



Smart Ticketing Alliance

Reference Documentation

Version 1.2.1



Table of Contents

1	Introduction	4
1.1	Abbreviations.....	5
2	ISO (International Standards Organisation)	7
3	CEN (Committee for European Standardization [Norms]).....	16
4	ETSI (European Telecommunications Standards Institute)	23
5	GSMA (GSM Association)	24
6	EMVCo (Europay Mastercard Visa).....	25
6.1	Terminal Type Approval:.....	25
6.2	Mobile Type Approval	25
7	Global Platform	26
8	GCF (Global Certification Forum)	28
9	NFC Forum (Near Field Communications).....	29
10	Other Standards.....	33



Version Control

Version	Comments	Date	Editor
V1.0.0	Initial Publication.	December 2016	Mike Eastham
V1.0.1	2017 – Update 1	April 2017	Mike Eastham
V1.0.2	2017 – Update 2	July 2017	Mike Eastham
V1.0.3	2017 – Update 3	October 2017	Mike Eastham
V1.1.0	2018 – First Issue. Added additional information on the status of ISO Standards when undergoing review or amendment.	February 2018	Mike Eastham
V1.1.1	2018 – Update 1	May 2018	Mike Eastham
V1.1.2	2018 – Update 2	August 2018	Mike Eastham
V1.2.0	2019 – First Issue. Added list of abbreviations.	January 2019	Mike Eastham
V1.2.1	2019 – Update 1. Added: ISO 14813-1. ISO/IEC 14888 Parts 1 to 3. (BS) EN 16157-2. Placeholders for BS EN 12896 parts 4 to 8 (published for comment).	September 2019	Mike Eastham



1 Introduction

In order to ensure interoperability from a Standards perspective the STA makes use of standards and specifications published by Organizations for Standards, bodies such as CEN and ISO; and other membership bodies such as GSMA, the NFC Forum, etc.

This document contains details of the reference documentation used in STA published documents. It is sub-divided by organisation. Note that no particular relevance should be ascribed to the order in which the various bodies appear; each is equally relevant in its own way to the work of STA.

Most STA Documents contain a section on “Normative References” and the latest versions of these references are all included in this STA References Document.

Specific references will continue to be included in STA documents, particularly where the references are dated and have specific relevance to the document they are referenced by. These references may be “cross checked” with the STA References Document to establish their currency. In other cases where the reference is effectively to the “latest version” of the standard or specification, STA documentation may index to this document.

Note: National Standards and Specifications are not considered here, except where they have been translated into other languages by other national standards bodies and hence have a clearly international dimension. Normally however national standards are the subject of use in specific countries. Often National Standards are National implementations of standards published by international Standards Bodies, such as CEN or ISO.



1.1 Abbreviations

The work of standardisation often produces abbreviations and these abbreviations are introduced where they are first used. They are also shown in the list below.

Abbreviation	Unabridged Term
AWI	Approved Work Item
Amd	Amendment
APDU	Application Protocol Data Unit
BS	British Standard
BSI	British Standards Institute
CEN	Centre for European Norms (Standards)
CLF	Contactless Front-end
CMP	Contactless Mobile Payment
DEF	Data Exchange format
EMV	Europay Mastercard Visa
EMVCo	EMV Company
EN	European Norm (Standard)
eSE	embedded Secure Element
ETSI	European Telecommunications Standards Institute
GCF	Global Certification Forum
E2E	End to End
GP	GlobalPlatform
GSM	Global System for Mobile [communications]
GSMA	GSM Association
HCI	Host Controller Interface
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
ITS	Intelligent Transport Systems
LLCP	Logical Link Control Protocol



MAC [1]	Message Authentication Code, when used in relation to cryptographic processes and ISO/IEC 14443 Message Authenticaion
MAC [2]	Media Access Control, when used in relation to networks and device management
NDEF	NFC Data Exchange Format
NFC	Near Field Communications
pr	Provisional. (This term is used most regularly for European Norms which will have national published versions, but which may not yet have been ratified by the member nations.)
SCP	Secure Channel Protocol
SE	Secure Element
SGP	SIM Group. (SGP is used as a reference for GSMA SIM Group's documents, to distinguish from SG, which is used by the Security Group of GSMA .)
SP	Service Provider
TEE	Trusted Execution Environment
UICC	Universal Integrated Circuit Card
WI	Work Item



2 ISO (International Standards Organisation)

A global standards body headquartered in Washington, USA.

- Notes:
1. In the following table the year of the latest publication of the relevant [part of] the standard is shown, which is the reference year for the publication of the “current” version. ISO/IEC standards use the nomenclature “standard number: year of publication”. ISO/IEC standards are reviewed every 5 years. A value for the year of publication of 2012 or earlier will mean that the standard has not been revised during its most recent review.
 2. Where known, the notes (shown in red) describe the status of the standard when it is undergoing periodic review, or amendment. The notes also highlight any standards that are thought to be due for review within the next 12 months.
 3. Where a standard has been recently amended, updated or reissued a note (also shown in red) details the publication date and the latest revision year date (or detail of the amendment) is highlighted in yellow.
 4. Other information is shown in blue.

Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 7810		Identification cards – Physical characteristics. <i>Note: A new version is in preparation that will incorporate the amendments into the standard. (Currently this is at FDIS Registered status – Aug 2019)</i>	2003	ISO/IEC 7810:2003 Amd 1:2009 ISO/IEC 7810:2003 Amd 2:2012
ISO/IEC 7812	1	Identification cards – Identification of issuers – Part 1: Numbering system <i>Note: Issuers and other users should note the following document to be found at:</i> http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref2146	2017	
	2	Identification cards – Identification of issuers – Part 2: Application and registration procedures.	2017	
ISO/IEC 7816	1	Integrated circuit cards with contacts – Physical characteristics. <i>Last Review: 2016 Standard Confirmed</i>	2011	



Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 7816	2	Integrated circuit cards with contacts – Dimensions and location of the contacts. Last Review: 2018 Standard Confirmed	2007	
	3	Integrated circuit cards with contacts: Electronic signals and transmission protocols Last Review: 2018 Standard Confirmed	2006	
	4	Integrated circuit cards with contacts: Organisation, security and commands for interchange Note: Amd1:2018 was published on 24/07/2018. Amd2 was published on 23/08/2018. This part of the standard is under development as a new version and is currently at DIS [Close of Voting] status [31/08/2019].	2013	ISO/IEC 7816-4:2013/Cor 1:2014 ISO/IEC 7816-4:2013/ Amd 1:2018 ISO/IEC 7816-4:2013/ Amd 2:2018
	5	Integrated circuit cards with contacts: Numbering system and registration procedure for application identifiers Last Review: 2018 Standard Confirmed	2004	
	6	Integrated circuit cards with contacts: Interindustry data elements for interchange This part of the standard is under development as a new version and is currently at DIS [Ballot Initiated] status [12/07/2019]	2016	
	7	Integrated circuit cards with contacts: Interindustry commands for Structured Card Query Language (SCQL) Last Review: 2018 Standard Confirmed	1999	
	8	Integrated circuit cards with contacts: Commands for security operations Note: The new version was published on 16/08/2019	2019	



Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 7816	9	Integrated circuit cards with contacts: Commands for card management	2017	
	10	Integrated circuit cards with contacts: Electronic signals and answer to reset for synchronous cards Last Review: 2018 Standard Confirmed	1999	
	11	Identification cards -- Integrated circuit cards -- Part 11: Personal verification through biometric methods. Note: This part of the standard is under development as a new version and is currently at CD [Approved for registration as DIS] status [29/04/2019]	2017	
	12	Integrated circuit cards with contacts: USB electrical interface and operating procedures Last Review: 2018 Standard Confirmed	2005	ISO/IEC 7816-12:2005/Cor 1:2014
	13	Integrated circuit cards with contacts: Commands for application management in a multi-application environment Last Review: 2017 Standard Confirmed	2007	
	15	Integrated circuit cards with contacts: Cryptographic information application	2016	ISO/IEC 7816-15:2016/Amd 1:2018
ISO/IEC 8825	1	Information technology-ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)	2015	
ISO/IEC 9594	8	Open Systems Interconnection The Directory: Public-key and attribute certificate frameworks Notes: A new amendment is at DIS status [close of voting]: ISO/IEC 9594-8:2017/DAmD 1 [11/05/2019]. A corrigendum is under development at CD status [approved for registration as DIS]: ISO/IEC 9594-8:2017/CD Cor 1.	2017	



Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 9798	2	Information technology – Security techniques – Entity authentication – Part 2: Mechanisms using symmetric encipherment algorithms Note: A new version of this Part was published on 03/06/2019.	2019	
ISO/IEC 10118	1	Information technology -- Security techniques -- Hash-functions -- Part 1: General Note: An amendment is under development: ISO/IEC 10118-1:2016/AWI Amd 1. [11/06/2019]	2016	
	2	Information technology -- Security techniques -- Hash-functions -- Part 2: Hash-functions using an n-bit block cipher Last Review: 2016	2010	ISO/IEC 10118-2:2010/Cor 1:2011
	3	Information technology -- Security techniques -- Hash-functions -- Part 3: Dedicated hash-functions Note: A new version of this Part was published on 31/10/2018.	2018	
ISO/IEC 10373	6	Identification cards -- Test methods -- Part 6: Proximity cards Notes: The current revision was published in July 2016. An amendment to this version was published in March 2018 (Amd 3:2018). A new version of 10373-6 is under development and is at FDIS stage – Registered for Ballot [07/08/2019]. There are now two amendments to the latest version under development: DAmD 1 at DIS [close of voting] [25/07/2018]. DAmD 2) at DIS [close of voting] [05/09/2019].	2016	ISO/IEC 10373-6/Amd 3:2018



Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 14443	1	Identification cards -- Contactless integrated circuit cards -- Proximity cards -- Part 1: Physical characteristics	2018	
	2	Identification cards -- Contactless integrated circuit cards -- Proximity cards -- Part 2: Radio frequency power and signal interface Note: An update to the standard is under development, currently at FDIS [Registered for formal approval], [14/08/2019].	2016	
	3	Identification cards -- Contactless integrated circuit cards -- Proximity cards -- Part 3: Initialization and anticollision Note: This is a new version (2018) published in June 2018 with (according to the ISO website) 1 amendment (DAmd 1) approved for registration as FDIS (July 2018). There is a second amendment at DIS [close of voting] [06/09/2019]. ISO/IEC 14443-4:2018/DAmd 2.	2018	
	4	Identification cards -- Contactless integrated circuit cards -- Proximity cards -- Part 4: Transmission protocol Note: This is a new version (2018) published in June 2018 with (according to the ISO website) 1 amendment (DAmd 1) approved for registration as FDIS (July 2018). There is a second amendment at DIS [close of voting] [07/09/2019]. ISO/IEC 14443-4:2018/DAmd 2.	2018	



Standard	Part	Description	Latest Revision	Amendment(s)
ISO 14813	1	Intelligent transport systems — Reference model architecture(s) for the ITS sector — Part 1: ITS service domains, service groups and services	2015	
	6	Intelligent Transport Systems – Reference model architecture(s) for the ITS sector – Data presentation in ASN.1	2017	
ISO 14817	1	Intelligent transport systems -- ITS central data dictionaries -- Part 1: Requirements for ITS data definitions	2015	
	2	Intelligent transport systems – ITS central data dictionaries – Part 2: Governance of the Central ITS Data Concept Registry	2015	
ISO 14817	3	Intelligent transport systems – ITS central data dictionaries – Part 3: Object identifier assignments for ITS data concepts	2017	
ISO/IEC 14888	1	Information technology -- Security techniques -- Digital signatures with appendix -- Part 1: General Note: This Part currently under review	2008	
ISO/IEC 14888	2	Information technology -- Security techniques -- Digital signatures with appendix -- Part 2: Integer factorization based mechanisms Note: This Part currently under review	2008	ISO/IEC 14888-2:2008/Cor 1:2015
ISO/IEC 14888	3	IT Security techniques -- Digital signatures with appendix -- Part 3: Discrete logarithm based mechanisms	2018	



Standard	Part	Description	Latest Revision	Amendment(s)
ISO/IEC 15408	1	<p>Information technology -- Security techniques -- Evaluation criteria for IT security -- Part 1: Introduction and general model</p> <p>Note: This is the Common Criteria for Information Technology Security Evaluation (abbreviated as Common Criteria or CC), an international standard for computer security certification.</p> <p>A new project has been approved to update this part of the standard to become 15408-1.3. It is currently designated ISO/IEC CD (Committee Draft) 15408-1.3 [referred back to working group], as at July 2019.</p>	2009	
	2	<p>Information technology -- Security techniques -- Evaluation criteria for IT security -- Part 2: Security functional components</p> <p>A new project has been approved to update this part of the standard. It is currently designated ISO/IEC CD (Committee Draft) 15408-2, [referred back to working group], as at July 2019.</p>	2008	
ISO/IEC 15408	3	<p>Information technology -- Security techniques -- Evaluation criteria for IT security -- Part 3: Security assurance components</p> <p>A new project has been approved to update this part of the standard. It is currently designated ISO/IEC CD (Committee Draft) 15408-3, (voting closed – 3rd time), as at September 2019.</p>	2008	



Standard	Part	Description	Latest Revision	Amendment(s)
	4	Information technology -- Security techniques -- Evaluation criteria for IT security -- Part 4: Framework for the specification of evaluation methods and activities A new project has been approved to update this standard. This is a new part, currently designated ISO/IEC CD (Committee Draft) 15408-4, (voting closed – 3 rd time), as at September 2019.	Not yet published	
ISO/IEC 15408	5	Information technology -- Security techniques -- Evaluation criteria for IT security -- Part 5: Pre-defined packages of security requirements A new project has been approved to update this standard. This is a new part, currently designated ISO/IEC CD (Committee Draft) 15408-5, (voting closed – 3 rd time), as at September 2019.	Not yet published	
ISO/IEC 17025	NA	General Requirements for the competence of testing and calibration laboratories	2017	
ISO/IEC 17065	NA	Conformity assessment -- Requirements for bodies certifying products, processes and services. Last Review: 2018 Standard Confirmed	2012	
ISO/IEC 18092	NA	Information technology -- Telecommunications and information exchange between systems -- Near Field Communication -- Interface and Protocol (NFCIP-1) Note: This standard is now under periodical review – review closed, not yet confirmed, Jun 2018.	2013	ISO/IEC 18092:2013/Cor 1:2015
ISO 24014	1	Public transport -- Interoperable fare management system -- Part 1: Architecture Note: A new version of this Part is under development at ISO. The project is designated ISO/CD 24014-1 and is	2015	



Standard	Part	Description	Latest Revision	Amendment(s)
		as CD approved for registration as DIS [28/09/2019].		
ISO/TR 24014	2	Public transport -- Interoperable fare management system -- Part 2: Business practices Note: Due for review within the next 12 months	2013	
ISO/TR 24014	3	Public transport -- Interoperable fare management system -- Part 3: Complementary concepts to Part 1 for multi-application media Note: Due for review within the next 12 months	2013	



3 CEN (Committee for European Standardization [Norms])

A European Standards Body.

Note 1: in the following table the following abbreviations apply:

- BS – British Standard
- EN – European Norm (or standard)
- TS – Technical Specification
- WI – Work Item

Note 2: In the following table, except where otherwise stated, Standards which start with the prefix BS are the British Standard [English] version of a European Norm. They may also be available in other languages (usually French and German as a minimum) with a different prefix.

Standard	Part	Description	Revision	Amendment
BS EN 1332	1	Identification card systems. Human-machine interface. Design principles for the user interface <i>Note: This is a national standard which does not have a CEN equivalent, but which has been translated into a number of other languages for use by other national standards bodies.</i>	2009	
	2	Identification card systems. Man-machine interface. Dimensions and location of a tactile identifier for ID-1 cards <i>Note: This is a national standard which does not have a CEN equivalent, but which has been translated into a number of other languages for use by other national standards bodies.</i>	1998	
	3	Identification card systems. Man-machine interface. Keypads <i>Note: This is a national standard which does not have a CEN equivalent, but which has been translated into a number of other languages for use by other national standards bodies.</i>	2008	



Standard	Part	Description	Revision	Amendment
BS EN 1332	4	<p>Identification card systems. Man-machine interface. Coding of user requirements for people with special needs</p> <p><i>Note: This is a national standard which does not have a CEN equivalent, but which has been translated into a number of other languages for use by other national standards bodies.</i></p> <p>Note: Currently under review.</p>	2007	
	5	<p>Identification card systems. Man-machine interface. Raised tactile symbols for differentiation of application on ID-1 cards</p> <p><i>Note: This is a national standard which does not have a CEN equivalent, but which has been translated into a number of other languages for use by other national standards bodies.</i></p>	2006	
CEN EN 12896		<p>Reference Data Model For Public Transport – also known as Transmodel. It is being updated to the 2016 version (from 2006 which will be withdrawn once all parts have been updated. For context see http://transmodel-cen.eu</p> <p>Road transport and traffic telematics. Public transport. Reference Data Model. As this is a European Norm each member of CEN has to publish its own version of this standard. The British versions (in English, one of 3 formal languages) are shown below, as published.</p>	2016	
BS EN 12896	1	Public transport. Reference data model. Common concepts	2016	
	2	Public transport. Reference data model. Public transport network	2016	



Standard	Part	Description	Revision	Amendment
BS EN 12896	3	Public transport. Reference data model. Timing information and vehicle scheduling	2016	
BS EN 12896	4	Public transport. Reference data model. Operations monitoring and control Current Status: Draft for Public Comment. [November 2018]	TBC	
BS EN 12896	5	Public transport. Reference data model. Fare management Current Status: Draft for Public Comment. [November 2018]	TBC	
BS EN 12896	6	Public transport. Reference data model. Passenger information Current Status: Draft for Public Comment. [November 2018]	TBC	
BS EN 12896	7	Public transport. Reference data model. Driver management Current Status: Draft for Public Comment. [November 2018]	TBC	
BS EN 12896	8	Public transport. Reference data model. Management information and statistics Current Status: Draft for Public Comment. [November 2018]	TBC	
PD CEN/TR 12896	9	Public transport. Reference data model. Informative documentation Note: will become Part 9 of BS EN 12896	2016	
BS EN 16157	1	Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 1: Context and Framework Note: Replaces CEN/TS 16157-1:2011	2018	
BS EN 16157	2	Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 2: Location referencing Note: Replaces CEN/TS 16157-2:2011	2019	



Standard	Part	Description	Revision	Amendment
BS EN 16157	3	Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 3: Situation Publication <i>Note: Replaces CEN/TS 16157-3:2011</i>	2018	
PD CEN/TS 16157	4	Intelligent transport systems. DATEX II data exchange specifications for traffic management and information. Part 4: Variable Message Sign (VMS) Publications <i>Note: Due for review within 12 to 18 months.</i>	2014	
PD CEN/TS 16157	5	Intelligent transport systems. DATEX II data exchange specifications for traffic management and information. Part 5: Measured and elaborated data publications <i>Note: New BS EN 16157-5 version is at Draft for Public Comment – published September 2019</i>	2014	
PD CEN/TS 16157	6	Intelligent transport systems. DATEX II data exchange specifications for traffic management and information. Part 6: Parking Publications <i>Note: Currently under review</i>	2014	
BS EN 16157	7	Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 7: Common Data Elements	2018	



Standard	Part	Description	Revision	Amendment
CEN TS 16794	1	Public transport. Communication between contactless readers and fare media. Test plan for ISO/IEC 14443 <i>Note: Work on drafting Edition 3 of this TS has now completed. Ballot completed in 2019. Publication expected early 2020.</i>	2017	-
CEN TS 16794	2	Public transport. Communication between contactless readers and fare media. Test plan for ISO/IEC 14443 <i>Note: Work on drafting Edition 3 of this TS has now completed. Ballot completed in 2019. Publication expected early 2020.</i>	2017	-
PD CEN TR 16959		Public transport. Network and Timetable Exchange (NeTEx). Examples, guidelines and explanatory materials <i>NeTEx - Network and Timetable Exchange NeTEx provides a framework for specifying communications and data exchange protocols for organisations wishing to exchange scheduled Information relating to public transport operations. See also netex-cen.eu</i>	2016	
PD CEN TS 16614	1	Public transport. Network and Timetable Exchange (NeTEx). Public transport network topology exchange format	2014	
	2	Public transport. Network and Timetable Exchange (NeTEx). Public transport scheduled timetables exchange format	2014	
	3	Public transport. Network and Timetable Exchange (NeTEx). Public transport fares exchange format	2016	



Standard	Part	Description	Revision	Amendment
BS EN 28701		<p>Intelligent transport systems. Public transport. Identification of Fixed Objects in Public Transport (IFOPT)</p> <p>Note 1: this replaced DD CEN/TS 28701:2010 which has been withdrawn. (It is now a BS)</p> <p>Note 2: The withdrawn standard has been replaced in some other countries with their own version. (For example: NF EN 28701 and DIN EN 28701:2013 – these are national translations of BS EN 28701.)</p> <p>Note: This standard is currently under review.</p>	2012	
EN 419212	1	<p>Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Services. Introduction and common definitions</p> <p>Note: This standard is currently under review.</p>	2017	
	2	<p>Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Services. Signature and Seal Services</p>	2017	
	3	<p>Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Services. Device authentication protocols</p>	2017	
	4	<p>Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Services. Privacy specific Protocols</p>	2018	
	5	<p>Application Interface for Secure Elements for Electronic Identification, Authentication and Trusted Services. Trusted eService</p>	2018	



Standard	Part	Description	Revision	Amendment
PD CEN TS 419221	1	Protection Profiles for TSP cryptographic modules. Overview	2016	
	2	Protection Profiles for TSP cryptographic modules. Cryptographic module for CSP signing operations with backup	2016	
	3	Protection Profiles for TSP Cryptographic modules. Cryptographic module for CSP key generation services	2016	
	4	Protection Profiles for TSP cryptographic modules. Cryptographic module for CSP signing operations without backup	2016	
BS EN 419221	5	Protection Profiles for TSP Cryptographic Modules. Cryptographic Module for Trust Services	2018	
PD CEN TS 419221	6	Conditions for use of EN 419221-5 as a qualified electronic signature or seal creation device. New: Published April 2019	2019	



4 ETSI (European Telecommunications Standards Institute)

ETSI, the European Telecommunications Standards Institute, [produces globally-applicable standards](#) for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and Internet technologies. ETSI's standards enable the technologies on which business and society rely. For example, standards for GSM™, DECT™, Smart Cards and electronic signatures have helped to revolutionize modern life all over the world.

Recent releases are highlighted in yellow.

Standard	Description
TS 102 225	Smart Cards; Secured packet structure for UICC based applications (Release 13.0.0 2018-07)
TS 102 226	Smart Cards; Remote APDU structure for UICC based applications (Release 13.0.0 2016-05)
TS 102 613	UICC CLF interface – Part 1 Physical and data link layer characteristics (Release 13.0.0 2018-08) Note: Beware: releases 12 and 13 were both published in August 2018.
TS 102 622	Smart Cards; UICC – Contactless Front-end (CLF) interface; Host Controller Interface (HCI) (Release 13.0.0 2016-10)



5 GSMA (GSM Association)

The membership body for GSM mobile communications (originally the GSM project.)

For more information on the work of GSMA please see their website. Follow the link to: <https://www.gsma.com/aboutus/> .

Requirements Documents	Description	Version
TS.26 NFC Handset Requirements	This document lists requirements for devices to support NFC services primarily focused on NFC services based on the UICC and eSE. It sets out a common framework of requirements, identifying and referencing relevant standards (or elements thereof), selecting options from among those allowed by existing standards to ensure interoperability. A list of relevant standards is captured in section 2 and further detailed by explicit requirements.	15.0 (19 Jun 2019)
TS.27 NFC Handset Test Book	This NFC Test Book stream is part of GSMA NFC activities. The participating GSMA TSG members have developed a set of test cases to be used for testing primarily the SE based NFC functionality within a Mobile Device. These tests have been collated in this "Test Book" and provide test case descriptions against the requirements listed in the GSMA TS.26 NFC Handset Requirements document [see above].	15.0 (19 Jun 2019)
SGP.04 NFC SP Applet Development Guideline	The purpose of this document is to provide to Service Providers with some rules, common to the Mobile Operators, in order to properly develop their mobile NFC service applet (Basic Applications). This document is for guidance only.	4.0 (30 Sep 2015)
SGP.03 NFC UICC Requirements Specification	This document lists for the NFC UICC a minimum set of requirements and the specification of technical gaps identified to ensure an efficient and consistent development and deployment of NFC services. In particular, this document details: <input type="checkbox"/> References to the standard technical specifications; <input type="checkbox"/> Optional requirements of the referenced standards that shall be implemented in the NFC UICC.	7.0 (21 Feb 2018)



6 EMVCo (Europay Mastercard Visa)

Standard	Description
EMVCo – Level1 EMV Contactless	<p>On EMV Contactless Cards – payments https://www.emvco.com/specifications.aspx?id=21</p> <p>The EMV Contactless Specifications for Payment Systems consist of the following documents available hereafter for view or download:</p> <ul style="list-style-type: none">• Book A: Architecture and General Requirements• Book B: Entry Point• Books C [C-1, C-2, C-3, C-4, C-5, C-6, C-7]: Kernel Specifications• Book D: Contactless Communication Protocol <p>Note: updates to EMV Co specification documents are published regularly. Follow the above link to find the most recent documentation.</p>

6.1 Terminal Type Approval:

EMVCo established the Terminal Type Approval process to create a mechanism to test compliance with the EMV Specifications. Type Approval provides an increased level of confidence that interoperability and consistent behaviour between compliant applications have been achieved. EMVCo Type Approval testing is divided into two levels. The Level 1 Type Approval process tests compliance with the electromechanical characteristics, logical interface, and transmission protocol requirements defined in the EMV Specifications. Level 2 Type Approval tests compliance with the debit/credit application requirements as defined in the EMV Specifications. Please visit the [Terminal Type Approval](#) section of the EMVCo website for more information.

You may also find the Product Approval section provides more information on Type Approval [here](#).

6.2 Mobile Type Approval

EMVCo established the Contactless Mobile Payment (CMP) Product Type Approval process to create a mechanism to test compliance with EMV Specifications, including those defined by other EMVCo working groups. The CMP Product Type Approval process provides an increased level of confidence for interoperability and consistent behaviour between compliant contactless mobile payment products.

EMVCo product approval does not address or supersede the payment schemes Contactless Mobile Payment product issuance and personalization requirements. Please contact the payment schemes directly to obtain more information regarding their vendor authorization programs and other contactless mobile payment product issuance and personalization requirements.

Please refer to <https://www.emvco.com/approvals.aspx?id=225> for more information.



7 Global Platform

GlobalPlatform is a non-profit, member driven association which defines and develops specifications to facilitate the secure deployment and management of multiple applications on secure chip technology. Its standardized infrastructure empowers service providers to develop digital services once and deploy them across different devices and channels. GlobalPlatform's security and privacy parameters enable dynamic combinations of secure and non-secure services from multiple providers on the same device, providing a foundation for market convergence and innovative new cross-sector partnerships.

GlobalPlatform is *the* international industry standard for trusted end-to-end secure deployment and management solutions. The technology's widespread global adoption across finance, mobile/telecom, government, premium content, automotive, healthcare, retail and transit sectors delivers cost and time-to-market efficiencies to all. GlobalPlatform supports the long-term interoperability and scalability of application deployment and management through its secure chip technology open compliance program.

For more information follow the link to the GlobalPlatform website:

<https://globalplatform.org/>

You can find details of GlobalPlatform's Technology Library here:

<https://globalplatform.org/specs-library/>

Specification	Description	Revision
GlobalPlatform Card Specification	<p>Published March 2018 – This maintenance release corrects issues in the previous version while maintaining full backwards compatibility. It also removes the deprecated Secure Channel Protocol '01' and deprecates the DES based Secure Channel Protocol '02'.</p> <p>This is the latest GlobalPlatform Card Specification. It is central to all GlobalPlatform card technology activity, and is core to the technical documents outlined in this section. Of interest to card and application developers, it defines card components, command sets, transaction sequences and interfaces. The technology also supports dynamic post-issuance card management, which facilitates the addition and modification of applications. This specification is hardware, operating system, vendor and application neutral, enabling it to be applicable to any type of deployment and industry.</p> <p>Card Specification v2.3.1 adds mechanisms which were originally specified in Amendments A, C, D and E and are now merged into this document. In addition, it includes some errata and precisions.</p> <p>The GlobalPlatform API Specifications (Java Card™ and MULTOS™) have been removed from this document and are now published separately on the GlobalPlatform website.</p> <p>Please visit: https://globalplatform.org/specs-library/ and search on “SE” to find the latest amendments and documents.</p>	V2.3.1



<p>GlobalPlatform TEE System Architecture v1.2 GPD_SPE_009</p>	<p>Published December 2018 – This document explains the hardware and software architectures behind the TEE. It introduces TEE management and explains concepts relevant to TEE functional availability in a device.</p> <p>Over the last few years, further new specifications have been brought out for the TEE and GP has defined its concepts of Root of Trust. This TEE Architecture document revision brings the related architectural and conceptual additions and clarifications into one place, enabling third parties to gain a quick overview of the possibilities when using a TEE.</p> <p>Please visit: https://globalplatform.org/specs-library/ and search for TEE and Specification in the drop down boxes.</p>	<p>V1.2</p>
<p>GlobalPlatform Messaging Specification for Management of Mobile NFC Services GPS_SPE_002</p>	<p>Published November 2015 – This document describes the extension of the GlobalPlatform System Messaging Core Specification allowing the exchange of messages for performing the delivery and the post-issuance management of mobile-NFC services, i.e. NFC Services deployed in a mobile phone environment. The scope of this specification is defined by the „GlobalPlatform’s Proposition for NFC Mobile: Secure Element Management and Messaging“ white paper, the UICC Card Configuration document and the GSMA/EPC white paper.</p> <p>This version contains clarifications, improvements and feedbacks coming from the field. It introduces a new actor related to Device Applications management. It also includes clarifications and changes requested by the End to End Simplified Framework Working Group. It also specifically addresses the new security levels defined in the Web Services Profile for GlobalPlatform Messaging version 1.1</p> <p>Please visit: https://globalplatform.org/specs-library/ and search for “SE” [leftmost box] and “System Specification“ (middle box) in the drop down boxes.</p>	<p>V1.2</p>
<p>GlobalPlatform System E2E Simplified Service Management Framework Transport GPS_GUI_014</p>	<p>Published July 2017 - In the same way as GlobalPlatform defined a system configuration for the Payment industry, this document defines a system configuration for the Transport industry. Applicable processes have been reviewed and a new mode for service management has been introduced in order to match some Transport industry practices.</p> <p>Note: The current version is the same textually as version 1.0.0. (published in March 2017). Some formatting glitches are corrected in version 1.0.1.</p> <p>Please visit: https://globalplatform.org/specs-library/ and search for “SE” [leftmost box] and “ALL DOCUMENT TYPES“ in the drop down boxes and type “TRANSPORT” in the [rightmost] search box.</p>	<p>v1.0.1</p>

Note: for more information and specifications on the work of GlobalPlatform please go to their website <https://www.globalplatform.org/>



8 GCF (Global Certification Forum)

GCF Certification exists to enable manufacturers to ensure their latest smartphones, handsets and wireless devices will work correctly on the world's mobile networks.

GCF Certification is maintained "by the industry for the industry" through the [Global Certification Forum](#) (GCF) whose growing membership includes:

- Mobile network [operators](#) representing all key markets worldwide
- More than 95 device [manufacturers](#)
- Observer Members and other [mobile industry stakeholders](#) including test laboratories, and test system manufacturers.

With its philosophy of "Test once, use anywhere" GCF aims to benefit the whole mobile industry by:

- Reducing testing costs
- Shortening time to market
- Raising the overall quality of wirelessly-connected products in the global marketplace.



9 NFC Forum (Near Field Communications)

The NFC Forum (<https://nfc-forum.org>) provides specifications and programs to create a highly stable framework for extensive NFC application development, seamless interoperable solutions, secure NFC-enabled transactions, and branding to ensure globally recognizable products and services.

A range of materials and documentation is available to support the adoption and deployment of NFC technology. These materials include detailed NFC Forum brand guidelines documentation, specifications, and interoperability guidelines.

The NFC Forum Certification program confirms an implementation's compliance to NFC Forum specifications. Conformance to the specifications provides consistency of behavior across NFC enabled devices and sets the foundation for interoperability.

Note that some documents contained in this section are only available to members of the NFC Forum. See: <https://nfc-forum.org/join/> to discover how to become a member.

Document Name	Description	Version
NFC Logical Link Control Protocol (LLCP) Technical Specification	<p>Defines an OSI layer-2 protocol to support peer-to-peer communication between two NFC-enabled devices, which is essential for any NFC applications that involve bi-directional communications. The specification defines two service types, connectionless and connection-oriented, organized into three link service classes: connectionless service only; connection-oriented service only; and both connectionless and connection-oriented service. The connectionless service offers minimal setup with no reliability or flow-control guarantees (deferring these issues to applications and to the reliability guarantees offered by ISO/IEC 18092 and ISO/IEC 14443 MAC layers). The connection-oriented service adds in-order, reliable delivery, flow-control, and session-based service layer multiplexing.</p> <p>LLCP is a compact protocol, based on the industry standard IEEE 802.2, designed to support either small applications with limited data transport requirements, such as minor file transfers, or network protocols, such as OBEX and TCP/IP, which in turn provide a more robust service environment for applications. The NFC LLCP thus delivers a solid foundation for peer-to-peer applications, enhancing the basic functionality offered by ISO/IEC 18092, but without affecting the interoperability of legacy NFC applications or chipsets. Version 1.3 of the LLCP specification added an unauthenticated secure data transport option to ensure privacy and confidentiality of messages exchanged between peer devices.</p>	1.3 (October 2016)
NFC Activity Technical Specification	<p>The specification explains how the NFC Digital Protocol Specification can be used to set up the communication protocol with another NFC device or NFC Forum tag. It describes the building blocks, called Activities, for setting up the communication protocol. These Activities can be used as defined in this specification or can be modified to define other ways of setting up the communication protocol, covering the same or different use cases. Activities are combined in Profiles. Each Profile has specific Configuration Parameters and covers a particular use case. This document defines Profiles polling for an NFC device and establishment of Peer to Peer communication, polling for and reading NFC Data Exchange Format (NDEF) data from an NFC Forum tag, and polling for a NFC tag or NFC device in combination.</p> <p>The combination of Activities and Profiles define a predictable behavior for an NFC Forum device. This does not limit NFC Forum devices from implementing</p>	2.0 (April 2017)














Document Name	Description	Version
	<p>other building blocks or defining other Profiles – for other use cases – on top of the existing ones.</p> <p>Version 2.0 of the Activity technical specification has been extended to support ACM for P2P communication and NFC-V technology. Additionally, updates have been included based on ongoing alignment efforts with other organizations and standards, such as EMVCo, ISO/IEC 14443 and ISO/IEC 18092.</p>	
NFC Simple NDEF Exchange Protocol specification	The Simple NDEF Exchange Protocol (SNEP) allows an application on an NFC-enabled device to exchange NFC Data Exchange Format (NDEF) messages with another NFC Forum device when operating in NFC Forum peer-to-peer mode. The protocol makes use of the Logical Link Control Protocol (LLCP) connection-oriented transport mode to provide a reliable data exchange.	1.0 (March 2017)
NFC Analog Technical Specification	<p>This specification addresses the analog characteristics of the RF interface of the NFC Forum Device. Its purpose is the characterization and definition of the NFC Forum Device's externally observable signals, without limiting the design of the NFC Forum Device's antenna. These analog characteristics include the Device's power requirements (determining operating volume), transmission requirements, receiver requirements and signal forms (time/frequency/modulation characteristics).</p> <p>Specification of the analog characteristics requires the definition of the characteristics of the signal measurement equipment. This technical specification defines the minimum measurement equipment necessary to delimit the analog interface. The equipment consists solely of the components that have direct interaction with the RF field. The various analog signals themselves still need to be measured by separate measurement equipment that is not defined in this specification.</p> <p>This specification assumes that the same requirements apply, independent of the mode in which the NFC Forum Device is operating. For example: devices that are self-powered might still be capable of operation once that power has been depleted.</p> <p>This document is intended for use by manufacturers planning to implement an NFC Forum Device.</p> <p>The Analog 2.0 Specification introduced Active Communication Mode for P2P data exchange and NFC-V technology in poll mode. Version 2.0 ensured full interoperability with devices conformant to ISO/IEC 14443 or ISO/IEC 18092 by harmonising the analog parameter for the contactless communication. This interoperability is important to enable the reliable usage of NFC devices with existing infrastructure using ISO compatible RF readers and/or cards (e.g. for contactless public transport applications). The 2.1 Version introduces some alignments to EMVCo and the NFC-V Listen mode requirements.</p>	2.1 (May 2018)
NFC Controller Interface (NCI) Technical Specification	The NCI specification defines a standard interface within an NFC device between an NFC controller and the device's main application processor. The NCI makes it easier for device manufacturers to integrate chipsets from different chip manufacturers, and it defines a common level of functionality and interoperability among the components within an NFC-enabled device. With the availability of the NCI, manufacturers have access to a standard interface they can use for whatever kind of NFC-enabled device they build – including mobile phones, PCs, tablets, printers, consumer electronics, and appliances.	2.1 (September 2018)



Document Name	Description	Version
NFC Data Exchange Format (NDEF) Technical Specification	Specifies a common data format for NFC Forum-compliant devices and NFC Forum-compliant tags.	1.0 (November 2018)
NFC Forum Connection Handover Specification	Defines the structure and sequence of interactions that enable two NFC-enabled devices to establish a connection using other wireless communication technologies. Connection Handover combines the simple, one-touch set-up of NFC with high-speed communication technologies, such as WiFi or Bluetooth. The specification enables developers to choose the carrier for the information to be exchanged. If matching wireless capabilities are revealed during the negotiation process between two NFC-enabled devices, the connection can switch to the selected carrier. With this specification, other communication standards bodies can define information required for the connection setup to be carried in NFC Data Exchange Format (NDEF) messages. The specification also covers static handover, in which the connection handover information is stored on a simple NFC Forum Tag that can be read by NFC-enabled devices. Static mode is used in applications in which the negotiation mechanism or on-demand carrier activation is not required.	1.4 (April 2018)
NFC Forum Certification Program Policy	<p>This document is intended primarily for the Supplier looking to certify a device and the test laboratory planning to provide testing services. This policy, in conjunction with the Device Requirements [DEVREQS], Certification Agreement and Certification License Agreement, constitutes a complete set of requirements and obligations for achieving certification. The Buyer intending to procure Certified Implementations will also find this document useful for understanding what can be expected from a Certified Implementation.</p> <p>Download the document from: https://nfc-forum.org/wp-content/uploads/2017/08/NFCForum_Certification_Program_Policy.pdf</p> <p>See also http://nfc-forum.org/our-work/compliance/certification-program/certification-documents/</p> <p>Certification Policy Version 1.5.01 was Published in June 2017.</p>	1.5.01



Document Name	Description	Version
NFC Forum Testing Documentation	Please see the NFC Forum website for the latest versions of the Testing Documentation, forms and applicability.	
	As an example, Test Release 11.1 (authorised for use in Certification from April 2018) contains the following documentation:	
	 Test Cases for Digital Protocol	(Version 2.0.01)
	 Test Cases for LLCP	(Version 1.2.02)
	 Test Cases for SNEP	(Version 1.0.06)
	 Test Cases for Tag Type 1 Operation	(Version 1.2.01)
	 Test Cases for Tag Type 2 Tag and Type 2 Tag Operation	(Version 1.0.01)
	 Test Cases for Tag Type 3 Tag and Type 3 Tag Operation	(Version 1.0.01)
	 Test Cases for Tag Type 4 Tag and Type 4 Tag Operation	(Version 1.0.01)
	 Test Cases for Tag Type 5 Tag and Type 5 Tag Operation	(Version 1.0.00)
	 Test Cases for Tag Performance	(Version 1.0.00)
	 Device Test Application	(Version 2.2.02)
 Test Case Mapping Table	(Version 3.0.00)	

For further information on NFC Specification Status please go to the NFC-Forum website:

<http://nfc-forum.org/our-work/specifications-and-application-documents/specifications/specification-releases/>

For more information on NFC Forum compliance see:

<https://nfc-forum.org/certification-program-overview/>

and

<https://nfc-forum.org/our-work/compliance/certification-program/certification-documents/>

and

<https://nfc-forum.org/our-work/compliance/certification-program/certification-releases/>



10 Other Standards

Norm	Description
W3C	<i>On Web-Services...</i> <i>XML, XSD, WSDL, SOAP</i>
IETF	Internationalized Resource Identifiers (IRIs) RFC3987 http://www.ietf.org/rfc/rfc3987
WC3	Widget Packaging and XML Configuration, http://www.w3.org/TR/widgets
RFC1032	Domain Administrators Guide, IETF RFC1032 http://www.ietf.org/rfc/rfc1032