

CSE2029: Data Communication & Computer Networks

Lecture-7: HTTP, Electronic Mail

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Outline

- ❖ *HTTP: Conditional GET*
- ❖ *Electronic Mail*
 - ❖ *SMTP*
 - ❖ *Message Formats*
 - ❖ *E-mail protocols and their communicating entities*

HTTP: Conditional GET

- Although caching can reduce user-perceived response times, it introduces a new problem—the copy of an object residing in the cache may be stale (outdated). In other words, the object housed in the Web server may have been modified since the copy was cached at the client.
- Fortunately, HTTP has a mechanism that allows a cache to verify that its objects are up to date. This mechanism is called the **conditional GET**.
- An HTTP request message is a so-called conditional GET message if (1) the request message uses the GET method and (2) the request message includes an If-Modified-Since: header line.

To illustrate how the conditional GET operates, let's walk through an example.

- **First**, on the behalf of a requesting browser, a proxy cache sends a request message to a Web server:

```
GET /fruit/kiwi.gif HTTP/1.1  
Host: www.exotiquecuisine.com
```

HTTP: Conditional GET

- **Second**, the Web server sends a response message with the requested object to the cache:

```
HTTP/1.1 200 OK
Date: Sat, 3 Oct 2015 15:39:29
Server: Apache/1.3.0 (Unix)
Last-Modified: Wed, 9 Sep 2015 09:23:24
Content-Type: image/gif

(data data data data data ...)
```

- The cache forwards the object to the requesting browser but also caches the object locally. Importantly, the cache also stores the **last-modified** date along with the object.

HTTP: Conditional GET

- **Third**, one month later, the browser requests the same object via the cache, and the object is still in the cache. Since this object may have been modified at the Web server in the past week, the cache performs an up-to-date check by issuing a **conditional GET**. Specifically, the cache sends:

```
GET /fruit/kiwi.gif HTTP/1.1
Host: www.exotiquecuisine.com
If-modified-since: Wed, 9 Sep 2015 09:23:24
```

- Note that the value of the **If-modified-since:** header line is exactly equal to the value of the **Last-Modified:** header line that was sent by the server one month ago. This **conditional GET** is telling the server to send the object only if the object has been modified since the specified date.

HTTP: Conditional GET

- Suppose the object has not been modified since 9 Sep 2015 09:23:24. Then, **fourth**, the Web server sends a response message to the cache:

```
HTTP/1.1 304 Not Modified
Date: Sat, 10 Oct 2015 15:39:29
Server: Apache/1.3.0 (Unix)

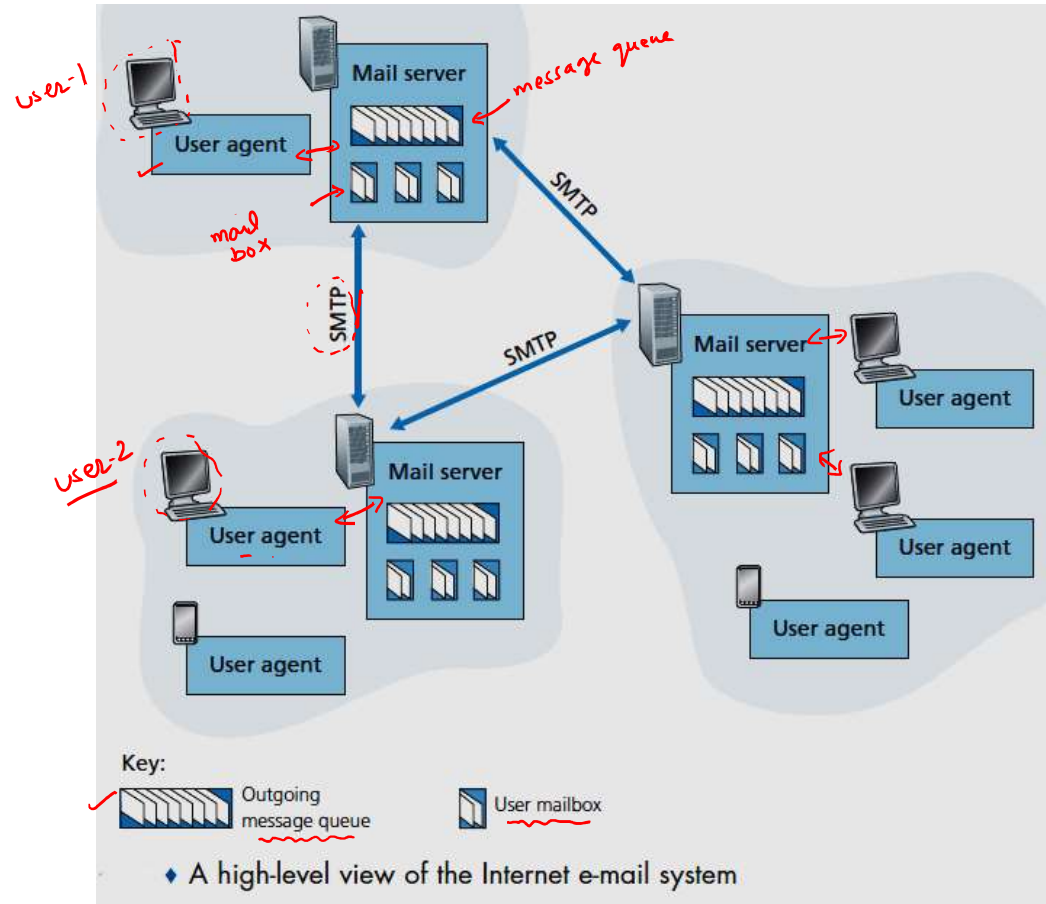
(empty entity body)
```

- We see that in response to the conditional GET, the Web server still sends a response message but **does not include the requested object** in the response message.
- Including the requested object would only waste bandwidth and increase the response time, particularly if the object is large. Note that this last response message has **304 Not Modified** in the status line, which tells the cache that it can forward its **cached copy** of the object to the requesting browser.

Electronic Mail

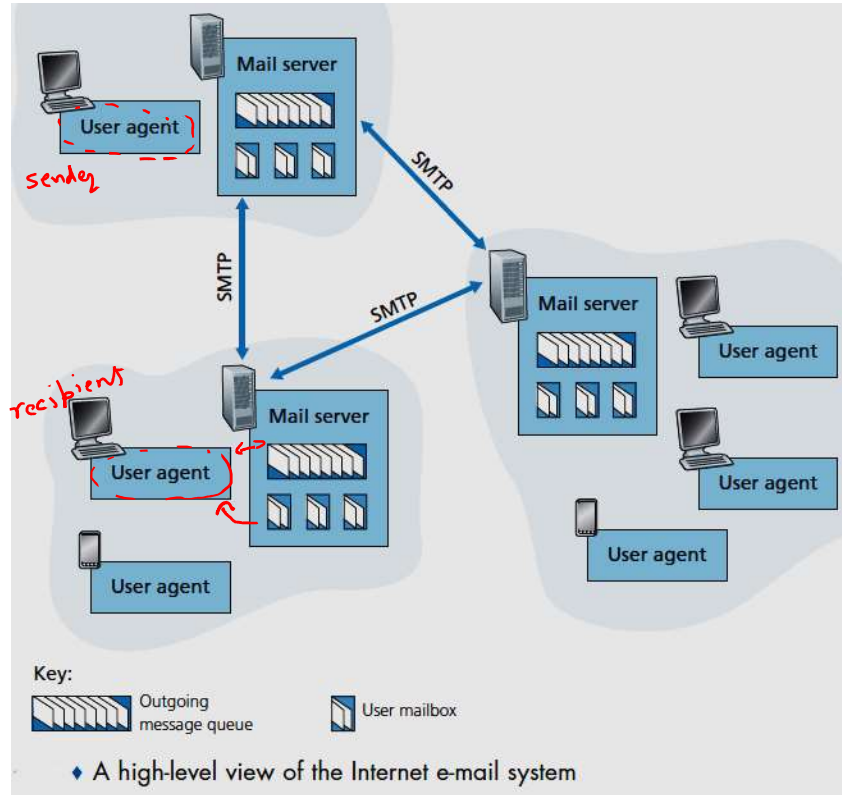
- Electronic mail, commonly shortened to “email,” is a communication method that uses electronic devices to deliver messages across computer networks. "Email" refers to both the delivery system and individual messages that are sent and received.
- Email has existed in some form since the 1970s, when programmer Ray Tomlinson created a way to transmit messages between computer systems on the Advanced Research Projects Agency Network (ARPANET). Modern forms of email became available for widespread public use with the development of email client software (e.g. Outlook) and web browsers, the latter of which enables users to send and receive messages over the Internet using web-based email clients (e.g. Gmail).
- The Figure on next slide shows the internet mail system and its key components:

Electronic Mail



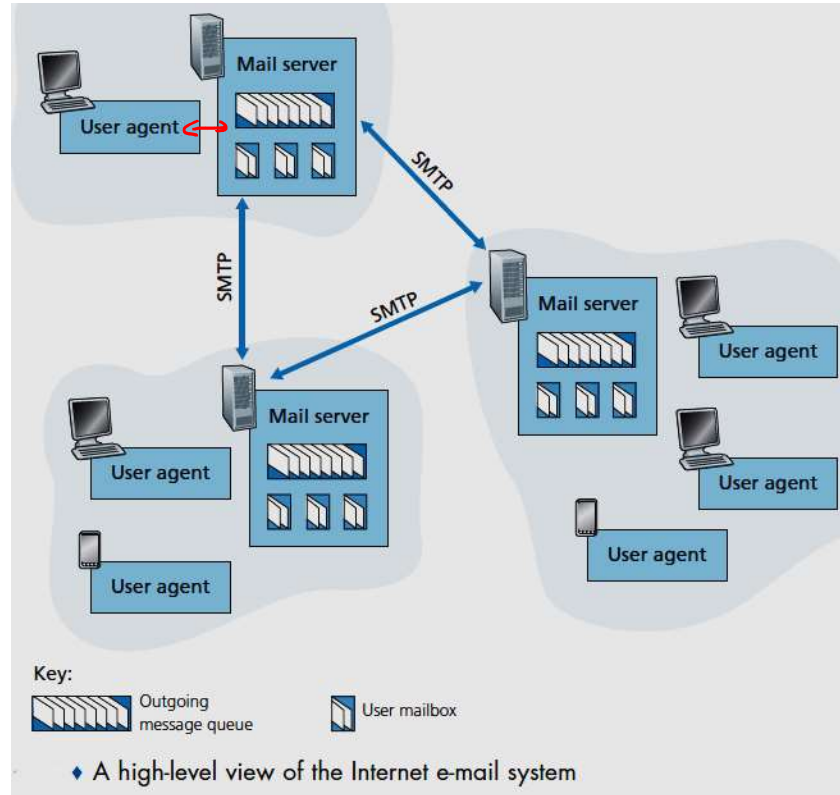
Electronic Mail

- The internet email system has three major components: **user agents**, **mail servers**, and the **Simple Mail Transfer Protocol (SMTP)**.
- User agents** allow users to read, reply to, forward, save, and compose messages. Examples of user agents for e-mail include Microsoft Outlook, Apple Mail, Web-based Gmail, the Gmail App running in a smartphone, and so on.
- When a user is finished composing his message, his user agent sends the message to his **mail server** where the message is placed in the mail server's outgoing message queue.
- When other user wants to read a message, his user agent retrieves the message from the mailbox in his **mail server** (on his end).



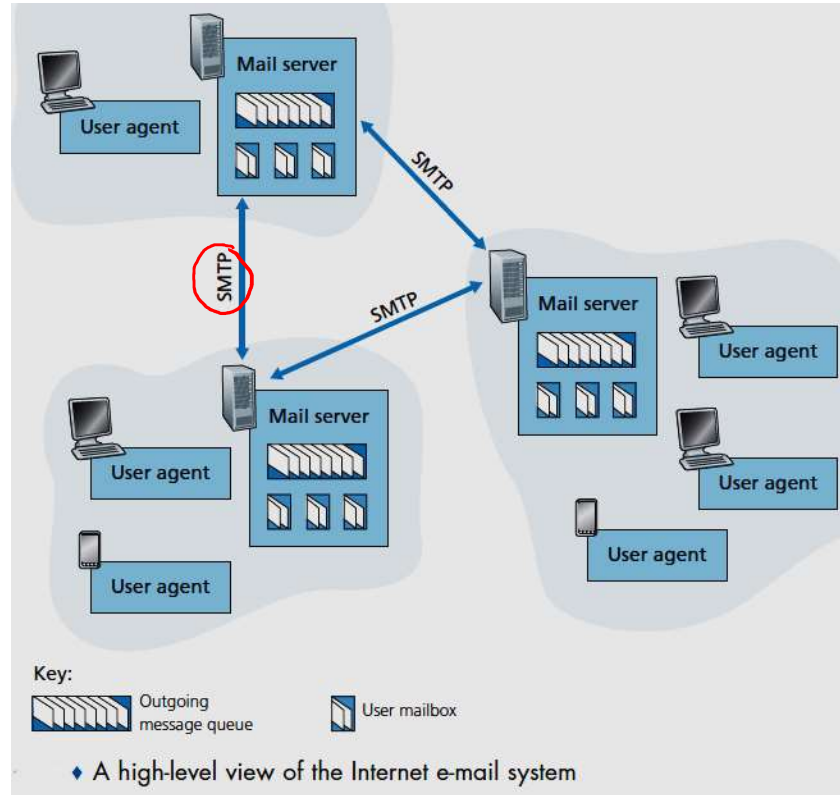
Electronic Mail

- Mail servers form the core of the e-mail infrastructure. Each recipient has a mailbox located in one of the mail servers. A user's mailbox manages and maintains the messages that have been sent to him.
- A typical message starts its journey in the sender's user agent, then travels to the sender's mail server, and then travels to the recipient's mail server, where it is deposited in the recipient's mailbox.
- When recipient user wants to access the messages in his mailbox, the mail server containing his mailbox authenticates that user (with his username and password).



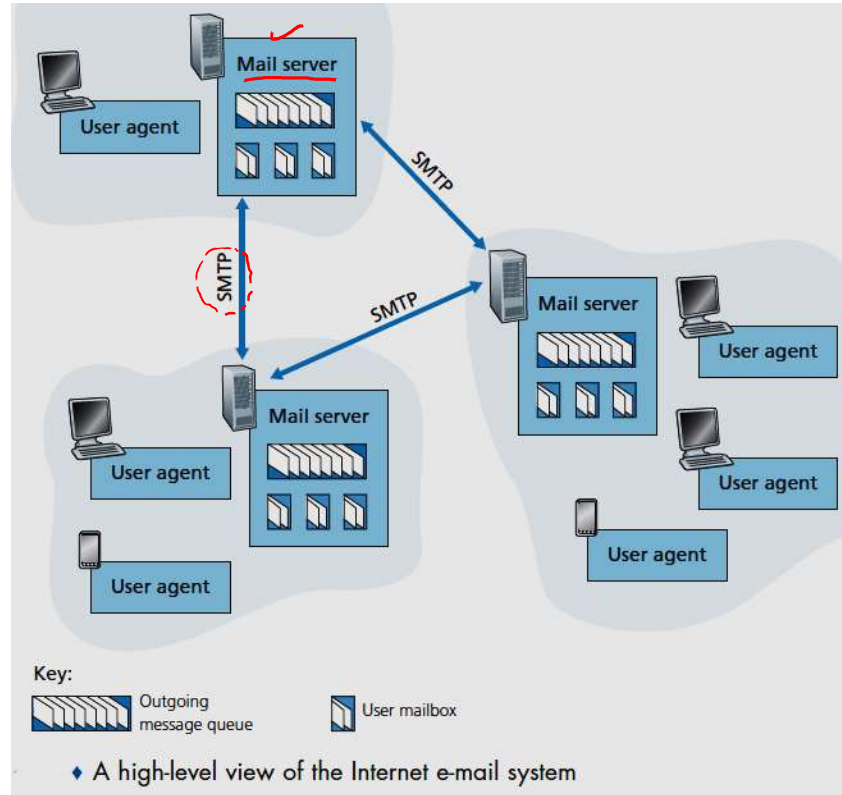
Electronic Mail

- Sender's mail server must also deal with failures in recipient's mail server. If sender's server cannot deliver mail to recipient's server, it holds the message in a message queue and attempts to transfer the message later.
- **SMTP** is the principal application-layer protocol for Internet electronic mail. It uses the reliable data transfer service of **TCP** to transfer mail from the sender's mail server to the recipient's mail server.
- As with most application-layer protocols, **SMTP** has two sides: a client side, which executes on the sender's mail server, and a server side, which executes on the recipient's mail server.



Electronic Mail

- Both the client and server sides of SMTP run on every mail server. When a mail server sends mail to other mail servers, it acts as an SMTP client. When a mail server receives mail from other mail servers, it acts as an SMTP server.



Electronic Mail: SMTP

- The Simple Mail Transfer Protocol (SMTP), is defined in RFC 5321 and is at the heart of Internet electronic mail. As mentioned above, SMTP transfers messages from senders' mail servers to the recipients' mail servers.
- SMTP is a legacy technology that possesses certain archaic (old-fashioned) characteristics. For example, it restricts the body (not just the headers) of all mail messages to simple 7-bit ASCII. This restriction made sense in the early 1980s when transmission capacity was scarce and no one was e-mailing large attachments or large image, audio, or video files. But today, in the multimedia era, the 7-bit ASCII restriction is a bit of a pain—it requires binary multimedia data to be encoded to ASCII before being sent over SMTP; and it requires the corresponding ASCII message to be decoded back to binary after SMTP transport.

Electronic Mail: SMTP

- It is important to note that SMTP does not normally use intermediate mail servers for sending mail, even if the two mail servers are located at opposite ends of the world.
- For example, If sender's server is in Hong Kong and receiver's server is in St. Louis, the TCP connection is a direct connection between the Hong Kong and St. Louis servers. In particular, if receiver's mail server is down, the message remains in sender's mail server and waits for a new attempt—the message does not get placed in some intermediate mail server.

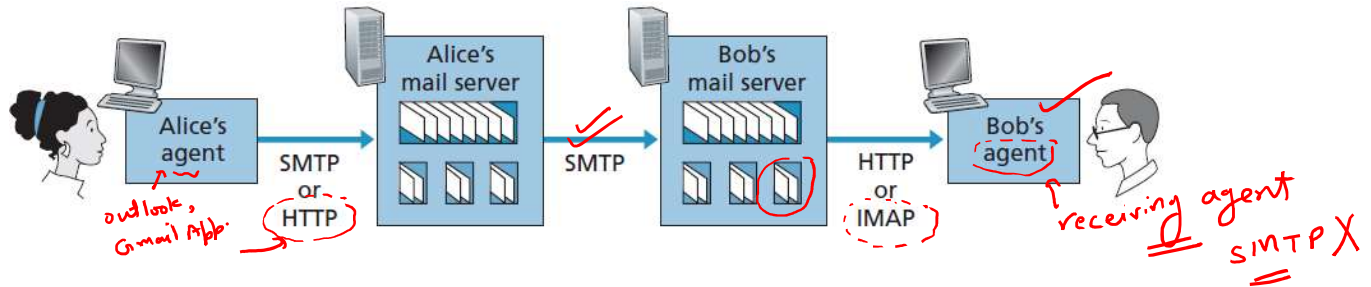
Electronic Mail: Message Formats ✓

- The Email message format includes the Message Header ✓ and Message Body ✓.
- The message header and body of the message are separated by a blank line (that is, by CRLF).
- The message header ✓ must have a “**From: header line**” ✓ and a “**To: header line**” ✓; a header may include a “**Subject: header line**” ✓ as well as other “**optional header lines**” ✓. A typical message header looks like this:

```
From: alice@crepes.fr  
To: bob@hamburger.edu  
Subject: Searching for the meaning of life.
```

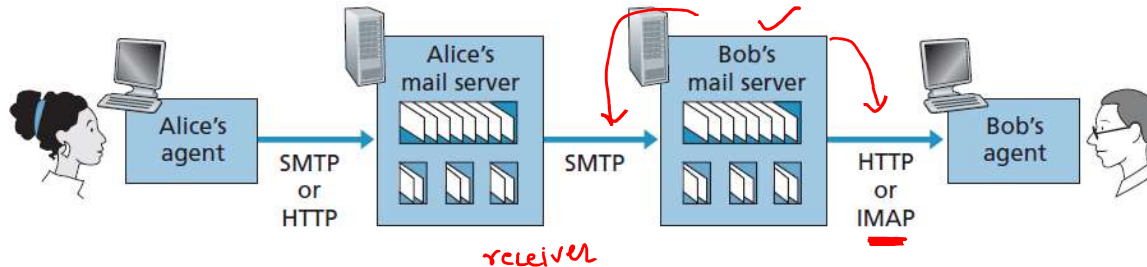
- After the message header, a blank line follows; then the message body (in ASCII) follows.

E-mail protocols and their communicating entities



- As shown in Figure, Alice's user agent uses SMTP or HTTP to deliver the e-mail message into her mail server, then Alice's mail server uses SMTP (as an SMTP client) to relay the e-mail message to Bob's mail server.
- **But there is still one missing piece to the puzzle!** How does a recipient like Bob, running a user agent on his local host, obtain his messages, which are sitting in a mail server? Note that Bob's user agent can't use SMTP to obtain the messages because obtaining the messages is a pull operation, whereas SMTP is a push protocol.

E-mail protocols and their communicating entities



- Today, there are **two common ways** for Bob to retrieve his e-mail from a mail server. If Bob is using Web-based e-mail or a smartphone app (such as Gmail), then the user agent will use HTTP to retrieve Bob's e-mail. This case requires Bob's mail server to have an HTTP interface as well as an SMTP interface (to communicate with Alice's mail server). The alternative method, typically used with mail clients such as Microsoft Outlook, is to use the Internet Mail Access Protocol (IMAP) defined in RFC 3501. Both the HTTP and IMAP approaches allow Bob to manage folders, maintained in Bob's mail server. Bob can move messages into the folders he creates, delete messages, mark messages as important, and so on.

Thank you.