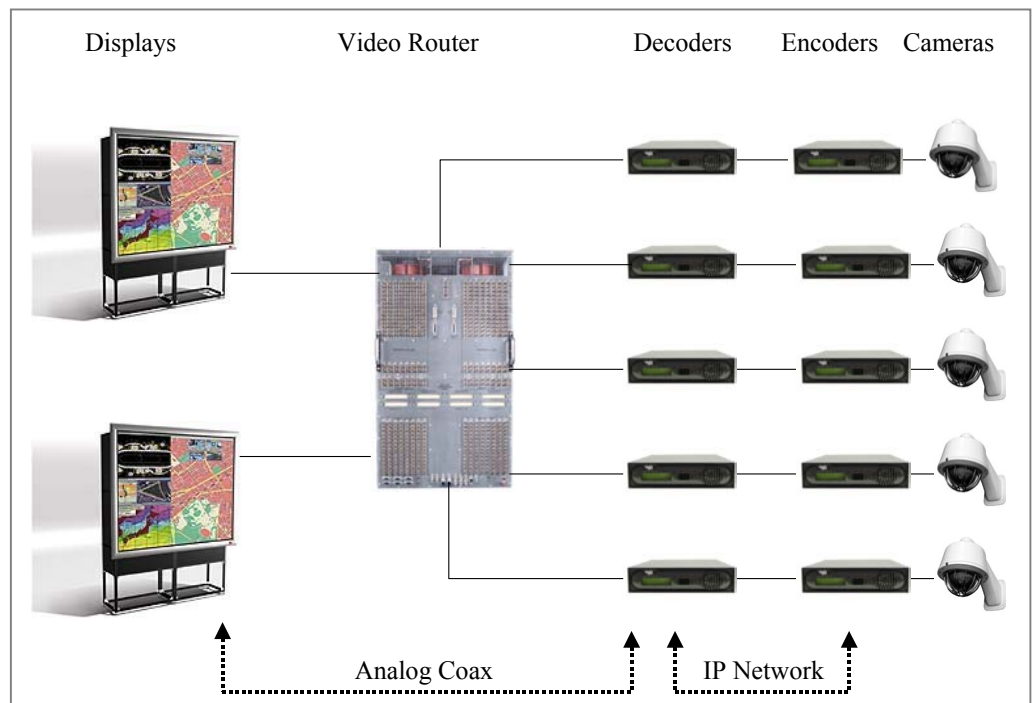


The Network Is The Video Switch

Intelligent Transportation Systems

Transportation Departments have certainly seen the benefits of digital video transmission, but conventional thinking still separates video “transmission” from “switching and routing”. Gone are the days when the video from highway cameras is transmitted via analog radio, coax, or uncompressed video. ITS systems have fully embraced the Internet Protocol – allowing high quality MPEG-2 and MPEG-4 video to be reliably delivered from hundreds of locations to multiple monitoring locations. These “converged networks” fully enable video, voice, and data and also enable data collection and control. “Amber Alert” systems, traffic control signs, roadside traffic monitoring devices, and similar systems are almost universally constructed to operate over Ethernet and IP or IP over ATM, and these same networks are used to deliver broadcast-quality video too.

Once the digital video signal arrives at a monitoring location, conventional wisdom would dictate that it be decoded and presented to an analog video switch or “router”. This approach requires a one-to-one relationship between video encoders and video decoders. It also

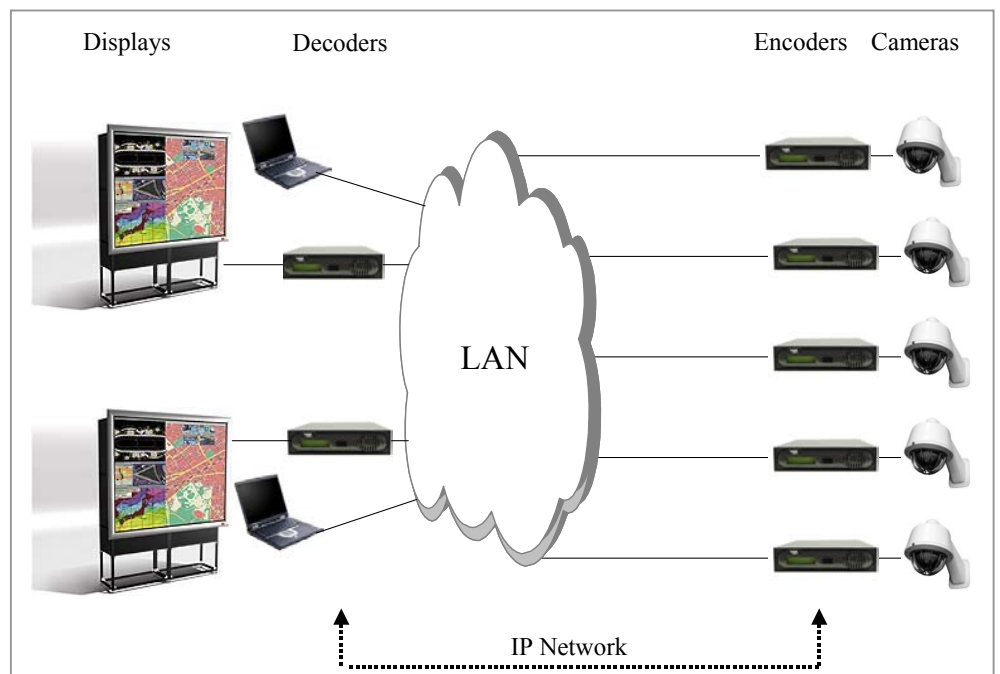


presupposes a system to control the video router (i.e. the video matrix switch).

The problem this architecture attempts to solve is both technical and human. How can an operator monitor a large number of live video feeds? Video engineers look to the “video router” to display multiple images on one display device, and to automatically cycle the displayed video between the many feeds. An operator can then view many cameras in a “Hollywood Squares” display, with each square sequencing between multiple cameras. If they see something of interest, they can command the “video router” to display a selected video feed full screen or send it to a selected monitor.

Digital networking, in particular IP Multicast, actually makes much of the analog video router redundant because the network itself already provides any-to-any connectivity. This fact suggests it is unnecessary to decode all video in a central location, but to distribute the decoding as required. You would not decode everyone’s email in a central location and install a special “email router” to distribute data traffic in analog form, so why do it for video?

When the decoder is connected directly to the display device, any video may be instantly displayed directly by simply telling the decoder which IP address to decode. A small application, running on the operator’s computer, communicates with

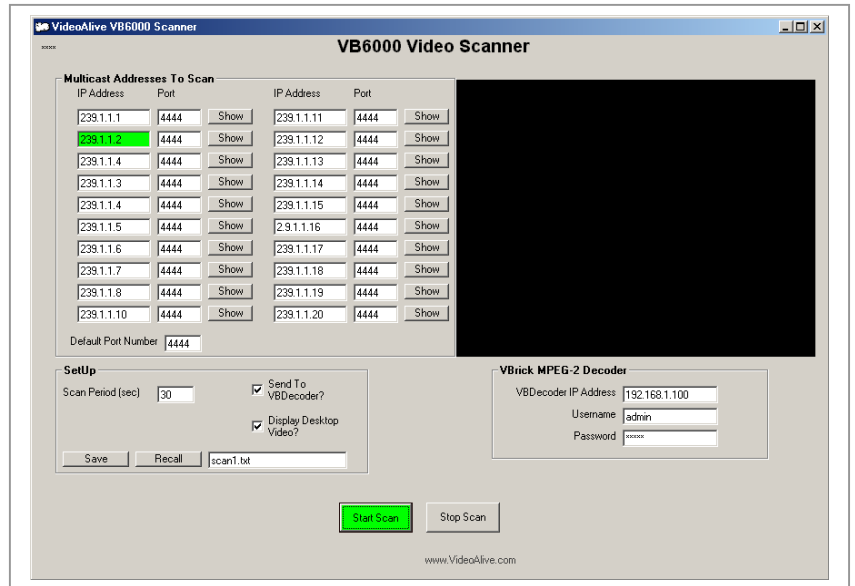


the decoder and causes it to “scan” any number of video streams, displaying each video on the display for a specified period. In addition, those same videos are

displayed on the operator's desktop in real time, and the operator can command any video to be instantly displayed. If desired, an IR remote control may also be used to manually "change the channel".

SCANNING

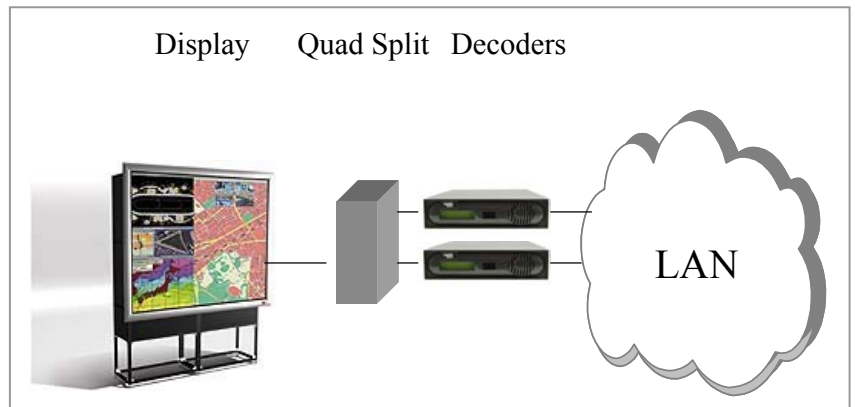
The VB6000 Video Scanner application illustrates how the digital network becomes the video router. The application supports up to twenty source addresses (the addresses to which the encoders send their video). When the application runs, each video is displayed on a target decoder, the desktop, or both, for the scan period. The operator can click on any video to display it immediately at any time.



Thus, not only is the video router eliminated, but also the number of decoders required is reduced to the number of simultaneous videos that must be displayed.

In many cases, it is unreasonable to display all available video feeds all the time because the images may end up being too small to be useful, the display surfaces (e.g. "Video Wall") may be too limited, or the resulting display just too overwhelming for the operators. To the extent camera "scanning" or "display cycling" is used, the elimination of the video router and the dramatic reduction in required decoders can save many thousands of dollars while improving performance. What's more, bringing the video directly to the desktop allows the video feeds to be monitored from manager's offices and other locations that may not have a view of the central "video wall".

The digital network (the LAN) can eliminate the need for video switching, but it does not provide video manipulations such as a split screen, quad view, or similar. To the extent such video display manipulation technology is not already built in to the display device (such as a high end video projector), it is easily accomplished with readily



available equipment. Two VBrick decoders, for example, can decode four MPEG-2 channels and present these to a “Quad Split” device for presentation. Each VBrick channel is independently controlled over the network and each channel may continuously scan the live video feeds.

Motion Detection & Image Processing

When digital video is delivered via IP multicast in the Local Area Network, it can be viewed and even recorded on any desktop via VBrick’s StreamPlayer Plus software. This certainly enhances flexibility, but this capability has dramatic implications for emerging imaging technologies.

Computer applications that detect motion, capture images, and even recognize objects may be integrated into the system with ease. This is because VBrick’s exclusive Capture Driver capability comes with StreamPlayer Plus. Virtually any Windows application that recognizes video via a “capture card” can operate directly on any of your live VBrick video streams. Low cost (\$30) third-party software is readily available that today detects motion, captures images, performs “web cam” operations, and much more. New and emerging image recognition software is counting cars on highways, determining speeds, and alerting operators when traffic flows fall above or below predetermined levels.

Archiving and Recording

That an operator can see live traffic via video from anywhere is only part of the story. While government must assure the privacy of citizens, there may be occasions when the events seen on a video camera should be recorded and archived. To the extent local policy allows or desires recording, a video may be digitally recorded locally at an operator's desktop or remotely at the encoder itself (via VBSTAR, VBrick's 60GB internal hard disk option). Recorded video files, in standard MPEG-1, MPEG-2, or MPEG-4 format, may be manually or automatically archived on Video On Demand servers or conventional file servers. Digitally recorded and archived video files may be instantly emailed or otherwise transmitted to law enforcement agencies and news agencies as appropriate, potentially enhancing government response to emergencies.

Time & Dates Display

It is not uncommon for location, date and time text to be inserted into the video feeds at the source, either by the camera or by ancillary equipment. With so many video feeds, such video insert ensures the operators know the location they are monitoring. Unfortunately, the location/date/time video overlay can hide important visual information. To the extent the display device supports standard closed captions (also referred to as "line 21"), they have the ability to turn it on or off at the decoder or the display device. This is true because the encoder inserts location/date/time information as closed caption data, meaning it will always be there but the operator can choose to display it or not*.

Video, Audio

In the vast majority of cases, Intelligent Transportation Systems and other video monitoring applications require video, not audio, and VBrick System manufactures video-only encoding models. Audio support should not be universally discounted, however. A microphone located near the camera can be useful to detect changes in

* Closed Captions may not be fully supported by all video display devices or video processors.

traffic pattern sounds, crash noises, and similar. Systems that support audio preserve a possible future capability, even if not used today.

Video Encoding and Transmission Standards

MPEG-2, the standard for broadcast television and DVD's, provides full NTSC or PAL resolution and is practically indistinguishable from uncompressed video. Intelligent Transportation Systems have largely standardized on MPEG-2 transmitted via Transport Streams. This is good news because MPEG-2 Transport Streams are widely supported by multiple vendors and are the basis for commercial satellite television and "digital cable TV". Consumer volumes help to drive costs down for this technology.

MPEG-2 video may also be transmitted as an "elementary stream". On the surface, this would make technical sense when audio is not contemplated. However, ITS professionals should be cautioned that systems built using elementary streams may be incompatible with the large number of hardware and software products already deployed, such as decoders, desktop players, recorders, video servers, multiplexers, and set top boxes. VBrick Systems supports both Transport Streams and Elementary streams.

"Web Cams", low frame rate JPEG captures, java applets, and server-based Internet video streaming products certainly exist and have been used where professional video cannot reach. Often, these technologies are either single vendor, are highly proprietary, or both. While useful in certain applications, designers are advised to proceed with caution.

MPEG-4 is a newer family of video standards that is today deployable in a multi-vendor environment. MPEG-4 delivers live video locally and over the public Internet and targets desktop players and certain Set Top Boxes. For live video, MPEG-4 today delivers less resolution than MPEG-2 but this is changing as vendors, including VBrick Systems, implement advanced MPEG-4 profiles. Today, MPEG-4

is the ideal alternative to proprietary desktop streaming, low bandwidth video monitoring, and streaming of live video to the general public.

MPEG video, whether MPEG-2 Transport Stream, MPEG-2 Elementary Stream, or MPEG-4 video stream, is transmitted via Ethernet and the Internet Protocol. The behavior of the encoding and decoding appliances is very important to maintain good network citizenship. For example, network managers look for devices that are fully SNMP manageable, do not exhibit excessive data bursts, support network Quality of Service capabilities, and more. Network performance, it turns out, is just as important as video fidelity.

While IP has many advantages, many Transportation agencies have deployed ATM networks. ATM has different advantages, in particular inherent Quality of Service that guarantees video network performance. While MPEG-2 video may be sent directly over ATM, it may also be sent as IP over ATM (IPoA). IPoA facilitates the “network is the video switch” concept, allowing the ATM network to deliver the video with high reliability while also allowing it to directly interconnect with a Local Area Network without central decoding. VBrick System supports both MPEG-2 over ATM and IPoA.

Camera and Accessory Control

Obviously, a decoder “connects” to a remote encoder to display a particular video. When this occurs, the decoder automatically maintains a full-duplex RS-232 data channel with the selected decoder. With a “joystick” connected to a decoder and a camera PTZ connected to the encoder, the operator automatically gains control of the camera he or she is viewing. Such automatic connection mechanism is much more complex and difficult if centralized decoding and video matrix switching is used. When “the network is the video switch”, the relationships between controlled devices, encoders and decoders is automatic.

Conclusion

Virtually every office building, including state and local government Transportation Departments, deploy Local Area Networks for data traffic and for control systems. The same network can be easily engaged to eliminate the need for a parallel coax cable analog video network. Bringing highway monitoring directly to decoders co-located with display devices can reduce or eliminate the need for legacy video routers and switches, and can save thousands of dollars. When IP multicast from remote encoders is directly available in a monitoring center's LAN, any video can be viewed directly on the desktop, and scanning, archiving, and advanced imaging capabilities may be more easily engaged.