Notes from BJA Technical Discussions on Body Worn Cameras

These notes are the result of informal discussions about technical considerations with regard to body worn cameras with technical experts in video analytics, speech analytics, human-computer interaction and usability, tactical camera standards, image biometrics, and privacy and security technologies. These notes suggest potential criteria and minimum requirements, but should not be interpreted as formal recommendations since technical requirements studies, measurement research, and formal standards activities would be required to create the necessary underpinnings for such recommendations. The goal of these notes are to begin a technical discussion and create awareness of some (not all) technical considerations, emerging technology directions, and existing standards when considering the acquisition and use of these devices.

Criteria	Choices	Considerations
Mounting	Variety of options: head, eyeglass, chest, shoulder, hat, dash option, etc.	Cameras are designed with widely varying mounting methods and options. Device should be selected for maximum usability and safety for the scenarios it will be used in.
Durability	Variety of environmental factors should be considered.	Device and storage should be certified to work under the physical conditions required. For example, these can include exposure to dust and water and humidity, vibration, mechanical shock, temperature range, RF interference, and other environmental factors.
Video resolution	VGA , HD 720P, and 1080 HD are predominant standard resolutions	The higher the resolution, the more storage is needed. Estimates below were created assuming H.264 compression with medium to high motion at 30FPS.[1]
	VGA (640 x 480)	550 – 1,100 MB per hour (.5 – 1.1 GB)
	HD 720P (1280 x 720)	1,650 - 3,325 MB per hour (1.65 – 3.325 GB)
	1080 HD (1920 x 1088)	3,750 -7,550 MB per hour (3.65 – 7.55 GB)
Video encoding/compression	MPEG-4, H.264, or H.265	H.264 is an improvement over MPEG-4 compression. H.265 is a new standard which further reduces storage needs while maintaining viewing quality.
File format	MP4 or MKV or other standard open formats.	Standard formats should be employed to support file-level interoperability. These can incorporate audio as well as video.
Audio resolution and encoding	Standard open encoding (e.g., MP3 or WMA) with speech quality resolution suggested.	Compressed audio requires less storage than video (4-60MB per hour per microphone depending on desired quality). If high speech quality is needed, a sampling rate of at least 22KHz with at least 24-bit capture is suggested per microphone. Higher values might be necessary to capture increased fidelity at a distance.
Recording speed	Framerate of at	Higher recording speeds capture more motion detail

[1] Estimated storage requirements were derived using a heuristic formula widely used in industry. Actual storage utilized is dependent on scene complexity and the motion of the video captured.

	least 25 frames per second (FPS)	but require increased storage. Frame rates lower than 25 FPS suffer from increased motion blur.
Recording latency	Latency should be minimal	Cameras take time to start recording video after being powered on and after recording is initiated. This latency period should be minimal and documented.
Battery	8-12 hours	Battery life should be sufficient to support the use of these devices over an entire shift.
Data Storage	8 –12 hours of non-volatile onboard storage	Storage can be integrated into the device or provided on removable industry standard memory cards. Removable media has utility in terms of versatility and expansion but has potential physical security risks.
Low Light	Variety of options	Low-light filtering, infrared, near infrared, and other low-light compensation technologies or mechanical filters can increase the quality of video taken in low light and severe weather conditions but can affect scene and motion detail.
Illumination	Flash and infrared	Visible flash and infrared illumination can increase the quality of video taken at night, but will affect battery life.
Field of view	Variety	Wide angle lenses capture more of a scene, but distort the view and lose detail towards the edges of the frame. Rendering tools may be required to properly analyze/view the video from extremely wide angle lenses.
Image capture settings	Variety	Either continuous autofocus or fixed focus should be employed for usability. Manual settings should be minimal as they can distract the user.
Onboard analytics	Potentially useful	Devices can incorporate automated detection of faces, objects, license plates, sounds and other content and automatically trigger higher quality video/audio and/or still image capture. Where possible, the performance of such features should have been rigorously tested according to generally-accepted standards, methods, and data.
Image stabilization	Suggested	Motion jitter and blur can be significant when the wearer is moving and/or is moving the camera. Automatic image stabilization technologies can reduce this effect.
Data tagging	Date/time, GPS, user ID Suggested	Automatically-generated data about the wearer, location, date and time can be collected and packaged in the video format. The device clock must be synchronized with GPS or another time standard to ensure accuracy. Burned-in metadata is discouraged since it obscures the imagery and can interfere with both manual and automated forensic analysis.
Recording option	Continuous, event-triggered, or user-triggered	The device should have a capture buffer so that a time window before and after an event can be recorded. The user should be able to disable recording (or annotate the recorded data to control distribution) to

		comply with applicable policies governing the collection and use of recorded imagery and audio.
Encryption	AES suggested	Standard encryption can be employed to protect data and improve the management of lost devices/memory cards.
DME Audit Log	Device must record audit log	Audit log must include device serial number, user ID, device events (on/off, charging, start/stop recording, and remaining storage capacity.)

More on Video Resolution:

1080 HD resolution is pervasive on cell phone cameras, and body worn cameras with this resolution are now widely available. Users should weigh the additional detail and clarity provided by higher definition video with the increased storage requirements. 1080 HD video requires more than 6 times the storage of VGA resolution video, but offers more than 6 times the detail. Given the current state-of-the-art in facial recognition technology as an imagery quality benchmark[2], a subject would need to be within roughly a meter of the camera to record a sufficiently detailed image of the subject's face to be automatically recognized with a high level of confidence at VGA resolution. All things being equal, 1080 HD resolution effectively extends this range out to 2-3 meters. Some devices support manual switching between resolutions and some permit the user to take high resolution snapshots -- both are options for reducing storage needs while capturing critical events in high definition. In addition to resolution, video must be encoded and compressed to be stored. The current industry standard is H.264. A new standard that is being adopted by industry is H.265 which has a significantly higher compression rate.

[2] Facial recognition is used here solely as an example of the objective impact of resolution on video quality. The performance of facial recognition technologies are affected by a variety of environmental factors and could vary greatly given the conditions under which the imagery was collected as well as properties of the equipment used to collect the imagery.