NICE-RJCS Volume 4, Issue 2013: pp!3-26

A Comparative Study of 3G, 4G Cellular Networks & Beyond and their Future Prospects in Pakistan

Engr. Akhtar Saeed
Research Assistant,
Department of Computer Science,
Newports Institute of Communications & Economics
'Akhtar@newports.eilu.pk'

Sadiq Ali Khan
Lecturer Associate Professor,
Department of Computer Science,
University of Karachi
'msakhan@uok.edu.pk'

Abstract

The research work of this paper is organized as follows: The part of the paper concisely focuses the evolution of cellular and mobile wireless systems focusing on their key primary parameters: Radio bandwidth, data and channel capacity rates and the techniques of access. The next step, which constitutes the main body of the subject, explores the current market scenario of the telecom sector in Pakistan along with the expected future mobile systems focusing on what it takes to the advancement. The third part highlights the key challenges in deploying modern G's like 3G & 4 G and submits a proposed hypothetical 5G Network hierarchy,a proposed 5G network architecture. Fourth part consists of the questionnaire, exploring the current mindset of the Pakistani nationals, about what they think of the services being provided to them. In the end, there are some recommendations concluded regarding the future research work to be carried out.

Introduction

The world has become a global village due to the presence of a vigilant communications system. The telecommunication protocols and technology has altered the norms of communications, resulting in the change of living of a common man The sector has emerged as a fast flourishing industry over the past few years. That is why different operators of the globe are motivated to provide enormous investments in this domain.

Cellular Generation Networks The cellular generations which have been evolving are vary from each other in the many different aspects, like spectrum of frequencies, rate of data transfer, techniques of radio accessing etc. 1G (first generation) cellular networks were analog systems (having the spectrum 10kHz-30kHz). FDMA (Frequency Division Multiple Access) was used for switching. 2G (second generation) cellular networks were being referred to as GSM (Global System for Mobile Communications). They had a nominal rate of data transfer of about 9.6 Kbps. TDMA (Time Division Multiple Access) was introduced together with the utilization of FDMA switching technique. 3G (third generation) cellular networks were then introduced with greater data rates, i.e. up to 2 Mbps which was enhanced further as it evolved. CDMA (Code Division Multiple Access) was adopted as the newer switching scheme. The latest generation currently being employed, i.e. 4G (fourth generation) reached the peak of rate of data transfer up to 100 Mbps and it continues to grow beyond.

Regrettably, the Islamic Republic of Pakistan has been left behind by some other counties of the world in the technological advancement of the telecommunications sector. From the perspective of the growth, Pakistan was the leading South Asian State in the past few years. But due to some political scenarios and law and order situations, we were unable to launch 3G on time. This detention made a major setback to the employment opportunities in Pakistan. Likewise, almost half the Pakistani population comprises the young generation who show very keen adoptability of new technologies (see Appendix A)

Certain radio access technologies like WLAN (Wi-Fi) etc have been introduced by the emergence of 4G systems. The 5G (fifth generation radio networks) is the current hot topic of the telecommunications engineers these days. This is a hypothetical and a prospective generation that would be a major mile stone of the present era. 5G is a terminology that commonly refers to a system of WWWW (World Wide Wireless Web), i.e. each and every system would go wireless and would be a part of a global network.

Information& Figures

Some prominent information on investment in the telecom sector in previous years is quoted as under. These facts are clear evidence that there is an urgent necessitatetakingdrastic measures to accelerate and facilitate the sector in the Islamic Republic of Pakistan

Foreign Direct Investment in Telecom Sector

(US $ million)

	FDI in Telecom	Total FDI	Telecom (%) Share
2003-04	207.1	949.4	21.8
2004-05	494.4	1,524.00	32.4
2005-06	1,905.10	3,521.00	54.1
2006-07	1,824.20	5,140.00	35.5
2007-08	1,438.60	5,410.00	26.6
2008-09	815.00	3,720.00	21.9
2009-10	373.62	2,199.44	17.0
2010-11	79.2	1,574.0	5.0

Table 1 Foreign Direct Investment in Telecom Sector

Source: http://propakistani.pk/2011/07/20/telecom-operators-reluctant-to-invest-in-pakistan/ By M Yasir Wednesday, Jul 20, 2011

The potential of the telecom sector in Pakistan is enormous. Just by looking at the depositions of up to 2012, it has made a huge contribution of Rs.363 billion to the Federal Reserve and still counting. The sector has shown a sharp increase of input, i.e. up to 5.4% since the previous year of 2011. Moreover, Pakistan has been ranked on the top notch position by the Global Information Technology Report of the World Economic Forum.

The important point to be noted done here, is that the threshold of the potential mobile subscribers would be reached up to 118.3 million till the completion of the year 2012.

A brief reference of some counties are as follows, who have already launched and deployed latest generation like 3G in their dominions and are still seeking 4G beyond the horizon.

India

The 3G spectrum bids in India made an exchequer of about U.S. $ 13510000000. Together with other auctions and bids, like broadband and BWA licenses, total revenue of over U.S. $ 21,190,000,000th has been generated by the Government of India.

Afghanistan

3G mobile services in Afghanistan were started in about 2012. The mobile operator was Etisalat which paid a huge amount of about U.S. $ 25 million.

U.S. policy and results

The prime leader in the world of 3G mobile communications is U.S., who initiated its development as early as in 2009. U.S. has already left behind Japan in the race of acquiring the technological investment. The investment ratio of U.S. in 4G in the period 2012-2016 could be in the bound of $ 25 - $ 53 billion, thereby creating huge employment opportunities.

Pakistan's Current Market Status It has been seemed that the PTA (Pakistan Telecommunications Authority has become a symbol of confusion and perplexity over the 3G license auction issue. Which in term has left the state behind in the run of deploying the latest technologies around the globe? This reality could be well-shown from the fact that the investments in this

sector has been severely abridged to U.S. $ 498 million. It shows that this is the high time for Pakistani market to bring more investments and to condemn the state of monopolization.

Problems in deploying 3G

A delay in some countries has been seen in the deploying procedure of the 3G networks. A prime factor is also the licensing fee, as in some countries in Europe. In Pakistan, customers are still in queue for utilizing 3G services on their cell phones. There are very strict and stern norms being defined by the PTA, along with a huge licensing amount of 3G licenses, which is the main cause of concern for the sector in the Islamic Republic of Pakistan.

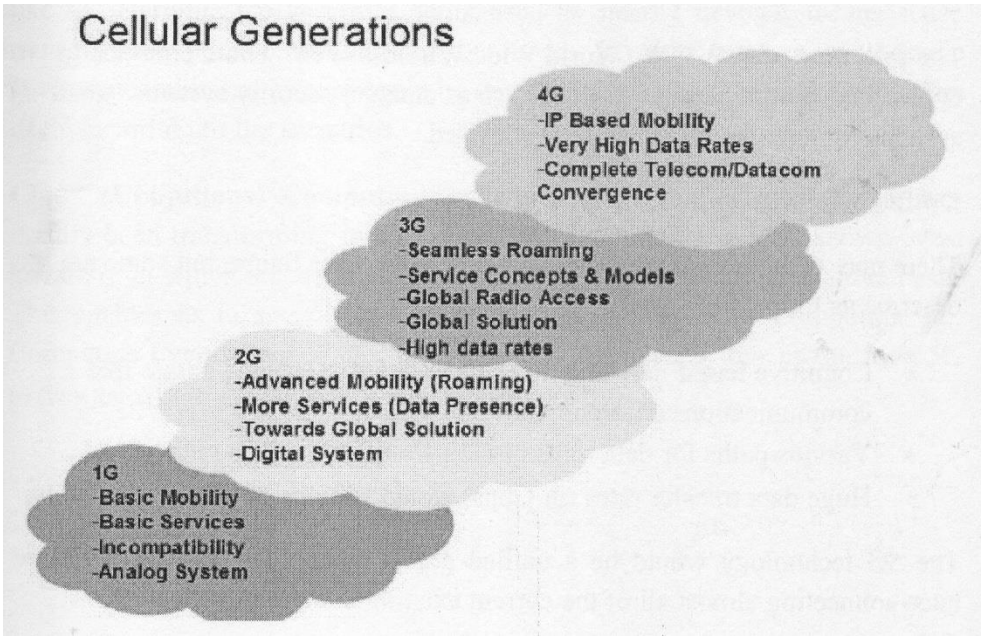

Figure 1: Cellular Generations Hierarchy

Source: http://information-technology-topics.blogspot.com/2011/09/cellular-generations-0g-lg-2g-3g-4g-5g.html

4G Cellular Networks

With the implementation of 4G infrastructure, cellular penetration further increased by utilizing greater throughputs. High-quality video calls and other prominent features became an integral part of the cellular networks. This blow has been proven to be a major breakthrough in the economical developments of the counties, such as in U.S. (United States), where the productivity and employment ratios have been increased many fold.

5G WWWW (World Wide Wireless Web)

The evolution of WWWW (World Wide Wireless Web) would continue to evolve in different phases. Utilities such as amateur security systems, smart systems for automation etc could be devised.

Opting 5G - Reason?

There may be numerous reasons for opting 5G in near future, but some are describe as follows:

- Cognitive based networks would enable us to provide hassle free communications environment
- Various paths for data transmission would be made a reality
- Huge data transfer rates (in Gbps) would become possible in mobility.

The 5G technology would be a unified-global technology that would allow inter-connecting almost all of the current existing communications.

The development of user terminals will be the prime focus of 5G mobile networks, which have an embedded feature of adapting a wide range of wireless technologies along with a broad spectrum for the data flow. Moreover, it will be upon the terminal's discretion which services to be accessed. The re-configurability of the 5G networks would be embedded on the core level such as the ubiquitous, IP-based kernels.

A Projected Architecture - 5G Network

A common point of discussion nowadays is of how 5 G Networks would be structured. Various suggestions have been made by different professionals and engineers, like as been mentioned in the International Journal of next-generation networks (IJNGN) Vol.4 No. 3, September 2012. The mean point in the discussion of 5G Networks is that they would be adjustable (i.e. can be reconfigured dynamically, which would be based on cognitive schemes of radio.Cognitive schemes are basically supposed to have AI (Artificial Intelligence) in which they have a built-in ability to reconfigure themselves, like to determine the spectrum being used by nearby devices, locate, sense transmission parameters and many more. In this way, a well-aware environmental based system could be devised which could optimize and adopt itself according to the scenarios.

Cloud (Ubiquitous) Computing The world of IT and telecom sector has rapidly been transforming into a Cloud Network. This is a well known latest hierarchy in which all the pool of resources is shared on a configurable basis. This enables us to say, we have introduced the Ubiquitous Computing, i.e. Computers Everywhere. This configuration is the heart of our prospective 5G networks, where all the shared resources remotely.

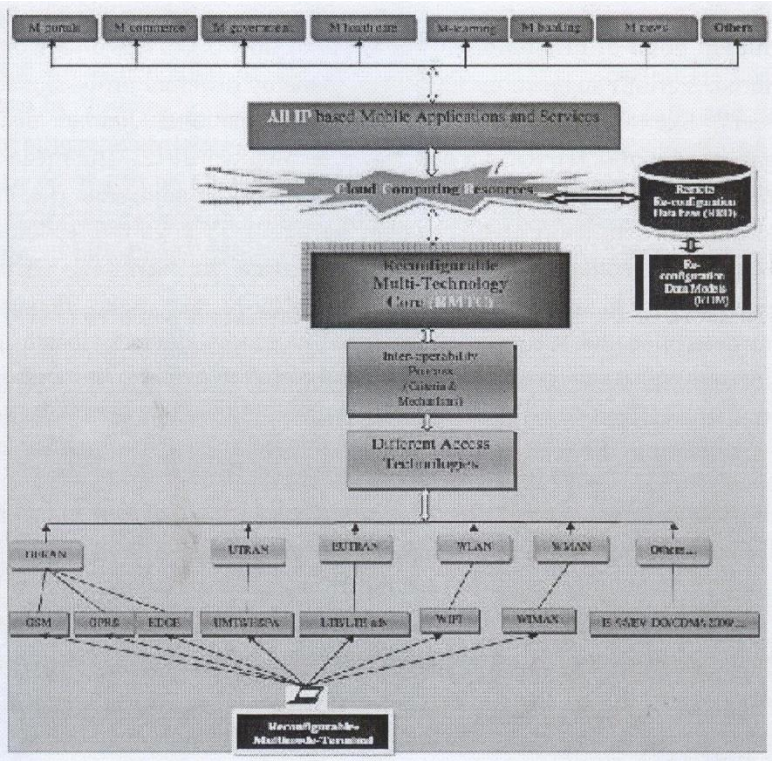

Figure 2: A proposed architecture (5G Network)

Source: Prospective of Fifth Generation Mobile Communications Dr. Anwar M. Mousa University of Palestine,Gaza- Palestine

Data Collection (Questionnaire)

Attached in Appendix A, a survey was conducted in the form of a questionnaire, which focuses the Pakistani nationals, mainly Professors, Engineers, Students of different universities etc. The questionnaire elaborated the potential of Pakistani customers and the need of the prospects of the Telecommunication services in Pakistan. The survey was conducted among 100 individuals. The number of respondents is shown along with their options in Appendix A.

Recommendations

1. A clear cut policy with immediate effects should be announced for the delayed auctions, like of 3G.
2. 4G infrastructure has also been evolved in various countries; PTA should also deem such steps.
2. In order b generate more revenues and competitions, globalcompanies should be implicated inthe telecom auction process.
3. The Competition Commission of Pakistan should also define its position and to contribute to the auction and bid.
4. There should be anenduring policy regarding IT and Telecom announced from the respective authority of Pakistan.
5. Spectrum (the frequency range)should be optimized by rolling the obsolete infrastructure on a scheduled basis.

Conclusion

The prospect of the mobile generations seems to be unpredictable and unprecedented. The rapid growth in the telecommunications sector throughout the globe has eventually influenced the sector in Pakistan, causing the policy makers to brain storm the future policy regarding the implementation of latest generations of mobile networks.

Moreover, the questionnaire activity reflected the current mind set of Pakistani Nationals, about how they think and want to be in the prospective global village of the mobile world.

The newer generations like 3G and 4G of wireless networks brought a revolutionary advancement in the way and standard of living of the humans around the globe. Life seems to be motionless with the usage of cell phones. The people of Pakistan are also influenced by the advancements and achievements of the telecommunications sector throughout the globe, especially in the cellular domain. All we can hope that this advancement would be in continuation and one day our global village would be transformed into a wireless-go-global.

References

1. Aamir, Atta *(2012)"3 G Auction in Pakistan on March 29th.",* Pro Pakistani, 17 Jan 2012. Web: <http://propakistani.pk/2012/01/17/3g-auction-in-pakistan-on-marcl>29th/>.

2. AdMob (2010), The U.S. leads the mobile advertising industry in mobile ad requests. *"AdMob Mobile Metrics: Metrics Highlights, "* May 2010; Global Industry Analysts.

3. ATRA (2012), Afghan Telecom Regulatory Authority, *"Telecommunications and Internet Policy Islamic Transitional Government of Afghanistan Ministry of Communications Final Working Draft."* 20 Mar 2012. Web. 18 Jun 2012. <http://www.atra.gov.af/en/telecom_policy.html>.

4. Dawn News *(20X2),"Auction of 3G licenses delayed.*", Dawn.com 27 Apr 2012. Web. 18 Jun 2012,<http://dawn.com/2012/04/27/auction-of-3g licenses-delayed/>.

5. Deloitte, n.d.,Deloitte Development LLC, *"The Impact of 4G Technology on Commercial Interactions, Economic Growth and U.S. Competitiveness."* Web. 15 Jun 2012. <http://www.deloitte.com/us/impactof4g>.

6. Friedrich K. Jondral (2005), *"Software-Defined Radio—Basics and Evolution to Cognitive Radio "* EURASIP Journal on Wireless Communications and Networking 2005:3, 275-283

7. Omair Najam (2004), Part-1 *"Standing Committee on IT & Telecommunications* ",[YP52-Sindh -04]

8. Sabina Khurram Jafferi (2012) - "3G *Mobile Spectrum - Issues & Prospects",*SBP Research Bulletin Volume 8, Number 1, 2012

9. Wikipedia (2012), the free encyclopedia, *"Indian Telecom Spectrum Auction.* ".Wikipedia, 20 Mar 2012. Web. 16 Jun 2012.

Appendix A - Questionnaire

1. **Your age**
    a. 20-25 years (65 respondents)
    b. 26-35 years (25 respondents)
    c. 36-50 years (5 respondents)
    d. Above 50 years (5 respondents)
2. **Occupation**
    a. Student (57 respondents)
    b. Salaried (33 respondents)
    c. Sefr-emp toyed *(id* respondents)
    d. Other (Please Specify)_(0 respondent(s))
3. **Gender**
    a. Male (59 respondents)
    b. Female (41 respondents)
4. **Education**
    a. Intermediate^ 5 respondents)
    b. Graduate (47 respondents)
    c. Post Graduate(33 respondents)
    d. Doctorate(5 respondents)
5. **City Area**
    a. Urban(91 respondents)
    b. Town (9 respondents)
    c. Rural (0 respondent(s))
6. **Which is more beneficial for you, among the following?**
    a. Mobile phones (92 respondents)
    b. Fixed line wireless (8 respondents)
7. **Which services do you prefer to use sending greetings?**
    a. By ordinary mail (4 respondents)
    b. By email (36 respondents)
    c. By SMS (60 respondents)
8. **What do you think about the use of mobile camera?**
    a. Good (77 respondents)
    b. Bad (15 respondents)
    c. Don't know (8 respondents)

9. **Do you think mobile set has become a status symbol in our society?**
    a. Yes(90respondents)
    b. No (6respondents)
    c. Don't know(4respondents)
10. **Have you faced any convenience in your life and how has it become easier by using mobile phones (like paying utility bills and charity has become easier)?**
    a. Yes(95respondents)
    b. No (5respondents)
11. **What do you prefer?**
    a. GPRS (41 respondents)
    b. Internet on your computers (52respondents)
    c. Don't use internet (8respondents)
12. **What is the main purpose of using telecom facilities for you?**
    a. For contacting with family and friends (77respondents)
    b. Business (23 respondents)
    c. Others (Please specify)_(0 respondents)_
13. **Do you think mobile phone is good for children & teenagers?**
    a. Yes(42 respondents)
    b. No (55respondents)
    c. Don't know (3respondents)
14. **Do you think the rapid influx of cellular services has interfered with your private life?**
    a. Yes(61 respondents)
    b. No (28respondents)
    c. Don't know (11 respondents)
15. **Do you think the telecom services are putting a strain on your family relation?**
    a. Yes(3 5 respondents)
    b. No (62respondents)
    c. Don't know(3respondents)
16. **Do you use mobile while driving?**
    a. Yes (40 respondents)
    b. No (53respondents)
    c. I don't drive (7respondents)

17. **In what situation do you prefer to use cell phones?**
    a. Weather(l 1 respondents)
    b. Info news (59respondents)
    c. emergency (30respondents)
18. **What is the purpose of your buying a cell phone?**
    a. Business(49 respondents)
    b. Leisure (35respondents)
    c. Emergency others (16respondents)
19. **What do you prefer?**
    a. SMS(48respondents)
    b. Voice calls (52respondents)
    c. Others (Please Specify)_(0respondents)_
20. **Do you excessively use your cellular phone for internet?**
    a. Yes (3 5 respondents)
    b. Moderately (42respondents)
    c. No (23respondents)
21. **What is your personal monthly expense on following facilities (approximately)?**
    a. Telephone (in rupees)
       Less than 500 _(56respondents)_between 500 and 1000 _(34respondents)_ More than 1000 _(10respondents)_
    b. Mobile: Rs.
       Less than 500 _(67 respondents)_ between 500 and 1000 _(23respondents)_ More than 1000 (10 respondents)_
    c. Internet: Rs.
       Less than 500 _(11 respondents)_ between 500 and 1000 _(65respondents)_ More than 1000 _(24respondents)_
22. **Do you think that cell phones have lessened the gap between rich and poor?**
    a. Yes (79 respondents)
    b. No (11 respondents)
    c. Don't Know (10 respondents)
23. **Do you think that the cellular phones have been penetrated in the veins of all Pakistanis, in terms of the usage of the services?**
    a. Yes (80respondents)
    b. No (12respondents)
    c. Don't Know(8respondents)

24. **Do you prefer using your cell phone over the PC (Personal Computer) for your office needs?**
    a. Yes (74 respondents)
    b. No (26respondents)
25. **What is your personal opinion regarding the PTA's (Pakistan Telecommunications Authority) step of auctions of 3G Licenses**
    a. 3G is an obsolete technology (45 respondents)
    b. PTA should opt for 4G(46respondents)
    c. Don't Know(9respondents)
26. **Should the PTA auction more cellular network licenses to other Global Operators?**
    a. Yes, it would promote more competitions among the operators (69respondents)
    b. No, the current operator numbers in Pakistan are sufficient (31 respondents)
27. **What is opinion about the Taxation being imposed on Mobile Calls, Card Recharges, etc?**
    a. Not fair (71 respondents)
    b. Fair (29respondents)
28. **Are you satisfied with the services being rendered by different cellular operators in Pakistan?**
    a. Yes (78respondents)
    b. No (22respondents)
29. **Do you wish to see the Mobile phones, as an integral part of the All-IP-based Network (4G)?**
    a. Yes (70respondents)
    b. No. (3respondents)
    c. Don't Know(27respondents)
30. **Do you wish to see the cellular network in Pakistan soon to be a part of WWWW (World Wide Wireless Web, 5G)?**
    a. Yes, it would be a landmark in the Telecom Industry of Pakistan (69 respondents)
    b. No, the current mobile services are sufficient (31 respondents)