



**5th NG112 Emergency Communications Plugtests;
Remote event;
23 January - 3 February 2023**



Keywords

Testing, Interoperability, NG112

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1 Executive Summary

ETSI, in partnership with EENA (the European Emergency Number Association), has organized the fifth NG112 Emergency Communications Remote Plugtests™ event. This event was held remotely, from 23 January to 3 February 2023.

The aim of the event was to trial independently and jointly all components of the 112 communication chain based on Next Generation networks. Different topics were addressed, including Location Based Emergency Call Routing, Policy Based Emergency Call Routing, Next Generation Media Types and interconnecting different ESInet deployments.

Seven organizations from Europe, and North America, had the opportunity to connect their equipment to the test infrastructure and validate the interoperability and conformity of their market solutions using different scenarios from their own labs. In addition, five organizations participated as observers. In total, 12 organizations were involved in the Plugtests.

The scope of the event included content-rich emergency calling, location- and policy-based routing and secure transport via TLS. Participants put their products to the test, gaining valuable insights from experiencing a variety of scenarios. Tested technologies included Unified Communication (UC) and Advanced Mobile Location (AML).

The event was used to validate the standard 'Core elements for network independent access to emergency services, ETSI TS 103 479'. This standard was published in June 2019 and a revised version will be published soon.

The results of the tests show that the NG112 technology is mature and that a large number of vendors provide the various elements of the NG112 equipment chain and that those elements interoperate with each other. Thus providing a large choice of innovative products to build next generation emergency communication solutions. With the technical foundation of ETSI TS 103 479 and its accompanying standards, the conditions for procurement and deployment are reached.

2 References

The following base specifications were validated in the Plugtest.

- [i.1] Emergency Communications (EMTEL); Core elements for network independent access to emergency services, ETSI TS 103 479; to be published in June 2019
- [i.2] Emergency Communications (EMTEL); Advanced Mobile Location for Emergency Calls, ETSI TS 103 625; to be published in June 2019
- [i.3] Emergency Communications (EMTEL); Total Conversation Access to Emergency Services, ETSI TS 101 470, June 2012.
http://www.etsi.org/deliver/etsi_ts/101400_101499/101470/01.01.01_60/ts_101470v010101p.pdf
- [i.4] Emergency Communications (EMTEL); Total Conversation for Emergency Communications, Implementation Guidelines, ETSI TR 103 201, March 2016.
http://www.etsi.org/deliver/etsi_tr/103200_103299/103201/01.01.01_60/tr_103201v010101p.pdf

- [i.6] 3GPP. TS 22.173: IP Multimedia Core Network Subsystem (IMS) Multimedia Telephony Service and Supplementary Services; Stage 1, Version 9.4.0, December 2009.
- [i.7] 3GPP. TS 23.167: IP Multimedia Subsystem (IMS) Emergency Sessions, Version 9.3.0, December 2009.
- [i.8] 3GPP. TS 24.229: IP Multimedia Call Control Protocol Based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP), Stage 3, Release 11, Version 11.4.0, June 2012
- [i.9] Emergency Communications (EMTEL); Conformance test specifications for NG112, ETSI TS 103 659; to be published in March 2019
- [i.10] Emergency Communications (EMTEL); Interoperability testing of core elements for network independent access to emergency services, ETSI TS 103 480; to be published in March 2019
- [i.12] Summary of all test resources at <https://forge.etsi.org/gitlab/emergency-communications/NG112>

3 Abbreviations

AML	Advanced Mobile Location
BCF	Border Control Function
ECRF	Emergency Call Routing Function
ELS	Emergency Location Service
ESInet	Emergency Services IP Network
ESRP	Emergency Services Routing Proxy
GW	Gateway
HELD	HTTP-Enabled Location Delivery
HTTP	Hyper-text Transfer Protocol
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IUT	Implementation Under Test
IVS	In-Vehicle System
LIS	Location Information Server
LoST	LoST: A Location-to-Service Translation Protocol
MNO	Mobile Network Operator
mTLS	Mutual TLS
NGCS	Next Generation Core Services
PSAP	Public Safety Answering Point
RFC	Request For Comments
SDP	Session Description Protocol
SIP UA	Session Initiation Protocol User Agent
SMS	Short Message Service
TLS	Transport Layer Security
TS	Technical Specification
UC	Unified Communication
UE	User Equipment

4 Participants

28 people including EENA (European Emergency Number Association) and the technical experts participated in the 5th NG112 Emergency Communications Plugtests™ event. They were supported by an additional five-member ETSI team.

Participating organizations in the Plugtests who signed the Rules of Engagement (RoE) and Non-Disclosure Agreement (NDA) are listed below:

Organization name	Category
AGEXIMCO	Observer
ATOS	Vendor
Cestel	Vendor
EENA (European Emergency Number Association)	Observer/Partner
Frequentis	Vendor/Technical expertise
Greater Copenhagen Fire Department (Hovedstadens Beredskab I/S)	Observer
GridGears GmbH	Vendor/Technical expertise
Intersys AG	Vendor
Microsoft	Vendor
Ministère de l'Economie et des Finances	Observer
Oracle	Vendor
SS8 Networks	Observer

Table 1: List of organizations

5 Scope of the event

5.1 Objectives

Main objectives of this event were to:

- validate the interoperability of different solutions on the market on end to end emergency communication utilizing next generation core services (NGCS)
- provide an opportunity for developers from different companies to get together to test their implementations and ensure interoperability between products
- evaluate the level of conformance of several implementations to interface specification (RFCs, TS, ...)

To validate interoperability the following features or services were considered for testing scenarios (a schematic overview of the test infrastructure is shown in Fig. 1):

- location conveyance (value and reference)
- location and policy based routing

- AML/ELS integration (SMS)
- secure transport (certificates and mutual authentication)
- ESInet peering options
- roaming scenarios

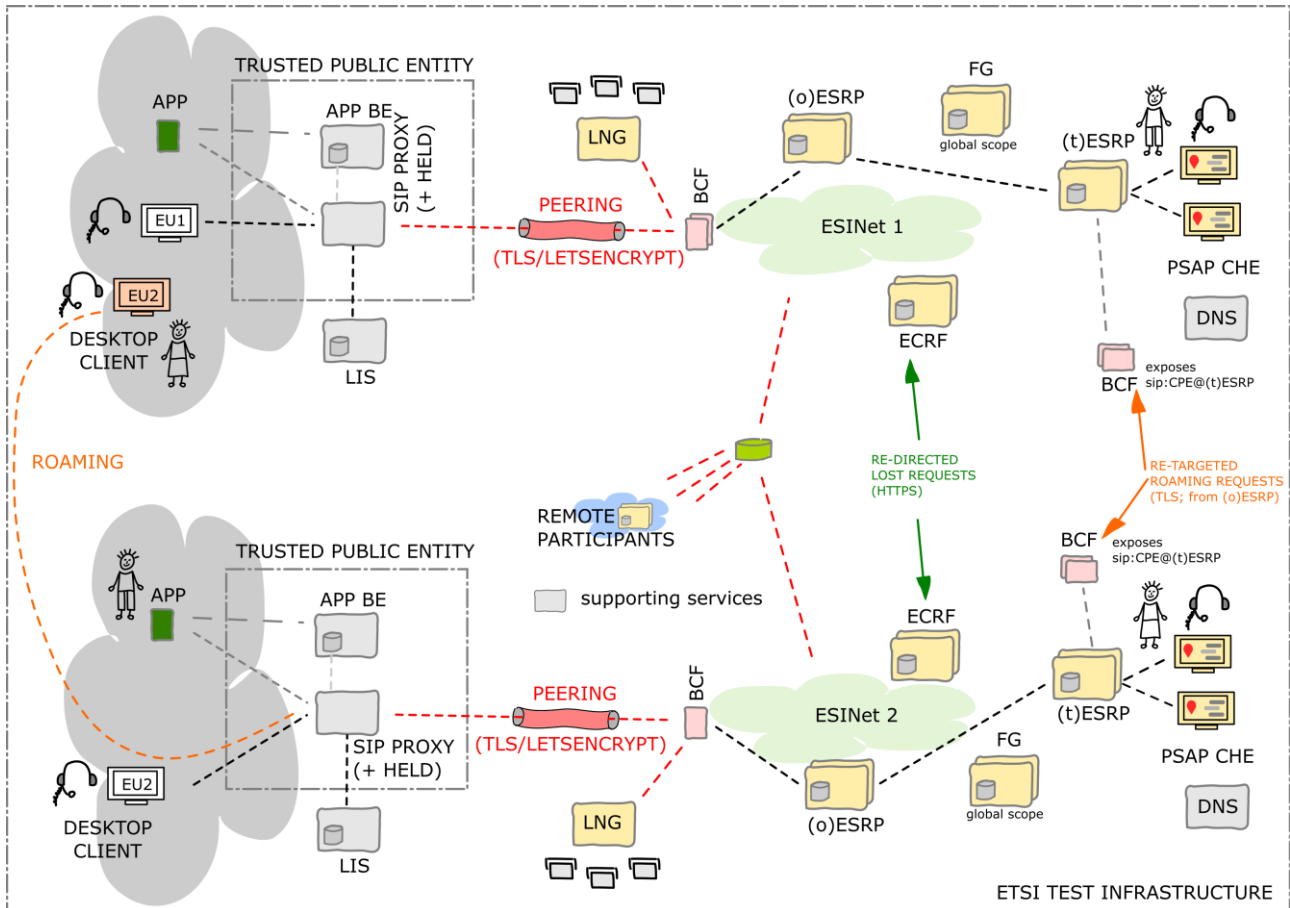


Figure 1: Test infrastructure (ESInet 1 & 2)

5.2 Description

In this event five groups of tests considering different scenarios and test cases (examples: location based call routing, accessibility, different types of originating networks) were performed:

- **Generic:** basic testing (audio, Location By Value (LbV), Location By Reference (LbR))
- **mTLS:** mutual authentication (valid, invalid certificates)
- **Policy:** retargeting based on time of day and SIP header fields
- **Peering:** ESRP (ESInet 1) to ESRP (ESInet 2) & ESRP (ESInet 1) to BCF/access IF (ESInet 2)
- **AML:** location updates and PSAP rebid (via HELD POST / GET location request)

5.3 NG112 Emergency Communication

5.3.1 General

As in the previous editions of the NG112 Communications Plugtest event, the NG112 components and their interfaces, as shown in Figure 1, of different vendors were tested working together. Scenarios and vendors combinations were planned and tests were executed.

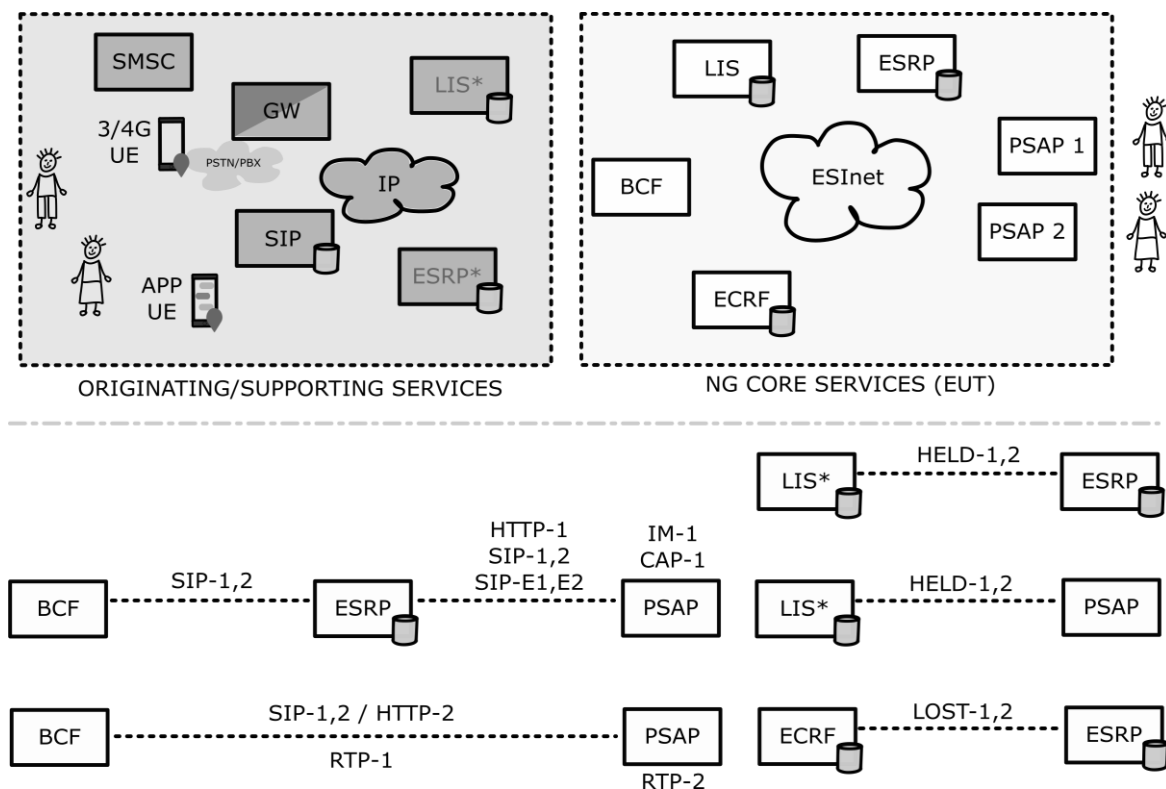


Figure 2: Functional elements and interfaces (refer to ETSI TS 103 479 [i.1])

The objectives of the tests were:

- **Connectivity:** Tests covered basic connectivity between functional elements at both, network and application layer
- **Routing:** Tests covered variants of location based emergency call routing. These included different methods how user location is assessed and how this information is delivered
- **Media:** Tests covered media types in order to contact emergency services
- **Location:** Tests covered variants of location configuration and conveyance methods such as advanced mobile location (AML)
- **Peering:** Tests covered ESInet peering in different configurations

Testing several scenarios required creating simple polygons that define PSAP areas (or service boundaries) surrounding the ETSI building. Figure 3 shows twelve polygons (rectangles) and predefined locations, three for each PSAP service boundary (2x point, 1x circle). ECRFs were configured with PSAP service areas (refer to Fig. 4) and SIP URIs that represent a PSAP vendor's call processing equipment. LIS' were preconfigured with locations (pin icons in Figure 3). For instance, <sip:alice-01@plugtests.app> resolves to a location within the top-left PSAP (area shown in Figure 3) and therefore calls originated by alice-01 shall route to the PSAP configured for that region.

To support ESInet 1 and 2, service boundaries were separated as illustrated in Figure 4. In total 48 locations (4 per service area) were available for testing: ALICE01, BOB01, CAROL01, DAVE01, ALICE02, ... with ALICExx and BOBxx as point, CAROLxx as circle, and DAVExx as civic location.

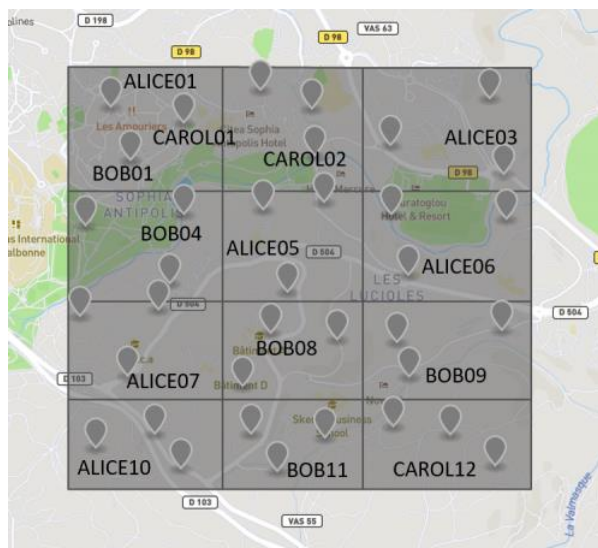


Figure 3: Pre-configured test locations and SIP identities (source: geojson.io)

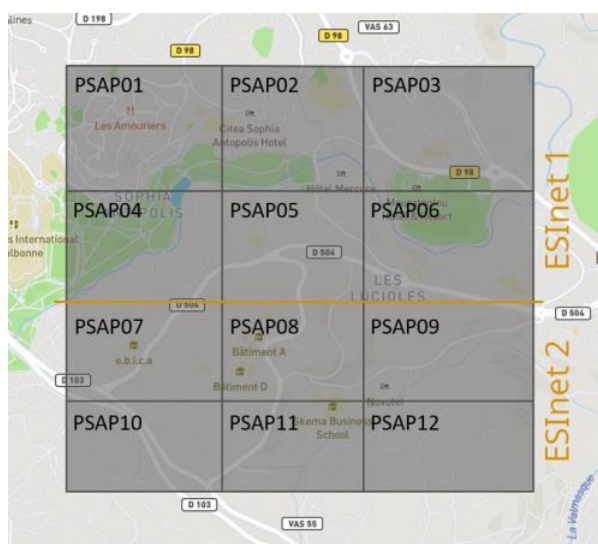


Figure 4: PSAP regions, split in ESInet 1 and ESInet 2 (source: geojson.io)

5.3.3 Test Tools

To simplify remote testing and to be able to perform simple tests without an originating device as part of a test scenario, a new tool (also known as RoboDialer) was used to trigger emergency communication. This tool can be operated via the command line with curl or via the web browser or *links* (see Figure 5). To trigger a call, the following attributes are required:

- **service=112|911**; used to set proper service URNs
- **caller=a2** (sip:alice-02@plugtests.app); used to define the location used for testing
- **bcf=vendor_1**; used to select the BCF (can be omitted)
- **esrp=vendor_2**; used to select an ESRP (indicated in a pre-loaded route-set)

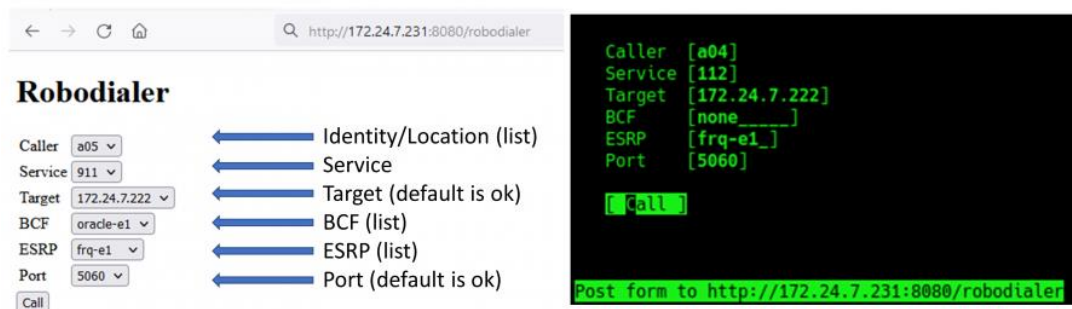


Figure 5: RoboDialer (Web UI and CL Tool)

5.3.4 Configurations

Different test configurations were used to test interoperability among different service instances from different vendors. The basic configuration, as briefly shown in Figure 6 below, supports Next Generation Core Service (NGCS) testing scenarios, including scenarios with different service urns (URN), multimedia communication (audio, video and text) and location delivery using identities (sip and tel URIs). Most test calls were placed from local user equipment (UE) configured to register one of the predefined identities with a SIP proxy. Depending on the emergency numbers dialled, the SIP proxy forwarded calls to the border control function (BCF) inserting the corresponding service URN (urn:service:sos).

BCFs used static routing to forward calls to the ESRP used in specific scenarios or combinations. To route to the correct PSAP based on the location received or requested at the LIS via HELD, the ESRP was requesting routing information at the configured ECRF, and finally forwarded the emergency call to the PSAP serving the location at which the caller is located.

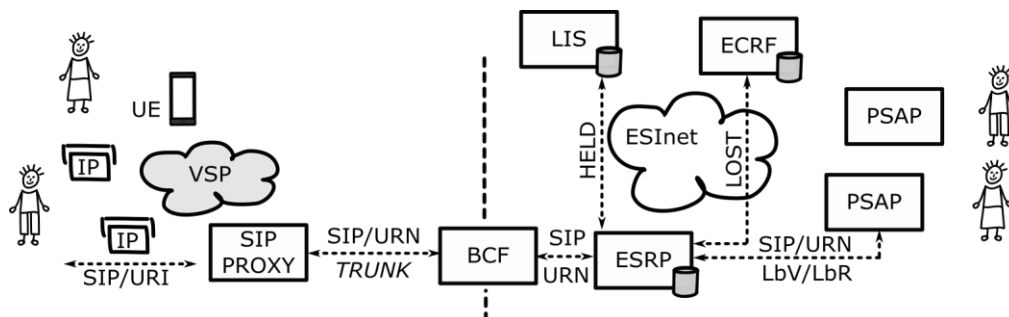


Figure 6: General NGCS Configuration

Testing AML required to interface with a mobile network operator (4G) using a location independent phone number, VoIP gateway (GW) services of a public VoIP service provider and a termination point within the lab, refer to Figure 7 below.

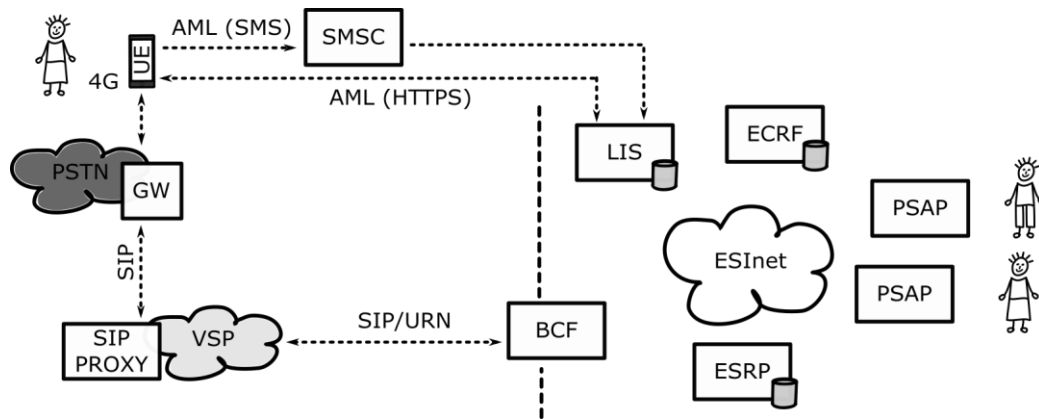


Figure 7: AML Test Configuration

Minor changes to the basic configuration were needed to support location by reference (LbR) testing. In that scenario, the *public* SIP proxy requested location information at the LIS using the identity (tel or sip URI) received with the emergency call as depicted in Figure 8. The response in a LbR scenario is an URL to be inserted in the SIP request as Geolocation header value. The next downstream element that requires location information uses the URL to dereference location information via HTTPS.

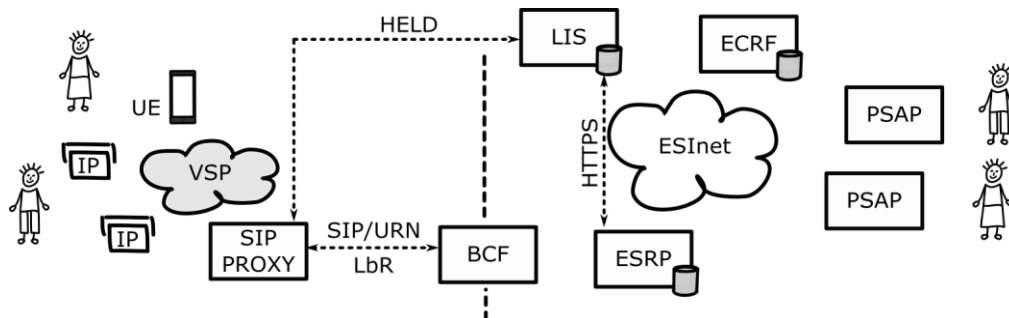


Figure 8: Location by Reference (LbR) Test Configuration

To test location by value, the *public* SIP proxy only forwarded calls by inserting a service URN, and the ESRP requested location information at the LIS using the identity (tel or sip URI) received with the emergency call as depicted in Figure 9. In addition the ESRP inserted location information as value (PIDF-LO) into the SIP message as part of a multipart MIME body. The next downstream element that requires location information (e.g. PSAP) uses the location received in the message.

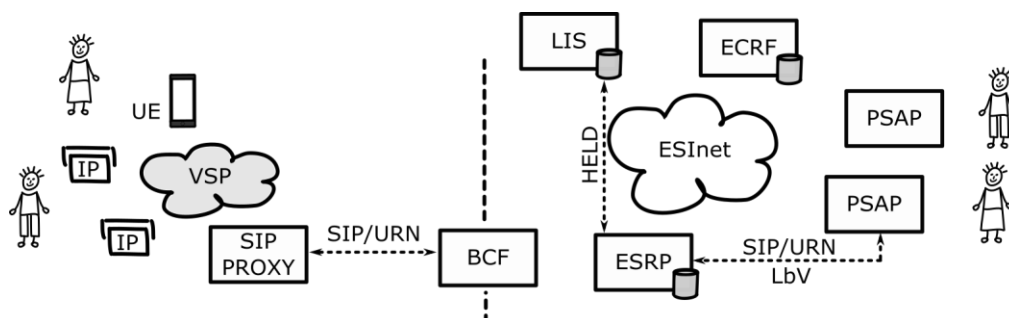


Figure 9: Location by Value (LbV) Test Configuration

Basic steps to test calls were: registering an UE using a specific identity (to get a location), dialing an emergency number, and setting up audio, or multimedia calls.

Using subnetting, it was possible to use the networks connected via VPN for two different ESInet configurations. IP addresses for NGCS were defined for ESInet 1 in the lower address range and for ESInet 2 in the upper address range. In the course of the tests, two peering variations were tested. Figure 10 shows a variant in which the BCF of ESInet 2 was used for routing, and Figure 11 shows a direct peering with the ESRP of ESInet 2. In order to test both variants, ECRF data were adapted accordingly.

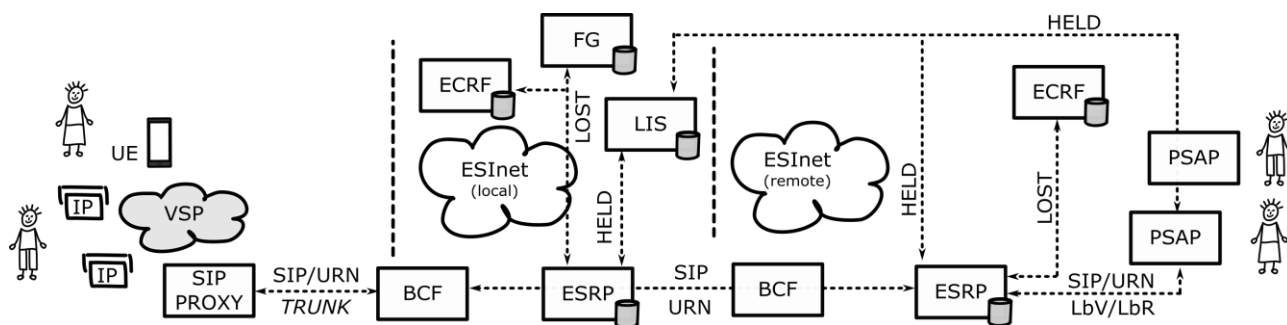


Figure 10: ESInet Peering variant 1

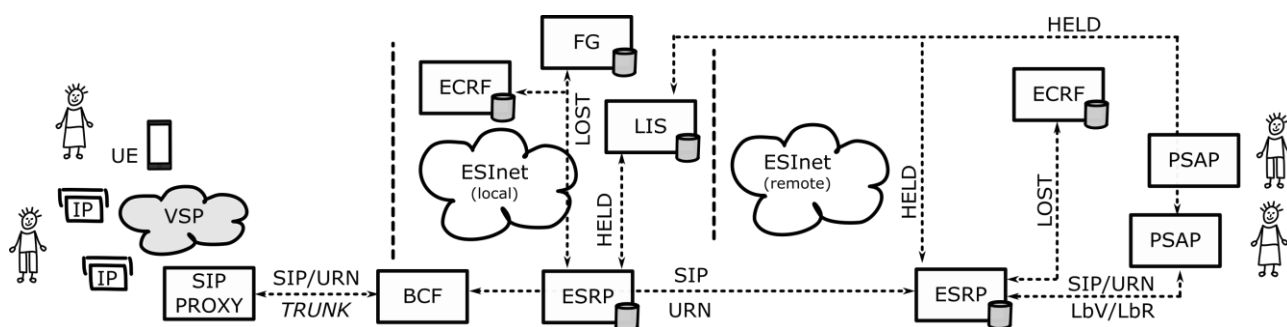


Figure 11: ESInet Peering variant 2

6 Achieved Results

6.1 NG112 Interoperability Testing Results

6.2.1 General Observations

- PSAPs and ESRPs can handle Location by Reference and by Value
- BCFs performed successful interoperability with all originating and terminating networks or systems
- All location boundaries were respected by the ECRFs and routed correctly by the ESRPs to the appropriate PSAPs
- Location provided by the LIS or by the end devices via AML was used successfully
 - Calls via a public operator using AML were successful (SMS) using ELS Manager application
- Emergency calls were successfully originated from Public VoIP network
- Signaling and media interoperability with ESInet functional elements achieved
- SIP-based audio calls connected with all PSAPs
- NG eCall (initially planned) could not be tested due to the lack of IVS vendors
- ESInet peering concepts successfully tested
 - Roaming scenarios and LoST hierarchy
- Successful use of custom certificate authority issuing certificates for testing mTLS (SIP and HTTPS)
- Policy routing (time or header value) successfully tested

- In general, TS 103 479 basic features were successfully validated; future events shall focus on advanced features

6.2.2 Statistics

Overall results considering configurations as introduced in 5.3.4

Table 2: Overall Results

Interoperability		Not Executed		Totals	
OK	NO	NA	OT	Run	Results
55 (100.0%)	0 (0.0%)	31 (36.0%)	0 (0.0%)	55 (64.0%)	86

Group results considering groups as introduced in 5.2

Table 3: Group Results

	Interoperability		Not Executed		Totals	
	OK	NO	NA	OT	Run	Results
Generic	24 (100.0%)	0 (0.0%)	12 (33.3%)	0 (0.0%)	24 (66.7%)	36
Peering	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)	4
AML	2 (100.0%)	0 (0.0%)	1 (33.3%)	0 (0.0%)	2 (66.7%)	3
Policy	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)	4
mTLS	21 (100.0%)	0 (0.0%)	18 (46.2%)	0 (0.0%)	21 (53.8%)	39

Test results considering individual scenarios based on configurations as introduced in 5.3.4.

Table 4: Test Results

	Interoperability		Not Executed		Totals	
	OK	NO	NA	OT	Run	Results
LOC_LBV_01	2 (100.0%)	0 (0.0%)	10 (83.3%)	0 (0.0%)	2 (16.7%)	12
LOC_LBR_01	10 (100.0%)	0 (0.0%)	2 (16.7%)	0 (0.0%)	10 (83.3%)	12
LOC_AML_01	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1
LOC_AML_02	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
LOC_AML_03	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1
MME_AUD_01	12 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	12 (100.0%)	12
POL_TAD_01	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
POL_SIP_01	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
PER_SIP_01	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
PER_SIP_02	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
TLS_SIP_01	3 (100.0%)	0 (0.0%)	2 (40.0%)	0 (0.0%)	3 (60.0%)	5
TLS_SIP_02	4 (100.0%)	0 (0.0%)	1 (20.0%)	0 (0.0%)	4 (80.0%)	5
TLS_SIP_03	3 (100.0%)	0 (0.0%)	2 (40.0%)	0 (0.0%)	3 (60.0%)	5
TLS_SIP_04	2 (100.0%)	0 (0.0%)	2 (50.0%)	0 (0.0%)	2 (50.0%)	4
TLS_HTTP_01	3 (100.0%)	0 (0.0%)	2 (40.0%)	0 (0.0%)	3 (60.0%)	5
TLS_HTTP_02	2 (100.0%)	0 (0.0%)	3 (60.0%)	0 (0.0%)	2 (40.0%)	5
TLS_HTTP_03	2 (100.0%)	0 (0.0%)	3 (60.0%)	0 (0.0%)	2 (40.0%)	5
TLS_HTTP_04	2 (100.0%)	0 (0.0%)	3 (60.0%)	0 (0.0%)	2 (40.0%)	5

History

Document history		
V0.1	20.02.2023	First draft
V0.2	07.03.2023	Final draft