EAGLE EYE NETWORKS

BEST PRACTICES GUIDE

Best of Both Worlds - Cloud For Your Existing Camera Investment

Upgrading Your Analog Video Surveillance System to a Modern, Digital Cloud System

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You can affordably upgrade your legacy analog surveillance system to a high-performing true cloud video management system (VMS) by reusing most, if not all, of your existing cabling infrastructure and analog cameras.

There are several approaches to successfully upgrading your system, depending on the type and operability of your cameras and your willingness to use your existing coaxial infrastructure. The easiest and most cost-effective way to preserve your current system is to simply plug your analog cameras and coaxial cable into a cloud-ready appliance. This digitizes your current video (and its image quality) to work within the cloud technology company's architecture. However, better image quality can be realized by attaching new high-definition cameras to your analog cabling and installing a matching high-definition receiver at the other end of the cable; thereby greatly improving the image quality, regardless of the transmission media in use.

In today's security industry, the technology exists to "encode" and transmit video in multiple accepted formats, and many video manufacturers have released products that do this quite well. The "gotchas" around reusing your existing cabling and cameras are few, but can be severe if you or your security service provider are unfamiliar with analog signal transmission and the power required to successfully transmit or convert it over the distance of the wiring.

This paper details the advantages of managing your analog camera video in the cloud, outlines video-to-cloud upgrade options, and provides readers with actionable information to successfully transition analog camera video to the cloud.

Moving to a Cloud System Architecture

Many organizations are moving to a cloud-based video management system (VMS) for the same reasons IT decision makers are moving most business applications to the cloud: high application availability (especially for mobile users), cost savings/optimization, improved disaster recovery/business continuity, and high system flexibility. A well-engineered cloud VMS provides much greater cybersecurity for video data than is feasible with fully on-premise systems. Additionally, artificial intelligence (AI) can be applied in the cloud to analyze security video and provide valuable business and security information.

Analog cameras and their coaxial cable infrastructure typically have 10- to 15-year or longer product lifecycles, which is why many organizations are improving the results from their analog video systems by upgrading the computing behind the cameras to a cloud-based system. Often the lowest-cost, highest-results approach to upgrading analog video camera systems is to start by switching from outdated on-premises video recording software and hardware to a cyber-secure, cloud-based VMS with AI-enabled video analytics.

Deploying a cloud VMS that includes AI-based video analytics cannot only increase the security return on investment (ROI) from your existing analog camera system, it can also provide new insights about activities that are meaningful to facility and business operations.

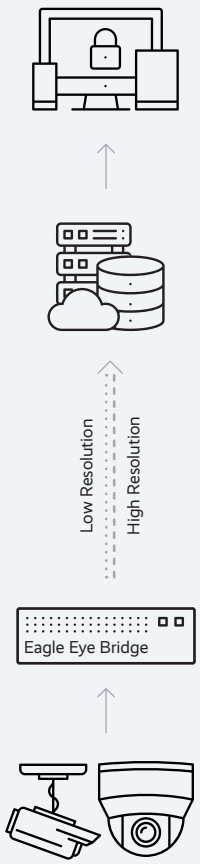
A true cloud VMS is a cloud-native application built using current-day cloud technology that's purpose built specifically to provide "anytime, anywhere" secure access to live and recorded video and its video analysis data. It is automatically kept updated, as computing technology and AI-based video analytics advance.

Cloud VMS Advantages

Some cloud-based VMSs enable reuse of one or both of the two most costly elements of analog video deployments: coaxial cable infrastructure and installed cameras. Often, the larger the analog video deployment, the greater the cost savings from reuse of existing cables and cameras. A cloud VMS replaces the short-lived on-premises recorders and adds improved search and video analytics – at a much lower cost than adding new network cameras, new video network infrastructure, and new onsite video servers.

Although much of the current security industry literature is focused on new network cameras for cloud-based systems, the fact is that video from existing analog cameras can be brought to the cloud easily – with no loss in video quality, and often with an improvement in the quality of viewable video. Video from individual single-site video systems can be brought together into a single cloud VMS application, managing the security and business personnel viewing and reporting privileges in a single easy-to-use application.

EAGLE EYE ARCHITECTURE



Pay for What You Need

A well-engineered cloud VMS is provided via subscription, based on actual performance and usage rather than hardware details. For example, a subscription will provide a specific video retention period – such as 14, 30, or 90 days and longer – regardless of how much recorded activity varies. Cloud computing technology allows the VMS to automatically scale its use of computing and storage resources up and down , so pricing can be based on actual use. On-premises systems must be designed (and thus priced) for the worst-case peak demand, because there's no way to size up and down the hardware processing and storage capacities in response to differences in daily and hourly demand.

One of the consequences of this situation is that many on-premises security video systems are undersized, and as a result, experience technical problems. Typically, they have been known to fail to record 10 to 20 percent of the incident video they're intended to capture. It's also difficult to add cameras to such systems without replacing existing video servers or compromising the recording quality or storage retention periods. In contrast, it only takes a few clicks in a cloud VMS to add cameras to the system, which instantly and automatically expands the computing and storage resources needed without interruption. Cloud computing technology is specifically engineered for this kind of flexibility.

On-premises video management systems start becoming obsolete the day they're installed. They have service and maintenance costs that increase as systems age. In contrast, cloud VMS deployments are kept technologically current and automatically receive feature and security updates with no human intervention and at no additional cost. This is why true cloud VMS deployments typically have a lower total cost of ownership than fully on-premises deployments.

Analog Video Cloud Options

There are three analog video-to-cloud upgrade options.

1. REUSE EXISTING CAMERAS AND CABLE – SEND VIDEO TO THE CLOUD
   Place one or more cloud-managed bridge appliances at the on-site recording locations. The bridge appliances buffer video until the optimal time to send to the cloud VMS data center. Video is always viewable through the cloud VMS application whether it resides in the cloud VMS data center or is still buffered in the bridge appliance.

2. ADD INTELLIGENCE AND NETWORK CAPABILITIES TO EACH ANALOG CAMERA USING VIDEO ENCODERS
   A network video encoder contains the electronics of a modern-day network camera and can process analog video streams with the same firmware and software found in current-day networked cameras, including basic video analytics. Send video and video meta-data streams to the cloud VMS data center using a bridge appliance designed for modern network video cameras. Existing analog camera coax cable can be retained or be replaced by local area networking.

3. REUSE RECENTLY ACQUIRED ANALOG CAMERAS AND REPLACE AGING CAMERAS WITH AFFORDABLE HIGH-DEFINITION TVI ANALOG CAMERAS AND REUSE THE EXISTING COAX CABLE
   Place inexpensive, supported TVI recorders (available from several high-end manufacturers) at the on-site viewing or recording locations and connect them to the compatible bridge appliance.

Cloud Analog Video Can Be the Smartest, Most Cost-Effective Upgrade

A well-engineered cloud video management system provides a safe and smart investment because it brings the following value while maximizing the returns from your original analog camera and cable infrastructure investments:

- Highly secure cloud data centers based on a modern redundant cloud architecture
- Evolvable compute and network infrastructure hardware- and software-optimized for intensive video processing
- High-performance cloud-native video management system software that uses cloud resource elasticity to assure full functionality under all loads, and cloud resource sharing to achieve affordability for its service
- A continuous-delivery approach to software engineering that provides product cybersecurity and feature updates
- A cyber-secure cloud-based security camera video management system with standards-based encryption of video data and strong authentication of users and mobile devices
- Purpose-built, self-configuring, secure on-premises video appliances that buffer video for dynamic internet bandwidth use and isolate cameras from internet cyber threats
- Automatic appliance security and feature updates, with no installer or end user action required
- Triple-redundant, multi-geographical storage for system configuration and recorded video data with standards-based data encryption
- Highly accurate machine learning-based video analytics technology

Once the move is made to a cloud VMS, it's easy to upgrade or expand the camera deployments to achieve enhanced security and business results at a pace that makes the most business sense.

Maximum Resolution Recording

It has been a common practice to record analog video at one-quarter the resolution (320 x 240 rather than 704 x 480 or more) than analog cameras typically provide. This began in the era when video cassette recorders (VCRs) were being used to allow four cameras to record to a single VCR. The practice continued when digital video recorders (DVRs) came into use to maximize the number of cameras that could be handled by a single DVR. For example, many DVRs could record eight or 16 cameras (instead of just two or four) if the recorded stream was set to one or two frames per second at 320 x 240 image resolution. This approach produces grainy video and often misses key action details.

A well-engineered cloud VMS allows recording analog video at an acceptable frame rate (typically 15 or 30 frames per second) and at full resolution (typically 704 x 480). Thus, analog video systems recording at low frame rates or video image resolutions will have significantly more usable video once they're upgraded to a cloud VMS system.

Most analog video cameras are still producing the same quality video as they did when they were first installed.

Qualifying Analog Cameras for Use

Most analog video cameras are still producing the same quality video as they did when they were first installed. Deteriorations in camera video quality are more likely to be due to dirty camera lenses or camera housing faceplates, or to excessive direct sunlight exposure, than to defects in the cameras themselves. These are the two most common factors in quality of video deterioration, and they affect all cameras, not just analog cameras. End users are often surprised to see the video quality improvements that result from cleaning cameras that are overdue for cleaning.

Sometimes an outdoor camera's image sensor is damaged, because for a portion of each year at certain times of day the camera is pointing directly at the sun. People unfamiliar with this aspect of outdoor camera usage can mistakenly conclude the cause of video deterioration over time is poor camera quality. Replacing those cameras with a different brand, but subjecting them to the same sunlight exposure, will likely result in similar video quality deterioration over time.

When analog camera video is consistently and successfully being transmitted for viewing or recording, moving that camera's video to a cloud VMS will result in the same or better camera quality for live and recorded viewing.

However, very old analog cameras (eight to 18 years and older) may not output a video signal adequate to drive modern-day analog video encoders, even though their amplified signal may be sufficient for an analog television display. Some video cameras sold as recently as eight years ago were built using electronic components designed 30 years ago or longer. For these and other reasons, the following guidance applies to evaluating analog cameras for continuing use.

Following these steps will result in a verifiable (auditable) camera acceptability review. This information will be helpful later in the transition to a cloud VMS.

1. CAMERA LIST
   Make a list of the cameras, noting for each:

   - **Type**
     Examples are box, dome, or pan-tilt-zoom (PTZ) camera.
   - **Camera Number**
     If cameras have been given a number for recordkeeping or display purposes – added to the live and/or recorded video.
   - **Installation Location**
     This is where the camera is installed or mounted, not at what direction it's pointing.
   - **Make and Model**
     Manufacturer name and model number.
   - **Description**
     Describe the field of view, such as "Building A Main Entrance from Inside" or "Parking Lot NE Corner."
   - **Purchase Date**
     If not known, then estimate. Use a reasonable date range if needed.
   - **Recorded Video Settings**
     Note the frame rate in frames per second (FPS) and the image resolution (such as 720 x 480, 640 x 480, or 320 x 240).
   - **Recorded Video Retention**
     Days before video is deleted, and whether manually or automatically deleted.

- **Warranty and Service**
  Note any manufacturer or service provider warranty or service contract for preventive and corrective maintenance.
- **Cable Connector Type**
  Make and model or description of connector type, such as BNC crimp-on, BNC twist-on, F compression connector – plus any adapters used.
- **Cable Connector Status**
  This is the status exactly as found: such as tight or loose, clean, dirty, or corroded.
- **Connecting Coax Cable Type**
  If the cable is labeled by the manufacturer or there is a record of the cable maker's name and the cable model or product number, note these and look up the cable details inspection. If the cable isn't labelled, selected cables should be examined closely to rate the three closed-circuit television (CCTV) coax cable requirements described below in the section titled, "Qualifying Coaxial Cable for Continued Use."
- **Estimated Coax Cable Length**
  Estimate the cable run length to an accuracy of 10 to 20 percent – noting the accuracy, as well as the length. This is required for project risk assessment regarding the cost of replacing various segments of the cable infrastructure.
- **Cable Extender Technology**
  Note any video signal amplifiers or other technology used to extend the length of the cable run beyond its rated length.
- **Power Sources**
  Describe the type and location of the camera's power source, as additional power may be required for a camera encoder or video amplifier.
- **Acceptability**
  When performing the steps below, note if the camera is acceptable "as-is," may need cleaning, may need repositioning to achieve a better field of view for security or other purposes, or may need replacing.

2. VIDEO QUALITY CHECK

Check several of each camera make and model for video acceptability. Save still images of best and worst example quality (it may vary with changes in lighting conditions). Note the results.

- **Security Acceptability**
  Whether acceptable for security use: Yes or No.
- **Other Purpose Acceptability**
  For cameras used also for training, supervision, quality control, or other purposes: Yes or No and what each purpose is.

3. QUESTIONABLE VIDEO PROCEDURE

If a camera's video quality is questionable, clean the camera's lens and/or camera enclosure faceplate according to the manufacturer's or security service provider's directions, saving still images of the "before" and "after" results.

Where an analog camera has deteriorated or been damaged beyond usefulness, consider current-technology analog camera replacement, because there are several very affordable high definition (HD) analog camera models in the recently created "HD over coax" product category. See the section titled, "High Definition Analog Cameras."

Qualifying Coaxial Cable for Continued Use

Over the past 40 years, CCTV security surveillance camera systems have been deployed using a variety of coax cable types, sometimes reusing coax cable originally intended for an earlier generation of network technology, or for cable TV (CATV) or satellite TV services. Coax cable suitable for analog camera systems and modern video recorders has three important characteristics. Qualifying existing coax cable for use for CCTV requires verifying that the cable meets the requirements for these three characteristics.

- **Impedance.** The impedance rating must be 75 ohms, as opposed to 50 ohms or 93 ohms – the cable ratings established for CATV and an earlier generation of networking technology.
- **Inner Conductor.** The inner conductor should be pure copper, not copper clad steel, which works well for satellite dish TV and CATV, but not CCTV.
- **Shielding.** Shielding is a thin layer of metallic material near the outside of a coax cable that prevents electronic "noise" from reaching the copper wire in the center of the cable that carries the video signal. Each coax cable acts like a long antenna. In unshielded cable when radio waves pass through the cable, they generate a small electrical pulse in the signal-carrying wire. The purpose of the shield is to "catch" these pulses and keep them from reaching the central wire carrying the signal.

  A 95 percent all-copper braided shield is best for CCTV, as opposed to a plain aluminum foil shield or braided shields made from stainless steel, aluminum, or a combination of aluminum and copper, which are all designed for other types of coax cable uses. The type of coax cable shield that's effective for protecting satellite TV or CATV signal frequencies isn't effective for protecting CCTV signal frequencies. Given the increasing use of wireless technologies, and the impending extensive use for emerging 5G cellular technology, the amount of external radio-frequency energy passing through coax cables will increase, not decrease. This is one reason why the type and quality of coax cable shielding matters more now than when older CCTV system cabling was first installed.

A 95 percent all-copper braided shield is best for CCTV.

Coax Cable Variations

RG59 coax cable (sometimes called "thin coax") is the industry standard and best choice for analog video systems. However, not all RG59 cable meets the requirements described above. RG6 coax cable (sometimes called "thick coax"), commonly used for satellite TV, does have variations that can be used for analog video systems. RG6 with a solid copper inner conductor and 95 percent copper braiding can be run longer distances than RG59, without video signal loss or degradation. However, RG6 is a thicker, more rigid cable, which can be more challenging to install, especially when corner wraparounds are needed.

RG59 is rated at 700 feet and RG6 is rated at 1,000 feet for analog CCTV. RG59 is more typically used. A single CCTV video amplifier (requiring a 12V DC power supply) can extend an RG59 cable run up to 3,000 feet for CCTV and 2,000 feet for HD analog cameras. An amplifier at each end of the cable run can nearly double those distances.

There can be many unseen factors that compromise coax cable infrastructure, even though the existing analog video system seems to be working well enough.

Mitigating Cable Infrastructure Risk

There can be many unseen factors that compromise coax cable infrastructure, even though the existing analog video system seems to be working well enough. Rodents can be feasting on the cable insulation, over time exposing more and more of the internal cable elements to water compromise and deterioration due to corrosive elements. Cables can be progressively weakened to the point where they break at areas of greatest damage. New sources of radio frequency interference can arrive, such as through the installation or relocation of power transformers or other electrical equipment close to the cable run.

If the customer does not have as-built diagrams of the current coax infrastructure, create them and characterize each cable run segment. What percentage of cable segments fall into these categories?

1. INSPECTED AND QUALIFIED
   The cable segment has passed:
   - **Visual Inspection.** Visually inspected for correct installation (appropriate routing and support, acceptable tension, no kinks) and physical integrity (no visually apparent damage).
   - **Electronic Testing.** Electronically certified for proper performance using appropriate test equipment (for example: Fluke LinkWare™ PC cable test management software and DSX-5000/5000R adapters with DSX-CHA003 coax cable adapter).

2. INSPECTED AND DISQUALIFIED
   The cable segment failed inspection and/or testing. Describe the cable shortcomings.

3. UNINSPECTED BUT LIKELY GOOD
   Inspection and/or testing not performed for cost or schedule reasons and:
   - **Similarity.** Similarity to other inspected and qualified cable segments installed at the same time in the same location.
   - **Recent installation.** Recent installation by a qualified contractor. No video quality issues or cable issues to date. Maker and type of cable verified as suitable.

4. UNKNOWN
   Has not been inspected in advance due to cost and schedule factors. Cable will be inspected and tested as part of the deployment process and replaced, if necessary, per contract terms.

   Sometimes it isn't worth inspecting some cable infrastructure segments in advance when the cable is expected to be satisfactory based on existing analog system performance and similarity to other qualified segments. If this is the case, contractual terms must be specific about (a) the approach to be taken if at deployment the cable infrastructure turns out to be unsatisfactory, (b) what extra costs may be involved, and (c) at what level the cost impacts require specific additional approval to proceed.

   It's important to educate the customer that visual inspection and electronic testing of cable infrastructure will uncover most (and perhaps all) of the problems, but isn't guaranteed to do so. Establish an appropriate allowance for inspected and qualified cable infrastructure segments per site, campus, or operations area, allowing, for example, up to 5 or 10 percent automatic replacement at agreed-upon cost without requiring specific customer approval. Work out appropriate terms for the other categories of cable infrastructure segments.

High Definition Analog Cameras

Today's high definition analog cameras (such as 1080p, 3MP, 5MP, and 8MP) exist because coax cable is capable of carrying much more video signal than is needed by a single security video camera. However, the electronic technology did not exist until now to take advantage of it. There are several formats of HD analog video. HD-TVI (Transport Video Interface), the latest and fastest growing format, is supported by more camera manufacturers than the other formats. Several HD-TVI cameras support Power over Coax (PoC), eliminating the need for separately provisioning power at the camera. There are also PTZ camera models available.

HD analog cameras enable improving the video views at critical locations using higher definition video. The cost of a good HD 1080p analog camera can be as low as $50, a cost lower than an IP camera because, unlike an IP camera, it's not an embedded computer device with a built-in web server. Additionally, analog cameras transmitting over coax don't have the cyber vulnerabilities that networked IP cameras have. Yet, it's still possible to send their video streams to the cloud for storage and deep-learning video analysis.

Cloud VMS as the First Step

Putting a cloud VMS in place as the first step in upgrading an analog camera surveillance system significantly enhances the operational value of the existing camera deployment. It also maximizes the future improvement options based on the wide array of business-value use cases made possible by deep learning-based video analytics.

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