

LINKS BETWEEN 5G PPP PROJECTS: THE ROAD FROM THE PAST TO THE FUTURE

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ABSTRACT: Creating an information society in the world is one of the most urgent and important tasks today. In such conditions 5G networks will become the most widespread telecommunication technological solution in the next decade. To ensure the European leadership in the direction of the development and deployment of 5G networks 5G PPP in close collaboration with EC supports different related activities. There were already launched the 5G PPP project of three phases. It was shown that they are closely linked. This aims to present and analyze the links between 5G-Xcast, 5G-TOURS, and 5GASP projects, the continuity of the conducted research activities, and new directions of future research. There were showcased which technologies and solutions from the past projects were reused for other projects and probably will be reused for further studies. Was underlined that the most valuable is the long-term follow-up of research according to the 5G PPP research roadmap. This hopefully will help to support vendors, MNOs, SMEs, and verticals in the EU on the road to the future information society.

KEYWORDS: 5G, 5G PPP, networks, projects, standardization, Horizon 2020.

INTRODUCTION

Creating an information society in the world is one of the most urgent and important tasks today [1]. The priorities for the formation of modern information infrastructure in the EU include the creation of high-speed mobile broadband access to Internet resources throughout the territory. This is broadband access based on the use of mobile technologies of the fourth generation 4G (Fourth Generation) and 5G (Fifth Generation). To address the implementation of 5G technologies on the targeted efforts of the largest cellular operators (Orange, Vodafone, etc.). At the same time, the impact of these technologies on modern society cannot be overestimated. Cellular communication is currently considered the norm, and mobile technologies are the most popular and rapidly evolving.

Along with the growing number of disparate devices connected to the Internet and new popular services (transmission of high-definition video 4K, 8K, virtual reality (Virtual Reality - VR), augmented reality (Augmented Reality - AR), the concept of Connected Cars, etc.), which put forward new requirements for the targeted efficiency of cellular networks (reducing latency, increasing the required bandwidth, etc.), the world is experiencing an exponential increase in data transmission, which is not always able to effectively cope with existing 4G cellular networks [2]. It is obvious that in the near future the existing networks will be unable to provide the required quality of service to mobile subscribers, cars and IoT devices. That is why it is the time for rising of 5G networks.

THE DEVELOPMENT OF CELLULAR NETWORKS

The 4G standard is capable of providing data rates of more than 100 Mbps to high-speed subscribers (eg trains and cars) and 1 Gbps to low mobility subscribers (eg pedestrians and fixed subscribers) according to the International Mobile Telecommunications Advanced International Specification (IMT). -Advanced) [3]. In general, 5G networks will be able to use the capabilities of all running cellular networks of previous generations simultaneously with the new radio interface New Radio (NR). So 5G should deliver significantly increased operational performance (e.g. increased spectral efficiency, higher data rates, low latency), as well as superior user experience (near to fixed network but offering full mobility and coverage) [4].

Comparison of key capabilities of IMT-Advanced (4th generation) with IMT-2020 (5th generation) according to ITU-R M.2083 is presented on the Figure 1 [5].

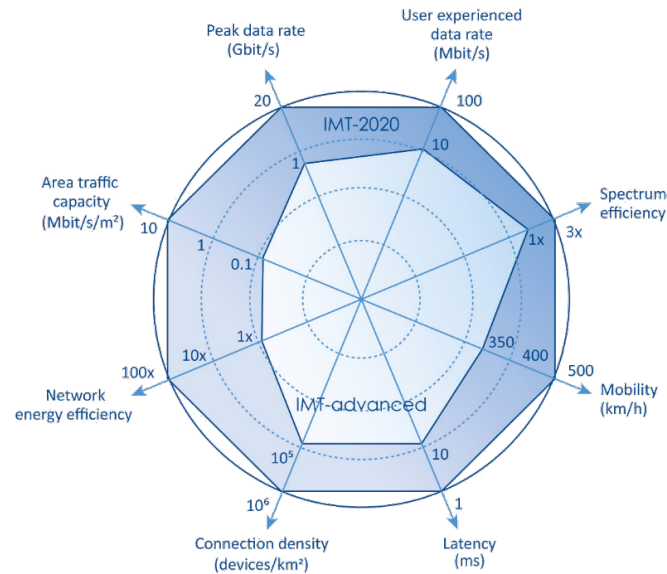


Fig.1. 5G networks requirements

As already noted, the number of devices connected to the World Wide Web and the requirements of subscribers to the speed of mobile Internet access are increasing every year. Developers of telecom equipment and telecom operators, striving to respond to new challenges [6], are preparing to seriously transform the network architecture and interaction regulations. This is how the first ubiquitous fifth generation (5G) networks emerge. The first commercial network of the fifth generation was launched in 2018 - telecom operator Verizon announced the launch of "the world's first 5G network" in four US cities: Houston, Indianapolis, Los Angeles and Sacramento [7]. At the same time, the launch of the first nationwide 5G network, which provided continuous coverage in South Korea in April 2019, turned out to be less effective [8]. To be honest it is fear to mention that almost all of the developments in 5G networks were made and continue in strict accordance with the 3GPP roadmap (Figure 2a) [9]. And the current situation regarding the deployment of the different types of 5G networks is represented on the Figure 2b [10].

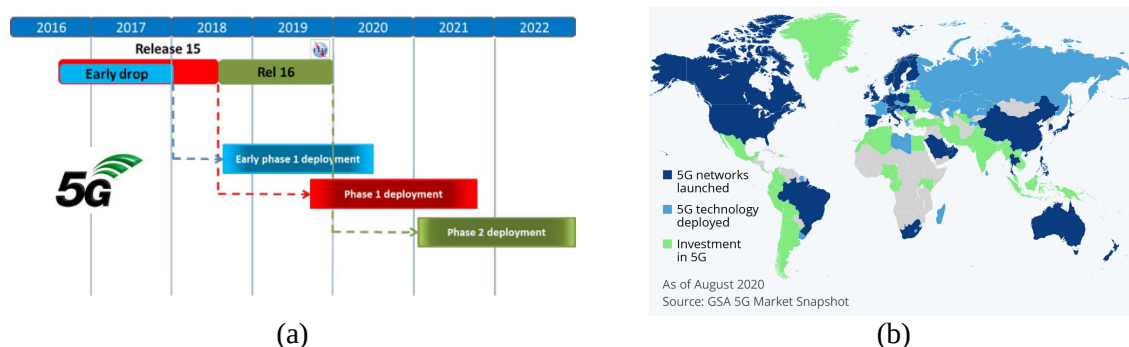


Fig.2. Current status of 5G networks deployment (a) according to the 5G networks standardisation roadmap (b)

LINKS BETWEEN 5G PPP PROJECTS

To achieve already mentioned above requirements defined for the 5G networks was made a lot of job, lot of tasks were solved in different working groups. Their activities were related to the development of novel solutions, architecture, standards etc. To support all these activities was organized the 5G PPP organization.

The 5G Infrastructure Public Private Partnership (5G PPP) is a joint initiative between the European Commission and European ICT industry (ICT manufacturers, telecommunications

operators, service providers, SMEs and researcher Institutions) [11]. The 5G-PPP is now in its third phase and many new projects were launched in June 2018. The aim of the 5G PPP is to deliver solutions, architectures, technologies and standards for the next generation communication infrastructures in the nearest future. The challenge for the 5G Public Private Partnership (5G PPP) is to secure Europe’s leadership in the particular areas where Europe is strong or where there is potential for creating new markets such as smart cities, e-health, intelligent transport, education or entertainment & media [11]. The 5G PPP was organised in three phases, encompassing research, optimisation and large scale trials. The aim of this paper is to showcase the links between different phases of 5G PPP and exact projects (Figure 3). It is made on the basis of the experience from participation in 5G PPP projects supported by European Commission (EC). Currently for the Phase 3 have been retained 8 Projects in response to the 5G-PPP ICT-19-2019 call [12].



Fig.3. Links between three 5G PPP projects

The first left project on Figure 3 is 5G-Xcast [13]. It was Phase 2 5G PPP research project. The main goal of this project was to bring the ability of multicast/broadcast delivery for 5G networks and its implementation to the architecture through the contributions to the standards (3GPP, ETSI, GSMA, DVB, etc.). The goals of the research were achieved by the very experienced consortium, which included manufacturers, academia, SMEs etc. The most outstanding achievement of the project was the 5G-Xcast core architecture for broadcast/multicast data delivery (Figure 4) [13].

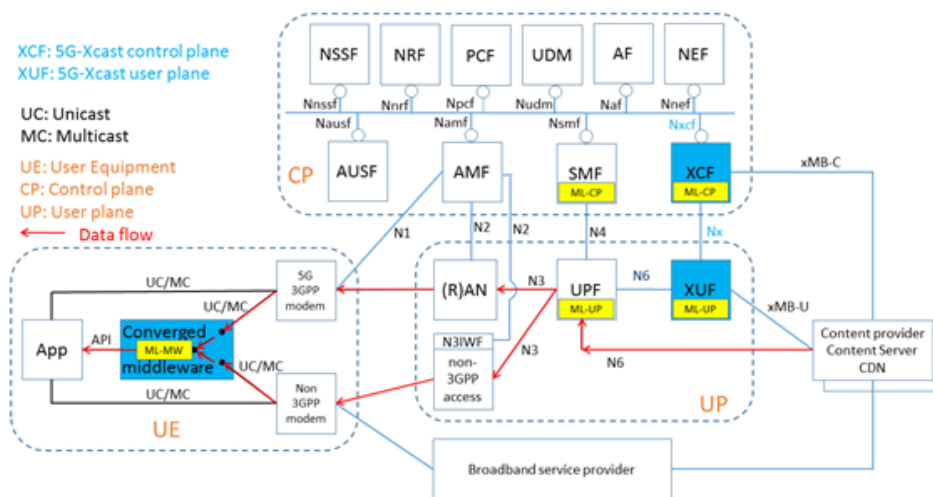


Fig.4. Developed 5G-Xcast core architecture for broadcast/multicast data delivery

The functionality of new networks functions, architecture analysis were presented in the deliverables of the project [14] and of course in the research papers [15 – 17].

Some of the project results were successfully reused in the Phase 3 5G PPP projects. These eight projects are ongoing. They started in June 2019. The main goal of launching these projects is to get the European 5G Vision of “5G empowering vertical industries” closer to deployment.

5G-Xcast's results were used in 5G-TOURS project. 5G-TOURS vision is to improve the life in the city for the citizens and tourists, making cities more attractive to visit, more efficient in terms of mobility and safer for everybody [18]. 5G-TOURS is focused on the realization of 13 highly innovative use cases in three types of cities: Touristic city (Turin, Italy); Safe city (Rennes, France) and Mobility efficient city (Athens, Greece) (Figure 5).



Fig.5. 5G-TOURS vision

To achieve the goals of the project was developed the unified 5G-TOURS architecture (Figure 6), which included the results from the past projects: 5G-MoNArch, 5G-Xcast and 5G-EVE. 5G-Xcast feature for the multicast/broadcast delivery was reused for the realization of the UC4 dedicated to the high definition multimedia content delivery in the center of Turin. Details regarding this realization can be found in the 5G-TOURS official newsletter [19].

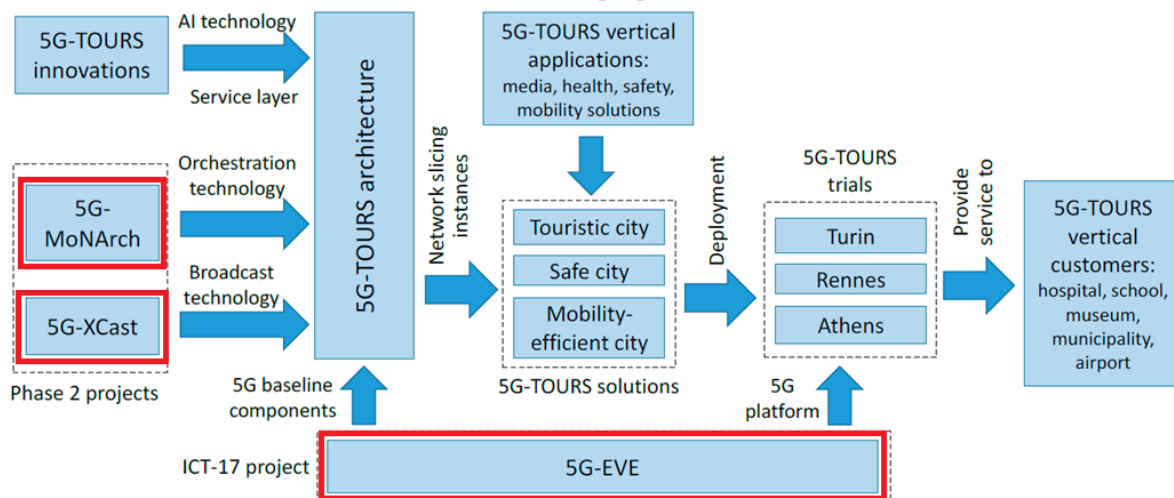


Fig.6. 5G-TOURS architecture

The next project in which will be reused the results from the past and ongoing projects is 5GASP [20]. It just started in January 2021. It will be based on the achievements of 5G-VINNI [21] and 5G EVE [22] projects. Also, some methods for testing, validation and the whole methodology for QoE/QoS analysis probably will be used by the project, which aims at shortening the idea-to-market process through the creation of a European testbed for SMEs that is fully automated and self-service, in order to foster rapid development and testing of new and innovative NetApps built using the 5G NFV based reference architecture [20]. The architecture of the project and related projects are represented on Figure 7.

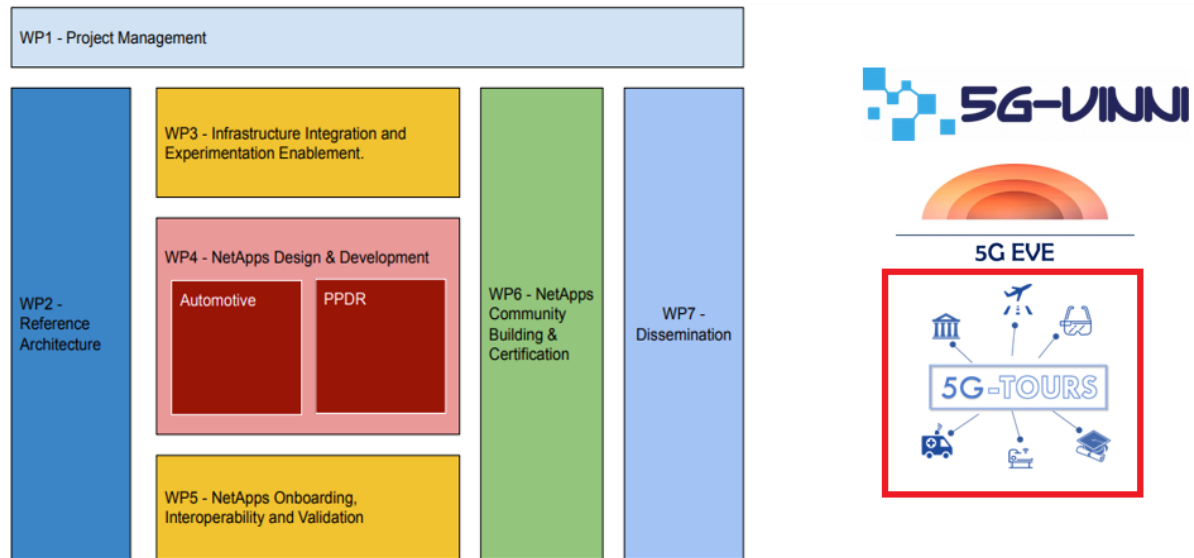


Fig.7. 5GASP project structure

CONCLUSIONS

5G networks are the future of the telecom industry. It is obvious that these networks will become the most widespread telecommunication technological solution in the next decade. To ensure the European leadership in the direction of the development and deployment of 5G networks 5G PPP in close collaboration with EC supports these activities. There were already launched the 5G PPP project of three phases. Projects of different phases are closely linked. This paper presented the links between 5G-Xcast, 5G-TOURS, and 5GASP projects, the continuity of the conducted research activities, and new directions of future research. There were showcased which technologies and solutions from the past projects were reused for other projects and probably will be reused for further studies. And the most valuable is the long-term follow-up of research according to the 5G PPP research roadmap. This hopefully will help to support vendors, MNOs, SMEs, and verticals in the EU on the road to the future information society.

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