White Paper

The Latest Advances in Megapixel Surveillance

VIVOTEK
BUILT WITH RELIABILITY

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Development of IP Surveillance

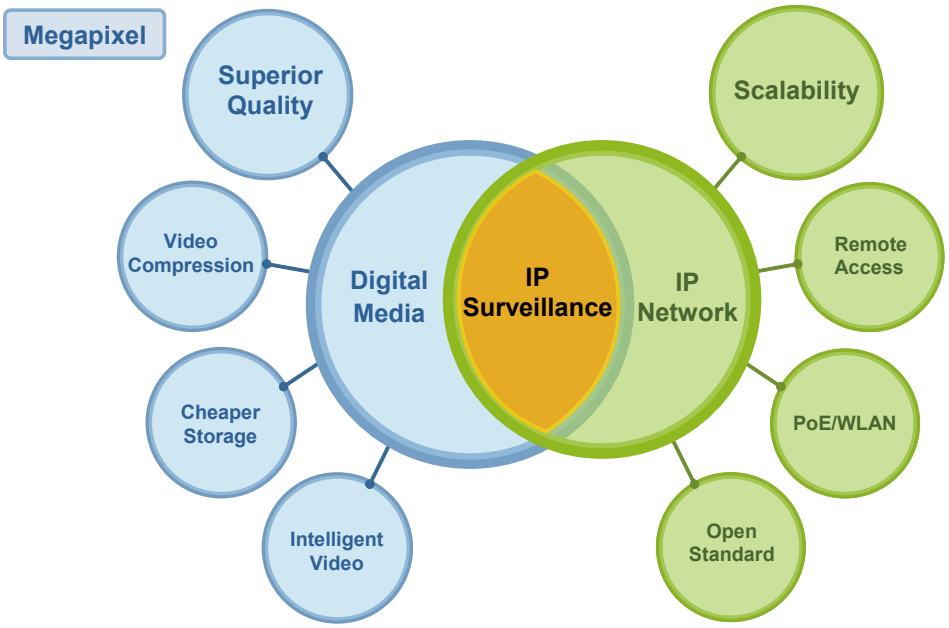
With security becoming increasingly important, video surveillance has seen rapid growth over the past decade. Although the video surveillance market is currently dominated by analog solutions, IP surveillance is quickly catching up.

Benefits of IP Surveillance

IP surveillance refers to the transmission of digital media over IP networks. By leveraging digital and networking technologies, it provides the advantages of both fields. Digital technologies enable IP surveillance to provide video quality superior to analog CCTV systems. Video and audio compression techniques can be applied to reduce bandwidth and storage space requirements, and because data can be recorded onto digital storage media, storage costs are significantly reduced. Additionally, data can be analyzed automatically to provide more useful behavior information.

Networking technologies bring to IP surveillance the benefits of remote access anytime, anywhere as long as an Internet connection is available. IP surveillance systems can be easily scaled up by connecting small systems together through IP networks, and can incorporate new technologies such as Power-over-Ethernet and wireless LAN. Because of their support for open standard Internet protocols, IP surveillance systems are compatible with a company's existing network infrastructure.

Among these benefits, superior video quality, especially for megapixel technology, is the most important driving force that will encourage continued migration to IP.



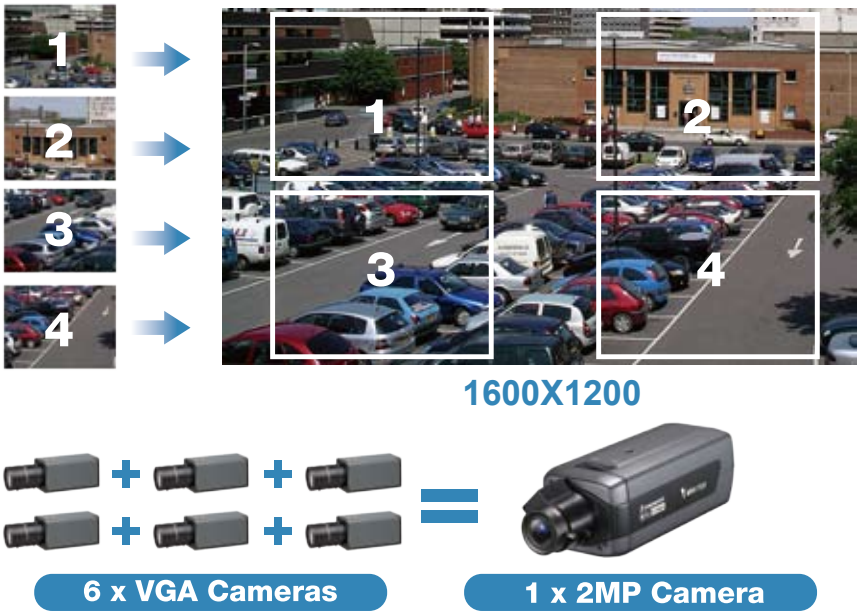
Development of Megapixel Surveillance

Compared with other types of network cameras, megapixel cameras will see stronger growth momentum. It is thus expected that megapixel network cameras will become the main trend in IP surveillance in the future.

Benefits of Megapixel Network Cameras

● Wide Coverage

The factors that contribute to the explosive growth of megapixel network cameras are their abilities to provide wider coverage and exceptional detail. A 2-megapixel network camera can cover an area 6 times larger than a VGA network camera. With a 2-megapixel camera compensating for 6 VGA cameras, the installation costs can be significantly reduced.



● Exceptional Detail

When monitoring an area, a megapixel camera provides superior image quality compared to a standard resolution camera. As illustrated below, which compares a VGA, 1.3MP, and 2MP image, the license plate in the 2MP image can be easily identified, but not in the case of VGA resolution. Thus, in applications where accurate identification is required, a megapixel camera image can provide detailed information that is obscure when using a VGA camera. The improved pixel count also allows for the application of ePTZ technology, which will be discussed later.

Challenges Facing Megapixel Network Cameras

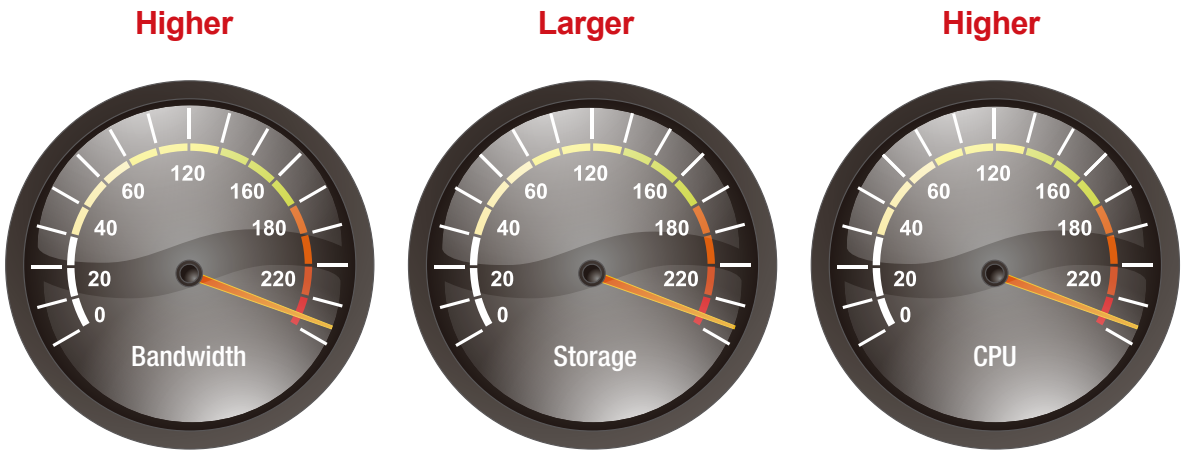
Although megapixel cameras possess amazing growth momentum, the challenges of bandwidth, storage, and CPU loading must be addressed before they can truly become widespread.

● Bandwidth and Storage Requirements

During transmission, a megapixel image takes up much more bandwidth than a standard VGA image due to its large file size. It also requires more storage space, and as a result, customers have to expand their bandwidth and storage space, increasing their installation costs.

● CPU Loading

Before transmission, a megapixel image must be encoded, and when it arrives at the back-end PC or server, the CPU has to decode and resize the image for live viewing. Due to the high pixel count and large image size, encoding and decoding can significantly increase CPU loading, leading to the possibility of system breakdown or reduced system performance.

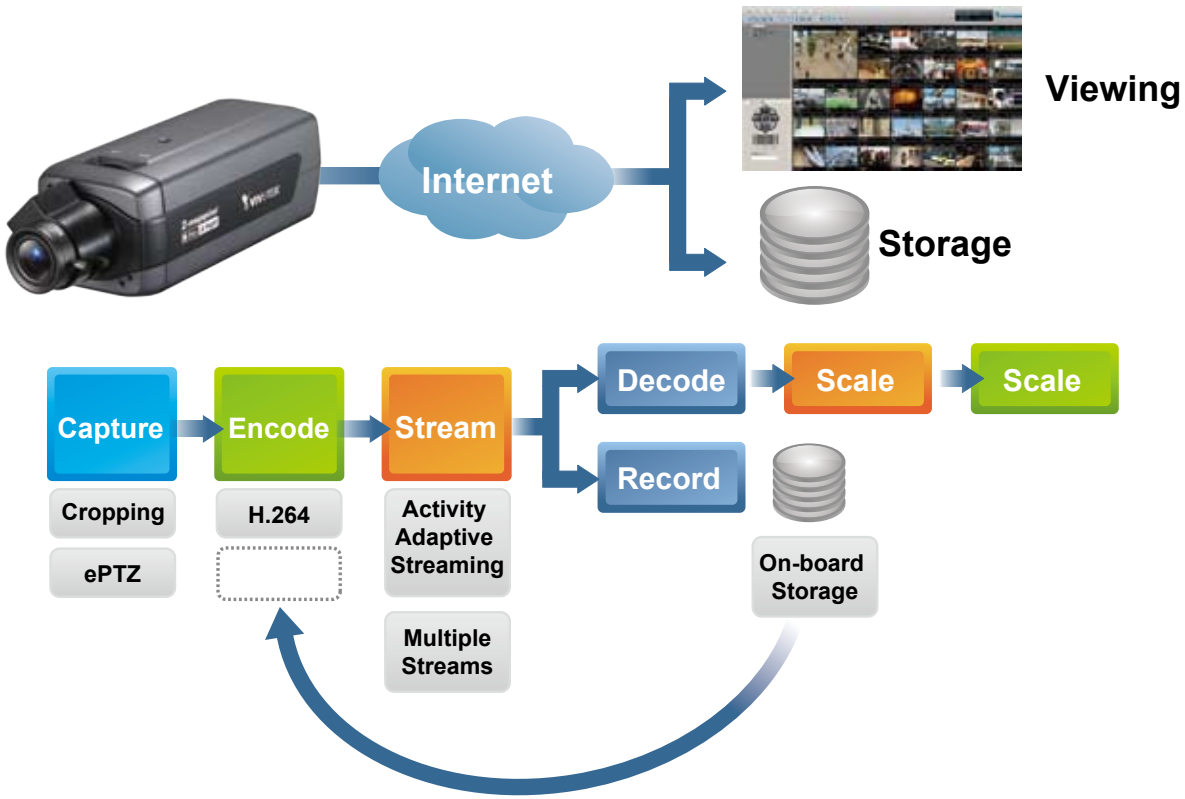


To thoroughly counteract these problems, a total solution must be designed that involves both bandwidth and CPU loading management. Some IP surveillance vendors address these issues with the promotion of H.264, a compression technology featuring high bandwidth efficiency. However, this only solves part of the problem. With H.264, the file size of a megapixel image can be reduced dramatically by 90%, resulting in significant bandwidth and storage savings. Unfortunately, the problem of CPU loading still exists.

True Megapixel Solutions with Maximum Value

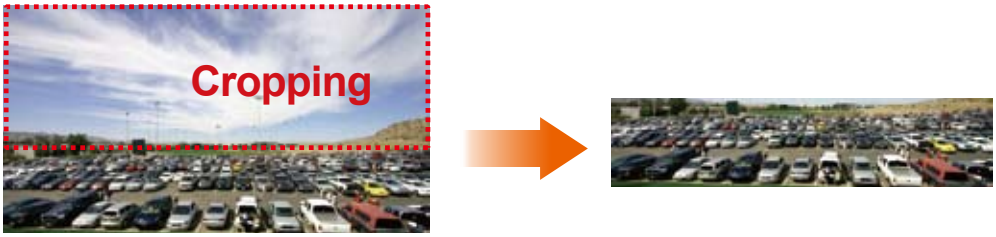
An IP surveillance setup includes network cameras on the front end and central management software on the back end, with an IP network connecting both parts. The network cameras capture and encode images and transmit them over the Internet in the form of video streams. When the central management software receives the video streams, they will be displayed on a device for live viewing and stored in a recording device. Video streams for live viewing must be decoded and scaled to the proper size before they can be displayed, thus increasing CPU loading.

For efficient bandwidth and CPU loading management, VIVOTEK has applied new technologies to each segment of the surveillance network to address megapixel cameras' problems from a comprehensive perspective. The new technologies include cropping and ePTZ for simplifying image capture, H.264 compression for encoding, and activity adaptive streaming and multiple streams for video streaming. Additionally, on-board storage is added to the camera for more efficient data storage.

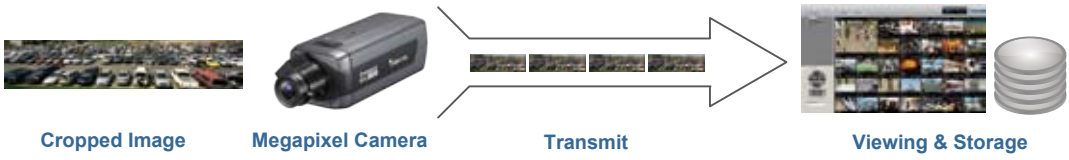


● Cropping

In many cases, camera images end up containing many unnecessary details such as still backgrounds. Therefore, transmitting the full view in megapixel resolution with the redundant data can be a waste of bandwidth and storage space. The cropping functionality allows users to crop unnecessary information and simply transmit video of the target region for viewing or storage. As a result, bandwidth and storage requirements as well as CPU loading can be drastically reduced.

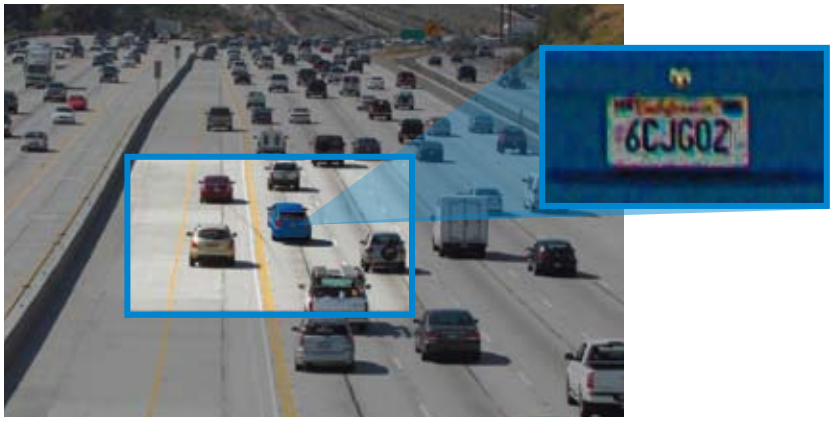


Remove unnecessary information before transmission



● ePTZ

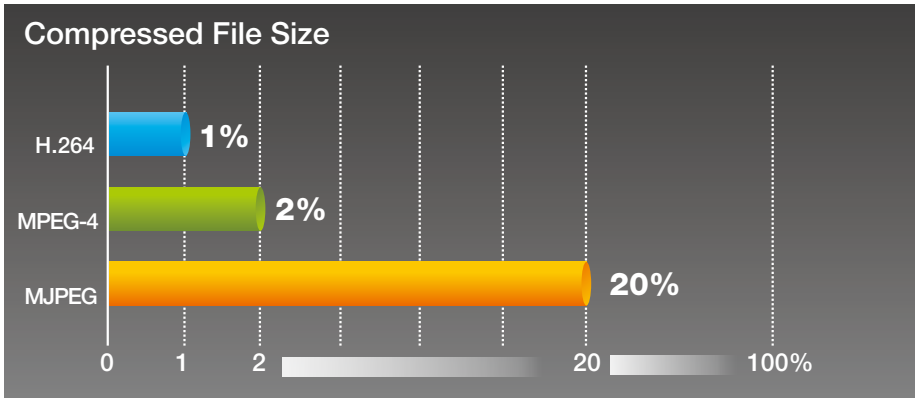
ePTZ, also known as electronic pan/tilt/zoom, enables users to select a target region for close-up shots by simply clicking on the camera video feed on their screen. By encoding and transmitting simply the image of the target region rather than the entire picture in megapixel resolution, ePTZ allows for more efficient bandwidth usage and CPU management. The electronic pan/tilt/zoom functionality also prevents a megapixel camera from mechanical wear and tear since it contains no moving parts.



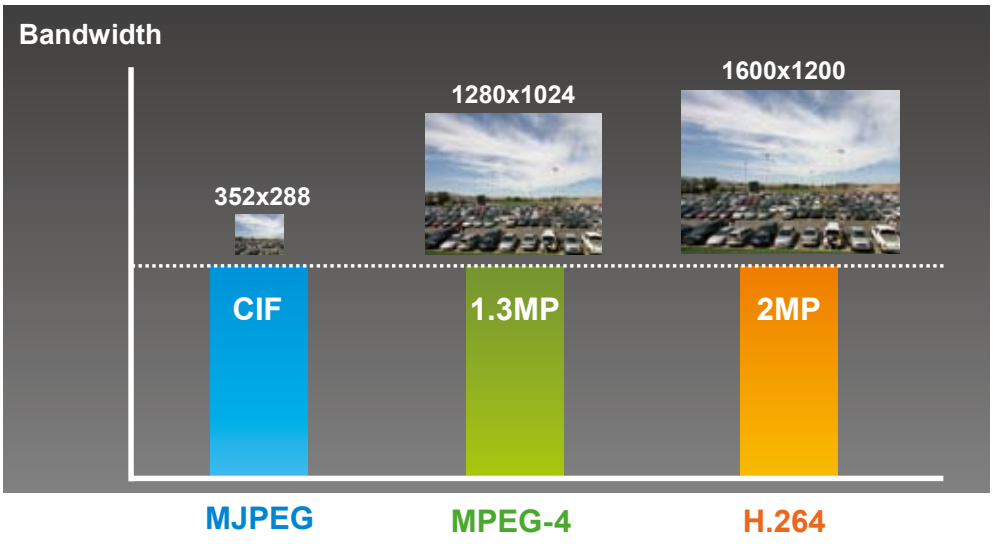
● H.264 Compression

Another way to utilize bandwidth more efficiently is to use compression technology with a higher compression ratio. MJPEG and MPEG-4 are currently the main compression standards for IP surveillance, but the newly developed H.264 standard will soon overtake MJPEG and MPEG-4 because of its superior compression efficiency.

H.264 is a high performance video compression standard that boasts a much higher compression ratio than MJPEG or MPEG-4, drastically reducing file sizes and conserving valuable network bandwidth. With a 90% reduction in file size, a 2MB image can be drastically reduced to 20KB with H.264, a 50% reduction in bandwidth or storage requirements compared with MPEG-4. As such, uncompromised image quality and less required bandwidth and storage space make H.264 ideal for megapixel cameras.

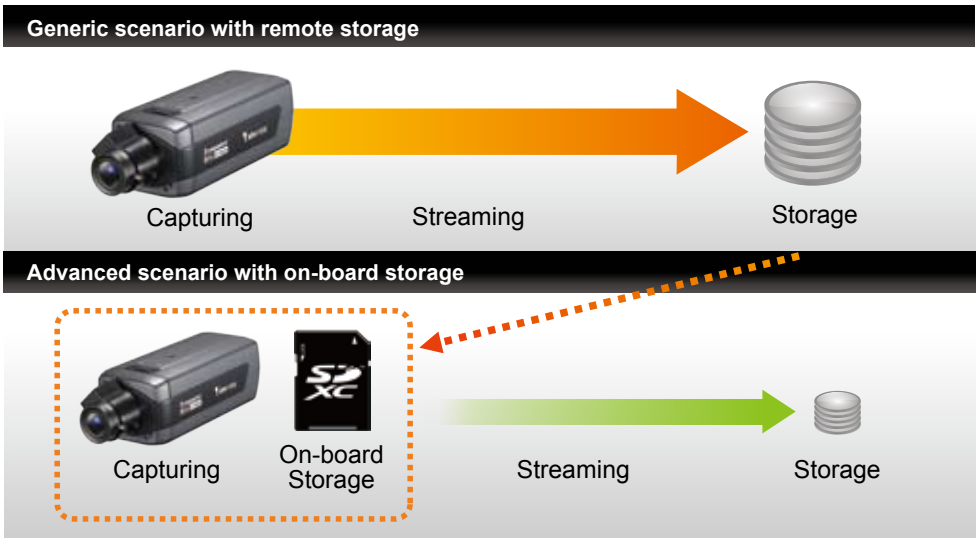


At a fixed bandwidth, an H.264 stream can be transmitted in higher resolution compared with MJPEG and MPEG-4 streams. For example, the same bandwidth can transmit a H.264 video stream in 2MP (1600x1200) resolution, but only an MJPEG stream in CIF (352 x 288) and MPEG-4 stream in 1.3MP (1280x1024). As a result, H.264 can improve the viewing experience without increased bandwidth requirements.

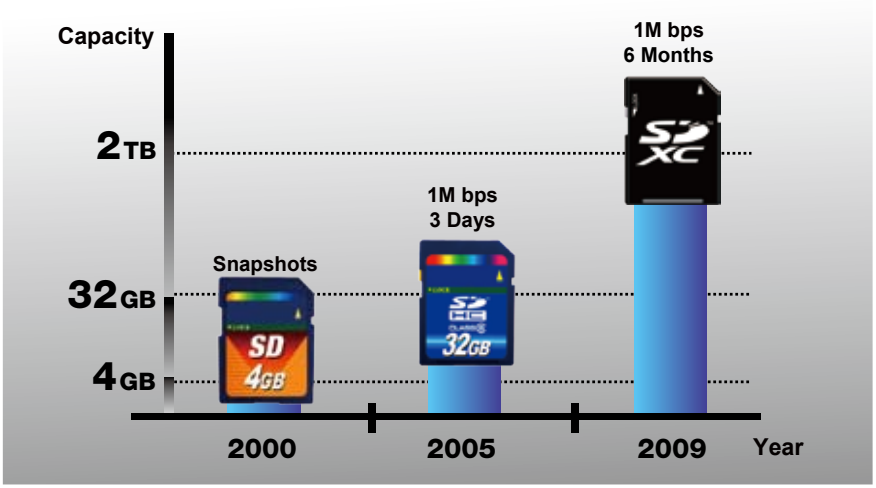


● On-board Storage

Back-end recording devices such as PCs or NVRs are widely used in daily surveillance. However, transmitting video streams containing no changes to back-end storage devices for continuous recording will consume a great deal of bandwidth. To reduce bandwidth requirements, a more efficient method is to store video images in the camera, such as on a SD/SDHC card, and have them transmitted only when an event occurs or when the operator needs to access the recorded data. The network is then only used by streams for live viewing, event-triggered recording, or backup. On-board storage allows for continuous recording while ensuring more efficient usage of bandwidth resources and storage space. It also guarantees constant recording, even when the network is disconnected.



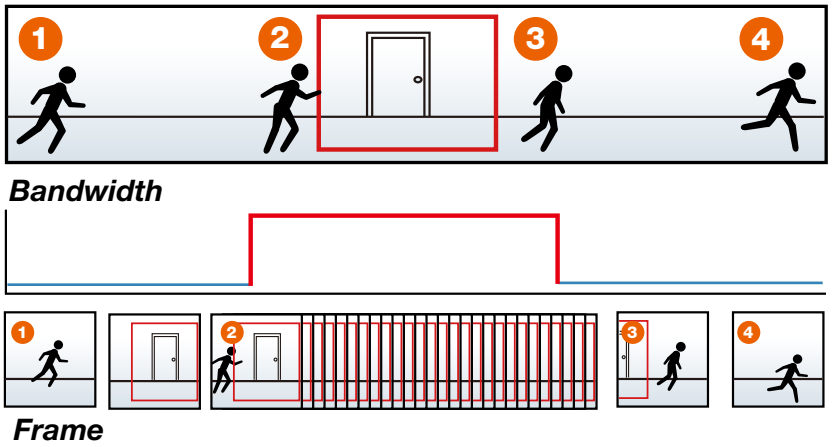
With rapid advancement in memory card technologies and capacity, storage on the front-end on the camera itself will become a major trend. An SD card with a maximum capacity of 4GB announced in 2000 can only save snapshots, but the 32GB SDHC card launched in 2005 can continuously record 1Mbps video images for three days. This year, 2009, saw the development of the 2TB SDXC card, which can store 1MB images continuously for up to 6 months and is large enough to fulfill the majority of consumers' demands.



• Activity Adaptive Streaming

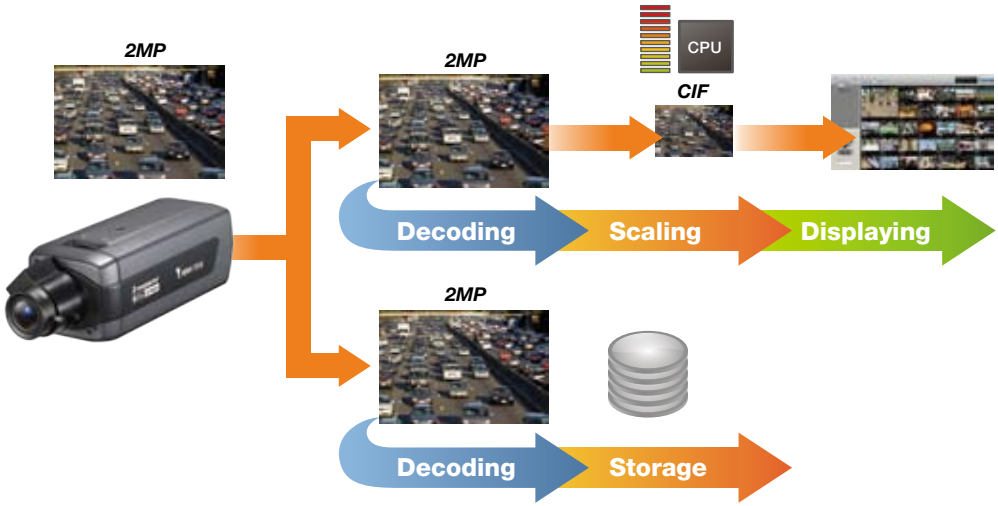
During normal monitoring, there is no need to receive high-definition images, only recognizable ones. Therefore, transmitting a megapixel image at a high frame rate would consume too much bandwidth. However, during event-triggered recording, high quality images and smooth video streams are necessary; in this case, a high frame rate is needed.

Activity adaptive streaming is a technology designed to use bandwidth in a smart way. It allocates bandwidth usage dynamically with a configurable frame rate according to the importance of the content. For example, during normal monitoring, the frame rate can be set low, e.g. 1 fps, to prevent video streams from taking up bandwidth. In an event-triggered situation, the frame rate will increase to a higher level, e.g. 30 fps, to allow for smooth and high quality video feeds. Activity adaptive streaming can optimize bandwidth usage during monitoring while ensuring superior image quality during recording.



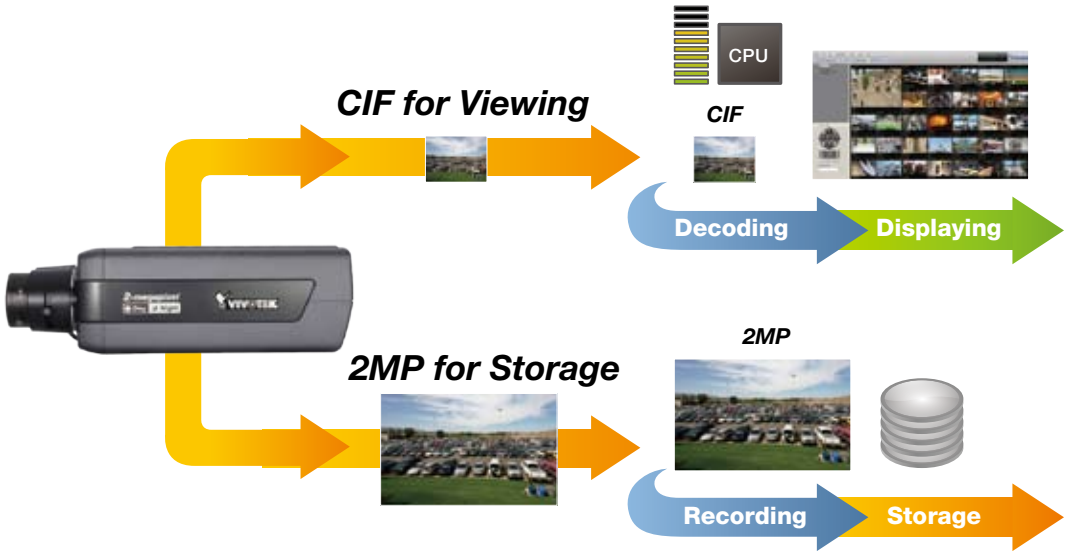
• Multiple Streams

Imagine how much workload the CPU would be burdened with if video streams could only be transmitted at full frame rate or in megapixel resolution. Besides the stream for storage, the central management software needs to process the megapixel video stream for living viewing at the same time, including decoding and resizing images to fit the display setting. This can be a big drain on CPU power. If a stream is encoded by H.264, it will consume even more CPU power because of the complexity of H.264.



Usually, users can make do with CIF images for live viewing; only when an event occurs will they need to receive higher resolution images or video streams at full frame rate. Images for recording, on the contrary, must be of high quality at all times. In order to address the two different demands, a camera must support multiple streams.

Multiple streams allow each video stream to be delivered in a different resolution, frame rate, and image quality for individual quality or bandwidth demands. As a result, the camera can simultaneously transmit a small image in CIF format for real-time monitoring and a large megapixel image for storage. The CIF image can be directly displayed on the screen without much decoding or further scaling, thereby drastically reducing CPU loading. In addition, because different devices such as PCs and mobile phones have different requirements for image sizes, resolutions, and frame rates, multiple streams give users a higher level of flexibility for dealing with camera images on different platforms.



Due to the difficulty in transmission, recording, and playback of megapixel video streams, network cameras must be flexible enough to deliver optimized streams for specific applications so as to avoid system overload. This is where multiple streams come in. It is expected that multiple streams will ultimately be a standard specification for megapixel surveillance.

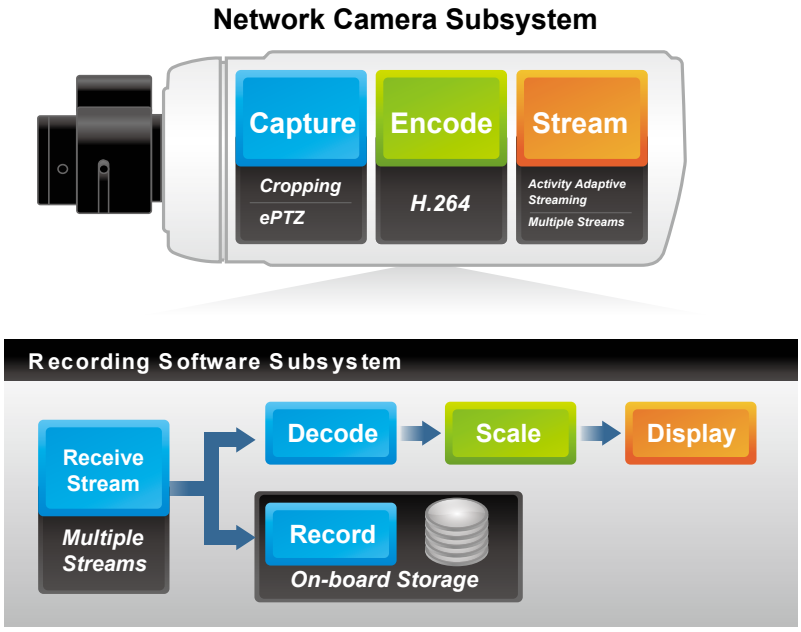
Conclusion

Taking the Lead with VIVOTEK's True Megapixel Solutions

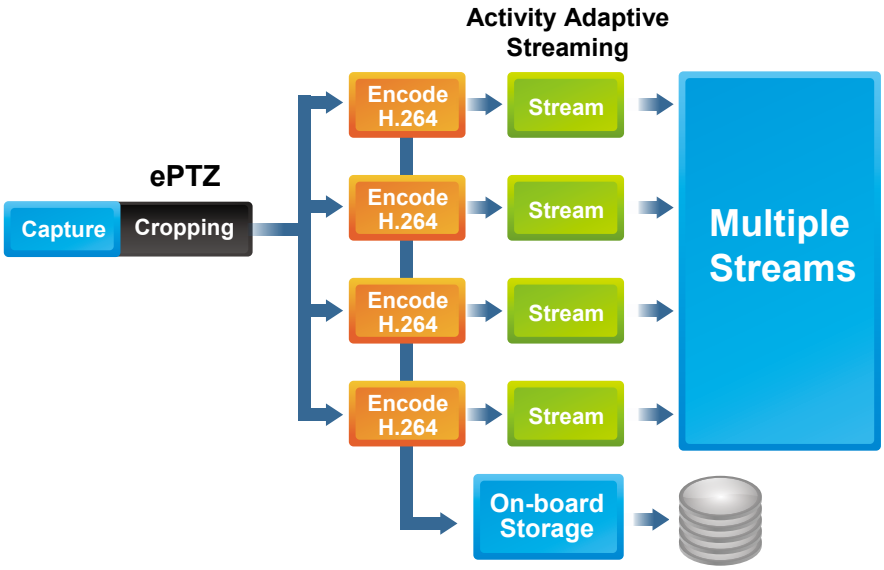
With network cameras driven towards higher resolutions due to demands for superior image quality, megapixel cameras are prepared to take their turn on the world stage. However, the challenges of bandwidth, storage, and CPU loading faced by megapixel cameras must be addressed beforehand.

A true megapixel surveillance solution hinges on the synergy of many elements, from image capture, through streaming, to storage. The development of H.264 does contribute to significant bandwidth efficiency, but it only solves part of the problem.

As an innovator in the IP surveillance industry, VIVOTEK has developed a systematic approach to help users maximize the value of megapixel network cameras. We have developed six new technologies in different parts of the surveillance system to improve bandwidth efficiency and CPU loading, including cropping and ePTZ for image capturing, H.264 for encoding, activity adaptive streaming, multiple streams, and on-board storage support.



The introduction of new technologies and functions into the camera makes our megapixel surveillance solution more sophisticated, with powerful bandwidth and CPU management capabilities.



VIVOTEK INC.
6F, No.192, Lien-Cheng Rd., Chung-Ho, Taipei County, Taiwan
Tel: +886 2 8245 5282 Fax: +886 2 8245 5532
E-mail: sales@vivotek.com http://www.vivotek.com

VIVOTEK USA INC.
470 Lakeside Drive Suite C, Sunnyvale CA 94085
Tel: 408-773-8686 Fax: 408-773-8298
E-mail: salesusa@vivotek.com