The Open Platform Company

Milestone Systems – White Paper

Edge Storage

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Introduction

Milestone Systems is the first open platform VMS vendor in the world to introduce support for edge storage in selected devices, with the Milestone XProtect® Corporate 4.0 release.

In video surveillance, edge storage (also known as on-board storage) is a technology that stores audio and video recordings in the on-board storage of cameras. This on-board storage is typically memory cards (such as those used in consumer digital cameras), built-in flash memory, or small hard drives.

Milestone XProtect Corporate 4.0 now supports retrieving these recordings from the cameras' on-board storage after system failures. This enables cameras to function as failover/redundancy devices and it increases the overall availability of the video system.

Target audience and white paper purpose

The primary audience for this white paper is surveillance system architects/designers and surveillance project consultants, as well as companies, organizations and governments with surveillance projects/installations.

The purpose of this white paper is to give a general overview of the edge storage implementation in XProtect Corporate, the technology behind it, and the benefits of using it. This white paper should enable the reader to understand the architecture and technology of edge storage in XProtect Corporate, as well as how to design and implement a surveillance system utilizing edge storage. The white paper assumes the reader has a general understanding of Milestone XProtect Corporate.

Central vs. Edge Storage architecture

Traditional central storage architecture using recording servers has many benefits, but also a few disadvantages. Milestone XProtect Corporate 4.0 addresses the latter by adding support for edge storage.

Advantages of storing recorded video in recording servers include:

- Storage technology can be chosen freely from different storage systems supported by Windows. This allows the surveillance system designer/administrator to choose the storage system that best fits their needs and budget.
- The storage can be scaled and expanded to virtually infinite size by using the right storage technology.
- The performance of the storage system can be tailored to the exact needs of the video system.
- Standard storage redundancy technology can be used to ensure that the storage system is always online and that data in the form of recordings is not lost.

Disadvantages of storing recorded video in the recording servers include:

- Video will not be recorded if the connection to the camera is down.
- Video will not be recorded if the recording server or storage solution is down - either because of a system failure or maintenance.

As the global industry leader in open platform IP VMS, it is natural for Milestone Systems to embrace and implement new technologies - storage as well as others - that improve our solutions. Likewise, camera manufacturers tend to integrate the newest technologies in their products as soon as the technologies become mature and inexpensive enough to succeed in the marketplace. Flash memory is a good example: It has now reached price points, capacities, and a level of reliability that make it ideal to include in video cameras.

The development of on-board storage in video cameras enables a different type of surveillance architecture. Instead of centralized storage, recordings can be stored in the cameras at the edge of the video surveillance system. This new edge storage architecture offers some key advantages compared to traditional central storage architecture, but can also result in some significant disadvantages.

The advantages of an edge storage solution compared to central storage include:

- No need for a central recording server and storage solution.
- The network is not burdened by video being continuously transferred to a central recording server and storage solution.

The disadvantages to relying solely on edge storage include:

- It can be unreliable as cameras can fail or be stolen - all recordings are then lost.
- On-board storage may not have the capacity to store video recordings in the desired quality for the desired period of time (such as H.264 HD 30 FPS for 90 days).
- Users cannot view recorded video from the camera if the network connection to the camera is down.
- Video recording is not as flexible as when controlled by a central recording server. For instance, there can be challenges for third-party solutions (such as server-based video analytics) to control recording based on events.

Milestone XProtect Corporate 4.0 strikes the perfect balance between these situations. It enables video surveillance systems that combine the advantages of edge storage technology and central storage architecture to create an even stronger solution than using either type of storage alone. In fact, by utilizing the edge storage capacity in cameras, Milestone eliminates a key point of failure in both centralized and edge storage, enabling video to be recorded even when the connection to a camera or the recording server is down.

Technical overview

Edge storage in video surveillance is the ability for a camera to record video and audio to on-board storage or plug-in-storage (e.g., memory cards) in the camera. These on-board recordings can then later be accessed and retrieved by the surveillance system.

Milestone XProtect Corporate 4.0 will retrieve these recordings whenever the connection is re-established to a camera that it has been offline for a period. Cameras can be offline either because they are mobile (e.g., mounted in a vehicle) and temporarily are out of network reach, or due to system faults or maintenance, such as the recording server or the network connection to the camera are down for a period of time. Below are descriptions of some of these situations.

"Connection to camera is down" scenario

When the recording server has been operating normally, but the network connection to a camera has been down, the recording server will register the time the connection was lost. Once the connection is re-established, the server will retrieve all the audio and video recorded during the time interval from when the connection to the camera was lost to when it came back online. This retrieved audio and video will be stored in the standard database for this camera on the recording server.

Many cameras support definition of a schedule or a rule that only records to the on-board storage, when there is motion in the video, or on specific events. If such settings or criteria are set up in the software, they can be used to reduce the amount of video that are recorded to the on-board storage and thus the amount of video that will be retrieved by the recording server. Once the recordings have been retrieved from the camera, users will be able to view them as they would any other normal recording.

"Recording server is down" scenario

When the recording server is down - either because it is turned off or has experienced a hardware or system fault - recordings from each camera's on-board storage will be automatically retrieved as soon as the recording server is online again. This ensures that no video is lost during the time the recording server is down.

In order to know when the Recording Server last was OK, it continuously writes the last known OK time in a file. When the recording server is re-started, it looks in this file to see the time period it was offline and retrieves the recordings made during this time interval from each camera’s built-in storage.

"Recording server is turned off for maintenance" scenario

When the recording server is turned off for maintenance and there is no failover server in the system, the cameras will continue to record audio and video to the on-board storage. When the recording server is turned back on, the recordings are retrieved from each camera. This leaves no ‘holes’ in the video recordings (missing video evidence) and

makes hardware maintenance and software updates of the recording servers less of an issue whenever they need to be done.

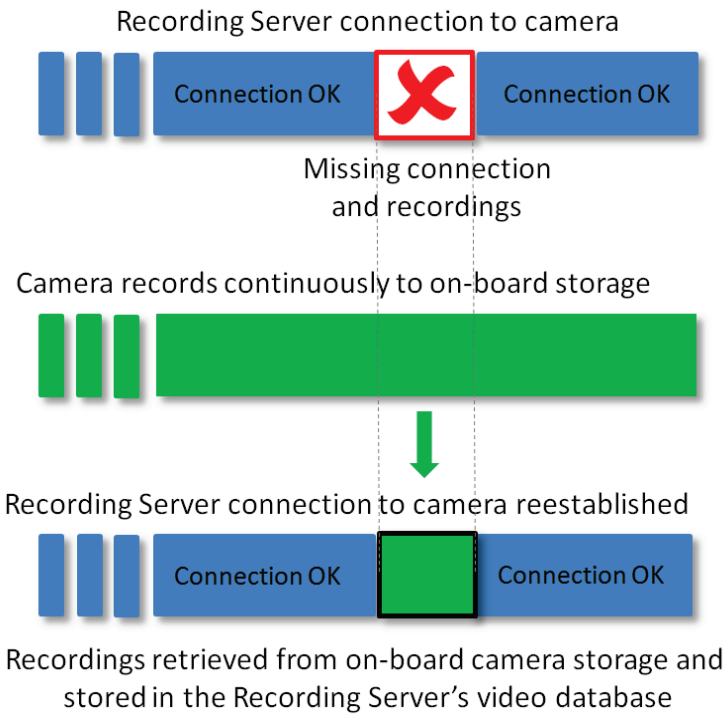
Mobile camera scenario

In many implementations, cameras are mounted in moving vehicles such as buses. These vehicles drive around during the day without any network connection. During the time a vehicle is on the road, video is recorded to the camera's on-board storage. Once the vehicle returns to the garage (or any other point with network connection), the recording server connects to the camera and retrieves the recorded video. The video is then secured in the system's recording server and can be viewed in the standard clients.

Edge storage retrieval principle

The principle behind Edge Storage is very simple: The camera simply records continuously to the on-board storage.

When the video surveillance system detects that it is missing recordings for a time period, either because the camera connection was down, or the Recording Server was offline, the Recording server retrieves the recordings from the camera's on-board storage once everything is online again.



When retrieval of on-board recordings is necessary, it may take some time to complete for two reasons. One: the missing video can cover a large period of time and thus constitute a sizeable amount of data. Two: live and recording streams are typically being continuously retrieved at the same time as the missing video.

The diagram shown illustrates a scenario where the connection to the camera has been down.

Time synchronization

In order for a combined edge and centralized storage system to work optimally, it is very important that all cameras and servers in the XProtect Corporate system are time synchronized. The best method for doing this is to set up and configure a time server. Having a time server makes it possible for different XProtect Corporate servers and

cameras to retrieve the current time via the NTP protocol and thus ensure proper time synchronization.

The XProtect Corporate management server requires a server operating system like Windows 2003 or 2008. Both of these operating systems include a NTP service that can be enabled. In a setup without a domain, the server running the management server can be used as NTP server for the rest of the servers and cameras.

If the servers in the surveillance installation are members of a domain, the domain will normally include the NTP server. The surveillance servers and cameras can then be configured to synchronize the time with the domain NTP server. If it is not possible for the cameras to reach the domain's NTP server due to network design, the same method as described for a setup without a domain can be used, with one small change: the management server must be set up to synchronize its NTP server's time with the domain NTP server's time.

Edge storage support in camera drivers

XProtect Corporate uses camera drivers installed on the recording servers to communicate with the cameras. These camera drivers are installed via a device pack installer that can be downloaded from the Milestone website.

For Milestone to develop a driver for a camera with Edge Storage support, it requires that:

- The camera has on-board storage that can be used for continuous recording
- The camera has a documented API that can be used to code retrieval of the images by the VMS

To see which cameras support edge storage, please refer to the latest Milestone device pack release note on: http://www.milestonesys.com/Downloads?tab=3

Benefits of using edge storage

Edge storage technology provides greater fault tolerance in all types of installations.

Installations with cameras on wireless or public (Internet) connections
When cameras are connected to the surveillance system over a public network like the Internet or a potentially unstable network like wireless, recording servers from time to time might experience a lost connection to the camera. In this situation edge storage is a perfect solution because the camera by itself will record to the on-board storage. Once the connection is returned, recordings will be transferred to the recording server, thus ensuring continuous recorded video even on an unstable network.

Installations with mobile cameras

Using edge storage technology makes it possible to deploy cameras in a wide range of mobile installations (such as buses, trains, taxis, and police cars) where the recordings are made in the camera and later transferred to the recording server when the vehicle is back within network range.

Larger installations with failover recording servers
In large installations, the task of ensuring continuous video surveillance is normally handled by failover recording servers that can take over for standard recording servers in times of failure. Nevertheless, even in this setup there can be a small gap in the recordings from the time a recording server fails until a failover recording server starts and takes over. The missing gap can be covered by using edge storage in the cameras. The system will know which time period was not covered by either the recording or failover servers, and thus can retrieve these recordings from the camera's on-board storage.

Smaller installations without failover recording servers
In smaller installations that are not monitored live, it might be too expensive to have a failover recording server standing by and doing nothing most of the time. In these installations edge storage can be a good substitute for a failover server since the end result, when recorded video should be viewed, will be the same because the camera will record video in periods where the recording server is down or offline.

User's experience in clients

Client operators do not have to do anything extra to view recordings imported from cameras using edge storage.

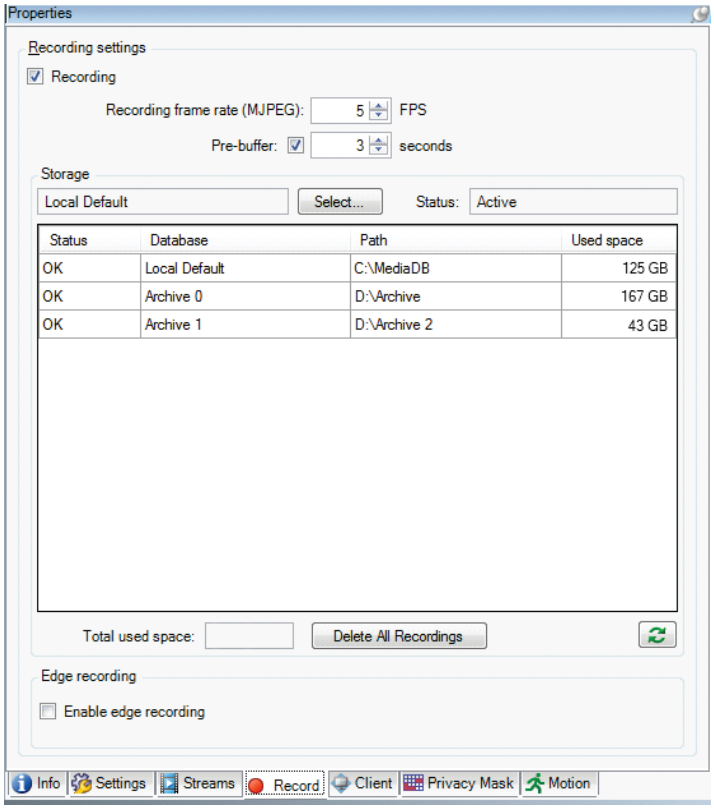
When the recording server retrieves the recordings from the camera's edge storage, they are stored in the recording server's normal video database for the respective cameras. This enables seamless playback of video recorded by the cameras and video recorded by the recording server.

Administrator's experience in Management Client

XProtect Corporate 4.0 provides a completely new way of configuring the recording database(s) and related archives.

As a part of the new database management interface, the camera's old 'Record' dialog has been replaced with a new 'Record' dialog which also contains the option to enable/disable edge storage.

To enable edge storage on a camera supporting on-board storage, simply select the checkbox called 'Enable edge recording'. (For cameras not supporting edge storage, the checkbox will be disabled.)



Summary

Combining central storage with edge storage provides many benefits in surveillance installations. Incorporating edge storage can:

- Increase system reliability over unstable connections like wireless networks
- Provide additional recording redundancy during system failures or maintenance downtime
- Supply a superior solution for handling the video data recorded by mobile units that go in and out of network coverage

Milestone XProtect Corporate makes edge storage extremely easy to deploy. Just choose compatible cameras with support for edge storage and enable this storage in XProtect Corporate through a simple checkbox.

Once edge storage is integrated and enabled in the surveillance system, operators will have seamless access to the recordings whether they have been recorded by the recording server or the camera's on-board storage.

The Open Platform Company

About Milestone Systems

Founded in 1998, Milestone Systems is the global industry leader in true open platform IP video management software, according to IMS Research six years in a row. The XProtect® platform delivers powerful surveillance that is easy to manage, reliable and proven in thousands of customer installations around the world. With support for the widest choice in network hardware and integration with other systems, XProtect provides best-of-breed solutions to 'video enable' organizations – managing risks, protecting people and assets, optimizing processes, and reducing costs. Milestone software is sold through authorized and certified partners in more than 100 countries. For more information please visit **www.milestonesys.com**

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