
**How to Choose the Right Network Cameras
for Your Surveillance Project**

Surveon Whitepaper



From CCTV to Network, surveillance has changed from single professional-orientated technology to one integrated complete solution. The technical brief is to help system installers and conventional CCTV engineers to establish a complete concept of network surveillance architecture and then to take advantage of the full IP-based surveillance trend in the security industry.

Responding to the development trend of high-resolution video surveillance, we are going to reveal the secrets of network HD surveillance solution in details concerning its architectures, designs, and practical planning. Hoping this technical brief can inspire people who wish to join this industry to build a solid background, cultivate a systemic thinking structure, establish a concrete technique and develop the ability to plan a surveillance solution in order to grab the new opportunities that HD surveillance has brought.

The technical brief will be divided into several parts. Firstly an overview of the network HD surveillance status, this part contains 4 important elements, Network Camera, Video Management Software, Network Video Recorder and Video Storage. Secondly how to build in the surveillance products and turn into practical applications through project analysis; this part is to illustrate by their levels of how to design a project from different aspects such as network architecture, number of cameras, and the complexity of the project. To classify the size of a project from the number of the cameras used, small-sized projects may contain less than 32 cameras, middle-sized projects 64, and 200 to 1000 or more cameras deployed can be seen as large-sized projects. The architectures can be also further defined as all-in-one, multi-points distributed, central distributed, and centralized cloud-based management. Thirdly examples sharing, example projects will be provided and analyzed to guide users to build a complete project step by step. Hoping that through these 3 parts of descriptions and practical demonstrations, users can handle more than 80% of projects and extend the knowledge to integrate different security surveillance projects in other industries.

From analog to network surveillance, the entire value chain of video surveillance has been deconstructed and reconstructed bringing great opportunities and challenges to the market. Geoffrey Moore, author of *Living on the Fault Line* and a business advisor on strategy and transformation challenges in the high-tech sector, Silicon Valley has pointed out in his book that the technology breakthrough has progressively penetrated into various markets and the target customers has changed from high-end technology-oriented buyers to main stream economical buyers, for

instance, from large-scale governmental projects to commercial markets. Products and channel patterns are changed from single technology-oriented business to complete solutions strengthening sales and technical support.

Compared to the network surveillance development nowadays, we are right at this technical and market-oriented turning point. Therefore traditional CCTV manufacturers, IP equipments supplier, or even IT manufacturers, ISP providers, whoever wants to seize the network HD surveillance opportunities today has to acquire basic knowledge of network, imaging technology, architectures, relevant applications and products in order to obtain the abilities of project planning and analyzing.

Basically the architectures of the traditional CCTV surveillance and the IP monitoring are quite the same. However when planning a project, the IP monitoring needs to put the followings into consideration, including resolution, network bandwidth limitation, coding/decoding, compression, network architecture, NVR platform, storage efficiency, and storage capacity. These key aspects, which may be foreign to CCTV surveillance, will be introduced in this technical brief. Now we will focus on the camera part.

Deconstruction of the Network Cameras

Traditional installers are good at selecting right analog cameras, but for IT system installers this is the main obstacle that keeps them from moving into the security surveillance industry. In fact, the components and the technologies are basically the same in the analog and network cameras. Drew an easy comparison with the monocular cameras below, users can perceive the basic concept of network cameras better.

The basic components of the monocular and network cameras include lens, filter, sensor, and image signal processor while the differences are processor for compression and networking functionalities.

Lens

Aperture

For CCTV surveillance, there are about 2 kinds of lens, fixed focal and vari-focal. However there are still some basic parameters that all practitioners should know, for example, IRIS, F-Stop, Focal Length, and Angle of View. Iris control contains auto iris

and manual iris. Whether it is an analog camera or a network one, iris control is always the key. You can calibrate the fixed focal lens to its maximum aperture value and for vari-focal lens via ISP detecting to control the iris (Auto-Iris or DC-Iris) to have the best performance.

The biggest difference between a monocular camera and a CCTV camera is that monocular camera only needs to determine the aperture value the moment a user press the shutter to bring out good results. But CCTV camera is working 24/7; for the best aperture value, it is required to continuously calibrate according to different lightings. ISP lens can provide better image quality for different lightings in the day time, cloudy days, or at night, auto detecting but the pricing is also higher. While fixed focal lens is better to be installed indoors for their steady lightings.

The mentioned F-Stop means the maximum aperture value; higher value indicates smaller aperture. Bigger aperture means more lights can be penetrated and therefore with better results in the low-lux environments. However, different from the artsy atmosphere that monocular cameras intend to create by using lesser depth of field, CCTV surveillance requires greater depth of field to have a wider monitoring range. How to maintain the smallest aperture, bigger depth of field, and visible images in the well-lit environments are the issues that cameras need to handle. Sometimes installers have the cameras set up in the day time and the images are clear. But when it comes to night, the image becomes blurry and out of focus. That is because the aperture has opened widely and then has shortened the depth of field.

Focal Length

After understanding the aperture focal value, now we are going to talk about focal length. Analog cameras are like digital cameras; their lens can be divided as fixed focal and vari-focal. Fixed focal lens can only be used in applications with unchanging depth of field and angle of view, while vari-focal lens is more flexible and can be adjusted to different situations. Factors such as lens with varied focal length and the distances between the camera and the object can result in huge differences in images. The bigger focal length produces bigger object images when the distance is closer, but when the distance is farther, the object images will be smaller. In fact, in order to select an appropriate lens, there are only 2 parameters you need to gather. Firstly, know the distances between the camera and the object. Secondly make sure the monitored object is zoomed in the image.

Due to the diverse monitoring environments, when installers do not know the exact situation, they often choose the vari-focal lens, regardless of their costly pricing, to avoid the adjustment problems on-site. But this may lead to additional costs. If installers can learn the distance between the monitored object and the camera beforehand, the installation costs can be lowered by purchasing the right lens. Normally fixed lens and indoor dome are sufficient for indoor usage.

Angle of View

Angle of view is also called field of view (FOV), meaning visible angle of a camera. Basically the wider the field of view, the bigger the monitoring ranges. Short focal length provides wide angle of view, while long focal length provides telescopic sight, narrow angle of view. Take the built-in camera in the smart phone as an example, the FOV of the built-in camera is way smaller than the one in the CCTV camera. Through the introduction above, you will be able to know the lens related specifications. Besides that, shutter speed can also determine the overall amount of light coming in and this also can affect the image quality. The slower the shutter speed means the longer the exposure and the larger amount of light; under low light conditions, the picture is clear but the image can also become blurry. Therefore, choosing the right shutter speed for the right environment is also very important when selecting the perfect camera for your project.

IR Cut Filter

The light coming into the lens will go through the filter before getting to the sensor. This functionality is called Day & Night.

Human eye can only see 400nm-700nm in the spectrum range but the invisible infrared light is also included in the sensor imaging. In order to filter out invisible infrared light, a filter needs to be added to ensure the image realism.

Featured with Day and Night functionality means it is built with IR-cut Filter Removable, ICR. When the ICR is switched on in the daytime, it will block infrared light and allow only visible light to past through. At night, the ICR is switched off to receive more sensitive to infrared light. A common misunderstanding is to think the IR LED implies Day & Night functionality, but what Day & Night functionality really requires is the IR-cut Filter.

Sensor

After lens acquisition and through invisible light filtration, the image will appear on

the sensor and then convert to digital format. Basically every cell on the sensor will collect only R.G.B. 3 colors to form raw images and through image signal processor (ISP) converting to real images.

When choosing a sensor, the most important things are resolution, size, and sensitivity. Since CCD sensor has its technical limitations, all the megapixel cameras nowadays are equipped with CMOS sensors. The quality of a sensor is determined by the receiving range and the sensitivity of every pixel. Thus the performance of the 1/2.8" 2M sensor is better than the 1/4" 2M sensor.

As for the professional grading, most seniors from this industry believe CCTV sensors from Japan are better than the ones from America. However, regarding the sensor performances, sensors for the webcam and smart phone are poorer than the ones for CCTV.

Image Sensor Processor (ISP)

Images are converted to digital format and then ISP will convert them to real images to human eye. Other than converting, ISP also performs other advanced functionalities, such as 3A algorithms (Auto White Balance, Auto Exposure, and Auto Focus), Wide Dynamic Range (WDR), Back Light Compensation (BLC), iris opening, shutter controls and so on. If the lens and sensors are in the similar grading, a camera is good or not lies in the choice of ISP and the manufacturer's skills of adjustments.

Take AXIS cameras as an example, some of their series deploy SONY sensors and utilize the ISP on their self-developed SoC.

In the early stages some big manufacturers such as Pelco and Bosch, they use (Digital Signal Processor) DSP as a platform for ISP adding a self-developed imaging technology. Therefore there are lots of features concerning ISP related specifications in the camera specification section. For example, all the functionalities of Video Control are executed by the built-in independent ISP, including Auto Gain Control (AGC), Auto Electronic Shutter (AES), and 3D Noise Reduction.

Once obtaining the specification knowledge, you will know how to select the right camera.

Lens, filter, sensor, ISP and mixed video signals, these are the composing factors of the traditional CCTV cameras. As for network cameras, there are more, including video compression and built-in processor for network, web, I/O managements, for instance, compressing video formats to H.264, M-JPEG, MPEG4, as well as the compression rate, controls over I/O and RS-485; these congenerous abilities are similar to what a personal computer can deliver. And SoC controls internet protocols, including FTP, RTSP, Email, and SD card.

From the illustrations above, users should be able to know what the network camera specifications are all about, including lens, sensor, filter, compression and internal controls. Beside what we have gone through, installers only need to know the monitoring environment, object relational mapping (ORM), camera types, such as dome, bullet and speed dome to handle more than 80% of megapixel network cameras.