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A Life Saving Cloud Computing Architecture for Mobility of Sufferings

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Abstract: ***We have presented here a newly designed system with cloud computing approach is a solution for remote districts, villages in hilarious regions where mobile network exists. It can provide better solution for the patients admitted in a hospital or primary health center. The developing countries are still fighting with less number of doctors in those areas and sometime in town or big cities are also searching for certain specialist medical practitioners opinion. Existing system in major parts are based on manual paper work and independent standalone applications in some districts'/ small towns' hospitals and primary health centers which results in waste of resources, high construction and maintenance costs and difficult to manage and maintain. The main objective of proposing cloud based solution is to reduce the cost (construction and maintenance), to reduce data loss risk, to gather all the hospitals on one platform to better access patients' medical information for easy management and maintenance. The proposed cloud computing solution is intended to be used by hospitals and primary health centers of third world countries; however the solution is generic and can be used by hospitals of any country and the community based hospitals. This approach also saves a massive amount of paper works and be able to save trees to fulfill one step ahead to the greener world. In future the proposed system will have a huge impact on saving human life and we will feel goodness by dedicating this system for humankind.***

Keywords:Cloud Computing, Hospital Information System (HIS), Patient, Smartphone, Laptop, Desktop.

I. INTRODUCTION

The biggest invention of recent times in twenty first century is cloud computing [1], which made us computer savvy and keeps the feeling that the world is in our palm. The ultra modern city life gave us immense confidence about gathering information of the whole universe from any part of the world in a few seconds. We can use this computer technology with high speed internet connection to save someone's life too. The use of cloud computing in several areas in multinational companies prove huge benefits in terms of monetary as well as where service matters. A network supported operating system can be used in the server of the communicating hospital where UNIX operating system will be used for security reasons. Generally those hospitals are eligible are using Hospital Information System (HIS) software. The individual hospitals must be equipped with their own server, an application server on which the whole database will store. The application server will be able to communicate with laptops or smart phones used by doctors. The application server may communicate with cloud server through mobile connectivity towers. Thus the information can be shared among the world. The expert advice, better medicine can be taken for the patient admitted even in a remote area. According to World Health Organization (WHO) report [2] there are 1.5 million deaths in Tuberculosis (TB) is second only to HIV/AIDS as the greatest killer worldwide due to a single infectious agent. In 2012, malaria caused an estimated 627 000 deaths (with an uncertainty range of 473 000 to 789 000), whereas TB and Malaria both are preventable and curable disease. Unfortunately big amount of the death reported is unavailability of doctors/medical advisors which are curable. Our proposed system will increase the mobility of healthcare professionals in the whole world. This paper describes several diagrams and figures to make others understand about our proposed system for mankind.

II. CLOUD COMPUTING

Mobile Cloud Computing (MCC) would be the best solution for future trends where shortage of medical practitioners throughout the world. Cloud services are internet-service-oriented computing concept, where Hardware, Software and data are shared. The proper definition may be "Share and use of applications and resources of a network environment to get work done without concern about ownership and management of the resources and applications"- (M-S. E Scale, 2009) [3]. It is also a combination of preexisting technology, which gives some services. The two different models used in cloud computing are Deployment model and Service model. The service models are of three types Software as a Service (SaaS), Platform as a Service (PaaS), and Cloud Infrastructure as a Service (IaaS) as described in Figure 2. They follow NIST **(**National Institute of Standards and Technology) model [4]. We will concentrate on the IaaS part for our proposed system.
The essential characteristics of cloud computing are On-demand services, Broad network access, Resource pooling, rapid elasticity, measured service, self provisioned, pay per use (lower cost), scalability, ease of utilization, quality of

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service, reliability, outsourcing, simplified maintenance and upgrade, low barrier to energy etc. Figure 1 shows actual cloud system architecture communicating with mobile devices as well as servers along with virtual machines.

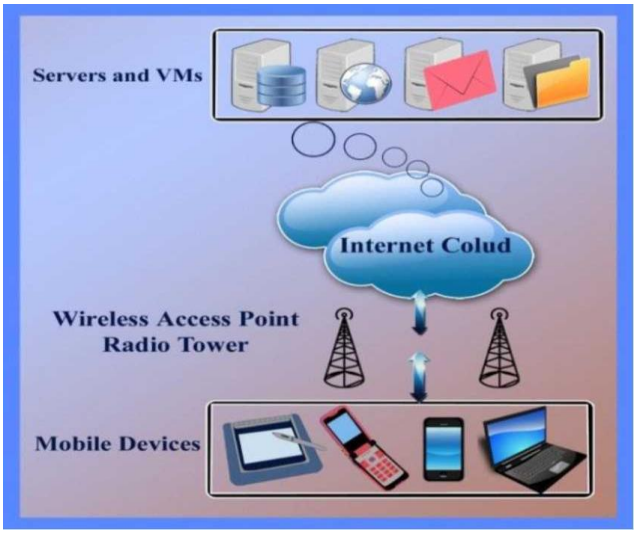

Fig. 1. Cloud System Architecture.

"Mobile Cloud Computing (MCC) at its simplest refers to an infrastructure where both the data storage and the data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and mobile computing to not just Smartphone users but a much broader range of mobile subscribers" [5][6].

For sake of our proposed system cloud Infrastructure as a Service (IaaS) will be used to store the data provided by the application server. As the system uses cloud services, it does not depend on geographical locations. To reduce cost the cloud infrastructure including fujitsu server must be placed in a country where electricity cost is lowest [7].

The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g. host firewalls) [8].

III. HOSPITAL INFORMATION SYSTEM

Hospital Information System (HIS) is a centralized database [9] application generally more like an MIS system. User management, staff management, appointment management doctor with patient, patient registration, laboratory management, medical information management, safety system with different parameters are different segments in general HIS [10]. Pharmacy management ambulance system, health insurance is also play a big role in modern HIS. There is a centralized HIS server placed in between all the parts described in the figure 2. The HIS connects through internet system with cloud server in both ways.

Fig. 2. Basic Hospital Information System (HIS) software Segments.

IV. FUJITSU SERVER

Fujitsu server system prototype we are using in the cloud because of high geared speed and flexibility measured so far in simultaneous application.

Here system performance is measured in every pico second. The next generation server is using Resource pool architecture [11][12]. Pooling or arranging of µ-processors, hard disk drives (HDDs) are done for high performance, high utilization and serviceability [13][14]. Fujitsu cloud services which provide a fully flexible model for IT infrastructure, platforms and applications, allowing companies to match technology systems and costs directly to changing business needs [15].

V. THE PROPOSED SYSTEM

The system need the cloud services (IaaS), where the UNIX server with HIS is being installed. Desktop computer connected with video camera and LAN enabled with application server is needed. Besides laptops, Smartphone's using wi-fi and 3G/4G enabled network connectivity is best for the system. They communicate the server cloud through mobile tower. The problems and solutions to achieve the goal using our system both will be discussed. The system has two parts as cloud computing and mobile computing Basic structure for the proposed system is as follows:

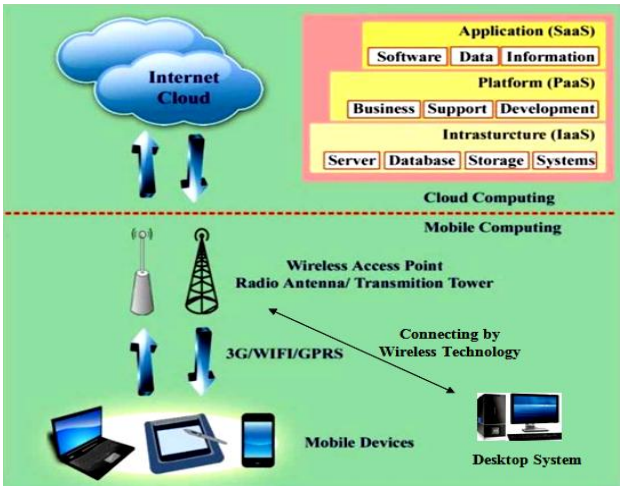

Fig. 3. Proposed System Architecture (Basic).

The above diagram (Figure 3) tells us about the basic idea about the Desktop system (connecting by wireless technology), Laptop, Tabs, Smartphones connecting with application server using mobile cloud computing technique. Virtual machines at clouds provided at cloud systems with the help of wireless communication system like mobile tower. There are lots of intermediate devices and protocols are there, we will discuss them later on this paper.

VI. PROBLEM WITH CURRENT SYSTEM

The biggest crisis with the existing system is that either they use standalone computer system; sometimes is connected with privately owned LAN with HIS or they maintain everything on papers only. This creates a big trouble like data loss and storing patient data elsewhere in the computer system. Retrieval of data in proper order is a difficult issue. Now on actual challenge is faced by the patient when they go for better treatments for other specialized hospital because the independent system cannot provide the every minute data due to data sharing [16]. Independent HIS needs huge space to store patient's data which is other term is wastage of money. The up gradation, maintenance of HIS is also serious issue for the hospitals. Time and service utilization of doctors is inefficient in the existing system.

VII. SOLUTION WITH OUR PROPOSED SYSTEM

The solution is diverse for distinguished systems but the main essence is the same for all. Remote places in country side or hilarious regions or less connected regions generally fights with few numbers of doctors or specialists can get the benefits from our system. The system sends the patient's data to the clouds and a specialized doctor can treat them from their office, home or in travelling anywhere sitting idle by using laptop, desktop, smartphone or tablets with high speed data connectivity. Data in cloud can store in private or public cloud as per need shown in figure 5. A real-time [17] approach for patient management is trying to achieve here. We have categorized three different categories of hospitals like:

a. Hospitals with manual system.
b. Hospitals with computerized system.
c. Hospitals with HIS system.

A. HOSPITALS WITH MANUAL SYSTEM

The hospitals with manual system can best use a router to communicate with cloud server and all the dumb terminals and a high speed internet connection. Terminals with very less cost for the nurse or other staff of the hospital put data to the server computer. In this case the dumb terminals are well connected with the server. Very less hard disk space is needed to store and maintain the internal data. Server is directly connected with the router with different firewalls and other protection strategies to avoid misuse of resources. All other doctors using personal laptops or smart-phone may connect with the server [18]. Now the entire patient data will directly stored in cloud, similarly other migrated patients' data can be accessed through it. Best patient monitoring system includes a digital camera with the server. Data storage in this case obviously in clouds because the video data size is too large to store in a single PC.

B. HOSPITALS WITH COMPUTERIZED SYSTEM

In the same way we can do it for the systems followed by the hospitals with computerized system. This type of system replaces the dumb terminals with desktop PC if already existed. Otherwise purchasing of dumb terminals instead of PC will include additional expenses. The patient's data must be stored in clouds through the server and router as discussed above. We must need to ensure about the LAN connections with the server exists or not. The audio, video, text, image data with several formats for the patient can be uploaded and downloaded both ways as per need with same or different hospitals.

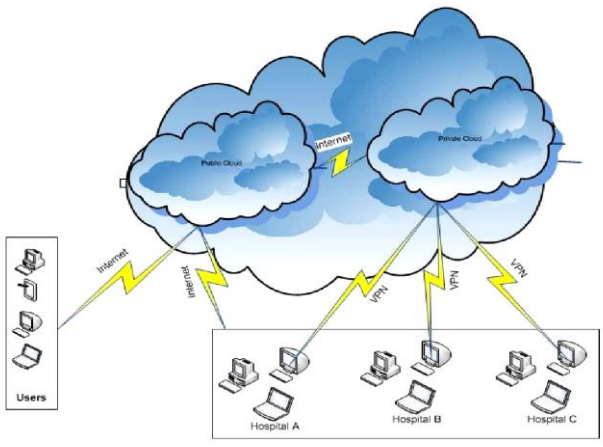

Fig. 5. Thought about proposed system.

C. HOSPITALS WITH HIS SYSTEM

Even the hospitals well equipped through HIS had wasted a lot of money on it can use. The main problem it can face if it uses distributed database which is exceptional or in case of centralized HIS database the format may differ with the cloud database. Rarely if there is distributed database is used in HIS then a mammoth effort is needed for converting it into centralized or store data in clouds in cloud servers' specified format. The centralized format of data in HIS must support the cloud structure to store and receive data.

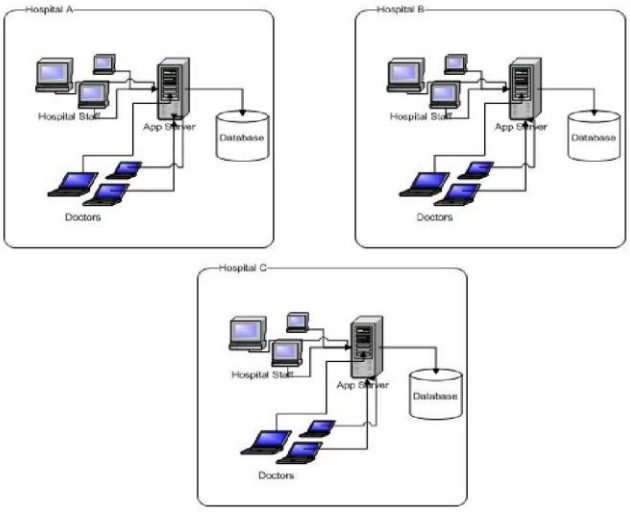

Fig. 4. Individual HIS system.

It is being assumed that video data format is already defined in HIS. Now the HIS database must be able to send and receive data amid cloud server in the company of router by using internet connection.

Figure 4 shows the individual HIS system as we assume hospital staffs uses desktop PC, doctors may use laptops. All of them are connecting through an application server. The server is backed by a database with patient records. MCC in medical applications is used to minimize the limitations of traditional medical treatment [e.g., small physical storage, security and privacy, and medical errors (D. Kopec *et al*, 2013)]. Mobile healthcare (m-healthcare) offersmobile users with appropriate help to access resources easily. m-Healthcare provides healthcare organizations a diversity of on-demand services on clouds rather than standalone applications on local servers [19].

VIII. COMMUNICATION STRATEGY

The communication strategy is the smartest in comparison to existing system. Though it uses all existing technologies in a better way to find out the solution. Here it is given some important parts of it.

A. HARDWARE APPROACH

The data transfer initiates at the desktop PC's used by the hospital staffs including nurses. The wired devices in each hospital obtain data from desktops among wired LAN, laptop by means of WLAN. After edge routers, the packet gets routed to the core routers behind the internet backbone and then to the data centers. The power consumption of switches has been excluded as this has not relevance with our topic. In most cases there will be only a few number of them and their power consumption in insignificant when considered [20]. Figure 6 shows the proposed architecture of advanced system to use Wireless and wired routers directly connected to the internet gateway designed by ubuntu linux for security purpose. Linux has secured by three tier security parameters like userid/password, encryption/decryption and r-w-x (read-write-execute) permissions. Now gateway is directly connected to an ADSL modem which provides data in binary format.

B. THE APPLICATION FRAMEWORK

The application framework the proposed system includes IEEE 802.11 standard for WLAN which uses Enhanced Data GSM Environment (EDGE). We use EDGE protocol that is several times faster (around 236 Kbit/sor more) than the primeval General Packet Radio Services (GPRS) speed at about 56Kbit/s based on wireless fidelity.

The digital transmission method includes 3G cell phone network protocols like Universal Mobile Telecommunication Service (UMTS), Wideband Code-Division Multiple Access (WCDMA), High-Speed Downlink Packet Access (HSDPA) [21], and Evolution Data Maximized (EV-DO) with Data and voice (EV-DV) too. These technologies provide a maximum data transfer speeds of up to 3 Mbps. it is easy to browse full-fledged Web pages, watch streaming video, images, digital reports of different medical tests & much more. IP connectivity of this technology is packet based.

A district town or village is divided into several cells; each cell is typically sized at about 10 square miles (26 square kilometers) i.e. the range of one mobile tower. Cells are normally thought of as hexagons on a big hexagonal grid. Each cell has a base station that consists of a tower and a small building containing the radio equipment. Base stations are often called masts, towers or cell-sites; they follow the concept of mesh topology..

C. DATA TRANSMISSION

The data transmission of a Smartphone is between 0.6 watts to 3 watts; which is lesser than Citizen Band Radios. The two non-adjacent cells can reuse the same frequency. They fulfill the two requirements, first the frequency will remain within the cell and secondly the saving of phone batteries.

All Base Station (BS) within a cluster (A group of adjacent cells) are connected to a Mobile Switching Centre (MSC) using land lines. Each MSC of a cluster is then connected tothe MSC of other clusters and a Public Switched Telephone Network (PSTN) main switching centre. The MSC stores information about the subscribers located within the cluster and is responsible for directing calls to them.

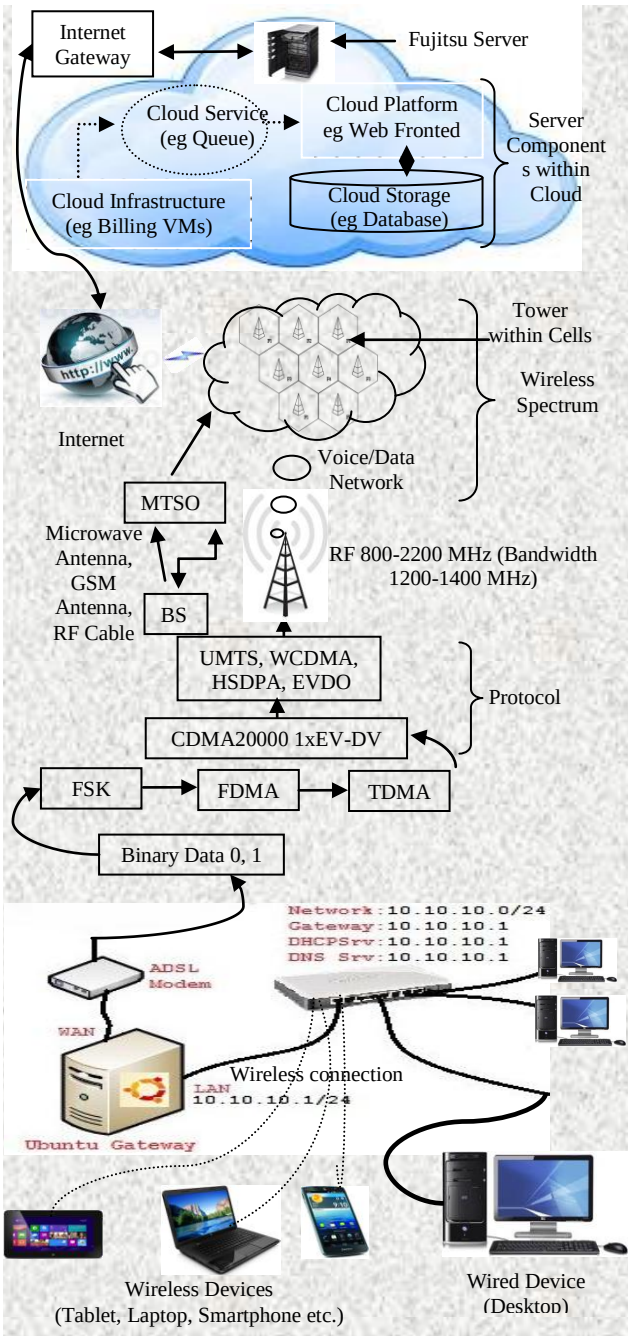

Fig. 6. Advanced System Architecture (proposed).

Each carrier in each city also runs one central office called the Mobile Telephone Switching Office (MTSO). This office handles all of the phone connections to the normal land-based phone system, and controls all of the base stations in the region. The Components of the base station include transceivers, which enable the transmission and reception of radio signals through the antennas, plus signal amplifiers, combiners, and a system controller.

Laptop, Desktop, Smartphone deals on digital data (the voice, image, video are converted into binary i.e. 0 and 1.)Frequency Shift Keying(FSK) uses two frequencies, one for 1s and the other for 0s, alternating rapidly between the two to send digital information between the cell tower and the phone. Frequency Division Multiple Access (FDMA) puts all the binary data (including voice) on a separate frequency. The frequency of cell phones, cordless phones, and cell phone tower signals ranges between 800 and 2200 MHz. The frequency it considers is Radio Frequency.

Cell phone technology combines the two great technologies named traditional telephone and old radio technology [22].

The wireless spectrum which is a limited resource used by cell phones can communicate on 1,664 channels or more. In addition, cell phones Time Division Multiple Access (TDMA) use a dual band. It assigns each call a certain portion of time on a designated frequency. This means that it can operate in between 800 MHz to 1900 MHz (or around 2.2 GHz) bands. Clearly the bandwidth, a cell phone uses is 1100-1200 MHz.

Code Division Multiple Accesses (CDMA) [23] gives a unique code to each call and spread it over the available frequencies. Here we will use CDMA2000, which is of three types namely CDMA2000 1x, CDMA2000 1xEV-DO (First Evolution Data Optimized) and CDMA2000 1xEV-DV (First Evolution Data and Voice). For our case it better to use CDMA2000 1xEV-DV where the forward link it supports is 3.08 Mbps and a reverse link nearly 1 Mbps [24]. The Cloud Radio Access Network (RAN) will be use by the proposed system as also for fault tolerance [25].

CONCLUSION

Implementation of the real system will start a revolution in developing countries where death rate with curable diseases is touching sky level. The fastest fujitsu server should install in cloud server to get the maximum benefit out of it. The proposed system will be beneficial for the cloud computing service providers like Amazon web services, Rackspace, CenturyLink/Savvis, Salesforce.com, Verizon/Terremark, Joyent, Microsoft, Google, IBM, Sales force etc. It will increase their business volume and quality of service. This theoretical approach can be making a practical one if we get proper guidance and funding for welfare of humankind.

LIMITATION

The proposed system needs high speed internet connectivity, which is another cons found in Android based phones; failure of this could stop the desktop, Laptop and Apps in a Smartphone. The 4G technology is also available and that can provide the better result.

REFERENCES

[1] Santanu Koley, Navjot Singh (2014) “Cdroid: Used In Fujitsu Server For Mobile Cloud” GE-INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH, Vol. 2, Issue 7, ISSN: (2321-1717), PP 1-6.

[2] http://www.who.int/mediacentre/factsheets/fs104/en/
[3] Sandeep B Kallur, Gayatri Mugli, Vani Priyadarshini and Swapna Kulkarni (2012) "Applications of cloud computing technology in mobile communication engineering" World Journal of Science and Technology 2012, 2(10):204-208, ISSN: 2231 – 2587, pp 1.
[4] Peter Mell, Timothy Grance (2011) "The NIST Definition of Cloud Computing", Computer Security Division Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899-8930, NIST special publication 800: 145, pp 6-7.
[5] http://www.mobilecloudcomputingforum .com.
[6] Hoang T. Dinh, Chonho Lee, Dusit Niyato, and Ping Wang (2013) "A Survey of Mobile Cloud Computing:Architecture, Applications, and Approaches", Accepted in Wireless Communications and Mobile Computing – Wiley, pp 2.
[7] M.Rajendra Prasad, Jayadev Gyani, P.R.K.Murti (2012) "Mobile Cloud Computing: Implications and Challenges" Journal of Information Engineering and Applications Vol 2, No.7, ISSN 2224-5782 (print) ISSN 2225-506 (online), pp 13.
[8] Pragya Gupta, Sudha Gupta (2012) "Mobile Cloud Computing: The Future of Cloud" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 1, Issue 3, ISSN 2278 – 8875, pp 134-145.
[9] Asabe, S. A., Oye, N. D., Monday Goji (2013) "Hospital patient database management system a case study of general hospital north-bank makurdi- nigeria", COMPUSOFT, An international journal of advanced computer technology, 2 (3), Vol. II, Issue III, ISSN:2320-0790, pp 65-72 .
[10] Noor Fadzlina Mohd Fadhil, Mariana Jusop, Dr. Abdul Aziz Abdullah (2012) "Hospital information system (his) implementation in a public hospital: a case study from malaysia", Far East Journal of Psychology and Business Vol. 8 No. 3, www.fareastjournals.com, pp1-11.
[11] http://www.fujitsu.com/global/news/pr/archives/ month/2011/20110926-01.html.
[12] David Chernicoff (2011) "Five Nines: The Next Gen Datacenter "http:// www.zdnet.com/blog/ datace-nter/fujitsu-prototypes-resource-pool-architect ure-cloud-servers/1036.
[13] Dingding Li, Xiaofei Liao, Hai Jin, Bingbing Zhou, Qi Zhang (2012) "A New Disk I/O Model of Virtualized Cloud Environment", IEEE Transactions on Paralle and Distributed Systems (TPDS). 24(6): 1129-1138 (2013) pp 10.
[14] http://www.techopedia.com/definition/29545/re source-pooling.
[15] Ian Mitchell, Stephen Isherwood, Marc Silvester (2011) "The whitebook of cloud adoption", Fujitsu Services Ltd, ISBN: 978-0-9568216-0-7, pp 57.
[16] Adeel Akbar Memon, Muhammad Rashid Naeem, Muhammad Tahir, Muhammad Aamir, and Atif Ali Wagan, "A New Cloud Computing Solution for Government Hospitals to Better Access Patients' Medical Information." *American Journal of Systems and Software*, vol. 2, no. 3 (2014): 56-59. doi: 10.12691/ajss-2-3-1.
[17] Atluri Venkata Gopi Krishna, Cheerla Sreevardhan, S. Karun, S.Pranava Kumar (2013) "NFC-based Hospital Real-time Patient Management System" International Journal of Engineering Trends and Technology, Vol. 4, Issue 4, ISSN: 2231- 5381 http://www.ijettjournal.org, pp 626-629.
[18] Santanu Koley, Shivnath Ghosh (2014) "CDroid in Fujitsu Server for Mobile Cloud", Data Analytics and Business Intelligence: Emerging Paradigms, pp 80.
[19] Debabrata Sarddar Rajesh Bose (2014) "A Mobile Cloud Computing Architecture with Easy Resource Sharing" International Journal of Current Engineering and Technology Vol.4, No.3, E-ISSN 2277 - 4106, P-ISSN 2347 - 5161 ©2014 INPRESSCO®, pp 1249-1254.
[20] Milindkumar H. Tandel, Vijay S. Venkitachalam (2012) "Cloud Computing in Smartphone: Is offloading a better-bet?" >CS837-F12-MW-04A, pp 2-4.
[21] K. Kumaravel (2011) "Comparative Study of 3G and 4G in Mobile Technology" IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 3, ISSN (Online): 1694-0814, pp 257.
[22] Fact Sheet (2004) "Cell Phone Towers and Cell Phones" Connecticut Department of Public Health Environmental and Occupational Health Assessment, pp 2.
[23] Harte, Hoeing, McLaughlin, Kta (1999) "CDMA IS-95 for cellular and PCs", McGraw-Hill, ISBN: 0070270708.
[24] Hsiao-Hwa Chen, Mohsen Guizani (2006)"Next Generation Wireless Systems and Networks" ISBN-13 978-0-470-470-02434-8(HB) Wiley, pp 123.
[25] Soongohn Kim, Eungnam Ko (2014) "An Adaptive Fault Tolerance Running on a Cloud Computing Environment", International Journal of Multimedia and Ubiquitous Engineering Vol.9, No.5, ISSN: 1975-0080 IJMUE, Copyright ⓒ 2014 SERSC, pp.355-362.

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