The Research on Web-mail Server System using a Cluster of Linux PCs

2001年 2月
The Research on Web-mail Server System using a Cluster of Linux PCs

2000년 10월

2000년 12월

Copyright(c)2002 by Seoul National University Library. All rights reserved.(http://library.snu.ac.kr)
SMTP デフォルトパスワードの確認、MDA, PC, SMTP に影響を与えないことを確認してください。

PC アドレス: 99419 - 542
1. ..........................1
2. ..........................4
  2.1 ..........................4
    2.1.1 ..........................4
    2.1.2 Sendmail program........7
      2.1.2.1 'sendmail'........7
      2.1.2.2 'sendmail'........8
      2.1.2.3 'sendmail'........8
    2.1.3 ..........................9
      2.1.3.1 Cluster mailhub...10
      2.1.3.2 Duke...............10
      2.1.3.3 Earthlink.........11
      2.1.3.4 Porcupine Scalable Mail Server 13
  2.2 ..........................15
    2.2.1 Round Robin DNS(RRDNS)........15
    2.2.2 Network Address Translation(NAT).........16
    2.2.3 Tunneling.........................17
    2.2.4 Direct Routing(DR)..................17
    2.2.5 Broadcasting & Filtering(BF)........18
  3. ..........................19
  3.1 ..........................19
    3.1.1 MTA(Mail Transfer Program)......20
    3.1.2 MDA(Mail Delivery Agent)...20
    3.1.3 mail server program........21
      3.1.3.1 node thread...........21
      3.1.3.2 operation thread......22
  3.2 ..........................24
    3.2.1 ..........................24
    3.2.2 mail client program.......24
    3.2.3 authtake thread, authgive thread....25
    3.2.4 datatake thread.............26
    3.2.5 operation thread..........26
<table>
<thead>
<tr>
<th>No.</th>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>4.</td>
<td>mail client program</td>
<td>25</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>32</td>
</tr>
</tbody>
</table>
1. 

Earthlink [1] was the first ISP to offer an online service in 1996. In 1997, they had 350,000 users. Hotmail [2] had 75,000,000 users in 1998. [3] shows that each PC has a network speed of 10Mbps, 100Mbps fast ethernet, or Gigabit ethernet.  

1) 2000 Hotmail users.
[2002년 서울대학교 도서관 저작권 ©]
2. \textbf{MDA and MTA}

\textit{MDA} (Mail Delivery Agent) and \textit{MTA} (Mail Transfer Agent) are essential components of the \textit{linux} mail system. \textit{MDA} manages the delivery of mail to mailboxes, while \textit{MTA} is responsible for the actual sending of mail.

\textbf{2.1. MTA}

The \textit{MTA} is responsible for sending mail using the \texttt{sendmail} command. It processes incoming mail and delivers it to the appropriate mailbox. The \texttt{sendmail} command is the gateway between \textit{MDA} and \textit{MTA}, handling the sending of mail and ensuring that it reaches its destination.

\textbf{2.1.1. The process}

The process of sending mail through \texttt{sendmail} involves several steps: first, the mail is read from the mailbox by the \textit{MDA}. Then, the \texttt{sendmail} command is invoked, which processes the mail and sends it to the appropriate destination. This process ensures that the mail reaches its destination accurately and efficiently.

\textcopyright\textregistered 2002 by Seoul National University Library. All rights reserved. (http://library.snu.ac.kr)
MUA (Mail User Agent)는 'sending MUA'인 Microsoft의 'Outlook Express', Netscape의 'Netscape mail', UNIX의 /usr/ucb/mail'과 같이 [6].

MTA (Mail Transfer Agent)는 SMTP (Simple Mail Transfer Protocol)를 이용한 전달 메소드로 'sendmail'과 같이 MDA (Mail Delivery Agent)를 지원합니다. MTA는 MDA에서 메일을 직접 전달할 수 없으므로, MTA와 MDA는 완전히 독립적으로 작동합니다. [5], 'qmail'과 같이 SMTP (Simple Mail Transfer Protocol)를 사용할 수 있습니다.
2.1.2 Sendmail

`sendmail` is a mail delivery agent (MDA) that provides a simple interface for MTA. When an MTA receives a message, it delivers it to the MDA. The MDA then delivers the message to the mailbox. A mailbox is a directory or file that stores mail messages. There are two main kinds of mail delivery agents: `sendmail` and `postfix`. `sendmail` is a simple and widely-used MTA, while `postfix` is a more complex and feature-rich MTA.

2.1.2.1 `sendmail`

`sendmail` is a simple and widely-used MTA. It provides a command-line interface for delivering mail messages to mailboxes. It can be configured to deliver mail messages using different protocols, such as POP3, IMAP, and SMTP. `sendmail` can also be configured to accept mail messages from other mail delivery agents, such as `postfix`.

`sendmail` is widely used in Linux distributions and on Unix-like systems. It is known for its flexibility and configurability, but it can be complex to configure and maintain. It is often used in environments where a simple and reliable MTA is needed, such as in small organizations or in personal mail servers.
2.1.2.2 ‘sendmail’

`sendmail' requires temporary file, process forking, lock-file, queue, qf-, df-
overhead [4]. temporary file for sendmail is required to create queue qf-, df-
overhead [13]. process forking for sendmail SMTP process is required to create
process fork. thread process creates overhead. thread lock-file for sendmail is required to create queue qf-, df-
lock of lock and lock of linux [13]. Linux queue is required to create DNS.
2.1.3 ‘sendmail’ process 

SMTP "sendmail" fork 'sendmail' 
queue 'sendmail' 

load average 
process sendmail load average

QueueLA (x) 

'msgpri > q / ( la - x + 1 )' 

sendmail queueing refused 

QueueLA (x) default 600,000 QueueFactor (q) default 8

msgpri message priority 'msgpri = size - ( class * z ) + ( receipients * y )' 

size default 0, receipients ClassFactor (z) default 1800, RecipientFactor (y) default 30,000 refuseLA default 12

2.1.3 Cluster mailhub [15], Duke
‘[1], 'EarthLink' [2], 'Porcupine Scalable Mail Server'[3] 

2.1.3.1 Cluster mailhub [15]


2.1.3.2 Duke [1]

mailhub, mail gateway, queue, DNS MX record, round robin, multiple gateway, DNS round robin, POP, IMAP, multiple post office machine, CNAME DNS record, sendmail, userdb, mail server, CNAME record, mail software, BIND DNS record, CNAME record, MUA, SMTP, sendmail, MDA, sendmail, mail.local, mailbox, quota check.

2.1.3.3 EarthLink [1, 2]

EarthLink, SMTP, POP, File, Authentication DB, DNS MX, Round Robin, SMTP, sendmail, sendmail, mail.local, mailbox, quota check.
POP daemon, mailbox location, balanced hash, mail queue. Filesystem NFS
'dataless POP' mount '/var/mail#' mailbox location, balanced hash
mailbox file, mail queue balanced hash. Authentication DB passwd
database, passwd file MDA passwd, getpwnam() SQL query
globally unique mailbox, global mailbox

OS, switched FDDI, dataless POP

switched FDDI, dataless POP server, RAID

DNS round robin file locking open system call O_EXCL flag
lock file, synchronous NFS operation

DB, SMTP POP lock file, SMTP POP

[3].
Porcupine Scalable Mail Server [3]

Porcupine Scalable Mail Server [DNS A, MX record] [SMTP, POP, IMAP socket] [client] [DB] [hash] [spool] [NFS] [SMT P, POP, IMAP] [session] [DB] [hash] [spool] [user directory] [user directory] [distributed membership protocol] [DB] [hash] [spool].
network [parallel RPC]

user directory
NFS gateway daemon
directory
OS

directory
NFS
gateway
disk

Myrinet
linux
pthread
prototype
simulation
scalable
scalable
10
network
Gb/sec
bandwidth
node
disk
bottleneck

NFS
broadcast
network traffic
2.2 ROUND ROBIN DNS (RRDNS)

Round Robin DNS (Domain Name Service) [20] NCST [20]
- HTTP [20]
- NCST [20]
- IP [20]
- RRDNS [20]
- NAT [20]
- DR [19]
- BF [19]

2.2.1 Round Robin DNS (RRDNS)

Round Robin DNS (Domain Name Service) [20] NCST [20]
- HTTP [20]
- NCST [20]
- IP [20]
- RRDNS [20]
- NAT [20]
- DR [19]
- BF [19]
- BIND (Berkeley Internet Name Domain) [20]

- 15 -
2.2.2 Network Address Translation (NAT)

Network Address Translation (NAT) is a technique that translates the IP addresses of devices on a network to another address, typically to a different network. This is commonly used to conserve addresses and to provide a layer of security. When a device makes a connection, it is assigned a temporary IP address from a pool of addresses provided by the NAT device. The NAT device keeps track of the real IP address and forwards packets to and from the device.

In a typical network setup, the NAT device is often placed between the Internet and the private network. The NAT device translates the private IP addresses used by the devices on the private network to public IP addresses that can be accessed from the Internet. This allows multiple devices on the private network to share a single public IP address.

There are different types of NAT devices, including: Static NAT, Port Address Translation (PAT), Network Address Port Translation (NAPT), and Network Address Resolution (NAR). Each type of NAT has its own advantages and disadvantages.

For example, Static NAT is simple and easy to configure, but it does not provide many features. On the other hand, NAPT provides more features but requires more complex configuration.

Other common NAT features include: IP Address Mapping, Port Mapping, and Load Balancing. IP Address Mapping allows multiple devices to use the same public IP address, which can be useful for sharing a single public IP address among multiple devices.

Port Mapping is used to forward incoming packets to the correct device on the private network. This is useful for applications that require a specific port number, such as web servers or database servers.

Load Balancing is used to distribute incoming traffic to multiple devices, which can help to improve performance and reliability. This is commonly used in web hosting and cloud computing environments.

In summary, Network Address Translation (NAT) is a powerful tool that can be used to conserve addresses and provide a layer of security to a network. However, it is important to carefully consider the advantages and disadvantages of different NAT devices and features to ensure that they meet the needs of your network.

Copyright(c)2002 by Seoul National University Library. All rights reserved.
2.2.3 Tunneling

Tunneling involves IP frames being encapsulated within IP packets, which are then sent over a network. This process continues until the IP packets are received at the destination. The encapsulated IP packets are then sent over the tunnel. The destination host extracts the original IP packets from the tunnel and processes them as if they were received directly over the network.

3.2.4 Direct Routing (DR)

In Direct Routing (DR), IP packets are sent directly from the source to the destination without being encapsulated. This is more efficient than tunneling when the source and destination are connected directly. Direct routing uses MAC addresses for direct communication, while tunneling uses IP addresses. Direct routing is more suitable for short distances, while tunneling is better for long distances or when direct connectivity is not available.
3.2.5 Broadcasting & Filtering (BF)

Broadcasting & Filtering (BF) uses the IP protocol for NAT, tunneling, DR. The source IP address is always 0.0.0.0. Tunneling uses the specific tunneling ID (FF:FF:FF:FF:FF) as the source IP address. The packet to the destination is sent with the destination IP address being FF:FF:FF:FF. The destination IP address is the IP address of the gateway. The source IP address is the IP address of the host. The destination IP address is the IP address of the host. The tunneling ID is the ID of the tunnel.

Copyright (c) 2002 by Seoul National University Library. All rights reserved. (http://library.snu.ac.kr)
3.1.1 MTA (Mail Transfer Agent)

MTAはsendmailを利用したものが一般的である。sendmailを介して他のMTAへメッセージを転送することもできる。

3.1.2 MDA (Mail Delivery Agent)

sendmailを利用した場合でも、local MDAはprocmailを使用してメッセージを適切に処理する。
3.1.3 mail server program

'mail server program' with 'sendmail' and 'mail server program' TCP. POSIX pthread fork and fork overhead. 'auth' thread 'authgive thread', 'auth' thread 'authtake thread', 'datatake thread', 'data', 'operation thread'. MTA node thread 'node thread' 'node channel'.

3.1.3.1 node thread

'mail server program' local MDA node thread 'node thread' 'node channel'
TCP persistent, local MDA 'node thread' 'operation thread' 'queue' 'work list' 'queue' 'work list'... 'mail server program' 'work list' 'queue'

3.1.3.2 operation thread

primary node

'wait list' queue

UNIX linux

mbox path.

MUA POP

directory

32,000 Redhat 6.2 linux
directory sub-directory 32,000

'ID.sent' mbox

header 'ID.info'

Porcupine[3][4]

network overhead.
3.2 mail client program

…

3.2.2 mail client program

'mail client program' IDÆ script Æá¹ö¿¡ÄûÇϴ¸ÅÀÛ¾÷¸¶´Ù ‘mail client program’ ¿¬°áÁß°èÇÏ´Â mail client program ‘mail client program’ ¿¬°á Áß°èÇÏ`µÇâÀ»¹ÞÁö¾Ê°ÔÇÑ´Ù.

3.2.1 - - -

…

3.2.1 - - -

…

Copyright(c)2002 by Seoul National University Library. All rights reserved.(http://library.snu.ac.kr)
4 mail client program

3.2.3 authtake thread, authgive thread

'mail client program' auth channel, 'auth channel'
'data channel', 'TCP overhead'

'-auth channel' script, 'TCP overhead'

'mail client program' 'primary node'

'the data channel'

'mail client program' 'primary node'

'the data channel'

'primary node'

'mail client program'
3.2.4 datatake thread

...datatake thread...

3.2.5 operation thread

...operation thread...

...work list...

...queue...

...mbox...

...script...
4. MDA (Mail Delivery Agent)

MDA (Mail Delivery Agent) is a component that manages the mailbox of a computer system. The MTA is responsible for sending and receiving mail. The MDA, on the other hand, is responsible for delivering mail to the appropriate destination.

4.1 round robin DNS

Round robin DNS is a technique used to distribute traffic across multiple DNS servers. It works by rotating the DNS servers over time, ensuring that each server receives the same amount of traffic. This helps to ensure that no single server becomes overloaded.

Example: round robin DNS [14]

1. 100Mbps Fast Ethernet switch

Example: 100Mbps Fast Ethernet switch [13]

2. switch

Example: switch [12]

3. card

Example: card [14]

Pentium III 550 MHz dual CPU, 256MB RAM, UDMA66 EIDE 5GB HDD, Redhat
Linux 6.2\, sendmail 8.11.1 \, sendmail \, MDA \, forwarding \, F=w \, flag \, round robin DNS \, Local MDA \, MDA \, 'Mlocal' \, 'sendmail' \, 'mail.local' \, 'mail.local'

\begin{center}
\begin{tikzpicture}
\node (server) at (0,0) {DNS server};
\node (node1) at (2,0) {Node};
\node (node2) at (4,0) {Node};
\node (node3) at (6,0) {Node};
\node (node4) at (8,0) {Node};
\node (node5) at (10,0) {Node};
\node (root) at (12,0) {Root};
\draw (server) -- (node1);
\draw (node1) -- (node2);
\draw (node2) -- (node3);
\draw (node3) -- (node4);
\draw (node4) -- (node5);
\draw (node5) -- (root);
\end{tikzpicture}
\end{center}

\textbf{4.2 \, Section}
bottle  nect


dvertisements

'mail server program'

'gettimeofday'

postgres DB

postgres DB

DB
4.3 

4.3.1 

`/etc/passwd` 
`procmail` 
MDA 
`bottle neck` 
MDA 
`dummy` 
MDA 
`queue` 
`process` 
`load average` 
msgprio 
`message` 
`sendmail` 
`deliver` 
`queueing` 
MDA 
SMTP [1]. 
SMTP 512 Byte [1] 
SMTP 27 [2] 
SMTP 35 [3] 
SMTP delay 
SMTP . 

4.3.2 

--- 

4) 2.1.2.3 sendmail [1] 

`/etc/passwd`  `procmail`  `sendmail`  `postgres DB`

Sendmail latency 3ms, 5ms, 18ms, 100ms

256 KByte latency 30ms, 32ms, 256 KByte latency 30ms, 32ms
<table>
<thead>
<tr>
<th></th>
<th>512 B</th>
<th>4 KB</th>
<th>32 KB</th>
<th>256 KB</th>
</tr>
</thead>
<tbody>
<tr>
<td>기본 시스템</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>DB (단위)</td>
<td>0.929</td>
<td>0.931</td>
<td>0.928</td>
<td>0.911</td>
</tr>
<tr>
<td>latency (단위)</td>
<td>30.988</td>
<td>31.763</td>
<td>30.403</td>
<td>22.971</td>
</tr>
<tr>
<td>DB (단위)</td>
<td>28.261</td>
<td>27.167</td>
<td>19.695</td>
<td>7.033</td>
</tr>
</tbody>
</table>
5. 

'\texttt{etc/passwd}' etc 'procmail' MDA procmail

SMTP connection

MDA

SMT P connection

PC

round robin DNS virtual host

load balancing

- 33 -


Abstract

This paper addresses a web-mail server system using a cluster of Linux-based PCs.

The experiment shows that the low performance in general email server systems using `/etc/passwd' file and 'procmail' results from a slow MDA program and the limitation of concurrent SMTP connections.

In this paper, we modify the delivering procedure from MDA to user's mailbox in order to overcome such a problem. It is proved that the DB for a web-mail service and a wrong mailbox management approach can cause the low performance.

As a result, the implemented prototype system based on this observation, has about twice receiving performance as much as general mail server systems.

Because of an implemented web-mail system using linux PC cluster system, it has the advantage as if concurrent SMTP connections increases.

Keywords: email server system, cluster, mailbox, MDA, Linux PC

Student Number: 99419 - 542