5G NETWORKS ON NEXT-GENERATION DIGITAL HEALTH SERVICES

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Due to the current demographic change occurring in the society, a tremendous consumption of health resources in terms of personnel, cost and technology is threatening the sustainability of the worldwide healthcare (HC) systems. For instance, by 2030 16% of the world population will be over 60 years [1] and chronic diseases will contribute up to 57% of the global burden diseases in 2020 (with cost estimate of $4 trillion) [2]. To cope with this situation, United Nations demands in one of its Sustainable Development Goals the need of "ensure healthy lives and promote wellbeing for all at all ages" [3]. However, HC systems present the following deficiencies and challenges to meet the UN requirement: 1) the HC systems are not patient-centric so individuals are not empowered in their care process; 2) neither provides personalized assistance since diagnostics and prescriptions are based on population average over individual conditions; 3) the equitably accessibility is not guaranteed being similar HC facilities only reachable by certain people based on their socioeconomic status, geographic residence, etc.; 4) an holistic/data-driven approach that considers past and evidence-based medical decisions should be addressed to avoid faulty systems, processes and condition that lead professionals to medical errors; 5) the complexity of the HC information systems as well as devices with sensor-based applications in hospitals require bandwidth, high data rate and very low latency to provide an efficient processing of heterogeneous health information and an optimal resources allocation and management.

This context has emphasized the need of technological advancements in HC systems to provide efficient, affordable and secured solutions to an increasing number of patients [4]. Such advancements are carried out by "smart healthcare" solutions [5] where wearable computing, bio-engineering and mobile devices have enabled the exploitation of ubiquitous and pervasive wireless technologies to offer a more personalized medicine with real-time capabilities [3]. On the contrary, current technologies restrict the full potential of smart healthcare due to high hardware, operational costs, lack coordinated information exchange, insufficient data transfer rates and latency. In addition, HC providers hardly receive reimbursement from telemedicine solutions which discourage their use and patients manifest a lack of trust in their data privacy management.

These trends along with an increase of 10K times in mobile traffic data in this decade [6] as well as HC information systems above mentioned requirements place the 5G wireless technology as the most appropriate network to deploy the next-generation digital health services guaranteeing security, quality of service (QoS), seamless integration, very low latency, bandwidth, scalability, high network capacity, large number of sensory devices, faster data generation and processing, resource-constrained devices, long

battery lifetime, reliability and resilience. Therefore, 5G will bring into reality services like [7] [3] [4]: *telesurgery* that allows remote operation with greater precision thanks to haptic feedback and high resolution visualization; *service robots* capable of assisting patients and older people to be remain active and independent; *real-time telemedicine* to provide online expert-based and personalized medical care from a distance with an efficient exchange of different kinds of information; *in-home health monitoring* decentralizing healthcare facilities building up the concept of virtual hospital as well as opening new use-cases of non-invasive behavior monitoring (e.g. fall detection of elderly); *virtual and augmented reality* to enable patients for a comprehensive experience of rehabilitation; *internet of medical skills* to training remotely professionals through tactile and visual communication.

The distinctive features of 5G as well as services supported on its network will be the driving force in the future of medicine allowing a transition from reactive care to a patient-centric and proactive care. On the other hand, 5G refers to the following “five goals”: cost effectiveness, comfortability, personalization, sustainability, and smartness [8]. By adopting 5G, HC systems’ economic figures will have a promising impact, e.g. 99B€ can be saved annually through smart healthcare solutions in European Union. Moreover, in terms of health resources, a reduction of 35% of hospital admissions, 53% use of accident and emergency department visits and 59% of hospital bed days could be achieved as well as a one million lives could be saved in Sub-Saharan Africa over the next five years. These opportunities translated into a global digital health market of around 200 B€ in 2020 will not only aimed at healthcare stakeholders but also network operators, telecommunication providers and software developers [3].

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