ETSI Plugtests Report V1.0.0 (2026-06)

10th ETSI MCX Plugtests
Sophia Antipolis, France
18 – 22 May 2026

Keywords
Testing, Interoperability, Mission-Critical, LTE,
MCPTT, MCData, MCVideo, FRMCS

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Executive Summary

The capabilities of Mission Critical Push to Talk (MCPTT), Mission Critical Data (MCData) and Mission Critical Video (MCVideo) – together abbreviated as MCX services – were tested during the tenth MCX Plugtests from 18 May to 22 May 2026 at the ETSI premises in Sophia Antipolis, France using 4G and 5G test networks.

The 10th ETSI MCX Plugtests have concluded with a success rate of 92% of the executed tests in the validation of 3GPP mission critical services vendor interoperability. More than 240 delegates participated during the 10th MCX Plugtests event on-site in Sophia Antipolis and off-site from their labs, making it the largest MCX Plugtests to date.

These tests are essential to ensuring seamless access to mission-critical services over 4G and 5G networks across different vendor products and implementations.

The MCX ETSI Plugtests series is the first independent testing of public safety and other mission critical services over 4G/LTE and 5G networks. The Interworking Function (IWF) to LMR (narrowband Land Mobile Radio networks) systems like TETRA, Interconnection (Inter-MCX) between MCX servers, eMBMS (multicast), conformance test tools and performance testing tools were particularly tested in these 10th MCX Plugtests. The preparations for the tenth Plugtests started with VPN integration from 23rd March to 10th April 2026, followed by integration with 4G and 5G test networks from 13th April to 30th April 2026, a one-week pre-testing phase from 4th to 8th May 2026, and were finalized with one week of face-to-face end-to-end interoperability testing with 4G and 5G test networks at ETSI in Sophia Antipolis.

The tests were conducted based on 3GPP Releases 18 and 19, with a total of 356 tests executed between different vendors across 112 test sessions. The existing test cases have been further expanded for this Plugtests with additional multi-client, conformance and complex multi-vendor scenarios. A total of 466 test cases are now available for the MCX and FRMCS Plugtests. Besides the MCPTT, MCData and MCVideo Application Servers and Clients, the testing also included Dispatchers, User Equipment (UEs), Rugged Handheld Phones, Interworking (IWF) with TETRA, eMBMS (Evolved Multimedia Broadcast Multicast Services) multicast components, inter-MCX (server-to-server) communication, conformance test tools and performance monitoring tools. Seven test streams were defined: MCX over 4G (Stream A), MCX over 5G (Stream B), IWF (Stream C), Inter-MCX (Stream D), Multicast/eMBMS (Stream E), Conformance Testing (Stream F), and Performance Testing (Stream G). Both 4G and 5G networks were used as the radio access network.

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

The testing during the 10th MCX Plugtests was complemented by an observer programme with presentations, round-table discussions, and demos for the observers.

This tenth MCX Plugtests was organised by ETSI with the support of the TCCA and UIC. The Plugtests event was co-funded by the European Union (EU) and the European Free Trade Association (EFTA). The Plugtests event was a pure interoperability testing event, and **no products or vendors were certified**.

The next MCX Off Network, FRMCS and MCX Plugtests events are planned for November 2026, February 2027 and September-October 2027 respectively.

The following observer organisations participated in this Plugtests:

- A.S.T.R.I.D, Public safety network operator, Belgium
- BDBOS, Federal Agency for Public Safety Digital Radio, Germany
- Deutsche Bahn (DB), Railway Operator, Germany
- Erillisverkot, Public Safety Network Operator, Finland
- FirstNet, Public Safety Network Operator, USA
- GCF, Global Certification Forum
- Home Office, United Kingdom
- MCF, Swedish Civil Contingencies Agency, Sweden
- National Police ICT-unit, Norway
- Nkom, Norwegian Communications Authority, Norway
- N.C. Department of Information Technology, USA
- NIST, National Institute of Standards and Technology, USA
- TCCA, The Critical Communication Association


Vendors
ETSI
AIRBUS
ALEA
a LEONARDO company
amper
Caltta
सी-डॉट
C-DOT
ENENSYS
CONNECT
5G
CONSORT
CROSSCALL
DGT
Druid
eurofunk
creating safety by technology
EVIDEN
FREQUENTIS
HMF
smart solutions
Hytera
kontron
L3HARRIS
nemergent
solutions
funkwerk
PRESCOM
IoT
RideOnTrack
empowering communication
ISO 9001 : 2008 CERTIFIED
mclabs
MOTOROLA
SOLUTIONS
ROHDE&SCHWARZ
RugGear
ROHILL
OCSTARS
Connecting New Frontiers
Teltronic
VALID8.com
SAMSUNG
VIAVI
SOFTIL
INNOVATIVE COMMUNICATIONS
sepura
STREAMWIDE
ZETRON
SMART ROUTE
T Systems
TASSTA

S


Observers
ETSI
astrid
DB
Federal Agency for Public Safety Digital Radio
FIRSTNET
Built with AT&T
TCCA
NIST
Home Office
N K O M
Erillisverkot
NCDIT
NORTH CAROLINA DEPARTMENT OF INFORMATION TECHNOLOGY
GCF
Test Certify Connect

1. Introduction

Mission Critical Push To Talk (MCPTT) is a 3GPP standardized voice service for mobile radio systems which ensures that LTE and 5G systems support mission-critical communications.

The global mission-critical communication market was valued at approximately US$25.53 billion in 2024 and is projected to reach US$37.32 billion by 2030, growing at a compound annual growth rate (CAGR) of 8.4% during the forecast period, as per Strategic Market Research. Another estimate by The Business Research Company values the market at US$20.91 billion in 2025 and projects it to reach US$34.06 billion by 2030 at a CAGR of 10.1%.This growth is driven by the increasing adoption of mission-critical communication systems across various sectors, including public safety, transportation, energy, utilities, defence, and mining, as well as the transition from legacy narrowband systems to broadband-based, interoperable platforms.

Several regions have initiated nationwide rollouts of mission-critical LTE or 5G networks, leading to significant investments in this sector. Notably, countries such as the United States, South Korea, Finland, France, the United Kingdom, Norway, Sweden and various nations in the Middle East and Asia have been at the forefront of these developments. The transition is further accelerated by nationwide LTE/5G build-outs enabling network slicing, edge analytics, and new tools for situational awareness.

Mission Critical Push To Talk (MCPTT) was the first of several Mission Critical features standardized by 3GPP in Release-13. Mission Critical Video and Mission Critical Data standardization started with Release-14. With the standardization of MCX (Mission-Critical PTT, Video & Data) and other critical communications features by 3GPP, LTE and 5G NR networks are increasingly gaining recognition as an all-inclusive communications platform for public safety, rail, utilities and other critical communications sectors.

Preparations for the 10th ETSI MCX Plugtests event started in December 2025 with the registrations of vendors and observers in January and February 2026. During bi-weekly conference calls from January 2026 to May 2026, the setup of the tests, the test specification and organisational discussions were agreed between the participants. Before the main event, the vendors integrated with the test network and conducted remote pre-testing of their implementations via VPN tunnels, which connected their labs to a central exchange hub at ETSI.

The VPN integration phase ran from 23rd March to 10th April 2026, followed by integration with 4G and 5G test networks from 13th April to 30th April 2026, and a one-week pre-testing phase from 4th to 8th May 2026. The main face-to-face interoperability testing event took place from 18th to 22nd May 2026 at the ETSI premises in Sophia Antipolis, France.

All the information required to organise and manage the 10th 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 10th MCX Plugtests event wiki (login required).

Clause 4 describes the management of the Plugtests event.

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

- MCX Application Servers (MCX AS)
- MCX Clients
- Evolved Node B (eNB)
- Next Generation Node B (gNB)
- User Equipment (UE) – including Rugged Handheld Phones
- Land Mobile Radio (LMR) Systems – TETRA
- Evolved Packet Core (EPC)
- 5G Core (5GC)
- Broadcast Multicast Service Center (BMSC)
- Evolved Multicast/Broadcast Multimedia Service Gateway (eMBMS-GW)
- MCX Conformance Test Tools
- MCX Performance Test Tools
- Dispatchers

In this Plugtests, multiple Application Servers and Clients were evaluated in dedicated test streams (Stream A & B). Stream A was available for vendors to evaluate their equipment for end-to-end interoperability testing over 4G networks (Bands 38/40), and Stream B for testing over 5G networks (Band 78). In this Plugtests it was required to test each Application Server with at least 2 different Client implementations.

The Interworking Function (IWF) with LMR systems (TETRA) was evaluated in a dedicated IWF test stream (Stream C). Stream D was available for vendors to evaluate their equipment in interconnected MCX systems (Inter-MCX, server-to-server communication).
eMBMS multicast functionality was tested in a dedicated test stream (Stream E), which was available for multicast service centre, gateway and MCX server/client vendors to test multicast implementations.
A dedicated Conformance test stream (Stream F) was available for conformance test tool vendors and MCX server, client and dispatcher vendors to check their tools and the conformance of their implementations. A dedicated Performance test stream (Stream G) was available for performance monitoring and drive test tool vendors to evaluate end-to-end performance KPIs of MCX services.
The remote test infrastructure is described in clause 6; the test procedures are described in clause 7.
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 MCX services.

For the 10th MCX Plugtests, the MCX test specification now contains a total of 466 test cases. An updated test specification version will be published as a new version of ETSI document ETSI TS 103 564 (after ETSI TC CCS approval).
The detailed results of the tests are available for the involved vendors in these test sessions 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 are very valuable because they give the vendors valuable information to improve their implementations. They also help to discover errors or ambiguities in the standards and to clarify and improve the specifications.
ETSI plan to conduct more FRMCS/MCX Plugtests in the future.
Vendors and observers who have not participated in the previous MCX Plugtests events are welcomed and encouraged to join the next MCX Plugtests event.

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 Release 19 versions for the tenth MCX Plugtests. Please see also the test specification document [1] 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.

[3] 3GPP TS 23.280: Common functional architecture to support mission critical services.

[4] 3GPP TS 23.379: Functional architecture and information flows to support Mission Critical Push To Talk (MCPTT)

[5] 3GPP TS 24.229: IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP).

[6] 3GPP TS 24.281: Mission Critical Video (MCVideo) signalling control.

[7] 3GPP TS 24.282: Mission Critical Data (MCData) signalling control.

[8] 3GPP TS 24.379: Mission Critical Push To Talk (MCPTT) call control.

[9] 3GPP TS 24.380: Mission Critical Push To Talk (MCPTT) media plane control.

[10] 3GPP TS 24.481: Mission Critical Services (MCS) group management.

[11] 3GPP TS 24.482: Mission Critical Services (MCS) identity management.

[12] 3GPP TS 24.483: Mission Critical Services (MCS) Management Object (MO).

[13] 3GPP TS 24.484: Mission Critical Services (MCS) configuration management.

[14] 3GPP TS 24.581: Mission Critical Video (MCVideo) media plane control.

[15] 3GPP TS 24.582: Mission Critical Data (MCData) media plane control.

[16] 3GPP TS 26.179: Mission Critical Push To Talk (MCPTT); Codecs and media handling.

[17] 3GPP TS 26.346: Multimedia Broadcast/Multicast Service (MBMS).

[18] 3GPP TS 29.212: Policy and Charging Control (PCC).

[19] 3GPP TS 29.214: Policy and Charging Control over Rx reference point.

[20] 3GPP TS 29.468: Group Communication System Enablers for LTE(GCSE_LTE); MB2 reference point.

[21] 3GPP TS 33.180: Security of the mission critical service.

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

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

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

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

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

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

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

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

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

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

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

[33] OMA. OMA-TS-XDM_Core-V2_1-20120403-A: XML Document Management (XDM) Specification.

[34] OMA. OMA-TS-XDM_Group-V1_1_1-20170124-A: Group XDM Specification.

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

[36] IETF RFC 5246: The Transport Layer Security (TLS).

[37] IETF RFC 6101: The Secure Sockets Layer (SSL).

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

[39] 3GPP TR 21.905: Vocabulary for 3GPP Specifications.

[40] ETSI TS 100 392-19-1: Interworking between TETRA and Broadband systems: Critical Communications Architecture for Interworking between TETRA and Broadband applications. (not published)

[41] ETSI TS 100 392-19-2: Interworking between TETRA and Broadband systems: Format for the transport of TETRA speech over mission critical broadband systems.

[42] TIA-102.BACA-B-3: Project 25 Inter-RF Subsystem Interface Messages and Procedures for Voice Services, Mobility Management, and RFSS Capability Polling Services.

[43] TIA-102.BACD-B-3: Inter-RF Subsystem Interface (ISSI) - Messages and Procedures for Supplementary Data.

[44] OMA. OMA-TS-REST-NetAPI-NMS-V1-0-20190528-C: RESTful Network API for Network Message Storage".

[45] OMA. OMA-TS-REST-NetAPI-NotificationChannel-V1-0-20200319-C: RESTful Network API for Notification Channel.

3. Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [39] 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 [39].

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
DHS	Department of Homeland Security
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
FRMCS	Future Railway Mobile Communication System
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
IWF	Interworking Function
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
P25	Project 25
PCC	Policy and Charging Control
PCRF	Policy and Charging Rules Function
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
TETRA	Terrestrial Trunked Radio
TR	Technical Recommendation
TRT	Test Reporting Tool
TS	Technical Specification

UE	User Equipment
UIC	International union of railways (Union Internationale des Chemins de fer)

4. Technical and Project Management

4.1 Scope

The main goal of the tenth MCX Plugtests was testing the interoperability of the MCPTT, MCData and MCVideo ecosystem signalling and media plane at different levels. The Multi-client scenarios, Inter MCX, Multicast and interworking (IWF) with LMR were tested during the event.

The basic scenario tested comprised MCX application server(s) -both controlling and participating- and multiple MCX clients deployed over a generic SIP/IMS core, LTE & 5G access network with and without MCX required PCC capabilities with native multicast support (i.e. Release-14 -and higher- eMBMS) and UEs. The following Figure 1 illustrates the basic test infrastructure.

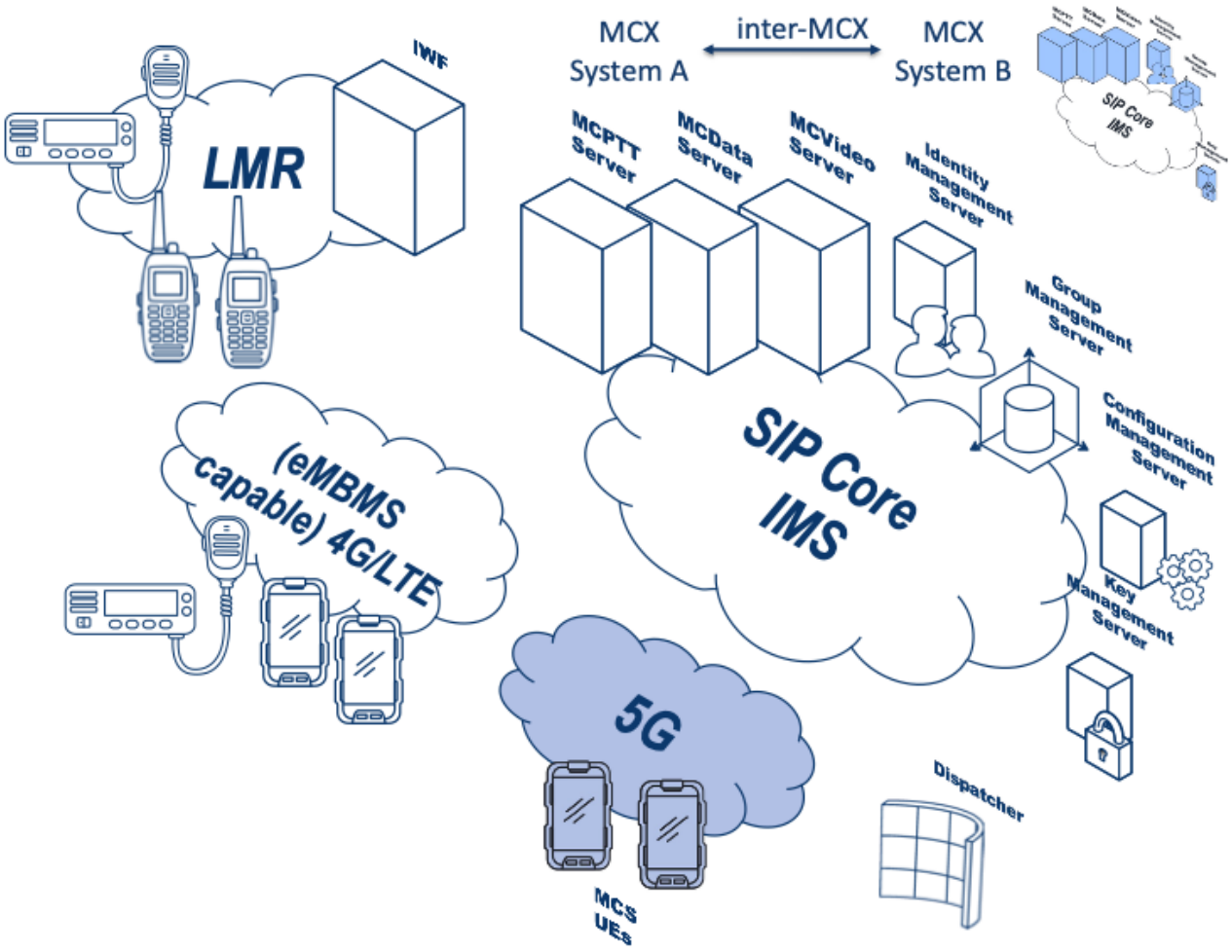

Figure 1. Typical MCPTT/MCData/MCVideo scenario to be considered in the Plugtests

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 this 10th Plugtests, AS vendors provided their own built-in SIP/IMS cores so that Clients registered into different cores depending on the specific test session. Application level refers to e2e signalling, media, floor controlling (and other involved) protocols in use. Plugtests participants were encouraged to carry on CONN tests over Mission Critical LTE/5G for unicast – or UNI-MC-LTE/5G – and Mission Critical LTE with multicast eMBMS-capabilities – so called MULTI-MC-LTE. 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 fea-

tures 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. New MCLoc capabilities were added to the testing scope.

- **eMBMS (EMBMS)**: Comprised checking of eMBMS specific signalling both in the MB2-U/C interface and e2e.
- **Multi IOP**: Interoperability testing-oriented complex test cases were added for Multi-client scenarios.
- **Interworking Function (IWF)**: MCPTT connectivity test cases were re-used to test interworking with LMR systems (Tetra).
- **Inter MCX**: MCPTT/MCVideo connectivity test cases were used to test interworking between application servers.

4.2 Timeline

The preparation was run through different phases as described in the Figure 2 below.

	January			February				March				April					May		
	wk 03	wk 04	wk 05	wk 06	wk 07	wk 08	wk 09	wk 10	wk 11	wk 12	wk 13	wk 14	wk 15	wk 16	wk 17	wk 18	wk 19	wk 20	wk 21
Conference Calls		X - Open		X		X		X		X		X		X		X		X	
Registration		15/01/26 - 13/02/26																	
Equipment Registration							23/02/26 - 06/03/26												
VPN Integration											23/03/26 - 10/04/26								
Integration MCX AS with 4G/5G Network														13/04/26 - 30/04/26					
Pre-Testing																	04/05/26 - 08/05/26	Reserved	
Plugtests																			18/05/26 - 22/05/26

Figure 2. Plugtests event timeline

Registration to the MCX Plugtests event was open from 15th January 2026 to 13th February 2026 to any organisation willing to participate in testing the MCX Services Ecosystem. A total of 243 people were finally involved in the Plugtests event.

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 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-19 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, considering input and feedback received from Plugtests event participants. See details in clause 8.

4.2.2 Integration & pre-testing

Participants connected their implementations remotely to the Plugtests event infrastructure, known as HIVE: Hub for Interoperability and Validation at ETSI. Participants also integrated their equipment with LTE and 5G test network cores to participate in all the streams.

From 23rd March to 10th April 2026, participants connected their equipment's with LTE and 5G network to collaboratively run the Interoperability Test Sessions remotely. Integration with MCX AS and EPC/5GC was performed from 13th April to 30th April 2026. Over the top IP based testing was performed during the pretesting phase from 04th May to 08th May 2026.

During this phase, up to 36 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 Plugtests event time and smoother Interoperability test sessions.

A VPN connection to the HIVE was highly recommended for participants providing MCX Application Servers, MCX Clients, Dispatchers, gNB and EPC 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.

For the LTE and 5G testing in Sophia Antipolis, MCX AS Servers were connected to the LTE and 5G test systems. Assistance was provided by the test system experts to debug integration issues with the test networks.

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 18th May to 22nd May 2026, participants connected their equipment with the test network to collaboratively run the Interoperability Test Sessions onsite.

The scheduling of individual test combinations was partially randomised using the ETSI Test Reporting tool from Tuesday, 19th May, to Thursday, 21st May. Participants agreed on test session slots between themselves for Monday, 18th May, and Friday, 22nd May. 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.
- **Shipment of Equipment** – Information regarding shipment of equipment.
- **Participants in the event** – List of participants in the event.
- **Schedule –** Complete schedule of the event.
- **Observer Program** – Information about the Observer presentations and Observer demo during the Plugtests event.
- **Conformance Test Tools** – Information from the conformance test tool vendors about what kind of tests they are offering for the Plugtests.
- **Performance Test Tools** – Information from the performance test tool vendors about what kind of tests they are offering for the Plugtests.

- **Test Network Information –** LTE and 5G test network information.
- **IT Infrastructure** - HIVE connection request tool, and remote connections status overview.
- **Specifications -** High Level Test Scope including the test specification and reference to 3GPP and IETF specifications.
- **Equipment under Test** - Participating EUTs overview and contact information.
- **Provisioning Information -** Pre-configured parameters for EUTs.
- **Test Reporting Tool** - Documentation of the Test Reporting Tool.
- **Conf Calls** - Calendar, logistics, agendas and minutes of the bi-weekly conference calls run during the remote integration and pre-testing phase.
- **Observations** - Issues found during Plugtests event.
- **Networking Dinner** – Information regarding networking dinner.

In addition, the participants communicated with each other during the pre-testing phase and Test Sessions using Slack and Google Sheets, and they included 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 main 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 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.

5. Equipment Under Test

The tables Table 1 to Table 10 below summarise the different EUTs provided by the Plugtests event participants (the support information is based on the vendor's declarations of what they wanted to test, it does not guarantee that a test sessions including a specific feature was actually conducted):

5.1 MCX Application Servers

Organisation	Support
Airbus	MCPTT, MCData, eMBMS
Alea	MCPTT, MCData, MCVideo, IWF, Inter-MCX, eMBMS
Caltta	MCPTT, MCData, MCVideo
Cdot	MCPTT, MCData, MCVideo, IWF
Consort	MCPTT, MCData, MCVideo
Eviden	MCPTT, MCData, MCVideo
Frequentis	MCPTT, MCData, MCVideo, IWF, Inter-MCX
HMF	MCPTT, MCData, MCVideo, Inter-MCX
Hytera	MCPTT, MCData, MCVideo, IWF, Inter-MCX, eMBMS
Kontron	MCPTT, MCData, MCVideo, IWF, Inter-MCX
L3Harris	MCPTT, MCData, MCVideo
MCLabs	MCPTT, MCData, MCVideo, Inter-MCX, eMBMS
Motorola Solutions	MCPTT, MCData, MCVideo, IWF, Inter-MCX
Nemergent	MCPTT, MCData, MCVideo, IWF, Inter-MCX, eMBMS
Pocstars	MCPTT, MCData, MCVideo
Samsung	MCPTT, MCData, MCVideo, IWF
Sanchar	MCPTT, MCData, MCVideo
Smart Route	MCPTT, IWF
StreamWide	MCPTT, IWF, Inter-MCX, eMBMS
Tassta	MCPTT, MCData, MCVideo
Teltronic	MCPTT, MCData
Valid8	MCPTT, MCData, MCVideo, Inter-MCX

Table 1. MCX Application Servers Under Test

5.2 MCX Clients

Organisation	Support
Alea	MCPTT, MCData, MCVideo
Caltta	MCPTT, MCData, MCVideo
Cdot	MCPTT, MCData, MCVideo, Inter-MCX
Consort	MCPTT, MCData, MCVideo
DGT	MCPTT, MCData
Eviden	MCPTT, MCData, MCVideo, Inter-MCX
HMF	MCPTT, MCData, MCVideo, IWF
Hytera	MCPTT, MCData, MCVideo, IWF, Inter-MCX, eMBMS
Kontron	MCPTT, MCData, MCVideo, IWF, Inter-MCX
Nemergent	MCPTT, MCData, MCVideo
Pocstars	MCPTT, MCData, MCVideo
RideOnTrack	MCPTT, MCData
Sanchar	MCPTT, MCData
Sepura	MCPTT, MCData, IWF
Softil	MCPTT, MCData, MCVideo, Inter-MCX
Teltronic	MCPTT, MCData, IWF, Inter-MCX
Viavi	MCPTT, MCData, MCVideo, IWF, Inter-MCX

Table 2. MCX Clients Under Test

5.3 Dispatcher (DISP)

Organisation	Support
Amper	MCPTT, MCData, MCVideo
Caltta	MCPTT, MCData, MCVideo
Cdot	MCPTT, MCData, MCVideo
Eurofunk	MCPTT, MCData
Eviden	MCPTT, MCData, MCVideo
Frequentis	MCPTT, MCData, Inter-MCX
Hytera	MCPTT, MCData, MCVideo
RideOnTrack	MCPTT, MCData
Softil	MCPTT, MCData, MCVideo
Teltronic	MCPTT, MCData, IWF, Inter-MCX
Valid8	MCPTT, MCData, MCVideo
Zetron	MCPTT, MCData, MCVideo, Inter-MCX

Table 3. Dispatcher (DISP) Under Test

5.4 Evolved Packet Core (EPC) and Evolved Node B (eNB)

Organisation	Support
Druid	B38
Enensys	B38
Teltronic	B40

Table 4. Evolved Packet Core and eNB Under Test

5.5 5G Core (5GC) and 5G New Radio (5GNR)

Organisation	Support
Connect 5G	N78
Druid	N78
Enensys	N78

Teltronic	N78

Table 5. 5G Core and 5G NR Under Test

5.6 User Equipment (UE)

Organisation	Support
Caltta	4G, 5G-NSA, 5G-SA
Crosscall	4G, 5G-NSA, 5G-SA
Hytera	4G, 5G-NSA, 5G-SA
RugGear	4G, 5G-NSA, 5G-SA
Sepura	4G, 5G-NSA, 5G-SA
Viavi	4G, 5G-NSA, 5G-SA

Table 6. User Equipment Under Test

5.7 Land Mobile Radio (LMR)

Organisation	Support
Amper	TETRA System Emulator, MCPTT, MCData
Prescom	LMR System Emulator, MCPTT
Rohill	TETRA System, MCPTT, MCData
SmartRoute	TETRA System, MCPTT
T-Systems	TETRA System Emulator

Table 7. Land Mobile Radio Under Test

5.8 Evolved Multimedia Broadcast Multicast Services (eMBMS) Components

Organisation	Support
Enensys	MBMS-GW/SC
Teltronic	MBMS-GW/SC

Table 8. Evolved Multimedia Broadcast Multicast Services (eMBMS) Components Under Test

5.9 Conformance Test Tools

Organisation	Support
Rohde & Schwarz	
Valid8	

Table 9. Testers Under Test

5.10 Performance Test Tools

Organisation	Support
Valid8	MCPTT, MCData
Viavi	MCPTT, MCVideo, MCData, eMBMS, 4G, 5G-NSA

Table 10. Testers Under Test

6 Test Infrastructure

6.1 Remote Test Infrastructure

The remote testing and pre-testing phase were enabled by the setup as shown in Figure 3:

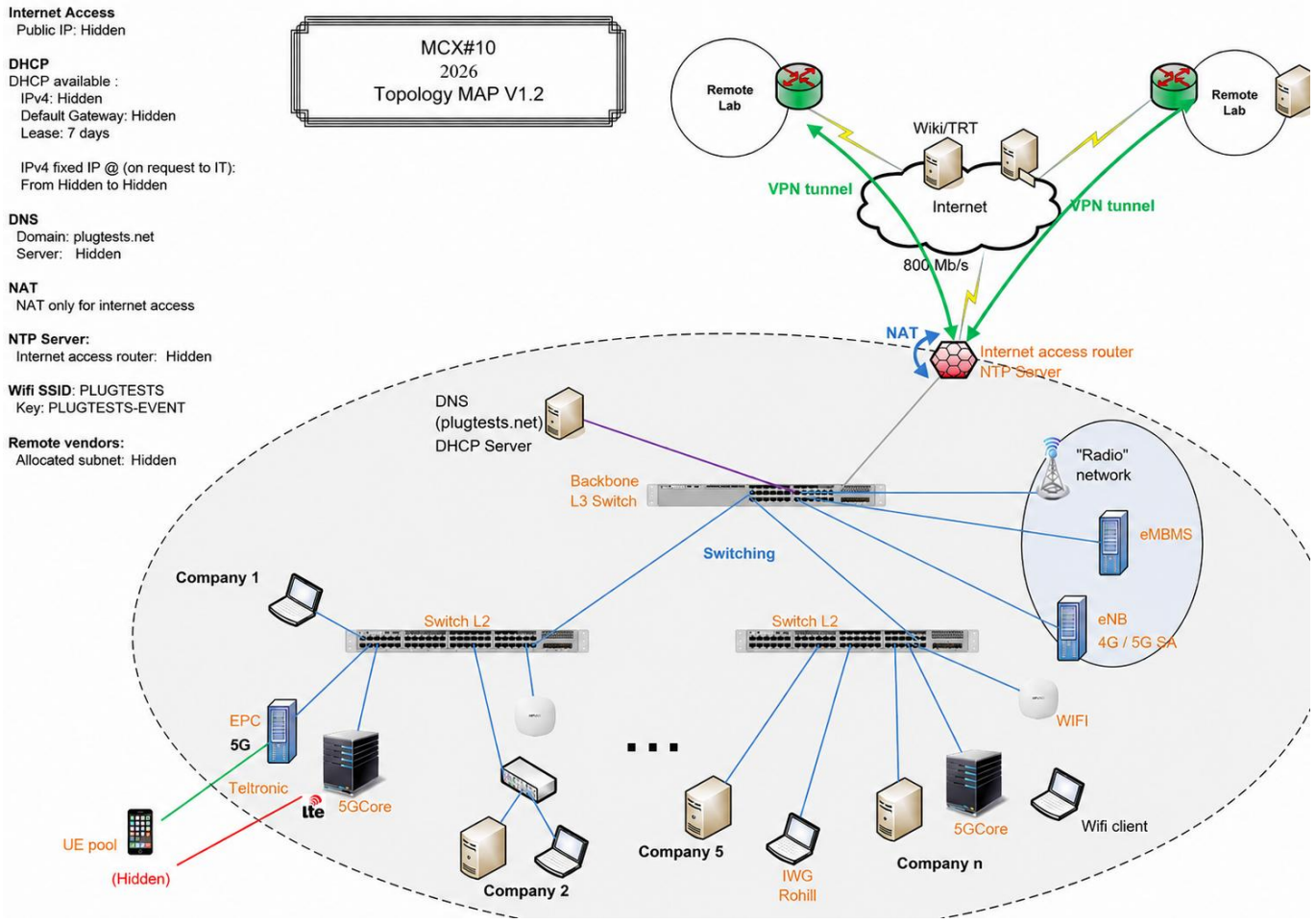

Figure 3. Remote Test Infrastructure

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

7 Test Procedures

7.1 Test Streams

The testing and test setup were structured in different test streams in this Plugtests. Table 11 shows the available test streams in the MCX#10 Plugtests.

Stream	Purpose	Description
A	MCX/4G	Testing of MCX components over a 4G network
B	MCX/5G	Testing of MCX components over a 5G network
C	IWF	Testing of MCX and LMR components, connected via IWF
D	Inter-MCX	Testing of Interconnected MCX servers
E	Multicast	Testing of Multicast/eMBMS components with MCX components
F	Conformance	Conformance test tools and MCX server/clients
G	Performance	Performance test tools for MCX ecosystem

Table 11. Available test streams in MCX#10 Plugtests

7.2 Remote Integration & Pre-testing Procedure

During the remote integration and pre-testing phase, the participating Equipment Under Test followed the following procedures: 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 (see Table 12) were used in the pretesting phase.

The pre-testing reports were not considered for the final Plugtests statistics.

Config Name	Pre-testing Configuration
Config_PRE_OTT	MCX Client + MCX AS
Config_PRE_OTT Disp	Dispatcher + MCX AS
Config_PRE_IWF	MCX Client + MCX AS + LMR
Config_PRE_InterMCX	MCX Client + MCX AS + MCX Client + MCX AS
Config_INT_4G	MCX AS + 4G
Config_INT_5G	MCX AS + 5G
Config_INT_IWF	MCX AS + LMR
Config_INT_Multicast	MCX AS + eMBMS

Table 12. Pre-testing Configuration

7.3 Interoperability Testing Procedure

During the Plugtests event, a daily Test Session Schedule was added and shared via the TRT. 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 (see Table 13).

Stream	Config Name	Main Test Configuration
A	Config_A_MCX 4G	MCX Client + MCX AS + MCX Client + 4G
A	Config_A_MCX 4G 2 Disp	MCX Client + MCX AS + MCX Client + 4G + Dispatcher + Dispatcher
A	Config_A_MCX 4G Disp	MCX Client + MCX AS + MCX Client + 4G + Dispatcher
B	Config_B_MCX 5G	MCX Client + MCX AS + MCX Client + 5G
B	Config_B_MCX 5G 2 Disp	MCX Client + MCX AS + MCX Client + 5G + Dispatcher + Dispatcher
B	Config_B_MCX 5G Disp	MCX Client + MCX AS + MCX Client + 5G + Dispatcher
C	Config_C_IWF 4G	MCX Client + MCX AS + Tetra + 4G
C	Config_C_IWF 4G Disp	MCX Client + MCX AS + Tetra + 4G + Dispatcher
C	Config_C_IWF 5G	MCX Client + MCX AS + Tetra + 5G
C	Config_C_IWF 5G Disp	MCX Client + MCX AS + Tetra + 5G + Dispatcher
D	Config_D_Inter MCX 4G	MCX Client + MCX AS + 4G + MCX Client + MCX AS
D	Config_D_Inter MCX 4G Disp	MCX Client + MCX AS + 4G + MCX Client + MCX AS + Dispatcher
D	Config_D_Inter MCX 5G	MCX Client + MCX AS + 5G + MCX Client + MCX AS
D	Config_D_Inter MCX 5G Disp	MCX Client + MCX AS + 5G + MCX Client + MCX AS + Dispatcher
D	Config_D_Inter MCX multiRAN	MCX Client + MCX AS + 5G + MCX Client + MCX AS + 4G
E	Config_E_Multicast	MCX Client + MCX AS + 4G + eMBMS
F	Config_F_AS	Tester + MCX AS
F	Config_F_Client	Tester + MCX Client
F	Config_F_Client RAN	Tester + MCX Client + UE
F	Config_F_Disp	Tester + Dispatcher
F	Config_F_IWF	Tester + MCX AS
F	Config_F_IWF_LMR	Tester + LMR
G	Config_G_Monitor 4G	Tester + MCX Client + UE + MCX AS + 4G
G	Config_G_Monitor 5G	Tester + MCX Client + UE + MCX AS + 5G
G	Config_G_Perf 4G	Tester + MCX Client + UE + MCX AS + 4G
G	Config_G_Perf 5G	Tester + MCX Client + UE + MCX AS + 5G

Table 13. 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.

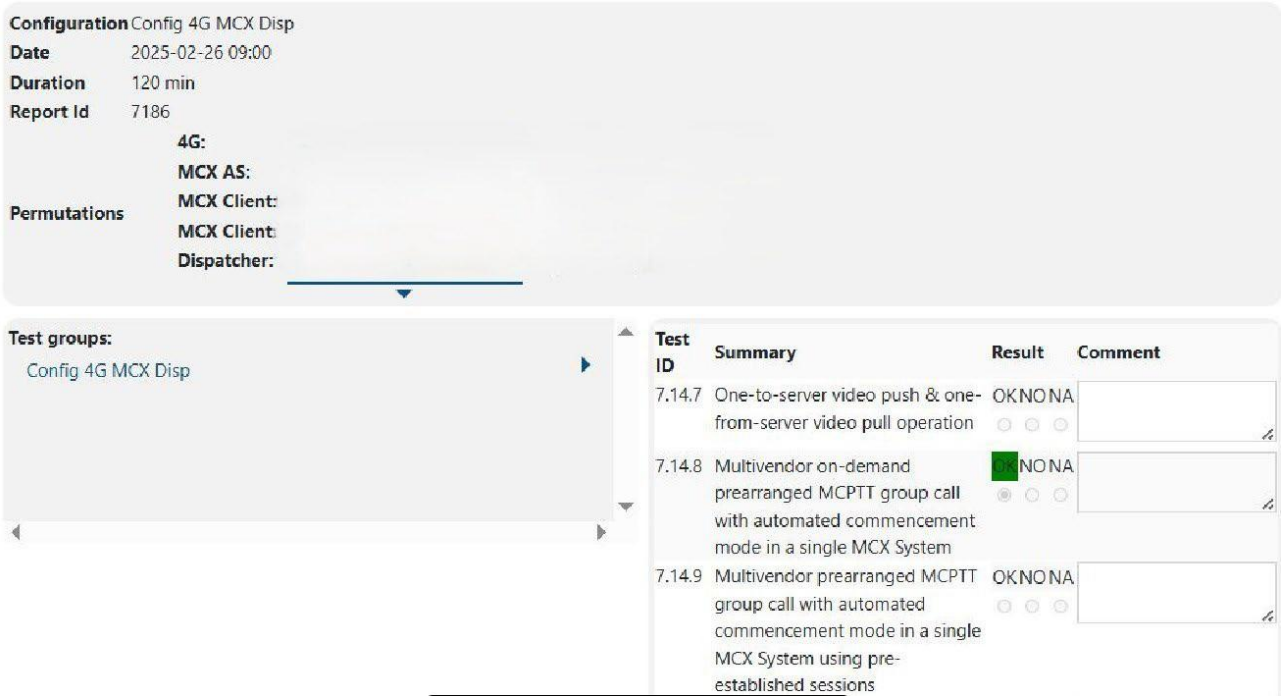

Figure 4. Test Session Report

2. For each Test in the Test Plan:

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

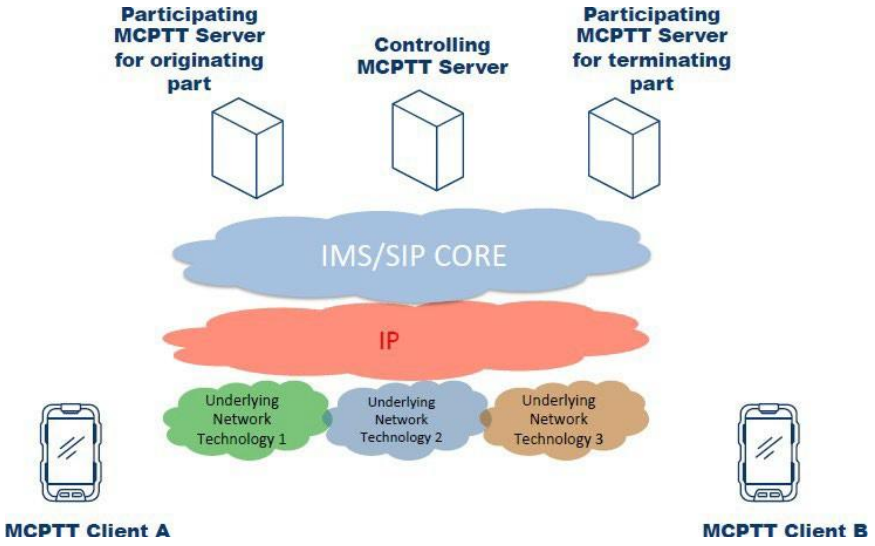

Figure 5. System Under Test (SUT) Configuration – MCPTT example

Interoperability Test Description			
Identifier	IWF/MCPTT/CONN/ONN/CTRL/PRIV/AUTO/ONDEM/WFC/NFC/01		
Test Objective	Verify IP connectivity, SIP core/IMS configuration and proper routing and SIP signalling for LMR user, LMR user triggering a private call to a MCPTT user in automatic commencement mode with the IWF on the controlling role		
Configuration(s)	• CFG_ONN_OTT-1 (clause 5.2) • CFG_ONN_UNI-MC-LTE-1 (clause 5.3) • CFG_ONN_MULTI-MC-LTE-1 (clause 5.4)		
References	• SIP (see ETSI TS 124 229 [6] and other references in ETSI TS 124 379 [9])		
Applicability	• IWF-MCPTT_AFFIL • IW-MCPTT_PART • IWF-MCPTT-Part_ONN-MCPTT-CALL • IWF-MCPTT-Part_MCPTT-FC • MCPTT-Client_ONN-MCPTT-CALL, MCPTT-Client_AMR-WB • MCPTT-Client_AFFIL, MCPTT-Client_MCPTT-FC (clause 6.2) • MCPTT-Part_ONN-MCPTT-CALL, MCPTT-Part_AFFIL (see note) • MCPTT-Part_MCPTT-FC, MCPTT-Part_RX (CFG_ONN_UNI-MCLTE-1 only) • MCPTT-Part_GCSE (CFG_ONN_MULTI-MC-LTE-1 only) (clause 6.5) • MCPTT-Ctrl_ONN-MCPTT-CALL, MCPTT-Ctrl_AFFIL (see note) (clause 6.6)		
Pre-test conditions	• IP connectivity among all elements of the specific scenario • Proper configuration of the SIP core/IMS to forward the signalling to the specific controlling and participating servers including the IWF in participating mode • LMR UEs and MC clients properly registered to the LMR and SIP core/IMS and MC system respectively • Static/dynamic mapping of the SIP identity (i.e. IMPU) vs. mcptt_id		
Test Sequence	**Step**	**Type**	**Description**
	1	stimulus	LMR user triggers a private call towards a user mapped to a mcptt_id (i.e. mpctt_id_clientB)
	2	check	Resulting INVITE is generated in the IWF on a controlling role providing the private calling function to the LMR user
	3	check	The IWF forwards it to the terminating participating
	4	check	MCPTT client receives the INVITE, send a notification to the user (i.e. rings) and sends back a 200 OK
	5	verify	Call connected and private call between LMR and MCPTT user stablished
NOTE: It is not considered the triggering and possible effects of (un)successful implicit affiliation in the MCPTT participating server for the case when the calling is not affiliated to the group identified in the "SIP INVITE request for originating participating MCPTT function" as determined by clause 9.2.2.2.11 in ETSI TS 124 379 [9].			

Figure 6. 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.

7.4 Identified Challenges

During and after the MCX#10 Plugtests participating vendors, observers, and the ETSI Plugtests team made a few observations on potential improvements. These observations will help to organize the next Plugtests better.

The main observations highlight the need for longer and better-structured test sessions, improved pre-testing and preparation, earlier and more controlled scheduling, and enhanced coordination for multi-vendor scenarios. Additionally, improvements in resource allocation, participant readiness, and overall session planning would significantly increase testing efficiency and effectiveness.

Observations were:

- A key observation was that several vendors did not correctly configure their equipment using provisioning information. This resulted in significant time being spent on properly configuring MCX clients during the test sessions.

- The allocated two-hour test sessions were generally insufficient to complete full test scenarios. This limitation was particularly evident in multi-vendor sessions, which typically required significantly more time—up to three to four hours—to achieve meaningful results. Consequently, a number of test sessions could not be fully completed, adversely impacting the overall test coverage

- Random sessions should also be scheduled during the pre-testing phase, and these sessions should then be continued during the main event.

- All vendors should use the IDMS, CMS, and GMS processes for registration and provisioning.

- Attending the observer demos may prevent vendors to continue testing. This should not be the case.
  It may make sense to limit the number of demos a vendor can participate in to ensure vendors can continue testing with other vendors during the time of the observer demos.

8 Test Plan Overview

8.1 Introduction

This 10th MCX Plugtests Test Plan was developed following ETSI guidelines for interoperability. Additional Release-19- based test cases, comprising Multi-Client scenarios and IWF, were included.

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 previous Plugtests event 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 subgroups.

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/5G access network with and without MCPTT required PCC capabilities and native multicast support (i.e. eMBMS). Furthermore, a series of support servers were integrated in the so-called Common Services Core provide configuration, identity, group, and key management capabilities.

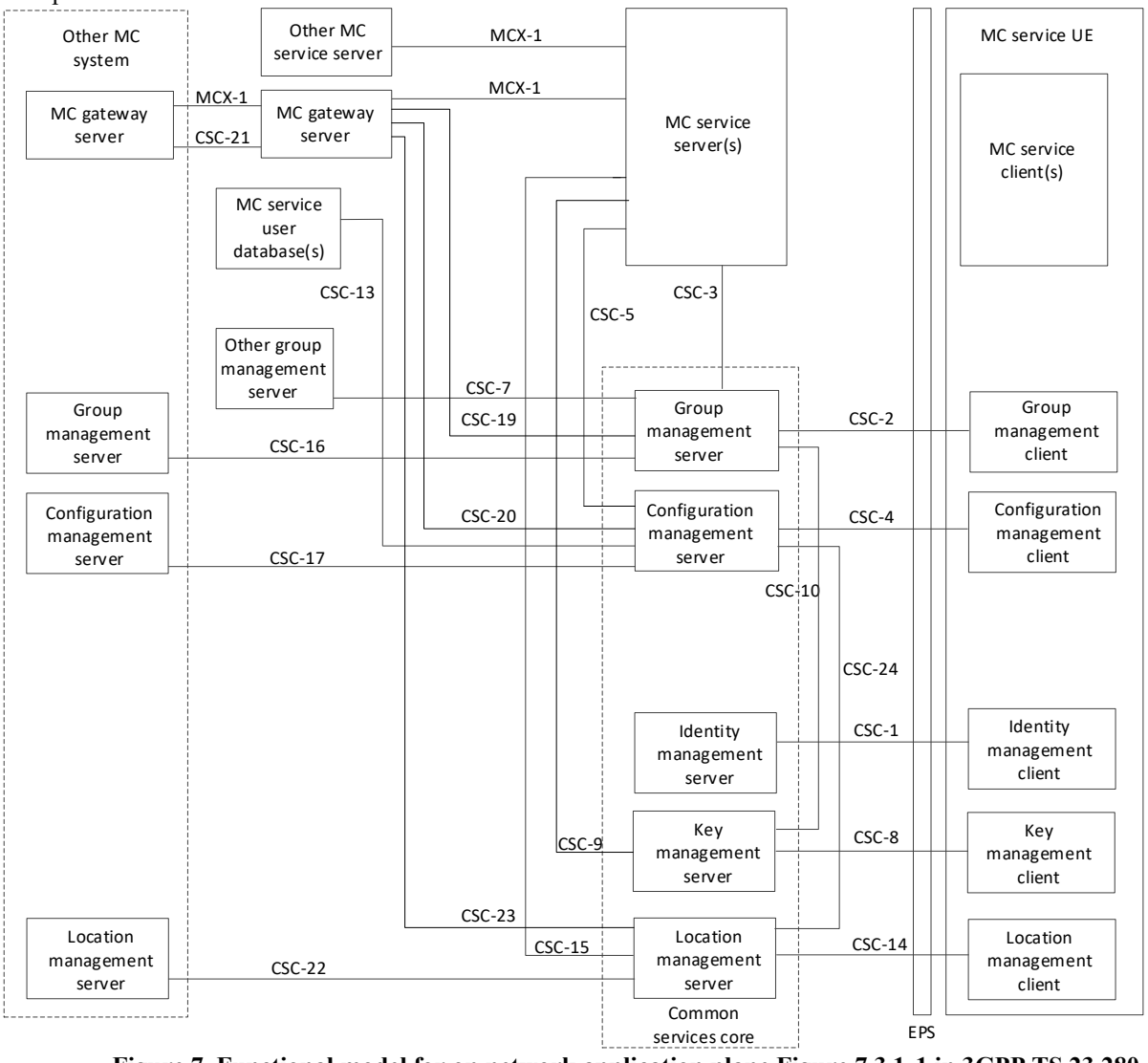

Figure 7. Functional model for on network application plane Figure 7.3.1-1 in 3GPP TS 23.280 [3]

Figure 7.3.1-1 in 3GPP TS 23.280 [3] (see Figure 7) 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/N5/N33 and MB2-C/MB2-U) involving other supporting technologies like LTE EPS, 5G, etc. 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/5G and multicast Mission Critical LTE/5G (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/5G, 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/5G). Therefore, although not usable in a real world Mission Critical environment but for non-3GPP devices such as dispatchers, it was used for connectivity tests since it did not require any binding between the IMS/SIP Core and the underlying LTE/5G infrastructure and allowed both signalling and media plane parallel testing easily.

8.2.2 Unicast Mission Critical LTE/5G for On-Network calls (CFG_ONN_UNI-MC -1)

In this configuration the LTE network (both EPC and eUTRAN) and 5G network (both 5GC and gNB) 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 (or 5G Qi 65/69), and the availability of a PCRF with MCPTT compliant Rx/MCPTT-5 interface (or PCF with an N5/N33 in a 5G core). Specific Rx/MCPTT-5/N5/N33 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 8, MCVideo/MCData could follow the same approach.

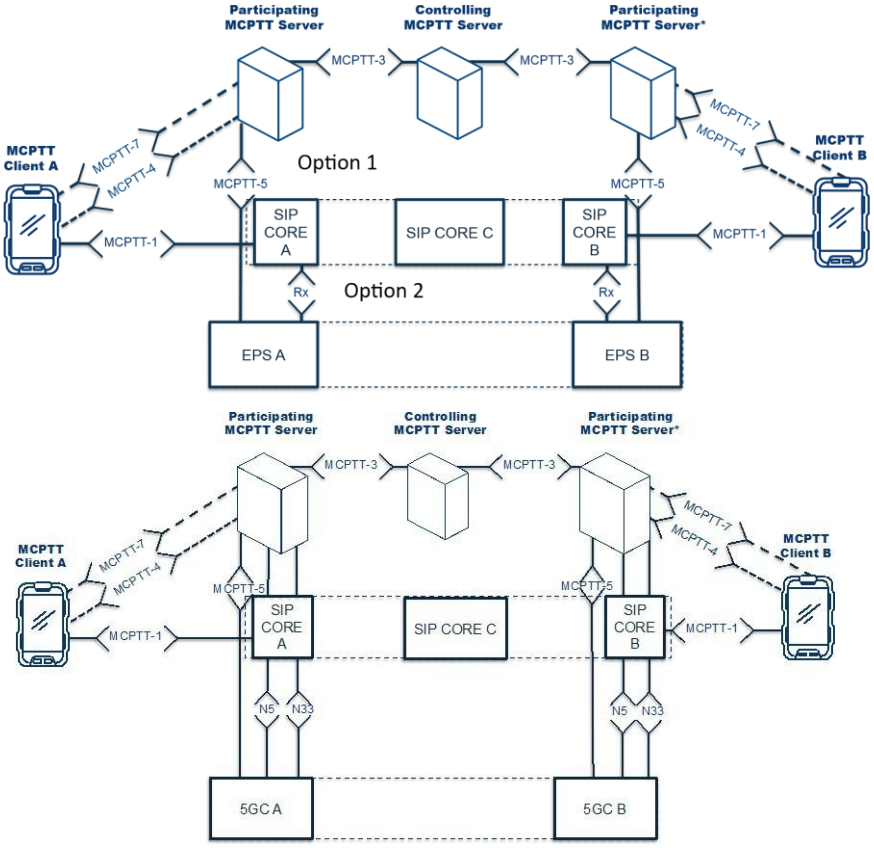

Figure 8. CFG_ONN_UNI-MC- 1 configuration

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.

NOTE: In this 10th MCX Plugtests both configurations (unicast and multicast scenarios) were possible.

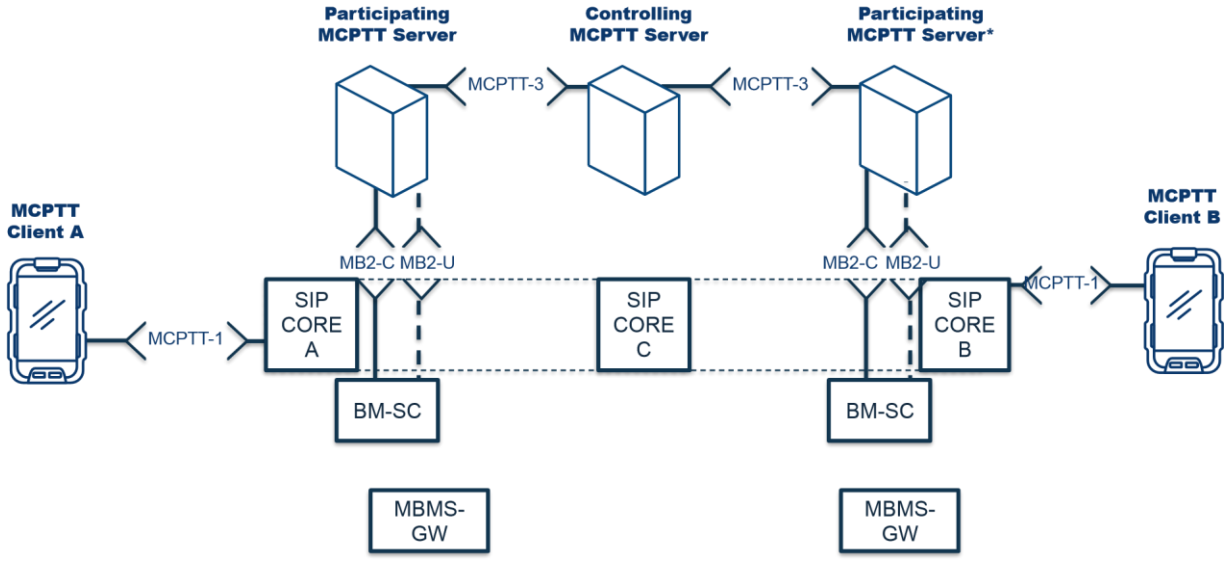

Figure 9. CFG_ONN_MULTI-MC-LTE-1 configuration

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_PRE_OTT Config_PRE_OTT Disp Config_PRE_IWF Config_PRE_InterMCX Config_INT_IWF Config_INT_Multicast Config_INT_4G
ONN-LTE	Config_A_MCX 4G Config_A_MCX 4G 2 Disp Config_A_MCX 4G Disp Config_C_IWF 4G Config_C_IWF 4G Disp Config_D_Inter MCX 4G Config_D_Inter MCX 4G Disp Config_E_Multicast
ONN-5G	Config_B_MCX 5G Config_B_MCX 5G 2 Disp Config_B_MCX 5G Disp Config_C_IWF 5G Config_C_IWF 5G Disp Config_D_Inter MCX 5G Config_D_Inter MCX 5G Disp Config_D_Inter MCX multiRAN

Table 14. Mapping of scenario architecture configurations and Plugtests event practical configurations

9 Interoperability Results

9.1 Overall Results

During the Plugtests event, a total of 112 Test Sessions were run: that is, 112 different combinations based on different configurations in Test Scope: MCX Client, MCX Server (Participating and Controlling), eNB, EPC, gNB, 5GC, LMR, Dispatcher, 4G UE, 5G UE, MBMS GW, BMSC and Testers were tested for interoperability. Overall, 356 test executions were conducted and reported interoperability and conformance results.

Table 15 and Figure 10 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.

Interoperability		Totals
PASS	**FAIL**	**Run**
328 (92.1 %)	28 (7.9 %)	356

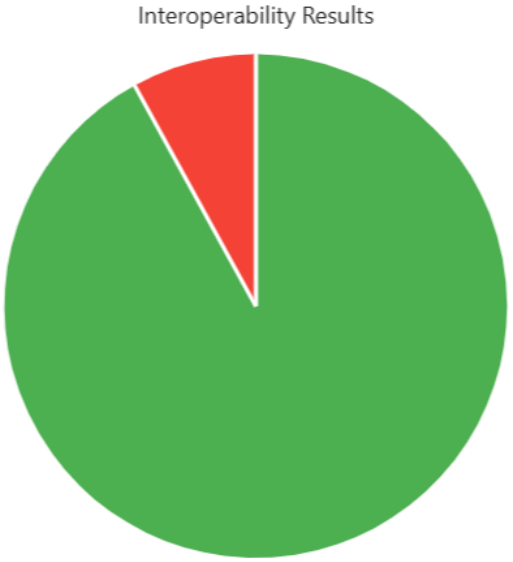

Figure 10. Overall Interoperability results based on executed testcases

A overall interoperability success rate of 92.1% was achieved, which indicates a good 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

Table 16 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				
Stream	**Configurations**	**PASS**	**FAIL**	**Run**
A	**Config_A_MCX 4G Disp**	146 (93.6%)	10 (6.4%)	156
A	**Config_A_MCX 4G**	15 (100.0%)	0 (0.0%)	15
A	**Config_A_MCX 4G 2 Disp**	0 (0.0%)	0 (0.0%)	0
B	**Config_B_MCX 5G Disp**	132 (90.4%)	14 (9.6%)	146
B	**Config_B_MCX 5G**	3 (100.0%)	0 (0.0%)	3
B	**Config_B_MCX 5G 2 Disp**	0 (0.0%)	0 (0.0%)	0
C	**Config_C_IWF 4G Disp**	2 (66.7%)	1 (33.3%)	3
C	**Config_C_IWF 4G**	4 (100.0%)	0 (0.0%)	4
C	**Config_C_IWF 5G Disp**	0 (0.0%)	0 (0.0%)	0
C	**Config_C_IWF 5G**	5 (100.0%)	0 (0.0%)	5
D	**Config_D_Inter MCX 4G Disp**	0 (0.0%)	0 (0.0%)	0
D	**Config_D_Inter MCX 4G**	0 (0.0%)	0 (0.0%)	0
D	**Config_D_Inter MCX 5G Disp**	0 (0.0%)	0 (0.0%)	0
D	**Config_D_Inter MCX 5G**	0 (0.0%)	0 (0.0%)	0
D	**Config_D_Inter MCX multiRAN**	0 (0.0%)	0 (0.0%)	0
E	**Config_E_Multicast**	21 (87.5%)	3 (12.5%)	24

Table 16. Results per Test Configuration

The table shows the execution and interoperability rates for different Test Configurations.

9.3 Equipment Integrations and Test Combinations

The following Figures Figure 11 to Figure 18 show the integrated equipments and test combinations for each test stream. The grey lines show the initially planned integrations before the remote pre-integration phase; the blue lines show the successful pre-integrations during the pre-integration phase which were done via the VPN connections; and the purple lines show the actual test combinations which were used for the tests during the Plugtests week.

Please note that the indicated combinations do not bear any information whether a specific test combination has passed or failed the test cases. It only shows which equipment was tested with which other equipment. The information is based on all TRT reports which were approved by all involved vendors latest a week after the Plugtests week.

Please note that due to a limitation of the TRT tool, for all test streams UEs were not reported in the TRT reports, hence no information about their involvement during the Plugtests week (purple lines) is shown. Information regarding used UEs is entirely based on vendor information outside of the TRT.

Greyed out equipment was registered for the test stream but was not involved in any test session in this stream.

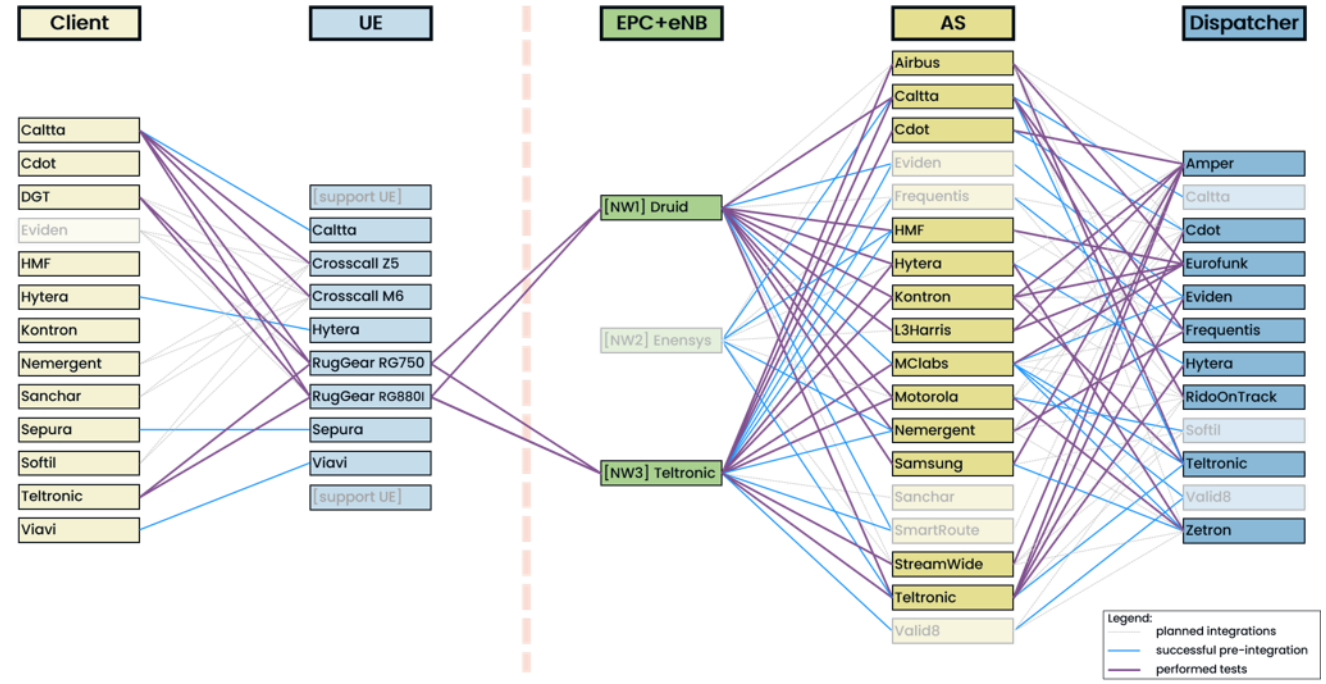

Figure 11. Tested Equipment for Stream A: MCX over 4G

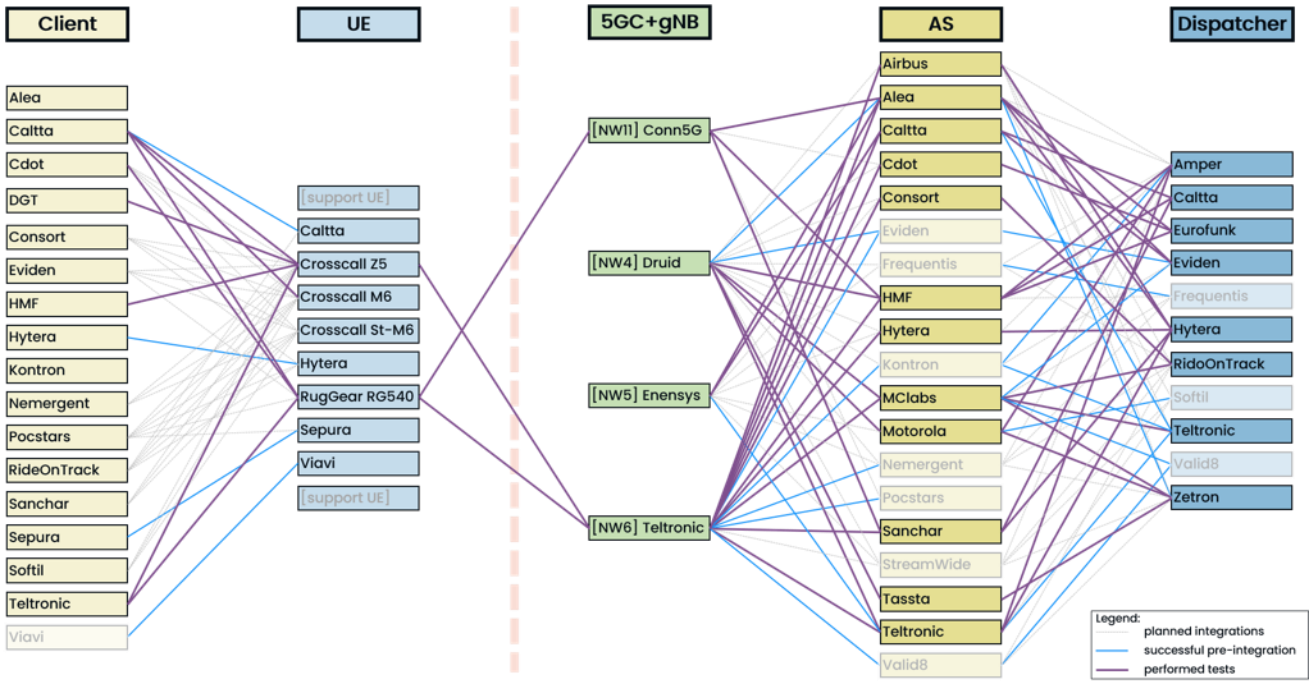

Figure 12. Tested Equipment for Stream B: MCX over 5G

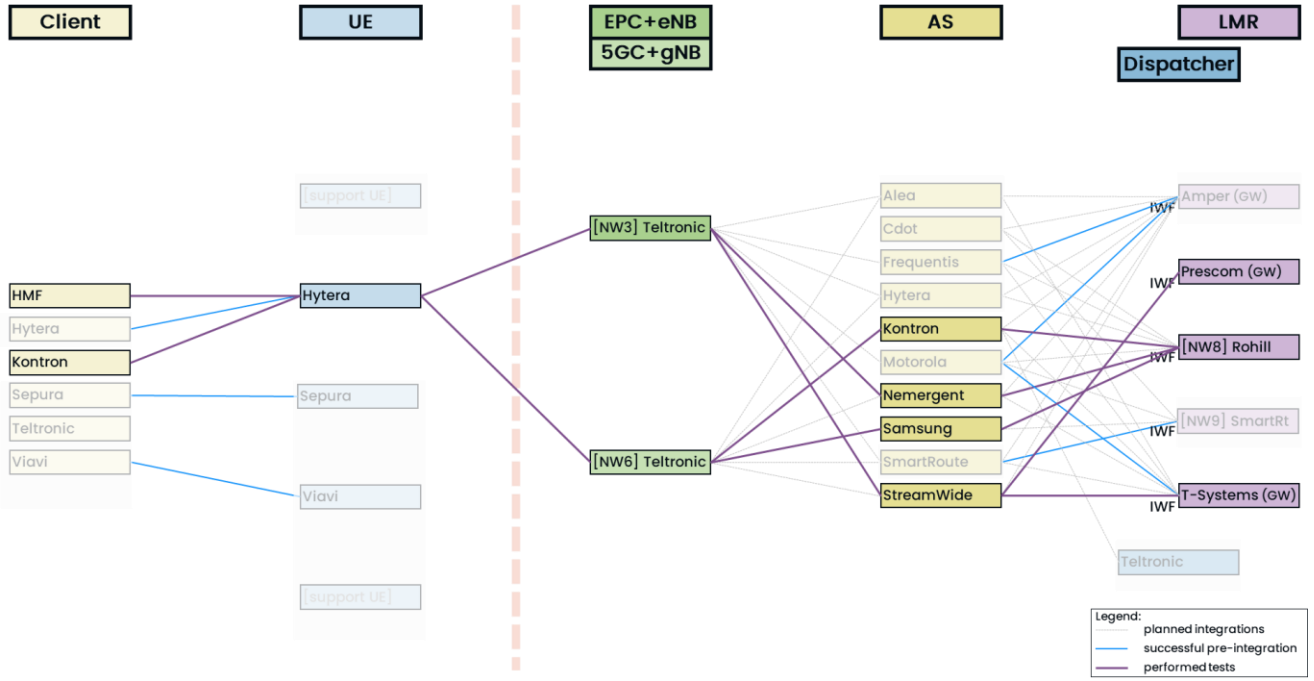

Figure 13. Tested Equipment for Stream C: Interworking Function (IWF)

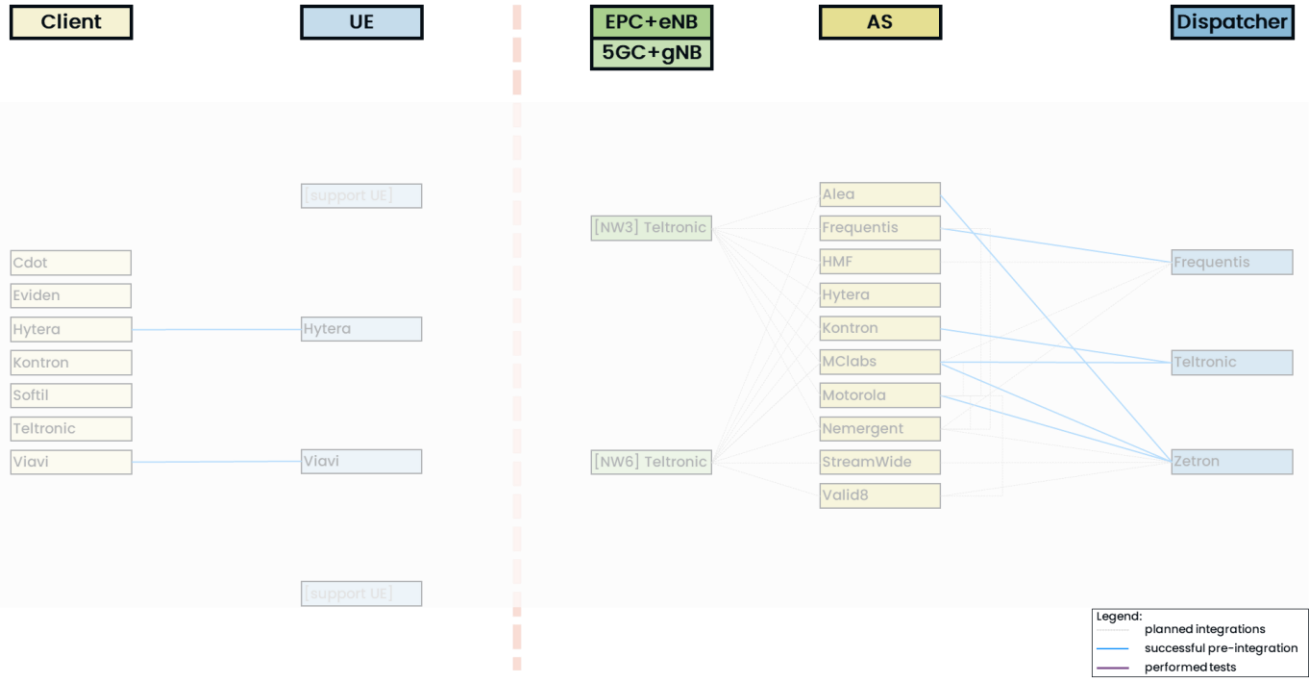

Figure 14. Tested Equipment for Stream D: Inter-MCX

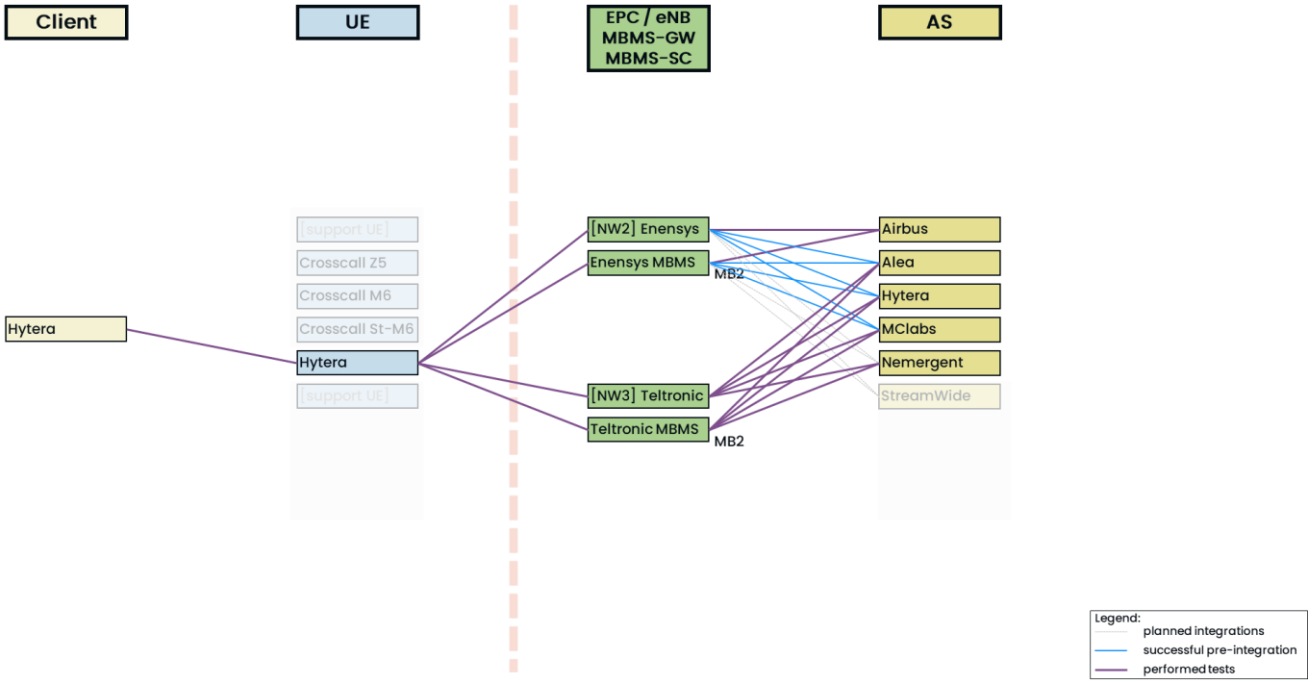

Figure 15. Tested Equipment for Stream E: Multicast - eMBMS

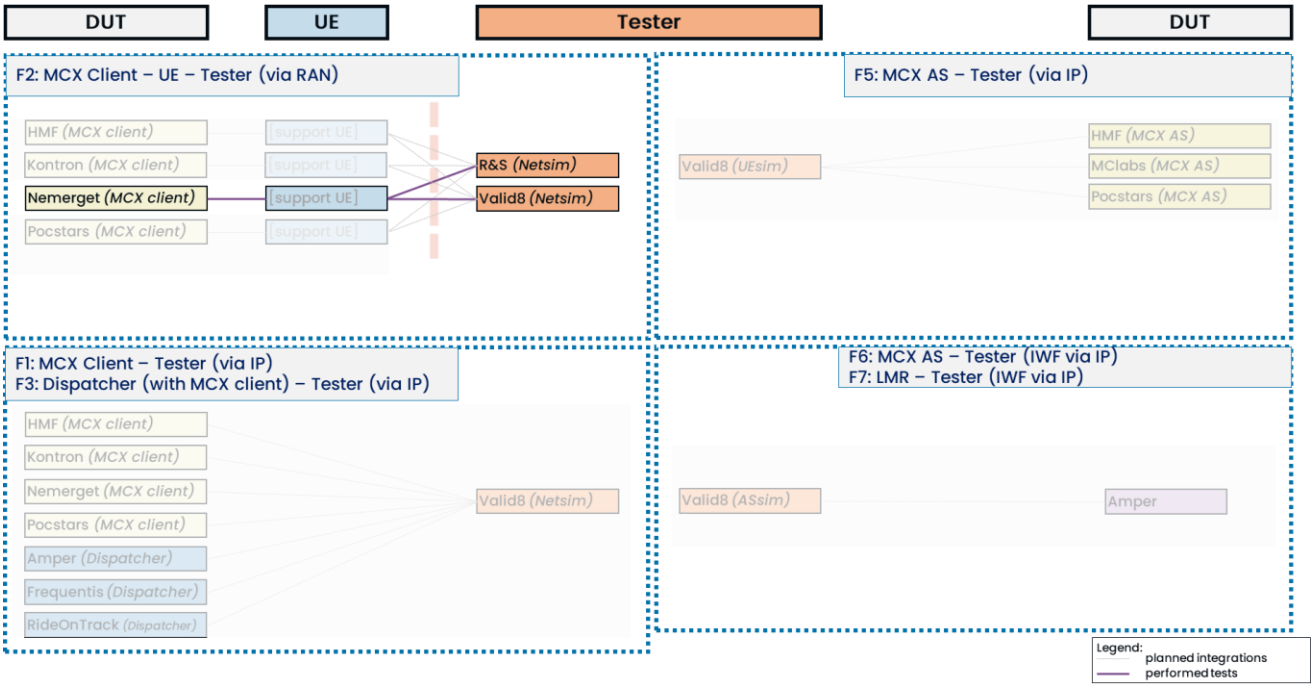

Figure 16. Tested Equipment for Stream F: Conformance Test Tools

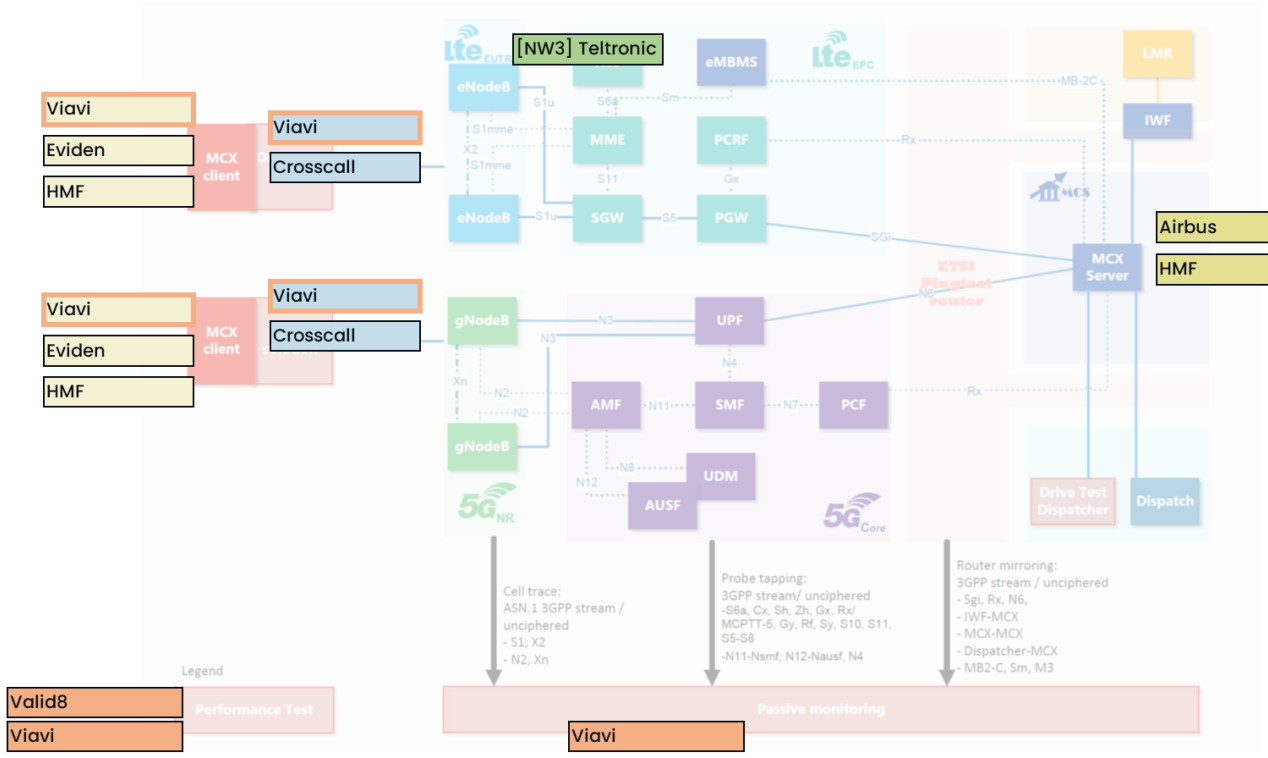

Figure 17. Tested Equipment for Stream G: Performance Test Tools

Figure 18 shows all client-server relations which were tested during the MCX#10 Plugtests in all Streams. This information cannot be shown in the above figures, hence is provided here for information. Please note that a shown relation only means that this specific client-server combination was tested, it does not give any information whether the tests have passed or failed.

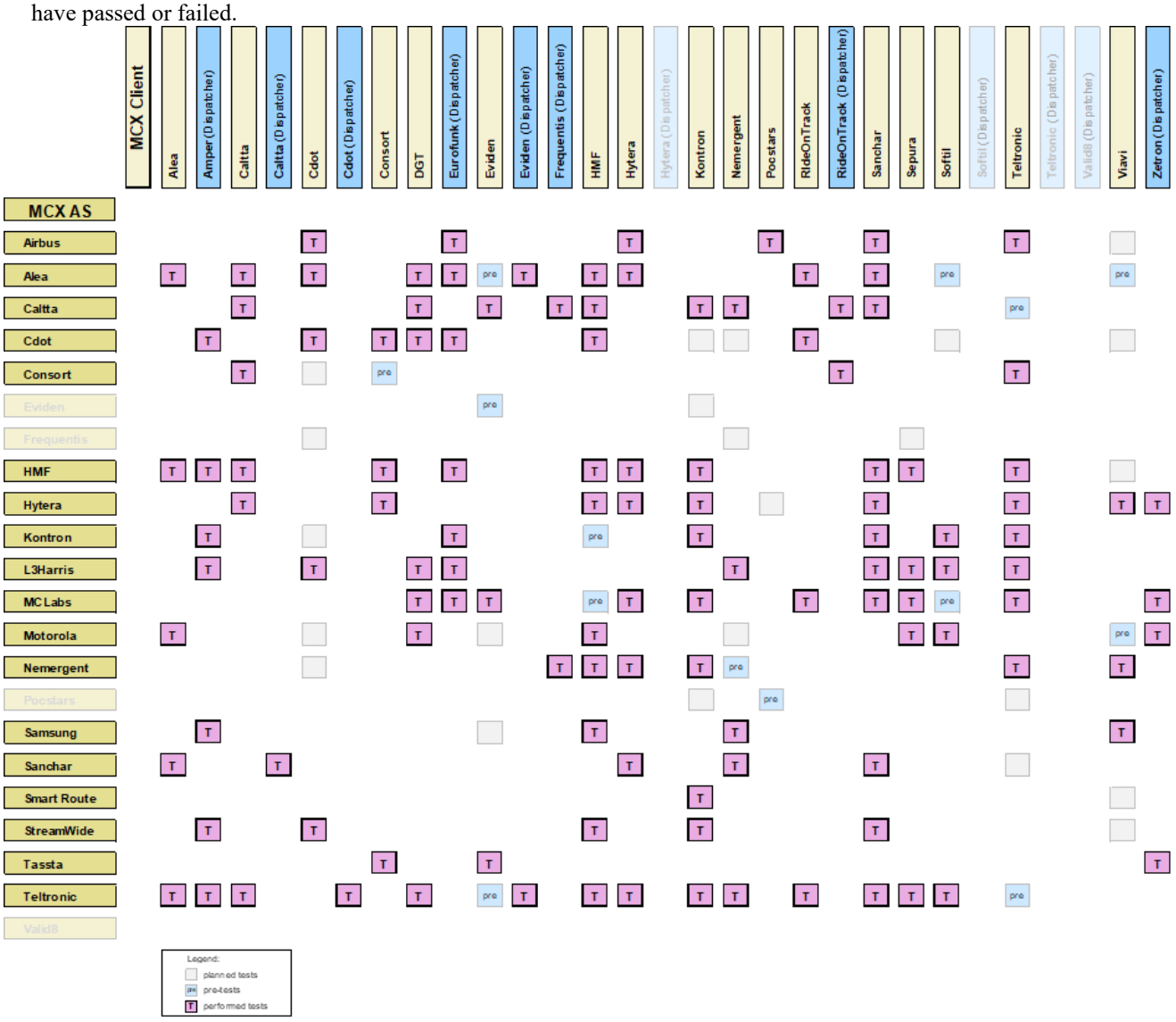

Figure 18. Client-Server Relations over all Streams

9.4 Results per Test Case

Table 17 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 [1].

Please note that for this MCX#10 Plugtests only a subset of all test cases from ETSI TS 103 564 were selected and could be executed by the vendors.

Interoperability		
TC #	**Pass**	**Fail**
7.2.149	0 (0.0%)	0 (0.0%)
7.2.150	0 (0.0%)	0 (0.0%)
7.2.151	0 (0.0%)	0 (0.0%)
7.2.152	0 (0.0%)	0 (0.0%)
7.2.153	0 (0.0%)	0 (0.0%)
7.2.154	0 (0.0%)	0 (0.0%)
7.2.155	0 (0.0%)	0 (0.0%)
7.5.2	19 (100.0%)	0 (0.0%)
7.5.4	0 (0.0%)	0 (0.0%)
7.5.5	3 (100.0%)	0 (0.0%)
7.5.8	3 (100.0%)	0 (0.0%)
7.5.10	12 (100.0%)	0 (0.0%)
7.5.12	2 (100.0%)	0 (0.0%)
7.5.14	2 (100.0%)	0 (0.0%)
7.5.16	1 (100.0%)	0 (0.0%)
7.5.18	1 (100.0%)	0 (0.0%)
7.6.2	0 (0.0%)	0 (0.0%)
7.6.3	4 (100.0%)	0 (0.0%)
7.6.4	1 (100.0%)	0 (0.0%)
7.6.5	0 (0.0%)	0 (0.0%)
7.6.6	0 (0.0%)	0 (0.0%)
7.6.7	2 (100.0%)	0 (0.0%)
7.6.8	0 (0.0%)	0 (0.0%)
7.7.10	13 (100.0%)	0 (0.0%)
7.8.4	9 (100.0%)	0 (0.0%)
7.8.5	5 (100.0%)	0 (0.0%)
7.8.6	9 (100.0%)	0 (0.0%)
7.8.7	5 (100.0%)	0 (0.0%)
7.8.8	9 (100.0%)	0 (0.0%)
7.8.9	5 (100.0%)	0 (0.0%)
7.8.10	8 (100.0%)	0 (0.0%)
7.8.11	6 (85.7%)	1 (14.3%)
7.8.12	0 (0.0%)	0 (0.0%)
7.8.13	3 (100.0%)	0 (0.0%)
7.8.14	4 (100.0%)	0 (0.0%)
7.8.15	0 (0.0%)	0 (0.0%)
7.8.16	3 (100.0%)	0 (0.0%)
7.8.17	3 (100.0%)	0 (0.0%)
7.8.18	4 (100.0%)	0 (0.0%)
7.8.19	0 (0.0%)	0 (0.0%)
7.8.20	3 (100.0%)	0 (0.0%)
7.8.21	0 (0.0%)	0 (0.0%)
7.8.22	2 (100.0%)	0 (0.0%)
7.8.23	2 (66.7%)	1 (33.3%)
7.8.24	1 (100.0%)	0 (0.0%)
7.8.25	0 (0.0%)	0 (0.0%)

7.8.26	0 (0.0%)	0 (0.0%)
7.9.9	3 (100.0%)	0 (0.0%)
7.9.10	0 (0.0%)	0 (0.0%)
7.9.11	0 (0.0%)	0 (0.0%)
7.12.1	0 (0.0%)	0 (0.0%)
7.12.2	0 (0.0%)	0 (0.0%)
7.14.1	5 (83.3%)	1 (16.7%)
7.14.2	4 (80.0%)	1 (20.0%)
7.14.3	0 (0.0%)	0 (0.0%)
7.14.4	4 (80.0%)	1 (20.0%)
7.14.5	0 (0.0%)	0 (0.0%)
7.14.6	0 (0.0%)	0 (0.0%)
7.14.7	0 (0.0%)	0 (0.0%)
7.14.8	30 (81.1%)	7 (18.9%)
7.14.9	8 (88.9%)	1 (11.1%)
7.14.10	33 (94.3%)	2 (5.7%)
7.14.11	0 (0.0%)	0 (0.0%)
7.14.12	3 (75.0%)	1 (25.0%)
7.14.13	0 (0.0%)	1 (100.0%)
7.14.14	0 (0.0%)	0 (0.0%)
7.14.15	0 (0.0%)	0 (0.0%)
7.14.17	1 (100.0%)	0 (0.0%)
7.14.18	1 (100.0%)	0 (0.0%)
7.14.19	0 (0.0%)	0 (0.0%)
8.2.1	4 (100.0%)	0 (0.0%)
8.2.2	2 (66.7%)	1 (33.3%)
8.2.3	4 (100.0%)	0 (0.0%)
8.2.4	2 (66.7%)	1 (33.3%)
8.2.5	0 (0.0%)	0 (0.0%)
8.2.6	0 (0.0%)	0 (0.0%)
8.2.7	0 (0.0%)	0 (0.0%)
8.2.8	0 (0.0%)	0 (0.0%)
8.2.9	0 (0.0%)	0 (0.0%)
8.2.10	0 (0.0%)	0 (0.0%)
8.2.11	0 (0.0%)	0 (0.0%)
8.2.12	0 (0.0%)	0 (0.0%)
8.2.13	0 (0.0%)	0 (0.0%)
8.2.14	0 (0.0%)	0 (0.0%)
8.2.15	0 (0.0%)	0 (0.0%)
8.2.16	0 (0.0%)	0 (0.0%)
8.2.17	0 (0.0%)	0 (0.0%)
8.2.18	0 (0.0%)	0 (0.0%)
8.2.19	0 (0.0%)	0 (0.0%)
9.3	12 (80.0%)	3 (20.0%)
9.4	3 (100.0%)	0 (0.0%)
9.5	1 (100.0%)	0 (0.0%)
9.6	2 (66.7%)	1 (33.3%)
9.7	0 (0.0%)	0 (0.0%)
9.8	9 (90.0%)	1 (10.0%)

9.9	0 (0.0%)	1 (100.0%)
9.1	6 (85.7%)	1 (14.3%)
9.11	29 (96.7%)	1 (3.3%)
9.12	0 (0.0%)	0 (0.0%)
9.13	1 (100.0%)	0 (0.0%)
11.2.1	1 (100.0%)	0 (0.0%)
11.2.2	2 (100.0%)	0 (0.0%)
11.2.3	0 (0.0%)	0 (0.0%)
11.2.4	0 (0.0%)	0 (0.0%)
11.2.5	0 (0.0%)	0 (0.0%)
11.3.1	2 (100.0%)	0 (0.0%)
11.3.2	0 (0.0%)	0 (0.0%)
11.3.3	0 (0.0%)	0 (0.0%)
11.3.4	2 (100.0%)	0 (0.0%)
11.3.5	0 (0.0%)	0 (0.0%)
11.3.6	0 (0.0%)	0 (0.0%)
11.3.7	0 (0.0%)	0 (0.0%)
11.3.8	0 (0.0%)	0 (0.0%)
11.3.9	1 (100.0%)	0 (0.0%)
11.3.10	0 (0.0%)	0 (0.0%)
11.3.11	0 (0.0%)	0 (0.0%)
11.3.12	0 (0.0%)	0 (0.0%)
11.3.13	1 (100.0%)	0 (0.0%)
11.3.14	0 (0.0%)	0 (0.0%)
11.3.15	1 (50.0%)	1 (50.0%)
11.3.16	0 (0.0%)	0 (0.0%)
11.3.17	0 (0.0%)	0 (0.0%)
11.3.18	0 (0.0%)	0 (0.0%)
11.3.19	0 (0.0%)	0 (0.0%)
11.3.20	0 (0.0%)	0 (0.0%)
11.3.21	0 (0.0%)	0 (0.0%)
11.3.22	1 (100.0%)	0 (0.0%)
11.3.23	0 (0.0%)	0 (0.0%)
11.3.24	0 (0.0%)	0 (0.0%)
11.3.25	0 (0.0%)	0 (0.0%)
11.3.26	0 (0.0%)	0 (0.0%)
11.3.27	0 (0.0%)	0 (0.0%)
11.3.28	0 (0.0%)	0 (0.0%)
11.4.1	0 (0.0%)	0 (0.0%)
11.4.2	0 (0.0%)	0 (0.0%)
12.2.2	0 (0.0%)	0 (0.0%)
12.2.3	0 (0.0%)	0 (0.0%)
12.2.4	0 (0.0%)	0 (0.0%)
12.2.5	0 (0.0%)	0 (0.0%)
12.2.6	0 (0.0%)	0 (0.0%)
12.3.2	0 (0.0%)	0 (0.0%)
12.3.3	0 (0.0%)	0 (0.0%)
12.3.4	0 (0.0%)	0 (0.0%)
12.3.5	0 (0.0%)	0 (0.0%)

12.3.6	0 (0.0%)	0 (0.0%)
14.2	3 (100.0%)	0 (0.0%)
14.3	3 (100.0%)	0 (0.0%)
14.4	0 (0.0%)	0 (0.0%)
14.5	0 (0.0%)	0 (0.0%)
14.6	0 (0.0%)	0 (0.0%)
7.5.6	0 (0.0%)	0 (0.0%)
7.2.1	0 (0.0%)	0 (0.0%)
7.2.39	0 (0.0%)	0 (0.0%)
7.2.56	0 (0.0%)	0 (0.0%)

Table 17. 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 MCX 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 Release 19 was considered for the tenth MCX Plugtests event.

The 10th 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 Observations

10.1.1 Unknown behaviour of the participating and targeted client when sending/receiving location reporting configuration

Clause 13.2.2 in 3GPPT TS 24.379 and 13.3.2.1 (both referenced from other sections) do not state the expected behaviour upon submission/reception of SIP MESSAGE for location reporting configuration.

10.1.2 Non explicit behaviour of the LMC when receiving LocationConfiguration notification

Clause 6.2.2.5.2 in 3GPPT TS 24.283 does not define how the LMC should answer to the LocationConfiguration POST from the LMS (204 assumed).

10.1.3 Typo or unclear behaviour upon reception of location notification request

Final steps of 6.2.2.7.2 in 3GPPT TS 24.283 have either a typo or an unclear behaviour. The yaml seems to define a 200 OK with the MCUELocation should be answered but instead the description refers to 6.2.2.8 for a POST.

"Upon receiving the HTTP POST request, the LMC shall: When the LMC receives that location request, then the LMC: 1) shall send a location report as specified in clause 6.2.2.8; and 2) shall reset the minimumReportInterval timer."

Additionally the need to add requestID to the request is only mentioned in 6.2.2.8.2 but not in 6.2.2.7.2.

10.1.4 No explicit 200 OK to the SIP MESSAGE location reporting configuration request

Clause 13.3.21 in 3GPPT TS 24.379 defines the behaviour of a MCPTT Client receiving a location reporting configuration request from the participating (either triggered by the participating itself or initiated by an authorized client). Although 200 OK could be considered as the default behaviour upon reception of a SIP MESSAGE this is not explicitly indicated (while is in the originating authorized client -> participating step).

10.1.5 Clarification of the authorization mechanism for location configuration request in step 7 c) i) in 13.2.2A

Step 7 c) seems to be extracted from 13.2.3.2 and might be updated indicating the authorization of the location reporting configuration, not location. It is not clear whether there is a single authorization for any location procedure and, additionally, clause 7.4 Location user configuration data document in TS 24.484 seems to be applicable to MCLoc (and not traditional location) only.

10.1.6 RequestId in MCLoc Request - Publish sequence

Step 1 in clause 6.2.2.8.2 "LMC reports to LMS using LocationReportPublish" in 3GPPT TS 24.283, indicates that the MCUELocation datatype shall include "a reportID attribute if the report was triggered by a location request, set to the value of the requestID attribute in the received request". However, only reportId is described in the API definition in yaml document and requestID should be added.

10.1.7 Value of MCVideo Transmission control specific data field ID

In 3GPP TS 24.581 "Table 9.2.3.1-1: Transmission control specific data fields" Video SSRC of the Transmitting User - Field ID 24 DEC does not equal to FieldID 00010111 BIN (23 dec).

10.1.8 Purpose of MCVideo transmission control timer T4 not clear

In 3GPP TS 24.581 clause 6.3.4.4.10 "Timer T4 (Transmission Grant) expired N times" states that the transmission control state machine "1. shall remain in the 'G: Transmit Taken' state". Apparently, this would lead to a loop of Transmission Granted messages to the client that already owns Transmission Grant. According to some vendor(s) the purpose of such a timer after reaching N expirations would need to be further clarified.

10.1.9 Value of the fmt attribute in media descriptions is not specified for general purpose MBMS subchannels

Media-fields (the "m=" lines) in the SDPs as defined in RFC8866 must contain a <fmt> subfield. The ABNF grammar included in section 9 of the same RFC clearly defines these subfields as mandatory.
Accordingly, for example section 4.3.3.1 of 3GPP 24.380 specifies that, for the media plane control channel, the value "MCPTT" is to be used for the fmt subfield.
General purpose MBMS subchannels are not media plane control channels, but the specifications do not define an fmt value to be used for them.

10.2 Technical constraints

10.2.1 Implementation issue due to the server endpoint in the LMC in MCLoc

Clause 6.3.2.4.2 in 3GPP TS 24.283 states that the LMS will notify the authorized user about other users' location information by sending HTTP POST message to the LMC using the notification URI received in the location information request, as specified in clause 7.2.5.2.2. So it means that LMC in a MCX client (i.e. in a mobile device) should need to expose an HTTP interface (a server). From a technical point of view this is both technically difficult (i.e. if protected privileged ports are to be used) and extremely unfriendly with NAT or firewalled scenarios.

11 Observer Program

The Observers contributed to the MCX#10 Plugtests in the definition of the scope and scenarios, in the Observer Pro- gram and for the Observer demo.

11.1 Preparation Phase

During equipment registration, interested vendors provided their intention to showcase during the observer demo. Test cases from ETSI TS 103 564 were used for the observer demo.

11.2 Observer Presentations

Observer presentation during MCX Plugtests event focused on the deployment plans and challenges of mission critical services.
The observer program provided a platform to the various stakeholders in the critical communication industry to discuss the progress of MCS technology. The speakers were from government organisations, operators, regulators, users, and associations, which provide updates on deployment plans in their respective countries, pilot projects and updates on standards.
The observer program was conducted for half a day on 19th May 2026. Some observers attended online. The speakers who presented the program are outlined in Table 18.
Presentations in the observer program and the Questions & Answers are available on the Plugtests WIKI.

Presentations included:

Moderator – Hans Petter Naper / Nkom - Tuesday 19th May 2026

Program	Name/Organisation	Allocated Time
Welcome and Agenda	Hans Petter Naper / NKOM	09:30
TCCA Update	Tero Pesonen / TCCA	09:40 - 10:00
Creation of ETSI TC CCS (EUCCS)	Junttila Kari / Erillisverkot	10:00 - 10:20
Status report Virve 2.0	Junttila Kari / Erillisverkot	10:20 – 10:40
Mission-Critical Network Model in Norway	Knut Baltzersen / Nkom	10:40 – 11:00
Coffee Break – 30 mins		
NATO / Defence Related Topics	Tero Pesonen / TCCA	11:30 – 11:50
GCF MCX Certification Update and Technology Roadmap	Asif Hamidullah / GCF	11:50 – 12:10
FirstNet MCX Roadmap	Charles Hardnett / FirstNet	12:10 – 12:30
TAK/MCX Demo	Softil / Alea	12:30 - 13:00
Lunch - 13:00 to 14:00		

Table 18. Observer Program

11.3 Observer Round Table Discussion

Observer round-table discussions were organised on 20th May 2026 during the MCX Plugtests event, which focused on sharing ideas and strategies for testing mission-critical networks and the ecosystem.

Some of the topics discussed during the roundtable discussion are:

- RAN parametrization
- Slicing challenges in rural areas
- New Nodnett

11.4 Observer Demos

The Observer Demo allowed vendors to present their solutions and features to the observers.

During the Plugtests preparation phase the observers defined a number of topics which they would like to see in the demos. These topics are listed in Table 19.

Topics No.	Topic
1	Location (LOC)
2	Interoperability Scenarios (IOP)
3	IWF - MCPTT calls
4	Inter-MCX (IMCX) - MCPTT and Video
5	CALLOUT [COUT]
6	Many parallel ongoing group calls
7	Performance Testing

Table 19. Observer Demo Topics

The demos took place on the 21th of May 2026. The demos which are shown in Table 20 were presented:

MCX#10 Plugtests Observer Interop Demos

21 May 2026, 9:30-16:00

Time Slot#	Date	Time	Other vendors may watch	Observers without NDA may watch	Demo#	Topic	Airbus	Alea	Amper	Crosscall	Druid	Enensys	Eurofunk	Eviden	Frequentis	HMF	Hytera	Kontron	MCLabs	Motorola	Nemergent	RideOnTrack	Rohill	Samsung	Smart Route	Softil	StreamWide	Teltronic	T-Systems	Valid8	Viavi	Zetron
T01	21.May.26	09:30 – 09:50	N	Y	#15	1				X				X					X			X						X				
T02	21.May.26	09:55 – 10:15	N	Y	#13	2				X				X				X								X		X				
T03	21.May.26	10:25 – 10:45	N	Y	#05	2				X							X		X										X				
T04	21.May.26	10:50 – 11:10	Y	N	#01	3				X	X									X						X			X			
T05	21.May.26	11:20 – 11:40	Y	Y	#04	3			X		X														X							
T06	21.May.26	11:45 – 12:05	Y	Y	#11	3					X					X							X	X								X
T07	21.May.26	12:15 – 12:35	Y	N	#14	4				X	X				X					X	X					X						
T08	21.May.26	12:40 – 13:00	N	Y	#02	5				X	X		X			X										X					X	
T09	21.May.26	14:00 – 14:20	Y	Y	#06	7													X									X		X		
T10	21.May.26	14:25 – 14:55	N	Y	#03	7				X		X			X						X										X	
T11	21.May.26	15:00 – 15:30	N	Y	#09	7	X		X	X	X	X	X		X	X					X						X	X			X	
T12	21.May.26	15:40 – 16:00	Y	Y	#12	oos		X		X	X															X						

Table 20. Observer Demos

12 Interoperability Implementation Guide

The MCX and FRMCS Plugtests test case document (ETSI TS 103 564) specifies interoperability tests with the purpose of supporting those series of events. It therefore follows ETSI Interoperability best practices, including the identification of requirements specific methods, techniques and tools to be used, the naming conventions including test components and test purposes, the definition of test purposes, among others.

As part of the testing methodology, whenever an ambiguity or gap in the standards is identified a so-called observation is collected and conveyed to the relevant working group in the standardisation organisation for clarification. However, even with a common understanding of the interfaces and standards to be evaluated during the

interoperability tests, some practical or implementation questions arise that may have an impact into not only the interoperability testing carried out during the Plugtests themselves but also while deploying MCX systems in multivendor scenarios. The following list summarises some of the findings during the 10th MCX Plugtests.

Handling of SIM cards. Due to the large number of participants, multiple 4G EPC and 5G Core providers, and the seven test streams (A through G), the number of SIM cards and the eventual need to swap them for different test sessions depending on the number of UEs available per MCX client vendor demand a careful handling and tracking by the participants. The deployment of three 4G networks (Bands 38/40) and four 5G networks (Band 78) further increased the complexity of SIM card management. Although no issues or complaints were finally reported to the ETSI team, a unified or systematic approach for the abovementioned handling is deemed useful.

Need for frequency management. The deployment of multiple 4G and 5G radio equipment across seven networks required a proper management of the spectrum to be used, requesting the proper permission from ARCEP (the French spectrum regulator) and coordinating in specific frequency bands, namely Bands 38, and 40 for 4G and Band 78 for 5G.

Usage of specific test-related PLMN IDs. Some commercial devices either ban or already have an OEM hard-coded configuration for test PLMN IDs (such as 001 01). This was announced in advance but, anyway, some EPC and 5GC providers decided to change the typical configuration to prevent any problems during the face-to-face event. Unique PLMN IDs should be used for each 4G or 5G network present in the Plugtests and support of these PLMN IDs must be supported by the UEs.

Provisioning information. In the internal WIKI page for the 10th MCX Plugtests specific provisioning information was shared to help the interoperability and reduce the preparation needed for every test session, including PLMN IDs to be used, details for the domains/realms, Application Server information, and conventions for SIP/IMS and MCX identities and functional aliases. However, the availability of bootstrapping mechanisms, the usage of Managed Objects (MOs) according to ETSI TS 124 383 or the adoption by the vendors of off-line (i.e. using MDM/OTA/TP or any other) automated provisioning method is not homogeneous in vendor implementations, making the final configuration mechanism mostly manual and therefore slow and error prone, consuming a non-negligible part of the test sessions, especially in those involving multiple clients and/or servers.

Role of the SIP/IMS cores and SIM cards. Similarly to the previous, the usage of SIM based authentication and derivation of SIP identities and realms from the ISIM within the physical SIM card for SIP registration and IMS-AKA based authentication is still not available in many MCX clients/UE vendors. Similarly, the automated discovery of P-CSCF from the 4G or 5G network signalling was not used. Instead, manual configuration for every SIP/IMS core registrar server was needed, leading again to delays.

MTU and fragmentation issues. The testing setups typically involve connecting to components in different networks (4G, 5G, Ethernet, VPN) even remotely through the ETSI HIVE, with different MTU sizes. Since there is no agreed PMTU discovery mechanism in place and sometimes the MCX components do/can not properly control the Don't Fragment (DF bit) capabilities in IP datagrams there typically appear hard-to-troubleshoot connectivity issues. Although such issues were also announced and reminded to the participants it was still present during the event.

13 History

Document history		
V0.0.0	28/May/2026	First Draft
V0.0.1	29/May/2026	Draft
V0.0.2	01/June/2026	Stable Draft
V0.0.3	02/June/2026	Stable Draft
V1.0.0	08/June/2026	Final Draft Published