SHEET 2

VIDEO SURVEILLANCE NETWORKS

ANALOG AND FULL IP TECHNOLOGY

INTRODUCTION

Security is one of the major considerations of the 21st century and, in this era of images and all-digital, it is logical that video should be one of the preferred media used to guarantee security and integrity of property and people. Such is therefore the role of video surveillance.
It has become an essential system for buildings, since it contributes to the security of the company and its employees.
Today there are two technologies, the Analog system and the Full IP system, differentiated in particular by the type of data transmitted over the network. In addition, twisted pair, found everywhere in businees is presented as an obvious solution in terms of infrastructure. What are the constraints to be considered? Is it a real advantage in comparison with a traditional coaxial network? And how will this market evolve?

These are some of the questions that should be considered when deciding to install a video surveillance network.

CONVERGENCE AND IP

CONVERGENCE

This is a term used to cover a reality that has become increasingly palpable as data exchange has become easier. IP (Internet Protocol) has made a major contribution to standardizing data exchange rules and formats. In a building, convergence means unification of networks, communication systems (computer and telephony), security systems and building management on the same medium.
Having initially been independent of the other systems of the company, video surveillance systems are converging increasingly with IP networks such as computer or telephone systems.

PROTOCOLE IP

Regardless of the communication medium used (twisted pair, fiber optics, wireless, etc.), IP (Internet Protocol) defines the simple and highly standardized communication rules that allow any of the items of equipment or systems to communicate with each other.

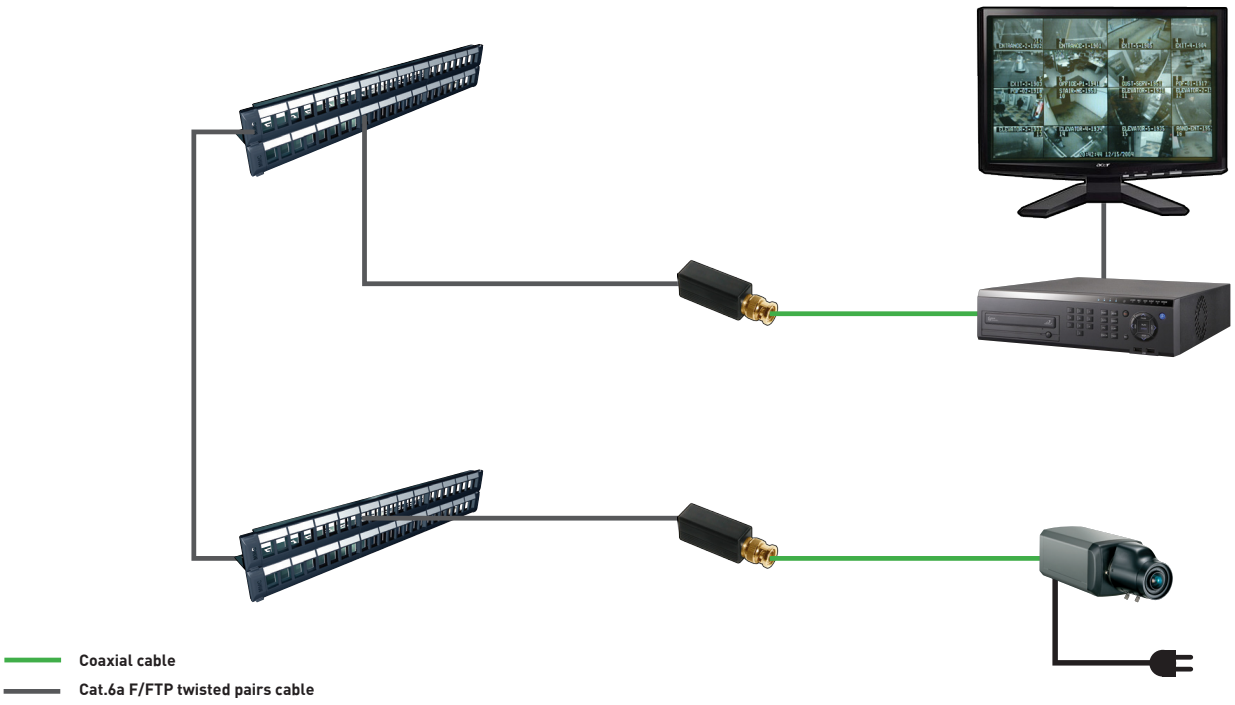
Although twisted pairs require conversion for analog systems, they are a favored medium for these two types of installation.
In the next five years, FULL IP technology should reach almost half of the video surveillance market. It is therefore necessary from now on to plan an appropriate infrastructure for this migration.

ANALOG VIDEO SURVEILLANCE NETWORKS

Video surveillance signals can be carried by the network cabling infrastructure without being digitized. However, the connections are only point-to-point and cannot be routed by computer switches.

From coaxial to twisted pair

Traditionally, analog video surveillance is implemented by connecting the camera with a coaxial cable (75 Ohm) for the video signal, a 12V DC, 24V AC or 220V AC power supply cable and possibly an RS485 connection for controlling the camera, in particular when the latter is a PTZ camera.
The development of impedance transformation technologies makes it possible to convert the video signal and to transmit it over a twisted pair cable whilst maintaining an analog signal. To do this, a Balun (Balanced/unbalanced) impedance transformer is used, making it possible to go from a 75 Ohm (coaxial) unbalanced cable to a balanced 100 Ohm cable (pairs).



However, it is also possible to bundle the three types of signals (power supply, video and control) in the balun ('Pass-thru' balun) and to avoid the need for a local 24V AC power supply. However, this technique greatly restricts the maximum length of connections especially if the cable used has a small copper diameter.

Maximum transmission distance

Since the RS485 connection used to control the camera can be transmitted over a maximum length of 1,220 meters on a Cat.5e cable, the installation length is not restricted by this data flow.

The transformed video signal can also be transmitted over long lengths. The maximum loop resistance of the system, however, must not exceed 128 Ohm for correct reception.

Since the average linear resistance of a Cat. 5e cable is 19.2 Ohm/100m, this resistance is lower than 15% on an AWG23 Cat.6 cable and 25% on an AWG23 Cat.7 cable.

This means that the transmission lengths are directly proportional to the copper cross section of the twisted pair cables.

TRANSMISSION DU SIGNAL VIDÉO

CABLE LENGTH	LINEAR RESISTANCE IN OHM		
	CAT5e -AWG24	CAT6 - AWG23	CAT7 - AWG22
50m	9.6	8.16	7.2
100m	19.2	16.32	14.4
150m	28.8	24.48	21.6
300m	57.6	48.96	43.2
450m	86.4	73.44	64.8
500m	96	81.6	72
650m	124.8	106.08	93.6
750m	144	122.4	108
850m	163.2	138.72	122.4

For the power supply aspect, however, the loss is much greater. The maximum power supply distance depends in particular on:

- The voltage required by the camera
- The power required by the camera
- The loop resistance of the cable

Max. linear resistance corresponding to max. length

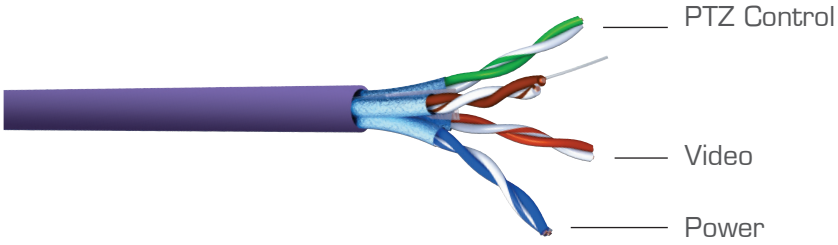
POWER SUPPLY TRANSMISSION LENGTH: 24 V AC CAMERA - CAT.5E CABLE

CAMERA POWER	24V AC CAMERA - AWG24 CAT5E CABLE	
	Min. voltage	Max. length
5w	21.6V	113 m
10w	21.6V	57 m
20w	21.6V	28 m
30w	21.6V	19 m
40w	21.6V	14 m
50w	21.6V	11 m

PARTICULAR INSTALLATION REQUIREMENTS

The system can be compromised by grounding problems. The balun ensures transfer of the alternative signals and does not act as a filter in the event of an overvoltage, which can damage the camera or recorder. It is therefore essential to use a cabling system that allows correct grounding, like shielded cabling for example.

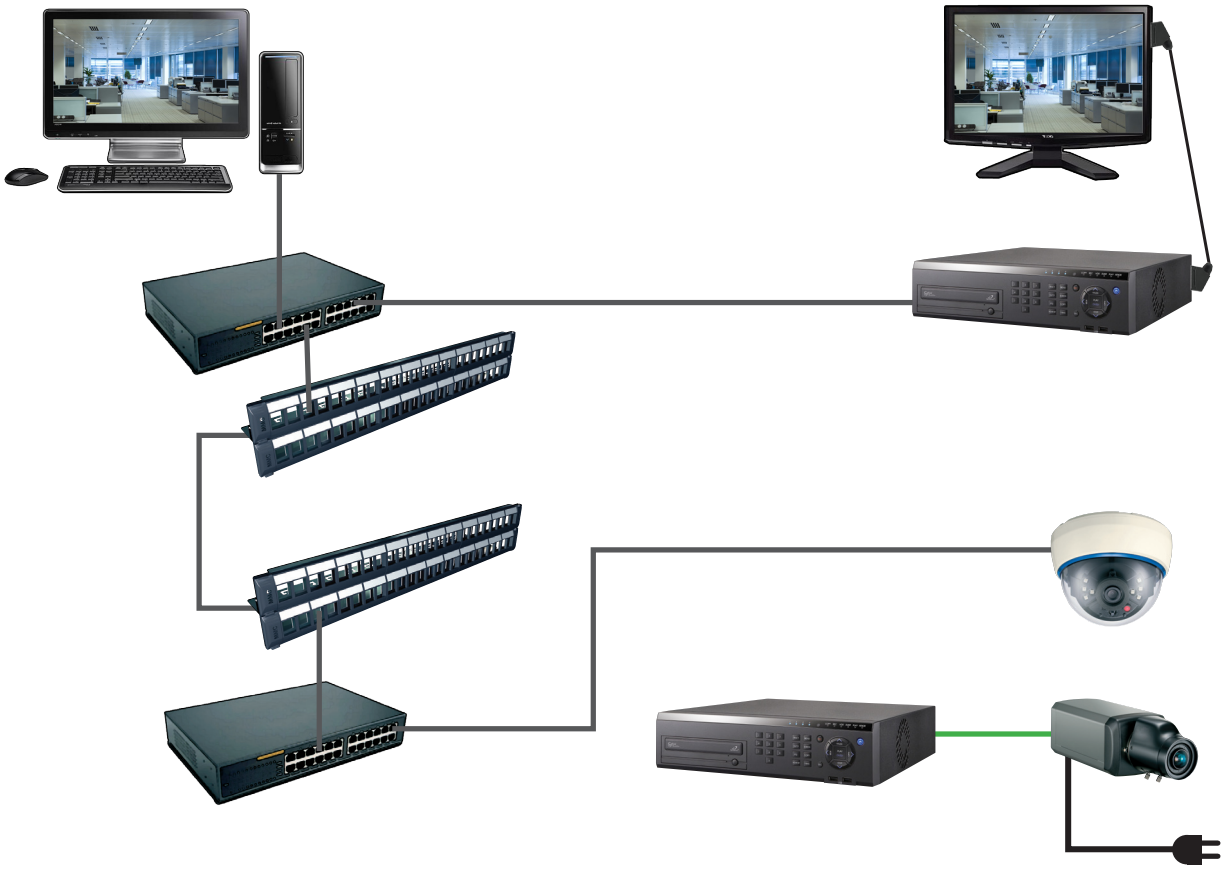
In the case of use of 'Pass-Thru' baluns, i.e. combining power supply, control and video, the use of pair by pair shielded cabling is strongly recommended in order to prevent crosstalk circuit effects in the cable.



PTZ camera
Motorized camera equiped with a zoom

'FULL IP' VIDEO SURVEILLANCE NETWORKS

Use of IP digital cameras generates a data frame with identical properties to those of an Ethernet frame. Their use thus amounts to network administration with some special features, in particular associated with the methods of supplying power to the cameras.

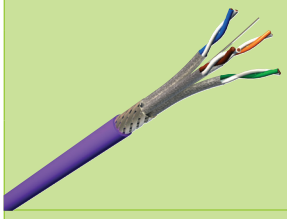
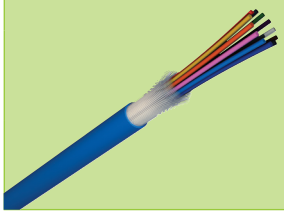


Coaxial cable
Cat.6a F/FTP twisted pairs cable

IP BUT WHAT BANDWIDTH?

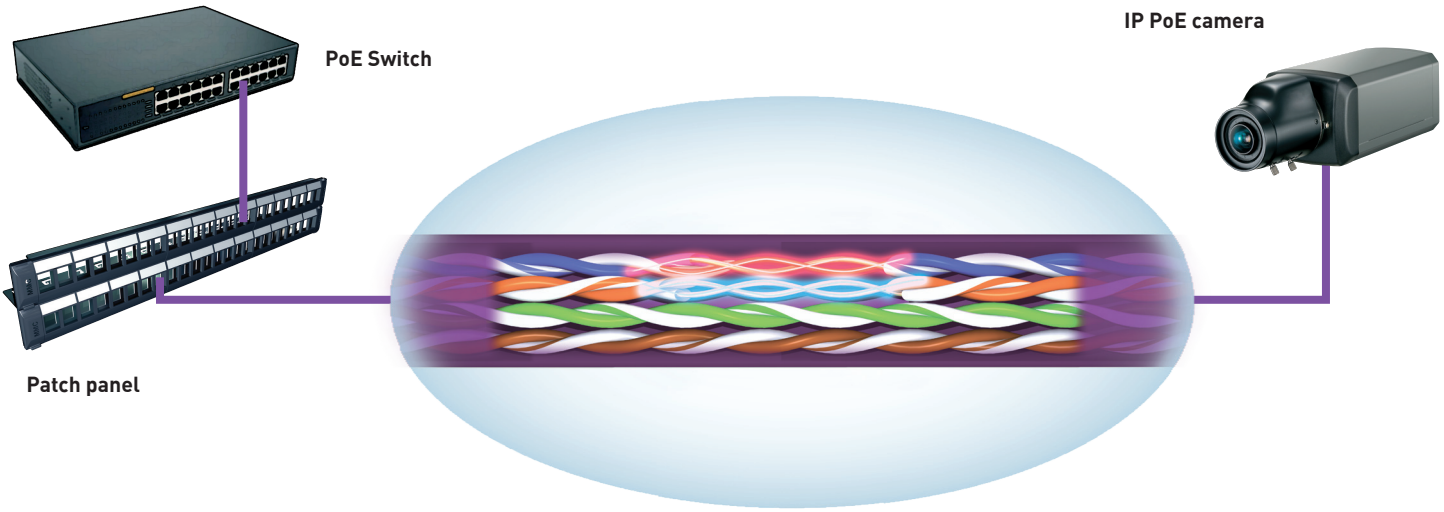
An SD (standard definition) video signal is a 4 to 5 megabit/s flow whilst an HD signal is a 10 to 11 megabit/s flow. The multiplication of cameras and DVR (Digital Video Recorder) interconnections entails use of a large bandwidth particularly between the switches allowing interconnection with video storage elements. It is also recommended to implement backbone connections in OM2 fiber optic, at minimum. The distribution connections are implemented in copper because remote power feeding is impossible over fiber optics.

The camera transmissions are characterized by the need to ensure an error rate of 0% whilst the majority of Ethernet protocols, due to their nature (CMA-CD), allow errors and correct them. The cabling must therefore be overdimensioned deliberately in comparison with standard office applications.

Type	Applications	Cable Category	Max Link	Video application
Copper twisted pairs 	**Horizontal cabling**	5e	100 m	Analogical camera signal transmission converted into digital
		6	100 m	Digital signal transmission MPEG2/MPEG4(HD) ou H264
		6a	100 m	Digital signal transmission Multi-megapixel (HD) with Edge Analytics
Fiber optical cables 	**Backbone cabling**	om2	550 m	Analogical camera signal transmission converted into digital
		om3	550 m	Digital signal transmission MPEG2/MPEG4(HD) ou H264
		om4	550 m	Digital signal transmission Multi-megapixel (HD) with Edge Analytics

POE - WHICH BENEFIT FOR WHICH CONSTRAINTS?

The greatest advantage of use of an IP camera is definitely the possibility of supplying power directly via its local RJ45 connection. This application is called PoE (Power over Ethernet) and can deliver 15 to 24 Watt (PoE plus).



2 pairs for data transmission

2 pairs for power transmission (48V DC 350 mA)

Transmission of an alternative power signal over twisted pair cabling creates three particular constraints:
- The increase in cable temperature due to the Joule effect
- The creation of capacitive couplings between the pairs
- Creation of electric arcs during connections and disconnections of RJ45 sockets

Given that the future of the PoE is to move towards a 70 Watt power supply in the coming years in order to allow the further development of applications based on this technology, it is essential to understand and anticipate the real electrical constraints associated with this protocol.
As with a low-voltage electrical installation, the key characteristic for the cable is its cross section. The greater the cross section, the lower the linear resistance.

CABLE TYPE		CAT.5E PATCH	CAT.5E	CAT.6	CAT.7A
Gauge value	(AWG)	26	24	23	22
Diameter	(mm)	0,40	0,51	0,57	0,64
Section	(mm^2)	0,13	0,20	0,26	0,33
Linear resistance	(Ohm/meter)	0,13	0,08	0,07	0,05
Compatibility PoE – 15W		⊙	⊙	●	●
Compatibility PoEP – 24W		○	⊙	●	●
Compatibility Future PoE - 70W		○	○	○	●

● : Recommended ⊙ : Suitable ○ : Not suitable

IT IS IMPORTANT TO CONSIDER THE SPECIFIC CHARACTERISTICS TO ENSURE OPTIMUM CONVERGENCE
The video surveillance network is now shared with the VDI network. Since it is more sensitive than the latter, its access must be restricted as much as possible. Use of protected racks with three-point locking and a digital code can protect the system core.
On the other hand, the DVRs and monitors have the effect of adding to electrical power consumption and thus increasing the temperature to be dissipated. For this reason, the cooling must be more effective and implemented using robust, reliable equipment.
In order to facilitate use of the networks, identification of the data flows and equipment must be rapid and infallible. Use of level 2 or 2+ switches is necessary for installation of dedicated VLAN with use of a specific software for infrastructure management for large-scale installations.