ETSI Plugtests Report V1.1.0 (2019-12)

4th ETSI MCX Plugtests
Kuopio, Finland
23 – 27 September 2019

ETSI

Keywords
Testing, Interoperability, Mission-Critical, LTE, MCPTT

ETSI

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

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

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-préfecture de Grasse (06) N° 7803/88

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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 week of the fourth MCX Plugtests on 23rd to 27th September 2019 in Kuopio, Finland. More than 1800 test scenarios were executed between vendors and equipment, based on 3GPP Release-14.

The 4th ETSI MCX Plugtests have concluded with a success rate of 95% of the executed tests in the validation of 3GPP mission critical services vendor interoperability.

These tests are essential to ensure seamless access to mission critical services over 4G networks across different vendors' products and implementations.

The MCX (collectively for MCPTT, MCVideo and MCData services) ETSI Plugtests series is the first independent testing of public safety and other mission critical LTE. The preparations for the fourth Plugtests started in April 2019, were followed by remote testing over the summer and were finalized with a five-day face-to-face session, held at the end of September in Kuopio, Finland at the Savonia University of Applied Sciences.

The tests were based on 3GPP Release-14 and more than 1800 tests were executed between the different vendors in more than 210 test sessions. They will be officially part of a future version of ETSI TS 103 564 after the ETSI committee TCCE approval. Besides the MCPTT, MCData and MCVideo Application Servers and Clients, the testing also included devices (UEs), LTE networks with eNBs, EPC (Evolved Packet Core), IMS (IP Multimedia Subsystem) and eMBMS (Evolved Multimedia Broadcast Multicast Services) components and testing of Floor Control, Affiliation, Mission Critical Bearers handling, Multicast, and Server to Server communication.

The observations from the Plugtests events provide essential feedback to 3GPP Working Groups as work continues on mission critical communication specifications.

This fourth MCX Plugtests was organized by ETSI in partnership with Erillisverkot (State Security Networks Group Finland) with the support of TCCA and the European Commission.

The following equipment was tested:

MCX Application Servers:

- Airbus
- Alea
- Ericsson
- Frequentis
- Genaker
- Havelsan
- Huawei
- IIT Bombay
- Kontron(Kapsch)
- L3Harris
- Leonardo
- Motorola Solutions
- Nemergent
- Samsung
- Streamwide
- Tassta
- Valid8

MCX Clients :

- Aina
- Airbus
- Alea

- Armour
- Etelm
- Frequentis
- Funkwerk
- Genaker
- Havelsan
- Huawei
- Kontron(Kapsch)
- L3Harris
- Leonardo
- MCOP
- Nemergent
- Polaris
- Prescom
- Samsung
- Softil
- Sonim
- Tassta
- Valid8

Evolved Multimedia Broadcast Multicast Services (eMBMS) Components :

- Athonet
- Expway ENENSYS
- one2many
- Valid8

LTE network components :

- Athonet
- Etelm
- Expway
- Huawei
- Kontron(Kapsch)

User Equipment :

- Aina
- Bittium
- Ecom
- Funkwerk
- Huawei
- Sonim

IP Multimedia Subsystem (IMS) :

- Athonet
- ng-voice
- Valid8

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

The next MCX Plugtests event is planned for Q2 2020.

1 Introduction

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

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 finalized in Release-14 by 3GPP working group SA6.

Preparations for the 4th ETSI MCX Plugtests event started in April 2019 with the registrations of vendors and observers. During bi-weekly conference calls from April to September 2019 the setup of the tests, the test specification and organizational issues were agreed between the participants. Before the actual face-to-face tests end of September 2019, the vendors have been done remote pre-testing of their implementations via VPN tunnels which connected their labs to a central exchange hub.

All the information required to organise and manage the 4th 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 4th MCX Plugtests event wiki: https://wiki.plugtests.net/4th-MCX-Plugtests/index.php/Main_Page (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
- User Equipment (UE)
- LTE network components: Evolved Packet Core (EPC), Evolved Node B (eNB) and Multimedia Broadcast Multicast Service (eMBMS)
- IP Multimedia Subsystem (IMS)
- Broadcast Multicast Service Center (BMSC)

The remote pre-test and on-site test infrastructure is described in clause 6; the test procedures are described in clause 7.

In June 2019 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 MCPTT. During June-September 2019 the vendors conducted pre-tests with each other.

ETSI has developed a test specification with more than 120 test cases. See clause 8. The test specification will be published as an update of ETSI document ETSI TS 103 564 after ETSI TC TCCE approval.

About 1800 tests were conducted by the vendors. 95% of the tests were successful, the remaining 5% 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 and Rules of Engagement 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.

ETSI plan to conduct more MCX Plugtests in the future. The next MCX Plugtests sessions are planned for Q2 2020. Vendors who have not participated in the previous MCX Plugtests events are welcome and encouraged to join the next MCX Plugtests event. The interest of ETSI and TCCA is to have one global standard for Mission Critical services, which can be ensured by interoperability testing at the Plugtests.

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: Plugtests scenarios for Mission Critical Services.

[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 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.

[6] 3GPP TS 24.281: Mission Critical Video (MCVideo) signalling control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[7] 3GPP TS 24.282: Mission Critical Data (MCData) signalling control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[8] 3GPP TS 24.379: Mission Critical Push To Talk (MCPTT) call control; Protocol specification, Release 14, Version 14.4.0, December 2017.

[9] 3GPP TS 24.380: Mission Critical Push To Talk (MCPTT) media plane control; Protocol specification, Release 14, Version 14.5.0, December 2017.

[10] 3GPP TS 24.481: Mission Critical Services (MCS) group management; Protocol specification, Release 14, Version 14.3.0, December 2017.

[11] 3GPP TS 24.482: Mission Critical Services (MCS) identity management; Protocol specification, Release 14, Version 14.2.0, December 2017.

[12] 3GPP TS 24.483: Mission Critical Services (MCS) Management Object (MO), Release 14, Version 14.3.0, December 2017.

[13] 3GPP TS 24.484: Mission Critical Services (MCS) configuration management; Protocol specification, Release 14, Version 14.4.0, December 2017.

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

[15] 3GPP TS 24.582: Mission Critical Data (MCData) media plane control; Protocol specification, Release 14, Version 14.2.0, December 2017.

[16] 3GPP TS 26.179: Mission Critical Push To Talk (MCPTT); Codecs and media handling, Release 14, Version 14.0.0, March 2017.

[17] 3GPP TS 26.346: Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs, Release 14, Version 14.5.0, January 2018.

[18] 3GPP TS 29.212: Policy and Charging Control (PCC); Reference points; Release 14, Version 14.6.0, Dec 2017.

[19] 3GPP TS 29.214: Policy and Charging Control over Rx reference point; Stage 3, Release 14, Version 14.6.0, Dec 2017.

[20] 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.

[21] 3GPP TS 33.180: Security of the mission critical service, Release 14, Version 14.2.0, January 2018.

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

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

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

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

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

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

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

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

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

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

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

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

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

[35] IETF RFC 7230: Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing, June 2014.

[36] IETF RFC 5246: The Transport Layer Security (TLS) Protocol Version 1.2., August 2008.

[37] IETF RFC 6101: The Secure Sockets Layer (SSL) Protocol Version 3.0., August 2011.

[38] IETF RFC 4975: The Message Session Relay Protocol (MSRP), September 2007.

3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [27] 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 [27].

AMR	Adaptative Multi-Rate Audio Codec
AMR-WB	Adaptative Multi-Rate Audio Codec Wideband
APP	Application
AS	Application Server
CMS	Configuration Management Server
CSC	Common Services Core
CSCF	Call Session Control Function
CSK	Client-Server Key
DUT	Device Under Test
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
iFC	Initial Filter Criteria
IFS	Interoperable Functions Statement
IMPI	IP Multimedia Private Identity
IMPU	IP Multimedia Public identity
IMS	IP Multimedia Subsystem
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 second MCX Plugtests was testing the interoperability of the MCPTT, MCData and MCVideo ecosystem signaling and media plane at different levels.

The basic scenario tested comprised MCX application server(s) -both controlling and participating- and MCX clients deployed over a generic SIP Core/IMS, LTE access network with and without MCPTT required PCC capabilities with native multicast support (i.e. Release-14 -and higher- eMBMS) and UEs. The following figure (Fig 1) illustrates the basic test infrastructure. Additionally the server-to-server interface between controlling and non-controlling controlling server for temporary groups has been addressed.

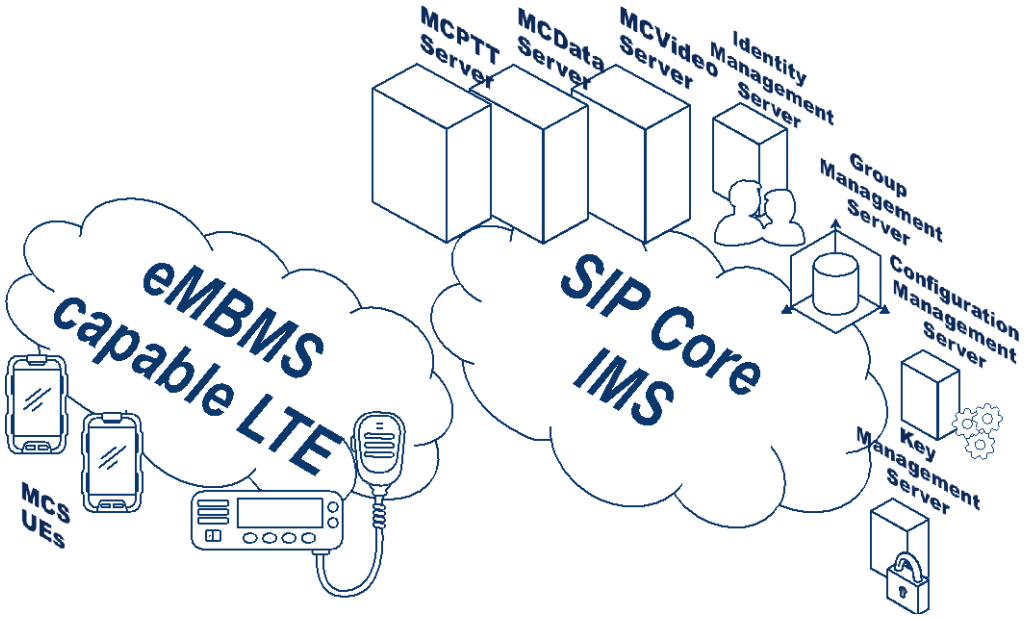

Figure 1. Typical MCPTT/MCData/MCVideo scenario to be considered in the Plugtests

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. At LTE level, unicast and more particularly eMBMS multicast connectivity was evaluated. Tests at IP layer targeted pure OTT connectivity regardless the underlying access network. SIP connectivity tests checked proper deployment of MCX AS over the selected SIP Core/IMS so that all SIP messages were successfully delivered from MCX Clients to Participating/Controlling MCPTT Servers and vice versa. In the 4th Plugtests some AS vendors provided their own builtin SIP/IMS cores so that Clients registered into different cores depending of the specific test session. Application level refers to e2e signalling, media, floor controlling (and other involved) protocols in use. Although for this Plugtests participants were encouraged to carry on CONN tests over Mission Critical LTE for unicast – or UNI-MC-LTE – and Mission Critical LTE with multicast eMBMS-capabilities – so called MULTI-MC-LTE -, most tests used the OTT (i.e. using WIFI / wired connections) one for its flexibility and the possibility of scheduling parallel test easily. Additionally, low level configuration-specific details (i.e. MCPTT. MC QCI and eMBMS bearer management) were considered in the PCC and eMBMS specific objectives.. 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. New test cases comprises more advanced floor controlling (i.e. timeouts and revokes) were evaluated.

- **Policing (PCC)**: Comprised specific checking proper LTE dynamic bearer signalling and allocation by eUTRAN/EPC.
- **eMBMS (EMBMS)**: Comprised checking of eMBMS specific signalling both in the MB2-U/C interface and e2e.
- **Registration and authorization (REGAUTH)**: Comprised MCX Client registration.
- **Affiliation (AFFIL)**: Comprised MCX 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 (including both signalling and media cyphering and key retrieval considered in KMS-related test cases in CSC test cases).
- **MCVideo Transmission Control (TC):** Once Transmission Control procedures have been further clarified in 3GPP, basic mechanisms were evaluated (while no imposing media mixing).
- **Server-to-server communications (S2S)**: Controlling to non-controlling interface for temporary groups in different trust configurations.

4.2 Timeline

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

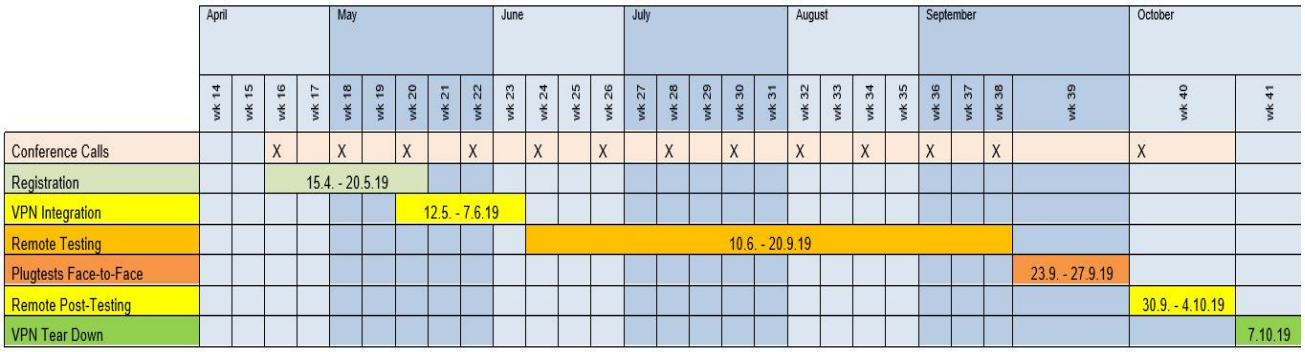

Figure 2. Plugtests event timeline

Registration to the MCX Plugtests event was open from 15th April 2019 to 20th May 2019 to any organisation willing to participate in testing the MCX Services Ecosystem. Additional remote participation (i.e. back office support) was possible and supported with electronic tools, see clause 4.3. A total of 117 people were finally involved onsite in the face-to-face part of the Plugtests event plus remote labs.

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 face-to-face 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.

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

4.2.2 Remote integration & pre-testing

Starting in June 2019, 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 30 remote labs connected to HIVE and each of them was allocated a dedicated network. The interconnection of remote labs allowed running integration and pre-testing tasks remotely among any combination of participating EUTs, in order to ensure an efficient use of the face-to-face Plugtests event time and smoother Interoperability Test Sessions.

A VPN connection to HIVE was highly recommended for participants providing MCX application servers, MCX Clients and IMS for first connectivity tests, trouble shooting and infrastructure access purposes.

Additional details on the remote test infrastructure, remote integration and pre-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 on-site phase.

4.2.3 Plugtests event

From 23rd of September to the 27th of September 2019, participants sent representatives to the Savonia University of Applied Sciences, Kuopio to collaboratively run the Interoperability Test Sessions. The Plugtests were kindly hosted by Erillisverkot at the University premises.

This one-week on-site face-to-face event was scheduled as follows:

MCX#4 PLU Agenda (23-27 September 2019)						
Time	Sunday 22	Monday 23	Tuesday 24	Wednesday 25	Thursday 26	Friday 27
08:30		Room opening	Room opening	Room opening	Room opening	Room opening
09:00 10:30		SET-UP / WELCOME PRESENTATION	TEST SESSION #4	TEST SESSION #8	TEST SESSION #12	TEST SESSION #16
10:30 11:00		COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
11:00 12:30		TEST SESSION #1	TEST SESSION #5	TEST SESSION #9	TEST SESSION #13	TEST SESSION #17
12:30 14:00		LUNCH BREAK	LUNCH BREAK	LUNCH BREAK	LUNCH BREAK	LUNCH BREAK
14:00 15:30	Room open to participants for set-up	TEST SESSION #2	TEST SESSION #6	TEST SESSION #10	TEST SESSION #14	TEST SESSION #18
15:30 16:00		COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	FINAL WRAP-UP
16:00 17:30		TEST SESSION #3	TEST SESSION #7	TEST SESSION #11	TEST SESSION #15	TEAR-DOWN STARTS AT 16:15
17:30 18:15		WRAP-UP	Bus leaves at 17,45	WRAP-UP	WRAP-UP	
			Social event starts 18:00			

Figure 3. High-level schedule for Plugtests event on-site

Sunday and first half of Monday was dedicated to local installation and pre-testing continuation, this time also including local implementations. A number of EUTs were installed and connected locally to the HIVE infrastructure, as well as some test and support functions.

The following 5 days were dedicated to on-site interoperability test sessions involving all the participating EUTs organised in several parallel tracks, see details in Clause 4.3.2.

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.

4.3 Tools

4.3.1 Plugtests event WIKI

The Plugtests event WIKI was the main source of information for the MCX 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.
- **Observers** – Observer program during the Plugtests event.
- **Network Information** - HIVE connection request tool, and remote connections status overview.
- **Testing Information -** Pre-configured parameters for EUTs.
- **Conference Calls** - Calendar, logistics, agendas and minutes of the bi-weekly conference calls run during the remote integration and pre-testing phase.
- **Base and Test Specs -** High Level Test Scope including the test specification and reference to 3GPP and IETF specifications.

- **Test Reporting Tool** - Documentation of the Test Reporting Tool.
- **Plugtests Observations** - Issues found during Plugtests event.
- **Equipment Registration** - Participating EUTs overview.
- **Company Information** - Main Contact Details, Location and Time Zone.
- **Social Event** – Social event details.

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, include their remote colleagues (back-office support) in the discussions.

4.3.2 Test Reporting Tool (TRT)

The Test Reporting Tool guides participants through the Test Plan test cases during the pre-testing and on-site 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 sessions and 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.

2017-06-20 16:00	120	Test Slot 4	Main_CONFIG 1	Athonet - IMS / SIP Core Alea - MCPTT AS Armour - MCPTT Client
2017-06-20 16:00	120	Test Slot 3	Main_CONFIG 2_eMBMS_OTT	Huawei - BM-SC Hytera - MCPTT AS
2017-06-20 14:00	120	Test Slot 5	Main_CONFIG 1	Athonet - IMS / SIP Core Tassta - MCPTT AS Spirent - MCPTT Client
2017-06-20 14:15	120	Test Slot 6	Main_CONFIG 1	Athonet - IMS / SIP Core Airbus - MCPTT AS Armour - MCPTT Client
2017-06-20 16:30	120	Test Slot 6	Main_CONFIG 1	Athonet - IMS / SIP Core Harris - MCPTT AS Airbus - MCPTT Client
2017-06-20 16:15	120	Test Slot 5	Main_CONFIG 6	Athonet - ePC + eNB Nemergent - MCPTT AS Nemergent - MCPTT Client Armour - MCPTT Client
2017-06-20 14:15	120	Test Slot 7	Main_CONFIG 1	Athonet - IMS / SIP Core Airbus - MCPTT AS Hytera - MCPTT Client
2017-06-21 11:00	120	Test Slot 6	Main_CONFIG 1	Athonet - IMS / SIP Core Airbus - MCPTT AS Genaker - MCPTT Client
2017-06-21 11:00	120	Test Slot 3	Main_CONFIG 1	Athonet - IMS / SIP Core Harris - MCPTT AS Etelm - MCPTT Client

Figure 4. Test Reporting Tool – example screen shot

5 Equipment Under Test

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

5.1 MCPTT Application Servers

Organisation	Comment
Airbus	
Alea	Supports split operation as Participating AS and Controlling AS
Ericsson	
Frequentis	Participating AS only; included in the Frequentis Control Room
Genaker	Supports split operation as Controlling AS
Huawei	
IIT Bombay	
Kontron (Kapsch)	
L3Harris	
Leonardo	Supports split operation as Participating AS and Controlling AS
Motorola Solutions	
Nemergent	Supports split operation as Participating AS and Controlling AS
Samsung	Supports split operation as Participating AS and Controlling AS
StreamWide	
TASSTA	
Valid8	Controlling AS only

Table 1. MCPTT Application Servers Under Test

5.2 MCVideo Application Servers

Organisation	Comment
Alea	Supports split operation as Participating AS and Controlling AS
Genaker	
Havelsan	
Kontron (Kapsch)	
L3Harris	
Leonardo	Supports split operation as Participating AS and Controlling AS
Motorola Solutions	
Nemergent	Supports split operation as Participating AS and Controlling AS
StreamWide	

Table 2. MCVideo Application Servers Under Test

5.3 MCData Application Servers

Organisation	Comment
Alea	Supports split operation as Participating AS and Controlling AS
Genaker	
Kontron (Kapsch)	
L3Harris	
Leonardo	Supports split operation as Participating AS and Controlling AS
Motorola Solutions	

Organisation	Comment
Nemergent	Supports split operation as Participating AS and Controlling AS
StreamWide	
TASSTA	
Valid8	Controlling AS only

Table 3. MCData Application Servers Under Test

5.4 MCPTT Clients

Organisation	Comment
Aina	
Airbus	
Alea	
Armour	
Etelm	included in the Etelm TETRA Base Station
Frequentis	
Funkwerk	
Genaker	
Havelsan	
Huawei	
Kontron(Kapsch)	
L3Harris	
Leonardo	
MCOP	(Mission Critical Open Platform)
Nemergent	
Polaris	
Prescom	
Samsung	
Softil	
Sonim	
TASSTA	
Valid8	

Table 4. MCPTT Clients Under Test

5.5 MCVideo Clients

Organisation	Comment
Alea	
Funkwerk	
Genaker	
Havelsan	
L3Harris	
Nemergent	
Polaris	
Prescom	
Samsung	
Softil	
Sonim	

Organisation	Comment
TASSTA	
Valid8	

Table 5. MCVideo Clients Under Test

5.6 MCData Clients

Organisation	Comment
Airbus	
Alea	
Etelm	
Frequentis	
Funkwerk	
Kontron(Kapsch)	
L3Harris	
Leonardo	
Nemergent	
Polaris	
Prescom	
Samsung	
Softil	
Sonim	
TASSTA	
Valid8	

Table 6. MCData Clients Under Test

5.7 User Equipment (UEs)

Organisation	Comment
Aina	
Bittium	
Ecom	
Funkwerk	
Huawei	
Sonim	

Table 7. User Equipment Under Test

5.8 IP Multimedia Subsystem (IMS)

Organisation	Comment
Athonet	
ng-voice	
Valid8	

Table 8. IP Multimedia Subsystem (IMS) Under Test

5.9 LTE Network Components

The organisations listed below provided the LTE Network Components for the Plugtest, i.e. Evolved Packet Core (EPC) and Evolved Node B (eNB).

Organisation	Comment
Athonet	
Etelm	
Expway Enensys	
Huawei	
Kontron(Kapsch)	

Table 9. LTE Network Components Under Test

5.10 Evolved Multimedia Broadcast Multicast Services (eMBMS) Components

Organisation	Comment
Athonet	
Expway Enensys	
one2many	
Valid8	

Table 10. Evolved Multimedia Broadcast Multicast Services (eMBMS) Components Under Test

5.11 Configuration Management Server (CMS)

Organisation	Comment
Alea	
Kontron(Kapsch)	
L3Harris	
Nemergent	
Samsung	

Table 11. Configuration Management Server

5.12 Group Management Server (GMS)

Organisation	Comment
Alea	
Kontron(Kapsch)	
L3Harris	
Nemergent	
Samsung	

Table 12. Group Management Server

5.13 Identity Management Server (IdMS)

Organisation	Comment

Alea	
IIT Bombay	
Kontron(Kapsch)	
Nemergent	
Samsung	
TASSTA	

Table 13. Identity Management Server

5.14 Key Management Server (KMS)

Organisation	Comment
Armour	
Kontron(Kapsch)	
Nemergent	
Samsung	
TASSTA	

Table 14. Key Management Server

6 Test Infrastructure

6.1 Remote and Local Test Infrastructure

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

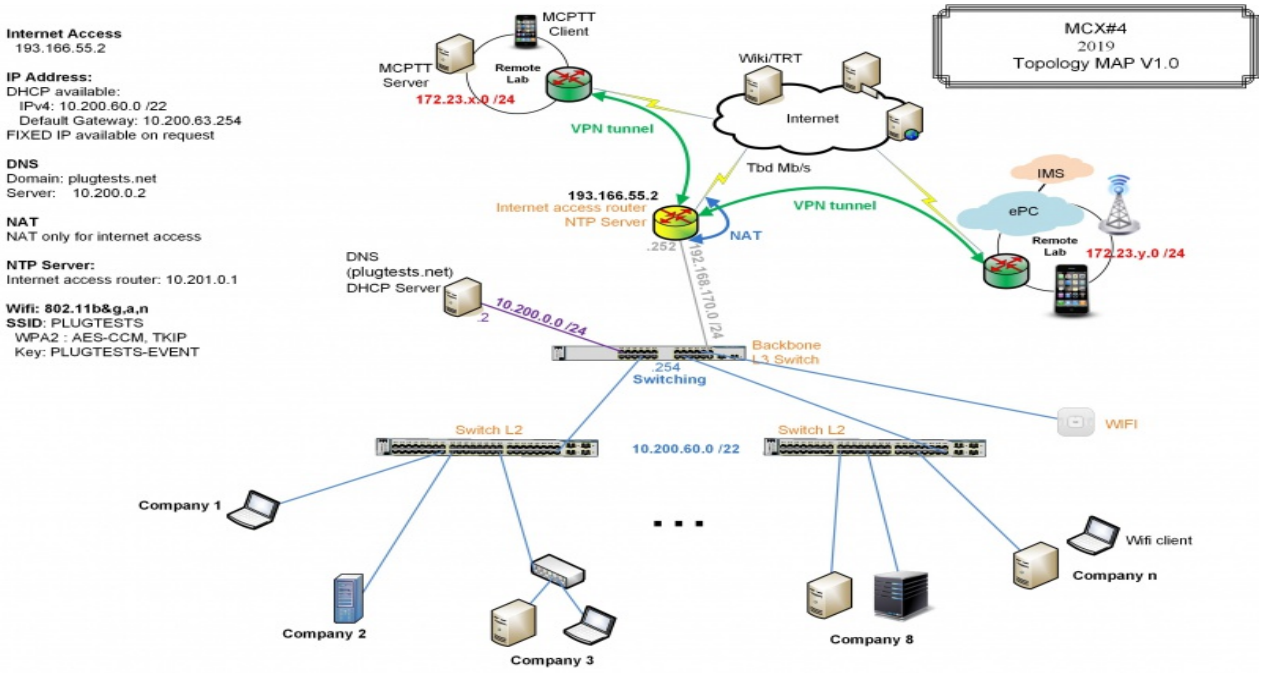

Figure 5. Remote Test Infrastructure

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 30 Remote Labs connected to the setup described above as a participant's lab.

7 Test Procedures

7.1 Remote Integration & Pre-testing Procedure

During the remote integration and pre-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 pre-testing

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

Config Name	Pre-testing Configuration
Config_MCS_remote (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)	MCX Client + MCX AS (Participating + Controlling) + IMS / SIP Core
Config_MCS_MBMS	MCXAS (Participating + Controlling) + BMSC

Table 15. Pre-testing Configuration

Subgroups (IdMS. GMS, KMS etc) in the Test Reporting Tool are similar to PICS (Protocol Implementation Conformance Statement) which are defined under the main configuration. To execute the test cases for that subgroup, the PICS should be true for both MCX Client and MCX Server. For example: to run IdMS test cases , MCX Client and server should have support for IdMS i.e. IdMS support was declared during the equipment registration and the subgroup configuration test cases will be visible in TRT for execution.

7.2 Interoperability Testing Procedure

During the on-site face-to-face part of the Plugtests event, a daily 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.

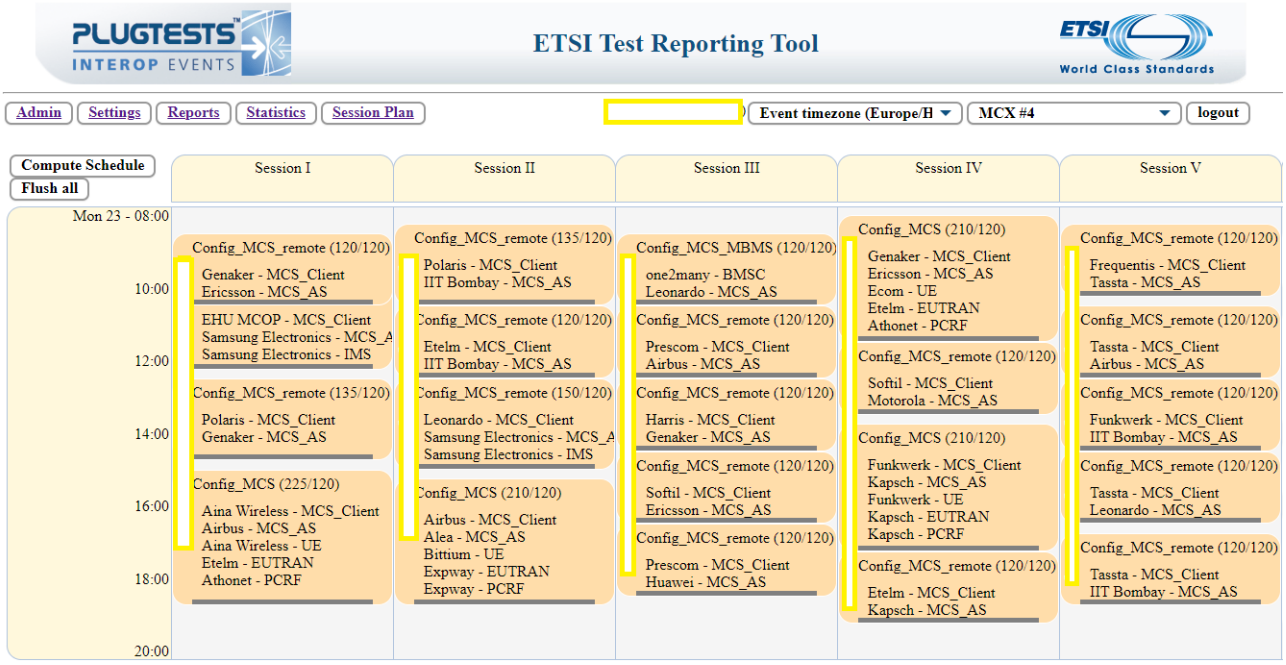

Figure 6. Daily Schedule & Test Sessions – example excerpt

Config Name	Main Test Configuration
Config_MCS (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT,	MCX Client + MCX AS (Participating+Controlling) + IMS + UE + EUTRAN + PCRF

Config Name	Main Test Configuration
MCData, MCVideo)	
Config_MCS_e2eMBMS	MCX Client + MCX AS (Participating+Controlling) + IMS + UE + EUTRAN + PCRF + BMSC
Config_MCS_MBMS	BMSC + MCX AS (Participating+Controlling)
Config_MCS_MultipleClients (Subgroup MCData)	MCX Client+ MCX Client+ MCX Client+ MCX Client + IMS + MCX AS (Participating+Controlling)
Config_MCS_OS1	MCX Client+ MCX Client + IMS + MCX AS (Participating+Controlling)
Config_MCS_OS2	MCX Client+ MCX Client+ MCX Client+ MCX Client + IMS + MCX AS (Participating+Controlling)
Config_MCS_OS4	MCX Client+ MCX Client + MCX Client+ UE + UE + UE + IMS + MCX AS (Participating+Controlling) + EUTRAN + IMS + PCRF + BMSC
Config_MCS_OTT_UE (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)	MCX Client + MCX AS (Participating+Controlling) + IMS + UE
Config_MCS_remote (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)	MCX Client + MCX Client + MCX AS + MCX AS
Config_MCS_Server2Server	MCX Client + MCX AS (Participating+Controlling) + IMS + UE
Config_MCS_xMS	MCX Client + MCX AS (Participating+Controlling) + IMS + IdMS + CMS + KMS + GMS

Table 16. Main Test Configurations

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.

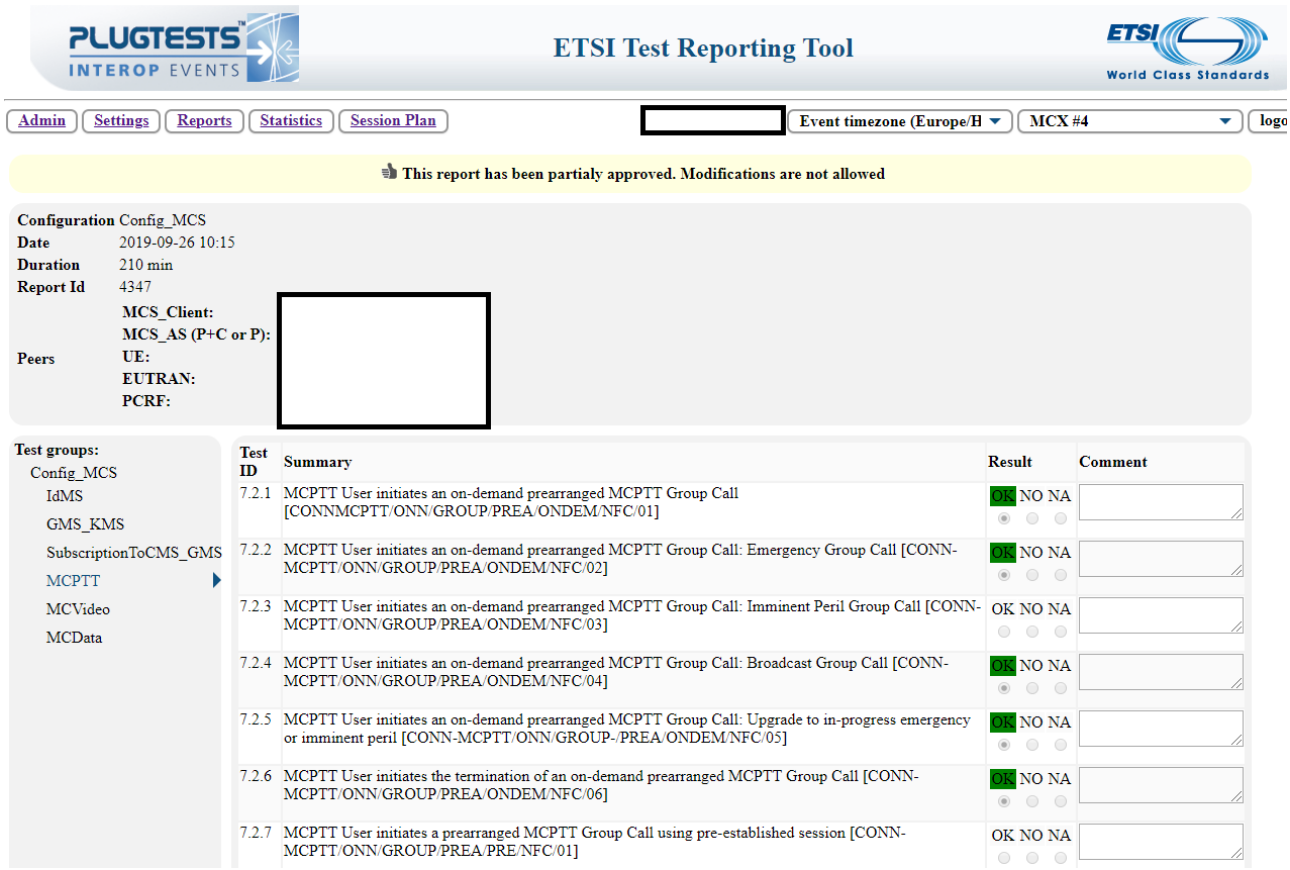

Figure 7. Test Session Report

2. For each Test in the Test Plan:

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

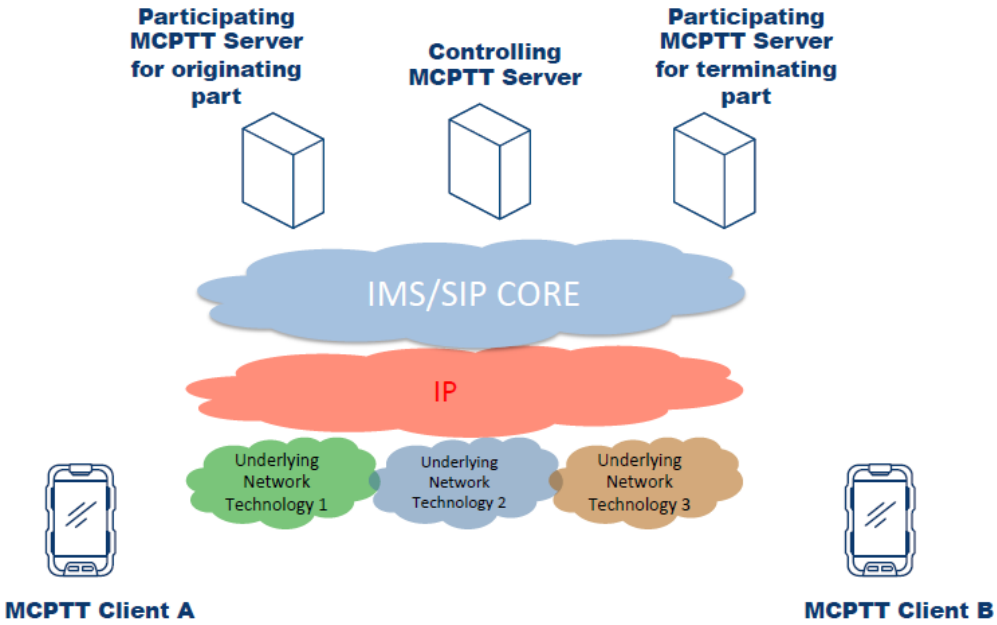

Figure 8. System Under Test (SUT) Configuration – MCPTT example

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 preconfigured 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 9. 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 4th MCX Plugtests Test Plan was developed following ETSI guidelines for interoperability. It is based on the test plan from the previous Plugtests (using Release 14 TSs). Additional test cases were included comprising late call entry and rejoin, subscription to conference event package, advanced Floor Control operations, MCVideo Transmission Control, server to server in different configurations. Finally complex scenarios based on Observers' proposals were evaluated during last two days of the Plugtests f2f event.

The Test Plan was reviewed and discussed with participants during the preparation and pre-testing phase. Considering the huge number of resulting test cases and difference expected maturity of the implementations and differences from participants in the first Plugtests and new companies, 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, LTE access network with and without MCPTT required PCC capabilities and native multicast support (i.e. Release-14 eMBMS). Furthermore, a series of support servers were integrated in the so-called Common Services Core provide configuration, identity, group and key management capabilities. Note, again 3GPP Release-14 compliant On-Network operations only were considered.

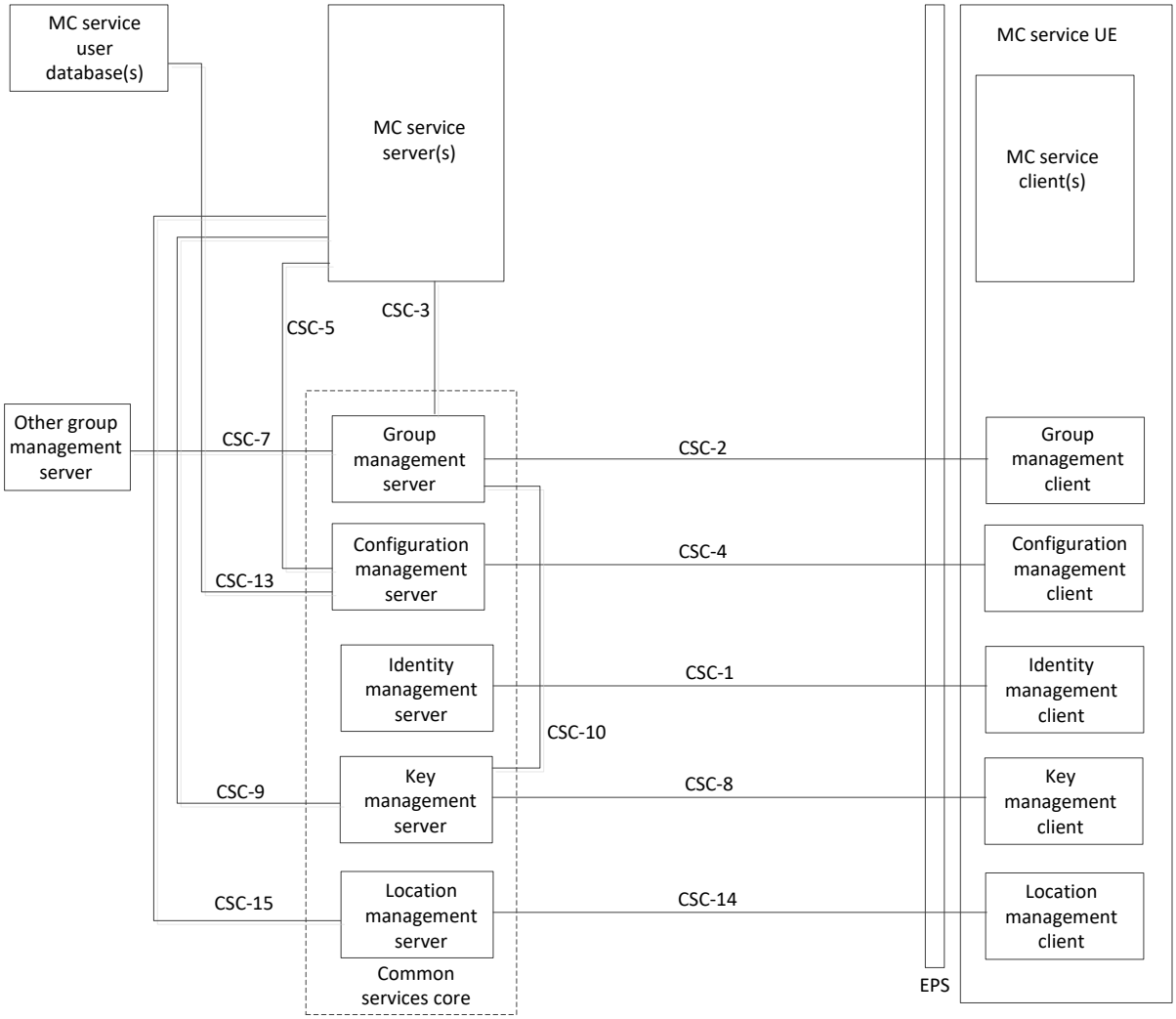

Figure 10. Functional model for application plane Figure 7.3.1-1 in 3GPP TS 23.280 [3].

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) involving other supporting technologies like LTE EPS. In order to focus on MCS signalling the following three 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).

During this 4th MCX Plugtests real Over-the-Air operation (i.e. using Mission Critical LTE networks and UE) were encouraged. So, although Over-the-Top, MC-LTE unicast and Multicast configurations were defined, the first one was intended to be used during the pre-testing stage mainly, while the other two ones during the f2f event.

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). Therefore, although not usable in a real world Mission Critical environment, it was used for connectivity tests since it did not require any binding between the IMS/SIP Core and the underlying LTE infrastructure and allowed both signalling and media plane parallel testing easily.

8.2.2 Unicast Mission Critical LTE for On-Network calls (CFG_ONN_UNI-MC-LTE-1)

In this configuration the LTE network (both EPC and eUTRAN) provided PCC capabilities and therefore enforced QoS policies in terms of prioritization and pre-emptiveness of Mission Critical unicast bearers. That included new Public Safety QCI 65/69 support in UEs and EPC/eUTRAN, and the availability of a PCRF with MCPTT compliant Rx/MCPTT-5 interface. Specific Rx/MCPTT-5 reference points and unicast bearer setup and update triggering mechanisms were tested using this configuration. Note that, although MCPTT only is mentioned and depicted in the following figure, MCVideo/MCData could follow the same approach.

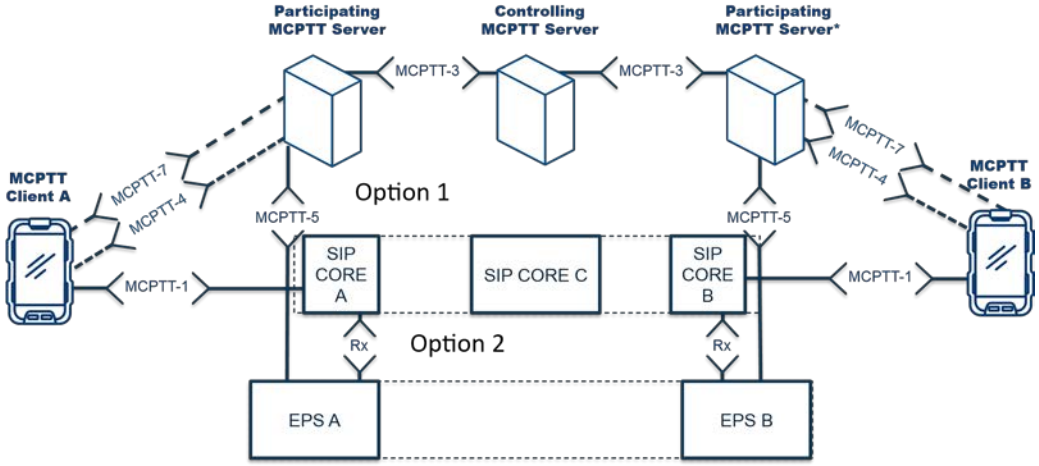

Figure 11. CFG_ONN_UNI-MC-LTE-1 configuration

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

In this configuration LTE provided multicast capability including Rel. 14 (and beyond) LTE-A Pro eMBMS and needed interfaces both in the core side (MB2-C and MB2-U with the BM-SC) and in the eUTRAN/UE side. It was used to test eMBMS bearer setup and update related test cases.

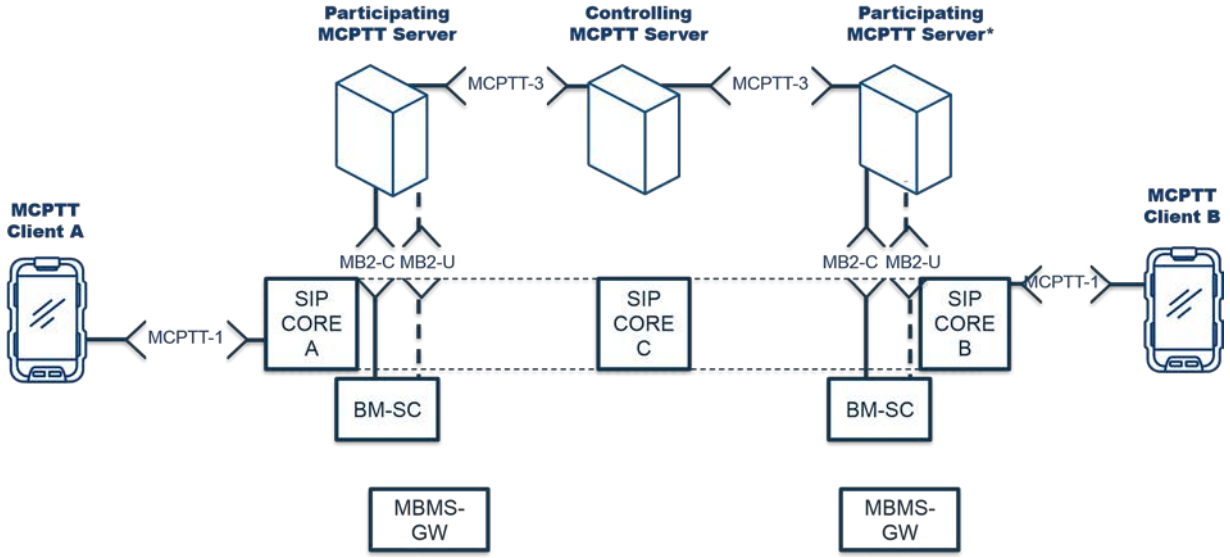

Figure 12. CFG_ONN_MULTI-MC-LTE-1 configuration

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 11 according to the following mapping.

In order to deal with the different test setting according to the three aforementioned configurations and cover specific more complex test configuration involving different clients and Observer test cases, the following configuration modes were defined in the TRT tool.

Configuration	Resulting configuration mode in the Plugtests (TRT)
ONN-OTT	Config_MCS_OTT_UE (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)
	Config_MCS_remote (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)
	Config_MCS_Server2Server
	Config_MCS_xMS
UNI-MC-LTE	Config_MCS (Subgroups IdMS, GMS_KMS, SubscriptionToCMS_GMS, MCPTT, MCData, MCVideo)
MULTI-MC-LTE	Config_MCS_e2eMBMS
Complex	Config_MCS_MultipleClients (subgroup MCData)
	Config_MCS_OS1
	Config_MCS_OS2
	Config_MCS_OS4

Table 17. Mapping of scenario architecture configurations and Plugtests event practical configurations

8.2.4 Group of test cases

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

In order to avoid bottlenecks, Connectivity (CONN), Floor Controlling (FC), Registration and authorization (REGAUTH) and Affiliation (AFFIL) objectives were tested on the ONN_OTT configuration only. On the other hand Policing (PCC) related test cases were evaluated using UNI-MC-LTE configuration and eMBMS (eMBMS) used MULTI-MC-LTE configuration.

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

Test Id	Test Purpose
	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 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])

Test Id	Test Purpose
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)
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
CONN MCVIDEO/ONN/PRIV/AUTO/ONDEM/WTC/NTC/01	On-demand private MCVideo call in automatic commencement mode with transmission control
CONN-MCVIDEO/ONN/PRIV/AUTO/ONDEM/WOTC/01	On-demand private MCVideo call in automatic commencement mode without transmission control
CONN-MCVIDEO/ONN/GROUP/PREA/ONDEM/NTC/01	On-demand prearranged MCVideo Group Call
CONN-MCVIDEO/ONN/GROUP/CHAT/ONDEM/NTC/01	On-demand MCVideo Chat Group Call
CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/07	Late call entry of a MCPTT User during an on-demand prearranged MCPTT Group Call
CONN-MCPTT/ONN/GROUP/PREA/PRE/NFC/03	Late call entry of a MCPTT User during a prearranged MCPTT Group Call using pre-established session
CONN-MCPTT/ONN/GROUP/PREA/ONDEM/NFC/08	Rejoin of a MCPTT User during an on-demand prearranged MCPTT Group Call
CONN-MCPTT/ONN/GROUP/PREA/PRE/NFC/04	Rejoin of a MCPTT User during an on-demand prearranged MCPTT Group Call using pre-established session
CONN-MCPTT/ONN/GROUP/CHAT/ONDEM/SUBCONF/01	Subscription to Conference Event package

Table 18. 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]
FC/ADV/01	Floor control revoking upon expires (T2)
FC/ADV/02	Floor control revoking upon release
FC/ADV/03	Floor control revoking upon revoke

Table 19. 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 20. 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 21. 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
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 22. 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])

Test Id	Test Purpose
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 23. 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 24. 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 25. 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

Test Id	Test Purpose
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
SEC/XMLENCRYPT/REGAUTH/01	XML contents encryption in registration and authorization procedures

Table 26. Test Group for the Security (SEC) objective

Test Id	Test Purpose
TC/BASIC/01	Basic TC functionality
TC/BASIC/02	Effect of maximum number of transmitters
TC/BASIC/03	Effect of maximum number of receivers

Table 27. Test Group for the MCVideo Transmission Control (TC) objective

Test Id	Test Purpose
S2S/ONN/GROUP/PREA/ONDEM/TEMP/01	On-demand prearranged MCPTT Group Call to temporary group in trusted mode
S2S/ONN/GROUP/PREA/ONDEM/TEMP/02	On-demand prearranged MCPTT Group Call to temporary group in untrusted mode

Table 28. Test Group for the Server-to-server communications (S2S) objective

Test Id	Test Purpose
OS1	Emergency call
OS2	Emergency call handling
OS3	Encrypted private call
OS4.1	eMBMS MCPTT
OS4.2	eMBMS MCVideo
OS5	Switching on
OS6	Encrypted MCPTT group call
~~OS7.1~~	~~Enhanced status~~ NA in this Plugtests

Test Id	Test Purpose
OS7.2	MCDATA SDS
OS8	Encrypted MCVideo Group Call
OS9	Parallel MCPTT and MCVIDEO

Table 29. Observers test cases

9 Interoperability Results

9.1 Overall Results

During the Plugtests event, a total of 218 Test Sessions were run: that is, 218 different combinations based on different configurations in Test Scope: MCX Client, MCX Server (Participating and Controlling), UE, eNB, EPC, PCRF, BMSC and IMS/SIP Core were tested for interoperability. Overall, 1924 test executions were conducted 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.

Interoperability		Totals
OK	**NO**	**Run**
1833 (95.3%)	91(4.7%)	1924

Table 30. Overall Results

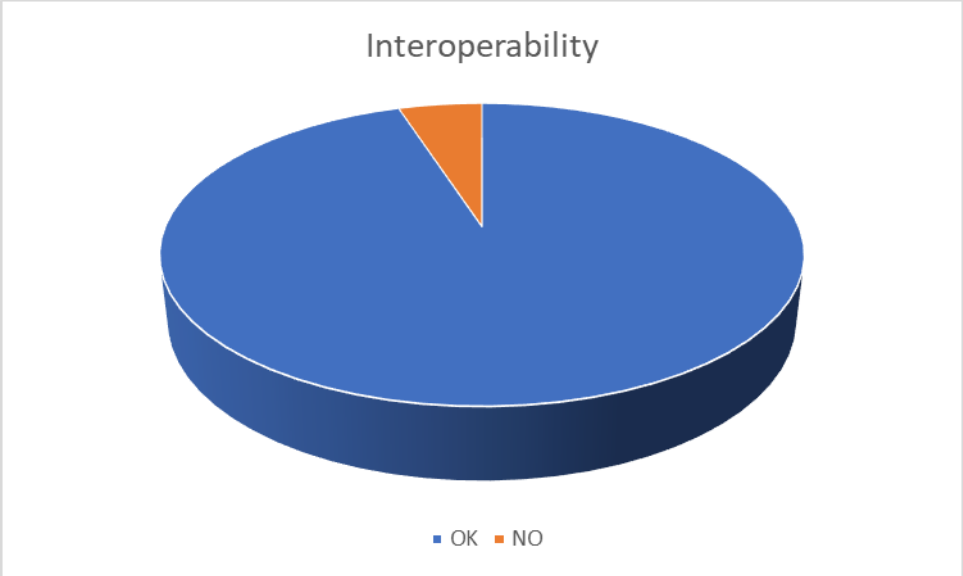

Figure 13. Overall results (%)

A overall interoperability success rate of 95% 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. The below configurations are defined in clause 7.2.

	Interoperability		Total
	OK	NO	Run
Config_MCS_MBMS	51 (100.0%)	0 (0.0%)	51
Config_MCS subgroup IdMS	54 (91.5%)	5 (8.5%)	59
Config_MCS subgroup GMS_KMS	3 (75.0%)	1 (25.0%)	4
Config_MCS subgroup SubscriptionToCMS_GMS	9 (100.0%)	0 (0.0%)	9
Config_MCS subgroup MCPTT	1191 (94.7%)	66 (5.3%)	1257
Config_MCS subgroup MCVideo	36 (87.8%)	5 (12.2%)	41
Config_MCS subgroup MCData	72 (90.0%)	8 (10.0%)	80
Config_MCS_xMS	7 (63.6%)	4 (36.4%)	11
Config_MCS_remote subgroup IdMS	9 (100.0%)	0 (0.0%)	9
Config_MCS_remote subgroup GMS_KMS	26 (100.0%)	0 (0.0%)	26
Config_MCS_remote subgroup SubscriptionToCMS_GMS	12 (100.0%)	0 (0.0%)	12
Config_MCS_remote subgroup MCPTT	192 (99.5%)	1 (0.5%)	193
Config_MCS_remote subgroup MCVideo	10 (100.0%)	0 (0.0%)	10
Config_MCS_remote subgroup MCData	16 (100.0%)	0 (0.0%)	16
Config_MCS_OTT_UE subgroup IdMS	8 (100.0%)	0 (0.0%)	8
Config_MCS_OTT_UE subgroup GMS_KMS	0 (0.0%)	0 (0.0%)	0
Config_MCS_OTT_UE subgroup SubscriptionToCMS_GMS	4 (100.0%)	0 (0.0%)	4
Config_MCS_OTT_UE subgroup MCPTT	101 (99.0%)	1 (1.0%)	102
Config_MCS_OTT_UE subgroup MCVideo	0 (0.0%)	0 (0.0%)	0
Config_MCS_OTT_UE subgroup MCData	3 (100.0%)	0 (0.0%)	3
Config_MCS_MultipleClients subgroup MCData	2 (100.0%)	0 (0.0%)	2
Config_MCS_OS1	13 (100.0%)	0 (0.0%)	13
Config_MCS_e2eMBMS	8 (100.0%)	0 (0.0%)	8
Config_MCS_OS2	0 (0.0%)	0 (0.0%)	0

Config_MCS_OS4	4 (100.0%)	0 (0.0%)	4
Config_MCS_Server2Server	2 (100.0%)	0 (0.0%)	2

Table 31. Results per Test Configuration

The table shows that very high execution and interoperability rates for different Test Configurations were achieved.

9.3 Results per Test Case

The table below provides the results for each test case in the scope of the Plugtests event. Test Cases numbering is referred from ETSI TS 103 564.

Table 32. Results per Test Case

	Interoperability		Total
	OK	NO	Run
7.2.1	101 (96.2%)	4 (3.8%)	105
7.2.2	89 (96.7%)	3 (3.3%)	92
7.2.3	73 (97.3%)	2 (2.7%)	75
7.2.4	33 (100.0%)	0 (0.0%)	33
7.2.5	22 (91.7%)	2 (8.3%)	24
7.2.6	86 (98.9%)	1 (1.1%)	87
7.2.7	7 (63.6%)	4 (36.4%)	11
7.2.8	7 (87.5%)	1 (12.5%)	8
7.2.9	74 (100.0%)	0 (0.0%)	74
7.2.10	13 (81.3%)	3 (18.8%)	16
7.2.11	11 (91.7%)	1 (8.3%)	12
7.2.12	10 (100.0%)	0 (0.0%)	10
7.2.13	8 (100.0%)	0 (0.0%)	8
7.2.14	7 (100.0%)	0 (0.0%)	7
7.2.15	87 (96.7%)	3 (3.3%)	90
7.2.16	78 (97.5%)	2 (2.5%)	80
7.2.17	1 (50.0%)	1 (50.0%)	2
7.2.18	2 (100.0%)	0 (0.0%)	2
7.2.19	58 (96.7%)	2 (3.3%)	60
7.2.20	64 (92.8%)	5 (7.2%)	69
7.2.21	1 (100.0%)	0 (0.0%)	1
7.2.22	0 (0.0%)	0 (0.0%)	0
7.2.23	9 (75.0%)	3 (25.0%)	12
7.2.24	8 (80.0%)	2 (20.0%)	10
7.2.25	1 (100.0%)	0 (0.0%)	1
7.2.26	0 (0.0%)	0 (0.0%)	0
7.2.27	3 (100.0%)	0 (0.0%)	3
7.2.28	3 (100.0%)	0 (0.0%)	3
7.2.29	2 (100.0%)	0 (0.0%)	2
7.2.30	20 (90.9%)	2 (9.1%)	22
7.2.31	19 (100.0%)	0 (0.0%)	19
7.2.32	0 (0.0%)	0 (0.0%)	0

7.2.33	0 (0.0%)	0 (0.0%)	0
7.2.34	29 (93.5%)	2 (6.5%)	31
7.2.35	26 (100.0%)	0 (0.0%)	26
7.2.36	0 (0.0%)	0 (0.0%)	0
7.2.37	0 (0.0%)	0 (0.0%)	0
7.2.38	0 (0.0%)	0 (0.0%)	0
7.2.39	41 (91.1%)	4 (8.9%)	45
7.2.40	0 (0.0%)	0 (0.0%)	0
7.2.41	0 (0.0%)	0 (0.0%)	0
7.2.42	27 (87.1%)	4 (12.9%)	31
7.2.43	0 (0.0%)	0 (0.0%)	0
7.2.44	0 (0.0%)	0 (0.0%)	0
7.2.45	0 (0.0%)	0 (0.0%)	0
7.2.46	0 (0.0%)	0 (0.0%)	0
7.2.47	0 (0.0%)	0 (0.0%)	0
7.2.48	0 (0.0%)	0 (0.0%)	0
7.2.49	17 (100.0%)	0 (0.0%)	17
7.2.50	13 (100.0%)	0 (0.0%)	13
7.2.51	0 (0.0%)	0 (0.0%)	0
7.2.52	0 (0.0%)	0 (0.0%)	0
7.2.53	0 (0.0%)	0 (0.0%)	0
7.2.54	10 (76.9%)	3 (23.1%)	13
7.2.55	26 (96.3%)	1 (3.7%)	27
7.2.56	5 (100.0%)	0 (0.0%)	5
7.2.57	3 (100.0%)	0 (0.0%)	3
7.2.58	9 (100.0%)	0 (0.0%)	9
7.2.59	1 (100.0%)	0 (0.0%)	1
7.2.60	5 (100.0%)	0 (0.0%)	5
7.2.61	1 (100.0%)	0 (0.0%)	1
7.3.1	97 (94.2%)	6 (5.8%)	103
7.3.2	49 (92.5%)	4 (7.5%)	53
7.3.3	39 (97.5%)	1 (2.5%)	40
7.3.4	22 (100.0%)	0 (0.0%)	22
7.3.5	18 (100.0%)	0 (0.0%)	18
7.4.1	32 (94.1%)	2 (5.9%)	34
7.4.2	95 (96.0%)	4 (4.0%)	99
7.4.3	45 (95.7%)	2 (4.3%)	47
7.5.1	1 (100.0%)	0 (0.0%)	1
7.5.2	7 (100.0%)	0 (0.0%)	7
7.5.3	1 (100.0%)	0 (0.0%)	1
7.5.4	5 (83.3%)	1 (16.7%)	6
7.5.5	0 (0.0%)	0 (0.0%)	0
7.5.6	1 (100.0%)	0 (0.0%)	1
7.6.2	6 (100.0%)	0 (0.0%)	6
7.6.3	7 (100.0%)	0 (0.0%)	7
7.6.4	2 (100.0%)	0 (0.0%)	2
7.6.5	3 (100.0%)	0 (0.0%)	3

7.6.6	0 (0.0%)	0 (0.0%)	0
7.6.7	13 (100.0%)	0 (0.0%)	13
7.6.8	1 (100.0%)	0 (0.0%)	1
7.6.9	3 (100.0%)	0 (0.0%)	3
7.7.1	60 (93.8%)	4 (6.3%)	64
7.7.2	13 (100.0%)	0 (0.0%)	13
7.7.3	44 (89.8%)	5 (10.2%)	49
7.7.4	2 (66.7%)	1 (33.3%)	3
7.7.5	0 (0.0%)	0 (0.0%)	0
7.8.1	15 (100.0%)	0 (0.0%)	15
7.8.2	6 (100.0%)	0 (0.0%)	6
7.8.3	7 (100.0%)	0 (0.0%)	7
7.9.1	2 (100.0%)	0 (0.0%)	2
7.9.2	3 (100.0%)	0 (0.0%)	3
7.9.3	4 (100.0%)	0 (0.0%)	4
7.9.4	2 (100.0%)	0 (0.0%)	2
7.9.5	5 (100.0%)	0 (0.0%)	5
7.9.6	3 (100.0%)	0 (0.0%)	3
7.9.7	3 (100.0%)	0 (0.0%)	3
7.9.8	3 (100.0%)	0 (0.0%)	3
7.10.1	3 (60.0%)	2 (40.0%)	5
7.10.2	1 (50.0%)	1 (50.0%)	2
7.10.3	1 (100.0%)	0 (0.0%)	1
7.10.4	6 (85.7%)	1 (14.3%)	7
7.10.5	4 (100.0%)	0 (0.0%)	4
7.10.6	4 (80.0%)	1 (20.0%)	5
7.10.7	2 (100.0%)	0 (0.0%)	2
7.10.8	2 (100.0%)	0 (0.0%)	2
7.10.9	0 (0.0%)	0 (0.0%)	0
7.10.10	2 (100.0%)	0 (0.0%)	2
7.10.11	2 (100.0%)	0 (0.0%)	2
7.10.12	0 (0.0%)	0 (0.0%)	0
7.10.13	2 (100.0%)	0 (0.0%)	2
7.10.14	1 (100.0%)	0 (0.0%)	1
7.10.15	2 (100.0%)	0 (0.0%)	2
7.10.16	2 (100.0%)	0 (0.0%)	2
7.10.17	2 (100.0%)	0 (0.0%)	2
8.2.1	13 (100.0%)	0 (0.0%)	13
8.2.2	12 (100.0%)	0 (0.0%)	12
8.2.3	12 (100.0%)	0 (0.0%)	12
8.2.4	11 (100.0%)	0 (0.0%)	11
8.2.5	0 (0.0%)	0 (0.0%)	0
8.2.6	0 (0.0%)	0 (0.0%)	0
8.2.7	0 (0.0%)	0 (0.0%)	0
8.2.8	0 (0.0%)	0 (0.0%)	0
8.2.9	0 (0.0%)	0 (0.0%)	0
8.2.10	0 (0.0%)	0 (0.0%)	0

8.2.11	0 (0.0%)	0 (0.0%)	0
8.2.12	0 (0.0%)	0 (0.0%)	0
8.2.13	0 (0.0%)	0 (0.0%)	0
8.2.14	0 (0.0%)	0 (0.0%)	0
8.2.15	0 (0.0%)	0 (0.0%)	0
8.2.16	0 (0.0%)	0 (0.0%)	0
8.2.17	0 (0.0%)	0 (0.0%)	0
8.2.18	0 (0.0%)	0 (0.0%)	0
8.2.19	0 (0.0%)	0 (0.0%)	0
7.11.1	2 (66.7%)	1 (33.3%)	3
7.11.2	0 (0.0%)	0 (0.0%)	0
7.11.3	0 (0.0%)	0 (0.0%)	0
7.12.1	3 (100.0%)	0 (0.0%)	3
7.12.2	3 (100.0%)	0 (0.0%)	3
7.2.62	0 (0.0%)	0 (0.0%)	0
OS 1 - Emergency call	6 (100.0%)	0 (0.0%)	6
OS 3- Encrypted Private Call	4 (100.0%)	0 (0.0%)	4
OS 2- Emergency Call handling	0 (0.0%)	0 (0.0%)	0
OS 4.1 - eMBMS MCPTT	0 (0.0%)	0 (0.0%)	0
OS 4.2 - eMBMS MCVIDEO	0 (0.0%)	0 (0.0%)	0
OS 5 - Switching on	0 (0.0%)	0 (0.0%)	0
OS 6 -Encrypted MCPTT Group Call	2 (100.0%)	0 (0.0%)	2
OS 8 - Encrypted MCVIDEO group call	0 (0.0%)	0 (0.0%)	0
OS 9 -Parallel MCPTT and MCVIDEO	0 (0.0%)	0 (0.0%)	0

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 MCPTT TSs.
- **Technical constraints**: Related to implementation issues, not covered by the standards, but which need to be faced by MCX vendors in most deployments.

The reader should note that 3GPP TS approved in December 2017 (mostly 14.4.0) were considered for the fourth Plugtests event.

The 4th MCPTT 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 Location configuration

In location configuration message, NonEmergencyLocationInformation and EmergencyLocationInformation are marked as optional, but if the AS does not send it, some clients do not send location report. A clarification of why those would not be mandatory whenever there is a location configuration message would be beneficial (or alternatively make them mandatory).

10.1.2 Meaning of QCIs in MBMS bearer announcement

Apparently there is no associated functionality in Clients regarding the QCIs included in the MBMS announcement. Any clarification otherwise would be appreciated by technical teams responsible for implementations. In case there is non, it should be removed.

10.2 Technical Constraints

Most of the observations are related with possible enhancements to 3GPP's TS that, even not being strictly needed from a functional point of view, would help partners in their implementations.

10.2.1 Paylod type and sRTP

When using sRTP in encrypted call if the AS changed the payload type (something common in some SIP stacks) due to prior client negotiation the signature would be no longer valid.

In order to avoid this either the client should ignore the received payload type and filter only the ssrc received in floor taken, or the client should later use the payload type send in SDP by the AS (but in this case, multi AS case could still be an issue).

10.2.2 Detection of no-longer-valid registration

The classical Subscription to REG/Expiration mechanism seems to be too long most of the times due to the signalling overhead/responsiveness. Some partner claims that client should know asap that it should re-register again instead.

In case of using SIP signalling over TCP without external IMS, some client implementations already consider that if the TCP connection is dropped by any reason the client is actually deregistered and should trigger the whole registration process again. Other possibilities include some sort of "SIP keepalive" mechanism that could be tentatively included in 3GPP TSs.

Furthermore, side effect of (de)registration and (de)affiliation should be considered.

History

Document history		
V0.1.0	17/10/2019	First Draft
V0.2.0	09/12/2019	Stable Draft
V0.3.0	09/12/2019	Minor corrections in executive summary
V0.4.0	10/12/2019	Minor corrections
V0.5.0	10/12/2019	Changes to clause 9.2 and 9.3
V0.6.0	11/12/2019	Reference to ETSI 103 564 is added and subgroup in TRT is defined
V1.0.0	13/12/2019	Final report
V1.1.0	13/12/2019	Final report published