

An Optimization concept for capacity analysis of (3G-4G) in relation to Quality of service

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Abstract: The “G” stands for generation, meaning 4G is the most current generation of cell phone network coverage and speeds. 3G technology created the first networks fast enough to make Smartphone. The fifth generation wireless 5G development initiative is based upon 4G, which at present is struggling to meet its performance goals. The comparison between 3G and 4G wireless communication systems in relation to its architecture, speed, frequency band, switching design basis and forward error correction is studied, and were discovered that their performances are still unable to solve the unending problems of poor coverage, bad interconnectivity, poor quality of service and flexibility. An ideal 5G model to accommodate the challenges and shortfalls of 3G and 4G deployments is discussed as well as the significant system improvements on the earlier wireless technologies. The radio channel propagation characteristics for 4G and 5G systems are discussed.

Keywords: Network Role, Impact of 4G, GPRS, Wi-Fi vs. WiMax, 1G TO 5G,4G trends

1. INTRODUCTION

Cellular Communication is becoming a reality, as the Internet generation grows to broadband access wherever you go, and not just at home but in the office also. Out of the expected 1.8 billion people who will have broadband by 2012, some of them will be mobile broadband consumers and the most of these will be served by HSPA (High Speed Packet Access) and LTE (Long Term Evolution) networks. During EDGE (Enhanced Data Rates for GSM Evolution), large-volume transformation of data was possible, but still there is some problem as the packet movement of the air-interface behaves like a circuit switch call. Thus, part of this packet connection efficiency is lost in the circuit switch environment. Moreover, the standards for developing the networks were different for different regions of the world. Hence, it was decided to have a network which provides services independent of the technology platform and whose network design standards are same globally[5]. Thus, 3G services were born. The emergence of new technologies in the cellular communication systems and also the constantly increasing growth of user demand have triggered researchers and companies to come up with a complete demonstration of the up-coming fourth generation 4G network system. In contrast to 3G, the new 4G framework to be recognized will try to achieve new levels of user experience and multi-service capability by also integrating all the mobile technologies that already exist (such as GSM: Global System for Mobile Communications, GPRS: General Packet Radio Service, IMT-2000: International Mobile Communications, Wi-Fi: Wireless Fidelity, Bluetooth). Currently, 4th Generation technologies are being obtained around the world and devices are being made accessible that may enjoy this brand-new mobile development in speeds and consistency. In telecommunications, 4G is the fourth generation of cellular wireless standards. It is basically succeeding 3G and preceding 5G network[1]. The Fourth Generation of mobile networks will truly turn the current mobile phone networks in to end IP based networks. Every device in the world will have a unique IP address that allows full IP based communications from a mobile device right to the core of the internet and back out again. 4G is set to deliver 100Mbps to a roaming mobile device globally and up to 1 Gbps to a stationary device. It won't be just the phone networks that need to evolve, increased traffic load on the Internet as a whole will need to expand, with faster backbones and a link requiring major upgrade. 4G Bandwidth will always be the main factor in the development of application and devices. 3G networks are clear, it's just not fast enough, and offering 384kbps doesn't meet the requirement of the most users. The evolution from 3G to 4G will be driven by services that offer better quality of video & sound. Greater bandwidth, more

sophistication in the association of a large quantity of information. 4G will encompass all systems from various networks public and private operator-driven broadband networks to personal area and ad hoc networks [3].

2. NETWORK ROLE

3G technologies are in widespread use while 4G compliant technologies are still in the horizon. The biggest difference between the two is in the existence of compliant technologies. There are a bunch of technologies that fall under 3G, including WCDMA, EV-DO, and HSPA among others. Although a lot of mobile phone companies are quick to dub their technologies as 4G, such as LTE, WiMax, and UMB, none of these are actually compliant to the specifications set forth by the 4G standard. These technologies are often referred to as Pre-4G or 3.9G.

4G speeds are much faster compared to 3G:

4G speeds are meant to exceed that of 3G. Current 3G speeds are topped out at 14Mbps downlink and 5.8Mbps uplink. To be able to qualify as a 4G technology, Speeds of up to 100Mbps must be reached for a moving user and 1Gbps for a Stationary user. So far, these speeds are only reachable with wired LANs. The fourth Generation is faster, it is said to be four times faster than its predecessor. This allows for a connection speed more comparable to DSL and home cable networks. It is great News for those completing work and accomplishing important tasks away from their home and office. When uploading large documents and communicating via the internet, a fast connection is important. Whereas 3g doesn't favors such speed as Compared to that of 4G [2].

3G or 3rd generation mobile telecommunications is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. Application services include wide area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment. ITU has not provided a clear definition of the data rate users can expect From 3G equipment or providers. 3G networks offer greater security than their 2G predecessors. By allowing the UE (User Equipment) to authenticate the network it is attaching to, the user can be sure the network is the intended one and not an impersonator. 3G networks use the KASUMI block crypto instead of the older A5/1 stream cipher 3G can implement various network technologies such as UMTS, GSM, CDMA, WCDMA, CDMA200, TDMA and EDGE.

Impact of 4G:

Fourth Generation (4G) also called Next Generation Network (NGN) offers one platform for different wireless networks. A successor of 2G and 3G, 4G promises a downloading speed of 100Mbps and is yet to shower its wonders on. then with the case of Fourth Generation that is 4G in addition to that of the services of 3G some additional features such as Multi-Media Newspapers, also to watch T.V programs with the clarity as to that of an ordinary T.V. In addition, we can send Data much faster than that of the previous generations. A 4G system is expected to provide a comprehensive and secure all-IP based mobile broadband solution to laptop computer wireless modems, Smartphone's, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users. In 4G the integration of network and its applications is seamless

Therefore there is no risk of delay. While implementing 4G the cost issue needs to be taken into consideration so that users can benefit from this technological development fully [4].

3. GLOBAL SERVICE ACCESS IN GPRS

GPRS is a more radical step in the development of GSM towards higher data rate communication and was introduced into GSM networks as an intermediate step between 2G and 3G. The implementation of GPRS allows a move away from circuit-switched data to the delivery of packet data based on GSM's TDMA technology. The packet switching nature of GPRS makes mobile data faster and cheaper and offers continuous connectivity and access to online services. Some operators have chosen to charge users as a function of data transmitted rather than connection time, as is the case for GSM voice calls, because GPRS uses network resources and band-width only when data is actually transmitted.

GPRS capability to provide a higher data rate relies [8]

Wi-Fi vs. WiMax

Additionally, for commercial deployment, frequency allocation will be an issue. With the three dominant communications players controlling the best frequencies, it will be hard to get the type of traction needed with the remaining companies

operating in the frequencies available. WiMax will become extremely robust and displace Wi-Fi as the deployment of choice for commercial deployments, but that could not even begin until the end of 2006. Based upon the number of public hotspots already deployed, WiMax will not be chosen to replace those as they are up and running adequately and personnel involved understand how to work with the technology. The business case does not exist at the hotspot level. Where it may exist is for wider free use deployments such as city deployments (free ones) and other government sponsored or carrier sponsored (with ultra inexpensive pricing for consumers) deployments. If this happens then it's only Wi-Fi that will be displaced, but also cable and DSL will also lose a percentage of their subscriber base. What will cause the displacement is the consumer's proven desire for a bundled package [5].

4. EVOLUTION FROM 1G TO 5G

1G, 2G, 3G & 4G ("G" stands for "Generation") are the generations of wireless telecom connectivity. 1G (Time Division Multiple Access and Frequency Division Multiple Access) was the initial wireless telecom network system. It's out-dated now. The analog —brick phones and —bag phones are under 1G technology. Cell phones era began with 1G. The next era, 2G has taken its place of 1G. Cell phones received their first major upgrade when they went from 1G to 2G. This leap effectively took cell phones from analog to digital. 2G and 2.5G were versions of the GSM and CDMA connections. And GSM is still the most popular technology, but with no internet. Fortunately, GPRS, an additional service, is provided over GSM for the purpose of internet access. GPRS has been developed and thus, EGPRS was created. It's more secure and faster than GPRS. Then 3G came, the new Wireless CDMA technology. It is the first wireless telecom technology that provides broadband-speed internet connection on mobile phones. Further development led to the creation of 3.5G, which provides blazing fast internet connection on phones, up to the speed of 7.2 MBPS. A smart phone can be connected to a PC to share its internet connection and 3G and 3.5G are ideal for this 4G, which is also known as beyond 3G or fourth-generation cell phone technology, refers to the entirely new evolution. Developers are now going for 4G (OFDMA), which will provide internet up to the speed of 1 GBPS. It is said to be able to overcome the problems of weak network strength and should provide a much wider network, making sure that the users get high-speed connectivity anytime anywhere. No doubt, 4G will open new doors of revolutionary internet technologies, but for now, 3G and 3.5G are the best. 4G will allow for speeds of up to 100Mbps. 4G promises voice, data and high-quality multimedia in real-time form all the time and anywhere [6].

5. HOW 4G NETWORK WORKS

As the need for communication rather fastest communication is the foremost priority of present era also the need of quick transfer. Distant business correspondence by sharing data becomes very important. Ever growing technology is the example of one such step towards the fastest transmission of data. 4G stands for fourth generation is the latest technology with high speed transferability of data with security measurements. It is coming with wireless broadband for the instant download.

Talking about the standard of 4G technology, still not defined as set standard, two technologies are supposed to be the based features of 4G.

- WiMAX
- LTE

ITU promotes the technologies against the defragmentation and incompatibilities in 4G technologies. WiMAX stands for Worldwide Interoperability of Microwave Access previously worked as fixed wireless facility under the 802.16e band. Now the modified standard 802.16m has been

developed with the properties of speed, wide spectrum, and increase band.

4G has an advantage of having the WiMAX as a product because IEEE introduces and releases it already therefore economic as no need to pay for its manufacturing price. 4G supports two basic equipments;

WiMAX Network system (network infrastructure) mobile phone set[7]

6. 4G TECHNOLOGY SECURITY ISSUES

In 4G technology there are so many security issues: Interference, Scrambling Attacks, signal Jamming, Location Tracking, Key management, Bandwidth, Denial of Service attacks, open Nature.

- 1. Interference:** inserting man made interference onto a medium a communication system can stop functioning due to a high signal to noise ratio. Interference attacks can be easily carried out as the equipment and knowledge to carry out such attacks are widely available. It is easy to detect using radio spectrum monitoring equipments.
- 2. Scrambling Attacks:** Scrambling is a form of interference which is activated for short intervals of time. Scrambling is targeted against a specific frame or part of frames. The attacker may target management of control information of a particular user to disrupt service. The attacker has to be sophisticated and knowledgeable since specific frame and time slots must be identified for the attack to be successful.
- 3. Signal Jamming:** high-speed wireless data networks are vulnerable to a simple jamming technique that could block service across much of a city. Radio frequency can be jammed or blocked, if a transmitter sends a signal at the same frequency. The LTE signal is very complex made up of one subsystem, and in each case if you take out one subsystem, you take out the entire base station. All that is required is a laptop and an inexpensive software defined radio unit and battery power.
- 4. Location Tracking:** tracking in a particular cell or across multiple cells. Location tracking is made possible by tracking a combination of the cell radio network temporary identifier(C-RNTI) with handover signals or with packet sequence numbers. C-RNTI is transmitted in clear text an attacker can determine whether the UE using the C-RNTI is still in the same cell or not. An attacker can link the new C-RNTI from the handover command message and the old C-RNTI.
- 5. Key Management:** key management for WiMAX at the MS has been designed to safeguard. This is possible since the old traffic encryption key and new TEK are included in the key replay message. It can trigger frequent exchange of keying materials. This will cause confusion at the Ms and exhaust resource at the BS.
- 6. Bandwidth Stealing:** buffer status reports are used as input information for packet scheduling, load balancing, and admission control. Due to the nature of the packet scheduling algorithm by sending a false buffer report.
- 7. Denial of service attacks:** Denial of service attacks are a concern for WiMAX networks. DOS attacks can be initiated via simple flooding attacking authenticated management frames. The BS has to sign and replay with it is the public key, processing of public key encryption and signature is CPU intensive.
- 8. Open Nature:** Open Nature of the network architecture and protocols (IP-based). Open protocol standards, 4G wireless networks are now susceptible to computer attack techniques present on the internet. Networks will be increasingly vulnerable to a range of security attacks including for Malware Trojans and viruses [9].

7. TRENDS OF 4G TECHNOLOGIES

The idea of convergence means that the creation of the atmosphere that can eventually provide seamless and high reliable and quality broadband mobile communication service and ubiquitous service through wired and wireless convergence networks without the space problem and terrestrial limitation, by means of ubiquitous connectivity. Convergence among industries is also accelerated by Formation of alliances through participation in various projects to provide convergence services. 4G mobile systems will mainly be characterized by a horizontal communication model, where such different access Technologies as cellular, cordless, wireless LAN type systems, short-range wireless connectivity, and wired systems will be combined on a common platform to complement each other in the best possible way for different service requirements and Radio environments. The development is expected to inspire the trend of progressive information technologies a far from The current technical focus on fully mobile and widespread convergence of media. The trends from the service perspective include integration of services and convergence of service delivery mechanisms. In accordance with these trends, mobile network architecture will become flexible and versatile, and new services will be easy to deploy [7]

8. SERVICES PROVIDED BY 4G

4G will likely become a unification of different wireless networks, including wireless LAN technologies public cellular networks (2.5G, 3G), and even personal area networks. Under this umbrella, 4G needs to support a wide range of mobile devices that can roam across different types of networks. These devices would have to support Different networks, meaning that one device would have to have the capability of working on different networks. One solution to this “multi-network functional device” is a software defined radio. QoS assurance is important for real time traffics like Voice over IP (VoIP), online gaming, IP TV and video streaming etc. QoS enables network administrators to avoid network congestion and manage the network resources efficiently. The goal of the 4G is to provide the users the facility of Always Best Connected (ABC concept). Fourth generation of networks is a combination of different networks. It gives a platform

for various technologies to be accessed. To provide QoS in 4G is not simple and easy job as one has to deal with different parameters in different technologies. Like if a user is moving and changing his coverage network, so to provide service under QoS framework is challenging. While a mobile user is moving from one network to another network his communication session needs to be Maintained seamlessly irrelevant of the coverage network. Similar is the case with video conferencing and video streaming, the users like to receive the services seamlessly. There are some protocols designed to maintain the seamless communication of the users while moving or in other words to minimize the latency and packet loss of the ongoing communication session. The mobility protocols are Mobile IPv6, Hierarchical MIPv6, Fast MIPv6 and some more (details of all these protocols are given in chapter Handovers). These protocols can help in improving the mobility management of mobile users. In order to provide QoS to the mobile users we propose a combination of mobility protocol Seamless Mobile IPv6 (SMIPv6) and Session Imitation Protocol (SIP). There are two types of losses when a mobile user switches network, one is called segment packet loss and the other is called edge packet Loss. Segment packet loss is because of the undeterministic nature of the handoff while the edge packet loss is between the Mobility Anchor Point (MAP) and the MN. To minimize these losses different approaches are used, to minimize edge packet loss the MN is moved as close to the MAP as possible, while for The segmented packet loss two approaches are used one is synchronized packet simulcast (SPS) and hybrid simulcast mechanism are used. In SPS the packets are sent to both the current network as well the potential network the MN is approaching [14]. While hybrid simulcast mean that the mobile node informs the network about the handoff to be taken into effect but it is decided by the network to which AR the MN shall attach. This way the packet loss is minimized the detailed mechanism is given in chapter of handover). Session Initiation Protocol (SIP) is used to manage mobility of different entities such as session, terminal, service and personal mobility. It facilitates mobility and maintains the real time multimedia sessions. SIP is an application layer protocol therefore it can work both in IPv4 and IPv6. SIP work along with other protocols Such as Real Time Transport Protocol (RTP)[4].

9. CONCLUSION

4G seems to be a very promising generation of wireless communication that will change the people's life to wireless world. There are many striking attractive features proposed for 4G which ensures a very high data rate, global roaming etc. New ideas are being introduced by researchers Someday 4G networks may replace all existing 2G and 3G networks, perhaps even before a full deployment of 3G. Multiple 3G standards and springing up that would make it difficult for 3G devices to be truly global. Next 5G it should promote in less price for public use.

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