LB/DON/33/00
7

REQUIREMENT-BASED POLICIES FOR ELECTRONIC MESSAGE DISTRIBUTION

BY

M. SHANTHA DEWSIRI FERNANDO

A thesis submitted to the University of Moratuwa
in partial fulfillment of the requirements
for the Degree of Master of Philosophy

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

පුස්තකාලය
මොරටුව විශ්ව විද්‍යාලය. ශ්‍රී ලංකාව
මොරටුව.

Research work supervised

By

Dr. W. S. Wijesoma
Dr. Gihan V. Dias

71955

681.3 "00"
681.32

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

MARCH, 2000

TH

71955

DECLARATION

This thesis is a report of research work carried out in the Department of Computer Science and Engineering, University of Moratuwa, between March 1995 and March 2000.

Except where references are made to the other work, the content of the thesis is original and includes nothing which is the outcome of work done in collaboration. The work has not been submitted in part or in whole to any other university.

M. S. D. Fernando

Department of Computer Science and Engineering

University of Moratuwa

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

ABSTRACT

Many parts of the world endeavour to extend access to more individuals and institutions by means of the electronic messaging system in the ever-evolving Internet. While that messaging system is continuing to incorporate more and more features such as multi-media information, technical barriers in many parts of the world or uncontrolled behaviours of originators hinder such expansion. It is the lack of user-requirement based policies in the messaging system that increases the constraints to such environments. At the same time the need to integrate and coordinate other messaging systems such as fax, paging, postal mail etc. with the Internet messaging system still exists. On the other hand whether constrained or not, users wish to administer their retrieval of messages in particular manners such as blocking unwanted messages, using alternate message delivery media, using strategic message delivery methods especially for lengthy messages, etc., which in turn leads to a formation of requirement-based policies of the messaging system.

Currently there are standards governing message handling, in particular MIME (Multipurpose Internet Mail Extensions), for exchanging mail messages encompassing a multitude of media, such as graphics images, voice, data and full motion video apart from plain text. However, the MIME standard presupposes certain minimum technical capabilities amongst interconnected and participating mailservers and nodes for distribution of such multimedia mail. In particular, the interconnecting channels between mailservers should be of sufficient bandwidth to conduct the large amount of data in MIME messages at 'reasonable' rates and also the nodes must have adequate storage capacity for the same. This requirement for bandwidth of channels and storage of mailservers for MIME capability prevents users connected to 'under-privileged' mail nodes from enjoying the benefits brought about by multi-media information and messaging. This may be in spite of the end users owning or having access to resource rich machines.

On the other hand, with the introduction of MIME capabilities, users are faced with the essential requirement of administration at the server side owing to the fact that the availability of many media types would impose increased abuses, intended or accidental, especially in the face of new inventions of media types.

University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

As a strategic solution to this phenomenon, the concept of an adaptive, service-oriented mail server employing a smart approach to routing of multi-media messages in an internetwork of mailservers, disparate in storage capacity, performance, network bandwidth and administration, is presented. This concept, described as Hierarchical Actions Transfer (HAT) concept, involves offsetting the bandwidth and capacity limitations or "desires" of a node at a specific level by requesting a mail node a step higher up to oblige to perform services on its behalf (which the former node is incapable of performing or not willing to, due to capacity or bandwidth limitations or self imposed restrictions).

The service requests that are in line with the Requirement-Based Policies are known to the server through a specific configuration mechanism. When delivering messages, the server will first look at the configuration of each connected node and then the message delivery will take place accordingly. It would be inevitably a service-oriented strategy to relieve nodes in constrained environments.

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

An added advantage of the approach is that it implements administrative policies for controlling traffic and congestion arising from MIME mail to a mailserver site and the level of MIME services made available to users connected to that site. Further, the technique also integrates conventional and primitive messaging mechanisms, such as postal mail, courier by diskettes/tapes, facsimile and paging, into the realm of electronic messaging.

It could be further enhanced by the incorporation of Artificial Intelligence if it could identify patterns of frequent node requests. However, current implementation that uses "sendmail" as the Message Transfer Agent (MTA) focuses only on the manual and semi-automatic configuration of such services.

ACKNOWLEDGMENTS

It is my pleasure to thank Dr. W. S. Wijesoma and Dr. Gihan V. Dias for being supervisors and committing their time to contribute, guide and instruct me in evaluating, revising and writing up of this thesis. I also would like to thank Prof. Priyan Dias for evaluating and revising the editorial aspects of this thesis. My thanks are due to Dr. N. K. Wickramarachchi, Head of the Department of Computer Science and Engineering for arranging the necessary formalities and Dr. Ruwan Weerasinghe for serving as the External Examiner.

I should be much obliged to Information Laboratories (Pvt.) Ltd. for providing me with equipment (computers), literature, software and Internet facilities to successfully complete this research.

My thanks are due to the former Head of the department Dr. A. S. Induruwa and other members of the staff of Department of Computer Science and Engineering.

University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

It is not complete if I do not thank my wife for encouraging me whenever there was lack of enthusiasm due to pressures of work and other commitments.

To

my wife Achala

daughter Anarga

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

and

my parents

CONTENTS

Abstract i

Acknowledgments iii

List of Tables viii

List of Figures ix

List of Listings x

Abbreviations xi

1. INTRODUCTION 1

1.1. Background 1

1.2. Uses of Electronic Mail 2

1.3. Abuses of Electronic Mail 6

1.4 Summary 8

2. ADVANCES IN ELECTRONIC MESSAGING 9

2.1. Recent Developments 9

2.1.1. Basic Media Types 12

2.1.2. Encodings Supported 14

2.1.3. Experimental Media Types 14

2.1.4. Other Media Types 16

2.1.5. Other Features Introduced 20

2.2. Future Developments 25

2.3. Summary 25

3. ENHANCEMENT AND ITS PROBLEMS 27

3.1. Introduction 27

3.2. Categories of Problems 28

3.2.1. Problems Faced due to Limitations of the Server 28

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

3.2.2. Problems Faced due to Limitations of the Client 30

3.2.3. Problems Faced due to Limitations of the Link 32

3.2.4. Problems faced due to Inability of the Client to Administer the Traffic According to User's Requirements 34

3.3. Summary 34

4. ALTERNATIVE SOLUTIONS 35

4.1. Introduction 35

4.2. Explored Solutions 35

4.2.1. Filtering by MUA 35

4.2.2. Filtering by MTA 36

4.3. The Hierarchical Actions Transfer (HAT) Concept 37

4.4. Summary 40

5. SPECIFICATIONS OF THE HIERARCHICAL ACTIONS TRANSFER(HAT) CONCEPT 41

5.1. Introduction 41

5.1. Theory and Concept 41

5.1.1. Concept 41

5.1.2. Theory 42

5.2. Rationale 43

5.3. A Sample Model of HAT Concept 44

5.4. Design Philosophy 47

5.4.1. Definitions 48

5.4.2. Implementation Concepts 49

5.4.3. ACTIONS File: The key to Administer Message Delivery: 50

5.4.4. The NODECAT File 55

5.4.5. Format of ACTIONS File 59

5.5. Implementation Guidelines 68

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

5.5.1. Processing of ACTION File 68

5.5.1.1. Implementation Guidelines for Processing the Service Requests in the ACTIONS file 69

5.5.2. Processing of Message Headers 82

5.5.3. Updating or Changing the ACTIONS File 87

5.5.4. Log Maintenance 88

6. IMPLEMENTATION STRATEGIES 90

6.1. Introduction 90

6.2. Implementation Alternatives 92

6.3. Why "sendmail" 94

6.4. "sendmail" Architecture 96

6.5. What HAT Requires from "sendmail" 98

6.6. Proposed "sendmail" Architecture 99

6.7. Current State of the Implementation 101

6.8. Problems Faced During the Implementation 102

7. CONCLUSIONS AND RECOMMENDATIONS 104

7.1. Conclusions 104

7.2. Recommendations 105

7.3. Enhancements: Looking into the Future 106

REFERENCES 107

APPENDIX A: Approach to the Implementation 111

APPENDIX B: Pseudo Code for the Implementation 113

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF TABLES

1.1	Discrete Media Types	12
1.2	Composite Media Types	12
5.1	List of Options for Configuration of a Node	51
5.2	Default Node Categories	56

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF FIGURES

Figure 5.1. - Effective Vectors with respect to a Message being Routed 45

Figure 6.1. - Role of sendmail.cf File 96

Figure 6.2. - Selection of Delivery Agent 97

Figure 6.3. - Flow of Addresses Through the Rule Sets 97

Figure 6.4. - Role of ACTIONS File 99

Figure 6.5. - Selection of Delivery Agent and Services(options) for each Recipient 100

Figure 6.6. - Place of the Selection of Services(Options) in the Flow of Addresses through the Rule Sets 100

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF LISTINGS

Listing 5.1 - BNF Notation for the NODECAT file 57

Listing 5.2 - An example NODECAT file 58

Listing 5.3 - BNF Notation for the Format of ACTIONS file 59-62

Listing 5.4 - An example ACTIONS file 64-66

Listing 5.5 - Format of KDBINFO File 74

Listing 5.6 - Format of Server Log 89

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

ABBREVIATIONS

MIME	Multi-purpose Internet Mail Extensions
MUA	Message User Agent
MTA	Message Transfer Agent
RFC	Request for Comments
IETF	Internet Engineering Task Force
HAT	Hierarchical Actions Transfer
BNF	Backus-Naur Form
MHS	Message Handling System
OSI	Open Systems Architecture
SMTP	Simple mail Transfer Protocol
UUCP	Unix to Unix Copy Protocol
POP	Post Office Protocol
SGML	Standard Generalized Markup Language

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk