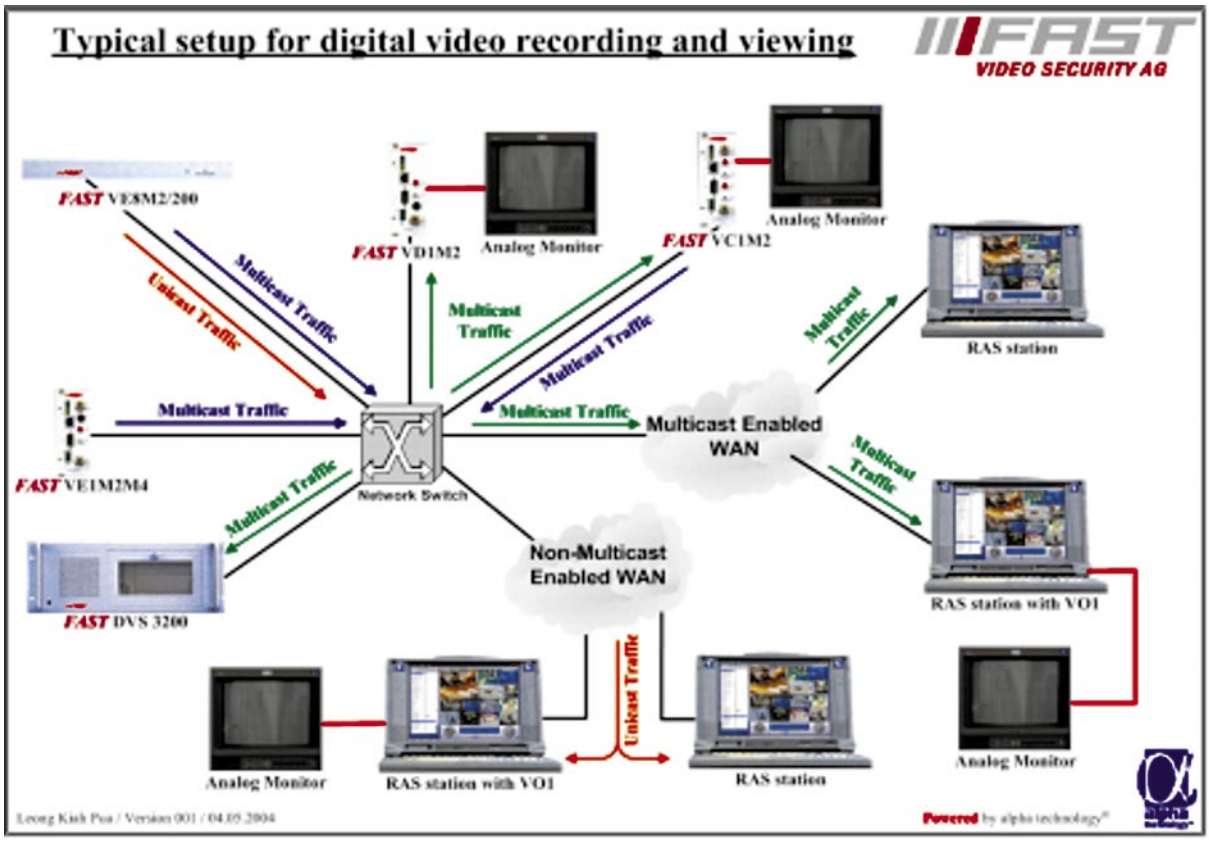
FAST Video Security AG

Network architecture of digital CCTV systems

This article is not meant to be a comprehensive summary of the complex subject of network technology, but rather an overview demonstrating the increasing importance of network know-how for digital CCTV systems. If you are not entirely familiar with the terminology, please refer to the glossary at the end of this article which explains some of the most commonly used terms.



Any network layout starts with an assessment of the network load depending on the number of cameras and the compression mode to be used. Just looking at MPEG2 and MPEG4, the ISO/IEC standardised compression algorithms, their mode and parameter settings will have a considerable impact on the network load. MPEG4, designed for low bandwidth transmission, will allow good image quality at bit rates well below the Mbps limit. If image quality has priority, MPEG2, designed for broadcast quality video transmission, will provide a superior picture. Until the hardware (i.e. chips) significantly improves in processing power, MPEG2 will remain the most cost-effective way to compress and transmit digital video data, in particular given full-resolution and real-time requirements. Bit rates are typically set at several Mbps, requiring sufficient network capacity in the mostly dedicated networks. The figure below shows a typical network layout used in a CCTV system.

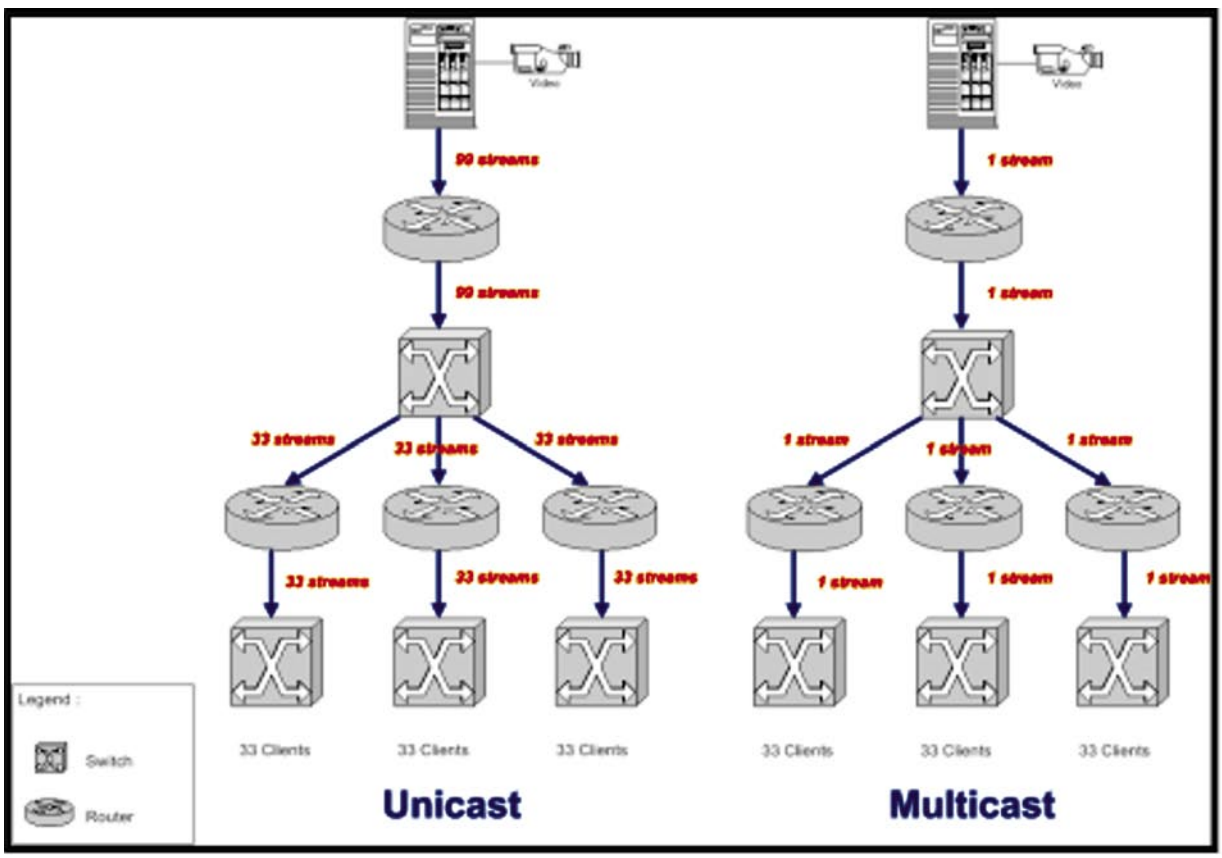
When working out the network requirements, the bit-streams for video and audio

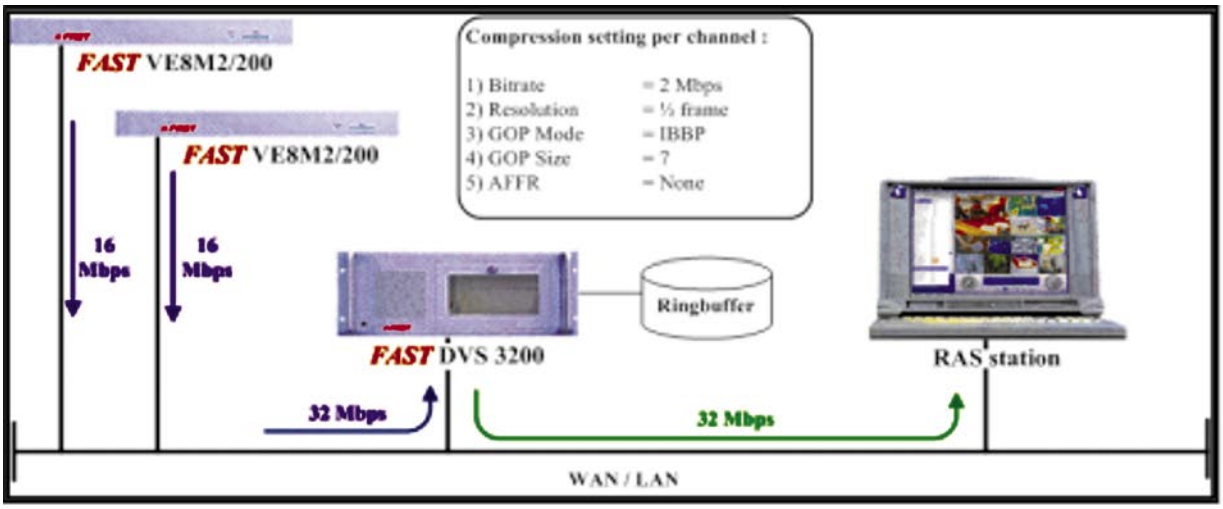
transmission will have to be added, taking overhead into account. A Gigabit network can typically handle 400 Mbps, which is equivalent to approximately 100 streams of 4 Mbps or 100 cameras streamed through one port. Thanks to their short command structure, PTZ control features have virtually no impact on the network load. Such calculations will have to be done separately for each node of the network depending on the way the various elements are linked together and on the streaming modes applied, such as multicast or unicast. Since in a multicast environment the data stream is sent out only once for several concurrent users versus multiple streams as in unicast and broadcasting, IP-multicast switching and routing significantly reduces the required server capacity and network load (see Figure 2: Unicast - Multicast).

Network configurations

The encoders can be linked directly to digital video servers with internal storage or RAID systems attached (see Figure 3: Direct Connection of Encoders). As a result, the network load is limited to viewing or replay requests. Alternatively, with a decentralised architecture of components, the encoders can be integrated into the network via switches providing full virtual matrix capability; this is particularly recommended if several view stations request images from the same camera (see Figure 4: Network Connection of Encoders).

The storage elements such as RAID systems are typically linked to the servers via SCSI connectors in order to ensure the sufficient reliability of the high-capacity data throughput. Fibre optic components are more expensive but allow higher data throughput and are not susceptible to electromagnetic interference. SANs (Storage Area Networks) are under consideration, however, the reliability of large incoming and outgoing data stream handling has yet to be proven.



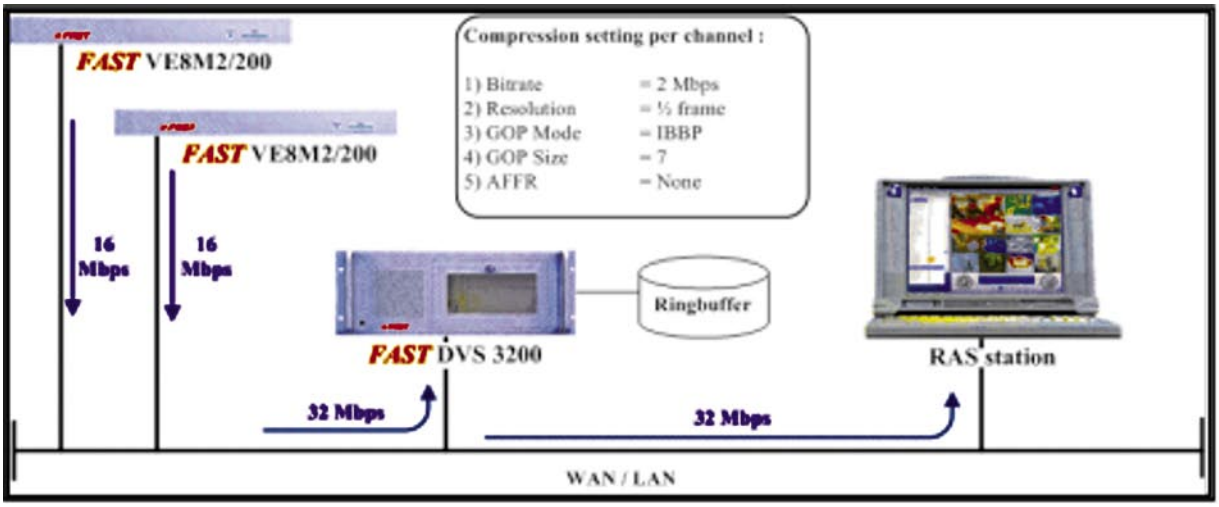


Remote transmission over public networks

Video streaming can be done over public networks, however, it is highly sensitive to the mostly limited bandwidth. 56 or 128 kbps lines for ISDN and even ADSL with higher bit rates may necessitate the suppression of audio and limit the transmission to lower-resolution images in time-lapse mode such as 5 pictures per second or lower. Whether access is gained through dedicated software or via a web browser application, security issues will be of concern with regard to the sensitivity of the content to be transmitted.

Conclusion

There are no standard recipes for network designs in relation to CCTV systems, and yet it is clear that the configuration and proper setup of the network is of crucial importance to the overall performance of the system. New compression algorithms, intelligent image analysis methods and the continuing improvement of network technology will drive digital CCTV systems to performance levels yet unknown over the coming years.



***Benedikt Schwartz**, Director Sales & Marketing and Member of the Board, in charge of global sales strategy and operational sales in America and the Asia Pacifics. Benedikt previously worked in several senior management positions of international companies in the IT and machinery industry. He graduated as a mechanical engineer and holds both an M.Sc. from the EPF/ETH in Zürich and an MBA from IMD in Lausanne, Switzerland.*

This article has been written with the help of Leong Kiah Pua, Professional Service Manager, FAST Video Security AG.