BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

FINAL YEAR PROJECT REPORT

Internet Protocol Network Gateway Optimizing System

BY

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DECLARATION

I, **Kiyingi Raymond**, do hereby declare that this project report is my original work and has never been published and/or submitted for any other degree award to any other university or institution of higher learning.

Signature.....

Date.....6th/06/2018.....

APPROVAL

This is to certify that the project proposal titled "**Internet Protocol Network Gateway Optimizing System**" has been done under my supervision and is now ready for examination.

Mr. Ocen Gilbert

Signature.....

Date.....

Department of Computer Engineering

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My Supervisor, Mr. Ocen Gilbert who has continuously guided me and prayed for throughout this project. He has been a parent to me and provided where necessary, may God bless you sir. Not forgetting my father Mr. Ssekubunga Robert, mother Mrs. Nakitto Juliet and the entire Kiyingi and Jjingo family who have provided financially, materially, spiritually until the completion of this project, may God bless you abundantly. I will not forget Brenda, Doreen, Zauja, Kenneth, Jaba, Valerian, Mark, Isaac ,Anthony, all my friends and Busitema University Anglican church community, who have stood with me in prayer and in material provision and it has encouraged me, I am so happy for you people May God bless you. Most important of all, the almighty God, he has worked both indirectly and directly to see to it that I am successful, I will serve you forever.

DEDICATION

I dedicate this report to my beloved parents Mr. Ssekubunga Robert and Mrs. Nakitto Juliet and the entire Jjingo and Kiyingi family. Your contribution to my education has been wonderful, encouraging and promising a bright future in my life. They have always been there for me even when the going seems toughest, I love you all and may the almighty God reward you with unfathomable blessings, Glory be to God Almighty.

LIST OF ACRONYMS

ARP: Address Resolution Protocol

ASIC: Application Specific Integrated Circuit

AVG: Active Virtual Gateway

AVF: Active Virtual Forwarder

BGP: Border Gateway Protocol

CPU: Central Processing Unit

DSP: Digital Signal Processor

EGP: Exterior Gateway Protocol

GLBP: Gateway Load Balancing Protocol

GNS: Graphical Network Simulator

FHRP: First Hop Redundancy Protocol

HSRP: Hot Standby Redundancy Protocol

IEEE: Institute of Electrical and Electronic Engineering

IETF: Internet Engineering Task Force

IGP: Interior Gateway Protocol

IP: Internet Protocol

IPNGOS: Internet Protocol Network Gateway Optimising System

IP SLA: Internet Protocol Service Level Agreement

IOS: Internetwork Operating System

LAgP: Link Aggregation Protocol

LAN: Local Area Network

PAgP Port Aggregation Protocol

PBR: Policy Based Routing

SSH: Secure Shell

TCP: Transmission Control Protocol

VND: Variable Neighbor Descent

VNS: Variable Neighbor Search

VRRP: Virtual Router Redundancy Protocol

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ABSTRACT

Uganda as a developing country has been having some of the organisations and companies getting their services accessible online. These organisations include UMEME, URA, National Water, KCCA and PayWay with services used on a daily basis by Ugandans. The services include electricity, tax, water and financial payment.

At peak hours when many users are making payment or accessing the services, their network goes off at times. The causes network outage range from a number reasons including link failure, server failure, network device failure or wrong configuration on a device. Some of the causes are natural and unavoidable like broken cables, wrong configurations and others can be mitigated.

Among the causes, is network device failure and yet all the devices provide different functionality for the services. The devices include servers for storage and handling requests from users, routers for routing packets within a network, switches for layer 2 traffic flow and gateways for providing a boundary between an enterprise network and the Internet Service Provider (ISP).

This project focuses on the gateway among devices mentioned above because it is the highway for all traffic flowing in and out of the network and so being more susceptible to bottlenecking compared to any other device. When many users are using the service, interfaces on the gateway become over utilised resulting into a delay a response hence poor delivery of a service. Hence the need for optimal selection of an interface depending on the type traffic flowing through network.

In incidents of high interface utilistion, protocols like Link Aggregation Protocol (LAgP) and Port Aggregation Protocol (PAgP) are used to create port channels with higher throughput. Also optical fibre which has a high bandwidth can be used to accommodate more traffic. However both need extra hardware to be implmeneted in a network which implies more cost to implement.

The objective of this project is to develop a python application that monitors interfaces on gateways running Host Standby Redundancy Protocol between them and automatically send traffic to an underutilised interface on the gateway. The application implements a policy to send specific traffic through a less utilised Vlan connected to one of the gateways. This improves packets per second flowing to and fro the host, hence an improvement in the reliability of the network and the service.

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CHAPTER ONE

INTRODUCTION

1.1 Background

A gateway is a network device that connects a private network to the public network in an Internet Protocol (IP) network. It performs routing of ingress and egress traffic in the network which implies a gateway is also a router. Ingress traffic enters the network whereas egress traffic leaves the network. Gateway and router will be used interchangeably to mean the same thing in this context. Unlike a catalyst switch which uses Application Specific Integrated Circuitry (ASICs) in its forwarding logic [1], a router is software based so as to intelligently route packets based on policies set, access control lists available. On top of that, the gateway should monitor availability of third parties using IP Service Level Agreement (SLA) and send keep a live messages for the routing protocol neighbors using both Interior Gateway Protocol (IGP) and Exterior Gateway Protocol (EGP) that's Border Gateway Protocol (BGP). All and more than that is performed on the cost of the gateway's resources.

There are typically packet handling resources in the gateway such as Digital Signal Processors (DSPs), and one or more Central Processing Units (CPUs). Each incoming packet that the gateway accepts consumes packet-handling resources of the system. In addition, it generates data traffic that must be handled by the CPU or CPUs[2]. Other resources include memory and interface (bandwidth).

It doesn't mean that the gateway is unable to process new packets when all handling resources are exhausted. Accordingly there are methods for handling the case where the resources are exhausted. In such a case, the CPU will start to ignore ("drop") those packets that it cannot process[2]. Dropping of these packets degrades the performance of the gateway. In extreme cases, a CPU may be so overloaded that it cannot complete signaling processes that are time-sensitive such as video traffic in an IP network and leads to loss of connection to neighbors in a routing protocol, poor network availability to users.

Even with the presence of methods to handle packets with exhausted resources, failure still occurs at a certain point on the gateway. There are already methods to handle failure of the gateway because if it goes down, then access to an entire network outside their own network would go

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