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STUDY PAPER ON 5G NETWORKS: FUTURE ASPECTS

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ABSTRACT

The communication network and service environment of 2020 will be infinitely richer and more complex than that of today. Our expectation is that in 2020 the network infrastructure will be capable of connecting everything according to a multiplicity of application specific requirements: People, things, processes, computing centers, content, knowledge, information, goods, in a flexible, truly mobile, and powerful way. The future will encompass connected sensors, connected vehicles, smart meters and smart home gadgets way beyond our current experience of tablet and Smartphone connectivity.

European industry and collaborative research and roll-out are a precondition for the 5th generation of communication systems (5G). It is a threat not only for the telecom sector, it jeopardizes the short- and long-term success of the entire industry of Europe, as telecom infrastructure and 5G are the basis for the Internet of Things (IoT) and Industry 4.0 (the Industrial Internet). While Europe leads in 5G technology development and standardization, Europe lead in the deployment of new communication systems in 4G/LTE as well as 5G itself, which will emerge 2018 (first pre-standardized network trials with pre-commercial hardware) and 2020 (first networks with commercial hardware). This requires a very ambitious pan-European target that could galvanize Europe's telecoms industry.

Keywords: 5th generation, Internet of Things, standardization Network, commercial hardware.

INTRODUCTION

5G will provide better speeds and coverage than the current 4G. 5G operates with a 5 GHz signal and is set to offer speeds of up to 1 Gb/s for tens of connections or tens of Mb/s for tens of thousands of Connections. Huawei, a major player in the Chinese mobile market, believes 5G will provide speeds 100x faster than 4G LTE offers. 5G also increases network expandability up to hundreds of thousands of connections. The signal technology of 5G has also been improved for greater coverage as well as spectral and signaling efficiency. These improvements stand to further enable changes like pervasive computing and the Internet of Things (IoT).Although 5G is not scheduled for launch until 2020, some manufacturers are already incorporating elements of the coming standard's specifications into their products.

KEY PERFORMANCE INDICATORS

- Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010.
- Saving up to 90% of energy per service provided. The main focus will be in mobile communication networks where the dominating energy consumption comes from the radio access network.
- reducing the average service creation time cycle from 90 hours to 90 minutes.
- Creating a secure, reliable and dependable Internet with a "zero perceived" downtime for services provision.
- Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people.
- Enabling advanced User controlled privacy.

STAKE FOR EUROPE

- **Jobs & growth.** 5G is a key technology for the entire European industrial base – all vertical industries will be effected (e.g. car industry, logistics, health care).
- **Innovation.** Innovation will help to prepare for the next phase of industrialization and societal innovations.
- **Research.** 5G reinforces European lead, in particular in ultrafast broadband and Internet of Things (including massive and critical machine-type-communication (MTC)).
- **Investments.** Early lead would boost a positive investment cycle.
- **Harmonization.** Europe could be in a position to lead in building a globally harmonized standard.

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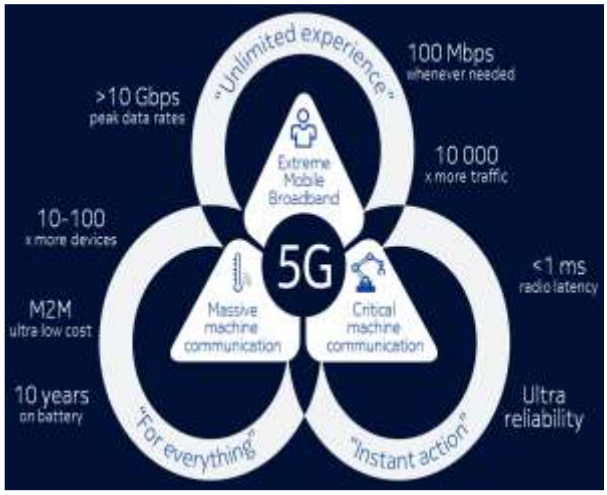

Fig.1: 5G Technology

5G FOR CITIZENS

- Demand: - The increasing users in the mobile network generate the necessities of higher capacity and lower latency. 5G will offer data rates higher than 10Gb/sec as compared to the 450Mb/sec of LTE.
- Societal innovations**:-** 5G will support applications and industries of today and the future such as innovative health care services, self-driving cars and next generation of industry automation – disrupting and renewing entire industries. 5G will mean stepping away from best effort towards communication with highly increased reliability. Flexible integration of existing access technologies such as LTE and Wi-Fi with new technologies creates a design that is future proof at least until 2030 by re-using legacy investment.
- **Internet of Things.** 5G will be designed for use cases expanding from humans to machines requiring more of networks. 5G supports the huge growth of machine-to- machine type communication, also called Internet of Things, through flexibility, low costs and low consumption of energy. At the same time, 5G will be reliable and quick enough for even mission-critical wireless control and automation tasks such as self- driving cars.
- **Energy and cost.** 5G will yield lower costs and consumption of energy. Energy efficiency is an integral part of the design paradigm of 5G, not an afterthought. Virtualized and scalable technologies will further facilitate global adoption.

HOW FAST 5G WILL BE?

5G has the potential to offer speeds up to 40 times faster than 4G -- fast enough to stream "8K" video in 3-D or download a 3-D movie in about 6 seconds (on 4G, it would take 6 minutes).Unfortunately for consumers, there's a difference between lab experiments and reality. Peak speeds are fun to dream about, but in the real world, actual speeds are much slower than promised.

Nokia, one of the biggest 5G players, believes that its 5G technology will allow for real-world speeds of about 100 Megabits per second when the network is most congested -- that's about four times faster than 4G's top speed.

Another characteristic of 5G is that it will have ultra-low latency, meaning that it could drastically reduce the amount of time it takes for the network to respond to your commands. That could give the appearance of much faster loading websites, apps, videos and messages.

WORKING OF 5G

A lot of the wireless companies' 5G experimentation is taking place in super-high frequencies -- as high as 73,000 MHz Today's cell phone networks broadcast signal in a range of 700 MHz to 3,500 MHz The advantage of high-frequency signals is that they're capable of providing significantly faster data speeds. The disadvantage is that they travel much shorter distances and they can't easily penetrate walls. That means thousands -- perhaps even millions -- of mini cell towers, or "small cells" would need to be placed on top of every lamp post, every building, inside every home and potentially every room.

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That presents a host of problems. How can cell phone companies possibly process all that data? There are companies, such as Google's recently acquired Alpental that are working on those "backhaul" issues. That's why 5G might complement 4G, rather than outright replace it. In buildings and in crowded areas, 5G might provide a speed boost. But when you're driving down the highway, 4G could be your only option -- at least for a while.

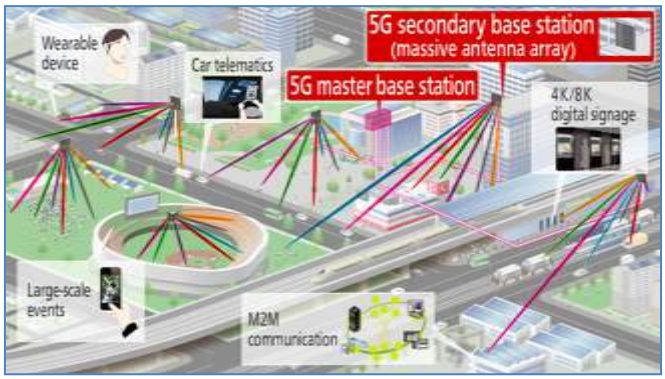

Fig. 2: 5G Connection station

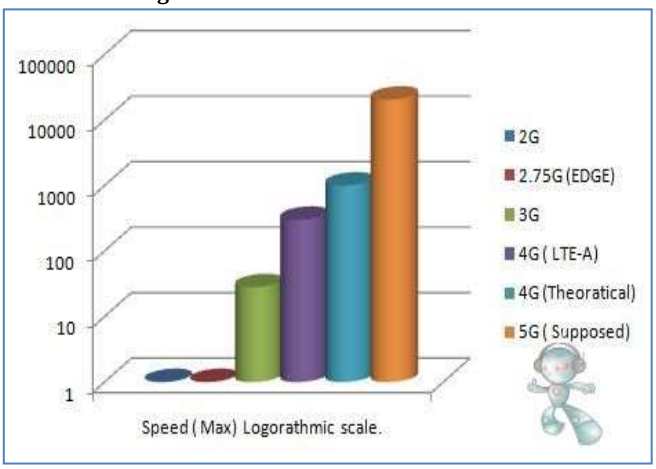

Fig. 3: 5G Statistics

CHALLENGES

- **Privacy by design challenge**: provide accountability within the communication substrate and enable truly private communication when needed, aligned with policy constraints in terms of data management and ownership, ensured by the infrastructure operators that realize the overall service.
- **Quality of Service challenge**: in order to allow for optimizing the Quality of Experience (QoE) for the end user, 5G should provide differentiated services across various dimensions such as throughput, latency, resilience and costs per bit as much as possible independent of users' location with respect to the antennas deployment geography. This includes increased security, availability, resilience and delivery assurance for mission critical applications such as health-related or emergency applications, but also ultra-low cost solutions for emerging countries with less stringent QoE requirements.
- **Simplicity challenge**: provide to 5G users the best network services seamlessly without complex customer journeys (e.g. for inter RAT switching).
- **Density challenge:** increased number of diverse devices connected in proximity, e.g., challenging the current architecture for mobility management.
- **Multi-tenancy challenge**: provide service solutions across different infrastructure ownerships, with the different networks (not necessarily IP-based) co-existing and providing and providing an integrated as well as efficient interaction between the wireless domain and the backhaul.
- **Diversity challenge**: Beyond the aforementioned diversity of stakeholders, 5G must support the increasing diversity of optimized wireless solutions (to different application domains, e.g., M2M) and the increasing diversity and number of connected devices, and associated diversity of traffic types.

- **Harnessing challenge**: exploit any communication capability, including device-to-device (D2D), for providing the most appropriate communication means at the appropriate time.
- **Harvesting challenge**: devise radically new approaches to provide devices with power, which not only has to come from batteries, but also harvests existing environmental energy.
- **Mobility challenge**: support for unlimited seamless mobility across all networks/technologies
- **Location and context information challenge**: provide positioning and context capabilities in the sub-metre range in order to enable the Internet of everything, e.g., through the integration of cellular and satellite positioning systems**.**
- **Open environment challenge**: enable horizontal business models by opening the right business interfaces within the system in order to enable flexible operator models in a multi-tenancy fashion.
- **Manageability**: Improve manageability of networks in order to reduce the need for manual management and reduce the human involvement.

RECOMMENDATIONS

R1. Investigate and define disruptive network architectures harnessing all available network technologies and services to address the 5G challenges.

- Launch efforts for increased network heterogeneity, looking for (meta-) architectures that can be evolvable, while retaining optimal advantages of existing solutions under control of different operators
- Investigate synergies between SON and Software Defined Networking (SDN) architectures and protocols

R2. Investigate, develop and deploy the necessary access, networking (core & transmission) and virtualization technologies that will drive the advances of 5G system components.

Develop scenarios where the control and management planes are increasingly complex and aware of user and network context, including tailored network behavior per user and device.

- Initiate activity on advanced network and service virtualization to enable efficient RAN & backhaul sharing as well as efficient integration of satellite and terrestrial domains.
- Allocate/assign new spectrum beyond 6 GHz for meeting the requirements in 5G systems.

R3. Investigate, formulate and incorporate the driving system-level principles, such as flexibility and programmability that will allow for implementing the 5G vision across the developed technologies

- Investigate current and future network deployments that allow for network/infrastructure/resource sharing at all levels

CONCLUSION

Present study led us to 5 major conclusions.

- 5G is a user centric.
- We have proposed 5G wireless concept designed as an open platform different layers.
- A new revolution of 5G is going to give tough competition to normal computers and laptops whose market place value will be affected.
- The new coming 5G technology is available in the market place in affordable prices and higher peaks future and much reliability than its preceding technologies.
- This technology helps to promote stronger links between people working in different fields creating future concepts of mobile communication, internet services, and nanotechnology.

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