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# A Survey of Embedded Cellular Technologies and Cellular Companies in Pakistan

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**Abstract**– A cellular network is a wireless communication network, in which different network entities play their role to establish a secure connection for transmission of data over a network. This paper provides an insight about different features required for an efficient transmission over a communication link for e.g. Wi-Fi, WiMAX, 3G and 4G. We have briefly explained the different cellular technologies used by cellular networks nowadays and their comparison based upon the data rates, speeds and currently used technologies. Finally, we have summarized the comparison of various cell phone service providers in Pakistan with the hope that the future of the struggling telecommunication industry in Pakistan will be bright for future generations to come.

**Index Terms**— Comparison, Frequency, GSM, Organization, Subscribers and 3G

## I. INTRODUCTION

THE mobile phone industry has seen a remarkable boom from 1990, when there were just 11 million cell phone subscribers around the world. This number gradually increased until at the end of 1998, there were more than 300 million mobile endorsers globally [25]. This steady increase in the number of subscribers led to the continuous development and evolution of different standards and products. The evolution of digital era began with the replacement of analog networks with the digital technology. The advent of digital communication revolutionized telecommunication industry in both the developed and underdeveloped nations across the world.

In the last few years, several cellular technologies have emerged and there is not one good enough to entirely replace the previous one. Each technology has its own advantages, merits and development possibilities. For example, Wireless Metropolitan Area Network (WMAN) technologies are used for the deployment of metropolitan networks and for the extension of wired Local Area Network (LAN). Wi-Fi has been developed and it is also being used for public wireless networking deployment. Third generation (3G) technologies, Universal Mobile Telecommunication System (UMTS), Code Division Multiple Access (CDMA 200) is purposing network access which is associated to the telephony service.

This paper gives an overview of different emerging cellular technologies along with their data rates and some other developments. In addition, we have given a comparative analysis of different cellular companies in Pakistan with distinct parameters to distinguish one from the other. This paper is organized as follows. In Section II, we have given an overview about the evolution of different cellular technologies, how they emerged and replaced the other ones in partial manner and also about 3G, fourth generation (4G) subscribers till October 2016. In section III, we have provided detailed description of the five cellular companies currently prevalent in Pakistan along with their historical background, number of subscribers, market share and network coverage details. Section IV provides the details of technological features used by each service provider. Section V shows the percentages of subscribers from different companies in Pakistan. Section VI describes the comparative study of cell phone companies in Pakistan by using different parameters like technologies, frequencies, coverage rate etc. The last section sums up the comparison of the cellular companies with concluding remarks for Pakistan's Telecommunication industry.

## II. OVERVIEW OF CELLULAR TECHNOLOGIES

### A. Wi-Fi and WiMAX

These technologies are used where long range wireless networking is required. It basically has two base major stations in which one station is installed on main service provider and second station is installed on the customers end devices. Worldwide Interoperability for Microwave Access (WiMAX) communication standard has a data rate of approximately 30 to 40 Mbps [1]. Wi-Fi has small range about ten to fifteen meters but WiMAX has greater range and performance in the same cost. WiMAX provides uninterrupted communication to the customers [2]. Wi-Fi is based on the 802.11 standard that defines physical and Media Access Control (MAC) layers of wireless communication. This technology is an extension of wired networks. It is not an operator technology as WiMAX or UMTS. WiMAX provides broadband access which is alternative to Digital Subscriber

Line (DSL) or cable. It decides the access mechanism, physical layer design, mobility management and wireless medium.

Next Generation Wireless Networks (NGWNs) will be the integration of existing technologies. For example, In mall it'll be connected to a Wi-Fi point when in the street it will be handover to the WiMAX while in train it will connect to UMTS: they will change their access technology with the change of environments and in this perspective in [3] the author has purposed integrated model of Wi-Fi and WiMAX. This framework defines architecture to optimize layer 2 handover management during homogeneous and heterogeneous mobility.

### B. GSM

Global System for Mobile (GSM) specifications were made by the European Telecommunications Standards Institute (ETSI) in 1989 and service was started in 1991 but handsets were available in 1992. This technology is used for transmission of data services and mobile voice. GSM operates on the combination of Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA). GSM operates on 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. It is based on circuit switching system and divides 200 KHz into eight different 25 KHz channels among eight users. 935 and 960 MHz are the forward Absolute Radio Frequency Channel Number (ARFCNs) and 935 and 960 MHz are the ranges of reverse ARFCNs. There are eight time slots per channel and each slot has duration of 576.96 microseconds. These eight slots make a single frame and these 26 frames make a multi frame. Interference protection level is high in GSM as compared to Interim Standard 95 (IS-95) and data in reverse and forward channel is handled in similar manner.

GSM has a market share of more than 70 % [2]. In 1993, 36 GSM operators were working in 22 countries while in January 2002, there were 470 GSM working operators accommodating 646 million users in 172 countries and this strength reached one billion users in 210 countries all over the world [2, 4]. Along with data and voice service GSM also provides Roaming service (usage of one cell number to other GSM network).

### C. CDMAOne or IS-95

IS-95 is second generation communication standard. It was the first cellular technology that used code division multiple access method, CDMA. The IS-95 has greater protection against the interference. CDMA scheme allows more users to exist simultaneously, with minimum mutual interference. In this scheme, data signal is multiplied by spreading signal. Then it is integrated with Walsh code to obtain orthogonal relation with other codes in the same cell.

Forward channel ranges for IS-95 are 869 to 894 MHz while reverse channels use between 824 to 849 MHz Forward transmissions are based on Quadrature Phase Shift Keying (QPSK) and reverse transmission is done with Offset

Quadrature Phase Shift Keying (OQPSK) in order to synchronize with mobile power.

### D. GPRS

GSM provides connectionless service which is limited to 160 characters for the messages and data transferring is done with circuit switch technology with a data rate of 14.4 kbps. These limitations standardized another technology called General Packet Radio Service (GPRS). GPRS has characteristics of GSM frequency bands, radio modulation, frame structure, but it is based on some principles like Always on, High bit rates, and separate downlink and uplink channels. Improved usage of radio resources, data transferring and voice call can be held simultaneously. It uses the privacy procedure and authentication of existing GSM. GPRS has greatly improved and simplified wireless network to packet data networks which applies radio packet principal for the transferring of user data packets between mobile station and external network [5]. Data rates of GPRS range from 14.4 to 115 kbps. Its speed is four times greater than conventional GSM. In GPRS retransmission and error detection scheme is used to ensure delivery of data packets to mobile users. One time slot in GPRS can be shared by many users and vice versa.

### E. 3G Technologies

3G network succeeded Second Generation (2G) technology by offering faster data rates. International Telecommunications Union (ITU) defined International Mobile Telecommunication Standard 2000 (IMT-2000) standards for third generation of mobile telephony services to facilitate increased bandwidth, growth, support and more different applications. This technology enables video calling and makes best use in smart phones, which require high speed internet for advanced type of applications. Two 3G technologies are discussed below, which are CDMA2000 and UMTS.

CDMA2000 International Mobile Telecommunication Multi Carrier (IMT MC) belongs to 3G technology standards for sending data voice between cell phones. It is complete family standard having evolutionary technologies. CDMA2000 Interexchange Radio Transmission Technologies (1xRTT), 1X Advanced, CDMA2000 Interexchange Evolution Data Optimized (1xEV-DO): Release 0, Revision a, Revision B, Ultra Mobile Broadband (UMB) etc. Cdma2000 1x is an advanced form of Cdma one and has data rate of 144kbps. Cdma 2000 1xEV-DO is evolution of cdma2000 standards which is mostly used in wireless broadband Internet access. It uses time division multiplexing and code division multiple access [6] to increase the throughput of individual user as well as the overall system throughput. The carrier required for data of EV-DO is 1.25 MHz Data rate of EV-DO is 3 Mbps but in reality the speed of download burst is from 600Kbps-1400Kbps to 2Mbps and of upload burst from 500Kbps to 800Kbps to 1.8Mbps. Pakistan Telecommunication Company Limited (PTCL) and World

Call Operator introduced this technique in Pakistan [2].

Universal Mobile Telecommunications Service (UMTS) is 3G packet-based, broadband transmission of video, digitized voice, text and multimedia. Data rate of UMTS is 2 Mbps. When UMTS is available, users can be constantly connected to Internet wherever they roam with same capabilities.

#### F. 4G or Fourth Generation Technology

4G is advancement in 3G network by adding more services and bandwidth. The 4G LTE stands for Fourth Generation Long Term Evolution. It gives fastest internet access to mobile users. It has data rates of 1Gbps [2]. Features of 4G include low latency, downlink data rates well over 100 Mbps and low-cost implementations. Wireless Universal Serial Bus (USB) can be used for internet access due to its high data rates. There are a lot of applications of 4G technology. For example, multiple user conferencing video, data intensive applications like satellite mapping, applications which are based on real time location like weather findings [7]. Fig. 1 and Fig.2 shown below are comparing 3G and 4G subscribers in different cellular companies in Pakistan from 2013-October 2016.

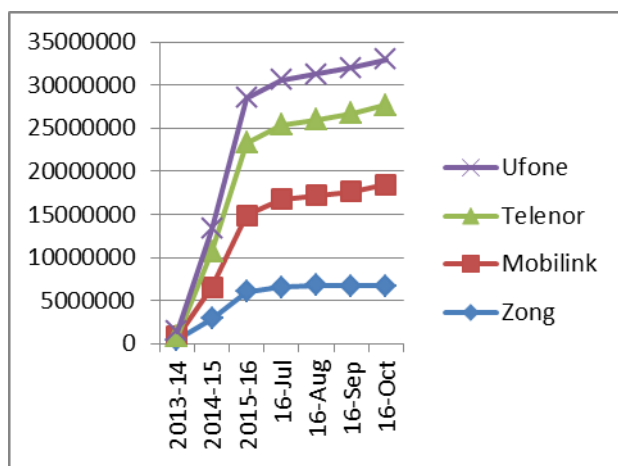


Fig. 1: 3G Subscribers in Pakistan from 2013-2016

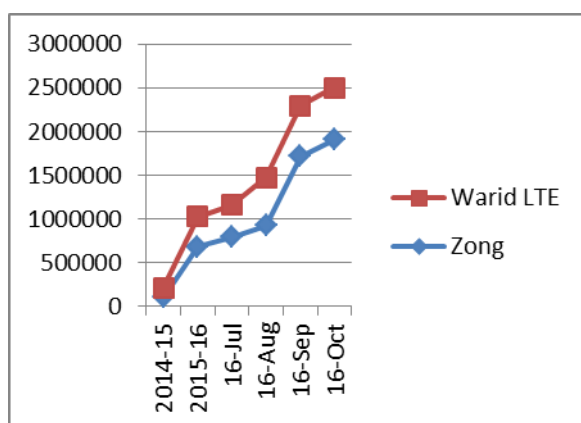


Fig. 2: 4G Subscribers in Pakistan from 2014-2016

### III. CELLULAR COMPANIES IN PAKISTAN

All the wireless communication features discussed above are currently being employed by Pakistan's telecommunication industry which has strived day and night to meet the demands of cell phone users and to competitively establish itself in the global market. Since independence in 1947, Pakistan's telecommunication industry has come a long way [7]. Pakistan Telecommunication Company Limited (PTCL), started as the first telecommunication service provider in 1947[8]. At that time, it was the only service provider in Pakistan. Gradually, cell phone companies emerged with Instaphone being the first one in 1991 [2]. Soon afterwards, various cell phone service providers began operating in Pakistan. Over the course of years, several technological advancements took place. Today's cell phone subscribers in Pakistan are mainly using 3G and 4G. A brief overview of existing cellular companies in Pakistan is discussed in the remaining section III.

#### A. Zong

Zong or China Mobile Pakistan is a versatile cell phone company headquartered in Islamabad, which offers voice and information services running from postpaid and prepaid to 2G, 3G and 4G administrations. It is the main overseas setup of China Mobile through obtaining a permit from Millicom to work as a GSM company in Pakistan in 2008 [20]. It is Pakistan's second biggest GSM service provider and third biggest service regarding endorser base of more than 25.6 million. It has a market share of 19% among all cell phone service providers in the nation [20].

#### B. Warid and Mobilink

Mobilink [10] began operations in 1994 as the principal GSM cell phone company in Pakistan with a joint venture by Saif Group and Motorola Inc. They later sold it to Orascom Telecom, an Egypt-based multinational organization, and after that they additionally sold it to Vimpelcom Group, a Russian Company. Mobilink is currently owned by Vimpelcom and is Pakistan's largest network in terms of mobile phone subscribers and coverage area. It provides a number of prepaid and postpaid voice and information services to both individual and corporate endorser.

Warid Telecom International is an Abu-Dhabi based versatile firm whose portfolio organizations give communication benefits in the Republic of the Congo, Pakistan, and Uganda [23]. In Pakistan, it is providing its services across 7000 different destinations.

On 26th November 2015, Vimpelcom and Abu-Dhabi Group consented to merge Mobilink and Warid into a solitary organization [15].

#### C. Ufone

Pak Telecom Mobile Limited or Ufone is a Pakistani GSM cell phone organization [21]. It was the third biggest service provider to enter Pakistani market. It began its operations under the brand name of Ufone, in Islamabad on January 29, 2001. Ufone is one of the biggest GSM service providers and

fourth biggest cell phone service since it has more than 24 million subscribers. It has a market share of 18% among versatile administrators.

**D. Telenor**

Telenor Pakistan is 100% claimed by the Telenor Group which is a global supplier of great voice, information, substance and correspondence in 13 markets across Europe and Asia. Telenor Group is among the biggest in the world with 180 million versatile memberships and a workforce of roughly 33,000. Telenor Pakistan has reported an endorser base of more than 36 million, making it Pakistan's second largest cell phone service [17].

**E. SCO**

Special Communications Organization (SCO) is a Government Organization running under Ministry of Information Technology and Telecommunication. It is maintained by Pakistan Army. SCO is assuming significant part in providing cell phone coverage in Azad Jammu and Kashmir and also Gilgit Baltistan. It is additionally giving cell portable administration under the brand name of SCOM. SCOM [18] is the first ever GSM administration of Azad Jammu and Kashmir and Gilgit Baltistan. DSL and Dialup Internet administrations are given under the brand name of SNET [18].

**IV. PARTICULARS OF CELLULAR COMPANIES IN PAKISTAN**

**A. Timeline showing evolution of companies**

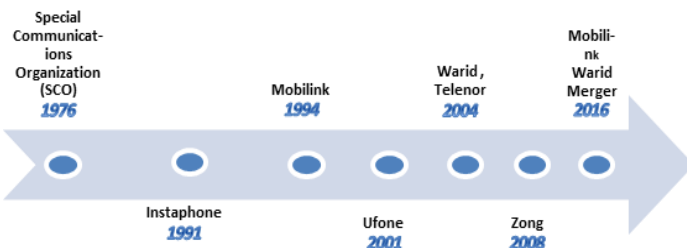


Fig. 3: Timeline showing the year of foundation of each company

**B. Technologies used by mobile network operators**



Fig. 4: Technologies used by different companies

**V. CELL PHONE SUBSCRIBERS IN PAKISTAN**

Mobile phone users are increasing day by day in Pakistan. The reason of this can be attributed to the wide variety of services, features and advancement in cell phone technologies. At the end of May 2014, cell phone users in Pakistan exceeded 139.20 million [24]. Previously, Mobilink had the highest number of subscribers in Pakistan. When the Mobilink-Warid merger took place, the number of subscribers reached the maximum number i.e., 38 %. Therefore, an expansion of mobile network took place with 80% coverage of network across Pakistan resulting in the largest network with 5000 3G and 4G/LTE sites [15]. Percentage of different subscribers in Pakistan is shown in Fig. 5.

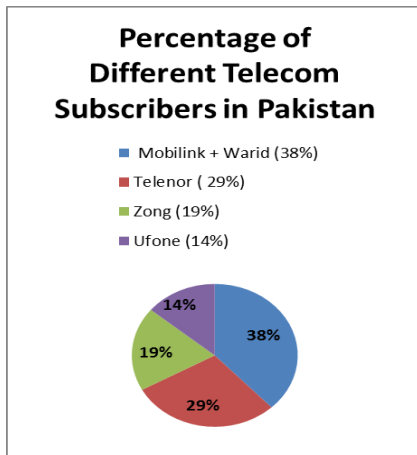


Fig. 5: Percentage of subscribers

## VI. COMPARISON OF CELLULAR COMPANIES IN PAKISTAN

The goal of this research was to compare the existing cellular companies in Pakistan based on a few parameters. This has been done to collate information for people so they have access to the facts and particulars of any service provider in Pakistan. No doubt, in this era of technology, people are aware of which network to buy based on the packages offered by cell phone companies. But very few individuals know about the technologies currently used at backend to facilitate them. This research intends to provide an overview of cellular technologies along with the comparison of mobile phone operators in Pakistan. Table I shows this comparison.

TABLE I: AN OVERVIEW OF CELLULAR TECHNOLOGIES ALONG WITH THE COMPARISON OF MOBILE PHONE OPERATORS IN PAKISTAN

Company	Founded	Type	Services Offered	Parent Company	Code	3G Coverage area	Revenue in a month	Total Subscribers	Latency	Speeds (2G/3G/4G)
Zong	2008	Telecommunication operator	<ul style="list-style-type: none"> <li>Mobile services</li> <li>Data services</li> <li>Mobile banking</li> <li>Telephony</li> <li>Blackberry solution</li> </ul>	China Mobile (CMPak)	031x	40 cities of Pakistan	PKR 5 billion	26.3 Million	357 ms	Download: 4.81 Mbps Upload: 3.25 Mbps
Warid and Mobilink	2016	Private	<ul style="list-style-type: none"> <li>Mobile broadband</li> <li>Postpaid &amp; Prepaid</li> <li>Mobile Banking</li> </ul>	Vimpelco m Ltd + Warid Telecom International	030x+032x	200 cities in Pakistan	Rs 38.5 billion	40.85 Million	294 ms	Download: 3.65 Mbps Upload: 1.32 Mbps
Ufone	2001	Private	<ul style="list-style-type: none"> <li>Prepay</li> <li>Postpay</li> <li>Upaisa</li> </ul>	PTCL Pakistan	033x	25 cities of Pakistan	PKR 200 billion	18.8 Million	380 ms	Download: 2.14 Mbps Upload: 1.72 Mbps
Telenor	2004	Subsidiary	<ul style="list-style-type: none"> <li>Mobile Telephony</li> <li>Mobile Banking</li> </ul>	Norwegian Telenor Group	034x	60 cities of Pakistan	6.214 million	38.47 Million	303 ms	Download: 2.58 Mbps Upload: 1.59 Mbps
Special Communication s Organization (SCO)	1976	Public	<ul style="list-style-type: none"> <li>Landline</li> <li>CDMA</li> <li>GSM</li> <li>Internet</li> </ul>	Government of Pakistan	0355	Azad Kashmir, Gilgit Baltistan	Non-profit	4.5 million	-	-

## VII. CONCLUSION

Telecommunication plays a crucial role in the economic development of any country. No doubt, in recent years, these companies have provided great services which have played a pivotal role in the establishment of telecom sector of Pakistan. With the advent of 3G and 4G [7], the number of users in Pakistan has increased significantly and the use of cell phone

has become more of a necessity rather than an entertainment. However, the telecommunication industry in Pakistan still has a long way to go. Pakistan needs to increase research and development in telecom sector to further strengthen its social and economic development on an international platform.

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