

MTN 4th Generation Long Terminal Evolution (4Lte), a New Technological Paradigm for Ghana's Economy

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Abstract — The advancement of wireless technology especially with Mobile Radio Technologies have revolutionized the way and manner communication takes place, permeating all facets of human endeavor. The proliferations of mobile devices and mobile applications have placed high demand on the bandwidth of cellular wireless networks. Despite its numerous challenges, cellular networks in Ghana are experiencing a new dawn of ultra-high-speed multimedia transmission with increased bandwidth specially to serve as backbone for business applications and services that consume computing resources and places demand on data communication networks. In Ghana however, the story is no different as government policies have changed the

metamorphosis of Cellular Networks development (Mobile Telecommunication or Telcos). MTN Ghana, the country's largest telecommunication company has recently upgraded its network to 4G LTE technology thereby upgrading the country's telecommunication infrastructure system and connection to the internet. This paper therefore develops a historical perspective of MTN Ghana, from inception till date, technical and business operations and how it has transform the telecommunication and business landscape of Ghana and the future of the 4G Long Term Evolution platform.

Keywords: MTN 4G, Technologies, Evolution, Telecommunication, Cellular Networks

1. INTRODUCTION

The MTN (Mobile Telecommunication Network) Group is one of Ghana's major telecommunication giants, formerly M-Cell, is a South Africa-based multinational mobile telecommunications company, operating in many African countries, European and Asian countries. Its head office is in Johannesburg. As of 30 September 2015, MTN recorded over 300 million subscribers across its operations (MTN Ghana, 2017). The company sponsored the CAF Champions League football competition as well as APOEL FC, winners of the Cypriot First Division in 2009, 2011, 2013, 2014 and participants in the 2009–10 and 2011–12 UEFA Champions League (MTN Ghana, 2017). On 18 March 2010, it was announced that MTN signed a sponsorship deal with English football club Manchester United F.C. In March 2016, MTN Group, LTD appointed Rob Shuter as Chief Executive Officer. Launched in 1994, the MTN Group is one of the leading telecommunication giants especially on the African continent and rest of the world especially, connecting subscribers in 22 countries in Africa, Asia and the Middle East. The MTN Group is listed on the JSE Securities Exchange

in South Africa under the share code: "MTN." As of 30th June, 2013, MTN recorded 201.5 million subscribers across its operations in Afghanistan, Benin, Botswana, Cameroon, Cote d'Ivoire, Cyprus, Ghana, Guinea Bissau, Guinea Republic, Iran, Liberia, Nigeria, Republic of Congo (Congo Brazzaville), Rwanda, South Africa, Sudan, South Sudan, Swaziland, Syria, Uganda, Yemen and Zambia (MTN Ghana, 2017). MTN's brand is the most valuable in Africa, and is ranked in the top 100 brands worldwide. MTN's shares constitute the biggest primary listing on the JSE (Johannesburg Stock Exchange – Africa's largest stock exchange. In Ghana, MTN Group, was registered as Spacefon, with its post-paid package for Ghana's first GSM (*Global System for Mobile Communication*) service in November 1996 (MTN Group, 2017). First was the thrill that came with the new service's Caller ID (Note that Caller ID is an integral feature of GSM). Spacefon's service gained more and more popularity by the day (MTN Ghana, 2017). New features like Call Forwarding, Call Holding, International Roaming, Short Messaging Service (SMS) was soon made available to the

increasing number of subscribers. The birth of MTN Ghana can be traced to 1994 when a small company called Scancom Limited was registered in Ghana with authorization to operate the Global System for Mobile Communications (GSM) system. After about two years of preparation, Scancom commenced operations under the trade name, Spacefon, launched GSM services in November 1996 and began operating with coverage areas around Accra and Tema (MTN Ghana, 2017). In 1997, coverage expanded to Kumasi and Obuasi, and two years later, in 1999, Takoradi, Bibiani, Tarkwa and Cape Coast were added to the Spacefon coverage map. Scancom Ghana Limited (Spacefon) commenced its operations with a staff strength of 20, including six Ghanaians (MTN Group, 2017). In 1998, Spacefon launched its prepaid service and christened it SNAP. It came with many of the features of a digital mobile phone service, with the convenience of being prepaid [33]. It became more popular, especially amongst the youth population. The focus on expansion continued, with Scancom going through change of ownership and of trade names *SPACEFON TO SPACEFON AREEBA TO AREEBA* until MTN entered the scene in 2nd August 2007. MTN Ghana now has a staff capacity of 1,919 employees, out of which 685 are direct employees, 57 on contract and 1,177 being third party contractors. GSM evolution in Ghana, started essentially as far back as November 1996 with the launch of the first GSM (Global System for Mobile Communication) service by Scancom Limited under the brand name of Spacefon and became Spacefon Areeba and now known as MTN (MTN Ghana, 2017). The remaining chapters of the paper is organized as follows: The chapter two is the Literature Review revealing the technical history of telecommunications technologies, from 1G to the current and latest technology called 4G LTE and other similar technologies deployed in other countries (MTN Ghana, 2017). Chapter three which is the Methodology focuses more on the technological impact MTN telecommunication company have had on the Ghanaian economy till date, where chapter four focus on the Results and Analysis and gives a summary on the services provided by MTN till date especially the unlimited opportunities introduced by MTN 4G LTE and the way forward for Ghana's economy including Start-Ups and small-scale businesses and the opportunities for E-businesses. Chapter five ends the paper with Conclusion and Acknowledgment.

1.1 The Aim of MTN Ghana

The main aim of the Foundation is to have a broad community impacting and supporting national and international development priorities and projects (MTN Group, 2017). It facilitates partnership and

sharing of resources to achieve the following mutual objectives:

- I. To demonstrate MTN Ghana commitment to, and support for community empowerment and national development.
- II. To administer social investment programs as part of the core business of MTN Ghana.
- III. To enhance the image of MTN as a responsible corporate citizen.
- IV. To develop a holistic Corporate Social Responsibility (CSR) program as part of the reputation management strategy for MTN Ghana.
- V. To improve upon the MTN brand in all operating areas.
- VI. To foster network values among MTN Ghana staff through a proactive Employee Volunteer Association.
- VII. To foster strategic partnership with other national/international partners and stakeholders.

2. CONCEPTUAL FRAMEWORK

2.1 Historical Perspective of the Wireless Communication Spectrum (1GHz - 4GHz LTE)

From electromagnetic to digitization and IP routing, the technological world has witnessed massive development dating back in 1864 when James Clark Maxwell predicted the existence of radio waves with a simple experiment, again in 1886, Heinrich Rudolph Hertz also demonstrated the presence of radio waves to support the experiment conducted by J.M Clark. Furthermore, in the era of 1895-1901, a famous scientist and physicist named Guglielmo Marconi was able to demonstrate the power of radio waves in wireless communications over increasing and long distances (Chen, 2003). Also in the 1890s, the following scientists Nikola Tesla, Alexander Stepanovich Popov, Jagdish Chandra Bose and others, demonstrated various forms of wireless communications using radio waves (ITU-R, 2007). The era of early 1900's characterized the development of broadcast radio, and later television (TV) transmission systems. The World War 2 marked the advent of two-way radio communication in closed networks especially defense. In the year of 1972, witnessed NMT development to cater for telephony for nomadic populations in Scandinavian countries (Chen, Yue, 2003). 1982, saw the use of digital coding, modulation and communications systems emerging and in 2009, the first 4G LTE super high-speed communication system for commercial networks in Scandinavia was launched (CELTIC/CP5-026, 2009).

1st MOBILE RADIO TELEPHONE 1924



Courtesy of Rich Howard

Fig 2.0 : The birth of wireless communication

TABLE 2.0: COMPARISON OF WIRELESS NETWORK EVOLUTION AND SPECTRUM ALLOCATION

| Bands | Regions | Frequencies (MHz) | GMS/E DGE | UMTS/ 3GSM | CDMA 2000 | TD-SCDMA |
|---------------------|------------|-----------------------------------|------------|------------|-----------|----------|
| NMT/C DMA 450 | EU/Glo bal | 460-493 | | | Yes | |
| GSM 450 | EU/Glo bal | 450-467 | Yes | | | |
| GSM 480 | EU/Glo bal | 478-496 | Yes | | | |
| GSM/C DMA 850 & 850 | US | 869-894 | Yes | | Yes | |
| GSM 900 | EU/Glo bal | 925-960 | EU/Glo bal | Yes | | |
| DCS 1800 | EU/Glo bal | 1805-1880 | Yes | | | |
| PCS 1900 | US | 1930-1990 | Yes | Yes | Yes | |
| IMT 2000 | EU/Glo bal | 1920-1960 & 211D-2117 | | Yes | | |
| China 3G | China | 1880-1920 & 2010-2025 & 2300-2400 | | | | Yes |
| AWS | | 1710-1755 & 2110-2155 | | Yes | Yes | |
| 700 MHz | US | 746-764 & 776-794 | | Yes | Yes | |
| ITU Proposal | EU/Glo bal | 2500-2690 | | Yes | | |

2.1 Technological Advancement and Features

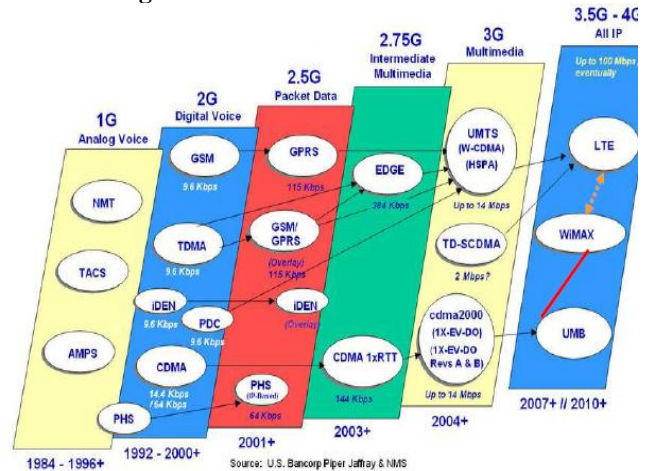


Fig 2.1: US Bancorp Piper Jaffray & NMS

3.0 TECHNICAL REVIEW OF WIRELESS TECHNOLOGIES

3.1 The First-Generation (1G) of Wireless Communication Technology (Analogue)

In the year 1980, the evolution of the mobile cellular had begun and ever since mobile communication had undergone tremendous and rapid growth. Fig.2.1 displays the evolution of the mobile networks. First it started with the First-generation mobile systems used with analog transmission for speech services. In 1979, the first cellular communication system in the world operational and functional by Nippon Telephone and Telegraph in Tokyo, Japan. Two years after, the cellular epoch reached both southern and northern Europe (Fumiyuki, 2001). The then two most famous analogue systems were Nordic Mobile Telephones (NMT) and also Total Access Communication Systems (TACS). This form one of the inevitable challenges of first-generation mobile communication networks. The Advanced Mobile Phone System (AMPS) was launched in 1982 in the United States of America. This system was offered 40-MHz bandwidth within the 800-900 MHz frequency range by the Federal Communications Commission for AMPS. In 1988, an additional 10MHz bandwidth, Expanded Spectrum (ES) was allocated to AMPS. It was launched in Chicago, with a service area of 2100 square miles. The technology offered by AMPS made available about 832 channels, with a data of 10 kbps. Despite the use of omnidirectional antennas in the earlier AMPS implementation, it was realized that using directional antennas resulted in better cell reuse (Giannin, 2008). The smallest reuse factor that would fulfill the 18db signal-to-noise interference ratio (SIR) using 120-degree directional antennas was found to be 7. Subsequently, a 7-cell reuse pattern was adopted for AMPS. The transmission of cellular signals to base stations occurred over the forward channel using

frequencies between 869-894 MHz. The reverse channel is used for transmissions from mobiles to base station, using frequencies between 824-849 MHz. AMPS and TACS both adopt the use of frequency modulation technique for radio transmission (3gamericas,2010).The traffic is multiplexed onto FDMA (i.e Frequency Division Multiple Access) system.

3.2 Second-Generation(2G) and Phase 2++ Systems (TDMA/CDMA)

The second-generation (2G) mobile systems were adopted somewhere in the end of 1980s to 1981. The Low Bit Rate(LBR) data services for the 2G network were also supported as well as the traditional speech service(ITU-R,2008). In comparison to the first-generation systems, second-generation (2G) systems used digital multiple access technology for efficient use of the channels, such as TDMA (time division multiple access) and CDMA (code division multiple access). As regards the spectrum efficiency, when compared with first-generation systems, the higher spectrum efficiency of a system, the better the data services, and other more advanced roaming services were also offered by 2G systems (Baschiroto,2008). In Europe, the Global System for Mobile Communications (GSM) was also deployed in order to provide the user with a single unified standard. These seamless services are enabled throughout Europe by means of international roaming services(3GPP,2009). Global System for Mobile Communications, or GSM, for more than 20 years GSM uses TDMA technology to support several users, the GSM technology has been significantly improved in order to offer better and improved services in the market (3gamericas ,2010). New technologies have been developed and deployed based on the original GSM system, that led to some more advanced systems known as 2.5 Generation (2.5G) systems. In the United States, the second generation of digital cellular systems were three lines of development in second-of digital cellular systems and technologies (3gamericas,2010). The first digital cellular system, introduced in 1991, was referred to as the IS-54 (North America- TDMA Digital Cellular),(3GPP,2010) this technology brought about new versions and features supporting additional services (IS-136) was introduced in 1996 as well as IS-95 (CDMA One) which was implemented in the year 1993. The United States Federal Communications Commission (FCC), the certified and recognized body in-charge of telecommunication and standards also auctioned a new block of frequency spectrum in the 1900 MHz band (PCS), paving the way for GSM1900 to enter the US market (3gamericas,2010).Also in Japan, the Personal Digital Cellular (PDC) system, formerly known as JDC (Japanese Digital Cellular) was initially defined in 1990 (Giannini,2008) as de

facto standard at that time. The aftermath of the deployment of the first networks that appeared at the beginning of 1991, GSM gradually witnessed certain growth and improvement to meet the requirements of data traffic and many more related services as compared to the original networks. GSM (Global System for Mobile Communication): The key elements associated with this system are the BSS (Base Station Subsystem), in which there are BTS (Base Transceiver Station) and BSC (Base Station Controllers); furthermore, the NSS (Network Switching Subsystem), in which there is the MSC (Mobile Switching Centre); VLR (Visitor Location Register); HLR (Home Location Register); AC (Authentication Centre) and EIR (Equipment Identity Register) (3gamericas ,2010). This cellular network technology is capable of providing all the basic services on a bandwidth of up to 9.6kbps, fax, etc. This GSM network also has the capability of extension to the fixed public telephone network. The introduction of a new network design was deployed into the Mobile Switching Center of Second-Generation systems (2G networks). In particular, the use of Base Station Controllers (Basic Station Controllers) alleviates the burden of load placed on the MSC (Mobile Switching Center) found in the First-Generation systems(1G networks).This new design allows the interface that exist between the Mobile Switching Centre and Base Station Controllers to be standardized and formalized. In addition to enhancements in MSC design, the mobile-assisted handoff mechanism was introduced. By sensing signals received from adjacent base stations, a mobile unit can trigger a handoff by performing explicit signaling modulation with the network (3GPP, TR 36.913,2009). Global System for Mobile telecommunication and VAS (Value Added Services): The next major advancement experienced in the GSM system was the addition of two platforms, called Voice Mail Service (VMS) and the Short Message Service Centre (SMSC). Along with VAS, IN (Intelligent services) also made its mark in the GSM system, with the sole advantage of giving the operators the opportunity to create a whole range of new services. The integration of Fraud management and 'prepaid' services are the result of the Intelligent services. GSM and GPRS (General Packet Radio Services): As the wireless spectrum requirement for sending data on the air-interface increased, new elements such as SGSN (Servicing GPRS) and GGSN (Gateway GPRS) were added to the existing GSM system[5-6-7]. These new elements enabled packets of data to be sent on the air-interface. The part of the network handling the packet data is also called the 'packet core network'(3GPP,2010). In addition to the SGSN and GGSN, it also contains the IP routers, firewall servers and DNS (Domain Name Servers) as

well as enabling wireless access to the internet and data rate reaching 150 kbps in optimum conditions. The 2.5G network began with General Packet Radio Service (GPRS),(3GPP,2010). GPRS is a radio technology for GSM networks adding packet-switching protocols, shorter setup-time for ISP connections, and the possibility to charge by the amount of data sent, rather than connection time, (3GPP,2010). Packet switching is a routing technique whereby the information (voice or data) to be sent is broken up into packets, of at most a few Kbytes each, and routed by the network to different destinations based on addressing scheme (3GPP,2010). GPRS is a major step towards 3G. GSM and EDGE (**Enhanced Data rates in GSM Environment**): there was the need to increase the data rate and this was done by using more sophisticated coding methods over the internet and thus increasing the data rate up to 384 kbps (E. Mino,2007). Implementing EDGE required relatively small changes to network hardware and software as it deploys same TDMA (Time Division Multiple Access) frame structure, logic channel and 200 kHz carrier bandwidth as GSM networks. As EDGE coexisted with 3G WCDMA, data rates of ATM-like speeds of 2 Mbps could be available Kamarularifin,2009). Second-generation digital cellular systems still dominate some part of the mobile industry in the whole world, however third generation (3G) systems have been introduced in the market and are penetrating the telecommunication industry (ITU ,2009).

3.3 Third-Generation (3G-WCDMA in UMTS,CDMA200 & TD-SCDMA)

The technology available in EDGE, high-volume movement of data was possible, but still the data packet transfer on the air-interface behaves like a circuit switch call hence, the birth of 3G(ITU-R PDNR,2002).The International Telecommunication Union (ITU) defined the demands for 3G mobile networks with the IMT-2000 standard. An organization called 3rd Generation Partnership Project (3GPP) has continued the work on mobile telecommunication by defining a mobile system that fulfills the IMT-2000 standard (Toh, C. K.,2002). In Europe it was called UMTS (Universal Terrestrial Mobile System), which is ETSI-driven. IMT2000 is the ITU-T name for the third generation system, whereas cdma2000 is the name of the American 3G variant. WCDMA(Wide Code Division Multiple Access) is the air-interface technology for the UMTS. The main components includes BS (Base Station) or node B, RNC(Radio Network Controller),apart from WMSC(Wideband CDMA Mobile Switching Centre) and SGSN/GGSN(ITU,2010). The 3G network enabled the network operators to offer users or customers a broad range of advanced network services

while reaching greater network capacity by improving the efficiency of the spectrum. Network services include wide-area wireless voice telephony, video calls, and broadband wireless data, in a mobile environment (3GPP,2010). Additional features also include HSPA (**High Speed Packet Access**) data transmission capabilities able to deliver speeds up to 14.4 Mbps downlink and 5.8 Mbps uplink. The first commercial 3G network was launched by NTT DoCoMo in Japan branded FOMA, based on W-CDMA technology on October 1, 2001 (Toh, C. K,2002). while the second network technology to go commercially live was by SK Telecom in South Korea on the 1xEV-DO (Evolution- Data Optimized) technology in January 2002 followed by another South Korean 3G network was by KTF on EV-DO in May 2002. In Europe, 3G services were introduced starting in March 2003 by (Part of Hutchison Whampoa) in the UK and Italy. This was based on the W-CDMA technology (ITU ,2010). The first commercial United States 3G network was by Monet Mobile Networks, on CDMA2000 1x EV-DO technology and the second 3G network operator in the USA was Verizon Wireless in October 2003 also on CDMA2000 1x EVDO. The first commercial 3G network was launched in the southern hemisphere by Hutchison Telecommunications branded as Three using UMTS in April 2003 (ITU ,2010). The first commercial launch of 3G in Africa was by EMTel in Mauritius on the W-CDMA standard. In North Africa (Morocco), a 3G service was provided by the new company, Wana in late March 2006. Roll-out of 3G networks was delayed in some countries due to the additional spectrum licensing fees (ITU,2010). In countries all over, 3G networks do not use the same radio frequencies as 2G, therefore mobile operators must build entirely new networks and license entirely new frequencies; an exception is the United States where several carriers operate 3G services in the same frequencies as other services (ITU-R,2008). The other delays were due to the expense incurred in upgrading the network equipment for the new systems. China also delayed its decisions on 3G because of the technological cost involved for many years (ITU-R,2008). In January 2009, however China was able to launch 3G network but three major telecom companies in China also had the license to operate the 3G network but on different standards, and the standards were ,China Mobile for TD -SCDMA, China Unicom for WCDMA and China Telecom for CDMA2000 as well (T. Tjelta).

3.4 Fourth-Generation Technology (4G, IP - based network)

The new generation of mobile communication technology is focused on 4G LTE as well as *Worldwide Interoperability for Micro Wave Access*

(WiMax)[29].The advent of new long haul communication technologies and the internet penetration rate coupled with growth rate in internet accessibility have compelled researchers and industries to develop a comprehensive plan for the fourth generation(4G) mobile communication systems. Comparing 3G to the 4G, the new 4G framework would improve upon user experience and facilitate multi-service capacity by the integration of all existing mobile technologies previously deployed (e.g. the GSM - Global System for Mobile Communications, GPRS - General Packet Radio Service, IMT-2000 International Mobile Communications, Wi-Fi - Wireless Fidelity, Bluetooth, WiMax etc.) (ITU,2010). The fourth generation mobile network technology presents a common platform that serve as a hub for connecting all the other technologies developed and currently in-use and to harmonize with user expectations of the many services to be provided. There are fundamental differences between the GSM and 3G and also 4G LTE is that of the functionality of the RNC and BSC is now delegated to distributed to the Base Transceiver Station(BTS) and a set of servers and gateways (R. Agustin,2004). This means that the 4G network will be less expensive and data transfer will be much faster relative to the previous technologies already in existence (ITU,2010).

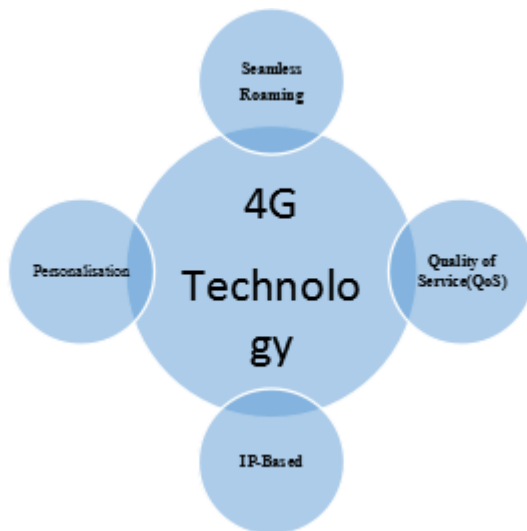


Fig.3.1: The next Generation Mobile Communication in Ghana (4G LTE)

Another new generation of 4G network is the IMT-Advanced 4G standards that will introduce new era of mobile broadband and cellular communications in telecommunication history (MTN Group,2017).The ITU-R specification, indicates that IMT-Advanced provides a system of global communication and a mobile network platform on which we can have (MTN Group,2017) to build next generations of powerful

interactive mobile services or IP based and internet enabled application and services ushering us into a new era of internet of things will provide faster data access, plus enhanced roaming capabilities especially location detection, unified messaging as well broadband multimedia applications (O. Challenge,2008). According to ITU assertion, "Information and Communication Technologies and broadband networks would become vital to the overall development national infrastructure (T. Tjelta,2007) that is similar to transport, energy and water networks. These technological development and major enhancements in wireless broadband communication has the potential of drive both social and economic development, and facilitate and accelerate progress towards achieving the United Nations' Millennium Development Goals (T. Tjelta,2007).

The technological requirements and projections for IMT-Advanced are stated below:

- Peak data rate of 1 Gbps are expected for downlink (DL) while 500 Mbps uplink (UL).
- Downlink spectral efficiency of about 15 bps/Hz and uplink spectral efficiency of up to 6.75 bps/Hz with an antenna configuration of 4×4 DL and 2×4 UL.
- The spectral efficiency averagely in DL (with inter-site distance of 500m and pedestrian users) is 2.2 bps/Hz/cell with MIMO 4×2 ,
- In the same scenario with 10 users, cell edge user spectral efficiency will be 0.06 in DL 4×2 . In the UL, this cell edge user spectral efficiency must be 0.03 with MIMO 2×4 and mobility of up to 350 km/h in IMT - Advanced.
- In IMT-Advanced , spectrum aggregation with transmission bandwidths would be supported with more than 40MHz in DL(Downlink) and UL(Uplink).
- Backward compatibility and internet with legacy systems and standards (M. Tan ,2008).

4. MTN 4G LTE FOR BUSINESS

4.1: Introduction

The upgrade of MTN telecommunication machinery from 3G technology to 4G LTE has ushered in a new of mobile broadband technology in Ghana's history of telecommunication (MTN Ghana,2017)).With 4G LTE, internet applications can be accessed faster and conveniently on any platform ,internet accessibility on mobile platforms is again faster with increased bandwidth and finally more businesses can now connection due to the high rate of internet penetration in the country. With MTN post-paid package and other minor services for Ghana's first GSM service recorded in November 1996 ,the country begun a journey is the history of telecommunication .The grandeur name was Spacefon with the new services and Spacefon's

services gained more and more popularity by the day. New features like:

- I. Caller ID (Note that Caller ID is an integral feature of GSM).
- II. Call forwarding,
- III. Call holding
- IV. International roaming
- V. Short Messaging Service (SMS)

These were some of the major services (Perspire,2004) available to Spacefon increasing number of subscribers(MTN Ghana,2017). “A record of strategic investment, innovation and customer focus underlies the success and growth of Mobile Telecommunication Network (MTN) Ghana, the Chief Executive Officer ,MTN Ghana (CEO)”, Ebenezer Twum Asante, has stated (MTN Group,2017).

TABLE 4.1:FIG.4.0: WIRELESS TECHNOLOGIES

| Technology(G) | Key Features | BandWidth Alloc. |
|---------------|--|--|
| 1 | Analog | Typical 2.4kbps;22kbps |
| 2 | Digital-TDMA,CDMA | 9.4-14.4 kbps (circuit data) |
| 2.5 | Mux packets in voice time slots | 15-40 kbps |
| 3 | Improved modulation using CDMA variants | 50-144 Kpbs(1xRTT); 300-384Kbps UMTS; 500Kbps-2.4Mbps EVDO |
| 3.5 | Increased modulation and encoding schemes | 2-14Mbps(HSPA), 28Mbps,42/84Mbps HSPA+ evolution |
| 4 | New modulation(OFDM A);Multi-path (MIMO); All IP | LTE :100 Mbps with adequate spectrum (15 or 20 MHz) |

Fig. 4.0: The various generations of Wireless Technologies

MTN has tremendous contribution of customers to its 20-year journey. Since 2006 Scancom Ghana’s total infrastructural investment are put at US\$ 2.5 billion while this year 2016, the company is investing US\$ 96million in the upgrade of the 3G network, made up of US\$ 62million in the traditional network, US\$ 16million in information technology (IT) and US\$ 18million on LTE deployment respectively (MTN Group,2017) .Ghana inherited 2.5 million subscriber base when the company took ownership from Spacefon Areeba and by the end of 2007 MTN recorded four million subscribers, a massive growth rate and by December 2009, 8 million subscribers were recorded (MTN Ghana,2017). In 2011, MTN Ghana had achieved 10 million subscribers milestones,

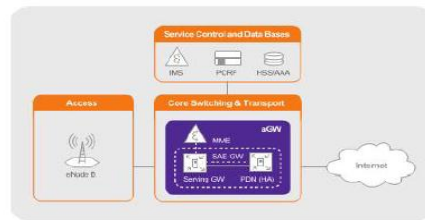
subsequently twelve million also in March 2013, and a rapid growth rate of 15 million in July 2015 and currently of a ground-breaking record 17 million putting MTN Ghana on top of the chat as the country’s largest subscriber base and biggest telecommunication giant (T. Tjelta,2008).Not only has MTN Ghana grown in voice customers, the company’s data and corporate customers also continue to grow.

4.2 Key Technological Achievements

- i. LTE (4G Network deployment currently)
- ii. Robust 2G and 3G network
- iii. State-of-the-art Data centers
- iv. West African Cable System (WACS)
- v. Over 5,000 KM of fiber optic cables across the country(Ghana)

Furthermore, MTN Internet Bandwidth guarantees the corporate market dedicated, unlimited and direct connection to the internet,a tailor-made suit to meet your specific requirements that offers bandwidth ranging from 128Kb to anything in excess of 10Mb with dramatic increase after deploying 4G LTE in Ghana.

SIMPLIFIED LTE ARCHITECTURE



- eNodeB:** Evolved node-B
- AGE:** Access gateway entity
- EPC:** Enhanced packet core
- IMS:** IP Multimedia system
- PCRF:** Policy and charging function
- HSS:** Home subscriber server
- MME:** Mobile management entity
- SAE:** System architecture evolution

Fig.4.1: The architecture of 4G LTE

4.3 MTN 4G Contribution to Ghana’s Economy.

MTN Ghana’s total payments in tax to government as at 2014 amounted to GH¢ 605 million, again in seven (7) years, MTN Ghana Foundation executed over 95 massive projects at a total cost cost of GH\$15.5 million, and impacted over 213,000 people directly and 2.5 million indirectly cutting, various districts and regions, heterogenous societies across the country (MTN Ghana,2017).Also some major projects were recorded the areas of education, health and economic and women empowerment, massive infrastructural investments in Information and Communication

Technology (ICT), the construction of libraries, dormitories, classrooms and the provision of scholarships from which over 800 benefited, with a direct impact for more than 150,000 Ghanaians can be overlooked, it was a life-changing experience the Ghanaian folks. As if that is not enough, MTN Ghana supported micro enterprises, executed the business incubator project (a projects for encouraging and supporting business star-ups), supported surgeries for life-threatening ailments and executed the *Y’ello Care-employee* volunteer programme, and blood donation exercises across the country raised more than 2,000 pints of blood for the some of the major hospitals in the country (M. Tan no,2008).Finally, the Ghana Multimedia Incubator Centre (GMIC) was established by the Government of Ghana in 2005 and is mandated to promote ICT entrepreneurship development through business incubation. It also provides training in Business Process Outsourcing (BPO). GMIC currently operates under the National Information Technology Agency (NITA) and through this programme, a new generation of young entrepreneurs have emerged in Ghana. Scancom Limited, operators of MTN Ghana, Ghana’s telecom giant, became the winners in the auction process for one frequency spectrum lot in the 800 MHz Band for mobile services (Dishrag,2004). The spectrum is 4G Long Term Evolution(LTE). The 4G LTE which is the Fourth Generation or Long Term Evolution.“Scancom Limited, thus, have been provisionally awarded one lot of 2 x 10 MHz in the 800 MHz Band, pending their fulfillment of other requirements,” the NCA added. MTN 4 G coverage span all ten regional capitals in Ghana. Currently, there are 290 LTE sites across all regions and key mining towns and roll out underway to extend the services offered by 4G LTE . 4G LTE aims to offer users faster, more reliable mobile broadband internet for devices like smartphones, tablets and laptops. 4G LTE has enormous benefits to subscribers over 3G (Nokia,2009). 4G LTE is 5 to 10 times faster than 3G meaning faster downlink and uplink speeds.

4.3 Graphical representation of Telecom penetration in Ghana

4.3.0 Ghana’s mobile voice market share Sept., 2017

Figure 1 – Mobile Voice Market Share for September 2017

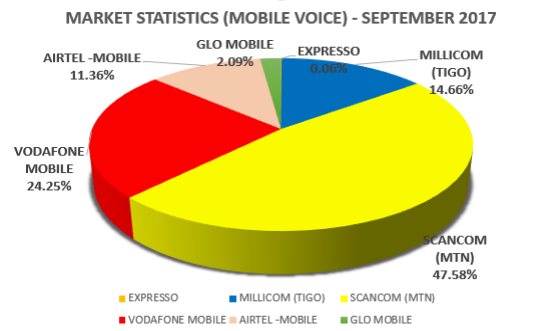


Fig.4.2: Market statistics of Mobile Voice,Sept.,2017
Source: NCA-Ghana,2017

4.3.1. Ghana’s mobile voice subscrip., for Sept.,2017

Figure 2 – Mobile Voice Subscription Trend for September 2017

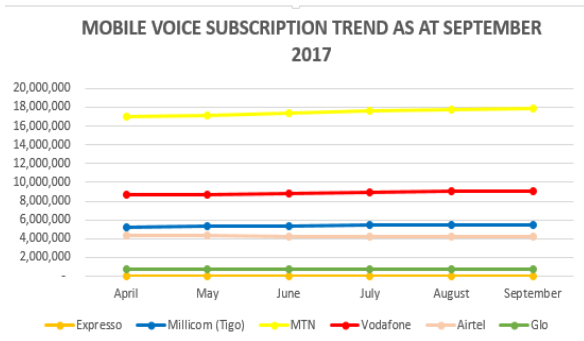


Fig.4.3:Market statistics for mobile voice subscription ‘17

Source: NCA-Ghana,2017

4.3.2.Ghana’s mobile data market share,July 2017

4.1(i) Figure 4 – Mobile Data Market Share for July 2017

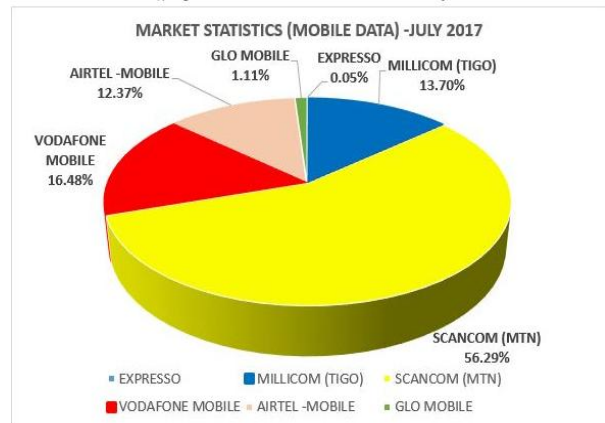


Fig.4.4:Market statistics for mobile data ,July2017
Source: NCA-Ghana,2017

4.3.3. Ghana’s data market share (4G Operators), July ‘17

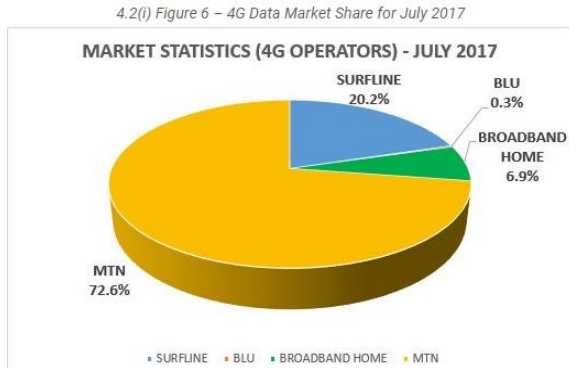


Fig.4.5:Market share for 4G Operators in Ghana, July ‘17
Source: NCA-Ghana,2017

4.3.4 Ghana’s 4G operators subscription trend, July ‘17

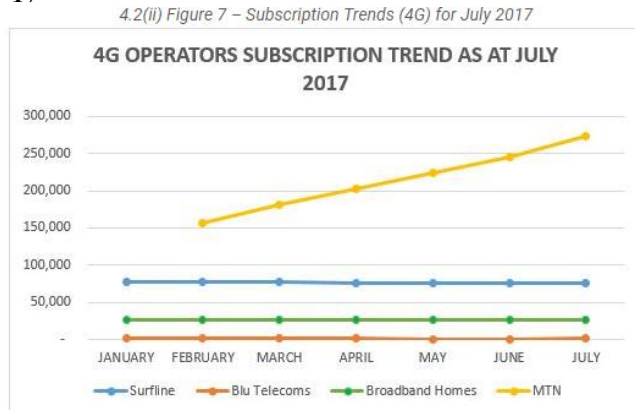


Fig.4.6:4G operators subscription trend, July ‘17
Source: NCA-Ghana,2017

4.4 The Business Benefits of MTN 4G Long Term Evolution

Information and Communications Technology (ICT) continues to develop at a supersonic growth rate, the business world is taking advantage of this new era by applying it across diverse applications and systems, hence in Ghana, West Africa ,the story is no different as the improvement in mobile communication networks have changed the “format of conducting business” . The critical aspect of this development is mobile network communications’ technology . The latest of such technologies is 4G LTE (‘Fourth Generation – Long Term Evolution’), providing massive substantial performance and offers unprecedented internet connectivity (MTN Group). These massive improvements in application performance and enterprise mobility have the following benefits:

1. Increased sales and improved customer service delivery
2. Improvements in products and services
3. Productivity gains
4. Personal and team productivity
5. Management effectiveness and innovation
6. Process efficiency and effectiveness

Countries that have their businesses relying heavily on the 4G LTE have accrued enormous benefits as a result of these deployment in the technology. Recently a survey conducted by EE, the organizations using LTE in the United States, have 67% increased productivity as a result. Again,47% have reduced their expenditure,increased savings and 39% have established more business linkages. In comparison with already existing mobile network technologies (MTN Ghana,2017). 4G LTE mobile technology offers much higher bandwidth (speed of data transfer), lower latency (faster response times from the network) and improved spectrum efficiency (increasing overall network capacity).For that matter, more mobile applications to be used on mobile devices anytime, anywhere and also faster or real-time exchange of large files and streaming media. Furthermore, real-time delivery of time-sensitive data especially for real-time interaction or transactions compared with Wi-Fi and WiMax technologies, 4G LTE allows fully mobile-based applications that require true broadband speeds and also improved security because there is no need to authenticate onto another, possibly public, network. Lon Term Evolution(4G) will. The new technology would improved user experience (MTN Group). Finally,the LTE’s high bandwidth have the capacity to support the rapid set-up of temporary workplaces. Again ,other services provided by 4G LTE includes but not limited to large file transfers, rapid workplace set-up environment, rich machine to machine learning and remote monitoring applications, videoconferencing and faster life streaming schemes, tele-presence and rich media collaboration as well as remote access to business applications (MTN Ghana).

5. CONCLUSION AND RECOMMENDATION

In Ghana ,the business environment continues to demand richer communication and collaboration platform for employees who are increasingly mobile Most companies and organization springing up, provide rich content and services to their staff and customers and these services needed to be accessible away from the office, and even accessible on multiple devices example is the customized tablet used by Commissioned Sales Executives CSE of Barclay’s bank of Ghana.The tablets are used to collect data

about markets trends while on the field and also register prospective customers who want to create an account with the bank but could have time to visit any of their branches to do so. Furthermore, most Ghanaian businesses are increasingly deploying (or allowing) smartphones and tablets for employee use and other related services. The Ghanaian business customer or client would expect an easy, quick and powerful experience whenever they do anything on these Smart devices and they want the same in their business lives too. These developments can be summarized in three key trends:

- I. Increasing mobility and flexibility of the workforce
- II. Popularity of cloud-based service delivery
- III. The consumerism of ICT in organizations
- IV. The impact of these trends will see the already dramatic increase in data demand from consumers also reflected in the business world especially market trends, driven by a diverse range of business-specific mobile driven applications. As a result of these high-performance mobility applications the benefits expected are enormous including increased sales and improved customer service, enhancing sales and online meetings with richer multimedia content, again increasing the productivity rate of a mobile sales force, the massive improvements in products or service quality, the incorporation of enhanced mobile functionalities in products, the improvement of quality of service provision through faster access to information or media content applications. transforming productivity and flexibility through rich mobile applications. Finally, the upgrade of MTN 3G network to 4G LTE is a booster to Ghana telecommunication industry and has put the country on higher pedestal to improving information and communication technology products and services and by revolutionizing the business landscape of Ghana through a more robust and efficient deployment of information and communication technology infrastructure.

5.14G LTE Business Gains in Ghana:

- i. Significantly increased peak data rates, scaled linearly according to spectrum allocation
- ii. Instantaneous downlink peak data rate of 100Mbit/s in a 20MHz downlink spectrum (i.e. 5 bit/s/Hz)
- iii. Instantaneous uplink peak data rate of 50Mbit/s in a 20MHz uplink spectrum (i.e. 2.5 bit/s/Hz)
- iv. Expectations of additional 3G spectrum allocations
- v. Greater flexibility in frequency allocations
- vi. No native support for circuit switching domain

- (e.g. voice)
- vii. Continued cost reduction
- viii. Keeping up with other (including unlicensed) technologies (eg. WiMAX)
- ix. – Use the growing experience with the take-up of 3G to clarify the likely requirements of users, operators and service providers in the longer term

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