Project Number: 688624

Project Acronym: Q4Health

Project Title: Quality of Service & Prioritisation for Emergency Services in the LTE Ran Stack

Final Public Summary

V1.0 Initial Version 26 March 2017

Quality of Service and prioritisation

for emergency services in the LTE RAN stack

Project number: 688624

Deliverable D5.5 Final Public Summary

Author(s)	UMA Team: Almudena Díaz, César A. García, Álvaro Martín, Pedro Merino and Álvaro Ríos
	Eurecom Team: Navid Nikaein, Konstantinos Alexandris, and Shahab Shariat.
	RedZinc Team: Donal Morris, Ricardo Figueiredo, Terry O' Callaghan, Pilar Rodríguez, Paulo Silva Vitor, Jeanne Caffrey
Status	Final
Version	1.0
Date	2017-03-26

Objectives

The objectives of the Q4Health project were defined as follows:

Objective 1   Integrate RedZinc's BlueEye wearable paramedic video system and Eurecom's OpenAirInterface systems at the Fed4FIRE & FLEX facilitate on the PerformLTE testbed and configure the testbed to perform six experiments.

Objective 2   Conduct three EPC experiments related to these systems in the area of Application to service control, In Building Handover, OpenFlow/EPC Integration in order to identify and measure a range of KPI improvements.

Objective 3   Conduct two radio access experiments related to these systems in the area of antenna performance measurements and scheduler control in order to identify and measure a range of KPI improvements.

Objective 4   Create an integrated platform to validate the total system and provide a showcase for interested third parties in order to demonstrate the complete set of KPI improvements.

Seventeen Project level key performance indicators (KPI) are were measured in a set of experiments. Nine experiments were implemented:

Experiment	Experiment Name (defined in the DoA)	
EPC	**Experiment A**	Application to EPC Service Control Evolution of the Rx interface using OpenFlow
	Experiment B	Application Controlled In Building Handover Between LTE pico cells, small cells and Wi-Fi

Public

	Experiment C	Group Video over OpenFlow at Adjacent Macro Cell OpenFlow to support group sharing of video/audio directly to adjacent eNodeB without trombone to EPC
Access	**Experiment D**	Scheduling Optimisation for Priority Video Scheduling programmability through API allowing application-specific resource allocation
	Experiment E	UE Antenna evaluation Comparison of belt mounted wearable antenna
Additional Experiments	**Experiment Zero**	Functional test to verify functions on the blueEye as deployed in Malaga testbed
	Experiment G	Modem comparison (Telit LTE modem with Intel Chipset vs Quectel modem with Qualcomm chipset)
	Experiment H	Battery Life Analysis
Showcase	**Experiment F**	Integrated Experiment to showcase optimal features Validation of all features with end to end validation and showcase

These experments wereimplemented over a period of 26 months from January 2016 to Feburary 2018 and Experiment F is a good summary of the project. Experiment F is the integration of the previous experiments of the project, it comprises the configuration and procedures to reproduce them in an optimal way having in account the selection of the most appropriate components and the information learned during the previous work. This experiment is split into two parts focused is:

1. Experiment F1 RAN, scheduling and local video server integration.
2. Experiment F2 EPC and Fog communication with commercial eNodeB

Experiment F1 exploits the SDN-based RAN monitoring and programmability capability implemented in OpneAirInterface to enforce the required QoS policy to satisfy the SLA of BlueEye users. Experiment F2 takes advantage of the capabilities of the Fog GW to provide a solution for group communication without the overhead of the EPC routing between two users connected to the same eNodeB.

Several Showcases and events have been realized with the aim of present the project to the stakeholder: emergency services, 4G telcos and the LTE research and development community.

- – EuCNC 2017 Showcase
- – Malaga Police Showcase
- – Granada paramedic Showcase
- – Windfarm Showcase

With these Showcases, not only the objectives of the project have been evaluated but also we have obtained a global vision of the needs covered from the point of view of the final user. The level of acceptation into the market and the impact of the project for the potential customers: paramedics, police, tele-maintenance, etc.

Four showcases/pilots were implemented. Two of these were in operational environments.

EUCNC June 2017- As mentioned, the EuCNC conference was also used to perform a continuous demo of the results obtained during the project. The demo compared the latency seen by a user connected to the local mobile network (owned by Telia Finland) and the same user connected to our setup with a MEC solution to expedite the distribution of packets when possible, showing a significant latency reduction when the system is active. At EuCnC in Oulu a showcase was prepared for a number of parties including:

Emergency Doctor in Oulu hospital

Medical image expert at Oulu hospital (University Department)

Senior executive from Deuteche Telekom

Research personnel from various European research companies.

Malaga Police. In August of 2017, Q4HEALTH realized a Showcase with the collaboration of the Malaga Police service. Along the Feria of Malaga, an annual, public, and cultural event, the Police used the BlueEye service in security controls like registers in the access points, controls during the cleaning activities or horse carriages eviction, among others.

Andalucía 061 Ambulance Service. A two-day demo was located in the CMAT clinical training center in Granada, two scenarios were prepared Andalucia 061 Ambulance Service:

- - A response to an ictus suffered in the house of the patient, with direct communication to the hospital coordinating the paramedic response.
- - An accident and run-over scenario in a street with different vehicles involved and patients with injuries of several magnitudes. In this case, the communication was established to the emergency centre coordinating the response.
- - See further details in the videos.

Windfarm in Ireland. Testing of BlueEye UE at Windfarm in Cappawhite, Co Tipperary, Ireland, 20 December 2017.

- Cappawhite Wind Farm is located at the southernmost extent of the mountain range known as the Hollyford Hills in Tipperary South Riding.

The highlight of the project is the interest in which the stakeholders have in the outcome of the project. The main highlight of this period has been to realize realistic cases with <u>real</u> professionals who have seen great opportunities to improve their services thanks to the service presented in this project. The participants of the showcases could verify the improvements that the solutions which this project comprises offer in comparison with the current solutions of the <u>mobile</u> network, nowadays.

Regarding impact, when a person has a heart attack or a stoke it is important to provide rapid treatment. There is a 'golden hour' during which rapid treatment is important and patient brain or heart tissue can be saved. But it can take some time for an ambulance to arrive and to bring the person to a hospital. RedZinc's innovative product BlueEye is designed to allow remote doctors to directly support paramedics and ambulance technicians in assisting patients, during the 'golden hour' in acute pre-hospital situations. BlueEye can directly impact patient outcomes by enabling remote expertise at the scene of the emergency.

The rise in healthcare costs as a percentage of economic growth or GDP continues to expand faster than the average economic growth. In an effort to save costs and optimize healthcare, digitalization and virtualization of care are slowly transforming healthcare from a hospital-based, specialist-driven system towards a distributed, patient-centered care model with the point-of-care shifting to the periphery. Wearable video with high definition camera, mounted on glasses, can support acute pre-hospital patients triage decisions, remote diagnosis, treatment and monitoring, enhancing patient outcome. The potential benefits are:

- **Emergency Doctors** can accelerate decision making with pre-hospital triage
- **Paramedics** can provide additional remote expertise, enhancing productivity
- **Patients get** earlier diagnosis & treatment in emergencies and potentially better outcomes
- **Health Funders** get greater efficiency by pre-hospital triage, reduction in transfers and hospital bed costs if patients are stabilised at home (e.g respiratory patients).

"Mobile high definition video communication offers the opportunity to increase patient safety in prehospital emergency medicine in highly developed emergency systems. It is likely to increase patient safety in countries with less developed prehospital emergency systems as well."

-International Journal of Reliable and Quality E-Healthcare