Transmission

Analog to Digital Process

Digital technology involves conversion of the traditional analog signals to a digital format for transmission. These systems use an analog-to-digital converter that can be located either at the camera or anywhere along the path back to the headend monitoring and control location. This type of system uses the traditional coaxial transmission media but also may use twisted-pair and optical fiber cable. If a distributed architecture is used, the transmitted video signals can be recorded and distributed.

Copper Cable Types

Two main types of copper cable are used for transmitting video signals:

- Unbalanced (coaxial)
- Balanced (twisted-pair)

The majority of traditional analog CCTV signal transport has been accomplished through coaxial cable.

Unbalanced (Coaxial) Cables

An unbalanced signal is one in which the signal level is a voltage referenced to ground. For example, a video signal from the camera is between 0.3 and 1.0 V above zero (ground level). The shield is the ground level.

Impedance is measured between the inner conductor and the outer sheath. Cable with a characteristic impedance of 75 ohm is the standard used in CCTV systems. Coaxial cables with an impedance of 75 ohm are constructed from various materials, each having their own effect on signal propagation.

For example, some cables with 75 ohm characteristic impedance have a center conductor constructed of copper clad steel. This cable is well suited for the distribution of CATV type signals due to the high strength provided by the steel center conductor. These signals are comprised only of high-frequency components, which flow well on the copper clad outer skin of the center conductor.

These CATV or master antenna television (MATV) cables are not suitable for CCTV signals because steel is not particularly well suited for the transportation of the relatively low-frequency signal component of a composite video signal. Solid center conductors are not recommended for locations subjected to continuous flexing (e.g., external pan and tilt drives).

Similarly, the construction of dielectric insulation between the center conductor and shield has an effect on the cable’s capability of transporting the high-frequency component of a composite CCTV signal. Different sheath materials produce different capacitance from the shield to the center conductor.

Other techniques (e.g., using dielectrics constructed from foam material) also provide low capacitance but may be problematic if used in environments where water ingress or pulling difficulties are expected.

Transmission, continued

The conductor material and impedance are critical properties of a transmission media that must be considered during the design process. Center conductors and shields may include both copper and aluminum.

Multiple ground references connected to the shield may create a ground loop. The difference of potential on the shield ground may generate loss of signal in the center conductor. The most frequent symptom of this defect is the rolling of dark bands through the picture in regular intervals.

The outer insulation must be properly designed to match the environment in which it is installed. The cable assembly must meet code requirements for flame spread and smoke characteristics in the most restrictive environment where it is installed.

When installed outdoors in an aerial application, the outer jacket of the cable should be constructed of ultraviolet (UV) resistant polyethylene or another like substance and may contain water-excluding gel if approved for direct burial. Cables used in ordinary applications are typically jacketed with polyvinyl chloride (PVC) or other durable coverings.

The distance that a CCTV signal may be run is determined by the:

- Signal strength at the source (camera).
- Required signal strength at the receiving end (monitor).
- Signal loss over the distance of the cable run.

At this end is the signal loss over the cable run, which varies depending on the frequency of the signal. The standard rules are as follows:

- For mini coaxial—107-152 m (351-500 ft) color signal
- For radio grade (RG)-59—230-305 m (750-1000 ft) color signal
- For RG-6—305-457 m (1000-1500 ft) color signal
- For RG-11—671-900 m (2200-3000 ft) color signal

Using powered baluns on both ends over twisted-pair, the signal will go up to 2743 m (9000 ft). Using strategically placed amplification may extend these distances. However, conversion to another media may be more cost effective and provide better results. Refer to Table 8.2 for typical coaxial cable signal loss.