Review Paper on 4G Communication Network

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Abstract—The development of broadband wireless access technologies in recent years was the result of growing demand for mobile internet and multimedia application. With the growing user demands, the third generation (3G) network faces various limitations with respect to its bandwidth, data rate, etc. which cannot accommodate the future multimedia environment. This has given rise to the fourth generation network which tries to accommodate all the shortcomings of the 3G network with its unique needs and aspirations. This review paper describes the 4G network in detail along with its scope in the ever growing communication industry.

Keywords—4G (Fourth generation), CDMA, Wi-Max, Security and MIMO.

I. INTRODUCTION

The ability to communicate with people on the move has evolved remarkably since Guglielmo Marconi first demonstrated radio’s ability to provide continuous contact with ships sailing the English channel. That was in 1897, and since then new wireless communication methods and services have been adopted enthusiastically by people throughout the world. The commercial proliferation of cellular voice and limited data service has created a great demand for mobile communications and computing. Wireless communication is enjoying its fastest growth period in history due to enabling technologies which permit widespread deployment. In 1946, the first public mobile telephone service was introduced in 25 major American cities. Each system used a single powered transmitter and large tower in order to consider distances of over 50km in a particular market. Historically, growth in mobile communications field has come slowly and has been coupled closely to technological improvements.[5]

<table>
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<tr>
<th>APPLICATIONS</th>
<th>EXISTING STANDARD/TECHNOLOGY USED</th>
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<tr>
<td>Mobile telephony (digital cellular telephony)</td>
<td>GSM, CDMA</td>
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<td>Wireless LAN/MAN/WAN</td>
<td>IEEE 802.11 [Wi-Fi], 802.16 [WIMAX], etc.</td>
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<td>Personal area communication</td>
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<td>Wireless local loops</td>
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<td>Mobile satellite communication,</td>
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<td>global communication</td>
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<td>Digital video broadcast, DTH</td>
<td>DVB</td>
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<td>Mobile ad hoc networks</td>
<td>All WLAN/WMAN standards and Bluetooth</td>
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<td>Digital audio broadcast, HD radio</td>
<td>DAB</td>
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Major Changes That Took Place In The 1G To 3G Wireless Communication Systems:

First Generation [1G] Systems:
- Complete analog systems mainly dealing with audio (except television with analog video)
- Analog mobile phone systems (AMPS)
Second generation [2G] Systems:
- Partially analog and digital systems where audio and images were communicated.
- Bit rate was very low around 10 to 50 kbps

Third Generation [3G] Systems:
- Fully digital systems with audio, image and video
- Tremendous rise in the bit rate, of the order of 2 to 20 Mbps, in Wi-Fi and WiMAX even up to 54 Mbps.

Characteristics of Fourth Generation [4G] Technology:
- Overcoming the shortcomings in the 3G network, 4G provides mobile ultra-broadband internet access, example, in laptop with USB, in wireless modems etc.
- 4G network works faster, is comparatively more expensive and is covered in less area than the 3G network.
- 4G devices also have 3G support.
- They have speed as high as 100 Mbps and users in strongly supported areas have speed ranging from 15 to 20 Mbps. The speed generally varies depending on its distance from the transmission tower.
- The 4G systems have speed, are fully digital anywhere anytime and converged wireless communication is expected with total multimedia.
- They are more advanced in technology than all the previous generations and are a multistand wireless system with Ad Hoc networking.

II. TECHNOLOGY USED IN 4G NETWORK
- MIMO - Minimum antenna configurations.
  – For the BS - a minimum of 2 Tx and 2 Rcv antennas
  – For the MS - a minimum of 1 Tx and 2 Rcv antennas
- MIMO Techniques -
  – Beam forming – makes use of multiple antennas to steer or focus signal in a particular direction. Can reduce adjacent site self-interference & add reach.
  – SU-MIMO (Single User MIMO)
  – Transmitting parallel & unique data streams in the same frequency-time resource to a single user. (Spatial Multiplexing)
    • Improves individual users throughput.
  – MU-MIMO (Multiple User MIMO)
- Transmitting parallel & unique data streams in the same frequency-time to multiple users. (Spatial multiplexing)
  • Improves sector/site capacity throughput.
    – STBC - Space Time Block Coding
      • The simplest of the STBCs transmits multiple copies of a single data stream across a number of antennas which improves the SNR of the received data to improve the reliability of data-transfer.
- OFDMA – Orthogonal Frequency Division Multiple Access. (LTE DL only, WiMAX UL and DL).
  • Two types of sub-carrier permutations.
    – Contiguous subcarriers grouped into logical sub-channels (Used in LTE & WiMAX sub channels).
  – Pseudo-random subcarriers grouped into logical sub channels (Used in WiMAX FUSC and PUSC).

- SC-FDMA – Single Carrier Frequency Division Multiple Access. (LTE UL only)
  • Low peak-to-average power ratio conserves mobile battery life.
- ACM – Adaptive Coding and Modulation
  • Changing the coding (1/2, 2/3, 3/4) and modulation schemes (BPSK, QPSK, 16 QAM, 64QAM) based upon current RF conditions
- HARQ - Hybrid automatic repeat request
  • The most common versions use transmissions with incrementally more redundant error-detecting codes such as cyclical redundancy checking and forward error correction bits.
III. CHALLENGES FACED IN 4G

IPv6 protects the transmitted data only when the connection is secured. In the absence of a secure connection, security threats arise thus proving to be a major loop hole.

VoIP requires real time communication, however IP networks which are the core of all VoIP infrastructure are not designed for such real time applications.

Voice quality degradation, compromised data, delay etc. are experienced. Network performance differs based on network traffic.[2]

Since wireless devices are used for vast number of applications like personal computers, mobile phones, tablets etc. they have to be scanned completely and frequently to remove hidden threats and the antivirus installed has to be upgraded periodically.
Security issues with respect to the SIM services with location tracing becoming easy also provides a major threat. (Though this issue is still debatable)

Cell phones with 4G technology shouldn’t be used ever so often with the phone heating up when used for a prolonged period, producing radiation, thus becoming a threat to humans with diseases such as cancer stemming from it. Also the 4G connection differs from area to area.

IV. EXPECTATIONS FROM 4G

Today’s market demands value added services. With the success of 3G network, user expectation with 4G have shot up by a hundred fold. The dream of internet-style functionality via wireless communication is expected to surpass that available in 3G.

The expected applications to be available in 4G include:

- 4G network should handle broadcast quality data loads over much cheaper, faster and in more number of mobile communication networks. Eg. One developer nomad innovations offers a WiMAX based modem that attaches to the back of a professional video camera, obviating the need for satellite connectivity in the field.
- Cloud computing should be more safe, authentic, dependable, impregnable and more operative.
- Large files should be transferred in less time and applications developed for mobile users should have maximum compatibility with the network.
- In mobile gaming, multi-player games can be played at a high speed.
- The cameras installed in traffic light can be deployed with 4G network thus increasing the law and order in the city.

4G network will provide broadband access (even in remote areas).

V. CONCLUSION

For the 4G network to be a success, the coverage area has to be maximum along with its capacity. Over the past few years the use of internet has changed considerably from user to user and is still ever-changing. Keeping this in mind the 4G network should fulfil the demands of shared channels, since they allow substantial number of simultaneous users to be served with satisfactory perceived speeds. Thus, for it to be a complete success it has to meet the criterion set by the user only then will it prove to be a complete winner!

REFERENCES


