To explain the architecture of e-mail, we give four scenarios. We begin with the simplest situation and add complexity as we proceed. The fourth scenario is the most common in the exchange of e-mail.
Topics Discussed in the Section

☑ First Scenario
☑ Second Scenario
☑ Third Scenario
☑ Fourth Scenario
Figure 23.1 *First scenario*
When the sender and the receiver of an e-mail are on the same mail server, we need only two user agents.
Figure 23.2  Second scenario

UA: user agent
MTA: message transfer agent

1. Alice sends a message to the MTA Client.
2. The MTA Client stores the message in the spool.
3. The message is sent over the Internet to the MTA Server.
4. The MTA Server delivers the message to Bob's UA.
5. Bob receives the message from his UA.
When the sender and the receiver of an e-mail are on different mail servers, we need two UAs and a pair of MTAs (client and server).
Figure 23.3  Third scenario

UA

MTA Client

MTA Server

Spool

MTA Client

LAN or WAN

Internet

Boxes

MTA Server

Mail server

Mail server

UA: user agent
MTA: message transfer agent

Alice

UA

Bob
When the sender is connected to the mail server via a LAN or a WAN, we need two UAs and two pairs of MTAs (client and server).
Figure 23.4  **Fourth scenario**

UA: user agent
MTA: message transfer agent
MAA: message access agent
When both sender and receiver are connected to the mail server via a LAN or a WAN, we need two UAs, two pairs of MTAs (client and server), and a pair of MAAs (client and server). This is the most common situation today.
The first component of an electronic mail system is the user agent (UA). It provides service to the user to make the process of sending and receiving a message easier.
Some examples of GUI-based user agents are Eudora, Outlook, And Netscape.
Figure 23.6  Format of an email

Mail From: forouzan@deanza.edu
RCPT To: firouz@net.edu

From: Behrouz Forouzan
To: Firouz Mosharraf
Date: 1/5/05
Subject: Network

Dear Mr. Mosharraf
We want to inform you that our network is working properly after the last repair.

Yours truly,
Behrouz Forouzan
Figure 23.7  *E-mail address*

- **Local part**: Mailbox address of the recipient
- **Domain name**: The domain name of the mail server
The actual mail transfer is done through message transfer agents (MTAs). To send mail, a system must have the client MTA, and to receive mail, a system must have a server MTA. The formal protocol that defines the MTA client and server in the Internet is called Simple Mail Transfer Protocol (SMTP). As we said before, two pairs of MTA client-server programs are used in the most common situation (fourth scenario). Figure 23.8 shows the range of the SMTP protocol in this scenario.
Figure 23.8  SMTP range
Figure 23.9  Commands and responses
Table 23.1  Commands

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Argument(s)</th>
<th>Keyword</th>
<th>Argument(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELO</td>
<td>Sender’s host name</td>
<td>NOOP</td>
<td></td>
</tr>
<tr>
<td>MAIL FROM</td>
<td>Sender of the message</td>
<td>TURN</td>
<td></td>
</tr>
<tr>
<td>RCPT TO</td>
<td>Intended recipient</td>
<td>EXPN</td>
<td>Mailing list</td>
</tr>
<tr>
<td>DATA</td>
<td>Body of the mail</td>
<td>HELP</td>
<td>Command name</td>
</tr>
<tr>
<td>QUIT</td>
<td></td>
<td>SEND FROM</td>
<td>Intended recipient</td>
</tr>
<tr>
<td>RSET</td>
<td></td>
<td>SMOL FROM</td>
<td>Intended recipient</td>
</tr>
<tr>
<td>VRFY</td>
<td>Name of recipient</td>
<td>SMAL FROM</td>
<td>Intended recipient</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>System status or help reply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>Help message</td>
<td></td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>Service ready</td>
<td></td>
<td></td>
</tr>
<tr>
<td>221</td>
<td>Service closing transmission channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>Request command completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>251</td>
<td>User not local; the message will be forwarded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>354</td>
<td>Start mail input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>421</td>
<td>Service not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>Mailbox not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>451</td>
<td>Command aborted: local error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>452</td>
<td>Command aborted; insufficient storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>Syntax error; unrecognized command</td>
<td></td>
<td></td>
</tr>
<tr>
<td>501</td>
<td>Syntax error in parameters or arguments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>502</td>
<td>Command not implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>503</td>
<td>Bad sequence of commands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>504</td>
<td>Command temporarily not implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>Command is not executed; mailbox unavailable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>551</td>
<td>User not local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>552</td>
<td>Requested action aborted; exceeded storage location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>553</td>
<td>Requested action not taken; mailbox name not allowed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>554</td>
<td>Transaction failed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 23.10  Connection establishment

- MTA Client
- 220 service ready
- HELO: deanza.edu
- 250 OK
- MTA Server
Figure 23.11  Message transfer

1. MAIL FROM: forouzan@deanza.edu
2. 250 OK
3. RCPT TO: firouz@net.edu
4. 250 OK
5. DATA
6. 354 start mail input
7. From: Behrouz Forouzan
8. To: Firouz Mosharraf
9. Date: 1/6/05
10. Subject: Network
11. Blank line
12. Dear Mr. Mosharraf
13. We want to inform you that

A single dot

n-1

n

250 OK
Figure 23.12  Connection termination

1. MTA Client
2. MTA Server

1. QUIT

2. 221 service closed
Figure 23.13  Pop3 and IMAP4
Figure 23.14  Pop3

Mail Server       User Computer

POP3 Server       POP3 Client

1. user-name
2. OK
3. password
4. OK
5. list
6. e-mail numbers and their sizes
7. retrieve 1
8. e-mail 1
   ·
   ·
n-1. retrieve N
  n. e-mail N
E-mail is such a common application that some websites today provide this service to anyone who accesses the site. Three common sites are Hotmail, Yahoo, and Google. The idea is very simple. Let us go through two cases:
Figure 23.19  Web-based e-mail, case 1

1. SMTP Client (Alice) sends an email to SMTP Server (Alice site).
2. SMTP Server sends the email to the Internet.
3. The email is delivered to the SMTP Server (Bob site).
4. HTTP transactions are performed between HTTP Server and HTTP Client (Bob).
Figure 23.20  Web-based e-mail, case 2
<<< 220 ztxmail01.ztx.compaq.com ESMTP ready
>>> EHLO EX4.DEMO.COM
<<< 250-ztxmail01.ztx.compaq.com
<<< 250-PIPELINING
<<< 250-SIZE 6000000
<<< 250-VRFY
<<< 250-ETRN
<<< 250 8BITMIME
>>> MAIL FROM: JOE@DEMO.COM
<<< 250 Ok
>>> RCPT TO: JOSEPH.NEUBAUER@COMPAQ.COM
<<< 250 Ok
<<< DATA
<<< 354 End data with <CR><LF>.<CR><LF>
<<< 250 Ok: queued as 63CA927D6