GKB

Making Security Easier.

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IP Camera Network Installations are More Difficult than Analog Camera Installations? **Not So!**

Here Are The Facts.

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Overview

GKB has produced this white paper to explain the steps involved in a typical IP camera network installation. It is intended as a short, easy-to-use educational paper to help system integrators who are feeling uncertain about new IP camera technology and are not sure what a typical IP camera installation involves. With a straightforward, easy-to-follow guide, we show that IP-based systems are not difficult to install.

There are two types of IP-based system. This white paper deals exclusively with the installation process of a "pure" IP-based network system. It does not cover conversions / upgrades from an analog to a digital video system.

A Brief History

Original closed circuit television (CCTV) networks were analog systems, built using analog cameras, coaxial cable and analog videocassette recorders (VCRs). As technology developed, digital video recorders (DVRs) were introduced to replace VCRs. DVRs were able to convert the analog video streams to digital format and store the video streams on built-in hard disks. PCs were then introduced, connected to the DVRs via a digital network (Ethernet / IP network). Software could be installed onto these PCs to manage the storage and streaming of the video via the network. This formed a kind of "hybrid" network that mixed modern network technology with existing analog CCTV infrastructures. It often proved a cost-effective way of upgrading camera security networks without the need to replace the entire infrastructure.

Most new, medium- to large-scale CCTV systems are now based entirely on internet protocol (IP) technology. This provides many benefits over analog systems, such as the ability to remotely manage and control cameras. IP systems can also more easily incorporate video content analysis software, which enhances the effectiveness of video as a surveillance tool. Furthermore, there is a lot of evidence showing that IP camera networks are cheaper overall i.e. the total cost of ownership (TCO) is lower[1], and the costs are falling rapidly as more manufacturers enter the market.

The latest IP-based networks completely eliminate the need for coaxial cable. Video streams and images can be viewed from anywhere on the internet and any computer connected to the network can be set up to record the video output. Market analyst company J.P. Freeman states that "intelligent video technology represents a major growth opportunity for hardware and software companies wanting to position themselves for growth in the rapidly expanding international security industry"[2].

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1 For example, see the white paper published by Axis Communications™: "Total Cost of Ownership: Comparison of IP- and analog-based surveillance systems", 2008.

2 Introduction to the market report IMS Research report entitled "The Worldwide Intelligent Video & Smart Camera Market", 2007. From jpfreeman.com.

A Big Market Opportunity

The security camera market is in the midst of profound changes towards IP-based systems. Because sales of IP-based systems are growing very quickly, system integrators are now presented with a good opportunity to improve sales and profit margins.

Although reliable data on the value and growth of the global IP network market is difficult to come by, estimates from well regarded sources are available. IMS Research estimated the 2009 market value for network cameras at over US$1 billion[3]. John Honovich of IPVideoMarket.info puts the 2008 global market value at US$700 million and sales over the period 2008 to 2018 at a probable US$20-40 billion. By his estimate, 2008 global sales of IP-based cameras totalled roughly 1 million units, 80% of which were used in the surveillance market. Increasing adoption of open standards (such as ONVIF and PSIA) are expected to further accelerate the trend towards growth in IP network video surveillance. Therefore, we believe that system builders should consider learning about IP network security systems to take advantage of the large and growing demand.

Two Types of IP-based Systems

There are two types of IP-based network systems.

- "Hybrid" systems are built on existing analog network infrastructures. These provide an upgrade to the existing system so that the analog video streams may run into an IP network via a local area network (LAN), and from there onto the internet.
- "Pure" IP-based systems do not utilize any analog system infrastructure. We focus exclusively on the "pure" IP-based systems in this white paper.

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3 IMS Research News - Security & ID Newsletter, March 2006.

Note Before Installing:
A Series of Installation-Related Decisions

The first thing system builders need to do is make a choice between using powered or non-powered switches. The type of switch chosen will affect the nature of the installation and the equipment needed.

We therefore describe two types of installation in this paper: one based on powered switches (page 5), and one based on non-powered switches (page 8).

Decision 1:
Powered (PoE) or Non-Powered (Non-PoE) Switches?

Explanation of "Power over Ethernet": Power over Ethernet (PoE) is a technology which allows both power and data to be carried along the same cables within a network. When we say "powered" switches, we mean PoE switches, and use these terms interchangeably in this paper.

- PoE Switches: "powered" switches have the function of carrying both data and power to cameras. They are the point of connection between a network and its cameras, like intersections or traffic circles in a highway system, splitting the flow of power and data so that it can go to several cameras at once.

  It is important to ensure that the PoE switches have sufficient power ratings to supply all cameras on all connections. Networks using this type of switch are easier to install and generally more popular. GKB recommends using relatively high capacity Gigabit (1,000 Mbit/s) switches because this will allow upgrades to camera models or higher framerates / resolutions to be used later without the need to upgrade switches.

- Non-PoE Switches: "non-powered" switches only carry data to cameras. Power needs to be supplied independently. The advantage of this is that the cameras continue to receive power if there is a problem with a switch. Each camera can therefore continue to record data onto internal memory in the case of a switch failure. This type of switch is appropriate for customers for whom it is critical that there is no interruption to video recording, although this requirement is likely to be relatively rare.

  For non-PoE switches, GKB also recommends using Gigabit switches for the same reason as above.

Decision 2:
Which Network Cables?

These can be Category 5 (Cat5), Category 5e (Cat5e) or Category 6 (Cat6). These cables carry both data and power. Cat6 cables are recommended for use whenever possible because these carry more power and therefore allow upgrades to camera models later, while the price difference is very small. They are sometimes also referred to as Ethernet, "LAN" or "network" cables.

Decision 3:
Which Network Cameras?

These can be fixed cameras or pan, tilt, zoom (PTZ) cameras. PTZ cameras can be moved via the network i.e. a user can move these cameras remotely over the network (LAN) or the internet. Network cameras are either PoE compatible or not PoE compatible. If they are not PoE compatible, an extra piece of equipment called a "PoE splitter" is required. IP network cameras are also referred to as "network cameras", "IP cameras" or "internet cameras".

Decision 4:
Choosing a Network Video Recorder

A network video recorder (NVR) is simply a kind of computer with NVR software installed on it. To choose the correct specification of computer necessary to support all the cameras on the network, you will need to find out the customer's framerate and resolution requirements for the cameras (as this affects the size of the data being recorded). We then recommend seeking advice from your equipment supplier or an IT professional regarding the appropriate specifications to ensure that the computer is sufficient to your requirements.

An NVR records and stores live video streams and can be used to control the cameras remotely. One big advantage is that, once the video stream has been stored, it can be accessed remotely at any time from any point on the network (LAN), or via the internet. An NVR can be located anywhere on the Ethernet network. Most computers used for NVR applications have a small hard disk to run the NVR software and operating system (such as Windows 7), and a large hard disk (often more than one) for video storage.

Note: A network video recorder (NVR) is not to be confused with a digital video recorder (DVR), which should not be used in a "pure" IP camera security network installation (see "Two Types of IP-based Systems", above). DVRs are used when an IP-based network is built on an existing analog network infrastructure i.e. it is used in what can be called a "hybrid" IP network.

Installation of a Wired IP Network Built with PoE Switches

Wired IP networks based on PoE switches are the most straightforward to install and require the least amount of equipment. In the sections below we describe the equipment needed for a wired IP network installation, the typical installation steps, and a diagram of what an ideal network should look like.

Equipment Needed for a Network Built Using PoE Switches

The following equipment is for a network built using PoE switches (as described in more detail above):

- Network Cables
- Network Cameras (IP Network Cameras)
- Computer / Network Video Recorder

Other equipment required:

- Network Video Recorder Software: This is supplied by the manufacturer and needs to be installed on the computer to turn it into a network video recorder (NVR). Software is automatically installed upon insertion, which makes finding cameras on the network something system builders do not need to worry about.
- A Router: this is the "gateway" from your local area network (LAN) to the internet i.e. it connects your LAN to the internet so that video can be accessed and cameras controlled via the internet. Setting up a router and IP cameras is very technical and we therefore do not attempt to deal with it in this paper. For guidance and help on setting up a router to work with your LAN, we recommend talking to your equipment supplier or an IT professional.
- Power over Ethernet (PoE) Splitter: this "splits" the power from the data coming from a network cable to deliver both separately to the camera. This is necessary if the camera is not PoE compatible. It is sometimes also referred to simply as a "PoE power device (PD)".

Typical Network Installation Steps if Using PoE Switches

1. Firstly, identify:
   a. The number of cameras needed.
   b. The distance of the cameras from the site of the computer.

2. Determine the number of switches needed:
   a. The maximum recommended length for network cables (Cat6 cables) is 100 meters.
   b. Therefore, there needs to be 1 switch for every 100 meters of cable.

3. Determine your customer's recording requirements by:
   a. Identifying the framerate required for the video.
   b. Identifying the resolution required for the video.

4. Choose an appropriate computer to become your network video recorder (NVR): To do this you will need to give the customer's framerate and resolution requirements to your equipment supplier or an IT professional and seek advice.

5. Install your switches, cameras and computer in the appropriate places.

6. Connect the network cables (Cat6 recommended) between:
   a. The computer.
   b. The PoE switches.
   c. The cameras.

7. If the cameras are not PoE compatible, connect PoE splitters to the cameras (one per camera). If cameras are PoE compatible this step is not required: plug the network cable directly into the cameras.

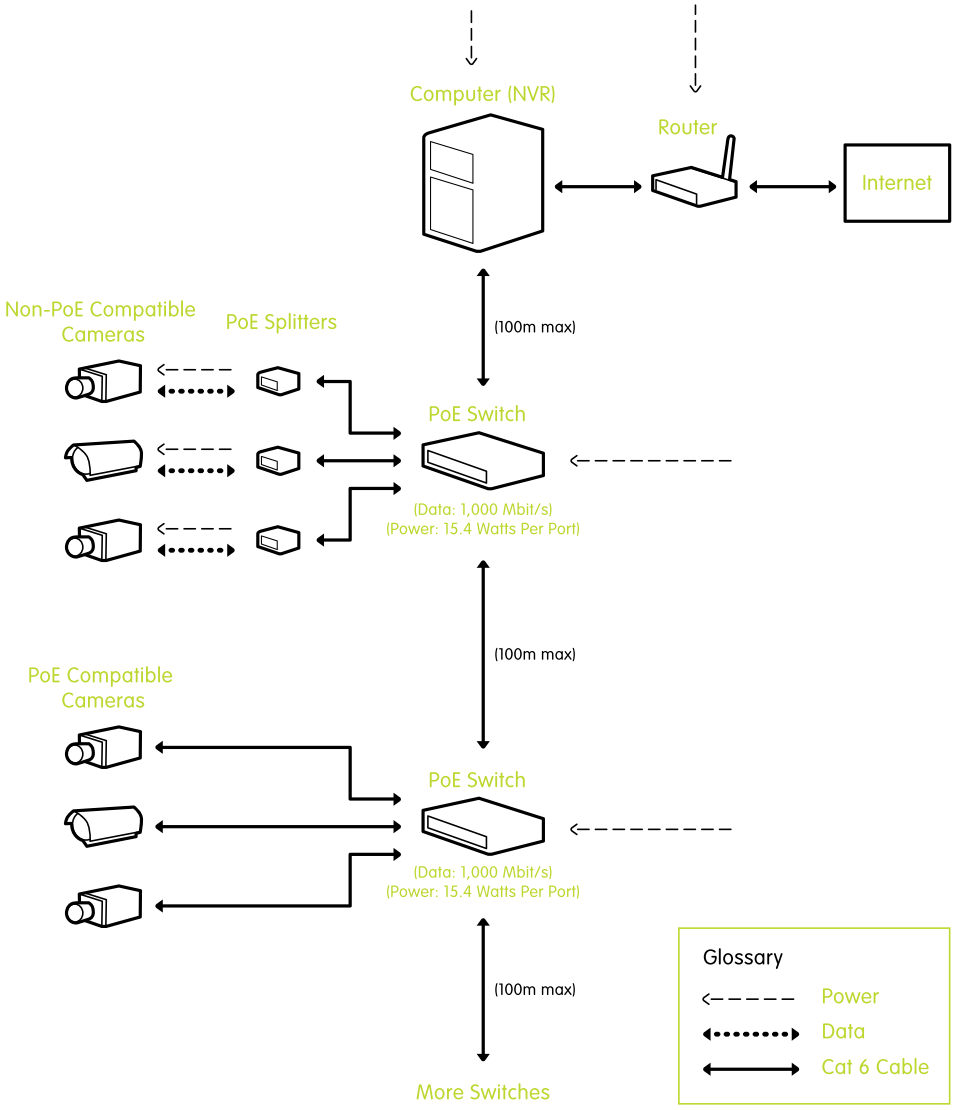
8. Run the network video (NVR) software on the computer:
   a. This software automatically installs itself and turns the computer into an NVR.
   b. The software locates the cameras on the network and sets them up.

   Note: The software should be free with the cameras; there is no need to buy a physical NVR.

9. Your hardware installation is complete.

10. Vary the NVR settings in accordance with the customer site requirements.

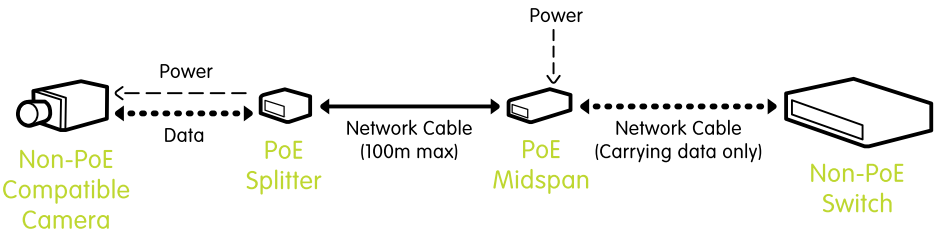
Diagram of an Ideal Wired Network with PoE Switches



Installation of a Wired IP Network Built with Non-PoE Switches

If not using PoE switches, there are two ways to supply power to cameras. The first involves an additional piece of equipment, called a "PoE midspan", which adds power to the network cables running to the cameras (i.e. independently of the switch). The second method involves simply laying a separate power cable from the power source alongside the network cable to the camera.

The first method is shown in the diagram below. The switch is non-PoE. A PoE midspan is attached to the switch and has its own independent power supply. A network cable then carries both the power and data to the PoE splitter, which supplies the data and power to the camera separately, as the camera is not PoE-compatible. The network cable could be very long, up to a recommended maximum length of 100 meters.



Equipment Needed for a Network Built Using Non-PoE Switches

The equipment for a network built using non-PoE switches is the same as when using PoE switches, in terms of the following (see page 5 for detailed descriptions):

- Network Cables
- Network Cameras (IP Network Cameras)
- Computer / Network Video Recorder
- Network Video Recorder Software
- Power over Ethernet (PoE) Splitter
- A Router

The following equipment is different:

- Power over Ethernet (PoE) Midspan: Its function is to take the data coming from the non-PoE switch and add power to the cable independently so that both power and data run along the same network cable. This unit is also sometimes referred to as "PoE power supply equipment (PSE)".
- Non-Power over Ethernet (PoE) Network Switches: Non-PoE or "non-powered" switches do not use power over ethernet (PoE) technology, which means that cameras are powered independently of the switch. GKB recommends using relatively high capacity Gigabit (1,000 Mbit/s) switches because this will allow camera upgrades or higher framerates / resolutions to be used later without the need to upgrade switches. These are sometimes also referred to as "switching hubs", "layer 2 switches", or simply as "switches" (with these terms there is no difference in the names between PoE compatible and non-PoE compatible switches).

Note: If not using PoE midspans a panel or rack mount power supply is required. In this case, seek advice from your equipment supplier or an IT professional regarding the most appropriate unit to use.

Typical Network Installation Steps if Using Non-PoE Switches

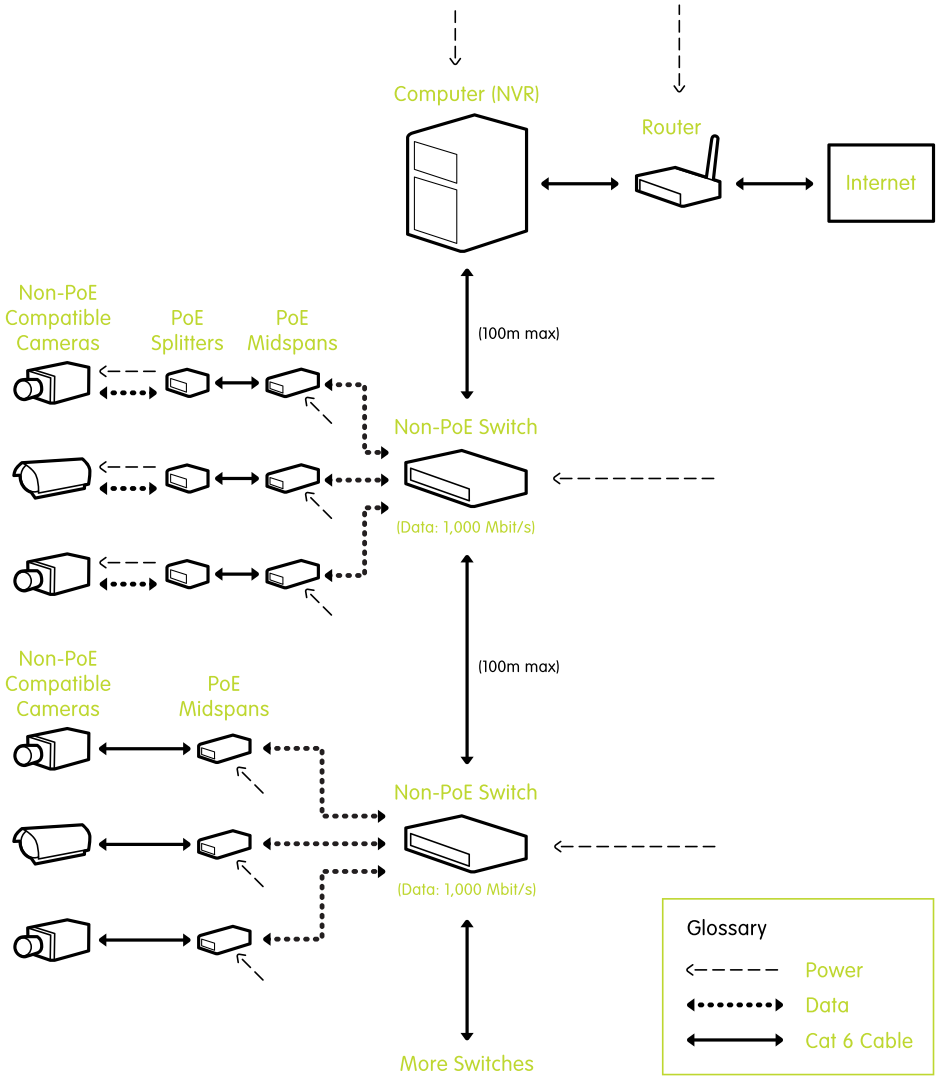
The installation steps described here assume that power will run to the cameras via a network cable i.e. each network cable running to a camera will be connected to a PoE midspan.

Note: Steps 1 through 6 are the same as the installation with PoE switches (page 6).

1. Firstly, identify:
   a. The number of cameras needed.
   b. The distance of the cameras from the site of the computer.
2. Determine the number of switches needed:
   a. The maximum recommended length for network cables (Cat6 cables) is 100 meters.
   b. Therefore, there needs to be 1 switch for every 100 meters of cable.
3. Determine your customer's recording requirements by:
   a. Identifying the framerate required for the video.
   b. Identifying the resolution required for the video.
4. Choose an appropriate computer to become your network video recorder (NVR): To do this you will need to give the customer's framerate and resolution requirements to your equipment supplier or an IT professional and seek advice.
5. Install your switches, cameras and computer in the appropriate places.
6. Connect the network cables (Cat6 recommended) between:
   a. The computer.
   b. The PoE switches.
   c. The cameras.
7. Connect PoE midspans to the network cables running to the cameras (one per cable / camera).
8. Connect PoE splitters to the cameras (one per camera) if the cameras are not PoE compatible. If cameras are PoE compatible this step is not required: plug the network cable directly into the cameras.
9. Run the network video software (NVR) on the computer:
   a. This software automatically installs itself and turns the computer into an NVR.
   b. The software locates the cameras on the network and sets them up.

   Note: The software should be free with the cameras; there is no need to buy a physical NVR.
10. Your hardware installation is complete.
11. Vary the NVR settings in accordance with the customer site requirements.

Diagram of an Ideal Wired Network with Non-PoE Switches



Glossary / Jargon Reference Guide

- **CCTV:** "Closed Circuit Television". Any closed camera / television network i.e. one which is not broadcast. This can be based on an analog or IP network infrastructure.
- **DVR:** "Digital Video Recorder". These are used in creating IP-based networks built on analog network infrastructure. They function by converting analog video feeds into digital streams that are stored on built-in hard disks. These streams can then be viewed over Ethernet / internet networks.
- **Ethernet:** the name for the family of technologies involved in local area networks (LANs). This technology is now the standard for all modern IP networks.
- **Ethernet Cables:** this is the same as Cat5, Cat5e, Cat6, or local area network (LAN) cabling. The names are interchangeable.
- **GUI:** "Graphical User Interface". This is a type of software that allows users to interact with programs in a visual way i.e. as with Microsoft Windows™, as opposed to a text-based interface system.
- **IP:** "Internet Protocol". This refers to the technology involved in transferring data over the internet. The full name of the technology used in transferring data over Ethernet / internet networks is called TCP/IP. ("Transmission Control Protocol / Internet Protocol"). The TCP part exchanges the data reliably over a network whereas the IP part handles the addressing and routing part of getting data from A to B.
- **LAN:** "Local Area Network". A computer network covering a relatively "small" physical area i.e. not between cities or regions. A network covering an area as large as an airport will still correctly be referred to as a local area network.
- **Network Bridge:** network bridges and switches are very similar. A switch is a bridge with numerous ports.
- **Network Camera / Internet Camera / IP Camera / IP Network Camera:** these are all different names for the same thing. There is no difference between them in practice; the names are interchangeable.
- **Network Hub:** these were used in older network installations and have now largely been replaced by network switches. Names also include: "ethernet hub", "active hub", "repeater hub", "concentrator", or simply "hub".
- **Node:** a connection point in a network i.e. a modem, hub, bridge, switch, router or server.
- **PoE:** "Power over Ethernet". This is the technology that allows the transfer of both data and power over an ethernet / network cable simultaneously, meaning that you only need to install a single cable for a camera to function properly.

- **PoE Splitter:** a device which "splits" the data and power from an ethernet cable so that the two streams can enter a camera separately. This is necessary if the camera is not PoE compatible.
- **PSE:** "Power Sourcing Equipment". A device, such as a network switch or hub, which provides power in a PoE system. A "PoE midspan" is a type of PSE.
- **VID:** "Video Image Detection". This refers to software technology which enables intelligent use of video for such things as face recognition or fire / smoke detection. Image detection often takes place using software running within the cameras themselves i.e. at the "edge" of the network.
- **Video Server:** video servers convert analog video streams into a digital format. They usually have the capacity to store the video streams and often have a built-in user interface system, meaning that a user can access and manage the camera network independently of connected PCs. An NVR is one form of server.
- **VDSL:** stands for a "Very-high-bitrate Digital Subscriber Line". It provides very high speed internet over the wires of a local telephone network i.e. up to 52 Mbit/s downstream (download) and 16 Mbit/s upstream (upload) speeds. The most modern network connections are VDSL, allowing for such services as high definition television (HDTV) and voice over IP (VOIP) telephone.
- **WAN:** "Wide Area Network". A computer network linking cities, regions, or which crosses national boundaries.
- **WLAN:** "Wireless Local Area Network". The same as a LAN but using wireless internet technology i.e. Wi-Fi. Wireless networks reduce the costs of network installation and expansion. They are particularly appropriate in spaces where cables cannot be run, such as outdoor areas and historical buildings.
- **Wi-Fi:** "Wireless Fidelity". The most widely used class of wireless network technology, it is often used as a common term for a wireless local area network (WLAN). Wireless networks reduce the cost of network installation and expansion. They are particularly appropriate in spaces where cables cannot be run, such as outdoor areas and historical buildings.

www.gkbsecurity.com

7F, No.1, Lane 641, Shen Ling S. Road,
Taya Hsiang, Taichung, Taiwan
T 886 4 25605225~7 | F 886 4 25690506

About GKB

Founded in 1996, GKB Security Corporation is a global security solution provider based in Taichung, Taiwan. We are dedicated to developing practical security solutions for small and medium-sized system integrators and installers, featuring advanced integration of hardware and software, and intuitive, easy-to-use products.

As well as security hardware, GKB is currently the only provider which offers solutions with automatic camera internet protocol (IP) mapping from the router. This makes connecting a local area network (LAN) and security cameras to the internet easy. A full range of IP network security cameras and IP-based network equipment is also available and can also be found on the GKB website.