SourceSecurity.com®

Technology Report

IP in a Box: The Advantages of Embedded Network Video Recorders

About the author

An experienced journalist and long-time presence in the U.S. technology marketplace, Larry Anderson is the Editor of leading digital publication SourceSecurity.com. Mr. Anderson is the website's eyes and ears in the fast-changing security sector, attending industry and corporate events, interviewing leaders and contributing original editorial content to SourceSecurity.com. He leads a team of dedicated editorial and content professionals, guiding the editorial roadmap to ensure that SourceSecurity.com and SourceSecurity.com US Edition provide the most relevant content for industry professionals. From 1996 to 2008, Mr. Anderson was editor of *Access Control & Security Systems* magazine and its affiliated websites. He has written many articles for and about some of the largest companies in the security industry and has received numerous awards for editorial excellence. He earned a Bachelor of Arts in Journalism from Georgia State University with a minor in Marketing.

Technology at a Glance

Hikvision commissioned SourceSecurity.com to produce this document.

IP in a Box: The Advantages of Embedded Network Video Recorders

Video surveillance has historically been largely a hardware market – cameras connecting to recorders, enabling viewing of live or recorded footage on monitors. Back in the analog era, recording equipment (i.e., video cassette recorders [VCRs] and later digital video recorders [DVRs]) set the standard in terms of system performance, and also provided the benefits of plug-and-play installation and appliance-like functionality that was simple, predictable and robust.

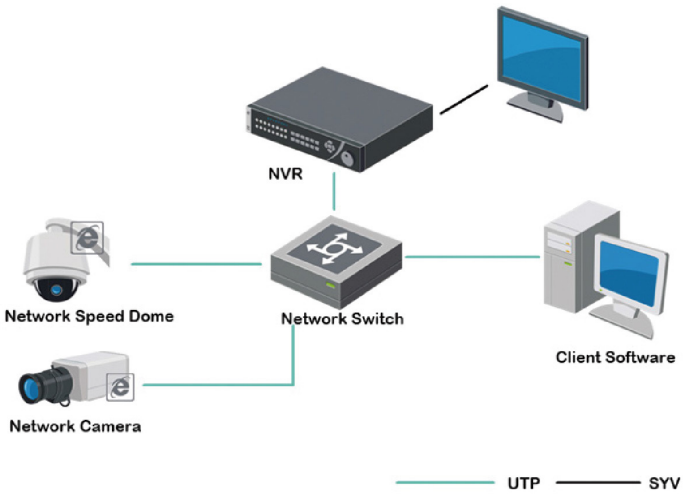
Embedded network video recorders (NVRs) provide many of the same advantages in the era of Internet protocol (IP) video systems. Embedded NVRs are central components in new, simplified end-to-end IP video solutions. These appliances are the successors to the analog era's DVRs, except they connect to IP cameras. They are simple "boxes" with embedded software to which IP video cameras can be connected and automatically configured. It's a simple solution for an industry that was built on simple hardware solutions; it also offers the benefits of IP video, but with no complex integration or configuration required.

This **SourceSecurity.com Technology Report** will take a closer look at the advantages of embedded network video recorders, and their role in creating modern, simplified solutions that provide all the benefits of IP video with less of the downside. Specifically, the report will highlight embedded NVRs by Hikvision, a leading manufacturer of video equipment worldwide.

Some applications – arguably, the majority of applications – are perfectly suited to pre-configured plug-and-play systems with an embedded NVR at the center.

Achieving Robustness in the Software Era

Since the advent of IP video, software has been a driving force in the market for IP video surveillance. Often running on off-the-shelf personal computers (PCs) and servers, software has expanded end users' abilities to control IP video camera views and to record and review footage. The rise of software in what was traditionally a hardware-based market has been remarkable.



Network topology incorporating an embedded NVR.

Achieving robustness in the software era has come with some challenges, including repeated software updates, cybersecurity vulnerabilities, the need to accommodate changes in camera hardware, and so forth. The cameras used in a system must be integrated with software, and their performance depends on the "depth" of that integration. Many argue that combining "best of breed" solutions ensures a better system – but at what cost? And, in many cases, to what end?

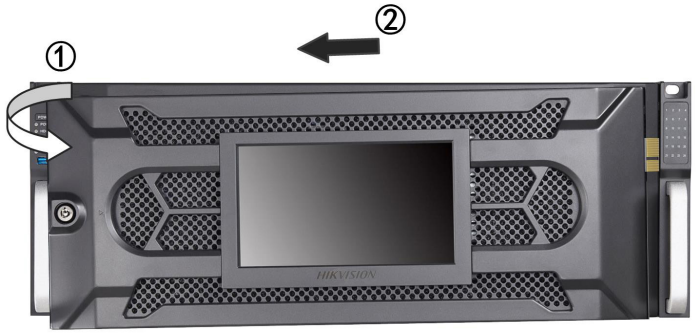
A benefit of the maturing of IP video has been a much more stable environment. Technology development, including software updates, has slowed down, and even less expensive systems offer immense capabilities. The fact is: Not every application requires a "best of breed" solution. Some applications – arguably, the majority of applications – are perfectly suited to pre-configured plug-and-play systems with an embedded NVR at the center. A benefit of the maturing IP video market is development of these simple, predictable and robust systems that can address 90 percent or more of applications.

In short, IP video systems are becoming more like analog systems – plug-and-play, equipment-centric, preconfigured. And they are again hardware solutions that work right out of the box.

Advantages of Embedded NVRs

Let's examine some of the advantages of embedded NVRs as compared to the alternative approach of software installed on an off-the-shelf computer.

- **Stable Linux architecture.** Linux architecture, used by embedded NVRs, is more stable and less likely to crash than a Windows-based system, thus ensuring more dependable operation. As an operating system, Linux is also more flexible, adaptable, and offers broader interoperability than Windows.
- **Simplified installation.** Embedded NVRs come preconfigured out of the box so that connection to cameras and other devices is simpler and more straightforward. There is no software to load onto a PC, no complex configuration or extraneous variables to address. Cameras simply plug into the NVR, and everything works. Power over Ethernet (PoE) provides the camera power supply. Hard disk installations are also simpler. For some embedded NVRs, users only need to open the front panel and insert hard disks. There is no need for a screwdriver.



NVRs make hard disk installation simpler – and no tools needed.

- **"One-Box" design.** Designed as an appliance that incorporates both hardware and software as a single entity, an NVR eliminates the need to deal with software and hardware as separate components. There are no challenges such as compatibility, software updates, or mismatched product versions. All the components are included in a single box.
- **More compact.** Designing a purpose-built appliance allows elimination of any elements that are extraneous to the task at hand. The result is a simplified design, likely to take up less space. Careful product design also promotes aesthetics and optimizes how components fit together. Although a high-end 256-channel NVR would be larger, there are some NVRs that are very compact in size, reflecting thoughtful, streamlined design.

Embedded NVRs come preconfigured out of the box so that connection to cameras and other devices is simpler and more straightforward.

NVRs are designed and targeted to video as the only task they seek to accomplish.

Dependability That End Users Require

Products must be designed to meet end users' needs, and at the top of the list for most customers is dependability. Systems that run dependably without interruption provide cost savings for customers by avoiding downtime and the need for additional technical service. No customer should miss capturing video because of a failure of equipment. In fact, many end user companies and institutions depend on video surveillance systems as critical to their company's security. Dependability is paramount in any video system. Here are some factors that make embedded NVRs more dependable:

- **Mature product, tested in the video environment.** Development of NVRs with embedded software is not news – the devices have been around for a decade or more. During that time, they have gotten better and better, benefitting from multiple product design iterations, and new technology developments in component areas such as computer chips. They have also been used successfully in thousands of applications in a variety of video environments.
- **Long lifespan for hard disks.** NVRs use hard disks, which have demonstrated their long lifespan in a variety of environments. Embedded NVRs operate 24/7 using surveillance-level hard disks for longer lifespan.
- **Product reliability.** NVRs are reliable system components, boosted by features such as dual power supplies and redundant design (dual operating systems). They can reliably store and retrieve thousands of hours of video in any IP-based system. Hikvision's embedded NVRs also support hard disk drive (HDD) pre-allocation functionality to improve the efficiency of hard disks, correcting file fragmentation, and resulting in longer HDD drive. The HDD's data protection patent ensures no data loss even with frequent device power-offs. A specialized file system ensures data safety – hard disks can only be read on Hikvision devices.

Equipment Dedicated to the Job at Hand

Any product that is designed for a specific task is logically more adept at that task than a more general-purpose product. It is unlikely a product designed to do several tasks can perform any one of them as well as a competing product that focuses just on a single task. Such is the logic of embedded NVRs. Computers and servers are built to do hundreds of tasks; loading video software merely adapts them to the video market. In contrast, NVRs are designed and targeted to video as the only task they seek to accomplish. Design decisions considered along the way are all focused on maximizing one aspect – the storage and retrieval of video. Here are some other ways that NVRs demonstrate the advantages of specialization:

- **No extraneous elements.** Components and other elements that are not focused on video – extra technology baggage, if you will – add to costs but not to suitability for the specific task of managing video. Such is not the case with embedded NVRs.
- **Separate from the PC -- less distraction for operators.** Personal computers are everywhere in our daily lives, so many people are adept at working with computers – or think they are. The familiarity of the PC format makes it a tempting target for anyone who considers himself or herself a computer geek. An operator could also be tempted by other elements available on a PC, whether it's a social media or news site, or even YouTube. These elements are not available on an NVR as a possible distraction.

Choosing the Right Embedded NVR Product

As the world's leading supplier of video surveillance solutions, Hikvision offers a range of video products in every category – including embedded NVRs. Hikvision's large research and development workforce drives product development and ensures the quality, dependability and functionality of the company's embedded NVRs. But how can a customer choose?

The decoding capability of an NVR is a key factor in selecting the right product for an application. Decoding capability determines how many channels of high-resolution video the NVR can support and record – i.e., how many cameras. Other variables in choosing an NVR are storage capability and feature set. Feature set options include 4K (ultra-high resolution) output, high-resolution camera input, RAID [random array of independent disks] storage, hot-spare capability, redundant design (dual operating systems), and support of H.265+ video compression. Hot spare capability provides a failover mechanism and immediate standby functionality. In the case of a group of NVRs, if one unit fails, a backup can be used to provide reliability in system configuration.

Hikvision's H.265+ compression helps end users get the most value from an embedded NVR by reducing the bit rate for less bandwidth usage. More cameras can be connected, and the storage period can be expanded. End users save on storage costs.

H.265+ improves the compression ratio based on three key technologies. One is prediction encoding technology (inter-frame and intra-frame) based on the background model. Another is background noise suppression technology: an intelligent analysis algorithm can distinguish between the background image and moving objects. Finally, long-term bitrate control allows more bitrate to be assigned to busy hours while reducing bitrate in idle hours.

Here is a sampling of Hikvision's range of embedded NVR products:

- **Entry Level.** An entry-level embedded NVR typically supports 4, 8 or 16 channels and provides 1 to 2 HDDs of storage. An example is Hikvision's DS-7616NI-E2/8P, a Plug & Play embedded NVR supporting up to 2 SATA interfaces and video output at up to 1080P resolution. Versions offer 8 or 16 channels.
- **Middle Range.** Offering up to 32 channels, a middle-range NVR would typically support 1 to 4 HDDs. An example is Hikvision's DS-7732NI-E4/16P plug & play embedded NVR, supporting up to 4 SATA interfaces, with video output at up to 1080p resolution. Another example is DS-7732NI-K4/16P, a 32-channel embedded 4K NVR with 256 Mbps incoming bandwidth that supports H.265 codec and 4 HDDs, each offering 6 terabytes of capacity. (A 16-channel version supports up to 8-megapixel resolution using 160 Mbps incoming bandwidth.)
- **High-End.** A high-end embedded NVR typically supports up to 256 channels, using 16 or 24 HDDs to provide adequate storage. For example, the DS-96256NI-I24/H New Super 4K NVR supports 256 channels, H.265+ codec, RAID, dual power supply, an optional LCD screen, up to 24 HDD interfaces and is applicable to video wall applications. A similar product also has 128 channels.

Hikvision entry-level NVR.

Plug-and-play embedded NVR for the mid-range.

A rack-mount embedded NVR for the high-end market supports up to 256 channels.

Software licenses are an expensive and ongoing cost for many security customers – but they don't apply to embedded NVRs.

Trends Supporting Greater Usage of NVRs

There are many reasons embedded NVRs have caught on in the market. Here are a few of them.

- **No software licenses.** Software licenses are an expensive and ongoing cost for many security customers – but they don't apply to embedded NVRs.
- **The stable market equals less need for upgrades.** The pace of change in the video market has slowed down, which creates a great environment for embedded NVRs. Although they can be updated via firmware and software upgrades, the need for such upgrades has slowed down as video technologies have matured. Compared to PC-based systems, NVRs are simpler to update and need less frequent updates due to the stable Linux architecture. In contrast, PC-based system need frequent upgrades.
- **Designed to complement cameras.** NVRs are a system component often sold by the same manufacturer as the cameras used in a system. Development of those cameras and the company's NVRs happen in lockstep – the NVR evolves to optimize technology innovation in the cameras, and vice versa. Integration of NVRs and cameras by the same manufacturer are likely to be "deeper" and "tighter" than ad hoc integrations by VMS vendors as the variety of camera features change. The components are combined into a unified system. (Alternatively, NVRs are compatible with other third-party cameras, too, using ONVIF and other protocols.)
- **Compatible with software to unify multi-site systems.** Software can unify multiple NVRs into larger systems, and NVRs can provide a building block to even big installations.
- **Less bandwidth consumption, less cost.** NVRs accommodate the latest codecs – including H.265+ – to compress video (while maintaining quality), resulting in less need for bandwidth and storage, and less overall system cost.
- **Less power consumption.** An embedded NVR with POE interface must provide power to the connected IP cameras. However, the embedded NVR itself is not high in power consumption. Use of fewer modules and simpler system design help to save power.

Additional Benefits of NVRs

- **They work well alongside PC-based solutions.** Compatibility of system components across a range of manufacturers ensures that embedded NVRs can be used in a variety of environments.
- **Less expensive.** NVRs can be less expensive than PC-based systems (considering the elimination of extraneous technology elements that can add cost). The NVR is tailored for video surveillance with concentrated functions. It uses SOC (system on chip), while PC-based systems contain many more modules. And it's only one component for surveillance. Unnecessary resources add cost. The economic picture gets even more favorable if one considers the total cost of ownership (TCO). Greater efficiency/effectiveness of a system that includes cameras and NVRs developed and integrated together make for a better system. Cost saving also is achieved in easier installation.

- **They include interfaces/outputs for alarms and access control.** NVRs provide outputs and interfaces to facilitate integration with a variety of alarms and access control systems, not to mention point-of-sale (POS) systems and business intelligence systems. Multiple alarm and audio interfaces are easy to connect.
- **Storage flexibility/options.** The storage capability of NVRs can support up to 24 HDDs, with each providing 6 terabytes of capacity. In contrast, PC-based systems involve building a data center for storage.
- **•Hardened for harsh environments.** NVRs provide robust options, even for harsh environments. Embedded NVRs support a much wider range of temperature and humidity than PC-based systems. For example, the Hikvision SSD (Solid State Drive) NVR supports working temperatures from -10° to +70° C, and can further sustain constant vibration with an anti-vibration mechanism, as well as dust prevention.

Vertical Markets for NVRs

The embedded NVR is ideal for a range of surveillance applications in a variety of vertical markets, from residential to law enforcement:

- **Private Residences.** A historical market for simplified analog systems, residences also represent an opportunity for embedded NVRs. Video systems are more popular than ever, and some larger residences may have more cameras than a small business. Home automation systems and other “smart home” devices provide a perfect environment for embedded NVRs. But adding more cameras for extra security does not have to involve a complex system of computers, software and customized integration. Embedded NVRs provide a simpler route to provide the needed surveillance. For use with a WiFi connection in a residential or small business application, Hikvision offers the DS-7108NI-E1/V/W mini WiFi NVR. Features include up to 6 megapixel recording and video output up to 1080p.

NVRs provide outputs and interfaces to facilitate integration with a variety of alarms and access control systems, not to mention point-of-sale (POS) systems and business intelligence systems.

Hikvision’s mini WiFi NVR for private residences or small businesses.

For multi-site businesses, standardizing on embedded NVRs removes many of the variables and ensures system uniformity across a variety of sites.

All-in-one NVR combines an embedded NVR with an LCD monitor.

- **Small to Medium Business.** Thousands and thousands of small- to medium-sized businesses use video as a tool to protect their people, premises and assets. Whether it's a convenience store, a jewelry store or an office building, these locations need a small video system that is a simple, yet powerful. Many of these locations have historically used analog systems; they are a perfect market for the deployment of pre-configured systems that leverage embedded NVRs and IP cameras. The DS-7600NI-E1/A all-in-one NVR combines an embedded NVR with an LCD monitor, offering 8 channels of video input. It can be connected with other display monitors or PCs (using VGA cable), laptops (using HDMI), or a network switch.
- **Law Enforcement.** The simplicity of operating NVRs with embedded software is perfect for law enforcement applications, where ease of operation is a requirement. Police officers are not technicians, and simple operation provides them access to video feeds and the evidence they need.

Hikvision's SSD (Solid State Drive) NVR can withstand vibration and temperature extremes.

- **Manufacturing.** The manufacturing base requires environmentally robust equipment that works dependably in a variety of conditions, such as temperature change and vibration when there are trailers coming and going. For example, Hikvision's SSD (Solid State Drive) NVR is ideal to be installed where there could be constant vibration, and it sustains temperature from -10° to +70° C. It can work alone as a recorder or cooperate with other devices to form a comprehensive surveillance system.
- **Education.** Video systems in educational institutions are often operated by school administrators or campus police officers. Simple-to-use embedded NVRs are a perfect fit.

Other Application Scenarios

There are also other scenarios that are especially suitable for NVRs. For example, each location of a multi-site business requires a simple, easily replicated video system that operates dependably. Standardizing on embedded NVRs removes many of the variables and ensures system uniformity across a variety of sites. The NVRs can also be combined into a unified system using software, controlled from a central location.

For existing systems, the flexibility of embedded NVRs allows them to be deployed as an addition to existing video surveillance systems. NVRs interface with existing systems using standardized connections and provide an easy-to-install route to expansion.

Keeping It Simple – and Lowering Costs

Simplicity is often an overlooked and underappreciated aspect of business, especially when it comes to technology systems. Often a desire to remain on the cutting edge leads customers toward overly complex solutions. It's much better to consider carefully the exact needs of an application and then match available equipment choices more closely to meet those needs.

Simpler may be better. It will almost certainly be less expensive.

Applying the principles of simplicity to video surveillance in the era of IP systems leads customers almost inescapably to embedded NVRs. As we have seen, these "boxes" offer a range of advantages when compared to more complex systems. Furthermore, their performance and dependability exceed customers' expectations. There are plenty of great reasons for today's IP video customers to "think inside the box" and choose embedded NVRs.

Applying the principles of simplicity to video surveillance in the era of IP systems leads customers almost inescapably to embedded NVRs.

SourceSecurity.com®