Analysis of Transpire 5G Wireless Technology Worldwide Wireless Web (wwww)

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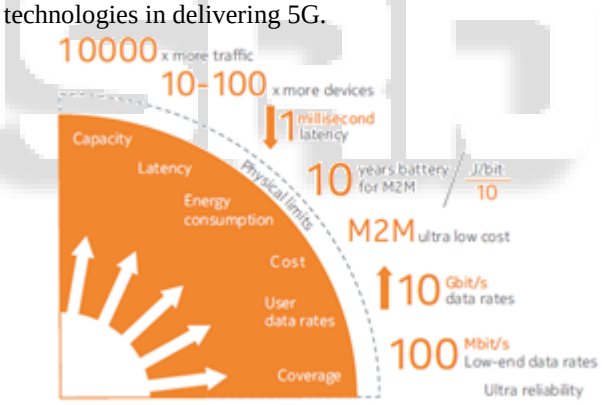
Abstract— 5G will be the fifth generation of wireless networks, which is expected to dominate the current generations in the next decades. In today's technology of mobile networks and wireless systems, the most users are using 4G, which is the 4th generation of mobile networks and almost every single user is enjoying this wonderful wireless technology, but a true confess is that the most users are already waiting for the next generation of mobile networks, which is called for 5G. This paper gathers and reviews the emerging 5G wireless technology which is coined as Worldwide Wireless Web (wwww)

Key words: wwww, 5G, Worldwide Wireless Web, Dynamic Adhoc Wireless Networks (DAWN), small cells or millimeter wave links, Cloud Radio Access Network (C-RAN), Wireless Local Area Network (WLAN) and Wireless Metropolian Area Network (WMAN), Wireless Personal Area Network (WPAN)

I. INTRODUCTION

The aim of this review work is to describe and discuss the emerging technology behind the 5G systems, which is the 5th generation of the mobile networks and wireless systems.

The Future of Wireless Networks is 5G – Worldwide Wireless Web (wwww) which aims at providing infinite capability to mobile users with increased much more maximum throughput with Wireless-based web applications that include full multimedia capability beyond 4G speeds. In 5G research is being made on development of World Wide Wireless Web (WWWW), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless World. The most significant technologies for 5G are Wireless Local Area Network (WLAN) and Wireless Metropolian Area Network (WMAN), Wireless Personal Area Network (WPAN) in digital communication. The cellular networks that have provided steady progress in wireless communications capabilities (up to and including 4G) are evolving into new forms that rely increasingly on local communications over short distances(e.g., small cells or millimeter wave links, Cloud Radio Access Network (C-RAN)). 4G Long Term Evolution (LTE) networks now incorporate small cells to increase capacity. Most announcements about future 5G network designs include some reference to small cell concepts, albeit at a more advanced level of technology than what is in use today. Recent descriptions of 5G emphasize improvements in network speed and capacity and the introduction of new communications technologies. Speed and capacity will be needed to support the communications of potentially billions of wireless devices, from tiny sensors to unmanned aerial vehicles, many of which will connect to each other through the Internet. 5G will combine LTE cellular network and IEEE WiFi standards, supplemented by new technologies. Views diverge on whether 5G will remain within the suite of cellular technologies—a further advance of LTE—or represent a new direction in network architecture with an important role for breakthrough technologies in delivering 5G.



COMPARISON OF ALL GENERATIONS OF MOBILE TECHNOLOGIES [5].

Technology / Features	1G	2G	3G	4G	5G
Start/ Deployment	1970 – 1980	1990 - 2004	2004-2010	Now	Soon (probably 2020)
Data Bandwidth	2kbps	64kbps	2Mbps	1 Gbps	Higher than 1Gbps
Technology	Analog Cellular Technology	Digital Cellular Technology	CDMA 2000 (1xRTT, EVDO) UMTS, EDGE	WiMax LTE Wi-Fi	WWWW(coming soon)
Service	Mobile Telephony (Voice)	Digital voice, SMS, Higher capacity packetized data	Integrated high quality audio, video and data	Dynamic Information access, Wearable devices	Dynamic Information access, Wearable devices with AI Capabilities

Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

Table 1: Comparison of All Generations Of Mobile Technologies

As the take-up of Long Term Evolution (LTE)/4G cellular accelerates, there is increasing interest in technologies that will define the next generation (5G) telecommunication standard. This review work gathers and identifies several emerging technologies which will change and define the future generations of telecommunication standards. Some of these technologies are already making their way into standards such as 3GPP LTE, while others are still in development.

Fig. 1: Existing mobile technologies will not be able to provide the capabilities to meet market demands

Beyond 2020. Sustained research will be needed to create a high performance 5G environment [1]

The figure above, figure 1, is demonstrating the challenges that 5G is going to offer to all of the users. The challenges that 5G is offering are: capacity (10000 more traffic and also 1-100 more devices), latency (the latency reduces), energy consumption (10 years battery for M2M / ((J/bit)/10), cost (M2M ultra low cost), user data rates (user data rates will rise) and coverage (100 Mbit/s Low-end data rates, Ultra reliability).

According to the journal "5G- The Future of Mobile Network", 5G technologies will change the most high-bandwidth users access their phones, and people are also going to experience a much more effective level of call volume and data transmission never experienced before. The services that 5G will offer compared to the present generation of mobile networks can be described as: services in product engineering, documentation, supporting electronic transactions and much more. The supporting electronic transactions can further be describes as e-payments and e-transactions. Another ability and service that 5G will offer is you can use 5G cell technologies to connect your phone to your laptop and the aim of doing this is to earn the broadband internet access [3].

The most interesting distinguishing factor between 3G and 4G is the data rates. For instance 4G can at least support 100 Mbps peak rates in full mobility wide area coverage and 1 Gbps in low mobility local area coverage, but 3G can support up to 2Mbps, which compared to 4G the value of its speed is much lower. According to the experts, the 5th generation of mobile networks will introduce the real and the perfect world of wireless to us. With other worlds the 5th generation of the mobile networks will be described as "www, worldwide wireless web". The Idea of "www, worldwide wireless web" was started from the 4th generation, which means the following evolution will be based on 4G.

For mobile and wireless technologies, the limited spectrum was a challenge. The limited frequency and time are divided to be used among number of users, and because of this condition it is expected to improve the effectiveness to enhance the capacity and the quality of the system. The multiple access systems that are used today consist of:

- Orthogonal Frequency Division Multiple Access (OFDMA)
- Frequency Division Multiple Access (FDMA)
- Time Division Multiple Access (TDMA)
- Code Division Multiple Access (CDMA)

In these multiple access systems, the capacity of a mobile communication system depends on time and frequency. This will be a challenge to develop a similar access system, multiple access system, which is able to resolve the dependencies of capacity to the limited frequency spectrum.

II. ADEQUATE BROADBAND AND CAPACITY

As can be analyzed from figure 2, the future 5G network shall provide adequate broadband and capacity in order to support the high upload/download speed and peak speed of terminal devices compared with that of 4G. At the same time, facing the year 2020, the total network flow of the entire 5G network will be 1000 times higher than that of current network, so does the total throughput (more than 100Gbps/km2). In addition, the 5G network has to support more accessed devices (ca 100times) than current accessed mobile devices.

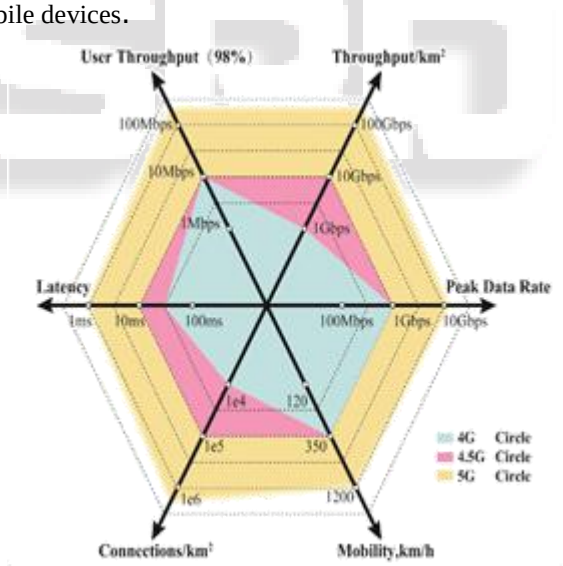


Fig. 2: the requirements and abilities that 5G communication is expected to reach in comparison with 4.5G and 4G communication [6]

A. Heterogeneous Networks Small Cells:

As the demand for higher data rates increases, one of the solutions available to operators is to reduce the size of the cell. By reducing the size of the cell, area spectral efficiency is increased through higher frequency reuse, while transmit power can be reduced such that the power lost through propagation will be lower. Additionally, coverage can be improved by deploying small cells indoors where reception may not be good and offloading traffic from macro cells when required. This solution has only been made possible in

recent years with the advancement in hardware miniaturization and the corresponding reduction in cost. Additionally, changes to the functional architecture of the access network allowed data and control signals to tunnel through the Internet, enabling small cells to be deployed anywhere with Internet connectivity. Small cells can have different flavors, with low powered femtocells typically used in residential and enterprise deployments, and the higher powered picocells used for wider outdoor coverage or filling in macro cell coverage holes.

The concurrent operation of different classes of base stations, macro-, pico-, and femto- base stations, is known as heterogeneous networks (or HetNets). This is used to provide a flexible coverage area and improve spectral efficiency. Overlaying different classes of base stations can also potentially provide a solution for the growing data traffic, especially when the transport of data is optimized to take advantage of the characteristics of heterogeneous networks. 3GPP has identified various scenarios and requirements for the enhancement of small cells in [2].

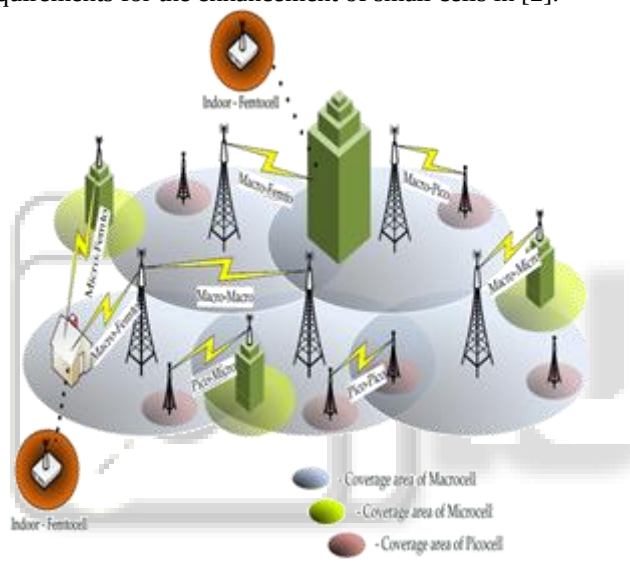


Fig. 3: depicts Het Net topology

B. Millimetre Wave:

An obvious way of increasing the throughput will be through bandwidth expansion. However, the available bandwidth below 6 GHz is limited, and re-farming analogue TV spectrum will not sufficiently meet the burgeoning demand. Already, there are efforts to look beyond 6 GHz and also at the millimetre wave frequencies to evaluate their feasibility for use in future networks. However, the characteristics of higher frequencies are not well studied, and measurement campaigns and channel modelling for different scenarios and environments will be required before transmission technologies can be designed for them. It is believed that millimetre wave frequencies holds the most promise, and there are already on-going efforts to make this a possibility. In [5], millimetre wave frequencies of 28 GHz and 38 GHz are extensively studied to understand their propagation characteristics in different environments, paving the way for their use in future wireless systems.

C. Cloud Radio Access Network (C-RAN) Architecture:

In traditional architecture of cellular networks, users communicate with a Base Station (BS) that is statically assigned to them. Radio and baseband processing units are located close to each other within a few meters range, connected by loss RF coaxial cables. In a distributed architecture known as D-RAN, the base station is divided into radio unit and signal processing unit. Radio unit is called Remote Radio Head (RRH) and performs digital signal processing, digital to analog conversion, power amplification, filtering and optical conversion. The signal processing part is called Baseband Unit (BBU). Common Public Radio Interface (CPRI) is the radio interface protocol used for data transmission between RRH and BBU.

C-RAN is a novel base station architecture where baseband processing is shared among several RRH in a centralized virtual baseband unit pool. Centralized signal processing greatly reduces the number of site's equipment room needed to cover the same areas; Co-operative radio with distributed antenna equipped by Remote Radio Head (RRH) provides higher spectrum efficiency, compared to traditional or distributed architecture, where the assignment is static [6][7]. Figure 4 depicts the C-RAN topology.

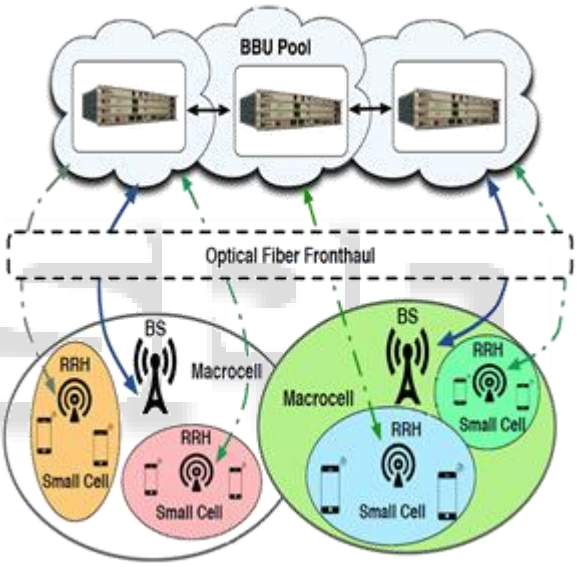


Fig. 4: cloud radio access network architecture [7]

Mobile operators can exploit C-RAN to quickly upgrade their network. They only need to install new RRHs and connect them to the BBU pool to expand the network coverage or split the cell to improve capacity [8].

C-RAN can achieve significant savings in both capital and operating expenditures (CAPEX & OPEX) through the exploitation of real-time Cloud infrastructure based on open platform and BS virtualization. Furthermore the latter techniques enable C-RAN to reduce the power consumption and increase the infrastructure utilization rate more.

III. CONCLUSION

5G is going to have a much tougher process behind its development level. The 5th generation will support more connected devices worldwide compared to the generations before and it also will be more efficient compared to them. By making advantage of IP version 6, 5G will have a higher security compared to its previous generation.

In order to achieve more optimization than 4G LTE, operators have to first provide a richer network infrastructure in terms with adequate network broadband and capacity as well as less latency and more reliability. Then in order to approach optimization of the network, it has to come up with some innovative methods such as dense the network based on dense the small cell for hotspot and indoor (LTE-Hi) technique targeting on providing broadband mobile data within high-frequency hotspot, providing more flexible, reliable network and connectivity, more intelligent network and wireless resources management.

In 5G, Network operators by will exploit intelligent management of cellular network infrastructures, such as C-RAN and HetNet, to support the increasing number of connected devices and the traffic demand while decreasing their capital and operational costs. These technologies let them to easily upgrade their existing networks and enhance their coverage.

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