



White Paper

Networked Video Surveillance System

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The internet and wireless broadband infrastructure is becoming robust enough to permit excellent remote video surveillance. Stage is set for evolution of the next generation of video surveillance system in the form of Networked Video Surveillance System (NVSS). The ability to remotely monitor facilities and business operations at any time and from any location would not only give enhanced ability to improve security, but will also allow businesses go beyond security to improving productivity, customer satisfaction and regulatory compliance of the business. With advances in hardware and software technology and the emergence of ubiquitous internet infrastructure and wireless networks with broadband capability, it is now possible to design and build a networked video surveillance system that can do an excellent job of remote video supervision from any where and at any time. The requirements of a networked video surveillance system differ in important ways from CCTV, DVRs and NVRs. This white paper presents essential requirements of NVSS and discusses why they are

needed in realizing full potential of networked video surveillance system.

Market evolving from CCTV, DVRs and NVRs to NVSS

Digital Video Recorders (DVRs) were a great improvement over the tape based video recorders for video surveillance. Standard DVRs use same analog video signal but record the video on digital hard drive. The incoming analog video signal from cameras is captured, digitized and compressed by electronics in the DVR and both audio and video is stored on hard drive for playback at a later time.

NVRs connect to IP cameras or streamers over a LAN or a WAN and record video as data streams. For the purpose of live viewing, the compressed streams received at the NVR need to be uncompressed and re-assembled as per viewer request. Hybrid DVRs accept input for both analog and IP based digital cameras.

DVRs, NVRs and Hybrid DVRs, all have their roots in the traditional video surveillance. These systems are primarily focused on meeting needs of security. IP cameras and NVRs make use of the connectivity and wiring techniques developed for LANs and WANs

using the Ethernet protocol and use IP protocol for data transport. Use of the system as networked video surveillance system has been an after thought in these solutions. These devices were designed primarily as recording devices and were not designed to take advantage of IP network infrastructure and as such are limited in terms of remote live preview, replay and remote administration and management of the system.

NVSS is a natural next step for video surveillance. At the heart of an NVSS is IP network and the Internet. Performance and use over internet possess challenges and to build a highly effective system the NVSS systems need to be engineered from the ground up considering the strengths and challenges of the Internet.

As the industry embarks on this next generation of video surveillance solutions using NVSS, there are many key requirements that must be met to have a useful and effective system. A list of these is as follows:

1. Secure Access.
2. Satisfactory remote viewing experience of live audio video streams in spite of Internet bandwidth variations.
3. Location independent access to all features and functions remotely or

locally.

4. Support for mobile devices.
5. Configurable local storage and Network Attached Storage (NAS).
6. Local and remote archiving.
7. Dynamic DNS to allow use of dynamic IP addresses.
8. Variety of user classes to allow management of access authority.
9. Real time alerts through email and SMS.
10. Integration with other IT and security applications.
11. 24x7 availability as surveillance moves into a mission critical role.
12. Intelligence-at-the-edge and event driven Surveillance.

Secure Access: Surveillance, both audio and video from business locations such as factories, franchises or warehouses need to be transported over the network for remote supervision. These video streams should not be viewable by any one not authorized to do so. The streams must be encrypted and utilize virtual private network to ensure completely secure access.

Remote Viewing: For the purpose of remote supervision, authorized individuals need to view the video over the internet from any location worldwide. At any given moment the actual available bandwidth is unpredictable and can change at any moment. NVSS needs to continuously estimate the available bandwidth and adapt the compression parameters to facilitate smooth motion video viewing experience. In addition to adjusting compression rates to the instantaneous bandwidth of the internet, audio and video needs to be kept in synch for a richer viewing experience.

Location Independence: Authorized personnel need to be able to configure, change settings, view live video,

analyze stored video and access all the features and functions from anywhere through Internet. This requires full functional portable client that supports both locally, on LAN or on the internet.

Mobile Device Support: Mobile phones and PDAs are ubiquitous and are more easily accessible compared to computers. NVSS must send alerts as SMS or email messages to portable devices so as to enable prompt action, if needed.

Network Attached Storage: Most current solutions require that the video be stored locally to the DVR or NVR. There have been many cases where the system has been stolen along with the local storage. There is also a requirement for adding storage beyond the capacity provided locally. Network attached storage enables the NVSS to extend storage capabilities of the system, allows it to be located away from the system and provide RAID capabilities for added availability.

Archiving: Mission Critical Video data needs to be archived on demand or automatically, locally or away from the surveillance system for later use or for audit purposes. NVSS must enable users to archive either locally or remotely and also allow for automatic continuous archival.

Dynamic DNS: Most current systems require that the IP address of the DVR or the NVR be a static fixed IP. This adds additional recurring cost and may make the cost prohibitive specifically when the video surveillance network is made of many nodes. NVSS must support dynamic DNS capabilities so dynamic IP address can be used for each NVSS node.

User Classes: Businesses require that only the authorized individuals perform control and management of the

surveillance systems. Certain cameras should be restricted to specific personnel. NVSS must implement comprehensive user classes and authorization mechanisms to facilitate such control.

Alerts: NVSS are required to generate timely alerts based on detected video events or combination of related events from related applications from one or more locations. These alerts are to be transmitted as e-mail or SMS messages to appropriate personnel or invoke other actions as desired, such as sounding an alarm, close a gate or convert motion based recording cameras to continuous recording.

Robustness and Availability: Since the video surveillance is moving into a mission critical role and access may be required from locations spread out all over the world, it is necessary that the NVSS be available 24x7. Redundant systems can be deployed at the same location. In addition, NVSS must support intelligent UPS which communicates with the NVSS and can facilitate appropriate action, such as graceful shutdown or sending necessary alerts, in case of unexpected power outages.

Integration with other security and operational applications: One of the critical requirements of NVSS is to work well with other related solutions as seamlessly as possible. Most businesses have access control solutions that track entry and exits to secured areas. It is a natural requirement that the surveillance audio and video be effectively accessible and synchronized with the events associated with these systems. There are systems for building management that include fire and hazardous material safety. These systems need to be appropriately integrated with the NVSS. In addition, many establishments have

point of transaction systems, where it is required that the audio and video of a transaction be available when needed. This video would enable verification of a disputed transaction or coaching opportunity for improving customer service.

Professionals can best perform with such integration with a large variety of applications with domain expertise in each vertical. It is required that an open Application Programming Interface (API) be made accessible for domain experts to effect such integration to address the needs of corresponding vertical markets. NVSS platform should offer such a programming and integration interface with necessary support.

Intelligence-at-the-edge and Event Driven Surveillance: The market requires that detection of relevant events be available for a broad set of video surveillance solutions. Businesses need the surveillance process to be driven by interesting events. Video Content Analysis (VCA) needs to be deployable ubiquitously and scheduled on demand. For NVSS, it means that any of the cameras could be directed to ‘look’ for a particular event and send a real time alert if so desired, or tag the video in a way that it can be retrieved efficiently. Potentially interesting events in surveillance video can be classified in 3 categories:

- **People Video Analytics:** Counting people, intrusion, cashier absent from station, wrong way movement, face capture when in view, falling and running etc.
- **Vehicle Video Analytics:** License plate reading, stopped car, wrong way, speeding, model and make etc.

- **Object Video Analytics:** Unattended object, removed object, object moved etc.

Many of these kinds of events are of interest beyond security. It is required that these relevant events are detected and the video be appropriately tagged so as to facilitate efficient forensic analysis. Also, many of the video surveillance solutions today store all the video captured for later forensic review.

For effective use of Video Content Analysis (VCA) the quality and capability of video content analysis needs to be improved to minimize false alarms and at the same time not miss on detecting relevant events. To do so, one needs good quality video that is available at the source of the video namely the camera. This suggests that the intelligence processing needs to move closer to the edge of the network.

Conclusion

Networked Video Surveillance Systems will play an important role in the deployment of next generation of video surveillance systems. Networked Video Surveillance Systems of the kind that are needed to take full advantage of internet and wireless infrastructure must attend to a number of new requirements that are very different to the type of capabilities of earlier DVR and NVR systems. All individual technical pieces required for building next generation of NVSS are in place. Market demand is strong and will get even stronger. We can expect next generation of video surveillance systems in the form of NVSS, that implement some or most of the capabilities to become available in the market in the near future. ■