Operational Requirements Document (ORD)
for the
Blast Resistant Autonomous Video Equipment (BRAVE)

Contents

1. General Description of Operational Capability

The rapid development of low cost forensic camera systems for use by the First Responder community and ancillary markets will give state, local and tribal and transit authorities the ability to determine incident cause at a low total cost of ownership in numerous applications. While technologies are currently being explored and developed at locales like Chicago, LA, Seattle and other metropolitan areas, a low cost alternative with high rapid potential deployment to more users compared to these more costly systems is attractive for many reasons.

In one example, mass transit vehicles and networks represent a potentially attractive target to terrorists and a unique challenge for law enforcement and transit personnel, due to their relative openness and large user base. Recent attacks in London, Madrid, and elsewhere around the world have demonstrated the devastating impacts of attacks carried out on mass transit vehicles. The investigation of the July 2005 attacks in London also demonstrated the forensic power of employing video surveillance data to successfully identify the terrorists directly and indirectly involved in such an attack.

While many communities and transit agencies in the United States have implemented the use of video surveillance systems within their transit infrastructure, uniformity of coverage is lacking. Financial, technical, and policy challenges continue to limit the implemented coverage. As a result, the requirement exists to enhance the capability to obtain, store and protect video surveillance information gathered from mass transit systems for forensic purposes.

The operational capability described herein, will provide user communities with a self-contained low-cost video surveillance option that can be implemented as an adjunct to an existing system or as a primary source for forensic video surveillance information. The system will support greater surveillance implementation and meet a range of surveillance requirements for operators in applications where infrastructure intensive approaches are impractical.

1.1. Capability Gap

A gap currently exists in the surveillance coverage of national critical infrastructure. For example, the majority of major mass transit systems are not able to reliably collect, store and protect video surveillance of potential future terrorist attacks throughout their transit networks. While specific technical capabilities exist, coverage is limited in many localities due to high costs and infrastructure requirements of existing systems. Except in select localities (e.g. Chicago), most cities have video surveillance capabilities in a small percentage of mass transit buses and often less in rail applications. This coverage gap directly limits the ability to investigate, pursue, and prosecute terrorists following a potential terrorist act involving non-covered conveyances.

Infrastructure intensive technical approaches present a capability gap for mobile platforms (e.g. buses and trains) where sufficient transmission bandwidth may not be available, is cost prohibitive, and may raise security concerns. Existing surveillance approaches typically require an extensive wired (or wireless) network to support high bandwidth transmission of data to centralized processing and storage facilities. Centralized networked systems also incur intensive manpower requirements for installation, monitoring, and maintenance.

Pursuit of the system described herein will facilitate the closing of the coverage gap in video surveillance coverage by providing a low cost capability to supplement existing capabilities and coverage or a stand-alone system in the case where no legacy capability exists. The intended end users of the system are the impacted local transit authorities (represented within DHS by Transportation Security Administration – Rail and Surface Transportation), transit and local law enforcement officers, and the federal agencies involved in the forensic investigation of a terrorist attack.

1.2. Overall Mission Area Description

Video surveillance systems are currently used by mass transit operators and associated law enforcement departments for a wide range of missions. Mission applications include support of transit operations, criminal investigation, litigation support, enforcement of passenger regulations, training, and improved safety of passengers and employees due to a deterrent effect.

The system identified herein will have the additional capability to protect recorded video surveillance data, without external infrastructure, in the event of a terrorist attack, and to support forensic investigation of the same. The system is expected to provide coverage of areas not currently reached by video surveillance and in some cases to provide supplementary blast resistant video coverage in areas currently service by other systems. In addition to post terrorist attack forensics, the system is expected to extend coverage of other mission applications including criminal investigation and litigation support to newly covered areas. Due to its decentralized approach, however, the system will not directly support mission applications requiring real time monitoring of data (e.g. support to transit operations).

1.3. Description of the Proposed System

The proposed system will be a stand-alone fixed video surveillance unit that will produce and maintain a continuous video recording of a designated transit vehicle, infrastructure component, access control point, or other location of interest within its designated field of view. It is expected that multiple such units will be necessary to provide full coverage of individual transit vehicles and other areas of interest. Each unit will record continuously and store data for a specified period of time, after which data will automatically be overwritten as necessary. Following installation, the system will not require user intervention to maintain continued operation.

In the event of a terrorist attack or catastrophic event, the unit will protect the recorded data from damage or tampering until retrieval by authorities. Only survival of the video data sufficient for retrieval and playback of the collected video surveillance is expected. The system will also allow for data retrieval by authorized individuals as required for other mission applications.

Each BRAVE unit will be a self contained device that includes a camera, removable data storage, and protective hardening for the data storage. System power may be provided by the installed platform (e.g. bus) or by an included power source. In the case of an external power option, a transformer, as necessary, will be included within the system housing.

1.4. Supporting Analysis

This ORD is supported by "Application of Video Surveillance Technology in Public Transit Systems" submitted to DHS S&T through the U.S. Army Natick Soldier Research Development and Engineering Center (NSRDEC) and prepared by the Center for Technology Commercialization. The analysis is further supported by visits to transit authorities in Seattle, WA; Washington, DC; New York, NY; and Chicago, IL conducted by NSRDEC and DHS S&T representatives in February 2008.

1.5. Mission the Proposed System Will Accomplish

The proposed system will provide a low-cost option for provision of a blast-resistant video surveillance capability to mass transit platforms without such a capability. Once installed, BRAVE will support investigation of terrorist and criminal activities conducted within the visual coverage of the deployed system.

The system will serve primarily to visually record all activity within its field of view for a designated period of time. Video data will be recorded continuously during designated operational periods. Video data stored beyond the designated storage duration will be overwritten as necessary to provide storage for more recent video data. In the event of an explosion caused by a terrorist attack, the system will protect the data from blast and other damage and allow recovery of the video data for purposes of forensic investigation and/or prosecution.

1.6. Operational and Support Concept.

1.6.1. Concept of Operations

BRAVE will be used by local transit authorities and law enforcement officials to supplement video surveillance coverage in areas and vehicles not currently covered by legacy systems. Localities making use of the system will identify areas requiring coverage based upon their local procedures, including identification of specific installation locations.

Transit maintenance or contracted personnel will install units in identified locations including connection to locally available power source as applicable. Upon installation, each unit will provide continuous video recording whenever powered. User support and maintenance will be minimal.

Retrieval of data will use commercially standard interfaces (e.g. Secure Digital card, or USB connection) to retrieve data. Video will similarly be stored in a commercially standard, non-proprietary format to facilitate easy review of data in a range of commercially available software applications.

1.6.2. Support Concept

The design will support easy installation by transit service maintenance or contracted personnel. No special skills except knowledge of the interfacing platform's power system will be required.

Maintenance requirements for the system will be minimal. Each unit will include basic self test mechanisms to indicate proper operation visually (e.g. through the use of LEDs). System design allow for easy replacement of defective unit by a new

unit with no need for user level maintenance. Defective systems will be returned to the manufacturer for disposition.

No user installed spare parts are expected. Memory cards, if used to meet storage requirements, will be compatible with existing commercially available formats.

2. Threat

Public transportation systems continue to be targets of terrorist attacks. Recent attacks including London (2005), Madrid (2004), and elsewhere around the world demonstrate a general persistent terrorist threat to mass transit systems. In particular, transit systems provide an potentially attractive target to terrorists by virtue of their access to large populations with currently less restrictive access controls than airline and other transportation methods.

3. Existing System Shortfalls

Existing video surveillance systems provide a variety of technical capabilities including systems that meet or exceed specific technical capabilities required herein. However, system and supporting infrastructure costs and maintenance requirements for these systems are often high enough that implementation and system coverage has been limited, thereby reducing the system-wide surveillance capability.

Existing fixed systems include those placed in stations, in tunnels, on bridges, and at access control points. These systems typically rely on a hardwired infrastructure to transmit data away from the point of interest for storage, processing, and commonly viewing. Onsite backup storage is optional but is not often employed. In cases where onsite backup is employed currently, the level of protection in the event of a terrorist attack is largely unknown.

4. Capabilities Required

4.1. Operational Performance Parameters (T: Threshold / O: Objective)

4.1.1. Form Factor

Each BRAVE unit will occupy a volume of less than 3" by 3" by 2" (T) 2" x 2" x 1.5" (O).

4.1.2. Resolution

The system will record and store color video data at a resolution of at least 1CIF (T) / 4 CIF (O).

4.1.3. Frame Rate

Video data recorded and stored by BRAVE will have a frame rate of at least 7.5 FPS (T) / 30 FPS (O). The frame rate will be adjustable at time of installation (O).

4.1.4. Field of View/Focal Length:

The system will be capable of recording video at focal lengths ranging from 3 to 50 ft. Focal length will be set at installation (T) / adjust automatically (O).

4.1.5. Data Format

Video data will be stored in a format in a manner suitable to meet evidentiary requirements (T/O). Recorded data will include a calibrated time stamp that can be used during data retrieval and review (T/O). The system will produce a message digest or "digital fingerprint" of recorded data using cryptographic hash function MD5 or SHA-1 (T/O) to assist in preserving the evidentiary status of the recorded data. Stored videos shall be accessible with standard commercial and open source video playback software (O).

4.1.6. Tamper Resistance

BRAVE units will be constructed to prevent unauthorized access to stored data, device power, and device activation mechanism (T/O).

4.1.7. Power Source

BRAVE units will be compatible with 48V DC, 120 AC, and 12V DC power sources and include any necessary transformer with the system (T) Device will provide self-contained power capability (e.g. solar cells) (O)

4.1.8. Environmental

BRAVE will demonstrate capability to perform within the full range of environmental conditions without degraded performance. System will meet all environmental requirements specified in IEEE 1478 Standard for Environmental Conditions for Transit Rail Car Electronic Equipment for the E3 (Vehicle Exterior, Body Mounted) and E4 (Vehicle Interior, Non-Conditioned) environments.

- Temperature: In addition to the requirements of IEEE 1478, the system will experience no degraded performance due to rapid changes in temperature of 20°C
- Dust: Blowing sand and dust testing will include testing with steel sand and dust particulates
- EMI/EMC: System performance will not be degraded due to electromagnetic interference from external devices

4.1.9 Blast Survivability

The BRAVE memory component will demonstrate a capability for stored data to survive a blast for the purposes of reading video imagery. Parameters for this section will be provided separately.

4.2. Key Performance Parameters (KPPs)

4.2.1. Cost

Individual unit cost will not exceed $200 (T) / $100 (O) based on production quantities of 100,000 or more. Costs of support equipment and software to operate and access data on individual surveillance units will not exceed $1,000 (T) / $0 (O) per 100 units in use.

4.2.2. Storage Capacity

Data storage will be sufficient for data storage of continuous video recording for a period of 7 days (T) / 14 days (O).

4.3 System Performance.

4.3.1 Mission Scenarios

BRAVE units will be located on mass transit vehicles or infrastructure (e.g. tunnels and bridges). Units will be installed to continuously monitor a designated area with minimal human intervention required until data retrieval or unit replacement is required. BRAVE will operate in a range of environmental conditions including large temperature swings, humidity, rainfall, vibration/shock, dust, and EMI/EMC considerations. Units will also be capable of recording in low light conditions.

In the event of a terrorist attack, when catastrophic data retrieval is required, video storage will be recovered and transferred from the potentially damaged housing of the units of interest. Recorded video data will be reviewed and analyzed as part of the forensic investigation as appropriate.

In non-catastrophic data retrieval scenarios, such as data use in a criminal investigation or forensic investigation from a unit not damaged by the attack; the unit housing and electronics will be reused. In these cases, the operator will remove the current memory card, taking care to document the proper chain of evidence, and replace it with a new unused memory card.

Periodic visual checks of the system's self diagnostic indicator will be conducted by operators or maintenance personnel. Minimal training of personnel is required to ensure proper understanding of system self diagnostic indicators.

4.3.2 Interoperability

Recorded data will be compatible with existing commercial and open source file formats including MPEG2, MPEG4 or H264 (T/O). Stored videos shall be accessible with standard commercial and open source video playback software (O)

4.3.3 Human Interface Requirements

Once installed, direct human interface with the system will not be required except for data retrieval. Installation will require basic mechanical skills to attach and position the unit. Knowledge of the interfacing power system will also be required. Data access and retrieval will require basic to intermediate computer skills and familiarity with using memory cards or USB storage mediums (dependant of final design).

Human interface is also required to periodically check maintenance self check indicators. If needed, unit replacement will require similar skills to installation.

4.3.4 Logistics and Readiness

The system is required to be operational for long periods of continuous operation without interruption. No user level maintenance or spare part replacement is required. Replacement units and memory cards should be available in case replacement is required.

Mean Time Between Failure (MTBF): 40,000 hours (T) 80,000 hours (O)

5. System Support

5.1 Maintenance

Each BRAVE unit will have the capability to visually indicate to a minimally trained individual that it is no longer functioning and needs repairs or replacement. User level maintenance shall be limited to monitoring of self diagnostic indicator and installation, removal and replacement of the system. All other maintenance will be vendor provided as necessary.

5.2 Supply

No special tools or support equipment are required for installation or replacement. Manuals will be provided to the operator by the vendor and will include installation procedures, information on diagnostic indicators of unit self test, and replacement procedures. Manual will also provide information on routine and catastrophic (i.e. after a terrorist attack) data retrieval.

5.3 Support Equipment

All self test diagnostic tests will be contained within the unit. No external support equipment will be required to maintain and operate the unit. Suitable computer equipment will be required to review data retrieved from the system. Specific hardware and software requirements will depend on the level of analysis to be conducted and the quantity of video data to be analyzed.

5.4 Training

Users will be instructed on the installation and replacement of units; interpretation of self test diagnostic indicators; and data retrieval procedures by manuals and written procedures supplied by the unit manufacturer.

5.5 Transportation and Facilities

Once installed, individual units will remain in place until removed or replaced. Transportation of individual units for installation or replacement is expected to be well within individual carriage limitations and will be dependant on the local installation point.

Transportation of retrieved digital media will require no special technical capability but should be conducted consistent with applicable procedures to preserve chain of custody when data retrieval is conducted for use in legal proceedings (e.g. criminal prosecution or civil litigation).

Facilities and suitably computer equipment will be required to review data retrieved from the system. Facility sophistication and size will depend on the level of analysis to be conducted and the quantity of video data to be analyzed.

6. Force Structure

Video surveillance cameras are typically positioned on vehicles to cover each entrance and the length of the vehicle in each direction. Cameras can also be positioned to show vehicle exteriors. Each standard bus is expected to make use a minimum of 4 units. Longer articulated buses will use 7 or more units, while Train cars can make use of 6 or more units. Based on current public transportation fleet size and current video surveillance usage rates, approximately 200,000 –

300,000 units would be required to provide the discussed video surveillance capability to mass transit vehicles without a current video surveillance capability.

Additional systems will be required within each locality based upon the demonstrated reliability rate to ensure that replacement systems are on hand for quick replacement of faulty units. An additional quantity of the appropriate removable memory cards will be necessary as well, to ensure availability of replacement cards when data is removed for forensic and other purposes.

Additional systems may be required for in station, infrastructure, and other surveillance purposes.

7. Schedule

Demonstration of an initial operational capability is required within 4 (T) / 3 (O) months. For the purpose of this effort, initial operational capability is defined as installation and field demonstration of 100 fully operational units will include in an identified major city transit system.

8. System Affordability

Individual unit cost will not exceed $200 (T) / $100 (O) based on production quantities of 100,000 or more. Costs of support equipment and software to operate and access data on individual surveillance units will not exceed $1,000 (T) / $0 (O) per 100 units in use.