GETTING THE FULL PICTURE

Video over IP opens up an entire range of surveillance opportunities. But, warns Alan Hayes**, it is not suitable for everyone, particularly those applications where image quality is critical**

The CCTV industry is to be congratulated on its use of cutting-edge technology to yield resilient, high camera count, managed video transmission systems suitable for round-the-clock operations backed up by ultra-high capacity storage and archive systems. However, the challenge we now face is the emergence of video post-processing systems such as intelligent video incident management.

Their image recognition and image tracking capabilities will transform the next generation of control rooms, banishing the banks of monitors with which we are all so familiar to history. But to maximise their effectiveness, we must take back control of the video signal. Information once removed cannot be restored and our choice of network and compression technologies may severely restrict post processing options for users at a time of rapidly evolving systems.

The recent IFSEC exhibition in Birmingham, UK attracted a large audience to the fringe of Shakespeare country to see the latest advances in CCTV networks technology. For CCTV system designers and users alike, the congregation of hundreds of manufacturers presented a rare opportunity to contrast and compare the different offerings and talk through possible solutions.

One technology that appeared to be omnipresent was Video over IP, with systems that compress the video signal in order to make it available and ready to transmit directly to the Ethernet or SDH network ranging from £50 to £2,000 per camera signal. Whether for low-end public information or scene monitoring, or complex incident and emergency management, the range of Video over IP offerings appears to cover a whole spectrum of possible uses. After all, Video over IP, or compressed video, allows us to take advantage of the network

capabilities of anywhere-to-anywhere, integrated switching, unlimited cameras, resilient networks, managed networks and outputs limited only by the network capacity.

However, experience tells us that the 'one solution suits all' model rarely, if ever, works. And, while video solutions running on SDH or IP networks are an absolute boon for many applications, they are not a universal panacea. The shortfalls of compressed video networks are now coming to the forefront. 'Horses for courses' applies just as much in CCTV surveillance as in every other field.

To establish if Video over IP is not necessarily the answer, we need to look at the questions we ask of our video systems. Questions that are dictated in most instances by the application that they are designed to serve. Questions that we need to ask when designing a CCTV system and when choosing a networking technology that will cope with current and future demands.

Installation scenarios

The majority of CCTV systems are installed into one of five scenarios – scene monitoring, incident management, emergency management, security agency applications and public information systems. Of these, scene monitoring covers the majority of smaller installations. In general, the larger and more sophisticated the system, the more that is required.

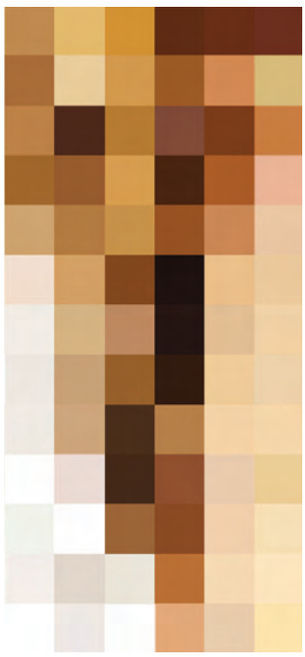
In passive scene monitoring systems, where there is no real time user involvement, the images are directly archived and it is not critical to take any immediate action. However, the cameras and the image quality should be set up such that the recorded images are fit for the future purpose. This may include triggering on different recording criteria based on what is happening in the image, such as higher quality recording or higher frame rate. Some applications require processing of the image, such as pulling out a number plate or recognising a face. It is important that the video signal presented to the recording or image-processing system has sufficient quality and quantity of video information for all the required circumstances. If a compressed video transmission system is used to collect the video, information 'thrown away' at compression cannot be put back.

Today, when active screen monitoring occurs, someone is looking at the image on screen. They may be merely monitoring or measuring activity. They may have to initiate action depending on what they see. There may be a requirement to focus in on some detail or switch between normal and very high quality images. This is when a CCTV system is most needed and it is at this point that the maximum amount of information or highest quality of image is required. It is at this point that any signal latency associated with compressed video systems, a latency that can increase as the image quality and content is increased, limits the use of pan, tilt and zoom cameras for finding out what is happening in the scene.

Importantly, it is possible to foresee that a lot of the monitoring activities will be automated in the future. Again it is important that the appropriate amount of information is available in the video signal when it is most required. The only sure way of being confident that you have all the video information you need is not to 'throw' any away, in other words to not compress the video signal. It is now becoming apparent that a previously compressed video image may not be suitable for video image processing solutions because of insufficient image content or quality.

Right information, right time

Incident management situations, such as highway and city centre monitoring, add the element of significant change to basic scene monitoring as a result of alarms being raised on a particular scene change or scene content. Again, more and more of the detection of this particular scene change or scene content will be automatic. It is important therefore at this stage to have sufficient quality or video content for the automatic systems to be able to do the required detection. Again, in other words the need to have the maximum amount of information available in the video signal to process. The time at which required detection needs to take place will probably be the time that the scene has the highest amount of content and the highest level of activity. Choosing a compressed video system can limit the ability to have the right amount of information available at the right time for automatic video detection systems to perform as required. On top of this, there may be a need for real time control of the cameras using pan, tilt and zoom facilities to explore what is happening. Installing a system with inherent 'high' latency would not appear to be a wise choice.



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In what may be considered an extreme version of incident management, emergency management adds the need to manage the surrounding area and distribute the images to multiple locations and agencies. Again, ensuring that the image has the maximum amount of image content and detail at the time, when it needs it most, arises. If the onward routing necessitates going over to another network, to roadside PDA's for example, then compression is definitely required. However this type of compression will not be consistent with any compression used to collect the video signals and the problem now exists that a previously compressed signal does not recompress well. Being able to collect the maximum amount of scene information in the video signal is of critical importance, especially when it may have to be reformatted and compressed for onward distribution.

Different formats

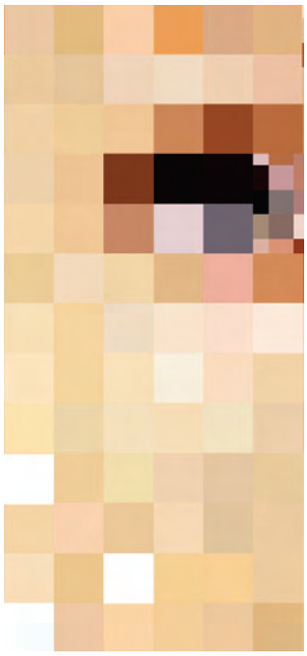
When it comes to security service applications, we may never know who is asking the question. But, we do know that the envelope of current and future technology capabilities will be pushed to the extreme and we can deduce that wide-area vehicle or people tracking, combined with the maximum amount of information processing will be used.

That leaves us with public information systems – the bit that we, the public, may be allowed to see. Here though, the onward routing of video is likely to be highly selective – in an emergency scenario, public access to the live images may not be valuable, whereas edited highlights for the TV news would be. And it is not just content and timing that might need to be closely controlled. The video will need to be transmitted in

different formats depending on the end user, where the requirements for a signal to the TV broadcasters are markedly different to a 3G handset or a PDA screen. These latter types of application require compression to stay within the bandwidth limitations of these technologies. However, problems arise when you have to recompress a previously compressed signal into different formats.

In attempting to summarise the variety of ways that CCTV cameras are utilised today, a number of common themes are apparent. It is obvious that different applications put differing constraints on the video content. What is less obvious is that there is huge variance even within individual systems, depending on what is being observed. So, we can expect:

- More and more dependence on image processing – a radical recasting of tomorrow's control rooms is in store, eliminating the banks of monitors with which we are all so familiar. Instead, intelligent video processing incident management systems will run quietly, but constantly, in the background.
- Less active involvement until an incident image recognition and image tracking capabilities will automatically concentrate human intervention on those isolated events considered serious enough. However, at this point, a huge ramp-up of information will be required.
- An increased amount of detail necessary to drive the image processing systems and the information demands arising from incidents.
- Onward routing with different quality requirements.



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Future needs

Two major themes for the future emerge. The first is that the video signal to the control room needs to have the capability to have the maximum amount of signal content as possible, to drive the image processing software and cope with peak demands in an emergency situation. Since information density requirements are increasing, this is the only sure way to know that future needs can be satisfied, which is not to compress or throw video information away.

Secondly, transmission is a vital component of future networks - but not as we routinely use it today. Any transmission of the signal to the control room must not compromise video latency, video post-processing or limit the information flow during an incident or emergency. Compression of a video signal just to fit in with the transmission can be very limiting.

The compression must be compatible with the multiple compression requirements of the onward signals to other agencies. Current image processing software is not always compatible with a video signal that has been compressed. In the future, when more and more detail is required for image processing, this situation will only worsen. What's more, re-compressing a once compressed video signal at a different rate for onward transmission leads to a severe deterioration in quality. Given that onward distribution to other agencies, such as media companies, can be a significant source of revenue, guaranteeing a high quality, uncompressed signal could be a very profitable investment. Finally, changing compression algorithms as the technology moves forward, may mean changing road or track-side encoders and network capacity. Wouldn't it be better to concentrate on getting it right the first time?

Network dependent

It is self-evident that, if network bandwidth is sufficient, uncompressed or lossless compression would be used in order to maximise information quality and future proof the system. It is also self-evident that tomorrow's networks must have the capabilities we take for granted, such as high camera counts, resilient networks, and management features.

However, it is the network that delivers these capabilities. And in order to get video over the available bandwidth in an Ethernet or ATM/SDH network, it is inevitably compromised by the compression algorithms. The choice of algorithm also raises further questions. There are many algorithms available – some standards-based, some proprietary; these include:

- MPEG2
- MPEG4
- Wavelet
- MJPEG
- MJPEG2000
- H263
- H264

Each of these are used to differing levels by different manufacturers. One manufacturer will do MPEG2 up to 2 Mbit/s another up to 15Mbit/s. The questions to be asked are:

- Which is going to suit my needs now – they all throw information away?
- Which is going to suit my needs in the future – what are my future requirements for video quality, video information content and latency, based on my future video detection and procession systems?
- Which technology will survive, which will go obsolete?
- Is there new technology that will render all obsolete?

The real questions we need to ask as we design networks capable of living up to user needs and expectations are – should we accept that information content is removed from the video signal and 'thrown away' in order to make it fit the network and can we design a network that accepts uncompressed video and ensure that it has the multiple access, redundancy and management features of the IP and SDH world.

AMG real-time digital video systems replicate the multiple access and management features of the traditional network. They offer resilient, nil latency, high camera count, real-time, dual redundancy, video anywhere to anywhere, and drop and insert video transmission systems, suitable for round-the-clock operations in sensitive or secure environments. Instead of necessitating that decisions are made 'at the camera' on the content of the video signal, they route pure, uncompressed signals to the DVRs, control room monitors and image processing software. And in retaining the entire signal, they secure all the information in every transmission. Most important of all, they allow users to evolve with CCTV technology and thus future-proof their investment. At a time when CCTV monitoring is vital to security, that's an answer to a tough question.

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