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Date	ITSO Ref.	Editor ID	Nature of Change to this Document (or Part)
Nov 2002	DCI 100 / create v2.1	SLB	Introduce overall terminology, references, scopes etc for the entire Specification. Remove informative portions to Part 0.
Nov 2003		SLB	Collation of new material and updates from Authors and Editors to create 1st CD to accompany the Consultation Drafts of Parts 2-7, 9 10.
Feb 2004		JCH	Implementation of all changes contained in DRC-P1-20040110. Includes comments up to and including TC N0434.
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Feb 2004		SLB	Clean up and format as final draft.
Mar 2004		SLB	Implement final changes and prepare for issue.
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ITSO Technical Specification 1000-1 – Interoperable Public Transport Ticketing using contactless smart customer media – Part 1: General Reference

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Foreword

This document is a part of ITSO TS 1000, a Specification published and maintained by ITSO, a membership company limited by guarantee without shareholders. The membership of ITSO comprises transport organisations, equipment and system suppliers, local and national government. For the current list of members see the ITSO web site www.itso.org.uk

ITSO TS 1000 is the result of extensive consultation between transport providers, sponsors, system suppliers and manufacturers. The Department for Transport (DfT) has also contributed funding and expertise to the process.

Its purpose is to provide a platform and tool-box for the implementation of interoperable contactless smart customer media public transport ticketing and related services in the UK in a manner which offers end to end loss-less data transmission and security. It has been kept as open as possible within the constraints of evolving national, European and International standards in order to maximise competition in the supply of systems and components to the commercial benefit of the industry as a whole. In general, it promotes open standards but it does not disallow proprietary solutions where they are offered on reasonable, non-discriminatory, terms and contribute towards the ultimate objective of interoperability.

ITSO has been established to maintain the Technical Specification and Business Rules required to facilitate interoperability. It also accredits participants and interoperable equipment. ITSO is a facilitator of interoperability at the minimum level of involvement necessary. It will not involve itself in any commercial decisions or arrangements for particular ticketing schemes; neither will it set them up nor run them. It will however “register” them in order to provide the necessary interoperability services (e.g. issue and control of unique scheme identifiers, certification and accreditation, security oversight).

Consequently, adoption of this Specification for particular ticket schemes will be a matter for the commercial judgement of the sponsors/participants, as will the detailed Business Rules and precise partnership arrangements.

Contents

1. Scope

ITSO TS 1000 defines the key technical items and interfaces that are required to deliver interoperability. To this end, the end-to-end security system and ITSO Shell layout are defined in detail; while other elements (e.g. terminals, ‘back-office’ databases) are described only in terms of their interfaces. The business rules that supplement the technical requirements are defined elsewhere.

ITSO TS 1000-1 (this part of ITSO TS 1000) provides a general reference for all Parts of ITSO TS 1000. In particular, it provides a glossary of terminology, a full set of data type definitions and a list of the documents used as references.

1.1 Scope of Part 0

ITSO TS 1000-0 is an editorial compilation of synopses provided by the Authors of Parts 2 – 10 of ITSO TS 1000. It provides a purely descriptive overview of those normative Parts of the Specification.

1.2 Scope of Part 2

ITSO TS 1000-2 defines the ITSO Shell and data storage. In particular it defines:

- The ITSO Shell architecture
- The Customer Media architecture
- The Environment Data Group
- The Directory Data Group
- The IPE Data Group
- The Value Record Data Group
- Log Directory Entries

1.3 Scope of Part 3

ITSO TS 1000-3 defines the requirements on Point Of Service Terminals (POSTs) in order that said terminals are able to support the interoperable smart customer media environment defined by ITSO. These POST requirements are grouped as follows:

- POST to media interface (external interface)
- POST to HOPS interface (external interface)
- POST to ISAM interface (internal interface)
- Human interface
- Functional requirements of the POST software

1.4 Scope of Part 4

ITSO TS 1000-4 defines the requirements of the ITSO Host Operator or Processing System (HOPS).

1.5 Scope of Part 5

ITSO TS 1000-5 describes and defines the data related to ITSO Product Entities (IPEs), specifically:

- IPE data content
- Transient Ticket Log data content

1.6 Scope of Part 6

ITSO TS 1000-6 defines the ITSO message data elements and structures except for messages between the ITSO Security Management Service (ISMS) and ISAMs / HSAMs, which are defined in ITSO TS 1000-8.

1.7 Scope of Part 7

ITSO TS 1000-7 defines the requirements for a Security Subsystem used in ITSO point of service terminals and head office processors. It does not cover the specification of any other, security related functions, outside the management of data flowing between Customer Media (CM), Point Of Service Terminals (POST) and Host Operator or Processing Systems (HOPS), nor does it cover the management of keys and secure devices. The Security Subsystem specified here is designed to be flexible enough to allow for the use of CM that differ in capability and security strategies.

1.8 Scope of Part 8

ITSO TS 1000-8 comprises the ISAM general specification, the ISAM function and command interface, the ISAM Acceptance and Capability Criteria Tables and files, and the additional commands that may be used.

1.9 Scope of Part 9

ITSO TS 1000-9 defines the communications and interface requirements of the ITSO environment.

1.10 Scope of Part 10

ITSO TS 1000-10 provides the Customer Media Definitions (CMDs) that define the mapping of the logical data elements onto a (defined) physical customer media platform.

1.11 Scope of Part 11

This part of ITSO TS 1000 defines the requirements on Remote Point of Service Terminals (POSTs) in order that such terminals are able to support the Interoperable Smart Customer Media environment defined by ITSO. These Remote POST requirements are grouped as follows:

- Remote POST Overview
- Remote POST Interfaces
- Remote POST Functional Requirements

Only requirements that are pertinent to Interoperable Smart Customer Media usage and interfacing to other parts of the ITSO Environment are defined herein. These requirements shall be applied as an Interoperability layer over the basic specification of a web or LAN based ticketing solution. The overall specification of such a solution is outside the scope of this document.

For the avoidance of doubt, the fact that a Remote POST may be certified as ITSO compliant does not mean that it is fit for purpose in any area other than its support for Interoperable Smart Customer Media usage. The design of any Remote POST shall mitigate all appropriate risks identified within the risk assessments for the environment within which it operates.

2. References

The following referenced documents are indispensable for the application of ITSO TS 1000. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) shall apply.

Table 1 - Normative References

Reference	Title	Specification part where the reference may be found								
		2	3	4	5	6	7	8	9	10
ITU-T X.25	ITU-T Recommendation X.25 Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit	✓								
ITU-T V.42	ITU-T Recommendation V.42 Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion	✓								
BS EN 1332-1:2009	Identification Card Systems – Human-machine Interface. Design principles for the user interface		✓							
BS EN 1332-3:2020	Identification Card Systems – User Interface. Key pads		✓							
BS EN 1332-4:2007	Identification Card Systems – Man-machine Interface. Coding of user requirements for people with special needs		✓							
BS EN 1545-1:2015	Identification Card Systems – Surface Transport Applications. Elementary data types, general codelists and general data elements				✓					
BS EN 1545-2:2015	Identification Card Systems – Surface Transport Applications. Transport and travel payment related data elements and codelists				✓					
ISO/IEC 639-1:2002	Codes for the *representation of names of languages — Part 1: Alpha-2 code*	✓								
ISO/IEC 646:1991	Information technology - ISO 7-bit coded character set for information interchangeinformation									
ISO/IEC 12905	Enhanced Terminal Accessibility (ETA) using cardholder preference interface.				✓					
ISO/IEC 13239	*Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures*	✓								
ISO/IEC 14443	*Identification cards - Contactless integrated circuit(s) cards - Proximity cards*	✓								✓
ISO/IEC 14443-2	*Identification cards - Contactless integrated circuit(s) cards - Proximity cards – Part 2: Radio frequency power and signal interface*		✓							
ISO/IEC 14443-3	*Identification cards - Contactless integrated circuit(s) cards -Proximity cards – Part 3:*	✓	✓							✓

	Initialisation and anticollision									
ISO/IEC 14443-4	*Identification cards - Contactless integrated circuit(s) cards – Proximity cards – Part 2: Transmission protocol*	✓	✓							✓
ISO TS 14904:2002	*Road transport and traffic telematics – Electronic fee collection (EFC) – Interface specification for clearing between operators*								✓	

3. ITSO terminology

Table 2 defines the terminology used within the ITSO TS 1000 Environment.

Table 2 - Terms, abbreviations and their definitions

Term	Abbreviation	Definition
Abstract syntax notation	ASN.1	A form of notation used to describe data elements and processes, specified in [ISO/IEC 8824-1]
Acceptance and Capability Criteria	ACC	Formally specified criteria against which the functionality and/or performance of an item may be judged to be acceptable for use in a specified application or, conversely, which can be stated as evidence of functionality and/or performance.
Account		The record of the current value and (truncated) transaction history of a product held on the 'back office' system of the 'product owner'.
Ack Cache		A file to store Secure Acknowledgements (SECACKS) of successfully processed Secure Data Frames
Acknowledge	ACK	A positive 'hand-shake' when exchanging data to confirm receipt back to the sender
Actionlist		A list of items related to ITSO Shell or Product instances, downloaded to POSTs, which shall be actioned by the POST if and when a specific ITSO Shell or Product instance referenced in the list is encountered by that POST.
Ampersand		The "&" symbol shall indicate a concatenation of data elements in the order in which the elements are written.
Anonymous CM		Customer media (CM) that is not linked to a named holder but which bears a traceable serial number (ITSO Shell Reference Number.
Answer to Reset	ATR	As defined in ISO/IEC 7816.
Anti- passback		Anti-passback' is a period of time during which a product may not be presented more than once, and is designed to prevent the deliberate multiple use of a travel permit by multiple users.
Anti-tear		Measures taken to avoid the corruption of data if the CM is removed from the Media Target Area whilst data is being written to the CM.
Anti -tear Protected Area	ATPA	An area of CM data memory which is protected from Tearing.
Anti-tear protection		There are three forms of anti-tear protection: software anti-tear; hardware anti-tear; tear Prevention.
Application		A file structure, directory entries and security scheme loaded onto a CM to perform a particular function.
Apportionment		The process of sharing revenue between companies accepting an interoperable ticketing product (as distinct from reimbursement of concessionary 'top-up' payments).
Asset Management System	AMS	A sub-system of a HOPS that records and manages the disposition status and configuration of ISAMs and HSAMs and some aspects of POST configuration.
Auto-Renew		A POST process by means of which the validity of an expired Ticket is automatically extended.
Auto-Top-Up		A POST process by means of which stored value is automatically loaded into the store held in a TYP 2 IPE.

	ASCII	Specifies a set of control and graphic characters such as letters, digits and symbols with their coded representation, as defined in [ISO 646].
	ATOC	Association of Train Operating Companies.
Bit		A single binary digit.
Business Rules		See ITSO Business Rules
Byte		A value composed of eight binary bits.
Cancellation		An EN1545 (see References) EventTypeCode condition, indicating that the ticket is marked as in use, or has been used, but is cancelled and may not be used again.
Card operating system	COS	The CM-resident programme that controls its input/output, basic functions and data storage.
Card type		The type of interface [ISO 14443] (Type A or Type B) to which the CM conforms. (Strictly applicable only to CMs in ID-1 card format.)
	CEN	The Committee for European Standardisation.
Certified Date		A trusted date received from an AMS or ISMS stored in the ISAM Data file: Coded as data type DATE. (See ITSO TS1000-8 Clause 4.11.25)
Charge to account	CTA	Facility/process for post-billing (rather than pre-payment or payment at the time of purchase).
Check Digit	CHD	This is a single BCD digit, which is calculated to be a check digit for all the preceding digits of the ISRN.
City card		The name given to CM issued by, or on behalf of, a local authority and that carries a variety of applications associated with local services and facilities.
Clearing		The processing and possible consolidation of transaction information passing between the parties accepting products or payments on each other's behalf.
Closed e-purse		An electronic replacement for cash, which may only be used within a single environment (e.g. transport providers).
Closed System		A closed system is one where the Mediaholder presents their CM both on entry to and exit from the system.
CM Acceptance Device	CAD	Card acceptance device as defined in ISO/IEC 7816 and extended by ITSO TS 1000 to include Customer Media (CM) acceptance.
Code		A numeric representation of an item. Typically represented within this document as a decimal number, codes are stored within data fields as hexadecimal numbers.
Compact Shell Compact ITSO Shell		An ITSO Shell in which only a defined sub-set of the data elements are actually present on the media.
Concession		An entitlement to a reduced (or zero cost) fare on the basis of a person's age, condition or status.
Consolidated Data Object	CDO	A data object that consists of a collection of Primitive Data Objects in accordance with ASN.1
Construct		A concatenation of data elements.
Contact Interface		An interface between CAD and CM using physical contacts according to [ISO 7816].
Cryptographic process		The processes carried out by the ISAM to secure data by use of cryptographic algorithms.

Charge To Account	CTA	A Product which allows the holder to pay for travel and services at a later date.
CTA Value Adjustment		When a customer media holder pays part or all of his outstanding CTA balance, held in an IPE TYP 4, then the value held in CumulativeAmount shall be reduced by the amount paid off. This action is known as a CTA Value Adjustment
Customer		A user of ITSO-compliant products.
Customer Media	CM	A Smart Card or other device, compliant with the requirements of the ITSO technical Specifications, capable of containing an ITSO Shell and Products.
Customer Media Definition	CMD	A definition contained in ITSO TS 1000-10, defining a type of Customer Media.
Customer Media Holder Not Present		A Transaction performed, usually via a Virtual Store, where the Customer Media holder and the CM are not physically present at a POST.
Customer Media Interface		The interface between the CM and the CM Accepting Device (CAD).
Customer Media Issuer		Organisation originally issuing the CM (which may be a multi-application card from a non-ITSO member, but accredited by ITSO).
Customer Media Number	CM Number	Every ITSO Shell has a unique ITSO Shell Reference Number (ISRN) and in the case of an ITSO-only CM this shall be the CM number.
Cyclic Log		The Cyclic Log holds records of temporary information such as tickets or events.
Cyclic Redundancy Checksum	CRC	All Cyclic Redundancy Checksum (CRC's) in this Specification are calculated in accordance with [ISO 13239].
Cipher Block Chaining	CBC	A common form of block cipher which uses the previous encrypted block as a basis for encrypting the next block of data. For the first block to be encrypted an Initialization Vector (IV) is required.
Data Element		One data element in a record.
Data Encryption Standard	DES	One of a number of possible standard methods of encrypting data to reduce the possibility of fraud or breaches of confidentiality.
	DF	As defined in [ISO 7816-4].
	DfT	The United Kingdom Department for Transport.
Data Groups		Data Groups; consisting of the ITSO Shell Environment, Directory, IPE, Value Record, Cyclic Log, that partly make up the ITSO Shell. See also Data Structures.
Data Management System	DMS	A computer system for the management of data.
Data Structures		Data Structures; consisting of The Label, The Dataset, The Seal, The Instance Identifier, that partly make up the ITSO Shell. See also Data Groups.
Data Transfer		The passing of information collected at POSTs or generated in the back office system to other devices by a variety of means.
Description		A single byte field describing the contents of a following table or list. Single or multiple tables or lists may be sent within each ISAM data file. The description byte may, if required, be used as a short file ID (see ISO/IEC 7816) for location of the table or list within the ISAM.
Destination		Geographical end point of a passenger Trip
Detached IPE		An IPE Data Group with associated Value Record Data Group, if required, that has been created in the absence of the physical ITSO Shell for which it is destined.

Directory Entry		A data structure within the Directory that acts as a Label for an IPE held within the ITSO Shell.
Directory IPE Map	DIM	A variable length field containing information relating to the structure and location of IPEs within the ITSO Shell.
Document Type Definition	DTD	A Document Type Definition (DTD) defines the legal building blocks of an XML document. It defines the document structure with a list of legal elements and attributes. A DTD can be declared inline inside an XML document, or as an external reference. See also XML.
EEPROM technology		Electrically Erasable Programmable Read-Only Memory.
	EF	As defined in [ISO 7816-4].
Electronic purse		An electronic store of value that may be used for the purchase of goods and services.
Electronic ticket machine.	ETM	A purpose-designed POST that is used for the sale and/or validation and/or cancellation of tickets.
Encryption		The process of modifying data according to algorithmic rules so that it can only be interpreted if the decryption rules are known and the necessary key(s) are known.
Exchange		An EN1545 (see References) EventTypeCode condition, indicating a change of service elements (such as reservations) without changing the terms of the underlying contract.
Exit processing		Reading (and/or writing) CM at the point of exit from a transport facility.
ExpiryDate	EXP	Date after which a Shell or IPE is no longer valid. The following exception shall be noted. Where an IPE of TYP 22 does not contain a Value Group, and contains an ExpiryTime value greater than 1440, then the IPE shall remain valid until ExpiryTime on the day defined by the current Ticketing Date.
Extensible Markup Language	XML	XML is a language used in messaging and was created to enable the structuring, storage, and transportation of information. XML (Extensible Markup Language) is used in ITSO as the transmission method for all messages passed between POSTs and HOPSs. See also Document Type Definition (DTD) in this table 2.
Fare		The price paid for a Journey made by public transport, e.g. Bus or Train.
Firmware		Firmware is software that does not change very often (if ever), e.g. the CM Operating system would be considered as firmware.
Front End Processor	FEP	The point at which raw data from POSTs is initially collected and processed e.g. Depot System.
Fulfilment POST		A POST that is able to handle the unambiguous delivery of Detached IPEs when off-line from central control.
Full ITSO Shell		An ITSO Shell in which all the constituent data elements are present on the media.
Fund		The revenue pool associated with a specific interoperable ticketing product.
Geography		The framework for describing/identifying the area of validity of a product (ticket), the start and end points of a journey or any exceptions to its validity.

Host Operator or Processing System	HOPS	That element of the back office system defined within this Specification, covering message handling, shell & product accounting, and Asset Management functions. The HOPS shall always be equipped with an HSAM.
Hotlist		A list of Customer Media, ITSO Shells, products or items of equipment where a transaction requires special attention.
HOPS SAM	HSAM	HOPS hosted ISAM.
Human/Machine interface	HMI	The interaction between equipment and its users.
Identifier Extension	PIX	As defined in [ISO 7816].
Identity	ID	A collection of information that identifies the named holder of a card.
IIN_Index		A pointer to IIN, occupying less space than the full IIN value, used in space sensitive applications. The values of IIN_Index, together with a cross reference to the relevant IIN values, are defined in ITSO DG0006 available from the (member area of the) ITSO web site www.itso.org.uk .
Instance Identifier		A data string uniquely identifying an entity. In the case where the identified entity is an IPE instance, the data comprises a concatenation of the following in the order shown: Product Owner IIN + Product Owner OID + TYP + PTYP + creating ISAM ID + creating ISAM Seq#.
Interruption		An EN1545 (see References) EventTypeCode condition, indicating that the service was only partially provided.
Intersector Electronic Purse	IEP	As defined in EN1545.
IPE		See ITSO Product Entity.
IPE Data Group		The portion of IPE data which does not normally change, or which is only changed under the control of a trained operator or by equipment that securely holds the customer media in place during the transaction.
IPE Embodiment		A Generic IPE type, Ticket type or Product type. IPE embodiment is Product owner specific. For example, a one day travel card issued by a specific issuer. Embodiments will have a defined issuer and acquirer set. Denoted by IIN, OID, TYP, PTYP and optionally TicketType (or similar field within the IPE,).
IPE Frame		The IPE frame encloses the IPE data within a secured packet. It ensures integrity of data and an audit trail for IPE loading and removal. The frame links the IPE and the ITSO Shell header together such that changes to the data content can be detected.
IPE Shell Retailer		ITSO Role: Business rules and other ITSO documentation define this and other roles.
IPE Type	TYP	IPE data format, identified by TYP.
ISAM		See ITSO Secure Application Module.
ISAM Working Date		A lower bound of the real-time date used by the ISAM when performing ITSO Commands. (See ITSO TS1000-8 Clause 2.5.6)
ISAM Identity	ISAMID	A unique ISAM identifier is made up of the OID of the operator to whom the ISAM is registered and a unique ISAM serial number.
ISAM VAlidity Period		The date range within which the ISAM services can be used. The ISAM Validity period starts on 'Certified Date' and extends for a further 'MAXDAYS' number of days. (See Part 8 Clause 4.11.24 and 4.11.25)
ISO Application Identifier	IAID	AID is defined in ISO/IEC 7816

Issuer Identification Number	IIN	This is a six BCD digit number registered with ISO as a unique global identifier, according to [ISO 7812-1]. Note that ISO/IEC 7812-1 : 2017 revised the IIN from 6 to 8 digits - consequently, ITSO have been issued with an IIN range (63359700-63359799) which enables the current six digit ITSO IIN to continue to be used until such time as the appropriate widespread changes can be made.
ITSO Application		The ITSO Shell.
ITSO Business Rules		Procedures, regulations and codes of practice that govern the use of the ITSO Specification, as set out in the Membership Agreement, Operator's Licence, Supplier's Registration Agreement and any such document as may be approved from time to time by the ITSO Board.
ITSO Compliant		Software or hardware certified by ITSO as being compliant in every way with the Specifications required for interoperability.
ITSO Compliant Scheme		A complete system, wherein one or more ITSO Licensed Members provide services to customers, using ITSO certified Customer Media, fully compliant with, and providing all the elements required by, the ITSO Specification. Provision of some or all elements by third party service providers is permissible.
ITSO Customer Media		See Customer Media.
ITSO Directory		Data structure within the ITSO Shell that specifies the contents and location of those contents
ITSO Host Operator or Processing System	HOPS	See Host Operator or Processing System
ITSO Licensed Member		The holder of a current ITSO operating licence. This term has the same meaning as the operating licence term ITSO Licensee.
ITSO Product Account	IPA	An Account maintained by an ITSO Product Owner relating to a specific, uniquely numbered, ITSO Product.
ITSO Product Entity	IPE	Data Structure used within the ITSO Shell to store formatting and other Product details
ITSO Secure Application Module	ISAM	ITSO Secure Application Module, as defined in ITSO 1000-8.
ITSO Security Management Service	ISMS	A service that provides secure messages to load keys and other security-related parameters of ISAMs or HSAMs.
ITSO Shell		The ITSO Shell is a notional area that holds the collection of all ITSO related data. The ITSO Shell may occupy a given Customer Media (CM) platform exclusively or sit alongside other non-ITSO data collections.
ITSO Shell Owner		ITSO Role: Business rules and other ITSO documentation define this and other roles.
ITSO Shell Reference Number	ISRN	A number that uniquely identifies the ITSO Shell.
ITSO Shell Serial Number	ISSN	This is a seven BCD digit number, in the range 0 – 9,999,999, that Licensed Members shall use to ensure their ITSO Shells are uniquely identified.
Journey		The complete sequence of one or more Trips required to achieve a specific purpose at a specific Destination
Journey History		A record of journeys or transactions made, held in the ITSO Shell or in an account.

Keep Alive Message		A Class 3 message carrying a benign Secure Data Frame, intended only to update the ISAM's Certified Date (formerly known as "DTS Update message").
Key		An alpha numeric string of characters which is used to control access to an application or product, or which is used as the basis of encryption
Key Identity Definition	KID	A single byte coded to indicate the identity of the key used.
Label		A Data Structure: The title of the Data Group, for IPE and Value Record Data Groups the Label is also normally the Directory Entry.
Least Significant Bit	LSB	The binary digit in a string of binary digits that represents the lowest power of 2 in the binary number represented by the string.
Legacy system		A UK smart card system, introduced prior to the adoption of the ITSO Specification, which is operational at the time of issue of this Specification.
Log Directory Entries		An entry in the Directory relating to a Cyclic Log.
Logical ISAM Group		A collection of individual ISAMs; • Are optional but recommended in part 4; • They provide a method of handling 1 or more ISAMs as a single entity; • This is a logical group, i.e. the group is implemented in the back office only, and the ISAM is unaware of the grouping.
Logical POST Set		A collection of POST Sets; • Are optional; • They provide a method of handling 1 or more POST Sets grouped as a single entity; • This is a logical set, i.e. the set is implemented in the back office only, and the POST is unaware of the grouping; • Logical POST Sets may be private in that they are only known to the HOPS which controls them, or may be published to other HOPS for wider application.
Loyalty Scheme		Any Scheme which rewards use through accumulated points which may be exchanged for goods/services or discounted travel.
Manufacturer's ID	MID	A unique number programmed into the media at the time of manufacture that cannot be subsequently changed.
Mediaholder		A person in possession of a valid CM that they are entitled to use as a Customer.
Media Target Area		The active area of the CAD within which the CM functions.
Message Authentication Code	MAC	A computed field based on data in previously stated fields which allows a message to be verified as genuine. ITSO MACs are derived based on all (rather than selected) fields in either the batch header or the Transaction Record.
	MF	As defined in [ISO 7816-4]
Method 1 Diversified CM Access Key		A CM Access Key that is diversified according to ITSO TS 1000–8 Annex A Figure A.2
Method 2 Diversified CM Access Key		A Diversified CM Access Key that uses the ITSO Shell Environment Expiry Date in its diversification algorithm (see ITSO TS 1000–8 Annex A Figure A.6); effectively limiting its validity to that date. This type of key can be used as part of a strategy mitigating the risks associated with Customer Media that doesn’t employ hardware-backed key stores.
Most Significant Bit	MSB	The binary digit in a string of binary digits that represents the highest power of 2 in the binary number represented by the string.
Negative Acknowledge	NAK	A negative ‘hand-shake’ when exchanging data to confirm data was not received from the sender

Nibble		A value comprised of 4 binary bits
"Not On Us" (concept)		Transactions, Shells, Products and messages that do not belong to the entity handling them.
"On Us" (concept)		Transactions, Shells, Products and messages that belong to the entity handling them.
Open e-purse		A secure replacement for cash, which may be used for a variety of purchases (subject to banking or e-money regulations).
Open System		A system where a fixed fare is or toll is paid on commencement of the journey
Operator Identification Number	OID	Number issued by ITSO for unique identification of a participant within ITSO.
Origin		Geographical starting point of a passenger Trip.
Orphan IPE Data Group		These Data Groups, if present, use IPE Data Group structures but are not bound to the ITSO Shell and Directory Data Groups. The Orphan IPE Data Group shall be used with Single IPE ITSO Shells and in the Cyclic Log as required.
Outward		The initial Journey authorised by or made using a Return ticket
Owner		The organisation controlling an application or product and responsible for maintaining parameter tables and account data relating to it.
Padding		A Data Element included in a Dataset where needed to pad out the Dataset to a whole number of bytes or to force the Dataset to occupy a defined data block size" *It's not always at the end and there may be more than one. Also it may be used for two different purposes*
Pass		A special type of pre-defined ticket typically valid for a number of journeys or a number of days
Payment method		The means of payment for a product added to an ITSO Shell or for a transaction undertaken using the ITSO Shell.
Pass or Permit Issuing Authority Cost Centre		A cost allocation code issued by the Pass or Permit issuer for the purposes of identifying the body responsible for funding the said Pass or Permit.
Physical Form Factor		Form factor: technical term used for the shape of an object.
Physical ISAM Group		A collection of ISAMs that are identified by a common ISAM Group (ISG) value[1]: • The ISMS is aware of these groups, and some ISMS functions can be targeted at a Physical ISAM Group as well as to individual ISAMs; • ISG is subservient to the Licensed Member's OID; • They are used in class 3 messages; • They are used for bulk ISAM updates; • This is a physical group, in that the ISAMs are aware that they are part of the group, because they store a physical ISAM group file.
Point of Service Terminal	POST	A terminal where the CM is read/written to as appropriate to add products or value, to check the validity of products or to modify/remove products and or value. A POST contains an ISAM.
Point of Use		Location where an ITSO CM may be used.

[1] The term ISG is defined in ITSO TS1000-8

Positive Acknowledgements	ACK	A message returned to the sender to confirm successful receipt of a message.
POST Set		A collection of POSTs that are identified by a common SETID value: • They are not known to the ISMS; • They are used in class 2 messages; • SETID is subservient to the POST Owner's OID; • They are primarily used for distributing Hotlists, Actionlists and POST configuration data; • This is a physical set, in that the POSTs are aware that they are part of the set; • This is a private set in that it is only known to the HOPS which controls it.
Primitive Data Object	PDO	A Primitive Data Object in accordance with ASN.1
Private Application		An application that resides within the ITSO Shell but which is not subject to the data formats, security or operational rules defined by ITSO for its IPEs.
Product		Any type of IPE issued by an entity that is responsible for how it should be used.
Product Instance		A specific ticket or other product, loaded onto a specific smartcard. Denoted by IIN, OID, TYP, PTYP, optionally TicketType (or similar field within the IPE,), ISRN, ISAM ID and ISAM S# (where ISAM ID and ISAM S# are the values contained within the IPE Instance data elements).
Product Retailer		The Retailer of a Product.
Proxy ISAM		Proxy ISAMs are "virtual" ISAMs that may be installed inside a physical ISAM in order to create IPEs on behalf of "not on us" IPE owners.
Ψ (Psi)		The number of bits needed to encode the SCT data element
PTYP		IPE Sub-type
Rail Settlement Plan	RSP	The rail industry agreement covering the sale of tickets and the apportionment of revenue to individual operators.
Receipt		A printed acknowledgment that a sum of money has been received .
Registered Application Identifier	RID	As defined in [ISO 7816-5].
Reimbursal/Reimbursement		The payment to an operator in return for the acceptance of a concession product (as distinct from apportionment of commercial revenue).
Reserved for future use	RFU	
Return		The second Journey authorised by or made using a Return ticket
Return journey		A ticket valid for two Journeys, where the Return Journey is the reverse of the Outward Journey, i.e. where the Origin of the Return Journey equates to the Destination of the initial Journey, and the Destination of the Return Journey equates to the Origin of the Outward Journey
Road User Charging	RUC	Charging road users for use of road space.
Rollover		The condition under which certain fields whose contents perform an incremental or decremental count will occasionally roll over from maximum value to minimum value, or vice versa. Unless otherwise defined in a specific data element definition, the minimum value shall be zero..
Route		A specific public transport service operating over a defined route between defined points, and identified by means of a route or service number

Scheme		A commercial agreement between participants which describes the conditions associated with the issue and acceptance of a product or group of products.
Scheme Operator		The organisation responsible for data clearance, network facilities, service point maintenance, merchant support for a scheme
Scheme Owner		The organisation responsible for defining the scheme, branding it, maintaining its integrity through the management of product accounts and answering customer queries relating to it.
Seamless travel		The opportunity for customers to move between parts of the public transport network with the minimum of inconvenience and without the need to acquire separate products (tickets).
Sector		The term sector is used in a similar manner to its use in the context of a floppy disc or hard drive, where physical memory is subdivided into smaller manageable sectors for reasons of access speed and convenience of handling for files of an average size. In much the same way ITSO have prescribed the notion of Sectors on the wide variety of CM it intends to use. In this context, a Sector may indeed be a sector on a memory card, an elementary file or record on a microprocessor card, or an alias on a java card or other device.
Service Operator		ITSO Role: Accepting the IPEs and providing travel services.
Settlement		The process of transferring value to/from the fund associated with each Product Owner in accordance with the apportionment formula.
Shell		See ITSO Shell.
Shell Expiry Date	EXP	The date, normally the end of a month, after which, the ITSO Shell shall no longer be valid in normal use.
Shell Retailer		The Retailer of an ITSO Shell.
Software Anti-tear		The most generic form of Anti-tear (see Anti-tear) protection that may be used on any ITSO CM and shall be supported in any POST environment.
Space Saving IPE		A type of IPE that has been designed to be hosted on media platforms with limited memory. Typically such an IPE will have restricted functionality
Static (in relation to IPEs) Static Data (in relation to IPEs)		The portion of IPE data (the IPE Data Group) which does not normally change, or which is only changed under the control of a trained operator or by equipment that securely holds the customer media in place during the transaction. (Previously known as IPE Fixed Data).
Store and Forward device		A device, other than HOPS, that is capable of accepting and storing data messages, and of forwarding these to another entity in due course, and which does contain an HSAM or ISAM
Stored Ticket		A concept in which one or more Tickets are stored in an inactive state within an IPE, and are activated or cancelled upon demand, subject to the Product Owner's business rules. For example, Stored Tickets could be implemented using a TYP 22 IPE containing a value group, where the QuantityCouponsRemaining element defines the number of inactive Stored Tickets remaining.
Stored Travel Rights	STR	A store of denominated units which may be exchanged for travel Tickets or other goods or services.
System		A public transport smartcard system. In the context of this document, this term shall apply to a locally implemented system, for example, the GMPTE, LT Prestige, Nottinghamshire, or Hertfordshire systems.
Tag Length Value	TLV	Also known as Type Length Value, a format for creating/describing data records such that the precise data content does not need to be defined except by the originating and accepting parties.

Target Area		See Media Target Area.
Ticket		An IPE or Transient Ticket Record giving entitlement to travel.
Ticketing Date		A notional date, used to calculate ExpiryDateCurrent and to determine ticket expiry. On any given day, Ticketing Date equals the calendar date applying at ValidityStartTime. For example, the Ticketing Date may be the 1st June, even though the current calendar date is the 2nd June where the ExpiryDateCurrent is calculated after midnight and before ValidityStartTime on the 2nd.
Time Out mechanism		A mechanism that terminates a process, or the attempt to initiate a process, after a pre-set period of time
Toll		The price paid to use a road or river crossing.
Torn Customer Media		A CM whose memory has been left in the wrong state due to a CM being removed from the Media Target Area whilst data is being written to the CM.
Train Operating Company	TOC	A franchised operator of UK Rail Services.
Transaction		The complete process from when a CM is first detected and processing commences until a record is made of the event
Transaction Record		The record of a Transaction, transmitted as a class 1 message from the POST to the HOPS.
TransactionReversal		The process of undoing a Transaction, for example, the cancellation of a Ticket and the refund of the fare. This process is sometimes known as Undoing or Annulment.
Transaction Session Batch		A set of Transaction Records that all share a common IBatch Header (see ITSO TS 1000-9). The IBatch Header is automatically computed / updated by the ISAM when its services are used to seal a Transaction Record within a (Class 1) Data Frame.
Travel card		A predefined ticket permitting unlimited travel in the area of its geographic availability for a period of between a few hours and one year, on the services of one or more operators.
Travel Related Voucher		A voucher for non transport goods or services, given or sold to passengers by a transport operator or authority normally together with a purchased ticket”
Trip		A self contained element of a Journey made on a single vehicle without changing from one vehicle to another
User Related Information	URI	User related information formatted in accordance with [EN 1332-4].
Validation		An [EN1545] (see References) EventTypeCode condition, indicating that the ticket is marked as in use, or has been used
Virgin product		Virgin product - An IPE instance that has not yet been used to carry out a transaction
Virtual Store		A system operated by a vendor of IPEs that is probably accessed via the internet and which allows the Customer to purchase one or more Detached IPEs for later fulfilment onto a CM belonging to them.
YYYYMMDD		A string containing date information in BCDN format, comprising 4 characters defining the year, 2 characters defining the month number where January is month 01, and 2 characters defining the day, for example 20080926.
YYYYMMDDHHII		A string containing date and time information in BCDN format, comprising 4 characters defining the year, 2 characters defining the month number where January is month 01, 2 characters defining the day, 2 characters defining the hour, and 2 characters defining minutes, using the 24 hour clock notation, for example 200809261657.

4. ITSO data types

4.1 General data types

The General data types used in the ITSO Environment are those shown in Table 3.

Table 3 - General data types

Data Type	Name	Format	Size	EN1545 equivalent (see References)
ASCII	ASCII	Text data coded using those ASCII codes included in the UTF8 character set as defined in [ISO 10646], excluding those codes that require more than one byte of storage.	Variable	
BCDN	Binary Coded Number (Value)	A Binary Coded Decimal value, where each of the characters 0 to 9 is encoded in 4 bits, and which, unless otherwise stated against a data element definition, shall be right justified and padded with zeros. The most significant character shall be encountered first in the data stream. The most significant bit of each character shall be encountered first in the data stream.	Variable	BCDString
BCDS	Binary Coded Number (String)	A Binary Coded Decimal value expressed as a string, where each of the characters 0 to 9 is encoded in 4 bits, and which, unless otherwise stated against a data element definition, shall be left justified and padded with 0xF HEX. The most significant character shall be encountered first in the data stream. The most significant bit of each character shall be encountered first in the data stream.	Variable	
BMP	BMP	An array of bit mapped elements	Variable	Not applicable (because it's a construct)
BIN	Binary	A binary coded element	Variable	
CRC	CheckSum	CRC to [ISO 13239] Note that further information on CRC is given in ITSO 1000-2, Annex A.	2 bytes	Int
DATE	Date	According to [EN1545-1] DateStamp A value of zero shall be interpreted as meaning	14 bits	DateStamp

		10/11/2041[2]		
DEC	Decimal Number	An unsigned BCD encoded number. The most significant byte shall be encountered first in the data stream	Variable	BCDString
DOB	DateOfBirth	According to [EN1545-1] BirthDate	4 bytes	BirthDate
DOW	ValidOnDayTypeCode	According to [EN1545-1] DayOfWeek	1 byte	DayOfWeek
DTS	DateTimeStamp	According to TS 1000-1 Annex A DateTimeStamp	3 bytes	Not equivalent to EN1545
FLAG	Flag	Boolean A value of “0” shall indicate “false” or “flag clear”; a value of “1” shall indicate “flag set”.	1 bit	Boolean
HEX	HEX number	Integer: the most significant byte shall be encountered first in the data stream, also known as "big endian" or "Motorola" format	Variable	INTEGER
IIN	Issuer Identification Number	BCD, according to [ISO 7812-1]	3 bytes	IIN
ISRN	ITSO Shell Reference Number	ISRN is a concatenation of the following four data elements that uniquely identifies each instance of an ITSO Shell: ITSO Issuer Identification number (IIN); ITSO Operators Identification Number (OID); ITSO Shell Serial Number (ISSN); and Check digit (CHD)	Variable	Construct[3]
uISRN	Unencrypted ITSO Shell Reference Number	The ISRN construct formatted for transmission in unencrypted form within data messages – see section 4.2.7 of this Part 1.	16 bytes	Construct[4]
eISRN	Encrypted ITSO Shell Reference Number	The ISRN construct formatted for transmission in encrypted form within data messages – see Part 8	16 bytes	Construct[5]
IPEIDM	IPE definition	construct see 4.2.1	7 bytes	Construct
LOC1	location definition type 1	construct see 4.2.4	Variable	Construct

[2] Note that the interpretation of Date values other than zero remains unchanged.

[3] Constructs in the context of this section have no direct equivalent within EN1545, but their constituent elements should have an equivalent in EN1545.

[4] Constructs in the context of this section have no direct equivalent within EN1545, but their constituent elements should have an equivalent in EN1545.

[5] Constructs in the context of this section have no direct equivalent within EN1545, but their constituent elements should have an equivalent in EN1545.

LOC2	location definition type 2	construct see 4.2.4	7 bytes	Construct
LOC3	location definition type 3	construct see 4.2.4	8.5 bytes	Construct
LOC4	location definition type 4	construct see 4.2.4	12.5 bytes	Construct
LocDefType	Location Definition Type	Integer	1 byte	LocationQualifierCode
LOCE	LocationElement	Construct see 4.2.4.3	variable	Construct
LoyaltyPoints	Value (loyalty)	Integer	3 bytes	LoyaltyPoints
Seal	Seal	Integer A form of Message Authentication Code, defined in ITSO TS 1000-7	variable	Authenticator
MOP	Method of payment	Code according to [EN1545-1] PaymentMeans	4 bits	PaymentMeans
OID13 OID14 OID16	ITSO operators identification number	Integer	2 bytes (Note that OID may be masked to less than 2 bytes when used in the ITSO directory)	ShortCompanyID
PAD	Padding	Padding always be set to a value of zero (unless otherwise stated)	Variable	
PTYP	IPE sub type	Integer (0..31) PTYP values are defined by the IPE owner, or for a private application where TYP = zero the PTYP element is RFU	5 bits	ProductID
RDATE	RemoveDate	Integer: count of days from Expiry Date	1 byte	HangoverPeriod
RFU	Reserved for Future Use	Data element, bit within a bit map, or code within a code list which is reserved for future use by ITSO. Where applied to a data element or to a bit within a bit map, the value of the element shall be set to zero unless otherwise specified in the data element definition. Any device encountering a RFU data element or RFU bit within a bit map shall not attempt to interpret the contents of the data	Variable	No equivalent

		element.		
SEQ	sequence number	integer: increment only	Variable	SequenceNumber
TIME	TIME	According to [EN1545-1] Timestamp	11 bits	Timestamp
SNCODE	Limited Service Number Code	See Table 41	5 bits	
SNCODE2	Extended Service Number Code	See Table 42b	6 bits	
TS#	Transaction Sequence Number	A 12 bit binary integer in the range 0,00 – F,FF (hex) that is incremented by 1 every time the data structure within which it occurs is used or rewritten. In the event that this value rolls over from F,FF (hex) it shall be set to 0,00 (hex).	12 bits	SequenceNumberOne-Five
TYP	IPE type	Integer (0..31)	5 bits	DataGroupType
UD	User defined	This data field may be formatted as the IPE Owner desires (see note following this table).	Variable	no equivalent
VALC	CurrencyCode	According to [EN1545-1] PayUnitMap[6]	4 bits	PayUnitMap
VALI	Value (currency) A gross amount including any VAT or other tax, excepting when a specific element defined as type VALI contains a VAT or TAX amount.	integer	Variable	Amount
VALS	Signed Value (currency) A gross amount including any VAT or other tax, excepting when a specific element defined as type VALI contains a VAT or TAX amount.	Signed integer, in 2's complement format	Variable	SignedAmount
VAT	VATSalesTax	percentage in 0.01 steps, 0..4095	12 bits	Percentage-2
VATM	VATSalesTax (message form)	Format as VAT, occupying the least significant byte and the 4 least significant bits of the most significant byte. The 4 most significant bits of the most	2 bytes	Construct

[6] Users should take note that use of a scaling factor reduces the available granularity of the currency in question.

		significant byte shall be set to zero		

Note. A User Defined (UD) data element may contain whatever values or encoding that the Product Owner (i.e. the owner of the IPE containing the user defined data element) wishes it to contain. The Product Owner will need to communicate the definition of the use of this data element to all POST developers, via service providers, whose POSTs will have to accept the relevant Product Embodiment.

4.2 Specific data types

4.2.1 IPEIDM

Table 4 - IPEIDM definition

Name	Offset	Size (in bytes)	Type	Comment
Issuer Identification Number	0	3	IIN	
ITSO operators identity number	3	2	OID16	
IPE type	5	1	TYP	A 5 bit value occupying bits 0 to 4 of the element. Bits 5 to 7 shall be set to 0 except when required to store larger values as directed elsewhere in this specification.
IPE sub type	6	1	PTYP	A 5 bit value occupying bits 0 to 4 of the element, bits 5 to 7 shall be set to 0

4.2.2 Note on Start and Expiry Dates and times

StartDate – Products are valid at all times upon the day defined by StartDate, unless the product contains a specific StartTime data element.

Expiry dates (such as EXP, ExpiryDate, data elements ending with "ExpiryDate" and "EndDate") are defined as the last day of validity. Expiry shall occur at the commencement of the specified minute of any ExpiryTime or data element, noting that for values of ExpiryTime equal to or greater than 1440 product expiry occurs on the day following the last day of validity. ExpiryTime shall always be configured with a meaningful value indicating a valid time of day. The default value for ExpiryTime shall be 1440, indicating expiry at midnight on the last day of validity.

4.2.3 Roll over

Certain fields implement an incremental or decremental count which will on occasion roll over from its maximum value to 0, or vice versa. In a similar manner date and time counts will on occasion roll over from a maximum value to 0. This is a valid condition and all implementations shall handle this condition in a satisfactory and seamless manner. Note that HOPS and POST software may need to examine additional data elements, such as a date, when determining whether rollover has occurred or an older value or version has reoccurred.

Note that for some such fields zero is not a valid condition and roll over shall be from the maximum value possible to 1, or vice versa.

4.2.4 Definition of Location

In many instances geographical location needs to be defined. This can be done in a number of ways depending upon circumstances. To accommodate this, a structure is used allowing various types of location definition to be stored within a standard IPE or message data element.

This structure shall consist of a Location Definition Type (LocDefType), an optional size data element, and one or more Location Elements (LOCE). This structure is represented graphically as follows:

Table 5 - Location definition structure

LocDefType	Structure size (optional)	LOCE	LOCE (optional)	LOCE (optional)

Note that LocDefType is equivalent to EN1545 LocationQualifierCode, and LOCE is equivalent to [EN1545-1] LocationID[7]. The entire structure is equivalent to [EN1545-1] LocationIdentifier.

4.2.4.1 Definition of Location Definition Types

Table 6 - Definition of location definition types

LocDefType	**Data Element (LOCE) definition**			
	Definition	**Data Format**	**Minimum LOCE Size[8] (bytes)**	**Comments**
0 – 199	As defined in [EN1545-1] LocationQualifierCode			
200	RFU, or product specific coding where specifically permitted for an IPE definition within ITSO TS 1000-5			
201	RFU			*Authors Note. This code should be reserved for a location type required to be used in a LOC3 or LOC4 structure , because of the LocDefType storage size constraint.*
202	Bus Fare Stage type 1	Machine number (3 bytes) + Fare stage number (1 byte) Both in HEX	4	

[7] LocationReference was previously known as LocationData

[8] Excluding the LocDefType and length (if present) elements

203	Short Rail National Location Code (NLC)	NLC (4 bytes ASCII)	4	Use of this coding is not recommended, excepting where space is at a premium. The alternative UIC compatible coding (code 208) is preferred.
204	Zonal bit map – valid anywhere in zone (see 4.2.4.3. 11/12)	3 bytes bit mapped	3	
205	Zonal bit map – valid zone to zone (see 4.2.4.3.11/12)	3 bytes bit mapped	3	
206	National bus stop code (NaptanCode)	NaptanCode bus stop number, BCD	4	Refer to full details of this type below, for data formatting
207	Zone Number	4 byte zone number, in HEX	4	
208	Full Rail National Location Code (NLC)	padding (4 bits) + UIC country code (12 bits DEC) + NLC (4 bytes ASCII)	6	
209	Bus fare stage type 2	OID (2) + Service number (4 X 5 bit SNCODE) + Padding (4 bits) + Stage number (1 HEX)	6	Note that service number and stage number shall be determined by the operator defined by OID, and published by him for inter-operability purposes
210	Service Numbers	4 X 5 bit SNCODE	20 bits	Shall only be used to define journey or journey leg commencement points for the purpose of determining ticket validity. This shall not be used in the Transient Ticket store.
211	National bus stop code (AtcoCode)	AtcoCode bus stop number	1	AtcoCode was previously known as Naptan number. Its function and content are identical to that of Naptan number.
212	Multiple National bus stop code (NaptanCode)	One or more NaptanCode bus stop number, BCD	4	Refer to full details of this type below, for details of data formatting.
213-215	RFU			*Authors Note. Codes 213, 214 and 215 should be reserved for a location type required to be used in a LOC3 or LOC4 structure, because of the LocDefType storage size constraint.*
216	Extended Service Number & Bus Stop code (NaptanCode)	OID (2 Hex) + Service Number (4 X 6 bit SNCODE2) + NaptanCode (4 BCD)	9	Note that Service Number shall be determined by the operator defined by OID, and published by them for interoperability purposes

217	Bus fare stage type 3	OID (2) + Service Number (4 X 6 bit SNCODE2) + Stage number (1 HEX)	6	Note that Service Number shall be determined by the operator defined by OID, and published by them for interoperability purposes
218	Extended Service Numbers	4 X 6 bit SNCODE2	4	Shall only be used to define journey or journey leg commencement points for the purpose of determining ticket validity. This shall not be used in the Transient Ticket store.
219-254	RFU			
255	Null	HEX	0	Where no location can be recorded in a given location structure, LocDefType shall be set to 255, and a value of 0 shall be written to that location structure.

Unless specified otherwise above, any location definition may be used to define journey start, journey end, intermediate point or area of validity for both ticket checking purposes and for recording events.

4.2.4.2 Location Data Structures, Definition of types

There shall be four types of location definition data structures.

Table 7 - Location structures, definition of types

Type code	Description	Comments
LOC1	A variable length structure.	This type shall not be used in the transient ticket store.
LOC2	A fixed length structure.	This type shall be used in the transient ticket store, and may be used elsewhere.
LOC3	A fixed length structure.	This type may be used where storage space must be used efficiently
LOC4	A fixed length structure.	This type may be used where a type LOC3 is extended to include via information

Note that any new location definitions introduced in future versions of this specification shall, if required to be used with the LOC2 type, not exceed 6 bytes in length (excluding LocDefType). If they exceed 6 bytes in length then a note shall be added prohibiting use within the LOC2 type. Similar restrictions apply to the LOC3 and LOC4 types.

Coding of each type of location definition record is as follows:

The first byte encountered in the record shall contain LocDefType.

Where the record contains a length byte, this shall occupy the second byte in the structure. Subsequent bytes shall contain data. Where the length of the data is not a whole number multiple of 8 bits, padding bits shall be added at the end of the data so as to end the record on a byte boundary. Said padding bits shall be set to zero.

4.2.4.2.1 Fixed length structure, LOC2

Total length = 7 bytes.

Table 8 - Fixed length structure, LOC2

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Data	1	Variable	LOCE	
Padding	1 + length of (data)	Variable	PAD	Trailing zeros as required to pad the record to a total of 7 bytes.

Data shall comprise NULL, NLC, Fare stage, zone bit map or any other suitably sized location code as defined below.

4.2.4.2.2 Variable length structure, LOC1

LOC1 structures shall use a tag/length/variable format, where LocDefType shall be used as the tag. Format shall be as shown graphically below:

Table 9 - Variable length structure, LOC1

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	Length of data and any padding in bytes
Data	2	Variable	LOCE	Optional only when null code LocDefType = 255
Padding	2 + length of (data)	Variable		Trailing zeros (if any)

The length element shall occupy 1 byte, allowing data sizes from 1 byte up to 255 bytes. Where no location is recorded the null code (LocDefType = 255) shall be used. For the avoidance of doubt, a length of zero bytes shall not be used, except where the null code (LocDefType = 255) is used and no data is included.

4.2.4.2.3 Fixed length structure, LOC3

Only 0.5 bytes are allocated to Location definition type. To determine the value of LocDefType, 200 (decimal) shall be added to the value contained in the location definition type element. For this reason, only location definition types with LocDefType codes in the range 200-215 shall be stored in a LOC3 structure.

No size element is provided, the location definition data structure is of fixed size.

Where a location definition type is too large to fit within this structure, then that type of location definition shall not be used.

Table 10 - Fixed length structure, LOC3

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	Only the 4 least significant bits of LocDefType are stored here. Therefore this element shall

				contain LocDefType minus 200.
Data1	0.5	4 Max	LOCE	Journey Origin.
Padding	As required	As required	PAD	Pad with zeros such that the size of Data1 plus this padding equals 4 bytes.
Data2	4.5	4 Max	LOCE	Journey Destination
Padding	As required	As required	PAD	Pad with zeros such that the size of Data2 plus this padding equals 4 bytes.

4.2.4.2.4 Fixed length structure, LOC4

Only 0.5 bytes are allocated to Location definition type. To determine the value of LocDefType, 200 (decimal) shall be added to the value contained in the location definition type element. For this reason, only location definition types with LocDefType codes in the range 200 to 215 shall be stored in a LOC4 structure.

No size element is provided, the location definition data structure is of fixed size.

Where a location definition type is too large to fit within a structure, then that location definition type shall not be used.

Table 11 - Fixed length structure, LOC4

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	Only the 4 least significant bits of LocDefType are stored here. Therefore this element shall contain LocDefType minus 200.
Data1	0.5	4 Max	LOCE	Journey Origin.
Padding	As required	As required	PAD	Pad with zeros such that the size of Data1 plus this padding equals 4 bytes.
Data2	4.5	4 Max	LOCE	Journey Destination
Padding	As required	As required	PAD	Pad with zeros such that the size of Data2 plus this padding equals 4 bytes.
Data3	8.5	4 Max	LOCE	Via
Padding	As required	As required	PAD	Pad with zeros such that the size of Data3 plus this padding equals 4 bytes.

4.2.4.3 LOCE structure definitions

4.2.4.3.1 Fare Stage Type 1, LocDefType = 202

Total length in LOC2 structure = 5 bytes

Table 12 - Fare stage type 1, LocDefType = 202, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Machine Number	1	3	HEX	
Stage Number	4	1	HEX	

Total length in LOC1 structure = 6 bytes

Table 13 - Fare Stage Type 1, LocDefType = 202, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	PAD	
Machine Number	2	3	HEX	
Stage Number	5	1	HEX	

Table 14 - Fare Stage Type 1, LocDefType = 202, LOC3 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Machine Number	0.5	3	HEX	
Origin Stage Number	3.5	1	HEX	
Destination Stage Number	4.5	1	HEX	
Padding	5.5	3	PAD	Pad with zeros

Table 15 - Fare Stage Type 1, LocDefType = 202, LOC4 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Machine Number	0.5	3	HEX	
Origin Stage Number	3.5	1	HEX	
Destination Stage Number	4.5	1	HEX	
Padding	5.5	3	PAD	Pad with zeros
Via Stage Number	8.5	1	HEX	If any. Otherwise set to zero
Padding	9.5	3	PAD	Pad with zeros

4.2.4.3.2 UK National Rail Location Code, LocDefType = 203

Total length in LOC2 structure = 5 bytes

Table 16 - UK National Rail Location Code, LocDefType = 203, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
NLC	1	4	ASCII	UK National Rail NLC location code

Total length in LOC1 structure = 6 bytes

Table 17 - UK National Rail Location Code, LocDefType = 203, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
NLC	2	4	ASCII	UK National Rail NLC location code

Table 18 - UK National Rail Location Code, LocDefType = 203, LOC3 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin NLC	0.5	4	ASCII	UK National Rail NLC location code
Destination NLC	4.5	4	ASCII	UK National Rail NLC location code

Table 19 - UK National Rail Location Code, LocDefType = 203, LOC4 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin NLC	0.5	4	ASCII	UK National Rail NLC location code
Destination NLC	4.5	4	ASCII	UK National Rail NLC location code
Via NLC	8.5	4	ASCII	UK National Rail NLC location code if any. Otherwise set to zero.

4.2.4.3.3 Zonal bit map, LocDefType = 204 & 205

This LocDefType shall only be used for establishing validity of a ticket at the point of use.

Total length in LOC2 structure = 4 bytes

Table 20 - Zonal bit map, LocDefType = 204 & 205, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Zone Byte 1	1	1	See 4.2.4.3.11/12	
Zone Byte 2	2	1	See 4.2.4.3.11/12	
Zone Byte 3	3	1	See 4.2.4.3.11/12	

Total length in LOC1 structure = 5 bytes

Table 21 - Zonal bit map, LocDefType = 204 & 205, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Zone Byte 1	2	1	See 4.2.4.3.11/12	
Zone Byte 2	3	1	See 4.2.4.3.11/12	
Zone Byte 3	4	1	See 4.2.4.3.11/12	

Table 22 - Zonal bit map, LocDefType = 204 & 205, LOC3 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Zone Byte 1	0.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 2	1.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 3	2.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 4	3.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 1	4.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 2	5.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 3	6.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 4	7.5	1	See 4.2.4.3.11/12	

Table 23 - Zonal bit map, LocDefType = 204 & 205, LOC4 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Zone Byte 1	0.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 2	1.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 3	2.5	1	See 4.2.4.3.11/12	
Origin Zone Byte 4	3.5	1	See 4.2.4.3.11/12	

Destination Zone Byte 1	4.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 2	5.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 3	6.5	1	See 4.2.4.3.11/12	
Destination Zone Byte 4	7.5	1	See 4.2.4.3.11/12	
Via Zone Byte 1	8.5	1	See 4.2.4.3.11/12	If any. Otherwise set to zero
Via Zone Byte 2	9.5	1	See 4.2.4.3.11/12	If any. Otherwise set to zero
Via Zone Byte 3	10.5	1	See 4.2.4.3.11/12	If any. Otherwise set to zero
Via Zone Byte 4	11.5	1	See 4.2.4.3.11/12	If any. Otherwise set to zero

4.2.4.3.4 National Bus stop code (NaptanCode), LocDefType = 206

A location defined using LocDefType 206 shall contain a value created in accordance with the national standard for Naptan codes, formatted as a “NaptanCode”, and which is stored in the national database for such codes. The values stored shall be formatted in accordance with the instructions on storing NaptanCode values below.

Total length in LOC1 structure = 6 bytes

Table 24 - Bus Stop Code, LocDefType = 206, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Bus Stop code	2	4	BCD	This value shall be a nationally defined NaptanCode bus stop number

Total length in LOC2 structure = 5 bytes

Table 25 - Bus Stop Code, LocDefType = 206, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Bus Stop code	1	4	BCD	This value shall be a nationally defined NaptanCode bus stop number

Table 26 - Bus Stop Code, LocDefType = 206, LOC3 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Bus Stop Code	0.5	4	BCD	This value shall be a nationally defined NaptanCode bus stop number
Destination Bus Stop Code	4.5	4	BCD	This value shall be a nationally defined NaptanCode bus stop number

Table 27 - Bus Stop Code, LocDefType = 206, LOC4 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Bus Stop code	0.5	4	BCD	This value shall be a nationally defined NaptanCode bus stop number
Destination Bus Stop code	4.5	4	BCD	This value shall be a nationally defined NaptanCode bus stop number
Via Bus Stop code	4.5	4	BCD	If any, this value shall be a nationally defined NaptanCode bus stop number

Storing NaptanCode values.

NaptanCode values consist of 8 characters, each of which may be mapped to a numeric value, allowing these 8 characters to be stored in 4 bytes of BCD. The mapping between the allowable characters and the equivalent numeric code is shown in the following table. It is suggested that numeric codes could be used throughout in POSTs, avoiding continuous translation between NaptanCode values and the numeric code values. This means that configuration files should all be converted into numeric code values prior to dispatch to the POST.

In circumstances where the NaptanCode only occupies 7 digits, these shall be encoded in the least significant 7 digits of the location element, and the most significant digit set to zero (0).

Table 28 - NaptanCode Mapping

This table shows the NaptanCode characters and their equivalent numeric code:

Numeric code	NaptanCode characters					Comments
0	0					Not used
1	1					Not used
2	2	A a	B b	C c		
3	3	D d	E e	F f		
4	4	G g	H h	I i		
5	5	J j	K k	L l		
6	6	M m	N n	O o		
7	7	P p	Q q	R r	S s	
8	8	T t	U u	V v		
9	9	W w	X x	Y y	Z z	

4.2.4.3.5 Zone Number, LocDefType = 207

Total length in LOC2 structure = 5 bytes

Table 29 - Zone Number, LocDefType = 207, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Zone Number	1	4	HEX	

Total length in LOC1 structure = 6 bytes

Table 30 - Zone Number, LocDefType = 207, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Zone Number	2	4	HEX	

Table 31 - Zone Number, LocDefType = 207, LOC3 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Zone Number	0.5	4	HEX	
Destination Zone Number	4.5	4	HEX	

Table 32 - Zone Number, LocDefType = 207, LOC4 format

Name	Offset	Size	Type	Comment
Location Definition type	0	0.5	LocDefType	
Origin Zone Number	0.5	4	HEX	
Destination Zone Number	4.5	4	HEX	
Via Zone Number	4.5	4	HEX	If any. Otherwise set to zero

4.2.4.3.6 UIC and UK National Rail NLC Location Codes, LocDefType = 208

Total length in LOC2 structure = 7 bytes

Table 33 - UIC and UK National Rail NLC Location Codes, LocDefType = 208, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
RFU	1	0.5	RFU	This element shall be set to zero
UIC Country Code	1.5	1.5	DEC	Country Code as defined by UIC for Location codes. For the UK, this shall be set to a value of 070 decimal.
NLC	3	4	ASCII	UK National Rail Location Code (NLC)

Total length in LOC1 structure = 8 bytes

Table 34 - UIC and UK National Rail NLC Location Codes, LocDefType = 208, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
RFU	2	0.5	RFU	This element shall be set to zero
UIC Country Code	2.5	1.5	DEC	Country Code as defined by UIC for Location codes. For the UK, this shall be set to a value of 070 decimal.
NLC	4	4	ASCII	UK National Rail Location Code (NLC)

This type shall not be used in a LOC3 structure.

4.2.4.3.7 Bus fare stage type 2, LocDefType = 209

Total length in LOC2 structure = 7 bytes.

Stage Number (1 byte – 0 to 255) is subservient to Service Number and holds the number of the stage on the route.

Table 35 - Bus fare stage, LocDefType = 209, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Operator identity	1	2	OID	
Service number	3	20 bits	4*SNCODE	
Padding	5.5	4 bits	PAD	
Stage number	6	1	HEX	

Total length in LOC1 structure = 8 bytes.

Table 36 - Bus fare stage, LocDefType = 209, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Operator identity	2	2	OID	
Service number	4	20 bits	4*SNCODE	
Padding	6.5	4 bits	PAD	
Stage number	7	1	HEX	

This type shall not be used in LOC3 or LOC4 structures.

In this context Service Number shall be formatted as follows. Char 1 shall be the most significant character in the Service Number.

Unused characters shall be set to ‘space’ (0x1F hex – see 4.2.4.3.10). Service Numbers shall be right justified, i.e. if a Service Number has only 3 characters, the 'space' occupies the char 1 slot; if the Service Number has only 2 characters, then spaces are put in the char 1 and char 2 slots (etc).

Table 37 - Limited Service Number Formatting (LocDefType = 209)

Char 1 (5 bits)	Char 2 (5 bits)	Char 3 (5 bits)	Char 4 (5 bits)	Spare (4 bits) set to 0

For coding of Limited Service Number characters see Clause 4.2.4.3.10

4.2.4.3.8 Service numbers, LocDefType = 210

This LocDefType shall only be used for establishing validity of a ticket at the point of use.

This LocDefType shall only be stored in LOC1 type structure.

Total length = variable.

Table 38 - Service Numbers, LocDefType = 210

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Service Number 1	2	20 bits	4*SNCODE	As defined in table 39
Service Number 2	4.5	20 bits	4*SNCODE	Optional, as defined in table 39
More Service Numbers	7	20 bits (each)	4*SNCODE (each)	Optional, as defined in table 39
Service Number n	2+((2.5 bytes)*(n-1))	20 bits	4*SNCODE	Optional, as defined in table 39. n is the number of Service Numbers in the structure.
Padding	2+((2.5 bytes)*(n))	As required	PAD	Trailing zeroes (if any)

No limit is imposed upon the number of Service Number identifiers that may be stored.

In this context Service Number shall be formatted as follows. Char 1 shall be the most significant character in the Service Number.

Unused characters shall be set to ‘space’ (0x1F hex – see 4.2.4.3.10). Service Numbers shall be right justified, i.e. if a Service Number has only 3 characters, the 'space' occupies the char 1 slot; if the Service Number has only 2 characters, then spaces are put in the char 1 and char 2 slots (etc).

Table 39 - Limited Service Number Formatting (LocDefType = 210)

Service Number n			
Char 1 (5 bits)	Char 2 (5 bits)	Char 3 (5 bits)	Char 4 (5 bits)

For coding of Service Number characters see section 4.2.4.3.10

4.2.4.3.9 National Bus Stop code (AtcoCode), LocDefType = 211

A location defined using LocDefType 211 shall contain a value created in accordance with the national standard for Naptan codes, formatted as “AtcoCode”, and which is stored in the national database for such codes.

Table 40 - Bus Stop code, LocDefType = 211, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Bus Stop Number	2	Variable, Maximum 12	ASCII	Author’s note: this value shall be a nationally defined bus stop number

This type shall only be used in a LOC1 structure.

4.2.4.3.10 Limited Service Numbers

For the purpose of saving CM memory space a customised 5 bit code, designated SNCODE, shall be used to store the Service Number. Service Number strings shall be 4 characters (20 bits) in length. Any unused characters or Service Number sub-structure shall be loaded with the value 1F HEX.

Table 41 - SNCODE definition

Code (Hex)	Character represented	Code (Hex)	Character represented	Code (Hex)	Character represented	Code (Hex)	Character represented
0	0	A	A	14	M	1E	Z
1	1	B	B	15	N	1F	space
2	2	C	C	16	P		
3	3	D	D	17	R		
4	4	E	E	18	S		
5	5	F	F	19	T		
6	6	10	G	1A	V		
7	7	11	H	1B	W		
8	8	12	K	1C	X		
9	9	13	L	1D	Y		

4.2.4.3.11 Zone Bit Map Definition

Each zone shall be allocated a zone number, a specific zone shall be valid for travel (or an event recorded in that zone) if the relevant bit in the zonal bit map is set. Zone numbers are allocated to bits in the zonal bit map as follows.

Table 42 - Allocation of bits in the zonal bit map

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	8	7	6	5	4	3	2	1
2	16	15	14	13	12	11	10	9
3	24	23	22	21	20	19	18	17
4	32	31	30	29	28	27	26	25

4.2.4.3.12 Zone bit map types

Valid within zone means that the ticket is only valid for journeys which commence, pass through and terminate within the zones specified.

Valid zone to zone means that the ticket is valid within the specified zones, and for travel between the specified zones commencing in one specified zone and terminating in another specified zone, even if this means travelling through other unspecified zones. In the latter case journey commencement or termination is clearly not allowed in unspecified zones even if they fall between specified zones.

4.2.4.3.13 Multiple National Bus stop code (NaptanCode), LocDefType = 212

A location defined using LocDefType 212 shall contain a value created in accordance with the national standard for Naptan codes, formatted as a “NaptanCode”, and which is stored in the national database for such codes. The values stored shall be formatted in accordance with the instructions on storing NaptanCode values in clause 4.2.4.3.4.

This LocDefType shall only be stored in LOC1 data structures.

Total length in LOC1 structure = variable.

Table 42a - Multiple Naptan Bus Stop Code, LocDefType = 212, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Bus Stop code	2	4 x number of bus stop codes stored	BCD	This value shall be one or more nationally defined NaptanCode bus stop number, the quantity defined shall be determined from the length data element

4.2.4.3.14 Extended Service Numbers (SNCODE2)

Where the use of a Service Number requires the use of excluded characters, or is not space-sensitive, a customised 6-bit code, designated SNCODE2, shall be used to store the Service Number. Service Number strings shall be 4 characters (24 bits) in length. Any unused characters or Service Number sub-structure shall be loaded with the value 3F HEX.

Table 42b – SNCODE2 definition

Code (Hex)	Character represented	Code (Hex)	Character represented	Code (Hex)	Character represented	Code (Hex)	Character represented
00	0	0A	A	14	K	1E	U
01	1	0B	B	15	L	1F	V
02	2	0C	C	16	M	20	W
03	3	0D	D	17	N	21	X
04	4	0E	E	18	O	22	Y
05	5	0F	F	19	P	23	Z
06	6	10	G	1A	Q	24-3E	RFU
07	7	11	H	1B	R	3F	space
08	8	12	I	1C	S		
09	9	13	J	1D	T		

4.2.4.3.15 Service Number & Bus Stop (NaptanCode), LocDefType = 216

A location defined using LocDefType 216 shall contain an Extended Service Number and a National Bus Stop Code value, created in accordance with the national standard for Naptan codes, formatted as “NaptanCode”, and which is stored in the national database for such codes. The values stored shall be formatted in accordance with the instructions on storing NaptanCode values defined in Clause 4.2.4.3.4 above.

Total length in LOC1 structure = 11 bytes.

Table 42c – Service Number & Bus Stop (AtcoCode), LocDefType = 216, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Operator Identity	2	2	OID	
Extended Service Number	4	3		SNCODE2
Bus Stop Code (NaptanCode)	7	4	NaptanCode bus stop number	This value shall be a nationally defined NaptanCode bus stop number

This type shall not be used in LOC2, LOC3 or LOC4 structures.

4.2.4.3.16 Bus Fare Stage Type 3, LocDefType = 217

Stage Number (1 byte – 0 to 255) is subservient to Service Number and holds the number of the stage on the route.

Total length in LOC2 structure = 7 bytes.

Table 42d – Bus Fare Stage Type 3, LocDefType = 217, LOC2 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Operator Identity	1	2	OID	
Extended Service Number	3	3		SNCODE2
Stage number	6	1	HEX	

Total length in LOC1 structure = 8 bytes.

Table 42e – Bus Fare Stage Type 3, LocDefType = 217, LOC1 format

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1	HEX	
Operator Identity	2	2	OID	
Extended Service Number	4	3		SNCODE2
Stage number	7	1	HEX	

This type shall not be used in LOC3 or LOC4 structures.

In this context Service Number shall be formatted as follows. Char 1 shall be the most significant character in the Service Number.

Unused characters shall be set to ‘space’ (0x3F hex – see 4.2.4.3.14). Service Numbers shall be right justified, i.e. if a Service Number has only 3 characters, the 'space' occupies the char 1 slot; if the Service Number has only 2 characters, then spaces are put in the char 1 and char 2 slots (etc).

Table 42f – Extended Service Number Formatting (LocDefType = 217)

Char 1 (6 bits)	Char 2 (6 bits)	Char 3 (6 bits)	Char 4 (6 bits)

For coding of Extended Service Number characters see Clause 4.2.4.3.14

4.2.4.3.17 Extended Service Numbers, LocDefType = 218

This LocDefType shall only be used for establishing validity of a ticket at the point of use.

This LocDefType shall only be stored in LOC1 type structure.

Total length = variable.

Table 42g – Extended Service Numbers, LocDefType = 218

Name	Offset	Size	Type	Comment
Location Definition type	0	1	LocDefType	
Length	1	1		
Service Number 1	2	3		SNCODE2. As defined in table 42h
Service Number 2	5	3		SNCODE2. Optional, as defined in table 42h
More Service Numbers	8	3 (each)		SNCODE2. Optional, as defined in table 42h
Service Number n	2+((3 bytes)*(n-1))	3		SNCODE2. Optional, as defined in table 42h. n is the number of Service Numbers in the structure.

No limit is imposed upon the number of Service Number identifiers that may be stored.

In this context Service Number shall be formatted as follows. Char 1 shall be the most significant character in the Service Number.

Unused characters shall be set to ‘space’ (0x3F hex – see 4.2.4.3.14). Service Numbers shall be right justified, i.e. if a Service Number has only 3 characters, the 'space' occupies the char 1 slot; if the Service Number has only 2 characters, then spaces are put in the char 1 and char 2 slots (etc).

Table 42h – Extended Service Number Formatting (LocDefType = 218)

Service Number n			
Char 1 (6 bits)	Char 2 (6 bits)	Char 3 (6 bits)	Char 4 (6 bits)

For coding of Extended Service Number characters see Clause 4.2.4.3.14

4.2.5 ITSO operators identification number (OID)

There are three types of OID (they are of different lengths) corresponding to three types of user:

- ITSO Shell issuer (who can also issue & accept products)
- product issuer (who can accept products but not issue ITSO Shells)
- product acceptor (who can only accept products)

which shall be stored in the following data types:

- OID13 (which can only be used to store ITSO Shell issuer OIDs)
- OID14 (which can only be used to store ITSO Shell issuer & product issuer OIDs)
- OID16 (which can be used to store any OID type)

4.2.6 CurrencyCode

CurrencyCode shall be coded according to [EN1545-1] PayUnitMap. In ITSO applications the PayUnitMap currency code bits shall be utilised as follows:

Table 43 - Definition of Currency code, bits 0 and 1

#	Bit 1	Bit 0	Description	Currency definition
0	0	0	local currency according to IIN / Networkid	£ Sterling, base unit shall be £0.01
1	0	1	global currency according to IIN / Networkid	Euro, base unit shall be €0.01
2	1	0	tokens defined according to IIN / Networkid	ITSO defined Tokens
3	1	1	Product owner defined tokens (could be used for a third currency)	IPE owner defined tokens

4.2.7 Unencrypted ISRN – uISRN

The Unencrypted ISRN data format is constructed according to the input data described in table 44.

Table 44 - Unencrypted ISRN Input Data (uISRN)

Group	Field	Size (bytes)
Padding	RFU for ITSO	3
ISRN	IIN Issuer Identification Number (internationally registered)	3
	OID Operator Identification Number	2
	ISSN ITSO Shell Serial Number	3.5
	CHD Check Digit	0.5
UD	User Defined – not used for interoperability. If not in use these shall normally be set to zeros.	4

This data construct is shown as uISRN where it is used in this specification.

4.2.8 EmbodimentList

This data type is used to send Embodiment Parameter Lists in messages.

Data Elements formatted according to EmbodimentList shall consist of a series of Constructs, comma separated when formatted in Transmission Format, i.e. in Transmission Format a comma shall be placed between each individual Construct. When a Construct is omitted (because there is no data to send) then an additional comma shall be inserted marking the place where that Construct would otherwise have been placed. ListData shall be treated as HEX for the purposes of conversion to Transmission Format, irrespective of the data type defined in the embodiment lists. Note that when the hash sealing transmission method is used as defined in ITSO TS1000-9, and Data# is set to a value of one (1), then commas shall not be used between Constructs when formatted in Transmission Format.

Each Construct shall contain a concatenation of the following Embodiment Parameter List Data Elements: ElementNumber; RuleCode; ListDataSize; and ListData. These Data Elements shall not be comma separated.

5. Data Format

Unless specifically stated to the contrary, all data shall be presented across ITSO defined interfaces in the following format:

Data elements shall be transmitted most significant bit first, that is the most significant bit shall be encountered first in the data stream.

For bitmapped elements containing flags, the most significant flag shall occupy the most significant bit. This is shown in the following example for an 8 bit element.

Table 45 - Example of a bit mapped field

Bit number	7	6	5	4	3	2	1	0
Significance	Most significant							Least significant
Corresponding Flag ID	7	6	5	4	3	2	1	0

Multi-byte data elements shall be transmitted most significant byte first, that is the most significant byte shall be encountered first in the data stream. (For the information of users, this format is also defined as “big endian” and commonly known as “Motorola” format.)

6. DTS - DateTimeStamp

DTS is a 24-bit signed number describing the displacement in minutes from the Epoch.

The Epoch defined in this specification is 24/11/2028 at 20:16:00.

Annex A

Annex A
(informative)
DTS - DateTimeStamp

This Annex is provided for explanatory purposes and illustrates the generation of DTS (DateTimeStamp) used in the specification. DTS data type is an exception to those specified in Table 3 (clause 4.1) because it is not encoded according to EN1545. The DateTimeStamp is calculated using the Two's complement signed arithmetic solution.

A.1 Using Two's complement for DTS

The Two's complement signed arithmetic provides ITSO a backward compatible solution to EN1545 DateTimeStamp expiry in 2028.

A.2 Difference between the old and new representation

Both systems do the maths differently but come to the same answers. Right up until an old POST wants a date after day 0xFFFFFF. The drawback is that the range of the 24-bit range number is (DECIMAL - 8388608) before the Epoch and (DECIMAL +8,388,607) after the Epoch.

In the 24-bit representation, the solution provides us 15.5 years, rather than the 31 years which was achieved with the old mechanism.

A.2.1 Test Data

DTS	Old	New
000000	01/01/1997 - 00:00:00	24/11/2028 - 20:16:00
7FFFFF	13/12/2012 - 10:07:00	06/11/2044 - 06:23:00
800000	13/12/2012 - 10:08:00	13/12/2012 - 10:08:00
FFFFFF	24/11/2028 - 20:15:00	24/11/2028 - 20:15:00

Note: The new solution is compatible with dates from 13/12/2012 at 10:08:00 onwards.