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AUTOMATED TELECOM NETWORK INFORMATION SYSTEM A CASE STUDY OF GLO MOBILE GHANA LIMITED

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ABSTRACT

This paper focuses on the development of Automated Telecom Network Information System (ATNIS), a case study of Glo Mobile Ghana Limited, Ghana.

Network information system is the management of network data for business intelligence purposes. Because the data needs to be processed and shared among different users in a networking environment, this can be made possible with the use of transmission media such as fiber optics cable.

Over the years, fiber optics cable as a transmission media has been seen as one of the striking answers to the growing data transfer rate in telecommunication industry. There has been a tremendous increase in usage of fiber optics cable in transferring data from source to destination. The fundamental reasons are due to its numerous benefits such as greater bandwidth as compared to copper and coaxial cables, ease of design and installation, data security and high immunity and reliability.

The ATNIS will assist management in facilitating decision making processes, provide faster and consistent information which will enable management to make changes in the network elements when the need arises, increase customer satisfaction and provide security of data as well as avoid data redundancy.

KEYWORDS: BSC, BTS, RNC, NodeB, HLR, MSC

I. INTRODUCTION

Telecommunication is the process or an act of communication using a telephone or network equipment. The process involves a sender, a receiver and a transmission media such as fiber cable. Telecommunication network is the linking of network elements using transmission media to transport voice of data either in a short or long distance.

The Automated Telecom Network Information System (ATNIS) is a system which will enhance faster data collection, processing, storing, retrieving, transmitting and displaying of information using fiber cable as the transmission media.

Different types of data transmission media have been used in telecommunication industry for many years now and the main goal is to enhance transmission reliability, boost the data transfer rate in order to send more data both in the short or long distances.

In sending information over transmission media, the information is modulated to an electromagnetic wave form which act as a carrier for the signal. The modulated signal is transmitted to the appropriate destination and at the receiving end; the original signal is attained through demodulation.

Optical fiber cable is mostly used in telecommunication industry. It is an apparent glass or plastic fiber which is designed to take and direct light alongside as it propagates.

Objectives and scope of the study

The objectives of this study are as follows:

1. to provide accurate, reliable and quality network information
2. to facilitate management of network information
3. to aid quick decision making
4. to provide faster and consistent information which will enable management to make changes in the network when the need arises.
5. to increase customer satisfaction through improved service delivery
6. to provide data security
7. to prevent data redundancy

In this study, the focal point is on the management of telecommunication network elements information using the Automated Telecom Network Information System. The telecommunication network elements include the Base Station Controller, Base Transceiver Station, Radio Network Controller, NodeB, Mobile Switching Center and Home Location Center.

II. LITERATURE SURVEY

The Head office of Glo Mobile Ghana Limited located in Accra and its branches in all regions have an existing system in which network elements data are processed manually. This type of manual processing has some drawbacks such as:

i. the process of making changes on the network elements is time consuming and very slow.
ii. lack of customers satisfaction due to delay in service delivery.
iii. network data received from different regions in Ghana are often duplicated and most especially not accurate.
iv. data collected from different regions are not consistent and accurate hence affects management decision making because garbage in is garbage out.

In Glo Mobile Ghana Limited, Fiber optics cable is the primary transmission media used in linking the network elements within Ghana although digital microwave radio is used as alternative transmission media in case of fiber failure.

A new technology which solves the problem of optical transmission emerged in the prevailing years. This new technology depends on the complete inner expression that can intern light in the material enclosed by other materials with lesser refractive index such as glass in air as expressed by (Harry J.R.Dutton, 1998).

In April 1977, General Telephone and Electronics tested and deployed the world's first-time telephone traffic through a fiber optic system running at 6Mbps in Long Beach California (Andreas O. & Kyriacos K. 1999).

The network elements include:

i. **Base Station Controller – (BSC)** – The Base Station Controller (BSC) manages the logical channel of the radio resources. It monitors and controls one or more BTS. It communicates directly with the Mobile Switching Centre.
ii. **Base Transceiver Station (BTS)** – The BTS comprises the radio frequency parts which make available the air interface for a specific cell site. The BTS manages the physical channel of the radio resources for 2G.
iii. **Mobile Switching Center (MSC)**

The Mobile Switching Centre is the equipment that performs call switching between mobile subscribers also between mobile and fixed subscribers. (Eric C. Coll, M. Eng.., P.Eng.2008).

iv. **Home Location Register (HLR)**

The HLR is the fixed database of the network which stores and controls the entire mobile station data that belongs to a specific network service provider. It is used to store subscriber subscriptions.

v. **Radio Network Controller (RNC)**

The Radio Network Controller (RNC) performs functions such as mobility or roaming administration, processing of calls, management of call hand over and other radio resources supervision.

vi. **Node B:** it manages the radio resources for 3G and supports one or several sectors.

III. METHODOLOGY

Data Collection Method

I interviewed some key staff of Glo Mobile Ghana Limited in the head office, Kaneshie, Accra to collect network elements data. Some of the key staff includes:

- **i.** Chief Technical Officer (CTO)
- **ii.** Head of Operations (HOO)
- **iii.** Base Station Subsystem and Transmission (BSS/TX) Engineers

Chief Technical Officer (CTO) is a senior management staff in charge of the networks project and operations in Ghana, he reports to the Head of Business (HOB). The Head of Operations (HOO) handles the Operations and Maintenance (O&M) of the network elements. Finally, the BSS/TX Engineers manage the operations and maintenance of network elements at different cell sites in all the regions in Ghana.

Data Analysis tools

I used quantitative data analysis in the research and the data collected were then studied carefully and analyzed through the use of tables and design of experiments.

System Requirements Specifications:

Functional Requirement

The system allows BSS/TX Engineer and vendors to perform the following functions:

- **i.** add and modify network elements
- **ii.** maintain any transmission related issues
- **iii.** view and modify System information

The system also allows the Head of Operations, Chief Technical Officer and Regional Technical Heads to perform the following functions:

- **i.** access any network elements on site
- **ii.** inspect the network elements status
- **iii.** generate report
- **iv.** view and modify the system

Non-Functional Requirement

The ATNIS is able to process and make available report of network elements reliably and timely. It stores, retrieves and prints report.

The system is able to connect and search the entire database for any record of telecom network elements.

Hardware Requirements

Minimum Hardware Requirements

Processor: Pentium IV or higher

- **i.** Hard disk: 50 GB or higher
- **ii.** Disk Space: 10 GB or higher
- **iii.** Main Memory: 1 GB or higher
- **iv.** Keyboard: ANY
- **v.** Mouse: ANY

Recommended Hardware Requirement

- **i.** Processor: Pentium IV or higher
- **ii.** Hard disk: 50 G or higher
- **iii.** Disk Space: 10G or higher
- **iv.** Main Memory: 4 GB or higher
- **v.** Keyboard: ANY
- **vi.** Mouse: ANY
- **vii.** Printer: Laser/DeskJet Printer

Software Requirement

Developer Side Software Requirement

- **i.** Operating System: Windows 7 or higher
- **ii.** Design tool: Visual Paradigm
- **iii.** Documentation tool: Microsoft Word
- **iv.** Presentation tool: Microsoft PowerPoint
- **v.** Development and testing tool: Netbeans 7
- **vi.** Database Management tool: MYSQL 5

Client Side Software Requirement

- **i.** Operating system: Windows 7 or higher
- **ii.** Java virtual Machine (JVM)

Server Side Software Requirement

Database Management tool: MYSQL 5.0

Feasibility Study

i. Economical Feasibility

The system will increase profit for the company as it provides value for customers and cost reduction for company. It will increase competitive advantages, market growth and provide reliable, timely and accurate data.

ii. Technical Feasibility

Both the software and the user's hardware were technically evaluated to applicably meet the expected needs of proposed system. The software should be able to run with ease without any hardware related errors provided the minimum hardware requirements are met.

iii. Operational Feasibility

The proposed system, ATNIS is expected to solve the identified problems of processing data manually.

IV. DATA ANALYSIS AND PRESENTATION

Architectural View of Application

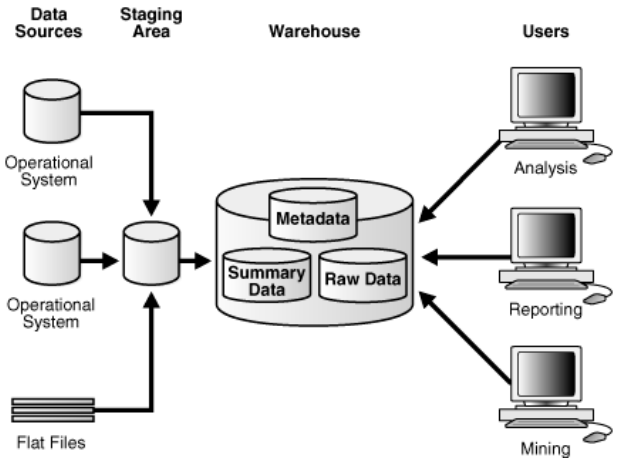

Figure 1: Architectural view of application

The architectural design comprises of three components namely:

i. **System structuring**: Here the system is planned into several sub-systems and each of the sub system is an autonomous software unit. Sub-systems communications are established
ii. **Control Modeling**: a model which indicates the control association involving the components system is established.
iii. **Modular decomposition**: The classified sub-system is divided into modules.

Use cases

Title:-fix transmission issues
Actor – BSS/TX Engineer
Scenario-

i. The BSS/TX Engineer access the network element
ii. The BSS/TX Engineer connects his laptop to the network element, performs troubleshooting, detects the fault and rectifies it.

Title: - fuel the generator at the network element cell site
Actor – power contractor
Scenario-

The contractors deliver the required quantities of diesel to the site to prevent it from going down in case of public power outage.

Title:-Cell site inspection
Actor -CTO
Scenario-

The User accesses the cell site and collect the required data.

Title: add network element
Actor – BSS/TX Engineer
Scenario-

The BSS/TX Engineer add network element to the system

Use cases and data flow Diagram

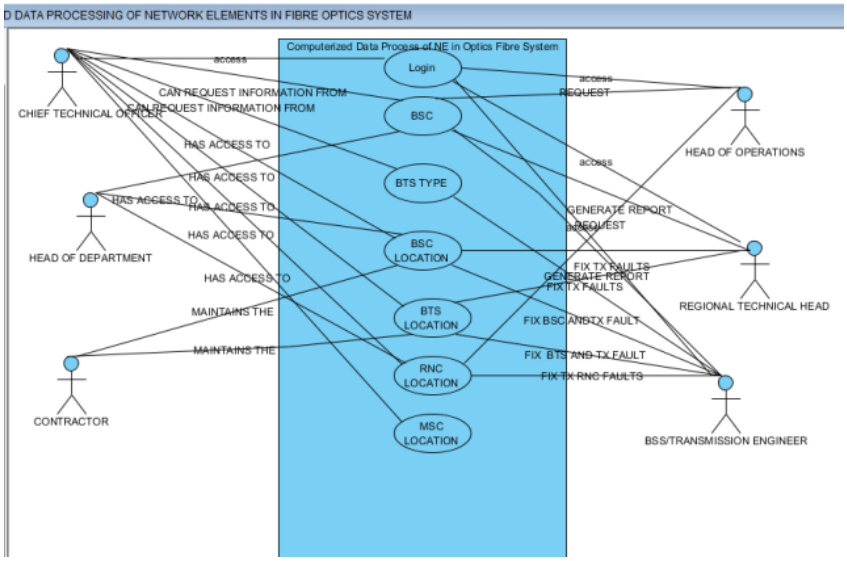

Figure 2: Use case diagram

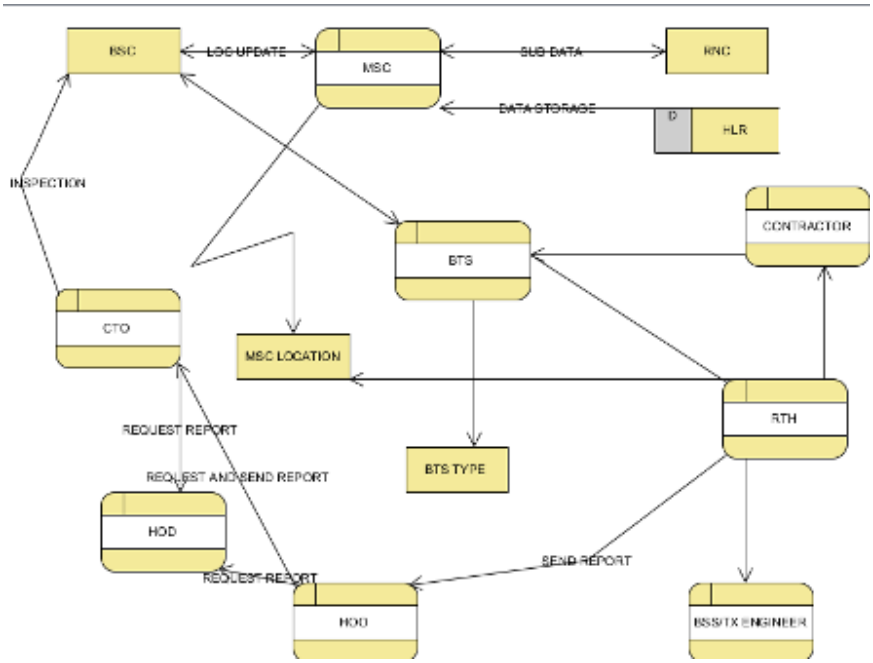

Figure 3: Data Flow Diagram

Interface Designs

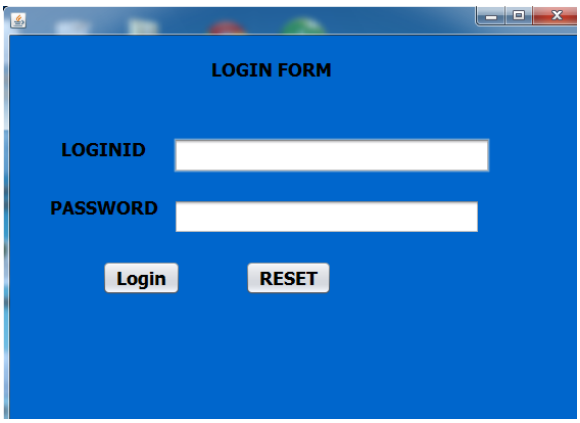

Figure 4 Main Login Form

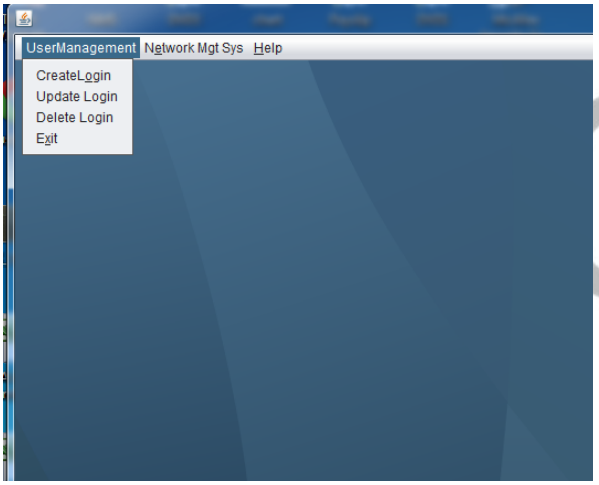

Figure 5 MDIApplication Form

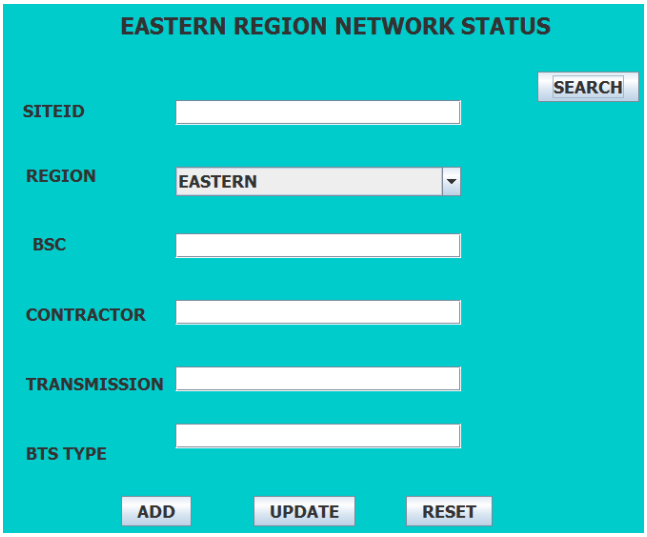

Figure 6 Network Status Form

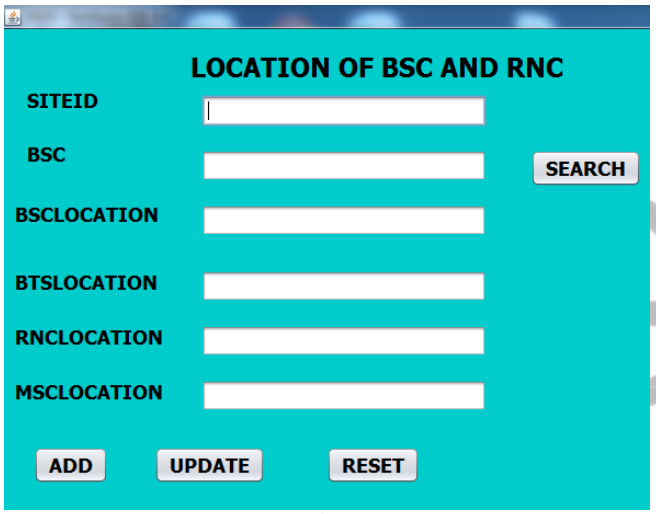

Figure 7 Location of BSC and RNC design

RESULTS AND DISCUSSIONS

i. Testing Methods and Techniques

Testing is performed in order to detect any bugs in the software. The requirements of ATNIS were analyzed and a test activity were performed to ascertain the ATNIS reliability.

ii. Integrated Testing

This testing mainly focuses on the combination of several parts of the software and making it to work. The testing activities were done at the end of the software development and based on the results of this testing the output was generated

iii. White Box Testing

The white Box Testing emphasizes on control structure of the software. It makes use of conditional and loop statements in the program.

iv. Black Box Testing

It is a testing technique that takes into consideration the inner apparatus of a system. It is also referred to as structural testing or glass box testing.

Test Cases and Test Result

Definition of Test Case

A test case is a valid document that comprises of a group of test data, some requirements, anticipated results and post conditions, built for a specific test scenario so as to authenticate conformity against a particular prerequisite.

A test case operates as the initiating position for the test implementation and after applying a set of input data, the application software generates output and leaves the application software at implementation post state. Some of the test case parameters are: test data, anticipated result, real result, test procedures and conditions.

In ATNIS, it can be authenticated if the input field such as LoginID can accept maximum of 15 characters.

Below table illustrate the test case. Here the first case is a pass scenario while the second case is a fail scenario.

Scenario	Test Procedure	Anticipated Result	Real Result
Authenticate that the LoginID field can accept maximum of 15 characters	Login to the application software and type in 15 characters	The application software can accept all 15 characters	The application software accepts all the 15 characters
Authenticate that the LoginID field can accept maximum of 16 characters	Login to the application and type 16 characters	The application software should not accept all the 16 characters	The application software accepts all the 15 characters

In this application software, if the anticipated result is not equivalent to the real result, it is concluded that the log is faulty otherwise the log is successful.

SITEID	REGION	BSC	CONTRACTOR	TRANSMISSION
ASA001	EASTERN	ACC079	CRUST RESOURCES	FIBER
ASA002	EASTERN	ACC079	CRUST RESOURCES	FIBER
KOF001	EASTERN	KOF002-BSC01	MELK GHANA LIMITED	FIBER
KOF002	EASTERN	KOF002-BSC01	MELK GHANA LIMITED	FIBER
MPR001	EASTERN	KUM41-BSC03	MELK	FIBER
MPR002	EASTERN	KUM41-BSC03	MELK	FIBER
NSA001	EASTERN	ACC079	BRICK AND CABLE	FIBER
NSA002	EASTERN	ACC079	BRICK AND CABLE	FIBER
ODA001	EASTERN	CKR006-BSC01	GHANITECH	FIBER
ODA002	EASTERN	CKR006-BSC01	GHANITECH	FIBER
ODA003	EASTERN	CKR006-BSC01	GHANITECH	FIBER
OGO001	EASTERN	HOO004-BSC01	RESOURCE PLUS	FIBER

Figure 8: Test result for Eastern Region Network Status

SITEID	BSC	BSCLOCATION	BTSLOCATION	RNCLOCATION	MSCLOCATION
KOF001	KOF002-BSC01	KOFORIDUA	ATTAKWAME KOFORIDUA	TEMA RNC01	SPINTEX MSC2
KOF002	KOF002-BSC01	KOFORIDUA	OBOUR TABRI KOFORIDUA	TEMA RNC01	SPINTEX MSC2
MPR001	KUM041-BSC03	KUMASI	ATIBIE	KUM041-RNC03	MSC21
MPR002	KUM041-BSC03	KUMASI	ODWEANOMA	KUM041-RNC03	MSC21
ODA001	CKR006-BSC01	ASSIN FOSU CENRAL REGION	ODA PRESBY	CAP018-RNC1	KANESHIE MSC1
ODA002	CKR006-BSC01	ASSIN FOSU CENRAL REGION	ODA ESTATE	CAP018-RNC1	KANESHIE MSC1
ODA003	CKR006-BSC01	ASSIN FOSU CENRAL REGION	MALABA ODA	CAP018-RNC1	KANESHIE MSC1
OGO001	HOO004-BSC01	HO	OGOME SOMAYA	TEM006-RNC1	SPINTEX MSC2

Figure 9: Test Result for Location of BSC RNC

V. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

Without the Automated Telecom Network Information System (ATNIS), the problem of making modifications to network elements on timely basis and collecting consistent, and accurate data from all the regions in Ghana for decision making would have been the greatest challenges for the company.

The key intention of this study is the development of ATNIS to solve the problems of time constrain in making changes to network elements, increase customer's satisfaction through fast delivery of services because happy customers are returning customers and to make available reliable, accurate and consistent data for decision making.

If the ATNIS is installed and used by the company, data redundancy in terms of resources wastage can be prevented, data will be more secured and it will smooth the progress of network elements operations and maintenance.

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