UTMC-TS003.003:2009

UTMC Framework Technical Specification

10 December 2009

Cover + 29 pages

Foreword

This document, UTMC Technical Specification 003 version 3 (TS003.003:2009), was prepared by the UTMC Technical Secretary with the support of the UTMC Development Group and the Department for Transport (DfT). It forms part of the range of UTMC specifications and updates the previous versions of the Framework Technical Specification, TS003.002:2008.

TS003.003:2009 presents the core technical standards recommended for use by UK traffic managers in their systems. There is only one minor substantive change from TS003.002:2008: the addition of an explicit statement on data compression (clause 6.5). The principal change is presentational, in that the majority of the non-normative annexes of TS003 have been removed and republished as separate technical guidance (TR) documents.

This document should be used in conjunction with the other main repository of UTMC technical recommendations, namely the UTMC Objects Registry, TS004. TS004 is under continuous review and update, while TS003 is intended to be stable for several years at a time.

Copies of all UTMC documentation, together with background material and other information, can be found on the UTMC website at: http://www.utmc.uk.com.

Please note: (1) Compliance with this specification does not of itself confer immunity from or compliance with any statutory or legal obligations. (2) Whilst DfT strongly supports the adoption of UTMC specifications, such specifications are not mandatory.

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1 Introduction

1.1 General

1.1.1 TS003 [1] specifies a framework of applicable standards for Urban Traffic Management and Control (UTMC) systems, which will provide a cost effective and flexible means to manage transport in urban areas to support a wide range of transport policy objectives. The UTMC framework facilitates integration of transport systems, and enables information to be provided to system for traffic management and as a means of influencing traveller behaviour.

1.1.2 TS003 has been developed to promote open systems and interoperability of components within UTMC systems. As far as possible, it utilises readily available open standards and makes maximum use of relevant international initiatives.

1.1.3 This document specifies, in the form of a framework, requirements for UTMC systems which will provide a cost effective and flexible means to manage transport in urban areas to support a wide range of transport policy objectives. It will facilitate integration of transport systems and make available information as a management tool and as a means of influencing traveller behaviour.

1.2 Evolution

1.2.1 The UTMC philosophy is to enable the framework to evolve over time in a way that balances the need for clarity with the opportunity for innovation. The UTMC Development Group (UDG), under authority delegated by DfT, is responsible for the management regime for this framework (see Annex B).

1.2.2 The majority of TS003 consists of references to mainstream industry standards. While every attempt is made to keep this document up to date, users should be aware that standards may be superseded and/or withdrawn by their controlling organisations.

1.3 Intellectual Property Rights and usage of this document

1.3.1 Intellectual Property Rights in the UTMC Technical Specification are protected. Those proposing changes shall be deemed to acknowledge and accept this, and to accept responsibility for ensuring that there are no third party IPR claims on the proposed change.

1.3.2 Anyone can make free use of this Specification, whether system/software developer or user. Users may freely cite clauses of this document when procuring systems. There is no obligation arising upon use.

1.4 Document approach and structure

1.4.1 TS003 is composed of numbered clauses and subclauses, which form the normative elements of the specification. The titles of each clause are listed in the contents list. This document incorporates, by reference, provisions from specific editions of other publications (Normative references) and other publications that provide information or guidance (Informative references). These references are cited at the appropriate points in the text.

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[1] In this volume, TS003 means TS003.003:2009 unless the contrary is specified.

1.4.2   The following annexes are included.

   Annex A: Normative Reference Documents: a list of all normative documents referenced in this document.

   Annex B: Management authority for this document: a statement of how this document is maintained and where questions relating to its provisions or updates should be addressed.

1.5   Definitions

1.5.1   The following definitions apply to this document:

Application: Software hosted on UTMC components and infrastructure to implement UTMC functions.

Application message: messages used to transfer data between applications within UTMC systems and between UTMC systems and external systems.

Architecture: a document describing the Components of a specific UTMC system, and the interfaces between them, specifically indicating the parts of this Technical Specification which are implemented in each interface.

Authority: local or central government or other body responsible for a UTMC system.

AVL: Automatic Vehicle Location, a system that determines the position of vehicles and communicates it to a control centre, where their movement can be processed and used in control decisions.

BER: Basic Encoding Rules, a standard way of arranging information in a data structure.

BSI: British Standards Institution, the UK's national standards body. Copies of European and international standards may be obtained through BSI.

CCTV: Closed-Circuit Television.

CDR: Common Data Representation, a standard way of arranging information in a data structure.

CEN: Comité Européen de Normalisation, the European Standards body. CEN functions via a series of Technical Committees (TC), with TC278 being responsible for transport telematics.

Communication protocol: A set of rules or procedures governing the transfer of data from one point to another.

Component: Any equipment connected to the UTMC infrastructure. Components can be either instation or outstation components. Components in a UTMC system may be supplied by more than one manufacturer.

CORBA: Common Object Request Broker Architecture, a technical framework for object-oriented programming suited to the open interconnection of systems.

CVIS: Cooperative Vehicle-Infrastructure Systems, a generic term for systems which involve communications between in-vehicle and on-street components.

DATEX: A European initiative to standardise information exchange between Traffic Management centres. Two voluntary standards were published in 2000 but these have since been overtaken by DATEX II (qv).

DATEX II: A European project to update the DATEX specifications, initiated by the European Commission.

DSRC: Digital Short Range Communications, a term for a number of radio communications protocols designed specifically with local vehicle-to-infrastructure links in mind.

ETSI: European Telecommunication Standards Institute, a European standards body which serves the general telecoms industry.

External system: Systems that are not formally part of an individual UTMC system, but may exchange information with the UTMC system. An external system has no direct contact with UTMC outstations.

FEP: Front End Processor, a system which acts as an interface between a central application and a distributed set of units (eg detectors or controllers). FEPs may be used to manage communications, translate data protocols, provide security etc.

FTP: File Transfer Protocol, an internet protocol for the transfer of files across a network.

Functionality: The nature of what an application or component does within itself (cf interface).

Functions: Defined transport related activities performed by a UTMC system. Functions are implemented by single or multiple Applications hosted in single or multiple Components on the UTMC infrastructure.

GIOP: General Inter-ORB Protocol (GIOP), a CORBA protocol.

GML: Geography Markup Language, the XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features.

GPRS: General Packet Radio Service, a data communications service which enables internet protocol networks to communicate across GSM systems.

GSM: Global System for Mobile communications, the standard for cellular telephony across Europe (and much of the rest of the world).

HTML: Hypertext Markup Language, the language used for describing the layout of web pages. HTML scripts are exchanged over HTTP (qv) as are related protocols such as XML and GML.

HTTP: Hypertext Transfer Protocol, the transport layer for exchange of a wide range of data types over TCP/IP networks, including HTML and XML.

ICMP: Internet Control Message Protocol is a messaging and service management protocol for IP.

IDL: Interface Definition Language, used for specifying CORBA interfaces.

IETF: Internet Engineering Task Force, the global body responsible for managing internet protocol standards.

IHL: Internet Header Length, a parameter used in internet protocol communications.

IIOP: Internet Inter-ORB Protocol, the standard used to enable CORBA services to run over internet protocol networks.

Information: Processed data to meet the needs of authorities or travellers.

Interface: The technical means by which one application, component or element of a UTMC infrastructure connects to others, through communications and information exchange.

Instation: Collection of UTMC components and applications based in an indoor environment. Instations will typically be regularly manned.

IP: Internet Protocol, the network protocol used within the internet and most private systems networks. IP provides for addressing as well as the structure of the "packets" into which data is split prior to communication.

ISO: International Standards Organisation, the global body for general standards. In Europe (including the UK), CEN standards have primacy over ISO standards. Other global bodies manage standards in specific areas (eg ITU, IETF).

ITS: Intelligent Transport Systems, ie any information or communications systems used in a transport context.

ITU: International Telecommunications Union, the world telecommunications standards body.

LAN: Local Area Network, a means of enabling computers to exchange data within a local area (usually within a building).

Message: Package of information created for the purposes of communications between components or between applications.

MIB: Management Information Base, a data structure used as part of the SNMP protocol.

MIB-II: Managed objects for the internet suite of protocols as defined by RFC1213.

Module: A group of components, applications or elements of a UTMC infrastructure subject to separate procurement, against specifications for functionality and interfaces. A module may be a single product or package of several products.

MPT: Ministry of Post and Telecommunications, an old-style Government term which remains in the reference number of some radio standards.

NTCIP: National Transportation Communications for Intelligent Transport Systems (ITS) Protocol as prepared by the NTCIP Joint Standards Committee and referred to the ISO.

OASIS: Organisation for the Advancement of Structured Information Standards, open industry-led body responsible for development of standards such as UDDI and development of XML-based services

Ofcom: The Office of Communications, the UK's regulatory body for telecommunications service providers.

OID: Object Identity, a global reference number for data Objects.

OMG: Object Management Group, an international grouping of systems developers that maintains CORBA.

Open standards: Standards in the public domain. Two kinds of 'standards' are distinguished: de jure (created in a formal legal manner by standardisation body, eg ISO, CEN, or BSI), and de facto (specifications that gain near-universal adoption, eg Microsoft Windows). Some standards are administered to be open by a user group or committee rather than a legal standards body – see under IETF, W3C, and OMG.

ORB: Object Request Broker, an automated service which matches data and function providers to applications which require them, under the CORBA architecture.

OTU: Outstation Transmission Unit, field-based equipment that communicates with the transport controller within a UTC network.

Outstation: UTMC components and applications based in the field. Outstations will not normally be manned.

PDU: Protocol Data Unit, a data element in an internet communication.

Physical interface: Physical and electrical interface types - connectors, signal levels, device addressing schemes etc.

PMR: Private Mobile Radio, a radio based network which is wholly owned and managed within an organisation (as opposed to public radio services such as cellular telephony).

PPP: Point-to-Point Protocol, links two permanent points enabling IP transport of data.

Product: A package of components, applications or elements, with or without associated services, offered for sale to potential implementers of UTMC systems, and possessing specifications for functionality and interfaces.

PSTN: Public Switched Telephone Network, the general term for the systems used to link telephones. Generally this refers to the fixed network of landlines and switches, rather than mobile telephony systems.

RFC: Request For Comment, used as the description of internet 'standards' by the IETF.

RTTE: Radio & Telecommunications Terminal Equipment.

SCOOT: Split Cycle Offset Optimisation Technique, a real time adaptive control system for linked signal junctions.

SGML: Standard Generalised Markup Language, a "metalanguage" used to define languages and embodied in the international standard ISO 8879. XML and HTML are both implementations of SGML.

SLIP: Serial Line Internet Protocol, an access protocol primarily designed to allow PCs to access the internet using a modem although this technology has now been surpassed by PPP.

SMTP: Simple Mail Transfer Protocol, a protocol for the sending and receiving of emails via IP.

SNMP: Simple Network Management Protocol, a protocol for enabling automated interrogation of relatively simple unmanned systems by a central management application, over an IP network.

SOAP: Simple Object Access Protocol, an XML language used to make requests for service and receive the response.

SQL: Structured Query Language is employed for accessing databases.

STMF: Simple Transport Management Framework, see following.

STMP: Simple Transport Management Protocol, a transport-specific variant of SNMP designed to minimise communications requirements. STMP is defined within a framework called STMF (qv) as part of the US NTCIP project. Now generally avoided in favour of SNMP itself.

SUPS: Simple UTC Protocol System, a protocol defined within the UTMC research programme to enable a single UTC instation to communicate with a number of FEPs, and thereby to use diverse outstations.

SVD: Selective Vehicle Detection, an application which can identify subsets of 'target' road users (eg public transport, emergency services) with a view to giving them priority at junctions etc.

TCP: Transmission Control Protocol, the primary transport protocol for IP networks. TCP is a handshaking protocol, ie the receipt of packets is acknowledged: see UDP.

TETRA: Terrestrial Trunked Radio, a European standard for digital radiocommunications, principally geared to PMR.

TOS: Type of Service, a parameter in internet protocol systems.

Traffic and Travel Data Dictionary: The data dictionary prepared by the DATEX Task Force and referred to CEN.

Traffic Management System: Any collection of components and applications deployed for the purposes of managing and controlling road traffic in a specific area, whether or not it complies with the UTMC Technical Specification.

TTL: Time To Live, describing how long a piece of data will remain valid.

UDDI: Universal Description, Discovery and Integration – an XML language used to catalogue Web Service providers.

UDG: UTMC Development Group, the organisation responsible for day to day management of the UTMC Technical Specification and associated support activities. The UDG is a community body including both highways authorities and private sector suppliers of systems/services.

UDP: User Datagram Protocol, an important transport protocol for IP networks. UDP is a non-handshaking protocol, ie the receipt of packets is not acknowledged and the sender will not know whether his messages have arrived at the receiver: see TCP.

UHF: Ultra High Frequency, radio waves in the frequency range 300MHz-3GHz.

UTC: Urban Traffic Control, a system which manages the traffic signals across a sizeable area. UTC systems involve a range of algorithms; see SCOOT.

UTMC Object: A specific coherent structure of data, registered for public use at the UTMC Objects Registry. UTMC Objects may be defined to several different standards for use by different technology systems.

UTMC Objects Registry: The repository of UTMC Objects and other semantic elements of the UTMC Specification, managed on behalf of the UTMC community and recorded in TS004.

UTMC infrastructure: Basic UTMC system services that support components and applications, such as communication services, database management systems, operator interfaces etc.

UTMC system: an integrated Traffic Management System (qv) that conforms to the requirements of the UTMC Technical Specification.

UTMC Technical Specification: TS003 and TS004 taken together.

VHF: Very High Frequency, radio waves in the frequency range 30MHz-300MHz.

VMS: Variable Message Sign, a controlled sign usually fitted to the roadside, and giving dynamically controlled information to road users.

W3C: The World Wide Web Consortium, an open organisation of developers responsible for developing and maintaining web applications standards including XML, WSDL and SOAP

WAN: Wide Area Network, a means of enabling computers to exchange data outside a local area (for example around the UK).

Web Services: a set of industry standards, using XML, which allow applications to share functionality and data with other applications connected by a network.

WSDL: Web Services Description Language – an XML language used to describe services that are available.

XML: eXtensible Markup Language – a language for describing data in a simple ASCII Text document. XML, like HTML, is a specific implementation of SGML.

XML Schema: Used to define an XML language in terms of tag names, data types and formats. The schema is itself an XML document.

2 UTMC compliance

2.1 Interface compliance

2.1.1 The primary intention of UTMC Technical Specification is to facilitate the interoperability of modules in a Traffic Management System, and between such systems and external parties. In this regard:

a) A specific interface in a Traffic Management System may claim to be a "UTMC compliant interface" if all communications across it are conducted using the technical standards of TS003 sections 4-8, conveying only registered UTMC Objects as listed in TS004.

b) An interface may claim to be an "extended UTMC compliant interface" if it uses the technical standards of TS003, and the data it conveys are in the structure of registered UTMC Objects wherever they are available.

2.2 UTMC compliance of Products and Systems

2.2.1 Products may have a number of interfaces, and a Traffic Management System may be constructed from a number of Products configured in a particular way. It will not always be necessary or efficient for all of these interfaces to be UTMC compliant interfaces, in order to meet the primary goals of facilitating interoperability. Thus, the "UTMC compliance" of a Product or System is not a simple yes-or-no property.

2.2.2 Nevertheless, it is recognised that suppliers and traffic managers would value the ability for Products and Systems to be assessed against the UTMC Specifications and, if appropriate, their compliance recognised. To this end, the Department for Transport is currently working towards the establishment of a suitable monitoring and assessment regime for Products and Systems.

2.3 Statutory and legislative compliance

2.3.1 All UTMC systems, their components and applications shall conform to all relevant UK and EU statutory or legislative requirements.

2.3.2 The European Procurement Directive 2004 includes specific regulation on the use of standards in procurement specifications.

2.4 System Certification

2.4.1 UTMC systems should be tested and accepted in line with standard good practice for integrated systems. The Highways Agency publication TA84 may be helpful in this.

2.5 Compliance and procurement decisions

2.5.1 The UTMC Specifications are guidelines only, which document a consensus technical approach to modular Traffic Management Systems. Procurement decisions must continue to be made in accordance with procurement regulations.

2.5.2   Specifically, the UDG does not currently police compliance claims, and it is a matter for individual buyers to establish the evidence of compliance that they require from their suppliers.

2.5.3   Similarly, while suppliers and users may refer informally to "UTMC products" or state that "X is UTMC compliant", it must be recognised that this is at best a convenient shorthand. The only technically valid, and testable, statements would be that "product X has UTMC-compliant interfaces as follows…".

3 Architecture

3.1 Introduction

3.1.1 A UTMC system shall have a documented Architecture which includes a schedule of Components and the communications links between them. In documenting this Architecture the following reference models may be usde:

a) The Logical Reference Model of section 3.2;
b) The Functional Reference Model of section 3.3.

3.1.2 Each interface between Components of a UTMC system shall be clearly identified in the Architecture, and shall be compliant with this UTMC Technical Specification. The communications characteristics of the interfaces shall reflect the functional and physical requirements of the links, in respect of volumetrics, latency/timeliness, security, resilience, operational management and cost.

3.2 Logical Reference Model

3.2.1 The Logical Reference Model describes a UTMC system as a series of interconnected nodes (see figure 3-1).
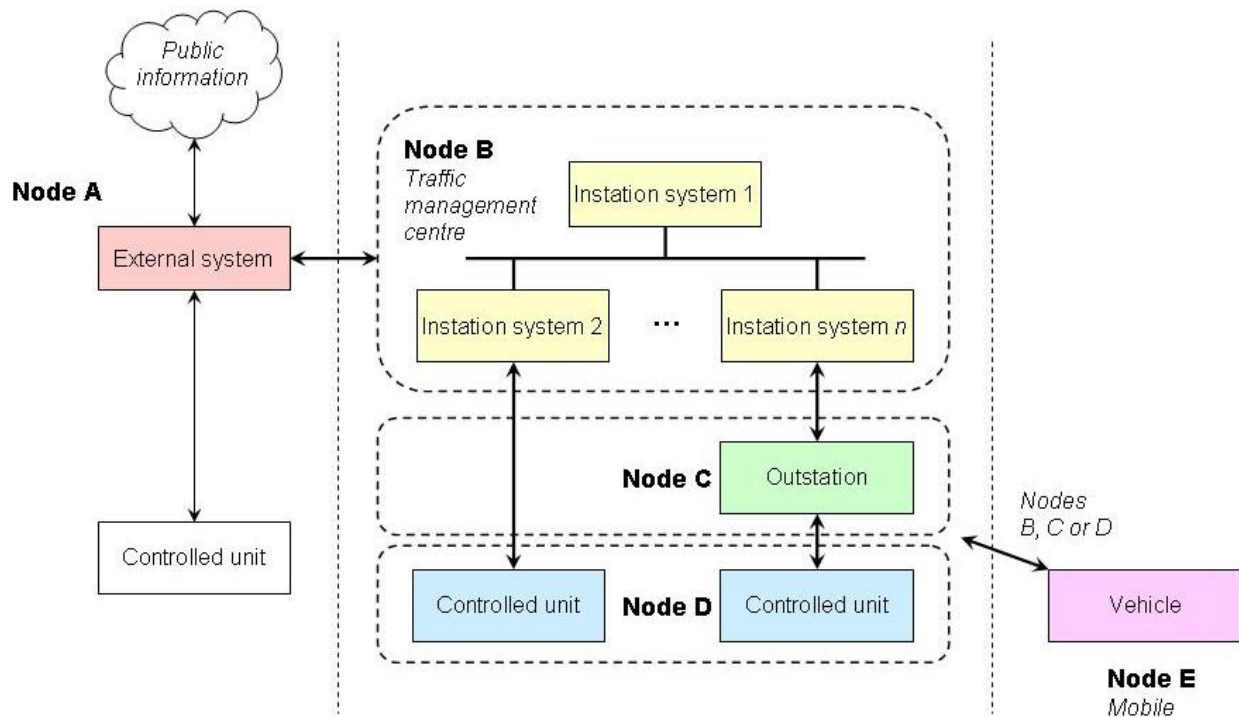

Figure 3-1: The Logical Reference Model for a UTMC system

3.2.2 UTMC nodes are defined as:

a) Node A: external systems which connect via Node B;
b) Node B: UTMC management centres;
c) Node C: UTMC outstations;

     d)   Node D: UTMC controlled units; and

     e)   Node E: mobile units which have an external connection to the UTMC system via Nodes B, C or D.

3.2.3   Node A includes other UTMC systems, public transport management systems, emergency service central systems, travel information systems, etc.

3.2.4   Node B may be physically distributed in several locations, but shall act as a single logical node. Node B will typically host a range of components and applications, including databases.

3.2.5   Nodes C may be capable of acting autonomously taking higher level control decisions. Nodes C may be permanent or temporary installations.

3.2.6   Nodes D cannot act autonomously. They may be under the control of:

     a)   Node A: either directly over a provided communications channel, or more likely mediated via Node B;

     b)   Node B: either directly, or indirectly mediated via node C;

     c)   Node C: acting autonomously, in which case it will normally inform Node B of its actions.

3.2.7   Nodes D may be permanent or temporary installations.

3.2.8   Nodes E principally relate to in-vehicle systems, including selective vehicle priority "tags", tolling units, electronic vehicle identification systems, and CVIS. They may range from simple passive units to sophisticated units with local processing power.

3.2.9   Components at Nodes A and E are outside the UTMC system. However the data exchange channel is an integral part of the system, which must be agreed with the operators of these Nodes.

3.2.10   Node A and Node E are usually under different management control from Nodes B-D, although:

     a)   An LA-provided travel information system would probably be treated as Node A;

     b)   A council vehicle configured to act as a network probe would be treated as Node E.

3.3   Functional Reference Model

3.3.1   The elements of the Functional Reference Model are:

     a)   User interface;

     b)   Applications;

     c)   System management services;

     d)   Communication services.

3.3.2   Applications may have local, private databases or data caches associated with them.

3.3.3   A UTMC system may host non-UTMC applications. These may be wholly independent of the UTMC system (eg office software residing on a control workstation) or not (eg legacy traffic management systems interfaced into the UTMC system). The Architecture shall clearly identify non-UTMC systems and any interfaces. See also Section 6.1.

3.3.4   Communications services are based on a stack architecture of five levels (see figure 3-2):

a)   *Information Level* – Standards for the data elements, objects, and messages to be transmitted. These are specified in section 5 of this document.

b)   *Application Level* – Standards for the process and structure of information exchange, and of session management. These are specified in section 6.

c)   *Transport Level* – Standards for data packet subdivision, packet re-assembly, packet error detection and retransmission, and routing. These are specified in section 7.

d)   *Sub-network Level* – This level provides standards for the physical interface and the data packet transmission method). These are specified in section 8.

e)   *Plant Level* – Standards for the physical transmission media. These are also specified in section 8.

3.3.5   A physical Common Database, providing a repository of data relevant to multiple applications, may be implemented but is not mandatory. (See also Section 6.3.) A valid alternative is the direct exchange of data between Applications using UTMC formats and protocols.
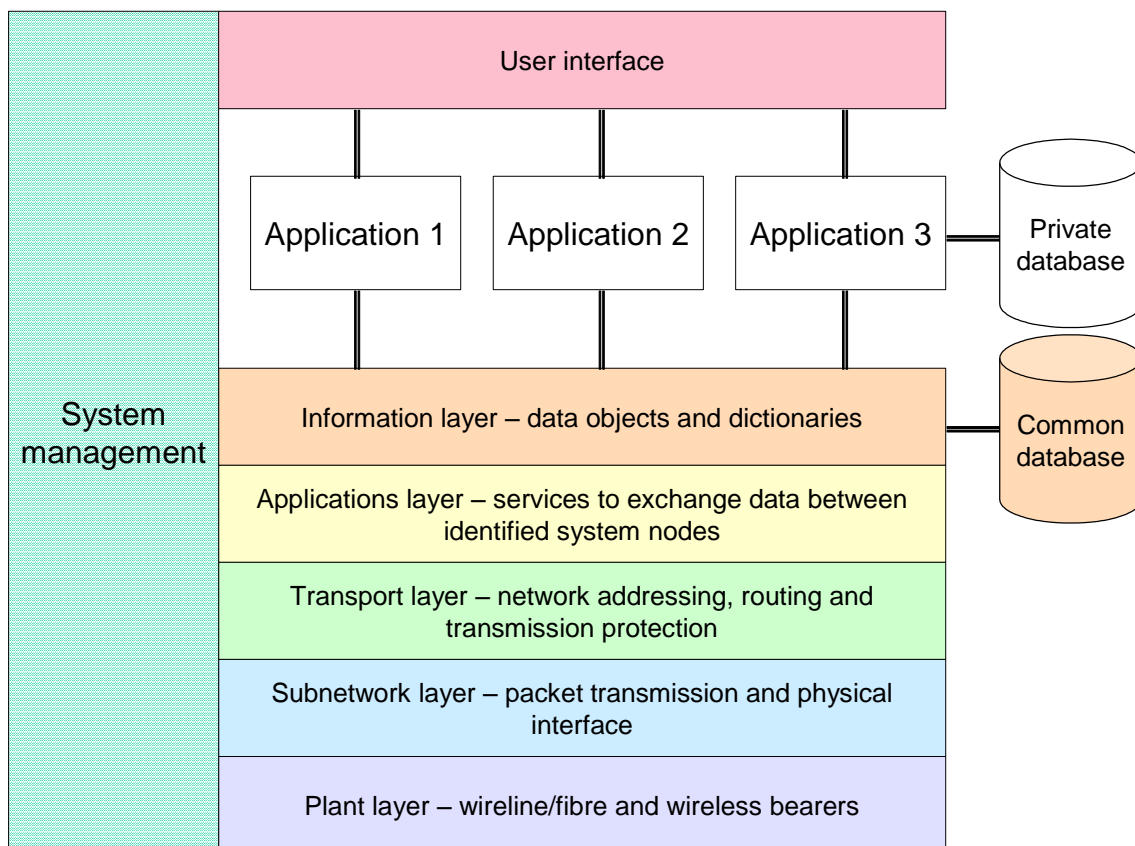

Figure 3-2 – Functional Reference model for a UTMC system

4 Human-Machine Interface

4.1 User Interface

4.1.1 A UTMC system shall have a consistent user interface to configure and control applications at Node B. A user interface may also be available at Nodes C.

4.1.2 Nodes A and E are external to the UTMC system and may have their own user interface. Where direct control access to Node A or Node E applications is provided, this may be achieved:

    a) via remote applications within the UTMC system, passing control requests across Node A/ Node E links;

    b) via direct access to the remote application through a suitable user interface, such as a browser window, which is logically outside the UTMC system (but which shares the UTMC communications network);

4.1.3 The user interface for every application should be available from all operator terminals, where applicable.

4.1.4 The user interface for every application shall provide user authentication and access control for security purposes.

4.1.5 The UTMC user interface shall operate over a common and suitably open operating system. The programming interface will normally be one of the following:

    a) Browser interfaces based on HTML and extensions;

    b) Microsoft™ Windows™, Win 32 API;

    c) X/Open standards, X/Window and X/Terminal.

4.1.6 Any programming language or development environment may be used for the UTMC user interface.

4.2 System Management Services

4.2.1 The following system management facilities shall be provided as a minimum:

    a) Management/monitoring to ensure the operational status of components and communication links; and

    b) Facilities to configure components and communication links.

4.2.2 System management facilities shall be provided as part of the Node B network operating system. Where components of a UTMC system require to be managed centrally, a suitable standard device management protocol shall be used. The preferred standard is SNMP.

4.2.3 System management facilities for the configuration of remote networking components and communication links shall comply with SNMP as specified in RFC 1157 and its successors.

5 Information level standards

5.1 General

5.1.1 Data communicated across an interface between modules separately procured in the development of a UTMC system, or between a UTMC system and an external system, will be subject to contractual specification. If UTMC compliance is desired, all such data will need to be constructed as registered UTMC Objects (see section 2). Data communicated within a module of a UTMC system is not required to follow this Technical Specification.

5.1.2 UTMC Objects are used to specify both the data content and the transaction structure of a UTMC data exchange. Object definitions address the following aspects:

   a) object structure and 'packaging' information;
   b) units and coding standards for parameter values;
   c) source and destination;
   d) data quality measures.

5.1.3 A UTMC Objects Registry, TS004, has been established as a companion to this document. This Registry maintains an open list of approved UTMC Objects of all types, and is subject to continuous review. The procedure for registering and using UTMC Objects, and the current list and definitions of registered UTMC Objects, may be obtained from the contact points in Annex B.

5.2 Types of UTMC Object

5.2.1 A UTMC Object shall be of one of the following types:

   a) Database Objects.
   b) XML Objects.
   c) MIB Objects.
   d) Services.

5.2.2 UTMC Objects, and their exchange processes, shall be specified in a suitable standard specification language. Acceptable languages include:

   a) UML, for data modelling and abstract Objects;
   b) Tabular description in spreadsheet form (particularly for human-readable descriptions of Database Objects);
   c) XML Schema (particularly for XML Objects);
   d) Abstract Syntax Notation 1 ASN.1 (particularly for MIB Objects);
   e) IDL (for Services applicable to CORBA environments);
   f) WSDL (for web Services).

5.2.3 **Database Objects** are units of information. They were developed primarily for use between applications within Node B, and between Nodes B and C, via the Common Database. They may also form the basis of the message content for other transactions (eg VMS messages to Node D or flow reports to Node A). In information systems terms, these are "entities" with "attributes".

5.2.4 A data model is recommended. This should be compatible, as far as possible, with relevant international standards. In particular there are two European initiatives which are recommended as a basis for developing UTMC Objects:

a)   DATEX II v1.0, which covers the road domain excluding public transport.

b)   Transmodel (EN12149), which covers the public transport domain.

5.2.5   ***XML Objects*** are transaction structures for the exchange of data over XML/HTTP. They are intended primarily for exchanges between Node B and Node A, but may also be used within Node B (between applications or to user screens) or, where bandwidth is sufficient, over other links. XML Objects will be XML schemas.

5.2.6   ***MIB Objects*** are frameworks for local information management in managed devices. They are Management Information Bases (MIB) and are intended specifically for use over SNMP. Their primary role is seen as between Nodes B/C and D, though they may be applicable to other contexts too (eg to Node E where applications involve reading in-vehicle tags, such as access control).

5.2.7   ***Services*** are frameworks which establish the protocols of data exchanges between Components. This would include IDL scripts for CORBA environments, as well as Web Service descriptions based on WSDL/SOAP etc.

6 Application level standards

6.1 General data exchange

6.1.1 UTMC systems provide a platform and a range of services to users. In many cases it will be desirable to use this platform to host non-UTMC systems. This need not compromise the UTMC system itself, but it does need to be carefully distinguished for system management purposes.

6.1.2 "General data exchange" is the exchange of information which is either not related to the traffic management function (eg finance systems, internet browsing or office documents), or which is traffic-related but not required or intended to be integrated into a management information system (eg informal traffic-related messages exchanged via email). General data exchange may be achieved through:

a) automated system-to-system exchange;
b) user information access, at one of Nodes A, B, C or E;
c) user messaging;
d) user initiated file transfer.

6.1.3 In each case, system designers should assure themselves that sharing physical platforms and communications is efficient and not likely to compromise the performance or integrity of the UTMC system. In the case of relevant but non-integrated applications, system designers should assure themselves than integration (and therefore a non-UTMC solution) is not appropriate.

6.2 UTMC specific data exchange

6.2.1 "UTMC specific data exchange" comprises the exchange of UTMC Objects.

6.2.2 Any UTMC Objects may be exchanged using a suitable XML schema over HTTP.

6.2.3 MIB Objects shall be exchanged using the Simple Network Management Protocol (SNMP) as specified in RFC1157 and its successors (and associated documents)[2].

6.2.4 A CORBA-compliant object brokerage service used to exchange UTMC Objects shall use the Internet Inter-ORB Protocol (IIOP) over TCP/IP.

6.2.5 In the case that it necessary to use a null or proprietary applications layer communication protocol (for example, because of limitations in the capacity of a communications bearer), the communications link shall be regarded as embedded in a component. In this case, an interface shall be provided as near to one end of the communications link as practical which utilises a suitable open applications layer protocol.

6.3 Common Database and Data Services: Applications Interface

6.3.1 A UTMC Common Database may be implemented using a middle tier Applications Server between UTMC applications and the database server. A UTMC Common Database Applications Server shall be based on either XML/HTTP or CORBA or both.

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[2] Earlier versions of SNMP (v1 and v2) provide weaker security mechanisms and later versions are preferred, although it should be noted that UTMC MIBs may not all be available for SNMP v3.

6.3.2   A UTMC Common Database Applications Server shall offer query and subscription services. The interfaces offered by the UTMC Common Database Application Server shall be based on suitable approved Interface Definition Language (IDL) scripts and/or XML schemas, as appropriate.

6.3.3   All user visible names (tables, columns etc) must be as given in the logical data model for the system; this will normally be the entity, field etc name from the relevant UTMC Object in TS004. Names which are normally hidden from the user (constraints, indices etc) may follow any rational scheme.

6.3.4   All datatypes should be SQL92 compliant equivalents of the generic types expressed in the logical data model.

6.3.5   A Common Database will normally be based on a relational database management system. Integrity constraints (or triggers) should be used to enforce referential integrity of the expressed relationships. Good practice in database design (for instance, regarding the use of indices) and operation (for instance, regarding account management and database administration) shall be followed.

6.4   Applications Service Interfaces

6.4.1   The interface between Applications, or between an Application and a Common Database, shall use agreed written specifications for relevant service features. These specifications may include aspects such as:

a)   Whether 'push' or 'pull' delivery (or both) is to be adopted.
b)   'Granularity' of the blocks in which data may be requested or provided.
c)   Applications-level triggers and handshaking protocols for data exchange.
d)   Application-to-application authentication.
e)   Directory services.
f)   An assessment of likely data exchange volumes.
g)   Conditions on acceptable delivery, for instance on timeliness.

6.4.2   The interface specifications for both "push" (subscription) and "pull" (direct request) within CEN SIRI (CEN/TS15531-Part 2) are recommended as suitable for UTMC systems that use XML/HTTP as a data exchange protocol.

6.4.3   The documentation provided from time to time by the Travel Information Highway (TIH) initiative is recommended as an additional source of good-practice guidelines.

6.5   Data compression

6.5.1   The use of data compression technologies is recommended where it can assist in rendering the transmission of data faster and/or more cost-effective.

6.5.2   Where compression of HTTP content (including XML) is enabled, it should include the option of gzip (following RFC 1952) as a minimum. Compression format must be specified in the HTTP header with the 'Content-Encoding' parameter. Where a particular compression scheme is not supported, the HTTP response status code of 415 should be used (following RFC 2616).

6.5.3   Compression is required for ANPR Camera and Instation implementations where UTMC XML is used. Camera and Instation implementations should use the 'Accept-Encoding' HTTP header to indicate the supported compression schemes.

7 Transport level standards

7.1 Communication protocols

7.1.1 For communications between nodes, UTMC systems shall utilise the Internet Protocol (IP) as specified in RFC791 and associated documents.

7.1.2 IP addressing may be dynamic or static, depending on the local needs and policies. IP addresses of units connecting externally (ie to Node A or Node E) will normally be static.

7.1.3 For SNMP communications, the preferred transport level standard is the User Datagram Protocol (UDP) as specified in RFC768 and associated documents. Transport control (that is, ensuring that packets have been delivered and resending if necessary) should be achieved end-to-end, at the application level. It is also acceptable to use the Transmission Control Protocol (TCP) as specified in RFC793 and associated documents.

7.1.4 For XML/HTTP and CORBA communications, the transport level shall use TCP.

7.2 UDP and IP usage: the 'typical implementation'

7.2.1 This section presents the preferred build of a UDP/IP implementation for UTMC systems (a 'typical implementation'). Other build are permissible where local economic or technical constraints indicate them.

7.2.2 A typical implementation of UDP shall support the following capabilities:

a) data transfer as specified in RFC 768, page 2 and RFC 1122, Section 4.1.1.
b) port addressing as specified in RFC 768, pages 1 and 2 and RFC 1122, Sections 4.1.1, 4.1.3.1, 4.1.3.5, and 4.1.3.6.
c) checksum as specified in RFC 768, page 2 and RFC 1122, Sections 4.1.1 and 4.1.3.4.
d) MIB-II UDP group as specified in RFC 1213, Sections 3.10 and 6.9.

7.2.3 A typical implementation shall support the following fields as described in RFC 768:

a) source port;
b) destination port;
c) length;
d) checksum.

7.2.4 General Interface requirements are as specified in RFC 768. A typical implementation shall:

a) act upon all ICMP messages as stated in RFC 1122, Section 4.1.3.3.
b) support the UDP to Application Layer Interface requirements as defined in RFC 1122, Section 4.1.4.
c) pass IP options as described in RFC 1122, Section 4.1.3.2. A user-defined IP option is described for use with multiple addressing. This transport profile defines this option.
d) implement and use the checksum as described in RFC 1122, Section 4.1.3.4.
e) provide for UDP Multihoming as described in RFC 1122, Section 4.1.3.5.
f) support the MIB-II UDP group object definitions as defined in RFC 1213, Sections 3.10 and 6.9.

7.2.5   A typical implementation shall support the following capabilities:

a)   data transfer as specified in RFC 791, Sections 1.1 and 2.3.
b)   addressing as specified in RFC 791, Sections 1.4, 2.3, 3.1, and 3.2 and RFC 1122, Section 3.2.1.3.
c)   fragmentation/reassembly as specified in RFC 791, Section 1.4, 2.3, 3.1, 3.2 and RFC 1122, Section 3.3.2, 3.3.3, and 3.2.1.4.
d)   header checksum as specified in RFC 791, Section 1.4, 3.1 (page 14), and RFC 1122, Section 3.2.1.2.
e)   Type of Service (TOS) field as specified in RFC 791, Section 1.4, 3.1, 3.2 and RFC 1122, Section 3.2.1.6.
f)   time-to-live as described in RFC 1122, Section 3.2.1.7
g)   additional options as described in RFC 1122, Section 3.2.1.8, as further modified by this standard.
h)   MIB-II IP group as specified in RFC 1213, Section 3.7 and 6.6.

7.2.6   A typical implementation shall support the following fields as described in RFC 791, Section 3.1 and 3.2:

a)   version number, also as specified in RFC 1122, Section 3.2.1.1;
b)   Internet Header Length (IHL);
c)   type of service (TOS), also as specified in RFC 1122, Section 3.2.1.6;
d)   total length of datagram;
e)   segment identification, also as specified in RFC 1122, Section 3.2.1.5;
f)   control flags;
g)   fragment offset, also as specified in RFC 791, Section 3.2 and RFC 1122, Sections 3.2.1.4 and 3.2.1.5;
h)   time-to-live (TTL), also as specified in RFC 1122, Section 3.2.1.7;
i)   protocol;
j)   header checksum, also as specified in RFC 1122, Section 3.2.1.2;
k)   source address, also as specified in RFC 1122, Section 3.2.1.3;
l)   destination address, also as specified in RFC 1122, Section 3.2.1.3;
m)   IP options, also as specified in RFC 1122, Section 3.2.1.8;
n)   padding;
o)   data.

7.2.7   The procedure calls described in RFC 791, Section 3.3 and RFC 1122, Section 3.1, 3.3.4, and 3.4 shall constitute the Internet/Transport Interface.

7.2.8   A typical implementation shall structure its addresses as a class A, B, C, or D addresses and follow the procedures described in RFC 1122, Section 3.2.1.3 or, optionally, use the Classless Inter-Domain Routing address structure and the procedures described in RFC 1517 through RFC 1520. For use within a transportation system, an IP Address may be allocated from the Private Address Space as described in RFC 1918, Section 3.

7.2.9   A typical implementation providing gateway functionality shall support the functions described in RFC 1122, Section 3.3.1.

7.2.10   A typical implementation shall provide for the requirements as described in RFC 791, Sections 3.1, 3.2, and RFC 1122, Sections 3.2.1.4, 3.2.1.5, 3.2.3, 3.3.1-3.3.7.

7.2.11   For use within the transportation environment, IP shall support a datagram size of at least 576 bytes per RFC 1122, Section 3.3.3.

7.2.12   A typical implementation shall provide:

     a)   the TOS field as specified in RFC 791, Sections 1.4, 3.1, 3.2, and RFC 1122, Section 3.2.1.6.
     b)   the TTL field as specified in RFC 791, Sections 3.1 , 3.2, and RFC 1122, Section 3.2.1.7. This field shall be used as a 'hop counter' as described in RFC 1122.
     c)   the MIB-II IP group object definitions as defined in RFC 1213, Sections 3.7 and 6.6.

7.2.13   Systems using ASN.1 should use Basic Encoding Rules (BER) for transmitting data in accordance with ISO 8825.

8 Subnetwork and plant level standards

8.1 General

8.1.1   The key areas for UTMC standardisation are in the information, application and transport levels. Lower levels will generally be free to adopt appropriate open-source communications technology.

8.1.2   A UTMC system shall utilise appropriate wireline or wireless bearers to meet performance requirements.

8.1.3   The following service and bearer types are recommended, provided they have been properly assessed to meet system-specific performance requirements:

   a)   Established retail offerings from any UK public telecommunications operator.
   b)   Managed network services which are capable of delivering IP networking, provided either by a UK retail operator or under a contracted service level agreement.
   c)   IEEE802 standards including Ethernet (including high-speed variants) and wireless networking protocols, for local area networking.
   d)   Digital Short Range Communications (DSRC).

8.1.4   Where none of these options is feasible or cost effective, other services and bearers may be considered.

8.1.5   The physical interfaces of a UTMC component shall conform to suitable open standards. No specific standards are mandated.

8.2 Use of wireless technology

8.2.1   Wireless links shall, wherever reasonably practical, support full duplex communications. A wireless bearer which is not full duplex shall be permitted provided that a pseudo full duplex service is maintained which is transparent to IP traffic.

8.2.2   Equipment providing a half-duplex air interface but presenting a full-duplex data interface to the user shall provide a 'transmit' buffer of suitable capacity and latency. The buffer shall provide an alert if it is close to full.

8.2.3   All wireless communications equipment deployed within a UTMC system shall either meet the type approval requirements of Ofcom, or be in accordance with the appropriate EuroNorm (EN) specifications for the class of equipment.

8.2.4   Good design practice should be used to ensure that antenna mounting, power emissions and other features provide an end-to-end bit error rate of better than $1:10^4$ under all operating conditions likely to be experienced at each installation site.

9 Safety and security

9.1 Operational safety

9.1.1 All UTMC projects should prepare a safety plan. The extent of safety analysis should be decided by each project individually. The safety analysis should be reviewed periodically throughout the service life of the system and on each and every system/communication network change.

9.1.2 Where the safety plan indicates that the specific project constitutes a "safety critical system" in the sense that a system failure will lead to a direct and immediate safety problem, the detailed technical approach of the international standard IEC 61508 shall be adopted.

9.1.3 In the event of system functional failure, the UTMC system shall degrade safely, following a defined hierarchy of failure modes. A hierarchy of failure modes shall be provided with the system design documentation.

9.1.4 UTMC system and component failures shall be logged, in a non volatile format, and displayed to system operators..Details of the method used to display failure logs, and initiate system alarms shall be defined in the system design documentation.

9.1.5 System alarms shall be initiated in the event of system functional failure. System failure alarms shall be graded in accord with the severity of the failure. Details of the grading of alarms shall be defined in the system design documentation.

9.2 Security and availability

9.2.1 All UTMC projects should prepare a security policy, based on BS/ISO/IEC 27000. The detail of the security policy should be decided by each project individually.

9.2.2 UTMC system design should take care to ensure the security and availability of the information they contain. A UTMC system security policy shall be prepared which describes the approach to be taken, if any, to security in the following areas as a minimum:

    a) Access control processes for user access to applications.
    b) Access control processes for application access to each other and to common data.
    c) Operation using trusted staff.
    d) System design to ensure that capacity, timeliness etc are not exceeded.
    e) Use where appropriate of technical solutions such as encryption, mirrored servers, and non-volatile records.

9.2.3 The security policy should be reviewed periodically throughout the service life of the system and on each and every system/communication network change.

9.2.4 The system security shall be validated against the system security policy.

9.2.5 All interfaces to the Internet shall be protected by appropriate security measures, including the implementation of a suitable managed firewall.

9.2.6 UTMC systems should include a suitable range of security audit tools.

9.2.7 Additional information is provided in Annex G (Informative).

A   References (Normative)

A.1   The following is a list of documents to which normative reference is made in the main text of this document. The standards may be obtained from their controlling organisation, except that ISO and CEN standards should be obtained through national bodies – in the UK, the British Standards Institution (BSI).

A.2   Please note that these standards are subject to update by the relevant authorities.

a)   RFC 768/STD006 – User Datagram Protocol: IETF,1980
b)   RFC 791/STD005 – Internet Protocol: IETF, 1981
c)   RFC 793/STD007 – Transmission Control Protocol: IETF, 1981
d)   RFC 821/STD010 – Simple Mail Transfer Protocol: IETF, 1982
e)   RFC 959/STD009 – File Transfer Protocol: IETF, 1985
f)   RFC 1155 – Structure and identification of management information for TCP/IP-based internets: IETF, 1990
g)   RFC 1157 – Simple Network Management Protocol (SNMP): IETF1990
h)   RFC 1212 – Concise MIB definitions: IETF, 1991
i)   RFC 1945: Hypertext Transfer Protocol -- HTTP/1.0: IETF
j)   RFC 1952 – GZIP file format specification: IETF, 1996
k)   RFC 2013 – SNMPv2 Management Information Base for the User Datagram Protocol using SMIv2: IETF
l)   RFC 2585 – Internet X.509 Public Key Infrastructure Operational Protocols: FTP and HTTP: IETF, 1999
m)   RFC 2616 – Hypertext Transfer Protocol -- HTTP/1.1: IETF, 1999
n)   RFC 2818 – HTTP Over TLS: IETF, 2000
o)   RFC 3411-3418 – SNMPv3 Management Information Base for the User Datagram Protocol using SMIv2: IETF, 2002
p)   RFC 3584 – Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework: IETF, 2003
q)   RFC 4251-4524 – The Secure Shell (SSH) Protocol: IETF, 2006
r)   DATEX II v1.0 Reference Set: DATEX
s)   CEN/EN12896 – Public Transport – Reference Data Model (Transmodel): CEN, 2006
t)   CEN/TS15531 – Service Interface for Real Time Information (SIRI): CEN, 2006
u)   ISO/IEC 8824:1990: Specification of ASN.1, ISO, 1990
v)   ISO/IEC 8824-1/2/3/4:1998 Various enhancements to ASN.1 specification, ISO, 1998
w)   ISO/IEC 8825:1990 Specification of Basic Encoding Rules for ASN.1, ISO, 1990
x)   ISO/IEC 8825-1:1998 Specification of Basic Encoding Rules (BER) Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER). Informative references, ISO, 1998
y)   ISO/IEC IS 10918-1, ITU-T T.81 – Digital Compression and Coding of Continuous-Tone Still Images – Requirements and Guidelines (JPEG): 1992
z)   BS/ISO/IEC 27000 series: Information Security techniques: Code of practice: 2005
aa)   MPEG (various standards): ISO, 1998-present
bb)   UML – Unified Modelling Language: Object Management Group
cc)   XML Schema 1.0 – World Wide Web Consortium: 2001
dd)   CORBA – Common Object Request Broker Architecture: OMG
ee)   SOAP – Simple Object Access Protocol: W3C
ff)   WSDL – Web Service Development Language: W3C
gg)   XML – eXtensible Markup Language and XML Schema: W3C (see also OASIS)
hh)   UDDI – Universal Description, Discovery and Integration: OASIS

A.3   Further information may be found on the following websites:

a)   UTMC: www.utmc.uk.com

b) DfT: www.dft.gov.uk
c) Highways Agency: www.highways.gov.uk. TA084/06 "Code of Practice Traffic Control and Information Systems for All Purpose Roads" is part of the Design Manual for Roads and Bridges (see http://www.standardsforhighways.co.uk/dmrb/vol8/section1/ta8406.pdf).
d) DATEX: www.datex2.eu
e) ISO: www.iso.ch
f) CEN: www.cenorm.be
g) IETF: www.ietf.org
h) OMG: www.omg.org
i) OASIS: www.oasis-open.org
j) W3C: www.w3.org
k) e-GIF: www.e-Envoy.gov.uk
l) TIH: www.tih.org.uk
m) RTIG: www.rtig.org.uk
n) SIRI: www.siri.org.uk
o) TPEG: www.ebu.ch/en/technical/projects/b_tpeg.php
p) Transmodel: www.transmodel.org.uk

B Authority for this Specification (Informative)

B.1   Management authority

B.1.1   The Technical Specification is formally managed by UTMC Ltd on behalf of UTMC Development Group (UDG), a cooperative grouping of local authorities and system suppliers. The UDG is currently the "relevant body" for matters relating to UTMC compliance (see section 2).

B.1.2   Under delegated authority the UDG Specifications and Standards Group oversees developments of this and other UTMC technical documentation and procedures on a day to day basis.

B.1.3   The contact address for this specification, from which the current issue of the Technical Specification and advice on its use can be obtained, is as follows:

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B.1.4   Any changes to this will be published on the UTMC website www.utmc.uk.com.

B.2   National authority

B.2.1   The Highways Agency, an Agency of the Department for Transport, sponsors the UTMC Technical Specification. The contact point within the Agency is:

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B.2.2   The UK Department for Transport endorses the use of the UTMC Technical Specification. The contact point within DfT Centre is as follows:

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