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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Mobile Standards Group (MSG).

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).

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1 Scope

The present document defines Interoperability Test Descriptions for the eCall High Level Application Protocol (HLAP).

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.

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

[1] ETSI TS 122 101: "Universal Mobile Telecommunications System (UMTS); LTE; Service aspects; Service principles (3GPP TS 22.101)".

[2] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008)".

[3] EN 15722:2015: "Intelligent transport systems - eSafety - eCall minimum set of data", (produced by CEN).

[4] EN 16062:2015: "Intelligent transport systems - eSafety - eCall high level application requirements (HLAP) using GSM/UMTS circuit switched networks", (produced by CEN).

[5] EN 16072:2015: "Intelligent transport systems - eSafety - Pan-European eCall operating requirements", (produced by CEN).

[6] ETSI TS 134 123-1: "Universal Mobile Telecommunications System (UMTS); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification (3GPP TS 34.123-1)".

[7] ETSI TS 151 010-1: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification (3GPP TS 51.010-1)".

[8] ETSI TS 122 003: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Circuit Teleservices supported by a Public Land Mobile Network (PLMN) (3GPP TS 22.003)".

[9] ETSI TS 102 936-1: "eCall Network Access Device (NAD) conformance specification; Part 1: Protocol test specification".

[10] Commission Delegated Regulation (EU) 2017/79 of 12 September 2016 establishing detailed technical requirements and test procedures for the EC type-approval of motor vehicles with respect to their 112-based eCall in-vehicles systems, of 112-based eCall in-vehicle separate technical units and components and supplementing and amending Regulation (EU) 2015/758 of the European Parliament and of the Council with regard to the exemptions and applicable standards.

[11] TS 17234:2018: "Intelligent transport systems - eSafety - eCall: Tests to enable PSAPs to demonstrate conformance and performance", (produced by CEN).

[12] EN 15722:2020: "Intelligent transport systems - eSafety - eCall minimum set of data", (produced by CEN).

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.

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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] ETSI ETR 266: "Methods for Testing and Specification (MTS); Test Purpose style guide".

[i.2] EN 16062:2011: "Intelligent Transport Systems - eSafety - eCall - high level application requirements (HLAP)", (produced by CEN).

[i.3] ETSI EG 202 798 (V1.1.1): "Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

base specification: specification of a protocol, telecommunication service, interface, abstract syntax, encoding rules, or information object

eCall: manually or automatically initiated emergency call, (TS12) from a vehicle, supplemented with a minimum set of emergency related data (MSD)

NOTE: As defined under the EU Commission's eSafety initiative.

implementation: instance of the reference specification for which conformity to that reference specification is claimed

IVS configured for eCall only service (restricted): eCall capable IVS that is not subscribed to other non-emergency services

NOTE: The IVS is not permitted to register on a PLMN except for the purpose of making an eCall, or a test/reconfiguration call to a designated non-emergency number, in accordance with ETSI TS 122 101 [1]. Following power-up the IVS may perform a PLMN search and maintain a list of available networks upon which to register, when an eCall or test/reconfiguration call is activated. Following an eCall or test/reconfiguration call, the IVS de-registers from the serving network within 12 hours.

IVS configured for eCall and other services (unrestricted): eCall capable IVS that has valid subscriptions to access other non-emergency services

NOTE: The IVS may register on a PLMN at anytime and may remain registered on a serving network indefinitely.

Minimum Set of Data (MSD): data component of an eCall sent from a vehicle to a Public Safety Answering Point or other designated emergency call centre

NOTE: The MSD has a maximum size of 140 bytes and includes, for example, vehicle identity, location information and time-stamp.

PSAP eCall Modem-server: PSAP equipment used to receive, validate and acknowledge the MSD sent from an IVS, to manage the voice call transfer to the PSAP operator and to facilitate call-back to the vehicle

NOTE: The eCall modem-server may also support other functions.

PSAP Pull mode: mode in which the PSAP is configured to immediately transmit the SEND-MSD (START) message without waiting for the INITIATION message send by the IVS

PSAP Push mode: mode in which the PSAP is configured to wait for the INITIATION message send by the IVS

NOTE: After reception of the INITIATION message the PSAP transmits the SEND-MSD (START) message.

reference specification: standard which provides a base specification, or a set of base specifications, or a profile, or a set of profiles, and for conformance to which the ICS proforma and test specifications are written

3.2 Symbols

Void.

3.3 Abbreviations

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

3GPP	Third Generation Partnership Project
AL-ACK	Application Layer - Acknowledgement (also called HL-ACK)
ANSI-C	American National Standard Programming Language C
CEN	Comité Européen de Normalisation
CFG	Configuration
CLI	Calling Line Identity
CRC	Cyclic Redundancy Check
CS	Circuit Switch
EMC	ElectroMagnetic Compatibility
ETSI	European Telecommunications Standards Institute
EU	European Union
EUT	Equipment Under Test
GSM	Global System of Mobile telecommunications
HLAP	High Level Application Protocol
HMI	Human Machine Interface
IE	Information Element
IFS	Interoperable Functions Statement
IFS_ID	IFS Identifier
ISDN	Integrated Services Digital Network
ITS	Intelligent Transport Systems
IVS	In Vehicle System

NOTE: eCall terminal and associated sub-systems in vehicle.

KPI	Key Performance Indicators
LL-ACK	Link Layer - ACK
LV	Low Volltage
MNO	Mobile Network Operator
MSD	Minimum Set of Data
NACK	Negative Acknowledgement
NAD	Network Access Device
NEC	Network Echo Canceller
PLMN	Public Land Mobile Network
PSAP	Public Service Answering Point
R&TTE	Radio and Telecommunications Terminal Equipment
SIP	Session Initiation Protocol
TD	Test Description
TPS	Third Party Service
TPSP	Third Party Service Provider
TS11	Teleservice No 11 (Telephony)
TS12	Teleservice No 12 (Emergency Calls)
UL	Uplink
UMTS	Universal Mobile Telecommunications System

4 Conventions

4.1 Interoperability test process

4.1.1 Principles

The goal of interoperability tests is to check that devices resulting from protocol implementations are able to work together and provide the functionalities provided by the protocols. As necessary, one message may be checked during a test, when a successful functional verification may result from an incorrect behaviour for instance. Detailed protocol checks are part of the conformance testing process and are thus avoided during the Interoperability tests.

The test sessions will be mainly executed between 2 devices (IVS and PSAP eCall modem-server) from different vendors.

In the present document, test description is provided to guide the test process during the test sessions.

4.1.2 The test description proforma

The test descriptions are provided in proforma tables following the format described in ETSI EG 202 798 [i.3] and ETSI ETR 266 [i.1]. The following different test events are considered during the test execution:

- A **stimulus** corresponds to an event that enforces an EUT to proceed with a specific protocol action, like sending a message for instance.
- A **verify** consists of verifying that the EUT behaves according to the expected behaviour (for instance the EUT behaviour shows that it receives the expected message).
- A **configure** corresponds to an action to modify the EUT configuration.
- A **check** ensures the receipt of protocol messages on reference points, with valid content. This "check" event type corresponds to the interoperability testing with conformance check method.

For the execution of the interoperability test sessions, the following conventions apply:

- Optional (check) tests should be performed using High Level Application Protocol (HLAP) monitor tools (see clause 4.2 'Tooling') and may be skipped due to time restrictions.

4.1.3 Interoperable Functions Statement (IFS)

The Interoperable Functions Statement (IFS) identifies the standardized functions of an EUT. These functions can be mandatory, optional or conditional (depending on other functions), and depend on the role played by the EUT.

The IFS can also be used as a pro-forma by a vendor to identify the functions that its EUT will support when interoperating with corresponding functions from other vendors.

Item column

The item column contains a number which identifies the item.

Item description column

The item description column describes in free text each respective item (e.g. parameters, timers, etc.). It implicitly means "is <item description> supported by the implementation?".

IFS ID column

The IFS ID column defines an identifier for this particular IFS item. The IFS ID is in the Test Description field "Applicability" to select/deselect the execution of a test.

Status column

The following notations are used for the status column:

m mandatory - the capability is required to be supported.

o optional - the capability may be supported or not.

n/a not applicable - in the given context, it is impossible to use the capability.

x prohibited (excluded) - there is a requirement not to use this capability in the given context.

o.i qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies an unique group of related optional items and the logic of their selection which is defined immediately following the table.

c.i conditional - the requirement on the capability ("m", "o", "x" or "n/a") depends on the support of other optional or conditional items. "i" is an integer identifying an unique conditional status expression which is defined immediately following the table.

i irrelevant (out-of-scope) - capability outside the scope of the reference specification. No answer is requested from the supplier.

NOTE: This use of "i" status is not to be confused with the suffix "i" to the "o" and "c" statuses above.

Support column

The support column shall be filled in by the supplier of the implementation using the following notations:

Y or y supported by the implementation.

N or n not supported by the implementation.

N/A or n/a no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status).

4.2 Tooling

Message monitoring solutions, including audio recording and event logging, where supported, may be used to facilitate the resolution of any interoperability and/or performance issues that may be encountered during interoperability testing.

4.3 Test Description naming convention

Table 1: TD naming convention

TD/<root>/<gr>/<nn>	Identifier	Description
<root> = root applicability	BAS	Basic tests
	ADV	Advanced tests
	PER	Performance tests
<gr> = group	IVS	eCall terminal
	PSAP	PSAP eCall modem-server
		IVS or PSAP
<nn> = sequential number	01 to 99	Sequential numbers

4.4 Test Summary

Test scenario with a detailed test description, are provided in the present document to provide guidance to the participants and to ensure consistent testing among the different test sessions and participants. The detailed test descriptions are in the clause 7. It is recommended to conduct all test cases for all technologies supported by the IVS, e.g. a dual mode GSM and UMTS IVS should conduct all tests with both technologies.

The test scenarios are split in 3 groups:

- The basic scenarios, which shall be executed during all test sessions, covering the basic features of an eCall devices (IVS or PSAP).
- The advanced test scenarios, which are provided to do additional testing according to the time left during the test sessions. These scenarios are focusing either on IVS or PSAP features.
- The performance test scenarios, similar to a real eCall service, dedicated to check some performance issues from PSAP side. These scenarios are focusing on some performance checks relating to repetitive or parallel calls from different IVS or IVS simulator to the same PSAP.

The basic test scenarios in Table 2 are foreseen to be executed during all interoperability test sessions, either with real IVS and PSAP, but also with testing devices simulating an IVS or a PSAP.

Table 2: Basic Tests

Test case ID	Summary
TD_BAS_01	MSD transmission/reception/acknowledgement with PSAP in Pull mode
TD_BAS_02	MSD transmission/reception/acknowledgement with PSAP in Push mode
TD_BAS_03	Voice communication after receipt of AL-ACK
TD_BAS_04	Retransmission of MSD on request from PSAP
TD_BAS_05	Voice communication after retransmission of MSD
TD_BAS_06	Clear-down/PSAP initiated network clear-down
TD_BAS_07	Clear-down/PSAP initiated application layer AL-ACK clear-down
TD_BAS_08	Call Back/PSAP initiated call back to IVS and re-send MSD
TD_BAS_09	PSAP correct handling of voice call in case of in-band modem resources busy or out of service
TD_BAS_10	MSD activation type indicator set to 'Automatic'
TD_BAS_11	MSD activation type indicator set to 'Manual'
TD_BAS_12	MSD call type indicator set to 'Test Call'
TD_BAS_13	Mute IVS audio during MSD transmission and un-mute after application layer acknowledgement
TD_BAS_14	Mute PSAP audio during MSD request/MSD transfer and un-mute after application layer acknowledgement
TD_BAS_15	Format of encoded and decoded MSD in accordance with EN 15722 [3]
TD_BAS_16	MSD transmission following NEC disabling tone with PSAP in Pull mode
TD_BAS_17	MSD transmission following NEC disabling tone with PSAP in Push mode
TD_BAS_18	Format of encoded and decoded MSD in accordance with EN 15722 [12]

The advanced and performance test scenarios in Tables 3, 4 and 5 are foreseen to do additional testing which goes beyond the basic test scenarios.

Table 3: Advanced IVS Tests

Test case ID	Summary
TD_ADV_IVS_01	Auto redial following busy during call set-up
TD_ADV_IVS_02	Auto redial following no-answer during call set-up
TD_ADV_IVS_03	IVS configured for 'eCall only' service (restricted)
TD_ADV_IVS_04	eCall deactivated during TPS call
TD_ADV_IVS_05	Fall-back to 112-based eCall when TPS is not functional
TD_ADV_IVS_06	IVS privacy protection from PSAP call-back

Table 4: Advanced PSAP Tests

Test case ID	Summary
TD_ADV_PSAP_01	Un-mute PSAP audio when Initiation Signal not received within 5 s (T4 expired)
TD_ADV_PSAP_02	PSAP handling of more than 1 eCall simultaneously
TD_ADV_PSAP_03	PSAP correct MSD additional data decoding

Table 5: Performance Tests

Test case ID	Summary
TD_PER_PSAP_01	PSAP handling a number of parallel random eCalls from different IVS
TD_PER_PSAP_02	KPI 1 Success rate of eCall
TD_PER_PSAP_03	KPI 2 Success rate of call backs using eCall
TD_PER_PSAP_04	KPI 3 Success rate of correct MSDs
TD_PER_PSAP_05	KPI 4 Success rate of correct re-transmitted MSDs
TD_PER_PSAP_06	KPI 5 Duration of voice channel blocking

5 Test Bed Architecture

5.1 Test site layout

The generic test bed used to carry out interoperability tests, is summarized in figure 1. In normal operation conditions, the IVS calls the 112 called party number and shall set the Emergency Category IE of the Emergency Setup message as defined in table 10.5.135d of ETSI TS 124 008 [2]. This call setting is then interpreted by the mobile network as a requirement to connect the IVS with the most appropriate PSAP, able to handle pan EU eCalls, accordingly to EN 16062 [4].

However, during an eCall interoperability event, IVS will need to be connected to a given PSAP in order to carry out pairing test sessions, following the test scenario provided in the present document. The selection of the PSAP is therefore achieved by the use of the called party number, corresponding to the access where the PSAP is connected (ISDN or SIP trunk).

For the purpose of carrying out tests in more real conditions different options are available:

- Using test tool providing PLMN and PSAP simulation (connection in shield cases or with cable).
- Calling 112 in real conditions, if the local authorities allow using the 112 connection and thus reaching the real PSAP.
- The IVS device has the ability to call TPSP or 112 eCall service over PLMN.

NOTE: Tests defined in the present document are applicable for aftermarket eCall devices as well as 112-based eCall in-vehicle systems (OEM pre-installed).

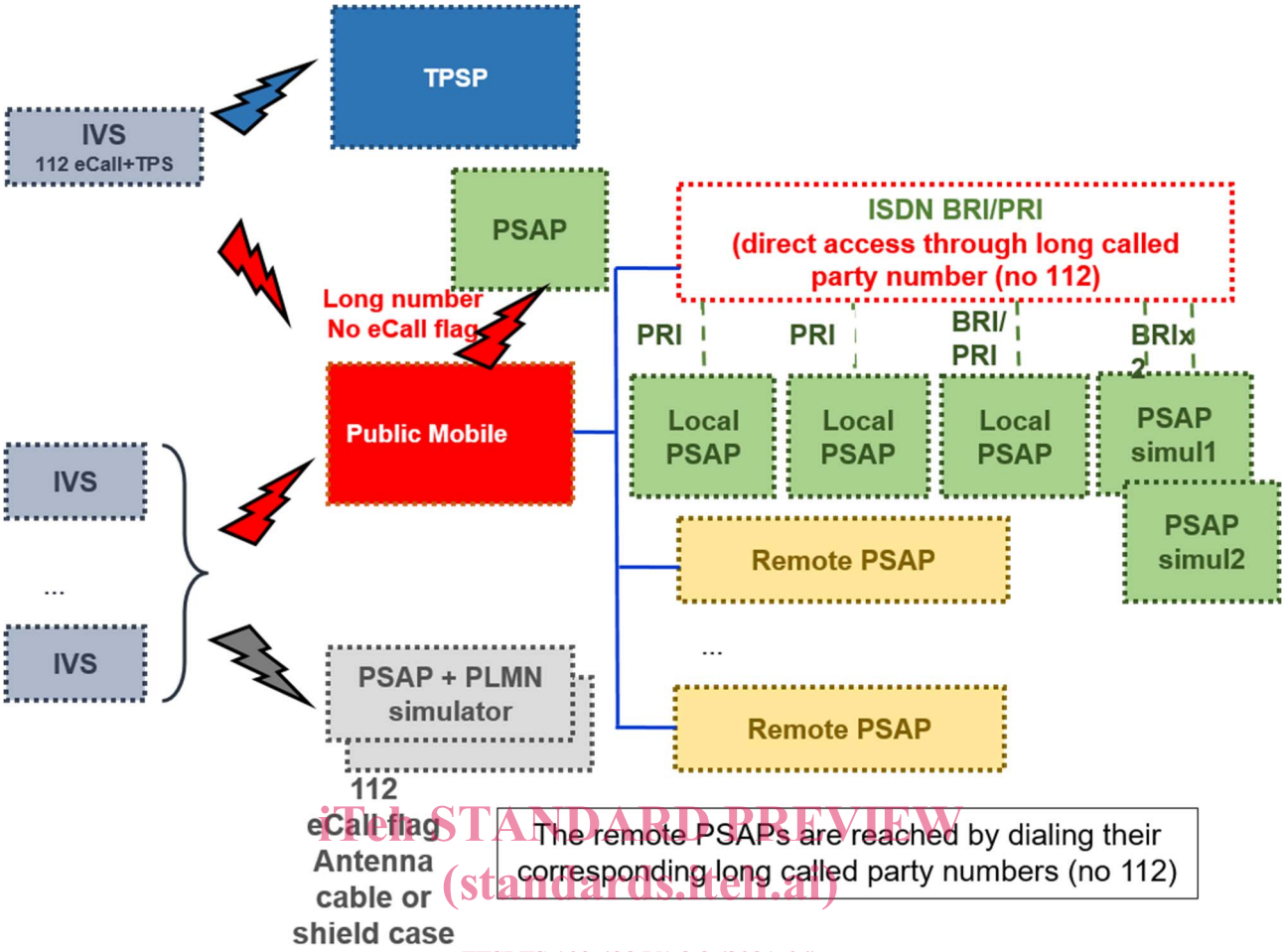

Figure 1: Test site layout

5.2 PSAP modes

Figure 6 given by EN 16062 [4] shows the overall HLAP flow diagram. It depicts the PSAP PULL and PSAP PUSH implementation variants in one diagram and requires some additional explanation for a better understanding.

In the PSAP PULL mode:

In PSAP PULL mode, the PSAP starts sending SEND-MSD (START) messages immediately after the eCall got connected, while it can optionally prepend a network echo canceller (NEC) disabler tone (typically 3,6 s). As the IVS cannot know in advance whether the PSAP is in PUSH or PULL mode, it always needs to send the PUSH-Req at the start of the eCall but should stop sending it as soon as it detects the SEND-MSD from the PSAP and then starts with the MSD transmission. Upon detection of UL sync, the PSAP should stop sending SEND-MSD and respond with NACK messages until it can decode the MSD, i.e. the flow arrow from PSAP after the first UL sync would be NACKs and not SEND-MSD in this case.

In the PSAP PUSH mode:

In PSAP PUSH mode, PSAP has to wait for UL sync of the PUSH-Req message (initiation signal) before it can start with SEND-MSD messages, i.e. the first 3 flow arrows from PSAP are not used in this case. As in the PULL mode, PSAP can optionally prepend a Network Echo Canceller (NEC) disabler tone before the SEND-MSD messages but should not do this before the initiation signal is detected.

Once the MSD transmission has started, the HLAP flow is the very same for PSAP in PULL and PUSH modes.

The application layer acknowledgement sequence is shown in figure 7 from EN 16062 [4].