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3rd ETSI MCX Remote Plugtests
3 Dec 2018 – 31 Jan 2019

Keywords

Testing, Interoperability, Mission-Critical, LTE, MCPTT

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Executive Summary

The capabilities of Mission Critical Push to Talk (MCPTT), Mission Critical Data (MCData) and Mission Critical Video (MCVideo) were tested during the 3rd MCX remote Plugtests. Around 150 combinations of vendors and equipment's, based on 3GPP Release-14, were tested.

The third ETSI MCPTT Plugtests attracted a total of 26 vendors (full list below). The execution of more than 1000 tests, based on a test plan in ETSI TS 103 564 with more than 100 test cases, with a 91 per cent success rate.

Building on the second MCPTT Plugtests in June 2018 in College Station, Texas, this third Plugtests event was conducted remotely via VPN. The MCX Plugtests are the first independent evaluations of public safety and mission critical Long Term Evolution (LTE) features and the interoperability of MCX products and services. The goal is to validate the 3GPP standards, provide a platform for vendors to test their implementation and products, and ultimately achieve a single, interoperable, global standard.

The event was organized by ETSI, and supported by TCCA, and the European Commission, endorsed by the Public Safety Technology Alliance (PSTA) and the Public Safety Communication Europe (PSCE)

The following vendors tested their MCX implementations and equipment with at least two other vendors:

- Alea
- Armour Communications
- Athonet
- Beijing Jiaxun Feihong Electrical Co
- ENENSYS Technologies
- Etelm
- Expway
- Frequentis
- Funkwerk
- Harris Corporation
- Indian Institute of Technology-Bombay
- Kapsch CarrierCom
- Leonardo
- Mission Critical Open Platform (MCOP)
- Motorola Solutions
- Nemergent Solutions
- Nokia
- Polaris Networks
- Prescom
- Samsung Electronics
- Softil
- Sonim Techhnologies
- StreamWIDE
- TASSTA
- Valid8.com
- ZTE Caltta

The Plugtests event was a pure testing event and no products were certified.

The next MCX face-to-face Plugtests event is planned for September 2019 in Kuopio, Finland, hosted by the State Security Networks Finland.

1 Introduction

Push-to-Talk (PTT) is a standard feature of narrowband Professional Mobile Radio (PMR) technologies developed specifically for mission-critical communications. PTT enables near instantaneous group communications – a critical requirement in an emergency situation. It is used in many systems like TETRA or P25 and mission critical networks today worldwide.

Mission Critical PTT (MCPTT) is a standardized voice service for LTE systems which ensure that LTE and 5G systems support mission-critical communications.

Although the PMR market shows no signs of slowing, mission-critical broadband will offer complementary capabilities, and its market is expected to grow at a compound annual growth rate of 20 per cent, from $1.1 billion in 2015 to $2.6 billion in 2020, according to IHS Market. The first nationwide rollouts in the United States, South Korea, the UK, the Middle East and Asian countries are expected to trigger significant large-scale investments in mission-critical LTE.

Mission Critical Push To Talk (MCPTT) was the first of a number of Mission Critical features which was finalized by the 3GPP working group SA6 in Release-13. Mission Critical Video and Mission Critical Data were introduced in Release-14 by 3GPP working group SA6. Further enhancements of mission critical features are planned in 3GPP Release-15 and Release-16 and possibly later releases as well.

Particularly the public safety customer community have a strong requirement for interoperability and multi-vendor supply. The multi-vendor market gives benefits both to the users in terms of the broadest product portfolio of compatible equipment, competitive pricing and rapid entry of new product models; and to the industry in terms of a wider accessible market, faster market take-up and better directed investment in new product developments.

ETSI Plugtests™events bring together products implementing standardized protocols regardless of whether they are early prototypes or market-ready products. These events are an opportunity to test the capabilities of these products to interoperate with others while also providing a non-rigorous assessment of their level of conformance to the standards. Although Plugtests events are of considerable value to the product developers who take part in them, ETSI also benefits by having its standards validated due to the extensive testing that takes place.

Note: Please refer to ETSI document IOT Best Practices regarding the best practices followed in the Plugtests Event.

Testing is an important part of providing this guarantee of interoperability and there are three different types of test activity that should be considered:

1. Conformance testing involves connecting a device to a test system and operating a set of stringently defined tests. This ensures that a (single) product implements the requirements laid down in a standard correctly.

2. Interoperability testing involves connecting devices from different vendors and operating them in a variety of real-life scenarios. Often this will be done at so called interoperability events (or Plugtests^{TM}). For ETSI, the feedback from such events is extremely valuable in helping to validate the standards themselves. In addition there are obvious benefits gained by product developers from this type of testing.

3. Interoperability testing with some conformance checking ensures that two or more products interoperate and that they do so by exchanging information according to the applicable standards. This approach is often employed in an ETSI Plugtests™ event or other Interoperability (IOP) testing (e.g. in TETRA) at various stages during the development and product life cycle.

The MCX Plugtests focus on interoperability testing to allow validation of the 3GPP standards and early checking of vendor's MCX implementation. The MCX Plugtests do not result in any kind of certification of products.

Preparations for the third Plugtests event started in October 2018 with the registrations of vendors and observers. During bi-weekly conference calls from October to November 2018 the setup of the tests, the test specification and organizational issues were agreed between the participants. Before the actual tests started in December 2018, the vendors had to set up their VPN connections, which established VPN tunnels from their labs to a central exchange hub in ETSI.

All the information required to organise and manage the 3rd MCX Plugtests event was compiled and shared with participants in a dedicated private WIKI which was put in place by ETSI. All participants were provided with credentials that allowed them to access and update their details. All the information presented in this document has been extracted from the 3rd MCX Plugtests event WIKI: https://wiki.plugtests.net/wiki/3rd-MCX-Plugtests-remote (login required). Clause 4 describes the management of the Plugtests event.

The following equipment was tested – please see also clause 5:

- MCPTT Application Servers (AS)
- MCData Application Servers (AS)
- MCVideo Application Servers (AS)
- MCPTT Clients
- MCData Clients
- MCVideo Clients
- Configuration Management Servers and Clients (CMS)
- Group Management Servers and Clients (GMS)
- Identity Configuration Management Servers and Clients (IdMS)
- Key Management Servers and Clients (KMS)
- IP Multimedia Subsystem (IMS)
- Broadcast Multicast Service Center (BMSC)

The remote test infrastructure is described in clause 6; the test procedures are described in clause 7.

In October and November 2018 the vendors and ETSI have set up VPN-Tunnels from the vendors' premises to the ETSI VPN hub. This allowed the vendors to start integration work and pre-testing of their equipment. During December 2018 and January 2019 the vendors conducted remote tests via the VPN tunnels with each other.

ETSI has developed a test specification with more than 100 test cases. See clause 8. The test specification was published as an update of the ETSI document ETSI TS 103 564 [1].

About 1000 tests were conducted by the vendors during the remote sessions. 91% of the tests were successful, the remaining 9% failed for various reasons. The detailed results of the tests are available for the involved vendors in these tests, but are not disclosed to the other vendors or to the public. All participants had to sign a Non-Disclosure Agreement before joining the Plugtests event. The statistics of the test results are listed in clause 9.

The failed tests give the vendors valuable information to improve their implementations. They also help to discover ambiguities in the standards and to clarify and improve the specifications. The observations from the Plugtests event are fed back to the 3GPP working groups. The observations are listed in clause 10

ETSI plan to conduct more MCX Plugtests in the future. The next MCX Plugtests sessions are planned for September 2019. Vendors who have not participated in the first MCX Plugtests events are welcome and encouraged to join the next MCX Plugtests event. The interest of TCCA and ETSI is to have one global standard for Mission Critical services. Only standard based MCX services can give true interoperability. Only testing can ensure true interoperability and standard-compliance. The MCX Plugtests ensure that interoperability is tested at an early implementation stage.

2 References

The following documents have been used as references in the Plugtests. The participants in the Plugtests agreed on a set of specific documents and versions for the second Plugtests. Please see also the test specification document for the references.

[1] ETSI TS 103 564: TCCE; Testing; Plugtest™ scenarios for Mission Critical Services, Version 1.2.1, March 2019

[2] 3GPP TS 22.179: Mission Critical Push to Talk (MCPTT) over LTE; Stage 1, Release 14, Version 14.3.0, December 2016.

[3] 3GPP TS 23.280: Common functional architecture to support mission critical services; Stage 2, Release 14, Version 14.4.0, January 2018

[4] 3GPP TS 23.379: Functional architecture and information flows to support Mission Critical Push To Talk (MCPTT); Stage 2, Release 14, Version 14.4.0, Jan 2018.

[5] 3GPP TS 23.468: Group Communication System Enablers for LTE (GCSE_LTE); Stage 2, Release 14, Version 14.0.0, March 2017.

[6] 3GPP TS 24.229: IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP), Release 14, Version 14.6.0, Dec 2017.

[7] 3GPP TS 24.281: Mission Critical Video (MCVideo) signalling control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[8] 3GPP TS 24.282: Mission Critical Data (MCData) signalling control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[9] 3GPP TS 24.379: Mission Critical Push To Talk (MCPTT) call control; Protocol specification, Release 14, Version 14.4.0, December 2017.

[10] 3GPP TS 24.380: Mission Critical Push To Talk (MCPTT) media plane control; Protocol specification, Release 14, Version 14.5.0, December 2017.

[11] 3GPP TS 24.481: Mission Critical Services (MCS) group management; Protocol specification, Release 14, Version 14.3.0, December 2017.

[12] 3GPP TS 24.482: Mission Critical Services (MCS) identity management; Protocol specification, Release 14, Version 14.2.0, December 2017.

[13] 3GPP TS 24.483: Mission Critical Services (MCS) Management Object (MO), Release 14, Version 14.3.0, December 2017.

[14] 3GPP TS 24.484: Mission Critical Services (MCS) configuration management; Protocol specification, Release 14, Version 14.4.0, December 2017.

[15] 3GPP TS 24.581: Mission Critical Video (MCVideo) media plane control; Protocol specification, Release 14, Version 14.3.0, March 2018.

[16] 3GPP TR 21.905: Vocabulary for 3GPP Specifications.

[17] 3GPP TS 24.582: Mission Critical Data (MCData) media plane control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[18] 3GPP TS 26.179: Mission Critical Push To Talk (MCPTT); Codecs and media handling, Release 14, Version 14.0.0, March 2017.

[19] 3GPP TS 26.346: Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs, Release 14, Version 14.5.0, January 2018.

[20] 3GPP TS 29.212: Policy and Charging Control (PCC); Reference points; Release 14, Version 14.6.0, Dec 2017.

[21] 3GPP TS 29.214: Policy and Charging Control over Rx reference point; Stage 3, Release 14, Version 14.6.0, Dec 2017.

[22] 3GPP TS 29.283: Diameter Data Management Applications, Release 14, Version 14.3., September 2017.

[23] 3GPP TS 29.468: Group Communication System Enablers for LTE(GCSE_LTE); MB2 reference point; Stage 3, Release 14, Version 14.3.0, December 2017.

[24] 3GPP TS 33.180: Security of the mission critical service, Release 14, Version 14.2.0, January 2018.

[25] IETF RFC 3515: The Session Initiation Protocol (SIP) Refer Method, April 2003.

[26] IETF RFC 3856: A Presence Event Package for the Session Initiation Protocol (SIP), August 2004.

[27] IETF RFC 3903: Session Initiation Protocol (SIP) Extension or Event State Publication, October 2004.

[28] IETF RFC 4488: Suppression of Session Initiation Protocol (SIP) REFER Method Implicit Subscription, May 2006.

[29] IETF RFC 4825: The Extensible Markup Language (XML) Configuration Access Protocol (XCAP), May 2007.

[30] IETF RFC 5366: Conference Establishment Using Request-Contained Lists in the Session Initiation Protocol (SIP), October 2008.

[31] IETF RFC 5373: Requesting Answering Modes for the Session Initiation Protocol (SIP), November 2008.

[32] IETF RFC 5875: An Extensible Markup Language (XML) Configuration Access Protocol (XCAP) Diff Event Package, May 2010.

[33] IETF RFC 6135: An Alternative Connection Model for the Message Session Relay Protocol (MSRP), February 2011.

[34] IETF RFC 6665: SIP-Specific Event Notification, July 2012.

[35] IETF RFC 7647: Clarifications for the use of REFER with RFC6665, September 2015.

[36] OMA. OMA-TS-XDM_Core-V2_1-20120403-A: XML Document Management (XDM) Specification, V2.1, April 2012

[37] OMA. OMA-TS-XDM_Group-V1_1_1-20170124-A: Group XDM Specification, V1.1.1, Jan 2017

[38] IETF RFC 6749: The OAuth 2.0 Authorization Framework.

3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [16] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [16].

APP	Application
AS	Application Server
CMS	Configuration Management Server
CSC	Common Services Core
CSCF	Call Session Control Function
CSK	Client-Server Key
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
EPC	Evolved Packet Core
EPS	Evolved Packet System
ETSI	European Telecommunications Standard Institute
EUT	Equipment Under Test
FD	File Distribution
FE	Functional Element
GCSE	Group Communication Service Enabler
GMK	Group Master Key
GMS	Group Management Server
HIVE	Hub for Interoperability and Validation
IMPU	IP Multimedia Public identity
IMS	IP Multimedia Subsystem
IOP	Interoperability
IP	Internet Protocol
IdMS	Identity Management Server
KMS	Key Management Server
MBMS	Multimedia Broadcast and Multicast Service
MCData	Mission Critical Data
MCPTT ID	MCPTT user identity
MCPTT	Mission Critical Push-To-Talk
MCVideo	Mission Critical Video
MCX	Mission Critical Services (X stands for PTT, Data and Video)
OAM	Operation and Maintenance
OTT	Over the Top
PCC	Policy and Charging Control
PCRF	Policy and Charging Rules Function
PES	Pre-established Sessions
PSI	Public Service Identity
PSTA	Public Safety Technology Association
PTT	Push-To-Talk
ProSe	Proximity-based Services
RAN	Radio Access Network
RTP	Real-time Transport Protocol
SDS	Short Data Service
SIP	Session Initiation Protocol
SPK	Signalling Protection Key
TCCA	The Critical Communications Association
TD	Test Description
TR	Technical Recommendation
TRT	Test Reporting Tool
TS	Technical Specification
UE	User Equipment

4 Technical and Project Management

4.1 Scope

The main goal of the third MCX Remote Plugtests was testing the interoperability of the MCPTT, MCData and MCVideo ecosystem signalling and media planes.

The basic scenario tested comprised MCX application server(s) -both controlling and participating- and MCX clients deployed over a generic SIP Core/IMS. Since the third Plugtests was remote (carried out over ETSI HIVE VPN infrastructure) the so called over-the-top (i.e. IP based) configuration was used. Therefore, although the following figure (Fig 1) illustrates the basic infrastructure common to the MCX Plugtests in this case multivendor LTE access network and air interface with multicast support (i.e. Release-13/Release 14 eMBMS) was not officially considered[1].

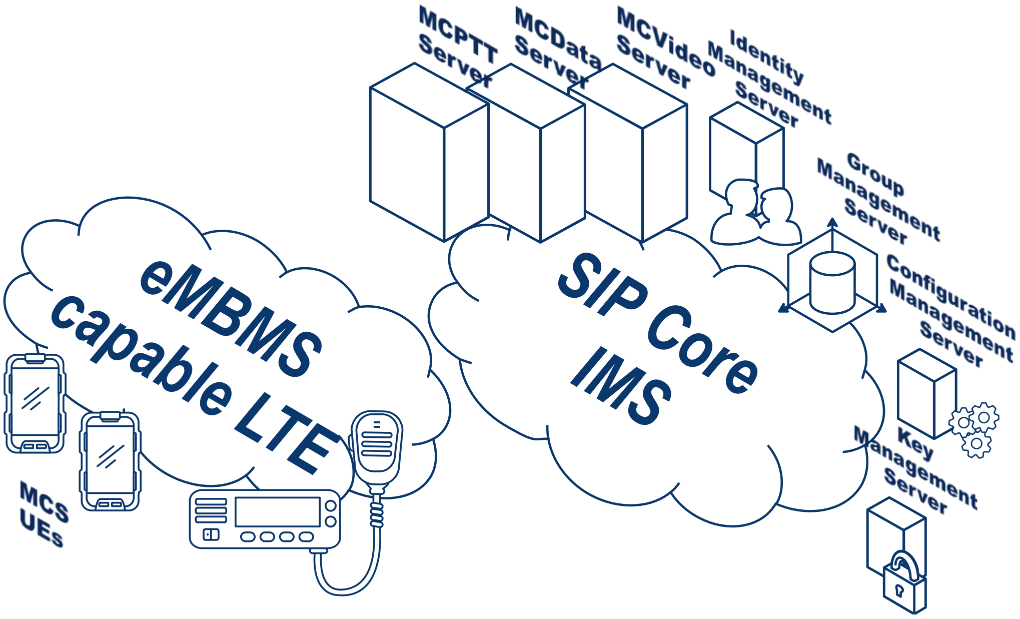


Figure 1. Typical MCPTT/MCData/MCVideo scenario to be considered in the Plugtests

In the scope of this Plugtests event, the following high level test objectives were performed

- **Connectivity (CONN)**: Tests covered basic connectivity between functional elements at different levels including Access Network (LTE), IP Network, SIP/IMS and MCPTT/MCData/MCVideo Application level. IP layers targeted pure OTT connectivity regardless the underlying access network. SIP connectivity tests checked proper deployment of MCPTT AS over the selected SIP Core/IMS so that all SIP messages were successfully delivered from MCPTT Clients to Participating/Controlling MCPTT Servers and vice versa. In this 3rd Plugtests some AS vendors provided again their own SIP/IMS cores so that Clients registered into different cores depending of the specific test case. Application level refers to e2e signalling, media, floor controlling (and other involved) protocols in use. Note that MCData and MCVideo features were mostly analysed in test cases associated to the CONN objective while sibling procedures (i.e. registration to different MCPTT/MCData/MCVideo servers) were carried out when needed.

- **Floor Controlling (FC):** Apart from the basic Floor Controlling procedures considered during the first CONN objective, FC comprised comprehensive interoperability analysis of more complex interactions, including prioritization and pre-emptive mechanisms.

- **Policing (PCC)**: Comprised specific checking proper LTE dynamic bearer signalling and allocation by eUTRAN/EPC.

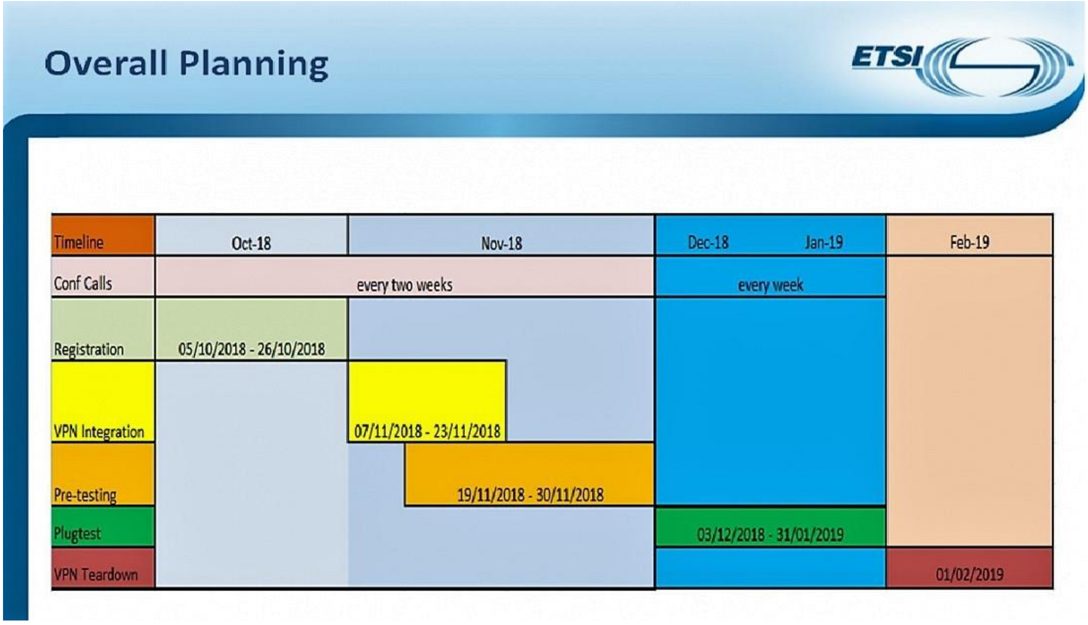
[1] Only the network components of eMBMS (BM-SC and MBMS-GW) were tested in this session.

- **eMBMS (EMBMS)**: Comprised checking of eMBMS specific signalling (mostly related with MB2 interface due to the remote nature of the third Plugtests).
- **Registration and authorization (REGAUTH)**: Comprised MCPTT Client registration.
- **Affiliation (AFFIL)**: Comprised MCPTT Client explicit and implicit affiliation
- **Location (LOC)**: In the test specification document several location configuration, retrieval and submission procedures were considered..
- **OAM procedures (CSC):** Comprised OAM related IdMS, CMS, GMS and KMS interfacing procedures. Mostly MCPTT mechanisms were evaluated since MCData/MCVideo implementations were not as mature as MCPTT implementations and are also mainly equivalent to MCPTT implementations.
- **Security (SEC):** Comprised security related procedures (mainly cyphering and some preliminary key retrieval considered in KMS-related test cases in CSC test cases).

Finally, note that, since Release-14 was evaluated during the 3rd Plugtests, a particular effort was devoted to check whether the updated Release-13 mechanisms were consistent considering new configuration files and data formats.

4.2 Timeline

The preparation was run through different phases as described in the figure below.



Overall Planning

Timeline	Oct-18	Nov-18	Dec-18 Jan-19	Feb-19
Conf Calls	every two weeks		every week	
Registration	05/10/2018 - 26/10/2018			
VPN Integration		07/11/2018 - 23/11/2018		
Pre-testing		19/11/2018 - 30/11/2018		
Plugtest			03/12/2018 - 31/01/2019	
VPN Teardown				01/02/2019

Figure 2. Plugtests event timeline

Registration to the MCPTT Plugtests event was open from 5th November 2018 to 26th November 2018 to any organisation willing to participate in testing the MCX Services Ecosystem. A total of 26 vendors were finally involved in the remote testing.

The following clauses describe the different phases of the Plugtests event preparation. It is worth noting that since the start of the documentation phase until the first week of the remote Plugtests event, bi-weekly conference calls were run among organisers and participants to discuss and track the progress, anticipate and solve technical issues, review the test plan, etc.

4.2.1 Documentation

Once the registration to the Plugtests event was closed, the following documentation activities were launched in parallel:

1) EUT Documentation

Participants documented their EUTs, by providing the information directly to the Plugtests event team. The Plugtests event team compiled the final EUT table for all the participating vendors and was appended to the Plugtests event Test Plan,

All the information described above was made available in the Plugtests event WIKI, so that it could be easily maintained and consumed by participants.

2) Test Plan Development

The Test Plan development was led by ETSI Centre for Testing and Interoperability following the methodology defined by 3GPP TSG SA6 and 3GPP TSG CT1. The Test Plan was scoped around 3GPP Test Specification Release-14 capabilities and concentrated on the features supported by the implementations attending the Plugtests event. ETSI TS 103 564 [1] was approved by ETSI TCCE which contains 100 test cases based on 3GPP Release -14.

The Test Plan was developed and consolidated in an iterative way, considering input and feedback received from Plugtests event participants. See details in clause 8.

4.2.2 Remote integration & testing

Starting in December 2018, participants connected their implementations remotely to the Plugtests event infrastructure, known as HIVE: Hub for Interoperability and Validation at ETSI.

During this phase, up to 28 remote labs connected to HIVE and each of them was allocated a dedicated network. The interconnection of remote labs allowed running integration and testing tasks remotely among any combination of participating EUTs.

Additional details on the remote test infrastructure, remote integration and testing procedures are provided in Clauses 6 and 7.

During this phase, the bi-weekly conference calls were continued among organisers and participants to synchronise, track progress and get ready for the remote testing phase. During the two months of the remote testing phase the participants held weekly conference calls to co-ordinate the testing and raise & discuss any testing issues.

4.2.3 Plugtests event

From 3rd of December 2018 to the 31st of January 2019, participants connected with ETSI HIVE to collaboratively run the Interoperability Test Sessions. This remote event schedule is present on the wiki.

The scheduling of individual test combinations was done manually with the inputs and requests from the participants. The schedule was adapted during the test session slots on a per need basis. First month of scheduling was done by the vendors themselves and second month of scheduling was done manually for the remaining test sessions by the ETSI Plugtests team.

4.3 Tools

4.3.1 Plugtests event WIKI

The Plugtests event WIKI was the main source of information for the MCPTT Plugtests event, from logistics aspects to testing procedures. Access to the WIKI was restricted to participating companies.

The main technical information provided in the wiki was organised as follows:

- **Event Information** – Logistics aspects of the Plugtests event.
- **First Steps** – Registration and Signing of NDA programme.
- **Conference Calls** - Calendar, logistics, agendas and minutes of the bi-weekly conference calls run during the remote integration phase; weekly conference calls during the testing phase.
- **Base and Test Specs -** High Level Test Scope including the test specification and reference to 3GPP and IETF specifications.

- **Participants** – List of Participants.
- **Network Information** - HIVE connection request tool, and remote connections status overview.
- **Testing Information -** Pre-configured parameters for EUTs.
- **Supported Functionality -** Functionality supported by EUTs.
- **Main Event Test Session** - Test session schedule for the main remote testing event.
- **Test Reporting Tool** - Documentation of the Test Reporting Tool.
- **Plugtests Observations** - Issues found during Plugtests event.
- **Equipment Test Case Registration**- Participating EUTs overview.

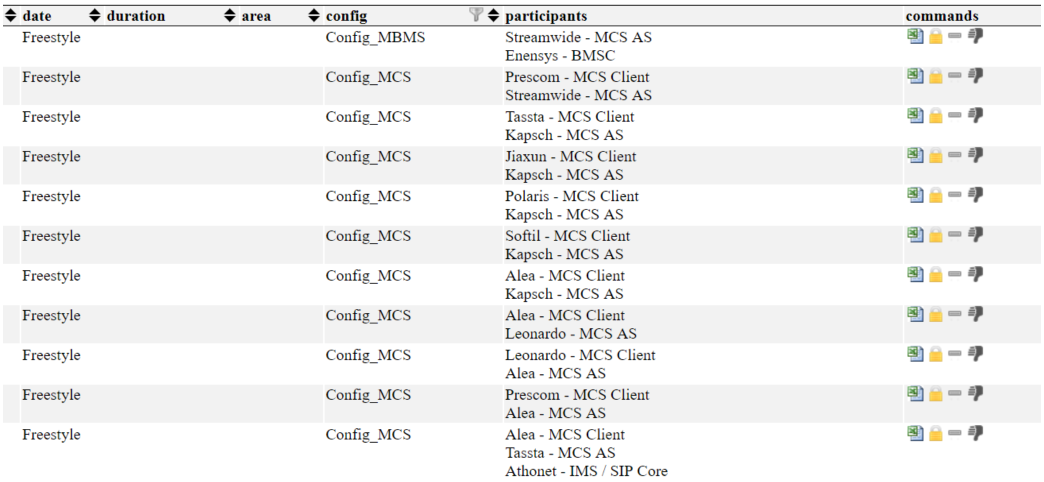
In addition, the embedded WIKI Chat and Slack was used among the participants to communicate with each other during the pre-testing phase and Test Sessions.

4.3.2 Test Reporting Tool (TRT)

The Test Reporting Tool guides participants through the Test Plan test cases during the remote testing Test Sessions. It allows creating Test Session Reports compiling detailed results for the individual scheduled Test Sessions.

Only the companies providing the EUTs for each specific Test Session combination have access to their Test Session Reports contents and specific results. All companies involved in a specific session, who have entered the test results, were required to verify and approve the reported results at the end of each session. Only test report which has been approved by all involved parties are considered as valid.

Another interesting feature of this tool is the ability to generate real-time stats (aggregated data) of the reported results, per test case, test group, test session or overall results. These stats are available to all participants and organisers and allow tracking the progress of the testing with different levels of granularity, which is extremely useful to analyse the results.



date	duration	area	config	participants	commands
Freestyle			Config_MBMS	Streamwide - MCS AS Enensys - BMSC	
Freestyle			Config_MCS	Prescom - MCS Client Streamwide - MCS AS	
Freestyle			Config_MCS	Tassta - MCS Client Kapsch - MCS AS	
Freestyle			Config_MCS	Jiaxun - MCS Client Kapsch - MCS AS	
Freestyle			Config_MCS	Polaris - MCS Client Kapsch - MCS AS	
Freestyle			Config_MCS	Softil - MCS Client Kapsch - MCS AS	
Freestyle			Config_MCS	Alea - MCS Client Kapsch - MCS AS	
Freestyle			Config_MCS	Alea - MCS Client Leonardo - MCS AS	
Freestyle			Config_MCS	Leonardo - MCS Client Alea - MCS AS	
Freestyle			Config_MCS	Prescom - MCS Client Alea - MCS AS	
Freestyle			Config_MCS	Alea - MCS Client Tassta - MCS AS Athonet - IMS / SIP Core	

Figure 3 Test Reporting Tool – example screenshot

5 Equipment Under Test

The tables below summarise the different EUTs provided by the Plugtests event participants.

5.1 MCS Application Servers

The following vendors which are listed in Table 1 have submitted either MCPTT, MCData or MCVideo Application Servers for the Plugtests, or a combination of these.

Organisation	Comment
Alea	with internal SIP Core
Frequentis	Participating AS only; using external IMS
Harris Corporation	using external IMS
IITB	with internal SIP Core
Jiaxun	using external IMS
Kapsch CarrierCom	with internal SIP Core
Leonardo	with internal SIP Core
Motorola Solutions	using external IMS
Nemergent	using external IMS
Nokia	with internal SIP Core
StreamWide	using external IMS and with internal SIP Core
TASSTA	using external IMS
ZTE	with internal SIP Core

Table 1. MCS Application Servers Under Test

5.2 MCS Clients

The following vendors which are listed in Table 2 have submitted either MCPTT, MCData or MCVideo Clients for the Plugtests, or a combination of these.

Organisation	Comment
Alea	–
Armour Communications	–
Etelm	included in the Etelm TETRA Base Station
Funkwerk	MCPTT Client on dedicated Cabradio-platform
Harris Corporation	–
Jiaxun	–
Kapsch CarrierCom	–
Leonardo	–
MCOP	(Mission Critical Open Platform)
Nemergent	–
Polaris	–
Prescom	–
Samsung	–
Softil	–
Sonim	–
TASSTA	–
Telo	–
Valid8	–
ZTE	–

Table 2. MCS Clients Under Test

5.3 IP Multimedia Subsystem (IMS)

Organisation	Comment
Athonet	–

Table 3. IP Multimedia Subsystem (IMS) Under Test

5.4 Evolved Multimedia Broadcast Multicast Services (eMBMS) Components

Organisation	Comment
Athonet	BM-SC, MBMS-GW
ENENSYS Technologies	BM-SC, MBMS-GW, MCE
Expway	BM-SC
Polaris	MBMS-GW
Valid8	BM-SC

Table 4. Evolved Multimedia Broadcast Multicast Services (eMBMS) Components Under Test

6 Test Infrastructure

6.1 Remote and Local Test Infrastructure

The remote integration and testing phased were enabled by the setup as shown in Figure 5:

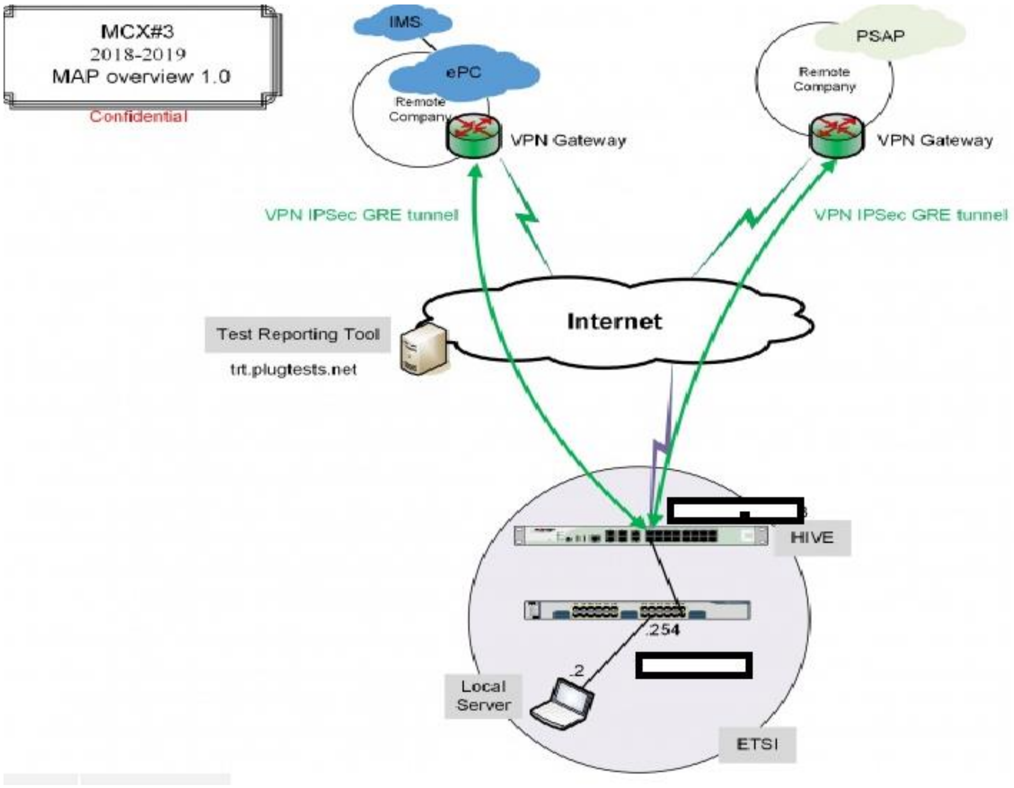


Figure 5. Remote Test Infrastructure

Once HIVE was deployed, a number of VPN tunnels were created to interconnect the equipment of the participants where the EUTs were running.

A total of 28 Remote Labs connected to the setup described above as a participant's lab.

7 Test Procedures

7.1 Remote Integration & Testing Procedure

During the remote integration and testing phase the following procedures were followed by the participating Equipment Under Test. Once the EUT documentation and HIVE connection had been successfully completed, the test cases from the test specifications were executed as part of the testing

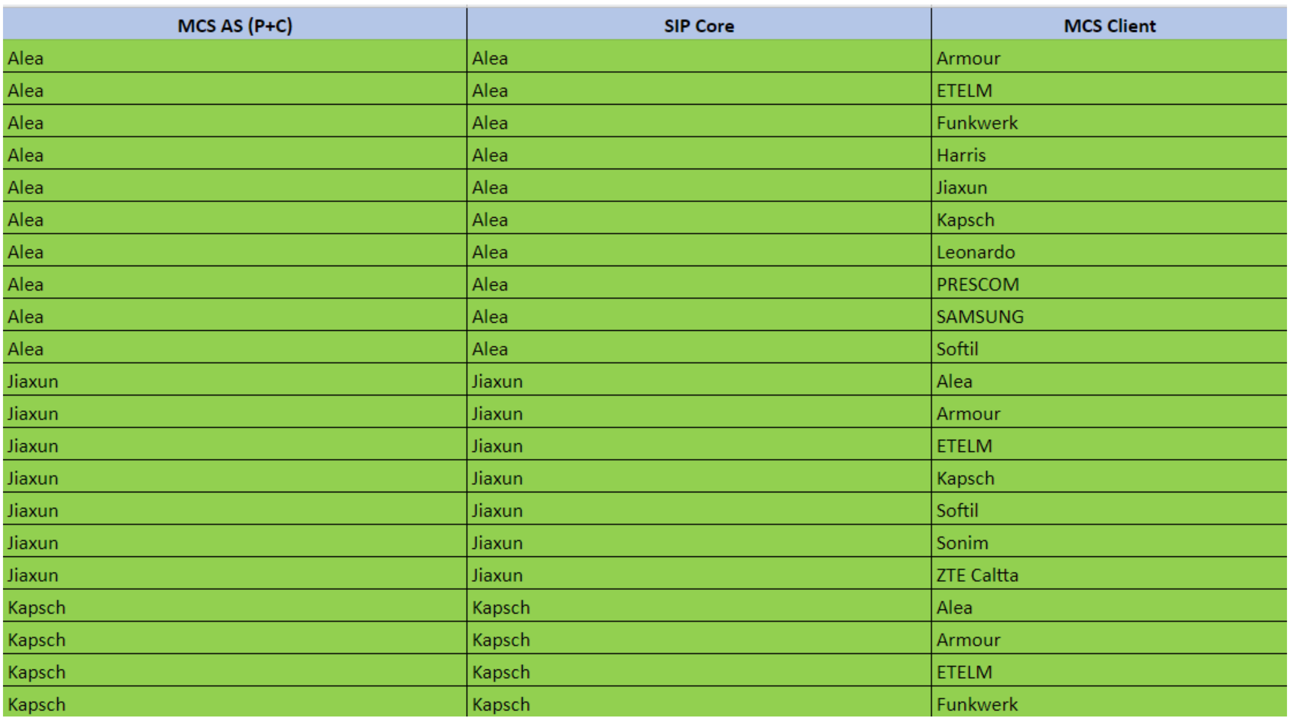
The progress of these procedures for the different combinations of EUTs was captured in the reporting function of TRT. The following Testing configurations were used in the testing phase

Config Name	Pre-testing Configuration
CONFIG_MCS	MCPTT Client + MCPTT AS (Participating + Controlling) + IMS / SIP Core
CONFIG_MBMS	MCPTT AS (Participating + Controlling) BM-SC

Table 5. Testing Configurations

7.2 Interoperability Testing Procedure

During the remote part of the Plugtests event, a weekly Test Session Schedule was produced and shared via the WIKI. Test Sessions were organised in several parallel tracks, ensuring that all participants had at least one Test Session scheduled any time. The different test configurations were used for the main event.

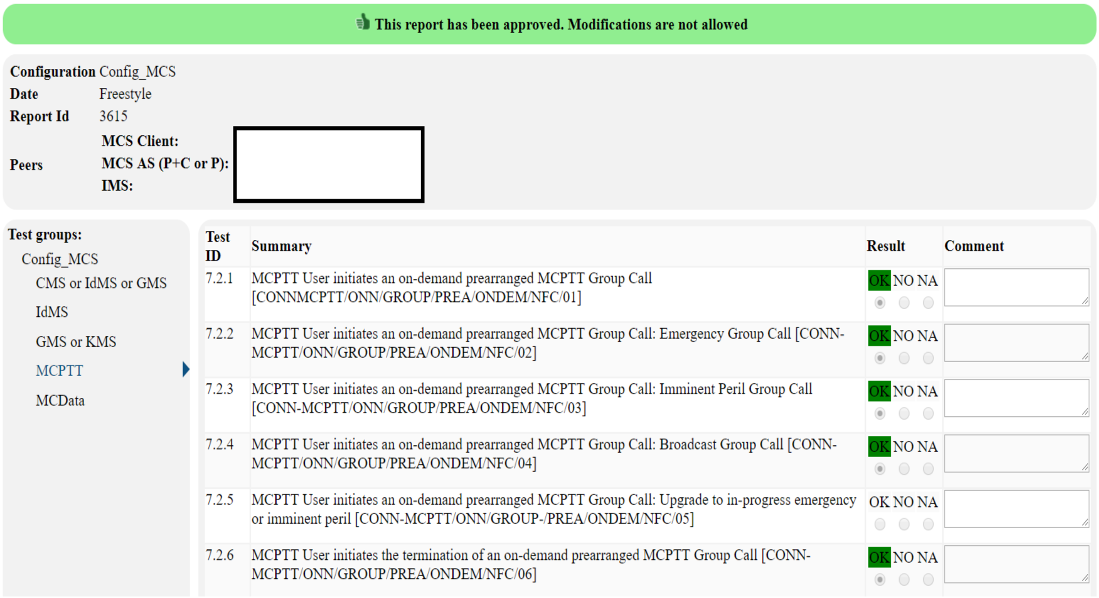


MCS AS (P+C)	SIP Core	MCS Client
Alea	Alea	Armour
Alea	Alea	ETELM
Alea	Alea	Funkwerk
Alea	Alea	Harris
Alea	Alea	Jiaxun
Alea	Alea	Kapsch
Alea	Alea	Leonardo
Alea	Alea	PRESCOM
Alea	Alea	SAMSUNG
Alea	Alea	Softil
Jiaxun	Jiaxun	Alea
Jiaxun	Jiaxun	Armour
Jiaxun	Jiaxun	ETELM
Jiaxun	Jiaxun	Kapsch
Jiaxun	Jiaxun	Softil
Jiaxun	Jiaxun	Sonim
Jiaxun	Jiaxun	ZTE Caltta
Kapsch	Kapsch	Alea
Kapsch	Kapsch	Armour
Kapsch	Kapsch	ETELM
Kapsch	Kapsch	Funkwerk

Figure 5. Monthly Schedule & Test Sessions – example excerpt

During each test session, for each tested combinations the Interoperability testing procedure was as follows:

1. The participating vendors opened the Test Session Report and the Test Plan.



This report has been approved. Modifications are not allowed

Configuration	Config_MCS
Date	Freestyle
Report Id	3615
Peers	**MCS Client:** **MCS AS (P+C or P):** **IMS:** [redacted]

Test groups:

- Config_MCS
  - CMS or IdMS or GMS
  - IdMS
  - GMS or KMS
  - MCPTT ▶
  - MCData

Test ID	Summary	Result	Comment
7.2.1	MCPTT User initiates an on-demand prearranged MCPTT Group Call [CONNMCPTT/ONN/GROUP/PREA/ONDEM/NFC/01]	OK NO NA ● ○ ○	
7.2.2	MCPTT User initiates an on-demand prearranged MCPTT Group Call: Emergency Group Call [CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/02]	OK NO NA ● ○ ○	
7.2.3	MCPTT User initiates an on-demand prearranged MCPTT Group Call: Imminent Peril Group Call [CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/03]	OK NO NA ● ○ ○	
7.2.4	MCPTT User initiates an on-demand prearranged MCPTT Group Call: Broadcast Group Call [CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/04]	OK NO NA ● ○ ○	
7.2.5	MCPTT User initiates an on-demand prearranged MCPTT Group Call: Upgrade to in-progress emergency or imminent peril [CONN-MCPTT/ONN/GROUP-/PREA/ONDEM/NFC/05]	OK NO NA ○ ○ ○	
7.2.6	MCPTT User initiates the termination of an on-demand prearranged MCPTT Group Call [CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/06]	OK NO NA ● ○ ○	

Figure 6. Test Session Report

2. For each Test in the Test Plan:

   a. The corresponding Test Description and EUT Configuration were followed.

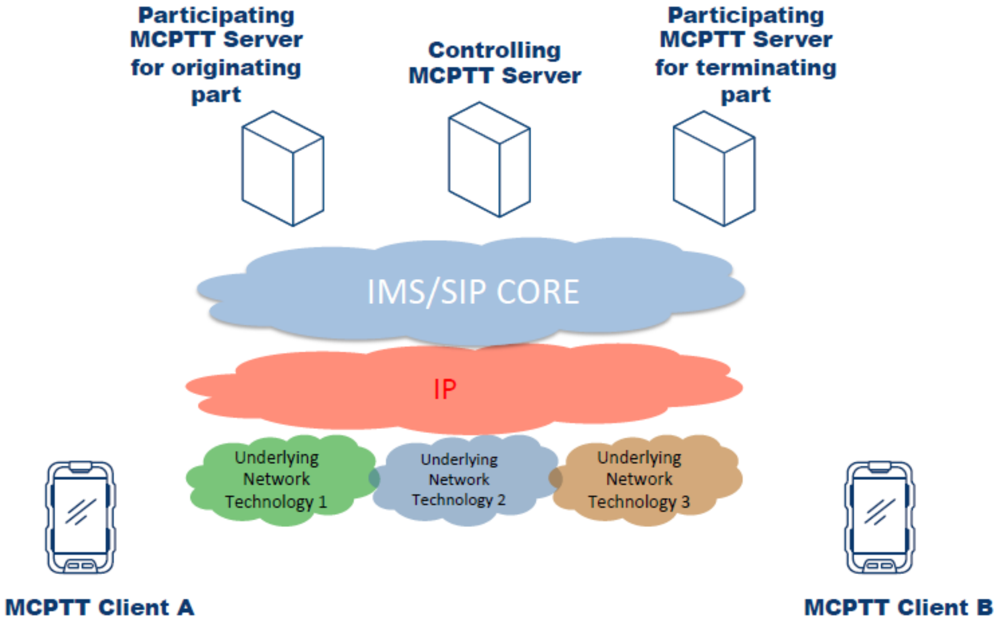
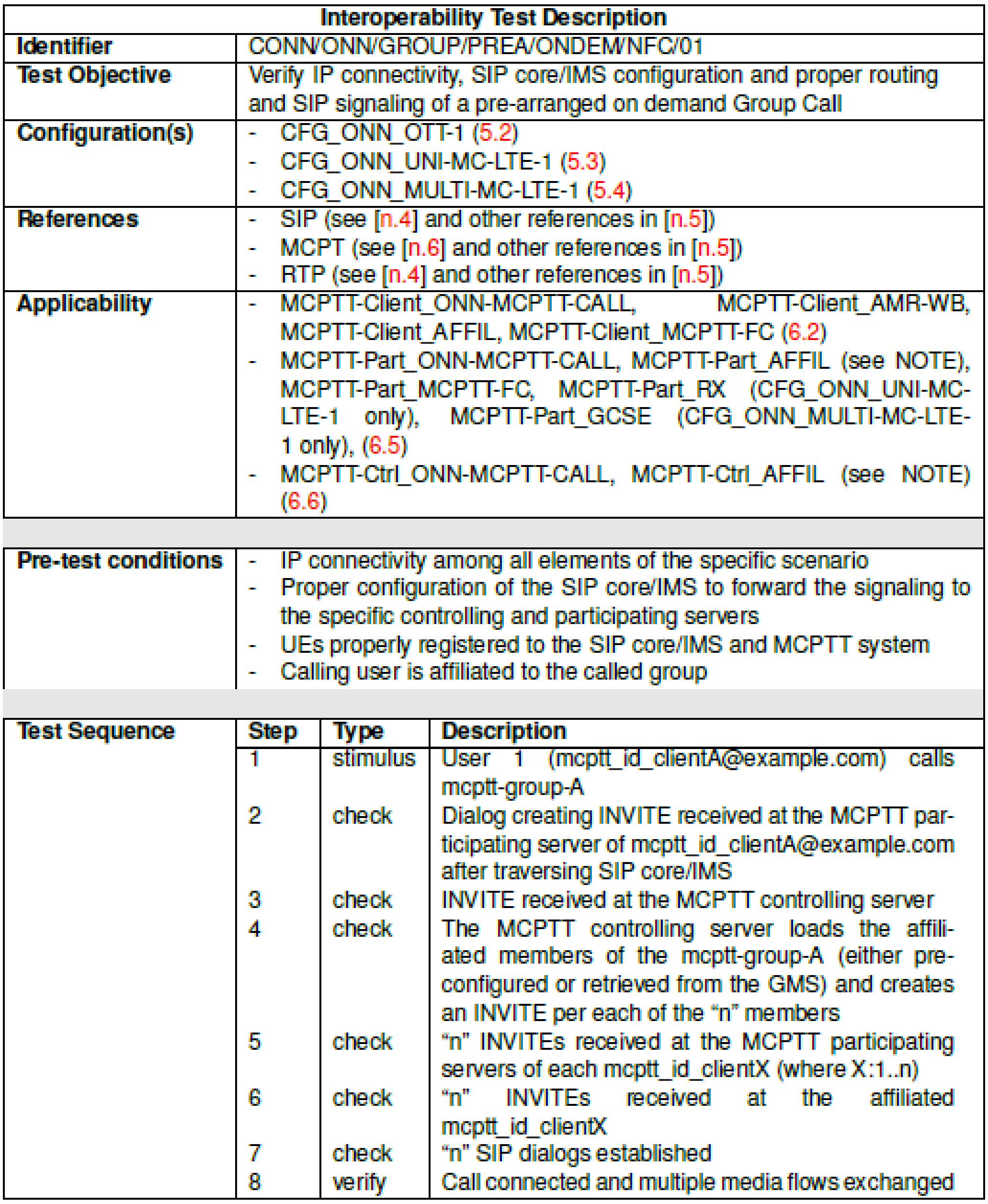

Participating MCPTT Server for originating part
Controlling MCPTT Server
Participating MCPTT Server for terminating part
IMS/SIP CORE
IP
Underlying Network Technology 1
Underlying Network Technology 2
Underlying Network Technology 3
MCPTT Client A
MCPTT Client B

Figure 7. System Under Test (SUT) Configuration – MCPTT example



Interoperability Test Description			
Identifier	CONN/ONN/GROUP/PREA/ONDEM/NFC/01		
Test Objective	Verify IP connectivity, SIP core/IMS configuration and proper routing and SIP signaling of a pre-arranged on demand Group Call		
Configuration(s)	- CFG_ONN_OTT-1 (5.2) - CFG_ONN_UNI-MC-LTE-1 (5.3) - CFG_ONN_MULTI-MC-LTE-1 (5.4)		
References	- SIP (see [n.4] and other references in [n.5]) - MCPT (see [n.6] and other references in [n.5]) - RTP (see [n.4] and other references in [n.5])		
Applicability	- MCPTT-Client_ONN-MCPTT-CALL, MCPTT-Client_AMR-WB, MCPTT-Client_AFFIL, MCPTT-Client_MCPTT-FC (6.2) - MCPTT-Part_ONN-MCPTT-CALL, MCPTT-Part_AFFIL (see NOTE), MCPTT-Part_MCPTT-FC, MCPTT-Part_RX (CFG_ONN_UNI-MC-LTE-1 only), MCPTT-Part_GCSE (CFG_ONN_MULTI-MC-LTE-1 only), (6.5) - MCPTT-Ctrl_ONN-MCPTT-CALL, MCPTT-Ctrl_AFFIL (see NOTE) (6.6)		
Pre-test conditions	- IP connectivity among all elements of the specific scenario - Proper configuration of the SIP core/IMS to forward the signaling to the specific controlling and participating servers - UEs properly registered to the SIP core/IMS and MCPTT system - Calling user is affiliated to the called group		
Test Sequence	**Step**	**Type**	**Description**
	1	stimulus	User 1 (mcptt_id_clientA@example.com) calls mcptt-group-A
	2	check	Dialog creating INVITE received at the MCPTT participating server of mcptt_id_clientA@example.com after traversing SIP core/IMS
	3	check	INVITE received at the MCPTT controlling server
	4	check	The MCPTT controlling server loads the affiliated members of the mcptt-group-A (either pre-configured or retrieved from the GMS) and creates an INVITE per each of the "n" members
	5	check	"n" INVITEs received at the MCPTT participating servers of each mcptt_id_clientX (where X:1..n)
	6	check	"n" INVITEs received at the affiliated mcptt_id_clientX
	7	check	"n" SIP dialogs established
	8	verify	Call connected and multiple media flows exchanged

Figure 8. Test Description example

3. MCX equipment providers jointly executed the different steps specified in the test description and evaluated interoperability through the different IOP Checks prescribed in the Test Description

    b. The MCX equipment provider recorded the Test Result in the Test Session Report, as follows:

        i. OK: all IOP Checks were successful

        ii. NOK: at least one IOP Check failed. A comment was requested.

        iii. NA: the feature was not supported by at least 1 of the involved EUTs. A comment was requested.

4. Once all the tests in the Test Session Report were executed and results recorded, the participants reviewed the Report and approved it.

8 Test Plan Overview

8.1 Introduction

This third MCX Plugtests Test Plan was developed following ETSI guidelines for interoperability. It is based on the test plan from the second MCPTT Plugtests.

The Test Plan was reviewed and discussed with participants during the preparation phase. Considering the huge number of resulting test cases and difference expected maturity of the implementations and differences from different participants, vendors selected the subset of test cases to evaluate in a per-testing slot basis.

The following sections summarise the methodology used for identifying the different configuration and test objectives leading to different test cases sub groups.

8.2 Test configurations

The overall MCX ecosystem comprises both controlling and participating MCPTT/MCData/MCVideo application server(s), MCPTT Clients deployed over a generic SIP Core/IMS. Furthermore, a series of support servers were integrated in the so-called Common Services Core provide configuration, identity, group and key management capabilities. Only 3GPP Release-14 compliant On-Network operations were considered.

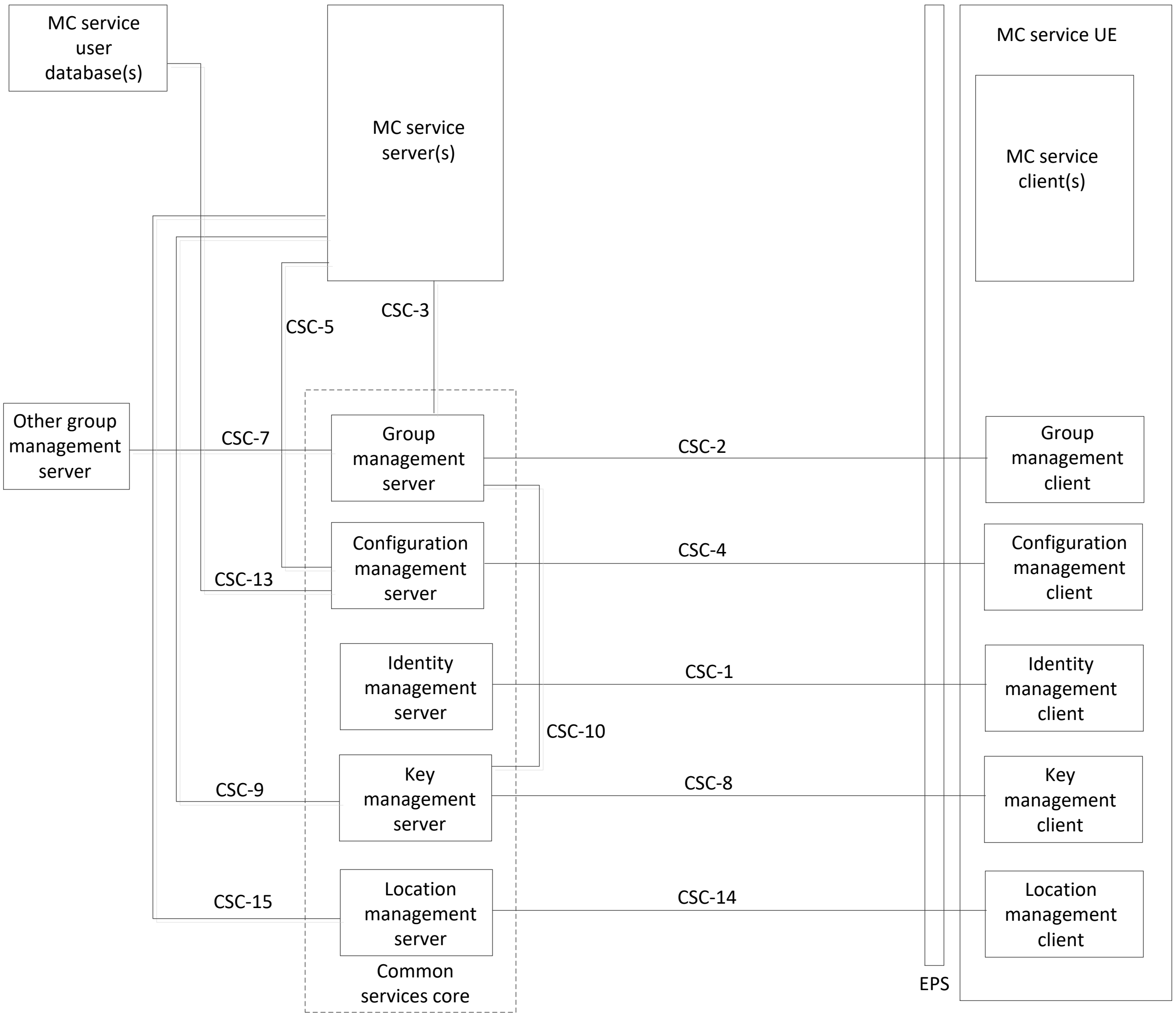


Figure 9. Functional model for application plane Figure 7.3.1-1 in 3GPP TS 23.280 [3].

Figure 7.3.1-1 in 3GPP TS 23.280 [3] describes the overall architecture and the reference points considered for the interoperability testing for any (MCPTT/MCData/MCVideo) MC Service (MCS). As can be seen, the resulting number of functional elements, interfaces and protocols involved is quite large. Furthermore, there are MCPTT/MCData/MCVideo-only specific interfaces and others (like Rx and MB2-C/MB2-U). In order to focus on

MCS signalling the following two different configuration were initially considered: MCPTT/MCData/MCVideo as an application service over IP networks (Over-the-Top), unicast Mission Critical LTE and multicast Mission Critical LTE (all of them for On-Network calls only).

8.2.1 Over-The-Top Configuration for On-Network calls (CFG_ONN_OTT-1)

This configuration considered On-Network Calls (ONN) with a pure Over-The-Top (OTT) approach. It emulated a scenario where any underlying network (i.e. commercial LTE, WiFi or any wired technology such as Ethernet) would provide a bit-pipe type only access. No QoS/prioritization enforcement neither access-layer multi/broadcasting capabilities would be provided (i.e. nor unicast PCC support or multicast mechanisms in LTE). This setup allowed remote testing of both signalling and media plane parallel testing easily.

8.2.2 Multicast Mission Critical LTE for On-Network calls (CFG_ONN_MULTI-MC-LTE-1)

In this configuration multicast elements BM-SC and MBMS-GW were tested. eMBMS needs interfaces both in the core side (MB2-C and MB2-U with the BM-SC) and in the eUTRAN/UE side. In this Plugtests only the MB-2 interface was in scope of the tests. It was used to test eMBMS bearer setup and update related test cases. Due to the remote nature of the third MCX Plugtests MB2-C/U was considered more in depth than the actual e2e eMBMS operation (including UE <-> enodeB air interface).

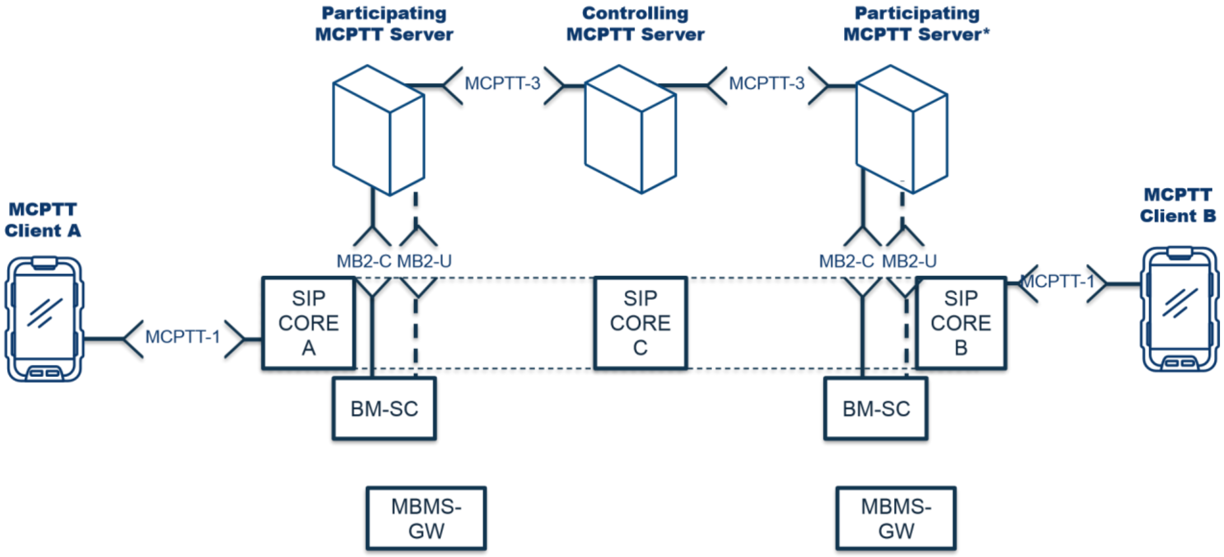


Figure 10. CFG_ONN_MULTI-MC-LTE-1 configuration

Due to specific low level technical constraints (i.e. the availability of joint/split participating and controlling AS, usage of MCPTT-5 interface instead of Rx for the PCC or eMBMS support in the UE) the original configurations led to the ones described in Figure 12 according to the following mapping.

Note that eMBMS_OTT refers to testing the eMBMS signalling in the MB2-C/MB2-U reference points and all the UE <-> MCPTT AS eMBMS triggering related signalling but with no eMBMS capable eUTRAN. Main_CONFIG 4 comprises MC QCI capable enodeB and UEs (and PCRF) and Main_CONFIG 7 the usage of alternative enodeB interfaces.

Configuration	Resulting configuration mode in the Plugtests (TRT)
ONN-OTT	CONFIG_MCS
	CONFIG_MBMS

Table 6. Mapping of scenario architecture configurations and Plugtests event practical configurations

8.2.3 Group of test cases

As described in the Subclause 4.1 of this document, different test objectives were considered.

The following tables collect the test cases grouped by test objective following the structure of the test specification document itself.

Test Id	Test Purpose
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/01	On-demand prearranged MCPTT Group Call (Sections 10.1.1.2.1, 10.1.1.3.1.1 and 10.1.1.4 in)
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/02	On-demand prearranged MCPTT Group Call (Sections 10.1.1.2.1, 10.1.1.3.1.1 and 10.1.1.4 in [9]): Emergency MCPTT Group Call (6.2.8.1.[1-8][13-17] in [9])
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/03	On-demand prearranged MCPTT Group Call (Sections 10.1.1.2.1, 10.1.1.3.1.1 and 10.1.1.4 in [9]): Imminent Peril MCPTT Group Call (6.2.8.1.9-12 in [9])
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/04	On-demand prearranged MCPTT Group Call (Sections 10.1.1.2.1, 10.1.1.3.1.1 and 10.1.1.4 in [9]): Broadcast MCPTT Group Call (6.2.8.2 in [9])
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/05	On-demand prearranged MCPTT Group Call (Sections 10.1.1.2.1, 10.1.1.3.1.1 and 10.1.1.4 in [9] : Upgrade to in-progress emergency or imminent peril (10.1.1.2.1.3, 10.1.2.2.1.4 in [9])
CONN-MCPTT/GROUP/PREA/ONDEM/NFC/06	Termination of an on-demand prearranged MCPTT Group Calls (Sections 10.1.1.2.3.1 and 10.1.1.3.3.1 in [9])
CONN-MCPTT/GROUP/PREA/PRE/NFC/01	Prearranged MCPTT Group Call using pre-established session (Sections 10.1.1.2.2, 10.1.1.3.1.2 and 10.1.1.4 in [9
CONN-MCPTT/GROUP/PREA/PRE/NFC/02	Termination of a prearranged MCPTT Group Call using pre-established session (Sections 10.1.1.2.3.2 and 10.1.1.3.3.2 in [9])
CONN-MCPTT/GROUP/CHAT/ONDEM/NFC/01	On-demand MCPTT Chat Group Call establishment (Sections 10.1.2.2.1.1, 10.1.2.3.1.1, 10.1.2.3.1.3 and 10.1.2.4.1.1 in [9])
CONN-MCPTT/GROUP/CHAT/ONDEM/NFC/02	Ongoing on-demand MCPTT Chat Group Call upgraded to emergency call (Sections 10.1.2.2.1.4, 10.1.2.2.1.2, 10.1.2.3.1.2, 10.1.2.3.1.4 and 10.1.2.4.1.2 in [9])
CONN-MCPTT/GROUP/CHAT/ONDEM/NFC/03	Ongoing on-demand MCPTT Chat Group Call upgraded to imminent peril (Sections 10.1.2.2.1.4, 10.1.2.2.1.2, 10.1.2.3.1.2, 10.1.2.3.1.4 and 10.1.2.4.1.3 in [9])
CONN-MCPTT/GROUP/CHAT/ONDEM/NFC/04	Cancellation of the in-progress emergency condition of an on-demand MCPTT Chat Group Call (Sections 10.1.2.2.1.3, 10.1.2.2.1.2, 10.1.2.3.1.2, 10.1.2.3.1.4 and 10.1.2.4.1.2 in [9])
CONN-MCPTT/GROUP/CHAT/ONDEM/NFC/05	Cancellation of the in-progress imminent peril condition of an on-demand MCPTT Chat Group Call (Sections 10.1.2.2.1.5, 10.1.2.2.1.2, 10.1.2.3.1.2, 10.1.2.3.1.4 and 10.1.2.4.1.3 in [9])
CONN-MCPTT/GROUP/CHAT/PRE/NFC/01	MCPTT Chat Group Call establishment within a pre-established session (Sections 10.1.2.2.2, 10.1.2.2.1.6, 10.1.2.3.2.1, 10.1.2.3.2.2 and 10.1.2.4.1.1 in [9])
CONN-MCPTT/PRIV/AUTO/ONDEM/WFC/NFC/01	On-demand private MCPTT call with floor control (Section 11.1.1.2.1 in [9]) and automatic commencement mode, see [31])
CONN-MCPTT/PRIV/MAN/ONDEM/WFC/NFC/01	On-demand private MCPTT call with floor control manual mode (Section 11.1.1.2.1 in [9]) and manual commencement mode, see [31])
CONN-MCPTT/PRIV/AUTO/PRE/WFC/NFC/01	Pre-established private MCPTT call with floor control (Section 11.1.1.2.1 in [9]) and automatic commencement mode, see [31])
CONN-MCPTT/PRIV/MAN/PRE/WFC/NFC/01	Pre-established private MCPTT call with floor control manual mode (Section 11.1.1.2.1 in [9]) and manual commencement mode, see [31])
CONN-MCPTT/PRIV/AUTO/ONDEM/WOFC/01	On-demand private MCPTT call without floor control (Section 11.1.1.2.1 in [9]) and automatic commencement

Test Id	Test Purpose
	mode, see [31])
CONN-MCPTT/PRIV/MAN/ONDEM/WOFC/01	On-demand private MCPTT call without floor control manual mode (Section 11.1.1.2.1 in [9]) and manual commencement mode, see [31])
CONN-MCPTT/PRIV/AUTO/PRE/WOFC/01	Pre-established private MCPTT call without floor control (Section 11.1.1.2.1 in [9]) and automatic commencement mode, see [31])
CONN-MCPTT/PRIV/MAN/PRE/WOFC/01	Pre-established private MCPTT call without floor control manual mode (Section 11.1.1.2.1 in [9]) and manual commencement mode, see [31])
CONN-MCPTT/ONN/FIRST/MANUAL/ONDEM/WFC/NFC/01	MCPTT User initiates an on-demand first-to-answer MCPTT call with floor control (Sections 11.1.1.2.1, 11.1.1.3.1.1 and 11.1.1.4 in [9])
CONN-MCPTT/ONN/FIRST/MANUAL/ONDEM/WOFC/NFC/01	MCPTT User initiates an on-demand first-to-answer MCPTT call without floor control (Section 11.1.2 in [9])
CONN-MCPTT/ONN/FIRST/MANUAL/PRE/WFC/NFC/01	MCPTT User initiates an on-demand first-to-answer MCPTT call with floor control using pre-established sessions (Sections 11.1.1.2.2, 11.1.1.3.1.2, 11.1.3.2.2 and 11.1.1.4 in [9] and [30])
CONN-MCPTT/ONN/FIRST/MANUAL/PRE/WOFC/01	MCPTT User initiates a pre-established first-to-answer MCPTT call in manual commencement mode without floor control
CONN-MCPTT/ONN/CALLBACK/SETUP/01	MCPTT User setups a private-call callback (Sections 11.1.1.2.1, 11.1.1.3.1.1 and 11.1.1.4 in [9])
CONN-MCPTT/ONN/CALLBACK/CANCEL/01	MCPTT User cancels a private-call callback (Section 11.1.2 in [9])
CONN-MCPTT/ONN/CALLBACK/FULFIL/01	MCPTT User fulfils a private-call callback
CONN-MCPTT/ONN/AMBIENT/ONDEM/LOCAL/01	MCPTT User setups locally an on-demand ambient listening call (Sections 11.1.6.2.1.1, 11.1.6.3 and 11.1.6.4 in [9])
CONN-MCPTT/ONN/AMBIENT/ONDEM/LOCAL/02	MCPTT User releases locally an on-demand ambient listening call (Section 11.1.6.2.1.3 in [9])
CONN-MCPTT/ONN/AMBIENT/PRE/LOCAL/01	MCPTT User setups locally an ambient listening call using pre-established session (Section 11.1.6.2.2 in [\ref{nr:3gpp-ts-23379}])
CONN-MCPTT/ONN/AMBIENT/PRE/LOCAL/02	MCPTT User releases locally an ambient listening call using pre-established session (Section 11.1.6.2.2.3 in [9])
CONN-MCPTT/ONN/AMBIENT/ONDEM/REMOTE/01	MCPTT User setups remotely an on-demand ambient listening call (Section 11.1.6.2.1.1 in [9])
CONN-MCPTT/ONN/AMBIENT/ONDEM/REMOTE/02	MCPTT User releases remotely an on-demand ambient listening call (Section 11.1.6.2.1.3 in [9])
CONN-MCPTT/ONN/AMBIENT/PRE/REMOTE/01	MCPTT User setups remotely an ambient listening call using pre-established session
CONN-MCPTT/ONN/AMBIENT/PRE/REMOTE/02	MCPTT User releases remotely an ambient listening call using pre-established session
CONN-MCPTT/ONN/GROUPCHANGE/01	Remote change of selected group (Section 10.1.4 in [9])
CONN-MCDATA/O2O/STANDALONE/SDS/SIP/01	One-to-one standalone SDS over SIP
CONN-MCDATA/O2O/STANDALONE/SDS/MSRP/01	One-to-one standalone SDS over media plane (MSRP)
CONN-MCDATA/O2O/SESSION/SDS/MSRP/01	One-to-one SDS session
CONN-MCDATA/GROUP/STANDALONE/SDS/SIP/01	Group standalone SDS over SIP
CONN-MCDATA/GROUP/STANDALONE/SDS/MSRP/01	Group standalone SDS over media plane (MSRP)
CONN-MCDATA/GROUP/SESSION/SDS/MSRP/01	Group SDS session
CONN-MCDATA/O2O/FD/HTTP/01	One-to-one FD using HTTP
CONN-MCDATA/GROUP/FD/HTTP/01	Group FD using HTTP
CONN-MCDATA/O2O/FD/MSRP/01	One-to-one FD using media plane (MSRP)
CONN-MCDATA/GROUP/FD/MSRP/01	Group FD using media plane (MSRP)

Test Id	Test Purpose
CONN-MCDATA/DISNOT/SDS/01	Standalone SDS with delivered and read notification
CONN-MCDATA/DISNOT/SDS/02	Group standalone SDS with delivered and read notification
CONN-MCDATA/DISNOT/FD/01	One-to-one FD using HTTP with file download completed notification
CONN-MCDATA/DISNOT/FD/02	Group FD using HTTP with file download completed notification
CONN-MCDATA/NET/FD/01	Network triggered FD notifications

Table 7. Test Group for the Connectivity (CONN) objective

Test Id	Test Purpose
FC/BASIC/01	Basic FC functionality (Subclause 6 in 3GPP TS 24.380 [10])
FC/BASIC/02	Basic FC functionality. Effect of Priorities (following A.3.5 example in 3GPP TS 24.380 [10]

Table 8. Test Group for the Floor Controlling (FC) objective

Test Id	Test Purpose
REGAUTH/IDMSAUTH/01	MCPTT Client authentication and tokens retrieval using IdMS 3GPP TS 24.482 [12]
REGAUTH/3PRTYREG/REGISTER/01	MCPTT Client registration using 3rd party register (Subclauses 7.2.1 and 7.3.2 in 3GPP TS 24.379 [9])
REGAUTH/PUBLISH/REGISTER/01	MCPTT Client registration using SIP PUBLISH (Subclauses 7.2.2 and 7.3.3 in 3GPP TS 24.379 [9])

Table 9. Test Group for the Registration and Authorization (REGAUTH) objective

Test Id	Test Purpose
PCC/BEARERSETUP/01	Unicast MC Bearer Setup by SIP Core/IMS (Sections 4.4.1 and 4.4.2 in [21])
PCC/BEARERSETUP/02	Unicast MC Bearer Setup by MCPTT Participating AS (Sections 4.4.1 and 4.4.2 in [21])
PCC/BEARERUPDATE/01	Unicast MC Bearer Update by SIP Core/IMS due to a change in the Call characteristics
PCC/BEARERUPDATE/02	Unicast MC Bearer Update by MCPTT Participating AS due to a change in the Call characteristics
PCC/BEARERSETUP/03	Unicast MC Bearer Setup by SIP Core/IMS using pre-established sessions (Sections 4.4.1 and 4.4.2 in [21])
PCC/BEARERSETUP/04	Unicast MC Bearer Setup by MCPTT Participating AS using pre-established sessions (Sections 4.4.1 and 4.4.2 in [21])

Table 10. Test Group for the Policing (PCC) objective

Test Id	Test Purpose
EMBMS/ACTIVATEBEARER/WPRETMGI/01	Use of dynamically established MBMS bearers in prearranged MCPTT group calls with pre-allocated TMGIs (Subclauses 5.2.1 and 5.3.2 in 3GPP TS 29.468 [23])
EMBMS/ACTIVATEBEARER/WOPRETMGI/01	Use of dynamically established MBMS bearers in prearranged MCPTT group calls without pre-allocated TMGIs
EMBMS/PREBEARER/WPRETMGI/01	Use of pre-established MBMS bearers in prearranged group calls with pre-allocated TMGIs
EMBMS/PREBEARER/WOPRETMGI/01	Use of pre-established MBMS bearers in prearranged group calls without pre-allocated TMGIs

Test Id	Test Purpose
EMBMS/MODIFYBEARER/01	Modification of MBMS bearers upon reception of emergency upgrade request
EMBMS/DEACTIVBEARER/WTMGIDEA/01	Deactivation of MBMS bearers after termination of a prearranged MCPTT group call with TMGI deallocation
EMBMS/DEACTIVBEARER/WOTMGIDEA/01	Deactivation of MBMS bearers after termination of a prearranged MCPTT group call without TMGI deallocation
EMBMS/SWITCHTOUNITMGIEXP/01	Switching to unicast bearer after TMGI expiration

Table 11. Test Group for the eMBMS (eMBMS) objective

Test Id	Test Purpose
AFFIL/DET/01	Determining self affiliation (Subclauses 9.2.1.3 and 9.2.2.2.4 in 3GPP TS 24.379 [9])
AFFIL/DET/02	Determining affiliation status of another user (Subclauses 9.2.1.3 and 9.2.2.2.4 in 3GPP TS 24.379 [9])
AFFIL/CHANGE/01	Affiliation status change triggered by the MCPTT User itself (Subclauses 9.2.1.2 and 9.2.2.2.3 in 3GPP TS 24.379 [9])
AFFIL/CHANGE/02	Affiliation status change triggered by another MCPTT User in mandatory mode (Subclauses 9.2.1.2, 9.2.2.3.3 in 3GPP TS 24.379 [9])
AFFIL/CHANGE/03	Affiliation status change triggered by another MCPTT User in negotiated mode (Subclauses 9.2.1.4 and 9.2.1.5 in 3GPP TS 24.379 [9])

Table 12. Test Group for the Affiliation (AFFIL) objective

Test Id	Test Purpose
LOC/3PRTYREG/CONFIG/01	MCPTT Client Configuration upon 3rd party register (Subclauses 13.2.2 and 13.3.2 in 3GPP TS 24.379 [9])
LOC/REQUEST/01	Request for Location Report to the MCPTT Client (Subclauses 13.2.3 and 13.3.3 in 3GPP TS 24.379 [9])
LOC/SUBMISSION/01	MCPTT Client Sends location upon trigger (Section 13.3.4 in 3GPP TS 24.379 [9])

Table 13. Test Group for the Location (LOC) objective

Test Id	Test Purpose
CSC-CMS/UECONF/UE/01	Subscription and UE configuration document retrieval from the MC UE (Sections 6.3.3 and 6.3.13 -specifically 6.3.13.2.2a and 6.3.13.3.2.3f- in [14]), OMA XDM mechanisms and procedures in [29])
CSC-CMS/UPROCONF/UE/01	Subscription and user profile configuration document retrieval from the MC UE
CSC-CMS/SERVCONF/UE/01	Subscription and service configuration document retrieval from the MC UE
CSC-CMS/SERVCONF/MCSSERV/01	Subscription and service configuration document retrieval from the MCS server
CSC-GMS/GROUP/UE/01	Subscription and group document retrieval from the MC UE
CSC-GMS/GROUP/MCSSERV/01	Subscription and group document retrieval from the MCS Server
CSC/MULTIPLESUBS/GROUP/UE/01	Subscription and retrieval of multiple documents from the CMS using subscription proxy

Table 14. Test Group for the OAM Procedures (CSC) objective

Test Id	Test Purpose
SEC/KEYMDOWNLOAD/WPROXY/01	Key material download from KMS to MCPTT client (CSC-8) with proxy
SEC/KEYMDOWNLOAD/WPROXY/02	Key material download from KMS to MCPTT server (CSC-9) with proxy
SEC/KEYMDOWNLOAD/WPROXY/03	Key material download from KMS to MCPTT GMS (CSC-10) with proxy
SEC/KEYMDOWNLOAD/WOPROXY/01	Key material download from KMS to MCPTT client (CSC-8) without proxy
SEC/KEYMDOWNLOAD/WOPROXY/02	Key material download from KMS to MCPTT server (CSC-9) without proxy
SEC/KEYMDOWNLOAD/WOPROXY/03	Key material download from KMS to MCPTT GMS (CSC-10) without proxy
SEC/KEYDIST/CSK/01	Key management from MC client to MC server (CSK upload)
SEC/KEYDIST/GMK/01	Key management for group communications (GMK)
SEC/KEYDIST/MUSIK/01	Key management from MC server to MC client (Key download MuSiK)
SEC/ENCRYPTION/PRIVATE/01	Encryption of MCPTT private calls (use of derived encryption keys from PCK for the audio and CSK for floor control and RTCP reports)
SEC/ENCRYPTION/GROUP/01	Encryption of MCPTT group calls (use of derived encryption keys from GMK for the audio and CSK for floor control and RTCP reports)
SEC/ENCRYPTION/GROUPEMBMS/01	Encryption of MCPTT group calls using eMBMS (use of derived encryption keys from MuSIK for the floor control and MSCCK for eMBMS control)
SEC/XMLENCRYPT/PRIVATE/01	XML contents encryption in MCPTT private calls (mcptt-info and resource-lists)
SEC/XMLENCRYPT/GROUP/01	XML contents encryption in MCPTT group calls (mcptt-info)
SEC/XMLENCRYPT/AFFIL/01	XML contents encryption in affiliation procedure
SEC/XMLENCRYPT/LOC/01	XML contents encryption in location procedure

Table 15. Test Group for the Security (SEC) objective

9 Plugtests Results

9.1 Overall Results

During the Plugtests event, a total of 149 Test Sessions were run: that is, 149 different combinations based on different configurations in Test Scope: MCS Client, MCS Server (Participating and Controlling), BM-SC and IMS/SIP Core were tested for interoperability. Overall, 1049 individual test cases were run and reported interoperability results.

The table below provides the overall results (aggregated data) from all the Test Cases run during all the Test Sessions with all the different combinations of Equipment Under Test from all the participating companies.

Among the executed Test Cases, the possible results were “OK”, when interoperability was successfully achieved and “NO” (Not OK) when it was not. The non-executed Test Cases were marked “NA” (Not Applicable) during the Test Session, to indicate that at least one of the EUTs involved in the Test Session did not support the feature in scope.

Plugtests Results		Totals
OK	**NO**	**Run**
957 (91.2%)	92 (8.8%)	1049

Table 16. Overall Results

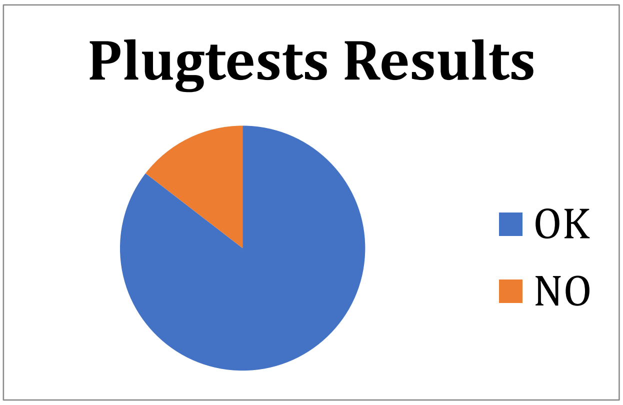


Figure 11. Overall results (%)

An overall success rate of 91.2% was achieved, which indicates a very high degree of compatibility among the participating implementations (EUTs) in the areas of the Test Plan where features were widely supported and the test cases could be executed in most of the Test Sessions. In the next clauses, we will see that this high rate is also a consequence of the good preparation and involvement of participants during the remote integration and pre-testing phase of the Plugtests.

9.2 Results per Test Configuration

The table below provides the results for each test configuration in the scope of the Plugtests event.

	Plugtests Results		Not Executed		Totals	
	OK	**NO**	**NA**	**OT**	**Run**	**Results**
CMS or IdMS or	105 (89.0%)	13 (11.0%)	118	0	118	236

GMS			(50.0%)	(0.0%)	(50.0%)	
IdMS	57 (96.6%)	2 (3.4%)	1 (1.7%)	0 (0.0%)	59 (98.3%)	60
GMS or KMS	2 (100.0%)	0 (0.0%)	34 (94.4%)	0 (0.0%)	2 (5.6%)	36
Config_MBMS	60 (98.4%)	1 (1.6%)	2 (3.2%)	0 (0.0%)	61 (96.8%)	63
MCPTT	684 (92.4%)	56 (7.6%)	714 (49.1%)	0 (0.0%)	740 (50.9%)	1454
MCData	29 (70.7%)	12 (29.3%)	123 (75.0%)	0 (0.0%)	41 (25.0%)	164
MCVideo	20 (71.4%)	8 (28.6%)	25 (47.2%)	0 (0.0%)	28 (52.8%)	53

Table 17. Results per Test Configuration

9.3 Results per Test Case

The table below provides the results for each test case in the scope of the Plugtests event.

	Plugtests Results		**Not Executed**		**Totals**	
	OK	**NO**	**NA**	**OT**	**Run**	**Results**
7.2.1	52 (89.7%)	6 (10.3%)	5 (7.9%)	0 (0.0%)	58 (92.1%)	63
7.2.2	40 (97.6%)	1 (2.4%)	5 (10.9%)	0 (0.0%)	41 (89.1%)	46
7.2.3	31 (100.0%)	0 (0.0%)	5 (13.9%)	0 (0.0%)	31 (86.1%)	36
7.2.4	11 (100.0%)	0 (0.0%)	10 (47.6%)	0 (0.0%)	11 (52.4%)	21
7.2.5	8 (61.5%)	5 (38.5%)	12 (48.0%)	0 (0.0%)	13 (52.0%)	25
7.2.6	45 (93.8%)	3 (6.3%)	5 (9.4%)	0 (0.0%)	48 (90.6%)	53
7.2.7	9 (60.0%)	6 (40.0%)	13 (46.4%)	0 (0.0%)	15 (53.6%)	28
7.2.8	9 (90.0%)	1 (10.0%)	11 (52.4%)	0 (0.0%)	10 (47.6%)	21
7.2.9	28 (96.6%)	1 (3.4%)	8 (21.6%)	0 (0.0%)	29 (78.4%)	37
7.2.10	7 (77.8%)	2 (22.2%)	13 (59.1%)	0 (0.0%)	9 (40.9%)	22
7.2.11	7 (77.8%)	2 (22.2%)	13 (59.1%)	0 (0.0%)	9 (40.9%)	22
7.2.12	8 (80.0%)	2 (20.0%)	14 (58.3%)	0 (0.0%)	10 (41.7%)	24
7.2.13	7 (87.5%)	1 (12.5%)	14 (63.6%)	0 (0.0%)	8 (36.4%)	22
7.2.14	6 (85.7%)	1 (14.3%)	13 (65.0%)	0 (0.0%)	7 (35.0%)	20
7.2.15	44 (93.6%)	3 (6.4%)	7 (13.0%)	0 (0.0%)	47 (87.0%)	54
7.2.16	40 (97.6%)	1 (2.4%)	10 (19.6%)	0 (0.0%)	41 (80.4%)	51
7.2.17	4 (66.7%)	2 (33.3%)	17 (73.9%)	0 (0.0%)	6 (26.1%)	23
7.2.18	2 (100.0%)	0 (0.0%)	13 (86.7%)	0 (0.0%)	2 (13.3%)	15

7.2.19	39 (95.1%)	2 (4.9%)	10 (19.6%)	0 (0.0%)	41 (80.4%)	51
7.2.20	43 (100.0%)	0 (0.0%)	6 (12.2%)	0 (0.0%)	43 (87.8%)	49
7.2.21	0 (0.0%)	0 (0.0%)	13 (100.0%)	0 (0.0%)	0 (0.0%)	13
7.2.22	0 (0.0%)	0 (0.0%)	13 (100.0%)	0 (0.0%)	0 (0.0%)	13
7.2.23	8 (100.0%)	0 (0.0%)	10 (55.6%)	0 (0.0%)	8 (44.4%)	18
7.2.24	8 (100.0%)	0 (0.0%)	10 (55.6%)	0 (0.0%)	8 (44.4%)	18
7.2.25	0 (0.0%)	0 (0.0%)	12 (100.0%)	0 (0.0%)	0 (0.0%)	12
7.2.26	0 (0.0%)	0 (0.0%)	12 (100.0%)	0 (0.0%)	0 (0.0%)	12
7.2.27	2 (100.0%)	0 (0.0%)	9 (81.8%)	0 (0.0%)	2 (18.2%)	11
7.2.28	2 (100.0%)	0 (0.0%)	9 (81.8%)	0 (0.0%)	2 (18.2%)	11
7.2.29	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.30	9 (100.0%)	0 (0.0%)	10 (52.6%)	0 (0.0%)	9 (47.4%)	19
7.2.31	9 (100.0%)	0 (0.0%)	10 (52.6%)	0 (0.0%)	9 (47.4%)	19
7.2.32	1 (100.0%)	0 (0.0%)	11 (91.7%)	0 (0.0%)	1 (8.3%)	12
7.2.33	1 (100.0%)	0 (0.0%)	11 (91.7%)	0 (0.0%)	1 (8.3%)	12
7.2.34	10 (100.0%)	0 (0.0%)	9 (47.4%)	0 (0.0%)	10 (52.6%)	19
7.2.35	10 (100.0%)	0 (0.0%)	9 (47.4%)	0 (0.0%)	10 (52.6%)	19
7.2.36	1 (100.0%)	0 (0.0%)	11 (91.7%)	0 (0.0%)	1 (8.3%)	12
7.2.37	1 (100.0%)	0 (0.0%)	11 (91.7%)	0 (0.0%)	1 (8.3%)	12
7.2.38	0 (0.0%)	0 (0.0%)	10 (100.0%)	0 (0.0%)	0 (0.0%)	10
7.2.39	10 (62.5%)	6 (37.5%)	4 (20.0%)	0 (0.0%)	16 (80.0%)	20
7.2.40	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.41	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.42	9 (81.8%)	2 (18.2%)	6 (35.3%)	0 (0.0%)	11 (64.7%)	17
7.2.43	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.44	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.45	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.46	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.47	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.48	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.49	6 (85.7%)	1 (14.3%)	7 (50.0%)	0 (0.0%)	7 (50.0%)	14
7.2.50	4 (57.1%)	3 (42.9%)	7 (50.0%)	0 (0.0%)	7 (50.0%)	14
7.2.51	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.52	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9
7.2.53	0 (0.0%)	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)	9

7.2.54	6 (66.7%)	3 (33.3%)	5 (35.7%)	0 (0.0%)	9 (64.3%)	14
7.2.55	5 (71.4%)	2 (28.6%)	7 (50.0%)	0 (0.0%)	7 (50.0%)	14
7.2.56	5 (71.4%)	2 (28.6%)	6 (46.2%)	0 (0.0%)	7 (53.8%)	13
7.2.57	4 (80.0%)	1 (20.0%)	7 (58.3%)	0 (0.0%)	5 (41.7%)	12
7.3.1	39 (90.7%)	4 (9.3%)	5 (10.4%)	0 (0.0%)	43 (89.6%)	48
7.3.2	24 (88.9%)	3 (11.1%)	7 (20.6%)	0 (0.0%)	27 (79.4%)	34
7.4.1	30 (75.0%)	10 (25.0%)	15 (27.3%)	0 (0.0%)	40 (72.7%)	55
7.4.2	66 (97.1%)	2 (2.9%)	9 (11.7%)	0 (0.0%)	68 (88.3%)	77
7.4.3	55 (96.5%)	2 (3.5%)	11 (16.2%)	0 (0.0%)	57 (83.8%)	68
7.5.1	0 (0.0%)	0 (0.0%)	11 (100.0%)	0 (0.0%)	0 (0.0%)	11
7.5.2	0 (0.0%)	0 (0.0%)	11 (100.0%)	0 (0.0%)	0 (0.0%)	11
7.5.3	0 (0.0%)	0 (0.0%)	11 (100.0%)	0 (0.0%)	0 (0.0%)	11
7.5.4	0 (0.0%)	0 (0.0%)	11 (100.0%)	0 (0.0%)	0 (0.0%)	11
7.6.2	5 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (100.0%)	5
7.6.3	5 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (100.0%)	5
7.6.4	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)	4
7.6.5	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
7.6.6	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)	2
7.6.7	5 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (100.0%)	5
7.6.8	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
7.6.9	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
7.7.1	49 (86.0%)	8 (14.0%)	3 (5.0%)	0 (0.0%)	57 (95.0%)	60
7.7.2	22 (95.7%)	1 (4.3%)	9 (28.1%)	0 (0.0%)	23 (71.9%)	32
7.7.3	33 (97.1%)	1 (2.9%)	6 (15.0%)	0 (0.0%)	34 (85.0%)	40
7.7.4	1 (100.0%)	0 (0.0%)	10 (90.9%)	0 (0.0%)	1 (9.1%)	11
7.7.5	1 (100.0%)	0 (0.0%)	9 (90.0%)	0 (0.0%)	1 (10.0%)	10
7.8.1	4 (100.0%)	0 (0.0%)	8 (66.7%)	0 (0.0%)	4 (33.3%)	12
7.8.2	4 (100.0%)	0 (0.0%)	8 (66.7%)	0 (0.0%)	4 (33.3%)	12
7.8.3	3 (100.0%)	0 (0.0%)	8 (72.7%)	0 (0.0%)	3 (27.3%)	11
7.9.1	2 (100.0%)	0 (0.0%)	12 (85.7%)	0 (0.0%)	2 (14.3%)	14
7.9.2	2 (100.0%)	0 (0.0%)	12 (85.7%)	0 (0.0%)	2 (14.3%)	14
7.9.3	2 (100.0%)	0 (0.0%)	12 (85.7%)	0 (0.0%)	2 (14.3%)	14
7.9.4	1 (100.0%)	0 (0.0%)	12 (92.3%)	0 (0.0%)	1 (7.7%)	13
7.9.5	2 (100.0%)	0 (0.0%)	12 (85.7%)	0 (0.0%)	2 (14.3%)	14
7.9.6	1 (50.0%)	1 (50.0%)	11 (84.6%)	0 (0.0%)	2 (15.4%)	13

7.9.7	1 (100.0%)	0 (0.0%)	13 (92.9%)	0 (0.0%)	1 (7.1%)	14
7.10.1	2 (100.0%)	0 (0.0%)	14 (87.5%)	0 (0.0%)	2 (12.5%)	16
7.10.2	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.3	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.4	2 (100.0%)	0 (0.0%)	14 (87.5%)	0 (0.0%)	2 (12.5%)	16
7.10.5	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.6	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.7	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.8	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.9	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.10	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.11	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.12	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.13	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.14	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.15	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.16	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
7.10.17	0 (0.0%)	0 (0.0%)	14 (100.0%)	0 (0.0%)	0 (0.0%)	14
8.2.1	6 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (100.0%)	6
8.2.2	6 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (100.0%)	6
8.2.3	7 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (100.0%)	7
8.2.4	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)	4
8.2.5	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
8.2.6	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (100.0%)	3
8.2.7	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
8.2.8	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
8.2.9	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
8.2.10	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
8.2.11	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
8.2.12	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
8.2.13	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
8.2.14	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
8.2.15	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
8.2.16	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
8.2.17	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2

8.2.18	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
8.2.19	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0

Table 18. Results per Test Case

10 Plugtests Observations

As a result of the Plugtests event activities some issues in 3GPP Technical Specifications (TSs) and related standards were identified together with practical deployment problems that may demand some clarification or feedback from the related SDOs. We have classified those aspects into the following two categories:

- **Observations to MCPTT Standards**: Missing, erroneous or ambiguous definition of procedures in 3GPP's MCS TSs.
- **Technical constraints**: Related to implementation issues, not covered by the standards, but which need to be faced by MCS vendors in most deployments.

The reader should note that 3GPP TS approved in December 2017 (mostly 14.4.0) were considered for the second and third Plugtests event and some fields may have changed or have been already solved.

The third MCX Plugtests event team wants to thank all the participants in the Plugtests for kindly sharing the following lessons learned. Specific actions towards pushing this feedback to relevant TSGs in 3GPP have already been started at the time of the release of this report.

10.1 Standards issues

10.1.1 MCPTT Administrator designation and checks

Not only on 3GPP TS 24.484 [14], but on other MCPTT related standards, the so called "MCPTT Administrator" is mentioned several times. However, in no document it is specified how this special MCPTT User is identified or distinguished from other regular MCPTT users. For CMS in particular, it is important to clarify this point, as this is the only user that can provision/manage configuration documents in this server. The checking mechanism should be specified. It is suggested to check the MCPTT ID of the access token against a configured value in the CMS.

10.1.2 MO and XML Document relationship

It is mentioned in 3GPP TS 24.484 [14], Figure 4.2.2-1, that following the bootstrap procedure, UE must download the "MCS UE initial configuration MO" and the "identified default MCS user profile configuration MO". This point is somewhat confusing, because it differs greatly with the wording regarding other CMS documents, where it clearly states that the UE must subscribe to the XML document.

In the case of these two documents (MO's) the TS does not mention the XML format for the documents, but the MO format. And it does not say the UE must subscribe, but simply download those documents. All of this seems to imply that the procedure to follow is wildly different from the regular CMS XML documents.

But, then, reaching section 7.2 of 3GPP TS 24.484 [14], there is a XML definition for the "MCS UE initial configuration document" (note here the notation change from "MO" to "document").

So, it needs to be clarified whether these two documents must be handled as normal XML CMS documents or have a different handling procedure. Based on what is specified in section 7, these documents should be handled the same way as the rest of the CMS documents. And thus, that figure and accompanying text should be changed to avoid confusion.

10.1.3 UE-init-conf and UE-conf storage paths and access URIs

It is mentioned on 3GPP TS 24.484 [14], sections 7.2 and 8.2 that "The master MCS UE (initial) configuration document name is assigned by an MCS administrator when the document is created and is stored in the user directory of that MCS administrator." So it is clearly defined where MASTER UE (initial) documents belongs to. These must serve as a template for generating specially targeted configuration documents that eventually are fetched from the correspondent UEs. But the standard does not indicate what URI must the UEs use to access those documents. It is highly improbable for the UEs to be capable of getting the documents from the MCPTT Administrator User's Tree, as this is the only defined path for UE initial document.

For the MCS UE configuration documents, the standard does say that "MCPTT UE configuration documents of a MCPTT user are contained as "XDM collections" in the user's directory of the "Users Tree"" so, at least for this type of document the path to be used for HTTP GET's and subscription is somewhat defined.

We think this should be more thoroughly specified in the standard, and provide a base set of parameters for each configuration document, such as (UE accessible URI, Admin provisionable URI, detailed MASTER -> concrete document transformation procedures). In the current state of the standard, interoperability capacity is very low due to missing details and open interpretation possibilities.

10.1.4 File Extension inclusion in XML values

In several places in the standard it is necessary to reflect documents filenames in different XML elements of the documents. In these cases, the full document file name has to be reflected, such as "mcvideo-userprofile-3shift.xml" or only the filename without the extension "mcvideo-userprofile-3shift".

Examples:

- 3GPP TS 24.484 [14] subclause 8.3.2.7 "The <ProfileName> element is of type "token" and specifies the name of the MCPTT user profile configuration document in the MCPTT user profile XDM collection and corresponds to the "MCPTTUserProfileName" element of subclause 5.2.7B in 3GPP TS 24.483 [4]"

- 3GPP TS 24.484 [14] subclause 9.3.1 "The name of the MCVideo user profile document matches the value of the <ProfileName> element in the MCVideo user profile document."

We advocate for the full filename option in this case, although we hold a little uncertainty about whether this refers to the filename (or document selector in XCAP jargon) or to another kind of "document name.

10.1.5 MCX Service Authorization

3GPP TS 33.180 defines two ways of performing MCX Service authorization with the MCX Server, but if we consider the full procedure a UE has to perform to bootstrap from cold start to a full working state within the network, there is a conflict with the REGISTER based workflow.

The REGISTER authorization workflow is based on the idea of including the MCPTT Access Token right in the IMS REGISTER SIP message the UE sends towards the IMS network when contacting it for the first time. But if according to 3GPP TS 24.484 [14], the UE must subscribe to the UE-initial-conf document and the default-user-profile, it has to be already registered in the IMS network, thus rendering the REGISTER workflow unusable.

For the moment PUBLISH Authorization workflow seems to be the only alternative.

10.1.6 Misleading typos

There are some types in configuration documents which can be specially misleading or modify significantly the meaning of the sentence. Following are some of them:

- "initial" word misplaced in sentences like "If there is no <mcvideo-UE-id> element in the MCVideo UE configuration document, then by default the MCVideo UE configuration document applies to all MCVideo UEs of the mission critical organization that are not specifically identified in the <mcvideo-UE-id> element of another MCVideo UE initial configuration document of the mission critical organization." This happens in 3GPP TS 24.484 [14] subclauses 8.2.1, 9.2.1, 9.2.2.7, 10.2.1 and 10.2.2.7 sections.

- The extra point at MCPTT User Profile Document at section 8.3.2.5 of 3GPP TS 24.484 [14]. It now says "application/vnd.3gpp.mcptt.-user-profile+xml". That point after the "mcptt" is misleading and probably incorrect, as the other MCX User profile counterparts do not have it.

10.1.7 Duration Data Type in Service Configurations

In 3GPP TS 24.484 [14] Section 8.4.2.6 (Page 84) it is stated that:

The elements of "xs: duration" type specified above shall be represented in seconds using the element value: "PT<h>H<m>M<n>S" where <n> represents a valid value in seconds.

NOTE 3: "xs:duration" allows the use of decimal notion for seconds, e.g. 300ms is represented as <PT0.3S>.

If any of the elements of "xs: duration" type specified above contain values that do not conform to the "PT <n>S" structure then the configuration management server shall return an HTTP 409 (Conflict) response including the XCAP error element <constraint-failure>. If included, the "phrase" attribute should be set to "invalid format for duration"

1. The first sentence is confusing, stating to use the XML Schema's *duration* data type, and also redefining it with a format string of "PT<h>H<m>M<n>S" to prevent the use of "<y>Y<m>M<d>D" between "P" and "T".
2. Also a few lines below, the format string changes to "PT <n>S".

We think that the actual intent behind this text is to define how an amount of time may be specified in the service configuration document. Our proposed way to do that would be to use the XML Schema's duration datatype without modifications as in the other configuration documents.

10.1.8 Nested PrivateCallKMSURI Element in User Profile Configuration

In 3GPP TS 24.484 [14] Section 8.3.2.1 item 8)-i-C-I a *PrivateCallKMSURI* element that contains one or more entry elements is defined. However, in the XSD, the *PrivateCallKMSURI* contains another nested *PrivateCallKMSURI* element, so that for example the following XML snippet is the only way to define a KMS URI with the value "sip:kms1@example.com":

```
<PrivateCallKMSURI>
   <PrivateCallKMSURI>
      <uri-entry>sip:kms1@example.com</uri-entry>
   </PrivateCallKMSURI>
</PrivateCallKMSURI>
```

We hardly see any reason for this nesting, especially, because the only other elements within the outer *PrivateCallKMSURI* element are the *anyExt* and *any* element. To follow the textual description exactly only the following line is needed in the XSD to define the *PrivateCallKMSURI* element:

```
<xs:element name="PrivateCallKMSURI" type="mcpttup:ListEntryType"/>
```

However, this would lead to a similar complex nesting, but at least not using the same name for the nested elements, e.g.:

```
<PrivateCallKMSURI>
   <entry>
      <uri-entry>sip:kms1@example.com</uri-entry>
   </entry>
</PrivateCallKMSURI>
```

So it could be considered a definition like:

```
<xs:element name="PrivateCallKMSURI" type="xs:anyURI"/>
```

Since the *PrivateCallKMSURI* is integrated in the enclosing *PrivateCallList* element using an *anyExt* element there can be an unbounded number of *PrivateCallKMSURI* anyway, which would satisfy the semantics of the textual definition in the standard.

10.1.9 Resource Namespace/Priority in Service Configuration

In 3GPP TS 24.484 [14] Section 8.4.2 it is stated that the *emergency-resource-priority*, *imminent-peril-resource-priority*, and *normal-resource-priority* elements have to contain two elements defined as follows:

a) one <resource-priority-namespace> string element containing a namespace defined in IETF RFC 8101 [20]; and

b) one <resource-priority-priority> string element element containing a priority level in the range specified in IETF RFC 8101 [20];

In RFC 8101 Section 3.1 can be read that:

The mcpttp namespace uses the priority levels listed below from lowest to highest priority.

mcpttp.0 (lowest priority)

mcpttp.1

mcpttp.2

[...]

mcpttp.14

mcpttp.15 (highest priority)

The Namespace Numerical Value is 46.

Analogously, the priorities for the *mcpttq* namespace are defined.

So a priority is the namespace string followed by a period an integer in the range [0,15]. Accordingly, in the XSD the two elements are declared to contain strings:

```
<xs:complexType name="resource-priorityType">
  <xs:sequence>
     <xs:element name="resource-priority-namespace" type="xs:string"/>
     <xs:element name="resource-priority-priority" type="xs:string"/>
     <xs:element name="anyExt" type="mcpttsc:anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>
```

An example would be the following snippet:

```
<emergency-resource-priority>
  <resource-priority-namespace>mcpttp</resource-priority-namespace>
  <resource-priority-priority>mcpttp.14</resource-priority-priority>
</emergency-resource-priority>
```

However, this definition seems to be a little bit confusing, since the name of the namespace is repeated in the *resource-priority-priority* element, where many expect an integer. This would also have the benefit of eliminating redundancy, etc.

We think that this definition could be improved to not only eliminate (potential errors due to) the redundancy (e.g. a namespace of *mcpttp* with a priority of *mcpttq.0* could be defined) but also restrict the priority value. Consider the following XML Schema example snippet in contrast to the *string* data type:

```
<xs:element name="resource-priority-priority">
  <xs:simpleType>
    <xs:restriction base="xs:integer">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="15"/>
    </xs:restriction>
  </xs:simpleType>
</xs:element>
```

10.1.10 On-network and Off-network: May, Shall and how often?

In 3GPP TS 24.484 [14] Section 7.2.2.1 the contents of the *mcptt-UE-initial-configuration* root element are defined as follows:

The <mcptt-UE- initial-configuration> document:

1) shall include a "domain" attribute;

2) may include a <mcptt-UE-id> element;

3) may include a <name> element;

4) may include a <Default-user-profile> element;

5) may include an <on-network> element;

6) may include an <off-network> element; and

7) may include any other attribute for the purposes of extensibility.

So, the <*mcptt-UE-initial-configuration*> element **may** contain **an** on-network element and **may** also contain **an** off-network element. In contrast, **Section 7.2.2.6** states that *"The <mcptt-UE-initial-configuration> element **shall** contain **one** <on-network> element and **one** <off-network> element."* Additionally, in the XML Schema both elements are nested within a `<xs:choice minOccurs="0" maxOccurs="unbounded">` which means they **may** occur and if they do, they **may** occur more than once.

We would need some clarification on whether presence of an on-network/off-network element is mandatory or not, and in any case, whether a restriction to a single maximum occurrence should be considered.

10.1.11 User Profile Document Name

In 3GPP TS 24.484 [14] Section 8.3.2.8 it is stated, that *The name of user profile configuration document shall be "user-profile"*, while in Section 8.3.1 the following definition is given: *The name of the MCPTT user profile document matches the value of the <ProfileName> element in the MCPTT user profile document.*

We think the latter naming convention for user profile documents is more practical, since there are certainly more than one in most cases. However, the ProfileName element is not mandatory, so clarification would be needed.

10.1.12 User Profile: PrivateCallURI and PrivateCallProSeUser

The standard states in 3GPP TS 24.484 [14] Section 8.3.2.1 that the *PrivateCallList* element contains a "*<PrivateCallURI> element that contains one or more <entry> elements*" and a "*<PrivateCallProSeUser> element that contains one or more <ProSeUserID-entry> elements*".

In the XSD the *PrivateCallURI* element actually is of type *EntryType* itself and therefore a single entry (named *PrivateCallURI*) and not a list of elements named *entry* of type *EntryType*. Basically the same applies to the *PrivateCallProSeUser* element.

However, because both are nested within a *choice* element with `maxOccurs="unbounded"` they themselves may occur more than once.

10.1.13 Minor but recurring inconsistencies between Structure & Validation chapters and the XSD

In this section a few common types of inconsistencies between the standard text in natural language (mostly the *Structure* and *Validation* sections for **every configuration document** (in 3GPP TS 24.484 [14] and 3GPP TS 24.481 [11]) and the *XML Schema Definition*, are listed with examples. Only one example per type is given.

1. Undefined *any*, *anyExt* and *anyAttribute* elements that are, nevertheless, in the XSD. For example: In the *mcptt-UE-initial-configuration* complex type an *any* and an *anyExt* element are defined without being mentioned in the text. In the textual definintion of the *mcptt-UE-id* neither an *any*, *anyExt*, or *anyAttribute* element are mentioned, but present in the XSD.
2. The *attributeGroup IndexType* is also never mentioned in the text.

10.1.14 Minor inconsistencies between the textual definition and the XSD

In this section a few minor inconsistencies between the standard text in natural language and the *XML Schema Definition*, are listed.

- 7.2.2.3: *mcptt-UE-initial-configuration*: `<xs:element name="HPLM">` maybe should be `<xs:element name="HPLMN">`
- 7.2.2.3: *mcptt-UE-initial-configuration*: `<xs:element name="VPLM">` maybe should be `<xs:element name="VPLMN">`
- The *Instance-ID-URN* attribute in the *mcptt-UE-initial-configuration* complex type is never mentioned to be there in the text.
- 8.3.2.1: *mcptt-user-profile*: The *EmergencyCall* element in the *PrivateCall* element is defined mandatory, but optionally in the XSD.

10.1.15 The *any*, *anyExt*, and *anyAttribute* Discussion

There has been quite some discussion on the pros and cons of using the XML Schema's *any* element, *anyAttribute*, and in this case also the locally defined *anyExtType* (For the sake of readability in the following it will be referred to these elements/attributes casually as "*anys*".). Especially when it comes to the validation of XML documents, there are many different views. We want to point out some examples of noteworthy effects we encountered.

Some noteworthy effects we have encountered so far are:

First, let us have a look at a simple case - here is a snippet:

```
    ...

        <oxe:supported-services>
            <oxe:service enabler="urn:urn-7:3gpp-service.ims.icsi.mcptt">
                <mcpttgi:mcptt-speech/>
            </oxe:service>
        </oxe:supported-services>

    ...
```

The error in this example is, that the `<mcpttgi:mcptt-speech/>` element does not belong directly under the `oxe:service` element. According to 3GPP TS 24.481 [11] (Release 14) Section 7.2, this snippet **must** look like this (enclosing the `<mcpttgi:mcptt-speech/>` element within an `<oxe:group-media>` element):

```
    ...
        <oxe:supported-services>
            <oxe:service enabler="urn:urn-7:3gpp-service.ims.icsi.mcptt">
                <oxe:group-media>
                    <mcpttgi:mcptt-speech/>
                </oxe:group-media>
            </oxe:service>
        </oxe:supported-services>
    ...
```

Nevertheless, using a standard XML Schema validator library the group configuration validates correctly against the associated XSD files.

```
    ...
        <xs:complexType name="serviceType">
            <xs:sequence minOccurs="0" maxOccurs="unbounded">
                <xs:element name="group-media" type="mediaListType" minOccurs="0"/>
                <xs:any namespace="##other" processContents="lax" minOccurs="0"/>
            </xs:sequence>
            <xs:attribute name="enabler" type="xs:string"/>
            <xs:anyAttribute processContents="lax"/>
        </xs:complexType>
    ...
```

Another phenomenon that we encountered are "dangling elements" that are present throughout the XSDs. By that we mean elements that in the XSDs are never declared to be used in an enclosing element although the standard defines where they are to be used. This work using *anys*. Here is an example, a snippet from the mcptt-user-profile.xsd:

```
    ...

    <xs:complexType name="PrivateCallListEntryType">
        <xs:choice minOccurs="1" maxOccurs="unbounded">
            <xs:element name="PrivateCallURI" type="mcpttup:EntryType"/>
            <xs:element name="PrivateCallProSeUser" type="mcpttup:ProSeUserEntryType"/>
            <xs:element name="anyExt" type="mcpttup:anyExtType" minOccurs="0"/>
            <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
        </xs:choice>
        <xs:attributeGroup ref="mcpttup:IndexType"/>
        <xs:anyAttribute namespace="##any" processContents="lax"/>
    </xs:complexType>

    ...

    <xs:element name="PrivateCallKMSURI" type="mcpttup:PrivateCallKMSURIEntryType"/>

    ...

    <xs:complexType name="PrivateCallKMSURIEntryType">
        <xs:choice>
            <xs:element name="PrivateCallKMSURI" type="mcpttup:EntryType"/>
            <xs:element name="anyExt" type="mcpttup:anyExtType" minOccurs="0"/>
            <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
        </xs:choice>
        <xs:attributeGroup ref="mcpttup:IndexType"/>
        <xs:anyAttribute namespace="##any" processContents="lax"/>
    </xs:complexType>
```

It would, for instance, also have been possible to write the PrivateCallKMSURIEntryType like this:

```
    ...

    <xs:complexType name="PrivateCallListEntryType">
        <xs:choice minOccurs="1" maxOccurs="unbounded">
            <xs:element name="PrivateCallURI" type="mcpttup:EntryType"/>
            <xs:element name="PrivateCallProSeUser" type="mcpttup:ProSeUserEntryType"/>
            <xs:element name="PrivateCallKMSURI" type="mcpttup:PrivateCallKMSURIEntryType"/>
        </xs:choice>
        <xs:attributeGroup ref="mcpttup:IndexType"/>
    </xs:complexType>

    ...
```

However, because of the *anyExt* used to include one of those "dangling elements", we only know what to do with the PrivateCallKMSURI element because in 3GPP TS 24.484 [14], Section 8.3.2.1 it is defined that:

...

The <mcptt-user-profile> document:

...

8) shall include one or more <Common> elements, each of which:

...

d) shall include one <PrivateCall> element. The <PrivateCall> element contains:

...

i) a <PrivateCallList> element that contains:

A) a <PrivateCallURI> element that contains one or more <entry> elements;

B) a <PrivateCallProSeUser> element that contains one or more <ProSeUserID-entry> elements; and

C) an <anyExt> element which may contain:

I) a <PrivateCallKMSURI> element that contains one or more entry> elements; and

...

This is, by the way, the minimal MCPTT user profile, that validates:

```
    <?xml version="1.0" encoding="UTF-8"?>
    <urn:mcptt-user-profile xmlns:urn="urn:3gpp:mcptt:user-profile:1.0"
        XUI-URI="sip:foo@bar.baz"
        user-profile-index="1" />
```

Although the root element is a complex type with a choice element with minOccurs="1" and some mandatory elements in that choice this is possible. The reason is, that there is an *any* element with minOccurs="0", so one can choose "minimally 1 times 0 any" which results in an empty root element.

10.1.16 MCData notifications

MCData notifications work in the following way:

When a MCData client sends a SDS or FD message, a request to receive notifications can be included. The MCData client who receives the message generates the notifications. The request to receive notifications is included in an additional field in message signalling. The notification messages use their own type and they are also included in the signalling part.

When the server receives a message including a notification request, it must save the Conv ID and Msg ID included in the message. This is necessary because when the server receives a notification it must check that the Conv ID and MSG ID included in it can be correlated to a previous message requesting the notification.

The MCData client must include the ID's from the message which requested the notification in the response. If the server cannot correlate a notification with a previous notification request, it must discard the notification message.

The following problem has been found:

According to 12.2.2.1.4) "if the incoming SIP MESSAGE request does not contain an application/vnd.3gpp.mcdata-info+xml MIME body with a <mcdata-controller-psi> element, shall reject the SIP MESSAGE"

It is stated that originating participating server must check the existence of this tag in the mcdata-info, otherwise it must reject the message.

According to 12.2.1.1 "The MCData client determines the controlling MCData function from the contents of the <mcdata-controller-psi> element contained in the application/vnd.3gpp.mcdata-info+xml MIME body of the incoming SDS or FD message request" and 12.2.1.1 4) shall insert in the SIP MESSAGE request an application/vnd.3gpp.mcdata-info+xml MIME body with an<mcdata-controller-psi> element containing the PSI of the controlling MCData function;

The MCdata client must include this in mcdata-info part, which has previously obtained from the incoming SDS or FD message which includes notification request.

After checking section 9.2.2, which explains how to generate and process SDS messages, the <mcdata-controller-psi> does not appear at any subsection and it does not mandate to include it in SDS messages. Therefore, if we follow this procedure, it does not look possible to generate correct notification messages.

The solution to this issue could be for the server to include its PSI in <mdata-controller-psi> in the initial MESSAGE.

10.1.17 MCVideo Media ID field

A definition for the Media ID field is still missing in 3GPP TS 24.581 [15]. This field is used when the media is multiplexed and is included in some of the message definitions in Section 9.2.4.

10.1.18 Usage of <mcptt-request-uri> element of mcptt-info+xml

As per 3GPP TS 24.379 [9], <mcptt-request-uri> should be used as follows:

> 3) the <mcptt-request-uri> can be included with:
>
> a) a value set to an MCPTT group ID or temporary MCPTT group ID when the <session-type> is set to a value of "prearranged" or "chat"; and
>
> b) a value set to the MCPTT ID of the called MCPTT user when the <session-type> is set to a value of "private";

But, in subclause 11.1.1.2.1.1 of 3GPP TS 24.379 [9], MCPTT ID of invited user is placed in MIME resource-lists body. To make prearranged group call and private call procedure consistent, the suggestion would be to remove usage of MIME resource-lists body in subclause 11.1.1.2.1.1 and instead use <mcptt-request-uri> element of application/vnd.3gpp.mcptt-info+xml MIME body.

10.1.19 Usage of <mcptt-called-party-id> element in mcptt-info+xml

The element <mcptt-called-party-id> of mcptt-info+xml MIME body contains redundant information which is already present in <mcptt-request-uri> element of mcptt-info+xml.

The usage of element <mcptt-called-party-id> of mcptt-info+xml MIME body can be removed. Information is already passed to relevant entity using <mcptt-request-uri> element of mcptt-info+xml.

10.2 Technical Constraints

During the 1st MCPTT Plugtests some technical constraints regarding how to deal with SBC/NAT. Since during the 2nd and 3rd Plugtests there have been identified no standardised solutions for some of these constraints, the analysis and constraints are again collected here. Additionally, other common needs for clarification have been gathered (collected as CLARIFICATION) from some participants.

The design of the MCPTT ecosystem as an overlay network on top of SIP/IMS core would allow a seamless and secure, by cyphering specific elements) traversal of information through the SIP/IMS core. The usage of participating ASs, MCPTT specific identities (mcptt-id, mcptt-client-id, etc) and the encoding of most of the relevant information in XML in the body of the SIP messages contributed to this de-coupling while making it possible to deploy MCPTT over different provider’s SIP/IMS Core (i.e. different trust domain).

However, in some cases, 3GPP TSs procedures assume “pure IMS/SIP Core” deployments, with direct e2e IP connectivity between the UE, the IMS/SIP Core and all the ASs for both the signalling and the media streams. Unfortunately, in most of the commercial SIP/IMS deployments (including VoLTE) there exist some kind of Source Border Controlling or NAT elements that either carry out some B2BUA operation and/or hide/replace original IP:PORT. That would include IMS-ALG/AGW/CGNAT/SBC/BCF/SIP-aware firewalls and DPI elements among others (we will use the term SBC indistinctly for all of them in this Section). The situation is particularly problematic in the MCPTT ecosystem since not only the signalling and audio streams need to reach the different AS but also the Floor Control. Additionally, the MCPTT Floor Control uses RTCP-APP which would be most of the time wrongly processed by currently available SBCs.

Although such kind of SBC elements are not considered as mandatory by 3GPP and the need to consider them in normative work could be argued, the participants agreed that some clarification/agreed procedure would no doubt reduce the deployment and integrations costs. In the following subsections this kind of problems are collected in subclause 10.2.1.

10.2.1 SBC: Contact Header

At least two different situations were identified already in 2nd Plugtests and are still pending.

1) Subclause 4.5 in 3GPP TS 24.379 [5] specifies the use of the contact header to carry the session ID. Most SBCs would however remove the session ID from the contact header and/or replace it. MCPTT client needs anyway the session ID to release the session according to 3GPP TS 24.379 [5]. Additionally, IETF RFC 3261 [28] states that “The Contact header field provides a SIP or SIPS URI that can be used to contact that specific instance of the UA for subsequent requests” only, so that the usage contact header to manage sessions could be re-visited.

2) Following 1) and according to subclause 6.3.3.1.2, subclause 6.3.2.2.3 and subclause 6.3.2.2.4 MCPTT servers shall include the MCPTT session identity in the Contact header field of SIP INVITE requests and 200 OK final responses. Contact headers can be modified by any SBC in the path between the participating MCPTT server and the MCPTT client. MBMS listening status reports sent by MCPTT clients shall include the MCPTT session identity in the MBMS usage info XML. MCPTT clients cannot learn the correct MCPTT session identity from the Contact header they receive in INVITE requests or 200 OK responses because it has been modified by an intermediate node.

Different alternatives were discussed to overcome both issues (out of standards), collected here for information purposes only:

For 1) A partner proposed considering the Session-ID header (IETF RFC 7989 [29]) as a possible alternative.

For 2) A partner proposed:

- The SBC could preserve just the user part of SIP URI which represents the MCPTT session identity. The client would include this value in the MBMS usage info XML and the MCPTT server could compare this value with the list of identities of ongoing MCPTT sessions, instead of the whole SIP-URI.
- The MCPTT server could include a custom SIP header to be traversed transparently by the SBC set to the MCPTT session identity. The MCPTT client could learn the correct MCPTT session identity from this header.
- The MCPTT server could include an additional tag in MCPTT-INFO body indicating the MCPTT session identity. Again, the MCPTT client could learn the correct MCPTT session identity from this new tag.

10.2.2 SBC: MCPTT-5, Rx

PCC related test cases define either P-CSCF or MCPTT Participating AS triggered Rx-interface operations. The associated Diameter interface with the PCRF demands proper IP-CAN information to be conveyed from the UE to the Application Function (being that the P-CSCF of the AS).

In general purpose IMS/VoLTE deployments if the SBC element is included as IMS-ALG in the P-CSCF it can access that information before the border controlling mechanisms are applied and interface the PCRF with proper IP information.

Proposed solutions include either enforcing transparent modes in the SBC (not always possible due to MCPTT specific headers and SDP media components for media and floor control) or using custom headers.

10.2.3 SBC: Conveying P-Preferred-Service and P-Preferred-Identity

In order to properly map the mcptt_id and IMPU the P-CSCF needs to forward the PAI header with the proper IMPU to the participating (in case different IMPUs -i.e. sip, tel URI, etc- are provided). Similarly the proper P-Asserted-Service needs to arrive at the S-CSCF for proper service routing.

Subclause 10.1.1.2.1.1 in 3GPP TS 24.379 [5] states in step 7) shall include an Accept-Contact header field with the g.3gpp.icsi-ref media feature tag containing the value of "urn:urn-7:3gpp-service.ims.icsi.mcptt" along with the "require" and "explicit" header field parameters according to IETF RFC 3841 [30];

Such headers should be properly forwarded by the SIP/IMS Core and any SBC in the path between the UE and the Participating. That would mean either a) trusting the MCPTT Client and the SIP/IMS Core copying the P-Preferred-X headers to P-Asserted-X counterparts in the inner trusted domain or ignoring them at the P-CSCF but properly setting them in any incoming request from MCPTT clients.

In fact, the procedure could be considered as ambiguous in 3GPP TS 24.379 [5]:

In subclause 10.1.1.2.1 for the client step 11) states that “it MAY include a P-Preferred-Identity header field in the SIP INVITE request containing a public user identity as specified in 3GPP TS 24.229 [4]” while in the Participating MCPTT function in subclause 10.1.1.3.1.1 step 2) states that it “SHALL determine the MCPTT ID of the calling user from public user identity in the P-Asserted-Identity header field of the SIP INVITE request…”.

10.2.4 CLARIFICATION: Need for Client Authentication in IDMS

Many of the vendors’ implementations of IdMS and MCPTT Auth included/required Client Authentication using HTTP Basic Auth.

Regarding 3GPP TS 33.180 [24] this type of mechanisms is only mentioned a couple of times, for example: "Note that client authentication is REQUIRED for native applications (using PKCE) in order to exchange the authorization code for an access token. Assuming that client secrets are used, the client secret is sent in the HTTP Authorization Header."

But nowhere else in the standard is mentioned the use of client authentication or Basic HTTP Auth mechanisms. It is missing completely from the example just below the aforementioned sentence, in section B.4.2.4. Moreover, most of the implementations require the presence of this Basic HTTP Auth (Authorization header) with a content consisting of user:password coded in Base64. This basic method is not specified in the standard (other than inter-domain auth), although it's specified in IETF RFC 6749 [38].

Adding an additional layer of client/UE authentication to the mix (apart from UE-id registering in the IdMS), would probably not represent any benefit. It really adds up to the UE registration phase, because instead of only provisioning the IdMS with the UE-id, the client secret must be also provisioned back to the UE.

If a discussion finally validates this HTTP Basic mechanism, it would be reasonable to modify the standard to include more details about this, and clarify client authentication procedures.

10.2.5 CLARIFICATION: eMBMS Bearer Preemption. Lack of notification to AS

When bearer preemption occurs, there is no 3GPP related way for the MCE to notify back to the Application Server that a bearer has been preempted. This results in the Application Server to think the bearer is going through, but the client will not receive anything anymore, or at least until the prioritized communication ends.

The MCE should notify such bearer preemption back to the MME that should inform the eMBMS Gateway that could then inform back the BM-SC. Once the BM-SC is aware, it should inform back the AS through the MB2-C interface.

10.2.6 CLARIFICATION: PMCH limitations impacting AS

A PMCH can only contain 28 bearers, so if there are numerous MCX bearers, the MCE needs to be carefully provisioned to allow for such quantity. This is done by creating more PMCH. However, it is also important to think about the capacity of such PMCH since MCPTT, MC Video and MC Data may not have the same capacity requirements. Finally, there can be only 15 PMCH per MBSFN area.

This means that there is a correlation between the number of bearers, the MBSFN area and the capacity of the PMCH. The more bearers, the more PMCH and the less capacity per PMCH. The larger the PMCH are (to accommodate for video), the less PMCH there can be, hence limiting the number of bearers.

Careful provisioning and interaction between BM-SC/MCE and AS is required to optimize the network based on the Mission Critical scenario.

History

Document history		
V0.1.0	07/02/2019	First Draft
V0.2.0	08/03/2019	Test results added
V0.3.0	14/03/2019	Test Observations added
V0.4.0	01/04/2019	Stable version after editorial corrections
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