Intelligent Network Video

Understanding Modern Video Surveillance Systems

Fredrik Nilsson ◆ Axis Communications
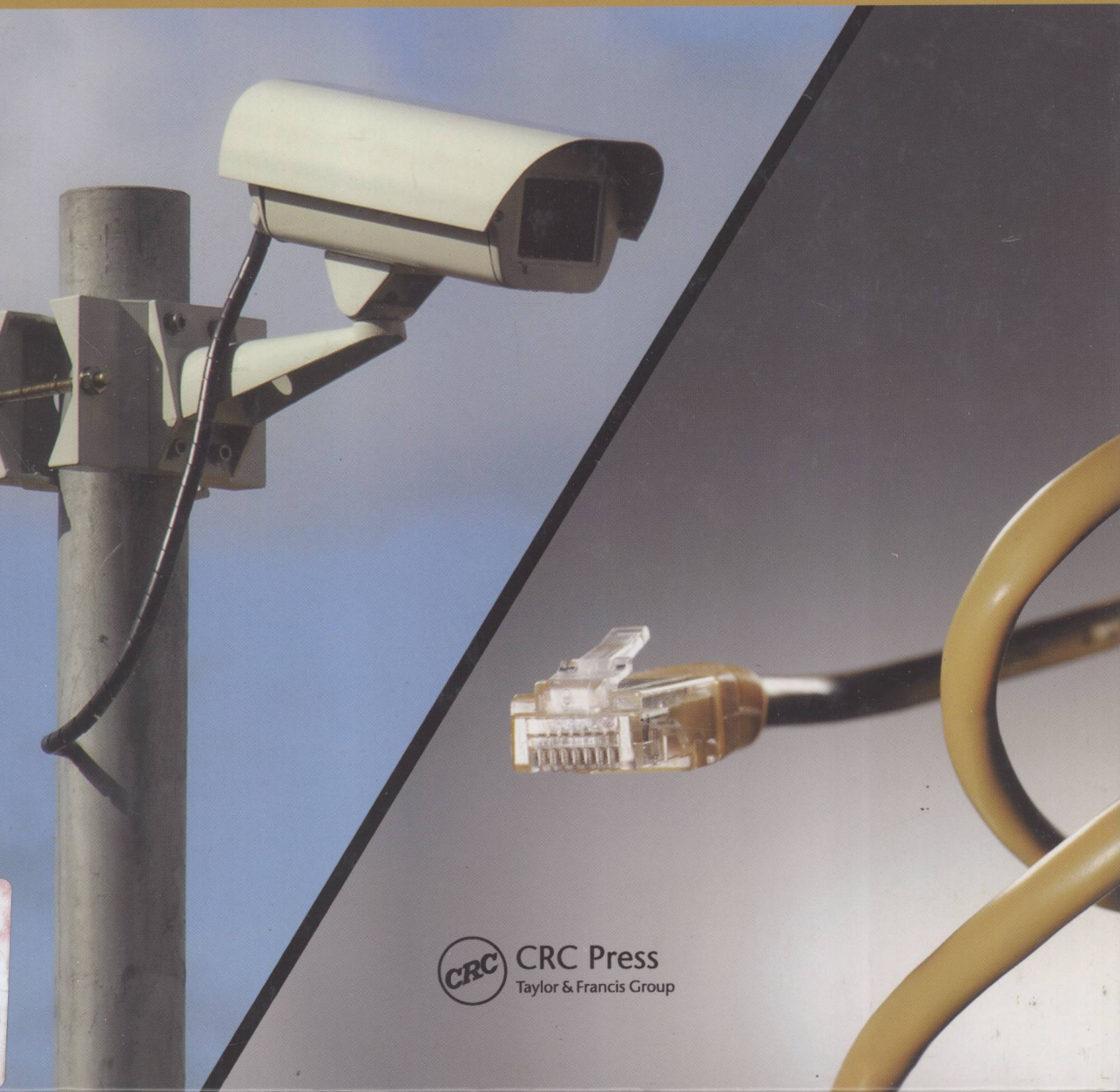
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What key people in the security industry say about *Intelligent Network Video*:

"If you have purchased or are contemplating purchasing this title, you are getting an exceptional, must-read book that was written for every professional that is serious about moving forward in a career with digital surveillance technologies. The author's insights, comprehension and his ability to explain and teach, traverse this exciting field in direct and easily understandable terms. By reading this book, you have taken your first true step toward being part of the future solution."

—Charlie Pierce, President LeapFrog Training & Consulting (LTC) and well-known author of three top-selling CCTV books.

"This book is the most comprehensive resource available to demystify the IP video surveillance market. It is equally as valuable to seasoned professionals as it is to those just entering the field. As a pioneer and leader in the video surveillance market, the author hits all the key issues needed for those interested in doing it right!"

—Sandra Jones, President and Founder, Sandra Jones and Company

"This book is written for those of us who have to "get the job done" using video technology, whether that job involves security planning, system design or operations. Even experienced industry veterans will appreciate the relevance and accuracy of all the material, and should gain an improved ability to discuss the technology with end users and decision makers. This book has definitely improved my thinking about video technology."

—Ray Bernard, PSP, CHS-III, Founder and President, Ray Bernard Consulting Services

"This is the first physical security convergence book to provide the 'Big Picture' on the technical and operational topics of IP networked video surveillance systems, and may well be the most complete and authoritative book written to date."

—Keven Marier, Editor-In-Chief, *IPVS Magazine*

"Opportunities for the use of video abound as never before. As we step back to consider all possible applications for video in surveillance and security, we see clearly that the advancement of video is closely intertwined with advancements and proliferation of other technologies. Fredrik Nilsson's study of the value of networked video shows us a modern problem solved by modern solutions."

—Steve Hunt, CEO and Founder of Hunt Business Intelligence, author of the SecurityDreamer blog

"No question—everyone trying to install new surveillance systems or converge security with IT will benefit from this well-done explanation of why network video is so hot."

—Joe Freeman, CEO, J.P. Freeman Co., Inc. and J.P. Freeman Laboratories, LLC

Introduction

Why is it important to understand network video and intelligent video? Because it represents and drives the most profound change the security industry has seen. We live in a digital and networked world; we use the Web every day, rely on it for banking, share pictures over the Internet, and, increasingly, also use the Internet for voice communication. IP (Internet Protocol) is changing the way we live and work. All markets eventually will be digitized and converge onto the Internet. It is not a matter of *if*, but *when*. The pace of technological development is unstoppable. Moore's law (after Intel co-founder Gordon Moore, who predicted that processing power would double every 18 months) continues to prevail for the foreseeable future as it has for the past 30 years, changing most markets in the process. Now the change has reached the physical security and video surveillance markets. Let us first take a look at three other markets that underwent the same changes.

How the Photography Market Changed

Photography is almost fully digitized but it has taken a long time. The first digital camera was launched in 1994 when the Apple Quick Take 100 stored images digitally. It took another 10 years before the technology was ready for mainstream audiences. In 2002, the first 3- and 4-megapixel cameras, along with ample memory cards, became available at reasonable price points. Today, only a few years later, digital cameras dominate the market with widespread adoption, whereas film cameras have almost disappeared.

The market has converged to a fully digital solution and, with that, the distribution of products also has changed. As IT resellers started to sell cameras, new Web-based services for sharing photos emerged. People started to print their photos on printers at home instead of going to the camera stores or mailing film for processing. Digital photography represents a change in technology, a change in vendors and service providers who address market demands, and a shift in customer behavior. Today, people take ten times more pictures than in the past but develop far fewer. What is next? Soon cameras in cell phones will be good enough to truly replace the traditional camera altogether and the world's largest camera manufacturer might not be Canon, but Nokia. One might wonder if Nokia was listed as a main competitor in the Kodak business plan of 1998. Markets change and manufacturers need to change with them to stay relevant.

How the Music Market Changed

In the mid-1970s, cassette tapes revolutionized the music industry. Consumers had a new medium that was mobile and had the ability to record. The first Sony Walkman came out in the early 1980s and made music easily portable and personal. The next evolution of the Walkman was the CD, a digital technology that provided better audio quality. However, the new technology really did not change the distribution pattern or the end-user experience. CDs are still a physical medium; they require shelf space for storage, need to be bought in person, are cumbersome to copy, and the music is not easily portable.

In 1998, the first MP3 player, Rio Diamond, was launched. By 2002, Apple launched the iPOD and the music industry has never been the same. With MP3 players, the music industry, including distribution, is now fully digitized. Like photography, music has found a fully digital and converged solution. Sony no longer leads the market in manufacturing portable music players; Apple does. Distribution and sales of music continue to change as services such as iTunes take more and more market share. Traditional music stores keep losing market share, and reputable household names such as Tower Records are forced to shut down. Another market has converged to a fully digital solution, and the market dynamics have totally changed.

How the Telecom Market Changed

Another example of a changing market is telecommunications. The telecommunications industry was born when Alexander Graham Bell made the

first telephone call in 1876. The industry has seen many gigantic companies emerge, such as Motorola and Ericsson on the vendor side and operators such as AT&T and Telefonica. The early giants were often monopolistic and state controlled. Then in the late 1990s, the first IP telephony solutions began to emerge. Many people frowned at the idea of using the Internet for end-to-end telephony. Common concerns focused on security, latency, and reliability. Many believed it would never work. Today, IP telephony has turned the telecommunications industry upside down. It is not uncommon for consumers to use Comcast as their phone provider and VoIP services such as Skype to dial friends and family overseas. The emergence of telephony companies has caused many large, state-run monopolies to restructure. The number of fixed phone lines in the United States is declining for the first time, and that trend is likely to continue.

More than Just a Change in Products

What is interesting is that any major shift in technology that serves a particular market will have an impact on not only the products themselves but also the route to market, that is, the sales channel and sometimes also the end user. Very rarely is this shift driven by the existing market leader but rather by new market entrants. These entrants — who are digitizing and converging yet another application in our daily lives for the ultimate benefit of the end user — have everything to win and nothing to lose. Convergence and digitization have played a part in the corporate world for a long time. As recently as 15 years ago, most corporate departments had their own computers, operating systems, vendors, and sometimes networks. HR, finance, and production each worked independently. Phone systems were also a separate system. That has completely changed. Functionality and systems have converged onto an open architecture and IP-based platform, saving millions of dollars for large and small companies (Figure I.1).

Change Has Come to the Security Industry

Just as major technological shifts have impacted the music and telecommunications industries and the corporate setting, a major shift is now also happening in the physical security and video surveillance markets. Video surveillance emerged as a viable market about 30 years ago, and the technology has matured year after year. The introduction of the digital video recorder (DVR) in the mid-1990s started to clear a path for a digital solution, but it was really a replacement for the VCR (videocassette recorder)
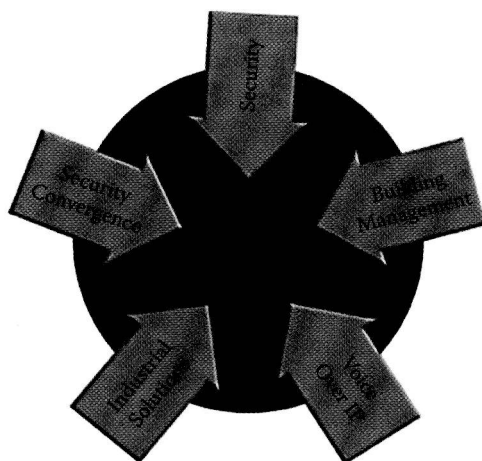
Figure I.1   More and more applications are converging onto IP networks.

and multiplexer. The DVR combined two products into one and added the benefits of digital recording, but it was still a box with analog inputs that simply recorded. New vendors entered the market but buyers did not change, and sales channels remained the same. The DVR signified an evolution in technology — not a revolution.

After a few years, DVRs were equipped with a communication interface that enabled the retrieval of recorded or live video from a remote location. Initially, the interface was a standard serial port that connected to a phone modem, but eventually it became an Ethernet port, requiring the first collaboration with the IT department. However, for the most part, security systems within an organization operated under the radar of CEOs and CIOs.

In 1996, the world's first network camera saw the dawn of light. That camera was the AXIS 200 (Figure I.2), a camera that could send a small-resolution image at one frame per second, and four frames per minute if one wanted full resolution. The AXIS 200 was a product that was poised to replace and overtake the Web camera market for remote monitoring and Web attraction applications. For security applications, however, that camera was far from sufficient. Fast-forward a few years and the network camera had evolved significantly. It could deliver 30 frames per second, had built-in video motion detection, and had an image quality that was similar to analog cameras. All of a sudden, cameras were deployed for security purposes.

Back in 1996, most networks were 10-Mbit networks, and just the thought of putting surveillance video on those networks was unthinkable. By the year 2000, 100-Mbit networks were commonplace, and by 2007, a common enterprise-class, 48-port network switch enabled Gigabit performance on every port and had the ability to stream video from thousands

Figure I.2 AXIS 200, the world's first network camera.

of network cameras at full frame rate via the 10-Gigabit backplane. Remember that Moore's law is still prevailing and technology development happens very fast — yesterday's bottlenecks might become tomorrow's opportunities.

Because of the open interface in the IT industry, independent software companies that build applications for video management started to emerge in Germany, the United States, Spain, Denmark, Japan, and Canada — essentially all over the globe. A new market was starting to take shape: the network video market.

The Changing Face of the End User

When the attacks of September 11th happened, security rose to the top of the agenda in every state, federal, and Fortune 1000 organization— not only physical security but also IT security. No longer was security just an issue of amateur hackers wanting to prove themselves by hacking Web pages of large companies. Now, terrorists wanted to disrupt financial systems and our daily lives. The post-9/11 world called for more integration of different departments and higher standards for the systems implemented. One is starting to see a transition to a structure where the security manager reports to the Chief Security Officer responsible for both physical and IT security. The purpose is twofold: (1) to integrate and coordinate all security, and (2) to migrate the security systems over to an open architecture and IP-based platform (Figure I.3).

What Is Open All About?

In IT, there is a lot of discussion about open systems, open architectures, open standards, and open APIs (application programming interfaces). For a systems integrator or an end user, those are key words. Openness, simply
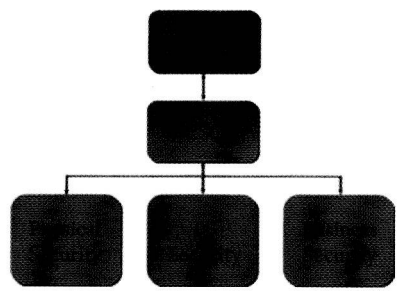
Figure I.3 With the increased importance of security, the Chief Security Officer (CSO) position has been put in place, managing both physical and IT security.

put, will provide a better system at a lower cost. Evolution in the IT industry has shown that this is really the only way to conduct a successful, long-term business. Look at various vendors that are focusing on specific disciplines: EMC for storage, Cisco for networks, Microsoft for operating systems, and Intel for processors. To be really successful, a company needs to focus on one discipline and identify partnerships or work in ecosystems to provide the rest of the pieces that make a complete system for the end user (Figure I.4). This also is why the systems integrator is a key player — to ensure that the pieces are properly integrated or "glued together." To a large extent, the glue that puts it all together is the Internet Protocol (IP). Compatibility and exchangeability are ensured by using open standards, and several standardization bodies, such as the IEEE (Institute of Electrical and Electronics
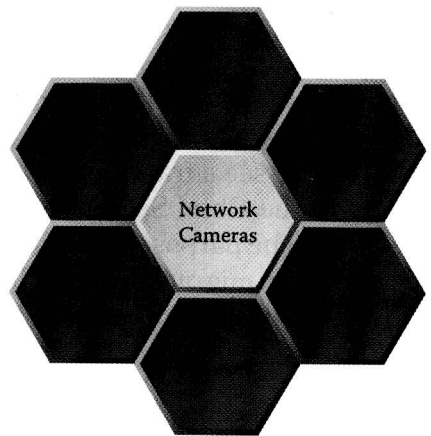
Network
Cameras

Figure I.4 A best-of-breed network video system consists of many components from different vendors, all communicating and interoperating via open interfaces.

Engineers), IETF (Internet Engineering Task Force), and MPEG (Moving Picture Experts Group), help make that happen.

History has shown that focusing on one discipline and partnering with other companies for other components were and continue to be the winning strategy in the fast-moving IT world. The beneficiary is the end user, who gets ever-increasing functionality at a lower cost, year after year. The alternative strategy would be a proprietary solution, with all components from one vendor. A proprietary system was the strategy in the early days of IT — back in the 1970s and 1980s — and was executed by companies such as Digital Equipment and Wang. Initially, this strategy was very successful, but when IP networks and standards emerged, it became very difficult for these companies to keep up. They lost market leadership, and some even went out of business.

How Open Is Open?

Proprietary systems can be great for a vendor because it means that the end user does not have to look anywhere else for system components. In a proprietary system, all system components are procured from one vendor. This kind of system is like a monopoly because prices — normally higher prices — are dictated by the vendor. Monopolies also typically mean longer product generation cycles. However, monopolies usually are not associated with an open and successful market. The trick is knowing what *open* really means.

Being *open* is a buzzword nowadays because many companies have shown that this is the most successful way to conduct long-term business. Today, it would be difficult to find a company that would market a system as being proprietary. However, it is more advantageous for a leading company that owns most of the market share to lock in a customer and make the system a little bit less open in an effort to control the customer's buying habits. The end user must be aware that there are many different degrees of openness. Watch out for companies that manufacture all of the components in a certain system, do not have openly published APIs, have a limited number of partnerships, or do not 100 percent comply with open standards. One will likely end up being locked in, with higher system costs as a result.

Why Intelligent Video Will Become Essential

One of the benefits of an IP-based video surveillance system is the ability to scale. Although a 50-camera system was considered large back in the

early 1990s, it is small compared to what an IP-based system enables. For example, an IP-based system can accommodate thousands or even tens of thousands of cameras in one integrated system. Who will monitor all the video? Research shows that even after 20 minutes, an operator will miss important events using a quad monitor. Already today, there are more than two million analog cameras in London alone, and 15 million in the United States. This is where video intelligence or video content analysis comes into play.

Video management systems, and even cameras, can do the monitoring and alert the operator to certain types of events, such as when a camera has been tampered with, if someone has entered the track in a subway, or in applications where there is a need to count the number of people going into a certain area. The intelligent video market is still an early market, but it will be an important driver for further deployment and usage of video systems. Intelligent video systems will be truly scalable and useful if the intelligence resides "at the edge" of the system, that is, in the network cameras.

Convergence: Here to Stay and Here to Change Our Lives

According to *Webster's Dictionary*, convergence means "the merging of distinct technologies, industries, or devices into a unified whole." Convergence changes many things: there is convergence of the technology, the route to the market, and the roles within the end-user organizations. Security is one of the last functions within many organizations that has not yet converged onto standard IT equipment. HR and finance departments did it a decade ago. It did not mean that those departments lost any control of their applications; on the contrary, it demonstrated the need to work more closely with the IT department to let it know what their needs were. It also meant that once those needs were clarified, the operation and maintenance of those systems were in the capable hands of the IT department, and there was one less worry for the HR and finance departments to think about and more time could be spent on their professions.

For many years, the discussion was whether convergence would happen in the security industry, and many people had their doubts. Since 2001, security systems have converged onto IP-based networks and the change is now widely accepted. 2006 and 2007 saw the beginning of the hypergrowth phase of network video, with the installation of thousands of cameras in the education, retail, and transportation markets. The writing is on the wall, and the question emerging is *"How fast?"*. How fast will security solutions within all organizations evolve to be yet another

application on the IP network? The technology is here, and it is here to stay, so the only alternative is to embrace it.

About This Book

Open systems and more choices are advantageous but they also call for a more educated end user and systems integrator. That is the main purpose of this book: to educate anyone interested in jumping onto the fast-moving intelligent network video train and benefit from the possibilities.

This book takes the reader through a logical tour of the building blocks of intelligent network video, including network cameras, video encoders, networks, storage, servers, and video management. Intelligent video, system design, and the cost of network video are discussed in detail at the end of the book. There are also a few chapters with fairly technical information. Such chapter titles end with the word "Technologies," indicating that they are suitable for the more technical reader. The book also comes with a system design tool DVD, a tool that helps one design a video surveillance project based on resolution, compression, frame rate, bandwidth, and storage considerations.

As one navigates through the fascinating world of network video, the authors hope the book will serve as a guide in helping implement successful IP-based video surveillance systems.

About the Author

Fredrik Nilsson currently serves as the general manager for Axis Communications, Inc., overseeing the company's operations in North America. He has been with Axis for more than 10 years and has been general manager of the North American region since 2003. In that time, he has helped the company increase revenue fivefold and has been instrumental in leading the industry shift from analog closed circuit television to network video.

Fredrik Nilsson also serves on the SIA (Security Industry Association) Board of Directors. He is a trusted industry speaker and has spoken at more than 20 conferences, including providing the keynote address at TechSec Solutions, the premier conference on IP-ready security technology, and at influential shows such as Securing New Ground, ASIS Emerging Trends in Security, ISC West, ISC East, and Interop.

He has been in top publications such as *The New York Times*, *USA Today*, and *The Washington Post*. He has also appeared on television shows such as CNN Headline News, CNBC's "Wake Up Call," and the Fox News Channel's "Fox & Friends." He has written articles for and been quoted in many publications in the security industry, including *Access Control & Security Systems, Security Products & Technology, Security*

Acknowledgments

Writing a book, like any large project you take on in life, cannot be completed without tremendous support from colleagues, friends and family. This book was no different.

I am fortunate enough to work for Axis Communications, a company that saw the value in the book, and not only gave me the time, but more importantly, all the required internal resources to complete it. All of you who helped, from proofreading to writing whole chapters, are aware of your invaluable contributions and my sincere thanks go out to all of you.

I am also lucky to be part of an industry with some outstanding people who are in the industry not only to make a living but also to help provide a safer and more secure life for all of us. Since moving to the United States six years ago, I have gained tremendous knowledge from many generous people willing to teach me from their lifelong experiences, many whom I call friends.

This book would not have existed without the understanding and support from my wife. Thanks for letting me spend so many weekends and nights on this project. I love you.

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