# Scientific Working Group on Digital Evidence

## Considerations for Body Worn Camera Systems

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## 1. Purpose

The purpose of this document is to provide considerations and offer guidance to organizations currently utilizing body-worn camera (BWC) systems, replacing body-worn cameras, or in the process of implementing a BWC system.

## 2. Scope

This document is intended for use by public safety command staff, administrators, technical support personnel, field practitioners, forensic practitioners, and/or others who are seeking information about BWC systems.

## 3. Limitations

This document is not intended to provide legal advice or replace an organization's standard operating procedures (SOPs). Any operational guidance derived from this document should be implemented only after consultation with legal personnel versed in the laws and rules applicable to the organization's particular location.

Additionally, this document is not all-inclusive and is not intended to state a position for or against the use of any particular product, or provide instructions or suggestions for use of the described technologies. It is offered solely as an informational overview of the technology to increase awareness of its potential impact on the digital evidence community.

While this document primarily addresses considerations for dedicated BWC systems (e.g., storage, security, evidence handling), they are also applicable to the evaluation and implementation of other video recording technologies that may be used in the context of this document. These may include, but are not limited to, mobile phones, action cameras, and other types of mobile digital video recorders.

References to any manufacturers, products, software providers, or applications are intended only to illustrate some of the options available at the time of this writing. They do not represent endorsements or recommendations of any specific products or tools.

## 4. Introduction

A BWC is a portable multimedia recording device, commonly worn by public safety members, security personnel, or other professionals to capture digital multimedia evidence related to their activities. The primary purpose of these devices is to provide an objective and less biased record of events from the perspective of the camera. While each BWC includes firmware for the operation of the device itself, it must also have a data management software system for managing all the BWCs and data associated with them.

BWCs are typically used to capture and document interactions with the operator and mitigate potentially confrontational interactions with the public. The use of BWCs also demonstrates transparency to the community and provides opportunities for organizational or institutional training.

Examples of the types of organizations that can utilize BWC technology include but are not limited to the following:

## 5. Components

When considering BWC technology, it is essential to understand that a BWC system encompasses numerous components beyond the BWC device itself. These components are necessary for general functionality and should undergo consideration from physical, technical, and software perspectives. For example, a component of a BWC system is a base unit and requires system management software to activate, configure, and optimize its functionality.

- Law Enforcement
- Corrections
- Schools
- Fire Rescue/EMS
- Retailers
- Private Security

### 5.1 Base Unit

This component is the core of the BWC, which is compact and attached to the operator's body. The following system components are often included as a part of the base unit.

- Camera lens
- Image Processor (e.g., POV camera)
- Microphone(s)
- Storage Media
- Wireless radio(s)
- Indicator lights
- Peripheral port(s)
- Infrared Illumination[1]
- Image sensor(s)
- GNSS/GPS Receiver
- Battery
- Software
- Display panel
- Buttons
- Speaker

[1] The release of a body-worn camera recording related to a critical incident should include a demonstrative advisory regarding possible differences between the video images captured using infrared illumination and the person's perspective (i.e., the human eye).



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*(Photo: Axon)* *(Photo: Motorola)* *(Photo: Getac)* *(Photo: Axis)*

***Figure 1. Examples of BWC Base Units (Front).***

*(Photo: Axon)* *(Photo: Motorola)* *(Photo: Getac)* *(Photo: Axis)*

***Figure 2. Examples of BWC Base Units (Display).***

The following system components are generally considered peripherals that can be obtained in addition to the base unit. These components are often considered external to the base unit and can extend or expand on the base unit's functionality, although in some systems these components are necessary for the base unit to operate properly.

- replaceable battery
- image sensor (e.g., POV camera)
- microphone[2]
- battery charging cable

[2] Some BWCs have a required or optional microphone that can be attached to the base unit.

## 5.2 Mounts

BWC manufacturers often provide various mounting options including magnetic, clip-on, and modular lightweight load-carrying equipment (MOLLE) mounts. Consideration should be given to possible interference with video capture based on camera placement. For example, a camera mounted at shoulder level may provide a useful perspective during routine activities, but the view could be impeded when the user raises their weapon. For this reason, some organizations have opted to mount the cameras slightly lower on the center torso. A camera mounted too low, such as on the duty belt, may provide a perspective that is too low and the view will likely be obscured during contact with drivers during motor vehicle stops.

- **Magnetic**: Magnetic mounts often come in a two-piece design, including a strong magnet placed underneath clothing material and metal plate that secures outside of clothing, allowing versatility in mounting to a variety of clothing and uniform options.
- **Clip-On**: Clip-on style mounts of different sizes and forms may accommodate various placement options, including on a belt, shirt pocket, or canine harness and can be removed.[3]
- **Fixed**: Fixed style mounts cannot be removed and attaches permanently to the component. Fixed style mounts can accommodate various placement options including on a helmet, eyeglasses, outerwear, and vests.
- **Adjustable**: This can be fixed or removable which most often allows for adjustment of the angle along the Y plane.
- **MOLLE**: Attach to stitched webbing on modern ballistic vests and may provide the most secure and stable mounting option.

*(Photo: Axon)* *(Photo: Motorola)* *(Photo: Getac)*

***Figure 3. Examples of Magnetic Mounts.***

[3] This software may also be used as a repository for the multimedia data imported from BWCs and any metadata that is added either on the device or after the transfer has been completed. Some manufacturers; however, will provide a separate application(s) for this purpose.

*(Photo: Axon)* *(Photo: Motorola)* *(Photo: Getac)*

***Figure 4. Examples of Clip-On Mounts.***

*(Photo: Axon)* *(Photo: Motorola)* *(Photo: Getac)*

***Figure 5. Examples of MOLLE mounts.***

***Figure 6. BWC Mounting Example. (Photo: Axon)***

*Figure 7. BWC Mounting Examples. (Photos: Axon).*

### 5.3 Docking Stations

BWC systems often include docking stations that connect to the data management software solution and facilitate battery charging, data transfer from the base unit to a server, synchronization to a vehicle, time synchronization, and/or device firmware/software updates.

*Figure 8. BWC Docking Station Example. (Photo: Axon)*

*Figure 9. BWC Docking Station Example. (Photo: Motorola)*

*Figure 10. BWC Docking Station Example. (Photo: Getac)*

### 5.4 System Management Software

This is software external to the BWC that is used to register and control the configuration of BWC devices, as well as view data associated with them. There may be multiple applications provided by the manufacturer, including mobile apps for handheld devices.

- Some BWC systems allow administrators to set device profiles (e.g., settings) for the desired performance of the devices, and to accommodate agency needs (e.g., pre-event buffers, tagging options, field of view, resolution, aspect ratio, frames per second).[4]

## 6. Technical Specifications

Many critical factors must be considered in the design and development of BWC systems. These include the following:

[4] Note: This software may also be used as a repository for the multimedia data imported from BWCs and any metadata that is added either on the device or after the transfer has been completed. Some manufacturers; however, will provide a separate application(s) for this purpose.

## 6.1 Physical Characteristics

### 6.1.1 Form Factor

Most BWCs consist of a single purpose-built device with fully integrated components, while others have the lens and/or microphone separated and attached via wire to the base unit. Additionally, some organizations utilize commercially available smartphones as BWCs.

### 6.1.2 Size and Weight

BWCs are designed to be compact and lightweight to ensure ease of wear and interfere minimally with the user's activities since they are most often attached directly to the uniform or other clothing.

### 6.1.3 Durability

BWCs are designed to be durable, with the ability to endure harsh environmental conditions and impact while remaining securely affixed during use. They rely upon optics, sensors, and other electronic components working together to capture and process multimedia data. If the camera is not properly designed and assembled, impact, shock, vibration, extreme temperatures, and/or intrusion by water or dust can cause a BWC to malfunction.[5]

***Figure 11. Example of IP Rating Chart. (Photo: IEC)***

[5] Manufacturers often provide an ingress protection (IP) rating for their product's resistance against the intrusion of dust or liquids.

## 6.2 Battery

Many manufacturers utilize internal rechargeable batteries, which are considered the most common input power. These internal batteries require an external power source such as a docking station to replenish. There are select models that offer interchangeable batteries either internally or detachable batteries externally. Interchangeable batteries extend the operation of the camera and can be useful in certain circumstances.

Special considerations should be given to address efficiency when considering the battery power of the BWC system as follows:

- **Runtime Capacity**: Consideration must be given to the runtime capacity of each battery. Some organizations have standard shifts that run as long as 12 hours, and users may frequently work beyond this period. The rechargeable battery should be capable of continuous operation for at least the length of the shift, with an option available for recharge or field replacement if it becomes necessary.
- **Temperature**: Temperature is also a factor in battery life. Both heat and cold can negatively affect battery performance and the life of the battery.
- **Camera Configuration Selections**: Some camera configuration selections will likely impact battery runtime, including the following:
    - wireless connectivity (e.g., Wi-Fi, Bluetooth, NFC, cellular)
    - GNSS/GPS coordinate data capture
    - resolution (e.g., 480p, 720p, 1080p, 4K)
    - bitrate
    - frame rate
    - low-light options
    - pre-event recording options
    - standby settings[6]
- **Recharge Options**: Most BWC systems include docking stations (e.g., multiple unit bank, single desktop, in-vehicle) that accommodate recharging of the battery. Some BWC models also accommodate cables that can be attached to the peripheral port for charging and/or data transfer. This option can be beneficial for someone who is actively utilizing a BWC and needs to add battery runtime without removal. These types of charging cables are often designed using magnetic connectors that can be quickly removed without causing any damage.

[6] Some systems have a standby or "sleep" option to place the device in a low-power mode when it is not being used to record and no motion is detected. This can extend battery runtime; however, it may also have an impact on pre-event captures, as buffered recording is likely to be disabled during this period.

- **Recharge Time**: Battery recharge times vary among cameras as well as the type of chargers used. Batteries degrade over time and their record and standby times are reduced as they age. It is recommended that recharge schedules and frequency should comply with organization's SOPs.

## 6.3 Video

High-quality cameras with a high dynamic range aid in capturing clear and detailed footage in various lighting conditions. The performance capabilities of the lens, image sensor, and image processor are directly related to the quality of the video produced by the camera. Many BWC manufacturers allow for various system configurations. Consideration should be given to the prioritization of settings so the system most accurately captures the officer's perspective.[7]

### 6.3.1 Resolution

It is important to carefully consider what resolution will be used for recording (and possibly live streaming) due to bandwidth and storage requirements. Higher resolutions also require more digital processing, which can negatively impact battery runtime. Although the BWC system may be capable of encoding and processing data at high resolutions, such as 1080p or even 4K, this may not be necessary to produce high-quality evidentiary recordings.

### 6.3.2 Field of View (FOV)

The lenses used for BWCs vary by manufacturer, as do their corresponding Field of View (FOV) capabilities. Field of View refers to the extent of the scene that is visible through the camera lens at any given moment and is typically measured in angles (e.g., 90°, 120°). Some BWC manufacturers offer FOV configurations from within the camera settings. FOV may be impacted by aspect ratio configurations from within the camera settings (refer to section 6.3.3 on Aspect Ratio).

Attention is often given only to the horizontal FOV; however, the vertical FOV can be consequential as well, especially with the disparities in how the BWCs are physically mounted or carried on the body. As the FOV broadens, more information is captured in images, but there will be an increasing warping effect that can also impact depth perception. Consideration should be made if the broadened FOV captures information not related to the interactions.

[7] The release of a body-worn camera recording related to a critical incident should include a demonstrative advisory regarding possible differences between the video images captured and the person's perspective (i.e., the human eye).

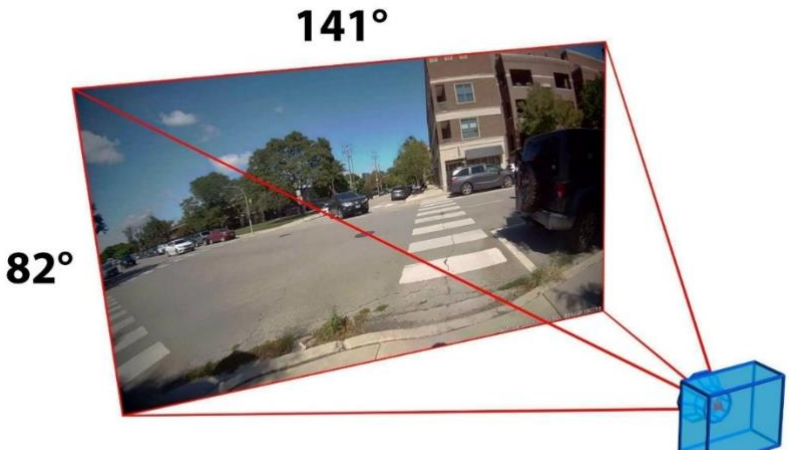


*Figure 12. Example of Common FOV @ 141° Horizontal / 82° Vertical. (Photo Credit: SWGDE)*

### 6.3.3 Aspect Ratio

Aspect ratio is the proportional relationship between an image's width and height. Common aspect ratios include 4:3 and 16:9. An aspect ratio of 4:3 provides a greater vertical field of view, in comparison to a ratio of 16:9 which offers a greater horizontal field of view. An example of this overlaid between the two aspect ratios is displayed in Figure 13 below.

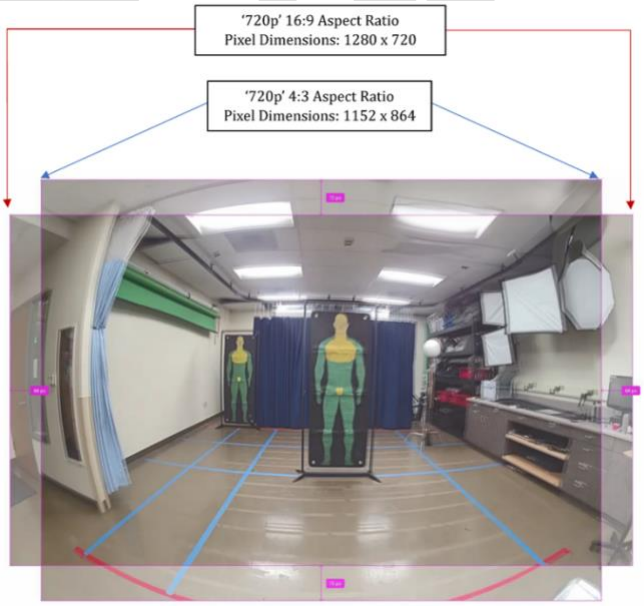


*Figure 13. Example of 16:9 and 4:3 overlaid to demonstrate image cropping. (Photo: Seattle Police Department)*

### 6.3.4 Low-Light Image Capture Capability

Some factors that contribute to low light performance include the type of optical sensors, image sensor size, the size of photosites on the image sensor, signal-to-noise ratio (SNR), lens aperture, and sensitivity. One example of a feature that can be used to improve the capability of the BWC in low light is Simulated Wide Dynamic Range (SWDR).

SWDR is a feature used in some systems to improve image quality in high-contrast lighting conditions. This feature as it relates to BWC processes for both light and dark conditions can be achieved using software. The resulting image contains a wider range of dark and light values.

Consideration should be given to the impact that SWDR and other enhancement features can have on differences between the captured images and the actual human experience. This is especially true if these features allow the camera optics to detect or miss images that would not be normally seen by an operator under the prevailing lighting conditions (e.g., Infrared illumination, thermal imaging).

### 6.3.5 Multimedia Container

Body-worn camera manufacturers may utilize standard or proprietary multimedia container formats to store video, audio, and associated metadata. Some systems use proprietary formats as either the default or exclusive method of storage, often in the interest of data integrity protection or to support vendor-specific features. While there may be operational advantages to these approaches, careful consideration must be given to long-term accessibility, forensic processing, and compliance with organizational and legal requirements.

Proprietary containers can limit the ability of agencies and forensic practitioners to view, preserve, authenticate, and export recordings. These formats may restrict the use of independent tools for bit-level validation or impede the workflows described in *SWGDE 23-V-001-1.2 Best Practices for Digital Video Authentication* in the Additional Resources section. They may also encapsulate critical metadata or secondary video streams (e.g., low-resolution proxy files, multiple tracks, sensor logs) in ways that are not preserved during export. If the vendor sunsets the product or discontinues software support, organizations may lose the ability to decode or access historical evidence.

When evaluating BWC systems, organizations should require:

- Access to the native multimedia container, including documentation describing how video, audio, and metadata are structured within the file.
- Selecting a BWC system with accessible, well-documented, and widely supportable container formats enhances interoperability, ensures continuity of access, and reduces the risk of losing evidentiary value due to future software obsolescence.

### 6.3.6 Video Encoding

Considerations for video encoding include file size, video quality, and compatibility. Many BWC manufacturers currently employ H.264 encoding, but some are now offering H.265 as an

option. Careful consideration must be given to playback compatibility and other factors during the selection of an encoding format in order to properly meet the organization's needs.

For more information related to H.264 encoding, see *SWGDE 19-V-001-1.0 Fundamentals of H.264 Coded Video for Examiners* in the Additional Resources section.

### 6.3.7 Frame Timing

Body-worn camera video formats generate timing information related to the intervals at which video images are documented. This timing information may be inaccurate at the encoding or decoding phases. This becomes increasingly important when evaluating the videos for synchronization issues (e.g., drift) when combined with other audio or video recordings. An effort should be made to determine the accuracy and stability of frame-time information for the specific BWC model in use, including identifying whether variable frame timing is present in either the buffered or active portions of the recording. For more information related to evaluating frame timing information, see *SWGDE 19-V-005-1.1 Best Practices for Frame Timing Analysis of Video Stored in ISO Based Media File Formats* in the Additional Resources section.

## 6.4 Audio

Audio capture capability is a critical component in the design of a BWC. The signals captured by the audio recording device can have a significant impact on decisions made either through investigation or judicial proceedings related to the audio recordings of the activities.

The audio stream often starts after the recording of video has been activated. This is due to the buffering of video where a portion of video is saved prior to when the decision is made to begin recording video. It is also worth noting that audio and video are separate streams recorded with different encoding methods. The alignment represented within a multimedia file containing both streams is not always synchronized. For more information see *Automated Pre- and Post-Event Capture* described in section 6.7.1 and *On-Demand Buffered Data Retrieval* in section 6.7.2.

### 6.4.1 Microphone(s)

The microphone options currently available on BWCs include built-in, wired, and wireless. Some systems also include multiple built-in microphones, which may not independently record audio but are used for digital signal processing (DSP).[8]

### 6.4.2 Digital Signal Processing (DSP)

Some BWCs utilize processing while recording. When multiple built-in microphones are used, they are often used simultaneously to optimize the capabilities including voice intelligibility or desired sounds. This becomes increasingly useful in environments with significant undesired sounds or background noises. Common features include adjustments to sensitivity, automatic gain control (AGC), and/or algorithms to detect and reduce noise (e.g., wind). Consideration

[8] Audio quality is heavily influenced by environmental factors and can be adversely affected by background factors, including wind, traffic, barking dogs, shouting, or the rustling of clothing to which the base unit is attached.

should be given to the overall impact of any such ambient noise filtering capabilities, or otherwise signal processing.

The recorded audio information is not intended to mirror what the operator would have heard from their perspective. Digital Signal Processing (DSP) operations, such as noise reduction, automatic gain control, beamforming, or multi-microphone processing, may suppress, enhance, or distort short-duration sounds (impulses). These impulses include events such as gunshots, glass breaks, or other similar acoustic events. Such effects can alter the amplitude, frequency content, or temporal characteristics of the audio. Consequently, the recorded audio may not accurately reflect the true source characteristics or the precise timing relationships of the acoustic event.

### 6.4.3 Audio Encoding

The same considerations for video file encoding apply to audio. Some common BWC formats include, but are not limited to: MP3, AAC, ADPCM, or PCM.

For recommendations regarding specific training areas, refer to the following documents located in the **Additional Resources** section.

- **Forensic Audio Training:** *SWGDE 10-A-001-3.3 Core Competencies for Forensic Audio*
- **Forensic Audio Analysis**: *SWGDE 08-A-001-2.5 Best Practices for Forensic Audio*
- **Audio Enhancement:** *SWGDE 20-A-001-2.0 Best Practices for Enhancement of Digital Audio*

## 6.5 Location Tracking

BWC systems typically incorporate GPS (Global Positioning System) technology, or more broadly, GNSS (Global Navigation Satellite System) receivers. GNSS utilizes signals from multiple satellite constellations (e.g., GPS, GLONASS, Galileo) to determine the device's location. This data is recorded for future recall and can also be displayed live using software provided by the manufacturer or in other situational awareness mapping solutions. Organizations must be aware of this capability and ensure that the information is kept secure, as it may inadvertently disclose a location that was not subject to public release. This data may be negatively affected by typical issues surrounding GNSS signal obstruction (e.g., within or around tall buildings, trees, inside vehicles) In addition, consideration should be given to the accuracy of the location data with respect to any margin of error established from the manufacturer.

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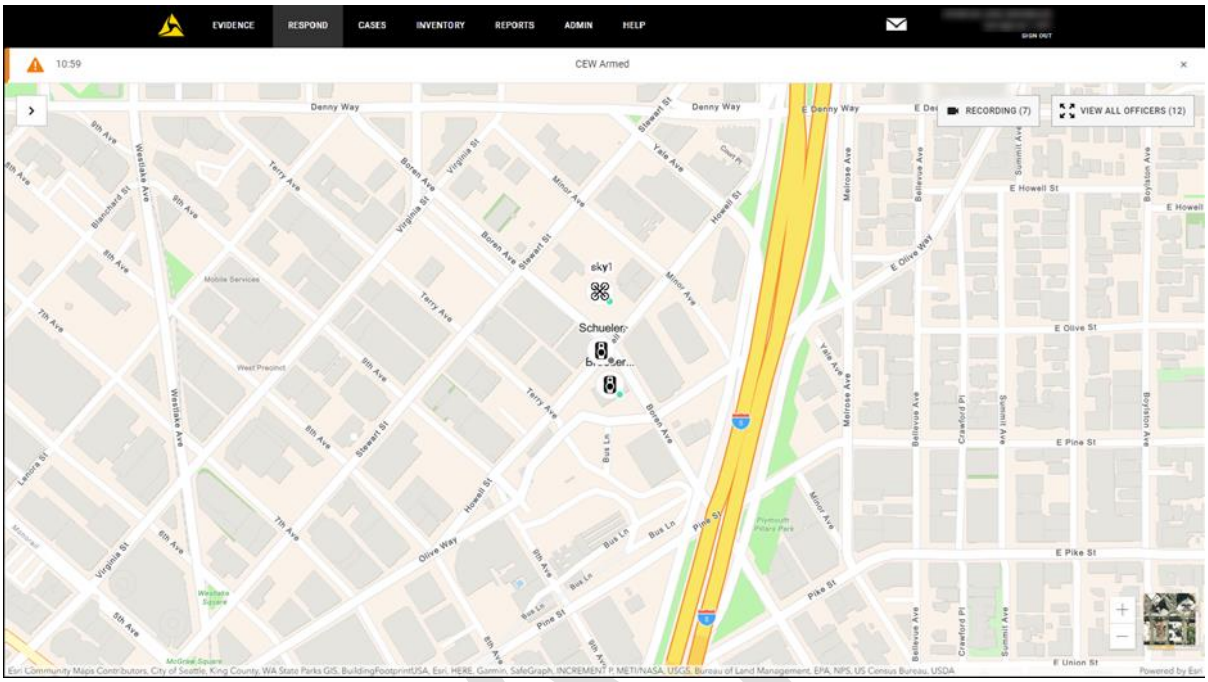


*Figure 14. Example of Real-Time Mapping of BWC Location Information. (Photo: Axon)*

## 6.6 Metadata

Exporting BWC footage and associated data outside of the data management system may be necessary for various purposes; however, upon export the BWC videos may not include all of the metadata available in the data management system. Exported video files may also differ technically from the native recordings. Some export formats may simplify timestamp or frame-timing information, omit certain metadata fields, or exclude status indicators such as audio-mute or buffer notifications unless added as overlays.

There are several types of metadata associated with body worn cameras, such as:

### 6.6.1 System Generated

- device identifiers
- date and time
- unit/user identifier(s)
- make, model, and serial number of the device
- GNSS/GPS location information
- incident number, if interfaced with computer-aided dispatch (CAD)

### 6.6.2 Operator Manual Input

- incident number (no interface)
- event category
- retention settings (i.e., records retention schedule)
- comments
- viewing restrictions (if applicable)

### 6.6.3 Watermarking

Information including date, time, camera serial number, and operational status (e.g., audio activated, audio muted) may be configurable to be included as a watermark overlay within the video. Watermarks may be permanent; therefore, their placement (if applicable) should be carefully considered. It should be noted that some watermarks may obscure parts of the video frame and by design, cannot be removed.

## 6.7 Buffered Recording

Most BWCs have the ability to continuously record while the device is powered on but not in an activated state. This captured data is then either appended to event recordings and/or retrieved independently when needed as documentation of an activity. Buffered recordings can be highly beneficial as an assurance tool that critical events have been properly recorded but may also prove to be problematic if organizations are unaware of their existence.

Buffered segments may also behave differently than recordings that begin when the user manually activates the camera. In some systems, the pre-event buffer is created using a different encoding structure, reduced metadata, or timing information that is less precise. As a result, the buffered portion may not match the frame timing or timestamp accuracy of the actively recorded portion. This can affect how reliably the buffered video can be synchronized with other recordings or used for detailed timeline analysis.

### 6.7.1 Automated Pre- and Post-Event Capture

This is a feature that allows for the capture of video images and/or audio prior to or following the activation of a camera by the user. Parameters such as the length of time and the inclusion (or not) of audio are generally configurable by administrators within the management solution. Pre-event recording is much more common than post-event recording for BWCs. With this type of buffering, the data is added to the file and preserved each time and event is recorded.

### 6.7.2 On-Demand Buffered Data Retrieval

This functionality allows users or administrators to retrieve multimedia data from a BWC that was not intentionally recorded through activation but nonetheless exists temporarily on the internal storage of the device. The length of time such data remains available often depends primarily upon the amount of storage space that exists on the device. For example, some systems allow for the recovery of multimedia data prior to the triggered event. Typically, administrators can select whether or not to include audio during buffering. This functionality should not be

underestimated as it gives the ability to recover video from an event even if the device was not physically activated by the operator.

### 6.8 Automatic Activation

The responsibility of activating the camera has typically fallen on the operator, who may be occupied with other duties and fail to activate the camera. In addition to manual activation, many BWCs have the option to automatically start recording based on input from one or more sensors. This automatic activation is oftentimes referred to as a trigger. Some sensors used for activating a recording are built into the camera, while others are installed within a vehicle or attached to the operator and connect wirelessly.

Organizations should evaluate and validate the latency, reliability, and false-activation rates of each trigger during acceptance testing, as these factors can influence expectations for when recordings should begin during critical incidents. These triggers, often combined with pre-event buffering, risk creating recordings of sensitive or private material at unexpected times for both the primary user and nearby officers.

These triggers can generally be configured based on organization policy or SOP. Common integrations or triggers include but are not limited to the following:

- wireless synchronization with in-car video system
- geofence (e.g., officer on-scene at call for service) (requires interface with computer aided dispatch (CAD))
- emergency lights and/or sirens
- proximity to other BWC users with active cameras (requires Bluetooth communication with other BWC's)
- shotgun and/or rifle holder (e.g., unlocked)
- handgun holster (e.g., weapon removed)
- taser holster
- officer running, struggling, or prone (accelerometer)
- voice command(s) and/or keyword(s)
- audio event (e.g., gunshot, breaking glass)
- vehicle speed threshold
- vehicle G-Force
- vehicle acceleration
- opening vehicle door

### 6.9 Real-Time Data Transfer Capabilities

Some body-worn camera systems offer optional real-time data transfer features intended to enhance situational awareness for supervisors, dispatchers, or command personnel. These capabilities may include:

- live video and audio streaming from the camera
- user location updates
- automated alerts to third-party monitoring systems based on sensor activations (e.g., gunshot detection, officer down, Conducted Energy Weapon (CEW) deployment)
- bi-directional communication between the operator and live viewer(s) through a microphone and speaker on the camera unit

Organizations should be aware that live-streamed video is not identical to the evidentiary recording stored on the camera. Real-time streams typically use lower resolution, higher compression, or different transmission protocols and may not retain the full image quality, timing characteristics, or metadata present in the native file. In some systems, streamed data is not automatically recorded or retained as evidence unless explicitly configured to do so. For these reasons, live-streamed video should be considered a situational awareness tool.

### 6.10 Server Connectivity Options

- upload event data
- download firmware and/or policy updates
- physical docking stations[9]

## 7. System Configuration Options

Most BWC systems allow administrators to select from a list of software configurations and set profiles that are then applied to individual users or groups of devices. Some are limited to general options, such as pre-event recording periods (e.g., 30 seconds) and audio muting capability, while others include more technical settings, such as resolution, field of view, aspect ratio, low-light compensation, frame rate, on-demand buffered data retrieval, and others.

### 7.1 Operational Indicators

Most BWCs allow administrators and/or users to configure the lights, audible indicators, and vibration settings for the device.

### 7.2 Covert Mode

Many BWC manufacturers have a covert mode feature that allows for the use of the device without audible and visual queues that it has been powered on or recording has been activated.

### 7.3 Muting and Stopping Recordings (Video and/or Audio)

Agencies may have varying policies regarding the permissible use of muting or stopping BWC recordings. Some common examples of reasons to mute or stop recordings are below:

[9] Most BWC footage can only be uploaded after syncing with a particular docking station. While some BWC allow viewing footage via a USB or wireless connection, BWC operators should ensure events captured via BWC are uploaded as soon as practical.

- **Confidentiality**
  Some organizations allow users to mute the audio during designated activities, some require users to state on the recording why they are muting while others require complete deactivation of the cameras or prohibit any interruption at all during criminal investigations. Consideration should be given to the technical capabilities of the camera, to ensure that it can be utilized by personnel in compliance with all organization-specific requirements.

- **Sensitive Areas/Information**
  BWC operators should be aware of where they take BWCs as they can record audio and video, and the operator may not be aware the device is activated, or with features such a pre-event buffering, could capture sensitive footage. Sensitive areas include county jail facilities, restrooms, locker rooms, hospitals, or investigative spaces. Sensitive information like personal identifiers or case specific details could inadvertently be captured throughout a recording that are not relevant to the content of the investigation. The camera should be deactivated in these areas while being worn. Alternatively, policy should be developed for redaction of sensitive areas prior to release. For recommendations on Audio/Video redaction, see *SWGDE 18-M-001-2.2 Video and Audio Redaction Guidelines*.

## 8. Video Playback Methods

Proper video viewing and analysis are critical for effective BWC implementation. Multiple methods exist for accessing BWC footage, each with varying capabilities and limitations for data visualization and analysis.

### 8.1 Direct Connection

- **Direct Connection via Cable**: Viewing footage directly from the BWC device via a cable connection to a computer may provide immediate access but often limits the availability of associated metadata. This method may be suitable for preliminary review but may not offer the comprehensive analysis capabilities of dedicated software solutions.
- **Wireless Connection**: Some BWC systems offer wireless connectivity, enabling users to view video recordings directly on their mobile devices via a dedicated application. While convenient for immediate review, this method may also have limitations in terms of metadata accessibility.

### 8.2 Transfer to Data Management System

For the most comprehensive viewing and analysis, uploading the data to the data management software is strongly recommended because it will provide all relevant metadata. The data management system typically provides:

- **Centralized Access:** a single point of access for all recorded footage

- **Enhanced Metadata Integration:** seamless integration and display of all captured metadata, including timestamps, GNSS/GPS coordinates, device information, operator information (name and badge number) and user-generated annotations
- **Advanced Search and Filtering Capabilities:** allows for efficient searching and filtering of footage based on various criteria, such as date, time, location, keywords, and personnel
- **Secure Storage:** ensures the secure storage and the ability to limit access
- **Enhanced Playback Features:** provides advanced playback features such as slow-motion, zoom, and annotation tools for detailed analysis

## 9. Data Management System

BWCs capture a significant amount of video footage, leading to large volumes of data. Managing and storing this data can be a significant challenge, especially considering the need for secure storage, quick retrieval, and long-term retention. Developing and implementing appropriate retention policies for BWC data is crucial. Balancing the need for storing evidence that may be involved in crimes that do not have statutes of limitations with common recorded encounters is a significant challenge.[10]

### 9.1 Cloud-Hosted or On-Premise Servers

Some BWC manufacturers only offer a cloud-hosted management solution, while others allow the organization to provide their own on-premise servers. Consideration should be given when making decisions regarding location and number of servers to ensure an efficient usage of an organization's resources.

### 9.2 Data Security

BWC data shall be securely stored in a location and manner consistent with the standards established by the Federal Bureau of Investigation's Criminal Justice Information Services (CJIS). See *FBI Criminal Justice Information Services (CJIS) Security Policy* referenced in the Additional Information section. Compliance with FedRAMP, HIPAA, SOC 2, and/or other security requirements may also be required. The system must provide administrative controls for the management of access only by authorized users. The roles and permissions should be specific enough to allow only the least privilege needed for each profile. Refer to the *Body-Worn Camera Toolkit* from the Bureau of Justice Assistance (BJA) for policy guides.

### 9.3 Data Integrity and Administrative Controls

Many BWC data management systems permit users or administrators to delete recordings based on role-based permissions. Consequently, organizations must evaluate how each system manages deletion controls, access permissions, and audit logging during the product assessment. Deletion

[10] Consideration should be made for linking multiple recordings and other digitally stored data under the same event/case for efficient retrieval.

and/or editing privileges should be restricted to the minimum number of personnel necessary to maintain operational integrity. Systems must also provide comprehensive, immutable audit logs so that any removal of evidence whether accidental or intentional, can be detected and reviewed. Additionally, files should be hashed immediately upon import, and a chain of custody established for reference as needed.

### 9.4 File Size

The size of the data should be addressed in both the creation, management, and archival processes for the retention of BWC video data. Special considerations should be made to physical versus cloud-based storage solutions.

### 9.5 Audit Log

Video should also be accompanied by a full audit log showing the operator's name, hash value of the video file, each instance the event was moved, reviewed, or exported with full verification data. Audit logs will often include how the video recording was initialized and deactivated.

### 9.6 Reporting

The vendor should fully describe its system features/capabilities for report generation by BWC users and/or organizations.

### 9.7 Redaction

Some data management systems have features that allow for redaction of audio and/or video. Redaction is the intentional removal or concealment of information in a multimedia recording. For more information related to audio/video redaction processes, see *SWGDE 18-M-001-2.2 Video and Audio Redaction Guidelines* for additional information.

### 9.8 Retention, Preservation, and Release

Consider any federal, state, tribal, and/or local rules for the minimum retention period applicable to the specific types of recordings. The system should be capable of data purging upon criminal adjudication and/or disposition of any administrative investigation. BWC original recordings must be preserved and maintained in the same manner consistent with the original capture method and consistent with the BWC manufacturer. For any transfer from the device to a management solution or directly from the device via USB/Wi-Fi, there must be corresponding audit trails. Many BWCs directly upload to a cloud-based management solution or comprehensive digital evidence management solution (DEMS), which creates the audit trails, a hash value, and a platform that allows for viewing and sharing of this original evidence. The data is retained dependent upon the individual organization and shared with relevant parties, internally and externally.

### 9.9 Exporting

Exporting BWC footage and associated data outside of the data management system may be necessary for various purposes; however, upon export the BWC videos may not include all of the metadata available in the data management system. Exported video files may also differ

technically from the native recordings. Some export formats may simplify timestamp or frame-timing information, omit certain metadata fields, or exclude status indicators such as audio-mute or buffer notifications unless added as overlays. In addition, optional watermarking(e.g., date/time text or other status information) can obscure portions of the image and should not replace the preserved original. For these reasons, exported files should be considered working copies, while the native file should be retained as the primary evidentiary record.

The need to export videos and associated data outside of the data management system may include:

- **Sharing with external agencies:** providing evidence to prosecutors, defense attorneys, or other law enforcement agencies
- **Court proceedings:** admittance of video evidence in court
- **Discovery requests:** fulfilling discovery requests from defense attorneys
- **Archival purposes:** long-term storage and preservation of evidence

Careful consideration of the data export capabilities of the BWC data management software, with a specific focus on the needs of all stakeholders involved in the judicial process, is essential for ensuring that BWC evidence is collected, managed, and presented in a manner that supports the integrity of the legal system.

For more information related to video redaction, see *SWGDE 18-M-001-2.2 Video and Audio Redaction Guidelines*. For more information related to clarification and conversion, see *SWGDE 18-V-001-2.0 Best Practices for Digital Forensic Video Analysis*.

### 9.9.1 Export Options

- download to a local device
- copy or move to DEMS, RMS, or other system (if interface exists)
- share via link to a website
- publish to physical media (e.g., flash drive, optical media)
- direct access by prosecutors or other trusted organizations

### 9.9.2 Data Available for Export

- **Original Recordings:** unaltered video and audio files as captured by the BWC
- **Metadata:** Upon export, not all metadata associated with the video may be available for export. This can significantly impact the evidentiary value and analysis capabilities of the exported footage. For example, the exported video may not include the date/time stamp. Types of metadata available may include:
    - **System-Generated Metadata:**(e.g., timestamps, GNSS/GPS coordinates, device information)
    - **Manually Added Metadata:** (e.g., annotations, redactions)

- **Software-Generated Metadata:** data derived from the analysis of the original recordings by the data management software, including but not limited to:
  - **Transcriptions:** text generated from audio recordings through speech-to-text algorithms
  - **Object Recognition Data:** information about objects identified in the video by computer vision algorithms (e.g., vehicles, weapons, people)
  - **Activity Logs:** records of all actions performed on the video file within the system (e.g., views, downloads, redactions)

### 9.9.3 Considerations for Exported Data

- **Export Formats:** Formats may be proprietary where an application may be needed for playback or be in a standard format (e.g., mp4, avi).
- **File Naming Conventions:** When exporting, consider utilizing file naming conventions that include relevant metadata such as officer name, badge number, date, and time of recording, and incident number. This facilitates easier organization, retrieval, and identification of exported files.
- **Manufacturer Support:**
  - Discuss the need to maintaining metadata integrity during the export process with the BWC manufacturer.
  - Inquire about available export options and the level of metadata preservation for each option.
  - Inquire about a method for validating file integrity, including file hashing and verification processes that are transparent and reproducible.
  - A plan for long-term accessibility, including periodic (e.g., 5-year) verification that historical files can still be opened and decoded.
  - Export options that preserve original metadata and timing information, and that do not require proprietary playback software solely for evidentiary review.
  - Non-encrypted, standards-based exports (e.g., MP4) for working copies, while retaining the native file as the original evidence.
  - Documentation of any secondary or low-resolution streams generated by the BWC (e.g., Low-Resolution Video (LRV)/Digital Rights Management (DRM) streams) and whether they are included on export.

### 9.9.4 Content Analysis

Although large amounts of video/audio data is captured through the daily use of BWCs, in most investigations, only a small portion may be reviewed. Most of the information is simply ingested into a data management system and preserved as long as required by law or as otherwise

established by the organization(s). An emerging trend in law enforcement is the automated analysis of multimedia content in BWC recordings.

Using advanced technologies, including artificial intelligence (AI), the video and audio streams can be processed, labeled, classified, and/or categorized based on criteria that have been predefined or customized by the organization. The results can be used for many purposes, including the development of tracked activity measures, triggering of follow-up reviews, redaction for public release, and/or submission of alerts related to exemplary or poor performance by camera operators. These approaches are not yet well understood due to a lack of research, so automated analyses of multimedia content should be carefully considered and validated.

#### 9.9.4.1 Video

Computer vision based on Deep Learning (DL) technology can be used to identify objects and place them into classifications in the video streams. See *Video Analysis for Body-worn Cameras in Law Enforcement: A White Paper Prepared for the Computing Community Consortium Committee of the Computing Research Association* in the Additional Resources section.

#### 9.9.4.2 Audio

Natural language processing (NLP), also based upon DL algorithms, may be used to transcribe the words that are interpreted in audio streams. Some BWC manufacturers are now offering a transcription feature that allows for an automated population of text in reports from audio data captured by the BWC. These automated features should only be used for investigative purposes as opposed to speech identification.[11]

## 10. Product Assessment and Comparisons

Prior to deploying BWC equipment, organizations implementing should consider evaluating equipment from several manufacturers, allowing end users to utilize the equipment during a trial period to find equipment that best serves their organization's needs. It may also be beneficial to review reports which describe similar tests on the unit(s).

Recommended criteria for evaluating the BWC equipment during the testing process may include:

- camera specifications (e.g., resolution, frame rate, aspect ratio)
- mounting options
- battery run time
- battery recharge time

[11] The accuracy of these automated transcription processes should be validated to determine the accuracy of the models applied. The ability of the model to generate content varies widely depending on quality, distance of speakers to the microphone, processing used when encoding the data, etc. The automated transcripts should be reviewed and corrected (as needed) before inclusion into reports or formal documentation. Transcriptions are considered subjective and often not able to be offered as part of expert testimony as they can invade the provenance of the trier of fact.

- ease of use

### 10.1 Automated activations

One example of a possible assessment method may be to attach the BWC to a subject who engages in physical activities, such as walking, running for a short distance, entering and exiting vehicles and buildings. The placement of the camera and lighting conditions could be varied to more comprehensively evaluate the product's performance.

Test recordings produced under these diverse conditions should be compared and contrasted to ensure the equipment meets the organization's standards for evidentiary quality. For additional requirements regarding the documentation of testing processes, refer to *SWGDE 18-Q-001-2.1 Minimum Requirements for Testing Tools Used in Digital and Multimedia Forensics* located in the Additional Resources section.

### 10.2 Equipment Evaluation and Performance Validation

Prior to deployment, organizations should evaluate equipment from multiple manufacturers. This allows end-users to utilize the hardware during a trial period to determine which system best serves the organization's operational needs. It is also recommended to review independent technical reports or peer evaluations describing similar testing on the units under consideration.

### 10.3 Technical Evaluation Criteria

Recommended criteria for evaluating BWC equipment during the testing process include:

- **Imaging Specifications:** resolution, frame rate, aspect ratio, and low-light performance
- **Hardware Ergonomics:** mounting options, ease of use, automated activations and tactile feedback for operators
- **Power Management:** battery run time and recharge cycles under typical shift conditions
- **Storage and Transfer:** upload speeds and the impact of the data management system on the organization's network

### 10.4 Field Performance Testing

Organizations should conduct functional testing that simulates field conditions to comprehensively evaluate product performance. One assessment method involves securing the BWC to a subject who engages in physical activities such as walking, running, and entering or exiting vehicles and buildings either in a real world testing environment or deployed in the field.

Testing protocols should account for:

- **Varying Environmental Conditions:** testing across different lighting levels and weather conditions to evaluate sensor adaptability
- **Mounting Stability:** assessing whether the mounting hardware maintains the camera's orientation during strenuous movement

- **Audio and Video Comparison:** reviewing test recordings to ensure that audio is intelligible and video remains stable without excessive motion blur or artifacting

## 11. Maintenance and Replacement

BWCs require maintenance and periodic replacement to ensure they are functioning properly. Organizations implementing BWCs should follow manufacturer recommendations regarding equipment maintenance and establish a replacement schedule.

### 11.1 Cleaning

Common maintenance recommendations suggest using a soft damp cloth to clean the BWC and avoiding using harsh solvents, jets of water, or compressed air as they may cause damage to the camera lens and/or microphone.

### 11.2 Firmware

BWCs may periodically require firmware updates and depending on manufacturer these updates may be made while the BWC is in the docking station.

### 11.3 Battery

Rechargeable Lithium-ion (Li-ion) battery capacity decreases gradually over time through charging/discharging cycles. Li-ion batteries typically have a life of hundreds of cycles, which varies based on several factors including frequency of use and other environmental factors such as storage temperature, sunlight exposure, and moisture. BWC manufacturers recommend replacement when the battery capacity reaches 70% of its rated capacity. Depending on the frequency of use, those implementing BWCs may expect to replace BWCs every couple of years.

## 12. End-of-Service Considerations

Prior to execution of a contract with a BWC provider, consideration should be given to the available options for data migration upon termination of the contract. Organizations must ensure an efficient and secure transfer of all data during such a transition. See below for examples:

- **Data Retrieval:** The provider must facilitate the export of all BWC data in a format compatible with industry standards, considering potential variations across organizations and the need for seamless integration into existing forensic and investigative workflows.
- **Data Format:** Exported data should be structured, searchable, and easily accessible for analysis and review.
- **Data Integrity:**
    - **Original Recordings:** Ensure the availability of all original BWC recordings in their native file format.
    - **Metadata:** Include all associated metadata, encompassing system-generated data, manually added metadata, and software-generated metadata (as outlined in *section 9.9.2, Data Available for Export*).

  - **Databases:** If applicable, provide access to relevant databases (e.g., SQL, JSON) containing critical information.
  - **Checksums:** Verify data integrity through the provision of checksums for all exported files.
  - All data, including original recordings and associated metadata, must be exported in an unencrypted format to ensure accessibility for law enforcement investigations and judicial proceedings. If the data is encrypted, the BWC provider must provide a method for decrypting the data.
- All sufficient time to retrieve the organization's data from the cloud once the contract ends.
  - The amount of collected data that must be migrated from one hosting provider to another may be significant.
  - Organizations should verify available options for this in advance with each of the vendors.

By carefully considering these factors during the procurement process, organizations can minimize disruption and ensure the continued usability and integrity of their BWC data following a change in providers.

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## 13. Additional Resources


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## 14. Image Sources

- Figure 01 – left to right
  - https://www.axon.com/press/axon-body-4 - (09/18/24)
  - https://www.motorolasolutions.com/content/dam/msi/images/body-worn-cameras/v700_body_camera_front.png - (09/18/24)
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- Figure 02 – left to right
  - https://www.axon.com/press/axon-body-4 - (09/18/24)
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- Figure 06 and 07.
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- Figure 08.
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- Figure 12.
  - SWGDE [09/18/24]
- Figure 13.
  - Seattle Police Department [09/18/24]
- Figure 14.
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## 15. History

| Revision | Issue Date | History |
|---|---|---|
| 1.0 DRAFT | 09/20/2023 | Initial draft created and contributed to by the video committee. |
| 1.0 DRAFT | 01/18/2024 | Content contributions and clarifications provided by Video committee members and guests during the workshop in Boulder. |
| 1.0 DRAFT | 05/12/2024 | Content contributions and clarifications provided by Video committee members and guests during the workshop in Denver. |
| 1.0 DRAFT | 09/16/2024 | Video committee members and guests continued to contribute content and edit the document in preparation for internal review by other committees. |
| 1.0 DRAFT | 01/13/2025 | Video committee members and guests continued to contribute content and edit the document in preparation for internal review by other committees. |
| 1.0 DRAFT | 01/16/2025 | SWGDE voted to release as a draft for public comment. Formatted for release for public comment. |
| 1.0 DRAFT | 05/19/2025 | Comments from the public were addressed with minor grammar updates and clarifications. No major revisions. Moved forward for SWGDE membership vote to release as a Final Approved Document. |
| 1.0 DRAFT | 05/22/2025 | SWGDE voted to release as a Final Approved Document. Formatted for release as a Final Approved Document. |
| 1.0 DRAFT | 08/08/2025 | Reformatted for release as a Final Approved Document. |
| 1.0 DRAFT | 09/18/2025 | Photographs have been replaced with images supplied by the manufacturer. The Video Committee completed a review and made minor grammatical adjustments only. No substantive content changes were made. The document will not be released until image authorization is obtained. |

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|---|---|---|
| 1.0<br>DRAFT | 11/17/2025 | SWGDE voted to release as a Final Approved Document. Formatted for release as a Final Approved Document. |
| 1.0<br>DRAFT | 01/15/2026 | Reviewed and adjudicated comments from internal membership. Substantive changes were made to the document, thus recommending release as a draft for public comment. |
| 1.0<br>DRAFT | 01/15/2026 | SWGDE voted to release as draft for public comment. |
| 1.0<br>DRAFT | 02/18/2026 | Document formatted for release as a Draft for Public Comment. |

DRAFT