

Networked Surveillance System Design Guide

Guide on setting up a networked video surveillance system

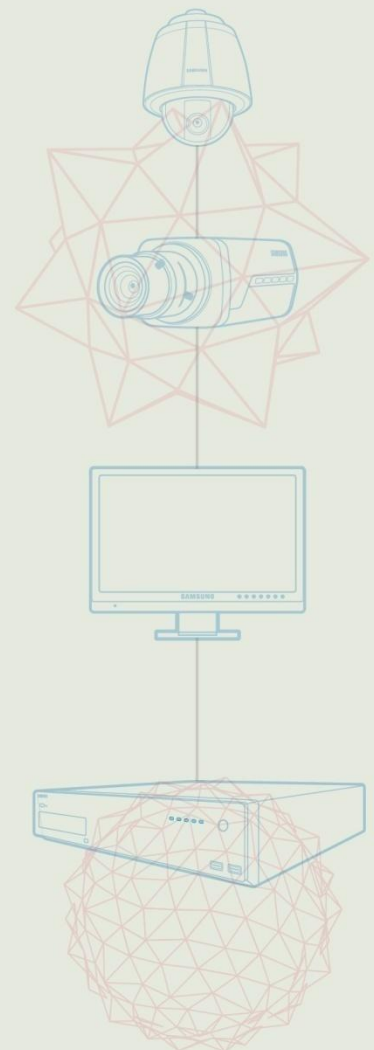


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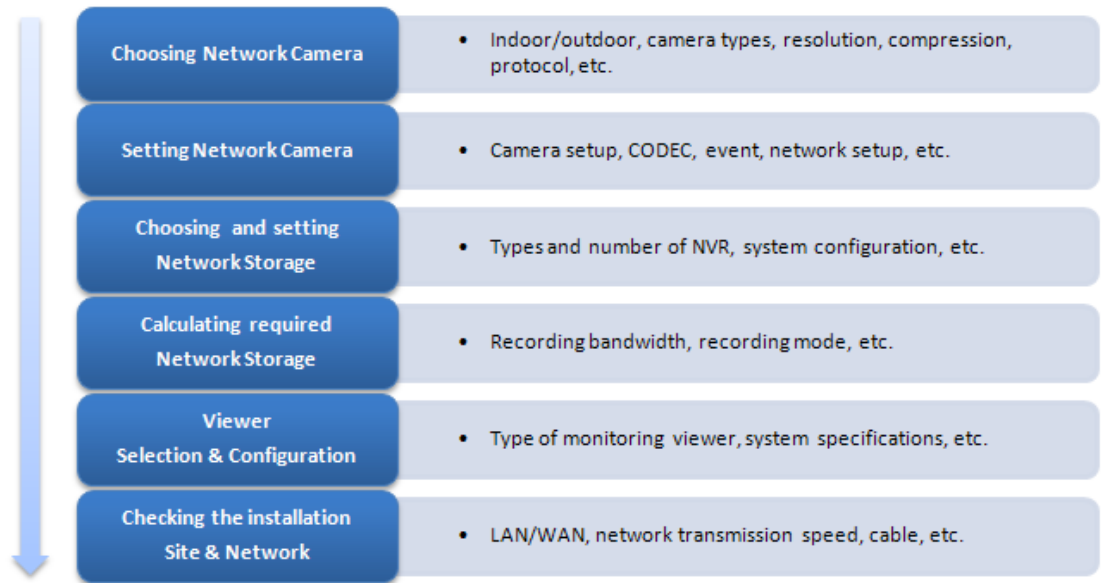
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Overview

Users and installers who are used to analog surveillance systems may have difficulties with the installation and configuration of a network digital surveillance system. This document explains the basic concepts and essential considerations on implementing a networked surveillance system.

Fig 1. Design Flow of Networked Monitoring System



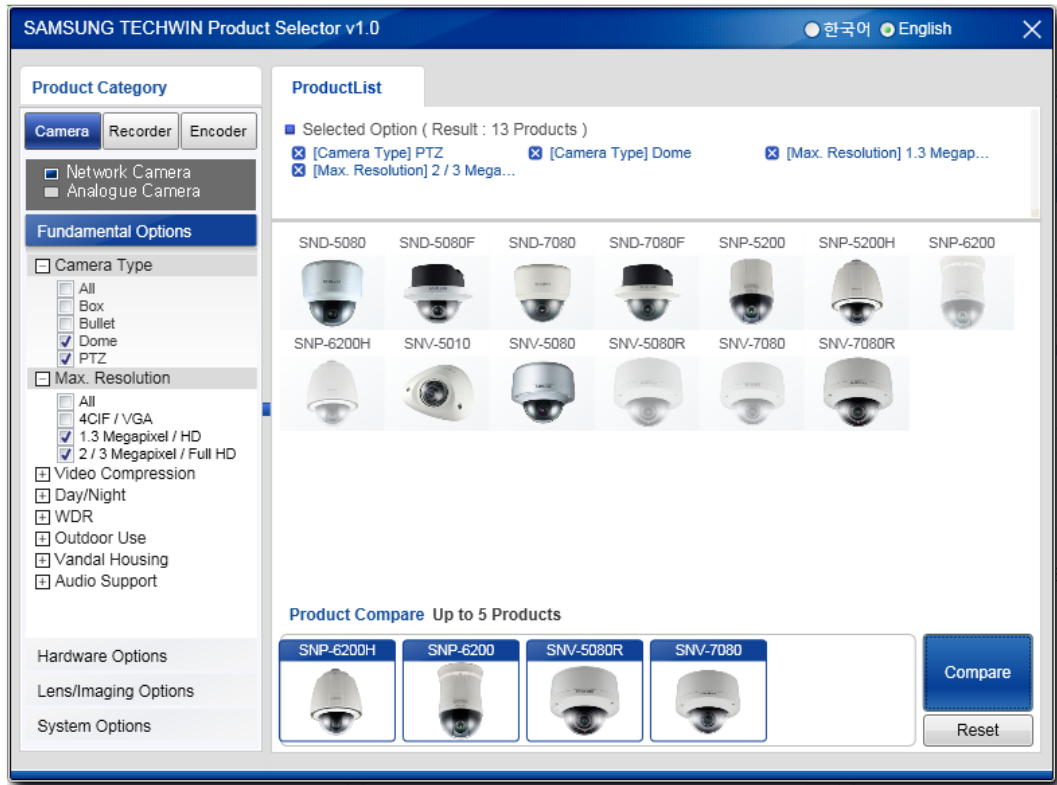
As the basic recommendation for general implementation, the above suggestion cannot be applied to every case and the order may be re-prioritized. When installing a networked surveillance system the relationship and functionality between the network environment and surveillance components should be considered.

Choosing Network Cameras

Network cameras are as varied as analog cameras. When selecting a camera, the installation site and purpose of monitoring should be carefully considered for satisfactory imaging result.

Having a large variety of camera models may cause difficulties when choosing the optimal camera selection for user’s circumstances. Samsung provides a “Product Selector” application program for better and easier selection of cameras to suit to user’s needs with comprehensive and easy comparison. It is downloadable from the Samsung website: www.samsungsecurity.com.

Fig 2. Product Selector Program



Samsung’s Camera Model Naming Convention

Samsung Network Camera names follow the naming convention as noted below, according to the types and features. A user can roughly tell the type and features of the camera by the product’s model name.

Fig 3. Naming Conventions

S	N	P	-	3	3	7	1	TH
Samsung	Network Camera	Appearance		Image Sensor (Pixel No.)	Lens (Zoom Ratio)		Ver.	Etc. Feature
		B : Box Z : Zoom V : Vandal Dome D : Interior Dome P : PTZ U : P/T United O : One body box M : Module		9 : EMCCD 8 : 5Mega 1 7 : 3Mega 6 : 2Mega 5 : 1.3Mega 4 : SVGA 3 : WDR CCD 2 : BLC CCD 1 : VGA CMOS	00 : No Lens 01 : 3mm Fixed 02 : 3 ~ 4mm Fixed 03 : 4 ~ 6mm Fixed 04 : 6 ~ 10mm Fixed 05 : 10mm Fixed 06 : 2x V/F 08 : 2 ~ 9x V/F 09 : 10x V/F XX : Zoom (PTZ, Zoom) 36 : 360° Fisheye			B : Black R : IR RF : IR + Flush type H : Housing C : Counting CF : Counting + Flush type T : Tracking TH : Tracking + Housing VH : Vandal + Housing

Indoor / Outdoor

By its exterior shape and material, network cameras are categorized into indoor and outdoor types.

Indoor

Indoor cameras are relatively less affected by ambient conditions, compared to outdoor cameras. In general, camera body and its housing such as dome cover of indoor cameras are made of plastic material.

Outdoor

Outdoor cameras should endure and provide protection from exterior influences. In general, outdoor cameras may include below features:

- ✧ **Heater & Fan**
Provides protection to the camera from ambient temperature and humidity. Heater or fan operation requires power, which should be provided with additional power supply .
- ✧ **Sun shield**
It protects the cameras lens from exposure from direct sun light, built-in for all Samsung’s outdoor PTZ cameras.
- ✧ **IP Rating**
Two digits of IP rating code where the first digit indicates the product’s protection against dust and the second against water. Samsung outdoor Network cameras are classified as at least IP66.
- ✧ **IK Ratings**
IK code indicates how well the product is protected from external impact. Some of Samsung Network cameras are classified as IK10.

Fig 4. Solid Particle Protection Ratings - IP Code

First digit		Second digit	
<i>: level of protection against dust</i>		<i>: level of protection against water</i>	
0	No protected	0	No protected
1	Protect against solid objects larger than 50mm (Large surface of the body, such as the back of a hand)	1	Protect against dripping water
2	Protect against solid objects larger than 12mm (Fingers of similar objects)	2	Protect against dripping water when tilted up to 15°
3	Protect against solid objects larger than 2.4mm (Tools, thick wires)	3	Protect against spraying water when tilted up to 60°
4	Protect against solid objects larger than 1mm (Most wires, screws)	4	Protect against splashing water
5	Protect dust (Ingress of dust is not entirely prevented)	5	Protect against water jets
6	No ingress of dust; complete protection against contact	6	Protect against powerful water jets
		7	Protect against immersion up to 1m
		8	Protect against immersion beyond 1m

Fig 5. Impact Protection Ratings - IK Code

IK number	
: level of protection against <i>mechanical impact</i>	
00	No protect
01 – 05	Protect against impact lower than 1Joule
06	Protect against 1Joule impact (Drop of 500g object from 20cm height)
07	Protect against 2Joule impact (Drop of 500g object from 40cm height)
08	Protect against 5Joule impact (Drop of 1.7Kg object from 29.5cm height)
09	Protect against 10Joule impact (Drop of 5Kg object from 20cm height)
10	Protect against 20Joule impact (Drop of 5Kg object from 40cm height)

Camera Types

Box Cameras

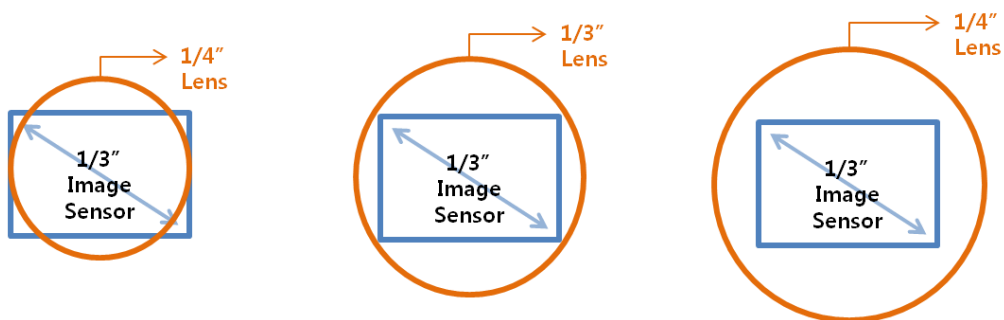
Fig 6. Box Camera



Box camera is a fixed camera type. This camera type is suitable if no movement adjustment is needed once installed, however box cameras can combine with modular pan/tilt driver. In this case, the camera should support RS-485 communication and its protocol also used by the pan/tilt driver module. A lens is not included in a box type camera, and a suitable lens should be purchased separately. When purchasing a lens, the size and resolution of the camera's imaging sensor should be considered.

When selecting a lens for the box type camera, the camera's imaging sensor size should be considered. The image sensor size specifies the diagonal length of the sensor, and the lens size indicates the diameter. If equipped with a lens that does not fit to the image sensor, vignetting may partial block areas of the sensor, which will result improper imaging.

Fig 7. Image Sensor and Lens Dimensions



Zoom Cameras

Fig 8. Zoom Camera



A zoom camera is a special type of box camera that includes an optical and mechanical zooming device. Camera movement is not available once installed, but its zoom capability provides zooming function to enlarge and reduce acquired images when required. While zooming is classified into two types, optical and digital zooming, zoom cameras utilise an optical zoom function.

✧ Optical Zoom

When using an optical zoom provided by optics of lens, the quality remains the same and full resolution can be used with enlarged images.

✧ Digital Zoom

Lens has no optical zoom feature; an acquired image is digitally processed for enlarging. Since digitally enlarged and interpolated, the image quality and sharpness are reduce.

Dome Cameras

Fig 9. Dome Camera



A Dome camera is fixed type camera designed to be installed on a ceiling. The lens module included with the dome camera should be adjusted to frame the desired monitoring angle during installation. Dome cameras are categorized by the focusing type as below:

- ✧ Fixed Focal Length

The focal length of the camera lens is fixed and focus is not changed. Suitable for monitoring static targets.

- ✧ Varifocal Lens

The Visible area and focus can be adjusted during installation. It is suitable for monitoring dynamic targets and if the distance to the subject cannot be accurately calculated or fixed. Varifocal lenses benefits from the versatility of viewing angles without having to replace the lens module, compared to a fixed type lens. A Varifocal camera's focal length should be adjusted during installation, to fit the desired target subject's size.

In general, a dome camera's focal length is adjusted manually when installed. For some products, an 'electric focus adjustment' feature allows for remote focus adjustment with video transferred via a network.

And for the housing, there are two types for dome cameras:

- ✧ Flush: Flushed mounting type, which will be flushed into the ceiling.
- ✧ Surface: Surface mounting type, surfaced on the ceiling when installed.

Infrared Cameras

Fig 10. IR Cameras



This type of cameras has built-in IR (Infra Red) LED illuminators. They create brighter and clearer images under low-illuminated situations compared to non IR illuminated cameras. The camera's visible range

and other conditions depend on the specification and number of IR LEDs.

Fig 11. IR Camera Recordings



PTZ Cameras

Fig 12. PTZ Camera



PTZ cameras are capable of remote control of their directional and zoom movement after the installation. PTZ means Panning (side to side), Tilting (up and down) and Zooming (in and out). A PTZ camera is suitable for monitoring multiple areas or moving objects rather than fixed views. The Camera specifications should be considered to when selecting a PTZ camera, such as PTZ control speed, patrols & presets and zooming ratio.

Visible Scene (Field of View)

When selecting a camera, the dimension of monitoring scene should be considered. The camera’s visible scene can be calculated by using lens format size, focal length of the lens, and distance between lens and object.

Samsung provides a “FoV Calculator” application program for better and easier selection of cameras to suit to user’s needs. It is downloadable from the Samsung website: www.samsungsecurity.com/.

Fig 13. Field of View calculator

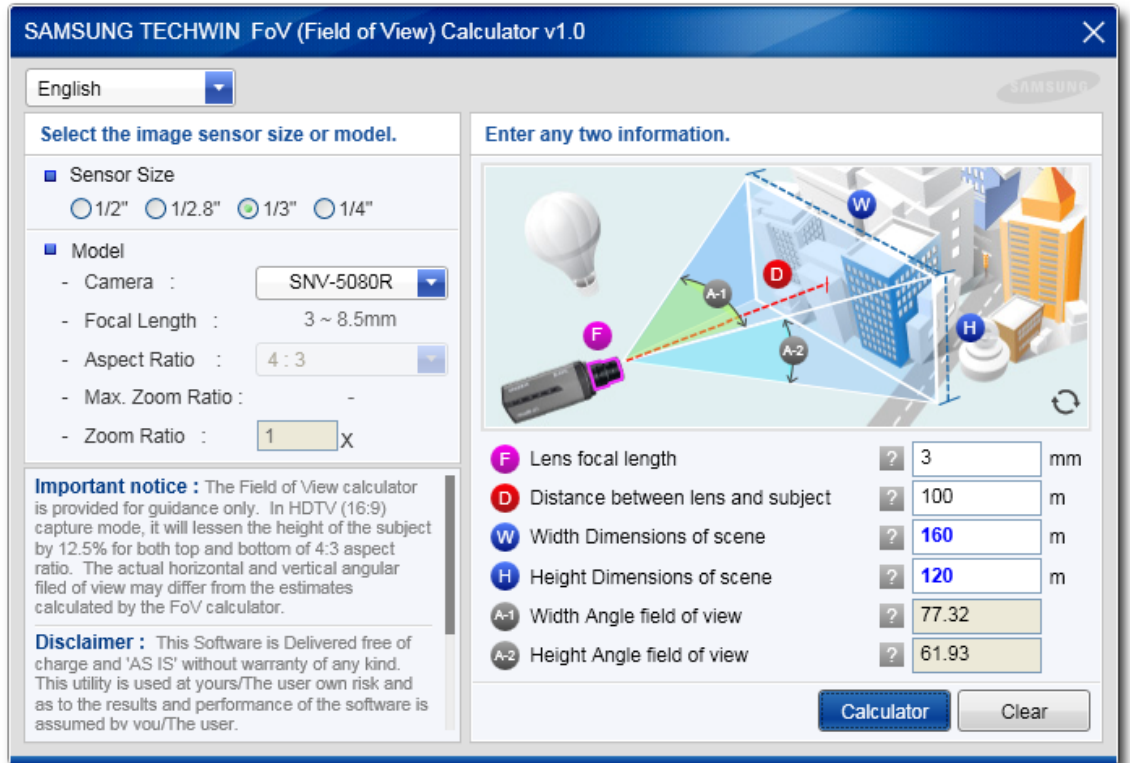
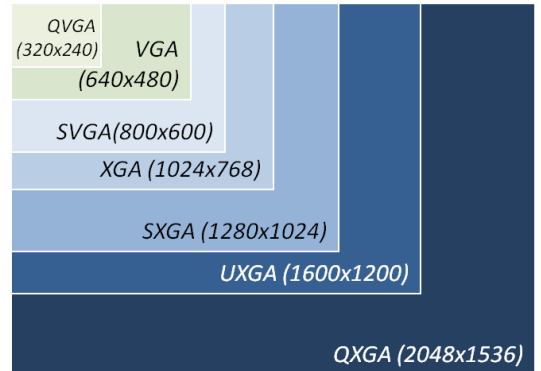


Image Resolution

Samsung’s cameras are categorized by 3 grades of resolution (VGA / HD with 1.3M Pixels / Full HD with 2M or 3M pixels). Higher the resolution, the clearer and larger the image that can be provided; the cost and video data size will also increases which subsequently require a bigger storage capacity and higher network bandwidth. Hence, when considering image resolution of cameras, one should regard the network environment of installation site storage components and features such as Smart Codecs.

Fig 14. Image Resolutions of Network Cameras

Format	Resolution	Pixel No.
QVGA (Quarter VGA)	320x240	0.077Mega
VGA (Video Graphics Array)	640x480	0.3Mega
SVGA (Super VGA)	800x600	0.5Mega
XGA (eXtended Graphics Array)	1024x768	0.8Mega
SXGA (Super eXtended Graphics Array) - An aspect ratio of 5:4 instead of 4:3	1280x1024	1.3Mega
UXGA (Ultra eXtended Graphics Array) - 4times resolution of SVGA (800X600)	1600x1200	1.9Mega
QXGA (Quad eXtended Graphics Array) - 4times resolution of XGA	2048x1536	3.1Mega



Video Compression Methods

Video compression methods are applied to network surveillance systems for effective video transmission and data storage to reduce the data size. Samsung provides three methods of video compression MJPEG, MPEG-4 and H.264.. Each compression standard employs different technologies and characteristics. You can select the optimal compression method according to your environment and purpose.

MJPEG (Motion JPEG)

MJPEG compresses each of the video frames of a digital video sequence separately using the JPEG format. As it compresses individual video frames, it does not compress inter-frames.. The compression ratio of MJPEG is relatively low compared to inter-frame compression standards (such as MPEG-4 and H.264). On the other hand, its frame independent compression exhibits low risk of video loss even if some of the frames are damaged or lost during transmission.

Fig 15. MJPEG Encoding



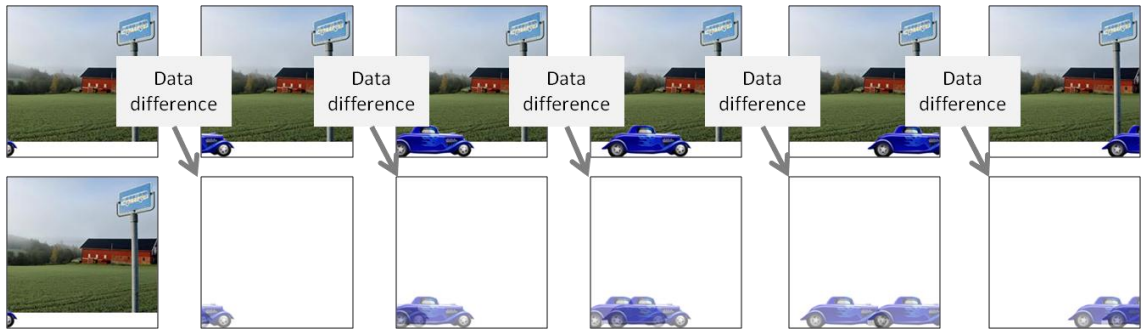
MPEG-4 (Moving Picture Experts Group 4)

MPEG-4 is an inter-frame video compression standard that compresses only the differences between frames in a video sequence, resulting in a better compression ratio compared to MJPEG, which

compresses individual frames. By its nature, playing back one frame image of an MPEG-4 compressed video sequence requires not only the target frame but neighboring frames too, which means that the loss of one data frame may affect other frames that require the lost frame's data. In practice, frames of inter-frame compressions are grouped together by GOP (Group of Picture) and playing a video sequence containing a damaged frame displays nothing from that frame until the next GOP begins.

In a GOP, the first frame is called an I-frame that has the full frame image data, and is compressed as in the MJPEG method. The rest of the frames in the GOP are referred to as P-frames and they are dependent on their previous frames. One GOP consists of one I-frame and multiple P-frames.

Fig 16. Inter-frame Video Compression



H.264

H.264 is the latest inter-frame video compression method; it exhibits a better compression ratio than the MPEG-4, and has gained popularity and has started to replace MPEG-4. It provides a better compression ratio while not compromising the quality, however it requires greater hardware system resources to process the encoding (compression) and decoding (decompression) compared to other compression standards. Hence, this method is commonly applied to reduce the network traffics and total amount of data storage when implementing the surveillance system with high-resolution network cameras.

Fig 17. Data Size Comparison on MJPEG and H.264 Encodings

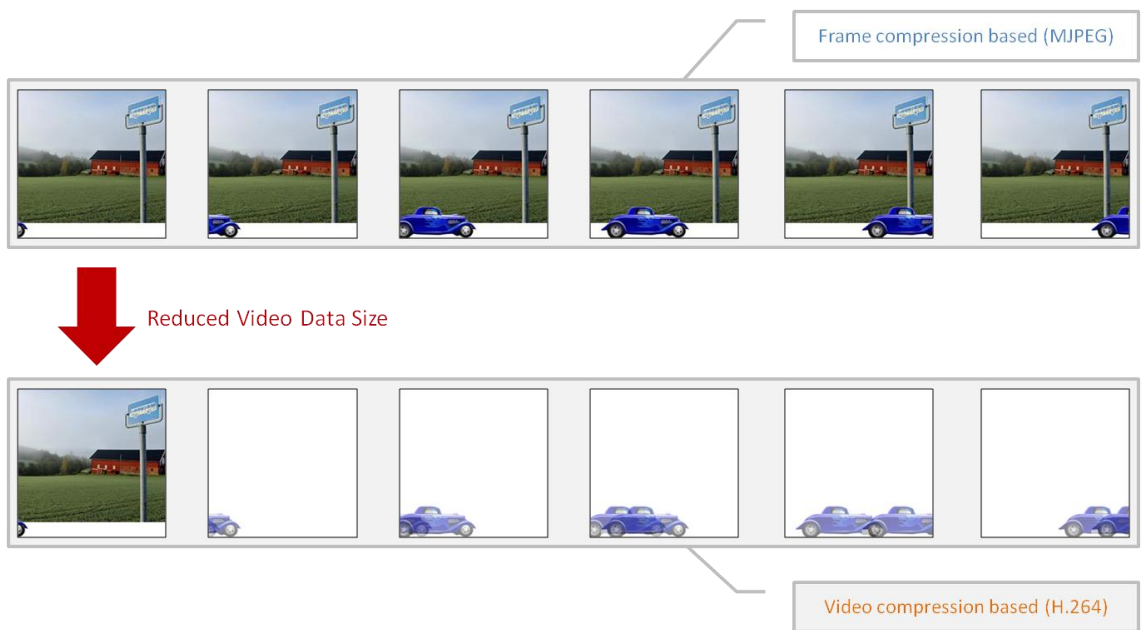
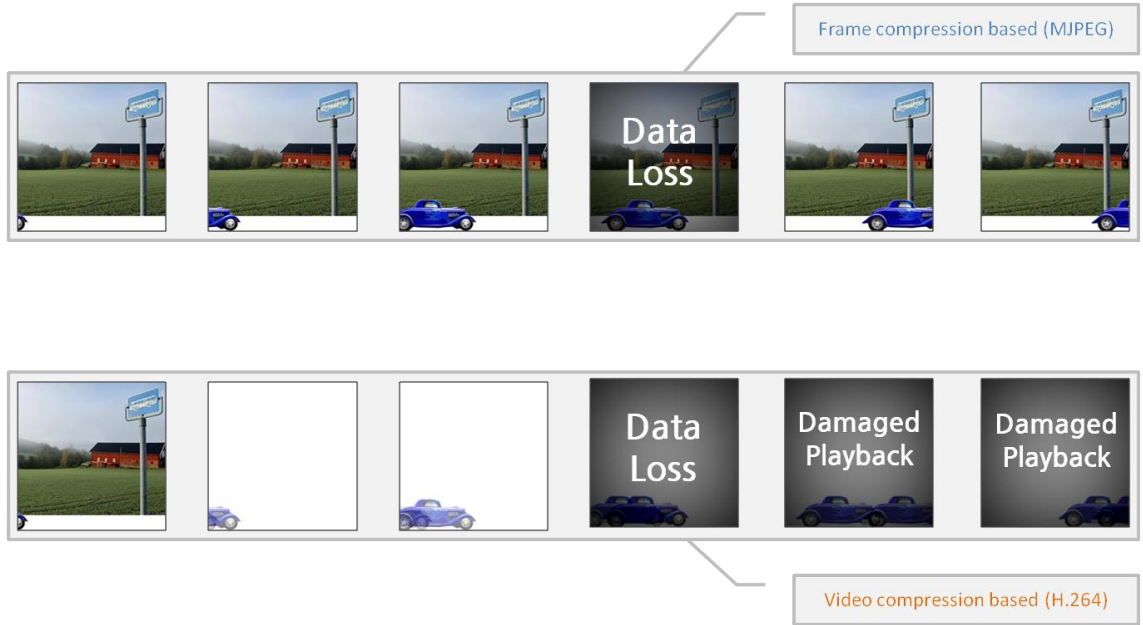


Fig 18. Data Loss
Comparison on
MJPEG and H.264
Encodings



Network Security

Various security devices are employed by network surveillance system for secure data transfer between devices. Network security and authentication methods provided by Samsung Network Cameras are described below:

HTTPS(SSL) Login Authentication

This communication protocol works the same as HTTP, added with SSL (Secure Socket Layer) data encoding. Applying SSL data encryption to all video data transferred slows down data transfer rate and causes delayed playback with a drop in frame rates due to the encryption / decryption process. To avoid such drawbacks, Samsung Network Cameras apply HTTPS (SSL) data transfer only for logging in authentication challenge with account name and password but not to the subsequent video data transfer.

Digest Access Authentication

The digest authentication method is a credential negotiation provided by IIS service, which applies protection to data communication with encryption. Samsung Network Cameras uses Digest method for user authentication with account and its password when initializing an access to a network camera.

IP Address Filtering

Users accessing network cameras from a certain IP address can be blocked. Samsung Network Cameras provide both Allow and Deny filtering. The Deny filtering allows all but listed IP addresses, while Allow filtering blocks all IP addresses unless allowed by the list.

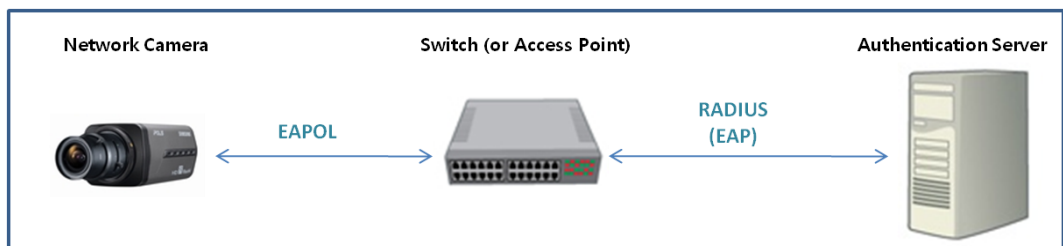
User Access Log

Network camera logs access activities of accessing user account and access time. The system administrator can view the corresponding log to check user’s access history.

802.1X Access Control

IEEE 802.1x is an IEEE (Institute of Electrical and Electronics Engineers Standards Association) standard for port-based LAN Network Access Control. It provides an authentication mechanism for accessing devices on the network to allow accessing for authenticated users only. To apply this authentication method to your network, you need an access control server that negotiates user credential to grant / decline a user access and an authenticator device (switch) that controls access accordingly.

Fig 19. 802.1x Authentication Method



802.1x authentication mechanism flows as below:

1. User (supplicant) attempts access to the authenticator (switch) device.
2. The authenticator (switch) asks user for ID.
3. User sends ID to authenticator.
4. The authenticator transfers user ID to authentication server.
5. The authentication server asks KEY for access grant.
6. The authenticator (switch) transfers KEY request to the user.
7. The user sends KEY to authenticator.
8. The authenticator transfers user KEY to the authentication server.
9. The authentication server checks transferred KEY and grants access accordingly.
10. The authenticator allows user access to the destination network component.

Communication Protocol

Communication protocol is a system of digital data formats and rules for exchanging messages in or between network devices that are required to use the same protocol for proper communication between multiple network components. For example, for network camera’s to communicate using Samsung protocol, other components such as storage devices and the monitoring viewer should use the Samsung protocol.

To avoid incompatibility in communicating various components from different manufacturers, efforts are under way to standardize surveillance communication protocols, such as ONVIF and PSIA.

✧ ONVIF (Open Network Video Interface Forum, <http://www.onvif.org>)

Driven to conclude standardization of network protocol by network camera manufacturers including AXIS, SONY, Bosch and in Samsung network cameras.

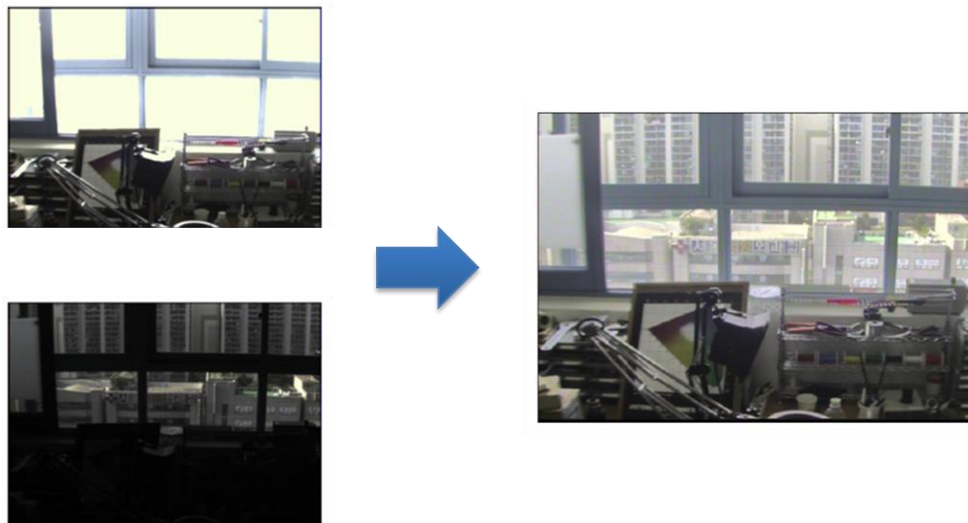
Other Considerations

Apart from the points mentioned above, there are more aspects to be considered in designing a surveillance system. Consider the points listed below and choose the appropriate camera device for your installation site's environments or monitoring purposes.

WDR (Wide Dynamic Range)

WDR function provides clear images of both bright and dark area even under backlight circumstances where the intensity of illumination can vary excessively. In practice, the camera records the same scene twice; firstly it adjusts the exposure appropriate to the dark area then for the bright areas before combining the two images to create the optimum result. Some products, when using the WDR function drop the frame rate of produced.

Fig 20. WDR Backlight Compensation



Audio Communication

If audio communication is supported by network cameras and installed with a microphone and speaker, you can listen to the audio around the remote camera or send your voice to a camera on a remote site. All Samsung network cameras supporting audio provide a full duplex audio communication enabling the sending and receiving of audio data simultaneously (two-way audio).

Saving Video into SD Memory Card

If the camera supports a SD memory card interface, you can set the camera to save video data onto the installed SD memory card. This feature is very useful in terms of continuous surveillance recording if the network connection is lost or the storage device such as NVR has problems with saving the data.

Compared to the generated video data size, the SD memory card has a relatively small capacity (usually 1GB ~ 32GB of SD/SDHC memory cards) and is not adequate to be used as the main storage device. It is recommended that the camera is configured to record onto the SD memory card for only events and similar situations or when the network connection is interrupted. Video data stored in the SD memory card can also be browsed and played from an external viewer program.

PoE (Power over Ethernet)

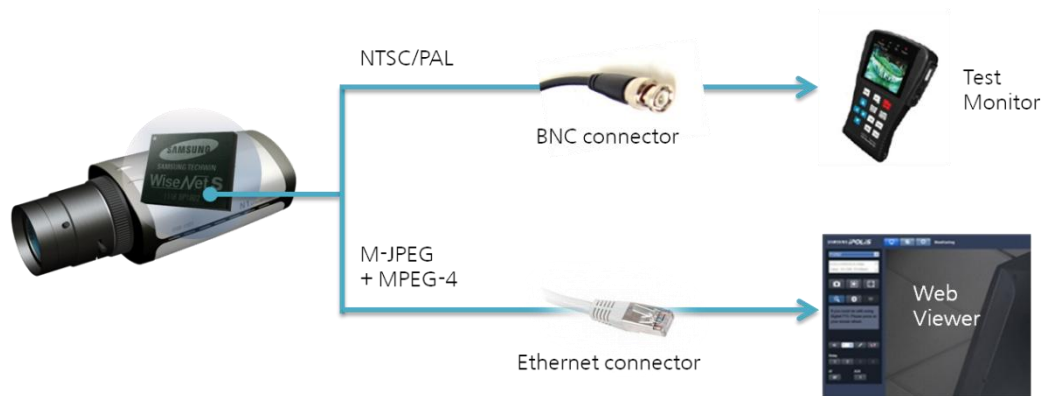
PoE (Power over Ethernet) means that the camera can receive power through the same cable that is used for the data. Removing the power cabling requirement by sharing the cable installation time and costs are reduced especially if there are a number of network cameras be connected. To take advantage of PoE, you need to install PoE supporting switch or converter on your network.

General PoE devices comply with the IEEE 802.3af standard, while most PTZ cameras consume more power for driving the PTZ comply with PoE+ (IEEE 802.3at). For some PoE enabled PTZ cameras with a built-in heater, power supplied by PoE is not enough for heater operation. To use the heater of such cameras, it is necessary for a separate power supply to be used.

Analog Video Out

A network camera's data communication is made in a digital format, yet some cameras provide analog output for installation adjustments of the lens and other settings. Such analog output supporting cameras may experience a reduced performance of lower frame rate on the digital output if the analog output is set to be enabled. It is recommended to turn off analog output function in the camera menu after the initial installation adjustments are complete.

Fig 21. Network Camera's Analog Video Output



Intelligent Video Analysis

By using Intelligent Video Analysis, the user can detect targeted moment from a video sequence. Video analysis types provided by Samsung Network Cameras are described below:

- ✧ Motion Detection
most of cameras provide this feature; detects motion on the video.
- ✧ Audio Detection

detects audio on the video.

✧ Face Detection

detects human face on the video.

✧ Tampering

detects tampering attempts, such as sudden change of camera's viewing direction, blocked lens and other overall change to the scenes on the video.

✧ Virtual Line

creates an event when a user-defined virtual line is crossed. Users can specify the orientation of such motion (→, ←, ↔) of objects against the defined line.

✧ Enter/Exit

creates an event when an object has entered or exited a user-defined area.

✧ Appear/Disappear

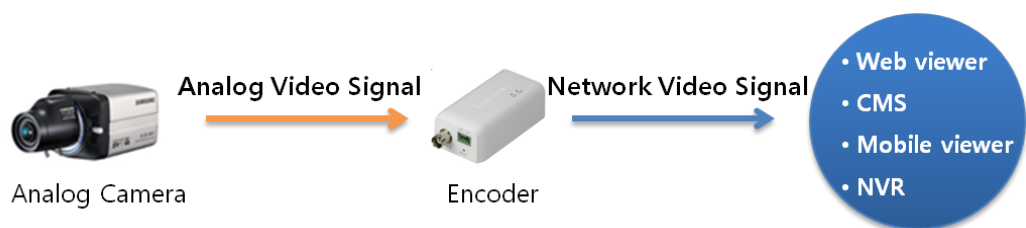
detects event that is continuous for a certain time period, for object's appearance or disappearance in a user-defined area.

Analog Camera + Encoder

An encoder is a device that converts an analog camera's video to digital video data and that is then transferred over a network.

The encoder only converts analog video from the analog camera into digital data; original video quality and compensation functions such as WDR and DNR will depend on the analog camera's specifications.

Fig 22. Data Transfer with Encoder Conversion



Setting the Network Cameras

After installing a network camera, it should be configured to adapt to the operation environments and produce the required video output.

Camera Setup

The camera settings listed below are constituents of a camera's configuration. (* A specific camera models may not support one or more items.)

Day and Night

During daylight, there is enough illumination for clear image but it is hard to acquire clear enough images as light diminishes at night. The Day and Night function of the camera is to improve the image quality under low illumination. There are two typical methods of Day and Night function:

✧ True Day and Night

In front of the imaging sensor of the camera, ICR (Infrared Cut-filter Removal) is fitted that cuts infrared light out in daytime. Infrared is allowed to go through the ICR in night time to produce clearer image. To improve the effect further, the color video image is converted into monochrome (black and white) by the camera's software (while remaining in color for daytime viewing).

✧ Software Day and Night

An ICR unit is not used, the camera's software simply converts the nighttime video images into monochrome (black and white). Since viewing in monochrome mode renders a better contrast for human eyes compared to viewing the same nighttime video images in color mode, this simple conversion method works well.

This function is required if the camera is installed in a place of varying illumination in accordance with time.

Backlight Compensation

If the camera's field of view contains light directly behind the object, then the objects in the scene become too dark to monitor properly. A typical case of backlight is viewing the building's entrance with a camera installed inside to monitor people entering. In such circumstances, outdoor illumination is brighter than that of inside the building and the camera produces video images with dark objects. Hence, the compensation function for backlight condition is required. Samsung cameras provide backlight compensation function of 3 types: BLC, HLC and WDR.

✧ BLC (Back Light Compensation)

Camera's BLC function works by hiding away portions of the scene with user-defined masking area to enhance the brightness and picture quality of the interested objects. BLC function's drawback is that the brighter portion of the image becomes saturated and not clear enough for monitoring.

✧ HLC (High Light Compensation)

The camera automatically detects overbright light from the viewable image and hides them (e.g. vehicle's headlight, spotlights of streetlamp, etc.) from over exposure to produce clearer result in the rest of the image.

✧ WDR (Wide Dynamic Range)

Camera captures backlight image twice. The first capture with a long exposure for darker areas, and the other with a short exposure for brighter areas. These are then combined to produce one image with both the darker and brighter portions are well displayed. Unlike BLC and HLC, it is not software processing but the imaging sensor hardware that processes the same frame twice.

✧ **SSDR (Samsung Super Dynamic Range)**

Useful in high contrast or backlight scene. Automatically lighten of the dark areas within a scene whilst maintaining the brighter areas at the same level. This ensures that the dark areas become more visible allowing the operator to view objects in the shadows.

Noise Compensation, DNR (Digital Noise Reduction)

It is an image processing function, using software that reduces the noise on a video image. Noise on images can be introduced by imaging sensor’s bad pixels, or low illumination.

Noise reduction methods can be categorized into 2-dimensional and 3-dimensional methods. 2-dimensional reduction compensates noise within a signal frame image, by referring to color values of neighboring pixels to the noisy pixel and corrects the noisy pixel’s color value with interpolation. With the 2-dimensional method applied to portion of a fixed object in the scene, color saturation may cause smudging of the objects border. The 3-dimensional method is inter-frame compensation, by referring to color values of the same pixel from multiple frames. If applying 3-dimensional method to a video sequence containing a moving object, inter-frame correction may produce afterimages in the scene. Samsung’s network cameras provide SSNR (Samsung Super Noise Reduction), a unique noise reduction method that combines both 2D and 3D methods to the noise reduction process . It distinguishes moving object in the fixed area from the video sequence, applying the 2D method to moving object and 3D method to fixed areas, resulting in optimal output with maximized noise reduction as well as a sharp and clear image. If a network camera is configured to apply noise reduction, user can expect both improved quality and reduced data size of the video; this can benefit effective data processing.

Fig 23. Noise Reduction



White Balance, AWB (Automatic White Balance)

This function automatically balances color distribution according to the ambient color temperature of the local environment. The local lighting influences colors captured by camera, and this function is required to reproduce the exact color of the scene.

CODEC Setup

This setting specifies how the network camera compresses and transfers video data. The produced data size and image quality depend on this setup. It is important to find the best and optimal settings for your purpose and environment.

For further information, visit Samsung website at www.samsungsecurity.com and refer to “Network Camera Video Settings” of the on-line tutorial.

CODEC Types

Samsung Network Camera supports 3 types of MJPEG, MPEG-4 and H.264. Network camera is capable of applying different codecs to different accessing clients accordingly, set your camera to use appropriate codec for a clients requirement.

Detailed codec setup items and available settings are listed below:

- ✧ MJPEG
Resolution / Frame Rate / Compression
- ✧ MPEG-4
Resolution / Frame Rate / Compression / Bitrate Control / Maximum Bitrate
- ✧ H.264
Resolution / Frame Rate / Compression / Bitrate Control / Maximum Bitrate /
Encoding Priority / GOP Size / Entropy Coding

Resolution

Resolution defines the size of video image. Samsung network cameras can be configured to produce images in various resolutions. The higher the resolution, the bigger the data size produced for the video image, resulting in higher network bandwidth and storage capacity requirements.

Frame Rate

The frame rate setting defines how many frame images for a certain time unit are produced and transferred. Generally, it refers to the number of frame images in one second and noted in FPS (frames per second) unit. Transferring a streaming video sequence in real-time at most resolution is available (at 25 fps or 30 fps), but some higher resolution settings may have a lower frame rate per one second. For example, SNB-7000 camera with 3 M pixels can send UXGA resolution video at a maximum rate of 20 fps. The lower the frame rate, the required network bandwidth and storage capacity drops but playback of this video sequence renders the viewing unnatural due to bigger time difference between frames.

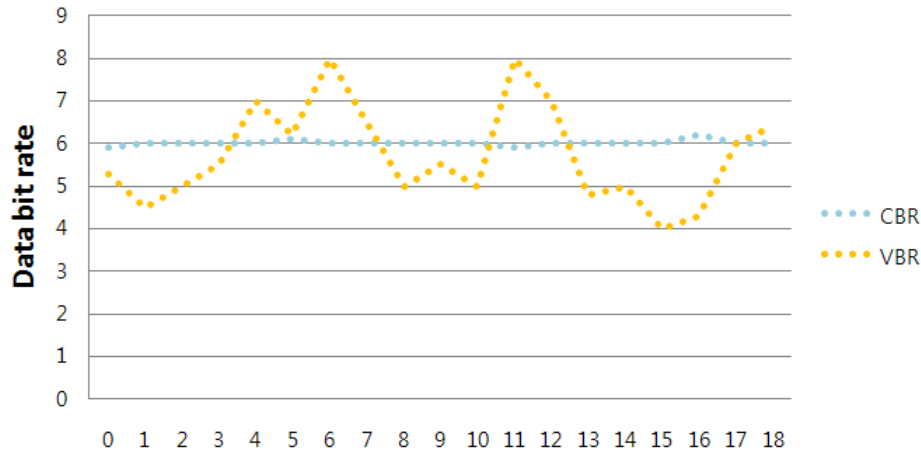
Compression

This setting decides the compression ratio of video image. A high compression ratio produces smaller frame data sizes but the image quality deteriorates accordingly.

Bit Rate Control

Bit rate control defines how the amount of data transfer is controlled. Apply the favorable setting to your installation environment for stable system operation.

Fig 24. Bit Rate Control



✧ CBR (Constant Bit Rate, Fixed Bit Rate)

Controls data transfer for all individual video images constantly. Due to its constancy, data processing is simple and the expected network traffic can be calculated easily benefiting a stable system operation. However, if an increased data size of dynamic or complex video frame image exceeds the limit, such images have to be compromised in quality or frame rate to maintain fixed bit rate. As a result, the overall image quality of video sequence cannot be maintained at a constant level. Additionally, it may waste network bandwidth and storage since it maintains constant bit rate, even if the frame images are simple and static and require far less bit rate.

✧ VBR (Variable Bit Rate)

Unlike CBR, VBR is designed to adjust to fluctuation in the data size of video images. It allows constant image quality and frame rates pre-specified by the user. On the other hand, the amount of data produced and transferred is not easy to predict due to its nature and results in difficulties with designing network bandwidth and storage capacity of the surveillance system.

Target Bit Rate (Maximum Bit Rate)

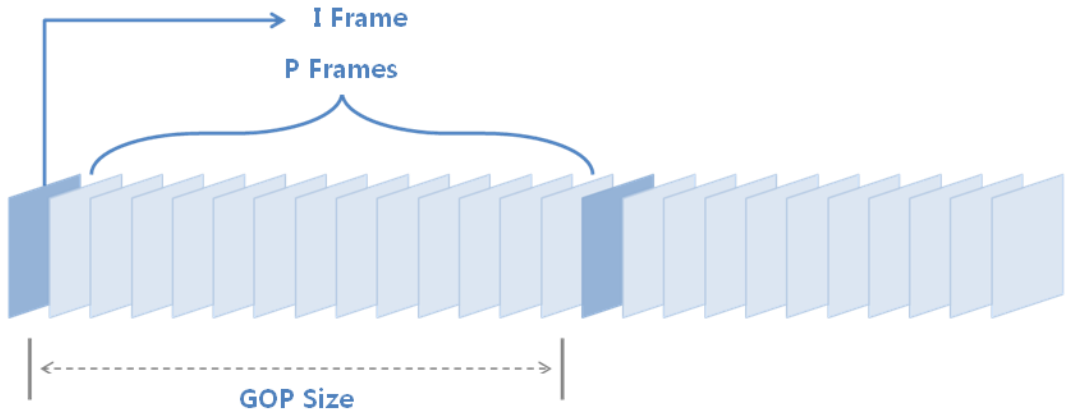
It sets the amount of transferred video data for the network camera. According to the bit rate control setup, this setting defines the target bit rate for CBR and the maximum bit rate for VBR.

You can configure a camera of CBR control to have priority for amount of produced data to be transferred exceeding the target bit rate. You can prioritize the frame rate or the image quality against each other. When the frame rate is prioritized, if the amount of video image data exceeds the target bit rate specified, then the camera lowers image quality to reduce the bit rate. When the quality is prioritized, it reduces the number of frames transferred to lower the bit rate.

GOP (Group of Pictures)

GOP means a set of relevant neighboring frames in inter-frame compression methods such as MPEG-4 and H.264. The GOP size is defined by the number of frame images from an I-frame and trailing P-frames before the next I-frame. As GOP size increases, the number of P-frames of the GOP increases and the size of entire video sequence decreases accordingly. On the other hand, if one frame image is damaged, many of the trailing dependent frames can become unusable too, until the next I-frame.

Fig 25. GOP Size



Entropy Coding

It is an encoding method of replacing input symbols by the corresponding variable-length prefix-free output codeword, according to the appearance probability of input video data symbol. Samsung network camera provides CAVLC and CABAC methods of entropy coding.

- ✧ CAVLC (Context-Adaptive Variable-Length Coding)
Relatively low compression ratio than CABAC, requires less hardware performance and resources than CABAC for encoding/decoding.
- ✧ CABAC (Context-based Adaptive Binary Arithmetic Coding)
Results better compression than CABAC, requires more hardware performance and resources than CAVLC for encoding/decoding.

Event Setup

Using the camera events, the user can easily be notified by the time of event, and search / save video data effectively. When the camera detects an event, it can save the event video sequence into the SD Memory Card or notify users with E-mail or FTP according to configured setup.

Motion Detection

Camera detects motion from the captured video sequence. The user can define a certain area or portion of the camera's field of view as a detection area or as excluded from detection. The sensitivity level of the sensor for detecting motions can be set too.

When setting the sensitivity level, it is recommended to set to a low level for distinctive scenes that are sufficiently illuminated and easy to distinguish subjects from the background. Set to high for low-light conditions with blurred subjects and background.

Audio Detection

This function generates event if sound (by volume) is detected.

Intelligent Video Analysis

By analyzing the video sequence being recorded, Intelligent Video Analysis detects certain changes to the video. Samsung network cameras provide analysis events for Appear / Disappear, Enter / Exit, Virtual Line and Tampering. In addition, user can specify object dimensions (width/height, max/min pixel size) and sensitivity. Applying the Intelligent Video Analysis may create differing results depending on the installed environment and settings, and may require adjustments to the settings in the field to produce intended results in practice.

Alarm

It is a type of events, generated by sensors and other alarm input devices connected to the camera. There are two typical alarm triggering conditions, NO and NC.

- ✧ NO (Normally Open)

Considers “Open circuit (contacting, closed door)” status of the sensor or alarm input device as normal, and triggers alarm event if they become “Closed circuit (not contacting, open door)” status.

- ✧ NC (Normally Closed)

Considers “Closed circuit (not contacting, open door)” status of the sensor or alarm input device as normal, and triggers alarm event if they become “Open circuit (contacting, closed door)” status.

Event Action

Users can configure how the network camera reacts to events, to notify system administrator or user with the event information. Samsung network cameras provide event actions as listed below:

- ✧ Transfers video footage of the event to an FTP server.
- ✧ Sends E-mail notification with the event video footage to specified recipients.
- ✧ Recording event video footage in inserted SD memory card.
- ✧ Triggers alarm out signal.

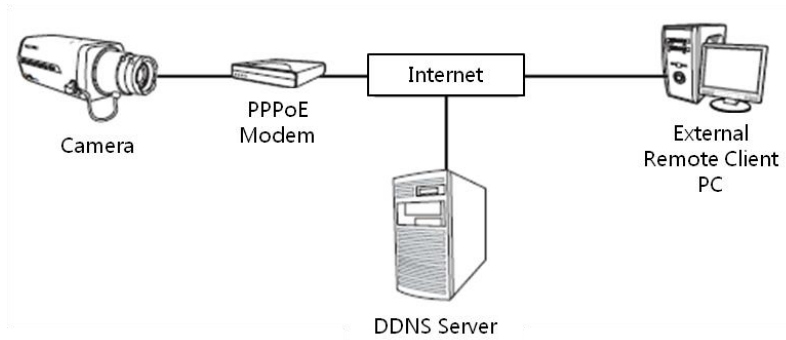
Network Setup

Network cameras should be configured according to the installed network environment.

DDNS (Dynamic Domain Name Service)

Network cameras should be assigned with IP address, and if the address may change from time to time by the ISP (Internet Service Provider), it may be better to assign a hostname to the camera for easier access instead of using its IP address. Using a DDNS service, users can easily remember a network camera’s name instead of using the IP address to access the camera. Samsung network cameras support private DDNS services, and Samsung’s own DDNS service is available too.

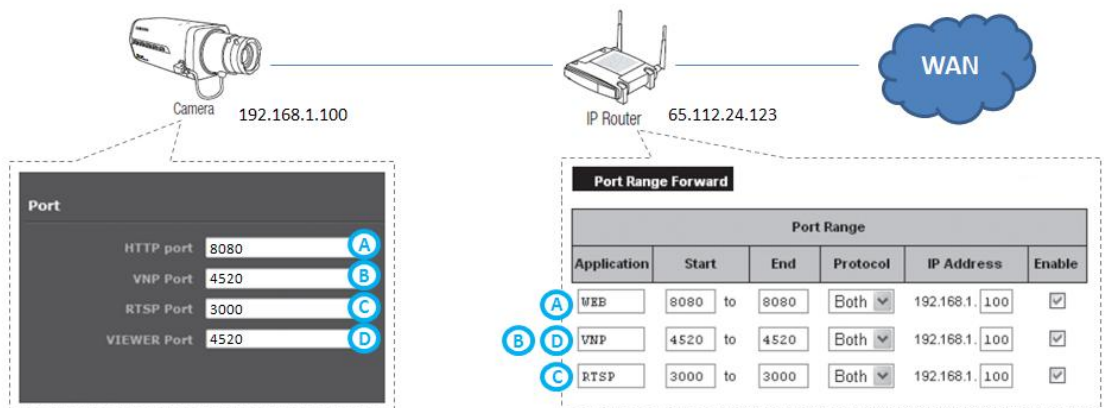
Fig 26. DDNS Service



Port Forwarding

If access to a network camera is relayed through a router, correct configuration of the router’s port forwarding must be properly made. The port forwarding setup should be configured in the router’s settings page to match the actual port used by the network cameras to ensure proper access and data transfer from/to an external network.

Fig 27. Port Forwarding



Data Transmission Protocol

This setup item defines the network camera’s protocol used for data transmission. To set the optimal

protocol to your network environment, it is better to understand the characteristics of each protocol.

✧ TCP (Transmission Control Protocol)

In TCP transmission, data of a certain amount is sent and the next transfer begins only if the acknowledgement from the recipient is received. If a problem of data loss is recognized through no acknowledgement from the recipient, the sender repeats the previous data message. This transmission method ensures no data loss, but waiting for acknowledgement in every transmission from the recipient and retransmission of lost data necessarily generate overheads of increased data processing/transmission and time.

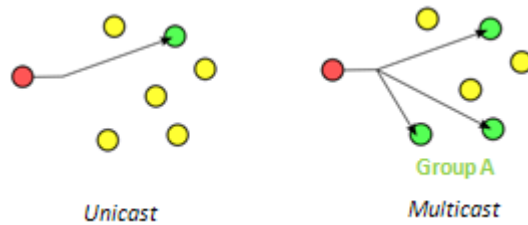
✧ UDP (User Datagram Protocol)

Unlike TCP, UDP is a protocol of data transmission requiring no response from the recipient; it keeps sending data packets. If transferred data is lost during the transmission, the sender does not know about it since there are no handshaking dialogs and thus exposing the receiving side to the unreliability of missing data. On the other hand, since it requires no acknowledgement from the recipient and no time is lost in handshaking, the overall transmission speed increases. In a stable network environment expected to have minimal data loss, it is more effective to use UDP for video communication with network cameras.

✧ UDP Multicast

Unlike unicast which maps sender and receiver 1-to-1 for data transmission, one multicast sender can transmits data to multiple receivers simultaneously. Using multicast, the sender transmits data only once to multiple receivers, this results in minimized bandwidth occupation and reduces the required system resources by avoiding multiple transmission of same data.

Fig 28. UDP Unicast & Multicast



Required multicast settings of a network camera for proper communication are listed below:

■ Multicast Group IP Address

For sending data to number of recipients, it requires the address of multicast group including the recipients instead of IP address of each recipient. A D-class IP address (224.0.0.0 ~ 239.255.255.255) is used for a multicast group address.

■ TTL (Time to Live)

This setting specifies how long the sender’s data lives on the network. It prevents a data packet from circulating indefinitely, and is used to ensure enough lifespan for the data packet to reach the recipient.

When using multicast for network cameras, other network components (i.e. switch and router devices) should support multicast for proper communication. If used with devices not supporting multicast and applied multicast to network cameras, video data from cameras cannot be displayed.

Network Camera's Data Size

Size of data produced by a network camera depends on its video settings. There are many factors that affect the final image's data size and it is not easy for users to predict required bandwidth for transmission of acquired video data. In that sense, Samsung provides a software program [Bandwidth Calculator] which reflects camera settings to calculate required data bandwidth.

The data size of an acquired network camera image is largely influenced by the environment, subject's complexity and motion. Samsung's Bandwidth Calculator calculates the bandwidth with provided camera settings with assumptions on environmental factors based on the manufacturer's test results, and may render a difference to the actual measurement. Users should be aware of this point.

Apart from the network camera's video settings, there are more factors that may influence required bandwidth. By the nature of compression methods, more activity in a video sequence or complex subject image may increase the size of a video sequence. At the moment, if the bandwidth required for transmitting such video sequence of increased data sizes exceeds the network system's bandwidth, the quality of displayed video becomes degraded or playback may stutter due to a reduced frame rate.

Motion in Scenes

Inter-frame compression methods like MPEG-4 and H.264 produce bigger video sequence as motion in the sequence grows, due to its nature of maintaining the difference between frame images. For example, the data size difference is obvious between footages taken in a crowded hallway and a no-go area having almost no activity.

Image Complexity

Compressed images produces larger data size as the complexity of the object or scene grows. For example, the data size difference is obvious between footages recording trees thick with leaves and an empty car lot.

Video Noise

Video sequences with greater noise (when captured in a dark place, produced many random noise) results in bigger data size. A camera installed outdoors, will produces clear enough image without noise during daylight but will produces more noise during nighttime. If your designs include such varying noise condition, it should be measured and taken into consideration when calculating the required bandwidth.

Image noise produced by cameras can be minimized by the DNR (Digital Noise Reduction) function even in a dark place, and using it can help acquiring clear images and reduced data size effectively.

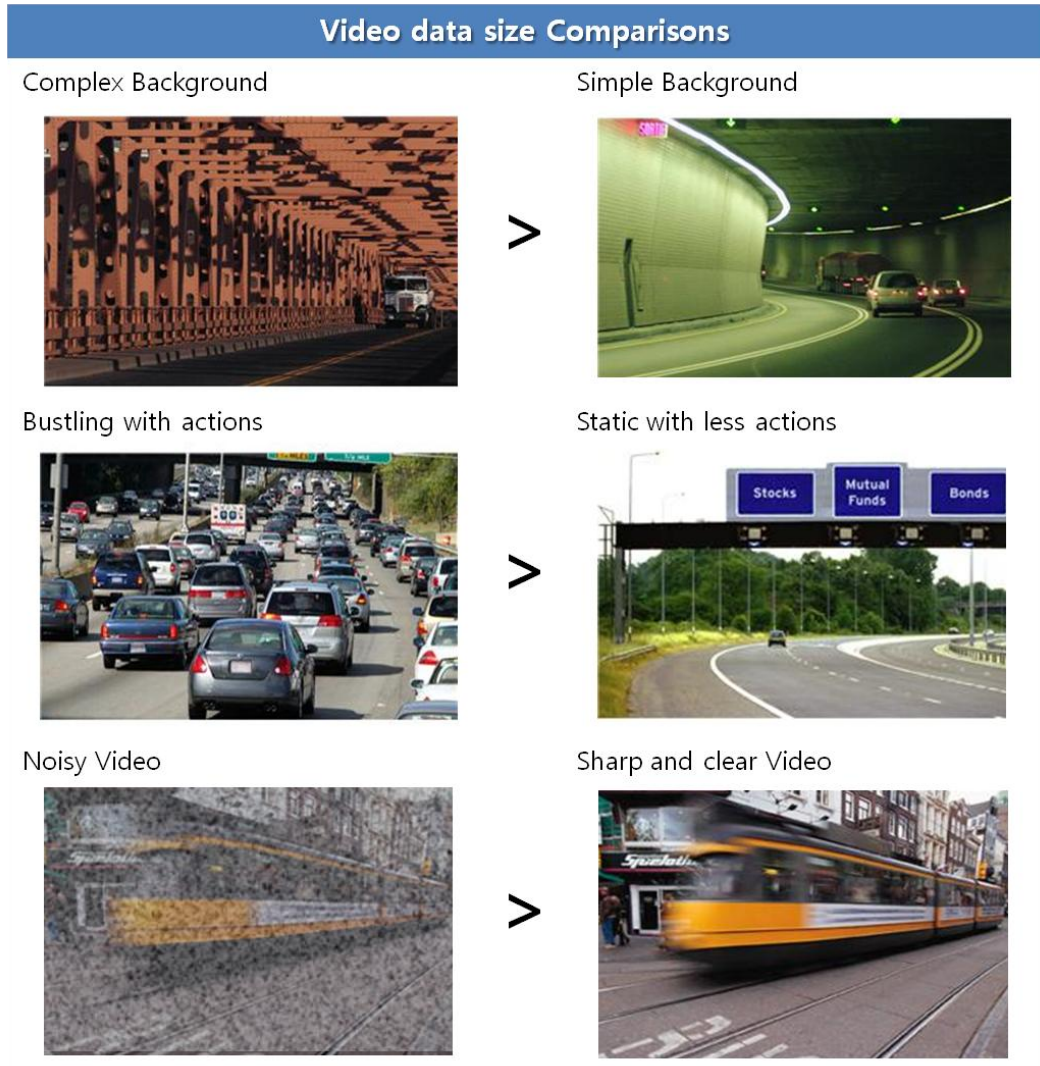
Audio Data

When calculating the required bandwidth, you should consider the amount of data transmission used for audio if network cameras on your surveillance network support audio eventhough the audio data size is quite small, compared to video data.

Event Frequency

If an event is notified by displaying it on a Viewer, FTP uploading or E-mail sending with event information and its video, such additional data traffic should be considered when calculating required bandwidth. There should be less influence if events are rarely expected, but frequent events may affect bandwidth occupation of the network with increased load, and should be considered.

Fig 29. Sizes by Video Characteristics



Choosing and Setting the Network Storage

Types of Network Storage Device

NVR, the Network Video Recorder is a storage device that stores video data sent from network cameras and encoders. This type of storage device can be categorized into hardware and software NVR.

Hardware NVR

This type of NVR is a hardware device that is commercially available. From the user's point of view, NVR device of this type requires no separate software installation while providing immediate operability and optimized to its own software. On the other hand, designing a surveillance system becomes limited by the performance and capability of hardware unit's specification, providing less flexibility and scalability. For example, if you want 17 network cameras to work with NVR, you will probably need one 16-channel NVR and one 4-channel NVR, to configure your surveillance system.

Fig 30. Hardware NVR



SRN-470D



SRN-1670D

Software NVR

A software NVR is an application software program commercially available, which is installed on a personal computer. To utilize NVRs of this type, you need a computer to install such a product. Since recording and saving performance is dependent to the performance of installed computer, you need to verify your computer's hardware specifications to ensure it meets the recommended requirements.

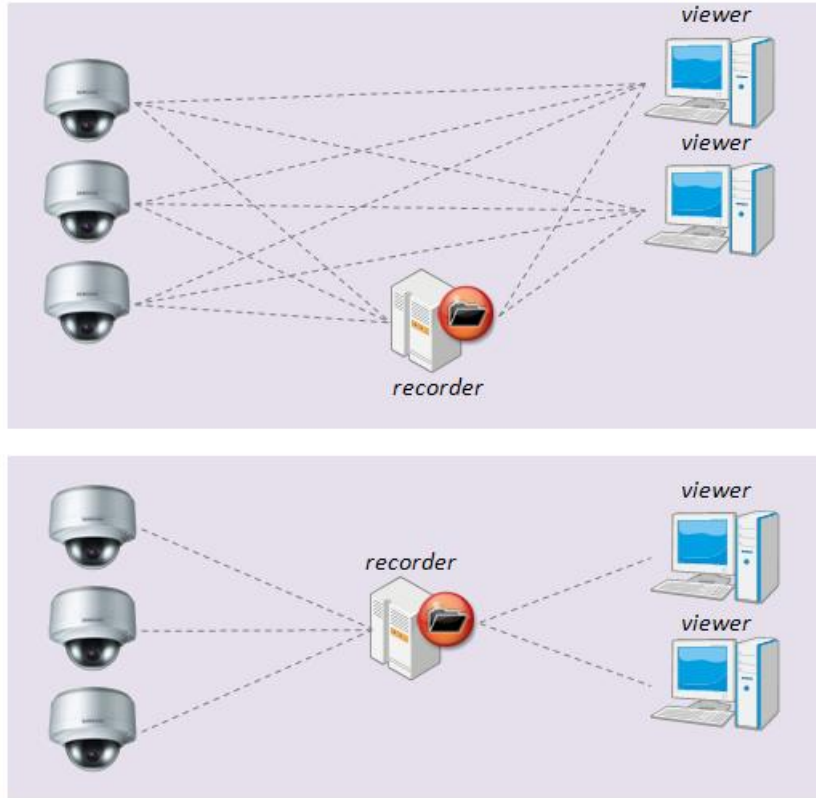
Fig 31. Software NVR



NVR System Configurations

A NVR device provides both storage for transferred video data from network cameras and distribution of stored footages. If multiple users are allowed to access a network camera for video transmission, the camera may be overloaded with requests. Hence, putting the load of video distribution onto the NVR reduces unnecessary overhead of network cameras and overall network traffic.

Fig 32. Effective NVR configuration for minimized network traffic



The first picture above shows a system configuration that does not use NVR for video distribution. And the second one shows the effectiveness in traffic control when the NVR controls networked video distribution. The first picture is contrasted with the second in the overall amount of traffic load on cameras and network. In general, controlling video distribution with the NVR in a surveillance network becomes more effective as the number of cameras and monitoring clients in the system grows.

Number of NVRs

Factors to be considered when deciding how many NVRs are required for the designed network surveillance system are listed below. Typically, two conditions are taken into account of number of NVRs.

- ✧ Data size produced by network cameras

Once the number of network cameras is decided, next to consider is how big will be the produced data size by all the cameras. Compare the storage capability of the NVR and estimation of produced data size of the network cameras, and calculate how many NVRs are required. For example, if the total data flow from network cameras is estimated to 500 Mbps, NET-i Ware that can handle data saving at 250Mbps, you will need 2 NVRs. As the SRN-1670D capable of 64Mbps is used, you will need 4 of them.
- ✧ Number of network cameras

Number of NVRs required can be calculated from the number of network cameras to be connected. For example, if you want to record videos from 128 network cameras, you will need 8 of 16-channel NVRs, or 4 of 32-channel NVRs.

You can calculate how many NVRs are required by using the Samsung’s Bandwidth Calculator, while

considering the number of network cameras and data size. (Refer to the figure.37.)

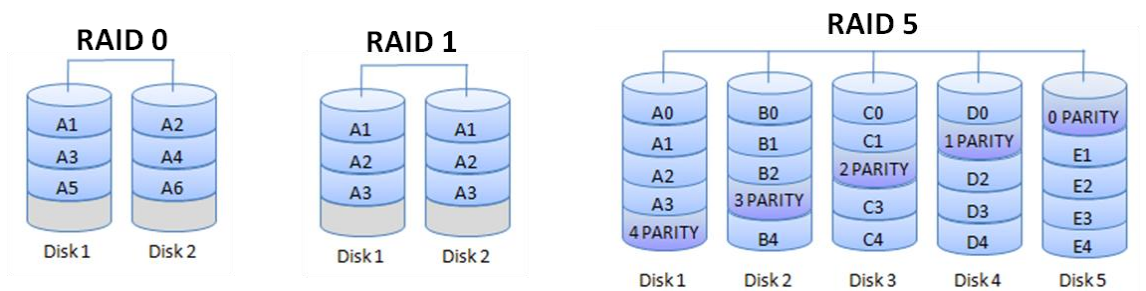
Configuring the Storage Devices

To save video recordings to the NVR for a period of time of your choosing, you may need to add additional HDD to provide enough capacity for your NVR. If the total storage capacity required for your design exceeds the product’s capability, you can connect an external storage device to expand the capacity. Refer to each NVR model’s specification for the detailed external storage support.

Storage devices usually save data onto HDD, and stored footages become unavailable if the HDD is damaged. RAID storages combine two or more HDDs and duplicates data and therefore is prepared for such damages. The main reasons for adopting such methods are improving the disk access speed, data recovery and high capacity. There are several RAID configurations, and the below describes typical examples:

- ✧ RAID 0
This method splits data evenly across multiple disks and uses them as one HDD. Builds up a huge capacity disk, and distributed read/write process improves the data accessing speed. Still, there is no recovery method of damaged data.
- ✧ RAID 1
Used mainly for data recovery, consists of arrays of mirroring HDD pairs and saves exact copy of data onto both paired HDDs at the same time. The activity of reading and writing data from/to HDD #1 is performed on HDD #2 at every time. If one HDD of the pair becomes unavailable you can still access to the data on the other HDD of that pair for proper read/write. Since each member of paired two HDDs contains a complete copy, it requires doubled capacity while read/write performance degrades.
- ✧ +RAID 5
Combines 3 or more HDDs and accessed as one virtual HDD. Block-level striping with parity data distributed across all member disks enables data recovery using undamaged HDDs if one of them is damaged. However, no data recovery can be made if two or more HDDs are damaged at the same time. This RAID mode allows all features of improved data access rate, huge capacity and data recovery at a low data redundancy.

Fig 33. RAID Levels & Schemes

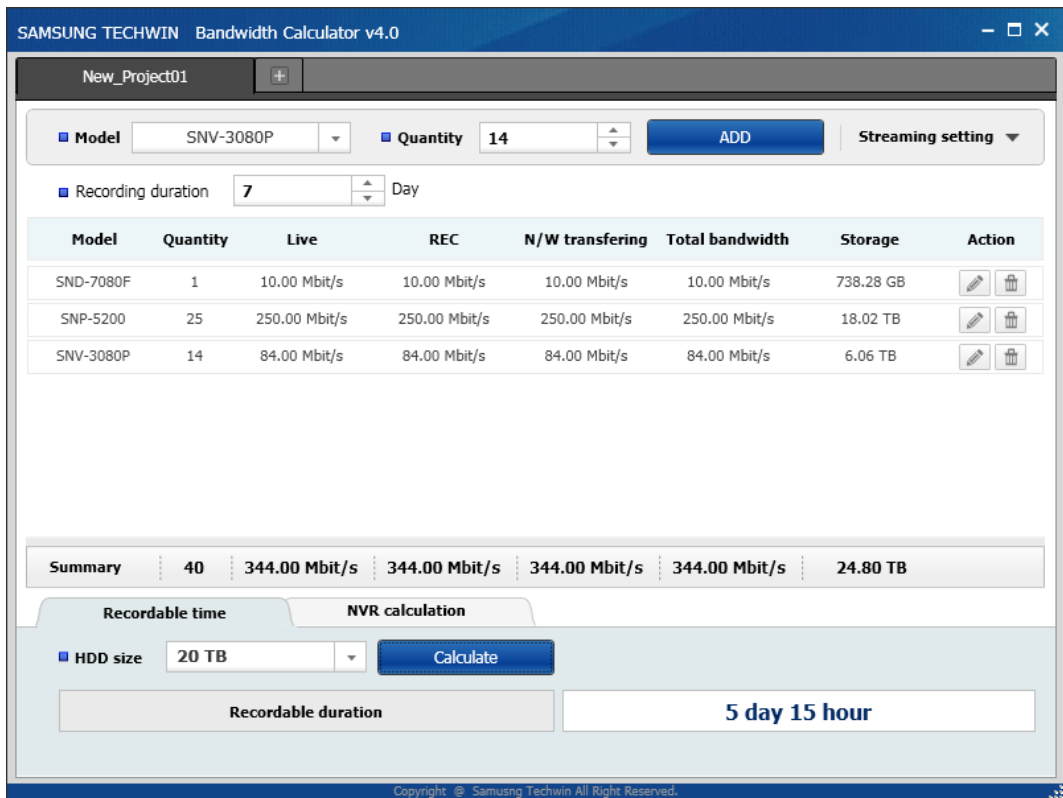


Calculating Required Storage

To maintain surveillance data in network storage devices, the total storage capacity should be greater than the capacity requirement of planned data retention period. In theory, required storage capacity per unit time can be estimated to be the same as the requirement of network bandwidth, which can be calculated with Bandwidth Calculator, but the calculation result of the program may render some difference in practice, as mentioned earlier.

The best way of estimating the required storage is measuring the data stored during a certain time period with the installed devices in the actual installation and calculating the total requirement by comparing to planned data retention period. Measure the total amount of stored data for 2 or 3 days, and draw the daily average, and then estimate the total storage requirement.

Fig 34. The Bandwidth Calculator



Input Bandwidth to Storage Device

The required storage capacity for saving video data from network cameras is equivalent to the total amount of data sent by network cameras. Hence, to estimate the required storage capacity, calculate the total network bandwidth of all connected network cameras first.

* Estimating required storage capacity based on bandwidth of network cameras

Assumed that input data into the storage device sums up to 48Mbps, then the data amount received per second will be 48Mbits which becomes 6 MB per second (8bit = 1Byte), and it's the capacity you need for saving data of 1 second. To save video of 1 hour long, you need 6MB x 3600 seconds = 21600MB, which is 21.6GB. Accordingly, you need 518.4GB for 1 full day, 3.6TB for a week, and 15.6TB for a month.

Recording Mode of Storage Device

Recording mode of the storage device also affects the required storage capacity and the length of the possible data retention period, this should be considered when planning the required storage.

Scheduled Recording

If you are applying a schedule to record for a certain time period of a day, you can estimate the required storage capacity with the recording time and the total network bandwidth. For example, if the total network bandwidth is 48Mbps and records from 9AM to 6PM only, the calculation becomes:

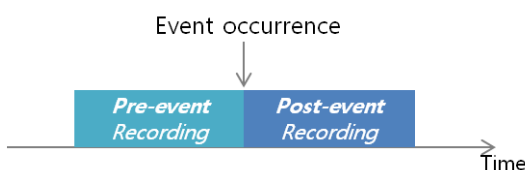
- ✓ Required capacity for one hour = $6MB (48Mbit)/sec \times 3600 \text{ seconds} = 21.6GB$
- ✓ Daily storage requirement (from 9AM to 6PM, 9 hours) = $21.6GB \times 9 \text{ hours} = 194.4GB$
- ✓ Monthly storage requirement (30 days) = about 5.8TB

Event Recording

Continuous recording wastes storage capacity with unnecessarily video data, this recording mode saves video footages only when an event is detected. To calculate the required storage capacity, you need to estimate the event frequency. Since event generation cannot be evenly distributed and forecasted, it is better to be prepared with enough supplemental storage space.

- ✧ **Event Types**
In general, events that trigger event recording are provided by the network cameras. In that sense, supported event types are the same as those supported by the network cameras.
- ✧ **Event Frequency**
As the required capacity depends on event frequency, the average frequency of event generation needs to be estimated. In cases in which events are expected to occur very often, you may consider configuring the storage device to ignore repeating the same event within a certain time period if necessary; this is an option supported by some devices.
- ✧ **Pre-event / Post-event Recording**
NVR provides pre-event and post-event recordings on events. Pre-event recording is offered by introducing a buffer so that the seconds or minutes of video before the time point of the event is saved. Since the NVR has to keep video data of a certain time period to provide such a buffer, setting pre-event time to a long period is not possible. Post-event recording sets how long the NVR will record video after the event time. When an event occurs and saves an event recording, its total length is the sum of [Pre-event + Post-event].

Fig 35. Pre-event / Post-event Recordings



Manual Recording

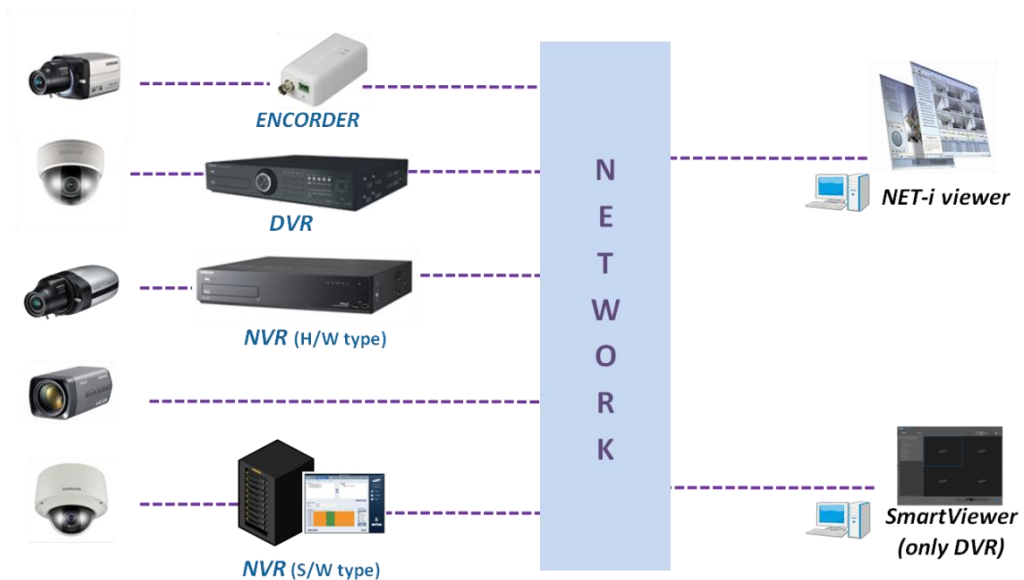
You can record and save the video by manually pressing the record button of NVR. The required storage capacity for manual recording can be calculated with the recording time. For example, assuming that the total network bandwidth is 48Mbps and records for 10 minutes manually, the required storage capacity for this manual recording will be:

- ✓ Required capacity for 10 minutes = 6MB (48Mbit)/sec X 600 seconds = 3.6GB

Viewer Selection & Configuration

The viewer is a monitoring interface that displays video from the network cameras; it can search and play stored video data in the storage device. You can connect a viewer directly to the network camera or to an NVR connected with network cameras to view real-time monitoring video from cameras and search or play stored footages.

Fig 36. Monitoring with Network Surveillance System



Viewer Types

Various viewers can be used according to your preference, purpose, scale of installed system, and supported functions.

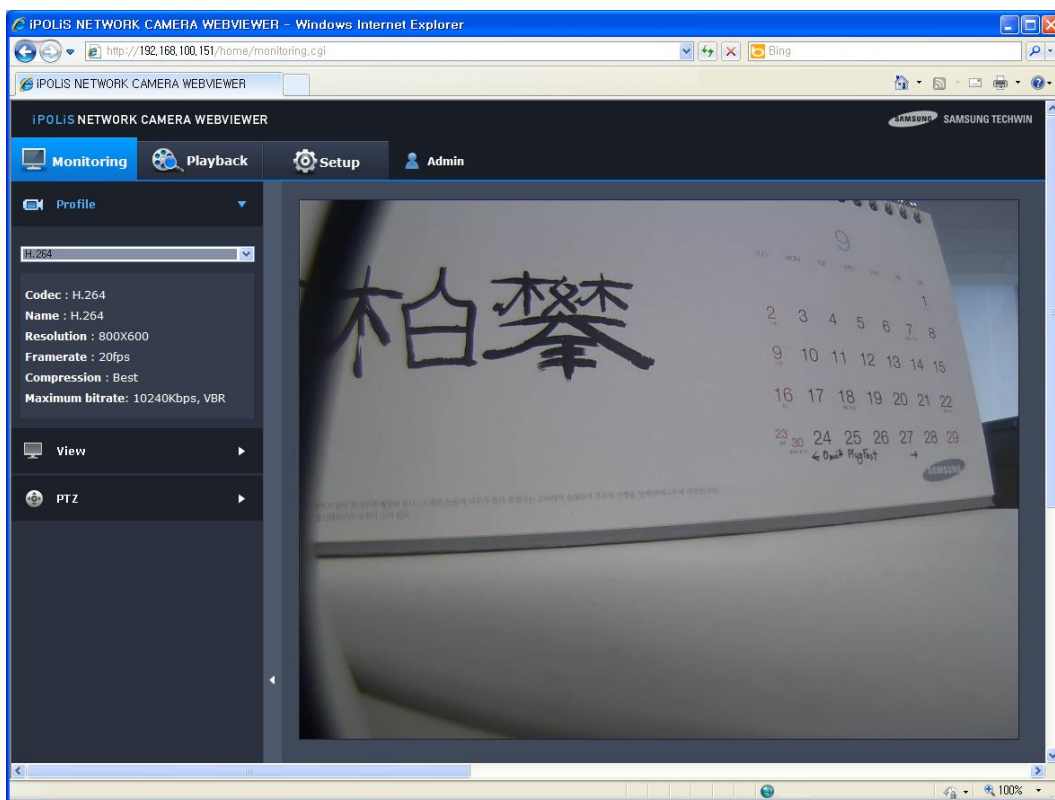
The Web Viewer

You do not need to install a separate software program on a computer; you can use Web Viewer for easy monitoring. If the product supports data saving, you can search and play stored data too.

Web Viewer accesses using the destination device’s IP address, and supports monitoring only one device at a time. It is not preferred for monitoring multiple surveillance components, and provides basic

features of monitoring.

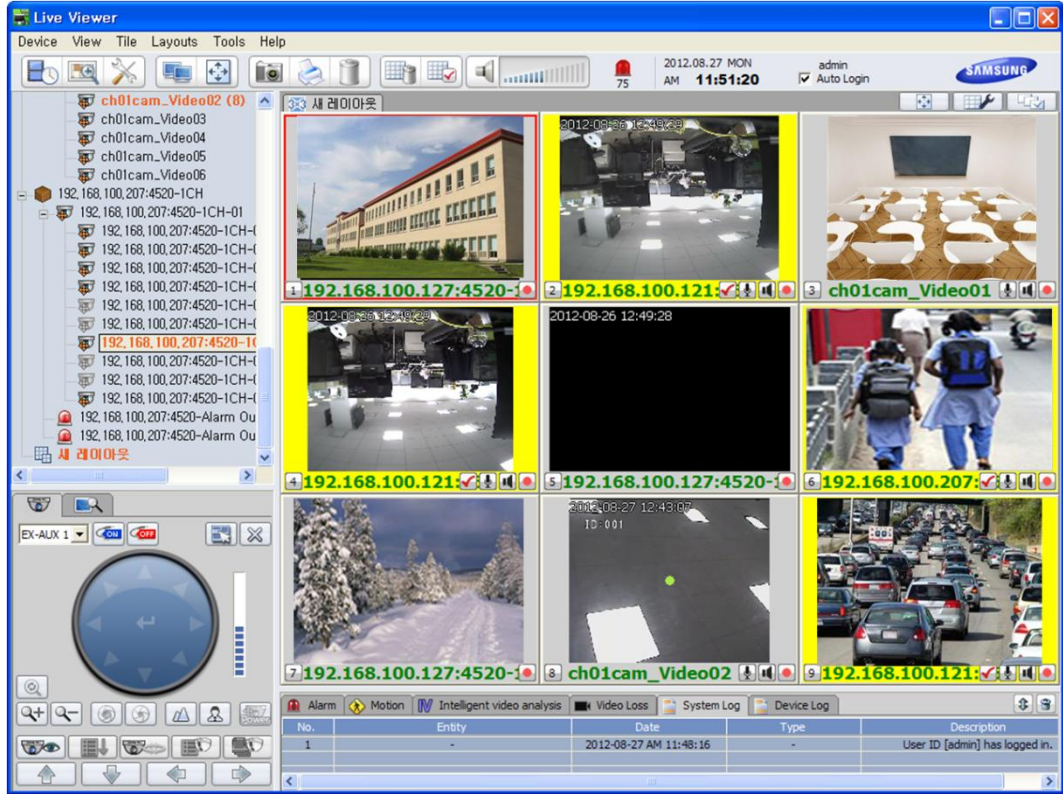
Fig 37. The Web Viewer



Integrated Viewers (CMS, Centralized Video Management Software)

If you expect many surveillance devices on your system, this type of viewer is optimal. A separate software program should be installed on a computer. It enables simultaneous monitoring of multiple channels from surveillance devices regardless of their type, as well as searching and playing stored data. Compared to the Web Viewer, it provides full features.

Fig 38. Integrated Viewer, CMS

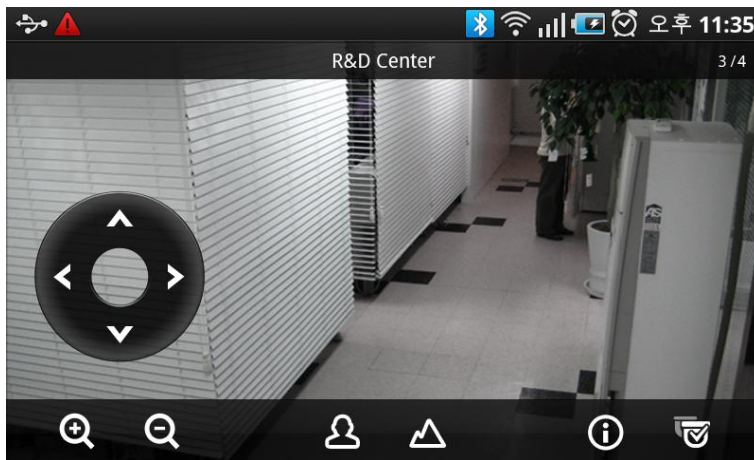


Mobile Viewer

Simple but handy viewer for mobile devices. Samsung provides the iPOLiS MOBILE application for smartphones to allow remote monitoring and controlling Samsung network cameras, encoders and DVR. Users can download and install the application for Android or iOS according to the device used.

Use the keyword of “iPOLiS”, “SAMSUNG” and “TECHWIN” (case insensitive) to find the Samsung Mobile Viewer from the application downloading page of each mobile operating system.

Fig 39. iPOLiS Mobile Viewer



Note that using mobile viewer for extended time for monitoring with data communication may involve an extra charge, so setting the devices for minimized data traffic is recommended to avoid such cases as well as delayed or lost data transmission.

*** Recommended network camera configuration for mobile viewer**

- If using 3G communication: 4fps @320X240
- If using Wi-Fi communication: 8fps @320X240

*** Recommended DVR configuration for mobile viewer**

- If using 3G communication: 320X240, Low quality
- If using Wi-Fi communication: 320X240, Low quality

Cautions on Using the Viewer

If the viewer is loaded with video data processing that exceeds the viewer's capability, symptoms mentioned below may happen:

- ✧ Video image displays blocky artifacts.
- ✧ Video renders unnatural motion due to dropped frames.
- ✧ Program slows down and may display delayed playback.
- ✧ Playback stops, or is disconnected from the network device.
- ✧ The network installed with the product shuts down.

Hence, minimizing video data traffic for monitoring with viewers is required. Check below points to find whether your configuration causes unnecessary data traffic on your network.

- ✧ Check if the viewer requests video in a resolution larger than that of the video provided by camera.
- ✧ Whether it requests video to channels not displayed for monitoring.
- ✧ When requesting directly to a network camera, whether the camera is connected to NVR and monitored through the NVR at the same time.
- ✧ Check if unnecessarily high-quality codec of bigger data size is applied with no reason.

The viewer is an application program that runs on a computer, and its performance depends on the installed computer's performance. Hence, if mentioned problem occurs, check if the computer installed with the viewer satisfies required hardware recommendations first.

Collaborating with 3rd Party Software

Samsung's network surveillance components support collaborating with software applications of reputed ISVs for better surveillance system implementation with flexibility.

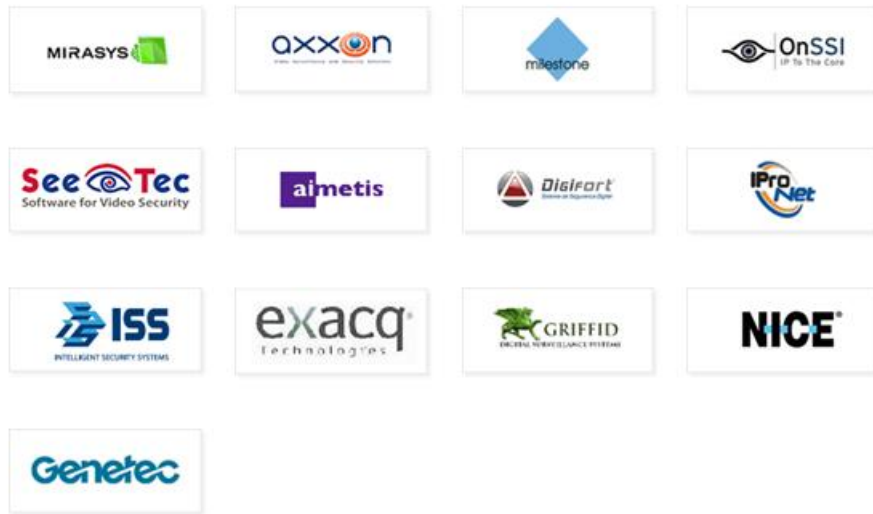
http://www.samsungsecurity.com/support/spt_technicalpartner.asp

*** What is ISV?**

Acronym of Independent Software Vendor, means companies specializing in making or selling software designed for components from various manufacturers while not bound to a specific hardware

manufacturer.

Fig 40. Major ISVs available to use their software with Samsung Network Cameras



SDK

SDK, Software Development Kit supports developers with developing software application working with the hardware devices. For developing software for Samsung’s network components, Samsung provides developers with SDK, technical documentations and firmware at the developer’s website. Software developers can download materials from the corresponding page, and can use Q&A board for answers to their questions.

<http://developer.samsungtechwin.com/>

Fig 41. STDN Website

The screenshot shows the STDN Samsung Techwin Developers Network website. The navigation bar includes 'GETTING STARTED', 'PRODUCT', 'SDK & API', and 'SUPPORT'. The main content area is titled 'SDK&API' and features a 'Login' form, a 'Download' section with links for 'HTTP, RTP, RTSP_(API)' and 'ActiveX SDK(SDK)', and a 'Q & A' section. The 'ActiveX SDK' section is highlighted, showing an 'Overview' and a 'Binaries' table.

File Name	Size	Version	Date	Download
XNS ActiveX SDK	22.0MB	v1.38.00	2012.06.06	Download
XNS ActiveX SDK (CAB file)	15.7MB	v1.38.00	2012.06.06	Download

Checking the Site & Network

When installing surveillance devices on an existing network, check the network environment before installing other network devices, and optimized the camera configurations in the design. If a new network is to be used for the surveillance system, the network should be designed to provide optimized network capacity considering targeted surveillance system.

LAN/WAN

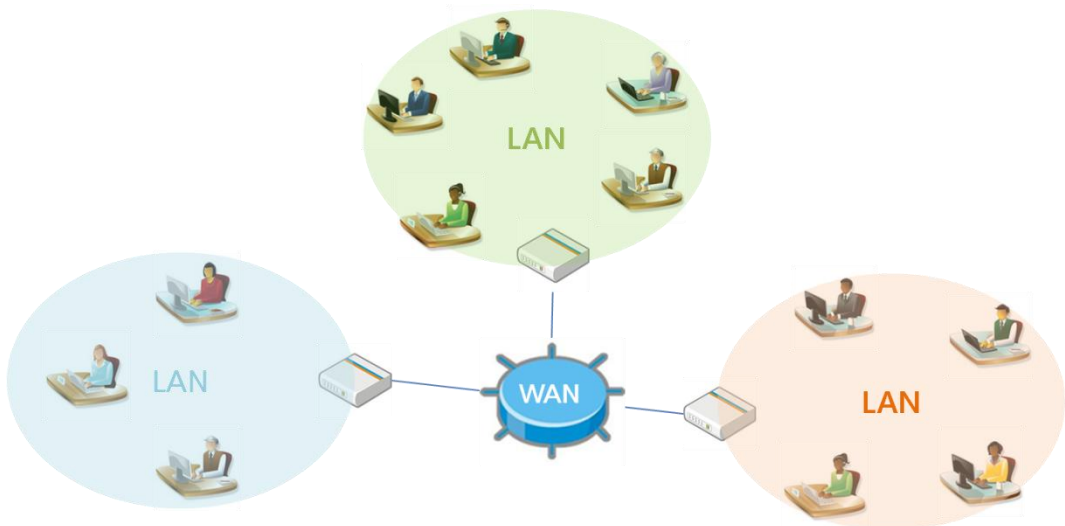
LAN (Local Area Network)

LAN means Local Area Network, a computer network that interconnects network devices in a limited area.. A LANs benefits include high speed stable transmission, but it does not provide remote access from an external network if not connected to a WAN.

WAN (Wide Area Network)

WAN network interconnects multiple external networks together . In general, a WAN refers to network connections such as ADSL and VDSL that are provided by telecommunication service providers (Internet Service Providers). A WAN provides remote accessibility to external networks, but can have low transmission speeds; possible data collision and loss should be considered when designing the system. Taking these into account, it is recommended to apply TCP protocol for communication and configure data transmission to have smaller size for less data loss or delay when implementing a surveillance system via WAN.

Fig 42. Structures of LAN and WAN



Network Transmission Speed

The transmission speed of a LAN depends on the performance of the network's component devices

such as routers, switches and hubs.

For a WAN network, its transmission speed is defined by the service provided by your ISP. According to the service type, the uploading and downloading bandwidth may not be the same, which should be considered when designing a surveillance system. For the exact transmission speed of your network, consult your Internet Service Provider.

Fig 43. Upload & Download Speeds of a Network



Sending video data from network cameras depends upon the uploading speed of the network, while storage devices and monitoring software by the downloading speed of the network. If the total amount of data sent by network cameras exceeds the maximum transfer capacity defined by the uploading speed, data may be delayed or lost.

Network Cable

Network cable is the network component that provides physical links between the network devices. There are many types of network cable, categorized by transfer capacity, transfer distance, price, and other characteristics. The 3 cable types mentioned below are the most commonly used network cables for general networking.

Coaxial Cables

Coaxial cable has an inner conductor core of copper wire surrounded by a flexible tubular insulating layer, surrounded by a tubular conducting shield and outer plastic sheath. At one time, it was the most popular network cable for most applications due to its relatively low cost, light weight, flexibility, easy handling and resistance to interference and attenuation. Coaxial cables can be categorized into 10-base-2 and 10-base-5.

TP (Twisted Pair) Cables

The insulated copper wires are paired and twisted around each other. Twisting wires reduces electric interference from other neighboring devices. The lower cost and easier expandability improved its popularity. It uses RJ-45 connector for interconnection.

TP cables are categorized into two types of UTP (Unshielded) and STP (Shielded). STP cable is protected by shielding from external electro-magnetic interferences and provides longer transmission distance. On the other hand, high cost and difficulties with handling compared to UTP limits its use for long-range transmission, while UTP is preferred for general networking.

Fig 44. Categories of TP Cables

Category	Max. Data Rate	Characteristics
CAT 1	1Mbps	Applied for general telephony services. Generally used for analog voice applications.
CAT 3	10Mbps	Applied for data and voice transfer, most popular for 10Mbps Ethernet networking cable.
CAT 5	100Mbps	100Mbps Ethernet networking cable.
CAT 5e	1000Mbps	CAT5 with enhanced specification, applied for networking of 1Gbps data transfer.
CAT 6	1000Mbps or higher	Cable standard for Gigabit Ethernet and broadband networks.

Fiber Optic Cables

Fiber optic cable containing one or more optical fibers. Optical fiber cables provide far higher data transfer rates up to a dozen times faster than other cables. Since it provides an almost complete protection from external interferences, it is commonly applied to Giga-bit Ethernet and WAN networking.

Fiber optic cable is categorized into multi-mode and single-mode. Multi-mode cable is called as 1000 Base SX and provides maximum transfer distance of 220m, while the Single-mode is called as 1000 Base LX and provides maximum transfer distance of 5Km.

Choosing the Network Cable

Consideration points on choosing optimal cable for your network implementation are listed below:

- How much network traffic will there be on average?
- How far should cabling extend?
- What is your cabling budget?
- How severe is the external interference / noise expected on your installation site?

Fig 45. Comparisons on Network Cables

	10 Base 2	10 Base 5	Twisted Pair	Optical Cable
Cost	Higher than TP	Higher than 10 base 2	Cheapest	Relatively High
Transfer Range	185m	500m	100m	Several 10 Km
Data Rate	10Mbps	10Mbps	10Mbps ~ Gbps	Over 100Mbps
Interference	Protected	Protected	Less protected	Completely protected
Feature / Application	Cheaper peripherals than TP Better for bigger and data security-concerned networks	Cheaper peripherals than TP	UTP: better for small-budget networks STP: fits networks of all sizes	Regardless of network scale, optimal to data speed and security concerned networks



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- You can find more information from the "Online Tutorial" at Samsung Techwin's CCTV website.
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