Overview of 5g technology: characteristics, current state and future perspectives...

Sociology, Communication

Introduction

Every new generation of wireless networks have delivered faster speeds and more functionalities, for example, 1G gave us cell phones, 2G gave us the ability to text, 3G took all of us online and 4G delivers the internet at such higher speeds. Now we are at a time where 4G is being driven into the past by what is known as the 5G network. 5G is the fifth-generation wireless mobile standard which is much faster, more efficient and has a potential to transform the internet. 5G is a software defined network that replaces the cable and uses cloud instead and hence leading to faster speeds, quicker response times than the traditional 4G.

State of the art of technology

5G systems are especially developed to enhance future cellular Machine-to-Machine(M2M) communications efficiently w lessened end-to-end (E2E) delay, wide inclusion, expanded battery working time, and support for a huge number of gadgets per cell. In this manner, a few standardizations bodies, for example, the European Media communications Standards Institute (ETSI), Third Age Partnership Project (3GPP) and IEEE are attempting to create the frontline advances for this new age of M2M/ Internet of Things (IoT) communications.

M2M Architectures and Standards

To ensure global connectivity and interoperability among M2M gadgets the main standardization bodies are involved in developing new standards and protocols.

To realize M2M communications globally, European Telecommunications Standards Institute (ETSI) proposed M2M network architecture by defining its service requirements. According to ETSI the basic architecture consists of following components.

M2M Application domain: Main purpose of Applications Domain is to provide server and end-user applications for M2M technology. Two important applications of M2M application domain are, Client Application and M2M Application. End-user services are provided by Client Application whereas M2M Application provides services located on the servers. This domain is built upon M2M service capabilities which have ability to interact with M2M devices.

M2M Device domain: The main task of M2M device is to collect and transmit data to nearby devices or infrastructure. Gathered information includes temperature sensing, humidity level, vehicle speed, and consumption of fuel by vehicle. Devices while connected to Local Area networks (LANs) transmit data to backend servers or combine data through M2M communication domain. Power line communication, short-range device (SRD), ultra-wideband (UWB), ZigBee, meter bus (M-BUS), wireless meter bus, Bluetooth, and cellular gateways/relays are few examples of LAN networks.

M2M Network domain: The data gathered from M2M gadgets is transmitted to gate-ways such as, roadside units and cell base stations, called eNBs. Communication networks enable devices to communicate with the application servers using wired or wireless connectivity. M2M gateway is like

a bridge, ensuring connectivity and communication between two or more devices and communication networks. Data is being forwarded from devices to bank-end servers by gateways.

Standardization of M2M communication: 3GPP, ETSI, IEEE, and the World Wide Web Consortium (W3C) are the standard bodies which are making serious efforts collectively in support of M2M applications development, and they came up with the idea of oneM2M architecture. oneM2M is an initiative that includes architecture, requirements, API specifications, privacy and security solutions and an interoperability framework for M2M/IoT technologies.

5G Architecture and major enhancements

The main challenge in the design of 5G is to provide connectivity to various devices with different characteristics and different application requirements. For instance, mission-critical M2M applications require least idleness, whereas applications like smart metering are delay-tolerant. A wide scope of applications with different QoS necessities prompts critical improvements in 5G. Below upgrades are required for bring compatible and integrated support for M2M communication.

Virtualization of network

Network virtualization has demonstrated its importance in setting efficient operation, management of resources and back end cost reduction in routing and switching. Due to its flexibility and dynamic requirements of resource management, virtualization of network is a decent possibility for combination of key empowering advances in 5G while limiting the cost of equipment and

decreasing complexity. Using network functions virtualization (NFV) 5G network components can be implemented as editable software components, which also helps to implement further enhancements by updating API of related components.

Cell Enhancements

Cell improvements play an important role in serving ultra-dense networks (UDNs) where a plenty of gadgets will work within a single cell. For example, underlay networks are used as data transmitters by micro, pico, phantom and femtocells. And also for potential performance improvements an improved concept on phantom cells on segregation of control and data planes are developed. Using macrocells is an important idea for control signalling over microwave or cellular frequencies, while microcells are used for data service operations on high frequency. A massive improvement in terms of efficiency of spectrum, M2M communication coverage and network capacity.

Radio Spectrum extension

Employing newly available spectrum in licensed and unlicensed bands is a key feature of 5G. As proposed in 3GPP Release 10 using career aggregation framework end devices are able to use inter and intra brand with different frequencies. Coordination of multi-point along multiple base stations and direct communication revealed an important research area in 5G based on advances interference mitigation and techniques of avoidance. These methods consider optimization of cell association and methods of power control for multi-tier networks, clearing road for M2Msystem integration.

Key Players in the Industry

Although 5G is not an accessible system yet, it is pegged to be impressively quicker than its antecedent 4G, and can possibly empower enormous information ventures, for example, the internet of things, smart homes. A research and development centre was developed in 2008 in South Korea to work on 5G mobile communication systems. Four years later, NYU WIRELESS, a research centre designed to carry out detailed work on the 5G wireless network was founded by New York University.

Samsung and Huawei have invested a huge amount of time and money in the development and testing of 5G networks. In 2015, 5G innovation centre was opened in the University of Surrey. Later the same year, Verizon has started testing the 5G in real-life situations. In 2016, Qualcomm announced the first 5G modem whose download speeds would be close to 5 Gbps. Huawei and DOCOMO conducted the first large-scale 5G field trial in 2016 achieving the speed of transfer close to 11 Gbps. Early last year, Ericsson created the first 5G platform which offered end-to-end support for 5th generation wireless network. Samsung has announced the first 5G enabled home router even though the rollout date is uncertain it is expected to hit the markets sooner than first expected.

Earlier this year, Nokia launched an end-to-end 5G product call ‘ 5G First’. This expands the list of Nokia’s contribution in research and development of 5G. 5G New Radio (NR) is being developed by key industrial players such as Verizon, Qualcomm and novotel wireless to speed-up its adoption and to help a full scale commercial network development.

Core technologies and stats

Currently MIMO technology is used in a much smaller form with base stations having between 8 to 12 antennas to handle all the traffic they transmit and receive. Massive MIMO takes this idea and expands on it with the ability to add hundreds of antennas per base station. The year 2017, Ericsson started shipping 64 antenna array systems, with multiple companies such as Huawei, ZTE and even facebook successfully demonstrating 96 to 128 array systems. Its important to keep in mind that we won't immediately use all that frequency spectrum. For the average consumer, it will be more like centimeter waves with licensed spectrums ranging from 24 upto 40 gigahertz initially. There will also be a shared spectrum ranging from 60 to 70 giga hertz for mission critical services. Mission critical services include smart city infrastructure, self driving cars, health care and more. These services require constant high speed and low latency connections, therefore a shared spectrum are the key and ensuring these devices are always connected. For eg: You wouldn't want a self driving car to drop connection because someone next to you got on a phone call. The shared spectrum is also designed with consumer use in mind, if in your location, the shared spectrum space isn't being accessed and there is a high density of consumer devices, some spectrum space can be allocated for temporary use.

Current and future research ideas and key innovations used

The next generation mobile network such as 5G will help to address some of the issues that the agriculture industry faces. Amongst the greatest challenges is the rapidly growing global population, that creates the need for

agriculture to satisfy an increasing demand, through increased efficiency and productivity. Sustainable farming (e. g. reducing net carbon emission per unit of food) and reduced use of pesticides are few areas in agriculture that next generation mobile networks will help to address. The agriculture industry has already started to embrace ICT and connectivity so t. The current USD 1. 27 billion ‘ Cat we find an increased rate of productivity. Farming companies will likely integrate into 5G networks; will enable further rollout of millions of connected sensors on a large scale to increase monitoring capabilities of harvest and soil. They are turning to real-time information systems to monitor the harvest and take informed decisions on treatment (e. g. use of pesticides).

Potential applications using 5G networks have distributed soil sensors: sensors that measure a number of parameters such as temperature, moisture or identify issues such as insects or diseases enable informed farming decisions. Crop monitoring sensors: real-time crop vegetation monitoring, which enables tracking negative as well as positive dynamics of crop development. Routing and monitoring of livestock sensors: real-time management of livestock. Smart irrigation: use of controllers and devices which reduce water usage by using real-time information about the site conditions.

Challenges for the industry Coverage: for 5G to live up to its potential within the agriculture sector, high coverage in rural areas needs to be achieved. The deployment of precisions and smart farming processes, such as

autonomous equipment and vehicles, will be hindered if coverage in rural areas is limited.

How 5G is a threat to the world?

1. 5G requires a myriad of small cell network towers that emit radio frequency radiations (RFR). The World Health Organization has classified RFR as a potential 2B carcinogen, which leads to cancer and disruption of cell metabolism.
2. The Millimetre Waves (MMW's) cause serious damage to the human skin. Majority of the microwave radiation is absorbed by the epidermis and dermis layers of the human skin and eventually in doing so, causes various skin disorders.
3. The Millimetre Waves (MMW's) cause " peroxide is enzyme spectrum change", which essentially deteriorates the cells of plants leading to irradiation of the planet's flora thereby damaging our source of food.
4. Many Animal researchers have stated that the microwave radiation and majority of MMW's damage the cell growth rate & eyes and immune system of the animals. 5G infrastructure requires a surfeit of small satellites which is propelled by hydrocarbon rocket engine. Research shows that using these many satellites will cause bizarre changes in atmosphere due to the emission of black carbon, leading to irregular ozone distribution and eventually towards global warming.

Conclusions

5G network is very fast and reliable. Fifth generation is based on 4G technologies. The 5th wireless mobile internet networks are real wireless

world which shall be supported by Large Area Synchronized Code-Division Multiple Access, Orthogonal frequency-division multiplexing, Local Multipoint Distribution Service, and IPv6. Fifth generation technologies offers tremendous data capabilities and infinite data broadcast together within latest mobile operating system. The 5th generation is expected to be released around 2020. The world of universal, uninterrupted access to information and communication will open new dimension to our lives and change our life style significantly that will add a great advantage for our generations. The development of mobile and wireless networks is going towards higher data rates and all-IP principle. Mobile terminals are obtaining each year more memory on board, more processing power and longer battery life for the same applications being used. 5g includes latest technologies such as SDR, cognitive radio, nanotechnology and cloud computing. It is expected that the initial Internet philosophy of keeping the internet network simple as possible, and giving more functionalities to the end nodes, will become reality in the future generation of mobile networks, here referred to as 5g.

The future enhancement of nano-core will be incredible as it combines with artificial intelligence (AI). A robot can be controlled from one’s mobile phone. Mobiles can automatically type the message what your brain thinks with the help of 5g network. There can be a circumstance where we don’t require any spectrum for communication.