



**Technology and Applications**

**WHITE PAPER**

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# **What is a Network Camera?**

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## 1. Introduction

*Wouldn't it be useful to be able to track every person that passes a high-security entrance point, or check for false alarms at your store from the comforts of your home? These and thousands of other groundbreaking applications have become possible with the advent of network camera technology.*

Starting with the world's first webcam in 1991, trained to remotely monitor the level of java in a Cambridge University coffee pot, the market and uses for network camera technology have exploded. Security solutions in banks, airports and casinos are only a few examples of professional applications based on network cameras, which are common today. Research firm Frost & Sullivan predicts that the global network camera market will reach approximately \$441 million by 2005—a more than ten-fold increase in five years. Axis Communications has been in the forefront of network camera technology from the very beginning, having developed the world's first network camera in 1996. Today, Axis is the worldwide leader in the network camera market, as well as in video servers.

## 2. Why use a network camera and where?

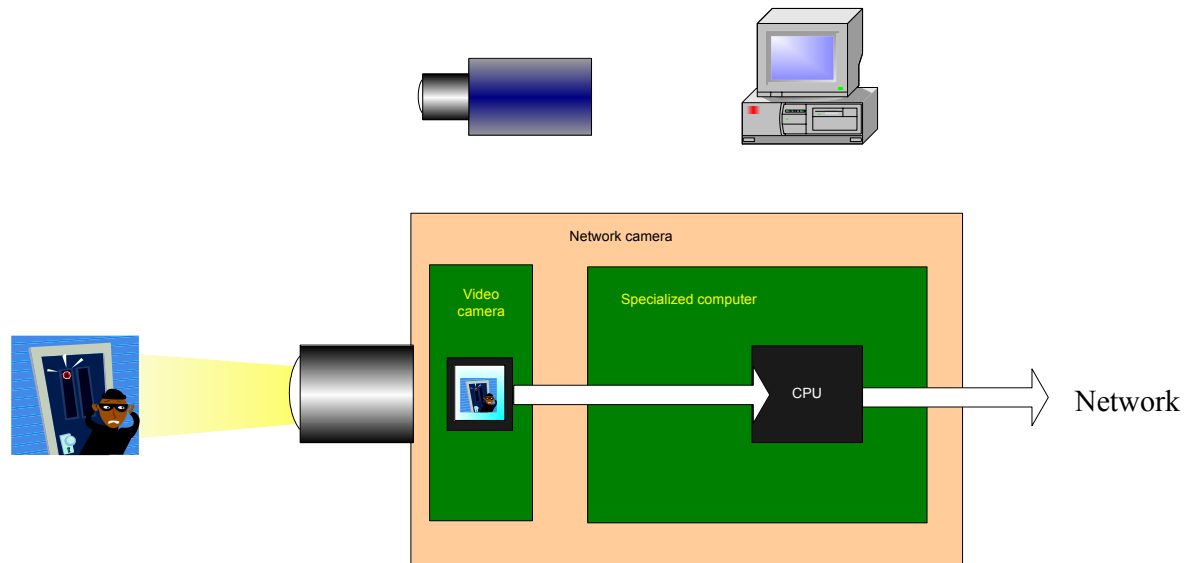
Recent advances make it possible to connect cameras directly to an IP-based computer network. Network camera technology enables a user to have a camera at one location and view live video at another location over the network/Internet. Access can be restricted so only authorized persons can view the images, or live video can be posted on a company's web site for all the world to see.

If a building is equipped with an IP- network, then the necessary infrastructure already exists to add network cameras. A network camera performs many of the same functions as a standard analog CCTV camera, but it does so with greater functionality at substantially lower costs. Because network cameras plug directly into the existing network via an Ethernet port, companies can save thousands of dollars by not having to wire their facilities with coaxial cabling as required for analog cameras. When computers are already in place, no additional equipment is needed to view network camera output. The output can be viewed in its simplest form in a Web browser at the computer monitor and in more complex security solutions with the aid of dedicated software. If analog cameras are already present at a site, the addition of a video server will make those images available in any location required.

## 3. Under the hood: Network camera technology

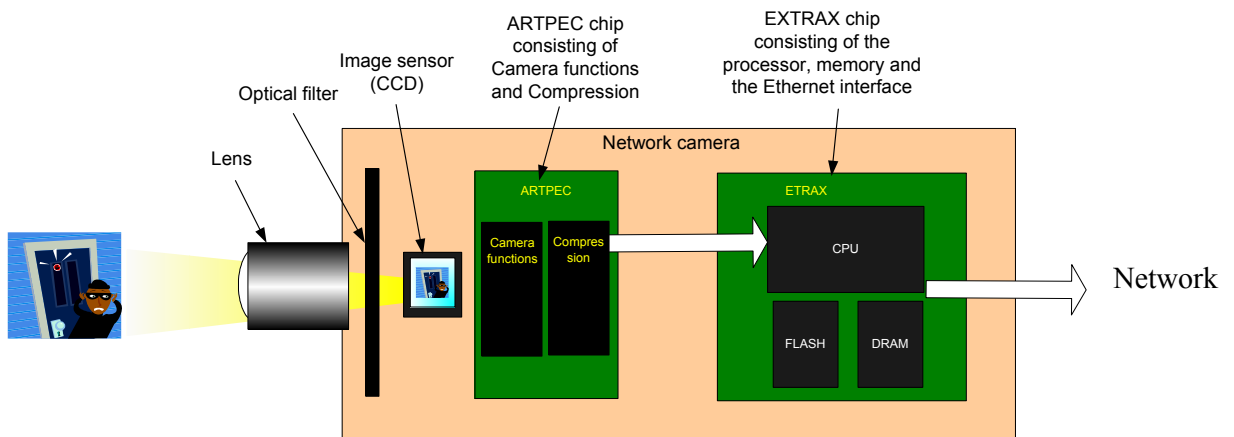
A network camera has its own IP address and built-in computing functions to handle network communication. Everything needed for viewing images over the network is built into the unit. A network camera can be described as a camera and a computer combined. It is connected directly to the network as any other network device and it has built-in software for a Web server, FTP server, FTP client and e-mail client. It also includes alarm input and relay output as well. More advanced network cameras can also be

equipped with many other value-added functions such as motion detection and an analog video output.



The network camera's camera component captures the image, which can be described as light of different wavelengths, and transforms it into electrical signals. These signals are then converted from analog to digital format and transferred into the computer function where the image is compressed and sent out over the network.

Let's examine the network camera components more closely.



The **lens** of the camera focuses the image onto the **image sensor (CCD)**. Before reaching the image sensor, the images pass through the **optical filter**, which removes any infrared

light so that the “correct” colors will be displayed. The image sensor converts the image, which is composed of light information, into electrical signals. These electrical, digital signals are now in a format that can be compressed and transferred over networks.

The **camera functions** to manage the exposure (light level of image), white balance (adjusts the color levels), image sharpness, and other aspects of image quality. These functions are performed by the Axis in-house developed camera controller and video compression chip, ARTPEC (Axis Real Time Picture EnCoder). The digital image is compressed into an image containing less data to enable efficient transfer over the network.

The camera’s Ethernet connection is enabled by Axis’ ETRAX chip - an optimized system-on-chip solution for connecting peripherals to the network. The ETRAX includes a 32-bit CPU, 10/100 MBit Ethernet connectivity, advanced Direct Memory Access (DMA) functionality and a wide range of I/O interfaces. The **CPU, flash and DRAM** represent the “brains” or computing functions of the camera and are designed specifically for network applications.

Together, they handle the communication with the network and the Web server.

## 4. The network camera in action

We’ve now seen the component parts that make up the network camera. But how does it actually function in terms of collecting and compressing images and transferring them over a network for remote viewing?

### 4.1 Connecting the camera to the network.

For most CCTV surveillance systems, it is relatively easy to expand the number of cameras and monitors within a building, but viewing those images from another location is another story. However, if a building is equipped with a network, the needed infrastructure is already in place to add network cameras, and dynamically expand when and where video can be viewed.

### 4.2 The IP-Network

TCP/IP is the most common computer communication protocol today, used for Internet and almost every newly installed network. In the typical office, computers are most likely connected via an Ethernet network, e.g. a Local Area Network (LAN). Each device in a LAN must have a unique address, the IP address, to be able to connect directly to the Internet. Today’s computers and network devices have a high capacity to simultaneously communicate with several different units. A high-end network camera, such as one from Axis, can send images to ten or more computers simultaneously. With a network camera sending images to an external web server, instead of directly to the viewers, real-time video can be seen by an unlimited number of viewers.

### 4.3 Storing and transferring images

To connect to the Internet many different kinds of transmission types are available. These include standard and ISDN modems, DSL modems, cable TV modems, T1 connections, and 10, 100, and 1000 Mbit Ethernet connections. In addition, cellular

phone modems and various wireless network options are also available. Digital images can be stored on hard disks. Typically several million images can be stored on one hard disk. When the hard disk is full, the computer can be programmed to automatically erase old images and make space for new images. There are a large number of professional security systems managing the complete security application available on the market today.

#### **4.4 Compression techniques and image resolution**

Resolution of digital images is measured in pixels. The more detailed an image is, the more data, and therefore the more pixels, it contains. Detailed images require more space on a hard disk and more bandwidth for transmission.

For storing and transmitting images over the network, the data must be compressed or it will consume too much disk space or bandwidth. If bandwidth is limited, the amount of information being sent must be reduced by lowering the frame rate or accepting a lower image quality. A number of compression standards exist that deal with the trade off between frame rate and image quality in different ways. Of the more common standards, both JPEG and MPEG transmit high-quality video, while the H-standards, normally used in video conferencing, do not generate clear images of fast-moving objects.

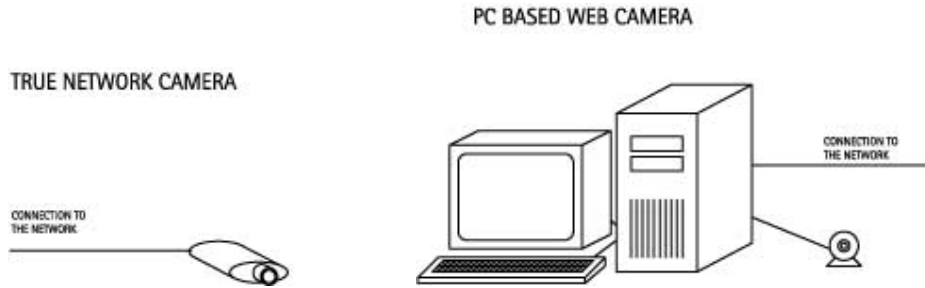
#### **4.5 Camera light requirements**

The most common reason for poor image quality is insufficient light. With too low a light level the colors will be dull and the images blurry. The light level is measured in Lux. Strong sunlight is approximately 100,000 Lux, full day light is 10,000 Lux and candle light is 1 Lux. Usually at least 200 Lux is required to capture good quality images.

Bright areas should be avoided, as images might become over-exposed and objects appear too dark. This problem typically arises when trying to capture an object in back light. A camera adjusts the exposure to obtain good average light level for the image, but the contrast of colors between the object and the background influences the exposure. To avoid this problem, small dark object should be displayed towards a dark background to achieve correct contrast and color.

## **5. The network camera in a class of its own**

For many, network cameras and WebCams, are the same thing—they are in fact quite different. As shown clearly in the diagrams below, a real network camera has its own “intelligence,” and does not need to be connected to a PC to establish a network connection.



## 6. Specific network camera applications

Network camera technology can be used for literally thousands of high-value, professional security and non-security applications. Uses range from offices to retail to casinos; and extend into monitoring manufacturing processes and web attraction. Here are a few of the many cost-effective and highly productive applications for network cameras:

### 6.1 Security Surveillance

Network cameras are used in professional security systems and enable live video to be viewed remotely by authorized personnel. The network cameras are easily integrated into larger, complex systems, but can also function as stand-alone solutions in entry-level surveillance applications.

- Network cameras can be used for surveillance of sensitive areas, such as **buildings, casinos, banks and shops**. Video of those areas can be monitored from relevant control rooms, at police stations and by security managers from a variety of locations.
- Network cameras are also effective substitutes for analog cameras in traditional **law enforcement** applications, such as keeping public places safe.
- Network cameras can be used for **access control**. People as well as vehicles can be recorded with time stamps that are easy to locate and review. The images can be stored in a remote location, making it impossible to steal the information.

### 6.2 Remote Monitoring

Network cameras are easily connected to the existing IP-network and enable real-time updates of high-quality video to be accessible from any computer on the network. Sensitive areas such as the server room, the reception area or any remote site can be closely monitored in a cost-effective and simple way, over the local network or via the Internet.

- Network cameras enhance the monitoring of a **retail** location by ensuring that everything is in good order. (Quality of Service)
- A network camera is a useful tool at the **office**. Areas like the reception area, and conference rooms can be monitored for activity. In addition, users can keep track

of who has been in the server room and take appropriate action when problems occur.

- Network cameras are useful tools for the **manufacturing** industry. Monitor robots, other machines and production lines from the office or home and allow service engineers to access the cameras remotely. With Pan/Tilt/Zoom cameras it is possible to look at comprehensive as well as detailed views.

### 6.3 Web Attraction

Network cameras enable high-quality, live video to be shown to the whole Internet community. Live video is an effective method for bringing visitors back to a Web site.

- Network camera technology can be utilized for web attraction; that is, making web sites more dynamic and interesting and thereby attracting more visitors to the web site. Weather cameras and other live cameras are popular ways to build web visitor traffic. Cameras can be mounted in a city center, at a university, on a mountain, or by the sea to show live updated video.

## 7. The future for network cameras

More than 10 years ago, some enterprising professors at Cambridge University used an early version of network camera technology to make sure they could always count on a hot cup of coffee. A few years later, after the Web was born, they made the coffee pot images available to anyone with an Internet connection. Probably due in part to the lack of exciting web material, the Cambridge coffee pot was an enormous hit, drawing around 2.4 million visitors, and launching the first popular application for network camera technology— web attraction. Web attraction remained a strong market in the early days of network camera growth. As the understanding of and interest in network cameras grew, security market applications based on remote monitoring and security surveillance, have become the largest market for network cameras.

Just as 100 network cameras providing 24/7 monitoring to viewers located anywhere is light years beyond that first coffee pot-cam, the future for network cameras is similarly limitless. In the future, “intelligent” cameras powered by increasingly sophisticated CPUs will not only constitute the eyes of security management, but the “brains” as well. These intelligent cameras will possess the capability to make decisions based on input and perform actions that add value, increase security, or whatever the application demands.



## About Axis

### Axis Communications

Axis develops solutions for user-friendly and secure communication over wired and wireless networks. The company is a worldwide market leader in network connectivity, with products for office, facility and industrial environments. Axis was founded in 1984 and is listed on the O-list (Attract 40) of Stockholmsbörsen (XSSE:AXIS). With more than 300 employees, and offices in 14 countries, Axis operates globally in cooperation with distributors and OEM partners in some 70 countries. Markets outside Sweden account for more than 95 percent of sales.

Information about Axis can be found at [www.axis.com](http://www.axis.com)

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