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e-Health Technical Committee NewsLetter

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On behalf of the e-Health Technical Committee (TC) of the IEEE Communications Society (ComSoc), we wish all our members a very instructive reading of this letter.

The contribution from this edition is coming from Pangea https://pangea-group.net/ and Kingston University London reporting on the 5G Smart Ambulance project https://www.kingston.ac.uk/news/article/2150/21-jan-2019-equipping-ambulances-with-5g-video-streaming-kingston-university-project-with-global-connectivity-provider-pangea-set/ Funded by Innovate UK and Pangea.

Members of the e-Health community are invited to contact the author for further information or collaborations.

We also welcome all our members to share their research activities and field experiences through this open newsletter and to open up new opportunities for discussions and collaborations.

Editor: Dr. Nada Philip (Kingston University London, UK)

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ENABLING MOBILE HEALTHCARE THROUGH 5G-CONNECTED AMBULANCES ACROSS THE UK

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I. INTRODUCTION

With the steady evolution in cellular networks, the idea of mobile healthcare is becoming increasingly popular. Recent rollouts of 5G networks, which are considered highlight reliable and fast, have underscored the fact that healthcare providers around us are not far from realizing concepts of Mobile Telemedicine and Telesurgery [1]. Using cellular connectivity to provide remote on-the-go diagnosis and treatment will not only enhance the provision of healthcare, but also alleviate the pressure on hospitals especially accidents and emergency (A&E) departments.

An essential part of mobile healthcare is to connect ambulances through cellular networks so that the data produced in ambulances can be shared with remote doctors. Once shared, this data can be used to perform diagnosis and the patients can be directly transferred to the relevant departments instead of burdening the A&Es. 5G networks have the capability to transfer all types of in-ambulance data with ultra-high speeds, 99.999 % reliability, minimal end-to-end delay. The project *5G enabled connected ambulances* is discussed in detail in the next sections.

II. CELLULAR CONNECTIVITY AND MOBILE HEALTHCARE

The key features of 5G New Radio (NR) include three unique use cases that will enable several vertical industries to enhance their current capabilities. These use cases

include enhanced mobile broadband (eMBB), ultra-reliable low latency communication (URLLC) and massive machine type communication (mMTC) [1]. The most relevant use case in terms of healthcare is the URLLC as reliability and end-to-end latency are of utmost importance when transmitting or sharing medical data. Mobile healthcare can only be made possible and commercially viable if reliability can be ensured as loss of data is simply not an option when it comes to medical data transmission.

Several related works across the globe are underway, which highlight the importance of 5G enabled mobile healthcare in terms of Telemedicine and Telesurgery. Examples can be found in [2] and [3] where authors have discussed how 5G is going to enable in-ambulance treatments, early diagnosis, and telesurgery. Though 4G networks have the capability to provide high speeds and low end-to-end delay but they cannot fulfill the requirements of reliability in terms of transmission errors or packet losses. Requirements of mobile healthcare in terms of reliability are shown in Fig. 1 for different types of in-ambulance data.

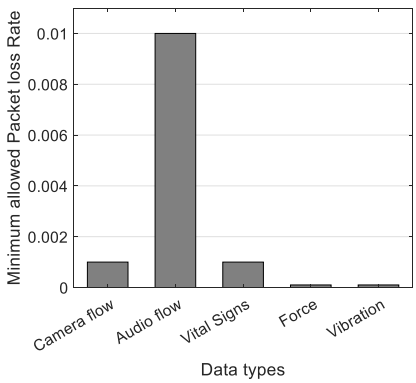

Fig. 1. Requirements for mobile healthcare in terms of reliability [1].

III. THE 5G ENABLED CONNECTED AMBULANCES

Based on our survey of National Health Services (NHS) in the United Kingdom (UK), the 6300 NHS ambulances have only basic two-way radio communication. There is no data exchange that takes place from the ambulances to the hospitals or doctors during the in-ambulance transit. A typical NHS ambulance is equipped with devices that record patient's vital signs and sonography equipment which is used for focused assessment with sonography in trauma (FAST). FAST is a rapid bedside ultrasound examination performed by certain trained paramedics as a screening test for blood around the heart (pericardial effusion) or abdominal organs (hemoperitoneum) after trauma. This data, which is produced at the scene of emergency or during the in-ambulance transit, becomes useful mostly when the patient arrives at a nearby A&E.

The 5G connected ambulance project aims to connect ambulances across UK through a 5G network with URLLC ensuring reliability, ultra-fast speeds and end-to-end delay as low as 1 millisecond. In a connected ambulance, a single or multiple camera system will be installed to provide in-ambulance video streaming to the remote doctors along with an onscreen display of patient's vital signs. Ultrasound videos will also be made available through live video streaming that will allow the doctors or physicians to make early diagnosis and provide immediate treatment. A clear flowchart of the 5G enabled connected ambulance project is provided in Fig. 2.

Enabling cellular connectivity in ambulances essentially means that each ambulance will have its own monthly data allowance. As one of the aims of this project is to alleviate pressure on A&Es hence saving potential costs, so having an efficient data plan for each connected ambulance is vital. We aim to reduce the data consumption by designing a smart and intelligent quality of experience (QoE) based video compression system. This compression system will compress the live in-ambulance video streams and ultrasound video streams in careful manner that they don't lose their diagnostic quality and at the same time don't consume too much data.

IV. MOBILE HEALTHCARE: NOW AND FUTURE

Mobile healthcare, Telemedicine and Telesurgery are not only gaining popularity, but these technologies are becoming need of the hour. This section emphasizes the importance and societal benefits of mobile healthcare in the modern-day world and its future impact.

Situations such as patients waiting in long queues to be checked by a local medical specialist can be avoided if they can be examined remotely by another specialist hundreds or even thousands of miles away. Remote lung screening, mammography and various types of ultrasound screening

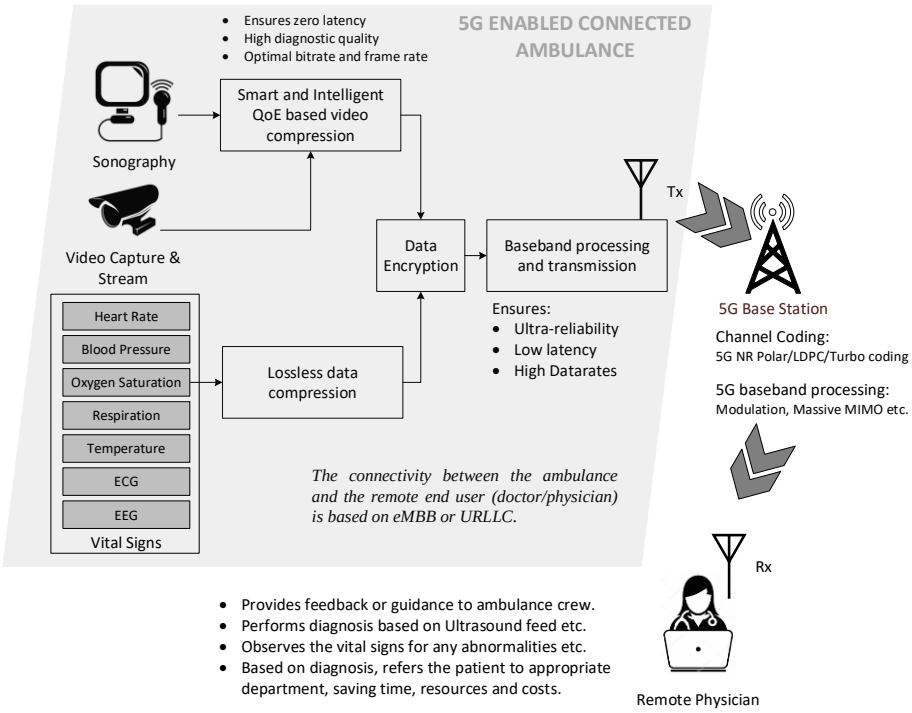

Fig. 2. The proposed model for 5G enabled connected ambulance.

procedures that help in detection of life-threatening diseases such as cancer, can help in efficient utilization of medical resources that include expert radiographers. Remote Telesurgery over a reliable 5G network can help saving lives and reduce associated costs as an expert medical professional can perform it from thousands of miles away.

Pandemics such as the novel corona virus (COVID-19) can be better contained if patients can be treated remotely. Measures such as social distancing can be more effective if remote healthcare available. This also helps in reducing the risks for medical staff to be exposed to the virus.

IV. CONCLUSION

Next generation wireless networks such as 5G networks have the capability to ensure all requirements of mobile healthcare, so it is about time that healthcare providers revamp their existing infrastructure and include practices such as Telemedicine and Telesurgery.

REFERENCES

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[2]. Wang, Q. et. al., SliceNet: End-to-end cognitive network slicing and slice management framework in virtualised multi-domain, multi-tenant 5G networks. In *2018 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB)*, June 2018.

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Call for Papers

The Future of eHealth: Applications, Solutions and New Visions in the IoT Era

The world today needs to face problems such as the aging population and the inherent need of assisted-living environments for elderly people. Traditional healthcare systems are not able to satisfy the needs of a continuously growing and developing society. A huge number of patients must have access to health-care services. Furthermore, shortage of cost-effective and accurate smart medical sensors, lack of uniform standards and communication interoperability across the eHealth devices, heterogeneity and multi-dimensionality of the data from the healthcare sector, and the trust issues pertaining to privacy and security of data pose significant obstacles to the expansion of IoT for healthcare, elderly and aging.

Recent advances in Internet of Things (IoT) are envisioned to break the above barriers. Thanks to its multidisciplinary approach, IoT has been phenomenal in revolutionizing many aspects of traditional healthcare paradigms providing optimized, flexible, reliable, secure, and power-efficient solutions that accelerate scientific research, personalised medicine, early diagnosis of diseases and more effective treatments.

The goal of this Special Issue (SI) is to solicit IoT solutions for eHealth, bringing together researchers from academia into a common platform to advance the state-of-the-art of eHealth by eliciting new applications and disruptive solutions for medical science and healthcare. The theme of this SI is three-fold: *i)* to discuss the latest advancements in the field of IoT for eHealth by presenting innovative and efficient solutions, *ii)* to illustrate aspects of applying IoT in healthcare experimental results to analyze the effects over lifestyle and healthcare systems and the response to technology-assisted medical care and treatments and *iii)* to give further directions for research, new problems and challenges in the eHealth field.

The SI invites original and breakthrough works in the field of IoT for eHealth. High-quality surveys, tutorial and practical use-cases in real life scenarios are also welcomed. Contributions to this SI should include (but not limited to):

- IoT sensors for smart eHealth devices
- IoT system architectures in healthcare
- Wearable medical wireless sensors
- New platforms and solutions for eHealth patient monitoring
- Cloud and edge computing for IoT-eHealth
- Interoperability and standards for IoT-eHealth
- Machine learning and artificial intelligence in eHealth
- Digital signal processing (DSP) algorithms towards early diagnosis
- Ubiquitous computing towards pervasive healthcare
- IoT-based remote healthcare for elderly
- Ambient assisted living IoT for active and healthy aging
- Implantable IoT devices
- eHealth-oriented software architectures
- Context awareness and autonomous computing for ambient assisted living
- Future technologies for the health of the brain
- In-body medical sensors communications

Important Dates

Submission Deadline: 15 September 2020
Initial Decision: 1 December 2020
Revised Manuscript Due: 1 January 2021
Final Decision: 1 February 2021
Final Manuscript: 15 February 2021
Publication: June 2021

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Further details on the call can be found here: https://www.comsoc.org/publications/magazines/ieee-wireless-communications/cfp/future-ehealth-applications-solutions-and