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Accompanying the document

COMMISSION DELEGATED REGULATION (EU) ../...

supplementing Directive (EU) 2018/1972 of the European Parliament and of the Council with measures to ensure effective access to emergency services through emergency communications to the single European emergency number '112'

{C(2022) 9394 final}

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Glossary

AS	Application Server
BEREC	Body of European Regulators for Electronic Communications
CA	Competent Authority
CLI	Calling Line Identity
ECN	Electronic Communications Network
ECS	Electronic Communications Service
ICS	Interpersonal Communications Service
IP	Internet Protocol
IMS	IP Multimedia Subsystem
LTE	Long Term Evolution
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
NB ICS	Number-Based ICS
NI ICS	Number-Independent ICS
NRA	National Regulatory Authority
OTT	Over the Top
PSAP	Public Service Answering Point
PSTN	Public Switched Telephone Network
UMTS	Universal Mobile Telecommunication System
VoIP	Voice over IP
VoLTE	Voice over LTE

1. Introduction

This Staff Working Document accompanies the Delegated Act (a Delegated Regulation) that is adopted to ensure effective access to emergency services through emergency communication under Article 109 of the European Electronic Communications Code (the "Code" or the "EECC")[1].

The following sections provide explanations regarding:

- emergency communication in the Union, the relevant conceptual framework established in the EECC, including definitions and understanding of the emergency communication chain, which provide a context for the mandate for the Commission to adopt a delegated act to ensure effective access to emergency services through emergency communication, and the content and rationale of Article 109(8) procedure followed in the adoption of the Delegated Regulation (section 1);
- the scope of the Delegated Regulation, including the explanation of effective access to emergency services and definition of effective emergency communication (section 2);
- the current implementation of emergency communication in the Union (section 3);
- the technical solutions for caller location information, access for end-users with disabilities and routing to the most appropriate Public Service Answering Point (PSAP) and their impact on effectiveness of emergency communication (section 4);
- the measures proposed in the area of caller location information, access for end-users with disabilities and routing to the most appropriate PSAP and their contribution to the achievement of effective emergency communication in the Union (section 5).

The Delegated Regulation applies directly within the Union and will apply within the European Economic Area (EEA) after its incorporation in the EEA agreement.

1.1. Emergency communications in the EECC

The first legislative harmonisation in EU law with regard to access to emergency services was achieved through a Council Decision[2] mandating the introduction of the single European emergency call number '112'. The Universal Service Directive of 2002[3], as amended in 2009[4], recognised the importance of access to emergency services and extended the scope of EU law to ensure that all end-users, including end-users with disabilities, have access to emergency services and that caller location information is provided.

[1] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (the EECC or the Code), OJ L 321, 17.12.2018, p. 36.

[2] 91/396/EEC: Council Decision of 29 July 1991 on the introduction of a single European emergency call number OJ L 217, 6.8.1991, p.31.

[3] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive), OJ L 108, 24.4.2002, p. 51.

[4] Directive 2009/136/EC of the European Parliament and of the Council of 25 November 2009 (Citizen's rights directive) amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws, OJ L 337, 18.12.2009, p. 11.

Technological developments have made it possible for end-users to access emergency services through a wider range of interpersonal communications services other than calls placed in circuit-switched 'legacy' networks. Meanwhile, more accurate caller location technologies are available, based not only on network information but also on information derived from the handset. These developments are reflected in the EECC[5]. The EU Member States were to transpose it to their national legal systems by 21 December 2020 and the transposition measures were to become applicable on the same date.

The provisions of the EECC are complemented and referenced by other EU legal provisions under the European Accessibility Act[6] and the Radio Equipment Directive[7].

The provisions that are relevant in the context of the Delegated act are analysed below.

1.1.1. Conceptual framework

The EECC (Article 2 – Definitions) defines key concepts that are adapted to the current and future architecture of access to emergency services and ensures common understanding of key terms such as emergency communication, public safety answering point (PSAP) and most appropriate PSAP, emergency service, caller location information or total conversation service.

In Article 2(38) EECC, emergency communication is defined as "communication by means of interpersonal communications services between an end-user and the PSAP with the goal to request and receive emergency relief from emergency services". It may include not only voice communication but other interpersonal electronic communication services like SMS, messaging, video, real time text, total conversation and communication through relay services[8].

The physical location where emergency communication is first received under the responsibility of a public authority or a private organisation recognised by the Member State is defined as 'public safety answering point' (PSAP)[9]. The PSAP is on the receiving side of an interpersonal communication where the request for emergency relief first arrives. The competence of the PSAP to handle and process the request may be determined on the basis of its geographical location or on the basis of a qualitative capacity to handle a certain type of communication. Therefore the most appropriate PSAP is defined to mean the "PSAP established by responsible authorities to cover emergency communications from a certain area or for emergency communications of a certain type"[10].

[5] See Article 2 and Article 109 EECC. Emergency communications are not restricted to voice communications; caller location relies on both network-based and handset-derived technologies.

[6] The European Accessibility Act (EAA), Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services, OJ L 151, 7.6.2019, p. 70.

[7] Commission Delegated Regulation (EU) 2019/320 of 12 December 2018 supplementing of Directive 2014/53/EU of the European Parliament and of the Council with regard to the application of the essential requirements referred to in Article 3(3)(g) of that Directive in order to ensure caller location in emergency communications from mobile devices, OJ L 55, 25.2.2019, p. 1–3.

[8] Recital 285 EECC

[9] Article 2(36) EECC

[10] Article 2(37) EECC

The functional goal of emergency communications is to enable the end-user to access emergency services to request and receive emergency relief. While emergency communications are set up between the end-user and the PSAP, it should be the role of the most appropriate PSAP to process the data received and convey the request to the emergency services[11]. The organisation of the emergency services is in the exclusive competence of Member States. Depending on the national organisation of PSAP systems and emergency services, these could be overlapping or autonomous entities. PSAPs may not have the operational competence to deploy the relief action. The latter is the competence of emergency services that are defined as being a service recognised as such by the Member State, that provides immediate and rapid assistance in situations where there is, in particular, a direct risk to life or limb, to individual or public health or safety, to private or public property, or to the environment, in accordance with the national law[12]. It is for the Member States to determine which services would be considered 'emergency services' in their jurisdiction, although the police, as well as fire and rescue services and ambulance/medical services are typically considered to be such services.

1.1.2. Access to emergency services

End-users of providers of publicly available NB ICS, including those using roaming services[13], have the right to access emergency services through emergency communications to the most appropriate PSAP[14].

The obligation to provide access to emergency services through emergency communications is incumbent on providers of publicly available NB ICS[15], where those services allow end-users to originate calls to a number in a national or international numbering plan. However, emergency communications are not necessarily reliant on NB ICS. According to the definition[16], an emergency communication is a communication by means of interpersonal communications services. Consequently, emergency communications may be provided also through emergency applications that enable NI ICS with the PSAP.

The legal requirement to provide access to emergency services applies to providers of all types of NB ICS, including network-independent providers of services such as VoIP and providers of over-the-top applications that allow end-users to originate calls to a number in a national or international numbering plan. In technical terms, due to the fact that network-independent providers would not normally have control over the network from origination to termination it may not be possible to reliably route the call to the most appropriate PSAP[17].

[11] As provided in Recital 290 EECC: "Caller location information, which applies to all emergency communications, improves the level of protection and the security of end-users and assists the emergency services in the discharge of their duties, provided that the transfer of emergency communication and associated data to the emergency services concerned is guaranteed by the national system of PSAPs. […]"

[12] Article 2(39) EECC

[13] Recital 285 EECC

[14] Article 109(2) EECC

[15] Article 2(6) EECC

[16] Article 2(38) EECC

[17] Recital 286 EECC

1.1.3. Routing emergency communications to the most appropriate PSAP

Emergency communications have to be routed to the most appropriate PSAP[18]. As explained above, the most appropriate PSAP is determined by the Member State on the basis of a territorial competence to handle emergency communications or a qualitative competence to handle a certain type of communication, e.g. a PSAP equipped to handle sign-language communication. The importance of the routing to the most appropriate PSAP resides in enabling the appropriate answering and handling of the emergency communications. The establishment of the most appropriate PSAP is governed by the national organisation of the Member State PSAPs.

1.1.4. Access to emergency services for end-users with disabilities through emergency communications[19]

Member States must ensure that an accessible means of access to emergency services through emergency communications is available for end-users with disabilities to enable the request for emergency relief. The legal requirement applies with regard to end-users that live with a disability that affects their capacity to effectively communicate through means of electronic communication services, in particular voice services, used for emergency communications that are enjoyed by other end-users.

Examples of end-users living with various types of disabilities that would need to be effectively served by adapted means of emergency communication include: deaf, hearing-impaired, speech-impaired and deaf-blind end-users[20]. Specific types of disabilities would need to be assisted with special terminal devices where the interpersonal communication service, by itself, does not ensure effective communication with the most appropriate PSAP.

Pursuant to Article 109(5) EECC, access to emergency services through emergency communications for end-users with disabilities must be equivalent to that enjoyed by other end-users. The mainstream means of emergency communications that other end-users benefit from is a call to '112', a two-way voice communication[21]. Hence, the equivalence requirement must be interpreted in relation to the effectiveness of a call to '112' that is enjoyed by other end-users. The principle of equivalence implies that disabled end-users should be able to access emergency services in a way functionally equivalent to the access to emergency services enjoyed by other end-users by way of calling the '112' number.

The EECC states that the requirement of ensuring equivalent access for end-users with disabilities to emergency services through emergency communications should be implemented in accordance with Union law harmonising accessibility requirements for products and services, i.e. European Accessibility Act (EAA)[22].

[18] Article 109(2) EECC

[19] Article 109(5) EECC

[20] Recital 288 EECC

[21] Article 2 point 31 EECC: 'call' means a connection established by means of a publicly available interpersonal communications service allowing two-way voice communication.

[22] Article 4(2) and (8), Annex I, Section IV (a) and V EEA.

While the principle of equivalence allows technological neutrality, the conformance with the Union law harmonising accessibility requirements for products and services requires, as a minimum requirement, that the technologies provided in the EAA are implemented within the timeframe provided therein. According to the EAA, voice synchronised with real time text[23] and, where video is available, total conversation[24] shall be deployed by electronic communication service providers by 28 June 2025[25]. Member States will have to ensure that by 28 June 2027 at the latest, the PSAP systems handle emergency communications based on real time text and, where video is available, total conversation to the single European emergency number '112'.

The Roaming Regulation[26] improves the awareness on emergency communications for end-users with disabilities, on one hand, obliging operators to inform end-users on the means of access to emergency services (not only voice) and on the other, obliging Member States to report only the technically feasible means of access in a database to be set up by BEREC[27].

1.1.5. Provision of caller location information

Member States are obliged to ensure that caller location information is made available to the most appropriate PSAP[28]. The case-law of the European Court of Justice held that the legal provision imposes on the Member States "[…] an obligation to achieve a result, which is not limited to putting in place an appropriate regulatory framework, but which requires that the information on the location of all callers to '112' be actually transmitted to the emergency services"[29]. Caller location information[30] is key data associated with emergency communications. Therefore, its transfer to the emergency services concerned should be guaranteed by the national system of PSAPs[31]. All means of emergency communications should benefit from the associated caller location information[32].

Member States have to ensure that network-based location information is always made available to the most appropriate PSAP. Meanwhile, Member States must also ensure that handset-derived caller location information is made available to the most appropriate PSAP

[23] Article 3 point 14 EEA: 'real time text' means a form of text conversation in point-to-point situations or in multipoint conferencing where the text being entered is sent in such a way that the communication is perceived by the user as being continuous on a character-by-character basis.

[24] Article 2 point 35 EECC: 'total conversation service' means a multimedia real time conversation service that provides bidirectional symmetric real time transfer of motion video, real time text and voice between users in two or more locations.

[25] Article 31 EEA

[26] Regulation (EU) 2022/612 of the European Parliament and of the Council of 6 April 2022 on roaming on public mobile communications networks within the Union (recast), OJ L 115, 13.4.2022, p. 1.

[27] Articles 15 and 16 of Regulation (EU) 2022/612

[28] Article 109(6) EECC

[29] Judgment of the Court of 11 September 2008, C-274/07, EU:C:2008:497, paragraph 40

[30] Article 2(40) EECC: 'caller location information' means, in a public mobile network, the data processed, derived from network infrastructure or handsets, indicating the geographic position of an end-user's mobile terminal equipment, and, in a public fixed network, the data about the physical address of the network termination point.

[31] Recital 290 EECC

[32] Article 109(6) EECC

except when the location information is not available on the handset[33]. The handset features that enable it to receive, process and make available for transmission the data from Global Navigation Satellite Systems and Wi-Fi data is mandated in EU law through the Commission Delegated Regulation (EU) 2019/320 and the essential requirements laid down therein. This Delegated Regulation applies as of 17 March 2022.

Member States must also ensure the making available of caller location information to the most appropriate PSAP without delay[34].

Furthermore, they are to ensure that both the establishment of caller location and the transmission of caller location are free of charge for the end-user[35] and the PSAP when using '112'. Member States may also extend these requirements to national emergency numbers.

Member States are obliged to lay down criteria for the accuracy and reliability of the caller location information provided. Setting the criteria is left to the national transposition and implementing measures. In regulatory terms, the criteria should set a minimum standard of quality of the caller location information with regards to its accuracy and reliability with the goal to assist emergency services in the discharge of their duties[36].

The jurisprudence[37] of the European Court of Justice limits the discretion of the Member States to set the criteria relating to the accuracy and reliability of caller location information by reference to the need to ensure the usefulness of the information transmitted, enabling the caller to be effectively located and, therefore, enabling the emergency services to intervene.

1.2. Relation with other EU legislation

Provisions related to emergency communications may be found in other EU legislation besides the EECC. The European Accessibility Act (EAA) that is the Union law harmonising accessibility requirements for products and services referenced in Article 109(5) EECC, introduces measures related to the accessibility of emergency communications and the answering of emergency communications, as explained in chapter 1.1.4. The Commission Delegated Regulation (EU) 2019/320 imposes obligations on producers of smartphones[38] to

[33] Ibid.
[34] Ibid.

[35] Article 109(6) EECC; Recital 290 explains: "[…] The establishment and transmission of caller location information should be free of charge for both the end-user and the authority handling the emergency communication irrespective of the means of establishment, for example through the handset or the network, or the means of transmission, for example through voice channel, SMS or IP-based."

[36] Recital 290 EECC: "Caller location information, which applies to all emergency communications, improves the level of protection and the security of end-users and assists the emergency services in the discharge of their duties, provided that the transfer of emergency communication and associated data to the emergency services concerned is guaranteed by the national system of PSAPs."

[37] Judgment of the Court of 5 September 2019, Case C-417/18, ECLI:EU:C:2019:671, (paragraph 34): "[Article 26(5) of Directive 2002/22 replaced by Article 109(6) EECC] must be interpreted as conferring on the Member States a measure of discretion when laying down the criteria relating to the accuracy and reliability of the information on the location of the caller to the single European emergency call number '112'; however, the criteria which they lay down must ensure, within the limits of technical feasibility, that the caller's position is located as reliably and accurately as is necessary to enable the emergency services usefully to come to the caller's assistance, this being a matter for the national court to assess.

[38] According to Article 1 of Delegated Regulation (EU) 2019/320, the Regulation applies to "hand-held mobile telephones with features similar to those of a computer in terms of capability to treat and store data", which are commonly referred to as smartphones.

ensure that handset-derived caller location information is made available for transmission in emergency communications. The Roaming Regulation provides measures on better transparency for end-users (including for end-users with disabilities) on the means of access to emergency services available while travelling in other EU Member States and reinforces the access to emergency services free of charge while roaming. The amendment of the eCall specifications[39] will seek to enable eCall provisions over packet-switched 4G and 5G networks.

1.3. Procedure for the preparation of the Delegated Regulation

In order to prepare the Delegated Regulation, the Commission services have relied on a broad range of inputs.

First, the Commission services have considered the results of monitoring of the implementation of the single European emergency number '112'. To that end, the Commission services took account of the two latest reports on the effectiveness of the implementation of the single European emergency number '112'[40] based on data gathering that relied on specific questions aimed at assessing the level of implementation of EU law requirements and the improvement of the national (PSAP) systems. The Commission services have also considered the results of broader monitoring exercises, such as annual country missions whose results are reflected in the yearly Digital Economy and Society Index (DESI)[41] and its Connectivity chapters. The infringement proceedings initiated in case of lack of compliance with EU law and the information provided in the course of such proceedings served as complementary sources of information.

Second, the Commission published for consultation a roadmap entitled "Ensuring effective access to emergency services in the Union through emergency communications to the single European emergency number '112'"[42] for a 4 week public feedback period. Feedback was received from 29 respondents[43] originating from 13 Member States[44]. Various stakeholders noted the need for a harmonised approach to emergency communications, in part through the adoption of common standards and architectures for emergency communications[45].

[39] Automatic emergency 112 eCall by onboard vehicle systems – EU-wide interoperability specifications (europa.eu)

[40] 2020 Report from the Commission to the European Parliament and the Council on the effectiveness of the implementation of the single European emergency number '112', COM(2020) 808 final and 2022 Report from the Commission to the European Parliament and the Council on the effectiveness of the implementation of the single European emergency number '112', COM(2022) 724 final.

[41] The Digital Economy and Society Index (DESI) summarises indicators on Europe's digital performance and tracks the progress of EU countries, see 'The Digital Economy and Society Index (DESI) | Shaping Europe's digital future (europa.eu)'.

[42] Emergency communications – improving access through the single European emergency number '112' (europa.eu)

[43] Company/business organisations and EU citizens each gave six responses, five responses were received from both public authorities and non-governmental organisations. Four business associations and two academic/research institutions provided feedback, and one response was received from another type of respondent.

[44] Seven respondents were from Belgium, five from Germany, three from France and Romania, two from Ireland and Spain, and one from Bulgaria, Denmark, Greece, the Netherlands, Poland, Slovenia, and Sweden.

[45] While the Commission services took note of those observations, standardisation policy and standardisation requests fall outside the scope of this Delegated Regulation and could not be addressed within it. For more information see Standardisation policy (europa.eu)

Furthermore, stakeholders acknowledged the trend of technological change raised by the Roadmap and indicated the PSAP upgrade as a necessary step to fully meet the requirements of effective access to emergency services. Some stakeholders suggested the Pan-European Mobile Emergency Application ("PEMEA") architecture as at least part of the solution towards a common standard for emergency communications through an application. Various groups of stakeholders noted that the challenges for over-the-top service providers relating to emergency communications obligations, such as location information and caller identity, should be addressed appropriately.

Third, the Commission services commissioned a "Study on Technical Solutions to Ensure Compatibility, Interoperability, Quality, Reliability and Continuity of Emergency Communications in the Union"[46] to an external contractor, the E-MERCURY consortium ("e-Mercury study"). The contractor was tasked with identifying the technical solutions for effective emergency communications to ensure access to emergency services to all citizens and assessing their technical and economic feasibility, as well as assessing regulatory gaps and need for regulatory intervention, in particular at EU level. The e-Mercury study was conducted between May 2021 and June 2022. It comprised extensive targeted consultation conducted in principle between December 2021 and February 2022, and bilateral meetings took place until end of March 2022. The targeted stakeholder consultation activities comprised three main elements: (1) a stakeholder workshop, attended by approx. 120 participants, (2) written comments to a consultation paper provided by 28 stakeholders, and (3) bilateral meetings with 11 selected stakeholders. The stakeholders provided inputs on the definitions proposed in the e-Mercury study, technical feasibility issues related to fulfilling the legal requirements of EECC, proposed methodology for the assessment of technical solutions, as well as preliminary description and assessment of technical solutions for the caller location information, equivalent access for end-users with disabilities, and routing emergency communications to the most appropriate PSAP. The findings of the e-Mercury study were also presented to the stakeholders in a final workshop in May 2022. In addition, the Commission services considered the inputs and opinions provided by stakeholders withing the targeted staleholder consultation conducted by the contractor. Likewise, the technical and regulatory recommendations for the effective implementation of the technical solutions identified in the e-Mercury study fed into the Commission services work on the delegated act and informed the relevant parts of this Staff Working Document.

Fourth, an Expert Group on Emergency Communications[47], composed of representatives of the Member States' competent authorities responsible for the functioning of the national PSAP system and the national regulatory authorities in the field of electronic communications was established on 6 March 2020. It met on 6 May 2020, 9 July 2020, 27 October 2021, 12 May 2022 and 8 September 2022. Revised drafts of the Delegated Regulation and Staff Working Document were shared with the Expert Group on 31 October 2022. Several members provided comments by 4 November and the final drafts were shared with the Expert Group on 12 December 2022.

[46] Study on Technical Solutions to Ensure Compatibility, Interoperability, Quality, Reliability and Continuity of Emergency Communications in the Union, CNECT/2020/OP/0079

[47] Register of Commission expert groups and other similar entities (europa.eu)

Finally, the Commission services also took into account BEREC's opinion[48] on the draft Delegated Regulation, issued on 14 October 2022 and the feedback received during the publication of the draft on the Commission's 'Have Your Say!' portal, from 8 August to 12 September 2022. Specifically in respect to the above mentioned feedback, 28 submissions were received: 13 from companies/business organisations (one of them is a global organisation representing mobile operators and organisations across the mobile ecosystem), 2 from business associations, 2 from public authorities, 5 from non-governmental organisations, 1 from a trade union and 5 from EU citizens. All replies are public[49].

In its opinion, BEREC considered and provided comments on all the measures proposed in the Delegated Regulation. With regard to caller location information, BEREC noted that the proposed provisions represent an important step forward, but considered that the Delegated Regulation could be more ambitious as regards harmonisation of technical solutions at the EU level. BEREC generally supported the functional equivalence requirements proposed in the draft Delegated Regulation and BEREC agreed with putting the focus on routing, especially in the context of migrating to an all-IP environment. BEREC also provided comments on the reporting obligations. Finally, BEREC highlighted that harmonisation and standardisation are crucial in order to solve the problems that currently exist in emergency communications. BEREC expressed the view that coordination in handling interoperability issues among Member States would be essential and noted that packet-switched emergency communications could be considered one of the future goals in Europe.

The 'Have Your Say!' feedback reflected a broad range of opinions on various topics with relatively low level of convergence among the stakeholders. A significant number of stakeholders, including a business association and two non-governmental organisations, expressed general support for the draft Delegated Regulation. Furthermore, a significant number of stakeholders, including one global organisation, two non-governmental organisations and a public authority, confirmed that emergency communications solutions have to adapt to the migration to packet-switched network technologies. Moreover, a number of stakeholders, including a global organisation, one non-governmental organisation and a public authority, highlighted the importance of standards to ensure the interoperability of emergency communications at handset, network and PSAP level. Finally, a number of stakeholders, including a business association and a global organisation, signalled the lack of interoperability in particular with regards to VoLTE communications.

The Commission services acknowledge the general support for the draft Delegated Regulation and perceived that the contributors consider the proposed measure as a step forward in terms of ensuring effective access to emergency services in the EU. The views expressed on the specific topics and proposed measures as well as the Commission services reactions are reported in the relevant sub-chapters of Chapter 5.

[48] BEREC Opinion on the draft Commission Delegated Regulation supplementing Directive (EU) 2018/1972 of the European Parliament and of the Council with measures to ensure effective access to emergency services through emergency communications to the single European emergency number '112', BoR (22) 142, 14 October 2022

[49] Accessible at: Emergency communications – improving access through the single European emergency number '112' (europa.eu)

2. Scope of the Mandate

2.1. Scope

Article 108(8) EECC mandates the Commission to adopt the first delegated act by 21 December 2022. A three-layered set of conditionality is attached to the mandate:

1) The delegated act(s) should aim to ensure the effective access to emergency services through emergency communications to the single European emergency number '112';
2) Effectiveness may be improved through measures necessary to ensure compatibility, interoperability, quality, reliability and continuity of emergency communications in the Union; and
3) The measures shall supplement paragraphs 2, 5 and 6 of Article 109 EECC and shall be taken with regard to caller location information solutions, access for end-users with disabilities and routing to the most appropriate PSAP.

The Delegated Regulation therefore clarifies the concepts of compatibility, interoperability, quality, reliability and continuity, as well as establishes requirements with regards to caller location criteria, equivalent access for end-users with disabilities and routing to the most appropriate PSAP taking into account the technological developments[50] that are enabling the effectiveness of emergency communications. It also establishes reporting obligations in these areas.

2.2. Effective access to emergency services through emergency communications

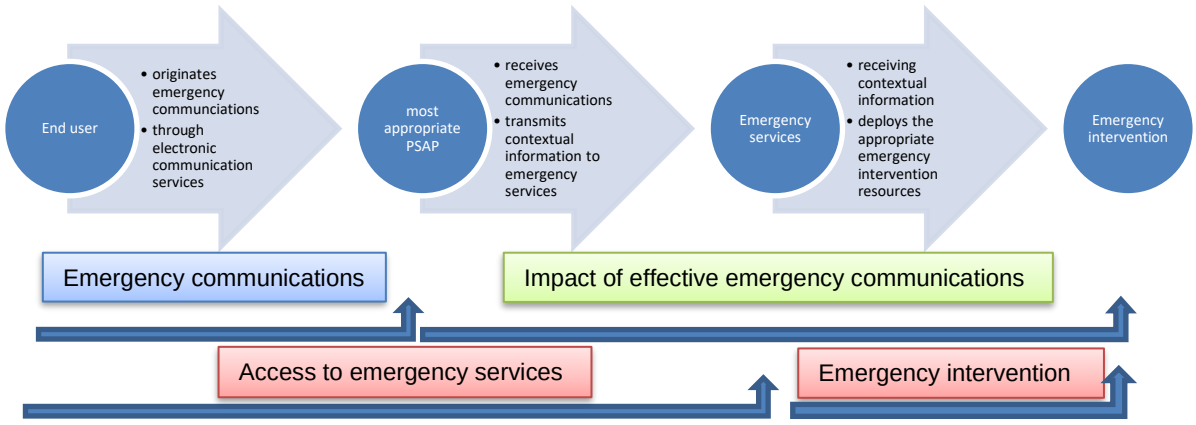

Figure 1 - Value chain of access to emergency services through emergency communications

The public policy goal of emergency services is to avoid, alleviate or manage the effects of an emergency incident through emergency intervention. The timeliness of the emergency intervention has a fundamental impact on the outcome of an emergency incident. As

[50] Recital 291 EECC: "In order to respond to technological developments concerning accurate caller location information, equivalent access for end-users with disabilities and call routing to the most appropriate PSAP, the Commission should be empowered to adopt by means of a delegated act measures necessary to ensure the compatibility, interoperability, quality, reliability and continuity of emergency communications in the Union […]"

presented in the figure, effective access to emergency services is ensured through effective emergency communications and conveyance of the emergency request by the PSAP to the emergency services. Emergency communications are the key enabler of the access to emergency services and, consequently, the enabler of the emergency intervention by emergency services. The main objectives of an effective emergency intervention are:

i) the timely mobilisation of the relevant intervention resources that could effectively address the emergency incident, and
ii) the quick arrival at the intervention scene ('on-scene arrival').

Both objectives are conditional on the access to emergency services and the contextual information available to the emergency services via emergency communications to the PSAP. Contextual information enables the description of the emergency incident, including the physical environment, the condition and abilities of the persons involved, the localisation of the incident, etc. The accuracy and richness of such contextual information enables the timely identification of the appropriate intervention resources (e.g. health condition, preferred means of communication , physical description of the area of emergency) and the quick arrival to the intervention scene (when an accurate caller location is available). This information may be conveyed to the PSAP through emergency communications by the end-user or derived automatically from the device of the end-user or the network. Consequently, in the Commission services' assessment, effective emergency communications contribute to the timeliness of emergency intervention by enabling the timely conveyance of contextual information, including the location of the incident, to the PSAP and emergency services.

In view of the above, the effectiveness of emergency communications may be affected by the time lag incurred due to the following factors:

a. Limitations of human interaction

The information on the emergency incident is conveyed by the end-user to the PSAP through the interview conducted by the PSAP call handler. The time to gather contextual information from the end-user depends on many factors that affect the end-user. In some circumstances the end-user might not be able to describe in a timely, coherent and reliable manner the emergency incident or the location of the emergency incident. These situations lead to a significant time lag that has a direct effect on the timeliness of emergency intervention.

b. Limitations due to the appropriateness of the means of emergency communications

In certain situations, the end-user cannot convey information through the available means of access to emergency services, leading to a significant time lag in the emergency intervention. This is the case i) when the emergency situation does not allow the end-users to use their abilities to communicate (for example when the voice communication would put the caller in danger or direct threat, e.g.: domestic violence, hiding from an attacker), ii) the means of emergency communication deployed to ensure access to emergency services for end-users with disabilities is sub-optimal (i.e. not adapted to the communication capabilities or choices of end-users with specific disabilities).

c. Limitations due to the lack of accuracy or reliability of caller location

As explained above, the timeliness of on-scene arrival, besides the presence of the most appropriate intervention resources, is key to a successful emergency intervention. Lack of accuracy or reliability of the caller location information could add a significant time lag, especially when the limitations of human interaction do not allow to overcome the lack of

information (e.g. end-users cannot explain where they are). The lack of reliability of caller location could also cause a significant delay of the on-scene arrival leading to the lack of availability of caller location information or misleading the emergency services.

d. Limitations due to the delay in routing of the emergency communication

The routing of emergency communication and caller location have a significant impact on the timeliness of emergency communication. Such delays may be caused, amongst others, by the lack of redundancy of the PSAP system, where the overload of a PSAP and lack of possibility of re-routing the emergency communications to competent call handlers may lead to the discontinuation of the emergency communication itself. Other, limitations of the routing system could be inflexible routing policies that may lead to situations where time-consuming re-routing or separate communication is necessary to reach the most appropriate PSAP.

e. Limitations in roaming services

Access to emergency services may be delayed by the lack of compatibility or interoperability of emergency communications or caller location in the visited networks. In addition, the language barrier may further add to the limitations of the human interaction as described in point a) above.

Technological developments allow the optimisation of emergency communication and the mitigation of the limitations described above[51]. Current and future communication technologies have the capacity to convey a broad set of automated contextual information that could overcome the limitations of human interaction by complementing, correcting or validating the information received from the end-user, with direct effect on the timeliness of emergency communications.

2.3. Definition of effective emergency communication

On the basis of the previously described role of the effectiveness of emergency communications for the effectiveness of emergency intervention, a definition could be established:

An effective emergency communication is an emergency communication as defined in Art. 2(38) EECC that ensures i) timely communication between the end-user and the most appropriate PSAP and ii) the making available in a timely manner of contextual information, including caller location information.

To complement the definition of effective emergency communication, ‘contextual information’ means the information conveyed through the emergency communication by the end-user or derived and transmitted automatically from the device of the end-user or the network in order to enable the timely identification of the appropriate intervention resources of the emergency services and the quick arrival to the intervention scene by emergency services. The contextual information contributes to the description of the emergency incident, for example, the physical environment, the condition and abilities of the persons involved, the localisation of the incident, etc. The availability and accuracy of contextual information enables both the identification of the appropriate intervention resources and the quick arrival

[51] Recital 291 EECC; these technological developments pertain to accurate caller location solutions, accessibility solutions based on IP-based packet-switched technologies and flexible routing mechanisms as presented in Chapter 4

at the intervention scene, in the shortest time possible (for example: when an accurate caller location is instantly available). This information may be conveyed to the emergency services via the interaction through emergency communications with the end-user, or derived automatically from the device of the end-user or the network.

Determining the functional effectiveness of a technical solution for emergency communication is therefore based on a technical solution's overall impact on the timeliness and appropriateness of an emergency intervention, i.e. ability to minimise the time between the citizen initiating an emergency communication and the emergency services arriving on the scene. The emergency communication should enable the description of the emergency incident (location, health status, level of danger, etc.) in order for the emergency services to receive sufficient contextual information to effectively manage the emergency intervention.

2.4. Relevant criteria for effectiveness of emergency communication

The measures provided for in the Delegated Regulation would have to be necessary to ensure the compatibility, interoperability, quality, reliability and continuity of emergency communications in the Union with regard to caller location information solutions, access for end-users with disabilities and routing to the most appropriate PSAP.

The concepts were defined in the e-Mercury study supporting the preparation of the Delegated Regulation and served as a basis for the development of the functional criteria used to assess the technical solutions. In the stakeholder consultation, the majority of the respondents agreed with the proposed definitions[52].

The Commission services consider that these attributes have to be interpreted having regard to the technical solutions for emergency communications. The understanding of the Commission services is consistent with that presented and consulted within the e-Mercury study. In the view of the Commission services, it is necessary to ensure first the common understanding of the attributes to establish any means necessary to meet the requirements expressed in those concepts.

Compatibility

Compatibility of emergency communications should be understood as the capability of a technical solution for emergency communications to work with existing or emerging systems of the handset, network or PSAPs.

Interoperability

Interoperability of emergency communications should be understood as the capacity of technical solutions for emergency communications to exchange data and share common resources over established interfaces using commonly defined protocols and data formats.

Quality

Quality should be understood as the set of characteristics of the emergency communication that bear on its ability to satisfy the requirements related to the operational needs of

[52] 52% of respondents agreed with the definitions proposed in the e-Mercury study, 14% did not express agreement or disagreement but provided comments and 34% respondents have not reacted, which can be interpreted as lack of disagreement. See summary of the stakeholder consultation in the Annex to the e-Mercury study

emergency services, in particular i) swift communication with the most appropriate PSAP and ii) making available in a timely manner the contextual information, including accurate caller location information.

Reliability

The reliability of emergency communications should be understood as the ability of the technical solution that ensures the emergency communications, to perform consistently or every time it is initiated, so as to meet the legal and quality requirements for emergency communications.

Continuity

Continuity of emergency communications should be understood as the capability to work seamlessly right across the Union, enabling end-users travelling between regions of the same Member State or between Member States to access emergency services using the same technical solution without intervention on the part of the end-user.

3. Implementation of emergency communications in the EU

Article 109(4) EECC mandates the Commission to submit a report to the European Parliament and to the Council on the effectiveness of the implementation of the single European emergency number '112' by 21 December 2020 and every two years thereafter. The latest report[53] (the Report) on the effectiveness of the implementation of the single European emergency number '112' analyses the means of access to emergency services implemented by Member States. The report relies on the responses provided by Member States representatives in the Communications Committee (COCOM).

In addition to the Report, the e-Mercury study provides information on the technical aspects of current implementations of emergency communcations.

In 2021, the share of emergency calls in the Union to the single European emergency number '112' represented 56% of all emergency calls: out of a total of 270 million calls placed in the Union, 153 million were '112' calls. It is estimated that 2.3 million emergency calls were placed by roaming end-users, out of which 1.5 million were '112' calls[54].

The number of calls to '112' is closely related to the level of end-users' awareness on the availability of the '112' number, but also on the co-existence of national 'legacy' emergency numbers (i.e. numbers other than '112'). '112' is the single emergency number in Denmark, Estonia, Finland, Malta, the Netherlands, Portugal, Romania and Sweden and, among the EEA countries, in Iceland.

A precondition of effective access to emergency services is the awareness of the means of access. To that end, the single European emergency number '112' enjoys a high rate of awareness amongst Europeans, 71% know about it in their own country while 41% know that it can be used across the EU[55].

[53] 2022 Report from the Commission, COM(2022)724 final

[54] The reporting period for the quantitative data (e.g. number of emergency calls to '112') is 1 January 2021 to 31 December 2021.

[55] https://europa.eu/eurobarometer/surveys/detail/2232

Calls from mobile phones significantly outweighed the number of calls from fixed phones. On average, in 2021 78% of the calls were placed from mobile phones. However, the use of mobile phones for emergency communication purposes varies significantly across Member States[56].

25 Member States reported less than 10 seconds average answering time, which is the time needed to get in contact with the emergency services. While end-users' behaviour and network issues do influence both answer times and call abandon rates, the organisation and capabilities of the national PSAP system is decisive in the effectiveness of handling the emergency calls and emergency communications through alternative means of access.

3.1. Caller location solution implementation

Network-based location

In most of the reporting Member States[57], the lack of availability of network-based caller location information occurs in less than 3% of the calls. Higher rates of failure to provide caller location were reported for the Netherlands (3%), Estonia (4%), Portugal (5%), Ireland (5.5%), Italy (9.4%), Spain (12.3%), Croatia (13.8%) and Latvia (21%).

In all Member States, as well as in Norway, the location of the caller from *fixed networks* is given by the installation address or street/mailing/billing address of the calling party.

All Member States reported that for calls from *mobile networks* the location is given by the Cell/sector ID providing a high reliability of the data transmitted to the PSAP operator. The reported accuracy ranges from 500 m to 40 km, depending on the density of the network, i.e. urban or rural area. More accurate mobile network-based location solutions used are Timing advance, Round trip time or Sector ID. These positioning methods substantially improve the accuracy of network-based location to up to 50 metres in some cases.

Due to the implementation of the "push" system or the automatic "pull" system all Member States reported near instant times (up to 10 seconds) for the provision of network-based caller location.

Handset-derived location

In terms of handset-derived location solutions, Member States reported the two types of implementation described below.

a) **Advanced Mobile Location (AML) solution** that can improve accuracy levels, providing accuracy up to under 100 m. The solution supplements the location information provided by the network with either GNSS or Wi-Fi location information derived from the handset. Currently, handset-derived location might not be available in up to 94% of the calls in specific Member States[58].

b) Location information derived from the handset through an emergency application deployed at a national or regional level that enable the delivery caller

[56] From 42% in Luxembourg and 63% in Germany to 96% in Cyprus and 99% in Czechia.

[57] 18 Member States have provided relevant data.

[58] Handset derived caller location is not available: PT (1%), HR (2%), HU (2.9%), SI (5%), SE (20%), DK (23.7%), NO (30%), RO (33.9%), LT (38%), MT (40.4%), EE (46%), IE (48%), CZ (50%), BG (68.2%), IT (94.2%)

location information (based on GNSS or Wi-Fi capability of the smartphone) that is more accurate than that provided through network-based solutions. However, these applications require prior action by the citizen – as opposed to AML – as they need to be downloaded. Morevoer, the transmission of location data is possible only when data connection is active.

The report found that roaming end-users, visiting other Member States, might potentially be in a more vulnerable situation in case of emergency as they may not be able to describe their location precisely. While AML is deployed in 22 Member States, Iceland and Norway, only 6 Member States confirmed that handset-derived location is available for roaming end-users.

Due to its inherent architecture, *handset-derived location* technologies rely on the speed of the handsets to derive relevant location parameters from GNSS or Wi-Fi signals. On the basis of the reports from 15 Member States, it was confirmed that the provision of handset-derived location could range from near instant to up to 26 seconds.

3.2. Access for end-users with disabilities

Member States have deployed a broad range of accessibility solutions to enable the access of end-users with disabilities to emergency services: real time text, total conversation, SMS, emergency applications, web services, relay services, access from special devices, email or fax.

SMS technology is the most deployed, in 22 Member States[59] and Norway. SMS technology ensures a two-way, text-based interaction between the person alerting the emergency services and the PSAP. SMS may generate an accurate handset-derived AML localisation, that is sent to the PSAP.

Emergency applications are deployed in 19 Member States[60] and, depending on their design, may rely on initiating emergency calls or SMS communications, but may also serve as a platform to provide state of the art real time text communications. In addition, applications may provide accurate handset-derived location based on GNSS/Wi-Fi positioning data (5-100 m) through the data channel.

Relay services[61] for end-users with disabilities may also relay the communication to the most appropriate PSAP. However, currently user location is in most cases not available for this means of access in Member States.

While fax and e-mail remain available as a means of access to emergency services in some Member States, they can hardly be considered equivalent. They do not ensure the swift two-way communication that is required in case of emergency, in contrast with the effectiveness of a '112' call. Furthermore, an e-mail does not allow the provision of automatic user location to the PSAP.

End-users with disabilities do not benefit from equivalent means of access, especially when roaming. While these end-users may not able to place a call to '112', they have to rely on nationally fragmented solutions often not equivalent to the two-way voice communication.

[59] AT, BE, CY, CZ, DK, EE, EL, FI, FR, HR, HU, IE, LT, LU, LV, MT, NL, PT, RO, SE, SI, SK.

[60] AT, BE, BG, CY, CZ, DE, DK, ES, FR, HU, IT, LT, LU, LV, MT, NL, PL, PT, SK.

[61] Please see description is section 4.3 below.

This state of affairs is in contrast with the availability of the harmonised single European emergency number '112' for other end-users. Access to emergency services for roaming end-users is not always ensured in the visited Member States. The new Roaming Regulation[62] obliges roming providers to inform their customers on the means of access to emergency services as of 1 June 2023.

3.3. Routing solutions to the most appropriate PSAP

Access to emergency services may be achieved only if the emergency communication is routed to the most appropriate PSAP as explained in Chapter 1.1.3. Routing solutions to the most appropriate PSAP follow the trend of technological migration from circuit-switched to packet-switched networks.

Current implementations of routing policies rely on the publicly available networks operated by electronic communications network providers in the Union. They are responsible for routing emergency communications to the most appropriate PSAP. The routing rules are built on policies agreed with the national PSAP organisations and the organisations of emergency services.

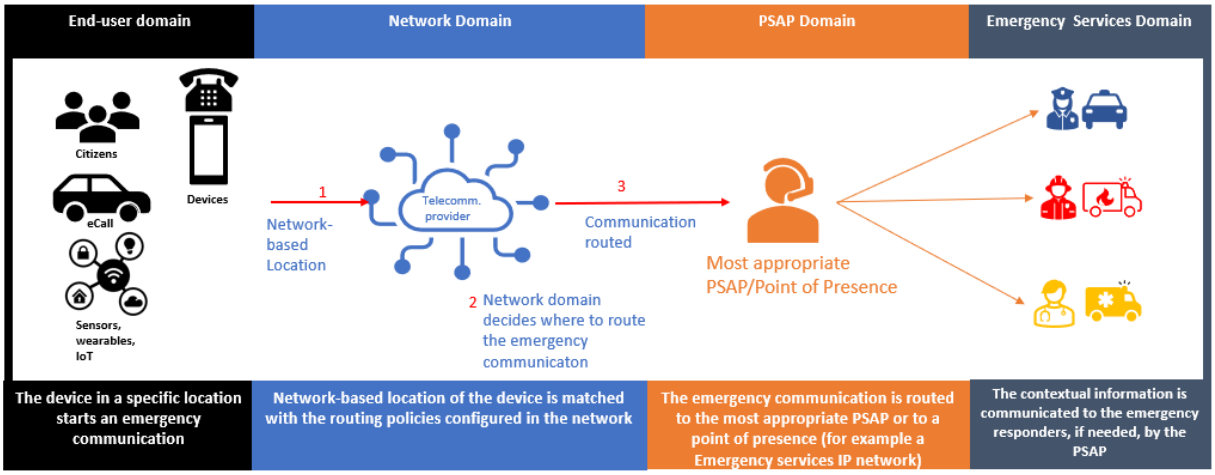

Figure 2 - Emergency Communications Routing by the Network Domain[63]

The elements of the network involved in the routing of emergency communications evolve depending on the technology implemented in the ECN as analysed in Chapter 4.4.

4. Technical solutions with regard to caller location, access for end-users with disabilities and routing to the most appropriate PSAP

4.1. Description of the technological development

Technological developments and end-user demand for new and innovative services have continued to drive investment in new higher capacity packet-switched networks based on Internet Protocol (IP) technologies.

[62] Regulation (EU) 2022/612

[63] Source: e-Mercury study

Circuit-switched networks still exist as the remaining parts of the Public Switched Telephone Network (PSTN) that is considered today to be legacy technology. Circuit-switching requires dedicated network resources to be reserved between terminal devices, whether fixed or mobile. A communication session is set up over signalling channels on the network and network resources such as the bearer channels will be reserved for the duration of a communications session. The configuration of circuit-switched networks is very centralised with the network operator having total control of access to the network and the operation of it thereby enhancing security and robustness. 2G and 3G mobile networks provide the voice service through circuit-switched technology.

Packet-switched networks use network resources much more efficiently by breaking the communication into packets of data which are sent through the network independently of each other and reassembled at the destination point. Signalling information is transported in the packet headers. As no dedicated communications channels are reserved between endpoints, all network resources are available for multiple endpoints to communicate at the same time. Earlier packet-switched protocols, such as X.25 and Asynchronous Transfer Mode (ATM), have now been superseded in electronic communications networks by IP-based packet-switching technology using an architectural framework known as IP Multimedia Subsystem (IMS).

IP Multimedia Subsystem (IMS) is an architectural framework standardized by 3GPP for delivering multimedia communications services such as voice, video and text messaging over IP networks[64]. Originally designed to evolve 3G networks to deliver enhanced multimedia capabilities to mobile users, IMS has become the core component within 3G/4G networks, cable TV networks and IP-based fixed telecoms networks.

The IMS specifications incorporate Session Initiation Protocol (SIP) for session control signalling. SIP is used in IP networks for initiating, maintaining, and terminating real-time multimedia communications sessions based on voice, video and messaging. The migration from circuit-switched to packet-switched technology triggers the deployment of voice services through IMS-based fixed and mobile managed VoIP technologies such as VoLTE, VoNR (5G) and VoWiFi[65]. Communication over IP also enables real time text and total conversation service. In line with the roadmap of deployment of these services by electronic communication service and network providers, emergency communications are also migrated to such technologies. The SIP allows the conveyance of contextual information such as caller location information. In addition to the abovementioned technological evolution at the network level, the uptake of advanced mobile handsets (smartphones) and popularisation of applications enabled the development of alternative means of emergency communications for end-users with disabilities and leveraged the capabilities of mobile handsets to provide accurate caller location information. Further, the evolution of the end-user's mobile terminal equipment enabled the development of application-based accessibility solutions such as real time text and total conversation.

[64] IMS (3gpp.org)

[65] Voice over LTE (Long-Term Evolution), Voice over New Radio, Voice over Wi-Fi

4.2. Solutions for caller location

The caller location process consists of two operations, namely the establishment of the location and its transmission to the PSAP. Following this, the caller location solutions have to be analysed with regard to both their establishment and their transmission.

4.2.1. Solutions for establishment of caller location information

The e-Mercury study[66] identified the available technical solutions for the establishment of caller location information that were also subject to stakeholder consultation. While stakeholders had numerous comments on the assessment and the description of the technical solutions, the correctness of the identification of the solutions was not contested[67]. Therefore, the Commission services consider that the solutions identified in the e-Mercury study can be considered the most widely recognised technical solutions for the establishment of caller location information. These are the following:

- Calling Line Identity (CLI)

Calling Line Identity (CLI) is a method by which inbound calls can be identified by their telephone number of origin. CLI is not location information itself but it provides a reference key to retrieve location information. CLI provides a reference key to help establish the location of an end-user when they initiate an emergency communication, by identifying the location information derived from the network infrastructure (i.e. from subscriber databases). The ECN/ECS providers assign a number to an individual subscriber as part of a service. This number remains associated with a subscriber in a customer database that also contains information on the physical address of the network termination point (fixed-line service) and billing address (fixed and mobile services).

CLI is an effective solution for emergency communications originating on fixed networks but also applies to emergency communications originating on mobile and nomadic Voice over IP (VoIP) services. Further, it performs well in terms of compatibility and interoperability since it is fully standardised and compatible with both circuit-switched and packet-switched publicly available networks as well as with the private networks equipment. However, CLI is unreliable when emergency communications are initiated from a private/corporate network environment or from a nomadic VoIP service. CLI may be used as reference key when retrieving Advanced Mobile Location information.

- Nomadic VoIP Location Determination[68]

A voice service that uses public Internet for connectivity and permits calling to numbers from national numbering plans is called a nomadic VoIP service. VoIP services predominantly use

[66] e-Mercury study, Section 13

[67] 24% of respondents agreed with the list of the technical solutions identified in the e-Mercury study, 34% did not express agreement or disagreement but provided comments and 42% respondents have not reacted, which can be interpreted as lack of disagreement. See summary of the stakeholder consultation in the Annex to the Study

[68] The solution described here is not the only one for establishing the location of a nomadic VoIP caller. However, the one analysed here is defined by ETSI in ES 203 178 and ES 203 283. Further, although this solution is based on harmonised standards the e-Mercury study did not provide any information on real deployments. (see Section 13.b of the e-Mercury study)

Session Initiation Protocol (SIP), a commonly used protocol for VoIP both in public networks and private/corporate networks. With ETSI N.VoIP, network-provided caller location information can be provided in the header field of the SIP-INVITE message. For example, location values such as the end-user's calling IP address and port number are provided.

Despite the fact that ETSI N.VoIP is fully standardised end-to-end and is compatible with circuit-switched and packet-switched publicly available networks, it seems that there are no real implementations of this solution. Given that it is a prerequisite that all parties involved in the conveyance of the emergency communication originating on a nomadic VoIP service must have implemented at least some of the interfaces and protocols for effective operation, this solution cannot be considered as mature. Hence, it faces both compatibility and reliability issues and its continuity across the Union in a roaming scenario cannot be guaranteed. Furthermore, it should be noted that, as it is the case also with CLI, no location information is directly retrieved as this solution only provides a reference key to retrieve location information from relevant databases. Hence, if the caller is in another country, access to the relevant databases may not be available to provide very accurate location especially in cases where the end-user is using a Virtual Private Network (VPN).

- Cell-ID

Cell-ID is the identity number designated by a mobile network operator to a Base Transceiver Station (BTS) which can be used to determine the physical location of the cell tower hosting that BTS. The MNO has information on the location of each cell tower and the coverage area of their own antennas hosted on that cell tower. By knowing which BTS a given device is connected to and using a database of base-station identification numbers and locations, the MNO can provide the approximate position of the connected mobile device within the cell area it serves.

Cell-ID based location is the most commonly available location method for emergency communications originating on mobile networks and it is compatible with all generations of publicly available mobile network. Due to this, Cell-ID can be considered as a highly interoperable and reliable solution that can also be supported in a roaming environment within the Union. Further, since this solution is supported purely by network functionalities, there is no requirement for advanced mobile handsets to support it.

Cell-ID is not location information in itself but it provides a reference key to retrieve location information. The location accuracy provided by Cell-ID alone can vary as it is dependent on cell size and network density. Reported accuracies can range from 500 m (high density) to 40 km (low density). If the emergency caller cannot explain their location to the PSAP call taker, a location accuracy range of 40 km provided by Cell-ID will not be very useful in ensuring a timely or useful intervention. An improvement of the accuracy of this solution can be derived in the case when a cell area is divided into sectors. This is done by having several antennas on a tower serving different sectors of the cell area instead of a single multi-directional antenna. A unique identifier can be assigned to each of the cell sectors and this is called Cell-Sector-ID.

- Assisted Cell-ID (A-Cell-ID)

The term assisted Cell-ID refers to solutions in which other mobile network-based location methods are used to complement Cell ID/Cell Sector ID, in order to provide more accurate location. These methods rely on radio measurements and are not immediately available when an emergency communication is initiated. Examples of these types of measurements are: the

Timing Advance (TA), the Round-trip time, the Radio Frequency Pattern Matching and the Observed Time Difference of Arrival (OTDOA)[69].

The A-Cell-ID methods are fully standardised and compatible with all generations of publicly available mobile network, including 5G in the future. Consequently, A-Cell-ID methods can be considered as a highly interoperable and reliable solution that can also be supported in a roaming environment within the Union. A-Cell-ID methods provide more accurate location than can be derived from Cell-ID alone[70]. However, the accuracy will be dependent on the availability of the methods, and as is the case also with Cell-ID, the cell density, cell size and environmental factors.

- Location based on satellite technologies

These are handset derived caller location solutions where the caller location is established on the Global Navigation Satellite System (GNSS) enabled mobile terminal equipment. The time taken for a GNSS-enabled device to acquire satellite signals and navigation data is called Time-to-First-Fix (TTFF). With clear skies and clear lines of sight, GNSS based solution provide a very accurate caller location (up to 5 metres), provided the device can find three or four satellites. In urban canyons[71] or indoors, satellite signals can be reflected away and the end-user's mobile terminal equipment may not be able to receive signals. In this case a solution that is called Assisted Global Navigation Satellite System (A-GNSS) can be used to provide the necessary data to the end-user's mobile terminal equipment using a land-based radio network rather than relying on the satellite link alone. The data is provided by a GNSS augmentation system that collects data from satellites and can then send that data to a mobile device using mobile data or Wi-Fi. By this mechanism the A-GNSS can significantly reduce TTFF.

Both GNSS only and A-GNSS are global solutions supporting multiple satellite constellations and are compatible with any end-user device with a GNSS/A-GNSS-enabled chipset. Consequently, GNSS/A-GNSS can be considered as highly interoperable and reliable solutions that can be supported in a roaming environment within the Union. Further, both methods provide a very accurate location based on latitude, longitude and elevation. The latter enables the establishment of vertical location information. However, GNSS signal might not be available indoors, in urban canyons or in certain weather conditions, situations in which the caller location establishment could be affected or the accuracy of caller location would not be reliable.

- Wi-Fi Positioning

Wi-Fi positioning uses information on the handset about the availability of nearby wireless access points. The location is extracted by using information from databases that hold location information for each uniquely identified access point.

[69] e-Mercury study, Section 13.c

[70] In case of Round Trip Time method, the expected accuracy can range from 150m-350m in dense urban environments to 500m-3km in rural environments. In case of Radio Frequency Pattern Matching Depending on the environment, RFPM has an accuracy range of between 150 m to 800 m. Depending on the environment, OTDOA has an accuracy range of between 50 m to 150 m.

[71] https://en.wikipedia.org/wiki/Urban_canyon; An urban canyon (also known as a street canyon) is a place where the street is flanked by buildings on both sides creating a canyon-like environment.

The Wi-Fi positioning provides a very accurate location based on the available parameters and it is compatible with any end-user device with a Wi-Fi-enabled chipset and access to smartphone's operating system location services. Furthermore, it is fully standardised global solution and thus suitable for roaming environment. However, while in urban or indoor environments it may provide a very accurate caller location information, in rural areas Wi-Fi based location information may not be available.

- Fused/Hybridised Location

An advanced mobile handset (smartphone) is able to receive signals from mobile networks, Wi-Fi access points and GNSS. When an emergency communication is initiated, the device can fuse or hybridise information from these signals to calculate a more accurate location estimate. Each handset's operating system uses measurements from GNSS, A-GNSS, Wi-Fi and mobile network location information (e.g. Cell ID, A-Cell ID) and calculates the location estimate using proprietary mechanisms.

The Fused/Hybridised location solution provides a very accurate location information based on multiple location methods which can be validated against each other. An important advantage of this solution is its increased reliability since it is able to provide location even in situations where one of the location methods is not available due to the environment or weather conditions. Furthermore, national borders are not an issue but a data connection is needed at least some of the time. However, although the location methods used to derive the location are fully standardised the fusing/hybridising of these location methods is largely based on proprietary technology. In addition, this location solution is available only on smartphones with Wi-Fi and GNSS capabilities (rather than on all mobile phones) and it would not be able to provide accurate caller location in case both the Wi-Fi and GNSS signal is not available.

4.2.2. Solutions for the transmission of caller location information

The e-Mercury study identified the available technical solutions for the transmission to the PSAP of the caller location information that were also subject to stakeholder consultation where the correctness of the identification of the solutions was not contested. The stakeholders commented rather on details concerning the description of the assessment of the technical solutions, which also supports the proper identification of the solutions as such[72]. Therefore, the Commission services consider that the solutions identified in the e-Mercury study can be considered the most widely recognised technical solutions for the establishment of caller location information. These are the following:

- Circuit-switched voice communications (CS Voice)

Circuit-switched voice communications has been the most common method of accessing emergency services for decades in both fixed and mobile networks. Using the SS7 signalling protocol (control plane), location information (e.g. CLI, Cell-ID code and VoIP flag) is transmitted in the Initial Address Message (IAM) over the signalling channels with the emergency communication. The CLI (for fixed and mobile originated emergency

[72] 20% of respondents agreed with the list of the technical solutions identified in the e-Mercury study, 31% did not express agreement or disagreement but provided comments and 49% respondents have not reacted, which can be interpreted as lack of disagreement. See summary of the stakeholder consultation in the Annex to the e-Mercury study

communications) and Cell-ID (for mobile originated emergency communications) are used to retrieve location information from relevant databases.

- IP-Multimedia Subsystem-based communications with Session Initiation Protocol (IMS/SIP)

IP Multimedia Subsystem (IMS) is an architectural framework standardised by 3GPP for delivering multimedia communications services such as voice, video and text messaging over packet-switched IP networks. As explained above, the Session Initiation Protocol (SIP) is the signalling protocol selected by 3GPP to create and control multimedia sessions with two or more participants in IMS and therefore is a key element in the IMS framework.

The same parameters as in the case for the CS Voice can be transmitted in the SIP_INVITE in packet-switched networks. The location information arrives at the most appropriate PSAP almost immediately. A SIP_INVITE message is used to initiate an emergency communication. Location information available at set-up can be inserted in the SIP Header. Handset-derived location can also be inserted into the SIP-INVITE if available when the emergency communication is initiated.

- Advanced Mobile Location (AML)

AML[73] is a transmission mechanism for making handset-derived location and associated data available to emergency services PSAPs. AML functionality is triggered by an emergency communication. Fused/hybridised location information established by the handset is encapsulated in an AML message string and is transported over user-plane transmission mechanisms using two transmission options (either SMS or HTTPS) to an endpoint in PSAP domain.

- HTML5

When an end-user is in contact with a PSAP though emergency communications, the PSAP may send the caller an SMS with an embedded web link. On condition the end-user approves to share the location information, the PSAP receives the handset-derived location through the web service that the link points to using the HTML5 protocol. It is a transport method that requires access to data services during an emergency communication.

- Transmission of emergency caller location information using NI ICS

In the past decade the penetration of smartphones increased exponentially[74]. Therefore, emergency mobile applications have emerged in many Member States to provide an additional means of access to emergency services. The communication takes place over-the-top which means that it is independent of the underlying network. These applications also provide a mechanism for transmitting handset-derived caller location information to the PSAP. Different proprietary solutions have been developed and their use is limited to the national jurisdiction. When the application is used from another country, the emergency communication and associated caller location information will normally be sent to the PSAP of the end-user's home country.

[73] ETSI TS 103 625 Emergency Communications (EMTEL); Transporting Handset Location to PSAPs for Emergency Calls - Advanced Mobile Location

[74] See e.g. DESI: Digital Infrastructures 2021 report according to which in 2019, 71% of people used a smart phone to access the internet (up from 49% in 2015), which is the vast majority of all regular internet users (84% of people in 2019).

To ensure continuity of NI ICS emergency communications and associated caller location information originating on smartphones, tablets, laptops and browsers throughout the EU, ETSI has developed a technical specification[75] defining an architecture – the Pan-European Mobile Emergency Application (PEMEA) framework - to provide NI ICS emergency communications continuity throughout the EU. PEMEA specifies the protocols and procedures enabling interoperable implementations of the architecture and provides extension points to enable new communication mechanisms as they evolve. The PEMEA framework was designed to allow applications, smartphones, tablets, laptops and browsers to roam and interoperate thereby ensuring continuity of NI ICS emergency communications with PEMEA-enabled PSAPs across Europe.

The reliability of transmission of caller location information is dependent on the availability of data connection.

- Network Induced Location Request (NI-LR)

Network Induced (or Initiated) Location Request (NI-LR) is a 3GPP-specified transport mechanism that allows mobile networks to securely acquire location information from an end-user device during an emergency all, and to route that data to the PSAP. When an emergency communication is initiated, the handset begins to calculate its location while the emergency communication is sent to the PSAP. In the meantime, the mobile network sends a request to the handset to provide location and it is transferred to the PSAP in the control plane. NI-LR is a well-established location delivery mechanism deployed in the US but, based on the results of the e-Mercury study, has not been deployed anywhere in Europe to date.

4.2.3. Assessment of caller location solutions with regards to the effectiveness of emergency communications

Caller location is one of the most important elements of contextual information associated with the emergency communication. It has a direct impact on the effectiveness of emergency communications. The caller location information accuracy and reliability influences the time needed to identify the site of the emergency and the on-site arrival of emergency services. For this reason, every emergency communication should benefit from timely caller location that is trusted by emergency services in the process of emergency intervention.

As confirmed in the e-Mercury study, the network derived caller location information is less accurate than the available handset derived caller location. Meanwhile, the reliability of establishment of caller location in case of handset derived caller location is dependent on handset capabilities and the availability of GNSS or Wi-Fi signals. In terms of transmission methods the transmission of caller location by the network on the control plane is more reliable and not exposed to contingencies to the extent user plane solutions are. This is confirmed by the two latest Commission reports on the effectiveness of implementation of the single European number '112' (presented in Chapter 3), where it is indicated that the availability of network derived location information is higher than the availability of handset derived location information.

[75] ETSI TS 103 478 v1.2.1, Emergency Communications (EMTEL); Pan-European Mobile Emergency Application

As recalled in Chapter 1.1.5, it is for the Member States to establish the caller location accuracy and reliability criteria. These criteria represent the minimum levels of accuracy and reliability of caller location that have to be implemented on the territory of the Member State through network-based and handset-derived technologies. The mix of these technologies ensure that even where a handset derived caller location solution fails to make available caller location to the most appropriate PSAP, emergency services could rely on network-based location to usefully come to the end-user's assistance, in line with the caller location accuracy and reliability criteria established by Member States.

As indicted in the e-Mercury study, the technological migration to all IP networks would trigger adaptations with regard to the establishment and transport of caller location. In IMS networks, both the network-based and handset-derived caller location information could be transported through SIP to the most appropriate PSAP. This is possible only if the national PSAP system is updated to be able to receive IMS communications being 'SIP-ready'. Today, the benefits of all IP communications with regards to caller location are not always realised in mobile networks, because in an emergency communications fall back to 2G or 3G services that usually fit the capability of the PSAP to handle emergency calls.

Member States have a key role to ensure that caller location solutions are effectively implemented and contribute to the effectiveness of emergency communications. Firstly, the establishment of caller location criteria should ensure through clear parameters the implementation of a mix of network-based and handset-derived caller location technologies that ensure a useful caller location information for every emergency communication. Secondly, in line with the findings of the e-Mercury study, Member States, in cooperation with relevant stakeholders, including electronic communication services and networks providers, PSAPs and emergency services, should define a roadmap for the implementation of IMS/SIP based emergency communications, like VoLTE and VoWiFi, including the transmission of caller location information specific to packet-switched technologies.

4.3. Solutions for access for end-users with disabilities

Member States must ensure that an accessible means of access to emergency services through emergency communications is available for end-users with disabilities to enable the request of emergency relief in an equivalent way with other end-users. The legal requirement applies with regard to end-users with disabilities, in particular those that face barriers to effectively communicate through means of electronic communication services used for emergency communications by other end-users. The currently dominant means of electronic communications that is used to access emergency services is voice-based interpersonal communications. While voice communication serves the majority of the population in case of an emergency, hearing and speech impaired end-users cannot effectively use this type of emergency communication.

As identified in the e-Mercury study, the services that end-users with disabilities could use as emergency communications are alternative to the mainstream voice services and enable those end-users with disabilities to communicate with the PSAP. These services may be delivered through various technologies: fax, email, text phone, smartphone applications, network native capabilities enabled in the core network.

Document Delivery

The delivery of information in the form of written documents is mainly considered by PSAP operators as a complementary technical solution that complement the underlying emergency communication. As a self standing service, it does not meet the equivalence requirement because it does not allow an interactive communication with the PSAP. Current implementations of document delivery reported by Member States are fax or email.

Chat/Messaging

Several technical solutions allow for the delivery of short messages between the end-user and the PSAP. These exchange of these messages are not providing the real time communication that real time text and total conversation services ensure, but allow an interactive communication with the PSAP.

Text phones

Text phone (also known as teletypewriter (TTY) device, Minicom, or texttelephone) solutions are compatible with legacy circuit-switched networks. A basic text phone consists of a keyboard, a display screen, and a modem deployed at a fixed location. Due to the fact that the textphone service is deployed on circuit networks at fixed location it expected to be replaced by IP-based solutions deployed in packet-switched networks.

SMS

The short message service (SMS) is available on both circuit-switched and packet-switched networks. It enables sequential communication of short messages to the PSAP. SMS technology enables communication to the '112' number. Emergency communication through SMS is routed to the most appropriate PSAP in case of use of domestic SIM-card users. However, the SMS to short emergency numbers originated through a roaming service is routed to the home network, not to the most appropriate PSAP. In the targeted stakeholder consultation organized in the e-Mercury study it was reported that standardization efforts with regard to the correct routing of the emergency SMS are being initiated. It is technically feasible to provide network-based and handset-derived caller location for emergency communications through SMS.

Emergency applications

A chat/messaging function may be configured on mobile applications. Current implementations of mobile applications rely on proprietary solutions that limit the use of the application outside the administrative area of the PSAP system that deploys the application.

Relay services

Relay services are provided by an intermediary that understands the communications from the end-user and translates it to the PSAP and vice versa. These services are needed in particular when end-users with disabilities use a specific communication method, for example sign language.

Direct relay service

The direct relay service is a service that is collocated with the PSAP or is called into the emergency communication by the PSAP. When a total conversation emergency communication is received the PSAP may call into a conference call a sign language interpretation service that enables the translation of the sign language to the PSAP operator. The sign language interpretation service might be a third party service.

Linked relay service

A linked relay service is a third party service that is contacted directly by the end-users with disabilities though an ICS. Depending on the type of service, this may be NB ICS (SMS, real time text, total conversation) or NI ICS (application). These relay services might be needed in particular for sign language interpretation. The direct relay service translates and forwards the communication to the most appropriate PSAP. The communication through a linked relay service does not ensure the provision of the network and handset derived caller location data to the most appropriate PSAP.

Real time text and Total conversation

As defined in Article 3 point 14 EAA, real time text "means a form of text conversation in point-to-point situations or in multipoint conferencing where the text being entered is sent in such a way that the communication is perceived by the user as being continuous on a character-by-character basis". This service enables end-users with hearing or speaking impairments to express themselves in an effective way by writing messages.

As defined in Article 2 point 35 EECC, total conversation service "means a multimedia real time conversation service that provides bidirectional symmetric real time transfer of motion video, real time text and voice between users in two or more locations". This service enables end-users with hearing or speaking impairments to express themselves in an effective way, in addition to writing messages, also by using sign language.

Native real-time text and total conversation

Real time text and total conversation service may be enabled in the IMS core nework. It is initiated by IMS/SIP, the preferred protocol for initiating, maintaining and terminating communication sessions on IP-based networks. Hence these services are not available in circuit-switched networks. Native real time text or total conversation are not yet deployed in the EU, but it is expected to be available in 4G and 5G networks as Member States implement the requirements of the EAA. Continuity is expected to be ensured in EU roaming, as there is an inherent capacity in the protocol to resolve cross-border issues and route emergency communications to the most appropriate PSAP. Native real time text or total conversation may be initiated as a number-based interpersonal communication service by dialling the single European emergency number '112'. It is technically feasible to provide network-based and handset-derived caller location for both services through SIP.

Real time text and total conversation on mobile applications

The real time text and/or total conversation service may be configured on mobile applications. Current implementations of mobile applications rely on propietary solutions that limit the use of the application outside the adminitrative area of the PSAP system that deploys the application.

Continuity of application based services in EU roaming

The e-Mercury study found that the continuity of service in EU roaming of emergency applications providing messaging, real time text or total conversation service may be supported through either the The Pan-European Mobile Emergency Application (PEMEA) architecture[76] or the implementation of the specifications for network-independent access to

[76] ETSI TS 103 478

emergency services. Both specifications have to be implemented in national PSAP systems and an ineroperability framework has to be agreed between those systems.

4.3.1. Assessment of solutions for end-users with disabilities with regard to the effectiveness of emergency communications

Like for all other end-users, the effectiveness of the emergency communication for end-users with disabilities is dependent on the timeliness of the communication with the most appropriate PSAP.

According to the e-Mercury study, total conversation services are the most effective in terms of two way interactive communication with the PSAP, while real time text also ensures appropriate interaction. IMS enabled native solutions would ensure continuity within the Union, although, the e-Mercury study signals the risk that interoperability issues might arise following the early implementation of VoLTE and other IMS enabled services at network and handset level. The decommissioning of 2G and 3G networks would trigger the use of packet-switched emergency communications in 4G and 5G networks. The interoperability of these services, in particular while roaming, should be ensured in a harmonised way with the aim to avoid the disruption of access to emergency services.

In order to effectively deploy services that rely on packet-switched technology, network enabled services or applications, PSAP systems capabilities have to be configured to be able to adequately receive and answer these new types of communications.

In order to ensure that the emergency communication is effective, it is important that equivalent quality of caller location information is generated for the emergency communication. Network enabled services could benefit from both network-based and handset-derived caller location information, while network-independent applications would rely on the handset-derived caller location solution.

It is important to ensure that end-users with disabilities are equally as aware as other end-users, of the means of access to emergency services. The network enabled solutions, as mandated by the EAA, can be initiated by dialling the well-known single European emergency number ‘112’.

As indicated in the Commission’s two latest implementation reports, the availability of a wide range of technical solutions, with varying levels of effectiveness, resulted in the past in a fragmented deployment of means of access to emergency services for end-users with disabilities. This shows that there is no common understanding of the functional equivalence requirement with regards to emergency communications. In order to overcome this fragmentation and limitation of the continuity of emergency communication within the Union, the e-Mercury study indicates that there is a need to establish and implement across the Union functional requirements for emergency communications that ensure comparable quality of access to emergency services for end-users with disabilities.

4.4. Solutions for routing to the most appropriate PSAP

The elements of the network involved in the routing of emergency communications depend on the technology of the ECN as follows:

2G/3G Networks

In 2G/3G mobile communication networks, the routing of the emergency voice call and/or emergency SMS (Short Message Service) is based on the circuit-switched technology. In these networks the most appropriate PSAP for an emergency call is selected by the Mobile Switching Centre (MSC)[77], considering the location of the device and the Service Category (SC)[78].

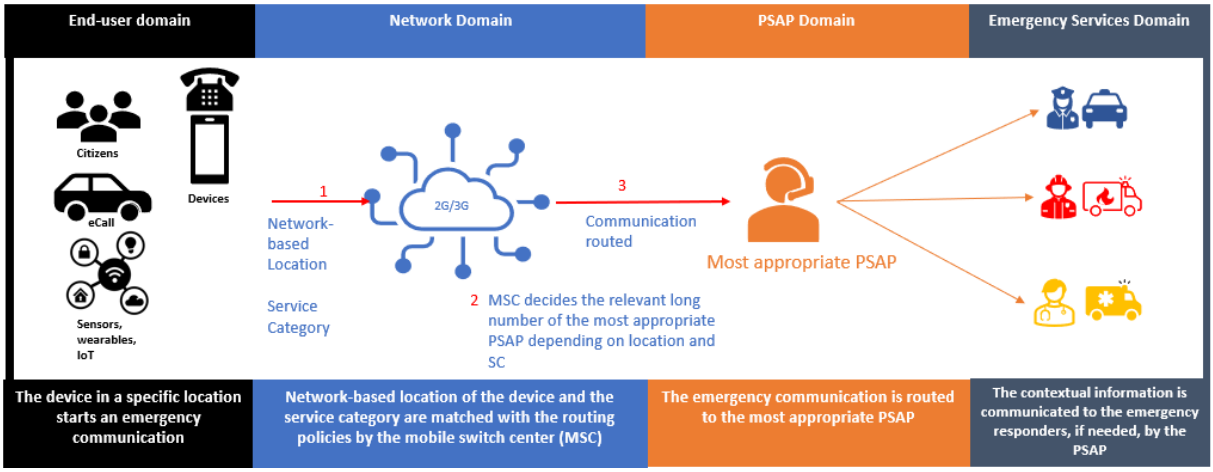

Figure 3 - 2G/3G Routing by the Network Domain[79]

IMS Networks

The IP Multimedia Subsystem (IMS) Core Network manages the emergency communications and routes them. It should be noted that for packet-switched communications based on IMS both the end-user device and the PSAP need to be IMS compatible. This is a prerequisite for the support of multimedia emergency communications such as video and real time text communications. In case on non-availability of IMS, the user device will receive a non-availability signal from the network. A communication based on 2G/3G will be initiated, as a fall back from a 4G/5G call. In this case, emergency communications are routed as explained for 2G/3G. Currently, in the majority of Member States, emergency communications fall back to 2G/3G networks, also because the 4G/5G networks did not yet reach a comparable coverage or due to relatively low penetration of 4G/5G capable mobile handsets that support also VoLTE/VoNR. Furthermore, it should be noted that there are still technical and standardisation gaps for routing emergency communications based on IMS when roaming or while in limited-service state[80].

[77] A mobile switching centre (MSC) is mostly associated with communications switching functions, such as call set-up, release, and routing. The MSC connects calls between subscribers by switching the digital voice packets between network paths.

[78] The emergency service category value is set by the device when launching the emergency communication to any emergency number. It is transparent to the user and has a different value depending on the service activated, ETSI TS 124 008 V11.17.1 (2018-01), Release 11

[79] e-Mercury study, Section 16

[80] Limited Service State includes support for emergency sessions in situations where, for example, an end-user mobile device may not have a Universal Integrated Circuit Card (UICC)/ Subscriber Identification Module (SIM) or the end-user mobile device is in an area where access is normally restricted, or may have failed other system-level verification after successful authentication.

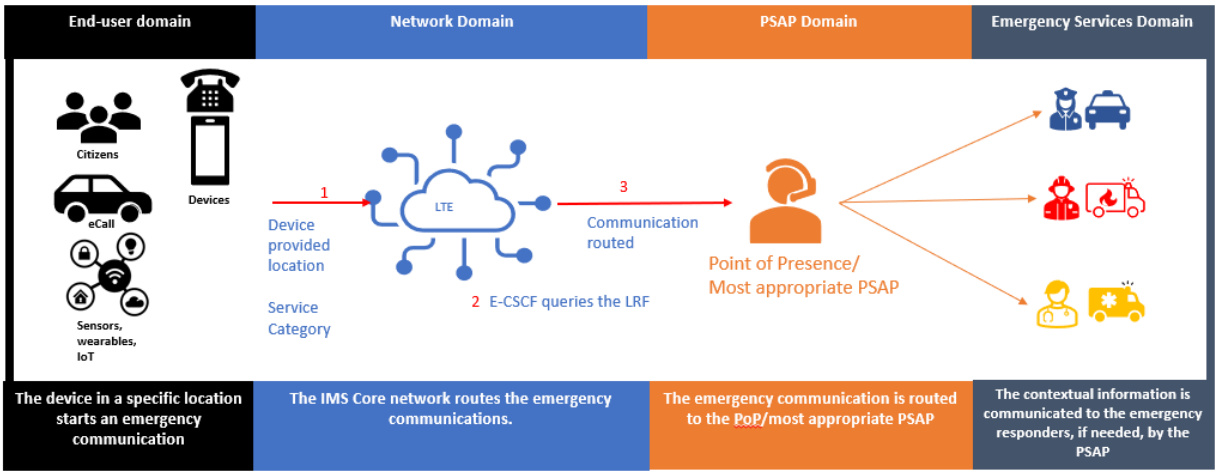

Figure 4 - IMS routing by the Network Domain[81]

Routing of Emergency SMS

As explained in chapter 1.3.2 in 22 Member States, SMS is used as means of access to emergency services dedicated for end-users with disabilities. In some Member States[82] the emergency SMS is an alternative means of access that is available to all citizens and can be used by end-users with disabilities as well.

The routing of the SMS is processed through the relevant Short Message Service Centre (SMSC) based on the Service Centre Address configured in the handset[83]. The SMSC will forward the SMS message to an External Short Messaging Entity (ESME) which will be configured with the unique emergency short codes for routing[84]. Using the Short Message Peer-to-Peer protocol (SMPP) all messages received by the ESME will be sent to the endpoint in the most appropriate PSAP[85]. This could be a centralised end point for all emergency SMS or, if the PSAP infrastructure is decentralised, to the most appropriate PSAP responsible for the geographic area of the originating SMS. In the PSAP domain an endpoint for receiving SMSs has to be implemented. Finally, it should be noted that there are still technical and standardisation gaps[86] for routing emergency communications based on SMS to the most appropriate PSAP when roaming.

[81] e-Mercury study, Section 16

[82] AT, BE, CY, CZ, DK, EE, EL, FI, FR, HR, HU, IE, LT, LU, LV, MT, NL, PT, RO, SE, SI, SK

[83] The Short Message Service Centre (SMSC) is a network element in the mobile telephone network. Its purpose is to store, forward, convert and deliver Short Message Service (SMS) messages.

[84] The External Short Messaging Entity (ESME) is an external application that connects to a Short Message Service Center (SMSC) to engage in the sending or receiving of SMS messages.

[85] The Short Message Peer-to-Peer (SMPP) protocol is an open, industry standard protocol designed to provide a flexible data communications interface for the transfer of short message data between the External Short Message Entity (ESME) and the Short Message Service Center (SMSC).

[86] e-Mercury study, Section 16

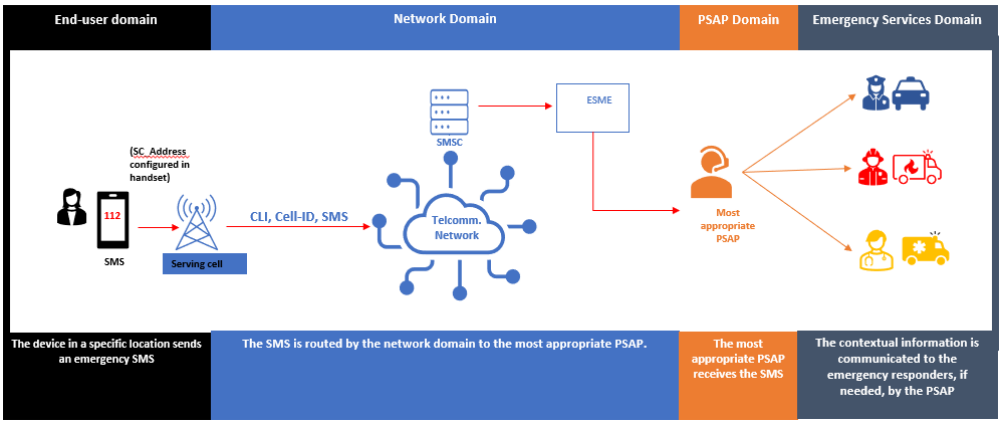

Figure 5 - Routing an emergency SMS[87]

Routing by PSAP Domain – PSAP IP architecture

Emergency communications are originated by diverse types of devices and are using networks with different technologies. The PSAP IP architecture specification[88] describes a series of components that enable the mapping and routing of emergency communications within the PSAP IP network to the most appropriate PSAP independently of the technology used by the device and the ECN.

From a general perspective, the underlying principle of this architecture is to convert, when needed, diverse types of technologies to enable their connectivity through a series of gateways.

The PSAP IP network is physically in the network domain, but it is managed by the PSAP domain. The PSAP IP network is an IP network connecting PSAPs and other components[89]. The network defines a Point of Presence (PoP) that serves as a gateway for ECN providers to which emergency communications are forwarded. Meanwhile PSAPs provide IP-based endpoints to receive emergency communications routed to them though the PSAP IP network.

[87] e-Mercury study, Section 16

[88] ETSI, Dec 2019, TS 103 479 v.1.1.1 - Core elements for network independent access to emergency services.

[89] In respect to the relevant components of the architecture these are: the ECRF (Emergency Call Routing Function), the ESRP (Emergency Service Routing Proxy) and LIS (Location Information Server). These are three core elements of the PSAP IP architecture that are used to route emergency communications to the most appropriate PSAP.

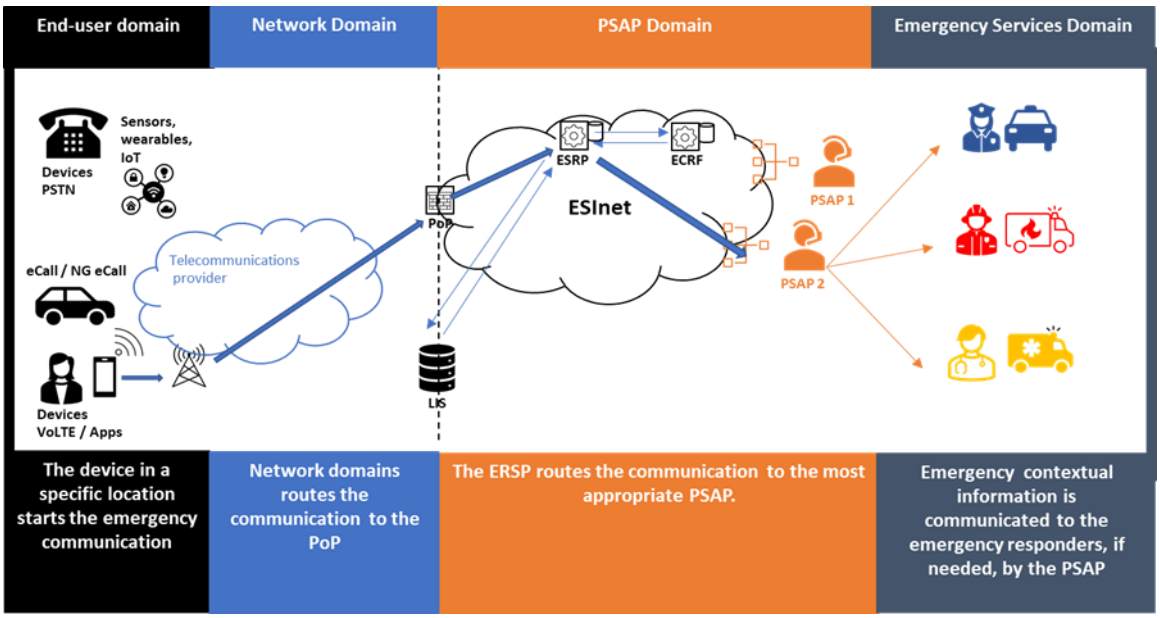

Figure 6 - Routing via the PSAP IP architecture[90]

Routing of emergency application communication

Applications give the possibility to citizens to access emergency services through emergency communications. The emergency application installed on the device communicates with its application service provider through proprietary solutions including servers, database, software, etc. The application is able to exchange data and, in some cases, it can establish a multimedia communication only with the PSAP service provider integrated with the application endpoint. In current implementations applications can establish a communications limited to the PSAP system of one Member State or a region of it. Therefore the same application cannot be used while roaming.

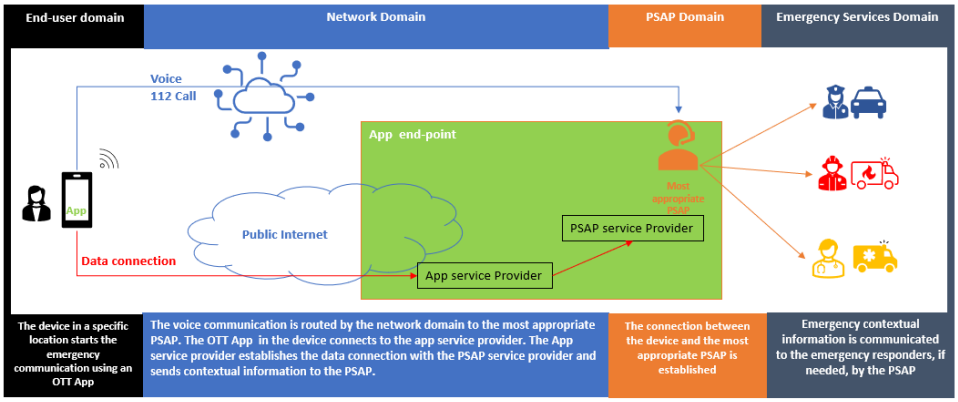

Figure 7 - Routing application based voice by the network domain[91]

The limitation in the continuity of the application service may be overcome either by deploying the same application in all Member States providing for a proprietary routing mechanism, or by implementing standardised solutions for the interoperability of emergency applications.

[90] e-Mercury study, Section 16

[91] e-Mercury study, Section 16

The e-Mercury study found that two standardised technological architectures may ensure the continuity of service of emergency applications. The first is built upon the PSAP IP network explained above with the condition that the regional or national IP networks are interconnected. The second solution identified is the Pan-European Mobile Emergency Application (PEMEA) architecture[92].

The focus of PEMEA is to provide a standards framework to allow routing to the most appropriate PSAP of the emergency communication in roaming environment. It has been designed to allow the integration of different channels of communications (voice, chat, etc). The specifications may be upgraded to allow real time text and total conversation communications without breaking backwards compatibility.

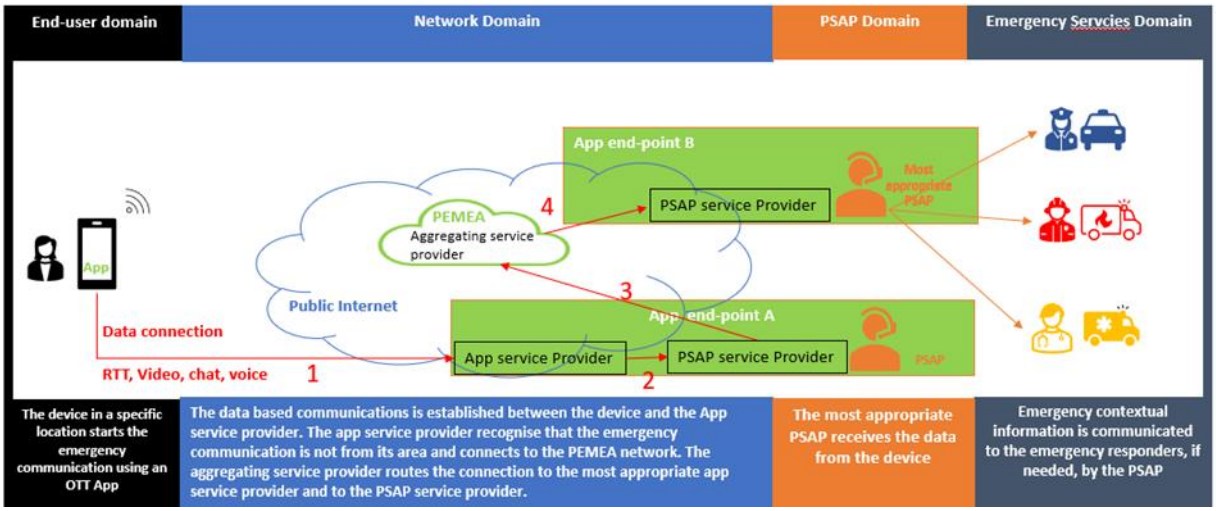

Figure 8 - Routing application based communication through PEMEA architecture[93]

The core component of the PEMEA network is the aggregating service providers. These are the entities that implement the routing policies and may be deployed in the national organisation of PSAPs. The specifications foresee the establishment of a PEMEA Registration Authority that maintains an exhaustive register of all end points of PSAPs and application service providers that comply with the PEMEA specifications. Only the entities registered may send or receive emergency communcations in the PEMEA network.

4.4.1. Assessment of solutions for routing to the most appropriate PSAP with regard to the effectiveness of emergency communications

It follows from the above that the migration from circuit-switched to packet-switched technologies in emergency communications brings about the possibility to deploy IP-based emergency communications. This is true for voice communications, but also for the types of communication that are mandated by the EAA, i.e.: real time text and total conversation. The latter cannot be provided via circuit-switched technologies.

[92] ETSI TS 103 478 V1.2.1 (2020-03) - Emergency Communications (EMTEL); Pan-European Mobile Emergency Application.

[93] e-Mercury study, Section 16

Consequently, the routing mechanisms implemented in the network domain and PSAP domain have to ensure that they allow the routing to the most appropriate PSAP, without delay and with sufficient flexibility to reach the competent PSAP operator. These competences include text communication and/or sign language communication. It appears that the solutions described above have the capability to ensure the availability and continuity of emergency communications and routing to the most appropriate PSAP in a timely manner. It is for the Member States to choose, adapt and implement these solutions to the specific organization of their national PSAP system.

However, the deployment of new, IP-based communications carries the risk of implementation of services without the guarantee of interoperability. In the consultation process, national authorities and relevant stakeholders raised issues related to the deployment of IMS-based interpersonal managed VoIP services such as VoLTE, VoNR (5G) and VoWiFi[94]. BEREC has also mentioned[95] technical issues with reaching the most appropriate PSAP in the case Of VoIP services using SIP-servers, and suggested that the Commission should consider them in the work on the Delegated Act. The switch off of 2G and 3G networks would not allow the fallback to those services as is currently the case in many jurisdictions. In addition, VoLTE interoperability in roaming is not always guaranteed.

The establishment by Member States of a clear roadmap for the migration to IP-based emergency communications will ensure that stakeholders are informed notably on the IP-based packet-switched emergency communications that will be implemented and the expected date of implementation as well as on the expected modalities and timing of the upgrade of PSAP systems to be able to receive and process those communications. Moreover, communication by Member States of the roadmaps to the Commission within one year after the entry into force of the delegated act would help ensure compliance with the obligation and monitoring of the content and implementation process of the roadmap.

5. Proposed measures

5.1. Caller location

As explained above, caller location is a key contextual information that has a high impact on the effectiveness of emergency communications. Member States have the discretion to lay down criteria for the accuracy and reliability of caller location information provided but, as it is established in the jurisprudence[96] of the European Court of Justice, this is limited by the need to ensure the usefulness of the information transmitted, enabling the caller to be effectively located and, therefore, enabling the emergency services to intervene.

The accuracy of caller location may be expressed as a maximum radius of the search area that is presented to the emergency services to intervene. Emergency intervention times could be significantly reduced when accurate and reliable network-based and handset-derived caller location information is available to the most appropriate PSAP, especially when end-users

[94] Voice over LTE (Long-Term Evolution), Voice over New Radio, Voice over Wi-Fi

[95] BEREC Opinion on the market and technological developments and on their impact on the application of rights of end-users in the EECC, BoR (21) 177, 9 December 2021.

[96] Case C-417/18 (paragraph 34), op. cit, see footnote 35.

requesting emergency assistance are not able to specify their location. Caller location criteria should ensure that the technical solutions that implement the prescribed requirements provide useful caller location information for the emergency services to effectively intervene.

The accuracy criteria should express the minimum level of accuracy of the caller location information that is made available to the most appropriate PSAP.

The reliability of caller location pertains to two aspects of the caller location information: the establishment and the transmission.

The reliability of establishment of the caller location information refers to the confidence level in the ability of the technical solution to establish a location estimate with a certain accuracy. The reliability of caller location information is established according to the statistical measurements that indicate the success rate with which the actual location of the handset matches the area indicated on the basis of the caller location information. An emergency communication should trigger both network-based and handset-derived caller location information, when the latter is available. The reliability of the caller location information for the emergency services should be established as a combined effect of these two technologies.

The reliability of transmission of caller location information is expressed as the success rate of the technical solution to consistently transmit the caller location information to the most appropriate PSAP. The success rate is dependent on the capabilities of the network to convey the information, in case of network-based caller location, or the interoperability between the handset and the network resources to allow the transmission and most appropriate PSAP capabilities to receive the information. By virtue of the legal requirement of Article 109(6) EECC, the reliability of the transmission solution or mix of solutions of the caller location information should ensure that a useful caller location information is always available for the most appropriate PSAP. Hence, the reliability criteria should express the confidence level in the accuracy of the caller location information made available to the most appropriate PSAP, while Member States ensure that a useful caller location information always reaches the most appropriate PSAP.

When establishing the caller location criteria Member States may take into account the network technology, network architectures, the area from which emergency communication is originated (e.g. urban or rural), the possibility to establish vertical coordinates and the source of caller location information. The technical feasibility of the caller location solutions should be also considered, including how different technologies complement each other, bearing in mind the need to ensure the usefulness of the caller location information in all scenarios.

Hence, caller location criteria may be established taking into account fixed and mobile networks, urban and rural areas or network-based and handset-derived technologies.

5.1.1. Establishing parameters for caller location criteria (fixed/mobile)

Currently, according to the information provided by the Member States, most Member States establish caller location criteria for fixed networks by reference to the physical address of the network termination point, and for mobile networks by reference to the Cell-ID[97]. The latter

[97] 2022 Report from the Commission , COM(2022) 724 final

criterion could yield an accuracy ranging from 50 metres to 40.000 metres, depending on the density of the network base stations, according to the information reported by the Member States. The usefulness of the caller location accuracy for emergency services to intervene cannot be ensured in the upper end of this range. The usefulness of this information might vary depending on the area from which emergency communication is originated (e.g. urban or rural) and could be reflected accordingly in the criteria set. Handset-derived caller location solutions seem to deliver much more accurate caller location information that enables emergency services to usefully intervene, i.e. even under 100 m. However, according to the Member States reporting[98] handset-derived location is not always available. This might be due to the lack of the relevant signals (GNSS or local area network), the lack of capabilities of the handsets or lack of the reliability of the transmission of caller location information. Therefore, the Commission services conclude that current implementations of the caller location accuracy and reliability criteria may not always ensure that the caller location information enables the emergency services to usefully and effectively intervene, which should be their ultimate objective as indicated by the Court[99].

Caller location criteria, which do not allow the establishment of minimum levels of accuracy and reliability, in meters and success rate (%), lead to implementations that do not ensure that emergency services receive caller location information, which they can effectively use. Current implementations show that reference only to a technology (for example Cell ID) does not ensure sufficiently accurate caller location. It is for the Member States to assess the combined effect of the technically feasible caller location solutions, and to establish minimum criteria for both accuracy and reliability of caller location, which, if implemented, would enable emergency services to usefully intervene.

Article 109(6) EECC already obliges the Member States' competent authorities to lay down criteria for the accuracy and the reliability of the caller location information provided to the most appropriate PSAP. The Commission services consider that in order to ensure effective emergency communication, this obligation should be supplemented with the requirement to establish those criteria through parameters that allow the assessment of the quality of the caller location information by emergency services. Therefore, when laying down criteria for the accuracy and reliability of the caller location information provided to the most appropriate PSAP, the Member States will need to set the caller location criteria having regard to specific parameters for fixed and mobile networks. While aiming to ensure the objective of the criteria of enabling emergency services to usefully intervene, it is for the Member States to consider specific national conditions, such as geographical location, network topology and generations, implemented technical solutions and their effectiveness, as well as existing technical solutions that could be implemented.

In line with the Court's decision, competent regulatory authorities should ensure, within the limits of technical feasibility, that the end-user's position is located as reliably and accurately as is necessary to enable the emergency services to come to the end-user's assistance.

In view of recital 286 EECC the technical feasibility should be assessed in particular with regards to network-independent providers, namely providers which are not integrated with a

[98] See 2022 Report from the Commission COM(2022) 724 final and stakeholder consultation report in the Annex to the e-Mercury study.

[99] Case C-417/18 (paragraph 34), op. cit.; see footnote 35.

provider of public electronic communications networks. As presented in sub-chapter 5.1.3 concerns with regard to technical feasibility of routing and provision of caller location were raised by a significant number of stakeholders, in particular network-independent providers of number-based interpersonal communication services. Furthermore, some stakeholders indicated the feasibility of providing vertical accuracy measurements within the caller location information.

Having regard to the above, the Commission services consider that Member States should set their reliability and accuracy criteria for caller location information according to the following parameters:

For fixed networks:

- The accuracy criterion for caller location information shall be expressed as information related to the physical address of the network termination point. For example: street address, apartment, flat, floor or similar information
- The reliability criterion for caller location information shall be expressed as the rate of success of the technical solution or mix of technical solutions to establish and transmit to the most appropriate PSAP a caller location information corresponding to the accuracy criterion.

For mobile networks:

- The accuracy criterion for caller location information shall be expressed in metres. If applicable, the elevation or vertical accuracy criterion shall be expressed in metres as well.
- The reliability criterion for caller location information shall be expressed as the rate of success of the technical solution or mix of technical solutions to establish and transmit to the most appropriate PSAP a search area corresponding to the accuracy criterion.

Member States should assess whether these parameters are feasible to be applied to network-independent NB ICS when these are used in fixed or mobile networks.

5.1.2. Reporting obligation

Member States' competent authorities shall establish the caller location information accuracy and reliability criteria taking into account that the caller location information made available to the PSAP and emergency services shall enable the emergency services to usefully come to the end-users assistance. For this purpose, it would be appropriate that the competent authorities and relevant stakeholders - including electronic communication services and network providers, national PSAPs and emergency services – are consulted beforehand and assess the technical feasibility of the implementation of caller location solutions in order to comply with the established criteria under consideration.

In order to enable the monitoring by the Commission of the adoption of the caller location criteria established according to the parameters set out in the Delegated Regulation, Member States will need to report to the Commission the adoption of those criteria, not later that one year after the entry into force of the Delegated Regulation.

5.1.3. Feedback received and the Commission services views

With regard to caller location information, BEREC noted in its Opinion that the draft Delegated Regulation bears provisions that represent an important step forward, but an even more proactive approach could be considered. Specifically, BEREC considered that the Delegated Regulation could provide detailed guidelines, with the aim of sharing solutions and consequently providing advice to Member States for possible future improvements and possible harmonisation, without currently imposing specific values. BEREC also suggested that the draft Delegated Regulation should aim at harmonised implementation of AML in the EU, and formulate the ambition to search for solutions around the localisation of nomadic services, e.g. by involving also European Telecommunications Standards Institute (ETSI).

In the 'Have You Say!' consultation, a significant number of stakeholders, including a business association and a public authority, indicated the need to provide for technically feasible solutions for caller location and a routing solution for network-independent providers of NB ICS. Furthermore, one stakeholder called on the Commission to impose an obligation on the Member States to identify a single default PSAP for network-independent NB ICS providers, to use when emergency caller location is not available. In addition, a significant number of stakeholders, including a non-governmental organisation and a public authority, suggested the harmonisation of the minimum criteria of caller location accuracy and reliability across the EU.

Support was expressed by a number of stakeholders, including two non-governmental organisations and a business association, with regard to the implementation of a standardised handset-derived Advanced Mobile Location solution across the EU, while making it available also in roaming. With regard to the accuracy of caller location, the vertical accuracy to support caller location at a floor-level accuracy inside buildings, also called z-axis, was deemed feasible by one stakeholder that is providing 3D geolocation services, while the importance of network-based caller location accuracy was stressed by another stakeholder.

Concerning the technical feasibility of provision of access to emergency services and caller location, the Commission services note that recital 286 EECC acknowledges that providing access to emergency services and caller location information might not always be feasible for network-independent providers, namely providers that are not integrated with a provider of public electronic communications networks. This assessment should be done by the Member State, which is responsible for the organisation of its PSAP system, as is now provided in Recital 8 of the Delegated Regulation.

On the harmonisation of caller location criteria across the EU, it needs to be considered that the establishment of the caller location criteria is an exclusive competence of Member States under Article 109(6) EECC. However, the Delegated Regulation sets out the parameters for caller location that Member States should take into account when defining such criteria in order to ensure a harmonised approach. Notably, Article 3 establishes that the competent regulatory authorities shall ensure, within the limits of technical feasibility, that the end-user's position is located as reliably and accurately as is necessary to enable the emergency services to come to the end-user's assistance. Furthermore, pursuant to Article 109(6) EECC, when laying down the criteria for the accuracy and reliability of the caller location information, competent regulatory authorities are to consult BEREC if necessary. The Commission services consider that the full effectiveness of Article 109(6) of EECC will only be ensured if the competent regulatory authorities cooperate among each other when laying down these

criteria and consult BEREC or other relevant fora competent to provide guidance in this regard, as indicated in recital 7.

As regards the proposals to mandate Advanced Mobile Location technology in the Delegated Regulation, Article 109(6) EECC sets out in clear terms the obligation of Member States to ensure that handset derived caller location is made available to the most appropriate PSAP. As explained in chapter 1.2, the Delegated Regulation (EU) 2019/320 imposes obligations on producers of smartphones to ensure that handset-derived caller location information is made available for transmission in emergency communications. The AML technical specification may be referenced for compliance with both legislations. De facto, all Member States that ensure compliance with the above-mentioned provisions of the EECC have implemented AML, as indicated in chapter 3.1.1. In addition, the importance of vertical criteria is acknowledged in Article 3(3)(a).

5.1.4. Impact of the proposed measure on the effectiveness of emergency communications

The proposed measure will contribute to the implementation of caller location accuracy and reliability criteria that enable emergency services to usefully intervene. Establishing the criteria according to the parameters prescribed by the Delegated Regulation will allow PSAPs and emergency services to receive caller location information that has a minimum level of accuracy and reliability. The need to have a clearer expression of the accuracy and reliability criteria was indicated in the targeted consultation organised in the e-Mercury study by the PSAP representatives[100]. In addition, the measure will contribute to the consistent monitoring by the Commission of the implementation of caller location information accuracy and reliability criteria under the EECC. The measure will also allow the criteria to be comparable across the Union enabling the exchange of best practice between Member States and improve the quality and reliability of caller location information across the Union. It is expected that the criteria established on the basis of the above parameters would encourage the identification and deployment of technically and economically feasible solutions for accurate and reliable caller location, with direct impact on the effectiveness of emergency communications.

5.2. Access for end-users with disabilities

It is established in Union[101] and national legislation that access to emergency services through emergency communications for end-users with disabilities must be equivalent to that enjoyed by other end-users. However, as established by the Commission report[102] the means of access to emergency services that are available to end-users with disabilities are nationally fragmented solutions often not equivalent to the two-way voice communication. The EEA mandates the deployment of real time text and total conversation, as of 2025[103]. The principle of equivalence implies that end-users with disabilities should be able to access emergency

[100] In feedback from PSAPs to the targeted consultation it was indicated the need to establish minimum criteria of accuracy and reliability, in particular for network-based location solutions.

[101] Article 109(5) EECC

[102] See 2022 Report from the Commission, COM(2022) 724 final

[103] Article 31 EEA

services through emergency communication in a way functionally equivalent to the access to emergency services ensured to other end-users through emergency communication, in particular by way of calling the '112' number. These means of access are considered alternatives to the calls to '112', i.e. alternative means of access to emergency services[104]. As explained in section 2.2, the effectiveness of emergency communications may be affected by the time lag incurred due to the fact that the means of access to emergency not adapted to remove the barriers in the communication with the PSAP of end-users living with disabilities. The technically feasible solutions implemented by Member States should ensure that the functional effectiveness of the emergency communication allows the transmission of contextual information with equivalent speed to the most appropriate PSAP and the emergency services.

5.2.1. Functional equivalence requirements

In order to ensure the continuity and quality of means of access to emergency services for end-users with disabilities, the Delegated Regulation defines the functional equivalence requirements. The e-Mercury study found that the fragmented deployment of means of access to emergency services for end-users with disabilities point to the fact that there is no common understanding across the Union of the functional equivalence requirement with regards to emergency communications. The e-Mercury study and the targeted stakeholder consultation confirmed a set of assessment criteria for emergency communications for end-users with disabilities to meet the equivalence requirement established in Article 109 EECC. Accordingly, it is recommended to establish the functional equivalence requirements of emergency communications that ensure that these are implemented across the Union, ensuring comparable quality of access to emergency services for end-users with disabilities. These functional equivalence requirements mirror the functional aspects of the mainstream voice-based communication, i.e. a call to '112', that is available to other end-users. These functionalities[105] have to be replicated in all Member States, subject to technical feasibility.

a) Two-way interactive communication

Access to emergency services through calls to '112' have an inherent quality that ensures a two-way interactive communication that allows the speed of interaction similar with a natural (not electronic) communication. Two-way voice-based emergency communication is currently ensured within all Member States and throughout the Union. The seamless access across the administrative and national borders without registration is also implemented. Similarly, the means of access, alternative to voice or synchronised with voice, for end-users with disabilities have to enable the two-way interactive communication in all scenarios. The interactive communication should allow the swift communication, replicating the effectiveness of natural communication/interaction. Technological solutions implementing

[104] Article 15(2) and Recital 57 of Regulation (EU) 2022/612: "Alternative means of access through emergency communications enable roaming customers, in particular roaming customers with disabilities, to access emergency services through means other than calls. For example, alternative means of access may be ensured through emergency applications, messaging, relay services or real time text or total conversation implemented pursuant to Article 4 of Directive (EU) 2019/882."

[105] Functional criteria for the assessment of technical solutions for equivalent access to emergency services for end-users with disabilities were established in the e-Mercury study: two-way communication, seamless access across administrative/national borders with no registration, appropriate answering and handling and awareness.

real time text and total conversation allow the communication with the call handler with the highest speed, for end-users that are not able to effectively communicate through voice only.

b) No pre-registration when travelling within the Union

Subject to technical feasibility, the alternative means of access should be available in a seamless way, without pre-registration, to end-users with disabilities travelling within the Union[106]. In current implementations, pre-registration is applied by some Member States for the use of SMS or applications-based emergency communications. In some cases pre-registration is used in Member States because of the need to limit the specific, non-voice emergency communications traffic only to end-users with disabilities. This might be due to the limited resources in the PSAP systems to handle the emergency communications or the impossibility to re-route the emergency communication to an idle PSAP resource, as is the case with legacy PSAP systems. Registration should be interpreted as a precondition to use an alternative means of access every time the end-user enters (travels) in a Member State, for example: completing a web registration form, downloading an application and registering, etc. It might not be technically feasible to implement the requirement of 'no pre-registration' through measures taken only in a single jurisdiction or Member State. Therefore, the technical feasibility of such solutions might rely on cross border agreements/arrangements that is not under the control of one single Member State.

c) Free of charge access

Similarly with end-users that have the right to access emergency services through emergency communications by using the single European emergency number '112' free of charge, end-users with disabilities should not be charged for the use of the alternative means of access.

d) Appropriate answering and handling

Similarly with the safeguards applicable to the use of the '112' number for other end-users, alternative means of access for end-users with disabilities have to reach the most appropriate PSAP with the goal to request and receive emergency relief. The effectiveness of the emergency relief is affected inter alia by the speed of emergency communication and the timely processing of the contextual information, including caller location information. Depending on the PSAP organisation, the competences to answer (i.e. response by a human operator) and handle (e.g. be able to communicate in sign language, to be able to receive and interpret contextual data and further route it to the most appropriate PSAP or emergency service) emergency communications are set on a geographical basis or depending on the capacity of the PSAP to process a certain type of emergency communication. Specialised PSAPs or specialised personnel could be designated to handle alternative means of access, in particular by handling text or video based communication. As explained above in chapter 4.3 relay services might need to be used to interpret the sign language communications. The effectiveness of the handling/processing of the emergency communication is also dependent on the capacity of the PSAP to convey the contextual information in a timely manner to the competent emergency services.

e) Provision of caller location information

[106] Article 109(5) EECC: "[…] The Commission and the national regulatory or other competent authorities shall take appropriate measures to ensure that, whilst travelling in another Member State, end-users with disabilities can access emergency services on an equivalent basis with other end-users, where feasible without any pre-registration […]".

The alternative means of access for end-users with disabilities should benefit from a functionally equivalent caller location information with the one that is provided with the call to '112'. This means that the quality of the caller location should meet the same accuracy and reliability levels of quality. By virtue of equivalence the caller location information should be provided free of charge for the end-user and the PSAP.

f) Awareness

Member States have to ensure the awareness on use of the single European emergency number '112', as well as its accessibility features, including through initiatives specifically targeting persons travelling between Member States and end-users with disabilities[107]. The single European emergency number '112' has a high rate of awareness amongst Europeans, 71% know about it in their own country while 41% know that it can be used across the EU[108]. Awareness of the means of access is a precondition of effective access to emergency services. There is no such harmonised means of access to emergency services for end-users with disabilities. In terms of implementation, similar effects could be achieved by implementing EU-wide access through real time text and total conversation to '112'[109] as mandated by the European Accessibility Act (EAA) or access through a means of access that would benefit from a similar level of awareness. The Roaming Regulation[110] ensures that roaming end-users with disabilities are informed on the alternative means of access.

5.2.2. Reporting obligation

Member States are obliged to ensure that end-users with disabilities, including those using roaming services, can access in an equivalent manner emergency services through emergency communications. As presented in sub-chapter 5.2.3 the functional equivalence requirements proposed, were generally supported by BEREC and relevant stakeholders, in particular a non governmental organisation representing persons with disabilities. The same contributors indicated the preference for the implementation of native network enabled real time text and total conversation services. The importance of continued monitoring of the accessibility of emergency communications was also highlighted by BEREC in an earlier Opinion on the market and technological developments and on their impact on the application of rights of end-users in the EECC[111]. Therefore, in order to enable the monitoring of the compatibility, quality, reliability, interoperability and continuity of the means of access to emergency services for end-users with disabilities, Member States' competent authorities should report the means of access to emergency services deployed in their jurisdiction for end-users with disabilities, including those using roaming services. The report should contain an assessment of the compliance of the reported means of access against the functional equivalence requirements. Member States should report to the Commission the means of access to

[107] Art. 109(7) EECC

[108] https://europa.eu/eurobarometer/surveys/detail/2232

[109] Article 109(7) EECC: "Member States shall ensure that end-users are adequately informed about the existence and the use of the single European emergency number '112', as well as its accessibility features, including through initiatives specifically targeting persons travelling between Member States and end-users with disabilities. That information shall be provided in accessible formats, addressing different types of disabilities. The Commission shall support and complement Member States' action".

[110] Articles 15 and 16 of Regulation (EU) 2022/612

[111] BoR (21) 177, op. cit., p. 12.

emergency services not later than one year after the entry into force of the Delegated Regulation, and every time a new mean of access for end-users with disabilities is deployed in the Member State. Member States should inform the Commission when the technical design of the mandated means of access to emergency services does not require or allow the use of the single European emergency number '112' and how it is ensured that the same or higher awareness is reached amongst end-users with disabilities with regard to that means of access.

5.2.3. Feedback received and the Commission services views

BEREC in its opinion generally supported the functional equivalence requirements proposed in the draft Delegated Regulation. However, in BEREC's view it is not necessary to refer to the technical feasibility of solutions as it is already part of the principle of proportionality, and it may lead to the implementation of different solutions in different countries rather than optimal service implementations based on international developments in technologies and standards. BEREC further suggested that a reference to the EAA should be made in the Article 4 rather than a recital for consistency reasons and that adding a link to the EAA and the timelines therein could be beneficial when considering accessibility measures for electronic communication towards PSAPs. With regard to specific means of access to emergency services, BEREC noted that real time text is already dormant in many handsets, but needs to be activated by mobile network operators in cooperation with handset or operative system providers. BEREC suggested that the draft Delegated Regulation could be used to ensure that accessibility solutions that are dormant in handsets are activated in Member States. Furthermore, in BEREC's view, the applications dedicated to end-users with disabilities may serve as supplementary services. BEREC further advised that, if an EU-wide application was to be considered, the objective should be a European harmonized application or a set of applications for all end-users, including disabled end-users, which would allow for routing of mobile application based emergency communications to the most appropriate PSAP at home and when roaming. BEREC noted that timely availability of such a European application(s) might also alleviate problems when accessing emergency services with voice over LTE when 2G and 3G networks are being phased out. Nonetheless, in the BEREC view, the primary solution for emergency communication should be standardised network- and handset-native services.

In the 'Have Your Say!' portal, with respect to emergency applications, several contributions, including from one non-governmental organisation that represents persons with disabilities from across Europe, expressed the view that these should be complementary to natively enabled text or video-based emergency communication, in particular when it comes to means of access for end-users with disabilities.

With regard to the implementation of means of access to end-users with disabilities, the Commission services underline that the Delegated Regulation is without prejudice to the obligations set in the EAA and the legal deadlines provided therein. Under these rules, Member States have to ensure by 28 June 2027 the appropriate answering by the most appropriate PSAP of the emergency communications to the single European emergency number '112', namely by using synchronised voice and text (including real time text), or, where video is provided, voice, text (including real time text) and video synchronised as total conversation. Emergency applications are complementary means of access to emergency services that have the potential to serve all end-users, and not only end-users with disabilities.

5.2.4. Impact of the proposed measure on the effectiveness of emergency communications

The proposed measures will ensure a common understanding of the equivalence requirement across the EU and hence ensure a high standard of quality and effectiveness of emergency communications for end-users with disabilities. It would also contribute to the reduction of the fragmentation of technical solutions deployed across the EU and discarding of technical solutions that do not meet the equivalence criteria. Furthermore, when developing any solutions for end-users with disabilities in the future, both the Member States and solution developers would benefit from the clarity stemming from the common understanding of 'equivalence'. Member States have to ensure the implementation of real time text and total conversation service as of 2025 under the European Accessibility Act. However, they have the discretion to deploy other means of access with the condition of complying with the equivalence requirement.

The reporting process would enable the Commission to monitor compliance with the obligation to ensure equivalent access to emergency services for end-users with disabilities. The reporting will support the exchange of best practice between Member States and the identification of technical feasibility issues and solutions.

5.3. Routing to the most appropriate PSAP

Member States have to ensure that access to emergency services is provided through emergency communication to the most appropriate PSAP. As explained in section 1.1.3, the most appropriate PSAP has the competence to adequately answer and handle the emergency communication. Timely routing to the most appropriate PSAP has a direct impact on the effectiveness of emergency communications. The emergency communications and gathering the contextual data from emergency communications should not be delayed by the routing process. Timely routing to the most appropriate PSAP should be ensured for any type of emergency communication. These include multimedia communications to the single European emergency number '112', through voice, text and video (e.g.: calls, real time text, total conversation). As presented in section 4.4, in packet-switched networks the routing to the most appropriate PSAP may be done both through network domain routing and PSAP domain routing. Flexible routing policies allow the identification of the available and competent PSAP, best placed to handle the emergency communication. As presented in section 2.2, the most appropriate PSAP shall convey, in a timely manner, the contextual data derived from the emergency communication to the emergency services.

The migration to all-IP networks triggers the deployment of electronic communication services in packet-switched network, while services provided on circuit-switched technologies are phased out. For example, in 4G networks Voice over Long Term Evolution (VoLTE) is being deployed. It is expected that voice services will be embedded in 5G services in the foreseeable future. Mobile network operators across the EU announced to decommission 2G and 3G networks and provide voice services on 4G and 5G networks, in particular VoLTE[112]. This evolution will prompt the need to enable the PSAP systems to ensure that emergency

[112] https://www.gsma.com/aboutus/workinggroups/key-areas/volte-roaming

communications via end-to-end packet-switched technology are adequately answered and handled. While the technological migration and deployment of voice, real time text, and total conversation services are not aligned across the EU, national authorities are best placed to assess the impact of the migration on the continuity of emergency communications. Competent authorities, network operators and PSAP organisations will need to cooperate to assess the implications of the technological migration on emergency communications. The e-Mercury study indicated that interoperability issues at network and handset level might affect the continuity of VoLTE services because fragmented implementations, in particular in roaming.

Taking into account the 2G and 3G sunset of national network operators, Member States shall draw up roadmaps on the evolution of their PSAP system in their territory to handle packet-switched communications, in particular VoLTE. This is needed in order to identify potential compatibility, interoperability and continuity issues that might affect packet-switched emergency communications, in particular VoLTE at different implementation stages of the roadmap. The Commission services will analyse these issues with a view to decide on the necessity of imposing measures, including mandating standards, that ensure the continuity of emergency communications across the EU.

5.3.1. Requirement on routing to the most appropriate PSAP

In view of the direct impact of the timeliness of routing on the effectiveness of emergency communications, Member States should ensure that the emergency communication and the caller location information is routed to the most appropriate PSAP without delay.

Depending on the national PSAP system the routing to the most appropriate PSAP could be done in the network domain (by public networks) or it can be done in the PSAP domain. The most appropriate PSAP has the key role of gathering the contextual information on the emergency incident. As presented above, in the context of the technological migration to all-IP communications on packet-switched networks voice, real time text and total conversation services will be delivered through emergency communications enabled by packet-switched technologies. Accordingly, the PSAP system will have to be able to receive such communications and derive the contextual information from it with the goal to make it promptly available to emergency services. Therefore, Member States shall ensure that the emergency communication is routed to the most appropriate PSAP that is technically capable to convey in a timely manner the contextual information to the emergency services from the moment those services are alerted by that PSAP. According to the national organisation of PSAPs, the most appropriate PSAP may assess the usefulness of the contextual data and filter the information to be provided to emergency services.

5.3.2. Obligation to cooperate

Ensuring seamless access to emergency services would require compliance with commonly agreed interoperability requirements. Without prejudice to the implementation of real time text and total conversation services pursuant Directive (EU) 2019/882, access for all end users to emergency services through voice, text or video services may be implemented, as complementary means of access, though emergency communications via mobile applications. As presented in sub-chapter 5.3.4, a number of stakeholders showed support to the standardisation of applications to enable their interoperability across the EU. BEREC and

relevant stakeholders highlighted the importance of the implementation of the European Accessibility Act within the deadlines provided therein. These stakeholders expressed the preference for natively enabled means of access in the network and handsets, without the need to download an application. Mobile Applications may enable, as a complementary means of access, the transmission of rich contextual data to the most appropriate PSAP and could serve all end-users, not only end-users with disabilities. Once the mobile application is downloaded and installed, the end-user may communicate with the most appropriate PSAP across the Union if the common interoperability requirements enable that, and the mobile application providers and the national PSAP systems comply with these requirements. The cooperation of Member States with the Commission in good faith is needed to identify the common interoperability requirements the implementation of which would enables the use of emergency communications to the most appropriate PSAP via mobile applications across the Union.

5.3.3. Reporting obligation

Competent regulatory authorities shall report to the Commission the performance of the routing systems implemented for emergency communications and caller location information in the context of the data gathering organised under Article 109(4), for the report to the European Parliament and to the Council on the effectiveness of the implementation of the single European emergency number '112'.

As presented in section 5.3.4 BEREC and relevant stakeholder recognised the importance of technological migration for emergency communications, including the upgrade of the PSAP systems to be able to answer and handle packet-switched emergency communications. Competent regulatory authorities will need to prepare and provide to the Commission a roadmap for upgrading the national PSAP system in their territory to be able to receive, answer and process emergency communications through packet-switched technology one year after the entry into force of the Delegated Regulation. While the measure would warrant the transparency towards all involved national stakeholders, it would also ensure the coherent and timely upgrade of the PSAP systems. The reporting obligation will enable an overview of national roadmaps of technological migration that will contribute to set an organised and transparent path towards such migration. The objective of the roadmap will be to ensure that all features emergency communications provided via packet-switched technologies are tested and deployed with the PSAP systems in a timely and cost-effective manner. Therefore, the roadmap should contain the necessary intermediary milestones, under national rules, for example public and stakeholder consultations, legislative measures, interoperability and reliability testing, public procurement, etc. Competent authorities should include in the report the expected date of deployment of emergency communications using packet-switched technologies, and if applicable, the expected legal mandate to deploy emergency communications through packet-switched technologies under national legislation. In particular, in line with the opinion expressed by BEREC and relevant stakeholders, the roadmap should contain information on the timeline of the upgrade of the capabilities of the PSAP systems, taking into account of the obligations set in the European Accessibility Act, within the legal deadlines provided therein, in order to allow the appropriate answering by the most appropriate PSAP of the emergency communications to the single European emergency number '112', namely by using synchronised voice and text (including real time text), or, where video is provided, voice, text (including real time text) and video synchronised as total

conversation. Member States will report to the Commission on the implementation of each stage of the Roadmap and on the interoperability, reliability and continuity issues identified.

5.3.4. Feedback received and the Commission services views

BEREC agreed with putting the focus on routing, especially in the context of migrating to all-IP or when using applications or "over-the-top solutions". In the BEREC opinion it may not be possible to ensure routing to the most appropriate PSAP without delay in case of technological limitations in roaming or border areas, or in the case of nomadic VoIP services, and BEREC underlines that harmonisation is important in addressing interoperability issues. Furthermore, in BEREC's view a short or longer-term roadmap should be set up by the draft Delegated Regulation in order to address all the envisaged problems concerning routing, and that the draft Delegated Regulation should envisage a roadmap to harmonise the solutions throughout the Member States. While BEREC expressed doubts as regards the need for reporting on the routing performance and on the roadmap to upgrade the PSAP system, it also suggested that guidance regarding such reporting would be necessary.

BEREC highlighted that harmonisation and standardisation are crucial in order to solve the problems that currently exist in emergency communications. BEREC is of the view that coordination in handling interoperability issues among Member States would be essential and noted that packet-switched emergency communications could be considered one of the future goals in Europe.

A significant number of stakeholders, including one global organisation, two non-governmental organisations and a public authority, confirmed that emergency communications solutions have to adapt to the migration to packet-switched network technologies.

Moreover, a number of stakeholders, including a global organisation, one non-governmental organisation and a public authority, highlighted the importance of standards to ensure the interoperability of emergency communications at handset, network and PSAP level. A number of stakeholders, including a business association and a global organisation, signalled the lack of interoperability in particular with regards to VoLTE communications. Specifically in respect to the VoLTE interoperability issues, one stakeholder urges the Commission to consider more binding incentives to ensure progress on VoLTE interoperability across all EU mobile networks and devices traded in the Single Market, including provisions mandating for the testing of this interoperability to help identify and incentivise any necessary upgrades. Concerns were raised by a number of stakeholders, including a business association and a global organisation, regarding the unavailability of access to emergency services in the context of the decommissioning of 2/3G networks, in Member States where the VoLTE communication is not seamlessly available for emergency communication purposes, suggesting that such networks should be maintained in those Member States. Support was received by a global organisation and two business organisations, with regards to the provision of national roadmaps for technological migration to packet-switched communication. In this context the issue of VoLTE based eCall availability was raised. Some stakeholders, including a global organisation and a public authority, indicated the need to bring certainty to the timeline of the migration by imposing a migration deadline.

Support was expressed by a number of stakeholders, including a business association and a public authority, with regards to the goal of achieving the interoperability of emergency

applications and a business association suggested to allow only a small number of national applications or a single EU wide application in order to facilitate the standardisation process and to avoid fragmentation.

A number of stakeholders, including a non-governmental organisation, indicated the need to implement harmonised solutions for emergency communications originated in private networks.

The Commission services note that the VoLTE interoperability issue reported by the stakeholders has several layers of complexity. These issues are not limited to implementation at electronic communication network and services level but also handset implementations. Hence the measures addressing them would fall outside of the scope of the mandate given to the Commission in Article 109(8) EECC. The Delegated Regulation requires Member States to report on interoperability and continuity issues encountered enabling the Commission to assess the necessity of adopting further measures, including standardisation mandates.

The Commission services consider that with regard to the timeline of the PSAP upgrades across the EU, the scope of the mandate provided in Article 109(8) EECC does not allow the imposition of a harmonised migration deadline since the mandating of emergency communication technologies as well as the migration of the PSAP systems to packet-switched communications falls within the competence of the Member States. In addition, the decommissioning of 2/3G networks is subject to the decision of networks operators. The Delegated Regulation will enable an overview of national roadmaps of technological migration that will contribute to set an organised and transparent path towards such migration. This will help the relevant stakeholders to anticipate and prevent interoperability or continuity issues, in particular in roaming, and appropriately address them.

As regards private networks, under Article 109(1) EECC, Member States shall promote the access to emergency services through the single European emergency number '112' from private networks. However, it is for Member States to mandate emergency communications from such networks. Currently, such emergency communications are mandated in a limited number of Member States, therefore this issue has not been addressed in this first Delegated Regulation.

5.3.5. Impact of the proposed measures on the effectiveness of emergency communication

Imposing a timeliness requirement of the routing of emergency communications would ensure the effectiveness of emergency communications in the context of the migration to all IP networks. This is necessary to ensure the quality and interoperability of emergency communications across the EU. The effectiveness of the routing systems will be monitored in the context of the report under Article 109(4) EECC optimising the administrative burden attached to the reporting obligation.

The cooperation between the Member States and the Commission could enable the identification of common interoperability requirements that make possible the emergency communication to the most appropriate PSAP via a mobile application anywhere in the Union. As an example of best practice that could be emulated in the future, it may be recalled

the recent experience of the EU Digital COVID Certificate that was deployed by establishing an EU gateway for the interconnection of national systems[113].

The reporting on the PSAP technological upgrade roadmaps and the timeframe of the deployment of packet-switched emergency communications, allows the timely identification of the potential compatibility, interoperability and continuity issues that might affect these processes. The reported interoperability and continuity issues will enable the Commission services to assess the necessity of adopting further measures, including standardisation mandates, that would address such bottlenecks.

[113] https://joinup.ec.europa.eu/collection/open-source-observatory-osor/news/eu-gateway-eu-digital-covid-certificate