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4G TECHNOLOGY

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Abstract:

Third generation (3G) mobile networks faces a new rival; so called 4G. An astonishingly new network may be even more profitable. The goal of 4G is to replace the current proliferation of core cellular networks, with a single worldwide cellular core network based on standard IP for control and media. In the Asian Union, the debate on 4G mobile has spawned the vision of a system that enables an "Always Best Connected" mode of communication for the citizen of forthcoming information society. This integrated 4G mobile system provides wireless users an affordable broadband mobile access solution for several applications. This paper describes some of the key opportunities that will be made available by 4G networks, present key challenges, and some proposed solutions. However this paper emphasizes on the technology involved in making 4G a success. Finally we conclude with the futuristic views for this emerging technology.

Index Terms: MIMO; OFDM; LTE; WiMAX; Security and Challenges; History of 4G & Architecture of 4G

1. Introduction:

Wireless technologies have transformed our lives greatly. Until a few years back, we needed a wired computer connected to telephonic ports to get internet access. Nowadays, mobile phones are used for super-fast internet, with applications ranging from banking to movie ticketing. This wireless technology helps reduce cost and also increases mobility. Devices are shrinking in terms of their size and are growing in processing speeds. 4G is the fourth generation of broadband mobile technology after 3G. All 4G technologies and other future technologies will serve the same expectation, i.e.: to provide enormously high data transfer rates to excessive number of users at the same time. 0G (zero generation) was the earliest form of internet technology, which was developed in early 1980s. Usually vehicle mounted, they had huge trans-receivers and dials. 1G (first generation) was more popularly known to cell phones using which telephonic communication was possible. Also known as Frequency Division Multiple Access (FDMA). Signals would be transmitted between radio towers with higher bandwidth of 150 MHz.

2G (second generation) digitalized the voice signal. Digitalizing helped to compress the signal which was much more efficient than analog systems, allowing the transfer of more packets into the same bandwidth and less power. Provided the service of Short Message Service (SMS). It was divided into Time Division Multiple Access (TDMA) and Code Division Multiple Access(CDMA). Based on TDMA, Global System for Mobile communications (GSM) was the first European standard for 2G telephony. Several other versions of the 2G communication were 2.5 GPRS and 2.75 EDGE. 3G (third generation) integrated voice and data applications. They also offer greater end to end security than their predecessors. However some flaws have been found in the security of 3G. Global Positioning System (GPS) was the biggest application under 3G technology.

In section II and III, we summarize the need for 4G technology. In section IV we present the challenges faced and overcome by 4G systems. Section V shows the

technology used for the 4G to develop. Lastly section VI presents weaknesses of this system followed by future expectations and research in section VII.

2. 4G Technology:

Definition:

It is basically an extended version of the earlier 3G technology with more bandwidth and services than that of its predecessor. From the consumers point of view, 4G is more of a marketing term more than a technical specification, while carriers feel justified in using the 4G label because it lets the customer know that he can expect high speed of data transfer. The expectation from 4G is high audio / video streaming over end to end Internet Protocol. Long Term Evolution (LTE) is sometimes also called 4G, which will be able to provide 150Mbps rates download rates for moving users and 1Gbps for stationary users. Though the exact definition is not yet known, we can say "4G is the fourth generation of wireless technology, for mobile multimedia, anytime anywhere with global support and integrated customized personal service."

Features Provided by 4G:

The main features of 4G services which are of interest to users are application adaptability and high dynamism users traffic, radio environment, air interfaces and quality of services.

- ✓ Support for interactive media, voice and video streaming, gaming, internet and other broadband services.
- ✓ IP based mobile system.
- ✓ High speed, high capacity and low cost per bit.
- ✓ Global access, service portability and scaling mobile services
- ✓ Avoidance of congestion.
- ✓ Seamless network of multiple protocols. Since 4G will all IP, it will be compatible with all common network technologies.
- ✓ Infrastructure to handle pre-existing 3G systems, along with other analog wireless technologies.

3. Need and Opportunity for 4G:

In general it is believed that 4G network is designed to facilitate development of superior alternative to the existing 3G strategies in terms of quality and data transmission rates. 4G promises to bring wireless experience to an entirely new level with impressive user applications, such as sophisticated graphical user interface, high-end gaming, high definition video streaming and high performance. With this perspective it is very important for new data network to meet the expected demands of consumer and different industries, which have come to depend upon high-speed data networks with minimal interruptions for variety of needs.

4. Challenges:

Security:

The goals for security with respect to communication networks is to ensure that the information being generated and transmitted by the users is protected against misuse and misappropriation. Because of the nature of the network there are increased likelihoods of security attacks, therefore multiple levels of security includes the increased requirement for authentication. The encryption and decryption followed by 3G cannot be used in 4G systems due to the introduction of new devices. However these security issues can be overcome in two ways:

- ✓ Modify the existing security and privacy methods so that they will be applicable to heterogeneous 4G networks.

- ✓ The other way is to develop new dynamic re configurable, adaptive and lightweight mechanisms whenever the currently used mechanism cannot be used for 4G systems.

Quality of Service:

With respect to network quality, telecommunication providers are promising that there will be enhanced connectivity and quality of transmitted data will be highest. With real time performance, 10 times higher data transfer rates as compared to mobile broadband networks, users can be connected even on the move. The main challenge faced by many telecommunication providers is merging IP based devices and non IP based devices. 4G service is working on serving both the devices.

Devices supporting 4G:

In 4G supportive devices, due to large number of transmitters and receivers, the battery seems to run off quite quickly. With the help of Large Scale Integration devices are also becoming smaller in size. Hence to design devices with enhanced battery life, a much powerful Li-on battery was made to increase the battery backup. However the size of the device would also increase. Other solutions were to develop a fast charger for such devices. Constant voltage charging was introduced in an attempt to force the battery voltage to a pre-set value.

5. Complex Architecture:

By comparison, 4G systems provide faster data transfer rates compared to its predecessors. Most importantly network connections are strong even when the user is on the move and towers locations are changing. Technologies that contribute to the 4G system include Orthogonal Frequency Division Multiplexing (OFDM), which are designed to carry more data by splitting radio signals that are broadcast over different frequencies and are immune to interference. The data transfer rates depends on number of available channels to be used. These channels are now cleaner thanks to adaptive processing which detects interference on a channel and improves reception by actively switching channels. 4G systems also use the smart antenna technologies which is used to aim the radio signal in the direction of the receiver from the base station. When teamed up, adaptive processing and multiple antennas help to nullify all kinds of interference in the channels.

Due to limitations in Quality of Service (QoS), Wi-Fi falls short as wireless technology which led to the advent of WiMAX and LTE which are stronger than Wi-Fi.

Long Term Evolution (LTE) technology has been developed by the Third Generation Partnership Project (3GPP) as an improvement to the current Universal Mobile Telecommunication systems. Based on Point to Multipoint connection systems, both WiMAX and LTE provide broadband wireless service. Through Base Stations (BS), Mobile Subscribers (MS) smart phones / laptops get connected to the internet, while BS controls the channel access of mobile subscribers. Frequency Division Duplex (FDD) and Time Division Duplex (TDD) are supported by WiMAX and LTE. In TDD, a cell operates in same frequency with separation in uplink and downlink transmission time.

LTE Network Architecture: It also provides a IP based architecture. It cannot meet enterprise security needs and authentication is done using IMEI and SIM details. An enhanced security method has been proposed which not only authenticates identity but also enterprise certificates. By using OFDM, and 2x2 multiple antennas for Multiple Input - Multiple Output (MIMO), this system can provide upto 150Mbps data transfer speed. The high bandwidth provides ideal mode for data transport. The OFDM allocates network resources to multiple users and provide high quality multimedia. 4G also

supports low latency data transmission. It is an entirely packet switched network with digital network elements. It supports global mobility and service portability. \

Due to its ability to handle multipaths, 4G systems have adopted OFDM as their base technologies. This OFDM helps to split resources into smaller granular units which can be then allocated to different services as required. OFDM is considered vital for achieving high spectral efficiency in wireless 4G networks.

6. Weakness of 4G Technology:

Although the speed of wireless and web-based applications would tremendously increase, it would not occur without a fee. This fee is not unusually high however, with the reduction in this fee comes cheap deployment of this technology which can disrupt the channels.

Also since many people are being connected over this network, they need to be aware of the security threats they are opposing on themselves.

Research will be done on how to increase the battery life for these 4G supported devices.

Some research will be required in knowing the risk of having a 4G enabled gadget and getting infected by viruses and tracking of cookies in this IP based system.

7. Future of 4G:

4G evolution still awaits India. Drastic changes and improvements from 3G is a priority and needs to be addressed. But if done intelligently and thoroughly, 4G holds enormous potential for India and can create an IT boom, key to Indian Economy. However other newer technologies such as 5G, 6G and 7G are being thought about. This will be a very intelligent system and connect the world without limits. 4G tech is not only more efficient, stable, scalable and reliable, but also provide a wider variety of services. These opportunities come with the need to rethink about security, privacy, architect and billing technologies. Newer technologies are working on such challenges and will overcome them. We hope that this paper helps build a stronger link between people working in different fields creating future concepts of mobile communication, Internet services etc.

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