



SOLUTION  
PAPER

# DEEP-DIVE INTO BODY-WORN CAMERA SOLUTIONS



Overview of the technology behind  
body-worn solutions

# A NEW PERSPECTIVE ON BODY-WORN CAMERAS

The use of Body-worn cameras is increasing, currently driven by law enforcement and private security to improve officer and citizen safety as well as case transparency. New camera types, higher camera resolutions, increased transmission speeds, and AI-driven analytics are in a constant state of development and have paved the way for the age of mobile and body worn cameras – and their almost inexhaustible potential across industries.

Body-worn cameras come in many different shapes and sizes and are traditionally worn on the torso, built into a helmet or worn around the neck with multiple cameras stitched together to provide a 360-viewing experience. The technology shares characteristics with other mobile camera solutions such as camera equipped drones and in-vehicle cameras – all technologies that complements and provide a new perspective compared to traditional fixed surveillance cameras.

The majority of the cameras has the captured data stored locally on the device. But as 4G and 5G networks make live streaming from the devices more affordable and feasible, the use areas are multiplying. The cameras typically include more sensors than just the camera, sensors that also generate meta data with regards to location, direction, speed, and time to help validate or enrich the captured video images.

So, when governments and organizations decide on a surveillance solution incorporating body-worn cameras, they should always ask themselves:

- Is the video used for “after the fact” viewing or do I need live streaming to remote storage and/or central operator?
- How flexible is the solution? Do I know all my needs now or do I need to be able to add more or deeper functionalities later?
- Will the video be combined with other video feeds from either fixed or mobile cameras?

- Is there value in further automated analysis of the video?
- How future proof is the investment?
- How many different cameras and devices do I want/ need to operate and monitor?
- Do I need a stand-alone body-worn camera or a full solution with a video management solution?

North America is the largest region for body-worn cameras with law enforcement and private security as main users. The device market is very fragmented, with many brands, models, and variants available, ranging from small innovative niche start-ups to the well know larger camera vendors with global presence. A key differentiator in this market is how, and with which solutions, brands and models integrate into an evidence management or video management system.

If the body-worn cameras are a part of a larger installation or if the video feeds will be combined with other video feeds, an integrated video management is the solution.



Figure 1: Linkflow FIT 360 Security, providing a multi-sensor body-worn camera for front and rear view recording and WiFi Transmission through ONVIF



Figure 2: Digital Barriers Connected Vehicle solution

# CAPTURING OPPORTUNITIES



Figure 3: Axis W100 body-worn camera worn by security and police

## What are body-worn cameras?

Body-worn cameras are small wearable devices that capture video, audio data, and sometimes also generate meta data (position, object classification, etc.). Often, a body-worn camera is a single, fully integrated device, but separate encoder-camera solutions are also available. Encoder-camera solutions are often used for live streaming solutions combined with specialty cameras like thermal cameras, low-light cameras, or high-speed cameras.

Body-worn cameras are used in professional environments, like governments or private-sector companies. The data can be recorded on the device locally and/or be live streamed to a centrally managed system. The cameras are battery-operated and are usually designed to be used in harsh or hazardous environments with long operation times to cover an entire working day. Often, body-worn cameras can also be used with external connections for audio communication equipment like headsets and carry IR lighting for best video quality in poor lighting conditions.

Body-worn cameras are not the same as the action cameras used in leisure and sports environment and should not be compared as such. Their use cases are very different, as is the output and usability for security, training, inspection, and /or remote assistance.

Action cameras focus mainly on image quality and single recording while body-worn cameras are a group of cameras providing multi-channel video streams as well as video availability for live streaming and recording. Most body-worn cameras today provide local recording only, but live streaming types that provide both are also available.

Due to the need for handling multiple cameras on a daily basis, body-worn cameras usually use docking stations where the recorded data can be offloaded from the device to free up space in the device data storage. When the data is offloaded, it can be stored for a longer period of time and processed for further analysis. However, many companies still spend a lot of costly hours manually offloading data by removing the data storage from the devices and copying the content to a central location.

A more efficient approach is to use video management software on an open platform. Body-worn camera manufacturers use their own systems to manage the camera settings, recordings, users, and the offloading/streaming process. These body-worn camera systems are mostly hosted in the cloud but are also available as private cloud or on-premises.

## Why use body-worn cameras?

### Body-worn cameras are used in many industries:

- Law enforcement
- Military
- Oil & Gas
- Construction
- Private security

The features and properties of the devices used in these industries can vary greatly. However, many manufacturers offer the same devices for one or more industries.

### Law enforcement and private security

Law enforcement units and private security often require secure recording and GPS positions. Because of the large volume of devices used, cost per device is an important factor to consider. Hence, most devices used by the police are “record only” offline body-worn cameras.

The police and law enforcement units use body-worn cameras to prevent escalation or to de-escalate heated situations. The devices may also be used to collect and document incidents for increased transparency. Because the body-worn camera can be used by multiple persons throughout the day, battery life and storage space are important requirements. Also, to ensure video integrity, encryption and digital signing are becoming increasingly important.

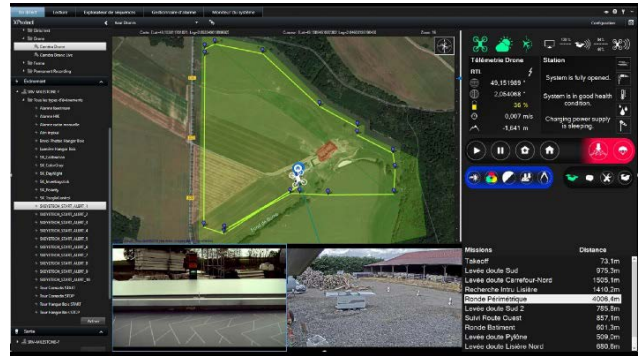


Figure 4: Skytech drone integration

### Military

The military requires ruggedized devices that are certified according to a military standard like MIL-STD-810. At the same time, the military often requires secure low latency, uninterrupted live streaming to have visual information at the command center during tactical operations.

### Industrial use

Oil & gas, construction, and heavy industry use body-worn cameras for safety and security purposes, but also for inspections, training, and remote engineer support requiring high resolution to capture small details. Inspection and remote engineer support can also be carried out via a live streaming device worn on the body or live streams from drones for overhead inspection or robotic devices.

# CHOICE OF TECHNOLOGY

**In the landscape of body-worn cameras, there are basically two options:**

1. Record Only cameras
2. Live Streaming cameras with recording

## Record only

95% of all deployed body-worn cameras are currently Record Only cameras, recording only when the “start recording” button is activated. The recordings are captured on the device’s internal storage. The camera may record audio in addition to video, and XProtect® can support both.

Usually, the devices support pre-recording, allowing the device to pre-record up to 120 seconds or more prior to an incident, which has the potential to record crucial information. Although Record Only cameras may seem to offer limited functionality, these types of devices have many interesting benefits to consider, especially when used by a large number of people within an organization.

### Use case for Record Only:

- De-escalation of incidents
- Capture evidence of incidents or inspections
- Training purposes
- Safety and confidence for user

### Benefits:

- Easy to use
- Less expensive compared to Live Streaming devices
- Captures only relevant video and/or audio data
- No need for complex wireless network infrastructures
- No bandwidth consumption/network load
- High-quality video/audio
- Reliable

### Disadvantages:

- Requires data offload mechanism to retrieve data
- No live situational awareness
- No real-time positioning information
- No live events or alerts



Figure 5: Zeppcam T2+ and docking station, recording only



Figure 6: Edesix VT50 - VT100 – VT200 recording only cameras



Figure 7: Axis W100 record only

After the user of a Recording Only body-worn camera returns the camera to the docking station, the process of offloading the footage starts, just as footage needs to be synchronized with the video management system.

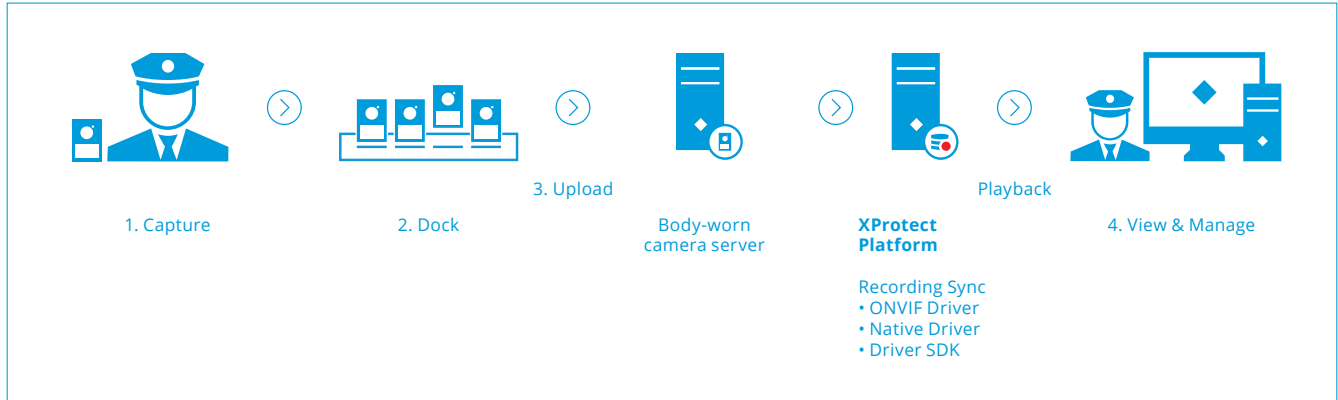


Figure 9: Schematic overview of Record Only solution

### Live Streaming

Live Streaming body-worn cameras can transmit live video through wireless networks like 3G/4G/5G networks or WiFi. The user can initiate the live streaming by pressing a button on the device, streaming can be initiated by operators from a centrally managed system, or it can be triggered by events.

Live Streaming body-worn cameras also (pre-)record video and audio locally on the device as a backup when the transmission fails or when no network service is available. The internal storage is also used to maintain the highest quality video and audio recording during times of low bandwidth connections, where cameras throttle bandwidth by lowering quality and or frame rate to adapt. This way, the central station is still able to maintain situational awareness with less detail while high quality footage can be offloaded or retrieved when required at a later point in time.

### Metadata

Some live streaming devices are also able to transmit a live stream with metadata offering additional information. Often, body-worn cameras and streaming devices offer GPS information as metadata.



Figure 10: Soliton ZAO-S encoder for ultra-low latency h265. Transmitting over up to three 4G/5G LTE networks simultaneously.

**Use case for Live Streaming:**

- Situational awareness
- Remote support and assistance
- Live video from blind spot areas
- Live communication

**Benefits:**

- Faster response times
- Real-time information = better awareness
- Live communication
- Off device analytics
- Rule-based platform automation
- Live events, alerts and notifications (panic button)

**Disadvantages:**

- Cost of Live Streaming over cellular networks
- More data storage requirements
- More expensive technology to deal with bandwidth throttling



Figure 12: Digital Barriers EdgeVis Live Streaming camera

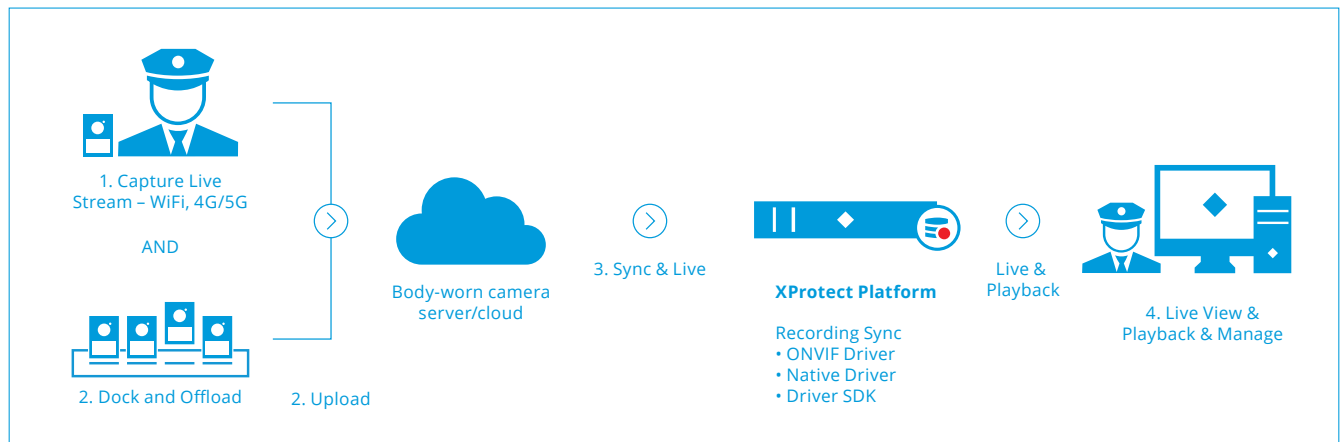


Figure 13: Schematic overview of Live Streaming solution

# MILESTONE XPROTECT®

## – Open platform and Integration Solutions

The Milestone XProtect® is one of the world's leading video management solutions. XProtect® can combine an existing fixed surveillance system with a body-worn camera system.

It connects to either the body-worn camera system or the camera directly and supports multiple body-worn camera systems. This creates freedom of choice, a single, easy-to-use user interface, and a best-of-breed solution for every circumstance. Milestone provides a bi-monthly device driver release to accommodate market demands for easy integration of new devices and functionalities.

XProtect® provides users with a single intuitive user interface and offers valuable audio and video footage, evidence and incident management, and forensic tools for investigations. When using XProtect® with a body-worn camera system and AI analytics, users get the most powerful solution on the market.

Since Live Streaming body-worn cameras can maintain a constant connection to XProtect®, operators do not have to wait to offload data from the device's internal data storage. The recorded footage can be retrieved at any time by the video management software as soon as there is a connection to the device or the device system. Within XProtect®, this is called SVQR (Scalable Video Quality Recording) and Flexible Retrieval.

### Your solution, your way

Body-worn cameras are often extensions to existing surveillance systems meant to enhance the operational conditions of its users. Many end-users, like governments, law enforcement units, and transportation companies, are large operations with many departments that have different requirements regarding the body-worn camera functionality. In the end, the data generated by body-worn cameras needs to be centrally managed and accessed. This requires that the video management software to which the body-worn cameras are connected is flexible, scalable, and open enough to support the most popular systems available.

XProtect® supports over 9,000 devices in the hardware layer to connect to most body-worn camera systems or devices directly. Alongside the available device drivers, the open platform also features a driver framework so the body-worn camera manufacturers can develop drivers that fits their unique strengths. This creates freedom of choice, a single, easy-to-use user interface, and a best-of-breed solution for every circumstance.

Furthermore, the Milestone Marketplace offers a variety of established third-party video management applications, hardware, and services that work with XProtect®, many of which are highly relevant for body-worn camera use cases. Currently the most visited pages on Milestone Marketplace



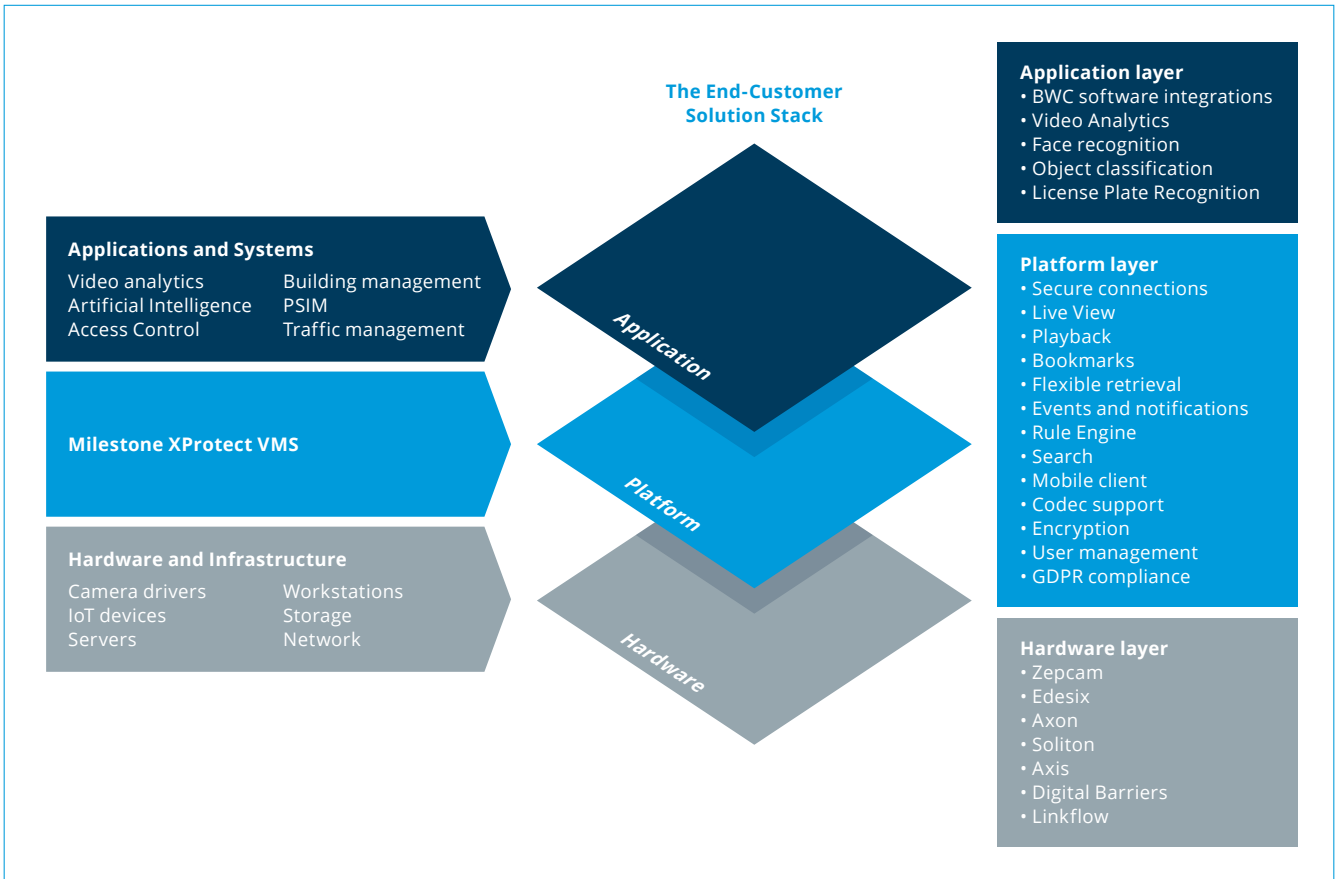


Figure 14: XProtect® Solution Stack for End-User-Access recorded video anytime – Flexible retrieval

# MANAGING AND SYNCHRONIZING RECORDINGS

Flexible retrieval is a feature that is used to automatically retrieve video from the storage system on body-worn cameras or to synchronize with the XProtect® video management software as soon as the camera is docked and recordings are uploaded to the body-worn camera system. The body-worn camera system can add a bookmark to the recording timeline for easy search. The flexible retrieval feature is also used as a backup for live streaming body-worn cameras in case the transmission is interrupted. The video can be retrieved from the body-worn camera platform automatically, manually, time scheduled, or triggered by an event. The retrieved video will be synchronized on the XProtect® recording server, so it becomes available to all XProtect® users for playback and investigation.

## Save bandwidth with Scalable Video Quality Recording (SVQR™)

SVQR is a feature that is used with live streaming devices. During the live streaming session, the XProtect® video management software can record the live stream in real time. To save bandwidth, the live transmission can be done as low-bandwidth low-resolution video for situational awareness at the central monitoring station. At the same time, high-quality footage is stored on the body-worn camera to be retrieved at a later stage when more bandwidth is available. SVQR in XProtect® automatically replaces the low-quality recording from the live stream session with the high-quality recording on the XProtect® server for investigation in high resolution and detail.

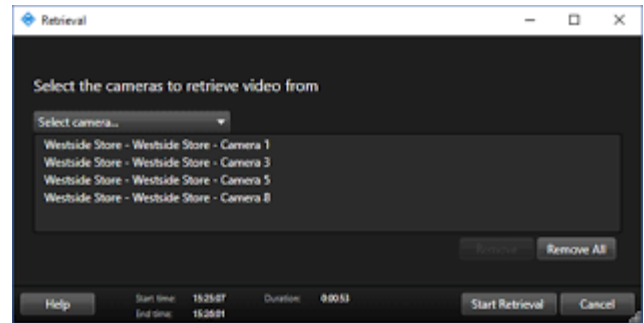


Figure 15: Retrieval jobs pending in XProtect

### Key Benefits:

- Only stores relevant high-quality video
- Lower storage requirement
- Less bandwidth requirement
- Less investigation time due to automated bookmarks

More information about flexible retrieval and SVQR can be found on the [Milestone Content Portal](#).

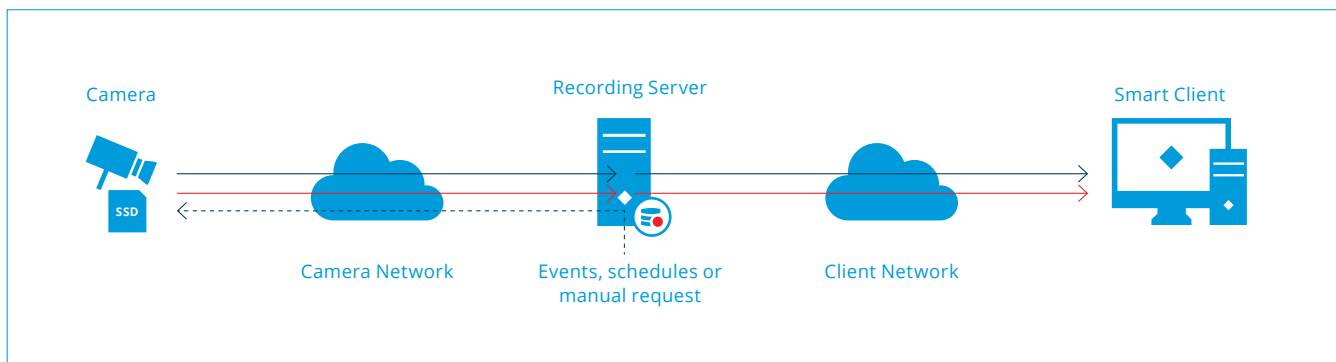


Figure 16: Flexible retrieval

# MANAGING EVIDENCE

After valuable video data is offloaded to XProtect®, the system provides tools, such as bookmarking, evidence lock, export, and third-party solutions, to manage evidence.

## Bookmarks

Bookmarking is the easiest and most used solution during case investigation. The operator can easily create a bookmark from the retrieved video for easy search and follow-up or sharing. The operator can add a headline (case number + title) and detailed comments about the incident. This can be done for one or multiple cameras at the same time when an incident is captured by multiple body-worn or fixed cameras. Some integrations with body-worn camera systems also create automatic bookmarks when the footage is retrieved to XProtect®. All action for creating and managing bookmarks are logged in the XProtect® audit log.

## Evidence Lock

As an alternative or in addition to bookmarking, the evidence locking feature enables you to prevent video sequences from being deleted, for example, while an investigation or trial is ongoing. This protection also covers audio and other data from devices related to the selected cameras. Once an evidence lock is in place, the system protects the data from being deleted. This means that neither you nor other XProtect® users can delete the data until an authorized person unlocks the evidence. With an evidence lock, the data is also protected from automatic deletion that would otherwise take place based on the system's default retention time. Depending on your user rights defined by your system administrator, you may or may not be able to create, view, edit, and delete evidence locks. With evidence lock, users can add a headline (case number + description) and comments. On top of this, the retention time can be set depending on user rights. The evidence lock can also be applied to one or multiple cameras.

All created evidence locks are shown in the evidence lock list for easy overview and filtering just as all actions regarding evidence lock are captured in the XProtect® audit log. Evidence locks can also be created through the MIPSDK2 allowing body-worn camera manufacturers to automatically lock uploaded video from body-worn camera systems.

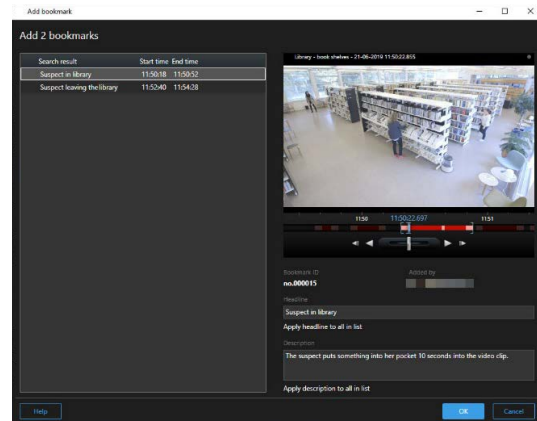


Figure 17: Creating bookmarks

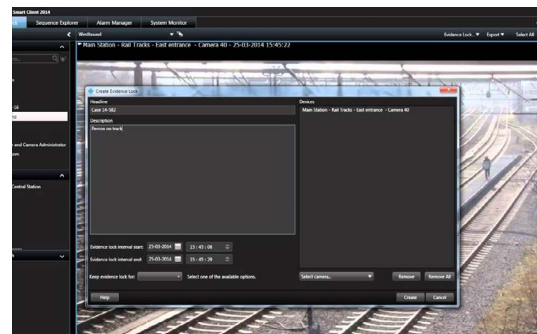


Figure 18: Creating Evidence locks

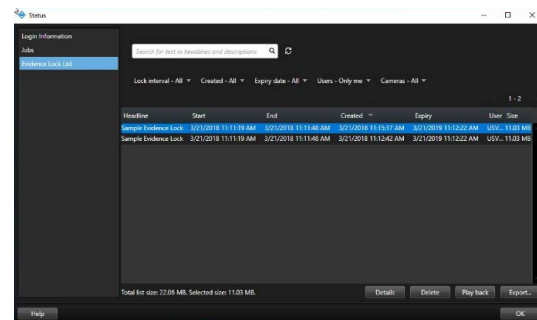


Figure 19: Evidence lock list

**Key benefits:**

- Data is protected from deletion and overwrite
- Easy search and filter options
- User role controlled
- Optional Automatic Evidence Locks though MIP-SDK

**Export**

Exporting footage from XProtect® is available within all XProtect® product variants as a standard feature. The export feature allows the footage to be stored, viewed, and shared outside XProtect®. Users can create exports from one or multiple cameras or directly from the stored evidence locks. During export, the evidence can be protected with AES256 encryption and hashed with SHA-2 digital signing to ensure the integrity and authenticity of the content. Also, privacy can be guaranteed by masking parts or individuals during export.

**Storyboarding**

The storyboard function makes it possible to paste together video sequences from one camera or from multiple cameras into one cohesive flow. The sequence of events, the storyboard, can be used as proof of evidence in internal investigations or courts of law. The function also makes it possible to skip all sequences that are not relevant and avoid wasting time looking through long sequences of video that are not needed, which also prevents the wasting storage space on stored sequences that do not contain relevant video.

**External evidence management**

The export feature also allows the use of external evidence management systems. During (criminal) investigations or training, evidence usually consists of more than one video captured by body-worn cameras. Evidence can be retrieved from phones, photo cameras, YouTube, Facebook, in-car video, etc. To manage all types of evidence, a Digital Evidence Management System is required. With the dedicated plugin for XProtect®, exports can be automatically uploaded to and managed by the Digital Evidence Management System. Using third-party Digital Evidence Management Software enables users to manage evidence from multiple evidence sources. It also provides advanced security and sharing options for different types of users.

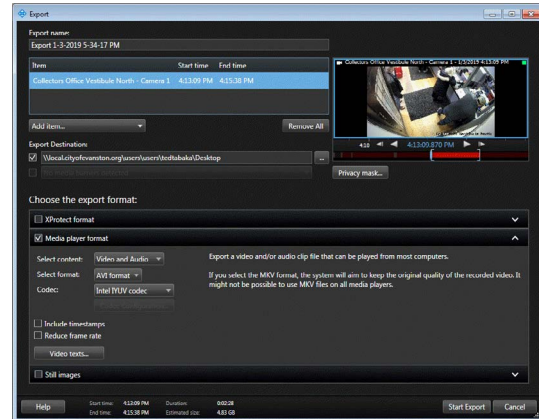


Figure 20: Creating evidence with export

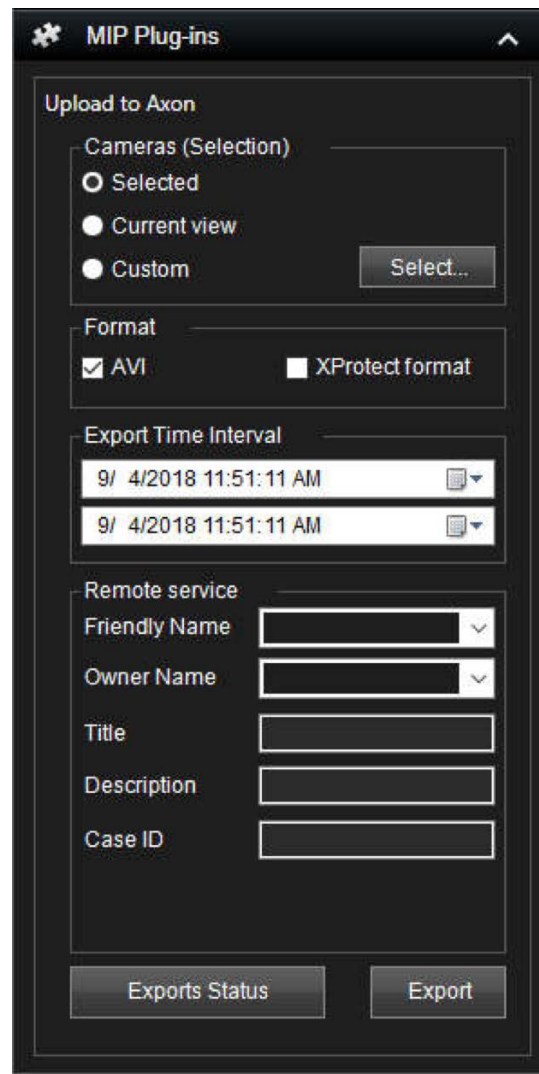


Figure 21: External digital evidence management system integrated with XProtect plugin

<sup>2</sup> MIP-SDK = Milestone Integration Platform SDK

**Key benefits:**

- Key benefits:
- Secure evidence handling
- Privacy masking prevents claims
- SHA-2 signing ensures sustainability during court of law
- Integration to DEMS adds value for investigations

# THE POWER OF OPEN

The true power of Milestone XProtect® as an open platform goes beyond the many types of hardware that it supports. It amplifies when body-worn cameras are combined with the many offerings at the application layer, as shown in Figure 15. Here, body-worn systems can benefit from the analytics solutions provided by the Milestone technology partners. AI-powered analytics can process live footage captured by the body-worn cameras to classify objects, as well as utilizing face recognition, license plate recognition, and personal protective equipment like helmets, glasses and masks. For example, alarms and events can be received in XProtect® when a suspect is identified with a face recognition system.

## Forensic search with video synopsis

With video synoptics, police and law enforcement units can reduce the use of valuable time during an investigation. By post-processing recorded footage stored on the XProtect® server from the body-worn cameras, users can search for age, gender, color, direction, vehicles or types of clothing.

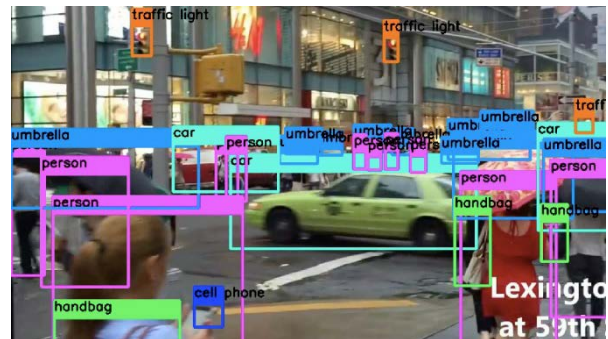


Figure 22: Object classification by VEER captured by mobile video devices



Figure 23: Briefcam forensic search tool review

# DATA PRIVACY AND GDPR

When video technology is used to assist in public areas, data protection and privacy must be considered, because video technology processes Personally Identifiable Information. Europe's General Data Protection Regulation (GDPR) helps ensure that all systems deployed comply with the rules and legislation of data protection, data processing, and privacy. Depending on the domain (private or government) and the use case, GDPR may or may not apply. Requirements can also vary from country to country, and it is advised to seek legal advice.

In many European countries, law enforcement and police fall under different legislation, where GDPR is not applicable, as compared to the private domain where GDPR does apply. Whether GDPR does or does not apply, XProtect® provides all the tools necessary to make a secure and compliant system approved by the European Privacy seal. Simply put, data privacy and GDPR compliance start with a secure system.

Thanks to digital signing and encryption of data storage, XProtect® is officially approved by many federal police forces in Europe as an authorized method of collecting evidence during covert operations.

## Just a few of the tools that contribute to the safety and security of XProtect®:

- End-to-end encryption from device to client device
  - Two-factor authentication for mobile devices
  - AES256 encryption on storage and export
  - Digital signing on storage and export
  - Extensive role-based user management
  - Extensive audit logging
  - Kerberos authentication support
  - Segmented network topology
  - Static, dynamic, and liftable privacy masking
- Milestone also offers a privacy guide on complying with GDPR.

# RESPONSIBLE USE OF TECHNOLOGY

At Milestone Systems, we are proud to see how video technology is coming to the forefront as a major means of support for businesses and workers, governments, and citizens. At the same time, we take the responsible use of technology very seriously, as stated in [the Copenhagen Letter](#).

We encourage all Milestone Systems partners and end-users to respect local laws regarding data protection and data privacy, and we may terminate the entire license for a product with immediate effect if it is used in a way we consider to be a material breach of our end-user license agreement. Innovations in technology should be celebrated, but we must acknowledge our role in developing new technologies responsibly.

### **About Milestone Systems**

Milestone Systems is a leading provider of open platform video management software; technology that helps the world see how to ensure safety, protect assets and increase business efficiency. Milestone enables an open platform community that drives collaboration and innovation in the development and use of network video technology, with reliable and scalable solutions that are proven in more than 500,000 installations worldwide. Founded in 1998, Milestone is a stand-alone company in the Canon Group.



**For more information visit:**  
[www.milestonesys.com](http://www.milestonesys.com)