SONY

White Paper | Network Video Management System

Edge Storage with flexible retrieval

Network Video Management System
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1. Introduction

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

Sony's Network Video Management System (NVMS) Enterprise Edition supports retrieving recordings from the cameras' onboard storage after system failures, based on events or time schedules or by manual request by users of the NVMS Smart Client. This enables cameras to function as failover/redundancy devices and it increases the overall availability of the video system. Cameras can also function as the primary recording device where the Recording Server only retrieves the recordings when they are needed or requested by the users of the system.

2. Purpose and target audience

The purpose of this white paper is to give a general overview of

- The Edge Storage implementation in NVMS Enterprise Edition
- The technology behind Edge Storage
- The benefits of using Edge Storage

This white paper should enable the reader to understand the architecture and technology of Edge Storage in NVMS Enterprise Edition, as well as how to design and implement a surveillance system using Edge Storage. The white paper assumes the reader has a general understanding of NVMS Enterprise Edition and IP video management solutions.

The primary audience for this white paper might include (but are not limited to) the following audiences:

- Surveillance system architects/designers
- Surveillance project consultants
- Companies, organizations and governments with surveillance projects/installations

3. Central vs. Edge Storage architecture

The development of onboard storage in video cameras enables a different type of surveillance architecture than the traditional centrally placed Recording Server architecture. Using Edge Storage, recordings can be stored in the cameras at the edge of the video surveillance system.

With the development of Edge Storage, there are now three main ways to store recorded video:

- Centrally in the surveillance system's Recording Servers using a dedicated storage system
- At the edge of the surveillance system in the camera's onboard storage device
- As a combination of edge and central storage

Both central and Edge Storage architecture have their strengths and weaknesses when used alone, but combining them in the same architecture will give you the best of both storage methods. This is exactly how we have implemented Edge Storage in NVMS Enterprise Edition.

Listed below are the strengths and weaknesses of all three solutions:

3.1. Central recording using recording servers

Advantages:

- Storage technology can be chosen freely from different storage systems supported by Microsoft® Windows®. This allows the surveillance system designer or 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:

- 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

3.2. Edge recording using onboard camera storage

Advantages:

- Reduces or eliminates the 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 recorded to a storage solution
- Enables recording of video in higher quality than what the network connection to the camera actually can carry because retrieval of video is limited to only relevant sequences that can be retrieved at a slower speed, instead of a constant stream of video that may or may not be recorded

Disadvantages:

- It can be unreliable as cameras can fail or be stolen or vandalized - all recordings are then lost
- Onboard storage may not have the needed capacity to store video recordings in the desired quality for the desired period of time
- Users cannot view recorded video from the camera if the network connection to the camera is down
- Slow retrieval and play back of recordings stored in the camera during incident investigation, making the investigation process slower and more cumbersome

3.3. Combined edge and central recording

NVMS Enterprise Edition strikes the perfect balance between utilizing the advantages and eliminating the disadvantages of both central and edge recording, combining the two technologies and architectures to form an even stronger solution than using either type alone. The next sections cover how to utilize the combined edge and central recording solutions in the best possible way depending on specific needs.

4. Technical overview

Edge storage in video surveillance is the ability for a camera to record video to onboard or an interchangeable data media (e.g., memory cards) in the camera. These onboard recordings can be accessed and retrieved later by the surveillance system.

NVMS Enterprise Edition can retrieve these recordings based on three different conditions:

- Recovery from lost connection due to maintenance or network or system failure
- On event or time schedule
- On manual request from users of the NVMS Smart Client

Cameras can be offline by different reasons; they could be mobile (e.g., mounted in a vehicle) and temporarily out of network reach or there could be a system fault or maintenance of network or servers. In this case, the missing recordings can be retrieved whenever the connection to the cameras is re-established.

In addition to working more as failover recording devices, Edge Storage cameras can also be used in normal working conditions where the recordings are stored on the camera until needed, for example: a system event has been triggered, as a delayed retrieval to save bandwidth during working hours or until manually retrieved by users of the Smart Client.

Below are descriptions of scenarios in which Edge Storage is beneficial.

4.1. Connection to camera is down

If the network connection to a camera is lost, the recording server will register the time the connection was lost. Once the connection is re-established, the server will automatically retrieve all recordings made during the time interval where the camera was out of reach. The retrieved recordings will be stored in the standard database on the recording server and be available for playback in the clients as all other recordings.

Many cameras support the definition of a schedule or a rule that only records to the onboard storage media when there is motion in the video, on specific events or time schedule. If such settings or criteria are set up in the camera, they can be used to reduce the amount of recordings stored on the onboard storage and thus the amount of recordings that needs to be retrieved by the recording server.

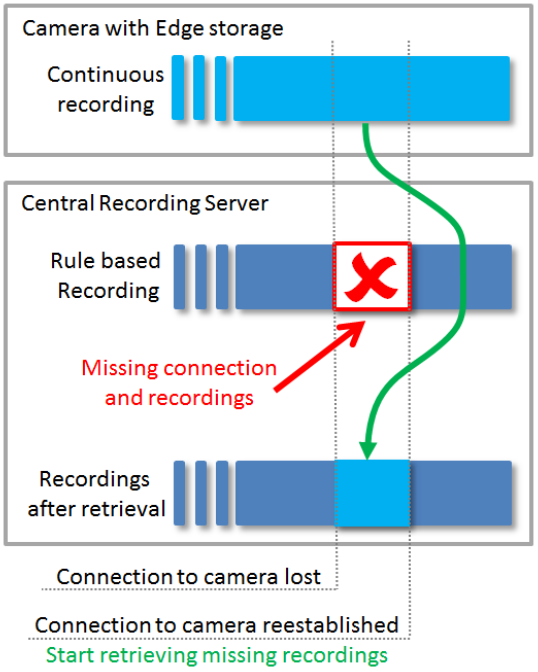
4.2. Recording server is down

When the recording server is down - either because it is turned off for maintenance or has experienced a hardware or system fault - recordings from each camera's onboard 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 operational before it went offline, it continuously writes the last known operational time in a file. When the recording server is restarted, it reads this file to calculate the time period where it was nonoperational and retrieves the recordings made during this time interval from each camera’s built-in storage.

4.3. Edge Storage retrieval principle – system or network failure

In the scenario where Edge Storage is used as recording failover, the principle is very simple: The camera simply records to the onboard storage, either continuously or based on motion detection, events or schedule.



When the video surveillance system detects that recordings are missing for a time period due to a failure, the recording server retrieves the recordings from the camera's onboard storage once the failure is resolved.

Retrieval of the recordings can take some time to complete because:

1. The missing video may cover a large period of time and thus constitute a sizeable amount of data
2. Live and/or recording streams are typically being continuously retrieved at the same time as the missing video, which may prolong the period it takes to retrieve the missing video recordings

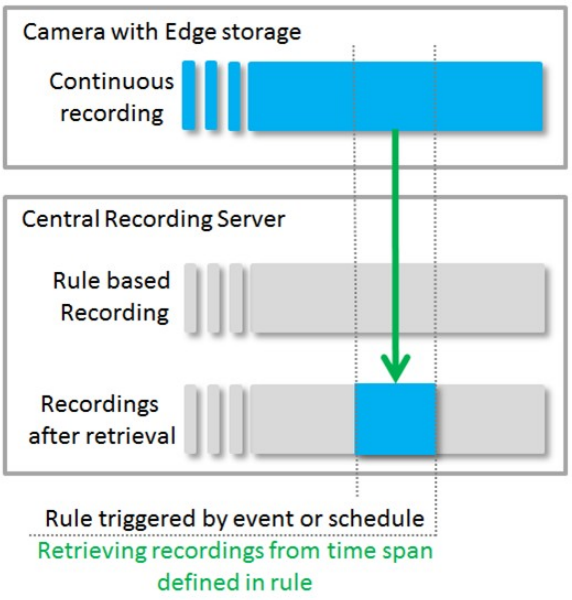
4.4. Scheduled, event-based or manual retrieval

Sometimes the bandwidth is limited to the cameras or the bandwidth should be reserved for business-related traffic during working hours. In this case, it may be desirable to postpone the retrieval of the camera's recordings until after working hours. This is done simply by creating a rule in NVMS Enterprise Edition, that based on a defined schedule will retrieve the day's recordings at a specific time, for example, during the night.

When the system is configured to retrieve recordings on a schedule it is sometimes desired to override the schedule and retrieve the recordings earlier, for instance if an incident such as a robbery has occurred. This can be done via a separate rule that retrieves the recordings when an event is triggered, for instance a shop's alarm, or alternatively it can be done by a Smart Client user manually creating a retrieval job.

4.5. Edge Storage retrieval principle – event, schedule or manual

The principle in this case is much the same as when used for failover recording: The camera simply records to the onboard storage, either continuously or based on local rules for recording on motion detection, events or schedule in the camera.



The recording server then retrieves these recordings when an event occurs, the schedule starts or by manual request.

The retrieval of the camera's onboard recordings may take some time to complete because the video can cover a large period of time and thus constitute a sizeable amount of data that needs to be retrieved.

4.6. Time synchronization

In order for a combined centralized and Edge Storage system to work optimally, it is very important that all cameras and servers in the NVMS Enterprise Edition system is 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 NVMS Enterprise Edition servers and cameras to continually retrieve the current time via the NTP protocol and thus ensure proper time synchronization.

If the system is running in a network without a domain controller or NTP server the system's management server can be used as a NTP server, either by enabling the NTP service built into the management server's OS (if running on server 2008 or 2012) or by installing a 3rd party NTP server.

If the servers in the surveillance installation are members of a domain, the domain will normally include a 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.

5. Edge Storage support in cameras and camera drivers

NVMS Enterprise Edition 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 Sony website.

To see which cameras support Edge Storage, check the Supported devices for NVMS Enterprise Edition webpage. Click the device in the list to see the full list of supported functions, like for instance Edge Storage.

6. Benefits of using Edge Storage

Edge Storage technology provides a range of benefits in different scenarios:

- Increased fault tolerance in all types of installations
- Conserves bandwidth on the network or Internet connection during periods where other traffic should be prioritized by postponing retrieval of the recordings until off-peak hours
- Records video in a higher quality than the bandwidth would allow if the video was streamed continuously to the recording server in the conventional way letting the recording server decide what should be recorded.

6.1. Installations with cameras on wireless or public 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 onboard storage.
Once the connection is restored, recordings will be transferred to the recording server, thus ensuring continuous recorded video even on an unstable network.

6.2. Installations that wish to transfer recordings on events or by user request

In some installations with distributed cameras, it is desirable that the camera does not load the network by constantly sending video to the central recording servers because video only should be recorded if certain events occur. In these installations, Edge Storage can be used for initial on-site recording and then only later be retrieved when needed by the system or an operator.

6.3. Installations that wish to conserve bandwidth during working hours

In some installations with distributed cameras and a central recording server, the bandwidth on the Internet connection is also used for business purposes. This could be the case in for example a retail chain with small stores that only has cameras installed in the individual shops.

In these cases, it is desirable that the cameras do not load the network by constantly sending video to the central recording servers. Here Edge Storage can be used for recording in the cameras locally in the shop and then later the recordings can be retrieved by the retail chain’s central recording server outside of working hours.

7. User's experience in NVMS viewing clients

The retrieval and synchronization of video initially stored in Edge Storage is fully transparent to the users of the various NVMS viewing clients that NVMS Enterprise Edition supports. Hence, operators do not have to do anything extra to view recordings retrieved 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.

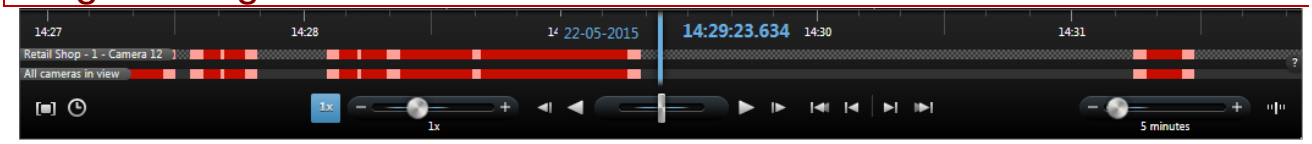
This of course assumes that the video have been retrieved when the recordings should be played back. In case the recordings still reside in the camera, they must first be retrieved from the camera. As soon as the system starts retrieving the recordings, they will become available bit by bit in the client.

If Edge Storage cameras are used as related cameras to alarms, it is necessary to create a rule that retrieves the recordings from the camera as soon as the alarm is triggered, or else it will not be possible to play back the recordings related to the alarm directly in the alarm handling dialog. Furthermore, it should be considered if the recordings can be retrieved fast enough for proper alarm handling. If the alarm response time is critical it is recommended that the recording is done by the recording server and not the Edge Storage in the camera.

7.1. Manual retrieval of recordings

When cameras are enabled to use Edge Storage it is possible to retrieve these recordings on manual request. This is done via the NVMS Smart Client and requires, in extension to a camera with Edge storage enabled, that the NVMS Smart Client operator has user rights to retrieve remote recordings. If this is the case, the camera timeline will display additional information and offer a function to retrieve the Edge Storage recordings.

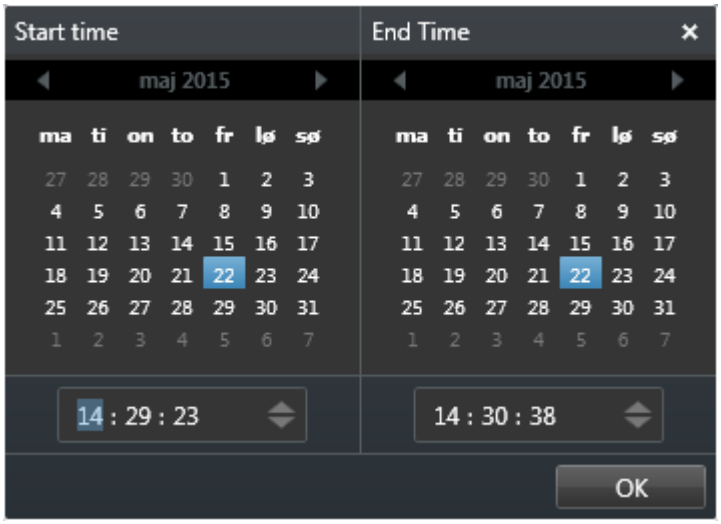
The possibility to retrieve the Edge Storage recordings is visualized by exchanging the normally black space on the timeline between recordings with a grey pattern instead. This indicates that there might be recordings on the Edge Storage camera that can be retrieved by the NVMS Smart Client operator.



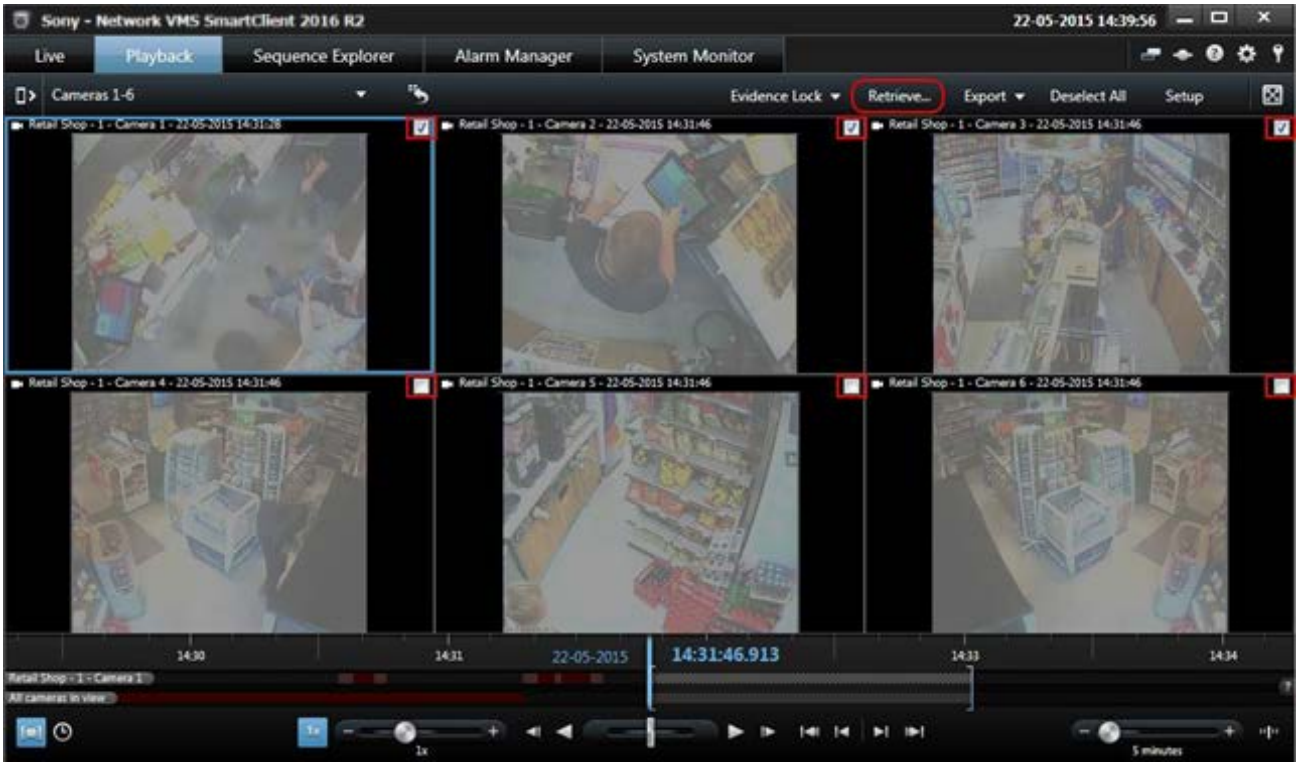
For these Edge Storage cameras where the operator has “Retrieve remote recordings” user rights, the camera’s recordings can be retrieved much like when selecting video to export.

Either - Click the button and select the desired timespan graphically on the timeline:

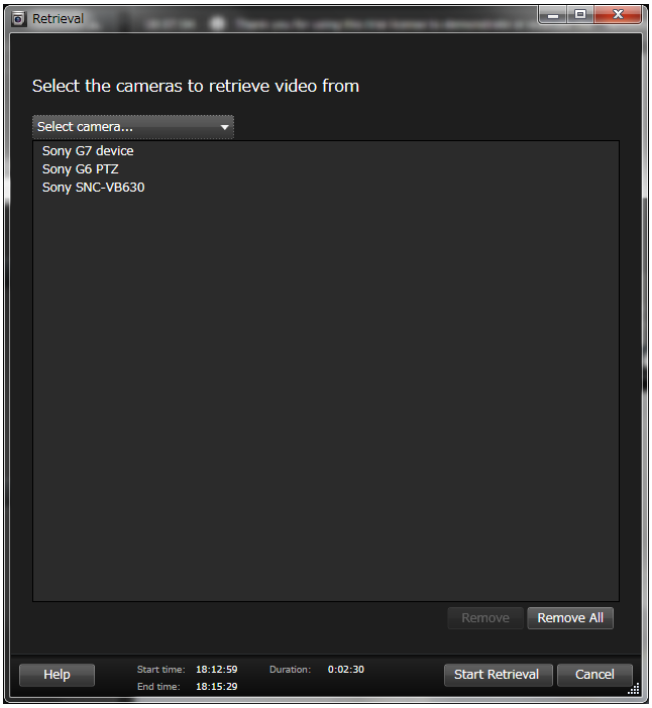
Or by entering directly the desired timespan by clicking the button and setting the start/end time:



Once the time span has been set, the cameras from which the recordings will be retrieved can be selected by clicking on the checkboxes displayed for each camera (the current camera is checked by default).



Once cameras and timespan has been defined the retrieval job can be created by clicking the **Retrieve…** button which will open the **Retrieval** dialog where additional cameras than the ones in the view can be selected.



Clicking the **Start Retrieval** button will create a retrieval job.

Once a remote recording retrieval job has been created it will be indicated on the timeline by a lighter grey pattern as shown below.

Sequence requested:

Sequence retrieved:

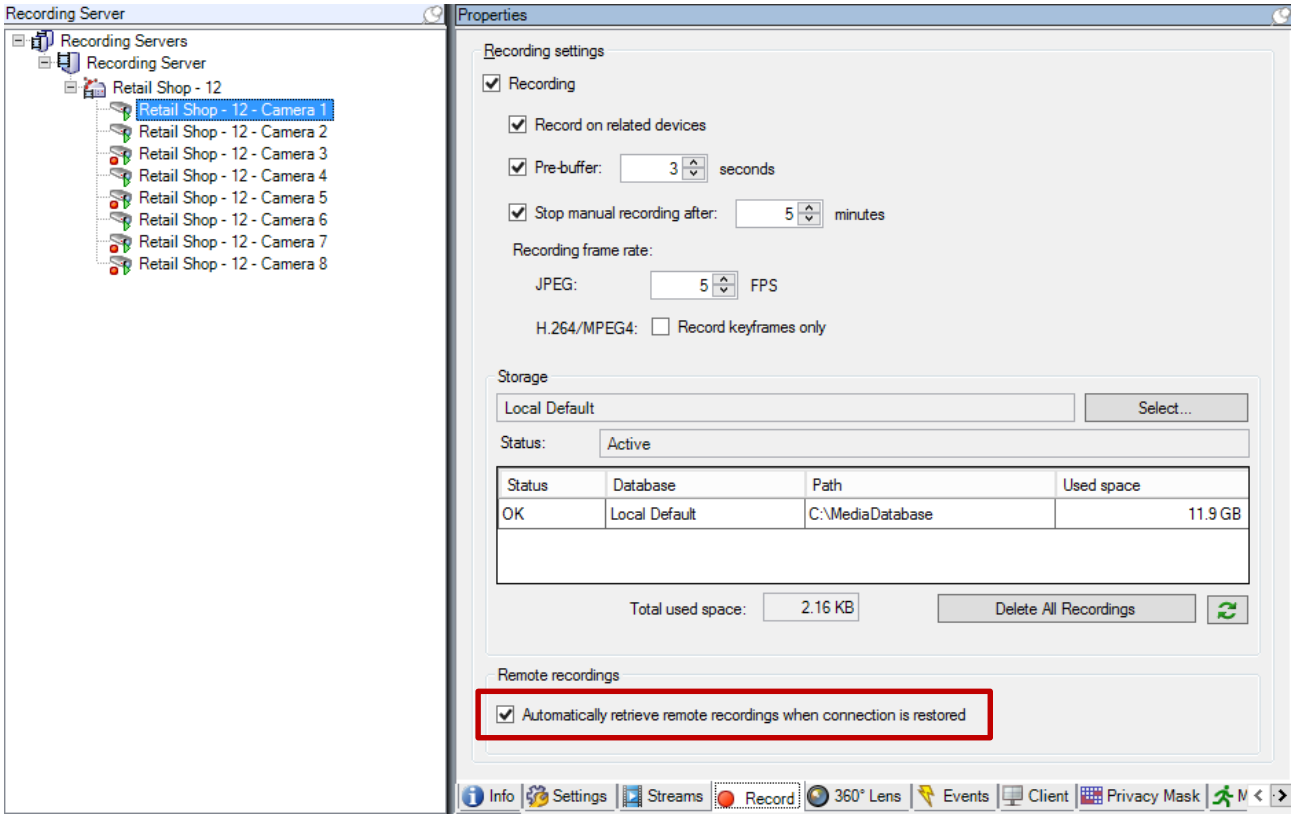
As shown above, when the retrieval job is complete, the timeline will show the retrieved recordings with the standard red color and areas that didn't have any recordings on the remote system by showing these segments with the standard black unpatterned background.

8. Edge Storage configuration

Edge Storage configuration is done in the standard NVMS Management Client as all other system configuration.

8.1. Enable Edge Storage

Edge Storage for failover usage is enabled simply by checking the **Automatically retrieve remote recordings when connection is restored** checkbox on the camera's record dialog.



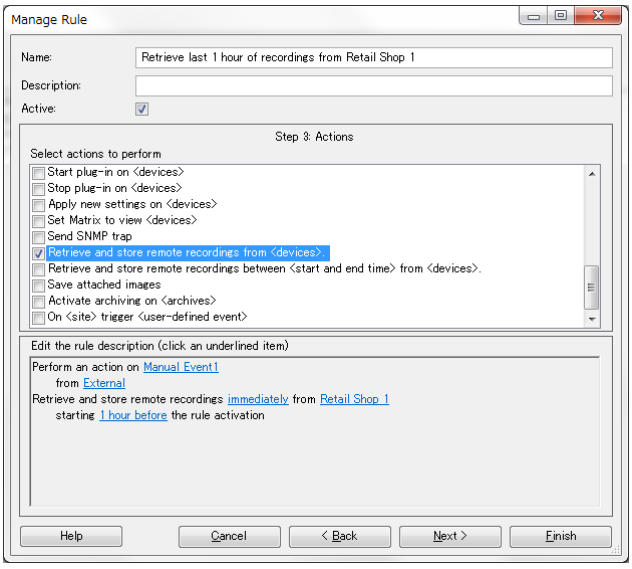
8.2. Retrieve Edge Storage recordings on event or time schedule

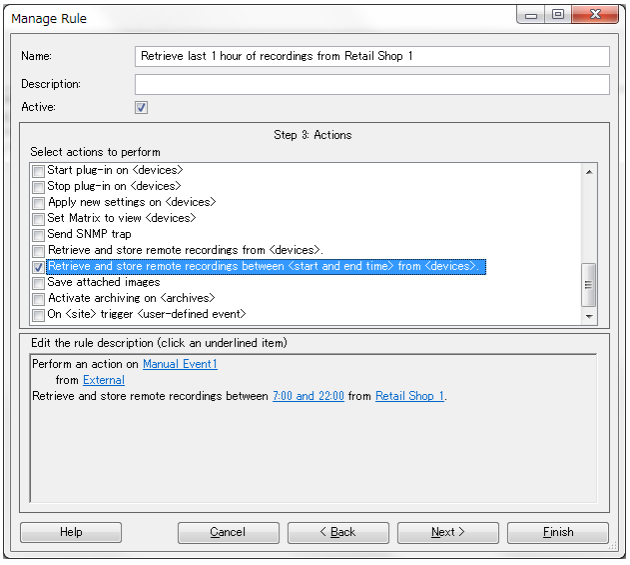
Edge Storage recordings can also be retrieved on event or schedule. This is done by

configuring a rule that retrieves the Edge Storage recordings on event and/or time schedule.

When retrieving remote recordings, it is possible to select to retrieve recordings from a specific time interval or a set time before the event occurred or schedule started.

Example of two rules retrieving the last hour of recordings (left) and retrieving recordings between 07.00 and 22.00 (right) from a group of cameras on an event.

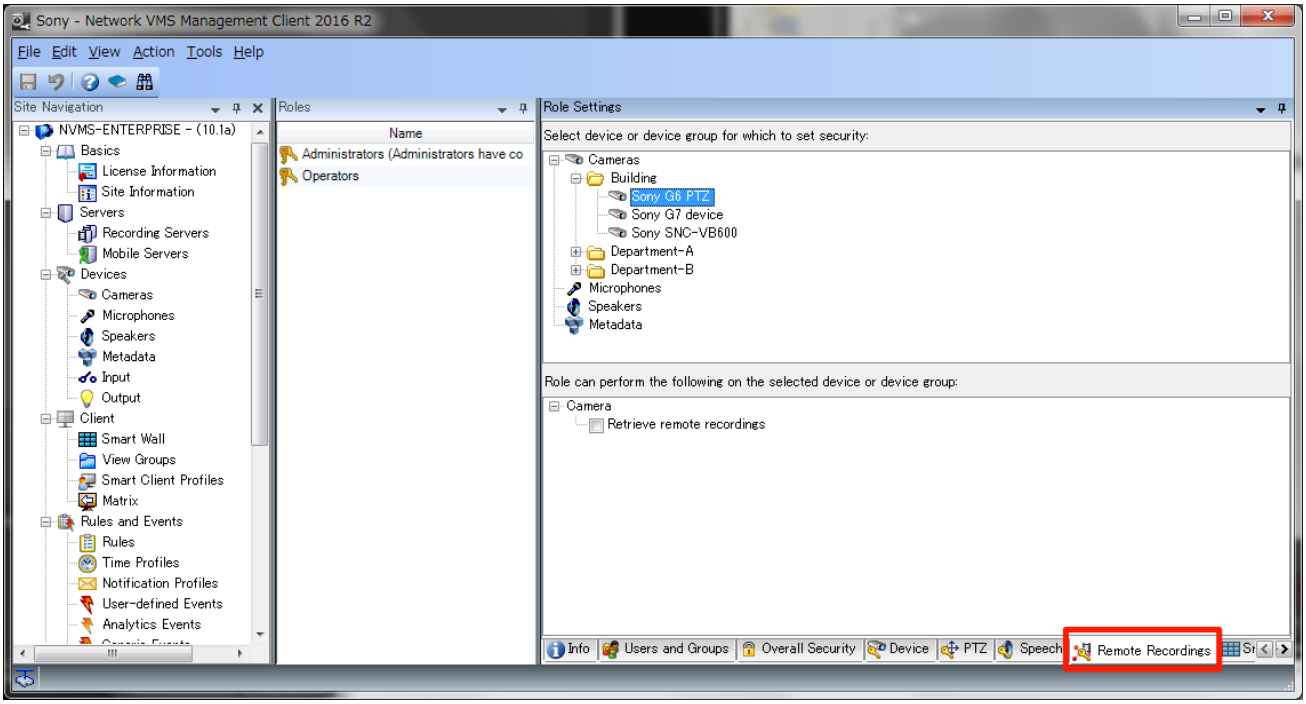




If the recordings needs to be retrieved on a schedule, the rules should just be changed to start on a standard time profile instead of an event.

8.3. Retrieve Edge Storage recordings on manual user request

In addition to the standard user rights for cameras, the Edge Storage enabled devices also have a dedicated tab called **Remote Recordings**. On this tab the rights to retrieve Edge Storage recordings can be set allowing users of the NVMS Smart Client to create Edge Storage retrieval jobs for the selected cameras.



9. Summary

Combining central storage with Edge Storage provides many benefits in surveillance installations. Incorporating Edge Storage into your NVMS Enterprise Edition system can:

- Leave recordings on the camera until they are needed
- Postpone retrieval of recordings to off-peak hours to conserve network bandwidth for other usage
- Increase system reliability over unstable connections like wireless networks
- Provide additional recording redundancy during system failures or maintenance downtime

NVMS Enterprise Edition makes Edge Storage extremely easy to deploy. Just choose compatible cameras with support for Edge Storage and enable them through a simple checkbox, basic rules and user rights.

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 saved on the camera's onboard storage.

Revision History

Date	Revision	Description
2016/10/07	1.0.0	First edition.