

**MAKERERE UNIVERSITY**  
COLLEGE OF COMPUTING AND INFORMATION SCIENCES  
SCHOOL OF COMPUTING AND INFORMATICS TECHNOLOGY

A REPORT ON  
FIELD ATTACHMENT/INTERNSHIP AT  
NATIONAL WATER & SEWERAGE CORPORATION  
(June-August,2018)

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Field attachment Report submitted to the School of Computing and Informatics  
Technology or College of Computing and Information Sciences.

In Partial fulfillment of the requirements for the degree of Computer Science of  
Makerere University Kampala.

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**Approval of the Internship Report**

I Aimemukama Dinton Harold of Registration Number 16/U/3020/PS, sincerely declare that the Internship Report is submitted to the partial fulfillment of the internship program during the last two months. Any part of this report has not been reported or copied from any report of the University and others.

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### **Acknowledgment**

The special thanks goes to my helpful supervisor **Mr.Ivan Atwiine**,(Senior Systems Administrator Kampala Water). The supervision and support that he gave truly helped in the progression and smoothness of the internship program.

I would also like to thank **Mr.kevin Nyeko**(Senior Officer Systems Administrator Head Office) and **Mr. Hilary Kansiime** (IT assistant Kampala Water). I have worked under their supervision. They have guided me with a lot of effort and time.

Their cooperation is much indeed appreciated. I would also like to thank **National Water & Sewerage Corporation** for allowing me to do my internship from their great Organization.

I also would like to thank all the respected officers and employees of **NWSC** for their continuous inspiration and support.

I am also very grateful to all of my lecturers and fellow friends for their encouragement and cooperation throughout my Internship and academic life.

Finally, I am forever grateful to my parents for their support and love.

**Dinton.A.H**

## **ABSTRACT**

This report is about to explain what I learned during my internship period with National Water & Sewerage Corporation, IT department,Kampala Branch. As the main purpose of internship is to learn by working in a practical environment and to apply the knowledge acquired during the studies in a real world scenario.

This report is divided into four sections. Section one will discuss about the background of NWSC. In Section two we will get the different activities I carried out during the Internship period. Section three my overall Internship Experience. The last section is the conclusion and recommendations of the previous sections.

My training focused on various things like system administration, networking, hardware repair and maintenance. Some of the activities i did during my internship training include assembling and disassembling computer systems, adding computers to the domain, IP print services, software installation, Network maintenance and trouble shooting, providing user support,IT stock taking and so many others.

The most important in an Internship program is that the student should spend their time in a true manner and with the spirit to learn practical orientation of theoretical study framework. This report is about my Internship that i have undergone at NWSC, IT department, Kampala Branch from June-August 2018.

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### **List of Acronyms**

NWSC .....	National Water & Sewerage Corporation
IT .....	Information Technology
IP .....	Internet Protocol
DHCP .....	Dynamic Host Configuration Protocol
DNS .....	Domain Name System
FTP .....	File Transfer Protocol
IIS .....	Internet Information Services
CMOS .....	Complementary Metal-Oxide Semi Conductor
IC .....	Integrated Circuit
PCI .....	Peripheral Component Interconnect
CD .....	Compact Disk
HDD .....	Hard Disk Drive
SATA .....	Serial Advanced Technology Attachment
CPU .....	Central Processing Unit
BIOS .....	Basic Input Output System
I/O .....	Input/Output
RAM .....	Random Access Memory
USB .....	Universal Serial Bus
IDE .....	Integrated Drive Electronics
AGP .....	Accelerated Graphics Port
PSU .....	Power Supply Unit
DVD .....	Digital Versatile Disc
PST .....	Personal Storage Table
NSF .....	Notes Storage Facility
IBM .....	International Business Machine
WAD .....	Windows Active Directory
PBX .....	Private Branch Exchange
Mbps .....	Megabits per Second
RAID .....	Redundant Array of Independent Disks

## Main Report

# 1 Introduction

## 1.1 Background of NWSC

[NWSC, 2018] National Water and Sewerage Corporation (NWSC) is a public utility company 100 percent owned by the Government of Uganda. The Corporation was established in 1972 under Decree No: 34. At its inception in 1972, the Corporation operated in three (3) major towns of Kampala, Jinja and Entebbe. These laws were revised in 1995 by the NWSC Statute and later on the statute was incorporated in the Laws of Uganda as CAP 317 (Laws of Uganda 2000). The primary aim of this was to revise the objectives, powers and structure of NWSC to enable the corporation operate and provide water & sewerage services in areas entrusted to it on a sound commercial and viable basis.

### 1.1.1 Vision

”To be the leading customer Centered Water utility in the world.”

### 1.1.2 Mission

”To sustainably and equitably provide cost effective quality water and sewerage services to the delight of all stakeholders while conserving the environment.”

### 1.1.3 Objectives

To provide water and sewerage services in urban areas under its Jurisdiction.

### 1.1.4 Core Values

Professionalism

Reliability

Integrity

**Innovation**  
**Team work**  
**Excellence**  
**Result Oriented**

#### **1.1.5 Operations/Services of NWSC**

##### **Water Quality**

NWSC ensures that the water supplied up to the customer's meter is of a very high standard. Customers are requested to maintain the water quality within their premises. Internal plumbing systems, water heating systems and water storage facilities, such as overhead tanks at homes, can compromise the quality of drinking water, if not well maintained.

##### **Water & Sewerage Services**

NWSC ensures that the water provided meets all regulatory standards they adhere to and distribute it equitably.

##### **Extension of Water & Sewerage Services**

NWSC endeavors to serve the populations of the areas in which they operate with clean, reliable and safe water.

They make mains extensions of water services to areas meet the demand.

They also provide Sewage collection, treatment and disposal services in accordance with the required environmental standards.

##### **Service Connections**

NWSC connects all applicants who meet their standard requirements in the areas where their services exist.

##### **Meter Reading**

They read all meters every 30 days. Where this is not possible, a reasonable estimate is determined using previous consumption trends of the last three consecutive readings.

##### **Billing and Bill Distribution**

They maintain a 30 days billing cycle for all customers. The water and sewerage billing is based on the consumption as recorded from the meter. Where a meter is not read, an estimate based on the three correct previous readings is used. The invoice is produced and delivered on the day of meter reading where we have adopted the on spot billing system and where bills are printed in the office, the bill is delivered by the fifth month.

#### **Collection of Payments**

Payments can be done by using the e-water payment system using mobile money and through the banks.

#### **Network Maintenance**

NWSC carries out daily monitoring of their distribution network and deal with all identified leaks and bursts within 24 hours.

#### **Sewerage Treatment**

NWSC provides sewerage collection, treatment and disposal services in accordance with the required environmental standards.

#### **Sewerage Disposal**

The Corporation only disposes off treated effluent that meets regulatory and other stakeholder requirements and in so doing, they ensure safety their customers, workers and the integrity of the receiving environment.

## **1.2 Structure of NWSC**

### **1.2.1 Organizational structure**

NWSC has to thrive to emplace management system that is democratic, honest, inspiring, transparent, and highly participatory. The corporation's top management includes the Managing Director, Deputy Managing Director Technical Services, Deputy Managing Director Finance & Corporate Strategy, Corporation Secretary, Director Engineering Services, Director Business & Scientific Services, Director Commercial & Customer Services, Director Internal Audit, Director Planning & Capital Development, General Manager Kampala Water, Director Revenue, Finance & Accounts.

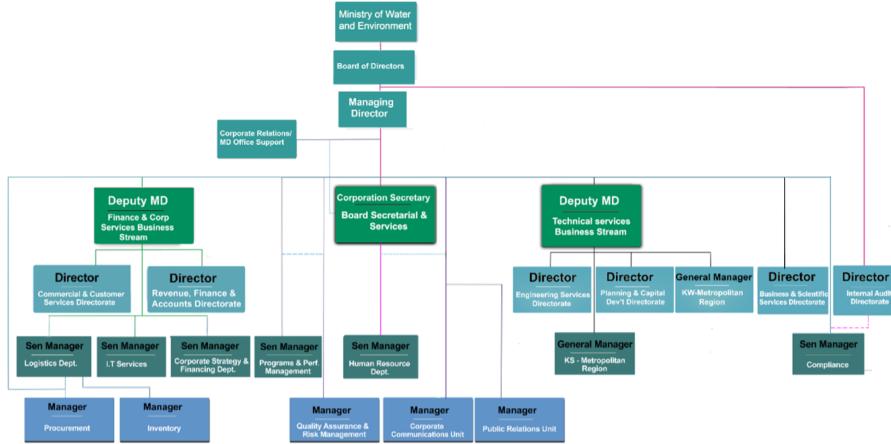


Figure 1: Organizational Structure and Work flow of NWSC

### 1.2.2 IT Structure

The top management of the IT department consists of the Senior Manager, Manager Systems Administrator, Manager Application Developer, Manager Infrastructure.

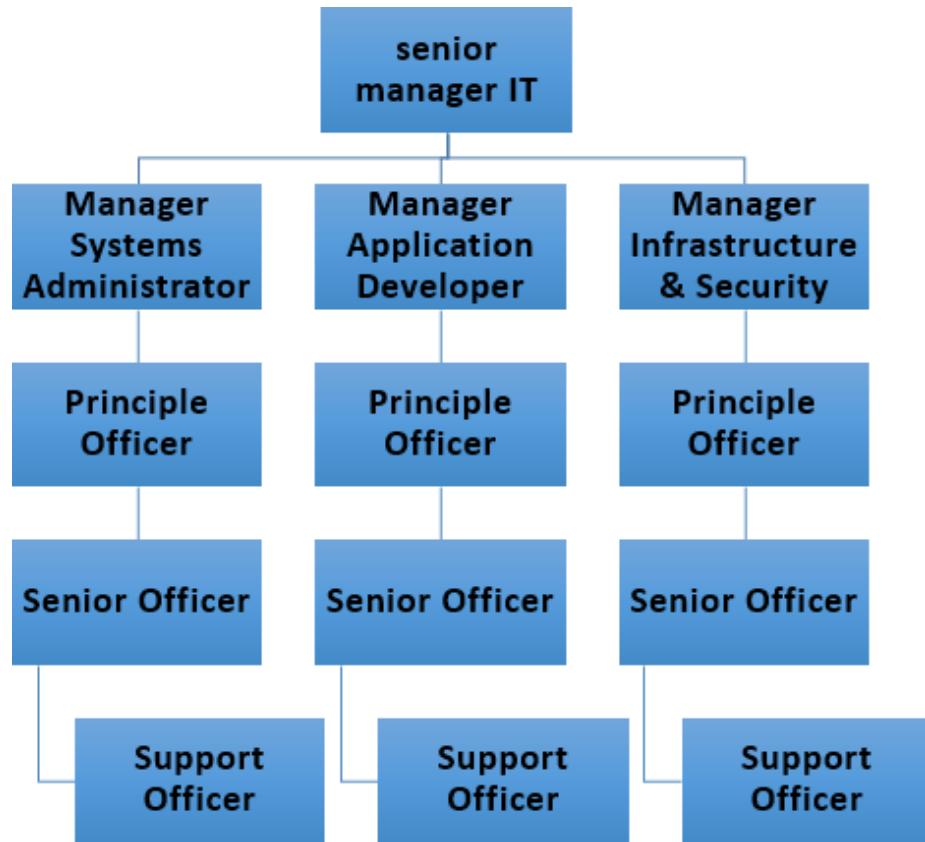


Figure 2: I.T Structure of NWSC

## **1.3 Main Activities of NWSC and ongoing IT projects**

### **1.3.1 Prepaid Metering System Project**

The prepaid metering system is a simple technology with three components; a card, an Internal Unit and a meter. Both the meter and the card reader will be installed at the premise. Each card is tailored to the meter and will be auto loaded with credit at NWSC approved vending points after which it is inserted into the Card reader Internal Unit to recharge the meter.

Before the credit runs out, the meter will produce an alert noise, if the card is not recharged the valve of the meter closes and water flow is stopped. The recharging points will be placed in different NWSC offices and will be accessible at all times.

#### **Benefits**

- Encourages Water Consumption Control.
- Shows Current credit and the corresponding water left.
- Customer can see current and past consumption.
- Identification of leaks.
- Smart Card – Simplicity.
- Emergency Water – Flexibility.

For further references see [Background of NWSC](#)

## **2 Field Attachment Activities**

### **2.1 Orientation**

Before we started internship, We had orientation that was held at NWSC International Resource Centre. We had different presentations from different speakers. First was the senior Human Resource manager Mr Makumbi Peter who talked about general Expectations and prohibited Acts. Then we had a presentation from principal Officer Geographic Information Systems ,Mr Gilbert Akol who talked about the background of NWSC. We also had a presentation from Engineer Francis Bbaale who talked about water supply, a presentation about sewage from Engineer Angelo Kvitonda, a presentation from Mr George Kasule about Call Centre Operations. We were then deployed to different branches under Kampala Water basing on our areas of residence to reduce on transport costs but all students under IT were deployed at sixth street Branch. We had orientation the next day with Senior Manager Billing and IT Mr Willy Nuwamanya and the Manager IT Kampala Water Mr Julius Ouma, We introduced ourselves to them and the different courses we were doing and also told them our general expectations from the internship. We were further re-deployed to other branches because our number could not be accommodated at Sixth street and that is when i was told to go to Jinja road branch which is the head office of Kampala Water.

### **2.2 Hardware Repair and Maintenance**

This included activities like identifying core components of any computer system, installing and configuring of Operating System; in this case I installed Windows 10 Professional and the device Drivers, analyzing the common hardware and software failures, causes and solutions. Basically there are two core components of any computer system and these are computer software and hardware components. Since software components are intangible and cannot be seen, the major focus was on the hardware components as far as identifying computer

components was concerned.

### 2.2.1 System Unit

[Morley and Parker, 2014] This is the enclosure that contains most of the components of a computer (excluding the mouse, keyboard and display).

I opened a systems unit/case and disassembled the different components found in it.

The different components that I identified were;

- CPU
- RAM chip
- CMOS battery
- South Bridge
- North Bridge
- HDD
- PCI slots
- Fan
- IDE cables
- SATA cables
- Motherboard
- Heat sink
- CD-drive
- Power Supply Unit
- IDE connectors
- BIOS

## **CPU**

The central processing unit (also known as the microprocessor) is the brain of computer it is where the processing of data takes place. It carries out the instructions of a computer program by performing basic arithmetic, logical, control and I/O operations. The CPU has four primary functions: fetch, decode, execute and write back.

### **Fetch**

The CPU gets the instruction that it needs to run in a program and each instruction in a program is stored in a specific address. The CPU has a program counter which keeps track of the CPU's position in the program.

### **Decode**

Here the compiler of a specific language breaks down the code in Assembly language that the CPU understands. Then the Assembler translates assembly language into binary code.

### **Execute**

Using the ALU the computer performs extremely complicated mathematical calculations. Moves data from one location to another. Jumps to different locations based on decisions made by the CPU itself.

### **Write back**

For every process the CPU produces some sort of output and it writes it into the computer memory.

### **RAM chip**

It is best known as computer memory. It is referred to as random access because you can access any memory cell directly if you know the row and column that intersect at that cell.

RAM has volatile memory which means the stored information on it is lost when there is no power.

RAM is used by the CPU when a computer is running to store information that needs to be used very quickly, but the information is not stored permanently.

### **CMOS battery**

CMOS is a physical part on the motherboard. It is a memory chip that houses setting configurations and is powered by an on board battery. It is reset in case the battery runs out of energy.

The CMOS battery power codes that runs before the operating system is loaded in a computer.

The common tasks completed are; activating the keyboard, loading the system drives and setting the system clock.

### **South Bridge**

South Bridge is an IC on the motherboard responsible for hard drive controller, I/O controller and integrated hardware.

Integrated hardware may include; the sound card, video card if on the motherboard, USB, PCI, IDE, BIOS and Ethernet.

### **North Bridge**

It is an Intel chipset that communicates with the computer processor and controls interaction with the memory PCI bus, Level 2 cache and all AGP activities.

### **Hard Disk Drive**

Its purpose is to store data or information permanently.

### **PCI slots**

These refer to a computer bus. It helps the computer to connect to peripheral add-on devices such as a PCI video card.

### **Fan**

There are two fans in the systems unit, one on the power supply and other on-top of the CPU.

They help in cooling the computer especially the CPU.

### **IDE cables**

The IDE cables connects CD drives and Hard drives to the motherboard. They transfer data and commands between the devices but not power.

### **SATA cables**

It is computer bus interface for connecting host bus adapters to mass storage devices such as hard disk drives and optical drives.

### **CD drive**

The computer uses this to read data encoded digitally on a compact disc.

### **Power Supply Unit**

PSU converts main AC to low-voltage DC power for the internal components of the computer.

### **IDE connectors**

It helps connect IDE devices to the motherboard. And this is done by the help of the IDE connectors.

### **BIOS**

BIOS works hand in hand with the CMOS and the bios help set up the computer and boot the operating system.

BIOS has drivers which are low-level drivers that give the computer basic operational control over your computer's hardware.

There is a BIOS setup that help in configuration of hardware settings including system settings like time, date and computer passwords.

### **Motherboard**

It holds many crucial components of a computer together, including the CPU, RAM and connectors for input and output devices.

#### **2.2.2 Assembling Computer Components**

After identifying the various core components of the computer, assembling them was the next task. Among the components that were assembled include but not limited to; Power supply, Motherboard, Processor, RAM chips, Disk drives, Expansion cards, Keyboard, Mouse, Monitor, Screws. The following steps were involved during the process of assembling the various computer components;

- Open the case
- Install the power supply (making sure the Power Cable is not connected)
- Attach the components to the motherboard
- Install motherboard
- Install internal drives

- Install drives in the external bays
- Install adapter cards
- Connect internal cables
- Re-attach side panels and connect external cables to the computer
- Connect the Power cable to the Power supply unit.

### **2.2.3 Installation of Windows 10**

I predominantly used a 16GB Flash drive with windows 10 stored on it , which I made bootable using disk part commands. I selected the language to use as English, I then entered the product key. I selected the type of installation as custom for my installation. Then I chose where to install the windows that is to say which drive. This can be done by either formatting the drive or simply partitioning the disc if you want to install on fresh drive. Now during my installation there were no drivers installed yet so I had to do so by clicking load drive to provide a mass storage drive for my installation, I restarted the computer after re-installing the hard disk (the reason here was, that server ever doesn't have controllers to detect the hardware drives for new operating system), BIOS check all the hardware to see if it's just fine then it loaded operating system.

## **2.3 Review of related Work and existing systems at NWSC**

### **Billing System**

This is the conversion of water consumption into monetary terms that is to say the amount of water consumed is converted into money and that is the amount of money on your bill.

The water and Sewerage billing is based on the consumption as recorded from the meter. Where a meter is not read, an estimate based on the three correct previous readings is used.The invoice is produced and delivered on the day of meter reading where they have adopted the on spot billing system and where bills are printed in the office, and the bill is delivered by the fifth month.

## Central UPS System

These provide power back up of the computer system within NWSC.

## 2.4 IT Stock Taking Exercise

I participated in the IT stock Taking Exercise of NWSC where we were collecting information about the different devices of NWSC for example Laptops, System units, monitors, keyboards, mice, routers, switches, printers, scanners, plotters and so many other devices. We were recording the Machine type, Make, Serial Number, User and status of the device. This exercise is done every financial year to keep track of the devices. We had to collect information and come up with a final report. Below is a table 1 showing how we were collecting information.

Table 1: Table showing how we collected data for the IT Stock Taking Exercise

## 2.5 Systems Administration

This is individual responsibility for maintaining a multi-user computer system, including a local area network. This can also be defined as the field of work in

which someone manages one or more systems, like software, hardware, servers or workstations and its main goal is ensuring that the systems are running effectively and efficiently.

### **2.5.1 Creating a Local user account**

I clicked start, selected administrative tools and then clicked computer management. In computer management, I clicked local users and group, I double clicked the user's folder, followed by right clicking in users list and then new user, filled in the information for my new user and finally clicked create. More users I created them using the same criteria. After all that I clicked close and I had all my users local accounts created.

If the account is to be used by a service application , uncheck user must change password at next log on and check the options below;

- Users cannot change password.
- Password never expires.

The newly created user accounts were seen. By default new user accounts are given limited permissions

### **2.5.2 Creating a domain user account**

- I clicked start, selected administrative tools and clicked Active Directory users and Computers.
- In Active Directory users and computers, I navigated the folder to store the new user, I right clicked the user list and clicked new user, filled in the new user information and clicked next, filled in the password information and clicked next.
- If the account is to be used by a service application , uncheck user must change password at next log on and check the options below;
  - User cannot change password.

- Password never expires
- Then I clicked finish and newly created user accounts were seen. By default new user accounts are given limited access permissions.

### **2.5.3 Mail Migration**

NWSC shifted from using Lotus Notes as their mail system to using Outlook. But along the way, staff could no longer access their old mail due to the migration from one mail system to another. So we did remote desktop connection to the server, got the files of the different staff who were complaining and used a software called Kernel Lotus Notes to Outlook. This software converts the files from **.NSF** file extension supported by IBM Lotus Notes database to **.PST** file extension that is supported by Outlook.

Next i had to export the Outlook **.PST** file. I followed the following steps below in order to do it;

- Open Outlook 2010.
- Go to File - Open and then click on Import.
- Select Export to a file and then click Next.
- Select Outlook Data File (.pst) and then click on Next.
- Select the top-most folder, check the box Include sub-folders and then click on Next.
- Click on the Browse button.
- Decide where you will export the .pst file and then click on OK.
- Click on Finish.

### **2.5.4 Configuring Proxy Server**

NWSC uses proxy server to bypass traffic and also IP blocking that is to say to restrict some devices with certain IP's from accessing the network.

It is also used for security that is to say it keeps the internal network structure of the company secret by use of Network Address Translation.

It is also used for monitoring and filtering by use of content-control software which restricts or controls the content an internet user is capable to access.

I configured proxy for so many users that wanted to access the internet using the following steps;

- Go to the Control Panel.
- Click on Network and Internet.
- Under Network and Internet, click Internet Options.
- Under internet options go to connections tab.
- Then the LAN settings.
- Check the box for use proxy server.
- Finally enter the Address and the Port and Click OK to finish.

## 2.6 Windows Active Directory

[Desmond et al., 2008] Windows Active Directory (WAD) is a technology installed on a computer to act as a domain controller. WAD can be installed on servers running Microsoft Windows Server 2003 (standard or enterprise edition), or Microsoft Windows Server 2012 (standard or enterprise edition). WAD of the NWSC is installed on servers. It stores information about objects on the network and makes this information easy for administrators to find and use.

Some of these objects include;

- Users
- Computers
- Printers
- Lists

### **Windows Active Directory Data Store**

A **domain** is a common directory database which stores information about the objects that belong to it. NWSC's domain is nwsc.co.ug.

A **tree** consists of a single domain or multiple domains in a contiguous name space.

A **forest** is a collection of multiple trees that share a common global catalog, directory schema, logical structure and directory configuration.

A **domain controller** is a server that is running a version of the Windows Server operating system and has Windows Active Directory Domain Services installed. Domain Controller is a dedicated computer purposely meant to manage users, properties in an organization unit.

WAD uses a structured data store as the basis for a logical, hierarchical organization of directory information. The data store contains information about WAD objects which typically include shared resources such as servers, printers and the network user and computer accounts. Security is integrated with WAD through log on authentication and access control to objects in the directory.

### **Windows Active Directory Replication**

Replication is the transfer of lists of users and documents to a newly created server and it does so with the installation of the domain. Windows Server sets up a replication topology to determine where a server updates from. In a large network, this keeps replication time down as servers replicate in a form of a ring network.

For more reference about this, please visit <https://activedirectorytutorial.blog/>

## **2.7 NWSC Local Area Network /Infrastructure**

### **Computer Network Installation, Maintenance & Administration**

Under this, activities like identifying network components and topologies and setting up a wireless network were covered.

#### **Identifying Network Topologies and Components**

This was done by reviewing the related work and existing system and also

studying the server room and components like routers, switch among others were identified.

- Router:this is a device that transfers data from one network to another in an intelligent way.
- Switch:termed as a network bridge with multiple ports which helps to connect other network devices on the network.
- Server:This is a machine which contains resources and files to be shared on the network.
- Patch panel: serves as a sort of static switchboard, using cables to interconnect network computers within a LAN and to outside lines including the internet.
- Fiber Media converter: is a simple networking device that makes it possible to connect two dissimilar media types such as twisted pair with fiber optic cabling.
- PBX: this is a telephone system within an enterprise that switches calls between enterprise users on local lines while allowing all users to share a certain number of external phone lines.

### Cables

I looked at data cables and a data cable is a medium that allows baseband transmission (binary 1,0 s) from the transmitter to the receiver.

Types of network cables are coaxial cable, optical fiber cable and twisted pair. Emphasis was put most on the twisted pair type of cables.

Twisted pair cabling is a type of wiring in which two conductors of a single circuit are twisted for the purpose of canceling out electromagnetic interference (EMI).

The unshielded twisted pair cables have categories which include;

Category	Property
Category 1	Voice Only (Telephone)
Category 2	Data to 4Mbps (Local talk)
Category 3	Data to 10Mbps (Ethernet talk)
Category 4	Data to 20Mbps (Token Ring)
Category 5	Data to 100Mbps (Fast Ethernet)
Category 5e	Data to 1000Mbps (Gigabit Ethernet)
Category 6	Data to 2500Mbps (Gigabit Ethernet)

Table 2: Table showing the different categories of unshielded twisted pair and their properties

### Terminating Network Cables

I was able to terminate cables that are very essential in networking. I terminated with RJ-45 connectors.

**RJ-45:** This is an 8pin jack commonly used to connect computers onto Ethernet based LAN.

The two cables I terminated were:

- Straight-through that connects dissimilar devices.
- Cross-over that connects similar devices.

Before termination there are necessary tools needed to do the job right and they are;

- Cat5e cable
- RJ-45 connector
- Cable stripper

- Scissors
- Crimping tool

Steps to follow when making connection/termination:

- Strip cable end
- Untwist wire ends
- Arrange wires
- Trim wires to the same length
- Attach connectors
- Check if all wires are touching the end of the connector.
- Crimp
- Test to see if the cable is working using a cable tester.

### **Wiring Standards**

There are different wiring standards while terminating cables. In this case **T568B** and **T568A** wiring standards are used for CAT 5 and 6 cables. These two wiring standards have different colour arrangements and below is a table showing the wiring standard and colour arrangement from top to bottom.

<b>T568A</b>	<b>T568B</b>
White Green	White Orange
Green	Orange
White Orange	White Green
Blue	Blue
White Blue	White Blue
Green	Orange
White Brown	White Brown
Brown	Brown

Table 3: Table showing the two Wiring Standards and their colour arrangement from top to bottom

The wires are arranged following one of the above standards.

Then the wires should be trimmed to the right size which is half.

The color order should be maintained when wires are being fixed into the RJ-45 connector and the connector should be facing downwards. Make sure all the wires extend to the end of the connector.

Squeeze firmly to crimp connector onto cable end.

For a cross over cable, one end can be T568A and the other T568B or viceversa while for a straight through cable both ends have to be similar depending on what you want. You can opt to use T568A or T568B as long as both ends are similar.

## 2.8 Virtualization and Cloud Computing

**Virtualization:** This is the act of creating a virtual version of something including virtual computer hardware platforms, storage devices and computer network resources.[Ruest and Ruest, 2009]

**Cloud Computing:** This is the practice of using a network of remote servers hosted on the internet to store, manage and process data rather than a local server or a personal computer.

NWSC uses large storage area networks to create storage pools and assigns them to different virtual machines in other words provides cloud storage for servers and users.

### **2.8.1 Vmware**

[Muller and Wilson, 2005] VMware Server is a virtualization product that makes it possible to partition a single physical server into multiple virtual machines. VMware server works with Windows, Solaris, Linux and Netware, any or all of which can be used concurrently on the same hardware.

NWSC uses Vmware for virtualization purposes.

Vmware ESX(Elastic Sky X) server is mainly used by so many enterprises because of the following merits:

- Cost effective use of hardware.
- Large portions of your production environment can be replicated on a few servers.
- Lower cost of hardware for the entire test environment.
- Faster rollback during testing.
- Faster deployment of a new test platform.
- Test Virtual Machines can be decommissioned and even deleted after they are not needed.

[Muller and Wilson, 2005]

### **2.8.2 RAID**

RAID is Redundant Array of Independent Disks. A number of disks are aggregated to form a single logical disk. Some of the raids are; RAID 0, RAID 1, RAID 2, RAID 3, RAID 4, RAID 5, RAID 6, RAID 7, RAID 10. All RAID configurations offer benefits and drawbacks. Standard RAID levels such as 2, 3, 4 and 7 are not as commonly used as others, such as 5, 1, 6 and 10.

NWSC normally uses RAID 5 configuration.

### **RAID 5** [Chen and Towsley, 1993]

RAID 5 is a redundant array of independent disks configuration that uses disk striping with parity. Because data and parity are striped evenly across all of the disks, no single disk is a bottleneck. Striping also allows users to reconstruct data in case of a disk failure.

#### **How RAID 5 Works** [Gray et al., 1990]

RAID 5 used parity instead of mirroring for data redundancy. When data is written to a RAID 5 drive, the system calculates parity and writes that parity into the drive. While mirroring maintains multiple copies of data in each volume to use in case of failure, RAID 5 can rebuild a failed drive using the parity data, which is not kept on a fixed single drive.

By keeping data on each drive, any two drives can combine to equal the data stored on the third drive, keeping data secure in case of a single drive failure. Drives can be hot swapped in RAID 5, which means a failed HDD can be removed and replaced without downtime.

#### **Considerations for using RAID 5**

RAID 5 is one of the most common RAID configurations, and is ideal for application and file servers with a limited number of drives. Considered a good all-around RAID system, RAID 5 combines the better elements of efficiency and performance among the different RAID configurations.

Fast, reliable reads are major benefits. This RAID configuration also offers inexpensive data redundancy and fault tolerance. Writes tend to be slower, because of the parity data calculation, but data can be accessed and read even while a failed drive is being rebuilt. When drives fail, the RAID 5 system can read the information contained on the other drives and recreate that data, tolerating a single drive failure.

RAID 5 evenly balances reads and writes, and is currently one of the most commonly used RAID methods. It has more usable storage than RAID 1 and RAID 10 configurations, and provides performance equivalent to RAID 0.

RAID 5 groups have a minimum of three hard disk drives (HDDs) and

no maximum. Because the parity data is spread across all drives, RAID 5 is considered one of the most secure RAID configurations.

#### **Drawbacks of RAID 5 [Chen and Towsley, 1996]**

Longer rebuild times are one of the major drawbacks of RAID 5, and this delay could result in data loss. Because of its complexity, RAID 5 rebuilds can take a day or longer, depending on controller speed and work load. If another disk fails during the rebuild, then data is lost forever.

## **2.9 Other IT field Activities**

- Installing drivers for the printers in various departments.
- IP-Print services
- User Support
- Software Installation
- Data Entry
- Creating Mail groups on Outlook and Adding users.

### 3 The Overall Internship Experience

#### 3.1 Inroduction

This chapter talks about the new skills gained, experiences as well as the challenges faced and how I managed to solve them during Internship. It also explains the relatedness of University's taught programmes to the Field work, benefits derived and Career Motivation.

#### 3.2 Lessons, Experiences, Skills and New Knowledge

- I was able to learn how to work efficiently under minimal Supervision since I was given tasks to do when my supervisor was very busy.
- **Work Ethics related Issue:** Internship is an opportunity to learn the skills and behaviors along with the work values that are required for success in the workplace. Workplace ethics are established codes of conduct that reflect the values of the organization or company where you are employed. I was able to possess the willingness to work hard for my supervisor during my internship period. In addition to working hard it is also important to work smart. This means I acquired the most efficient way to complete tasks and finding ways to save time while completing daily assignments. It's also important to care about my job and complete all projects while maintaining a positive attitude.
- **Practical Skills:** The Internship gave me the opportunity to connect classroom theory with current industry challenges, and have exposure to the latest technologies. Opportunities to converse and interact with a large pool of talented experienced department members provided a deeper insight to the overall operation, as well as providing a valuable pool of resources to assist in completion of internship program. This internship program was exactly what I needed to nurture the lack of practical skills I had. I would acquire practical experience to complement the theoretical content of my studies.

- **Theoretical Knowledge:** During my internship period at NWSC ,I was able to upgrade my theoretical knowledge,from the course unit of Computer Networks in the classroom for example Microsoft windows server 2016, DNS ,DHCP ,IIS ,FTP and Active directory domain service.
- **Time Management:** I learnt how to be punctual. NWSC is a busy organization and work had to be done as early as possible arrival time was 7:30am.
- **Communication Skills :** I improved on my communication skills in a formal and informal way. In the formal way as I had to communicate with my supervisor, staff and interacting with people while providing user support.
- **Internet Research Skills :** I greatly improved my research skills as most of the things learnt i had to get more knowledge about them so I used a great deal of websites to acquire more knowledge by researching on them.
- **Team Work :** I worked with fellow interns in teams on tasks assigned such as the IT stock taking exercise where we had to record the different devices owned by NWSC for example mice, keyboards, laptops,system units,switches,routers and so many others by recording the serial number, make, status and the user. At the end of the exercise we had to come up with a report.
- **Data Entry:** I improved my skills in data entry using software packages like Excel while analyzing data collected from stock taking exercise as well as creating different mail groups and entering data for example a mail group for Kampala Water Finance and Administration,Kampala Water branch engineers,Kampala Water commercial officers, Kampala Water commercial assistants, Kampala Water Branch Managers.
- **Knowledge of the Organization:** I gained knowledge on the operations of NWSC; and the overall staff conduct and guidelines through orientation which took place in the first week at NWSC International Resource Centre.

- User Support.
- Network printer Installation.
- Software Installation.
- Server Configuration and Management.
- Microsoft Office Installation.
- Anti-Virus Installation and Activation.
- Operating System Installation.

### **3.3 Most Interesting Experiences**

While at NWSC, I had several interesting experiences during my internship. The most interesting experiences while on internship included the following:

- Access to the server room: While at NWSC, my supervisor took us to the server room several times to add servers to the racks and also configure them, I was able to have my first glimpse at a real live server since I had been studying them theoretically. This was one of my most interesting experiences while at NWSC.
- Branch Visits: While at NWSC, Kampala Water where I was deployed handles all IT issues of the other several branches in Kampala. I was able to visit several branches to handle there IT issues for example adding new desktops at branches that means installing an operating system on the computer and other software needed on the computer, adding a printer on the network, Configuring proxy on there computers. This helped me gain enough experience as far as solving such problems.
- Making New Connections : I also made new contacts with people already working at NWSC. These contacts hence forth create vital network of mentors, who I can look up to for guidance and help. I also made new

friends with fellow interns and I was also able to learn something new from them.

- Learnt new Skills and Experiences: The opportunity to learn new skills and knowledge was exciting for example the important skills needed in a work environment. This will be of great importance in the future.

### **3.4 Relatedness of University's taught programmes to the Field work**

Despite the fact that much of the theory we acquire in class, is not directly applied at work, there is a relationship of what is taught from Year 1 through Year 3 at the University.

Course units like Communication skills are so crucial in the real work life as we demonstrated our team work, listening, speaking, and writing skills while at NWSC in different scenarios. Research methodology greatly helped to research effectively and thereby come up with literature like this very report and also through tools like latex that we were stressed to use in writing reports while doing Research Methodology course unit.

Many of the university programmes require one to be patient, committed, have discipline and integrity. This is evidenced while at the work environment as well.

There is a close relationship between the programs taught at university and fieldwork, an example of the course units that exhibited the most relevance include:

- Computer Literacy: Computer skills were very vital as all tasks at NWSC were computerized; therefore computer literacy is a must for every intern.
- Communication skills: These skills were very important during the field attachment; I had to listen to the instructions given to me by my supervisor and also communicating with staff at the corporation.
- Research methodology: This course content helped me in preparing reports especially this report, I applied the methods of data collection espe-

cially in the IT stock taking exercise that I was involved in.

### **3.5 Challenges faced and how managed**

#### **3.5.1 Individual Challenges**

- Financial constraint especially meals that were costly and were not being provided by the organization. This led to high daily expenses. Managed this by packing some snacks from home to reduce on the expenses.
- Heavy rain that would at times inconvenience my arrival time.

#### **3.5.2 Organizational Factors**

- High ranking officers who were so tough not allowing interns to work on their laptops by complaining whenever interns were sent to work on their issues.
- Some users were impatient when some computers were being worked on.
- Bio-metric system that needed ones thumb print to be in the system in-order to access the Office. This gave me hard time especially when i would come earlier than my supervisors. This was solved by my supervisor giving us user IDs and pin-codes so that we are able to access the Office without any inconvenience of waiting for someone to come and put their thumbprint.

### **3.6 Benefits derived from Field Attachment**

- Improved appreciation of the course: I worked under the supervision of Senior Systems Administrator as this is one of the prospective professions for a student of Computer Science, I got to understand the available professions for a graduate of this course and hence its applicability in the real world.

- Gained exposure to the demands and challenges of the workplace: The exposure to the organizational culture of the Corporation and the tasks given to me gave me great exposure to the demands and challenges of the workplace.
- Practical experiences: I also got a chance to apply the theory taught in class. This helped me get a clear concept through understanding its applicability in the real world.
- New knowledge and skills acquired: I acquired new knowledge and skills while on field attachment; Knowledge on the operations of NWSC through the orientation exercise where we had different presentations about the history of NWSC, Water Supply, Sewage, Call center Operations and so many others.

### **3.7 Career Motivation**

I must say that the I am encouraged that I took the right career path right from the day I decided to do a degree in Computer Science that would lead me to the future of my life as an IT specialist. I affirm that I have been able to acquire several job required skills both at the university and at NWSC IT department and I am highly motivated by this fact.I was able to interact with my supervisor and several other colleagues in the IT department that gave me different advise about different paths I can take in the IT field and the different certifications i can do in-order to become a Systems Administrator.

## **4 Conclusion and Recommendations**

### **4.1 Conclusion**

After going through the whole period of internship as an intern I've observed so many professional activities and learnt as well. This internship was very fruitful to me because I was able to cover many different fields. I also learnt new concepts and new ways of working.

The compulsory supervised industrial attachment of the University gives us students the opportunity to apply knowledge in real work, exposing us to work methods not taught at university. The program provides access to products and equipment not available in the university, as well as assessing our interest in the occupations we plan to undertake. To my understanding, the program has served its purpose to my academic progress and industrial practice.

NWSC is a very good and favorable environment for internship full of lots of new information technology practical aspects that are essential with the modern digital technology. The place is well organized and suitable for trainees who are willing to learn.

To conclude, I think that this internship was very beneficial to me as I learnt a lot, and it made me discover work in a real world.

### **4.2 Recommendations**

This is my first industrial training/internship in my university and I strongly recommend that;

- The university should establish partnership with organizations so that they can secure internship placements for students.
- The different departments and faculties in the university should look for internship places for the students because some of the students panic and cannot settle or concentrate because they have failed to get companies to work with.

- The University should continue supporting the field attachment program as it comes with benefits to the University and the Students. The University should also consider making field attachment when the students are through with third year during that time before graduation as this makes them have wider chances just incase opportunities come along and also improves on their work experience which would be helpful while applying for jobs as most jobs require work experience.

## 5 Appendix



Figure 3: An open System Unit showing the interior components after disassembling process



Figure 4: Me in the Server Room



Figure 5: A tone Tracer and Cable Tester



Figure 6: Me using a blower to perform hardware maintenance(Removing dust from the interior components of the Server)



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Figure 7: An IBM LTO Ultrium Data 6 Cartridge(Inserted into the Tape Library in the Server Room to improve on Data Storage

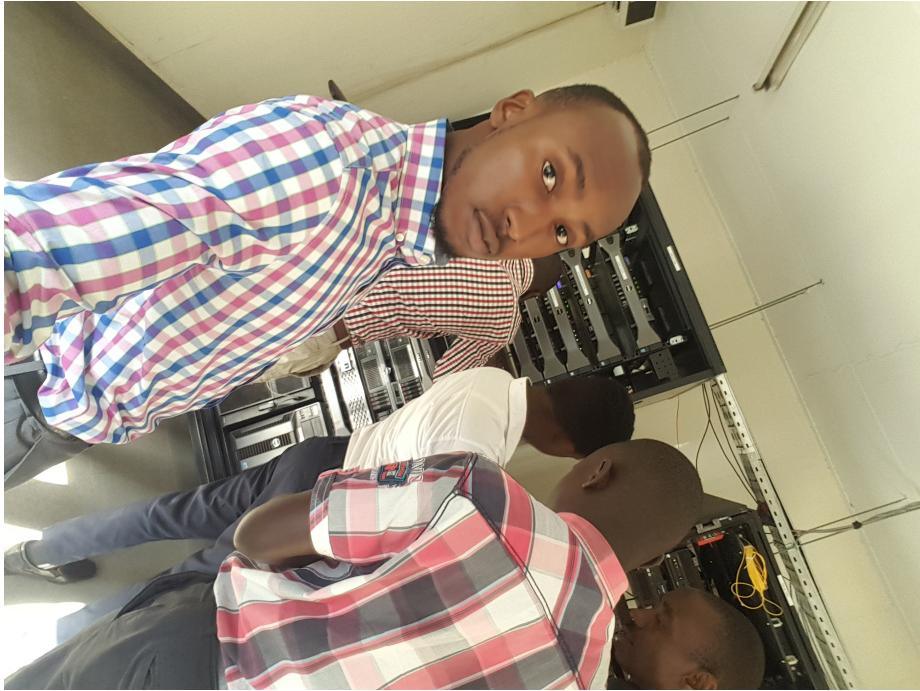


Figure 8: Me,my colleagues and Supervisor in the Server Room

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