



State of West Virginia  
 Department of Administration  
 Purchasing Division  
 2019 Washington Street East  
 Post Office Box 50130  
 Charleston, WV 25305-0130

# Request for Quotation

RFQ NUMBER  
 WSH13025

PAGE  
 1

ADDRESS CORRESPONDENCE TO ATTENTION OF:  
 ROBERTA WAGNER  
 304-558-0067

VENDOR

RFQ COPY  
 TYPE NAME/ADDRESS HERE  
 NewTech Systems, Inc  
 420 16th Street  
 Dunbar, WV 25064

SHIP TO

HEALTH AND HUMAN RESOURCES  
 WILLIAM R. SHARPE JR. HOSPITAL  
 CENTRAL RECEIVING  
 936 SHARPE HOSPITAL ROAD  
 WESTON, WV  
 26452 304-269-1210

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
05/24/2012				

BID OPENING DATE: 07/05/2012 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
0001	1	EA		936-73		
<p>REQUEST FOR INFORMATION</p> <p>WILLIAM R. SHARPE, JR. HOSPITAL, A 150 BED ACUTE PSYCHIATRIC FACILITY, IS GATHERING INFORMATION TO WRITE A SOLICITATION FOR A HOSPITAL-WIDE VIDEO SURVEILLANCE SYSTEM.</p> <p>AT THIS TIME, WE ARE REQUESTING VENDORS TO COME ON-SITE TO MAKE RECOMMENDATIONS THAT WE WILL CONSIDER WHEN WE COMPILE AND WRITE OUR BID SPECIFICATIONS. PLEASE NOTE THAT DURING THIS MEETING NO PRICING WILL BE DISCUSSED. THE MEETING WILL BE ON JUNE 21, 2012 AT 10:00 AM IN CONFERENCE ROOM F, AT WILLIAM R. SHARPE, JR. HOSPITAL, 936 SHARPE HOSPITAL ROAD, WESTON, WV 26452. UPON ARRIVAL AT THE FACILITY, AS THE SWITCHBOARD STAFF TO NOTIFY ROB KIMBLE OR BARBARA DAUGHERTY OF YOUR ARRIVAL</p> <p>DIGITAL VIDEO SURVEILLANCE SYSTEM</p> <p>REQUEST FOR INFORMATION TO PROVIDE A VIDEO SURVEILLANCE SYSTEM TO A 150 BED ACUTE PSYCHIATRIC FACILITY AT WILLIAM R. SHARPE, JR. HOSPITAL.</p> <p>TERM: INFORMATIONAL MEETING TO BE HELD JUNE 21, 2012 AT 10:00 AM IN CONFERENCE ROOM F, AT WILLIAM R.</p>						

RECEIVED  
 2012 JUL -5 PM 12:00  
 WV PURCHASING DIVISION

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE: *John Bond* TELEPHONE: 304-766-0000 DATE: 7-3-2012  
 TITLE: G. Manager FEIN: 20-5736303 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

**GENERAL TERMS & CONDITIONS**  
**REQUEST FOR QUOTATION (RFQ) AND REQUEST FOR PROPOSAL (RFP)**

1. Awards will be made in the best interest of the State of West Virginia.
  2. The State may accept or reject in part, or in whole, any bid.
  3. Prior to any award, the apparent successful vendor must be properly registered with the Purchasing Division and have paid the required \$125 fee.
  4. All services performed or goods delivered under State Purchase Order/Contracts are to be continued for the term of the Purchase Order/Contracts, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise available for these services or goods this Purchase Order/Contract becomes void and of no effect after June 30.
  5. Payment may only be made after the delivery and acceptance of goods or services.
  6. Interest may be paid for late payment in accordance with the *West Virginia Code*.
  7. Vendor preference will be granted upon written request in accordance with the *West Virginia Code*.
  8. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.
  9. The Director of Purchasing may cancel any Purchase Order/Contract upon 30 days written notice to the seller.
  10. The laws of the State of West Virginia and the *Legislative Rules* of the Purchasing Division shall govern the purchasing process.
  11. Any reference to automatic renewal is hereby deleted. The Contract may be renewed only upon mutual written agreement of the parties.
  12. **BANKRUPTCY:** In the event the vendor/contractor files for bankruptcy protection, the State may deem this contract null and void, and terminate such contract without further order.
  13. **HIPAA BUSINESS ASSOCIATE ADDENDUM:** The West Virginia State Government HIPAA Business Associate Addendum (BAA), approved by the Attorney General, is available online at [www.state.wv.us/admin/purchase/vrc/hipaa.html](http://www.state.wv.us/admin/purchase/vrc/hipaa.html) and is hereby made part of the agreement provided that the Agency meets the definition of a Cover Entity (45 CFR §160.103) and will be disclosing Protected Health Information (45 CFR §160.103) to the vendor.
  14. **CONFIDENTIALITY:** The vendor agrees that he or she will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in <http://www.state.wv.us/admin/purchase/privacy/noticeConfidentiality.pdf>.
  15. **LICENSING:** Vendors must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, and the West Virginia Insurance Commission. The vendor must provide all necessary releases to obtain information to enable the director or spending unit to verify that the vendor is licensed and in good standing with the above entities.
  16. **ANTITRUST:** In submitting a bid to any agency for the State of West Virginia, the bidder offers and agrees that if the bid is accepted the bidder will convey, sell, assign or transfer to the State of West Virginia all rights, title and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to the bidder.
- I certify that this bid is made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership, or person or entity submitting a bid for the same material, supplies, equipment or services and is in all respects fair and without collusion or fraud. I further certify that I am authorized to sign the certification on behalf of the bidder or this bid.

**INSTRUCTIONS TO BIDDERS**

1. Use the quotation forms provided by the Purchasing Division. Complete all sections of the quotation form.
2. Items offered must be in compliance with the specifications. Any deviation from the specifications must be clearly indicated by the bidder. Alternates offered by the bidder as EQUAL to the specifications must be clearly defined. A bidder offering an alternate should attach complete specifications and literature to the bid. The Purchasing Division may waive minor deviations to specifications.
3. Unit prices shall prevail in case of discrepancy. All quotations are considered F.O.B. destination unless alternate shipping terms are clearly identified in the quotation.
4. All quotations must be delivered by the bidder to the office listed below prior to the date and time of the bid opening. Failure of the bidder to deliver the quotations on time will result in bid disqualifications: Department of Administration, Purchasing Division, 2019 Washington Street East, P.O. Box 50130, Charleston, WV 25305-0130
5. Communication during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited (W.Va. C.S.R. §148-1-6.6).



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SHARPE, JR. HOSPITAL LOCATED AT 935 SHARPE HOSPITAL ROAD, WESTON, WV 26452.						
PLEASE NOTE THAT THIS IS FOR INFORMATION PURPOSES ONLY NO PURCHASE ORDER/CONTRACT WILL BE ISSUED VIA THIS RFI INQUIRIES: WRITTEN QUESTIONS SHALL BE ACCEPTED THROUGH CLOSE OF BUSINESS ON 6/22/2012. QUESTIONS MAY BE SENT VIA USPS, FAX, COURIER OR E-MAIL. IN ORDER TO ASSURE NO VENDOR RECEIVES AN UNFAIR ADVANTAGE, NO SUBSTANTIVE QUESTIONS WILL BE ANSWERED ORALLY. IF POSSIBLE, E-MAIL QUESTIONS ARE PREFERRED. ADDRESS INQUIRIES TO:  ROBERTA WAGNER DEPARTMENT OF ADMINISTRATION PURCHASING DIVISION 2019 WASHINGTON STREET, EAST CHARLESTON, WV 25311  FAX: 304-558-4115 E-MAIL: ROBERTA.A.WAGNER@WV.GOV						
NOTICE						
A SIGNED BID MUST BE SUBMITTED TO:  DEPARTMENT OF ADMINISTRATION PURCHASING DIVISION BUILDING 15 2019 WASHINGTON STREET, EAST CHARLESTON, WV 25305-0130						

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE	TELEPHONE	DATE
<i>Gen. Mgr.</i>	<i>304-766-0000</i>	<i>7-3-2012</i>
TITLE	FEIN	ADDRESS CHANGES TO BE NOTED ABOVE
	<i>20-5736303</i>	

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'



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THE BID SHOULD CONTAIN THIS INFORMATION ON THE FACE OF THE ENVELOPE OR THE BID MAY NOT BE CONSIDERED:  SEALED BID  BUYER:-----RW/FILE 22----- RFQ. NO.:-----WSH13025----- BID OPENING DATE:-----7/5/2012----- BID OPENING TIME:-----1:30 PM-----  PLEASE PROVIDE A FAX NUMBER IN CASE IT IS NECESSARY TO CONTACT YOU REGARDING YOUR BID:  ----- CONTACT PERSON (PLEASE PRINT CLEARLY): -----						

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***** THIS IS THE END OF RFQ WSH13025 ***** TOTAL:						

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WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

**ADDENDUM ACKNOWLEDGEMENT FORM**  
**SOLICITATION NO.: WSH13025**

**Instructions:** Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

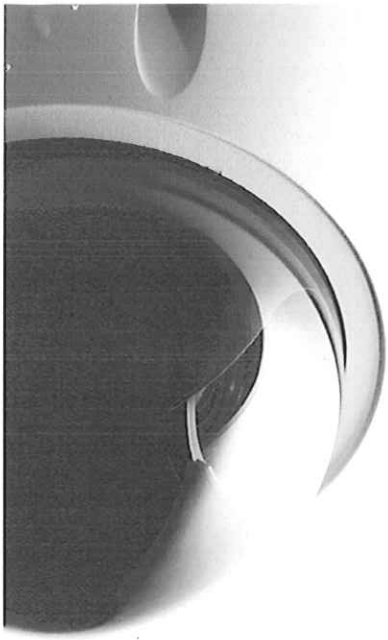
**Acknowledgment:** I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

**Addendum Numbers Received:**  
(Check the box next to each addendum received)

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Addendum No. 1 | <input type="checkbox"/> Addendum No. 6  |
| <input checked="" type="checkbox"/> Addendum No. 2 | <input type="checkbox"/> Addendum No. 7  |
| <input type="checkbox"/> Addendum No. 3            | <input type="checkbox"/> Addendum No. 8  |
| <input type="checkbox"/> Addendum No. 4            | <input type="checkbox"/> Addendum No. 9  |
| <input type="checkbox"/> Addendum No. 5            | <input type="checkbox"/> Addendum No. 10 |

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

New Tech Systems, Inc  
 Company  
  
 Authorized Signature  
7-3-2012  
 Date



## Understanding Compression Technologies for HD and Megapixel Surveillance

**AVIGILON**  
THE BEST EVIDENCE™

# Understanding Compression Technologies for HD and Megapixel Surveillance

When the security industry began the transition from using VHS tapes to hard disks for video surveillance storage, the question of how to compress and store video became a top consideration for video surveillance system designers. As the industry moves from analog cameras and digital video recorders (DVR) to IP cameras and network video recorders (NVR), how to compress and store video comes into question again. When analog cameras are connected to a DVR, video compression is performed inside the recorder unit at a central location. While IP camera video compression is performed inside the camera then transmitted to the NVR in the compressed format. The centralized compression of DVRs typically meant that all cameras in the surveillance system had to use the same compression technology. IP cameras, on the other hand, have allowed for the design of hybrid systems that can use multiple compression technologies on the same system. As a result, it is critical for end-users, integrators, and system designers to have a clear understanding of the compression technologies available. Knowing when each should be used will create the best results in a system design.

There are now a wide variety of compression technologies available on the market, but no clear standard has emerged. At the same time, implementations of a particular technology may vary from one vendor to another. Often, installers think only of file and disk size and how that determines the number of days video is stored, neglecting the fact that video compression can also impact a video surveillance system design. For example, video compression technology impacts the choice of hardware for client workstations, what transmission systems can be used, and the speed, success, and efficiency of investigations.



## Frame-by-Frame and Inter-Frame Compression Technologies

There are two broad groups of compression technologies currently used in video surveillance: frame-by-frame compression and inter-frame compression. Each technology group incorporates different formats and in turn has its own tradeoffs. Understanding these differences will allow the system designer to choose the right compression technology to best meet the project's requirements and performance objectives.

## Frame-by-Frame Compression

Frame-by-frame, or intra-frame, compression technologies compress video by applying a compression algorithm to each frame captured by a camera. The end result is a series of individually compressed images.

Video that is compressed using a frame-by-frame compression technology presents a number of benefits over the more complicated inter-frame compression technologies discussed later. First, the resulting video generated through frame-by-frame compression is a series of individually compressed frames that do not require information from other frames – they can be compressed and transmitted out of a camera more quickly to reduce latency. Second, because each frame acts as an independently accessible frame and is not built up from multiple frames, recorded video can be accessed more quickly. This rapid access improves investigation efficiency and can improve the forensic viability of the recorded video. In the most demanding high security situations, providing all recorded video as a series of independent video frames ensures that video integrity cannot be challenged as valid evidence due to incomplete frames generated by the compression process.

The two main frame-by-frame compression technologies currently used in video surveillance are discussed in more detail in the following sections: JPEG and JPEG2000.

### JPEG

JPEG compression is most widely used for static image compression in digital cameras and on the internet. JPEG compression is named after the Joint Photographic Experts Group and was initially introduced in 1992. Based on a compression technique known as a 'discrete cosine transform,' JPEG compression relies on blocks of pixels, typically 8x8 in size, to compress the information in an image and reduce its file size. This block-based transformation typically introduces blocking artifacts like those shown in Figure 2. These block artifacts can sometimes obscure image details when JPEG images are heavily compressed.



Figure 2 - Example image showing JPEG compression artifacts

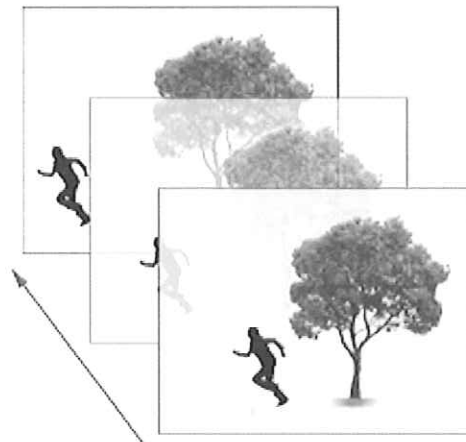


Figure 1 - Frame-by-Frame Compression

# Understanding Compression Technologies for HD and Megapixel Surveillance

## JPEG2000

Since its introduction in 2000, JPEG2000 has become a widely used standard in many different industries. For example, JPEG2000 is used in digital cinema, diagnostic medical images, document archiving, and in the capture and transmission of images from satellites and other military applications.

JPEG2000 is designed to preserve as much detail and evidence as possible within the image while greatly reducing file sizes. As a wavelet-based compression technology, JPEG2000 allows for additional compression with fewer artifacts in the image. The JPEG2000 compression process generates images that are 30 percent smaller in file size and bandwidth than a conventional JPEG image of the same visual quality, and adds additional features for effective streaming and transmission.

Two additional features of JPEG2000 compression are its ability to capture a wide dynamic range and its ability to scale to higher resolutions. Dynamic range is an important topic in surveillance because many cameras are challenged to record bright and dark areas that vary dramatically throughout the day and by season. The ability to capture dynamic range is expressed in bits. Most compression technologies capture 8-bits of dynamic range, which means it can describe 256 different intensities of light within the image. The sensors used in surveillance cameras are often capable of capturing more than 256 intensities of light and more information than even the human eye can see. JPEG2000 was designed to preserve the extra information that the sensors generate and maintain it in the compressed video. The second key feature of JPEG2000 is its use of progressive compression to efficiently allow the transmission and display of very high resolution images. Information on the JPEG2000 advantage and how Avigilon has combined it with High Definition Stream Management (HDSM) for even greater results is discussed in the 'Streaming and Network Effects of Compression' section.

## Inter-Frame Compression

Inter-frame compression technologies rely both on compressing data within a single frame and on analyzing changes between frames. The result is a stream of video that is compressed over multiple frames rather than a series of individual frames. Typically, an inter-frame compression technology will attempt to store only incremental changes between frames and store whole frames only on periodic intervals. Though this technique can result in bandwidth efficiencies, it can also lead to the loss of information because the whole frame is not retained. The technologies used for inter-frame encoding are also often referred to as temporal or 'time-based' encoding because they rely on information spread out over time. The two main inter-frame compression technologies currently used in video surveillance are discussed in more detail in the following sections: MPEG-4 and H.264.

### MPEG-4

MPEG-4 compression is an umbrella term used for many different technologies defined by the Moving Picture Experts Group. Most surveillance systems implement a variant of MPEG-4 Part 2, which was introduced in 1999. However, there are many different MPEG-4 compression technologies available and few are alike. MPEG-4 compression incorporates the same basic technology as JPEG compression for reducing the file size of a digital image, but encode different types of frames within video as a group of pictures (GOP) rather than as independent images.

A GOP is typically composed of three different frame types: I, P, and B frames. Intra-Frames (I-Frames) are complete encoded images similar to the images generated using JPEG or JPEG2000 compression. Predicted-Frames (P-Frames) are coded with reference to the previous image, which can be either another P-Frame or the previous I-Frame. Bidirectional-Frames (B-Frames) are sandwiched between I-Frames and P-Frames, and contain information on the changes calculated between the previous and subsequent frames.

Typically, MPEG-4 compression is limited to VGA resolutions and isn't commonly available for higher resolution surveillance cameras. Similar to JPEG, most implementations of MPEG-4 compression in surveillance are limited to 8-bits of dynamic range. This results in a loss of information if the camera is capable of capturing a wider dynamic range.

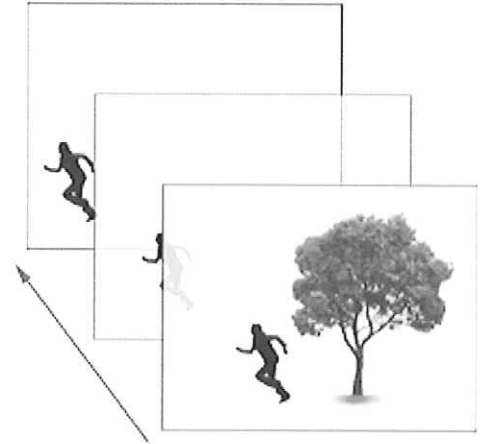


Figure 3 - Inter-Frame Compression

## H.264

H.264 is the newest compression technology used in the security industry. H.264 compression is actually a variant of the MPEG-4 standard, commonly referred to as MPEG-4 Part 10 Advanced Video Coding (AVC). It uses the same basic concepts of I, P, and B Frames to encode video, but relies on more advanced coding technologies. One example is motion compensation using motion vectors to compress video to a smaller size. H.264 compression allows frames to be inserted between I-Frames in a GOP to describe the relative movement of information from a reference frame, further reducing the information required to represent video.

# H.264

Another feature of H.264 that extends beyond standard MPEG-4 is the availability of de-blocking filters. De-blocking filters can smooth artifacts created by large amounts of compression. This allows systems to be configured with a higher level of compression while maintaining more detail in the images.

## Stream Size, Frame Rate, Lighting and Activity with Inter-Frame Compression

Inter-frame compression technologies rely on scene changes as part of its compression methodology, and can introduce variability in the size of the compressed data stream that is generated. This variability depends on the compression being used – if it is configured to use a constant bit rate (CBR) or a variable bit rate (VBR). When configuring a system for a constant bit rate, the amount of compression applied increases as more activities occur. This can add compression artifacts to the image and degrade image quality. When variable bit rate compression is used, the size of the compressed stream is allowed to vary to maintain consistent image quality.

Variability in the size of the compressed stream presents important challenges in system design. Networks and servers should be designed for the worst case bandwidth demands. This ensures that on higher activity, a network is not overwhelmed. Storage must also be chosen carefully to ensure that the required retention times can be met under all conditions. Alternatively, frame-by-frame compression technologies offer a predictable (constant) compressed data stream size and therefore allow for simpler system designs.

# Understanding Compression Technologies for HD and Megapixel Surveillance

Frame rate will also have a dramatic impact on the level of activity perceived in video by the compression technology. For example, a camera running at 30 frames per second may use a single I-Frame every two seconds and rely on changes in the scene to describe the other 58 frames in between. At this rate, the amount of change between individual frames could be very small, and substantial savings in bandwidth could be achieved by only storing scene changes for those frames. However, as the frame rate is decreased, the amount of change between frames can increase substantially. When running below 10 frames per second, there may be so much incremental change between frames that an inter-frame compression has little or no benefit over a frame-by-frame compression technology.

Scene lighting will also impact the ability of inter-frame compression algorithms to efficiently compress video. Often in low light scenes, noise within the image will be interpreted as a scene change by the compression algorithm, and cause bandwidth to increase. However, when implementing a compression technology, a camera manufacturer can optimize their motion detection algorithm to prevent the algorithm from interpreting noise in low light images as changes in the scene.

## Streaming and Network Effects of Compression

By increasing camera resolution, HD and megapixel IP cameras come with their own unique challenges for storage, bandwidth, and efficient video surveillance management. These issues can be addressed by the choice of compression technology and camera resolution. Here, we will compare JPEG2000 and H.264, the most current of the frame-by-frame and inter-frame compression technologies, and review their respective strengths and weaknesses related to streaming within a network.

### JPEG2000 and High Definition Stream Management

When used with high definition and multi-megapixel surveillance video, JPEG2000 can effectively and progressively compress the video and enable advanced functionality for retransmitting and managing the compressed video. Avigilon has designed High Definition Stream Management (HDSM) within the Avigilon Control Center Network Video Management Software (NVMS) to deliver these key features.



**HDSM**

# Understanding Compression Technologies for HD and Megapixel Surveillance

JPEG2000 progressive compression transforms an image into packets that allow a portion of the image to be transmitted and decompressed without requiring the rest of the image. This can be visualized in the cube displayed in figure 4 and 5. HDSM uses this feature to only transmit and decompress the portions of the video that the user is interested in, while storing the entire image on the server. If a low-resolution overview image is needed, only the front layer of the cube is sent, as shown in Figure 4. If a more detailed overview image is needed, additional layers of detail are sent. If a user is zooming in on a specific region to access full image detail, such as the license plate in Figure 5, HDSM will send multiple layers of that specific area for viewing.

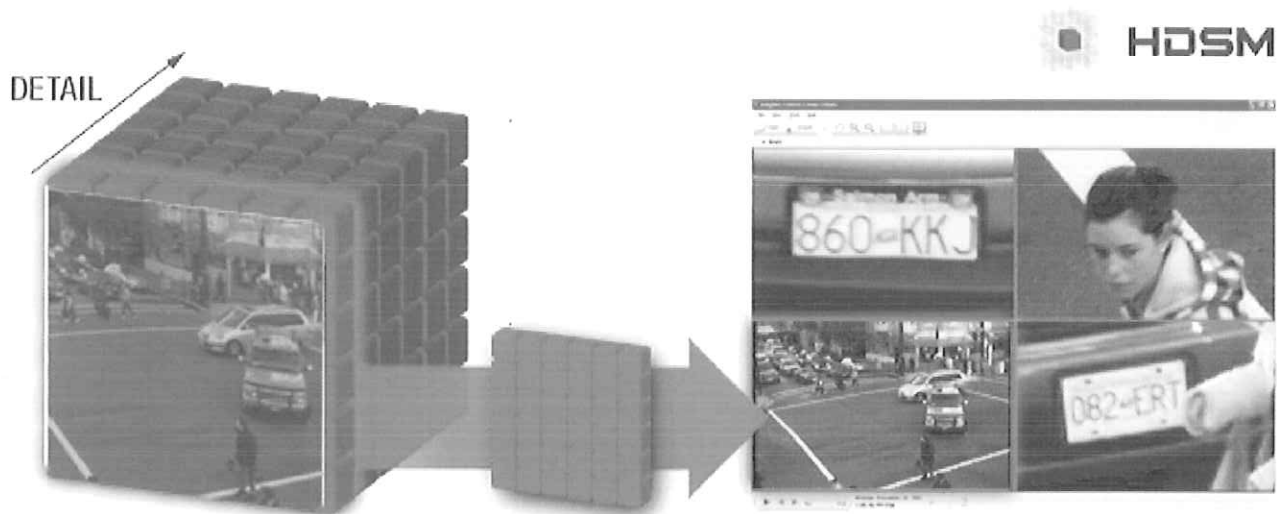


Figure 4 – Streaming Situational Awareness with JPEG 2000

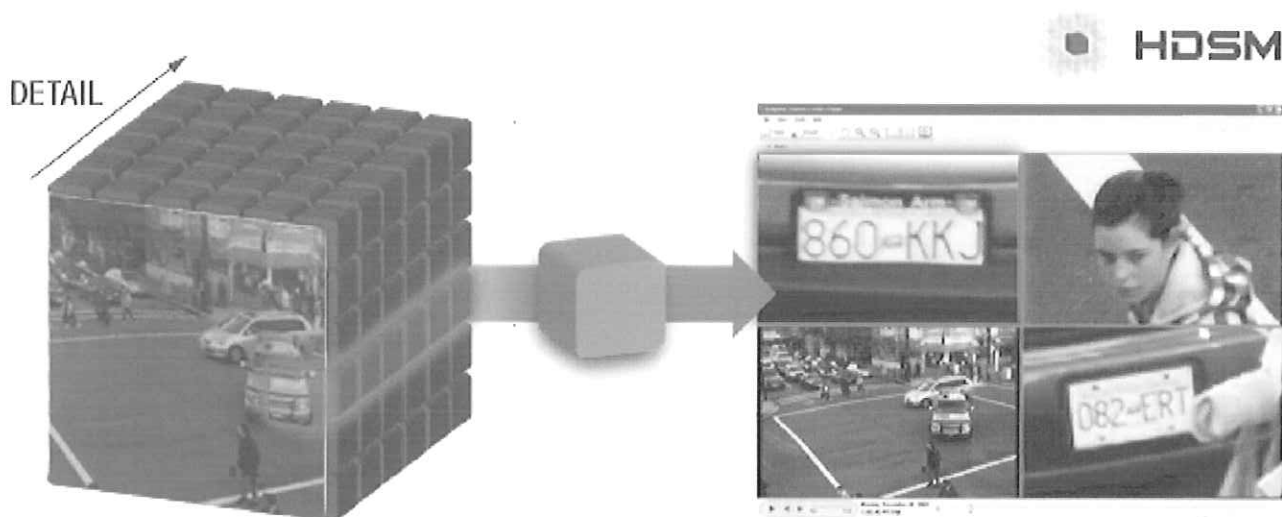


Figure 5 – Streaming high resolution Details with JPEG 2000

# Understanding Compression Technologies for HD and Megapixel Surveillance

Because HDSM can dynamically access the video in layers of detail, it can also tailor the size of the video stream being sent to the resolution of the monitor used. This results in a dramatic reduction in bandwidth between server and client compared to other compression technologies. For example, nine 5MP cameras generate 45MP of video information that is sent from camera to server. So if a connected client were viewing the video stream on a standard 1080p monitor with a total resolution of 2MP, only 2MP worth of video information is sent to the client. This allows HDSM to reduce the bandwidth between the server and client by 23 times while maintaining the ability to digitally zoom and pan within the original image at full resolution. In addition to reducing client bandwidth, HDSM also greatly reduces the processing load on the remote client. In the example, only 2MP of information is received and decompressed by the client instead of the 45MP of information.



Figure 6 – HDSM Benefits for Multiple High Resolution Cameras with JPEG2000

## H.264

Video compressed with H.264 can only be streamed in the original compressed resolution and the resolution cannot progressively adapt after compression. This means that as soon as video is sent over low bandwidth connections, the ability to dynamically adapt the resolution, as is possible with JPEG2000, is no longer available. Instead of dynamically adjusting, H.264 compresses multiple streams of video within the camera at different resolutions, and sends the lower resolution stream to the client for low bandwidth live monitoring while an alternate resolution is recorded on the NVR. These additional streams add to the bandwidth transmitted from the camera but are typically much smaller than the full resolution stream being recorded to the server.

There are two important trade-offs to remember when using H.264 multi-streaming for bandwidth management. First, when the remote client is only receiving a very-low resolution stream, it can view a scene in overview but cannot zoom in to see detail. The second drawback is apparent when viewing recorded video. Since video management servers are typically

# Understanding Compression Technologies for HD and Megapixel Surveillance

configured to record the higher resolution stream from the camera, there is no lower resolution stream available to view over low bandwidth connections. Without a low resolution stream, the higher resolution stream must be sent at a reduced image rate if limited bandwidth is available.

Avigilon's HDSM technology offers a unique way of working with multiple streams of H.264 compressed video to overcome many of these trade-offs. When multi-streaming is enabled for H.264 video, HDSM will adaptively manage both a full resolution and a lower resolution stream to the NVR and viewing client. The lower resolution stream will be used for any overview streams where detail is not required, allowing efficient viewing of large numbers of H.264 compressed video streams simultaneously. When a single stream is zoomed in for more detail, that stream will be automatically sent in full resolution while other streams are kept in low resolution for an overview version of the image. This allows details to be viewed from one video stream while keeping the overall streaming bandwidth low. For example, with nine 2MP H.264 cameras and multi-streaming enabled, users can effectively generate 9 x 2MP of information for the full resolution streams and 9 x 0.3MP for lower resolution streams. When viewed on the client, the total 21MP of information is reduced to 4.4MP of information if one stream is viewed in detail and eight streams are viewed in low resolution.



Figure 7 – HDSM Benefits for Multiple High Resolution Cameras with H.264

Avigilon's HDSM also employs unique technologies to help minimize the demands placed on the client PC for decompressing H.264 video. When available, HDSM will make use of the advanced processing unit available on NVIDIA graphics cards to decompress H.264 video without using the resources of the main processor. This greatly improves the efficiency of decompression and can allow multiple streams of HD video at 30 image per second to be decompressed simultaneously without using resources from the main processor. HDSM also dynamically adapts the resolution and methods used in the decompression of H.264 video to reduce the demands on the client machine. A four step control of display quality is also available to enable the manual optimization of the viewing client. You can choose to bias video display for low resolution decompression at a higher frame rate, or full resolution decompression at a lower frame rate.

## Choosing the Right Compression Technology

Choosing the right camera for each point in a system is critical to a successful video surveillance system design. The first factor to consider will always be resolution. Available online tools that include pixels on target calculators are instrumental in helping select the most appropriate camera. Once resolution has been determined, it is important to select a compression technology suited to the application. Resolution, frame rate, activity level, and investigative needs will all influence the selection of compression technology. If the end-user's goal is to cover a larger scene by using a high resolution camera above 2MP, then a frame-by-frame compression technology like JPEG2000 may be the only effective option. As resolution increases, the benefits of JPEG2000 and HDSM increase. For scenes on a site that require large multi-megapixel IP cameras, JPEG2000 compression is required to manage the high resolution information effectively. For lower resolution, or smaller scenes of moderate activity with high frame rates, an inter-frame compression technology like H.264 can help minimize the required network bandwidth and storage.

## Compression Technology Selection by Application

<b>Application</b>	<b>Resolution</b>	<b>Image Rate</b>	<b>Compression Technology</b>
Parking Lot	16MP	3	JPEG2000
Cafeteria	5MP	7	JPEG2000
Lobby	3MP	7	JPEG2000
Doorway	2MP	15	H.264
Hallway	1MP	15	H.264
Casino	1MP	30	H.264

## A&E SPECIFICATIONS - CSI MASTERFORMAT 2004

<b>PRODUCT</b>	Avigilon Control Center (ACC) Network Video Management Software (NVMS) and NVR Hardware
<b>Division 28</b>	Electronic Safety and Security
<b>Level 1</b>	28 20 00 Electronic Surveillance
<b>Level 2</b>	28 23 00 Video Surveillance
<b>Level 3</b>	28 23 13 Video Surveillance Control and Management Systems

### PRODUCTS

#### 2GENERAL

A All systems and components shall have undergone a thoroughly documented quality assurance process by the manufacturer. The manufacturer's warranty, extended warranty and replacement policies shall be included for each specified component.

B The Network Video Management Software, NVR Hardware and related components shall be installed and commissioned by authorized integrators trained and certified by the manufacturer. Certification and training for authorized integrators shall be available from the manufacturer.

C The manufacturer shall have a dedicated professional services group providing Integrators and End Users the following fee-based services including but not limited to: training, installation, commissioning, remote diagnostics and integration with 3rd party software and hardware systems.

#### 2DESCRIPTION

A The Network Video Management Software (NVMS) shall be Avigilon Control Center (ACC) version 4.8 or later. The NVMS shall be available as a stand-alone software offering or pre-loaded on turn-key workstations and servers running Microsoft Windows with configurable storage.

B The Network Video Management Software (NVMS) shall be an enterprise level software solution that shall be scalable from one client, server, and camera to hundreds of clients, servers, and cameras.

C The Network Video Management Software (NVMS) shall consist of server software applications and client software applications.

D The Network Video Management Software (NVMS) shall include a gateway software application that connects mobile devices to the NVMS.

EThe Network Video Management Software (NVMS) shall be available in the following languages:

- English
- Finnish
- French
- German
- Italian
- Portuguese
- Spanish
- Swedish

FThe Network Video Management Software (NVMS) shall include the following applications:

- Server Software Applications
  - Control Center Server
  - Control Center Admin Tool
  - Control Center Gateway
- Client Software Applications
  - Control Center Client
  - Control Center Web Client
  - Control Center Player
  - Control Center Camera Installation Tool

GThe Network Video Management Software (NVMS) shall permit server and client software applications to be installed and run on both the same computer or on separate computers.

HThe Network Video Management Software (NVMS) shall support edge based storage and processing of video and audio.

IThe Network Video Management Software (NVMS) shall support High Definition Stream Management (HDSM) architecture which includes:

- Support for industry standard JPEG2000, MJPEG, MPEG-4, and H.264 compression formats
- Support for reducing the required client bandwidth and processing power by only transmitting what is necessary to view the video stream at full quality (e.g. if a user is viewing a 16MP camera in a 1MP window then a 1MP representation of the 16MP image shall be transmitted).

JThe Network Video Management Software (NVMS) shall support recording and management of video and audio sources including:

- Avigilon HD IP Cameras (1 – 5 Megapixel)
- Avigilon HD IP Dome Cameras (1 – 5 Mega pixels)
- Avigilon Panoramic HD IP Dome Cameras (8 Megapixel)

- Avigilon HD H.264 Day/Night IP Cameras (1– 2 Megapixel)
- Avigilon HD H.264 Day/Night IP Dome Cameras (1– 2 Megapixel)
- Avigilon HD PRO IP Cameras (2 – 16 Megapixel)
- Composite video from analog cameras, PTZ domes and thermal imagers via Avigilon ENC-4PORT and ENC-4P-H264 analog encoders
- Third-Party IP Devices
  - ACTi Cameras/Encoders
  - Arecont Cameras
  - Axis Cameras/Encoders
  - IQInVision Cameras
  - Mobotix Cameras
  - ONVIF 1.00, 1.02, and 2.00 Cameras
  - Panasonic Cameras
  - Pelco Cameras
  - Samsung Cameras
  - Sanyo Cameras
  - Sighthogix Cameras
  - Sony Cameras
  - VideoIQ Cameras

KThe Network Video Management Software (NVMS) shall support receiving digital input triggers and triggering digital outputs through an I/O board.

LThe Network Video Management Software (NVMS) shall support recording and monitoring video and audio streams from sources with bandwidth up to 90 Mbit/sec, frame rate up to 60 fps, and video resolution up to 16 MP (4872 x 3248).

MThe Network Video Management Software (NVMS) shall support the decompression of H.264 video through the client graphics card instead of using the client processing power.

NThe Network Video Management Software (NVMS) shall require no proprietary recording hardware, no hardware multiplexer or time-division technology for video and audio recording or monitoring.

OThe Network Video Management Software (NVMS) shall not limit the storage capacity and shall allow for upgrades of recording capacity.

PThe Network Video Management Software (NVMS) shall digitally sign recorded video and audio using 256-bit encryption so video can be authenticated for evidentiary purposes.

QThe Network Video Management Software (NVMS) shall securely transmit all command and control data via TCP/IP using cryptographic keys based on SSL to prevent eavesdropping or tampering.

RThe Network Video Management Software (NVMS) shall be installed on systems which meet or exceed the manufacturer's requirements found in this link:

<http://avigilon.com/support/req/>

SThe Network Video Management Software (NVMS) shall also be available in turn-key NVR platforms utilizing enterprise-grade servers and workstations pre-loaded with NVMS software and tested to manufacturer specifications for deployment in enterprise applications.

TThe Network Video Management Software (NVMS) shall be available in either a licensed Enterprise or Standard edition.

UThe Network Video Management Software (NVMS) shall support integration with the GE Security Facility Commander Wnx v7.x platform for Electronic Access Control and Alarm Monitoring (Access System).

- Network Video Management Software (NVMS) will provide the mechanism by which individual alarm(s) from the Access system can be pre-selected and configured to be monitored and, in turn, trigger event driven video operations

- The Network Video Management Software shall support software level integration (via the Wnx API) with GE Facility Commander for facilitating real-time response to monitored events processed by Wnx v7.x. Alarm events. The API integration should include:

- Bi-directional alarm event processing for monitoring and acknowledgement
- Receiving card access activity events
- Receiving digital input events
- Receiving intrusion zone events

- Occurrences for "Alarm" and "Reset" conditions for each of the pre-selected Access system alarms will be processed and managed from the NVMS system's Live View workspace that is reserved for displaying alarm notifications in the alarm list message pane or from the FCWnx alarm viewer. If the Alarm pane is hidden, the alarm can be acknowledged from the Camera display tile.

- Once an Access system initiated alarm occurrence is acknowledged from the NVMS system, it should be automatically acknowledged and processed in the Access System alarm monitor queue without further operator intervention.

VThe Network Video Management Software (NVMS) shall support integration with Lenel OnGuard.

WThe Network Video Management Software (NVMS) shall support integration with Cardax FT Command Center.

XThe Network Video Management Software (NVMS) shall support integration with RS2.

YThe Network Video Management Software (NVMS) shall support integration with

DSX.

ZThe Network Video Management Software (NVMS) shall support integration with Jacques VoIP Voice Communication System.

AThe Network Video Management Software (NVMS) shall support integration with Stentofon AlphaCom XE.

AThe Network Video Management Software (NVMS) shall support integration with DDS Amadeus.

AThe Network Video Management Software (NVMS) shall support integration with Software House CCure 9000.

AThe Network Video Management Software (NVMS) shall be capable of being upgraded from one version to another without having to uninstall the previous version.

AThe Network Video Management Software (NVMS) shall be capable of being upgraded from Standard edition to Enterprise edition without having to uninstall the application.

AThe Network Video Management Software (NVMS) shall automatically detect if video or audio source firmware is out of date with respect to the current installed software and upgrade it.

AThe Network Video Management Software (NVMS) shall automatically detect if client application software is out of date with respect to the current installed server software and upgrade it.

AThe Network Video Management Software (NVMS) shall run as a service configured to automatically start when the server or workstation is powered on and automatically recover from failure or attempted tampering.

AThe Network Video Management Software (NVMS) shall allow system administration, and live and recorded video and audio monitoring all from a single client application that can be located anywhere on the network.

AThe Network Video Management Software (NVMS) shall automatically discover all Control Center Server instances running on computers connected to the same network as the Control Center Client.

AThe Network Video Management Software (NVMS) shall provide a search functionality to discover Control Center Server instances running on computers connected on a different network segment than the Control Center Client by using IP addresses or hostnames.

AThe Network Video Management Software (NVMS) shall automatically discover video and audio sources that are connected to the same network as the Control Center Server.

AThe Network Video Management Software (NVMS) shall provide a search functionality to discover video and audio sources that are connected on a different

network segment than the Control Center Server.

AThe Network Video Management Software (NVMS) shall provide the ability to connect a video or audio source to multiple NVRs to achieve redundant recording.

AThe Network Video Management Software (NVMS) shall provide the ability to create a failover connection for a video or audio source. If the NVR that the video or audio source is connected to goes offline then the failover NVR will take over the connection.

AThe Network Video Management Software (NVMS) shall provide administration of all system connections from a single window.

AThe Network Video Management Software (NVMS) shall support receiving Simple Network Management Protocol (SNMP) messages from servers and alert the user.

AThe Network Video Management Software (NVMS) shall detect if the video or audio signal is lost and alert the system administrator.

AThe Network Video Management Software (NVMS) shall provide the capability to rename all video and audio sources and NVRs.

AThe Network Video Management Software (NVMS) shall record video and audio streams based on a recording schedule that can be defined individually for each video source. The schedule shall be created with the following parameters:

- Recording Mode
  - Continuous
  - Motion
  - Digital Inputs
  - Alarms
  - POS Transactions
  - License Plates
- Time and Date Settings
  - Daily
  - Weekly

AThe Network Video Management Software (NVMS) shall provide the ability to manually trigger recording.

AThe Network Video Management Software (NVMS) shall provide a pre-event and post-event recording option.

AThe Network Video Management Software (NVMS) shall provide a reference frame recording option in the absence of events.

AThe Network Video Management Software (NVMS) shall perform motion detection on each individual video source with adjustable sensitivity, threshold and detection zones.

AThe Network Video Management Software (NVMS) shall provide the ability to

reduce the image rate of recorded video over time as a means of increasing record time. The image rate shall be able to be reduced to one half or one quarter of the original image rate. This setting can be configured separately for each video source.

AThe Network Video Management Software (NVMS) shall provide the ability to set a maximum recorded video retention time for each video source.

BThe Network Video Management Software (NVMS) shall perform dynamic bandwidth management to ensure that the total bandwidth does not overload the system.

BThe Network Video Management Software (NVMS) shall authenticate users before granting access to the system. Access rights for each user can be defined individually for each user, and shall include:

- Viewing live images
  - Using PTZ controls
  - Locking PTZ controls
  - Trigger manual recording
  - Trigger digital outputs
  - Listen to microphones
  - Broadcast to speakers
- Viewing recorded images
  - Exporting images
  - Backup recorded images
- Manage user sessions
- Connect and disconnect cameras
- Setup cameras
  - Setup general settings
  - Setup network settings
  - Setup image and display settings
  - Setup compression and image rate
  - Setup image dimension settings
  - Setup motion detection settings
  - Setup privacy zone settings
  - Setup manual recording settings
  - Setup digital input & output settings
  - Setup microphone settings
  - Setup speaker settings
- Setup servers
  - Setup general settings
  - Setup schedule settings

- Setup recording and bandwidth settings
- Setup user and group settings
- Setup alarm management settings
- Setup scheduled backup settings
- Setup POS transaction settings
- Setup email settings
- Setup rule engine settings
- View system log

- Access to individual video and audio sources

BThe Network Video Management Software (NVMS) shall provide the ability to import members of Active Directory groups as users in the NVMS. Changes made to members in the Active Directory are automatically synced with the NVMS.

BThe Network Video Management Software (NVMS) shall optionally support using Windows credentials to authenticate users.

BThe Network Video Management Software (NVMS) shall provide the ability to create and schedule alarms.

BThe Network Video Management Software (NVMS) shall provide the ability to schedule backups of recorded video with associated events to a local folder or mapped network drive.

BThe Network Video Management Software (NVMS) shall provide the ability to email users and system administrators when an event or system health error occurs.

BThe Network Video Management Software (NVMS) shall provide the ability to schedule when email notifications are sent.

BThe Network Video Management Software (NVMS) shall provide the ability to include camera images in email notifications.

BThe Network Video Management Software (NVMS) shall maintain an event log for the following events:

- Server Events
  - Server application starting up
  - Server application shutting down
  - Server application terminated unexpectedly
  - Server application low on resources
  - Server application installation error
  - Licensed feature expires soon
  - Licensed feature expired
  - Database error
  - Data initialization error
  - Data volume failed

- Data volume recovered
- Data volume size reduced
- Data write error
- Data upgrade started
- Data upgrade completed
- Data upgrade failed
- Data recovery started
- Data recovery completed
- Data recovery failed
- Network connection found
- Network connection lost
- Network error
- Network error resolved
- Email send error
- Server hardware error
- Backup started
- Backup completed
- Backup failed

- Device Events

- Connection created
- Connection removed
- Connection created to standby server
- Connection removed from standby server
- Connection failure
- Connection restored
- Network packet loss unacceptable
- Network packet loss acceptable
- Motion detection started
- Motion detection ended
- Recording started
- Recording ended
- Recording interrupted
- Recording resumed
- Digital input activated
- Digital input deactivated
- Firmware upgrade started
- Firmware upgrade completed

- Firmware upgrade failed
- User Events
  - User login
  - User logout
  - Server setting changed
  - Device setting changed
  - Device connected
  - Device disconnected
  - Digital output triggered
  - Bookmark added
  - Bookmark updated
  - Bookmark deleted
  - PTZ moved
  - PTZ idle
  - Export performed
  - Speaker activated
  - Speaker deactivated
- Alarm Events
  - Alarm acknowledged
  - Alarm auto acknowledged
  - Alarm triggered
  - Alarm assigned
  - Alarm unassigned
  - Alarm purged
- POS Transaction Events
  - POS transaction started
  - POS transaction ended
  - POS transaction exception
- License Plate Recognition Events
  - License plate detection started
  - License plate detection ended
  - License plate watchlist match

The Network Video Management Software (NVMS) shall have the capability to schedule and execute any of the following actions in response to any of the events listed above:

- User Notification Actions
  - Display on-screen message
  - Send an email

- Play a sound
- Monitoring Actions
  - Start live streaming video
- Device Actions
  - Reboot camera
  - Trigger digital output
- PTZ Actions
  - Go to Preset
  - Run a Pattern
  - Set Auxiliary
  - Clear Auxiliary
- Alarm actions
  - Trigger an alarm
  - Acknowledge an alarm

BThe Network Video Management Software (NVMS) shall provide the ability to create customized on-screen messages and email notifications.

BThe Network Video Management Software (NVMS) shall provide a maintenance log and audit trail of all system errors and events.

BThe Network Video Management Software (NVMS) shall provide the ability to receive transaction information from point-of-sale sources.

BThe Network Video Management Software (NVMS) shall support multiple encoding formats from point-of-sale sources.

BThe Network Video Management Software (NVMS) shall provide the ability to monitor live and recorded transactions from point-of-sale sources with linked video.

BThe Network Video Management Software (NVMS) shall provide the ability to generate events based on point-of-sale transaction exceptions.

BThe Network Video Management Software (NVMS) shall provide the ability to define a region of an image where license plate detection is performed. Detected license plates shall be stored along with the video data.

BThe Network Video Management Software (NVMS) shall provide the ability to create a watchlist that will be used to create events when any license plate on the watchlist is detected in the images being analyzed.

BThe Network Video Management Software (NVMS) shall provide the ability to enable and configure PTZ control on the RS-485 interface of a video source.

BThe Network Video Management Software (NVMS) shall support the following list of PTZ camera protocols:

- American Dynamics Sensormatic
- AXSYS

- AXSYS DCU
- Ernitec ERNA
- Honeywell Diamond
- Kalatel ASCII
- Pelco D
- Pelco P
- TEB Ligne
- Vicon extended
- Vicon normal
- Videotec Legacy
- Videotec MACRO

BThe Network Video Management Software (NVMS) shall provide the ability to change the network settings for a video and audio source.

BThe Network Video Management Software (NVMS) shall provide the ability to change image quality and image rate parameters for a video source without affecting the settings on the other video sources.

BThe Network Video Management Software (NVMS) shall provide the ability to enable a secondary stream for live viewing.

BThe Network Video Management Software (NVMS) shall provide the ability to change the exposure, iris, IR filter, backlight compensation, gain, priority, sharpening, saturation, focus, and white balance settings for a video source.

BThe Network Video Management Software (NVMS) shall provide the ability to change the image dimensions for a video source.

CThe Network Video Management Software (NVMS) shall provide the ability to rotate the image 90°, 180° or 270° for a video source.

CThe Network Video Management Software (NVMS) shall provide the ability to add privacy zones to a video source to block unwanted areas in the image field of view.

CThe Network Video Management Software (NVMS) shall provide the ability to set a maximum recording duration for manually triggered recording for a video source.

CThe Network Video Management Software (NVMS) shall provide the ability to change the input, output, gain and volume for an audio source.

CThe Network Video Management Software (NVMS) shall provide for full-duplex two-way audio communication.

CThe Network Video Management Software (NVMS) shall provide the ability to link any audio source to any video source.

CThe Network Video Management Software (NVMS) shall provide the ability to set a limit on the maximum bandwidth transmitted to the Control Center Client application from the Control Center Server application.

CThe Network Video Management Software (NVMS) shall provide the ability to automatically log in to an NVR.

CThe Network Video Management Software (NVMS) shall provide the ability to override user access to an NVR if there are insufficient licenses.

CThe Network Video Management Software (NVMS) shall provide the ability to automatically log out of an NVR when the application is left idle.

CThe Network Video Management Software (NVMS) shall provide the ability to save and restore the window layout.

CThe Network Video Management Software (NVMS) shall provide the ability to control the system using a PC keyboard or joystick.

CThe Network Video Management Software (NVMS) shall provide the ability to import and export client settings such as maps, views, and web pages.

CThe Network Video Management Software (NVMS) shall support live or recorded video monitoring of 1 to 36 video streams simultaneously on a single monitor with the following standard layouts:

- Full Screen
- 2 x 2
- 3 x 3
- 4 x 4
- 5 x 5
- 6 x 6
- 1 + 5
- 1 + 7
- 1 + 12
- 2 + 8

CThe Network Video Management Software (NVMS) shall support live or recorded video monitoring in a customizable video display beyond the standard layouts.

CThe Network Video Management Software (NVMS) shall support the ability to bias the displayed video to a higher frame rate or to a lower image resolution if the client network bandwidth or client processing power is insufficient to display the full frame rate and image resolution.

CThe Network Video Management Software (NVMS) shall support the ability to display the following list of image overlays:

- Camera Name
- Camera Location
- Timestamp
- Record Indicator
- PTZ Controls
- Motion Activity

- License Plate

CThe Network Video Management Software (NVMS) shall support an unlimited number of monitors for monitoring video and audio streams.

CThe Network Video Management Software (NVMS) shall support monitoring live and recorded video and audio streams simultaneously on the same monitor.

CThe Network Video Management Software (NVMS) shall support viewing the same live or recorded video stream at different zoom levels.

CThe Network Video Management Software (NVMS) shall support the ability to switch from live to recorded video on demand for an instant replay of recently recorded video.

CThe Network Video Management Software (NVMS) shall support the creation of unlimited views with unique layouts of video streams.

CThe Network Video Management Software (NVMS) shall support the ability to full-screen a view.

CThe Network Video Management Software (NVMS) shall support the ability to save views.

CThe Network Video Management Software (NVMS) shall support the ability to cycle through views (guard tour) based on a specified interval.

CThe Network Video Management Software (NVMS) shall display all video sources connected to the system.

DThe Network Video Management Software (NVMS) shall support the ability to drag and drop a video source from a tree of video sources into a window for live or recorded video and audio monitoring.

DThe Network Video Management Software (NVMS) shall support the ability to drag and drop a view from a tree of views into a window for live or recorded video and audio monitoring.

DThe Network Video Management Software (NVMS) shall support the ability to configure how the tree of video sources and views is displayed.

DThe Network Video Management Software (NVMS) shall support the ability to designate one or more regions in a window for displaying video directly linked to triggered alarms and rules.

DThe Network Video Management Software (NVMS) shall support the ability to acknowledge alarms from the designated video display area.

DThe Network Video Management Software (NVMS) shall support the ability to manually trigger digital output.

DThe Network Video Management Software (NVMS) shall support the ability to create a map that represents the physical location of cameras and other devices throughout the surveillance system. Maps shall be created from images stored in

JPEG, BMP, PNG, or GIF image formats. Maps shall have the ability to contain links so as to create a hierarchy of interlinked maps.

DThe Network Video Management Software (NVMS) shall support the ability to create a map that has a link to a section of the entire image region.

DThe Network Video Management Software (NVMS) shall support the ability to drag and drop a video source from a map into a window for live or recorded video and audio monitoring.

DThe Network Video Management Software (NVMS) shall highlight a camera on a map when an alarm linked to the camera is triggered.

DThe Network Video Management Software (NVMS) shall highlight a linked map that contains a camera when an alarm linked to the camera is triggered.

DThe Network Video Management Software (NVMS) shall support the ability to save a link to a web page and view the web page in a window.

DThe Network Video Management Software (NVMS) shall support digital zooming and panning on live and recorded video streams.

DThe Network Video Management Software (NVMS) shall support controlling mechanical pan-tilt-zoom, iris, and focus as well as setting presets and patterns.

DThe Network Video Management Software (NVMS) shall provide the ability to name pan-tilt-zoom presets.

DThe Network Video Management Software (NVMS) shall support controlling mechanical pan-tilt-zoom camera on-screen display and auxiliary controls.

DThe Network Video Management Software (NVMS) shall support locking PTZ controls.

DThe Network Video Management Software (NVMS) shall support control of a mechanical pan-tilt-zoom camera with a USB joystick.

DThe Network Video Management Software (NVMS) shall support forward and reverse playback of recorded video and audio at variable speeds.

DThe Network Video Management Software (NVMS) shall synchronously playback recorded video and audio from selected video sources.

DThe Network Video Management Software (NVMS) shall support navigation of recorded video and audio via calendar, timeline, or events.

DThe Network Video Management Software (NVMS) shall support a timeline that displays all connected video sources and the corresponding motion and recording events.

DThe Network Video Management Software (NVMS) shall support a timeline that can display the entire time range down to one second of recorded video and audio.

DThe Network Video Management Software (NVMS) shall support creating bookmarks for recorded video and audio from multiple sources, displaying the

bookmarks on the timeline, and searching for bookmarks.

DThe Network Video Management Software (NVMS) shall support protecting a bookmark so the video and audio data is never overwritten.

DThe Network Video Management Software (NVMS) shall support monitoring alarms.

EThe Network Video Management Software (NVMS) shall support the ability to assign alarms to users.

EThe Network Video Management Software (NVMS) shall support the ability to acknowledge alarms.

EThe Network Video Management Software (NVMS) shall support the ability to bookmark alarms.

EThe Network Video Management Software (NVMS) shall support searching through bookmarks based on various search criteria including bookmark name, notes, and linked camera names.

EThe Network Video Management Software (NVMS) shall support searching through recorded video and audio based on various search criteria including time, date, video source, and events.

EThe Network Video Management Software (NVMS) shall support searching through recorded video based on motion in user defined areas (pixel search).

EThe Network Video Management Software (NVMS) shall support searching through recorded video based on time, date, video source, and image region and have the results displayed as a series of thumbnail images.

EThe Network Video Management Software (NVMS) shall support searching through recorded video based on alarm events.

EThe Network Video Management Software (NVMS) shall support searching through recorded video based on point-of-sale transaction events.

EThe Network Video Management Software (NVMS) shall support searching through recorded video based on license plates detected in the images of the video source.

EThe Network Video Management Software (NVMS) shall support the ability to export recorded video in the following formats:

- Native
- JPEG
- PNG
- TIFF
- AVI
- WAV
- PDF
- Print

EThe Network Video Management Software (NVMS) shall support the ability to export

recorded audio in WAV format.

EThe Network Video Management Software (NVMS) shall support the ability to take a snapshot of a live or recorded image and export it from the system.

EThe Network Video Management Software (NVMS) shall support the ability to export a live stream of images in the following formats:

- JPEG
- PNG
- TIFF

EThe Network Video Management Software (NVMS) shall support the ability to export video from multiple camera streams in Native format.

EThe Network Video Management Software (NVMS) shall support reviewing video and audio that was exported in the Native format.

EThe Network Video Management Software (NVMS) shall provide the camera properties and time zone for video exported in Native format.

EThe Network Video Management Software (NVMS) shall support authenticating video that was exported in the Native format to validate that it was not tampered with.

EThe Network Video Management Software (NVMS) shall support converting video that was exported in the Native format to an industry standard format.

EThe Network Video Management Software (NVMS) shall support reviewing video and audio stored in a backup.