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H.264 Technology Overview

Understanding H.264 Video Compression and the
Benefits of the Nextiva Video Solution Portfolio

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VIDEO INTELLIGENCE SOLUTIONS™

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About Verint Video Intelligence Solutions

Verint® Video Intelligence Solutions™ is the leading global provider of networked video solutions that enhance the security of people, property and assets. Verint's award-winning Nextiva® portfolio includes video management software, integrated analytics, encoders and IP cameras, and intelligent DVRs for use in a variety of vertical market environments. Open, standards based and IT friendly, Verint solutions help organizations leverage their existing video investments and place IP video within the reach of virtually every organization.

About Verint Systems

Verint Systems Inc. is a leading provider of Actionable Intelligence® solutions for an optimized enterprise and a safer world. More than 10,000 organizations in over 150 countries rely on Verint solutions to perform more effectively, build competitive advantage, and enhance the security of people, facilities, and infrastructure.

Overview

A partnership between the ITU-T Video Coding Experts Group (VCEG) and the ISO/IEC Moving Picture Experts Group (MPEG) led to a new video compression standard. H.264, or MPEG-4 Part 10 Advanced Video Coding (AVC) as it is also known, was quickly picked up by a wide variety of industries and integrated into numerous hardware devices and software applications, including optical blu-ray DVDs, 3G phones, interactive video teleconferencing, multimedia streaming, video-on-demand, cable and satellite broadcast, and high-definition television. Video files recorded in H.264 are streamed over a variety of networks, such as ISDN, DSL, Ethernet and Wireless.

The popularity of H.264 is the result of its ability to deliver high-quality images at a substantially smaller file size. It improves on the video compression standards or codecs in use today, providing a crisper image and decreasing file size by an average of 50%. When compared with MJPEG, the reduction can be as much as 80%. In the security industry, these savings add up quickly. The retention of surveillance video can require an enormous amount of storage, especially with the increasing use of megapixel cameras and the demand for high-definition images. Since storage represents one of the most significant costs of maintaining a video management system, the H.264 video compression standard is especially important because it offers both superior image clarity and the potential for significant cost savings.

The following images illustrate the improved clarity of video compressed with the H.264 standard even at a significantly lower bit rate, when compared with MPEG4-SP — a leading compression standard in the video surveillance industry.



The image on the left was recorded at a bit rate of 2.5 Mb/s in MPEG4-SP, the one on the right at 1.5 Mb/s in H.264 Main Profile. Yet the quality of this image is higher. Details are more pronounced, edges are cleaner, and objects in the distance are clearer with more vivid colors.

Video Compression: The H.264 Advantage

The most common video compression standards for video surveillance are MPEG4-Simple Profile (MPEG4-SP) and Motion JPEG (MJPEG). Verint introduced a proprietary codec called SM4, which provides an image quality that is similar to MPEG4-SP, at the same resolution and frame rate, but typically uses less CPU power.

Video compression codecs use algorithms to compress or encode video as it is recorded and then decompress or decode it when it is played back. MPEG4-SP, SM4, and H.264 codecs do this by analyzing each video frame in a video clip and removing the information that is redundant from frame to frame. Full picture frames called key frames are inserted at configurable intervals to provide a reference for rebuilding or decoding the image when it is played back. These intervals are referred to as a Group of Pictures (GOP), and in addition to key frames, it includes delta frames.

Each frame is divided into a series of blocks called macroblocks. The pixels in each macroblock are analyzed and compared to those in the previous block. If the information is similar, but occurs in a different location — as is the case in high-motion video — the location is encoded, rather than the pixels, and this information is used to rebuild the frame.

MJPEG uses a slightly different scheme. It compresses each frame individually as a JPEG image. It therefore requires a higher bit rate to produce video quality that is comparable to SM4 or MPEG-4 SP.

H.264 improves on MPEG-4 SP coding techniques by using advanced algorithms such as CABAC entropy coding, simplified integer transforms, and in-loop deblocking filter. The end result is better image quality at lower bit rates.

H.264 Configuration Profiles and Parameters

H.264 is an open standard that organizations can adapt to meet the needs of their particular industry or market. For this reason, there can be a lot of variation between one H.264 codec implementation and the next.

At the highest level, H.264 includes a number of profiles that are intended for different industries and different markets. For the video security market, the most popular are Baseline and Main Profile. With the expertise and knowledge acquired in the development of SM4, Verint's development team performed a thorough analysis to determine the best implementation for the new series of Nextiva Intelligent Edge Devices and Network Video Recorders. Verint selected the Main Profile (MP) primarily for the more sophisticated entropy-encoding strategies provided by the context adaptive binary coding (CABAC) algorithm. CABAC provides 10 to 20% more efficient compression over context-adaptive variable length coding (CAVLC) present in the Baseline profile, particularly with high-motion video.

The following table compares the MPEG-4 SP/SM4 video standards with H.264 and shows how the target bit rate is optimized.

Video Resolution	Frames per second (fps)	MPEG-4 SP/SM4 (kb/s)	H.264 (kb/s)	Target bit rate optimized by
4CIF	30	3500	1200	65%
4CIF	15	1800	800	55%
4CIF	10	900	500	45%
4CIF	7.5	700	350	50%

It is in the recording of high-motion video that H.264 really excels. Potential savings for H.264 compared with SM4 or MPEG-4 SP range from 25% for low motion, to 40% for medium motion, and 60% for high motion.

The following table shows how the reduced bit rate translates into storage savings per month both in terabytes (TB) and in the number of days of video retention. It is based on a system running 100 cameras @ 4CIF/15 fps for 30 days, using the following formula:

Number of cameras * bit rate (kb/s) * number of seconds / hour * number of hours / day * 30 days

For example: for H.264 Main Profile: 100 * 800 kb/s * 3600sec * 24hours * 30days

	MPEG-4 SP/SM4	H.264 Baseline Profile	H.264 Main Profile
Bit Rate	1800 kb/s	920 kb/s	800 kb/s
Required Storage	58.3 TB	29.8 TB	25.9 TB

From these figures, we can see that H.264 Baseline Profile requires approximately half the storage of MPEG-4 SP/SM4 and that with H.264 Main Profile, the savings are even greater. This can translate into extra days of video retention: 37.5 days with the H.264 Baseline Profile and an additional 4.5 days with Main Profile.

Verint Nextiva and H.264

H.264 is more sophisticated than earlier compression methods. Therefore, it takes significantly more processing power to compress and decompress H.264 video. Verint has developed new network video recorders and video encoders to accommodate these new requirements. Additionally, the Verint Nextiva video portfolio fully supports H.264, including integration of H.264 cameras and other devices.

Nextiva Network Video Recorders

Nextiva IP-based, high-performance network video recorders (NVRs) deliver high-resolution images for both recording and live video viewing. Built with powerful H.264 video compression engines, these NVRs provide superior video quality — up to 480 frames per second of recorded video or up to 960 fps with an external IP video input — at significantly lower bit rates. This reduces storage and bandwidth requirements and can significantly lower cost of ownership and operation. These devices scale to large, distributed IP video operations for greater long-term value and lower migration costs. Built on Verint expertise from more than 70,000 DVR implementations, they are fully integrated with Nextiva multi-port video encoders, wireless edge devices, and IP cameras.



Nextiva EdgeVR™ is a high-performance, IP-based network video recorder. EdgeVR scales to large, distributed IP video operations more readily than analog-based, hybrid NVRs, for greater long-term value and lower migration costs. EdgeVR also features high-quality imagery, optimized bandwidth utilization, a secure embedded operating system, and industry-leading business and security system interfaces, for superior performance and unsurpassed value.

Nextiva Multi-Port Encoders

Nextiva multi-port encoders with H.264 Main Profile provide significantly more compressing power and several enhancements over previous versions with MPEG-4 SP and SM4 encoding technologies. These next-generation Nextiva encoders are optimized to provide outstanding video quality at exceptionally low bit rates. They are sustainable and environmentally friendly, with 25% weight reduction to help diminish carbon emissions produced during shipment, very low power consumption, 1.5W per input, and an external qualified power supply. They feature an intuitive Web browser Interface accessible through Nextiva and SNMP support for ease of integration with IT infrastructure.



Nextiva S1800e series multi-port encoders deliver H.264 and MPEG-4 video up to 4CIF/30 fps on all ports. By incorporating H.264 video encoding technology, these devices provide excellent image clarity, with up to a 50% reduction in use of network bandwidth and storage. They can simultaneously compress images at different rates and resolutions, so that video can be viewed at high resolution, yet stored at lower resolution.

The Nextiva Video Management Portfolio

Nextiva is the industry's most comprehensive networked video portfolio for enhancing security and operational effectiveness — a single source for virtually every facet of your video surveillance operations.

Certified by the Department of Homeland Security as an anti-terrorism technology, Nextiva is designed to enhance any video network: large or small, wired or wireless, mostly analog or mostly IP and everywhere in between. Open, standards-based, and IT friendly, Nextiva help organizations realize the benefits of IP video using their legacy video investments.

Nextiva is built on an open, standards-based architecture. Nextiva is highly scalable and is designed to integrate seamlessly with Verint's next-generation H.264 edge devices, as well as with H.264-enabled IP cameras from third-party manufacturers. Organizations that leverage Nextiva H.264-enabled solutions can benefit from a 25% to 60% reduction in bit rate, with higher quality video and lower network bandwidth and storage use. Nextiva solutions also require fewer servers and external storage arrays – all that can add significant cost in a video management solution.

Built for efficient deployment, easy maintenance, and low cost of ownership, these flexible and IT-friendly solutions can help your organization more effectively secure people, property, and assets.

For further information on the implementation of H.264 in Verint's products and solutions, visit www.verint.com.

The Industry's Most Comprehensive Networked Video Portfolio

Intelligent Edge Devices

- Decoders and encoders
- IP and megapixel cameras
- Wireless transmitters, repeaters, bridges, and access points
- Network video recorders for large, geographically distributed video operations
- Integrated, on-board video analytics

Video Management Software

- Automated video system health monitoring and diagnostics
- Policy-based event notification, video distribution, and process activation
- Virtual matrix
- Live and recorded video viewing with an interactive map of facility layouts and camera locations
- Investigation management for collecting case-related audio, video, and data

Vertical Market Suites

- Retail, banking, mass transportation, enterprise, education, government, critical infrastructure, homeland security, transportation networks

Integrated Video Analytics

- Camera tampering, wrong direction, perimeter intrusion, loitering, objects left behind or removed, traffic analysis, & more

Comprehensive Service and Support

- Staffed by experts in Nextiva deployment & operation
- Comprehensive warranty support
- Live technical support
- Web-based resources
- Advanced replacements
- On-site installation services
- Project management
- Integration engineering services
- Professional services

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