International Journal of Emerging Technology and Innovative Engineering
Volume 2, Issue 5, May 2016 (ISSN: 2394 – 6598)
Date of Publication:31.05.2016

DESIGN OF AN INTEROPERABLE WIDE AREA NETWORK FOR NATIONAL HEALTH INSURANCE SCHEME CARE DELIVERY IN GHANA

KUMASSAH. F.
Department of Electrical/ Electronics Engineering
Takoradi Polytechnic
Ghana
franklin.kumassah@tpoly.edu.gh

COBBINA. S.M.
Department of Electrical/ Electronics Engineering
Takoradi Polytechnic
Ghana
stephen.cobbina@tpoly.edu.gh

OTCHERE. P.
Department of Electrical/ Electronics Engineering
Takoradi Polytechnic
Ghana
peter.otchere@tpoly.edu.gh

ABSTRACT

In this study, the purpose was to basically increase public access to healthcare, improve healthcare quality and delivery, and enhance scheme efficiency through the design of an interoperable wide area network (WAN) platform for National Health Insurance Scheme (NHIS) care delivery in Ghana. In order to address the challenges confronting the scheme, the National Health Insurance Authority (NHIA) took some steps to streamline the operations of the National Health Insurance Scheme (NHIS) at both scheme and provider levels, yet there is more room for improvement. Some level of Information and Communication Technology (ICT) has been deployed into the scheme's operations nationwide to enhance its efficiency but the ICT uptake level is inadequate to address the problems confronting the Scheme. It was observed that the Ghanaian NHIS has not been able to integrate telemedicine into the mainstream healthcare delivery and a huge (ICT) deficit has been created in the scheme due to underinvestment in ICT. Conclusively, the NHIS has not been able to solve completely the pressing challenges such as poor healthcare service quality and delay in access to healthcare that fraught the erstwhile 'cash-and-carry' system, in spite of the number of successes the scheme has chalked over the years. An effective way of solving the problems bedevilling the NHIS is to operate a fully portable and sustainable NHIS fully supported and driven by a robust, secure and interoperable wide area network ICT platform. The designed WAN ICT platform is robust, secure and interoperable and affords the opportunity to improve healthcare access and quality and enhance scheme efficiency. ICT solutions are not a panacea to the problems facing the scheme. For a better improvement and transformation of the NHIS, ICT solutions should be pursued in tandem with key management reforms or business process re-engineering. Therefore, there is the need for the scheme to integrate telemedicine into the mainstream healthcare delivery to

achieve more cost savings. Also, service providers must have their ICT set-up in place at the point of care in order to facilitate NHIS card portability.

Keywords:

Wide area network (WAN), interoperable, ICT solutions, healthcare, quality, access,

1. INTRODUCTION

Disease and ill-health are recognised as barriers to economic growth all over the world. But these barriers seem to be more prevalent in developing countries including Ghana. Good health boosts labour productivity, educational attainment and income and so reduces poverty. A country's economic development is closely interrelated with the health status of its population and efficient and equitable health care system is therefore an important instrument in breaking the vicious circle of poverty and ill-health.

National Health Service (NHS) was initially set up to cater for the health needs of Ghanaians. NHS was fully financed by the state. The advantage of this system was that, it was progressive (high income individuals paid higher taxes than low income people). It also provided service for everybody at no costs, so it protected the poor from financial shocks. It did not involve user fees at Service Delivery Points (SDPs) or point of care. The disadvantages, however, were very clear, in that the medical services provided were indeed of low quality and it was biased toward the urban populace and neglected the rural poor.

In 1971, the government of Ghana introduced user fees to patients for hospital procedures [1]. Initially, the fees were small but the principle was established. By the early 1980s, Ghana was experiencing balance of payments crisis and consequently adopted the economic structural adjustment policies, including the introduction of cost recovery initiatives in the social sectors. Hospital fees legislation was introduced in 1985, and the 'cash-and-carry' (C&C)) system for health care to patients throughout the government health facilities (hospitals) was subsequently introduced [2]. Under the 'cash-and-carry' system, patients were asked to pay for full cost of medication and care. This initiative was based on the idea that charging for healthcare service would help finance and therefore improve the delivery of primary healthcare services. Furthermore, there was the presumption that cost recovery would help reduce unnecessary visits by patients who will abuse the system because it was free. There is empirical evidence that shows that, with the introduction of user fees there was a decrease in service utilization especially among the poor who were domiciled in the rural areas. However, there is not any strong evidence that significant amount of money were generated by the introduction of user fees which helped in improving health facilities. The name "cash-and-

carry" has also been a big part of the problem since it gives an unfeeling sense. It should have been "cost recovery".

The poor were simply priced out of hospital care and a two-tier care system came into operation with better facilities for those who could afford to pay. Once again, women and children bore the brunt of such harsh policies. People resorted to self-treatment and patronize traditional healers, itinerant drug sellers or pharmacy shops because of convenience, availability, rapid service, and absence of consultation fees and sometimes credit. The activities of these care givers were not properly regulated and therefore exposed their patients to dangers such as drug abuse, misdiagnosis, and contraction of diseases (e.g. AIDs) or even death.

Under the C&C system, an official policy exempting certain categories of clients – pauper, the elderly, under five's and antenatal mothers from paying for healthcare services was enacted at the beginning of 1998 [2]. Previous studies have shown that Ministry of Health (MOH) employees were often the largest beneficiary group from the exemption mechanism. The slow pace of exemption reimbursement of health facilities was even a greater problem.

It is against this backdrop that in 2003, the government of Ghana rekindled the need for social equity to be a key part of healthcare policy in Ghana [3]. This policy is to increase public access to healthcare, improve healthcare quality and delivery and lastly, improve and increase programmes of education on curative and preventive healthcare. As part of efforts to achieve the foregoing goal the government of Ghana established the National Health Insurance Authority (NHIA) and its subsidiary, the National Health Insurance Scheme (NHIS) in the year 2004. This study therefore seeks to design an interoperable wide area network (WAN) to increase public access to healthcare, improve healthcare quality, and enhance scheme efficiency.

2. PROBLEM STATEMENT

NHIA/NHIS was introduced in order to eliminate the problems 'cash-and-carry' brought. Though, some successes have been chalked such as providing affordable healthcare to the Ghanaian populace, there are still problems and challenges to be dealt with. Some of these problems and challenges are peculiar to the scheme. There remains frequent duplication of effort and manual processes and procedures abound in the scheme's operations, and opportunities for economies of scale are lost which are manifested in the healthcare delivery value chain, registration and renewal of NHIS subscribers, and processing of client claims [4]. These manual processes and procedures tend to waste resources such as the limited funds available, human efforts, time, stationeries, etc. and attract costs. Because most of these processes are not computerized and ICT-enabled, access to health care often gets delayed and hampered. These unnecessary delays particularly at the healthcare centres affect adversely the quality and delivery of healthcare. To address the foregoing problems, the Authority

has taken some steps to streamline the operations of the NHIS at both scheme and provider levels, yet there is more room for improvement. Some level of ICT has been deployed into the scheme's operations nationwide to enhance its efficiency but the ICT uptake level is inadequate to address the problems. There are a number of challenges facing the deployed NHIA/NHIS ICT platform. The link or connectivity drops during bad weather and also very slow during peak hours [5]. There are frequent power outages leading to temporary halt in NHIS clients processing for consultations. This leads to unnecessary delays in processing for consultation and subsequently claims processing. The existing NHIS ICT platform is with no or less interoperability within the scheme's value chain and scheme processes are fragmented. It is for the reason of solving the challenges facing the existing NHIA/NHIS ICT platform that the research seeks to design a more robust, secure and interoperable WAN ICT platform for the scheme.

3. OVERVIEW OF THE NHIS IN GHANA

Deployment of ICT into the scheme's operations is ongoing and rolled out in phases. Phase A (Schemes Applications) deals with configuration and rolling-out of schemes and providers software whereas phase B&C (NHIA Applications) involves the configuration and implementation of finance, payroll, accreditation, scheme registration and procurement systems. However, the ICT platform is not at the optimum level yet [6]. To address the ICT deficit in the scheme, the government has to increase the scheme's budgetary allocation.

3.1 ICT's Role in Healthcare Infrastructure

In recent years, the government has placed much emphasis on the restructuring of the healthcare infrastructure in order to keep up with the rate of technology advancement. Nevertheless, it is mainly because the government recognizes the immense potential of ICT in the healthcare field, not just applications in medical field, but also administrative uses that can greatly improve the efficiency of its services. In respect to healthcare providers, it would mean fewer visits to hospitals, reduction in healthcare cost to make medical care more affordable. Another trend is identified, in which there is a greater need than ever for connectivity and inter-operability; enabling data integration in hospitals to increase efficiency and reduce errors. Gradually, we can observe that healthcare systems are moving from Proprietary to Open Systems, and ICT plays a critical role in this [7]. Currently, many technologies are implemented in hospitals to meet the needs and demands of patients and also to improve general healthcare standards. The potential benefits of a diverse range of ICT innovations include providing healthcare practitioners with access to timely and accurate information and complementing their decision-making process with clinical decision support system, personalized healthcare, improvements in traditional health information systems; computer-aided diagnosis and treatment monitoring; a range of applications generically labelled 'telemedicine'; and the use of ICT to inform

general populations on health and healthcare, improving the performance of existing systems, allowing scope for radical innovations, or even changing basic assumptions about the provider–patient relationship.

3.2. ICT Solutions in Healthcare Industry

There are a number of ICT solutions available in the healthcare industry globally which are collectively known as electronic health applications (e-medicine or e-Health) or tele-medication which involves administering healthcare or treatment at a distance. The possible ICT solutions should be able to facilitate and integrate diverse business and clinical communication throughout the continuum of care in order to fulfil the following requirements [8]:

1. Communication needs for clinicians, patients, administrators, and partners.
2. Regulatory requirements for patient privacy and data security.
3. The unique information, technology, bandwidth, and integration challenges of healthcare.
4. Anytime, anywhere information capture and access for wired and wireless applications and devices.
5. Converged data, voice, and video networks.
6. Identity and policy-based security from inside the network to beyond organizational walls.
7. Transfer and storage of the large amounts of data created by healthcare applications.

3.3 Technical Architecture

Independent organizations usually have different architectures. For these independent organizations to provide service that cuts across regional and national boundaries to customers they need to cooperate in an inter-organizational network; and each organisation is involved in providing the service. This cooperation results in the creation of a complicated network as the participating organizations have different and heterogeneous types of systems that cannot be easily connected to each other. The network platform should be scalable, robust, interoperable, and secure, as the performance is dependent on the quality of network resources and adaptive to be able to change to changing circumstances. The network infrastructure provides the facilities enabling communication and can include basic services as authentication of users and billing services for the use of the network. The network infrastructure is often standardized and shared among parties, which enables connectivity and interoperability. Future services and entities can be added onto the network as and when the need arises. Often this inter-organizational network results in a heterogeneous environment consisting of assortment of software, hardware, and other network elements. The network elements which are based on outdated technology and can often not easily be accessed are designated as legacy systems [9].

The provision of new services requires a technical architecture that can integrate with the legacy systems found in the various departments and organizations to enable the reuse of data and functionality. Most systems architecture has to deal with heterogeneous information systems landscape, therefore in designing and developing new network architecture, it is very important to analyze the already existing systems and new ones to see how appropriate interfaces to these systems can be made and at what cost. Therefore the technical architecture or network for a healthcare industry needs to be robust, secure and interoperable to enhance system efficiency. The research therefore seeks to look at aspects of an effective wide area network ICT with which the Ghanaian NHIS can conduct operations.

3.4. Service Oriented Architectures (SOAs)

Service Oriented Architectures (SOAs) define how computing entities can interact in such a way that one entity can perform a unit of work on behalf of another entity. [10]. It is developed to support improved interoperability and to add flexibility to the design and deployment of the distributed applications that can be found in an inter-organizational network. SOAs are not technology-specific and have no specific description language. However, a number of technologies that support the web services protocol stack are often viewed as the defacto standards for SOA. SOA facilitates the use of legacy systems and new applications and network resources to integrate business processes. The interoperable feature of SOAs helps to minimize the time and cost of deploying new applications and network components. Openness and flexibility offered by SOAs enable new applications and components to be added and removed from the architecture without affecting other applications or components. As per the functionality and characteristics of the SOAs, it is prudent for clinical networks to have such traits of SOAs. Basically, the two main strategies for developing information systems are namely: "frameworks" and 'best-of-breed' [10].

3.5 Structural Principles and General Protocol Functions of Communication Architectures

Communication architectures are, in general, characterized by a layered set of protocols that define a functional decomposition of the overall communications task [11]. Of course, there are several possibilities of specifying the borderlines (interfaces) between the layers. Architectures provide the basis for a common understanding of the communication processes in a heterogeneous environment. This is the prerequisite for providing a precise definition of network services and protocols and creates a vendor-neutral reference world. The structuring principle used with most communication architectures involves modelling the behaviour of cooperating entities by specifying interaction interfaces at the boundaries of the entities. The architectural model originates from the fact that this principle is applied in three ways.

(1) The system interface defines the discrete systems between which communication is to take place. It differentiates between the end system, transit system, and

transmission medium. A transit system can be a computer or a computer network, which means that system interfaces can be defined more than once depending on the need for the abstraction.

(2) The specification of service interfaces breaks down communication processes functionality into (delegatable) sub-processes, ultimately leading to the creation of functional layers. The layering is designed so that functions that resemble each other are allocated to the same layer and independent sub-processes to different layers. Built in flexibility allows layers to be implemented on different hardware components or through the use of different techniques. Service interfaces also define virtual communication machines, which service providers exploit to offer their communication services to entities of the next highest layer at service access points (SAPs). Communication between the layers within a system, takes place over service primitives (i.e. service requests) at service access points. Service interfaces therefore produce "vertical" communication within a system.

(3) The protocol interface defines how a service specified by a service interface can be provided by the entities of a layer that are located in physically dispersed systems. The communication rules and data formats required are defined in layer protocols that control the layer connections in partner entities.

Entities (processes, programmes, stations) in the same layer in different systems are able to communicate with one another ("horizontal" communication) if they use the same layer protocol. If the underlying communication hierarchies are not compatible, then appropriate mapping functions are required between the protocol hierarchies of the different systems. The different standardization (e.g. ISO, internet) and proprietary (e.g. SNA) communication architectures used in practice differ from one another in a number of layers, therefore protocol mapping between the architectures using gateways is usually necessary when these systems are supposed to work together.

3.6 Healthcare System User Interface

Lack of good user interfaces has been a major impediment to the acceptance and routine use of health-care professional workstations [12]. Health-care providers, and the environment in which they practice, place strenuous demands on the interface. User interfaces must be designed with greater consideration of the requirements, cognitive capabilities, and limitations of the end-user. The challenge of gaining better acceptance and achieving widespread use of clinical information systems will be accentuated as the variety and complexity of multi-media presentation increases. Better understanding of issues related to cognitive processes involved in human-computer interactions is needed in order to design interfaces that are more intuitive and more acceptable to health-care professionals. Critical areas which deserve immediate attention

include: improvement of pen-based technology, development of knowledge-based techniques that support contextual presentation, and development of new strategies and metrics to evaluate user interfaces. Only with deliberate attention to the user interface, can improvement be made in the ways in which information technology contributes to the efficiency and effectiveness of health-care providers.

3.7 Network Management

Clinical networks represent a step change in ways of organizing services and managers face special challenges in making them work. Since new professional and organizational networks will have a major impact on the future quality of health and social care and on the experiences of users and carers, better understanding of the management of networks is vital for the development of intelligent management practice and policy. Recently, attention has focused on the development of clinical networks that concentrate on the creation of new linkages between secondary and tertiary care. Networks are increasingly being drawn into mainstream policy and decision-making discussions, particularly in developing countries where 'managed clinical networks' are being piloted across both specialties (such as neurology) and diseases (such as diabetes and cancer). Clinical networks allow for a continuous working relationship between organizations and individuals to improve the treatment of patients who require care across a range of different institutions by, for example: making more efficient use of staff, reducing professional and organizational boundaries, sharing good practice, putting the patient at the centre of care and improving access to care. Generally, clinical networks are not organized in any uniform pattern. They vary across a range of key dimensions. Different network forms appear, designed to achieve different tasks and require different management approaches. Three key, active network types exist, namely: enclave networks, hierarchical networks and individualistic networks [13].

3.8 Security Management

Among the priorities of healthcare organizations, protecting patient information is second only to protecting patient health. A breach in security could put healthcare organizations out of compliance with government and industry regulations and could also be quite costly in terms of both remediation and organization's reputation. The constant flow of patient information between doctors, hospitals, insurance schemes, pharmacies, and everyone in between only makes protecting it more complicated. Information, IT infrastructures, services, and production represent values that are exposed to threats of attack or improper use. Security measures that reflect the results of threat analyses or security risk analysis are needed to prevent damage and loss. The transforming and interoperable healthcare system requires utilization of effective security systems. The simple and proven Information Security Management System that supports this evolution is described in ISO 27002 Security Policy [14].

4. METHODOLOGY

4.1 Block Diagram Design

Microsoft word was used to design the block diagram. In designing the block diagram, simple rectangular and square boxes were chosen to represent the various components used in the design. The design concept of the WAN ICT set-up for NHIS is depicted in Fig 1.

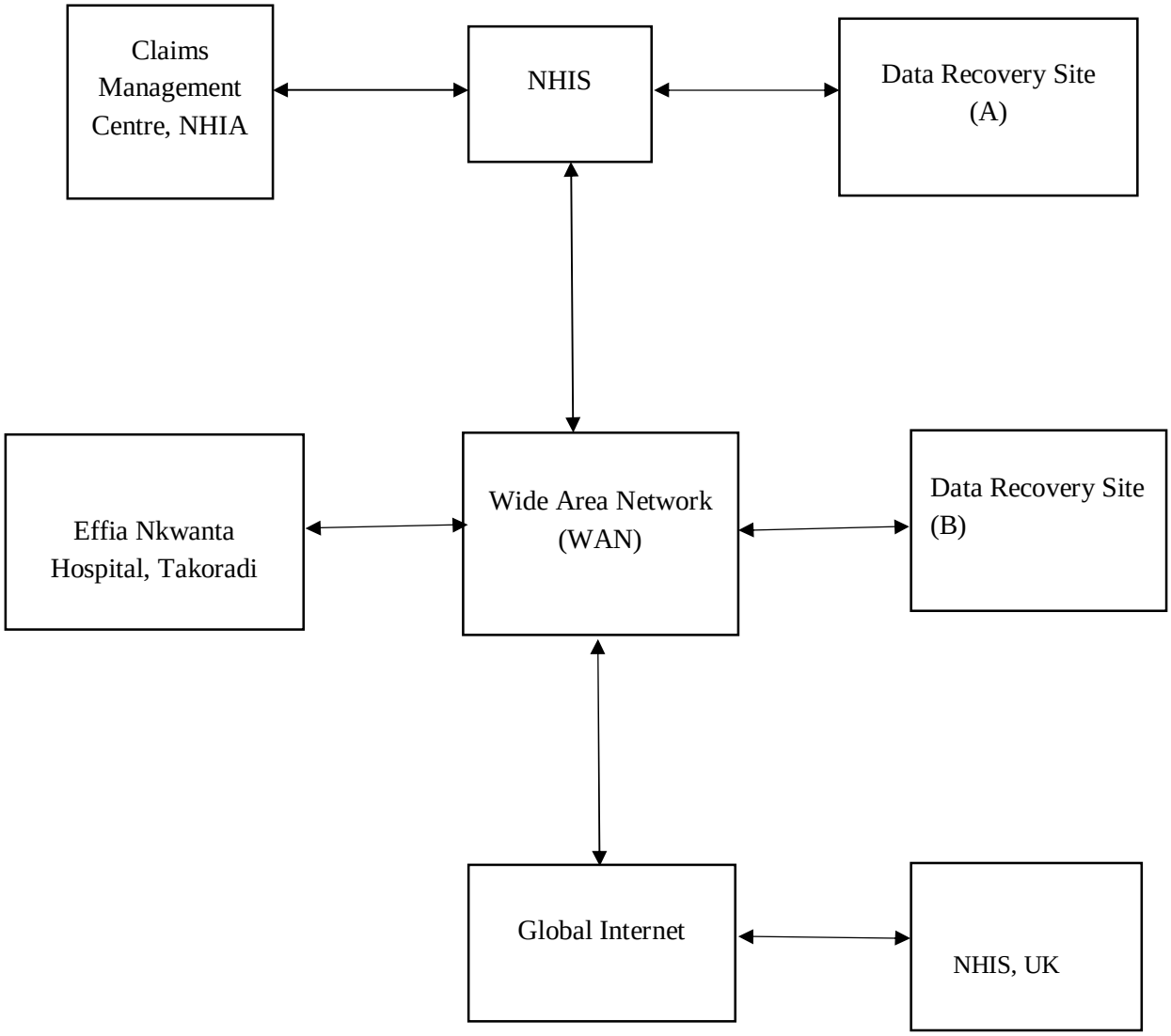


Fig. 1 Block Diagram of an Interoperable WAN for NHIS in Ghana

4.2 Design of an Interoperable WAN for NHIS in Ghana

Visio software was used to design the WAN ICT platform for the NHIS. The designed WAN ICT platform for NHIA/NHIS as shown in Fig. 2 is an advanced point-to-multipoint (PMP) wireless platform which offers broadband wireless access, deliver fibre-optic quality data and voice services for high-speed IP data and Internet applications and Carrier Class services at upstream and downstream rates of up to 34Mbps per sector.

The platform is built to provide last-mile solutions for scheme stakeholders such as the NHIA/NHIS, healthcare centres, diagnostic centres, pharmacy shops, etc. and ensures exceptional traffic handling capacity together with quality-class services providing fast, consistent and reliable data and voice services to health insurance schemes and providers using the platform.

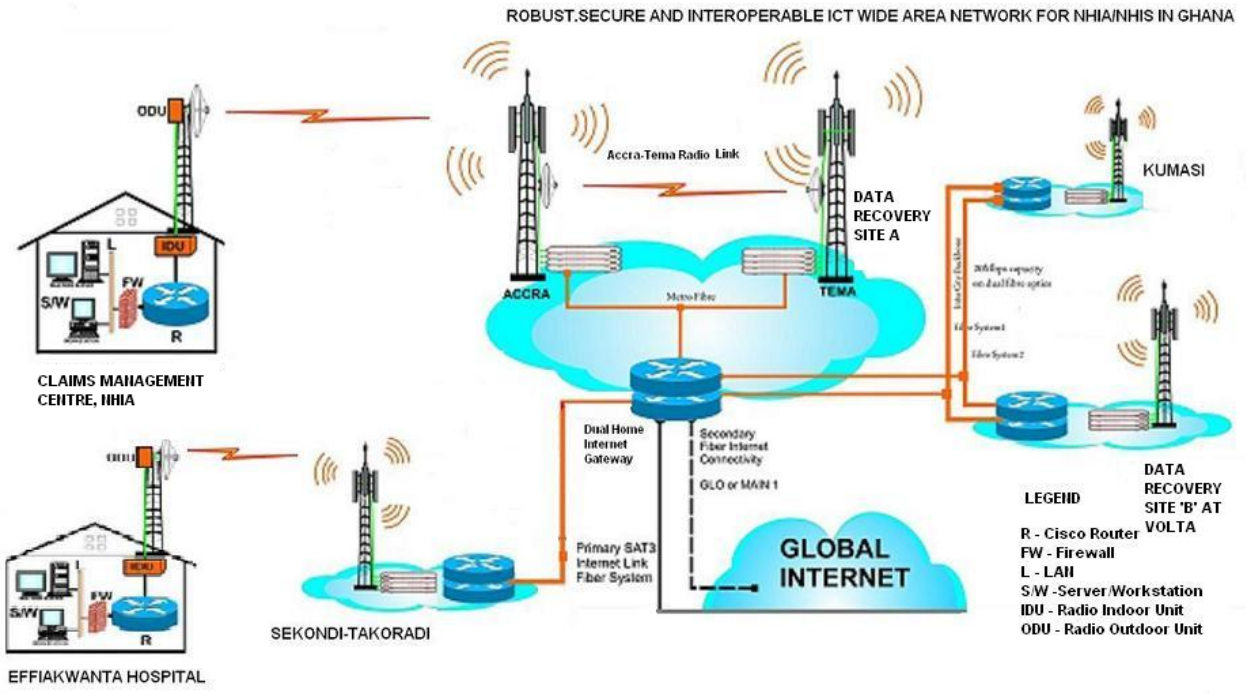


Fig. 2 Interoperable WAN ICT Platform for NHIA/NHIS in Ghana

The client/provider end installation components comprise of an indoor and outdoor unit. A terminal station (TS) is installed at the customer/client premises and interacts between the customer/client premises equipment (CPE) router and the designated base station (BS). The Terminal Station-Indoor Unit (TS-IDU) interfaces between the CPE router and the Terminal Station Radio Frequency Unit/Antenna (Outdoor Unit),using the TDMA protocol to handle traffic to and from the base station. The TS-IDU is connected to the Radio Outdoor Unit (ODU) via a coaxial cable, and can be easily mounted in a rack or on the wall, or fit conveniently on a desk. Once the Intermediate Frequency (IF) signal reaches the Radio Frequency Unit (RFU), it is converted to Radio Frequency (RF). The terminal station IDU is equipped with 1 x 10/100 BaseT interface providing diverse data and voice services and their required Quality of Service (QoS) and Condition of Service (CoS). Each TS-IDU comes with a Local Craft Interface (LCI) port to be used by the local craft terminal for installation and maintenance purposes. The terminal station is powered either by a DC standard source (48V) or an AC source to the indoor unit.

Each of the base stations of the WAN ICT platform is located at the centre of the cell linking Terminal Stations at Client premises via radio links. The base station microwave antennas operate on a licensed frequency of 10.5 GHz. Data and Voice traffic originating from Client/Provider Networks to the WAN ICT platform are backhauled onto a high speed Metro fibre backbone with a point-to-point microwave backup to:

- The DS3 (48Mbps) Internet backbone in the case of Internet Services or
- The claims management centre in the case of Wide Area Network Services.

The digital signal 3 (DS3) Internet backbone consist of two core routers, connected in a Dual homing fashion, handling a primary and secondary DS3 fibre system from two submarine fibre optic based service providers. This is meant to achieve a near 100% service uptime. The NHIA/NHIS WAN ICT platform is an excellent IP infrastructure for WAN services. Using VPN boxes at each of the client/provider offices to be connected to the central office (NHIA), WAN links are activated over the ICT platform via the 100Mbps metro and intercity fibre backbone linking all the base stations nationwide.

The Consolidated Claims Management Centre is a critical segment of the NHIA/NHIS WAN ICT platform which is set up at the Authority. It is designed to have a greater capacity to handle huge data traffic, monitor healthcare processes in real-time and processes claims electronically for quick payment. This centre helps to detect and prevent or reduce systematic abuse or fraud.

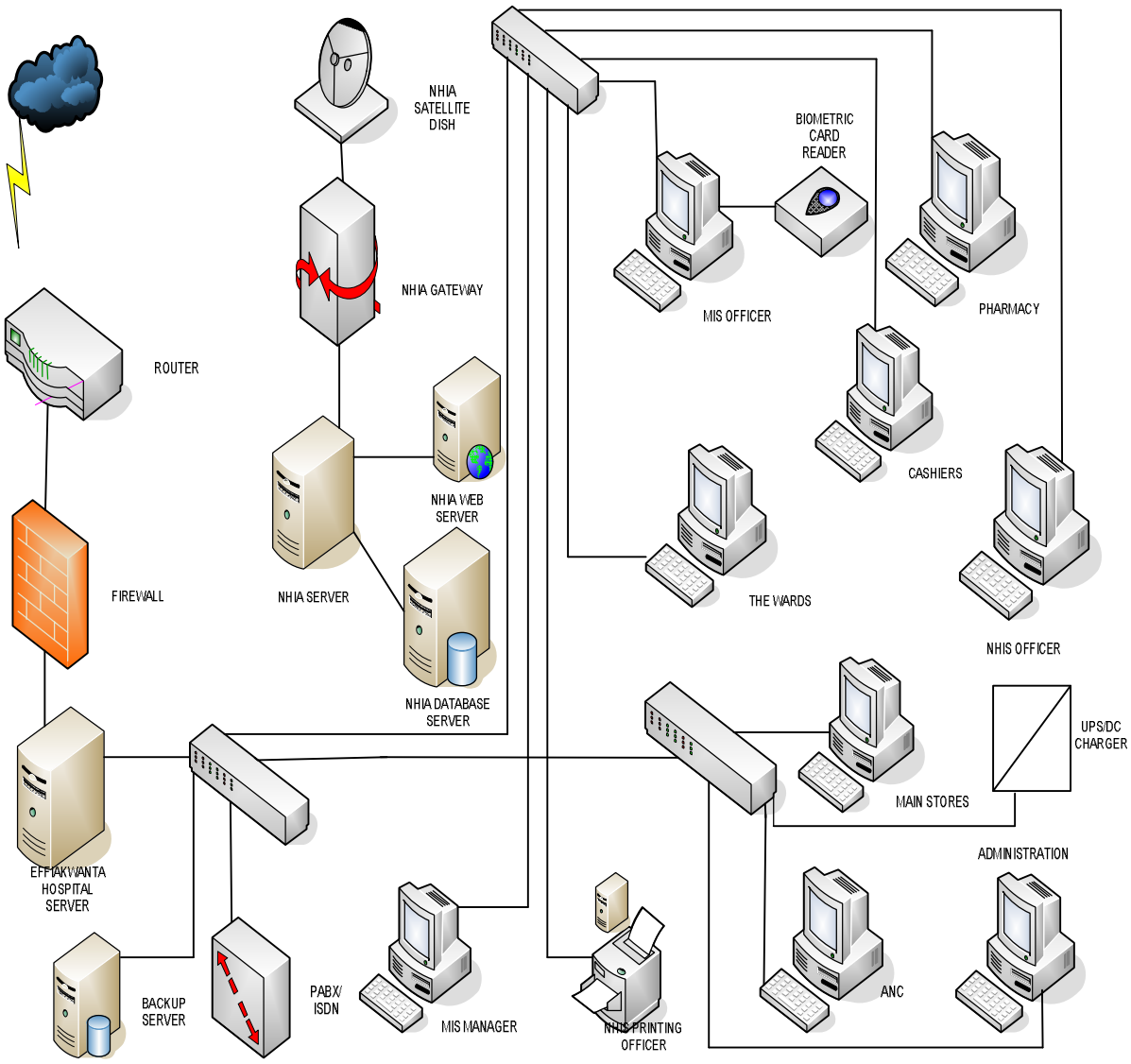
Data loss can occur due to systems or network components failure and even unexpected natural disaster. The best defence against data loss is having in place redundant and real-time backups. Lost data can be recovered through the use of data recovery tools (software and hardware). Loss of data can be prevented through the installation of advanced network backup systems such as redundant array of inexpensive (independent) disks (RAID) arrays, NAS servers, storage arrays and more. However, sometimes the RAID arrays fail; servers crash and the data centres suffer unexpected disasters. This loss of data is not just an inconvenience; it halts the scheme's operations and cost the scheme thousands, if not millions of Ghana cedis. Hence, there is the need for a standby quick response team to intervene to restore data quickly, securely and accurately, no matter how complex storage systems may be. Even this response team could be deployed on-site around the clock for mission-critical disaster recovery solutions. Data loss recovery is what Data Recovery Sites 'A' and 'B' at Tema and Volta respectively in the Designed NHIA/NHIS WAN ICT platform seek to achieve.

The network equipment requires a stable power supply. Therefore, an automatic voltage regulator (AVR) generator is used to accurately control voltage to the network equipment. The AVR generator keeps the output more constant with no surges or brown-outs regardless of the load. The AVR generator ensures an uninterruptible power supply to the network components and automatically detects when power is going off and switches power supply to a battery. Most of

the network equipment operate on a 12V or 48V DC.

4.3 Design of Effiankwanta (Sekondi-Takoradi) Regional Hospital ICT Set-Up

Visio software was used to design the ICT WAN for Effiakwanta Hospital in the Takoradi District of the NHIS. Fig. 3 depicts the design of Effiankwanta (Sekondi-Takoradi) regional hospital ICT setup



.

Fig. 3 Design of Effiankwanta (Sekondi-Takoradi) Regional Hospital ICT Set-up

In each District Mutual Health Insurance Scheme (DMHIS), there is an MIS officer who compiles subscribers' membership information (i.e. bio-data, sponsorship details, etc.), updates data and forwards it to respective project managers. Data then moves across several hierarchies for data checks, quality control and approval before the DMHIS ICT set-up captures the membership information into the national/centralized database/web. At hospital consultations, an NHIS subscriber/client sets the initial data by biometric authentication of his/her eligibility. This initiative

by the subscriber/client allows the various actors/players in the subscriber's healthcare value chain have access to his/her health data or records. After the consultations, drugs and services rendered to the patient/client are captured into the NHIS database by filling in or selecting from options provided by the database oracle software. This software displays options like 'Type of Disease', 'Type of Diagnosis', Price of Treatment and Drugs', etc. and requests the healthcare administrator to select from the options the one that commensurate with the hospital transaction. The client/patient validates the hospital transaction biometrically before leaving the healthcare facility. The pharmacy dispenses the drugs and the patient goes home in the case of an out-patient care. For in-patient care the validation takes place at the time the patient is discharged from the healthcare facility. The NHIA/NHIS ICT set-up monitors the healthcare processes in real-time and immediately captures the treatment and transaction data (e.g. claims) for processing and subsequent payment.

5. RESULTS AND DISCUSSIONS

The research identifies the design and implementation of a robust, secure and interoperable wide area network (WAN) ICT platform as paramount solution to the problems of inadequate access to healthcare, low healthcare quality and duplications of duties in the NHIS. The designed WAN affords the opportunity to improve access and quality of healthcare delivery in Ghana, improve claims administration through a centralized claims management, facilitate portability, harmonize the operations of the scheme and providers and improve the scheme's operational delivery. In order to achieve the foregoing, the ICT network needs to be robust to be able to handle huge data traffic. The designed WAN has substantial throughput and enhanced security features to be able to meet the demands of the NHIS. Also, patients' health information security is of critical concern in healthcare delivery, therefore networks designed to carry this information should have the necessary security features to be able to protect and preserve the data's integrity. The healthcare industry is one of the most rapid advancing sectors, hence its sector networks should have the interoperability functionality in order to contain or connect to future networks. Thus the designed WAN has the interoperable functionality to connect to other service providers and telemedicine services worldwide.

The Ghanaian NHIS has not been able to integrate telemedicine into its mainstream healthcare delivery. In order to increase access and quality of healthcare the Ghanaian NHIS has to emulate best industry (health) practices that have delivered well-documented results in other jurisdiction through eradicating human errors that can lead to dire clinical consequences. Telemedicine consists of a series of technologies that enable care services to be provided remotely. Telemedicine and other care-at-a-distance technologies can enable the sharing of information in the form of records, images, and audio. Telemedicine can be applied in scenarios where the physical presence of a healthcare professional is restricted, by distance or time.

Whether it is for analysis, diagnosis, consultation or treatment, telemedicine represents a convenient way for patients to gain access to medical skills in a suitable and timely manner. Home health monitoring has contributed to the reduction of unnecessary visits and clinician appointments as well as the identification of potentially serious situations that would require attention of a clinician. A number of key technologies have been identified as proven catalysts to significant healthcare improvement, efficiently and effectively meeting the increasing demands of stakeholders in the healthcare environment, patients, professionals and funders in other jurisdictions.

NHIS has not been able to solve completely the pressing challenges such as poor healthcare service quality and delay in access to healthcare that fraught the erstwhile 'cash-and-carry' system, in spite of the number of successes the scheme has chalked over the years. An effective way of solving the problems bedevilling the NHIS is to operate a fully portable and sustainable NHIS fully supported and driven by a robust, secure and interoperable wide area network ICT platform. The designed WAN ICT platform is robust, secure and interoperable and affords the opportunity to improve healthcare access and quality and enhance scheme efficiency.

ICT solutions are not a panacea to the problems facing the scheme. Scheme operations can only be transformed or improved when ICT solutions are combined with key management reforms or business process re-engineering. In addition effective government's policy and health insurance legislation should be put in place to inject probity and accountability into the operational dynamics of the scheme. Thirdly, enough investment in ICT should be made for optimum diffusion of ICT solutions throughout the scheme.

7. CONCLUSIONS

In this study, the purpose was to basically increase public access to healthcare, improve healthcare quality and delivery, and enhance scheme efficiency through an interoperable WAN ICT platform for National Health Insurance Scheme (NHIS) in Ghana. In order to address the challenges confronting the scheme, the National Health Insurance Authority took some steps to streamline the operations of the NHIS at both scheme and provider levels, yet there is more room for improvement. Some level of ICT has been deployed into the scheme's operations nationwide to enhance its efficiency but the ICT uptake level is inadequate to address the problems confronting the Scheme. The Ghanaian NHIS has not been able to integrate telemedicine into the mainstream healthcare delivery and a huge ICT deficit has been created in the scheme due to underinvestment in ICT.

Conclusively, the NHIS has not been able to solve completely the pressing challenges such as poor healthcare service quality and delay in access to healthcare that fraught the erstwhile 'cash-and-carry' system, in spite of the number of successes the scheme has chalked over the years.

An effective way of solving the problems bedevilling the NHIS is to operate a fully portable and sustainable NHIS fully supported and driven by a robust, secure and interoperable wide area network ICT platform. The designed WAN ICT platform is robust, secure and interoperable and affords the opportunity to improve healthcare access and quality and enhance scheme efficiency. For a better improvement and transformation of the NHIS, ICT solutions should be pursued in tandem with key management reforms or business process re-engineering. Therefore, there is the need for the scheme to integrate telemedicine into the mainstream healthcare delivery to achieve more cost savings. Also, service providers must have their ICT set-up in place at the point of care in order to facilitate NHIS card portability.

8. REFERENCES

[1] Ossei, N. Y. (2008). National Health Insurance Scheme: Healthcare for all. Retrieved from: http://ghanaweb.info/GhanaHomePage/features/artikel.php?ID=138893 [Accessed on 11/4/ 2016].

[2] Huff-Rousell, M. and Azeez, J. K. (2002). Ghana Pharmaceutical Pricing in the Public Sector. Retrieved from: http://pdf.usaid.gov/pdf_docs/PNACR170.pdf, [Accessed on 10/4/2016].

[3] NHIA.(2016). NHIS. Retrieved from: http://www.nhis.gov.gh/?CategoryID=159&ArticleID=91 [Accessed on 11/4/ 2016].

[4] Yeboah, L.A.(2010 November 18). Government Urged to Address NHIS Challenges, Daily Graphic 37:5.

[5] Apau, W. P., Lecture, Harnessing ICT for timely submission of NHIS claims, Assin Fosu, 11th October 2010, ST. Francis Xavier Hospital.

[6] Kusi, B. Lecture, NHIA ICT presentation, 17th September 2009, At stakeholder meeting.

[7] Abagna, T., Lecture, Use of the NHIA/NHIS ICT platform, Cape-coast, 16th September2009, Elmina Beach Resort.

[8] Health ICT Industry Group. (2009). ICT's Role in Healthcare Transformation. Retrieved from: http://www.hisi.ie/media/Report_of_the_Health_ICT_Industry_Group_November_2009.pdf, [Accessed on 30/4/2016].

[9] Hegering, H.G., Abeck, S. and Neumar, B. (1999). Integrated Management of Networked Systems, Morgan Kaufmann, Inc., San Francisco, California, pp. 6-16, 40-56, 94-95, 205, 297, 424-453, 562-564.

[10] Van de Kar, E.A.M and Verbraeck, A. (2008). Designing Mobile Systems, 2nd edition, IOS Press, Amsterdam, The Netherlands, pp. 57-77.

[11] Tanenbaum, A.S. (2003). Computer Networks, 4th edition, Pearson Education, Inc., Upper Saddle River, New Jersey, pp. 16-25.

[12] Tang, P.C., and Patelc, V.L. (1994). Major issues in user interface design for health professional work stations. Retrieved from: http://www.journals.elsevierhealth.com/periodicals/ijbold/article/0020-7101(94)90017-5/abstract, [Accessed on 7/3/2016].

[13] Goodwin, N. et al. (2004). Network Management. Retrieved from: http://www.sdo.nihr.ac.uk/files/adhoc/39-briefing-paper.pdf, [Accessed on 6/4/2016].

[14] Hupkens, P., Lecture, Organizational aspects of network, HAN University of Applied Science-Kumasi Campus, 6th November 2009, Council chamber of Kumasi Polytechnic.