Facilitating e-government by promoting use of broadband services in rural areas: a case of Bunda and Serengeti, Tanzania

Tumwesige David Mujwauzi
May 2009

Examiner: Prof. Björn Pehrson
Supervisor: Amos Nungu
Abstract

Governments’ promotion of ICT initiative in their countries seems to be a current trend in the contemporary world. Different reform programs have been undergoing to promote e-government in countries. However, in most developing countries the case is not as same as in developed countries and for those countries where there is e-Government initiatives, rural communities are left behind.

This thesis report presents results from a practical research that was conducted in rural Tanzania (in Bunda and Serengeti Districts). The research was conducted as part of a SIDA funded project ICT for Rural Development (ICT4RD). The research aimed at facilitating e-government initiatives by promoting use of ICT services in rural areas. The report presents the initial situation in the selected communities, the field work that was done in terms of technical and social engineering aspects, proposed solutions and challenges in relation to promotion of ICT services in rural areas, it then gives a number of recommendations that can be used as inputs to the National e-government strategy penetration to rural communities. Among the key challenges have to do with political influence in terms of government’s priority on ICT.
Acknowledgement

This thesis work would not have been possible without valuable contributions from different people. I would like to devote this paragraph to pass my sincere gratitude to the following people:

- Prof Bjorn Pehrson: For his assistance in various times during my studies, also for providing me the opportunity to work on this project and his guidance on formulating a proposal that will be of assistance to the rural community ICT initiatives.

- Amos Nungu: For his guidance and assistance during the whole cycle of this project as my supervisor. His direction to the right sources for interview at the Government from Dar es Salam to Bunda and Serengeti. The trust he bestowed on me, helped to work with open mind.

- Bunda DC (Hon. Chiku Galawa): For her support and inspiration on ICT activities and in ensuring that I get the venue and people needed for the seminars and workshop.

- Bunda TANESCO Staff: For their company and trust for providing me an office during the field works session.

- Dr. Ritha Willilo, Leonard James Ngeleja, Rajab Kitindi, and Japhet Samson: For their great supportive hearts during the days in Stockholm for Studies.

- Friends: For their challenging ideas that reminded me of keeping on towards the goal of my thesis.

- My Family: For their support and encouragement during the whole timeline of project field work and thesis writing.

For everyone who in one way another supported my thesis, many sincere thanks to you all.
Contents

Abstract ........................................................................................................................................... ii
Acknowledgement .......................................................................................................................... iii
Contents ........................................................................................................................................... iv
Acronyms .......................................................................................................................................... vi
List of figures ..................................................................................................................................... vii
1. Introduction .................................................................................................................................... 1
   1.1 Background ............................................................................................................................. 1
   1.2 Research Problem .................................................................................................................. 2
   1.3 Research Objectives ................................................................................................................ 2
   1.4 Research Motivation ............................................................................................................... 3
   1.5 Working Method .................................................................................................................... 3
   1.6 Thesis Outline ....................................................................................................................... 3
Part I ................................................................................................................................................ 5
2. Base ICT situation in Bunda and Serengeti ................................................................................... 5
   2.1 Bunda .......................................................................................................................................... 5
   2.2 Bunda District Governance ...................................................................................................... 5
   2.3 ICT in Bunda ............................................................................................................................. 6
   2.4 Serengeti .................................................................................................................................... 8
   2.5 District Governance .................................................................................................................. 8
   2.6 ICT in Serengeti ....................................................................................................................... 9
   2.7 Overview of ICT infrastructure Bunda and Serengeti ............................................................ 12
Part II ................................................................................................................................................ 13
3. Field Work .................................................................................................................................... 13
   3.1 Localization of District web and mail services ................................................................. 13
   3.2 Promotion of usage of District Website ............................................................................... 14
   3.3 Facilitation of usage of VoIP services .................................................................................... 14
   3.4 ICT awareness workshops ...................................................................................................... 15
   3.5 ICT Technical Training .......................................................................................................... 16
<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTH</td>
<td>Kungliga Tekniska Hogskolan [Royal Institute of Technology]</td>
</tr>
<tr>
<td>SIDA</td>
<td>Swedish International Development Agency</td>
</tr>
<tr>
<td>DIT</td>
<td>Dar es salaam Institute of Technology</td>
</tr>
<tr>
<td>COSCTECH</td>
<td>Commission for Science and Technology</td>
</tr>
<tr>
<td>ICT4RD</td>
<td>ICT For Rural Development</td>
</tr>
<tr>
<td>DC</td>
<td>District Commissioner</td>
</tr>
<tr>
<td>DAS</td>
<td>District Administrative Secretary</td>
</tr>
<tr>
<td>DED</td>
<td>District Executive Secretary</td>
</tr>
<tr>
<td>DEO</td>
<td>District Education Officer</td>
</tr>
<tr>
<td>DMO</td>
<td>District Medical Officer</td>
</tr>
<tr>
<td>DDH</td>
<td>District Designated Hospital</td>
</tr>
<tr>
<td>VSAT</td>
<td>Very Small Aperture Terminal</td>
</tr>
<tr>
<td>POP</td>
<td>Post Office Protocol. A protocol for retrieving emails from mail server</td>
</tr>
<tr>
<td>IMAP</td>
<td>Internet Message Access Protocol. A protocol for retrieving emails from mail server</td>
</tr>
<tr>
<td>MTA</td>
<td>Mail Transfer Agent</td>
</tr>
<tr>
<td>TANESCO</td>
<td>Tanzania Electricity Company</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name Service</td>
</tr>
<tr>
<td>SMTP AUTH</td>
<td>Simple Mail Transfer Protocol Authentication</td>
</tr>
<tr>
<td>CMS</td>
<td>Contents Management System</td>
</tr>
<tr>
<td>OpenSIPS</td>
<td>Secure Open Session Initiation Protocol</td>
</tr>
<tr>
<td>SUS</td>
<td>Software Update Server</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual Local Area Network</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Authority</td>
</tr>
<tr>
<td>ISP</td>
<td>Internet Service Providers</td>
</tr>
<tr>
<td>MDA</td>
<td>Ministry Department and Agencies</td>
</tr>
</tbody>
</table>
List of figures

Figure 1: ICT4RD network infrastructure at Bunda ................................................................. 15
Figure 2: ICT4RD network infrastructure at Mugumu-Serengeti ........................................... 18
Figure 3: ICT4RD network infrastructure at Nata-Serengeti .................................................. 19
Figure 4: Overview of ICT4RD Infrastructure from Bunda-Mugumu ....................................... 20
Figure 5: Simplified logical network diagram of the current Bunda-Mugumu network ............... 26
Figure 6: proposed logical network diagram for Bunda-Mugumu network. .............................. 28
1. Introduction

1.1 Background

In the modern world there is an increase in dependence of information and knowledge management to gain competitive advantage in the social and economic arenas. Governments in developed countries have invested in ICT to ensure that their strategies succeed through implementation and use of ICT to run their operations (e-governance). Though with slow pace, the same trend is being adopted with governments in the developing countries, Tanzania being one among the countries. In the process of implementing e-government practices, the country has made efforts to computerize its MDAs (Ministries, Departments and Agencies) through different reform programmes one of them being PSRP (Public Sector Reform Programme) [1]. The PSRP programme’s initial phase that begun on July 2003 till September 2007 has made some significant achievements in automating the Governments’ MDAs [2]. Among the PSRP’s deliverables is the initial draft of the national e-government strategy [3]. On the other hand, most of the achievements and inputs to the initial e-government strategy so far have much to do with the urban side of the country. The ICT situations in many rural areas are in very poor conditions, and needs a big boost for the e-government strategy of the country to succeed.

Some ICT research and development projects have been run in the Country’s rural areas with the aim of improving social and economic situation. In collaborative efforts between SIDA¹, DIT² and COSTECH³, a Swedish funded project ICT4RD (ICT for Rural Development) is one of these rural development projects. It has the objective of designing and validating a strategy for establishing sustainable, low cost connectivity in rural Tanzania [4]. Its main focus is to improve services by making information easily available and accessible in the areas of education, health and local government authorities [19]. The project has run two pilot sites in three Districts (Bunda, Serengeti and Bagamoyo) in two Regions of Tanzania (Mara and Coastal Region). In these pilot sites existing broadband infrastructure has been utilized to setup networks with broadband capacity. Also ICT services (www, email, Voice over IP, internet services and Telemedicine, E-Learning applications) have been installed to facilitate communication and improve social and economic development in the respective Districts. Despite these progresses in broadband infrastructure, services and application, observations have shown there were still problems that hinder use of these services and applications [5].

The research intended to use a project approach to find and implement a practical solution in Bunda and Serengeti Districts to promote use of ICT services and applications. The action plan focused on Local Government, Education and Health areas. Through the course of action inputs to solution for similar situations in other districts and inputs to the national e-government strategy will be produced.

---

² DIT – Dar es salaam Institute of Technology, www.dit.ac.tz
³ COSTECH – Commission for Science and Technology, www.costech.or.tz
1.2 Research Problem

The problem to be resolved by this research can be generally stated in two folds:

- In the rural areas: The problem of slackness in sustainable use of ICT services to improve local communication and thus social and economic development. This is most especially in the rural areas where ICT infrastructure and services are already in place. This threatens sustainability of initial investment efforts on ICT infrastructure from physical, software and intellectual efforts.


1.3 Research Objectives

The main goal of this research is to provide suggestive ways/approaches on how to increase usage of ICT services in rural community especially in the Local Government Authorities and to find out the challenges involved. The research will be done based on a project that will be conducted at Bunda district; the following are research objectives to consider:

- Expose and document the challenges involved in making people in the rural community use ICT services.

- To encourage all clerical staff at Bunda District Council use district governance email addresses (username@bunda.go.tz), on daily basis.

- To increase the awareness of Bunda District Council staff in the use of ICT services (Mail, www, and VoIP).

- To ensure that web and mail servers under the bunda.go.tz domain are hosted locally in Bunda district.

- To ensure that there is a trained website and information master to update the district website whenever required.

- To ensure that students in Bunda secondary schools have information about existence of the Bunda district website.

- To ensure that staff at the Bunda District council are aware of importance of the district website and make use of it.

- To ensure that concerned parties where VoIP communication systems are installed, are aware of the installed service.

- To ensure the presence of up and running services in Mugumu – Serengeti that are replicas of Bunda services.
1.4 Research Motivation
The rationale behind doing this research was risen from the need to contributing towards better service delivery within the Government system and between the Government and its citizens. The emphasis being in awareness of using ICT services in rural community will awaken the community on the benefits of ICT services, which will create positive dependence to ICT services, hence sustain its use. Moreover, the findings of this research are to contribute to the scarce literature base of ICT development in rural community.

1.5 Working Method
To accomplish its main goals, the research was conducted by a practical approach in the selected rural community. In this approach the researcher was physically present in Bunda and Serengeti, worked as a consultant in collaboration with community members to solve both technical and awareness issues. In that regard a combination of methods were used, as follows:

Data Collection:
- **Review of literatures:** A review of relevant literatures related to ICT4RD and Government initiatives to promote ICT use.
- **Observation:** Being present in the research area and observing the situation through enquiring.
- **Interviews:** Conducting informal interview as a result from the observations made while in the community.

Practical Solution:
- **Technical Solution:** Providing relevant technical solution whenever found necessary from the observation.
- **Training and workshops:** Conducting training sessions and workshops to selected community members, especially at local government.

1.6 Thesis Outline
This report is divided into six sections as follows: Part I: Presents the base/existing ICT situation in Bunda and Mugumu districts. Part II: explains the practical efforts that were applied during the field work session. Part III: presents the proposed solution for Bunda and Mugumu, in most part the technical solution and a brief management solution for sustainability of the project. Part IV: shows challenges
faced in promoting use of ICT services in rural areas. Part V: presents recommendations and Part VI: Future Works.
Part I

2. Base ICT situation in Bunda and Serengeti

2.1 Bunda

This is a district in the Mara region. A region that is on the North West side of Tanzania, aside Lake Victoria. It has an area of 3,088Km$^2$ of which 480Km$^2$ is Serengeti National Park, 200Km$^2$ is covered by Lake Victoria. The remaining 2,408Km$^2$ is suitable for residence, crop production and livestock keeping. Table 1 shows the demographic characteristics of Bunda District. From the table we see that Bunda’s population is 258,930. Its population annual growth rate is 1.8 %. The big portion of Bunda’s population is peasants, fishermen, livestock keepers, small scale traders [6].

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Bunda District</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>258,930</td>
</tr>
<tr>
<td>Male</td>
<td>123,978</td>
</tr>
<tr>
<td>Female</td>
<td>134,952</td>
</tr>
<tr>
<td>Population Characteristics (1)</td>
<td>258,930</td>
</tr>
<tr>
<td>Population below 15 years (1)</td>
<td>124,945</td>
</tr>
<tr>
<td>Population 15 to 64 years (1)</td>
<td>123,118</td>
</tr>
<tr>
<td>Population 65+ years (1)</td>
<td>10,867</td>
</tr>
<tr>
<td>Average Household Size (1)</td>
<td>6.1</td>
</tr>
<tr>
<td>Annual Growth 1988-2002 % (1)</td>
<td>1.8</td>
</tr>
</tbody>
</table>

2.2 Bunda District Governance

The district’s authority is divided in two parts. There is the District Local government and the district council. The District Local Government is a political representation of the Central Government and is led by the District Commissioner (DC) below the commissioner there is the District Administrative Secretary (DAS). The District Council is the acting agency of the district, it is led by the District Executive Director (DED) and there are nine departments and three specialised units under the DED:

- Finance and Trade
• Personnel and Administration
• **Education:** Lead by District Education Officer (DEO)
• **Health:** lead by District Medical Officer (DMO)
• Agriculture, Livestock and Cooperative
• Works
• Water
• Community Development
• Natural Resources
• Planning, Legal, and Internal Audit

The focus area for the research is on Education and the Health, in this regard more emphasis is put on the District Education Officer (DEO) and the District Medical Officer (DMO) offices.

In the education sector Bunda District has 153 pre-primary schools, 151 primary schools, 26 Secondary Schools, 1 Focal Development College and 1 Teachers Training College. Three of the 26 secondary schools are private owned.

In the health sector Bunda District the District has a total of 32 private dispensaries, 3 primary health centers and 3 hospitals. Two of the hospitals (Kibara and Bunda Designated District Hospital) belong to Faith Based Organizations (FBOs).

### 2.3 ICT in Bunda

#### Infrastructure

The District has an ICT infrastructure that is composed of a VSAT for internet, a fiber backbone to Serengeti district, and wireless LAN, which interconnect the District Governance offices, a teachers training college, Bunda secondary school, Manyamanyama health centre, and Bunda District Designated Hospital (Bunda DDH). **Figure 1** shows the ICT infrastructure in Bunda District.

#### Awareness and Use

In the district council there was only one PC and one VoIP phone that were connected to the District ICT infrastructure. Two members of staff were using this PC for browsing the internet. There is one office that has three PC that were connected to the council’s VSAT and some of the council staff were using this room for browsing the internet and accessing personal emails from commercial mail domains (e.g.
yahoo.com and hotmail.com). Apart from browsing the net and accessing individual emails, the ICT infrastructure was totally out of use. Other offices had standalone PCs that were not part of the LAN and main ICT activities in these PCs were word processing activities.

**Figure 1: ICT4RD network infrastructure at Bunda [7]**
2.4 Serengeti

This is a District in the Mara region same as Bunda. Its capital town is called Mugumu. It is the land of one of the large wild animals’ park in the Work (Serengeti National Park). The district has six townships Mugumu, Fort Ikoma, Natta, Nyichoka, Nyeberekera, and Nyamsingisi. Main economic activities in this District are farming, hunting, livestock keeping, and small scale traders [8]. Table 2 shows the demographic characteristics of Serengeti District. From the table we see that Serengeti’s population is 176,067.

Table 2: Demographic Characteristics of Serengeti Districts [17]

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Serengeti District</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Population Characteristics (1)</td>
<td>176,067</td>
</tr>
<tr>
<td>Population below 15 years (1)</td>
<td>89,522</td>
</tr>
<tr>
<td>Population 15 to 64 years (1)</td>
<td>80,566</td>
</tr>
<tr>
<td>Population 65+ years (1)</td>
<td>5,969</td>
</tr>
<tr>
<td>Average Household Size (1)</td>
<td>5.5</td>
</tr>
<tr>
<td>Annual Growth 1988-2002 % (1)</td>
<td>3.3</td>
</tr>
</tbody>
</table>

2.5 District Governance

As for Bunda district, the district’s authority is divided in two parts. There is the District Local government and the district council. The District Local Government is a political representation of the Central Government and is lead by the District Commissioner (DC) below the commissioner there is the District Administrative Secretary (DAS). The District Council is the acting agency of the district, it is led by the District Executive Director (DED) and there are nine departments and three specialised units under the DED:

- Finance and Trade
- Personnel and Administration
- Education: Lead by District Education Officer (DEO)
- Health: lead by District Health Officer (DHO)
The focus area for the research is on Education and the Health, in this regard more emphasis is put on the District Education Officer (DEO) and the District Health Officer (DHO) offices.

### 2.6 ICT in Serengeti

#### Infrastructure

The District has an ICT infrastructure that is composed of a fiber backbone from Bunda district, and wireless LAN, which interconnect the District Governance offices, Nyerere DDH, TANESCO offices, Nata Health Centre and Nata Secondary School. **Figure 2** shows the ICT infrastructure in Mugumu-Serengeti and **Figure 3** shows ICT infrastructure in Nata village in Serengeti District.

#### Awareness and Use

Compared to Bunda district Council, Mugumu district council does not own a VSAT for internet connection. There were standalone PCs in the district council’s offices. Main ICT services were word processing and when there is a need for browsing the internet or reading emails, members of staff had to visit an expensive internet café in the small town.
Figure 2: ICT4RD network infrastructure at Mugumu-Serengeti [7]
Figure 3: ICT4RD network infrastructure at Nata-Serengeti [7]
2.7 Overview of ICT infrastructure Bunda and Serengeti

Figure 4 shows the overall ICT infrastructure from Bunda to Mugumu-Serengeti. Note that both districts belong to one private network (192.168.5.0/24). IP addresses on equipments in both networks are being assigned by a DHCP server in Bunda server room (Bunda s/s).

Figure 4: Overview of ICT4RD Infrastructure from Bunda-Mugumu
Part II

3. Field Work

3.1 Localization of District web and mail services

Website services for Bunda and Serengeti districts were hosted at COSTECH in Dar es Salaam. This presented some difficulty to the local staff in updating the website. The difficulty was due to low bandwidth connection, which resulted to longer time in updating the website and sometimes connection errors to the webserver. Initial tasks on the field work were to localize the website to Bunda and localizing mail services in the district.

In localizing the district website and mail services the following technical activities were performed (Technical details and configurations for these tasks are on Appendix A)

- Installation of Ubuntu 8.04 for different services.
- Installation and configuration of the district’s DNS server. This activity involved installation of Bind9 DNS server and changing name server pointers from COSTECH servers to Bunda DNS server.
- Installation and configuration of mail services. This involved the following activities:
  - Installation and configuration of postfix for the Mail Transfer Agent (MTA) SMTP services [9].
  - Installation and configuration of Dovecot for POP3 and IMAP [10].
  - Installation and configuration of MySQL server for handling mail boxes for different virtual domains.
  - Installation and configuration of postfixadmin for easy web based administration of emails accounts and domains in the MySQL database [11].
  - Installation and setup of Squirrelmail to provide users with web access to mailboxes [12].
  - Installation and configuration of Spamassasin for handling spam emails [13].
  - Installation and configuration of ClaimAV and Amavis for protection against viruses [14].
In addition to the above to enhance security SMTP AUTH is set to allow authenticated users to access emails even when they are outside the district network. Also TLS encryption was set using OpenSSL [15].

- Installation and configuration of web services. This involved the following activities:
  - Installation of Apache2 webserver
  - Configuration of the MySQL database server.
  - Installation and setting up of Drupal Contents Management System (CMS).
  - Migration of website files and database from COSTECH to Bunda Server
  - Installation of educational wiki for providing access to academic materials to local scholars.

### 3.2 Promotion of usage of District Website

Now that the district’s web services are technically stable. Three workshops were conducted that involves awareness and training on use of different ICT services in the district. Among agendas in the workshop is the use of website for district users, in the aspect of sharing information and the administration of website through updates. The training on updates and general management of the website was conducted only to selected staff with basic skills on the technical aspect of ICT.

Training to technical staff involved:

- Installation and setting up of Drupal.
- Updating of contents and media.
- Management of the website database.

Training to other website users involved:

- The kind of information that could possibly be shared on the district website.
- How to navigate through the website.
- Encouragement to daily visit the website. This was further reinforced by including the link to visit district email service via the district website ([www.bunda.go.tz/webmail](http://www.bunda.go.tz/webmail)).

### 3.3 Facilitation of usage of VoIP services

Prior to research field work VoIP service was present in the district. There were slight problems in usage of the services. These problems can be explained as technical and social. On the technical side not all
subscribed IP phones were accessible in the network due to network connection problems of the LAN. On the social side, some key offices lacked IP phones thus hindering fast adoption of IP phones. e.g. there was only one IP Phone on the District Council premises that was installed in an ICT room, this implies that key person like the District Education Officer DEO did not have a phone on their desk, hence making it a bit cumbersome for them to walk down the corridor to make or receive phones from connected schools or other education centers.

In this regard as part of field work a Local Area Network (LAN) is installed in the District Council premises and additional IP phones were provided to key person as follows: District Commissioner, District Administrative Secretary (DAS), District Executive Director (DED), District Education Officer (DEO) and the District Medical Officer (DMO).

There was also a technical side of this activity, which involved installation and setting up of the new VoIP server (OpenSIPS). Along with the installation and configuration of this new VoIP server was the troubleshooting and rectification of problems in the District Area wireless network to ensure that all subscribers can be accessed on the network.

Communication that involved targeted parts (Schools, Health Centre and the Local Government person) were performed, at the end an easy phone numbers directory was created and supplied to all subscribers. An additional activity that was performed in this category was a daily call to different subscribers and say “hello” as a reminder for using the IP phones.

### 3.4 ICT awareness workshops
To create awareness of ICT issues in the districts, three ICT awareness workshops were conducted:

- **Sengerema ICT workshop**: This workshop was conducted in Sengerema District, in Mwanza Region. A neighbor Region to Mara Region, were Bunda and Mugumu are situated. The main purpose for this training was to prepare the two districts to formulate their ICT strategic and action plan. In addition to that presentations and discussion sessions on e-government, e-health and e-learning were conducted to stimulate a wider awareness of ICT issues in the country with respect to development in rural communities. On each of the “e-topic” participants were enlightened about the what? why? and how? of each topic. Participants in this workshop were: Staff from Bunda District council, Staff from Serengeti District Council and DC office, some selected representative members of the Bunda and Mugumu communities (Priests, Sheikhs, Business representatives, and local politicians)

- **Bunda ICT workshop**: This workshop was conducted to explain in detail importance of use of ICT communication services for daily operations (emails, website and VoIP). This section involved training on the use of district website and email services. Participants in this workshop were: The District Commissioner, The District Administrative Secretary, The District Executive Director, The District Education Officer, different heads of departments and District Council ICT staff.
- Mugumu ICT workshop: This workshop was conducted to explain in detail importance of use of ICT communication services for daily operations (emails, website and VoIP). This section involved training on the use of district website and email services. As compared to the number of participants in the Bunda workshop the participants in this workshop were very few and key district persons were lacking in the workshop.

### 3.5 ICT Technical Training

In both districts there is lack of people with technical skills in IT. In this regard two people were trained to take care of the technical aspects related to ICT services. One person from the Bunda district council and another from the ICT4RD project to oversee both Bunda and Mugumu network and services. They were trained on the following:

- Administration of the mail server.
- Administration of users’ mail accounts.
- Administration of webserver.
- Administration of VoIP server.
- Additional network troubleshooting skills.

### 3.6 Participation and Observation

In the timeline of the fieldwork cycle informal interviews and observations on ICT related activities and habits were conducted in the Local Government premises, Education centers and health centers. This led to the contributions as further explained in the challenges section.
Part III

4. Proposed Solution for Bunda and Mugumu

In regard to basic technical infrastructure Bunda and Mugumu have a good starting point for providing ICT services to their communities. However, in the long run this basic infrastructure might fail to support more users, which might lead to collapsing of the network. On the other side the cost of running the network and its available services are being funded by the ICT4RD project that has a limited time of support, this raises a need for a long term solution to sustain the available infrastructure and services. This section pin points the shortcomings of available basic infrastructure and proposes a scalable technical solution also propose a model to be followed in order to sustain the management of available infrastructure and services in a long run.

4.1 Detailed Existing Technical Solution

Figure 5 shows the simplified logical network diagram of the current Bunda-Mugumu network. From the VSAT the connection goes through the router then to the layer 3 switch. From the one huge single network (192.168.5.0/24) interconnects different network segments within the two districts.

Figure 5: Simplified logical network diagram of the current Bunda-Mugumu network
The design in figure 5 has the following flaws:

- **Security:**
  - All networks for different entities/offices are connected in the same large network for Bunda and Mugumu. This implies that a security risk such as virus breakdown that originates from one PC in one of the attached network segments can easily propagate to the rest of the network.
  - In case of an attack on any PC on the network, an attacker can easily gain access to any PC on the network.

- **Performance:**
  - Since the entire network is in the same collision and broadcast domain, broadcast packets from one PC can slowdown the whole network.
  - There is no proxy service to allow caching of frequent visited website pages. This implies that each connected PC has to get a fresh copy of the webpage from the internet; as a result more bandwidth is consumed.
  - There is no a software update server (SUS) for connected PCs to download software updates. This means each connected PC has to download software updates from a server located in the internet, hence consumption of more bandwidth.

- **Scalability:**
  - The choice of the private class (192.168.5.0/24) imposes a limit to the number of machines that can be connected in this network to only 254 machines.
  - The fact that all connected machines belongs to the same network has a repercussion that addition of more connected devises in the network will result to low performance and more security risks.

- **Reliability:**
  - Mugumu internet connectivity depends on the VSAT at Bunda site, and the fiber connection between Bunda and Mugumu. This implies that whenever there is a problem on the fiber connection between Bunda and Mugumu, then Mugumu is out of internet service.
4.2 Proposed Technical Solution

Figure 6: proposed logical network diagram for Bunda-Mugumu network.

Figure 6 shows the proposed logical network diagram for Bunda-Mugumu network. The new design has some added features as follows: a transparent proxy server is added on the core network at Bunda, VLANs are added to separate different network segments on the entire network and routers are used to perform routing between different VLANs (Inter-VLAN routing), as a result the whole network is no longer logically a single network, monitoring services/tools are added in the Bunda network operations centre to monitor network activities. The weaknesses in the current designed have been mitigated as follows:

- Security:
  - VLANs are added to separate different network segments as follows:
    - Bunda
• VLAN B-Services: The VLAN for the services provided from Bunda core network operations center

• VLAN B-Gov: The VLAN for the Bunda Local Government Network

• VLAN B-Edu: The VLAN for the Bunda Education sector

• VLAN B-Health: The VLAN for the Bunda Health sector

  - Serengeti (Mugumu)

  • VLAN S: The VLAN to interconnect Serengeti Link from Bunda core network

  • VLAN S-Gov: The VLAN for Serengeti Local Government Network

  • VLAN S-Edu: The VLAN for the Serengeti Education Sector

  • VLAN S-Health: The VLAN for the Serengeti Health Sector

• Performance:
  
  o A transparent caching proxy server is added to store and provide recent copies of frequent visited websites. This makes it fast for PCs in the district LANs to get a copy of a webpage, also utilizes bandwidth consumption since only few PCs will have to download web pages from the internet.

  o Introduced new VLANs divides the network into different collision domains, this implies that broadcast packets from one of the many segments wont flood the other network segments hence preserve performance of the network.

• Scalability:

  o Introduction of different VLANs makes it possible to add new network devises in the network without causing noticeable degradation in performance.

• Reliability:

  o To resolve the reliability issue of having only one link to connect Bunda and Mugumu, a new redundant link will have to be provided, but this can be costly in this regard the link has not been introduced on the design.
4.3 Proposed Management Solution (Sustainability)

The project is under funding and managed by the ICT4RD project. The funds from the ICT4RD project have a limited time frame; this implies that the community has to take ownership of the project. In this regard one of the suggested sustainability initiative is sharing the cost between the public and private organizations within Bunda and Mugumu communities [16]. This will add value through:

- Facilitating greater commitment by increasing communities’ stake in programme outcomes.
- Helping to enhance confidence in rural communities’ abilities to assist themselves.
- Improve programme sustainability by establishing funding mechanism.
- Increase the cost-benefit of programme activities.

At present in Bunda and Serengeti there are NGOs and Public organizations with own connections to the internet via VSATs, and other plans to connect to the internet via the same method. These organizations could come in a common agreement of utilizing available infrastructure and share cost on bandwidth and related IT operations technical costs. Private organizations like MCM, Compassion, and OXFAM on the public side the Local Government authority, schools and hospitals can get in a common agreement to share cost and run a bandwidth consortium for the two districts. The formed cooperation should run a non-profit ISP to provide service to its members.
Part IV

5. Challenges of promoting e-Government in rural areas

There are several challenges that face promotion of e-government in rural communities. These challenges range from political, technical to social challenges. This section categories different challenges as observed from the areas under case studies also from other areas as per similar projects in other countries.

5.1 Political

Most of the political leaders both in urban and rural areas have no interest in ICT, which may be due to lack of ICT awareness and lack of knowledge on how to use ICT services. Though the trend in the government have recently started to show some interest in ICT initiatives, the ripple effect of this have not reached much in the rural communities. Also despite the fact that the Government has started to show interest in ICT initiatives, still it is not in their priority area. This can be explained from most of political vote requesting debates were ICT is a term that can rarely be mentioned. It follows that with no mentioning of ICT in political vision, governmental leaders as well in rural areas will not put much emphasis on it, since they are supposed to execute the will of the government were ICT is not a key priority.

5.2 Technical

In most of rural areas there is noticeable lack of infrastructure for ICT services to reach the community. Except for fewer Regions and District like Bunda, Serengeti and Pwani were there are fiber optic cables from government MDAs for that are used for other purposes than ICT, most of the rural areas have no such infrastructure. There is a great lack of people with ICT skills in most rural areas, which can be a result of lack of ICT education centers, and for the few with skills it is not easy to maintain them in rural jobs. Better paying companies in urban areas absorbs the few skilled people who could have otherwise save the rural communities. There is also lack of ICT units in district local government offices, these units could have otherwise provide the districts with ICT human resource.

5.3 Social

People in rural communities are stack in the old tradition of keeping records and communicating, an idea for them to use computers for easy information processing is received with mixture of excitement and fear. Excitement that they are going to change and become up to date, and the fear of lack skills in
using computers. Some have fear that they will lose their recognition as being masters of the “old” methods of processing information.

People hear about ICT, but they are not well informed about it. This creates a tendency of perceiving ICT as a very difficult tool to master its use, even though most of them believe from hearing that it is the best tool for processing information.

5.4 Economical

Nature of economic activities in most of these places are currently operated without a direct link with ICT e.g. fishery, farming, local mining. These activities are being done in a traditional way and there are no initiatives to evolve them to technology dependency. In a way this lead to people in these areas not to be moved directly into using ICT.

Overall poor economic situation of the country leads to priorities being drifted away from ICT to other quick fix urgent needs. (e.g. quick fixes in education and health sector. Contraction of many schools followed by teachers trained in a month period to occupy posts in those schools. Construction of health centers in rural areas where it is difficult for qualified medical officers to serve for long period of time)
Part V

6. Recommendations

Following the whole cycle of the research field work practical and observations, the following are recommendations for facilitating e-government services in rural areas:

- The government from its development goals and through its Ministries, Departments and Agencies should prioritize use of ICT and demand to see progress in this sector from the Local Government Authorities. The bigger picture here is that, if ICT is among the key priority areas in the Country’s development policies, then leaders in the Local Government Authorities will fill obligated to stimulate ICT activities in their territories. Not only that should ICT be given priority on papers, but rather development should be measured in terms of indicators set forth to monitor ICT activities.

- Through initiatives to facilitate eGovernance in the country, the government should put emphasis on establishment of Telecentres in rural communities to improve access to ICT services and awareness.

- Along with Telecentres, in the rural communities there should be ICT learning centers, which can either be part of multipurpose Telecentres or they can be dedicated centers for skills creation and ICT capacity building.

- The government should consider putting emphasis on ICT lessons in elementary schools. The educational syllabuses should be amended to include different methods and procedure to build a nation of not only literate citizens, but ICT literate citizens.

- As for the major roads in the country, the government should consider seeing investments in ICT infrastructure as a key area for future long term investment in a Country of well informed and knowledgeable citizens, hence a stimulation of economical development for the country and its citizens.

- Both the public and private sectors should work in creating ICT awareness in such a way that ICT be among the top list in political champagnes. If it will reach a point were among other political promises ICT is among the top priorities in political arenas, then ICT development will gain a new gear to penetrate the society.

- The government should have a good policy of working in a good cooperation with the private sector, so as to form joint efforts in initiating and sustaining ICT project for rural communities.
At present the government should ensure that all its District LGAs have ICT units for training and supporting ICT activities. The current status is there is only Regional ICT focal point for each region, who attends the needs of all districts in that particular region [18].

The government should have a procedure of working to formulate District’s ICT boards that will own, oversee and stimulate ICT development activities in districts.

There should initiatives to establish challenges with reasonable awards in schools to stimulate ICT focus in students in rural communities.

Computer literacy should be put as a compulsory requirement in all government related jobs.

ICT should be added on the top slogans of the country. e.g. instead of sticking to the old eradication of poverty, and ill health, general illiteracy ICT illiteracy should added in the list.
Part VI

7. Conclusion and Future Works

7.1 Conclusion

The main goal of this research was to provide ways/approaches on how to increase usage of ICT services in rural community especially in the Local Government Authorities and to study the challenges involved in making this possible. The research was done on a project based approach and the following objectives were achieved:

- Exposure of challenges involved in the process of facilitating e-government activities in rural areas.
- Awareness trainings and workshops were conducted to a group with a mixture of people representing different units in the district (DC, DAS, DED, DEO, heads of departments, local politicians, priests, sheikhs, teachers, and representatives from NGOs)
- Locally hosting of stable web and mail services under the bunda.go.tz domain in Bunda district, with local administration.
- Training to webmaster and department heads on the importance and using websites and how to update the district website
- Disseminated information about the website to schools via awareness workshop to the District ICT board and to District Education Officer.
- Personalized email addresses were created for staff at the Bunda and Serengeti District Council (username@bunda.go.tz). Along with creation of personalized email addresses, staffs were given overview awareness training and the selected ICT focal person was encouraged to prepare an agenda for frequent local trainings.
- VoIP services were re-installed and more IP phones were added to stimulate communication via VoIP systems.
- In Mugumu training were given as a replica of what was done in Bunda. They also access their services directly from the servers in Bunda.

The whole research task was a success in large extent and field observations shows that there is a great possibility for the country to facilitate ICT activities in the rural community. This could be achieved when the government takes measure in prioritizing ICT activities and among other development indicators, ICT awareness should be of high priority.
7.2 Future Work

The following are activities that can be done to further improve the current situation of the ICT4RD project at Bunda and Mugumu:

- Formation of a PPP consortium and work together to establish and ISP for Bunda and Mugumu. The existence of such consortium will ensure sustainability of the project in terms of financial backup, management and social awareness creation of ICT.

- Strengthening of the Bunda and Mugumu network as per proposed technical solution. This will stabilize the network and give room to expansion of the network, meanwhile maintaining security and good performance.
8. References

[1]. Tanzania PSRP (Public Service Reform Programme), [www.utumishi.go.tz](http://www.utumishi.go.tz), last visited: January 2009


[3]. Tanzania e-government strategy, 2nd version of December 2008


[6]. Bunda District Governance Website, [www.bunda.go.tz](http://www.bunda.go.tz), last visited: May 2009

[7]. ICT4RD Project, “Bunda-Mugumu Broadband Network Documentation Version 1.0”

[8]. Prof O. Mascarenhas, E.Kimasha, A baseline study for assessing the impact of the fiber optic with broadband in Bunda and Serengeti Districts


[17]. URT 2002 Population and Housing Census

[18]. Interview with the Senior Computer Systems Analyst of the Local Government Authorities HQ in Dodoma.

Appendix A: Setting up a Robust Mail Server in Ubuntu 8.04

1. Install the MTA: Postfix

   1. Install postfix:
      a. sudo aptitude install postfix
      b. During installation select “Internet site” for mail configuration

   2. Install mailx package for use as command mail utility program (Not Necessary)
      a. sudo apt-get install mailx

3. Test default setup:

   Add a user before you start this.

   sudo useradd -m -s /bin/bash fmaster
   sudo passwd fmaster

   Test your default installation using the following code segment.

   netcat localhost 25

   Postfix will prompt like following in the terminal so that you can use to type
   SMTP commands.

   Trying 127.0.0.1...
   Connected to mail.fossedu.org.
   Escape character is '^]'.
   220 localhost.localdomain ESMTP Postfix (Ubuntu)

   Type the following code segment in Postfix's prompt.

   ehlo localhost
   mail from: root@localhost
   rcpt to: fmaster@localhost
   data
   Subject: My first mail on Postfix
Hi,
Are you there?
regards,
Admin
   (Type the [.dot] in a new Line and press Enter )
quit

Check the mailbox of fmaster

su - fmaster
mail

When you type mail command an output like follows display in your terminal.

Mail version 8.1.2 01/15/2001. Type ? for help.
"/var/mail/fmaster": 2 messages 2 new
>N 1 root@localhost Mon Mar  6 12:49   13/479 Just a test
N 2 root@localhost Mon Mar  6 12:51   15/487 My first
mail
&

4. Install Dovecot IMAP and POP3
   a. apt-get install dovecot-common
   b. apt-get install dovecot-dev
   c. apt-get install dovecot-imapd
   d. apt-get install dovecot-pop3d

5. Configure postfix:
   a. sudo dpkg-reconfigure postfix {an alternative to this is to use one by one sudo e.g. sudo postconf -e
      "mynetworks = 127.0.0.0/8, 192.168.1.0/24"}

      Insert the following details when asked (replacing server1.example.com with your domain name if you have one):

      • General type of mail configuration: Internet Site
      • NONE doesn't appear to be requested in current config
      • System mail name: server1.example.com (enter your mail server)
      • Root and postmaster mail recipient: <admin_user_name> (enter admin)....!!! U may leave this empty or admin@example.com
      • Other destinations for mail: server1.example.com, example.com, localhost.example.com, localhost ......!!! U must leave it empty if u
hosting virtual domains. This manual is for virtual hosts so leave this empty

- Force synchronous updates on mail queue?: No
- Local networks: 127.0.0.0/8, 192.168.5.0/24
- Yes doesn’t appear to be requested in current config
- Mailbox size limit (bytes): 0
- Local address extension character: +
- Internet protocols to use: all

b. Configure mailbox format

i. sudo postconf -e 'home_mailbox = Maildir/'

ii. sudo postconf -e 'mailbox_command ='

1. Note: This will place new mail in /home/username/Maildir so you will need to configure your Mail Delivery Agent to use the same path.

c. Test 2

Test your setup again using following code:

netcat mail.example.com 25
ehlo example.com.
mail from: root@example.com
rcpt to: fmaster@example.com
data
Subject: My first mail for my domain

Hi,
Are you there?
regards,
Admin
. (and Enter In a new Line)
quit

Check the mailbox of fmaster

su - fmaster
cd Maildir/new
ls

Troubleshooting: if you do not have the Maildir/new make sure that you have the mydestination set to server1.example.com, example.com, localhost.example.com, localhost

Where example.com is your domain name. (You will have to remove this later if you are planning to have virtual domains in your mail server)

Now you will see mail has a separate file.
Testing Dovecot POP3

Type in a terminal:

```
netcat mail.example.com 110
```

Use the following example code segment for your test. Be intelligent to tweak the changes appropriately to your environment. An output like follows will display in your terminal.

```
Connected to mail.yourdomain.com (208.77.188.166).
Escape character is '^]'.
+OK Hello there.
```

Type the following code segment in the prompt provided by the Courier POP3 server. I assume that you are intelligent enough not to type the lines which starts from +OK

```
user fmaster
+OK Password required.
pass password
+OK logged in.
quit
```

Testing Dovecot IMAP

Type in a terminal:

```
netcat mail.yourdomain.com 143
```

Use the following example code segment for your test. Be intelligent to tweak the changes appropriately to your environment. An output like follows will display in your terminal.

```
```

Type the following code segment in the prompt provided by the Courier IMAP server.

```
a login fmaster password
a OK LOGIN Ok.
a logout
```

-------- xxx it this point can work, but no security xxxxx --------
2. Install MySQL map support for Postfix
   i. apt-get install postfix-mysql package
   ii. mysql-client-5.0
   iii. mysql-common
   iv. mysql-server-5.0
   v. php5-common
   vi. php5-mysql
   vii. libapache2-mod-auth-mysql

3. Setting MySQL Backend (Configure MySQL DB for Postfix)
   i. Set MySQL root password:
      1. $ sudo mysqladmin -u root password rootpassword
      Or
      1. $ mysql -u root then
      2. mysql> SET PASSWORD FOR 'root'@'localhost' = PASSWORD('rootpassword');
   ii. Setting up MySQL DB
      1. Refer to Appendix 1 for the Scripts for Setting Up the Database

4. Setting MySQL Postfix maps
   a. Refer to Appendix II for the Scripts to Setting up MySQL postfix maps
      i. Creating Virtual Alias Maps
      ii. Virtual Domain Maps
      iii. Virtual Mailbox Maps
      iv. Virtual Mailbox Quota Maps
      v. Relay Domain Maps
      vi. Create a vmail user

5. Configuring Postfix with MySQL Maps
   a. Edit the postfix main.cf
      i. $ sudo editor /etc/postfix/main.cf then add the script in appendix III
6. Setting up Postfix

Postfix has several hundred configuration parameters that are controlled via the main.cf file. Fortunately, all parameters have sensible default values. We only have to define the following parameters

```
$ sudo editor /etc/postfix/main.cf
#The host name where your MX for virtual domains will point to
myhostname = mail.example.com
mydestination = #Remains blank since we are going to host virtual domains
relayhost = #Remains blank unless you are going to use your ISP's SMTP server mail sending out mails. In which case it would be set to the host name of the ISP's SMTP server

Leave the following to their default values

alias_maps = hash:/etc/aliases
alias_database = hash:/etc/aliases
myorigin = /etc/mailname
mynetworks = all
mailbox_size_limit = 0
recipient_delimiter = +
inet_interfaces = all
```

7. Link Dovecot with MySQL

a. Configure the Dovecot/MySQL setup in /etc/dovecot/dovecot-sql.conf using these settings:
   i. driver = mysql
   ii. connect = dbname=postfix user=postfixadmin host=localhost password=********
   iii. default_pass_scheme = PLAIN {u can put MD5 for security}
   iv. password_query = SELECT password FROM mailbox WHERE username = '%u'
   v. user_query = SELECT maildir, 106 AS uid, 106 AS gid FROM mailbox WHERE username = '%u'

b. Configure the Dovecot/MySQL setup in /etc/dovecot/dovecot.conf using these settings:
   i. protocols = imap imaps pop3 pop3s
   ii. disable_plaintext_auth = no
   iii. log_timestamp = "%Y-%m-%d %H:%M:%S"
   iv. mail_location = maildir:/home/vmail/%d/%n
   v. mail_access_groups = mail
   vi. first_valid_uid = 5000
   vii. first_valid_gid = 5000
   viii. protocol imap {
   }
pop3_uidl_format = %08Xu%08Xv
}

auth default {
  mechanisms = digest-md5 plain
  passdb sql {
    args = /etc/dovecot/dovecot-sql.conf
  }
  userdb sql {
    args = /etc/dovecot/dovecot-sql.conf
  }
  user = root
}
8. Setting up Postfixadmin

a. Postfixadmin
   i. Download postfix admin debian package from
      http://postfixadmin.sourceforge.net/
   ii. Install package: dpkg -i postfixadmin_2.2.0_all.deb
   iii. Restart Apache2: /etc/init.d/apache2 restart
   iv. edit /usr/share/postfixadmin/config.inc.php
      1. $CONF['configured'] = true;
      2. $CONF['postfix_admin_url'] = 'http://localhost/postfixadmin';
      3. $CONF['database_type'] = 'mysql';
      4. $CONF['database_host'] = 'localhost';
      5. $CONF['database_user'] = 'postfixadmin';
      6. $CONF['database_password'] = '******';
      7. $CONF['encrypt'] = 'cleartext';  {u can use MD5 if ur pop and imap support it}
      8. $CONF['domain_path'] = 'YES';
      9. $CONF['domain_in_mailbox'] = 'NO';
     10. $CONF['fetchmail'] = 'NO';
   v. Browse http://localhost/setup.php read the warnings
   vi. Rename the /usr/share/postfixadmin/setup.php file to e.g. setup.php.disabled
   vii. Enter into MySQL postfix database and add username admin in admin
        and domainadmins tables
   viii. Browse http://localhost/postfixadmin
   ix. Now you can add mailboxes and administer ur mail system via postfixadmin
   x.

9. Setting up Squirrelmail for webaccess

a. apt-get install squirrelmail
b. cp  /etc/squirrelmail/apache.conf /etc/apache2/sites-available/squirrelmail
c. ln -s /etc/apache2/sites-available/squirrelmail
       /etc/apache2/sites-enabled/squirrelmail
d. /etc/init.d/apache2 force-reload
e. Check if it works http://localhost/squirrelmail
f. Add plugins. E.g. password change plugin. Untar the following plugins in the /usr/share/squirrelmail/plugins directory
   i. http://www.squirrelmail.org/plugins.php (Choose a password plugins suitable
      for a mysql database, then follow instructions to install it)
   ii. In this case this plugin was used .. change_sqlpass-3.3-1.2.tar.gz, with
      the following compatibility plugin ... compatibility-2.0.tar.gz, some
compatibility plugins have disturbing errors, u may need to be patient to trouble shoot them.

g. cd /usr/share/squirrelmail/plugins/change_mysqlpass/
   i. copy config.php.sample to config.php
   ii. make changes to config.php as per your mysql server settings

h. Enable the change password and the compatibility plugins by running
   /etc/squirrelmail/conf.pl or squirrelmail-configure

i. Login into squirrelmail go to options, change password and observe the changes.

j. If you will encounter some errors try to resolve them by commenting responsible lines and observe the effect.

k. Customize the squirrelmail login interface to your liking in
   /usr/share/squirrelmail/src/login.php and /usr/share/squirrelmail/config/config.php

l. . . . Enjoy the squirrelmailing.


   a. SMTP Authentication

      i. Install Packages for SMTP authentication

         1. To provide encrypted smtp access: install postfix-tls package

         2. To allow authorized users to be authenticated from other networks:

            a. Install Cyrus SASL Library: libsasl2

            b. To add authentication mechanism for SASL library: Install
               libsasl2-modules and sasl2-bin

            c. To add MySQL support authentication mechanism: Install
               libsasl2-modules-sql

            d. To create certificates: Install openssl

      ii. Add the following in /etc/postfix/main.cf

         smtpd_sasl_local_domain = $myhostname

         smtpd_sasl_auth_enable = yes

         smtpd_sasl_security_options = noanonymous

         broken_sasl_auth_clients = yes
smtpd_recipient_restrictions = permit_sasl_authenticated, permit_mynetworks, reject_unauth_destination

iii. Create a directory mkdir /etc/postfix/sasl

1. Cd /etc/postfix/sasl

2. vim smptd.conf then enter the following:
   
   pwcheck_method: auxprop
   auxprop_plugin: sql
   mech_list: plain login cram-md5 digest-md5
   #sql_verbose: yes
   sql_engine: mysql
   sql_hostnames: 127.0.0.1
   sql_user: postfix
   sql_passwd: *****stn
   sql_database: postfix
   sql_select: select password from mailbox where username = '%u@%r'

iv. Restart postfix and dovecot

v. Configure your pop mail client with a “my outgoing server requires authentication” option

vi. Test your mail system by sending emails to your users.

vii. Send outside your domain like yahoo.com

viii. To receive mail from outside domains you have to do something on the MX record of outside DNS servers. (It is simple but outside the scope of this manual)

ix. I am wishing you happy secure emailing
b. ClamAV, Spamassassin and AMAVIS antivirus

i. For Virus and Anti Spam protection install and configure the following packages

1. apt-get install clamav spamassassin amavis

Appendix I: Script for setting MySQL Database

The schema is based on the postfixadmin MySQL schema. If you are impatient you can directly create the tables using following steps.

$ edit postfixadmin-mysql.sql

Then copy and paste the following script to the above file and save it. Replace postfixpassword on the INSERT INTO user line with a password of your choosing for the postfix user. Do the same for the postfixadmin password.

To create the database, type in a terminal.

$ mysql -u root -p < postfixadmin-mysql.sql

# This is the complete MySQL database structure for Postfix Admin.
# If you are installing from scratch you can use this file otherwise you need to use the TABLE_CHANGES.TXT or TABLE_BACKUP_MX.TXT that comes with Postfix Admin.
# There are 2 entries for a database user in the file.
# One you can use for Postfix and one for Postfix Admin.
# If you run this file twice (2x) you will get an error on the user creation in MySQL.
# To go around this you can either comment the lines below "USE MySQL" until "USE postfix".
# Or you can remove the users from the database and run it again.
# You can create the database from the shell with:
# mysql -u root [-p] < DATABASE_MYSQL.TXT

# Postfix / MySQL
CREATE DATABASE postfix;

GRANT SELECT ON postfix.* TO postfix@localhost IDENTIFIED BY 'postfixpassword';
GRANT SELECT, INSERT, DELETE, UPDATE ON postfix.* TO postfixadmin@localhost IDENTIFIED BY 'postfixadmin';

USE postfix;
#
# Table structure for table admin
#
CREATE TABLE admin (  
    username varchar(255) NOT NULL default '',  
    password varchar(255) NOT NULL default '',  
    created datetime NOT NULL default '0000-00-00 00:00:00',  
    modified datetime NOT NULL default '0000-00-00 00:00:00',  
    active tinyint(1) NOT NULL default '1',  
    PRIMARY KEY (username),  
    KEY username (username)  
) COMMENT='Postfix Admin - Virtual Admins';
#
# Table structure for table alias
#
CREATE TABLE alias (  
    address varchar(255) NOT NULL default '',  
    goto text NOT NULL,  
    domain varchar(255) NOT NULL default '',  
    created datetime NOT NULL default '0000-00-00 00:00:00',  
    modified datetime NOT NULL default '0000-00-00 00:00:00',  
    active tinyint(1) NOT NULL default '1',  
    PRIMARY KEY (address),  
    KEY address (address)  
) COMMENT='Postfix Admin - Virtual Aliases';
#
# Table structure for table domain
#
CREATE TABLE domain (  
    domain varchar(255) NOT NULL default '',  
    description varchar(255) NOT NULL default '',  
    aliases int(10) NOT NULL default '0',  
    mailboxes int(10) NOT NULL default '0',  
    maxquota int(10) NOT NULL default '0',  
    transport varchar(255) default NULL,  
    backupmx tinyint(1) NOT NULL default '0',  
    created datetime NOT NULL default '0000-00-00 00:00:00',  
    modified datetime NOT NULL default '0000-00-00 00:00:00',  
    active tinyint(1) NOT NULL default '1',  
    PRIMARY KEY (domain),  
    KEY domain (domain)  
) COMMENT='Postfix Admin - Virtual Domains';
#
# Table structure for table domain_admins
CREATE TABLE domain_admins (  username varchar(255) NOT NULL default '',  domain varchar(255) NOT NULL default '',  created datetime NOT NULL default '0000-00-00 00:00:00',  active tinyint(1) NOT NULL default '1',  KEY username (username) ) COMMENT='Postfix Admin - Domain Admins';

CREATE TABLE log (  timestamp datetime NOT NULL default '0000-00-00 00:00:00',  username varchar(255) NOT NULL default '',  domain varchar(255) NOT NULL default '',  action varchar(255) NOT NULL default '',  data varchar(255) NOT NULL default '',  KEY timestamp (timestamp) ) COMMENT='Postfix Admin - Log';

CREATE TABLE mailbox (  username varchar(255) NOT NULL default '',  password varchar(255) NOT NULL default '',  name varchar(255) NOT NULL default '',  maildir varchar(255) NOT NULL default '',  quota int(10) NOT NULL default '0',  domain varchar(255) NOT NULL default '',  created datetime NOT NULL default '0000-00-00 00:00:00',  modified datetime NOT NULL default '0000-00-00 00:00:00',  active tinyint(1) NOT NULL default '1',  PRIMARY KEY (username),  KEY username (username) ) COMMENT='Postfix Admin - Virtual Mailboxes';

CREATE TABLE vacation (  email varchar(255) NOT NULL default '',  subject varchar(255) NOT NULL default '',  body text NOT NULL,  cache text NOT NULL,  domain varchar(255) NOT NULL default '',  created datetime NOT NULL default '0000-00-00 00:00:00',  active tinyint(1) NOT NULL default '1',  PRIMARY KEY (email),  KEY email (email) ) COMMENT='Postfix Admin - Virtual Vacation';

#------------------------------------
# End copy---------------------------
Appendix II: Setting Postfix MySQL Maps

Creating Virtual Alias Maps

Postfix will use this file for Virtual Alias Maps and it will use The LHS of the mapping is defined as where_field and the RHS is defined as select_field. In this file it would be a mapping of the address column to the goto column.

$ sudo editor /etc/postfix/mysql_virtual_alias_maps.cf

Then add the following code segment to the above file.

user = postfix
password = postfixpassword
hosts = 127.0.0.1
dbname = postfix
table = alias
select_field = goto
where_field = address

Virtual Domain Maps

Postfix is only using domain field from this table. For domains we do not need to map LHS and RHS.

$ sudo editor /etc/postfix/mysql_virtual_domains_maps.cf

Then add the following code segment to the above file.

user = postfix
password = postfixpassword
hosts = 127.0.0.1
dbname = postfix
table = domain
select_field = domain
where_field = domain
#additional_conditions = and backupmx = '0' and active = '1'

Virtual Mailbox Maps

Postfix will map username column with maildir querying mailbox table.

$ sudo editor /etc/postfix/mysql_virtual_mailbox_maps.cf
Then add the following code segment to the above file.

```plaintext
user = postfix
password = postfixpassword
hosts = 127.0.0.1
dbname = postfix
table = mailbox
select_field = maildir
where_field = username
#additional_conditions = and active = '1'
```

**Virtual Mailbox Quota Maps**

Postfix will this maps to handle the quota for virtual mailboxes. **Username** column will be mapped with the **quota** column in the **mailbox** table.

```
$ sudo editor /etc/postfix/mysql_virtual_mailbox_limit_maps.cf
```

Then add the following code segment to the above file.

```plaintext
user = postfix
password = postfixpassword
hosts = 127.0.0.1
dbname = postfix
table = mailbox
select_field = quota
where_field = username
#additional_conditions = and active = '1'
```

**Relay Domain Maps (In rare cases)**

*If you are going to use your mail system only for hosting backup MX for some virtual domains then you need this mapping to tell the Postfix to enable the relaying for these domains.*

```
$ sudo editor /etc/postfix/mysql_relay_domains_maps.cf
```

Then add the following code segment to the above file.

```plaintext
user = postfix
password = postfixpassword
hosts = 127.0.0.1
dbname = postfix
table = domain
select_field = domain
where_field = domain
additional_conditions = and backupmx = '1'
```

**Secure Mapping files**
Execute the following commands to make these file secure from others.

To set the group of these files to postfix:

$ sudo chgrp postfix /etc/postfix/mysql_*.*.cf

To make the file readable by the group:

$ sudo chmod 640 /etc/postfix/mysql_*.*.cf

Create a vmail user

Our system can hold mailboxes for thousands of users. All of these users are virtual users and none of them is a Linux system user, hence these users can not store their mail in our system's hard disk. You probably do not want to assign a unique UID (user ID) to every user, so let's create a Linux user who will become the owner of all mailboxes.

$ sudo groupadd -g 5000 vmail
$ sudo useradd -m -g vmail -u 5000 -d /home/vmail -s /bin/bash vmail
Appendix III: Configuring Postfix with MySQL Maps

Open the main.cf file.

```bash
$ sudo editor /etc/postfix/main.cf
```

Then add the following code segment to main.cf

```bash
# Virtual Mailbox Domain Settings
virtual_alias_maps = mysql:/etc/postfix/mysql_virtual_alias_maps.cf
virtual_mailbox_domains = mysql:/etc/postfix/mysql_virtual_domains_maps.cf
virtual_mailbox_maps = mysql:/etc/postfix/mysql_virtual_mailbox_maps.cf
virtual_mailbox_limit = 51200000
virtual_minimum_uid = 5000
virtual_uid_maps = static:5000
virtual_gid_maps = static:5000
virtual_mailbox_base = /home/vmail
virtual_transport = virtual

# Additional for quota support
virtual_create_maildirsize = yes
virtual_mailbox_extended = yes
virtual_mailbox_limit_maps = mysql:/etc/postfix/mysql_virtual_mailbox_limit_maps.cf
virtual_mailbox_limit_override = yes
virtual_maildir_limit_message = Sorry, the your maildir has overdrawn your diskspace quota, please free up some of spaces of your mailbox try again.
virtual_overquota_bounce = yes
```

-------------------------------------
Tack so Mycket
-------------------------------------
Appendix B: Quick Step Guide for Setting Up VoIP System (OpenSIPS) on Ubuntu 8.04

By Tumwesige Mujwauzi

a. Pre-requisite: Install the following packages

  i. gcc, flex, bison, libmysqlclient15-dev, libexpat1, libexpat1-dev, mysql-client, mysql-server

b. Get source from opensips.org

  i. Download opensips-1.4.4-notls_src.tar.gz into /usr/local/src/ directory

  ii. Tar xvfz opensips-1.4.4-notls_src.tar.gz

c. Tune Makefile

  i. cd open opensips-1.4.4-notls

  ii. vim Makefile then

  iii. find exclude_modules? then remove mysql and jabber strings from the list

d. Compile OpenSips

  i. make all (to get nice output use NICER=1 make all)

e. Install OpenSips

  i. make install

f. What was installed

  i. Configuration file in /usr/local/etc/opensips/opensips.cfg

  ii. The binary and executable scripts are installed in /usr/local/sbin these are:

    1. Opensips – Opensips server
    2. Opensipsdbctl – script to create and manage database
    3. Opensipsctl – scripts to manage and control opensips server
    4. Opensipsunix- scripts to manage and control opensips server via unix sockets
To be able to use the binaries from command line make sure that 
\texttt{/usr/local/sbin} is set in the \texttt{PATH} environment variable.

1. echo \texttt{$PATH} to cross check
2. To add it do:
   a. \texttt{PATH=PATH:/usr/local/sbin}
   b. \texttt{export PATH}

\textbf{g. To start opensips run} \texttt{/usr/local/sbin/opensips}

\textbf{h. Create MySQL Database}

\textbf{i.} \texttt{vim} \texttt{/usr/local/etc/opensips/opensipsctlrc} and make changes as follows:

1. \texttt{SIP\_DOMAIN=example.com} “Change example.com to your domain”
2. \texttt{DBENGINE=MYSQL}
3. \texttt{DBHOST=localhost}
4. \texttt{DBNAME=opensips}
5. \texttt{DBRUSER=opensips}
6. \texttt{DBRWPW=’\texttt{opensipsrw}’}
7. \texttt{DBROUSER=\texttt{opensipsro}}
8. \texttt{DBROPW=\texttt{opensipsro}}
9. \texttt{DBROOTUSER=’root’}
10. \texttt{USERCOL=’username’}

\textbf{ii.} \texttt{Cd /usr/local/sbin/} then run \texttt{opensipsdbctl create ..enter mysql root password} , then create the db as per your choice

\textbf{iii. Configure opensips to use SQL}

1. \texttt{vim /usr/local/etc/opensips/opensips.cfg} then edit as follows:
- loadmodule "/usr/lib/opensips/modules/db_mysql.so"
- loadmodule "/usr/lib/opensips/modules/auth.so"
- loadmodule "/usr/lib/opensips/modules/auth_db.so"
- Then uncomment all lines that allow DB persistence...
- Then uncomment all lines that allow DB authentication...
- The fill your respective domain in the REGISTER section as follows
  "replace example.com with your domain":
  - if (!www_authorize("example.com", "subscriber")) {
    www_challenge("example.com", "0");
    break;
  };
  i. Add opensips to start at system boot
  i. cp /usr/local/sbin/opensips /etc/init.d/
  ii. update-rc.d opensips defaults
  j. Watch the server status using 'opensipsctl moni' try to login with your SIP client as user 'admin' with password 'opensipsrw'
  k. try adding new users using
     'opensipsctl add <name> <password>
  l. default values (database url, users and passwords) are:

        DEFAULT_DB_URL="mysql://opensips:opensipsrw@localhost/opensips"
        r/w user: opensips ; passwd: opensipsrw
        r/o user: opensipsro ; passwd: opensipsro

        VERY IMPORTANT NOTE: for security reasons, do change the values of passwords after installation

  m. The setup is complete, you can add subscribers in the database and respective IP phones in the network.

        xxxxxxxxxxxxxxxxxxxxxxxx Tack so Mycket xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx