

BUSITEMA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER ENGINEERING
LINUX BASED PBXTRA SYSTEM

BY

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A report submitted to the department of Computer Engineering in partial fulfillment of the requirement for the award of Bachelor of Computer Engineering in the Faculty of Engineering of Busitema University

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DECLARATION

This project report is my original work and has not been presented for a degree in any other University or any other award.

Sign:

Date:

APPROVAL

The undersigned certify that he has read and hereby recommend for acceptance of Busitema University a project report entitled Linux Based PBXtra System

Mr. Bwire Felix

Department of Computer Engineering

Sign:

Date:

DEDICATION

This report is dedicated to my beloved parents Bashasha Sharon and Engineer Bosco Edemaga Pariyo.

ACKNOWLEDGEMENT

My special thanks go to Mr. Bwire Felix, my only Supervisor, for the tireless support and guidance he offered to me which have propelled this work to completion. Without reservations, I take this opportunity to thank him for allowing me to be one of his students and to endure the disturbances that I have always brought to him during the course of producing this piece of work.

I also would love to thank the BCT department for giving me another opportunity to improve my work and produce better results and solutions that are relevant to the world.

ADRONI ANDREW

ABSTRACT

The Linux Based PBXtra system was a solution that was implemented to ease communication at relatively cheap costs. It was entirely programmed in C programming language and ASCII encoding to come out with a working prototype of the system. ASCII encoding language was used for creating the configuration files like sip.conf, extensions.conf, voicemail.conf, queues.conf in order to communicate and bridge the gap between different protocols like the ntp, dhcp, udp, sip and tcp. The system was able to provide functions like free voice calls over softphones that were installed on Android devices and laptop computers transmission aided by different codecs like the G711 codec, G729 and GSM codec among others. No internet connection could be required to use the system, only a simple network was required, in this case a wireless hotspot from an android device provided the network. Other functions were free voicemails, call queuing, music on hold, call waiting, call distribution, dialplan function, remote monitoring from Android device or computer via SSH server, automatic monitoring via the system interface, interactive voice response and password authentication.

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LIST OF ACRONYMS

PBX	Private Branch Exchange
TETRA	Terrestrial Trunked Radio
IVR	Interactive Voice Response
PSTN	Public Switched Telephone Network
VoIP	Voice over Internet Protocol
SIP	Session Initiation Protocol
IP	Internet Protocol
PABX	Private Automatic Branch Exchange
PMBX	Private Manual Branch Exchange

EPABX	Electronic Private Automatic Branch Exchanges
CO	Central Office
HTTP	Hypertext Transfer Protocol
SMTP	Simple Mail Transfer Protocol
SDP	Session Description Protocol
RTP	Real-time Transfer Protocol
SRTP	Secure Real-time Transfer Protocol
NTP	Network Time Protocol
DHCP	Dynamic Host Control Protocol
LAN	Local Area Network
ILBC	Internet Low Bitrate Codec
WAN	Wide Area Network
SSH	Secure Shell

CHAPTER 1

INTRODUCTION

1.1 Background

Communication is one of the prerequisite needs in operation of companies and other institutions of higher learning, with most people having to communicate on a daily basis for effective work and organization. In the last 15 years, Information Technology has gone from a costly, raw potential to a widely accessible and refined toolkit. [1] From software applications to mobile devices to the sophisticated networks they inhabit, the private sector has undergone a transformation driven by new technology.

This is perhaps nowhere more visible than in business telephony, where legacy phone networks are quickly giving way to the IP and Cloud Revolution [2] as the telecommunications industry introduces more mobile and multi-media capabilities while streamlining operations and expenses, PBX networks become increasingly outdated and limited. A PBX (private branch exchange) 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. [2]

The main purpose of a PBX is to save the cost of requiring a line for each user to the telephone company's central office. [3] Most businesses have a PBX telephone system, a key telephone system, or Centrex service. [2] The selection of a PBX is important to most companies because a PBX has a typical life span of seven to ten years. [4]

All PBXs offer a standard, basic set of calling features. Optional software provides additional capabilities. Communication in Uganda is priority when we come to the business world, however the cost of setting up traditional PBX systems is high which some small starting companies cannot afford to install, maintain and even purchase.

Companies are spending lots of money today on communication systems thus not meeting all their needs to their expectations. The system that was developed has a merit of being very cheap to install, easy to troubleshoot and maintain.

1.2 Problem statement

In a country like Uganda different companies are using several communication technologies to communicate which are very costly to setup, install, maintain and troubleshoot. Some of the traditional PBX systems like Alcatel OmniPCX 4200 PBX [2] used by most companies cannot be afforded by starter companies. For example, Civil Aviation Authority-Uganda uses TETRA for communication which is hard to setup and requires serious hard-wiring. Companies using these traditional ways of communication find a challenge in spending a lot of money on communication which affects their profit margin. Traditional Legacy systems require complicated hard-wiring for each phone in your office. Adding new employees or additional telephone lines requires new hardware, and that requires more time and money. And if you expand to a new office, all of your current hardware must be consistent across.

Linux Based PBXtra system that was develop is very cheap to setup, install, maintain and troubleshoot and can be used for small starter companies and large companies. The benefits this system now has include full customization with features like IVR, voicemail, call distribution, remote monitoring via android device, automatic monitoring mode, dial plan and free voice calls using VoIP technology.

1.3.1 Main objective

To develop a Linux Based PBXtra system that is very cheap to setup in terms of equipment and offering a wide range of features as compared to traditional PBX systems.

1.3.2 Specific objectives

- i. To study the inherent weaknesses of other traditional PBX technologies that are already existing so as to determine the requirements for the design of the Linux Based PBXtra System
- ii. To design the Linux Based PBXtra System with a main modules of voice calls and voicemails using the VoIP technology
- iii. To implement a working prototype of the Linux Based PBXtra system.
- iv. To test and validate the Linux Based PBXtra system basing on VoIP technology.

1.4 Justification

PBX technologies currently in use are very expensive to set up since their equipment are too costly and they have limited features as per the manufacturers which can't be customizable.

There is therefore need for a system that can be affordable by every company with more feature capabilities and fully customizable.

1.5 Significance

The system is cheap to install, secure, maintain, customize and even troubleshoot. The system allows unlimited number of users to connect to it unlike current PBX technologies which have a limit to the number of users who connect to them. The system offers free calls to those connected to the network and more call functions for effective communication

1.6 Scope

The scope is limited to the design of a Linux Based PBXtra system using VoIP technology and knowledge of the PBX systems that will be used by companies, businesses, universities and other institutions of learning. The major functions of the system include:

- i. Free voice calls: Users registered on the system were able to make free phone calls without being charged any money neither any data costs.
- ii. Voicemail service: Voicemail is a voice message that the caller leaves when the person called is absent or taken up by another conversation. The project had this feature incorporated
- iii. IVR: This was used throughout the voicemail system where the system could interact with the user via voice responses.
- iv. Call queuing: The system was also able to put users in a queue during the case of multiple phone calls simultaneously
- v. Call distribution: The system was able to make a call to two people simultaneously, that is, the support staff members using the call queuing strategy Fast in, Fast Out
- vi. Remote monitoring: The system could b monitored from an android device remotely via the ssh server.

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