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The Next Generation Mobile Network Researching

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Abstract

With the rapid development of wireless technologies, the concept of the Fifth Generation (5G) wireless communication system started to emerge. But most people know little about 5G, including some aspects of 5G wireless communication networks ,just like what 5G is about: what are the building blocks of core 5G system concept, what are the main challenges and how to tackle them. Besides. A number of countries and organizations working on 5G, 5G development situation in China is of concern to everyone, China also needs to have its own place in such a competitive environment.

Keywords: 5G Network, history, Core concept, Challenges, Solutions.

INTRODUCTION

5G (Fifth-generation mobile communications) is a new generation of mobile communication mobile communication systems for 2020, with high spectral efficiency and low power consumption, in terms of transfer rate and resource utilization improvement over 4G system 10 times, its wireless coverage performance and user experience will be significantly improved. 5G will be closely integrated with other wireless mobile communication technology, constitute a new generation of ubiquitous mobile information network, to meet future mobile Internet traffic 1000x development needs in 10 years. [1]

In this paper I will show you some latest research and development history, what are the building blocks of core 5G system concept, what are the main challenges and how to tackle them firstly. In the rest of paper will show how 5G development in China in recent years and my conclusion after research literature.

CORE CONCEPT

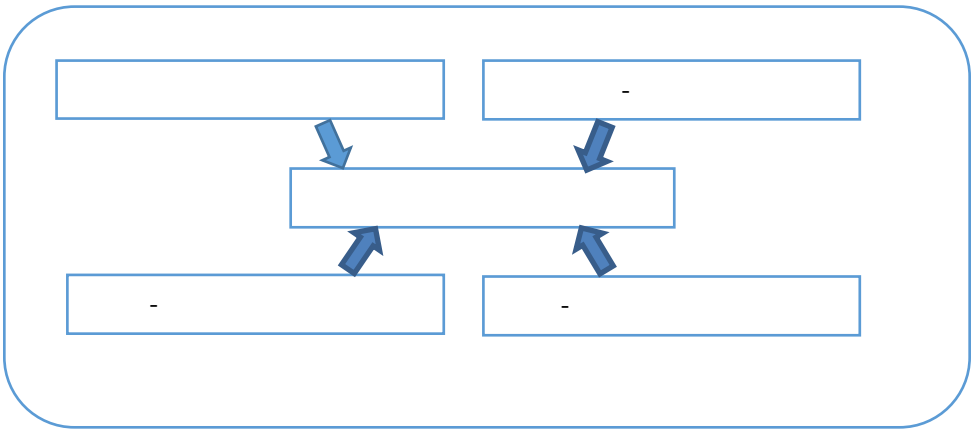
What is 5G? I believe many people will be so questionable when see 5G. Judging from the word meaning, 5G refers to the fifth generation of mobile communications. However, how should it define? Currently, the global industry for 5G concept not yet agreed. China IMT-2020 (5G) group released the White Paper considers the concept 5G, 5G integrated key capabilities and core technology, 5G concept by "important targets" and "a group of key technologies" to a common definition. Among them, the flag indicators "Gbps rate user experience" is a set of key technologies, including large-scale antenna array, ultra-dense networking, new multi-site, full-spectrum access and new network architectures.

Recalling the course of development of mobile communications, each generation of mobile communication systems can be defined by sexual performance indicators and signs of key technologies. Wherein, 1G using FDMA, only analog voice services; 2G mainly using TDMA,

can provide voice and low-speed digital data services; 3G to CDMA technology is characterized by user peak rate of 2Mbps to reach tens of Mbps, support multimedia data services; 4G OFDMA technology as the core, the user peak rate of up to 100Mbps ~ 1Gbps, can support a variety of mobile broadband data services.

5G key competencies richer than previous generations of mobile communications, user experience, speed, density of connections, end to end delay, the peak rate and mobility and so will be the 5G key performance indicators. However, unlike the case in the past only to emphasize different peak rate, the industry generally believe that the rate of the user experience is the most important performance indicators, it truly reflects the real data rate available to the user, and the user experience is the closest performance. Based on the technology needs of the main scene 5G, 5G user experience rate should reach Gbps magnitude.

Faced with diverse scenes of extreme performance demands differentiation, 5G cannot have solutions for all scenarios. In addition, the current wireless technology innovation has diversified development trend, in addition to the new multi-access technology, large-scale antenna array, ultra-dense network, the whole spectrum access, the new network architecture, also is considered to be the main technical direction.5G can play a key role in the major technology scene. [5]



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CHALLANGE AND SLOTUINS

In this part outline some observed research challenge sand directions in the mobile network development and show some may become the future trends and solutions that may lead to improved network performance while meeting the constantly increasing user demands.

5G Transport Challenge

In order to understand the 5G transport challenges one must understand how 5G may evolve the radio access segment. Among the various initiatives that are looking into 5G, we can define 5G in terms of scenarios which the next generation wireless access networks will have to support. [6] A total of five future scenarios have been defined, namely amazingly fast (users want

to enjoy instantaneous network connectivity), great service in a crowd, ubiquitous things communicating (i.e., effective support to Internet of Things), super real time and reliable connections, and best experience follows you. Each of these scenarios introduces a challenge.

Three of these challenges (i.e., very high data rate, very dense crowds of users and mobility) are more traditional in the sense that they are related to continued enhancement of user experience and supporting increasing traffic volumes and mobility. Two emerging challenges, very low latency and very low energy, cost and massive number of devices, are associated with the application of wireless communications to new areas. Future applications may be associated with one or several of these scenarios imposing different challenges to the network. In METIS twelve specific test cases were defined and mapped onto the five scenarios. The selected test cases essentially sample the space of future applications. Once technical enablers that fulfill there quirements for these test cases are defined, it is expected that other applications subject to the same fundamental challenges, will successfully be supported. As a consequence, defining technical enablers for the 5G test cases means also defining technical solutions to the 5G challenges.

While METIS [7] is focused on wireless access, the challenges defined for 5G are expected to impact also the transport. Support for very high data rates will require both higher capacity radio access nodes as well as a densification of radio access sites. This, in turn, translates into a transport network that needs to support more sites and higher capacity per site, i.e. huge traffic volumes. The great service in a crowd scenario will put requirements on the transport network to provide very high capacity on-demand to specific geographical locations. In addition, the best experience follows you scenario, suggests a challenge in terms of fast configurability of the transport resources. On the contrary, the other 5G challenges are not expected to play as important role for shaping the transport, as for example the case of very low latency and very low energy, cost and massive number of devices. A properly dimensioned transport network based on modern wireless and/or optical technologies is already today able to provide extremely low latency, i.e., the end-to-end delay contribution of the transport network is usually almost negligible. In addition, while a huge number of connected machines and devices will create a challenge for the wireless network, it will most probably not significantly impact the transport. This is due to the fact that the traffic generated by a large number of devices over a geographical area will already be aggregated in the transport. The three scenarios for the transport network described above are summarized along with their corresponding challenges and test cases. Note that does not report all the original test cases but only those that pose challenges to the transport network. This information will be used later in the paper to identify the appropriate transport technologies.

5G Transport Challenge and some Solutions

This section provides an overview of a number of transportations for 5G wireless networks. A 5G transport network can be divided in two different segments, i.e., small cell transported metro/aggregation (Fig. 2). The small cell transport segment aggregates the traffic to/from the wireless small cells towards the metro/aggregation segment. Different solutions in terms of technology (e.g., optics, wireless) and topology (e.g., tree, ring, mesh) are possible depending on the specific wireless access scenario. The metro/aggregation segment, on the other hand, connects different site types (i.e., macro and/or small cells) among themselves and to the core network, the latter via the service edge (service node for the interconnection among different network domains).

For the metro/aggregation segment one promising solution is represented by a dense-wavelength-division multiplexing (DWDM)[8] - centric network. In such a network, packet aggregation takes place at the edges of the network (e.g., at small/macro cells sites and at the service edge), while at center (i.e., between access and metro rings) switching is done completely in the optical domain thanks to active optical elements such as wavelength selective switches (WSSs) and reconfigurable optical add-drop multiplexers (ROADMs). It has already been demonstrated that DWDM-centric solutions have the potential to offer high capacity (in the order of tens to hundreds of Gbps) and lower energy consumption than their packet-centric counterparts (i.e., with packet aggregation at the center of the network). [9] For this reason the DWDM-centric metro/aggregation concept may represent a good candidate for future 5G transport networks. [10]

Machine to Machine Communication

Machine to Machine Communication Besides network evolution, we observe also device evolution that become more and more powerful. The future wireless landscape will serve not only mobile users through such devices as smartphones, tablets or game consoles but also a tremendous number of any other devices, such as cars, smart grid terminals, health monitoring devices and household appliances that would soon require a connection to the Internet. The number of connected devices will proliferate at a very high speed. It is estimated that the M2M traffic will increase 24-fold between 2012 and 2017. [11]

M2M communication is already today often used in fleet monitoring or vehicle tracking. Possible future usage scenarios include a wide variety of e-health applications and devices, for instance new electronic and wireless apparatus used to address the needs of elderly people suffering from diseases like Alzheimer's, or wearable heart monitors. Such sensors would enable patient monitoring and aid doctors to observe patients constantly and treat them in a better way. It will also reduce the costs of treatment, as it can be done. remotely, without the need of going to a hospital.

Remote patient monitoring using a Body Area Network (BAN), where a number of wireless sensors, both on-skin and implanted, record the patient's health parameters and sends reports to a doctor, will soon become a reality and an important part of 5G paradigm. Therefore, in order to offer e-health services, 5G will need to provide high bandwidth, meet extremely high Quality of Service (QoS) requirements, e.g., ultra low latency and lossless video compression for medical purposes, and implement enhanced security mechanisms. Furthermore, extended work will need to be done to efficiently manage radio resources, due to high diversity of traffic types, ranging from the reports sent periodically by the meters, to high quality medical video transmission.

Core Network Virtualization

Moving towards 5G imposes changes not only in the Radio Access Network (RAN) but also in the Core Network (CN), where new approaches to network design are needed to provide connectivity to growing number of users and devices. The trend is to decouple hardware from software and move the network functions towards the latter one. Software Defined Networking (SDN) being standardised by Open Networking Foundation (ONF) assumes separation of the control and data plane[12]. Consequently, thanks to centralization and programmability, configuration of forwarding can be greatly automated.

Moreover, standardization efforts aiming at defining Network Functions Virtualization

(NFV) are conducted by multiple industrial partners including network operators and equipment vendors within ETSI.[13] Introducing a new software based solution is much faster than installing an additional specialized device with a particular functionality. Both solutions would improve the network adaptability and make it easily scalable. As a result of simpler operation, one can expect more dynamic and faster deployment of new network features.

Summary

I only list a partial of the challenges of 5G networks and possible solutions , in fact, before making a formal universal 5G are still many problems to be overcome, it also requires effort frontline researchers.

REFERENCE

[1]Chen Si ,Li Hua Sheng,"5G technology trends and challenges for radio management", http://www.c114.net/news/41/a888991.html

[2] " Samsung developed 5G technology" , http://baike.baidu.com/link?url=m_HOSi6QF36L7im-m0NRBaQggvikTgV0GLWBNyvN1OllSGp6_nYwU2B_fXsl6tEnyO0lXAw4Fnk0Ku0vtPSBMq#reference-[2]-7641070-wrap

[3] C114 China Communication Network,(Shanghai) ,March2015 ," The EU announced 5G Vision: To guarantee the right to speak of global standards"

http://tech.163.com/15/0311/10/AKE0JHMD000915BE.html

[4] People's Posts and Telecommunications News (PPTN),March,2015," Bell Labs: 5G urgent task is to be completed as soon as possible standardization"

http://news.xinhuanet.com/info/2015-03/11/c_134058306.htm

[5] Baidu Encyclopedia, "5G network"

http://baike.baidu.com/view/6220993.htm"

[6] METIS deliverable D1.1, "Scenarios, requirements and KPIs for 5G mobile and wireless system", April 2013.

[7] METIS deliverable D6.1, "Simulation guidelines", October 2013.

[8] Shuqiang Zhang, Ming Xia, S. Dahlfort, "Fiber routing, wavelength assignment and multiplexing for DWDM-centric converged metro/aggregation networks," in Proc. of ECOC, Sept. 2013.

[9] B. Skubic, I. Pappa, "Energy consumption analysis of converged networks:Node consolidation vs metro simplification," in Proc. of OFC,March 2013.

[10] Matteo Fiorani,"Challenges for 5G Transport Networks",IEEE,2014

[11] Cisco, "Global Mobile Data Traffic Forecast Update,2012-2017," Feb. 2013, White Paper.