

# Network Evolution in 3G / 4G: Applications and Security Issues

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**Abstract --** During the 20th century, the key technology was information gathering, processing and distribution. This total technology will depend based on the network systems. Which are nothing but grouping of systems that should be controlled by a server. In business and home applications, mobile users, and in all social issues the networks are used. To enhance the benefits of these networks, we are introducing 3G systems. The aim of the 3G security architecture is to improve on the security of 2G systems. 3G systems have additional standards like EDGE and CDMA rather than older systems. It has a high quality voice and video services but has limited in coverage area. Now introducing the 4G technologies to full fill the limitations of 3G. The Fourth generation (4G) will provide access to wide range of telecommunication services, including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet based, along with a support for low to high mobility applications and wide range of data rates, in accordance with service demands in multiuser environment.

**Keywords --** 3G, 4G, CDMA, EDGE, GPRS, GSM, IMT, ITU, UMTS.

## I. INTRODUCTION

The 3G research and development projects started in 1992. In 1999, ITU approved five radio interfaces for IMT- 2000. There are revolutionary standards (EDGE and CDMA) that are backwards compatible extensions to preexisting 2G networks as well as revolutionary standards that require all new network hardware and frequency allocations. 3G mobile telecommunications is a generation of standards for mobile phones mobile telecommunications service fulfilling the international mobile telecommunications-2000 specifications by the international telecommunication union. In telecommunications, 4G is the fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. In 2009, the ITU-R organization specified the IMT-advanced requirements for 4G standards, setting peak speed requirements for 4G service at 100Mbps for high mobility communications and 1Gbps for low mobility communications.

## II. 3G – ARCHITECTURE

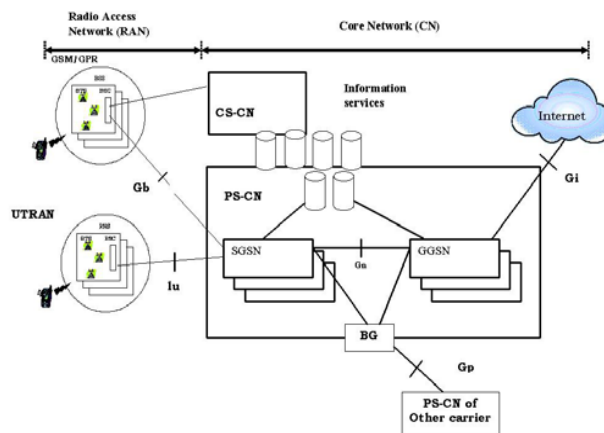


FIG. 1. ARCHITECTURE OF 3G

As can be seen in Fig. 1, the 3G network has two main parts

1. The Radio Access Network (RAN)
2. The Core Network (CN)

The RAN consists of the existing GPRS/GSM RAN system which is connected to the Packet Switched Network (PS-CN) and also to the circuit switched network (CS-CN). The PS-CN will eventually connect to the UTRAN system as part of the full transition to 3G. The UTRAN consists of subsystems, with each subsystem consisting of one Radio Network Controller (RNC) which is connected to several Base Transceiver Stations (BTN). The GRPS RAN has a similar architecture.

The Core Network consists of the PS-CN and the CS-CN. The PS-CN consists of several information servers, the SGSN and the GGSN. Each SGSN connects one or more RSC and BSC with the PS-CN. Its functionality includes access control, mobility management, paging and route management. The GGSN is the logical gateway to the Internet. The BG interface can be used to connect to another PS-CN or to another carrier. The information servers provide several functions. The Home Location Register (HLR) maintains subscriber information and the Authentication Center (AuC) maintains authentication information. There are also IP based servers such as DNS, DHCP and RADIUS servers which interact with the SGSN/GGSN and provide control and management functions.

The 3G system consists of two main parts: the User Equipment (UE) and the UMTS Terrestrial Radio Access Network (UTRAN). The UE is the mobile phone and the UTRAN is the base station and the network intelligence. Both the UE and the UTRAN are composed of different layers. The four lowest layers are: the physical layer (PHY), the Medium Access Layer (MAC), the Radio Link Layer (RLC) and the Radio Resource Layer (RRC). This text will provide a general description of the UE and the function of the different layers with the focus on the RRC layer since this is the only layer involved in the assignment.

### III.INTRODUCTION TO 3G WIRELESS

3G stands for third generation, and is a wireless industry term for a collection of international standards and technologies aimed at increasing efficiency and improving the performance of mobile wireless networks.3G wireless services offer enhancements to current applications, including greater data speeds, increased capacity for voice and data and the advent of packet data networks versus today's switched networks.

As second-generation (2G) wireless networks evolve into third-generation systems around the globe operators are working hard to enable 2G and 3G compatibility and worldwide roaming, including 3G UMTS, GSM, GPRS, IS-95A/B, 3G CDMA2000 1X and CDMA2000 1xEV technologies.

#### A.TYPES OF 3G

3G is a generic term covering a range of future wireless network technologies, including WCDMA, CDMA2000, UMTS and EDGE.3G combines high-speed mobile access with Internet Protocol (IP) based services. This doesn't just mean fast mobile connection to the World Wide Web - by liberating us from slow connections, cumbersome equipment and immovable access points, 3G will enable new ways to communicate, access information, conduct business and learn. This is summarized in the diagram on below produced by Allied Business.

#### B.FEATURE OF 3G

- ✓ The ITU (International Telecommunication Union) has proposed 3G telecommunications standards to provide cost efficient high quality, wireless multimedia applications and enhanced wireless communications.
- ✓ The features of 3G can be divided into two categories. One is data rates and the other is security.
- ✓ The Main feature of 3G technology is that it supports greater voice and data capacity and high data transmission at low-cost. 3G mobiles can operate on 2G and 3G technologies.
- ✓ The second major feature is the security:3G offers greater security features than 2G like Network Access Security, Network Domain Security, User Domain Security, Application Security.
- ✓ The technology provides localized services for accessing traffic and weather updates. Video calls

and video conference is another major feature in 3G mobile technology. These features reduces the communication barriers between people, that were not sacked even with mobile phones.

- ✓ Data transfer rates are high and can support even live TV channels over phone. Online media is another exciting feature in 3G mobiles. 3G mobiles highly attract the music lovers as they can listen to music and watch videos online and can download huge files with in less time.Few 3G mobiles support MS-Office and RSS feeds.

#### C.ADVANTAGES OF 3G

- 1) All the functions performed in a normal 2G mobile device can be performed in 3G at a higher speed.
- 2) 3G provides faster connectivity, faster internet access and music with improved quality.
- 3) Overcrowding is relieved in existing systems with radio spectrum.
- 4) Bandwidth, security and reliability are more. Provides interoperability among service providers
- 5) Availability of fixed and variable rates. Support to devices with backward compatibility with existing networks.
- 6) Always online devices – 3G uses IP connectivity which is packet based. Rich multimedia services are available.

#### D.APPLICATIONS OF 3G

- ✓ The 3G mobile can be used as a modem for a computer which can access internet and can download games and songs at high speed.
- ✓ 3G technology provides high quality voice calls and video calls.
- ✓ View live TV broadcasting in mobile. Get Weather updates and news headlines in mobiles.
- ✓ 3G increase bit rate which helps the service providers to provide high speed internet facility and many applications to its customers.
- ✓ 3G devices can provide data transmission speed upto 2mbits/s when used in stationary mode.
- ✓ Provides multimedia services such as sharing of digital photos and movies.
- ✓ This technology provides real time multi player gaming and location-based services.
- ✓ 3G allows user to be online all the time and also includes mobile office services, like virtual banking and online selling.
- ✓ Teleconferencing at work is one of the best applications.

#### E.DRAWBACKS OF 3G

Though there are many advantages with 3G technology, there are few drawbacks like

- 1) Upgrading the base station and cellular infrastructure to 3G incurs very high costs.
- 2) Service provider has to pay high amount for 3G licensing and agreements.

- 3) Problem with the availability of handsets in few regions and their costs.
- 4) High power consumption.

3G technology provides high data rates and improved call quality, video calling facility and much more. This technology provides huge benefits to mobile users. The major drawbacks are from the regions where 3G is in initial stages of launch. These drawbacks can be minimized when 3G services are used extensively.

#### F.3G DIFFERENT FROM 2G

- ✓ Packet data speed is higher in 3G, and it is up to 384 KBPS
- ✓ Voice and sms speed is also 384 KBPS in 3G
- ✓ 2G utilizes different switching techniques for voice and data, where as 3G uses single switching, irrespective of data
- ✓ 3G has at least 2MB of data link of a mobile, where in 2G the data rate is in KBPS
- ✓ 3G has WiMAX facility for faster VOIP and internet
- ✓ 2G uses GSM TDMA technology with narrowband 200Khz.
- ✓ 3G uses CDMA technology with broadband 5Mhz, with same frequency carrier and time.

#### G.BENEFITS OF 3G

- High Quality Voice Service: The quality of voice-falls under 3G will be much higher compared to 2G services.
- Enhanced content Service: 3G users can download full music files, full movie files and other files at high speed.
- Mobile Broadband: 3G user can use his handset for high speed internet any time anywhere (where connectivity is available).
- Video Services: 3G user can enjoy the video call facility where in both the caller and receiver will be able to see each other while speaking if both have 3G services and 3G enabled handsets.
- Mobile TV: 3G users can watch TV programmes of different video channels as per his liking while on the movie.

#### IV.SECURITY ISSUES IN CELLULAR NETWORKS

There are several security issues that have to be taken into consideration when deploying a cellular infrastructure. The importance of which has increased with the advent of advanced networks like 3G.

- Authentication: The purpose of 3G is to enable people to communicate from anywhere in the world, the issue of cross region and cross provider authentication becomes an issue.
- Integrity: With services such as SMS, chat and file transfer it is important that the data arrives without any modifications.
- Confidentiality: With the increased use of cellular phones in sensitive communication, there is a need

for a secure channel in order to transmit information.

- Access Control: The device might access a database where some sort of role based access control is necessary.
- Operating Systems in Mobile Devices: Some phones may use a Java Based system; others use Microsoft Windows CE and have the same capabilities as a desktop computer. Issues may arise in the OS which might open security holes that can be exploited.
- Web Services: A Web Service is a component that provides functionality accessible through the web using the standard HTTP Protocol. This opens the cellular device to variety of security issues such as viruses, buffer overflows, denial of service attacks etc.
- Location Detection: The actual location of a cellular device needs to be kept hidden for reasons of privacy of the user. With the move to IP based networks, the issue arises that a user may be associated with an access point and therefore their location might be compromised.
- Viruses and Malware: With increased functionality provided in cellular systems, problems prevalent in larger systems such as viruses and malware arise.
- Downloaded Contents: Spyware or Adware might be downloaded causing security issues. Users might download unauthorized copies of music, videos, wallpapers and games.
- Device Security: If a device is lost or stolen, it needs to be protected from unauthorized use so that potential sensitive information such as emails, documents, phone numbers etc. cannot be accessed.

#### V.3G SECURITY ARCHITECTURE

There are five different sets of features that are part of the architecture:

- Network Access Security: This feature enables users to securely access services provided by the 3G network. This feature is responsible for providing identity confidentiality, authentication of users, confidentiality, integrity and mobile equipment authentication.
- Network Domain Security: This feature enables nodes in the provider domain to securely exchange signaling data, and prevent attacks on the wired network.
- User Domain Security: This feature enables a user to securely connect to mobile stations.
- Application Security: This feature enables applications in the user domain and the provider domain to securely exchange messages.
- Visibility and Configurability of Security: This feature allows users to enquire what security features are available.

### A.3G Vs 4G

**3G** and **4G** are standards for mobile communication. Standards specify how the airwaves must be used for transmitting information (voice and data). **3G** (or 3rd Generation) was launched in Japan in 2001. As recently as mid-2010, the networks for most wireless carriers in the U.S. were 3G. 3G networks were a significant improvement over 2G networks, offering higher speeds for data transfer. The improvement that **4G** offers over 3G is often less pronounced. Analysts use the analogy of standard vs Hi-Def TV to describe the difference between 3G and 4G.

### B.COMPARISION TABLE

	<b>3G</b>	<b>4G</b>
<b>Data Throughput</b>	Up to 3.1Mbps with an average speed range between 0.5 to 1.5 Mbps	Practically speaking, 2 to 12 Mbps (Telstra in Australia claims up to 40 Mbps) but potential estimated at a range of 100 to 300 Mbps.
<b>Peak Upload Rate</b>	5 Mbps	500 Mbps
<b>Switching Technique</b>	packet switching	packet switching, message switching
<b>Network Architecture</b>	Wide Area Cell Based	Integration of wireless LAN and Wide area.
<b>Services And Applications</b>	CDMA 2000, UMTS, EDGE etc	Wimax2 and LTE-Advance
<b>Forward error correction (FEC)</b>	3G uses Turbo codes for error correction.	Concatenated codes are used for error corrections in 4G.
<b>Peak Download Rate</b>	100 Mbps	1 Gbps
<b>Frequency Band</b>	1.8 – 2.5 GHz	2 – 8 GHz

### VI.4G INTRODUCTION

- ✓ A short name for Fourth Generation.
- ✓ A stage of broadband mobile communications that supersede 3G.
- ✓ 4G is expected to use radio spectrum in an efficient manner, and as a result, provides cable-modem transmission speeds to the end users.
- ✓ This feature enables high-quality streaming video.
- ✓ Simultaneous connections to multiple high-speed networks, known as pervasive computing, are expected by 4G.
- ✓ Thus seamless handoffs are provided throughout a geographical area.

Coverage enhancement technologies, like femtocell and picocell are expected to develop for addressing various needs of mobile users in homes, public buildings etc..

4G takes on a number of equally true definitions, depending on whom you are talking to. In simplest terms, 4G is the next generation of wireless networks that will replace 3G networks sometimes in future. In another context, 4G is simply an initiative by academic R&D labs to move beyond the limitations and problems of 3G which is having trouble getting deployed and meeting its promised performance and throughput.

In reality, as of first half of 2002, 4G is a conceptual framework for or a discussion point to address future needs of a universal high speed wireless network that will interface with wire line backbone network seamlessly. 4G is also represents the hope and ideas of a group of researchers in Motorola, Qualcomm, Nokia, Ericsson, Sun, HP, NTT DoCoMo and other infrastructure vendors who must respond to the needs of MMS, multimedia and video applications if 3G never materializes in its full glory.

### VII.4G NETWORKS

4G is the next generation after 3G. Although still 3G has not been fully implemented in the real world, people have started talking about the features of 4G. Some of the 4G services talked about are incorporating quality of service (QoS) and Mobility

1. High usability: Anytime, anywhere and with any technology.
2. Support for multimedia services at low transmission cost.
3. Personalization.
4. Integrated services.

### A.REASON FOR DELAY IN IMPLEMENTING 3G & 4G MOBILE SERVICES

- The 3G services had only reached with in some towns of china, so that it may take time to reach to other countries.
- Another major defect of this is that wide band frequency spectrum, which is needed for 3G, is lacking.
- Another reason for this is that it is a cost bearing item especially for sending data.
- If it should be accepted among all customers, firstly it should be available at a lower rate, for which the rate of spectrum should be declined.

### i)REASONS TO HAVE 4G

- Support interactive multimedia services teleconferencing, wireless Internet, etc.
- Wider bandwidths, higher bit rates.
- Global mobility and service portability.
- Low cost.
- Scalability of mobile networks.

### ii) NEW IN 4G

Entirely packet-switched networks. All network elements are digital. Higher bandwidths to provide multimedia services at lower cost (up to 100Mbps). Tight network security.

### B.MOTIVATION FOR 4G BEFORE 3G

- ✓ 3G performance may not be sufficient to meet needs of future high-performance applications like multi-media, full motion video, wireless

teleconferencing. We need a network technology that extends 3G capacities by an order of magnitude.

- ✓ There are multiple standards for 3G making it difficult to roam and interoperate across networks.
- ✓ We need global mobility and service portability 3G is based on primarily a wide-area concept.
- ✓ We need hybrid networks that utilize both wireless LAN (hot spot) concept and cell or base-station wide area network design.
- ✓ We need wider bandwidth. Researchers have come up with spectrally more efficient modulation schemes that cannot be retrofitted into 3G infrastructure.
- ✓ We need all digital packet networks that utilize IP in its fullest form with converged voice and data capability.

### C.SPECIFICATION

- 1) 4G can provide 10 times increase in data transfer over 3G.
- 2) This speed can be achieved through OFDM.
- 3) OFDM can not only transfer data at speed of more than 100mbps, but it can also eliminate interference that impairs high speed signals.

### D.APPLICATIONS

1. 4G will provide for a vast no. of presently nonexistent application for mobile devices.
2. 4G device will differ from present day mobile device in that there will be navigation menus.
3. 4G will provide a seamless network for users who travel & required uninterrupted voice/data communication.

### E.NEED OF 4G

Firstly 3G's maximum data transfer rate of 384 kbps to 2 mbps is much slower than 20mbps to 100mbps of 4G. With its use of existing technologies & communication standards, 4G present a comparably inexpensive standard. 4G will utilize most of the existing wireless communication infrastructure.

### F.ISSUE IN 4G

- Access
- Handoff
- Location co-ordination
- Resource co-ordination to add new user
- Support for quality of service.
- Wireless securities & authentication.
- Network failure & backup. Pricing and billing.

### G.TECHNIQUE USED IN 4G

- OFDM
- USB(Ultra Wide Band)
- Millimeter wireless.
- Smart Antennas
- Long term power prediction.
- Scheduling among users.
- Adaptive modulation and power control.

### H.ADVANTAGES

1. Support for interactive multimedia voice, streaming video, internet & other broadband services.
2. IP based mobile system.
3. High speed, high capacity & low cost per bit.
4. Global access, service portability & scalable mobile services.
5. Better scheduling and call admission control technique.
6. Ad-hoc & multi-hop network.
7. Better spectral efficiency.
8. Seamless network of multiple protocols & air interfaces.

### I.DISADVANTAGES

1. Expensive .
2. Battery uses are more hard to implement.
3. Need complicated hardware.

### VIII.CONCLUSION

Security is an ever growing field. What is secure today may not be secure tomorrow. There will always be malicious users trying to exploit and find new holes in a network. Therefore, we need to look into the future so that we are able to face these security issues before they cause damage. Security is not just about putting big locks on the front door; it also involves making sure all the windows are shut. Each one can be individually fooled, but the comparison makes the system more secure as a whole.

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