5G Emergency Communications

Evangelos Markakis and Ilias Politis

1. Introduction

The migration of telecom operators to broadband IP infrastructures enforces emergency systems to follow this path and adapt their emergency communication platforms to fulfil next generation emergency services regulatory requirements. A key factor pushing towards this end is the support of diverse applications and services with heterogeneous performance requirements, including mission critical IoT communication, massive machine-type communication and Gigabit mobile connectivity. Eventually emergency systems will have to be upgraded to fulfil the next generation networks (NGN) regulatory requirements [1]. Legacy systems, protocols and the services provided by the emergency communications organizations and the public safety sector in general are going to be affected particularly by the increased performance of the next generation wireless and mobile networks, the enhanced security and the improved device-to-device communications.

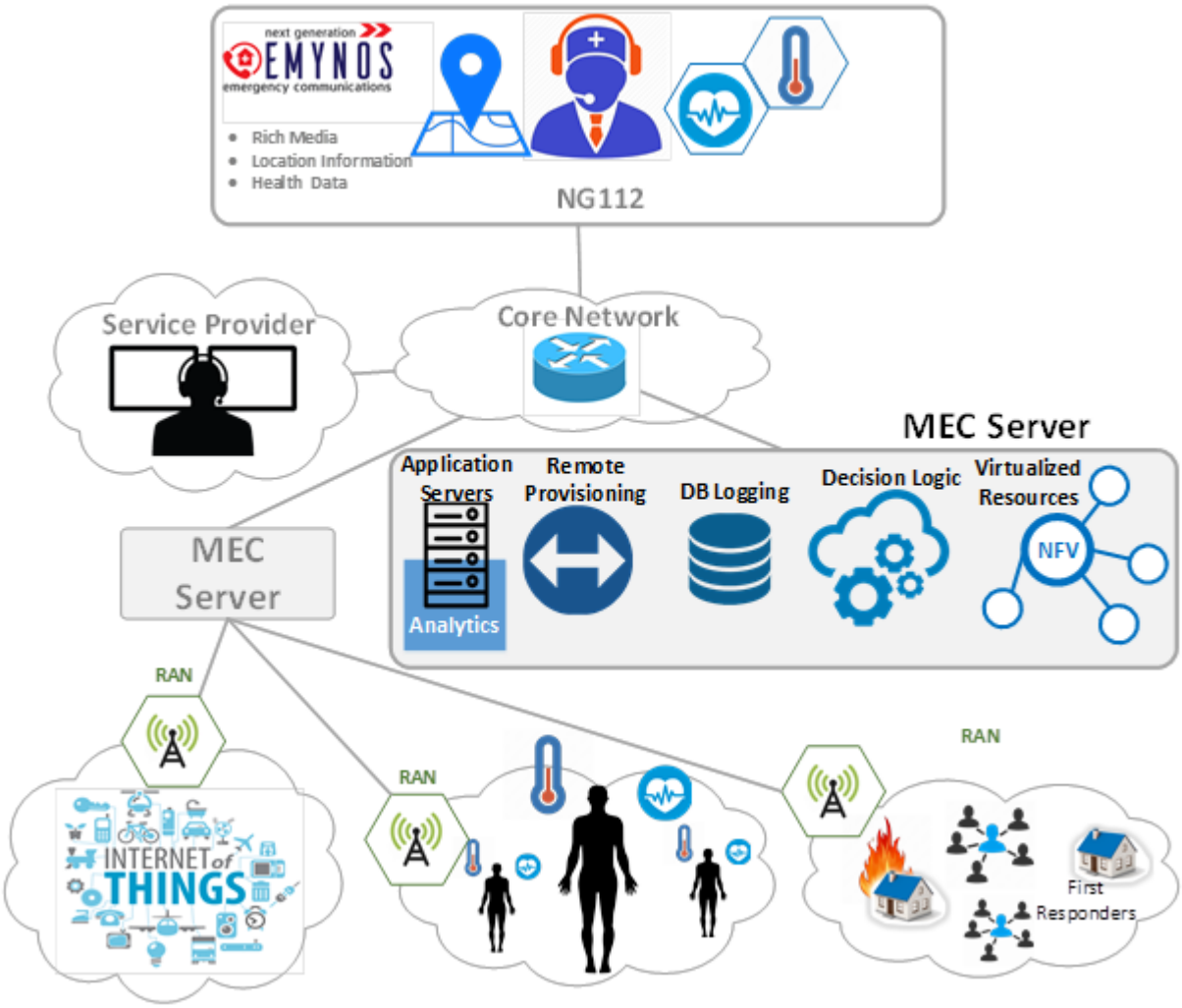
The envisioned 5G features will need to be tightly coupled with the stringent operational and management requirements of emergency services, which need to be maintained. Depending on the actual design of the 5G network, emergency communication is expected to support real-time, high priority total conversation services (voice, video, real-time text) and improved immunity to data pollution and security threats that potentially could disrupt the reaction time of the first responders [2]. Additionally, device-to-device communications will increase the availability of the communication channels and the uplink capacity, creating an "always connected" experience for the emergency workers and rendering them capable of utilizing high quality multimedia content for improved awareness. Towards this end, the network-slicing feature of the 5G network will enable network operators to dynamically adapt the transmission speed and latency of the network, ensuring high priority for first responders' communications [3]. To satisfy the strict requirements imposed by emergency communications and Public Protection and Disaster Relief (PPDR) services in general, the network operators are expected to ensure ultra-low latency, ultra-high availability and reliability for these services. Due to the low latency that will be provided by the underlying access network, next generation emergency services based on massive IoT and device-to-device communications will be characterized by higher throughput, higher Quality of Service (QoS) and Quality of Experience (QoE) and low buffer requirements for the user devices [4].

2. 5G Emergency communications paradigm

Mobile Edge Computing (MEC) has recently been proposed to fill this niche not well served by existing cloud architectures. MEC is regarded as a key enabling technology, which provides the capability to have a high performance virtual environment residing at the network's edge [5]. By being adjacent to the IoT environment, MEC can support applications and services with increased bandwidth, low latency and improved QoS [6].

Based on the ideas addressed in [7] the health care provider controls the MEC, therefore all the monitored data are stored and processed to the Cloud Edge. Potential emergencies, which would require remote intervention (e.g., emergency call back to the user, remote calibration of pharmaceutical dose, etc.) is detected at the MEC level. In the case where the emergency requires the intervention of first responders to the area, the health care provider initiates an emergency call to the emergency service operator, augmented with the current health sensor data, along with the patient's location information, medical history and insurance data. In the case of a fire detected by the building management system, the security service provider who owns the MEC platform can initially verify that it is not a false positive alert from video footage available from the site. Alternatively, an emergency call to the fire brigade is initiated, including a building floor plan for the first responders. Finally, the MEC's remote provisioning system can be utilized to decrease the sensors reporting interval to provide near real-time data delivery.

Opposite to what is the traditional case for emergency service networks based on GSM and LTE, where each one of the physical networks is reserved for one use case (e.g., GSM for voice, LTE for mobile data), the proposed network architecture for 5G emergency services can create and managing virtual instances of access networks, Hence providing customized network resources to each emergency service agency (i.e., police, ambulance, fire-brigade) to the area of the event.



The network slicing will eliminate communication interference between the different networks, ensuring extremely high throughput and ultra-low latency. This flexible orchestration of network slices is realized using software defined functions and programmable infrastructures. RAN's backhaul are governed by the NFV infrastructure, the control of which relies on the MEC. In this case, the bandwidth allocated to each wearable for the health monitoring, or the first responders' communication devices, the management of the traffic including delay, loss, active bearers, etc., are synchronized by the NFV controller located in the MEC.

3. Conclusions

As most operators have already migrated to broadband IP infrastructures, emergency systems also need to follow this path and adapt their emergency communication platforms to fulfil regulatory requirements in terms of next generation emergency services. Emergency service operators are against an enormous challenge to synchronize their model of operation with the 5G paradigm. The transition to 5G for emergency service providers is a chance for migrating their system to support an amalgam of diverse applications and services with heterogeneous performance requirements, including mission critical IoT communication, massive machine-type communication and Gigabit mobile connectivity.

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Evangelos Markakis (markakis@pasiphae.eu) holds a PhD from the University of the Aegean. Currently he acts as a Senior Research Associate for TEI of Crete and he is the Technical Manager for the HORIZON 2020 DRS-19-2014 “EMYNOS". His research interest includes Fog Networking, P2P applications and NGNs. He has more than 30 refereed publications in the above areas. He is a Member of IEEE ComSoc and acts as Workshop Co-Chair for the IEEE SDN-NFV Conference.

Ilias Politis received his Ph.D. in multimedia networking from the University of Patras in 2009. He is a postdoctoral research fellow at the School of Science and Technology at the Hellenic Open University and at the Wireless Telecommunications Laboratory of the Department of Electrical and Computer Engineering at the University of Patras. His research interests include multimedia networking, monitoring and management of multimedia QoE, and 3D video streaming.