TURKEY

NG112 Project

Report

In this Final Report for EENA's Next Generation 112 Project, discover the findings of the consortium based in Turkey.

EUROPEAN EMERGENCY NUMBER ASSOCIATION

TURKEY

NG112 Project Report

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1 | INTRODUCTION

The implementation of NG112 would address numerous difficulties faced by emergency services, including how to accurately locate a caller who cannot explain where they are and how to effectively warn the public of nearby threats and crises. In addition, NG112 can help to address the needs of the over 80 million Europeans with disabilities[1], for whom the current emergency system may not be accessible.

The concrete aim of this project is to showcase how voice and data can be delivered to Public Safety Answering Points (PSAPs) in a full IP environment using the international standards. The final objective is to launch the deployment of NG112 and promote the NG112 components. In doing so, the project aims to help to improve the quality of emergency response, taking advantage of the relevant available technologies to make emergency services as accessible and effective as possible. The ultimate objective of this project is to help save lives.

The project was assigned to different consortia to test and deploy the technical architecture enabling NG112 in different European countries, with a focus on demonstrating its use in real-life environments. This report summarises the test and demonstration activities that have been completed by the Turkish consortium.

EENA launched the NG112 Project to test and deploy the technical architecture enabling NG112 in different European countries, with a focus on demonstrating its use in real-life environments.

Three consortia were selected for the project:

CELESTE : Austria, Italy, Denmark

Croatia

Turkey

[1] *https://eena.org/wp-content/uploads/2019_04_09_NG112_Project_Description-1.pdf*

2 | OVERVIEW

The Turkish consortium, presented in Chapter 3, demonstrated four uses cases during the NG112 project.

These were:

1. Emergency voice calls are set up from a smartphone in a full IP environment.
2. Emergency video calls are set up from a smartphone.
3. Real-Time Text emergency communications are set up from a smartphone.
4. Intelligent home speakers are used to launch an emergency call in a full IP environment.

These use cases are presented in more detail in Chapters 4 and 5.

In Chapter 6, we explore the testing of emergency video and audio communications. The process and architecture for all use cases are clearly defined in the relevant chapter.

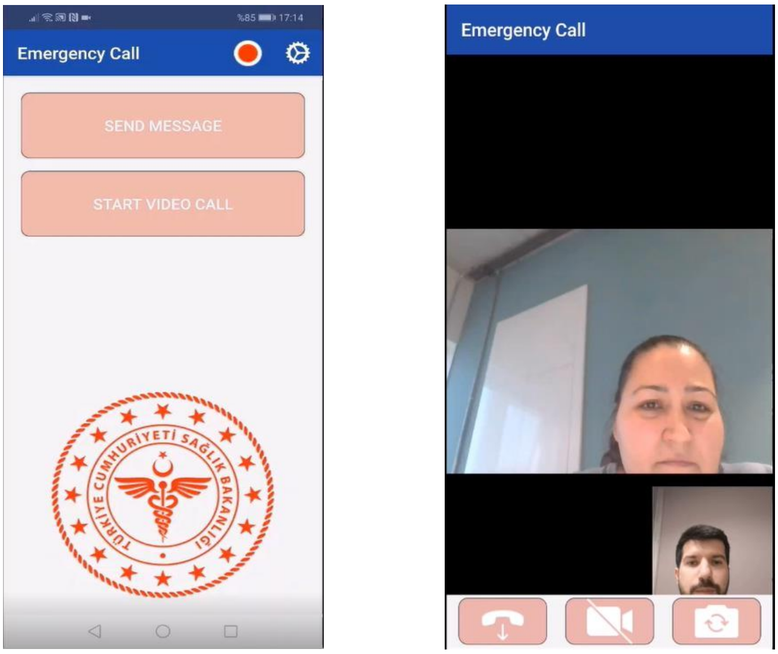


Figure 1: Screenshots for video and audio call (mobile app)

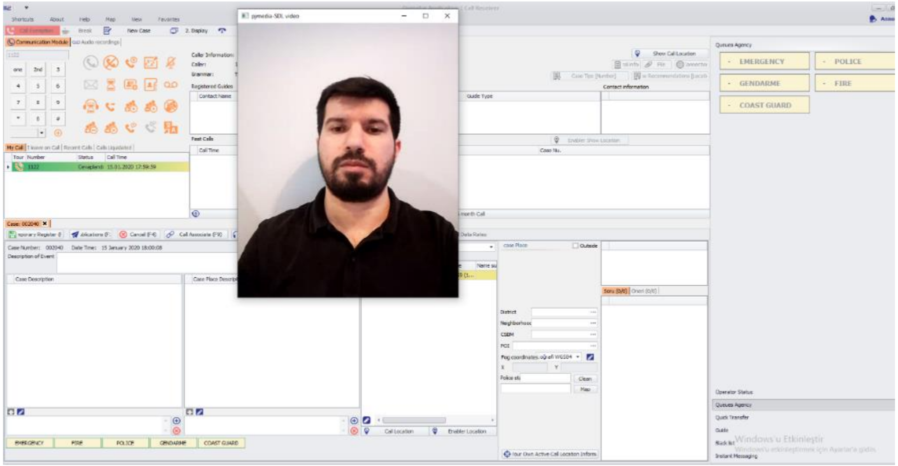


Figure 2: Screenshot 2 for video and audio call (desktop app)

Based on the tests carried out, the consortium plans to implement a video call feature in the desktop app and the ability to transmit the personal health data of the caller.

Chapter 7 introduces us to the testing of emergency text messaging.

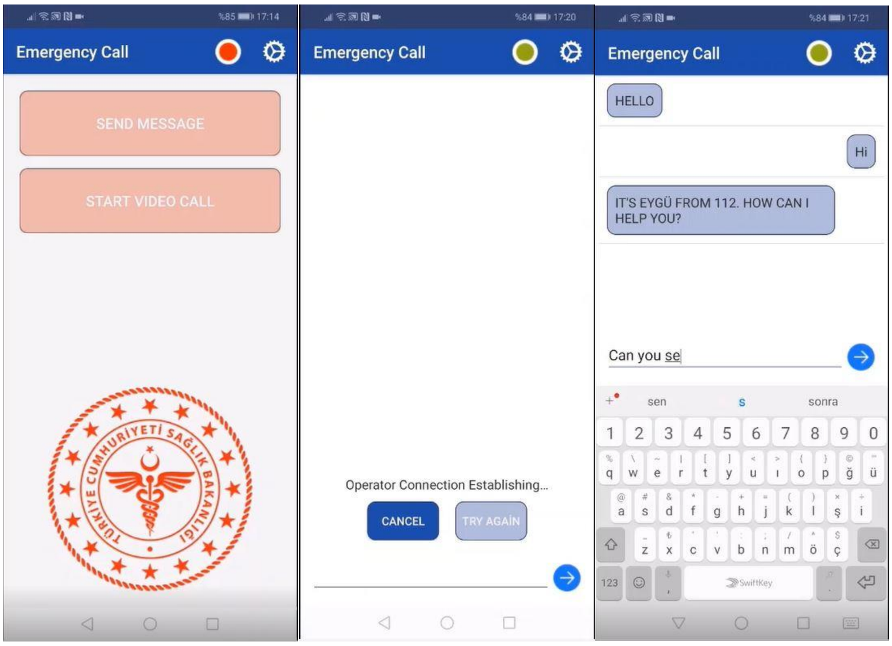


Figure 3: Screenshots for text messaging (mobile app)

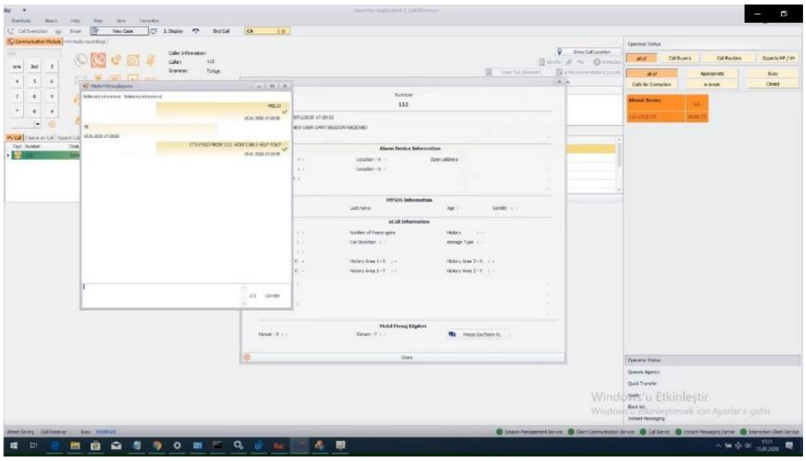


Figure 4: Screenshot for text messaging (desktop app)

The testing revealed that it could sometimes take a long time to write responses through the mobile application, due to the size of the smart phone screen. In response to this, the consortium plans to implement pre-defined smart sentences for both the caller and the call taker.

In Chapter 8, we explore the use case involving the home speaker application. The concept involved several pre-set emergency commands of specific and authorised users which could be detected by the system. Emergency signals would then be dispatched to NG112 centres to request help. The system design, setup, user interface and performance are detailed clearly in Sections 8.1-8.4.

3 | CONSORTIUM

Emergency Ambulance Physicians Association (AAHD)

Role: Medical End User; Emergency Medical Services (EMS) Advisor

Contact: Dr. Turhan Sofuoglu, *turhans112@gmail.com*, Dr. Zeynep Sofuoglu *zeynep.sofu@gmail.com*

About: AAHD was established in 2004 in Izmir, Turkey. The main missions of AAHD are to support RTD and innovation activities in the fields of Disaster Response and Preparedness and Emergency Medical Services. AAHD is highly experienced in responding to medical emergencies involving different kinds of disasters. AAHD has been actively involved in medical efforts and has responded to earthquakes, mine accidents, Chemical Biological Radiological and Nuclear (CBRN) incidents, major fires, and mass causality incidents in Turkey.

AAHD mainly contributed to the research part of the project: end user requirements, key performance indicators, reference scenarios, training material, as well as demonstration and pilot testing activities of the 7th Framework Programme / Horizon 2020 collaborative and RIA projects.

Turkish Ministry of Health

Role: Coordination among Ministries and Institutions in Emergency (Health) Call Center, Emergency Call Center (112 PSAP)

Contact: Samil Kurgun, *samil.kurgun@saglik.gov.tr*, Dr. Ahmet Haki Turkdemir, *eturkdemir@yahoo.com*

About: Ambulance services operate under Provincial Health Directories in 81 provinces in Turket, which are provincial organisations of the Ministry of Health in Turkey. 112 was used only as a health emergency number between 1994-2007. Ambulance, police, fire brigade and gendarmerie emergency numbers were combined with the 112 Single Emergency Call Number project that started in 2007. This project is ongoing and 112 Single Number Centres exist in 45 provinces.

Next Generation 112 Emergency Call Centre Software is used in 21 provinces. A joint call centre has been launched with all emergency institutions and the responsibility of the centres has been transferred to the Ministry of Interior. Now, all calls (police, gendarmerie, rescue teams, fire brigade, forest fire etc.) are transferred to a single number via 112 and sharing is provided within the building.

Applications are made with full digital exchange, location information, data sharing and SMS. Location information can be shared withs stations from all lines of communication. Accident location information, vehicle notification and all interviews can be accessed without interruption. An instant software and communication connection is established with all hospitals and data sharing is provided. 112 Call Centre can be accessed directly from the Ministry of Health Tourism Health Call Center and in 5 foreign languages. Direct access from vehicle accidents has been developed with the eCall study. With the 112 barrier-free practice, people with hearing and speech impairments can contact 112.

Armakom Information Technologies, Ankara, Turkey

Role: RTT, Emergency Video Call, Emergency Call from Intelligent Speaker

Contact: Ahmet Sevinc, *ahmet.sevinc@armakom.com*, Eygu Aksaray, *eygu.aksaray@armakom.com*

About: Armakom Information Technologies have been developing turnkey solutions for operation management systems, mobile data communication technologies and Internet of Things (IoT) since 2002. With the highly experienced crew, know-how and cutting-edge solutions developed with business partners – the pioneer technology companies in Turkey – today the solutions are used in a large number of organisations. The demand for our solutions is rapidly growing with the high customer satisfaction achieved.

Armakom's Emergency Call Management System has been developed meeting the specific requirements of Turkish Republic Ministry of Health and Ministry of Interior with the power of almost two decades of experience of R&D studies home and abroad, that is constantly updated with emerging technologies.

The solutions are used in all 81 provinces of Turkey. The 112 Emergency Call Management System is used in 57 provinces under the management of the Turkish Republic's Ministry of Health. The Next Generation Emergency Call Management System, under the management of the Turkish Republic's Ministry of Interior, is used in 24 provinces. In these 24 provinces, departments like Health, Police, Fire, Disaster and Emergency Management Presidency (AFAD), and Coast Guard are controlled from a single point with the Next Generation Emergency Call Management System. Police, Gendarmerie and Fire Departments in other provinces use Armakom's solutions, custom-made for their specific needs.

Havelsan, Ankara, Turkey

Role: NG112 Intelligent Home Speaker (command recognition system) – detection and recognition of predefined commands of authorised speakers

Contact: Dr. Tolga Sönmez, *tsonmez@havelsan.com.tr,* Çağlar AKMAN, *cakman@havelsan.com*

About: HAVELSAN offers a new generation of technologies from end to end with 38 years of experience in the fields of defence, simulation, ICT, homeland security and cybersecurity. Aside from being accepted as one of the largest and leading technology firms of Turkey, HAVELSAN is also a leading trademark in the international market as well as having deep-rooted experience, competent and specialised employees, and high-technology based software-intensive solutions and products. Furthermore, HAVELSAN proposes a wide variety of smart solutions involving mathematical modelling, signal processing, control systems, algorithm development and artificial intelligence under modelling and sensor technologies.

4 | PROJECT USE CASES

The NG112 project aimed to define how data-based emergency communications can be delivered to Public Safety Answering Points (PSAPs). The following use cases have been described and proposed to the participating consortiums:

(1) Emergency voice calls are set up from a smartphone in a full IP environment. This includes call routing based on location (and possibly based on additional policies) and the delivery of caller location information.

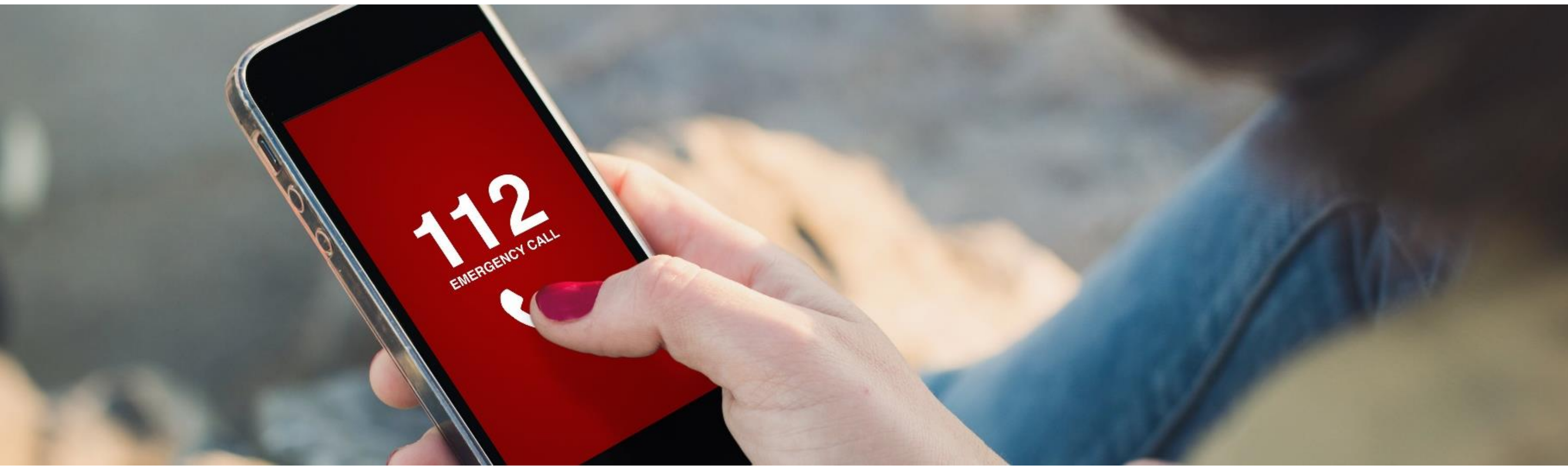
(2) Emergency video calls are set up from a smartphone.

(3) Real-Time Text emergency communications are set up from a smartphone.

(4) Intelligent home speakers are used to launch an emergency call in a full IP environment. The emergency call is routed to the most appropriate PSAP and handled by emergency services including location information data.

(5) A public warning message ("reverse-112") is sent to the home speaker based on its location (registered address or real-time location).

The Turkish consortium chose to demonstrate the first 4 use cases in the project according to the NG112 Long Term Definition document.



5 | CONSORTIUM USE CASES

As technology continually improves, 112 solutions should also improve by means of using new technology. With this idea, we implemented four new features in the Turkish 112 system according to Next Generation 112 System (NG112). The features are:

- Emergency Text Messaging module (Desktop & Mobile) – By implementing this module, the aim is to increase the options for requesting help. For example, after an earthquake, it is almost impossible to make a phone call and request help. With an application on mobile phones, one can initiate emergency text messaging with the PSAP and request an ambulance. In this scenario, the messaging is initiated by pressing the SEND button from the mobile application. The messaging request is delivered to the most available call taker and the reciprocal messaging starts as soon as the call taker accepts the messaging request. The messaging is like vocal communication. The call taker does not receive alerts for any other call request until the messaging ends.
- Emergency Audio & Video Call module (Desktop & Mobile) – As in the Emergency Text Messaging Module, the aim of implementing this module is also to increase the options for requesting help. With an application on your mobile, you can initiate an emergency video call with the PSAP and talk with the call taker face-to-face.
- Emergency Call from Intelligent Home Speaker (Desktop) – With the implementation of this module, the aim is to initiate an emergency communication request through a home speaker, with recognised pre-defined emergency keywords like "help", "ambulance", "fire", etc. from an authenticated speaker.

6 | EMERGENCY VIDEO & AUDIO CALL

(USE CASES 1 & 2)

The emergency video and audio call use the following architecture that is defined by the EENA *NG112 Long Term Definition Document*[2].

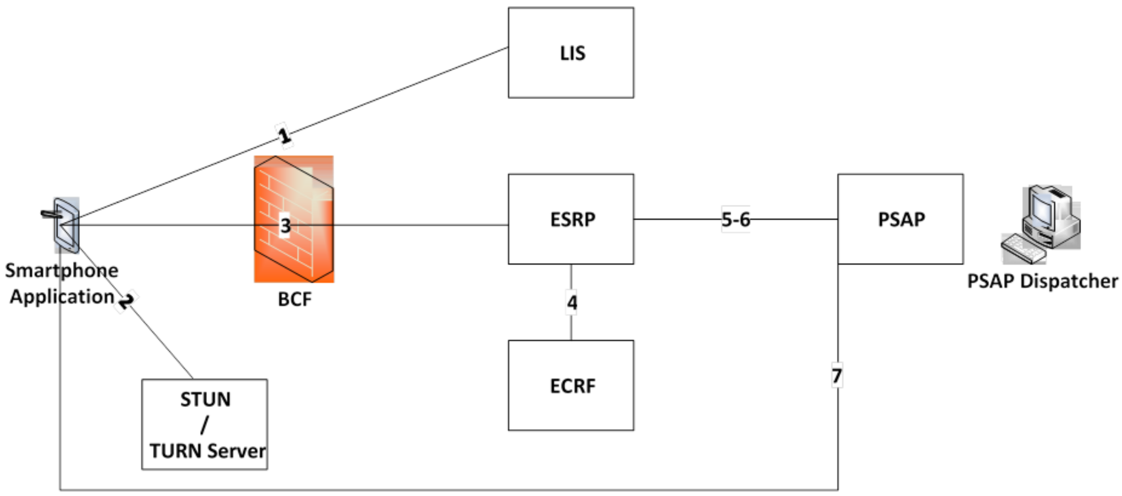


Figure 5: Emergency Video and Audio Call Architecture

The process for the emergency video and audio call has the following steps:

(0) The video call request is started by the application on the caller's smart phone.

(1) The precise caller location is published through a web service

(2) INVITE initiates from STUN Server

(3) INVITE SIP message is sent through BCF

(4) ECRF finds the correct PSAP according to the caller's location

(5) ESRP proceeds the request to the selected PSAP

(6) The request is directed to the first available call taker and as the call taker accepts the video call, the PSAP returns SDP (Answer) + ICE to the caller

(7) The media used between the caller and the call taker is transferred through the ESRP

[2] *https://eena.org/document/ng112-long-term-definition-standard-for-emergency-services/*

The screenshots taken through software tests:

Mobile App:

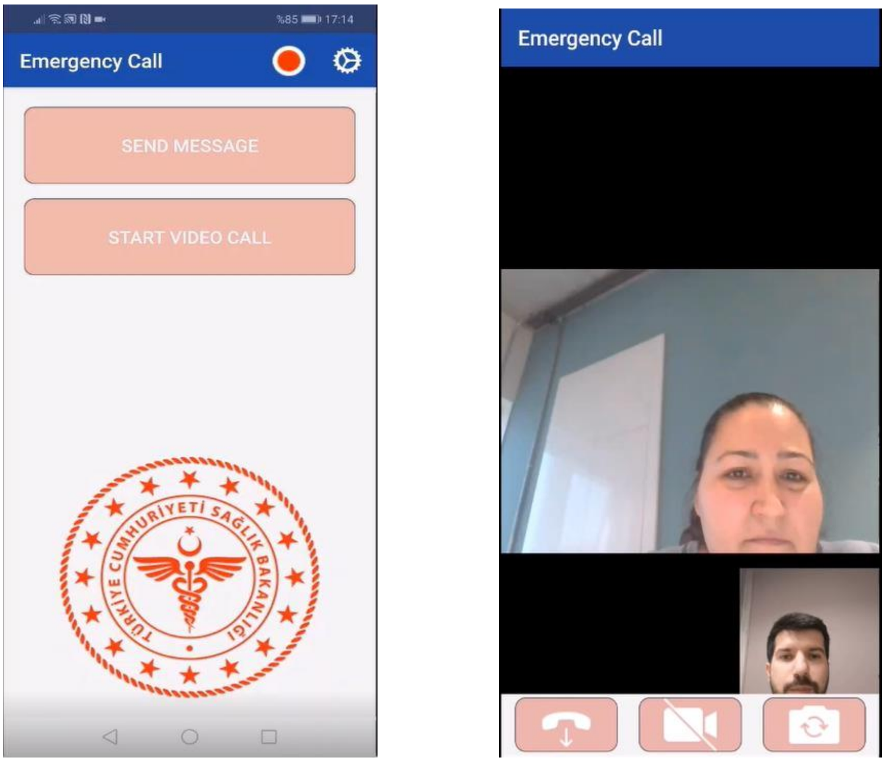


Figure 6: Screenshots for video and audio call (mobile app)

Desktop App:

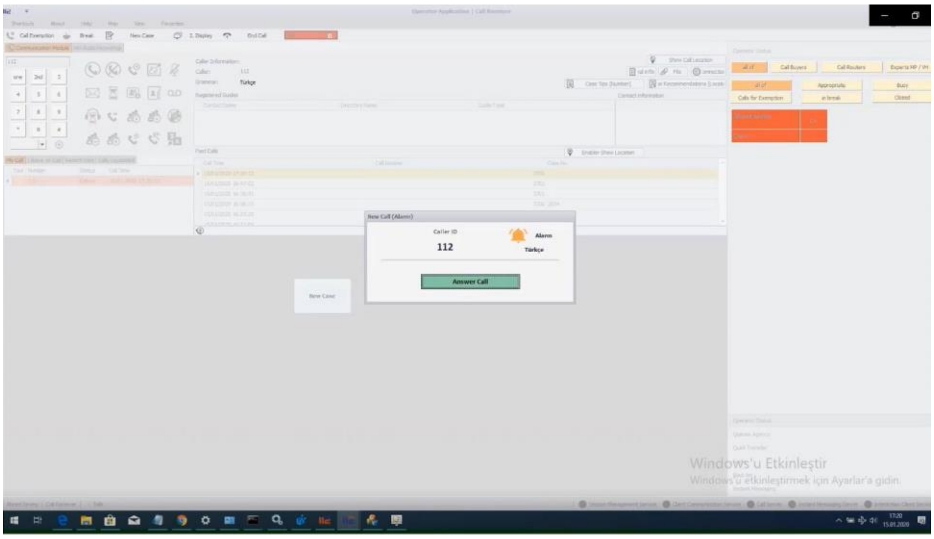


Figure 7: Screenshot 1, for video and audio call (desktop app)

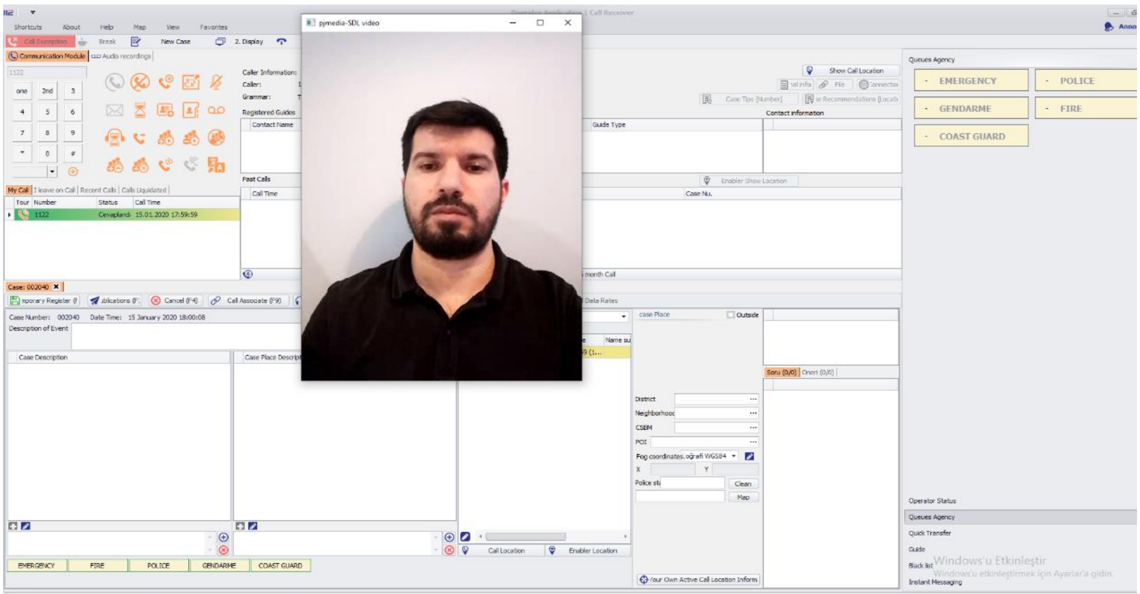


Figure 8: Screenshot 2 for video and audio call (desktop app)

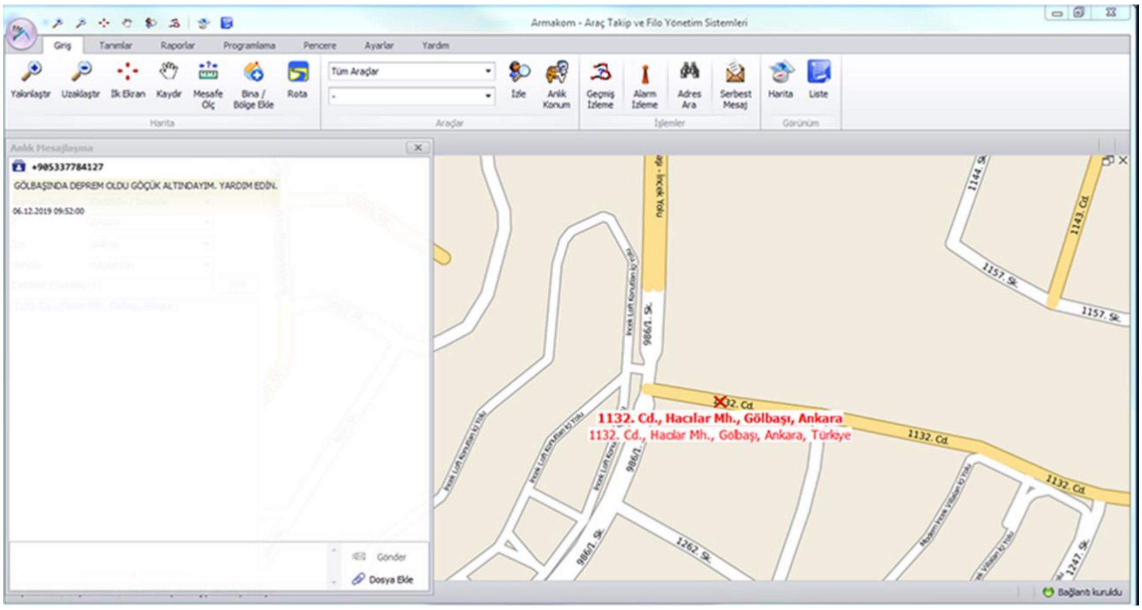


Figure 9: Location information screenshot

6.1 | DIFFICULTIES EXPERIENCED

At the beginning of the implementation, the quality of the standard video encoding used was not good within an acceptable data size. For this reason, we had to improve the quality of the video being transmitted.

During the software and field tests, we realised that we must indicate to the call taker that the location information received from the caller is precise location.

As the call taker is using a personal computer, the video taken from the PC should be optimised in order to reduce bandwidth requirement during the video call.

6.2 | FUTURE WORK PLAN

In the future, we plan to implement some features in order to improve the quality of the modules and make the interfaces more user-friendly.

- Implementation of video call feature to the desktop application – While testing scenarios, we realised that sometimes there are reasons to call back the caller. If the caller made a video call to request help, the call taker / dispatcher should also call back the caller through a video call. Now, the NG112 system does not have such an ability and it should be implemented.
- Implementation of transmission of personal health data of the caller – As the caller is requesting for him/herself; it would help the dispatcher if he/she knows the pre-diagnostics about the caller. For instance, whether he/she has a chronic diagnosis or is using medicine that should be taken into consideration during dispatch or when applying first aid.
- This could be done in two ways:
    1. By integrating with the *e-Pulse application*[3] of Ministry of Health through web services.
    2. By transmitting the data provided by the caller through the mobile application.

[3] *https://enabiz.gov.tr/Yardim/Index?lang=en*

7 | EMERGENCY TEXT MESSAGING

(Use Case 3)

The emergency text messaging uses the following architecture that is defined by the EENA *Long Term Definition* document[4].

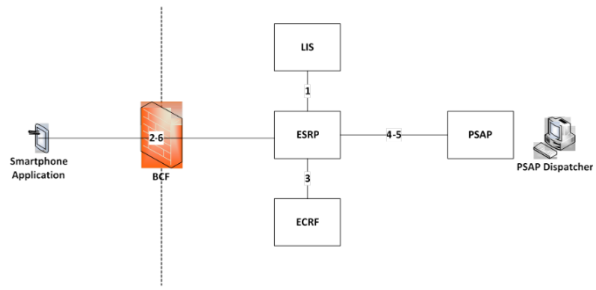


Figure 10: The emergency text messaging architecture

The process for the emergency text messaging has the following steps:

(0) The text call request is started by the application on the caller's smart phone.

(1) The precise caller location is sent through a web service

(2) The smartphone application starts a web service request through BCF

(3) ECRF finds the correct PSAP according to the caller's location

(4) ESRP proceeds the request to the selected PSAP

(5) The request is directed to the first available call taker and as the call taker accepts the text call, the PSAP returns an ACK to the caller

(6) After the ACK process, a text messaging session is initiated between the dispatcher and the caller and the text messages are transferred via web services.

[4] *https://eena.org/document/ng112-long-term-definition-standard-for-emergency-services/*

The screenshots taken through software tests:

Mobile App:

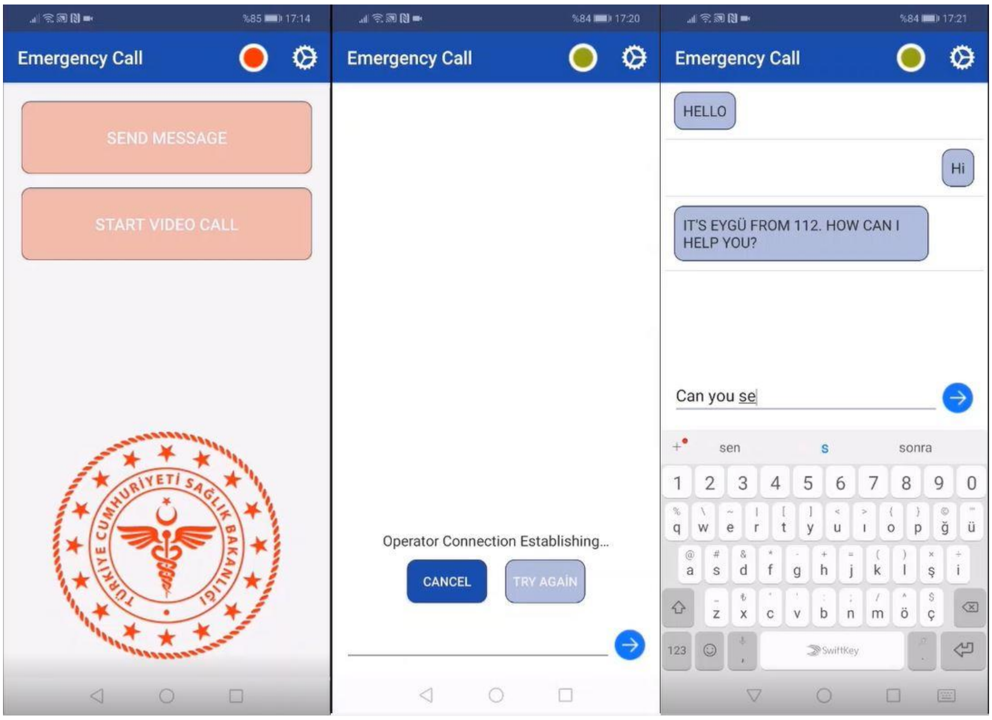


Figure 11: Screenshots for text messaging (mobile app)

Desktop App:

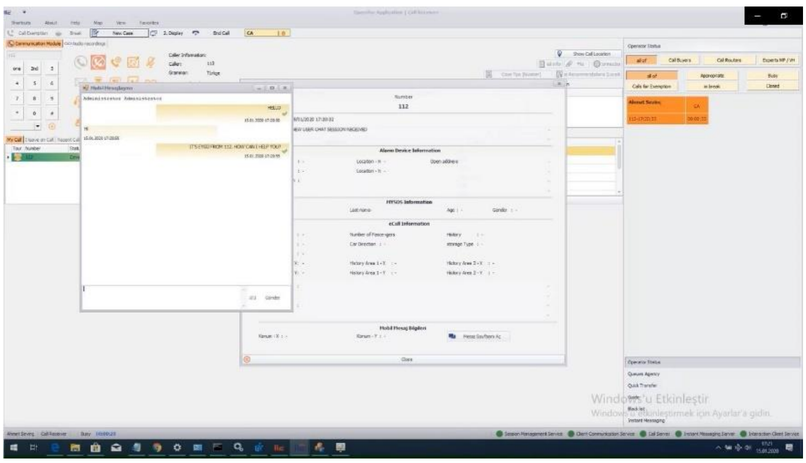


Figure 12: Screenshot for text messaging (desktop app)

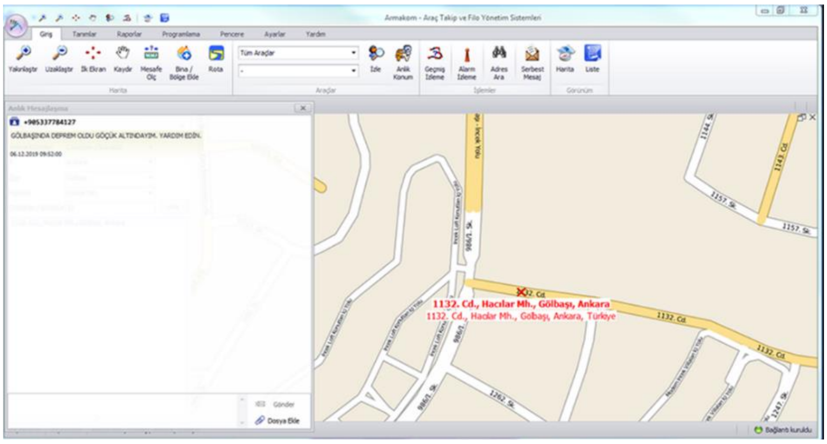


Figure 13: Location info screenshot

7.1 | DIFFICULTIES EXPERIENCED

During the emergency text messaging tests, we realised that it would take long time to write through the mobile application as the size of a smart phone screen limits the user.

7.2 | FUTURE WORK PLAN

In the future, we plan to implement some features in order to improve the quality of the modules and make the interfaces more user-friendly.

- Implementation of predefined smart sentences to be offered to both client and call taker – During the tests, we saw that it may take time to write every single word. For this reason, there should be an intelligent sentence offering mechanisms in both applications. In this way, the time taken to take action should be reduced.

8 | INTELLIGENT HOME SPEAKER APPLICATION

(Use Case 4)

The service aims to transform the current traditional call-based service to a voice over IP (VoIP) based call service that can be extended by the addition of other services. The goal of this sub-system is to develop a system that can detect the pre-set emergency commands of specific and authorised users, and then to dispatch emergency signals to the NG112 centres via Internet connection.

The NG112 Command Recognition System consists of a single microphone, a speech processor unit (desktop processor or a cloud service) and internet connection to the NG112 centre. The system is platform independent such that the system can run with any kind of microphone and operating system (Windows, Linux, Android, IOS etc.). The system performs not only command recognition but also speaker verification. The system can be scaled with any number of commands for any number of speakers. The speakers need to train the system for their own voices by repeating their commands a few times. After that, the system is updated and the system starts recognizing the new speaker for the emergency communication.

8.1 | SYSTEM DESIGN

High Level System Architecture

The intelligent command recognition system consists of a microphone for collecting surrounding speech and a connected processing unit providing "speaker and speech" recognition results to the central unit and clients. The system diagram is depicted in Figure 4.

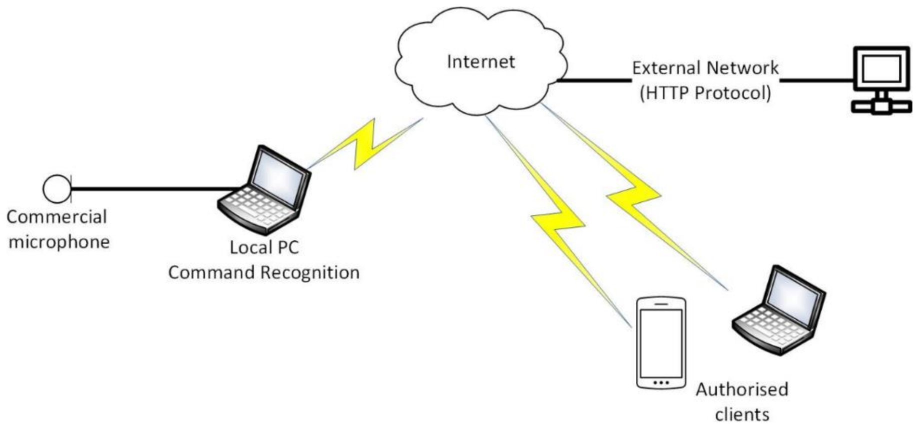


Figure 14: Top Level System Diagram

Microphone

The microphone can be selected as an ordinary commercial microphone for the system setup. In fact, the system is designed to work with any kind of microphone. However, the performance of the system is directly related to the specifications of the microphone. For the best system performance, the microphone should have the following specifications:

- The microphone should be omni-directional so that it can collect all surrounding speech with unity gain.
- The frequency band of the microphone should be appropriate for the human voice frequency interval [20 – 20.000] Hz.
- The sensitivity of the microphone should be high enough for indoor cases. The system should be adjusted so that it catches the speech at the required noise level.

Furthermore, the system performance may be further increased by using microphone array with beamforming algorithm so that the microphone gain increases and noise is suppressed[5].

[5] K. Kumatani, J. McDonough and B. Raj, "Microphone array processing for distant speech recognition: From close-talking microphones to far-field sensors," *IEEE Signal Processing Magazine,* vol. 29, no. 6, pp. 127-140, 2012.

Processing Unit

The processing unit can be any device varying from a local PC to a low-cost and low-power commercial embedded computer supporting Linux or Windows. In detail, the architecture of speech recognition software is modular and flexible for different platforms. The algorithm modules are in python language. The software is independent of an operating system and any hardware.

NG112 System Integration

In the NG112 solution, the command recognition system is integrated to the NG112 network as depicted in Figure 15.

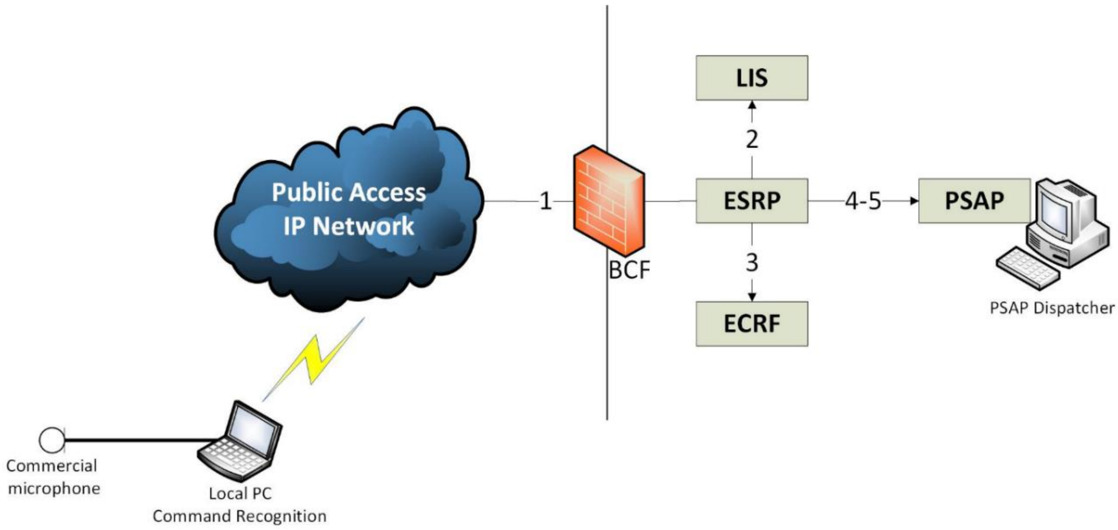


Figure 15: Command Recognition System (Integrated to NG112)

(0) Command recognition system continuously listens to the surrounding environment in pre-defined window intervals. When the system detects an authorised command (i.e. help, police, fire, ambulance etc.) of an authorised speaker, the detected command with speaker ID is sent to the server.
(1) The message is sent via http protocol from the command recognition system to the centre.
(2) Location information is inserted to the message via LIS (Location information service).
(3) PSAP (Public safety answering point) is found via ECRF (Emergency call routing function).
(4) The message proceeds to the selected PSAP.
(5) When the IP connection is accepted, ACK (acknowledge) returns back to the caller.

8.2 | SYSTEM SETUP

The command recognition system requires a microphone (connected to the PC wired or wireless), a processor unit (embedded computer or a local PC) and an internet connection. After installing the command recognition software on the processor unit, the system is ready to use.

Training Mode

1) The system is switched to training mode.

   The system should be trained by command records of the authorised speakers:
2) Authorised speakers repeat 5 or 10 times the same predefined command one by one

   This process is done for each command by each speaker.
   Example commands: ["Ambulance", "Police", "Fire", "Help", etc.]
3) The system automatically generates HMM and stores.

   Users can configure the authorised people by deleting an existing user or adding a new user.

Run-time Mode

1) The system is switched to running mode for online mode.

   It continuously monitors the environment only for specific commands in the list from the authorised speakers.
2) If the system is connected to the internet and the destination address is entered, then the system sends the detected commands and speaker identification result to the centre via the network.
3) The system is switched off for offline mode.

8.3 | USER INTERFACE

The command recognition system has a console interface for system setup and configuration as depicted in the figure below. The console interface might be used as engineering interface as well as proof-of-concept user interface when the command recognition system is used standalone. The console interface is basically used for speaker and command configuration, model generation and performance tests. In addition, it provides real time speech recognition console interface which shows only the detected command and the speaker. In fact, the output of the command recognition system is provided to external systems; thus, the user interface of the external system can display the result properly.

Figure 16: Command Recognition System (Console UI)

The modes and operations of the command recognition system are listed below:

Table 1: Command Recognition Systems Modes and Operations

1	The 1st option is the Real Time Listening mode. This is the default operation mode of the system and the system will identify speakers and commands registered to the system when they are spoken.
2	The 2nd option is to add new data to the system. The new data will be entered by first choosing the speaker, and then choosing the command. The recording time for a new entry is 2 seconds. The system will continue to ask for new data for the chosen speaker and command until the exit key of X is entered. After entering the new data, the model will be updated only after the 3rd option is executed to train the models.
3	The 3rd option trains the models with the current data and updates the current list of speakers.
4	The 4th option is a performance test. The model never uses the last entry for each speaker and command, and these entries are used in this method for testing the models.
5	The 5th option is a one-time version of option 1. It listens for 2 seconds as if it is taking a new entry, but it only estimates the new entry in this option. If there is no conclusion for a speaker or a command, the estimation result will be “None”.
6	This option deletes all the training data.
7	This option deletes specified speaker with all of its commands. The 3rd option should be executed as the model is updated after this command.
8	This option deletes specified command from each speaker. The 3rd option should be executed as the model is updated after this command.
9	This option deletes specified command from the selected speaker. The 3rd option should be executed as the model is updated after this command.
X	The option X exits the program.

8.4 | SYSTEM PERFORMANCE

The command recognition system continuously monitors the environment and seeks pre-defined commands from authorised people. The command recognition system performance results are as follows:

- Simultaneous real-time command detection accuracy above 95%
- Simultaneous real-time speaker identification accuracy above 95%
- Up to 20 commands (single and compound commands) detection
- Up to 3-5 speaker detection
- Speaker authorisation (only authorised speakers are detected)
- Near real-time command and speaker recognition (only network latency exists in an integration)
- Software runs on both Linux and Windows
- Cost efficient, only microphone hardware and a local PC are required.

8.5 | FUTURE WORK PLAN

Speech recognition is becoming more popular for human-machine interaction. In this application, we have shown a high success rate for recognising limited emergency call keywords while relaying the calls for authorised people only. In the future studies, we will add more keywords for a better specification of the emergency. We will analyse and provide strict compliance to General Data Protection Regulation (GDPR). We will also adapt our software to more home speaker devices that are already on the market.

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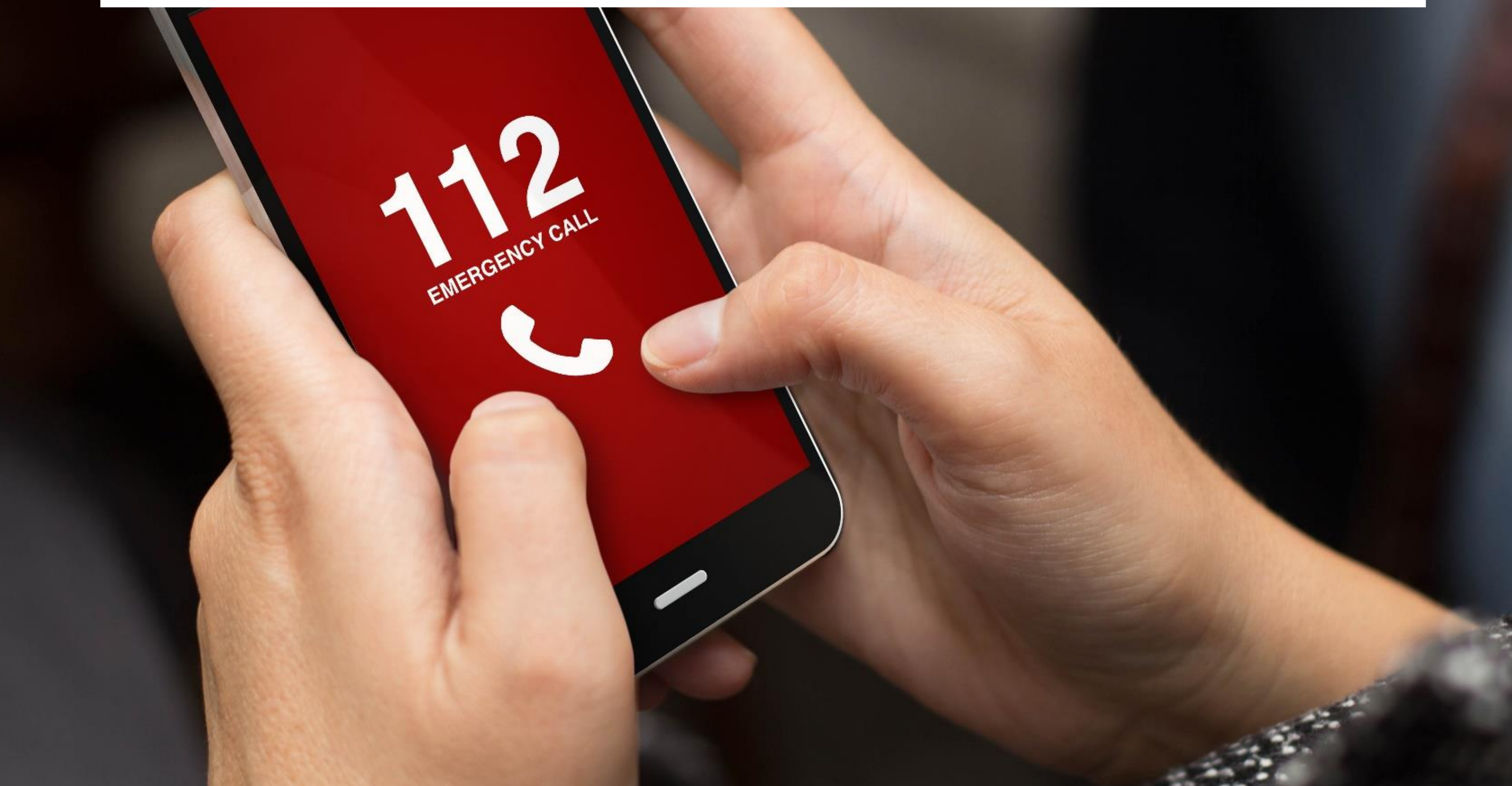

10 | GLOSSARY

ACK : Acknowledgement

BCF : Border Control Function

ECRF : Emergency Call Routing Function

ESRP : Emergency Services Routing Proxy

HMM : Hidden Markov Model

ICE : Interactive Connectivity Establishment

LIS : Location Information Server

PSAP : Public Safety Answering Point

RIA : Research and Innovation

SDP : Sesion Description Protocol

STURN : Session Traversal Utilities for NAT

TURN : Traversal Using Relays around NAT