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One Box: Single Vehicle Architecture Criteria

Publication No. 39/11

In association with

ACPO ITS Working Group
One Box Consortium

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Version 1.2

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Foreword

The emergency services, along with other public sector organisations, are facing significant pressures to maintain core services with significantly reduced budgets. One way of achieving this is through efficiency savings on the purchase and use of all services, including vehicles, through standardisation and the use of technology. Traditionally, the emergency services operate a large number and range of vehicles. These are mostly normal production vehicles that have been retrofitted with a wide array of aftermarket equipment, according to their role. Previously, this equipment has been fitted in a variety of ways and to no common standard.

This document outlines the standards relating to the One Box Single Vehicle Architecture (SVA), required by the Association of Chief Police Officers (ACPO) and the National Association of Police Fleet Managers (NAPFM), in relation to the future fitment of police vehicles. Its aim is to ensure commonality of approach, together with providing a safe and efficient working environment for officers. Furthermore, this approach will deliver cost efficiencies across the police service as well as providing a link to the standardisation of all types of police vehicle currently being undertaken by ACPO.

This work has been funded by the Home Office Centre for Applied Science and Technology (CAST) and the Metropolitan Police Services (Transport Services Department). It was led by the ACPO Intelligent Transport Systems (ITS) Working Group that, with a large consortium including third-party suppliers, vehicle manufacturers and other emergency services, have developed these criteria, which will be assessed by one or more accredited test houses.

These criteria are a major step forward for the police service in producing a standardised police vehicle, which is safe for the occupants and provides efficiency savings for the police service, with the possibility in the future of transferability to other emergency service vehicles. The requirement to comply with the One Box Single Vehicle Architecture (OBSVA) criteria will be included as part of the ACPO Fleet Procurement Technology Standardisation work for future police vehicle specification.

Suzette Davenport

Deputy Chief Constable
ACPO Lead for Roads Policing

Rob Coleman

Director
Home Office CAST

Management Summary

This version 1.2 of the One Box criteria has minor changes to the content and layout, to reflect the feedback received from stakeholders, to improve the readability and use of the document. The document format has been changed to provide three sections:

- One Box Concept
- Requirements and Specifications
- Compliance and Testing

The number of phases of testing has been reduced from three to two in order to streamline the process.

The aim of the One Box Single Vehicle Architecture (OBSVA) criteria is to facilitate the development and installation of effective, safe, emergency service equipment to vehicles.

Chapter 2 sets out the standards that OBSVA-compliant equipment or vehicle systems must meet, in order to be approved, together with the functionality required in all Single Vehicle Architecture (SVA) systems to be Listed[1] as compliant. Chapter 3 includes details of tests that equipment or systems will be subjected to. It also sets out the optional functionality that can be included.

The OBSVA criteria are owned and maintained by the Home Office Centre for Applied Science and Technology (CAST). They will be managed operationally by CAST, who will manage the Compliance Testing of candidate products against the criteria.

A periodically updated List of approved equipment or systems and components will be maintained by CAST.

These criteria will be subject to review, in order to keep pace with technological developments in the field of OBSVA equipment or systems.

Operational Relevance

Equipment or systems meeting the criteria laid out in this document will increase value for money for the emergency services, as well as improve the safety of emergency service drivers and other road users. It will increase standardisation of emergency service equipment and reduce the amount of time that vehicle fleets spend in build and in maintenance facilities. Additionally, it will also provide a platform for the introduction of Driver and Vehicle Data Management Systems (DVDMS), allowing the better management of both drivers and vehicles, which have been proven to generate significant savings across the police service.

[1] 'Listed' is capitalised where it refers specifically to inclusion of a system, a component or a device in the List of those that have been approved by the Home Office Centre for Applied Science and Technology (CAST)

Conclusions and Recommendations

It is recommended that emergency service fleet managers and procurement personnel mandate systems comply with these criteria. Only then will the benefits on offer be maximised.

Contents

Normative References

This document incorporates provisions from other publications. These normative references are cited at the appropriate places in the text. For undated references, the latest edition of the publication referred to applies (including any amendments). For dated references, subsequent amendments or revisions apply.

- BS EN 60529:1992, Specification for degrees of protection provided by enclosures (IP code), January 1992
- CiA (CAN in Automation) 447, 'Application profile for special-purpose car add-on devices,' May 2008, as amended
- FCS1362, UK Code of Practice for the installation of mobile radio and related ancillary equipment in land-based vehicles (previously known as MPT 1362), May 2008 ('FCS' is the 'Federation of Communication Services')
- MPT 1372, Code of Practice for field maintenance and repair of civil land mobile radio, Revised & Reprinted November 1996
- The Control of Noise at Work Regulations 2005
- ISO 11429:1996, Ergonomics – System of auditory and visual danger and information signals
- European Statement of Principles on the Design of Human Machine Interaction (HMI), 2008
- Council Directive 90/630/EEC, adapting to technical progress Council Directive 77/649/EEC on the approximation of the laws of the Member States relating to the field of vision of motor vehicle drivers, October 1990
- Home Office Centre for Applied Science and Technology (CAST), 2007 *Digital Imaging Procedure* (58/07). London: Home Office
- Council Directive 78/316/EEC, on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (identification of controls, tell-tales and indicators), December 1977, amended by 93/91/EEC and 94/53/EC
- ISO/IEC 11801: 2002 Category 7/Class F, Information technology – Generic cabling for customer premises
- Interior layout, 74/60, amended by 78/632/EEC
- Council Directive 74/60/EEC, on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (interior parts of the passenger compartment other than the interior rear-view mirrors, layout of controls, the roof or sliding roof, the backrest and rear part of the seats), December 1973, amended by 78/632/EEC
- Council Directive 2006/95/EC, on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits, December 2006 (known as 'Low Voltage Directive')
- AES Automotive Conformance Specification 5, 'A specification relating to the

electromagnetic compatibility (EMC) performance of vehicle mounted, electrically powered equipment, designed for use by the Police & Fire Services of England and Wales'

- AES Automotive Conformance Specification 6, 'A specification relating to the electromagnetic compatibility (EMC) performance of motor vehicles for use by the Police Services of England and Wales'
- AES Automotive EMC Assessment and Installation Evaluation Specification 13, 'A specification relating to the electromagnetic compatibility (EMC) assessment and installation evaluation of electrical, electronic and radio equipment in Police & Fire Service vehicles'
- Project One Box Single Vehicle Architecture Operational Requirements and Process Model (ACPO ITS)
- United Nations Regulation 116, Uniform technical prescriptions concerning the protection of motor vehicles against unauthorized use, April 2005
- ISO 9001, ISO 9000, ISO 9004 Quality Management
- Radio signalling legislation (European Telecommunications Standards Institute – ETSI)
- RJ45, registered jack, standardised as the IEC 60603-7 8P8C modular connector, physical dimensions of the connectors are specified in ANSI/TIA-1096-A and ISO-8877 standards
- ISO 11898, Road vehicles – Controller area network (CAN)
- ISO 4040, Road vehicles – Location of hand controls, indicators and tell-tales in motor vehicles
- ISO 3958, Passenger cars – Driver hand-control reach
- ISO 2575:2010, Road vehicles – Symbols for controls, indicators and tell-tales
- ISO/FDIS 15006, Road vehicles – Ergonomic aspects of transport information and control systems – Specifications for in-vehicle auditory presentation
- ISO 15005:2002, Road vehicles – Ergonomic aspects of transport information and control systems – Dialogue management principles and compliance procedures
- ISO 15008:2009, Road vehicles – Ergonomic aspects of transport information and control systems – Specifications and test procedures for in-vehicle visual presentation
- ISO 4513:2010, Road vehicles – Visibility – Method for establishment of eyellipses for driver's eye location
- RS-232, recommended standard 232
- RS-485, recommended standard 485, also known as TIA/EIA-485
- SAE J1113, Electromagnetic Compatibility Measurement Procedure for Vehicle Components – Immunity to AC Power Line Electric Fields
- IEC/EN 60950, Information technology equipment – Safety, 2005

- Council Directive 2004/104/EC, adapting to technical progress Council Directive 72/245/EEC relating to the radio interference (electromagnetic compatibility) of vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers, October 2004

- Council Directive 2005/83/EC, amending, for the purposes of their adaptation to technical progress, Annexes I, VI, VII, VIII, IX and X to Council Directive 72/245/EEC relating to the radio interference (electromagnetic compatibility) of vehicles, November 2005

- Council Directive 2006/28/EC, amending, for the purposes of their adaptation to technical progress, Council Directive 72/245/EEC of 20 June 1972 relating to the radio interference (electromagnetic compatibility) of vehicles and Council Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers, March 2006

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- Council Directive 72/245/EEC, on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles, June 1972

- United Nations Economic Commission for Europe (ECE) Regulation TRANS/WP 29/425, Uniform provisions concerning the approval of vehicle alarm systems (VAS) and of motor vehicles with regard to their alarm systems (AS), January 1996

- Council Directive 74/61/EEC, on the approximation of the laws of the Member States relating to devices to prevent the unauthorized use of motor vehicles, December 1973, amended by 95/56/EC and other Directives

- Other references may be included by way of addendum or in future releases

- Council Directive 2004/104/EC, adapting to technical progress Council Directive 72/245/EEC relating to the radio interference (electromagnetic compatibility) of vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers, October 2004, as amended by 2005/83/EC, 2006/28/EC, 2009/19/EC and other applicable Directives

- Council Directive 74/61/EEC, on the approximation of the laws of the Member States relating to devices to prevent the unauthorized use of motor vehicles, December 1973, as amended and corrected, amended by 95/56/EC

- Council Directive 2006/95/EC, on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits, December 2006 (known as ‘Low Voltage Directive’)

- Council Directive 90/630/EEC, adapting to technical progress Council Directive 77/649/EEC on the approximation of the laws of the Member States relating to the field of vision of motor vehicle drivers, October 1990

- Council Directive 78/316/EEC, on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (identification

of controls, tell-tales and indicators), December 1977, amended by 93/91/EEC and 94/53/EC

Guidelines

- FCS1362, UK Code of Practice for the installation of mobile radio and related ancillary equipment in land-based vehicles (previously known as MPT 1362), May 2008 ('FCS' is the 'Federation of Communication Services')
- MPT 1372, Code of Practice for field maintenance and repair of civil land mobile radio, Revised & Reprinted November 1996

Note: ISO standards are available through the ISO website at: http://www.iso.org/iso/home.html.

Definitions and Abbreviations

For the purposes of these criteria, the following definitions and abbreviations shall apply:

Note: Definitions relate to the terms used in this document and are not intended to define or exclude existing or alternative technologies.

ACPO – Association of Chief Police Officers

AES – Automotive and Equipment Section

Aftermarket equipment (AM) – vehicle equipment installed at any stage following vehicle production

ANPR – Automatic Number Plate Recognition

AWG – American Wire Gauge

Authorised agent – person or persons authorised to act on behalf of the registered owner or keeper of a motor vehicle

CAN – Controller Area Network

CAST – [Home Office] Centre for Applied Science and Technology

Commissioning – method of ensuring newly installed OBSVA is functioning correctly

Control equipment – component or components of the OBSVA that process the setting and un-setting commands

DVDMS – [One Box] Driver and Vehicle Data Management System

EMC – Electromagnetic Compatibility

esCAN – emergency service Controller Area Network

Evaluation Number – reference number issued by CAST to a type of OBSVA for identification purposes

FMEA – Failure Mode and Effects Analysis

FTA – Fault Tree Analysis

GNSS – Global Navigation Satellite System

GPRS – General Packet Radio Service

GPS – Global Positioning System

GSM – Global System for Mobile Communications

HMI – Human-machine interface, interaction between human and machine

I/O – input/output

ISO – International Organisation for Standardisation worldwide

ITS – Intelligent Transport Systems

LAN – Local Area Network

LED – Light Emitting Diode

MDT – Mobile Data Terminal

NAPFM National Association of Police Fleet Managers

OBSVA – One Box Single Vehicle Architecture; this refers to the criteria and compliant systems

OEM – Original Equipment Manufacturer (vehicle manufacturer)

OE – Original Equipment, meaning vehicle equipment installed during original vehicle production and fully validated by the engineering division of the vehicle manufacturer

Public authority – a publicly-funded or part-funded organisation, for example, the emergency services

Public Authority Standards – minimum standards of criteria that are required to satisfy both private industry and public authority organisations, and that are approved by an independent public authority

RFID – Radio Frequency Identification Device designed to emit and receive a radio signal as part of an electronic identification system

Rx – Received data

SLA – Service Level Agreement

SMS – Short Message Service

SOC – System Operating Centre

SVA – Single Vehicle Architecture

TETRA – Terrestrial Trunked Radio

Tx – Transmit data

Upgrade system – OBSVA installed on to a vehicle fitted with an existing recognised system in order to enhance the overall functions

Vendor – company that sells OBSVA systems

VSWR – Voltage Standing Wave Ratio

1 One Box Single Vehicle Architecture (OBSVA) Concept

This version of the One Box Single Vehicle Architecture criteria – version 1.2 – incorporates minor changes to the content and layout to reflect the feedback received from stakeholders and to improve its readability and usability. The document has been divided into three sections:

- One Box Concept;
- Requirements and Specifications; and
- Compliance and Testing.

The number of phases of testing has been reduced from three to two in order to streamline the process.

1.1 Description and Scope of the OBSVA Concept

The One Box Single Vehicle Architecture (OBSVA) is the name given to the integrated vehicle technology architecture to be used as the basis for emergency service equipment control and data management. It has been designed from the ground up to work with and, where appropriate and possible, integrate with the equipment installed by the vehicle manufacturers.

OBSVA is based on the multiple utilisation of components wherever possible, so long as this does not compromise safety or functionality. The vision is that OEM hardware components, such as switchgear and screens, are reused rather than additional technology being needed to manage emergency service equipment. These will run vehicle and emergency service functions in a much better integrated, more seamless way, creating a safer, more ergonomically efficient and more user-friendly in-vehicle environment.

The concept comprises a core architecture, consisting of an in-vehicle LAN for data transfer, the processing hardware and software to support this and the applications that will run on it. It includes provision for a managed power supply and connection points at key locations in the vehicle and a control system based on CAN bus technology.

The OBSVA concept includes the following elements:

- Power management;
- Wired LAN;
- Control systems; and
- Human-Machine Interface (HMI).

Industry standard connectors, outputs and operating systems are defined and independent test requirements must be met in order to be Listed as compliant with the criteria.

The scope of the physical architecture fitted to vehicles does not include those components that may be attached to it. Items such as cameras and light bars are

outside the scope of the architecture itself. That is currently restricted to the provision of cabling and control systems, together with physical interfaces, connectors, operating systems for the control systems and HMI for the hardware. Where an interface is used with emergency services equipment, it is considered as part of the architecture as it must be compliant with CiA447 and utilise the CAN power supply. As such, it would be within the scope of these criteria. The functionality of emergency service equipment itself is outside of the scope.

However, emergency services equipment considered overall must be compliant with the OBSVA criteria going forward. It will not be permitted to supply non-OBSVA-compliant equipment for fitment to police vehicles, for example.

Note that there is a distinction between the OBSVA criteria and the physical architecture that is fitted to the vehicle.

The OBSVA criteria will neither mandate a specific computer system nor an operating system. It will lay down industry standard protocols for specific components – for example, CAN (ISO 11898), wired local area network (LAN) and so on.

Crucially, the OBSVA will be designed and installed in cooperation with vehicle manufacturers and equipment providers. Better integration in this way will ensure that the architecture does not conflict with vehicle manufacturers' systems, whilst providing the functionality necessary to support current and future emergency service systems. This will include connection with relevant OEM systems, where appropriate, through agreed access points and managed by the vehicle manufacturer firewall.

OBSVA uses a CAN bus architecture that is managed in order to provide the capability for switching and operating emergency service equipment, such as emergency lights. It can switch emergency services equipment using OEM switchgear and display screens but without interfering with OEM vehicle systems. This is achieved by the use of a firewall (or gateway) interface between the OEM's vehicle CAN and the emergency services CAN (known as "esCAN"), which filters communications between the vehicle's systems and the emergency services equipment. The esCAN will operate on a principle similar to a vehicle CAN bus and will employ industry standard connectors that will be common to all vehicle, system and component manufacturers.

1.2 Why One Box?

The emergency services, in common with other public sector organisations, are facing significant pressure to maintain core services with significantly reduced budgets. One way of achieving this is through efficiency savings on the purchase and use of all equipment and services, including vehicles, through the use of harmonised technologies. This chapter outlines the concept of the One Box Single Vehicle Architecture (OBSVA), which provides the standard for the fitment of specified emergency service equipment within their vehicles.

The emergency services operate a large number and variety of vehicles, normally production vehicles that are retrofitted with a wide range of aftermarket equipment, according to their roles. In parallel with vehicle control systems, components of emergency services equipment have historically been standalone equipment that was individually hard-wired using bespoke cable runs and connectors. This ranges from relatively simple emergency warning equipment (single blue light) and radios, through to complex installations such as mobile data systems, cameras and data collectors. Historically, this equipment has not

been considered as an integrated system or fitted according to any common standard, save for the fact that it was required to meet the general requirements of the relevant AES Specifications for EMC compatibility. It was not considered as an integrated emergency service equipment package.

While this status quo has worked up to a point and has proved to be convenient for industry, it has placed a significant burden on customer resources in terms of fitting often complex and bulky cabling systems to vehicles in areas that already carry significant cabling. Where equipment needs maintenance, refreshing or replacement, vehicle trim often has to be removed, adding significantly to the cost of installation and at the end of the vehicles life, the bespoke cables must be removed.

Going forward, however, the fitment of the OBSVA to new police vehicles will be a requirement of ACPO and the NAPFM. The purpose of this is to facilitate the development and installation of effective, safe, better-integrated emergency service equipment to vehicles and to ensure commonality of approach, whilst providing a safe and efficient working environment for officers. This will lead to the realisation of cost efficiencies across the police service, as well as being in line with the standardisation of all types of police vehicle currently being undertaken by ACPO.

1.3 Motivation for CAN Bus Integrated Design Philosophy

The problem of installation of technology into vehicles is not unique to the emergency services. A similar situation was faced by the automotive industry in the late 1980s. It was faced with a burgeoning variety of increasingly sophisticated in-vehicle technology from a range of suppliers required to run electronic systems in the vehicle– some of it safety-critical. The complexity of the control systems and the need to exchange high-speed data between them meant that more and more hard-wired dedicated signal lines had to be provided. The traditional approach of individually wiring each stand-alone system resulted in expensive and cumbersome wiring looms and connectors. Apart from the cost, the physical size of the wiring looms made it difficult, if not impossible, to thread them around the vehicle and the length of cable and multiple connections created reliability issues and made fault diagnosis and repair complex and costly.

The solution was the development and adoption of the Controller Area Network bus (CAN bus), as developed by Robert Bosch – a serial communication bus for real-time control applications, with data rates of up to 1 Mbit per second. This is now standard fit on most vehicles, with in excess of seven CAN bus networks being fitted to more expensive vehicles, to control the complex electronics within the vehicle. It provides a cost-effective communication system for in-car electronics, with proven reliability and robustness. Applications range from safety-critical systems such as anti-lock brakes and engine management through to central door locking, electronically-adjustable seats, mirror controls and includes ‘infotainment’ systems.

The benefits of an integrated CAN bus system have also been widely recognised outside of the automotive industry and it is now widely used by a diverse range of industries, from shipping to manufacturing and even in toys to control complex electronic systems in a cost-effective way.

1.4 Maximisation of Usability

Usability is a key reason for taking an integrated approach to emergency service vehicle equipment fit. One way that is being turned to the advantage of the users of emergency service vehicles is by standardising the configuration and colours of the switchgear that operates the five most common modes of emergency service equipment, namely:

999; At scene; Front blues; Low power; ALL OFF

By ensuring that this configuration, order and colour of switches are consistent between emergency service vehicles, any officer should be able to find the controls necessary to perform their duties quickly and without significant distraction from the task of driving.

The adoption of the CiA 447 CAN open standard and the capability to reuse cables or to change between vehicle and equipment suppliers will become increasingly important for the emergency services. It should ensure that emergency service equipment is generic and has a high level of interoperability. The equipment fitted to a vehicle may well be replaced over its operational life as organisations introduce new technologies, such as mobile data and dispatching systems. Similarly, equipment may be added, removed or refreshed, such as when there is a change of equipment supplier. A CAN bus approach will minimise or ideally eliminate the requirement for a partial or full refit of the cabling and additional control systems within the vehicle, resulting in significant reductions to costs involved in stripping out and refitting proprietary control systems. OBSVA will also promote innovation and competition between equipment providers in terms of the provision of user functionality, interoperability and services to actively support delivery of front line services.

1.5 Elements of the OBSVA

1.5.1 Managed Power Supply

It is a requirement of OBSVA that a managed power supply be fitted to the vehicle, connected to one or more batteries, with power distributed to appropriate points in the vehicle.

The power supply can be in two forms:

- Core; or
- Enhanced.

A core power supply would normally be fitted to a vehicle which has less emergency service equipment fitted to it, such as a response vehicle. The power supply would be protected and would have between 10 and 20 suitably fused take-off points in the rear of the vehicle.

An enhanced power supply would normally be fitted to vehicles with more equipment fitted, such as ANPR. These may have additional power take offs at the front of the vehicle and in the roof, with additional enhancements including, for example, automatic shutdown of equipment to prevent battery drain, as detailed in the next chapter.

The distribution points would provide a managed and surge-protected power supply to the appropriate voltages and currents required by the connected devices, with sufficient spare capacity for future systems.

1.5.2 Use of a Wired LAN (Ethernet)

OBSVA requires a wired LAN to be fitted to the vehicle. This recognises the requirement for some emergency service equipment and applications to process and move bulk (in excess of 1 Mbit) data around the vehicle. This is primarily between the:

- video cameras and the processing unit;
- processing unit and the screen or input device; and
- docking station(s) and the processing unit.

Where these are fitted, they must enable the rapid, safe transportation of data, in a way that safeguards that data so that it is suitable for use as evidence in a court of law and complies with the CAST Guidelines concerning the handling and storage of digital data[2].

The inclusion of a wired LAN, together with standardised connectors, will both simplify emergency services equipment fitment and lead to enhanced functionality, whilst reducing overall cost over the vehicles life.

1.5.3 Emergency Services Controller Area Network ("esCAN") Controls, Equipment and Connectors

There is a requirement to send control data between a wide range of electronic emergency service equipment, for example, to switch functions and control systems on and off. This can be summarised as follows:

- To send low volume data from sensors to multiple locations.
- The problem of fitting bulky complex wiring looms in a vehicle.
- The requirement to standardise the control functions of a wide range of electronic emergency service equipment.
- Issues of reliability cost and service.
- The requirement to have a secure connection to the vehicle CAN to receive and at times input data and commands in a safe and controlled way.
- The requirement to collect data from a wide range of aftermarket and vehicle systems to prove activation but also ongoing functionality of that system.

Control inputs and system outputs are managed via a dedicated emergency service Controller Area Network – known as "esCAN." The esCAN interfaces with the vehicle's existing CAN through a firewall or gateway. It is anticipated that the gateway would be provided by the vehicle manufacturer, or by the esCAN supplier or installer in the case of aftermarket systems. If the gateway is provided on an aftermarket basis, the protocol surrounding which control inputs and outputs are transmitted via the OE CAN must be agreed with the vehicle manufacturer in order to ensure that they can ensure the operation of safety-critical systems on-board the vehicle. In this way, the reuse of OE switchgear and displays is possible but the vehicle manufacturer always retains control over safety-critical functions.

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[2] 'Digital Imaging Procedure' – CAST publication 58/07

The OBSVA control system utilises an intelligent data-controlled systems and switching approach, operating on CiA[3] 447 data standards and connectors, although the user interface will still appear as a simple switch (or touch screen display) for usability.

1.5.4 Design Philosophy for Controls and Switches

All driving is complex and becoming increasingly so, given growing traffic volumes and congestion on the roads. This situation is made significantly more difficult for emergency service drivers, who are often required to respond to emergency incidents, often at high speed, while trying to negotiate traffic. This section outlines the overview and principles for the fitting and use of controls and switches for emergency service equipment and should be read in conjunction with relevant sections of this document on HMI (see section 2.9) and the current version of the European Statement of Principles on HMI.

The principles of the OBSVA have been developed in recognition of the context of the operational use of emergency service vehicles and the complex environment that the occupants of such vehicles must operate them within, with the additional pressures and competing priorities of being required to respond to calls, deal with radios, plan responses and drive safely. This includes the provision of a standardised switch panel in all vehicles (see chapter 2), the placement of switches and controls and a requirement to comply as far as is possible with new vehicle legislation and the current version of the European Statement of Principles for HMI.

1.5.5 Reuse of Unused Original Equipment Manufacturer Vehicle Controls

The vehicle manufacturers have invested time and money to design vehicles that are safe and efficient to use and compliant with all relevant legislation. This includes the provision of a range of vehicle controls, located in and around the dashboard and on the steering wheel.

When a vehicle is converted to an emergency service vehicle, a number of the functions that are normally utilised in the vehicle are not used and the vehicle controls can be made available for reuse. These often include controls that were previously used to control entertainment systems or mobile phones in the vehicle, both on the steering wheel and on the dashboard or centre console.

The One Box Concept allows these controls to be reused to control emergency service systems such as activation of warning equipment or activation of MDT. They are most often directly connected to the vehicle CAN bus and can be pressed into service to control emergency service equipment but only as additional controls to the standardised five buttons that control critical emergency service warning instruments. For example, OEM switchgear could be used to activate the mobile data terminal (MDT) and emergency service radio.

1.5.6 Human-Machine Interface

While much of this document sets out the requirements for the physical architecture of cables and connections required to operate the emergency service equipment, the other critical area to consider is where and how the hardware is fitted in the vehicle and how the emergency service staff operate and interact with that equipment when the vehicle is:

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[3] CiA is an acronym for CAN in Automation, a Germany-based CAN Open organisation

- stationary;
- moving; or
- being driven as part of an emergency response.

This consideration must include both the driver and the front-seat passenger. The interaction between people and equipment is called the human-machine interface (HMI).

One of the underpinning principles of the OBSVA is the creation of a safe, efficient and effective working and driving environment for the operation of all the equipment within an emergency service vehicle, including the specialised emergency service equipment.

In order to achieve this, the OBSVA concept minimises any impact on the existing vehicle layout and ergonomics by focusing on the safe fitment and operation of the emergency service equipment. These criteria incorporate the requirement to comply with the current version of the European Statement of Principles for HMI and require the use of the Transport Research Laboratory (TRL) Checklist for HMI as part of the test requirements (see chapter 3).

1.6 Governance of the OBSVA Criteria

The OBSVA criteria document is a published specification that defines the One Box Concept for Single Vehicle Architecture. The OBSVA criteria are owned and maintained by the Home Office Centre for Applied Science and Technology (CAST). They will be managed operationally by CAST, which will oversee accreditation testing of newly developed products by accredited test houses against the OBSVA criteria.

Given the pace of change of technology and emergency service requirements, these criteria will be subject to periodic review as and when necessary to ensure that they remain current.

A requirement for review at least every 12 months has been incorporated within the criteria so that any omissions or proposed changes brought to the attention of the Home Office, Association of Chief Police Officers (ACPO) Intelligent Transport Systems (ITS) working group or an accredited test house can be considered and implemented if necessary in a timely manner throughout the life of the OBSVA criteria document.

If any OBSVA criteria user wishes to suggest amendments for the next review process, these should be notified for the attention of CAST via post or email so that they can be considered at the next review. Specific email addresses are not included in this document. Interested parties should contact CAST to ensure the correct current email address is used.

2 System Requirements and Specifications

2.1 Introduction

This chapter provides the functional and performance requirements and specifications of the OBSVA criteria including installation, commissioning, operation and procedures for an end-to-end system, that need to be implemented by companies manufacturing, installing, commissioning and operating both aftermarket equipment and original equipment manufacturer (OEM) OBSVA systems or components.

The OBSVA criteria are only intended to apply to emergency service vehicles and are currently restricted to the provision of cabling and control systems, connectors, operating systems for the control systems and the HMI for the hardware, either forming part of the OBSVA system or a component attached to it.

Systems that are accredited in accordance with the Compliance Procedure in Chapter 1 of this document and are demonstrated to meet the OBSVA criteria are eligible to be added to a Notification List of systems.

The specifications are based on the operational requirements of the OBSVA criteria, developed by a public-private partnership led by the Association of Chief Police Officers (ACPO) Intelligent Transport Systems (ITS) Working Group. This concept is further developed by these criteria to encompass existing national, European and international specifications, legislation and to anticipate future technological developments. Where practical, the specifications are common to standards that are established and recognised, and are considered to provide a high level of performance, safety and security, commensurate with the risks and liabilities posed by the use of emergency service vehicles.

These OBSVA criteria shall be of direct interest to vehicle manufacturers and importers, emergency service equipment manufacturers, suppliers, installers and importers and to motor vehicle insurers.

These specifications shall be subject to amendments or extensions from time to time, in order to recognise advances in technology, changes to and consolidation of standards, legislation and best practice.

These specifications are applicable to both new vehicle OEM fitment and systems professionally installed after the sale of the vehicle. However, the OBSVA criteria does recognise that while there must be commonality of functions, connectors and performance, the design and installation for OEM compared with aftermarket equipment may be different and this document identifies where this is so.

2.2 Legislative Requirements

The OBSVA system and the components attached to it must comply with all relevant new vehicle legislation for all fitments (both new and aftermarket).

The OBSVA shall also comply with all current legislative requirements to the extent that they are applicable. This includes but is not limited to:

- The Road Vehicles (Construction and Use) Regulations 1986
- The Road Vehicle Lighting Regulations 1989
- Data Protection Act 1998
- United Nations Economic Commission for Europe (ECE) Regulation TRANS/WP 29/425, Uniform provisions concerning the approval of vehicle alarm systems (VAS) and of motor vehicles with regard to their alarm systems (AS), 1 January 1996
- Human Rights Act 1988
- Radio signalling legislation – including European Telecommunications Standards Institute – ETSI
- Road Traffic Act 1991

Compliance with all legislation is the responsibility of the compliant OBSVA manufacturer, importer and installer.

Compliance with these criteria does not confer immunity from legal obligations. If a conflict exists between these criteria and those of legislation, the requirements of the legislation shall take precedence.

2.3 General Requirements

2.3.1 Introduction

Systems that are to meet the requirements of the OBSVA criteria for emergency service vehicles will be required to work effectively and reliably in the real world operating conditions faced by these vehicles.

When required to be activated, the entire end-to-end system, which includes the on-board equipment and back office, must operate effectively in order to deliver the safety and security benefits that are made possible by these criteria.

2.3.2 One Box Single Vehicle Architecture Operation

The OBSVA shall be designed to work with all of the following to which these criteria can be applied:

- vehicles;
- loads;
- fuel; and
- transmission types.

However, where an OBSVA cannot operate with a particular vehicle type (for example, if it were not compatible with electric vehicles) then subject to the

agreement of CAST, an OBSVA may be Listed as compliant with the criteria, subject to agreed exceptions in this area of operation, namely limits to vehicle, load, fuel and transmission type. Where this exception is requested, it shall be required to be clearly identified as part of the application process and, if agreed, shall be explicitly included in any OBSVA criteria summary report produced by the accredited test house. Furthermore, exceptions shall be stated clearly in any commercial or marketing information.

2.3.3 Safety and Reliability

The OBSVA and its installation shall be safe, reliable and durable, as defined by compliance with relevant sections of these criteria.

The mechanical and physical properties of the OBSVA shall be such that it presents no unacceptable risk of danger or hazard to any person.

The manufacturer of the OBSVA shall conduct a thorough assessment to determine the safety of their system using a recognised methodology. Consideration shall be given to all possible failure modes of the OBSVA so that it minimises the risk of danger or hazard to any person. The OBSVA shall as a minimum be as reliable as existing safety-related vehicle control systems.

The OBSVA shall, in the event of a system or component failure, not affect the performance or the safe operation of the vehicle or its components, especially with regard to brakes or steering. This is critical where the esCAN connects to the internal vehicle CAN and allows for message or command inputs.

2.4 One Box Single Vehicle Architecture Capabilities and Specific Requirements

The OBSVA criteria have been defined under four broad categories of system functionality:

- power management;
- control of emergency service Controller Area Network (esCAN) equipment, connectors and switch gear;
- high-volume data transfer, for example, wired local area network (LAN) – Ethernet; and
- HMI, for example, countermeasures to distraction.

The core functionality is described for each category below.

Each vehicle shall have a standardised wiring set consisting of power, data and signal control, together with OBSVA standard connectors and outputs as part of the operating system.

The system shall be capable of being fitted to all vehicles providing, as a minimum, the core functionality outlined below.

The vehicle manufacturer shall agree the secure, safe routing of cables, power and control capability. Any SVA electrical system must comply with AES Specification 5 guidelines, in order to ensure it is safe, effective and compliant with electromagnetic compatibility (EMC).

The cables shall be terminated with OBSVA standard fittings and, where fitted by a vehicle OEM as an emergency service vehicle standard fit, will be supplied, whether components are attached to them or not.

2.5 Power Management

2.5.1 Electrical Requirements

The main source of power for the OBSVA shall be taken from a location specified by the vehicle manufacturer and will be required to operate within the power management capabilities of the vehicle, without compromising other components through power drain.

The normal voltage for the OBSVA will be 12 volts.

The OBSVA power management system must also be able to operate with an external trickle feed power supply when used.

The OBSVA power, control and data management system shall require no more than 20 milliamperes (mA) quiescent current consumption when the equipment is not in use and the vehicle engine is not running, to reduce the risk of flattening the vehicle battery.

The OBSVA system shall be able to resume normal operation after repeated low, flat or no power events.

The power source from the vehicle to the OBSVA power management system shall be protected against over or under power.

The OBSVA shall continue to function correctly under conditions of supply voltage variation, specifically within the range of 9–18 volts.

The OBSVA power management system shall be earthed back to the negative terminal in the battery.

Emergency warning lights – the use of LED emergency warning lights is encouraged, in order to maximise the effect of the lighting system whilst minimising its impact on power consumption, as far as possible.

Power supply disconnection for up to 28 days shall be tolerated without loss of data and systems shall return to normal use when the power supply is reconnected.

The wiring of the OBSVA shall be of a standard suitable for the automotive environment.

The circuits and wiring of the OBSVA shall be adequately electrically rated for all states and conditions of operation.

2.5.2 Core Power Management System

The core power management system is the lowest level of functionality provided as part of the OBSVA. It consists of a power supply, provided from the existing vehicle power system, to an agreed location in the rear of the vehicle. The cable(s) for the power supply, the amperage and routing of those cables are agreed by the vehicle manufacturer, as appropriate for that purpose, as set out by the user and are electrically protected against reverse polarity and short circuit, and located and routed so as not to interfere with either the vehicle equipment or

emergency service aftermarket equipment, including all radio, communication and speed enforcement devices.

The core power management system shall have the following minimum functionality:

- It shall protect the emergency service aftermarket equipment and vehicle equipment from electrical surges, over/under powering or shorting, as a result of being connected to the core power management system.
- It shall have the capability to prevent the main vehicle battery from being reduced in charge by the attached aftermarket emergency service equipment to a level that prevents the vehicle from starting.
- It shall have the capability for emergency service aftermarket systems to draw power from a single location (suggested in the rear boot area):
    - response/beat vehicle – a minimum of ten standardised connection points for a general purpose type vehicle, each of which can be rated to differing amperages; and
    - Roads Policing/Automatic Number Plate Recognition (ANPR) vehicle – a minimum of twenty standardised connection points, each of which can be rated to differing amperages.
- Each power supply connection point shall be capable of supplying a maximum of 20 amps per connector supplied/fitted.
- Each connection point, power out or connection control point shall be able to be fused to standard values of 1 amp, 3 amps, 5 amps, 7.5 amps, 10 amps, 15 amps or 20 amps for each individual power supply point.
- It as a minimum shall be capable of providing the users requirement plus 20%.
- It shall be capable of receiving and sending control data to and from the esCAN.

2.5.3 Enhanced Power Management System

The enhanced power management system shall have all of the above capability and shall additionally provide the following:

- The capability for emergency service aftermarket systems to draw power from a second location at the front of the vehicle (for example, behind the glove box) via a minimum of ten standardised connection points, each of which can be rated to different amperages;
- The capability for emergency service aftermarket systems to draw power from a third location on or in the roof of the vehicle (suggested in the roof of the vehicle) via a minimum of five standardised connection points, each of which can be rated to different amperages;
- A cable direct from the vehicle battery to the master unit incorporating filtering (where required) to all subsequent power consumables;
- The capability to manage the distribution of power between the three locations;

- The capability to manage and utilise an emergency service battery supply that is in addition to the standard OEM-fitted vehicle battery (if fitted);
- The capability to automatically shut off power to the emergency service equipment systems in a managed and prioritised way, ensuring that emergency service equipment is maintained for as long as possible, where the power management system detects power usage from emergency service equipment that may risk the continued operation of the emergency warning equipment;
- The capability to automatically shut off power to the emergency service equipment systems in a managed and prioritised way, ensuring that emergency service equipment is maintained for as long as possible, where the power management system detects power usage from emergency service equipment that may compromise the vehicle's ability to start its engine;
- Where the power management system has to shut off the emergency warning equipment in order to protect the vehicle start capability, 5 minutes before doing so it must warn the emergency service personnel that this is about to happen, with the warning being repeated every 30 seconds thereafter. Acceptable warnings will include:
    - alert to Force Control Room – text or other;
    - distinct audible warning (sound or spoken);
    - distinct visual warning that can be seen from the vehicle; and
    - maximum decibel limit of 100 db(C) (C-weighted).

Note: There is a general requirement to ensure that vehicle occupants are not exposed to a daily or weekly exposure of 85db (A-weighted), as specified in the Control of Noise at Work Regulations 2005.

All visual and audible warnings must have the capability to be switched off by the user but must remind the user at every engine start that this functionality has been disabled.

2.5.4 Optional Functionality

The following capabilities are optional and are (or may be) linked to the provision of the esCAN or switching system.

Some manufacturers provide vehicles with the capability for automatic engine start/stop when the vehicle is stationary. Where agreed with the vehicle manufacturer and where the vehicle is already provided with a vehicle immobilisation capability – for example, Engine Run Lock or approved Remote Vehicle Immobilisation Systems – the enhanced power management system may also provide the capability to activate the vehicle start/stop capability in order to manage the power supply for the emergency service equipment. An example would be when the vehicle is protecting a scene for long periods with warning lights illuminated to reduce the engine run time at idle.

The enhanced power management system, where it records the actions it takes in managing the power system, may also have an output to the One Box Vehicle and Driver Data Management System or another data collection device.

2.5.5 Control of Emergency Service Equipment via an Emergency Service Controller Area Network Bus

The OBSVA criteria requires the fitment of a dedicated CAN bus compliant with the ISO 11898 specification, for communication and control of the emergency service electronic equipment within the vehicle for the reason set out above (see Chapter 1.3). This will use an open (published) data dictionary to enable all suppliers to the market to use it and allow for the interchange of equipment.

Note: ISO standards are available through the ISO website at http://www.iso.org.

The CAN bus system, hereafter, called the emergency service CAN or esCAN, will provide a cost-effective, safe and reliable mechanism by which all the emergency service systems and components of the system can be operated and controlled on a common bus.

The esCAN bus Data Dictionary shall mirror that set out in CiA 447. This will be published as an open standard at a date to be defined in the future. Organisations wishing to obtain copies of the standard prior to publication should contact CiA directly. The relevant headings of the CiA 447 currently utilised are listed in Appendix A. CiA 447 defines the standard messages that will be used on the esCAN bus system. It also defines connections to and communication with the internal vehicle CAN. The esCAN bus Data Dictionary will be maintained and extended by the CiA as part of their ongoing development of their standard.

The esCAN network will physically consist of industry standard CAN twisted pair wire. The CAN will only use the transmission rate of 125 kbit/s. The bit timing as defined in CiA301 shall be used.

Each relevant component of emergency service equipment systems will be connected to the relevant esCAN bus via a standard CAN bus controller. The provision of technology in emergency service vehicles will require CAN bus controllers to broadcast a status onto the CAN so that future data recorders may record that signal for any subsequent investigation. In other words, a 999 activation switch will need to send a message to activate the blue lights and also receive a message to illuminate the 999 function button when it is activated. This would include remote operation of the 999 function via a steering wheel control.

2.5.6 Emergency Service Controller Area Network

The information that the esCAN bus carries will include, but is not limited to, the following:

- emergency warning lights –controls;
- sirens –controls;
- RESTORE functionality;
- power management system –related to the above functions;
- Automatic Number Plate Recognition (ANPR) – controls/status;
- evidential or other camera – controls/status;
- speed or other enforcement equipment N.B. Any changes to enforcement system may require re-qualification of the device;
- matrix signs;

- GNSS (satellite navigation);
- One Box Driver and Vehicle Data Management System (DVDMS);
- defined subset of vehicle CAN data; and
- other non-safety-critical functions.

The OEM vehicle CAN bus firewall will be an agreed firewall provided by the vehicle manufacturer, as specified in CiA 447. This firewall will connect to the esCAN bus to allow the safe exchange of control and data signals between the fitted CAN systems. The firewall will be capable of reading information from the internal vehicle CAN, interpreting it and then writing it to the esCAN using the agreed Data Dictionary.

The esCAN is shown diagrammatically below.

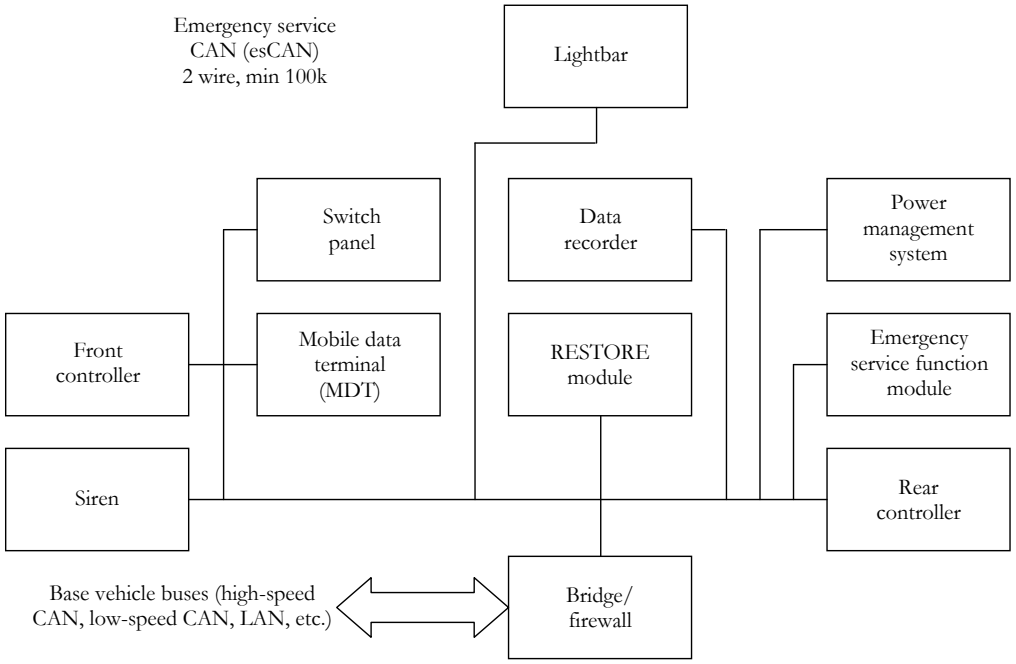


Figure 1 – esCAN Schematic

All messages on the esCAN can be received by the data recorder regardless of whether they originate from emergency service equipment installed on the vehicle or are messages from the base vehicle CAN that have been broadcast on the esCAN by the firewall.

The esCAN bus will also be used as the gateway between the vehicle systems and the emergency service equipment via a firewall. The esCAN will permit emergency service modules to operate base vehicle functions by transmitting the appropriate message via the firewall with permission from the vehicle OEM. The firewall will receive these messages and operate the requested base vehicle function via the vehicle OEM CAN bus.

The esCAN bundle may also include a twisted pair of wires, which will carry power to the esCAN modules to provide power for lower power systems such as light-emitting diode (LED) warning lights. The power that is provided is subject to the thresholds of the cabling used. This section must be read in conjunction with Section 2.7 below. The esCAN bundle may also carry additional cables to ensure built-in redundancy for future technology not yet developed. Redundant

wiring will be terminated to ensure safety and prevent interference with other vehicle systems.

2.5.7 Audit

As part of the operation of the OBSVA, it is essential that where control messages from after market equipment are sent via the esCAN, that they are also made available to the One Box Driver and Vehicle Data Management System (DVDMS) or other data collection device as part of the audit process and for analysis of driving and equipment operation. The esCAN will also carry the data from the vehicle OEM CAN as part of the emergency service data set. This will be required for both legal purposes, as part of the evidential process and to ensure and prove the proper use of the system.

The audit trail, where possible, requires the ability to identify the person undertaking each action, the date and time of the action, and the action or process carried out. The system shall be designed to identify all of the occupants of a vehicle and shall be capable of assigning control inputs to individual persons.

The One Box DVDMS, if fitted, or other data collection devices if not, will hold this audit trail.

2.5.8 Control and Switching Specification

The principle for the OBSVA controls and switch gear is that all emergency service equipment, whether installed by an OEM or when installed as an aftermarket fit:

- will comply with all relevant new vehicle legislation, Directives and standards for the installation and operation of aftermarket equipment, be that new vehicle or aftermarket fit;
- will comply with all relevant legislation, Directives and standards for installation and operation of new vehicle (OEM) equipment; and
- will comply with the European Statement of Principles on HMI.

Where, as part of the process of fitting aftermarket equipment, it is not possible to comply with new vehicle legislation, Directives, standards or HMI best practice, all deviations shall be formally recorded, the liabilities and consequences assessed and these shall be agreed to in writing by the customer, supplier and accredited test house, which may recommend to CAST that they consider refusing, restricting or removing the OBSVA criteria accreditation and/or the system from the List of accredited OBSVA systems.

Compliance with these principles shall guide the design, location and operation of all emergency service equipment and its associated switch gear and controls to ensure they maximise the safe operation of the equipment and minimise distraction to the driver.

2.5.9 One Box Single Vehicle Architecture Principles for the Reuse of Original Equipment Manufacturer Vehicle Controls

Where an OEM vehicle control is used for the activation of a safety-critical system such as the emergency warning lights or siren:

- the selection of the control, position, look, feel and functionality must be assessed as suitable for the operation of that safety-critical function,

while the vehicle is being operated under emergency response conditions; and

- the emergency warning system must, when activated by an OEM vehicle control or from an MDT screen, also activate an emergency service specific tactile control, which provides a visual indication and optionally an audible indication, that the warning device has been activated (see below).

2.5.10 Emergency Warning Switches

The location and operation of the primary five tactile emergency warning controls as defined above are critical to the safe and effective use of the vehicle and its emergency service operation.

The driver of an emergency service vehicle must at all times be able to confirm easily whether the emergency service warning equipment has been and remains activated, with the minimal distraction to driving. This requirement is applicable in:

- all light conditions: day, night, glare, etc;
- under normal and high demand vehicle use.

Confirmation of activation shall be such that it can be ascertained by the driver of a vehicle operating in high demand/emergency response mode, requiring the minimum of interruption of eye contact with the road. The confirmation shall be visual and may also be audible.

Where confirmation is also audible, there shall be a simple way for the user to adjust the volume of the audible signal to prevent driver distraction.

The following HMI requirements shall apply to these tactile switches:

- The location and design of emergency warning switches shall be such that the allocation of driver attention to the controls remains compatible with the cognitive demand of the driving situation in normal, high demand and emergency service use.
- The switches shall be positioned as close as practicable to the driver's normal line of sight.
- The switches shall be located and fitted in accordance with relevant regulations, standards and manufacturers instructions for installing the system in vehicles. (See switch control above.)
- No part of the switches shall obstruct the driver's view of the road scene.
- The switches shall not obstruct vehicle controls and displays required for the primary driving task.
- The switches shall also be located so that a front-seat passenger can operate them.
- No part of the switches or housing through it’s positioning or protrusion from existing dashboard or OEM equipment layout shall cause injury to a vehicle occupant when the vehicle is subject to a collision or other event.

- The switches shall have nationally agreed symbols (icons) colours and layout.
- The driver shall always be able to keep at least one hand on the steering wheel while operating the switches.
- The switches shall not require long and uninterruptible sequences of interactions.
- Switch controls shall be designed so that they can be operated without adverse impact on the primary driving task.
- The switches response (for example, feedback, confirmation) following driver input shall be timely and clearly perceptible.
- The switches shall be backlit illuminated.
- The controls, both functions and area fitted, shall be standardised in all vehicles.
- The primary controls shall be tactile controls, not screen based, so that the vehicle remains operational and useable should a screen issue arise.
- Controls and switches shall be clearly identifiable in all light conditions.
- Controls or switches shall be easy to operate when the driver is operating the vehicle in emergency service use.
- The switch panel shall clearly indicate to the driver and other vehicle occupants visually and in all light conditions that the control has been activated. There shall be clear distinction between controls through the use or combination of:
    - location;
    - touch; and
    - colour.
- A warning sound may also be emitted when a control is activated. However, due regard must be given to driver distraction.
- Where the emergency warning switches can be operated using redundant OEM vehicle controls, the suitability of the controls for that purpose will be evaluated and confirmed following testing during operationally realistic conditions of emergency response.
- Switches must be comfortable to touch, with no sharp edges likely to cause injury.

2.5.11 Non-Critical Switches and Controls

In addition to the safety-critical emergency warning controls, there may be a number of other control switches to operate and control a range of emergency service equipment.

These non-safety-critical control switches may be in the form of separate switches positioned singularly, incorporated into panels, included as part of an on-screen function within a touch-sensitive screen or integrated within the functions of an MDT.

Where non-safety-critical switches are required, these shall be clearly separated from the safety-critical emergency switches and warning controls.

Non-safety-critical switches for functions not intended to be used by the driver while driving shall be restricted or rendered inoperable while the vehicle is in motion or clear warnings shall be provided against their unintended use.

Where non-safety-critical switches or controls are fitted into the vehicle infrastructure, they shall meet the following requirements:

- They shall be designed in such a way that the allocation of driver attention to the controls remains compatible with the attention demand of the driving situation in normal and emergency service use.
- They shall be located and fitted in accordance with relevant regulations, standards and manufacturers instructions for installing the system in vehicles. (See switch control above.)
- They shall not obstruct the driver's view of the road scene.
- They shall not obstruct vehicle controls and displays required for the primary driving task.
- They shall be located so that a front-seat passenger can operate them.
- Switches and their housing shall be designed and located so as not to protrude from the existing dashboard or the OEM equipment layout, to minimise the possibility of causing injury to a vehicle's occupants should the vehicle be involved in a collision, or at any other time.
- They shall enable the driver to be able always to keep at least one hand on the steering wheel while operating the switches.
- They shall not require long and uninterruptible sequences of interactions.
- They shall be designed so that switch controls can be operated without adverse impact on the primary driving task.
- Response from the relevant switch (for example, feedback, confirmation) following driver input shall be timely and clearly perceptible by its operator.
- Switch functions and the area of the vehicle to which they are fitted shall be standardised, as far as is practicable, in all vehicles.
- A switch panel shall be provided that shall clearly indicate to the driver and other vehicle occupants, visually under all prevailing light conditions, that the control has been activated.
- There shall be clear distinction between controls.
- The 'ALL OFF' button shall enable the driver to switch off all emergency warning equipment through one button and provide visual confirmation.

2.5.12 Separate Switch Panels or Keyboards

Some emergency service applications may require a separate switch panel or keyboard for the operation of the emergency equipment. Where this is absolutely

necessary, in addition to the requirements for non-critical switches and panels, controls over and above the switch panel or keyboard shall meet the following requirements:

- They shall be designed so as not to cause injury to any vehicle occupant.
- They shall be designed and installed, so that any switch panel or keyboard can be securely and safely stowed, until required.
- All mountings, housings, brackets and other materials used for their fitting shall be designed, located and installed so as not to cause risk of injury to any vehicle occupant under any circumstances, including during vehicle collisions, whether the switch panel or keyboard is attached or fixed to its mounting or not.
- Any separate switch panels or keyboards requiring an extension or connection cord shall be designed, constructed and installed so as to minimise the risk to any vehicle occupant from contact under any circumstances, including during vehicle collisions.
- Any separate switch panels or keyboards requiring an extension or connection cord shall be designed, constructed and installed so as not to represent a trip hazard and to avoid the possibility of being used as a potential weapon against the occupants (for example, via strike or strangulation).

2.5.13 Fitting of Wireless Switch Panels or Keyboards

Any wireless switch panels or keyboards shall have the capability to be fastened securely when not in use so that they do not become an injury risk during a collision or incident. The fastening mechanism shall be safe, simple, effective and quick to use, facilitating both access and stowage. This paragraph shall be read in conjunction with the requirements in sections 2.9.3, 2.9.4 and 2.9.5 below.

2.5.14 Minimum Emergency Service Warning Controls

Emergency service warning controls, as a minimum, must include the following:

Control	Feature	Colour	Functions	Cancel – linked systems
1	999	Backlit. Change colour to blue when activated. Unique tactile switch surface (shape or feel).	Activate front and rear blue lights, including all blue auxiliary lights. Activate headlight flash or equivalent unless headlights are on. Arm siren, to standby. Arm run lock, where fitted.	Cancel by press again. Any of linked system buttons. Control 5 below.
2	At scene/ rear protect	Backlit. Change colour to red when activated.	Activate rear blue and red lights and rear blue and red ancillary lights, where fitted. Arm run lock, where fitted. If previously activated: Deactivate front blue lights. Deactivate headlight flash or equivalent.	Cancel by press again. Any of linked system buttons. Control 5 below.
3	Front blues	Backlit. Change colour to blue when activated.	Activate front blue lights and front ancillary blue lights. Arm siren. Arm run lock where fitted. Deactivate rear blue lights.	Cancel by press again. Any of linked system buttons. Control 5 below.
4	Low power	Backlit. Illuminate when activated.	Reduce power to 360 blue lights by 40%.	Cancel by press again. Control 5 below.
5	ALL OFF	Backlit. Change colour to green when system activated then return to backlit.	Turn off blue lights, rear lights and all blue and red ancillary warning lights. Restore lights to full power, where low power selected. Disarm siren. Disarm run lock.	

Table 1 – Functions of the five standardised buttons for all emergency service vehicles

The sequence of fitting in the horizontal position is as follows:

999	At scene	Front blue	Low power	ALL OFF

The sequence of fitting in the vertical position is as follows:

999
At scene
Front blue
Low power
ALL OFF

These five safety-critical controls shall be placed in the optimum location for the driver to operate while driving, without taking their eyes off of the road or requiring only a minimal glance. They must also be placed so that the front-seat passenger can operate them.

The intention is to standardise the placement and layout of these five controls on all vehicles as far as is possible within the target placement area depicted below by the yellow boxes.

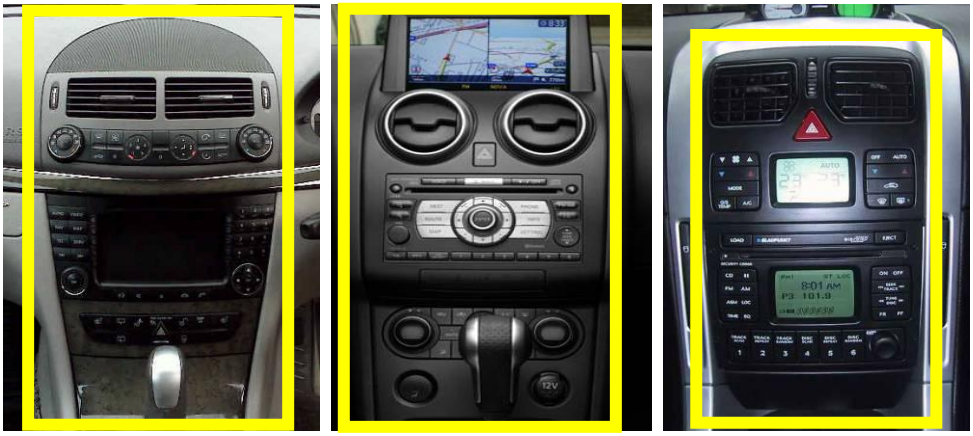


Figure 2 – Examples of where to place emergency service warning controls. They shall be placed within the area depicted by the yellow rectangle

2.5.15 Additional Controls

Additional controls for ancillary or non-safety-critical equipment shall be fitted so that they are distinct from the critical controls, but shall also comply with the OBSVA principles.

The ancillary controls may be included on the screen of an MDT, where fitted, subject to the requirements of HMI best practice. The ancillary controls shall

also be capable of being activated by both driver and front-seat passenger while the vehicle is moving.

All controls shall be clear and easy to use and locate in a hurry and in poor light conditions. The controls shall be easy to identify and differentiate. All logos and icons shall, as far as is possible, be standardised.

2.6 Fitting of Emergency Service Equipment to the Roofs of Vehicles

Emergency service vehicles are fitted with an array of equipment located on the roof, both in the middle or at the rear. These include:

- emergency warning lights;
- camera(s); and
- antennae.

Historically, each of roof mounts systems have been fitted in isolation, requiring power, control systems and data cables for them to operate. These require the cables to pass from the inside of the vehicle to the outside, requiring several holes to be cut in the vehicle roof, which can significantly reduce the resale value.

As part of the OBSVA criteria the requirement to drill holes will be reduced as far as is practical by:

- only permitting One Box compliant technologies to be installed to emergency service vehicles, including those that comply with AES Specification 5 (subject to limited exceptions for the reuse of existing ANPR technology, light bars or other technologies that are being re-deployed from another vehicle which have a CiA447 compatible interface;
- reusing existing holes in the roof provided by the vehicle manufacturer;
- grouping functionality and cabling together, where possible and through the provision of a single connection point on the roof of the vehicle for the light bar (connection points on the roof must utilise locations that minimise the impact on the vehicle resale, whilst achieving the required functionality); and
- providing sufficient wiring capability (power, data and control) where required to additionally run at least two ANPR or other evidential cameras, with the option of additional connection points being provided if required, operationally.

2.6.1 Antennae

Most vehicle manufacturers fit radio and GPS antennae to the roof.

The OBSVA criteria require the replacement of these antennae with a multi-band antenna to provide radio capability for:

- TETRA;
- General Packet Radio Service (GPRS)/Global System for Mobile Communications (GSM)/3G;

- car entertainment radio (if fitted); and
- GPS.

Roof-mounted antennae must have 150mm-long flying leads capable of being terminated in a range of industry standard connectors.

A further 2m of cabling will be provided to the boot area and this cabling must be un-terminated so that it can be trimmed to length dependent on the location of equipment in this area, having due regard to the matching of the antenna tune frequency to ensure that the voltage standing wave ratio (VSWR) performance is satisfactory.

The GPS cable will be able to be attached to a GPS splitter in order to provide the GPS signal to a number of applications within the vehicle from a single antenna.

This GPS connection is expected to be used for most applications within the vehicle. The exceptions would be where an additional covert GPS antenna is required for security reasons.

The TETRA cable shall permit connection for the emergency service radio.

The GSM/3G antenna will allow connection to multiple systems and is expected to be used for most applications within the vehicle.

The exceptions would be where an additional covert GSM/3G antenna is required for security reasons or where the gains of the receivers are not capable of being matched.

2.6.2 Power and Signalling Connections to Light Bars

The power and signalling/control cables for a light bar will be terminated in a CAN industry standard quick fit connector for termination, normally inside the light bar to ensure it is waterproof.

This will enable a component such as a light bar to be interchangeable.

These connector(s) (internal or external) must have sufficient wiring capacity to also run the controls and power for at least two ANPR cameras and where fitted, the Ethernet (wired LAN described below) connection.

2.6.3 Automatic Number Plate Recognition (ANPR) Cameras

To maximise resale of value of emergency service vehicles, cameras shall, where possible, be mounted other than on the roof where mounting holes may need to be drilled. This not only allows water ingress but seriously affects aftermarket prices when fleet vehicles are sold on.

Where possible, cameras shall be fitted and incorporated into other emergency service equipment, for example, within the light-bar or elsewhere in the vehicle at locations that will not adversely impact on safety functionality or vehicle resale values.

2.7 Wired Local Area Network – Ethernet Specification

The OBSVA criteria require the fitting of a single vehicle LAN that meets the requirements of IEEE 802.3.

The OBSVA authorised LAN connectors will be ‘RJ45’ dependant on the application.

The Ethernet bus will be the carrier for all data-intensive communications between emergency service modules within the vehicle. A bus with this capacity will be essential for carrying video or bulk data, such as used by MDTs.

This is shown in Figure 3 below.

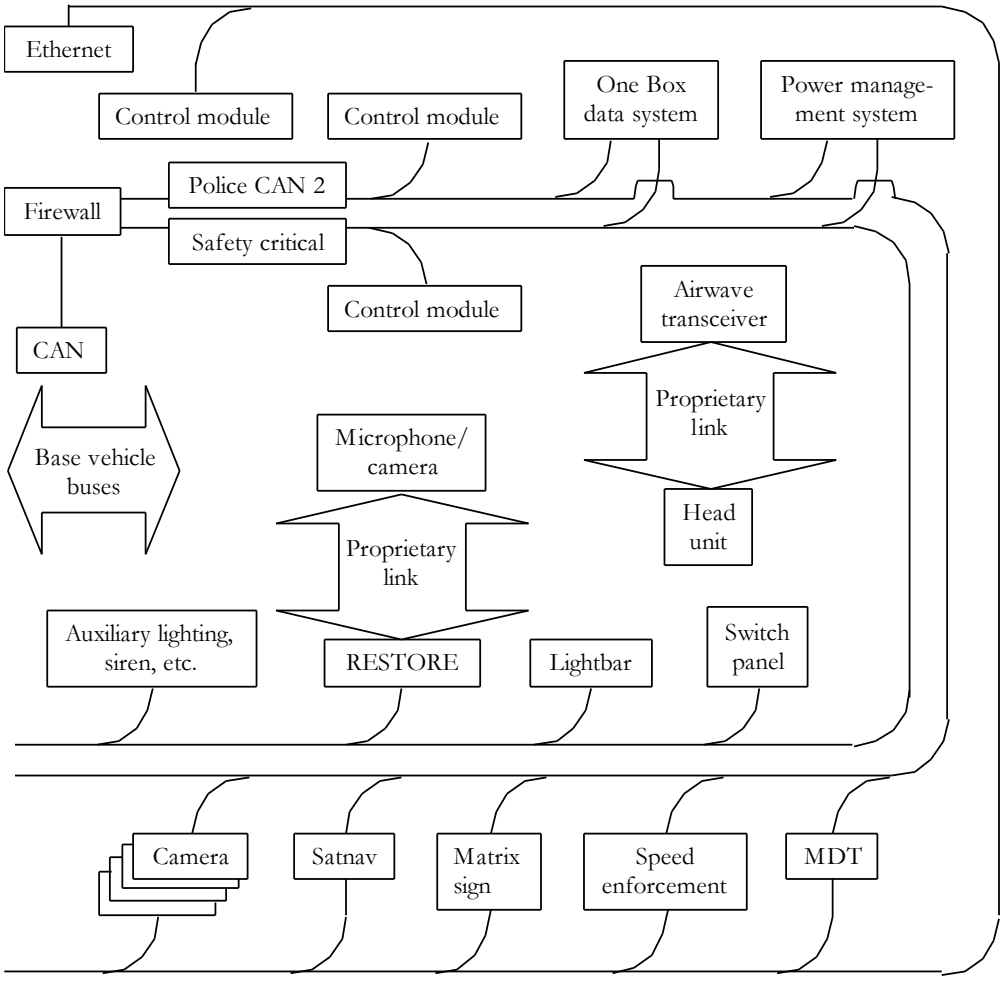


Figure 3 – Example of CAN bus architecture

2.8 Connectors and Interfaces

Normally a T-connection shall be used. This provides a point of attachment onto the bus cable and provides easy removal of a device without disrupting network operation. Devices may be connected to the network either directly to the T-connector or with a stub cable. The bus cable is terminated at both ends by termination resistors.

CiA447-1, Section 4.3 - Connectors recommends using the 18-pin VDA interface connector (e.g. micro quadlok system 0.64 from Tyco or equivalent connectors from other manufacturers). The 18-pin VDA interface socket connector is shown in Figure 4 below.

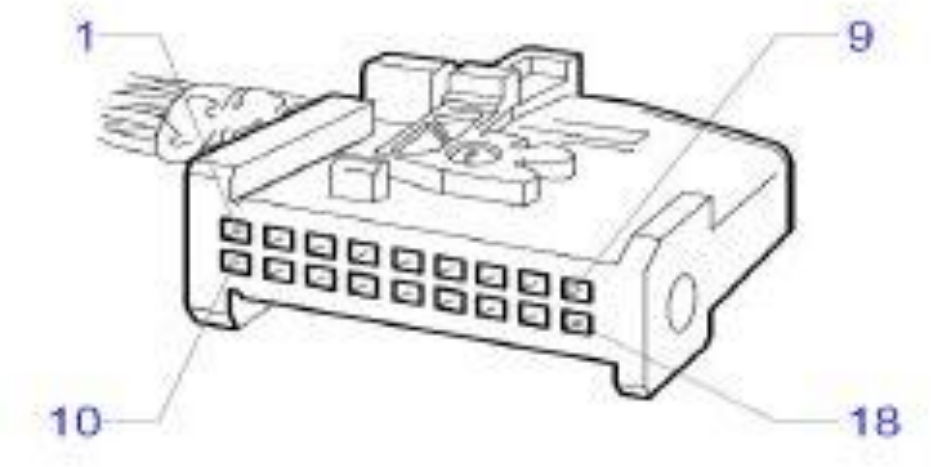


Figure 4 – Drawing of 18-pin VDA connector

Table 2 specifies the pin assignment of the 18-pin VDA interface connector. The signals S1 to S6 are car add-on device application-specific signals.

Optional/ mandatory	Pin no.	Color	Name	Description	Recommended use in emergency vehicle	Input/output from car view
Mandatory if 2-pin power-connector not used	1	brown	KL31	Ground (0 V/ max. 4 A)	Ground (0 V/ max. 4 A)	Output
Optional	2	brown/ violet	PTT	reserved for PTT	PTT mobile radio	Input/output
Optional	3	green/ blue	S1	reserved for PTT	PTT siren	Input/output
Optional	4	violet	S2	reserved for audio mute	Reserved for audio mute	Input/output
Optional	5	black/ white	S3	reserved	Beacon low	Input/output
Optional	6	brown/ black	S4	reserved	Radio emergency call request	Output
Optional	7	black/ green	AUDIO_OUT +	reserved for audio receiver	AUDIO_OUT +	Input/output
Mandatory	8	yellow	CAN_L	CAN low line	CAN_L	Bus
Optional	9	black	AUDIO_IN -	reserved for microphone shield	AUDIO_IN -	Input/output
Optional	10	black/ blue	KL15	Ignition	KL15	Output
Mandatory if 2-pin power-connector not used	11	red/ yellow	KL30	Power supply voltage (+11 V to 16 V/ max. 4 A)	Power supply volt-age (+11 V to 16 V/ max. 4 A)	Output
Optional	12	gray/ blue	KL58	Position lamp status	KL58	Output
Optional	13	green/ yellow	SPEED_PULS	Speed pulse signal	Speed pulse signal	Output
Optional	14	blue/ yellow	S5	reserved	Radio main switch	Input/output
Optional	15	blue/ white	S6	reserved	Beacon high	Input/output
Optional	16	green	AUDIO_GND	reserved for ground for audio signals	AUDIO_OUT -	Input/output
Mandatory	17	yellow/ black	CAN_H	CAN high line	CAN_H	Bus
Optional	18	white	AUDIO_IN/MIC	MIC +	AUDIO_IN +	Input/output

Table 2 – Pin assignment for 18-pin VDA connector

For high power devices (greater than 4 Amps), CiA447 recommends that a 2-pin power connector AMP926474-1 or an equivalent connector from Tyco or other manufacturer shall be used. Table 3 specifies the pin assignment of the 2-pin power connector.

Optional/ mandatory	Pin no.	Color	Name	Description	Recommended use in emergency vehicle	Input/output from car view
Recommended for current > 4A	1	bown	KL31	Ground (0 V/ max. 15 A)	Ground (0 V/ max. 15 A)	Output
Recommended for current > 4A	2	red/yellow	KL30	Power supply voltage (+11V to 16 V/ max. 15 A)	Power supply voltage (+11 V to 16 V/ max. 15 A)	Output

Table 3 – Pin assignment for 2-pin power connector

The 18-pin connector above shall be used for the esCAN side of the OBSVA vehicle firewall/gateway and the OEM interface on the firewall/gateway will be manufacturer dependent.

In order to increase the level of equipment compatibility and reduce the footprint of the connector, an additional connector type has been selected for slave esCAN devices: Tyco/Amp Connector Universal MATE-N-LOK, 4-way. Contacts accept 0.05-5.0 mm2 (30-10 AWG) wire sizes, equating to a maximum calculated current rating of 16.5 Amps. The plug part number is 1-480702-0 and the socket part number is 1-480703-0. Equivalent connectors from other manufacturers may be acceptable for slave devices on the esCAN. The 4-pin MATE-N-LOK connector is shown below with its associated pin assignment in Figure 5 – Pin assignment for 4-pin MATE-N-LOK connector below.

Pin 1 Ground

Pin 2 Power supply

Pin 3 CAN_L

Pin 4 CAN_H

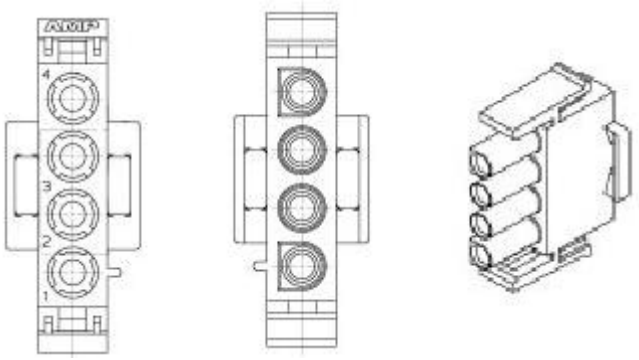


Figure 5 – Pin assignment for 4-pin MATE-N-LOK connector

The Ethernet physical layer shall utilise suitable cabling for the intended application and must conform to IEEE802.3. It will use an RJ45 interface.

2.9 Human-Machine Interface

2.9.1 Scope of Human-Machine Interface within the One Box Single Vehicle Architecture Criteria

The scope of the HMI requirements in the OBSVA criteria is limited to the location, installation and operation of the hardware provided as part of emergency service electronic equipment fitted to the OBSVA in that vehicle. Specifically, this includes:

- mobile data or aftermarket screens;
- emergency service equipment controls and switchgear;

- keyboards; and
- docking stations.

It excludes the software operating on systems, the content displayed on screens, the carriage of other emergency service equipment within the passenger or load carrying area (such as bags, cones, fire extinguishers, clipboards and torches).

However, the following guidelines and the European Statement of Principles on HMI may be a useful guide in these areas.

HMI requirements are laid out in the following sections.

2.9.2 Dedicated Emergency Service Equipment Control Screen

Where a screen is required to be fitted for the operation of emergency service equipment, it shall meet the following requirements:

- A single screen may suffice for the operation and display of all vehicle and emergency service equipment. However, should there be a need for two screens then this acceptable, so long as the HMI principles and the following requirements are met.
- The screen(s) shall be either flush mounted or recessed into the existing vehicle trim, with sufficient space behind it to comply with the new vehicle impact legislation.
- The screen(s) shall be a size and aspect ratio appropriate for the applications displayed on them.
- It shall normally be touch screen capable.
- The screen shall be positioned so as to comply with the European Statement of Principles on Design of Human Machine Interaction (HMI), 2008.
- The screen shall be located and fitted in accordance with relevant regulations, standards and manufacturers' instructions for installing the system in vehicles.
- The screen where appropriate may be located so that a front-seat passenger can operate it.
- No part of the screen or housing shall, through its position or by protruding from the existing dashboard or OEM equipment layout, cause injury to a vehicle occupant when the vehicle is the subject of a collision.
- The power on/off switch shall be positioned so as to be easily accessible for both driver and front-seat passenger and separate from the five emergency warning controls.
- The screen shall comply with all relevant regulations and in particular Construction and Use Regulations 104, 109 and 110.

2.9.3 Docking Stations

With the move to mobile data and increasing use of nomadic (handheld) devices that are used away from the vehicle, there is a requirement to dock the handheld devices (for example, Personal Digital Assistants (PDAs), laptops and smart phones) with the on-board vehicle systems to:

- share data between the device and the in-vehicle system;
- use the communication capability of the in-vehicle system; and
- use the processing power of the handheld device to operate the in-vehicle system.

Decisions regarding the location of the docking stations for these types of devices are made for a variety of different reasons:

- safety;
- cost;
- reliability; and
- ease of use – HMI.

2.9.4 Docking Station within the Passenger Cell of a Vehicle

Within the context of the OBSVA criteria, in addition to the requirements for screen and controls, the docking station shall comply with relevant legislation, Directives and standards for aftermarket and OEM fitment, as detailed above. The following functionality is also required:

- Any docking station that is within the passenger cell of the vehicle, whether the portable device is docked or not, shall be located so as not to cause risk of injury to a vehicle occupant(s) when the vehicle is in use, be that stationary, normal or high demand/emergency driving or during a collision or other event.
- Any device docked in a docking station shall be securely held by locking mechanisms that have been tested as suitable to safely restrain the device, should the vehicle be involved in a collision or other event.
- Any docking station securing mechanism within the passenger cell shall be able to confirm to the vehicle occupants that it has been properly docked, in a way that is clear and unequivocal. It shall warn the driver or vehicle occupants that it is not properly docked and continue to warn them until the device is properly docked. The warning shall be visual and may additionally be audible. Where an audible warning is provided, a user may deactivate this (for example, switch it off at night).
- Any docking station securing mechanism within the passenger cell must be able to alert the vehicle occupants should it become unsecured but not removed from the docking station immediately in a way that is clear and unequivocal. It shall warn the driver or vehicle occupants that it is not properly docked and continue to warn the occupants until the device is properly docked. The warning shall be visual and may additionally be audible. Where an audible warning is provided, a user may deactivate this (for example, switch it off at night).
- Any docking station must be easily accessible.
- Any docking station shall be designed and located so that the device can be undocked, docked and secured simply, easily and safely.
- Where a docking station in the passenger cell is used to run in-vehicle systems, connections between the device and the vehicle shall be secure

and resistant to vibration to ensure safe, effective and efficient function of on-board systems.

- Where a docking station in the passenger cell is used to run in-vehicle systems, its design, construction and installation shall ensure that, while the vehicle is in motion and those systems are in operation, the device cannot be undocked without a warning being given to the driver and other occupants that in-vehicle systems may no longer operate effectively.

2.9.5 Docking Station within the Load Area of the Vehicle

Within the context of the OBSVA criteria, in addition to the requirements for screen and controls to comply with legislation, Directives and standards for aftermarket and OEM fitment as detailed above, the following functionality shall be required:

- Any docking station that is within the load area of the vehicle, whether the portable device is docked or not, shall be located so as not to cause risk or injury to any vehicle occupant when the vehicle is in use, be that stationary, normal or high demand/emergency driving or during a collision or other event.

- Any docking station that is within the load area of the vehicle, whether the portable device is docked or not, shall be located so as not to be at risk of causing damage to, or being damaged by, equipment being held, placed in or removed from the load area, be that when the vehicle is stationary, normal or high demand/emergency driving or during a collision or other event.

- Any device docked in a docking station must be securely held by locking mechanisms that have been tested as suitable to safely restrain the device should the vehicle be involved in a collision or other event.

- Any docking station securing mechanism within the load area must be able to confirm to the vehicle occupants that it has been properly docked, in a way that is clear, unequivocal and warns the driver or vehicle occupants that it is not properly docked and continues to warn the occupants until the device is properly docked. The warning shall be visual and may additionally be audible. Where an audible warning is provided, a user may deactivate this (for example, switch it off at night).

- Any docking station securing mechanism within the load area must be able to alert the vehicle occupants should it become unsecured and not removed from the docking station immediately, in a way that is clear, unequivocal and warns the driver or vehicle occupants that it is not properly docked and continues to warn the occupants until the device is properly docked. The warning shall be visual and may also be audible. Where an audible warning is provided, a user may deactivate this (for example, switch it off at night).

- Any docking station must be easily accessible.

- Any docking station shall permit the device to be undocked, docked and secured simply, easily and safely.

- Where a docking station in the load area is used to run in-vehicle systems, connections between the device and the vehicle are secure and

resistant to vibration to ensure safe, effective and efficient function of on-board systems.

- Where a docking station in the load area is used to run in-vehicle systems that are still operating, that the device cannot be undocked without a warning being given to the driver and other occupants that in-vehicle systems may no longer operate effectively.

2.9.6 OBSVA Malfunction

The risk of vehicle malfunction attributable to the OBSVA and its installation shall be minimised through attention to quality of design, manufacturing and installation, as defined by compliance with relevant sections of these criteria, including audit and random inspection.

Additional or auxiliary equipment interfacing with the OBSVA shall not adversely affect the normal operation of the OEM OBSVA.

The OBSVA shall not degrade the performance of the vehicle, its systems or components, during the normal vehicle lifetime.

2.9.7 Upgradeable

The OBSVA should be designed to be upgradeable, to enable future functionality, with redundant communication and power capability to allow for expansion and through standardised connections, operating systems and Data Dictionary.

2.9.8 User Cannot Deactivate

The general user of the OBSVA shall have no facility to deactivate directly, change or override the functionality or performance of the system. This function will be limited to the supplier or a suitably authorised user within the organisation.

2.9.9 One Box Single Vehicle Architecture Operating Conditions

The entire system and the on-board equipment must be highly reliable and be capable of effective operation, as defined by compliance with relevant sections of these criteria.

For a system to meet the OBSVA criteria it must be designed with a minimum operational life span of ten years.

The OBSVA shall function correctly in all relevant environmental conditions where it is operated, to include:

- weather types;
- temperature – heat and cold -20 to +85C;
- atmospheric conditions; and
- water and dust.

2.9.10 Compatibility with Vehicle and Emergency Service or Other Specialist On-Board Equipment

The installed OBSVA shall not adversely affect the performance of the vehicle during the normal vehicle lifetime. All the components of the OBSVA shall be correctly rated and technically compatible and not interfere with other OEM or

aftermarket system components and with all vehicle systems, other than as outlined as part of these criteria. This includes EMC and mechanical interference. This requirement also applies to specialist equipment that may be fitted to this type of vehicle, including emergency service equipment, enforcement equipment and TETRA radio.

This will be tested through compliance with:

- EMC regulations: must meet 2004/104/EC; and
- The current AES Automotive Conformance Specification 5 for Emergency Service Equipment.

2.10 One Box Single Vehicle Architecture Additional Functionality

2.10.1 Cameras

Where the OBSVA criteria require the fitting of one or more cameras, these shall be digital and shall communicate via the installed LAN for bulk data. EsCAN may provide communication for camera control.

2.10.2 Voice Activation

Where voice activated systems are provided the microphone shall be located so as not to distract the driver. Where a voice command activates a safety-critical warning device, it must also activate the visual control system. The voice command given must not operate any other system except the one anticipated.

Where voice activation or text to speech functionality is provided this shall be tested by a competent organisation to ensure that it is not distracting and complies with HMI principles and regulations.

2.10.3 Hands-Free Operation of Emergency Service Radio

Where hands-free systems are provided, they shall be located so as not to distract the driver. They must be fitted in compliance with vehicle Type Approval requirements and must be sited outside of any safety device deployment area.

They must not be able to be moved into a position that is likely to interfere with or cause injury to the occupants, in the event of an incident or safety device deployment.

They must be clearly visible as to function and be static-fitted in relation to the steering wheel so they are able to be used safely in high demand driving situations, ensuring the driver has minimal movement away from the driving controls to operate the functionality they provide.

2.11 Marking

The OBSVA main control unit shall be marked with the following information:

- the compliant OBSVA manufacturer's name or trade mark;
- the model number or name;
- component part number; and

- the serial number or batch number or date of manufacture of the compliant OBSVA.

All large component parts shall be visibly identified by a part number. In addition, each component of the OBSVA containing software shall be labelled with the software version, number or code. This may be implicitly identified within the main part number.

2.12 Documentation

2.12.1 General

Clear and comprehensive Installation Instructions and User Instructions shall support the OBSVA. The user should be provided with clear instructions as to the use and operation of the system. This will include connection to the system, fault analysis and correct operation and maintenance.

2.12.2 User Instructions

The OBSVA manufacturer, supplier or importer shall supply for each system User Instructions detailing a clear and comprehensive description of:

- system components;
- operation of the OBSVA functions;
- action to be taken in the event of a malfunction or failure;
- inspection and maintenance requirements.

The User Instructions shall contain a general warning regarding the risk of making any alterations or additions to the compliant OBSVA; such alterations or additions can invalidate the Certificate of Installation and compliance to the OBSVA criteria.

The User Instructions shall contain no information on how to unset or bypass the OBSVA, other than by the normal un-setting control or controls or alternative (emergency) un-setting procedure.

2.13 Installation

2.13.1 General

Installation of the OBSVA may be carried out at any of the following locations:

- vehicle production line;
- vehicle import or distribution centre;
- vehicle dealer; or
- independent OBSVA installer.

The installer shall maintain a consistently high level of OBSVA installation quality and security.

The manufacturer or importer shall provide to the installer a kit of components for each OBSVA installation, as specified in this criterion and compliant with the testing procedure in Section 3.11.2, and the installer shall ensure that all

components of the kit are fitted when an OBSVA is installed. No other components may be substituted.

The OBSVA shall be subject to a minimum warranty of 12 months, covering system and installation.

There shall be made readily available a servicing and functional checking facility during the normal lifetime of the OBSVA.

The OBSVA will not be finally commissioned following installation, upgrade or repair until all of the functionality has been tested as part of an end-to-end system check.

2.13.2 Technical

The following technical installation requirements are specified in order to provide a minimum acceptable level of security:

- All components and wiring of the OBSVA shall be installed in the vehicle in locations and via routes agreed with the vehicle manufacturer and in accordance with the principles of AES Specification 5 as safe, effective and compliant with all EMC and legislative requirements, together with the requirements of other standards listed under Normative References.
- Where practical, all components and wiring of the OBSVA shall be concealed from view when installed, excepting visible indicators.
- All components and wiring of the OBSVA shall be securely fixed to the vehicle.

2.13.3 Installation Instructions

The OBSVA manufacturer, supplier or importer shall supply to each installer, after appropriate training, OBSVA-specific Installation Instructions detailing a clear and comprehensive description of:

- a list of the vehicles for which the OBSVA is applicable. The list may be specific or generic; for example, ‘all cars with petrol engines and 12V negative earth electrical systems’;
- system components;
- wiring diagrams;
- a schedule of routing for all wiring for that model of vehicle, as agreed with the vehicle manufacturer;
- power supply voltage range and system current consumption;
- the electrical characteristics of inputs and outputs;
- installation directions, illustrated by photographs or clear drawings;
- component installation directions – locations and orientations;
- wiring installation directions;
- recommended methods of wiring interconnection;

- specific fixing instructions for components and wiring;
- correct and incorrect vehicle circuits or systems to interface;
- earthing and fusing directions;
- specific detail of any adjustments and recommended adjustment procedure;
- the effects of adjustable controls on OBSVA performance;
- any special tools required;
- testing of the OBSVA;
- fault finding;
- maintenance directions; and
- and a requirement to conduct end-to-end system test of all functionality before final commissioning.

2.13.4 Procedures for Aftermarket Systems

All aftermarket OBSVA shall be installed in accordance with the specifications laid down in this document. Installation companies/installers shall adhere to OEM new vehicle legislation and regulations when installing compliant OBSVA fitted after vehicle production. Installers will normally need to be qualified to City and Guilds or BTEC Ordinary National Certificate standard in electrical/electronics or an equivalent certification through formal industry training schemes compliant with Quality management systems, BS EN ISO 9001: 2008 or by companies and technicians who are accredited to the administrative and technical standards of FCS 1362.

The OBSVA installer shall supply to the system user for each permanently installed OBSVA, a Certificate of Installation.

3 Compliance and listing

This section deals with the Testing, Management and Compliance procedures for the implementation and fitting of the One Box Single Vehicle Architecture.

The objective of validation and testing in accordance with these OBSVA criteria is to ensure a minimum high level of performance with regard to safety, security, reliability and functionality of the evaluated OBSVA.

This chapter provides a reference to work from to achieve compliance and sets out the protocol for the Compliance Procedure to be applied to the accreditation of One Box Single Vehicle Architecture (OBSVA) systems and their interface with emergency service equipment. It should be read in conjunction with Chapter 1 System Requirements and Specifications–, which defines the functionality, quality and performance specification of the OBSVA.

The OBSVA criteria incorporates a programme for the evaluation of customised OBSVA systems or components against a defined set of requirements for the purposes of generating a periodically updated Notification List of approved systems or components.

These criteria are intended to ensure that necessary emergency service equipment works as an integrated solution in emergency service vehicles.

Systems or components submitted for testing are expected to achieve full compliance with all relevant aspects of the criteria contained within the document.

However, it is recognised that it may take time for suppliers and users alike to move towards full system or vehicle compliance. To ensure that progress towards full compliance is recognised, accredited test houses will have the ability to report and certificate partial compliance in the main areas of the OBSVA under the headings contained in Chapter 2 – System Requirements and Specifications. For example, for a whole vehicle test, part compliance may be considered where a vehicle meets all of the section on human-machine interface (HMI) criteria and/or all of the section on power management criteria, but has not yet completed the signalling on the emergency service Controller Area Network (esCAN). An example of a statement of partial compliance might appear as follows:

> "Partial Compliance Certification – Compliant with Controls and Switches – 2.5.8 / Compliant with HMI – 2.9."

The OBSVA accreditation scheme is directed by a public-private partnership, led by the ACPO ITS Working Group.

The accreditation of OBSVA systems will be administered by CAST, who will appoint accredited test houses that will carry out end-to-end system compliance tests and technical component assessments either on their own or in partnership with other facilities (for example, sub-contractors). OBSVA systems will be accredited as non-compliant, compliant or, where deemed appropriate by CAST, partly compliant with the OBSVA criteria.

3.1 One Box Single Vehicle Architecture Systems

OBSVA systems are accredited primarily to demonstrate their safety and operational effectiveness, in allowing the fitment and control of a wide range of emergency service equipment. Clearly this needs to be operated within the context of emergency service vehicles. The quality of integration of OBSVA systems and the dedicated emergency service equipment that they service with existing original equipment manufacturer (OEM) vehicle systems will be considered as part of the process of accreditation.

The Compliance Procedure is applicable to the equipment fitted to the vehicle as part of its construction (OEM) or installed before or after the sale of the vehicle aftermarket. An application for evaluation may be made by a vehicle manufacturer or importer or by an emergency service equipment manufacturer or importer or by a duly accredited representative thereof, to CAST.

The OBSVA criteria also recognise that there may be the need for different installation requirements and Compliance Procedures between systems installed as part of vehicle manufacture (OEM) and that of post-build or aftermarket. These are to be identified within the criteria, where applicable.

3.2 Period of Application of the Compliance Procedure

The Compliance Procedure is applicable only to the evaluation of systems that fall under one of the specifications or requirements defined in Chapter 2 of this document.

CAST reserves the right to periodically revise the OBSVA criteria, including the Compliance Procedure. The existing OBSVA Notification of Compliance statements issued in accordance with the Compliance Procedure shall remain valid for a minimum of one year after a major revision of the criteria. Major criteria revisions shall be identified by a change of version number. During this period, repeat inspections shall be performed on the basis of the version of the criteria applicable at the time of accreditation. In order to maintain List quality, there shall be a maximum period notified to those affected suppliers, vehicle and system manufacturers governing the time permitted for old issue level systems to remain Listed. The accredited test house may stipulate a maximum Listing period in the Notification of Compliance statements issued for each system, after which the expired OBSVA may be removed from the List.

The Compliance Procedure and criteria may be subject to minor interim revisions by the publication of addenda to modify the current documentation. A transition period during which systems may be submitted for evaluation against the minor revision level shall normally be applied at the discretion of CAST.

3.3 Partial Compliance

In an effort to assist manufacturers to become fully OBSVA-compliant, an accredited test house can offer partial compliance certifications for full system vehicle testing to recognise manufacturers working towards a compliant system. The test process for partial compliance will be the same as for full testing, the only difference being the outcome. These certifications will be provided under the headings in Chapter 2 – System Requirements and Specifications. For example, an OBSVA system could be compliant in the areas of HMI and Power Management, whilst the manufacturer is working towards compliance with the remainder of the criteria. The system would be Listed as such.

The partial compliance certification is an interim measure and will be phased out over time, and is likely to be withdrawn within 24 months from the launch of the first version of these criteria, as suppliers work towards full compliance. The ongoing provision of the partial compliance option will be considered every six months when the document is reviewed, utilising processes explained above. Therefore, the provision of partial compliance certifications should be regarded as a temporary measure to support, encourage and recognise the efforts of manufacturers as they work towards full compliancy with the OBSVA criteria.

Partial compliance certifications will only be endorsed and appear on the List for 12 months. After this time the certification will expire and another full test must be applied for through a test house, so that the system presented can be entered onto the List for another 12 months if it remains partially compliant. If the system achieves full compliance, the system will revert to those processes for full compliant systems explained within this document.

3.4 Compliance Procedures and Administrative Requirements

3.4.1 Conditions of Evaluation

To qualify for a Notification of Compliance of an OBSVA:

- The Applicant shall agree to the Terms and Conditions for assessment by submitting the Request for Evaluation form;
- The OBSVA shall be demonstrated to comply with these criteria and shall have passed the tests successfully;
- All evaluation fees shall be paid prior to Listing; and
- The Applicant shall agree to the Terms and Conditions of Listing.

3.4.2 One Box Single Vehicle Architecture Systems Already Accredited to Relevant Standards

Where manufacturers or suppliers of equipment can evidence compliance with AES Specifications that are referenced within this document and are relevant to the OBSVA Compliance Procedures, at the discretion of CAST and the accredited test house, they may be released from the requirement to undertake specific portions of the test regime.

This shall be dependent upon the exact accreditation that was obtained to the relevant standard or standards.

This shall take into consideration the date of the most recent test or audit, in order to ensure that these processes are given full regard in accrediting or re-accrediting a system.

The decision of CAST in this matter shall be final and shall not be subject to an appeal process.

3.4.3 Application Procedure

The assessment shall be requested by submitting the Request for Evaluation form, completed and signed by the Applicant, to an accredited test house. The accredited test house will ensure that the application form is correctly completed

and will request that CAST issues a unique reference number for the application, which must be used in all future documentation and testing for this application.

The accredited test house will supply to the Applicant all the required documentation for testing, together with a list of charges, Terms and Conditions and timescales for testing. The accredited test house will be responsible for the testing of submitted systems against the OBSVA criteria and ensuring that the ongoing compliance and quality checking is undertaken.

The application, with supporting technical and administrative documentation, shall be considered commercially sensitive. All communications shall only be with the designated Applicant(s). The primary Applicant may nominate secondary representatives for correspondence. It is requested that for an evaluation against the OBSVA involving two or more interested parties, reporting access is permitted to all parties.

3.4.4 Evaluation

The evaluation is intended to demonstrate a minimum acceptable level of compliance by the system under test against the performance levels set out in the OBSVA, in the context of the real world operation of emergency service vehicles, with respect to security, safety, reliability, interference, functionality, distraction and documentation. The level of validation is high and is broadly based upon original equipment validation standards and AES Specification 5.

The evaluation shall be performed, in accordance with the OBSVA criteria and the Compliance Procedure, on the sample vehicles and documentation submitted to the accredited test house by the Applicant. The Applicant shall ensure that the test sample material is complete and identical to that in production.

For the evaluation, normally one complete test sample shall be submitted free of charge at specified times in the process. The exact number may vary depending upon the test programme.

The evaluation is progressed through three Phases of assessment, where validation is conducted progressively in order to avoid committing high testing costs and test capacity to systems, where they are unlikely to comply through all Phases. Part fees are payable in advance of each Phase before the commencement of work. Work shall not commence until such time that these fees are paid.

A system under test may progress to a subsequent Phase, only if the period between sign-off compliance of the current Phase and the commencement of the subsequent Phase is no longer than six months. If the period is longer than six months, the system shall then be defaulted to the start of Phase 1, as per a new application.

A system under test shall be required to complete each individual Phase of the evaluation within a period no greater than 12 months. Failure to complete each Phase within 12 months shall cause the system under test to be defaulted to the start of Phase 1, as per a new application.

No Applicant can claim compliance with the OBSVA criteria for emergency service vehicles, until such time that the testing process has been successfully completed and the Applicant has agreed to the Terms and Conditions of Listing and paid the required fees.

3.5 Phases of Evaluation

3.5.1 Phase 1: Questionnaire

The Request for Evaluation form shall be submitted together with a detailed Questionnaire and the supporting documentation requested in the Questionnaire. These shall be examined for compliance with the OBSVA criteria. A meeting with the Applicant, together with an initial examination of the system, shall normally be requested as part of this Phase. A close dialogue is encouraged between the Applicant and the accredited test house. The requirements for testing at Phase 2 shall be discussed and agreed. It is acceptable at this stage to present a prototype sample of the system.

Defined Phase 2 Vehicle Test requirements may specify that several vehicle models or manufacturers are to be inspected and multiple reports are required depending on defined vehicle fitment policy. (The OBSVA system under test may be vehicle manufacturer or model specific or a component within an identified system, and compliance will be determined within that agreed installation.) This may require a system versus vehicle model matrix, which shall be provided to the accredited test house, in order to clearly define fitment policy of the system or system variant. In this case, the accreditation fee may be higher than the standard charge.4 Requirements for inspection of quality control procedures at installation locations will be defined.

An analysis of the system under test for Phase 2 testing requirements may demonstrate that it has multiple derivatives, variants, optional components or will have to be tested in a modular way. The fee may be higher than the standard charge for a singular system.

Documentation and sample requirements for Phase 2 accreditation testing will be specified at this Phase and these items will be requested and checked.

3.5.2 For Vehicle Original Equipment Manufacturer Systems

Where a vehicle OEM develops, manufactures and installs an OBSVA system, as part of the process of building the vehicle, this may already have been checked and found compliant with the relevant legislation and standards. Where this is the case, the vehicle OEM will be required to submit a Parts Submission Warrant for all OBSVA criteria parts. These shall be supplied in electronic format. The accredited test house will check the information and retain electronic copies.

For the audit process, the accredited test house will require a new Parts Submission Warrant every two years after initial Listing, with a full reassessment after six years.

Documentation for Phase 2 compliance will be specified at this phase and these items will be requested and checked.

The accredited test house shall supply a master copy of the ‘Certificate of Commissioning’.

[4] Accreditation fees are at the discretion of accredited test houses.

3.6 Phase 2 Vehicle and Component Test Programme

3.6.1 Phase 2: Vehicle Test Programme

At least one vehicle shall be made available to the accredited test house and its accredited sub-contractors and/or agents with the system or systems under test pre-installed. Specific installation instructions shall be provided at this Phase. The system under test and installation shall be accurately representative of standard production specification with all components provided for inspection.

The quality of installation of all OEM and aftermarket OBSVA systems shall be inspected in accordance with the technical standards laid down in the OBSVA criteria and, where appropriate, the agreed AES/National Association of Police Fleet Managers (NAPFM) Guidance for fitment of equipment to emergency service vehicles.

A series of tests shall be conducted on the installed system under test.

The installed system shall be subject to end-to-end system test and monitoring, covering all areas and functionalities to include:

- safety;
- operation;
- effectiveness;
- interference – with vehicle systems and/or emergency service equipment (as per AES Specifications 5, 6 and 13);
- human-machine interface;
- distraction;
- reliability;
- ease of use;
- power management; and
- data management.

If failures and non-compliances arise during a test, the Applicant shall be approached with details of the failures and provided with a summary describing the nature of the failure, the root cause and the corrective action to be taken to eliminate the failure.

The summary report shall be issued to the Applicant detailing any non-compliances and recommendations. A statement of compliance or non-compliance shall be issued to the Applicant at the conclusion of this Phase.

A minimum of one model shall be assessed by a thorough vehicle inspection, and other vehicles may be validated by the inspection of vehicle-specific installation instructions to establish conformity across the range. The level of validation shall depend upon the particular circumstances and shall be determined by the accredited test house at Phase 1 after defining the fitment policy.

The fee at this Phase shall be dependent upon the level and complexity of the system under test and the validation required.

3.6.2 Phase 2: Component Test Programme for Aftermarket Systems

Normally one complete sample of the system under test shall initially be provided free of charge by the Applicant directly to the accredited test house. This shall be checked against documentation and sample lists for completeness. Further samples shall be provided, free of charge to the accredited test house, if required, to a maximum number of three. Samples shall be supplied in various formats depending on the projected test programme. This may require that they are functionally connected and mounted on test boards; functionally connected only; or boxed/packaged as supplied to the installer. These samples shall be subjected to the component test regime defined by the Performance Test Specifications.

A reference sample of the system under test shall be required upon completion of testing and retained for future auditing checks. The samples provided shall be complete and accurately representative of the standard specification with all components provided.

For evaluations of some integrated vehicle-specific original equipment systems, one or more vehicles may require to be inspected or tested at this Phase. The Phase 2 testing body shall be approved by CAST, as part of the approval process for the test house.

Validation of software may involve detailed discussions with the Applicant, in order to establish the integrity of the design.

Important: In order to ensure an audit trail, it is strongly recommended that any important correspondence with the accredited test house should be conducted by email and that notes of telephone conversations are kept in an organised fashion.

During Phase 2 testing, the accredited test house will, at its discretion, issue periodic reports to the Applicant indicating progress and failures. It should be noted that the accredited test house is not obliged to issue interim reports on request.

The test regime shall require to be completed satisfactorily and a test regime completion report issued in order to progress to Phase 3. A statement of compliance or non-compliance shall be issued to the Applicant at the conclusion of this Phase.

The fee at this Phase shall be dependent upon the level and complexity of the system under test and the validation required. The extent of testing shall take into account factors such as different systems under test variants, including build to specification and print types. It will also take into account minor system derivatives based on hardware or software and optionally specified components. It should be noted that multiple system derivatives or variants can lead to high test fees.

At the conclusion of the Phase 2 programme, the accredited test house shall return all test samples except one to the Applicant. The test house shall keep one test sample as a reference sample.

3.6.3 Original Equipment Manufacturer System Component Certification Programme

This phase shall be accomplished by the submission of the relevant certificates, for the compliance for the OBSVA criteria system parts, in line with the latest EC regulations.

3.6.4 Phase 3: Review and Notification

The results of the previous Phases shall be examined and if considered satisfactory, a Phase 3 statement shall be issued to the Applicant indicating a Notification of Compliance. This shall request from the Applicant further information relating to the List and require the Applicant to sign and return a statement, which agrees to further Terms and Conditions for Listing the system. The name of the system under test shall be confirmed and agreed at this time. The name selected shall be such that it is sufficiently dissimilar from unrecognised systems, or from earlier non-compliant versions of the Listed systems on the OBSVA. The Phase 3 Notification of Compliance statement represents an agreement between the accredited test house and the Applicant, and a Certificate of Compliance for the OBSVA. The system under test shall be issued with a unique reference number issued through CAST. This number shall be stated on Certificates of Installation and quoted in any further correspondence with the Applicant or the accredited test house.

CAST shall normally include the system that has passed the compliance tests on the subsequent Notification List following the issuing of the Phase 3 Certificate of Compliance.

3.6.5 Compliance Procedure Summary

Phase 1 – Questionnaire

- Complete and return Request for Evaluation form with fee
- Complete and return Questionnaire
- Parts Submission Warrant (OEM only)
- Submit documentary evidence of compliance
- Questionnaire reviewed and test programme established
- Notification of Compliance/Non-Compliance statement

Phase 2 – Vehicle Test Programme

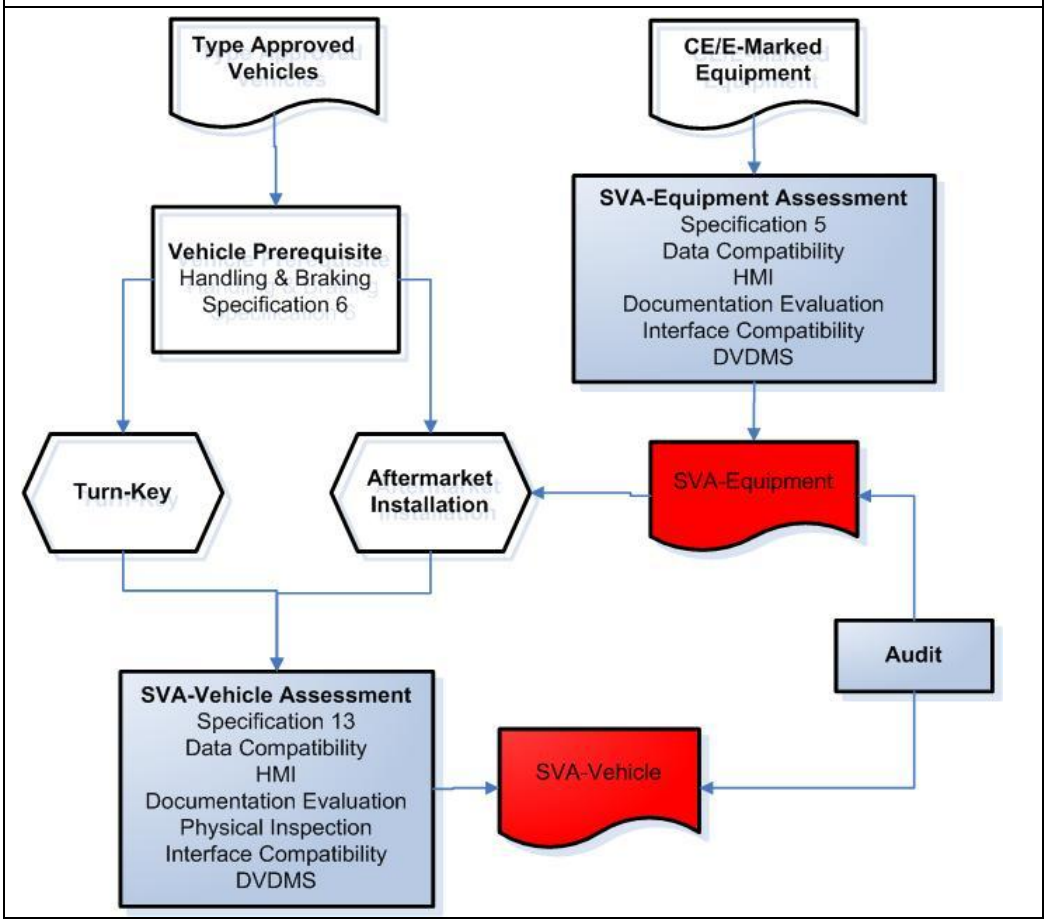
- Requisition of a vehicle or vehicles
- Requisition of components – installed on vehicle
- Check vehicle installation quality for compliance with criteria
- Notification of Compliance/Non-Compliance statement

Phase 2 – Component Test Programme

- Requisition of components for testing (OEM Component Certificates)
- Carry out performance and environmental testing (aftermarket only) – to include communication to and from the SOC
- Verification of OEM Component Certificates
- Notification of Compliance/Non-Compliance

Phase 3 – Review and Final Notification

- Final notification to the manufacturer and CAST of level of compliance with the OBSVA criteria



3.7 Management of Failures

In the event of failure, the Applicant shall be notified of the areas of non-compliance by the accredited test house. The Applicant may then do one of the following:

- Withdraw from the Compliance Procedure indefinitely;
- Rectify the system under test with modifications to documentation, installation or system within one month incurring no penalty. Areas of non-compliance shall then be retested. The retesting fees shall be charged to the Applicant; or
- Restart the testing process, incurring the full or part test fee as required by the test house, within six months.

3.7.1 Minimisation of Failures

In order to achieve a steady progression of the submitted OBSVA for evaluation through the Compliance Procedure, the Applicant shall observe the following guidelines:

- Ensure the return of the Request for Evaluation form and fee;
- Complete the initial Questionnaire comprehensively;
- Read and understand the specifications thoroughly;
- Conduct extensive validation prior to submission of the system in order to establish high confidence that the system will comply. Failures shall delay the progression of the evaluation, and may lead to enforced delays of two months before work may continue;
- Ensure that samples are identical to those in production;
- Check samples functionally and visually before submission. Physically non-compliant samples shall be rejected at an early stage. Samples shall be properly marked;
- Check that all documentation is complete and accurate – only correct drawings and instructions shall be accepted. Failure to provide adequate and complete documentation in the correct format shall delay testing and shall constitute non-compliance; and
- Ensure that manufacturing quality of samples is satisfactory. Poorly manufactured samples shall be rejected immediately.

If retesting is requested as a result of non-compliances, this can extend the duration of the evaluation significantly and the Applicant will incur associated retesting fees. These will be charged at normal accredited test house rates, supplemented by an administration charge.

3.7.2 Timings

Assuming no non-compliances at any Phase or Phases, the evaluation process timing shall normally be expected to be within four to six weeks. It shall be stressed that this is based upon good system performance combined with timely and accurate support from the Applicant.

3.8 Administrative and Technical Documentation

3.8.1 Documentation to be Submitted at Each Test Phase

Correct and complete documentation is a prerequisite of testing at each of the Phases 1, 2 and 3. It may also be required on request in the event of a system or random audit following Listing.

All documentation submitted shall be in English.

All documentation shall be submitted to the accredited test house in either paper or electronic format.

The following documentation, normally one copy of each item unless otherwise indicated, shall be submitted to the accredited test house no later than the commencement of the appropriate Phase.

3.8.2 Phase 1

- Request for Evaluation form.
- Parts Submission Warrant (OEM only).
- Supporting documentation as specified in Questionnaire.
- System/vehicle fitment plan (matrix).
- Part test fee as specified.
- Test plan (agreed by CAST before testing can begin).

3.8.3 Phase 2 Vehicle Test

- User Instructions, as required in the appropriate section of the OBSVA criteria.
- Vehicle-specific Installation Instructions.
- Part test fee, as specified.

3.9 Phase 2 Component Test

- User Instructions (as requested in the appropriate section of the OBSVA criteria).
- Special Operating Instructions for the system under test samples. These shall include commissioning procedures, use of any vehicle emulation or diagnostics equipment, data transmission protocol, timing diagrams/flow charts, decoding of data/batch codes on labels, vehicle functions (aftermarket only).
- General Installation Instructions for the system under test. These may be in draft form, the definitive version being submitted subsequently. The Installation Instructions shall meet the requirements laid down in the appropriate section of the OBSVA criteria.
- Part test fee as specified.
- Certificate of Compliance for OBSVA criteria parts (OEM only).

The system parts list shall include: description, manufacturer, part numbers, and issue level and software revision.

The electronic documentation shall be provided in indexed format. There shall be a register of the items included in the (aftermarket only) Technical File.

Electronic technical aftermarket documentation submitted shall be provided with the name of the manufacturer, component identification, drawing/document number and date. Component issue levels shall be clearly specified.

Part numbers, descriptions, issue levels and dates shall be clearly marked on all drawings.

Part numbers shall permit complete traceability as to the build level and date of manufacture of the system under test.

All documents shall be complete, clear and legible.

All items of documentation shall be consistent with the system under test.

All drawings shall be originals or, where produced electronically, certified copies.

3.10 Aftermarket Components Submitted for Evaluation

The evaluation shall be conducted in accordance with the Compliance Procedure and the OBSVA criteria on the aftermarket system test samples submitted to accredited test house by the Applicant. The Applicant shall ensure that any samples of the aftermarket system under test that are submitted are representative of series production and shall confirm this to the accredited test house in writing.

Submitted samples of components constituting the aftermarket system under accreditation testing shall include all the items listed in these criteria and shall include any optional equipment.

For the purposes of the evaluation, one complete and fully functional sample of the aftermarket system under test shall be submitted. Additional components may be requested for the purposes of component substitution. All necessary simulation and diagnostics equipment shall be provided if requested. Connected systems shall be such that monitoring of all outputs is straightforward.

The aftermarket system under test shall be visibly marked with the following information:

- the system under test manufacturer's name or trade mark;
- the model number or name;
- component part number;
- linked components, for example, cameras; and
- serial number, batch number or date of manufacture of the system.

In addition, each component of the aftermarket system under test containing software shall be labelled with the software version, number or code. This may be implicitly identified within the main part number.

There shall be directions provided for decoding data/batch codes and software revision levels.

Replacement or additional components shall be readily made available on request during the evaluation.

An audit trail of component samples submitted as part of aftermarket system accreditation testing shall be supplied on request by the Applicant to the accredited test house for quality control system monitoring purposes, if required.

3.11 Testing

3.11.1 Performance and Environmental Test Regime

The components of the OBSVA shall be tested in accordance with the test methods and parameters laid down in Chapter 2 – System Requirements and Specifications, which support this standard. These practically validate the system and components for security, safety, reliability, functionality and documentation.

For OEM systems, the performance criteria for success shall be the same as applied for other OEM systems, or parts fitted to that vehicle.

A test and evaluation strategy plan will be available once the test houses and facilities are in place.

3.11.2 Section 1 Testing

Components to be tested in Section 1 include:

- SVA control equipment;
- power management systems;
- fixings;
- brackets;
- protective shields;
- audible or visible indicators for change of status;
- wiring harnesses;
- connectors;
- fuses; and
- additional/optional equipment.

3.11.3 Failure Modes, Changes of State and IP Rating

The OBSVA shall operate without failure or change under the following conditions.

Changes of state of the OBSVA are considered to be:

- operation or non-operation of other output signal such as radio transmission, audible or visible indications;
- Enclosure protection and wiring:

- resistance to foreign objects and water ingress BS EN 60529 to a minimum level of IP54 for internal use and IP65 (IP66 would be preferable) for outside of the vehicle (for example, roof mountings);
- resistance to impacts; and
- resistance to tensile forces applied to wiring and connectors.

3.11.4 Performance and Environmental Testing Failure

A failure is considered to be an inadvertent change of state, or non-functioning status following the test, depending on the test. A failure is also considered to be mechanical or electrical damage, which may lead to subsequent failure at a later time.

Failure in accreditation, audit or dip testing shall result in a report to CAST, which shall consider remedial action, issuing a warning or de-Listing the relevant system.

3.12 Compliance Verification and Term of Validity

3.12.1 Quality Assurance

The Applicant shall:

- demonstrate the existence of production procedures for effective quality control of the proposed OBSVA system;
- ensure that production test result data are recorded and results remain available for a minimum of seven years;
- analyse the results of each test in order to verify and ensure the consistency of the OBSVA characteristics, making allowance for permissible variations in industrial production;
- ensure that for each type of OBSVA, the tests prescribed are carried out on a statistically controlled and random basis, in accordance with the regular quality assurance procedures;
- ensure that any set of samples or test pieces giving evidence of non-conformity in the type of test in question shall give rise to a further sampling and test; and
- take all necessary steps to ensure OBSVA conformity of the corresponding production as rapidly as possible.

3.13 Name Changes or Additions

The following shortened procedure shall apply if the Applicant has requested the Listing of an OBSVA system, the name of which has been changed or to which an additional name has been given with respect to a previously existing, accredited and Listed system.

The Applicant shall submit:

- a Request for Evaluation form;
- a completed Questionnaire;

- supporting documentation as specified in Questionnaire;
- a signed statement that the submitted OBSVA is identical to the existing compliant system;
- User Instructions;
- Installation Instructions;
- the appropriate fee; and
- (if requested) one complete sample of the name change/addition system for inspection (aftermarket only).

A Phase 2 test programme shall be required if the system or vehicle application is considered dissimilar. This shall be at the discretion of the accredited test house, which shall conduct a comparison of the submitted name change sample against the original reference sample. Subject to a satisfactory evaluation by the test house, the system shall normally progress as per the normal Compliance Procedure.

If it is established that the system is not simply a name change or addition based upon an identical system, then the system shall be regarded as a new system and shall require to be progressed through the complete evaluation procedure.

The maximum number of name changes for OBSVA, for both aftermarket and where the rebrands reflect the names of vehicle manufacturers, which shall not normally be limited.

3.13.1 Branding of Systems by Vehicle Manufacturers or Adding Additional Vehicle Models (Original Equipment Manufacturer Only)

The following shortened procedure shall apply if the Applicant has requested the Listing of an OBSVA system, the name of which has been revised due to the system being offered for fitment to vehicles from a different vehicle manufacturer or to new vehicle models with respect to a previously existing Listed system.

The Applicant shall submit:

- all documentation and components as specified in the section on name changes/additions in the application form; and
- an explicit statement from a qualified representative of the vehicle manufacturer or importer, requesting or giving permission to this name change/addition in the branding of the vehicle manufacturer.

Subject to a satisfactory evaluation by a test house, the system shall normally progress through to Phase 3 as per the normal Compliance Procedure.

In addition to the inclusion of the OBSVA system or component name in the system list section of the Notification List, there shall also be a limited listing in the vehicle manufacturers' fitment policy section, specifying the fitment of the OBSVA system or component on vehicle models, referenced against start and end dates and specifying whether the system is fitted on an optional or retro-fit basis.

If it is established that the system is not simply a name change or addition or that it is a new OEM vehicle model based upon an identical system, then the OBSVA

system shall be regarded as a new system and shall require to be progressed through the complete evaluation procedure.

3.14 System Derivatives

A system derivative is a system that has only minor changes with respect to a previously validated aftermarket system. Examples of acceptable derivatives may have depopulated circuit boards or other such minor variations. Also considered to be system derivatives are similar systems that are defined as 'build to specification' or 'build to print' from second source suppliers.

More complex systems, such as those with enclosure changes or significant component or circuit board modifications, are not normally considered to be acceptable system derivatives for these purposes and as such shall be treated as new systems.

The testing of an OEM or aftermarket system derivative may realise some economies in test timings and fees, although these are to be set by the test house and as such, cannot be guaranteed. CAST reserves the right to oversee the level of validation that is deemed appropriate for any system derivative. This shall normally be considered and defined at Phase 1.

If the Applicant requests to have an aftermarket derivative of an OBSVA system that has previously been issued with a Phase 3 Notification of Compliance included on a Notification List, then the following shortened procedure shall apply.

- The Applicant shall submit a short Technical File for all aftermarket OBSVA systems, describing any and all changes from the original OBSVA or systems submitted for testing. Any additional information supporting the application may be included in the Technical File.
- The Technical File shall be accompanied by one complete aftermarket OBSVA criteria sample with a statement relating this derivative system to an existing compliant system. For build to print variants, drawings shall be identical.
- At the discretion of the accredited test house, an agreed, shortened test may be acceptable. The test house may require further samples to be submitted on request, along with any outstanding items of documentation specified.
- If it is established that the aftermarket OBSVA system is not simply a system derivative based upon a very similar system, then the OBSVA system shall be regarded as a new OBSVA system and shall require to be progressed through the complete evaluation procedure.
- Appeals by the Applicant over system derivatives will be forwarded to CAST for a final decision, which shall be binding upon both the Applicant and the accredited test house.

3.15 Documentation Available to Applicants

Applicants may request the following documents from CAST:

- a Request for Evaluation form;

- the SVA criteria;
- a Questionnaire;
- schedule of fees from accredited test houses;
- the Performance Test Specifications;
- test documentation;
- the Terms and Conditions;
- a OEM Parts Submission Warrant (part of the OEM Questionnaire); and
- the approval process.

3.16 Schedule of Evaluation Rates

The cost of the evaluation depends upon the classification of the submitted OBSVA system.

Details of current fees are available directly on request from accredited test houses.

The quoted rates are based upon testing of a single system, requiring one vehicle inspection and one set of system samples. Costs may be higher for more complex submissions, based on multiple vehicle inspections and multiple system variants, combinations or optional components. These must be clearly defined before Phase 1 compliance is issued.

Accredited test houses may reserve the right to charge for additional meetings and consultations during the course of the evaluation that are considered to be above and beyond what is considered to be reasonable. This may possibly attract an administration charge.

The accredited test houses reserve the right to change rates charged for evaluation without prior notice, following notification to CAST. The exact rate or rates can be confirmed prior to application from specific accredited test houses at a specified Phase. All rates must be paid prior to the start of the evaluation Phase. A submitted OBSVA system shall not be Listed as OBSVA compliant until all outstanding rates are paid in full.

3.17 Reporting

3.17.1 Evaluation Progress Reports

The outcome of the evaluation shall be reported at the end of each of the four Phases, indicating either compliance (including partial) or non-compliance. During testing, the accredited test house, at its discretion, may issue periodic reports to the Applicant indicating progress and failures. It should be noted that accredited test houses are not obliged to issue interim reports on request. The final report at Phase 3 shall be submitted to CAST. On approval of the report, CAST shall instruct the accredited test house to issue a Certificate of Partial or Full Compliance. The accredited test house shall communicate the contents of the reports only to the registered Applicant or Applicants, meaning nominated secondary representatives.

The Phase 3 Certificate of Partial or Full Compliance report shall specify an alphanumeric code, known as the accredited test house Evaluation Number, which shall be specific to a Listed system. It shall take the format of:

- code letter for test house;
- ASS – Generic type of system;
- i – major Issue level of specifications;
- n –internal Evaluation Number;
- mm – Month of first Listing;
- yyyy – Year of first Listing, for example, 2010.

This code is unique to a specific Listed system and shall be quoted on Certificates of Installation and in any formal correspondence.

The accredited test house will also prepare a factual summary report of the key functionalities provided by each device in accordance with the OBSVA criteria to be included within the List to assist potential purchasers. The list of functionalities will be sufficiently generic to ensure that security benefits are retained.

3.17.2 Period for the Notification of Compliance

The evaluation shall normally be completed by issuing a Phase 3 Notification of Partial or Full Compliance statement within six months of the Application being submitted. The Notification of [Full or Partial] Compliance shall be issued by CAST, following notification by the accredited test house. If during the tests it is found that the requirements are not met so that at the end of the complete evaluation or individual phase, no Listing of the system under test can be granted, the Applicant shall be contacted as soon as possible. This may result in the extension of the complete evaluation period as estimated.

3.18 System Changes

The Applicant shall have a nominated representative or officer responsible for documenting all changes made to the OBSVA system in its lifetime. The representative shall consider the effect of each modification with respect to the ongoing compliance of the system. It should be stressed that if a modification gives rise to non-compliance or non-compliances at the system or random audit stage, the Applicant shall be liable to incur further test costs, possibly leading to the temporary or permanent deletion of the system name from the List.

The Applicant shall carefully monitor any modification to the system, installation or documentation for potential non-compliance with the OBSVA criteria. This shall include software changes. Each such proposed modification shall be reported in the following format to CAST, on request. The modification shall be reported in advance of its implementation if likely to affect compliance. The following documentation shall be submitted to CAST:

- a Request for Evaluation form, specifying modified OBSVA;
- the appropriate evaluation fee;

- a brief description of the modification concerned and, at the request of the accredited test house, submission of the system, installation or documentation as modified;
- drawings of the components or installation as modified; and
- the original drawings of the component or installation on which the modification concerned has been indicated, clearly showing all amendments, additions and deletions. All modifications shall be completely and accurately numbered and dated.

Upon evaluating the modification on the basis of the information supplied, CAST may refer the matter to the accredited test house for advice before informing the Applicant as to whether or not the modification concerned can be implemented in the production process by an administrative assessment without performing further testing, or whether a complete or partial revalidation shall be required, to be carried out at the expense of the Applicant, to demonstrate continued compliance. CAST will then update the List.

It is the responsibility of the Applicant to raise changes to the attention of CAST if they may be judged to affect the compliance of the approved OBSVA system with the OBSVA criteria. The Applicant shall also have the responsibility to control changes that may be made by installers in the field when fitting or servicing the OBSVA system. If it is found that installers are changing the system in the field, leading to non-compliances, then the Listing of the OBSVA-compliant system shall be at risk. This control of changes will be subject to audit at random and via pre-planned inspections by the designated inspection authority, CAST or its accredited agents.

3.19 Publication

CAST will publish the names of those systems accredited as meeting the requirements defined by the OBSVA criteria. These systems will be included in a Notification List of recognised, accredited systems, hereinafter referred to as 'the List'. An OBSVA component, system or piece of equipment shall be added to the List following the issuing of a Notification of Compliance statement by the accredited test house.

The List shall normally be updated four times a year or at more frequent intervals, if circumstances require. CAST shall solely determine the frequency and means of publication. The List shall normally be made available to the emergency services, trade bodies, manufacturers and/or importers, installation companies and other relevant interested parties.

3.20 One Box Single Vehicle Architecture Criteria List

Any information contained within the List may then be utilised as required by public authorities and, if it is relevant, to systems installed, as standard by vehicle manufacturers.

There are a number of sections incorporated within the List, principally to aid and benefit potential purchasers and manufacturers. The systems are divided into classifications depending on the type and level of equipment available, together with any fitment policy. A brief explanation of any special features of a system that may be supplementary to the base requirements is included. Vehicle manufacturers' systems are cross-referenced against fitment policy on vehicle models and model variants.

Systems will be entered onto the List and they will be described as having full or partial compliance with the OBSVA criteria.

Systems that fail the accreditation process will not be entered onto the List.

3.21 Use of the Names – Centre for Applied Science and Technology, Accredited Test Houses and Association of Chief Police Officers

The Applicant shall be permitted to use the name of the Home Office CAST or the accredited test house subject to the following provisions:

The Applicant may use only this statement or these statements, which may be reviewed at a later date in relation to the compliant OBSVA system:

- 'Complies with/meets the CAST OBSVA criteria for the fitting of equipment to emergency service vehicles.' OR
- 'As evaluated/assessed by the accredited test house for the testing of compliance with the Single Vehicle Architecture criteria for the fitting of equipment to emergency service vehicles.'

In particular, the Applicant may not use, without the specific authority of the relevant organisation or organisations:

- the figurative mark or logo of the Home Office CAST or the accredited test house unless permitted to do so;
- the name or designation of ACPO or its related working groups or business areas;
- the figurative mark or logo of ACPO or its related working groups or business areas; OR
- 'CAST, accredited test house [Name of test house], ACPO, approved' or any similar form of words.

The Applicant shall be obliged to submit electronically to CAST for review purposes proofs of all publications, including advertisements, leaflets, packaging materials and labelling, which use the names of CAST and/or ACPO. If the publication is not in compliance with the required stipulated provisions, CAST or the accredited test house shall issue a written statement prohibiting its use and shall enforce its ruling, which if not resolved may ultimately result in the product and the company being removed from the List.

If the Applicant should become non-compliant or fail to comply with the OBSVA criteria and consequently the Notification of Compliance should be withdrawn, the Applicant shall no longer be permitted to use any form of the names of the Home Office CAST, the accredited test house, ACPO or any of the statements specified above.

3.21.1 System Quality Audit

Throughout the ongoing Listing of an OBSVA system on a Notification List, the accredited test house will periodically audit the total system, as Listed, by means of repeat inspections.

For the purposes of the repeat inspection, the Applicant for an aftermarket OBSVA shall be required to comply with the quality control audit trail procedure through the accredited test house upon request.

Alternatively, the accredited test house can select samples at random from production or from distribution locations.

During the repeat inspection, an investigation shall be conducted to determine whether OBSVA systems being manufactured still conform to the OBSVA system as originally accredited in accordance with the Compliance Procedure, and whether these systems still comply with the OBSVA criteria.

A total system (as distinct from model) audit shall normally be conducted at two-yearly intervals to ensure that the quality and consistency of the system is maintained. The audit will be carried out every two years, from the date of first Listing, irrespective of any additional vehicle models (OEM only) tested between times. The audit may also apply to the vehicle installations of Listed systems (aftermarket only). The audit will consist of full function test as defined in the criteria. In addition, for OEM only, resubmission of the Parts Submission Warrant form will be required.

The process of auditing and associated costs shall be agreed between the accredited test house and CAST. These costs shall be met from charges levied by the accredited test house on the Applicant.

3.21.2 Audit Process

An external visual examination of components to compare the quality and construction against the reference sample held by the accredited test house shall be carried out. This shall include an examination of User Instructions and Installation Instructions.

A series of functional tests shall be performed in accordance with the Performance Test Specifications.

The manufacturer of the aftermarket OBSVA system may be asked to demonstrate which version of software the randomly-chosen sample incorporates and to provide a complete listing on request.

Provided that the construction and software of the audit sample is unchanged from the original test sample and the requirements of the appropriate functional tests have been met, a short report shall be filed indicating continued compliance.

If changes are found during the visual examination software audit or functional tests, the Applicant shall be informed. In order to demonstrate continued compliance, further testing may be conducted at the expense of the Applicant. Failure to agree with the testing will cause the Notification of Compliance to be withdrawn and the aftermarket OBSVA system to be removed from the Notification List with immediate effect.

It may be necessary to conduct any other tests that the accredited test house deems appropriate in order to assess specific changes to OBSVA systems.

If the sample examined does not correspond to the reference sample held by the accredited test house, is not compliant with the aftermarket OBSVA criteria or fails to meet the requirements of the tests performed, then the accredited test house shall have the right with immediate effect to forbid the Applicant from

continuing to use the name of the accredited test house, the OBSVA name and other designated statements, as specified in the Compliance Procedure. If the non-compliances are of a serious nature, significantly compromising safety, security or reliability, or the system has been changed out of all recognition, then the non-compliant OBSVA system or part thereof shall be de-Listed immediately.

In this event the Applicant shall:

- investigate immediately whether or not the method of production or the materials used show any irregularities. If this is the case, the Applicant shall correct these as quickly as is practicable;
- send a written report to the accredited test house on the investigation conducted, the conclusions thereof and the corrective action taken; and
- have the test that was performed with negative results repeated at the Applicant's expense on additional – normally three – samples from the same production series.

If requested samples pass the repeat inspection successfully, the temporary denial of the use of the 'names', as specified in Section 3.21 shall be cancelled. At this stage the accredited test house may request a name change for the system to differentiate it from potentially non-compliant previous samples. This may also apply to other forms of misrepresentation of the aftermarket non-compliant OBSVA name in the field.

If one or more of these requested samples fail to pass the tests successfully, then ACPO, CAST and the accredited test house shall continue to deny the further use of the name as detailed in Section 3.21 and other designated statements. The Listing on the Notification List shall then be withdrawn.

If the Applicant completely ceases to manufacture or market a type of system in accordance with these criteria, the Applicant shall inform CAST in writing immediately. As long as the OBSVA system remains accredited, it may remain on the List as detailed by Section 3.20. Otherwise, the name of the system and associated details shall then be deleted from the Notification List.

3.21.3 Random Audit

In addition to the annual system inspections, the accredited test house may perform tests on Listed systems obtained independently from the field. The accredited test house shall inform the Applicant of any negative results of such random tests, and the procedure as defined in Section 3.21.2 shall be initiated.

The process of random auditing and associated costs shall be agreed between the accredited test house and CAST. These costs shall be met from charges levied by the accredited test house on the Applicant.

3.22 Warranty, Notification Incidents and Performance Information

Information on warranty incidents, to include, failures, accidents, interference, and de-Listing of companies, shall be supplied to CAST monthly, free of charge, from the accredited test house or its designated agent. These will be collated to monitor the take-up and use of the system. If the warranty or incident levels on a specific system or by a specific organisation are demonstrated to be high, then

the Applicant shall be contacted to implement remedial action. After six months from this date, if no significant improvement has been observed, then CAST shall give consideration to withdrawing the Notification of Compliance and deleting the system from the List. This will be subject to a process of appeal.

3.22.1 Misrepresentation of Listed System Name

All Listed systems shall have easily identifiable and recognisable names. It shall not be possible for an organisation or user readily to confuse these names with similar names or non-compliant or unrecognised systems. If it is found that a Listed name is being misrepresented or may be readily confused with an unrecognised name, then consideration shall be given to withdrawing the Notification of Compliance and deleting the system from the List.

3.22.2 Discontinuation of Production

If the production or availability of the OBSVA system is discontinued at any time, the Applicant shall be required to inform CAST and/or the relevant accredited test house as soon as possible. The List shall be amended to note the equipment being out of production but still accredited to the OBSVA criteria for a period of no more than two years.

3.22.3 Withdrawal of the Notification of Compliance

If the Applicant fails to adhere to the Terms and Conditions of the Compliance Procedure, the Notification of Compliance shall be withdrawn with immediate effect. All systems falling under these circumstances shall be removed from the List managed by CAST, which shall under normal conditions give 28 days' notice of removal from the List. At the discretion of CAST, this period may be reduced. Under certain circumstances, CAST may decide to issue a suspension of recognition of a Listed OBSVA system prior to investigations, which may result in removal from the List, or alternatively may lead to reinstatement of the full Listing. If the Applicant wishes to regain a Listing of the system in a compliant form, the Applicant may, at the discretion of CAST, be permitted to re-enter the Compliance Procedure at an appropriate point and at the Applicant's own expense.

If the Notification of Compliance is withdrawn from a previously compliant OBSVA system in circumstances where there is considered to be a significant safety or security risk associated with the system, then CAST shall immediately issue a bulletin clearly drawing attention to the system deletion to all relevant parties.

3.22.4 Renewal of the Notification of Compliance

Subject to meeting the requirements of Section 3 above, the OBSVA system shall continue to be Listed. The Listing shall normally continue to be valid for a minimum of two years following the deletion of the criteria issue against which the OBSVA system was originally tested. Specifically, a random audit may be conducted against any OBSVA system (see sections 3.21.1, 3.21.2 and 3.21.3). Additionally, continued Listing shall be subject to an audit and annual Listing fee.

3.23 Certificate of Installation for Permanently Installed Original Equipment Manufacturer or Aftermarket One Box Single Vehicle Architecture

The installer shall supply to the system user for each installed OBSVA a Certificate of Installation specifying as a minimum the following information:

- vehicle make;
- vehicle model;
- vehicle registration number;
- vehicle identification number (VIN);
- OBSVA system name;
- OBSVA system model or part number;
- test house evaluation reference;
- date of installation;
- name of installation technician;
- dealer name;
- dealer signature; and
- certificate serial number.

For an upgrade system, the Certificate of Installation shall state clearly the name and test house Evaluation Number of the identified original classified system, complementary to the upgrade.

The Certificate of Installation is required only for permanently installed aftermarket OBSVA. It is not applicable to temporarily installed OBSVA.

3.24 Audit and Annual Listing Fee

Each product system Listed will be subject to an audit and annual Listing fee, the rates of which shall be listed in the CAST schedule of charges. This fee will cover any ongoing audit of the systems, administration of information on usage, faults and random audit inspections.

The annual Listing fee is mandatory and is required to ensure ongoing quality control and standards are maintained following initial testing. This is essential to maintain confidence in the system.

Failure to pay the fee will result in removal from the List and may require retest or administration fees to be paid prior to reinstatement onto the List.

Partial compliant systems will be required to be fully retested every year and therefore will not be part of the audit and re-Listing process. This both recognises those manufacturers that have achieved full compliance but also provides a time-limited option for those manufacturers wishing to work towards that aim.

3.24.1 Liability

CAST, ACPO and accredited test houses and their associates accept no liability, howsoever arising, for any personal injury, loss or damage caused by any of the systems or services that may, from time to time, be supplied having been Listed as compliant with the OBSVA criteria.

3.25 Acknowledgements

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