

A Framework for M-Health Services Using 4G (LTE) Technology

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Abstract:- The conventional limits of medicinal services have spread with the presenting of 4G and other long-term evolution (LTE) wireless innovation. The systems administration innovations broaden the compass of emergency clinic foundation and give on-request portable access to clinical sight and sound information. The mobile health (m-health) is at present uniting significant scholastic research and industry disciplines worldwide to accomplish creative arrangements in the territories of medicinal services conveyance and innovation division. Right now, propose an inventive and present day structure for versatile medicinal services (m-health), which altogether profits by the upgraded organize capacities of LTE remote advancements, by empowering a wide scope of Omnicell programming and database systems (such as picture documenting and correspondence framework, clinic data framework, and reporting framework) to be progressively in cloud-like distributed media information stockpiling. Our framework permits clinical information application to impart information to portable has over a remote system, (for example, Long Term Evolution), by official to existing programming frameworks and conveying them as m-health applications. Finally, the research presents some simulation of the proposed solutions and their results as a means of validation.

Keywords:- Long Term Evolution (LTE), Telemedicine, Mobile Health (M-Health), Digital Imaging and Communications in Medicine (DI-COM), Home Subscriber Server (HSS), Clinical Services Capability Framework (CSCF), Serving GPRS Support Node (SGSN), 3rd Generation partnership project (3GPP), Gateway GPRS Support Node (GGSN), Evolved UMTS Terrestrial Radio Access Network (E-UTRAN).

I. INTRODUCTION

The idea of portable medicinal services or m-health is one of the quickest developing territories of healthcare computing [1].

As electronic versatile and handheld gadgets put amazing convenient figuring gadgets under the control of an ever-expanding extent of mass population (comprehensive of those in low-income and hindered regions [2]), the stage is currently remote correspondence

advances to give human services administrations both compact and between operable. Presently the age of systems administration, the state of new 4G remote advances, for example, LTE, Wi-Max which are all IP-based heterogeneous networks structured at incredibly extending the openness and ease of use of any web associated framework. The LTE innovations are compact, lightweight and nonexclusive. It additionally gives cell phones access to incorporated interchanges benchmarks that have least transmission costs and quicker mixed media support. The fundamental motivation behind LTE remote innovations [3] is the essential of changed, solid remote information benefits that can allow even straightforward handheld gadgets to effortlessly utilize a few sight and sound information streams simultaneously [4]. The LTE involves the transmission of medical and personal data for diagnosis, treatment, supervision and monitoring, and record of patients. This modern way of care can improve patients' quality of life by giving them the proper care needed due to regular monitoring and efficient diagnosis. However, one of the major turning points in this advancement is the introduction of a fourth-generation (4G) mobile communication system.

➤ General concept of M-Health system

Telemedicine or M-Health (additionally composed as m-health or mobile health) is a term utilized for the act of medication and general health [5], bolstered by cell phones. The term is most regularly utilized about utilizing versatile specialized gadgets, for example, cell phones, tablet PCs, and PDAs, for health services and data, yet additionally to influence enthusiastic states. The M-Health field has risen as a sub-section of E-Health, the utilization of information and communication technology (ICT, for example, PCs, cell phones, an interchanges satellite, tolerant screens, and so forth, for health administrations and information. M-Health applications remember the utilization of cell phones for gathering network and clinical health information, conveyance of social insurance data to experts, specialists, and patients, constant checking of patient imperative signs, and direct arrangement of care (by means of portable telemedicine) [6].

The blends of these two variables have inspired a lot of conversation of how more noteworthy access to cell phone innovation can be utilized to moderate the various weights looked by building up nations' social insurance frameworks. The two elements are examined here.

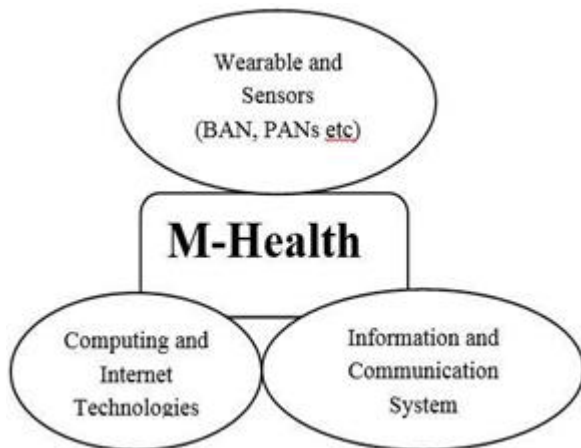


Fig 1:- General concept of M-Health system

Telemedicine is increasingly playing a vital role in the health care system [7]. Telemedicine offers benefits not only to patients but also to healthcare systems and society by offering better management of health resources which results in improved cost-effectiveness/performance ratio. As the population ages and is living gradually more with chronic diseases, telemedicine could be a solution for providing medical support while optimizing the cost for “at home hospitalization” and health care resources. Indeed, it is estimated that health care professionals spend 30% to 50% of their time on administrative tasks rather than on patient care [8]. Although nowadays the use of telemedicine is limited due to a highly fragmented market, it is expected to experience a growth rate of over 55% by 2014-2015. Moreover, 41% of patients in the United States declare they would like to use portable monitoring equipment to send data automatically to their doctors. This represents a golden opportunity for healthcare, telecoms, and customer electronics companies as well as software developers [8].

➤ Motivation of Telemedicine/M-health

M-Health is one part of E-Health that is pushing the constraints of how to get, transport, store, process, and secure the crude and handled information to convey important outcomes. M-Health offers [9] the capacity of remote people to take an interest in the social insurance esteem lattice, which might not have been conceivable previously. Participation doesn't suggest only the utilization of social insurance administrations. As a rule, remote clients are important supporters of assemble information with respect to sickness and general health concerns, for example, open air pollution, medications, and savagery. The inspiration driving the improvement of the M-Health field emerges from two elements. The primary factor concerns the bunch requirements felt by the social insurance frameworks of developing countries. These limitations incorporate high populace development, a high weight of malady predominance [10], a low human services work power, and huge quantities of provincial occupants, and constrained money related assets to help medicinal services foundation and health information frameworks.

The subsequent factor is the ongoing fast ascent in cell phone entrance in creating nations to enormous portions of the social insurance workforce, just as the number of inhabitants in a nation overall [8]. With more noteworthy access to cell phones to all portions of a nation, including country territories, the capability of bringing down information and exchange expenses to convey human services improves.

II. LITERATURE REVIEW

Various researchers have been projected in recent years based on M-Health services, 4G, and LTE technologies. In this part, we are going to introduce some literature's review of recent works:

By utilizing convenient technology Bo Fan, Chen et al. [11], addressed the trouble of resourcefulness allocations for wireless ex-ploiter in vehicular M-Health communicatings. They have some objectives such as

- maximize the EE of the wireless communicating devices in the M-Health system;
- defend the medical devices from destructive EMI;
- And conform to the QoS necessities of users in dynamic prece-dences.

They also contracted two channel allocation schemes which one is the QoS fulfillment scheme and another is the QoS recompense scheme.

In [12], presented a modern IoT-based mobile gateway clarification for mobile health (m-Health) situations. The authors used AMBRO mobile gateway utilization granted the universe of a ubiquitous in-telligence scenario where heterogeneous devices such as Samsung smartphone, the Shimmer sensor device, and the Motorola smart-watch. They have also addressed an algorithmic technique which is used for each mobile gateway serving, and the scenarios where the mobile gateway acts as a transmission channel or a smart object.

S. Saeedeh Sadegh, Parisa Khakshour et al. [13], proposed an excellent m-health evaluation framework. The proposed framework incorporates three steps of Service Requirement Analysis, Service Development, and Service Delivery. Finally, they have been utilizing the offered framework would benefit key stakeholders in recognizing, expanding and delivering proper m-Health services.

The authors [14] have concentrated on the design of an open tele-matics architecture for telemedicine connected to a device mobile and omnipresent including Long Term Evolution (LTE). Their entire technological method permits taking benefit of the services 4g and the geographic learning systems of health monitoring care of patients with chronic diseases in Colombia, where there are some remote areas and complicated access.

For enhancing the 4G technology for medical telerobotics and the remote ultrasonography paradigm [15], authors elaborated the potential and discuss associated difficulties focusing on the en-abling technologies, particularly robotic manipulation, telecommu-nications, and vision systems. They have used the terms wireless networks & video coding standards, 4G wireless networks and H.264/AVC standard for increasing the capacity of existing state-of-the-art solutions as well as performed to promote diagnostically lossless medical realtime video connections using the long-distance MELODY teleoperated robot.

Sandeep Kumar [16] proposed a primal design for smart healthcare services utilizing Near Field Communication (NFC) to recommend the purveying of medicinal services to patients anywhere, anytime applying smart mobiles that are related through wireless communication technologies. He inaugurated an answer for the EMR model utilizing NFC tags to raise security and tone assertion in medicinal services selective information support.

In [17], the authors presented recent research associating the de-veloping mobile health (m-health) area with the need for 5G and machine-to-machine technologies. They dig into the multiple prof-its that these issuing technologies could extend to generally expand m-health solutions.

In another work [18], the author proposed the m-health system a fundamental cloud server enabled to read medical sensors data of patients. This research introduces a model where the medical health position of a patient has prevailed and healthcare encouraging mes-sages are rescued from time to time the persons in a polish way through a wireless network system (WNS). Finally, the proposed mobile healthcare direction system of this research work satisfies the dream of incorporating several 4G and 5G technologies and tools with m-health systems.

Giulia Cisotto et al. [19] specified the technical requirements of future cellular networks to affirm a mixture of encouraging health-care services such as connected ambulances, smart hospitals, mi-crosurgery, and monitoring. It will also pave the way for future e- and m-health in the sixth-generation (6G) cellular networks. Finally, they concluded that 5G acantha new e- and m-health extend-ing, offering an individualized and omnipresent medicine, while even more sophisticated assumptions are already at the apparent horizon of 6G networks.

The authors have discussed Long-term diabetes care necessitates involvement from patients as well as doctors and family health care provider. The authors' context-aware, interactional m-health sys-tem (ImHS) supplies real-time, two-way communication between diabetes patients and caregivers by applying the Internet of Things technology [20].

III. TELEMEDICINE/M-HEALTH

Center pay and particularly low-salary nations face a shame of imperatives in their human services frameworks [21]. These nations face a serious absence of human and physical assets, just as the absolute biggest weights of infection, outrageous neediness, and enormous populace development rates. Furthermore, medicinal services access to all compasses of society is commonly low in these nations. Air conditioning cording to a World Health Organization (WHO) report from June 2011, higher-salary nations show more M-Health movement than do bring down pay nations (as steady with E-Health drifts when all is said in done). Nations in the European Region are as of now the most dynamic and those in the African Region the least dynamic. The WHO report discoveries likewise incorporated that M-Health is most effortlessly fused into procedures and administrations that generally use voice correspondence through customary phone systems [22]. The WHO takes note of an extraordinary deficiency inside the worldwide human services workforce. The WHO notes basic medicinal services workforce deficiencies in 57 nations a large portion of which are described as creating nations and a worldwide shortage of 2.4 million specialists, attendants, and mid-spouses [23]. The WHO, in an investigation of the medicinal services workforce in 12 nations of Africa, finds a normal thickness of doctors, attendants, and birthing specialists per 1000 populace of 0.64 [22].

A. Mobile Technology in Low- and Middle-income Countries

Versatile innovation has shown up into low and middle pay countries [24]. While, in the M-Health field, versatile innovation as a rule alludes to cell phone innovation, the passageway of different advances into these countries to encourage medicinal services are additionally talked about here.

B. Mobile Phones Penetration and Drivers of Growth

Cell phones have made an ongoing and quick passage into numerous pieces of the low-and center salary world, with the worldwide Mobile telephone entrance rate radically expanding in the course of the most recent decade. Enhancements in broadcast communications innovation framework decreased the expenses of versatile handsets, and a general increment in non-nourishment consumption has affected this pattern. Low-and center pay nations are using cell phones as "jump innovation" (Leapfrog Technology gives quality data and assets to encourage an organization's Network support, Hosting, Collocation, Web Development, VOIP) That is, cell phones have permitted many creating nations, even those with moderately poor foundation, to sidestep twentieth century fixed line innovation and hop to present day portable innovation [25], [26].

In an astounding turn on innovation, cell phone use in creating nations has outperformed that of created regions, as per an ongoing World Bank report. Around seventy five percent of the world currently have simpler access to a cell phone than a ledger, power, or clean water, the report said. Following a "portable first" way, the creating scene is utilizing versatile applications to help fabricate and instruct instead of engage. Somewhere in the range of 2000 and 2010, the quantity of versatile clients in developing nations outperformed those in high-income countries, bouncing from 29 percent to 77 in less-created territories. As of now, somewhere in the range of 80 and 95 percent of the number of inhabitants in Kenya, Mexico, and Indonesia send instant messages. In the a long time since the turn of the century,

cell phones have increased the world over, becoming from under 1 billion being used to 6 billion this year.

A pace that is unequaled throughout the entire existence of innovation, the World Bank said. It took hundred and twenty eight years to arrive at 1000 million fixed phone line clients; versatile systems accomplished that in two decades. In 2015, the quantity of versatile memberships surpass the total populace, as per the World Bank. In Oct. 2011, the quantity of remote endorser associations outperformed the U.S. populace—327600 thousand versus 315500 thousand, as indicated by Cellular Telecommunication and Internet Association (CTIA) [27].

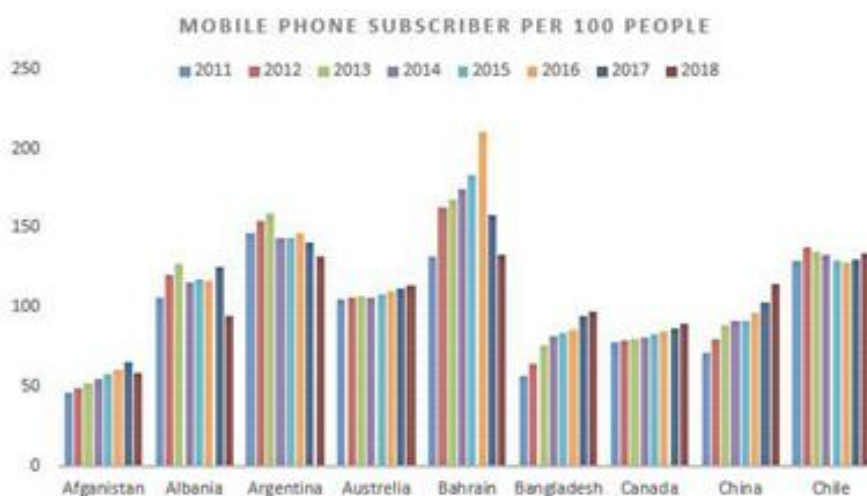


Fig 2:- Mobile phone subscribers per 100 people in various countries from 2011-2018

C. Applicability of Telemedicine in Bangladesh

Many developing nations can't give minimal health service to their people because of the deficient number of specialists, medicinal services experts, and clinical administrations [28]. Occasionally it is seen

| Facilities | Quantity | Year |
|---|----------|------|
| Total Number of clinic | 5816 | 2015 |
| Number of Clinic beds for each 1000 persons | 0.8 | 2015 |
| Populace for each Clinic bed | 2571 | 2011 |
| Clinic beds for each 10000 people | 343 | 2011 |
| Number of Health centers | 1385 | 2011 |
| Number of Doctors | 42881 | 2011 |
| People for each Doctor | 1817 | 2018 |
| Doctors for each 10000 people | 4.72 | 2015 |
| Nurse for each People | 0.3 | 2017 |

Table 1:- Health-care facilities in Bangladesh

That there are centers and emergency clinics however they are regularly mean prepared. This is especially valid for the medicinal services frameworks outside the urban territory, which are typically past the range of the general method of correspondences. The insufficient foundation makes it increasingly hard to give human services in country and remote territories at the perfect time. On the off chance that the voyaging cost of a patient to visit a clinical pro is higher than the expense of giving a telemedicine

counsel, at that point telemedicine may be a monetarily suitable arrangement. Bangladesh is one of the most thickly populated creating nations where a great many people are living in towns. There is a tremendous uniqueness in human services dispersions among rustic and urban territories. Individuals are likewise enduring because of an absence of clinical ability and health care facilities. In this scenario utilizing the limited re-sources, telemedicine may be an easier and cheaper way to dissem-inate healthcare

facilities to the rural areas. Giving clinical consideration is the protected commitment of the administration. The second objective of national health approach expressed: "To build up a framework to guarantee the simple and continued accessibility of health services for the people, particularly communities and urban territories". So as to meet the necessities of the general destinations of the health area, different projects were attempted during the previous decade. Solid telecommunications associations between remote health habitats and extraordinary clinics can assist the administration with reaching its objective no problem at all. Over the most recent couple of years, the data and correspondence framework of Bangladesh has been encountering immense blasting in development. Bangladesh's legislature has given tremendous significance to ICT (Information and Communication Technology) sector for advancement in financial development and neediness decrease.

D. Telemedicine/M-Health in Bangladesh: Why?

Bangladesh is one of the most thickly populated nations on the planet. In excess of 170 million individuals are living inside 144 thousand square km of land region. There is just six hundred and sixty three kilometer Government clinics in locale head-quarters and Upazila (a sort of sub-town) territory. The all out number of beds accessible in both open and private emergency clinics and facilities is 60 thousand. The proportion of emergency

clinics bed in Bangladesh is around 1:2315. Table 1 gives an outline of existing human services offices in Bangladesh. From this table, we can see the insufficient social insurance foundation of this exceptionally populated nation. Around 70% of the total population of this nation lives in rustic zones. In addition, the greater part of the doctors are town-based. In the wake of being chosen as units of Bangladesh Civil Services (BCS) for the most part the specialists get work in the remote health center of Bangladesh. Due to and poor foundation of a rustic health place and poor framework of the town the majority of them leave the provincial territories inside 1-2 years and move to the city zone. They feel that they become expertly secluded and outdated whenever positioned in remote territories. Thus health staff in rustic zones are normally youthful, have little work understanding and show high occupation pivot. In many cases, countryside health places are going by infirmary experts who are scarcely prepared. In that cases, individuals seldom get any authority expert's reference when they go to health attentions in Thana or Upazila level. To show signs of advance consultancy, provincial individuals burn through a large portion of their cash on movement to visit an expert in city regions. Now and then, it is further than the realm of fancy to expect to move a patient to the district or to the urban on time due to his/her basic health condition and poor correspondence offices in those territories.

| Facilities | Program No. | Program %a |
|------------------------|-------------|------------|
| Phone | 125 | 71 |
| Computer | 68 | 39 |
| Camera[Video/Photo] | 13 | 7 |
| PDA's/Tablet | 11 | 6 |
| GPS | 9 | 5 |
| Remote Diagnostic Tool | 8 | 5 |
| Smartcard | 6 | 3 |
| Unique identification | 5 | 3 |
| Radio | 5 | 3 |
| Other | 14 | 8 |

Table 2:- Technology-enabled programs by type of device

At this point giving social insurance in country territories, two alternatives are open. One is building medical clinics in provincial regions and improving the foundation with the goal that specialists and different staffs feel helpful to remain in these spots. The other is to take activities with the goal that it is simpler to get to the nature of social insurance benefits by individuals in country zones. To actualize the first gigantic speculation and time are required. Consequently, the subsequent one appears the most achievable choice. To actualize the subsequent choice, telemedicine/M-Health is the most ideal route as it can give better medicinal services by utilizing the greatest usage of restricted assets.

IV. GENERATION OF NETWORK

A 4G network is the fourth period of remote, flexible correspondence [29]. The general target for the framework is to give a broad and ensure about framework correspondence course of action with much faster data speeds than past ages. While as yet being created, the foundations for redesigning from 3G to 4G organization began in the mid-21st Century as associations introduced new development. New models, for instance, WiMAX and Long Term Evolution (LTE) have been insinuated as 4G, anyway there is some conversation concerning their status.

In media communications, 4G is the fourth era of PDA portable correspondences principles. It is a successor of third-age (3G) models. A 4G framework gives versatile ultra-broadband Internet access, for instance to PCs with USB remote modems, to cell phones, and to other cell phones. Possible applications incorporate revised portable web get to, IP communication, gaming administrations, superior quality versatile TV, video conferencing and 3D TV.

➤ *First Generation (1G)*

Definition: In the realm of PDAs, 1G implies original remote simple innovation measures that started during the 1980s. 1G was supplanted by 2G wireless digital standards [30]. Examples: 1G was presented as the simple standard for PDAs during the 1980s.

➤ *Second Generation (2G)*

Definition: In the realm of phones, 2G means second-age remote computerized innovation. Completely advanced 2G systems supplanted simple 1G, which started during the 1980s. 2G systems saw their first business light of day on the GSM standard [31]. GSM represents worldwide framework for versatile interchanges. 2G on GSM principles were first utilized in business practice in 1991 by Radiolinja, which was a Finnish GSM administrator established on Sept. 19, 1988. Radiolinja is currently part of Elisa, which was referred to during the 1990s as the Helsinki Telephone Company. Notwithstanding the GSM convention, 2G additionally uses different other computerized conventions including CDMA, TDMA, iDEN and PDC. GSM depends on TDMA. 2.5G crossed over 2G to 3G.

Examples: 2G wireless technology replaced 1G and is all digitals.

➤ *Third Generation (3G)*

Definition: 3G is the third era of cell phone models and innovation. 3G supplants 2G innovation and goes before 4G innovation. 2.5G was a transitory extension somewhere in the range of 2G and 3G. 3G innovations empowered quicker information transmission speeds, more prominent system limit, and further developed system administrations. The first pre-business 3G arrange is propelled in around mid-May 2001 by NTT Do-CoMo in Japan. The system was marked as FOMA. Following the first pre-business dispatch, NTT DoCoMo again impacted the world forever with the main business dispatch of 3G in Japan on October 1st, 2001.

Examples: 3G is the third generation of mobile phone standards and technology.

➤ *Upgrading From 3G to 4G*

The general execution of the 3G network far and wide took about 10 years. The ITU plans to have the 4G network turned out to the worldwide market in a considerably more compelling and auspicious manner. Enhancements made somewhere in the range of 2G and 3G required significant upgrades in equipment for cell phones, while organizations

developed numerous cell phones utilized on 3G systems for similarity with new 4G models. In any case, worries over steadiness and security have hindered some advancement, as specialist co-ops need to guarantee they ensure their clients' data. [32].

➤ *Fourth Generation (4G)*

4G remote is the term used to portray the fourth-age of remote assistance. 4G is a stage up from 3G, which is at present the most broad, rapid remote assistance. 4G is just accessible in restricted territories. While all 4G administration is designated "4G," the fundamental innovation isn't the equivalent. Run, for instance, utilizes Wi-Max innovation for its 4G organize, while Verizon Wireless uses an innovation called Long Term Evolution, or LTE. Regardless of what innovation is behind it, 4G remote is intended to convey speed. By and large, 4G remote should be somewhere in the range of four to multiple times quicker than the present 3G systems. Run says its 4G Wi-Max system can offer download speeds that are multiple times quicker than a 3G association, with speeds that top out at 10 megabits for each second. Verizon's LTE arrange, in the interim, can convey speeds between 5 Mbps and 12 Mbps.

➤ *4G Specifications*

The points of interest of the 4G network are intended for great help and quick information move rates. Needs for this standard include better gathering, with less dropped information, and quicker information trades. The International Telecommunications Union (ITU), the association that administers guidelines for remote networks, has expressed that generous upgrades to interactive media messaging services, including video services, are required to affirm another age. 4G requires an information speed transfer pace of in any event 100 megabits for each second while a client moves at high speeds, for example, being on a train, and a one gigabit for each subsequent information rate in a fixed position. The ITU additionally requires quick exchanges between systems without help interference or loss of sign. Telephones on a 4G arrange likewise need to utilize Internet Protocol (IP) innovation for information moves through parcels, as opposed to conventional telephone strategies.

➤ *Progress toward 4G*

An assortment of working gatherings have been built up to help build up the 4G network. Early improvements toward this innovation include Wi-Max, which is a quicker form of wireless data transfer than Wi-Fi systems. Long term evolution is another innovation that enhances more seasoned 3G frameworks, however neither standard very satisfies the ITU requirements for information rates. The two have been named as 4G systems, be that as it may, which have prompted some disarray and controversy. As the two techniques use IP parcels and have indicated a stamped improvement over 3G principles, the ITU has affirmed their marking as 4G. This is dependent upon the designers of Wi-Max and LTE pushing forward to satisfy the official guidelines for 4G, which they have kept on doing.

➤ Long Term Evolution (LTE)

LTE [33] is the thing that most are calling 4G however as a general rule, it is only a progressed 3G standard that some call 3.9G. LTE utilizes a totally unique radio innovation. Rather than CDMA, it utilizes orthogonal frequency division multiplexing (OFDM) and OFDM get to. This regulation system separates a channel generally 5, 10 or 20 MHz wide into littler sub-channels or sub-carriers every 15 kHz wide. Each is tweaked with part of the information. The quick information is partitioned into more slow streams that regulate the sub-carriers with one of several adjustment plans like QPSK or 16QAM. LTE likewise characterizes a multiple input multiple output (MIMO) activity that utilizes a few transmitter-collector receiving wires. The information stream is partitioned between the receiving wires to support speed and to make the connection increasingly solid. Using OFDM and MIMO lets LTE conveys information at a rate to 100 Mb/s downstream and 50 Mb/s upstream under the best conditions. Verizon and AT&T are utilizing LTE yet it isn't boundless yet. Dash and accomplice Clear wire use Wi-Max. They call Wi-Max 4G yet by definition, Wi-Max is additionally 3G. Run and Clear wire have plans to change to LTE later on. Voice isn't conveyed by this technology. Rather, all voice calls are still by means of 2G GSM or cdma2000. In the end, the voice will be extended LTE however it isn't there yet. In spite of the utilization of totally extraordinary innovation, the 3GPP and ITU-T despite everything call LTE a 3G innovation.

➤ Why LTE is better than WiMax?

- WiMax suffers greatly from having been developed in the com-puter world. It's basically an outgrowth of Wi-Fi. The people involved don't have a good working understanding of the real-ities of operating a cellular network, so they made some funda-mental mistakes. WiMax will work fine for fixed networks, for example, providing last-mile connectivity to rural locations.
- LTE came out of the cellular world and avoided the mistakes of WiMAX. LTE will work fine for large networks, for example, for serving a mobile population in an urban or suburban set-ting. The multiple accesses, Scheduling, Power control, Frame delay are the key for LTE success over WiMax.

V. OUR PROPOSED FRAMEWORK

Right now, go over the individual pieces of our structure for the incorporation of clinical information. Fig. 2 shows the theoretical blueprint of our system. This system is made out of gadgets inside and outside of emergency clinics and clinical establishments, both work area and portable, and 4G fit gadgets. Initially, our system design is naturally self-produced without the requirement for client enter or even system support in the host application. Then requested data is sent to the end-user through a service layer, control layer, and transport layer. Meanwhile, the requested data is processed in the hospital information system layer using clinical multimedia software. Technology used, by type of device and User case device

- Camera
- PC
- GPS (Global Positioning System)
- PDA (Personal Digital Assistant)
- Phones: Smartphone, feature phone
- Radio
- Remote/portable diagnostic tool
- Biometric scanner
- User Case
- Software
- Voice (e.g. VoIP, hotline)
- Internet: e-mail, web site, instant messaging
- Messaging (e.g. SMS, MMS)
- Video conference

A. Overall Architecture Design

The overall architecture consists of a three-layer between the end-user and backend system. The end-user might be a doctor or a patient or a medical student. The backend system is the ultimate database system for the desired data of the end-user. Among the three-layer service, the layer will act as a middleware between the front-end and back-end system which must be placed in hospital premises. The control layer will be responsible for the traffic con-trol of the network. End-user requests and responses will be com-municated through the transport layer.

B. Hospital Information System

- Multimedia data storage: It contains Picture Archiving & Communication System (PACS), Multimedia archives.

PACS: A picture archiving and communication system (PACS) is a medical imaging technology that provides economical stor-age of, and convenient access to, images from multiple modal-ities [34].

Multimedia archives: Which contain audio, video, multimedia images for future use

- Clinical Multimedia Software: It collects image, text, audio-visual data & metadata using Digital Imaging and Communica-tions in Medicine (DICOM) & Health Level-7(HL-7).

- DICOM: DICOM (Digital Imaging and Communications in Medicine) is a standard for taking care of, putting away, printing, and transmitting data in clinical imaging. It incorporates a record position definition and a system interchanges convention. The correspondence convention is an application convention that utilizes TCP/IP to convey between frameworks. DICOM records can be traded between two elements that are equipped for accepting a picture and patient information in DICOM group [35].
- HL-7: HL-7 and its individuals give a system (and related principles) for the trade, combination, sharing, and recovery of electronic wellbeing data. HL-7 norms bolster clinical practice and the administration, conveyance, and assessment of wellbeing

administrations, and are perceived as the most regularly utilized on the planet [36].

HL-7 standards are assembled into reference classifications:

- Section 1: Primary Standards-Primary gauges are viewed as the most mainstream norms necessary for framework combinations, between operability, and consistence. Our most every now and again utilized and sought after principles are right now.
- Section 2: Foundational Standards-Foundational guidelines characterize the key devices and building squares used to assemble the principles and the innovation framework that implementers of HL7 models must oversee. Structures and rules for programming and gauges advancement.
- Section 3: Clinical and Administrative Domains-Messaging and archive benchmarks for clinical claims to fame and gatherings are found right now. These models are generally executed once essential measures for the association are set up.
- Section 4: EHR Profiles-These measures give utilitarian models and profiles that empower the builds for the administration of electronic wellbeing records.
- Section 5: Implementation Guides-This area is for execution guides as well as help reports made to be utilized related to a current standard. All records right now as supplemental material for a parent standard.
- Section 6: Rules and References-Technical determinations, programming
- Section 7: Education Awareness-Find HL7's Draft Standards for Trial Use (DSTUs) and current ventures here, just as accommodating assets and devices to additionally enhance comprehension and selection of HL7 benchmarks [36].

➤ Hospital Database: Emergency clinic Database contains Hospital Information System (HIS), Radiology Information System (RIS) and Billing.

- HIS: HIS can be made out of one or a couple of programming segments with claim to fame explicit augmentations just as of an enormous assortment of sub-frameworks in clinical fortes, as for example Lab Information System (LIS), Radiology Information System (RIS) or Picture documenting and correspondence framework (PACS) [37].
- RIS: A radiology data framework (RIS) is an automated database utilized by radiology offices to store, control, and circulate quiet radiological information and symbolism. The framework for the most part comprises of patient following and planning, result announcing and picture following capacities. RIS supplements HIS (Hospital Information Systems), and is basic to productive work process to radiology rehearses.

Radiology data frameworks normally bolster the accompanying highlights:

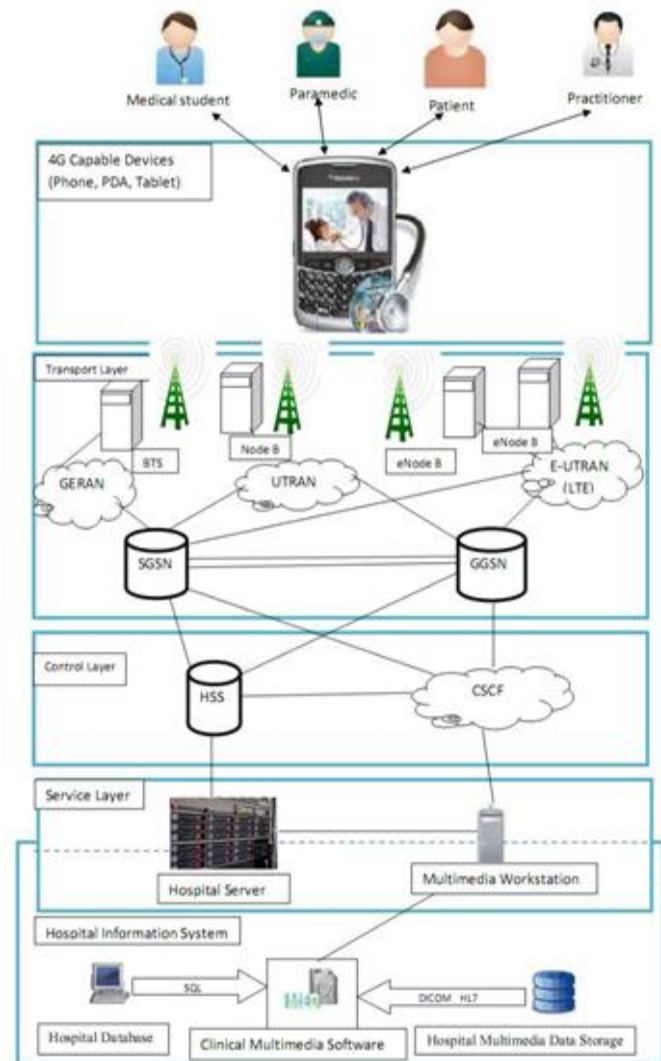


Fig 3:- Our Proposed Framework for M-Health using 4G Technology (LTE)

- ✓ Patient Registration and scheduling
- ✓ Patient List Management
- ✓ Interface with modality via Work list.
- ✓ Radiology Department workflow management
- ✓ Request and document scanning
- ✓ Result(s) Entry
- ✓ Reporting and printout
- ✓ Result(s) Delivery including faxing and e-mailing of clinical reports
- ✓ Patient Tracking
- ✓ Interactive Documents
- ✓ Technical Files Creation
- ✓ Modality and Material management.

In addition a RIS often supports the following:

- ✓ Appointment booking
 - ✓ PACS workflow
 - ✓ Custom report creation
 - ✓ HL7 interfaces with a PACS. HL7 also enables communication between HIS and RIS in addition to RIS and PACS.
 - ✓ Billing
 - ✓ Rule engines [38]
- Billing: An RIS facilitates detailed financial record-keeping, electronic payments and automated claims submission.

C. Service Layer

- Hospital server: hospital server is a platform for a variety of Omnicell software applications interfaced to hospital information system computers.
- Multimedia Terminal: Multimedia Terminal is a structure of modules and tools that is devoted to the design and variation of digital program content.

D. Control Layer

- HSS: Home Subscriber Server (HSS) is the access storehouse for endorser profiles, gadget profiles, and state data. As a compulsory control plane capacity in the Long Term Evolution (LTE) Evolved Packet Core (EPC), the HSS oversees endorser personalities, administration profiles, validation, approval, and Quality of Service (QoS) for LTE and IP media subsystem (IMS). Completely consistent with the Third Generation Partnership Project (3GPP) Release 8 standard, the HSS offers help for LTE interworking with non-3GPP systems and use the rich information of the executives abilities of Amdocs' Subscriber Data Broker™ to help endorser and gadget personality the board, administration profile the board, static/dynamic QoS the board, and state and usage following.
- CSCF: The Clinical Services Capability Framework for Public and Licensed Private Health Facilities adaptation 3 (CSCF v3.0) has been created because of a complete survey of form 2.0. The obligation regarding actualizing, checking, conforming to and telling changes in administration levels in general wellbeing offices [39].

E. Transport Layer

- SGSN: A SGSN (Serving GPRS Support Node) is liable for the transport of data packages from and to the versatile stations inside its geological help district. Its assignments fuse group guiding and move, convey ability the administrators (add/pull back and area the board), wise association the board, and affirmation and charging limits. The territory register of the SGSN stores zone information (e.g., current cell, current VLR) and customer virtuoso records of all GPRS customers enrolled with this SGSN [40].

- GERAN: GERAN is a truncation for GSM EDGE Radio Access Network. The models for GERAN are kept up by the 3GPP (Third Generation Partnership Project). GERAN is a key bit of GSM, and moreover of united UMTS/GSM systems. GERAN is the radio bit of GSM/EDGE together with the framework that joins the base stations and the base station controllers. The framework talks significantly of a GSM mastermind, through which calls and group data are guided from and to the PSTN and Internet to and from supporter handsets. A mobile phone director's framework incorporates at any rate one GERANs, joined with UTRANs by virtue of an UMTS/GSM organize. A GERAN without EDGE is a GRAN yet is regardless indistinguishable in thought. A GERAN without GSM is an ERAN [41].
- UTRAN: UTRAN, short for Universal Terrestrial Radio Access Network, is a total term for the Node B's and Radio Network Controllers (RNCs) which make up the UMTS radio access arrange. This trades arrange, by and large insinuated as 3G (for third Generation Wireless Mobile Communication Technology), can pass on many traffic types from continuous Circuit Switched to IP based Packet Switched. The UTRAN grants accessibility between the client hardware and the middle framework.

The UTRAN holds the base stations, which are called Node Bs, and Radio Network Controllers (RNC). The RNC gives control functionalities to at least one Node Bs. A Node B and a RNC can be a comparable contraption, but regular executions have an alternate RNC arranged in a central office serving different Node Bs. Notwithstanding the way that they don't should be truly secluded, there is a canny interface between them known as the Iub interface. The RNC and its looking at Node Bs are known as the Radio Network Sub-framework (RNS). There can be more than one RNS present in an UTRAN. Four interfaces partner the UTRAN inside or remotely to other valuable components: Iu interface, Uu interface, Iub interface and International Union of Radioecology (IuR). The Iu interface is an external interface that associates the RNC to the Core Network (CN). The Uu interface is moreover outside, partner Node B with the User Equipment (UE). In addition, at last, there is the Iur interface which is an inside interface usually yet can, particularly be an external interface too for some framework models. The Iur interfaces two RNCs with each other [42].

- GGSN. The Gateway GPRS Support Node (GGSN) is a principle segment of the GPRS organize. The GGSN is responsible for the interworking between the GPRS organize and external parcel exchanged systems, similar to the Internet and X.25 systems. From the outside systems' perspective, the GGSN is a switch to a sub organize, in light of the fact that the GGSN 'stows away' the GPRS infrastructure from the outer system. At the point when the GGSN gets information advertisement dressed to a particular client, it checks if the client is dynamic. In the event that it is, the GGSN advances the information to the SGSN serving the versatile client,

however on the off chance that the portable client is latent, the information are disposed of.

To do this, the GGSN tracks dynamic portable clients and the SGSN the versatile clients are connected to. It dispenses IP delivers to versatile clients and to wrap things up, the GGSN is liable for the charging [43].

- **E-UTRAN:** E-UTRAN is the air interface of 3GPP's Long Term Evolution (LTE) redesign way for portable systems. It is the shortening for developed UMTS Terrestrial Radio Access Network, additionally alluded to as the 3GPP work thing on the Long Term Evolution (LTE) known as the Evolved Universal Terrestrial Radio Access (E-UTRA) in early drafts of the 3GPP LTE particular [44]. It is a radio access organize standard intended to be a substitution of the UMTS, HSDPA and HSUPA innovations determined in 3GPP discharges 5 and be-yond. Dissimilar to HSPA, LTE's E-UTRA is a completely new air interface framework, random to and incongruent with W-CDMA. It gives higher information rates, lower inactivity and is streamlined for parcel information. It utilizes OFDMA radio-access for the downlink and SC-FDMA on the uplink.

F. 4G Capable Devices

4G telephones and systems use LTE for its 4G organize. LTE is currently one of the best 4G in the land and can give download speeds that are quicker than your home Internet association. Dash, then again, was the main bearer to enter the 4G game with Wi-Max, and still uses that standard. Wi-Max can lap 3G, however it's not as quick as LTE.

VI. RESULTS

The functionality and capabilities of our framework that means of a simulation study and the communication procedure detailed in the next section.

A. Simulation

A reproduction analyze was directed to assess the intelligent convenience and overhead expenses of our system, under the normal system conditions for typical use in a clinical domain. Our reenactment was designed according to a radio-logical work process.

B. Communication Procedure

In our framework, a user (medical students, paramedic, patient, and practitioner) can take healthcare by 4G capable devices through LTE or 4G network. At first, a user sends a request through a hand-held device to the transport layer. Depending on the handheld de-vices a reliable connection is set up with the transport layer. The GGSN keeps a record of active mobile users and the SGSN the mobile users are attached to. Then the transport layer sends the user request in the control layer. The control verified the requested user. Then the validated user request is received by the service layer.

The main function is performed in this layer. The service layer contains Instant Messaging server, Group Management server, and presence server and also multimedia workstation which is a system of components and equipment that is dedicated to the creation and modification of digital multimedia content. After all, the requested information is processed by the clinical multimedia software and send to the requested users.

C. Future Challenges of the LTE of M-Health

The idea of 4G health as characterized right now be one of the key center territories for future m-health exploration and undertaking exercises in the coming years. This development of m-health requires a reasonable worldwide arrangement and structure on how these frameworks will function and capacity in various nations and human services frameworks all around. In any case, a few difficulties and issues should be tended to promote on this issue. A portion of these are condensed as follows:

- **Public awareness of the M-Health system.** The 4G advancements possibly move a portion of the m-health administrations to a customized level, joined with social correspondence and an agreeable duty approach that can change the specialist tolerant information process extra towards the patient-doctor procedure in some human services conveyance administrations. In any case, clear legislative guidelines and changes should be examined inside this procedure.
- **Security and privacy challenges.** In our framework, we did not mention any security issues. It is a big challenge for our frame-work to provide privacy and ensure security for the purpose of using the M-Health system and emphasis on network security.
- **Future versatile advancements past 4G and future systems.** The exploration is as of now in progress to propose the cutting edge past the 4G versatile advances and future portable systems (5G). Future research issues incorporate multidisciplinary regions, for example, plan, social, strategy, and brain science notwithstanding the mechanical and clinical zones. Besides, new rising ideas, for example, "clinical quality if administration m-QoS" and "clinical nature of experience-m-QoE" will be a hot field of research zone inside the coming years, particularly from the future correspondences and system innovations viewpoint.

VII. CONCLUSION

In this context, we have been presented an innovative and new framework for M-Health services by using 4G LTE technology, which significantly welfares from the enhanced network capabil-ities of LTE wireless technologies, by enabling a wide range of Omni-cell software. Our proposed architecture can capable of allowing medical data applications to conduct data with mobile own-ers over a wireless network. In the future, the presented architecture requires to be appended more parameters for upgrading technology in enhancing more services and evaluate the performances in vari-ous aspects of the presented architecture as well.

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