Eagle Eye Application Note - AN008

Network Cabling Best Practices for the Eagle Eye Cloud VMS

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Target Audience

This Application Note provides detailed guidelines for selecting, installing, and specifying network cabling for an Eagle Eye video surveillance installation. It is intended for system designers, installers, and design consultants to help them make informed decisions about cabling infrastructure, ensuring reliable, efficient, and future-proof video transmission. It is a best practices guide and informational document only, and is not intended to supersede or preempt local authorities having jurisdiction, laws, or building codes within the U.S. or Internationally. Please consult local authorities or building codes regarding your ethernet cable selections and installation requirements.

Introduction

Selecting the right network cabling is important for reliable and efficient video data transmission in IP video surveillance systems. The right choice of cabling and fiber will not only affect the quality of the video stream but also impact the overall performance and scalability of the surveillance system. This document explores different cable types, their applications, and key selection criteria.

Types Of Network Cables

Ethernet Cabling

- Cat5e (Category 5e): Suitable for standard installations with data rates up to 1 Gbps (Gigabit per second). Cost-effective but not recommended for high-resolution cameras (4MP or greater).
- Cat6 (Category 6): Widely used for standard and high-definition cameras, supporting up to 10 Gbps. Recommended for future-proofing.
- Cat6a (Category 6a): Offers improved performance for demanding applications, including 10 Gbps and higher data rates. Ideal for future scalability.

To minimize insertion loss, cabling runs between equipment should be limited to 100 yards/meters and should never be spliced.

Shielded vs. Unshielded Cabling

- Shielded Twisted Pair (STP): Provides better EMI (electromagnetic interference) and crosstalk protection but is more expensive. Use in environments with high electromagnetic interference (EMI), such as industrial settings.
- Unshielded Twisted Pair (UTP): More common and cost-effective option, suitable for most indoor installations where EMI is not a major concern.

Fiber Optic Cabling

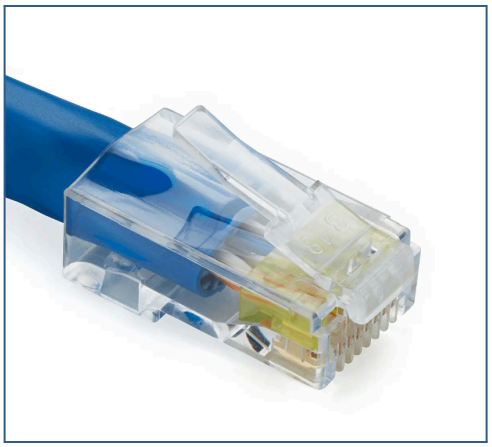
This is an excellent choice for long-distance or high-bandwidth IP video surveillance installations. Fiber offers greater bandwidth, immunity to EMI, and longer transmission distances compared to copper cables.

- Single-mode: Ideal for long distances (several kilometers) with high bandwidth. Suitable for large-scale installations covering extensive areas or connecting multiple remote connections.
- Multimode: Offers shorter distances (hundreds of meters) and lower cost. Commonly used for local area networks and shorter connections within buildings where distances are typically limited.

Choosing The Right Cable Connector

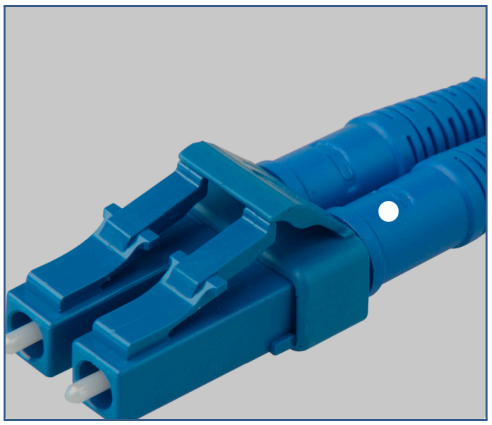
Selecting appropriate connectors and terminations for both copper and fiber optic cabling is essential to ensure reliable connectivity and seamless video data transmission. See below for a breakdown of key considerations:

Copper Cabling:



- RJ45 connectors: The standard choice for Cat5e, Cat6, and Cat6a cables.
- Termination techniques: Employ proper techniques like crimping or punching down to avoid signal loss and maintain performance.
- Connector gauge matching: Ensure the connector size (23g or 24g) corresponds to your cable gauge for a tight, secure fit.
- Shielded vs. unshielded: Opt for shielded connectors only in environments with significant electromagnetic interference. Ground the entire system properly from the camera to the switch using a shared ground point. Avoid field termination of shielded cables due to its complexity.

Fiber Optic Cabling:



- Lucent Connector (LC): Compact, push-pull design, ideal for high-density applications. Excellent performance and ease of installation make it a popular choice for IP video networks.
- Subscriber Connector (SC): Square-shaped, push-pull mechanism, reliable for single-mode and multimode applications. Widely used in network connections, including IP video networks.
- Straight Tip (ST): Older bayonet-style connector, relatively easy to terminate, suitable for field installations and backbone connections.
- Ethernet switches: Provide multiple ports to connect various network devices, ensuring efficient data transmission.

For fiber optic networks, equip your switches with SFP (Small Form-factor Pluggable) or SFP+ modules for direct fiber connection. (Eagle Eye Networks sells SFP LC type modules. Refer to the Eagle Eye Networks Price List for more information).

Key Considerations For Cable Selection

Distance: Match your cable selection to the required transmission distance. Remember that factors like equipment and environment can affect actual performance beyond advertised specifications. Consult manufacturer recommendations and consider potential future expansion needs.

Bandwidth: For high-resolution cameras or future-proofing, prioritize Cat6 or Cat6a. Fiber offers significantly higher bandwidth for demanding applications like 4K and 8K video.

Shielding: Opt for Shielded Twisted Pair (STP) cables only in environments with significant electromagnetic interference (EMI) to avoid signal degradation. Ensure proper grounding to mitigate potential hazards.

Power over Ethernet (PoE): Select cables that support the required PoE power level to power cameras and other devices directly through the network cable.

Other Required Infrastructure

In addition to fiber optic cables, connectors, and switches, several other infrastructure components are essential for IP video networks:

Patch Panels: Patch panels provide a centralized location for terminating and managing fiber optic cables. They allow for easy connections and facilitate future expansions or modifications to the network.

Media Converters: In cases where a mixture of fiber and copper-based equipment exists, media converters are used to convert the signals between different media types. They enable seamless integration of fiber optic devices with existing copper-based infrastructure.

Racks and Enclosures: Racks and enclosures are used to house and protect the network equipment, including switches, patch panels, and media converters. They provide organization, accessibility, and ensure proper airflow for optimal performance.

Splicing and Termination Equipment: Fiber optic cables often require splicing or termination during installation. Fusion splicers and termination kits are used to achieve reliable and low-loss connections between fiber optic cables.

Selecting The Correct Cable For Your Application

Building an IP video network using fiber optic technology involves careful consideration of fiber types, connectors, switches, and other necessary infrastructure components. Single-mode or multimode fiber can be selected based on the desired transmission distance, while connectors such as LC, SC, and ST provide reliable termination options. Ethernet switches and PoE switches are crucial for network connectivity. Patch panels, media converters, racks, and enclosures all contribute to efficient network management. By understanding the technical aspects and options available for fiber-based IP video networks, Eagle Eye VMS resellers can design and implement robust and high-performance surveillance systems.

Use Cat 6 For High-Speed and Reliable Data Transmission

Cat6 cabling is widely used in various network applications that require high-speed and reliable data transmission. Here are a few common use cases for Cat6 cabling:

Gigabit Ethernet Networks
Cat6 cables are commonly used in Gigabit Ethernet networks, where data rates of up to 1 Gbps are required. These networks are suitable for connecting computers, servers, switches, and other network devices within a local area network (LAN).

IP Video Surveillance Systems
IP video surveillance systems often rely on Cat6 cabling to transmit high-quality video streams from surveillance cameras to recording devices or network video recorders (NVRs). The higher bandwidth of Cat6 cables ensures smooth and uninterrupted video transmission, making them ideal for high-resolution and high-definition surveillance applications.

Data Centers
Data centers often employ Cat6 cabling to support high-speed data transmission between servers, storage devices, switches, and other networking equipment. The higher bandwidth of Cat6 cables allows for efficient data transfer and helps minimize latency, ensuring smooth and reliable operation of the data center infrastructure. When installing Video Surveillance in a Data Center environment, it is always best to use Cat6 Cabling to keep all cabling set to a common standard and for future-proofing your customer's investment.

High-Bandwidth Applications
Cat6 cabling is suitable for various high-bandwidth applications, such as multimedia streaming, video conferencing, and online gaming. These applications require fast and stable data transmission to deliver high-quality audio, video, and real-time interactions. Cat6 cables provide the necessary bandwidth and performance to support these demanding applications.

Future Scalability
Cat6 cabling offers higher performance and bandwidth compared to its predecessor, Cat5e. Choosing Cat6 cabling for network installations provides future scalability, as it can accommodate higher data rates and emerging technologies without the need for immediate cabling upgrades.

It's worth noting that while Cat6 cabling offers excellent performance, there are also advanced standards available, such as Cat6a and Cat7, which provide even higher bandwidth and better immunity to crosstalk and interference. These advanced standards may be more suitable for specific applications that demand even greater performance, longer cable runs, or higher levels of shielding.

Use Cat 5 Where Bandwidth Requirement Is Low

Cat5 cable, although an older standard than Cat6, still has various use cases in network installations where lower bandwidth requirements and cost considerations are primary factors. Here are a few common use cases for Cat5 cable:

Fast Ethernet Networks
Cat5 cables are commonly used in Fast Ethernet networks, which operate at data rates of up to 100 Mbps (Megabits per second). These networks are suitable for connecting devices within a local area network, including computers, printers, switches, and routers, where high-speed data transmission is not a critical requirement.

Voice and Data Integration
Cat5 cable is often used for integrating voice and data networks. In small office or home office environments, where both voice communication and data connectivity are needed, Cat5 cables can be utilized to connect IP phones, computers, and other network devices, enabling simultaneous voice and data transmission over a single cable.

Basic IP Surveillance Systems
For basic IP surveillance systems that do not demand high-resolution video or extensive network coverage, Cat5 cables can be employed to connect IP cameras to the bridge or to transmit video data over short distances. Cat5 cables can handle the data rates required for standard-definition video surveillance applications but are not recommended for resolutions of 4MP and above.

Legacy Systems
In some cases, Cat5 cables may be used to maintain connectivity in legacy systems where the infrastructure was originally designed for lower data rates. For example, in older buildings or installations that have not been upgraded, Cat5 cables can still serve the purpose of connecting devices that do not require high-speed data transmission.

Temporary or Non-Critical Installations
Cat5 cables can be a suitable choice for temporary or non-critical network installations, such as short-term events, trade shows, or temporary office setups. These cables are relatively inexpensive and readily available, making them a practical choice when cost and immediate availability are more important factors than achieving the highest data speeds, and where cable runs are generally short.

It's important to note that while Cat5 cables can still be functional in these use cases, if higher bandwidth or future scalability is anticipated, upgrading to Cat6 or newer cable standards may be recommended. Cat6 offers better performance, higher data rates, and improved resistance to crosstalk and interference, making it more suitable for modern network applications.

When To Use Fiber Optic Networks For IP Video Systems

Fiber optics have revolutionized the way video surveillance systems are deployed, offering numerous benefits over traditional copper-based networks. In this section, we will explore the advantages of using fiber for video surveillance system networks and delve into the key considerations for implementing such a solution.

Unmatched Bandwidth and Speed: Fiber optic cables provide significantly higher bandwidth capabilities compared to copper cables. This increased bandwidth allows for the transmission of the vast amounts of data generated by modern video surveillance systems, including high-definition video streams, audio, and other data signals. The high-speed nature of fiber ensures smooth video playback and minimizes latency, enabling real-time monitoring and quick retrieval of recorded footage. With fiber, surveillance networks can handle the ever-growing data demands of advanced camera systems and support future scalability without compromising performance.

Extended Transmission Distances: One of the standout advantages of fiber optics is their ability to transmit signals over long distances without experiencing signal degradation. Copper cables suffer from signal loss over extended distances, necessitating the use of signal repeaters to maintain video quality. Fiber optic cables can transmit data over much longer distances without the need for repeaters, making them ideal for surveillance systems covering large areas such as campuses,

industrial sites, or city-wide deployments. This advantage allows for flexible camera placement and reduces the infrastructure complexity associated with copper-based alternatives.

Immunity to Electromagnetic Interference: Electromagnetic interference can severely impact the performance of video surveillance networks, leading to distorted or disrupted video feeds. Fiber optics are immune to EMI since they transmit data using light signals rather than electrical currents. This immunity ensures that video footage remains clear and reliable, even in environments with high levels of electrical noise, such as near power lines or industrial machinery. By eliminating EMI-related issues, fiber-based networks provide a stable and uninterrupted video surveillance experience, enhancing overall system integrity.

Enhanced Security and Data Integrity: Data security is of utmost importance in video surveillance systems, as the footage captured is often sensitive and confidential. Fiber optic cables offer inherent security advantages over copper alternatives. Unlike copper cables, fiber does not emit electromagnetic signals that can be intercepted and tapped, making fiber networks highly resistant to unauthorized access or eavesdropping. Additionally, fiber optics are less susceptible to physical tapping due to their dielectric nature, making it harder for malicious actors to compromise the network's integrity. By utilizing fiber, video surveillance systems can ensure the confidentiality and integrity of their data transmission.

Future-Proofing Investment: Implementing a video surveillance system is a long-term investment, and it is crucial to consider future scalability and technological advancements. Fiber optic networks provide future-proofing capabilities by offering extensive bandwidth headroom for upcoming technologies. As video resolutions continue to increase and new camera technologies emerge, fiber networks can accommodate these advancements without requiring major infrastructure upgrades. By choosing fiber, organizations can future-proof their surveillance networks and avoid the need for frequent, costly overhauls.

Preferred Network Topology For Eagle Eye Cloud VMS

Deploying high-resolution IP Video Surveillance systems requires careful consideration of network topologies to ensure optimal performance, reliability, and scalability. Star Topology, along with its variant Hub and Spoke Topology, is a widely adopted network configuration for IP video surveillance systems, and is the preferred network topology for the Eagle Eye Cloud VMS.

In this configuration, each IP camera is directly connected to a central network switch (Star) or multiple camera switches are connected to a central switch or "hub" (Hub and Spoke) which is then uplinked to the Bridge or CMVR. This topology offers several benefits, including:

- Simplified troubleshooting: The star topology allows for easier identification and isolation of network issues since each camera is individually connected to the central switch.
- Better bandwidth management: By dedicating a separate network connection for each camera, the star topology ensures that bandwidth is efficiently allocated to support high-resolution video streams.

- Scalability: Adding or removing cameras is straightforward in a star topology, making it ideal for systems that may expand or evolve over time.

The Daisy Chain topology is not recommended for high-resolution IP Video Surveillance Systems.

Read AN051 Network Topology and Installation Best Practices for more information.