ETSI GS ARF 004-5 V1.1.1 (2022-12)

GROUP SPECIFICATION

Augmented Reality Framework (ARF); Interoperability Requirements for AR components, systems and services; Part 5: External Communications

Disclaimer

The present document has been produced and approved by the Augmented Reality Framework (ARF) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG.
It does not necessarily represent the views of the entire ETSI membership.

Reference

DGS/ARF-004-5

Keywords

AR cloud, architecture, augmented reality, data sharing, framework, interoperability, requirements

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

If you find a security vulnerability in the present document, please report it through our Coordinated Vulnerability Disclosure Program:
https://www.etsi.org/standards/coordinated-vulnerability-disclosure

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.
No recommendation as to products and services or vendors is made or should be implied.
No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.
In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

Contents

Intellectual Property Rights 4

Foreword 4

Modal verbs terminology 4

1 Scope 5

2 References 5
2.1 Normative references 5
2.2 Informative references 5

3 Definition of terms, symbols and abbreviations 6
3.1 Terms 6
3.2 Symbols 6
3.3 Abbreviations 6

4 Interoperability Requirements for AR3 7
4.1 Scope of the AR3 Reference Point 7
4.2 High-level requirements 7
4.3 Scene Management Function: Detection of External Application Support 8
4.4 Scene Management Function: Capability Exchange with External Application Support 9
4.5 Information Transfer between External Application Support and Scene Management 9

Annex A (informative): Standards of Relevance to AR3 Requirements 10

A.1 Introduction 10

A.2 Standards Supporting the Detection of External Services 10
A.2.1 Overview 10
A.2.2 Session Announcement Protocol 10
A.2.3 Service Location Protocol 10
A.2.4 DNS-Based Service Discovery 11
A.2.5 Multicast DNS 11
A.2.6 W3C Web of Things Discovery 11

A.3 Standards Supporting the Capability Exchange with External Services 11
A.3.1 Overview 11
A.3.2 Diameter Base Protocol 11
A.3.3 Message Queuing Telemetry Transport 12

A.4 Standards Supporting Information Transfer with External Services 12
A.4.1 Overview 12
A.4.2 IEEE 802.3 12
A.4.3 IEEE 802.11 12

A.5 Miscellaneous 12
A.5.1 Secure Data Transfer 12

History 14

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM**® and the GSM logo are trademarks registered and owned by the GSM Association.

Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Augmented Reality Framework (ARF).

The present document is part 5 of a multi-part deliverable covering Interoperability Requirements for AR components, systems and services, as identified below:

Part 1: "Overview";

Part 2: "World Storage and AR Authoring functions";

Part 3: "World Capture, World Analysis and Scene Management";

Part 4: "World Analysis, World Storage and Scene Management functions (AR8, AR10, AR11)";

Part 5: "External Communications".

The ISG ARF shares the following understanding for Augmented Reality: Augmented Reality (AR) is the ability to mix in real-time spatially-registered digital content with the real world. The present document specifies the interoperability requirements for Reference Points AR1 and AR2 of the reference architecture for AR solutions defined in ETSI GS ARF 003 [1].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document reviews the high level Reference Point requirements between the Scene Management and External Application Support functions as they are described in ETSI GS ARF 003 [1].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS ARF 003 (V1.1.1): "Augmented Reality Framework (ARF) AR framework architecture".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IETF RFC 7231: "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc7231.txt.

[i.2] IETF RFC 2974: "Session Announcement Protocol".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc2974.txt.

[i.3] IETF RFC 2608: "Service Location Protocol".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc2608.txt.

[i.4] IETF RFC 6763: "DNS-Based Service Discovery".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc6763.txt.

[i.5] IETF RFC 6762: "Multicast DNS".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc6762.txt.

[i.6] W3C® Working Draft, 10 August 2022: "Web of Things (WoT) Discovery".

NOTE: Available at https://www.w3.org/TR/wot-discovery/.

[i.7] IETF RFC 6733: "Diameter Base Protocol".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc6733.txt.

[i.8] OASIS Standard (7 March 2019): "MQTT Version 5.0".

NOTE: Available at https://docs.oasis-open.org/mqtt/mqtt/v5.0/os/mqtt-v5.0-os.html.

[i.9] IEEE 802.3TM-2018: "IEEE Standard for Ethernet".

NOTE: Available at https://ieeexplore.ieee.org/document/8457469.

[i.10] IEEE 802.11TM-2020: "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

NOTE: Available at https://standards.ieee.org/ieee/802.11/7028/.

[i.11] IETF RFC 5246: "The Transport Layer Security (TLS) Protocol Version 1.2".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc5246.txt.

[i.12] IETF RFC 8446: "The Transport Layer Security (TLS) Protocol Version 1.3".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc8446.txt.

[i.13] IETF RFC 9110: "HTTP Semantics".

NOTE: Available at https://www.rfc-editor.org/rfc/rfc9110.txt.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

AR scene: information describing the interactive content contributing to an augmented reality experience

reference point: point located at the interface of two non-overlapping functions and representing interrelated interactions between those functions

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AR	Augmented Reality
AVP	Attribute Value Pair
DNS	Domain Name System
Gb	Gigabit
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
IP	Internet Protocol
LAN	Local Area Network

Mb	Megabit
MQTT	Message Queuing Telemetry Transport
RP	Reference Point
SDO	Standard Development Organization
SM	Scene Management
TCP	Transmission Control Protocol
TLS	Transport Layer Security
URI	Uniform Resource Identifier
URL	Universal Resource Locator
WLAN	Wireless LAN

4 Interoperability Requirements for AR3

4.1 Scope of the AR3 Reference Point

The AR3 "External Communications" Reference Point (RP), as specified in ETSI GS ARF 003 [1] defines the dialog structure for real-time communication and data exchange between the Scene Management (SM) functions and an external system to ensure that relevant features of such a system are available to SM subfunctions for processing and control. Envolved in such activities are the subfunctions "Interaction Technique" and "Virtual Scene Update".

NOTE: In the reference architecture of ETSI GS ARF 003 [1] the external function block is named as "External Application Support". It should be mentioned that for the present document only service-related aspects of this function block are taken into account.

4.2 High-level requirements

The characteristics of the External Application Suport are described in ETSI GS ARF 003 [1] as repeated here:

"*This function shall handle real-time communication and data exchange between the AR implementation and an external system. An external system may provide data at runtime which can modify the AR scene. It may also receive data or commands from the AR implementation to control the external system. The potential types of external systems can be manifold. It ranges from a simple sensor measuring a certain data value up to a complex system with multiple components. In the present document the required communication and data exchange functionalities are subsumed under the term External Application Support*".

With this description, the communication across RP AR3 can be characterized by three high level requirements that are in sequence and are depicted in Figure 1.

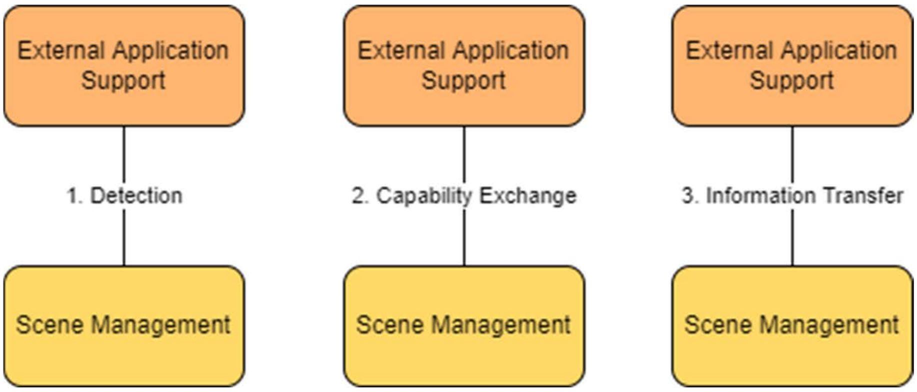

Figure 1: Sequence of AR3 requirements

The requirements of the AR3 reference point depend on the state the SM is in and can be classified as follows:

- Detection of the external application support:
  - Type of support that can be provided to the Scene Management.

  - Number of external services of similar type (when available).
  - Temporal and/or regional availability of external services; conditions of use.
  - Information about possible set-up scenarios for ensuring connectivity.
  - Basics about the type of information that can be provided.

- Capability Exchange:
  - Exchange of requests for the type of information to be transferred.
  - Requesting conditions for an information exchange (e.g. temporal, data ranges, resolution, measurement units).
  - Negotiations about the data format of the information to be transferred.
  - In case of multiple external services: identification/marking of information transfer, switching between services.

- Information transfer:
  - Packaging of information in the agreed format.
  - Initializating and closing the information transfer.
  - Metadata unambiguously associated to the information transfer.
  - In case of multiple external services: additional information about the delivering service.

4.3 Scene Management Function: Detection of External Application Support

The first set of AR3 requirements applies to the function's detection of services provided by external applications support. This activity is needed as an initial step for a possible future exchange of information between the SM and one or more external services. This function either relies on already known information about possible external services or on the availability of detecting appropriate external information that make themselves known to the SM. The SM function also sets up a list of candidates that are evaluated by the user or the AR implementation prior to the exchange of service-related information.

RQ-AR3-001	The SM shall have the ability to detect suitable external services provided by external applications support.

Requested information should include:

- Accessibility to external service (e.g. domain name, URL, temporal or regional restrictions, communication scheme (unicast, multicast, broadcast)).
- Characteristics of the external service (e.g. type of information that can be delivered, availability of metadata).
- Capabilities of the external service (e.g. computation support, data storage, etc.):

RQ-AR3-002	The SM shall have the ability to present detected external services for evaluation in case more than one service is detected.

This collection can include:

- A list of detected external services and a summary of their characteristics.
- A possibility for a human user to detect one or more of these services.
- A presentation of the collection in a format that is machine-readable.

4.4 Scene Management Function: Capability Exchange with External Application Support

Once the Scene Management has created a list of available external services for application support, a capability exchange starts with selected external services to decide which external services shall be incorporated for the sake of the AR implementation.

RQ-AR3-003	The SM shall have the ability to contact external services for a capability exchange.

The parameters for a capability exchange can include:

- Initialization parameters to start the capability exchange with an external service.
- Starting queries to tell the external service in which parameters the SM is interested in.
- Information about the availability of parameters and their representation (e.g. data format, measuring units, age of measured parameters (time stamps), temporal resp. spatial resolution).
- Information about data transfer characteristics (e.g. transmission format, transport protocol, transfer protection).
- Possibilities for monitoring and/or controlling an external service.
- Selected information to tell the external service which parameters shall be made available to the SM.
- Registration of selected parameters for usage by the Scene Management.
- Finalization parameters to stop the capability exchange with an external service.

4.5 Information Transfer between External Application Support and Scene Management

Under the control of the Scene Management and following the results of the capability exchange, data available from external services as well as for monitoring and controlling such services are exchanged between the Scene Management and the External Application Support.

RQ-AR3-004	Data streams shall be exchanged between the Scene Management and at least one external service using formats negotiated during the capability exchange.

Depending on the characteristics of both the external service and the AR scene, it may be useful to add time stamps to the data exchange to facilitate the handling of data by the AR scene or to trigger activities in the external service on the time.

RQ-AR3-005	Data streams may be extended by time stamps to facilitate synchronization between the SM and an external service.

Time stamps are the most common elements to support synchronization between components of a system. However, implementers are free to support other or supplementary levels of control (e.g. marking the availability of new data, provisioning data only for a certain time span, etc.).

Annex A (informative): Standards of Relevance to AR3 Requirements

A.1 Introduction

This annex includes standards identified by the ETSI ISG ARF while preparing the present document. The intention of this annex is to compile, for informational purposes, those Standards Development Organizations (SDOs) and working groups with relevant activities in the field of supporting data transfer with real-time aspects between different devices using a publicly available network. This annex is not exhaustive and it is expected that there are other standards and SDOs also working in this field but which are not explicitly mentioned in this annex.

A.2 Standards Supporting the Detection of External Services

A.2.1 Overview

Many AR implementations already possess pre-given addresses of external services to contact in order to run the implementation in a smooth and useful way. In almost all cases this is done by using the Hypertext Transfer Protocol (HTTP) as an application layer protocol of the Internet protocol suite by exchanging request and response messages between the AR implementation and the external service, a method known as HTTP Request (for details see section 4 of [i.1]). Where this is not the case, there are existing standards that support the detection of available services in IP-based networks using multicast or broadcast delivery mechanisms. These standards work on the network layer and allow users to find more information about the service they require. The standards identified include:

- IETF RFC 7231 [i.1].
- IETF RFC 2974 [i.2].
- IETF RFC 2608 [i.3].
- IETF RFC 6763 [i.4].
- IETF RFC 6762 [i.5].
- W3C® Working Draft [i.6].

A.2.2 Session Announcement Protocol

IETF RFC 2974 [i.2] defines the advertisement of sessions, and the possibilities to communicate the relevant session setup information to prospective participants using well-known multicast addresses. The information is periodically distributed by a session directory. The protocol does not contain any rendezvous mechanism, the announcer of a session is not aware of any listeners. The modification of a session is published by announcing a modified session description.

A.2.3 Service Location Protocol

IETF RFC 2608 [i.3] specifies a flexible and scalable framework for providing hosts with access to information about the existence, location, and configuration of networked services. Traditionally, users have had to find services by knowing the name of a network host which is an alias for a network address. This protocol eliminates the need for a user to know the name of a network host supporting a service. Rather, the user supplies the desired type of service and a set of attributes which describe the service. Based on that description, the Service Location Protocol resolves the network address of the service for the user.

The protocol is intended to function within networks under cooperative administrative control and is as such primarily designed for use within LANs. It support the usage of multicast and unicast delivery of IP packets.

A.2.4 DNS-Based Service Discovery

IETF RFC 6763 [i.4] specifies how DNS resource records are named and structured to facilitate service discovery. Given a type of service that a client is looking for, and a domain in which the client is looking for that service, the mechanism described in IETF RFC 6763 [i.4] allows users to discover a list of named instances of that desired service, using standard DNS queries, and then select, from that list, the particular instance they desire. Multicast and unicast operations are supported.

A.2.5 Multicast DNS

IETF RFC 6762 [i.5] is an extension to the possibilities given by a DNS-Based service discovery (see IETF RFC 6763 [i.4]) by allowing the identification of clients in a local link without setting up a DNS system for this local network. The domain names of the clients within the network are extended to characterize them as locally available and DNS queries are sent to a known multicast address within the local network.

A.2.6 W3C Web of Things Discovery

W3C® Working Draft [i.6] makes use of the above-mentioned network-related protocols by using DNS protocols for detecting "Things" that are not only abstractions of physical entities but can also refer to sessions. DNS queries lead to directory services that contain descriptions of Things. In order to access these services, the service name "_wot" is used. Each Thing responds with a self-description by passing the queries either straightforward to a directory owned by this Thing or to a description register. This mechanism is intended to enable interoperability across IoT platforms and application domains.

A.3 Standards Supporting the Capability Exchange with External Services

A.3.1 Overview

Many AR implementations possess application-specific information about which types of parameters more detailed information is needed in order to run the implementation in a smooth and useful way. Such a capability exchange is normally done by using the Hypertext Transfer Protocol (HTTP) as an application layer protocol of the Internet protocol suite by exchanging request and response messages between the AR implementation and the external service. Details about this method can be found in IETF RFC 7231 [i.1].

A capability exchange only about network-related parameters is possible by using the following standard:

- IETF RFC 6733 [i.7].

A content-related capability exchange is possible by using the following standard:

- Message Queuing Telemetry Transport [i.8].

A.3.2 Diameter Base Protocol

IETF RFC 6733 [i.7] is intended to provide a framework for authentication, authorization and accounting of applications such as network access or IP mobility. It specifies the message format, transport, error reporting, accounting, and security services used by all Diameter applications. One of the supported features is the capability exchange between clients related to network parameters. All data exchange between clients happens via Attribute-Value Pairs (AVPs). The Diameter protocol is designed to be extensible. Several mechanisms are available including the definition of new AVP values and the creation of new AVPs and new commands.

A.3.3 Message Queuing Telemetry Transport

The OASIS Standard [i.8] specifies a network protocol for machine-to-machine communication. It is especially designed for external applications with bandwidth restrictions and is event-driven. A message broker collects information from clients that are interested in offering their services (commonly called publishers) and from clients that are interested in receiving such services (commonly called subscribers). MQTT runs over a transport protocol that provides ordered, lossless, bi-directional connections. TCP/IP is the common connection protocol that is used. The exchange of information happens by pre-defined data packages called MQTT Control Packets that describe the type of data for this package, followed by the payload. The information is organized in a hierarchy of topics. The broker and the clients keep track of the session state of the information exchange between them.

A.4 Standards Supporting Information Transfer with External Services

A.4.1 Overview

There are several standards available supporting on the physical layer the transfer of information between the SM and an external service. However, for the large majority of all applications, a wired transmission makes use of the set of Ethernet specifications 802.3 [i.9] whereas for a wireless transmission the set of WLAN specifications 802.11 [i.10] is used. These specifications take into account the maximum achievable data rate and the type of connector used.

A.4.2 IEEE 802.3

This set of specifications for wired transmission, named after the name of the IEEE group that is responsible for these standards, takes into account the maximum achievable data rate ranging from 1 Mb/s up to 400 Gb/s, the type of connector used and whether the transport happens via copper or optical fibre. Detailed information about the structure of an Ethernet frame and the accompanying protocol mechanisms can be found in IEEE 802.3 [i.9].

A.4.3 IEEE 802.11

This set of specifications for wireless transmission is named after the IEEE group that is responsible for the development and maintenance of these standards. Depending on the characteristics of the transmission range, the available bandwidth, the number of antennas and the modulation scheme that is used, data rates ranging from 1 Mb/s up to approx. 7 Gbit/s are achievable. Detailed information about the structure of the data frame and the accompanying protocol mechanisms can be found in IEEE 802.11 [i.10].

A.5 Miscellaneous

A.5.1 Secure Data Transfer

While working on the present document, the aspect of a secure data transfer was also discussed within ISG ARF. It is obvious that the AR scene needs to trust the data that is provided by external services. The possibilities to achieve such trust are manifold and range from plausibility checks over the calculation of hash values to the encryption of transmitted data. All these possibilities mentioned here can also be combined. During the capability exchange between the SM and the external service, protection schemes are negotiated and the method selected will depend on the wanted level of trustworthiness and the methods and protocols that are available on both sides to achieve this level.

Taking into account that in almost all cases the HTTP protocol will be used to exchange data, a secure version of this protocol is often used called HTTPS (HyperText Transfer Protocol Secure). By using this type of protocol the principles of HTTP are not changed, but on the transport layer the methods provided by TLS guarantee mutual authentication of the parties involved and encryption of the transferred information. The suite of recommended encryption methods is updated at regular intervals. Older methods that are believed to be easily attackable are taken off, newer methods as elliptic curve encryption are added. At the time of publishing the present document, two TLS versions are recommended by IETF to be used, TLS 1.2 [i.11] and TLS 1.3 [i.12]. The definition of the HTTPS URI scheme and the mandatory activities accompanying the usage of this scheme are described in standard IETF RFC 9110 [i.13].

History

Document history		
V1.1.1	December 2022	Publication