Computer Networks and Communication

Lecture 4

Email, SMTP, MIME, HTTP

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Email

- Email or e-mail or Electronic mail
- One of the oldest services in the Internet
- Consists of three major components
  - **User agents (UA)**:
    - Mail applications residing in the end-systems
    - E.g., Thunderbird, Outlook, Webmail interface
  - **Mail servers**
    - Mail-delivering servers
    - Server's **mail transfer agent (MTA)** is responsible for sending out emails
  - **Simple Mail Transfer Protocol (SMTP)**:
    - The mail delivering protocol

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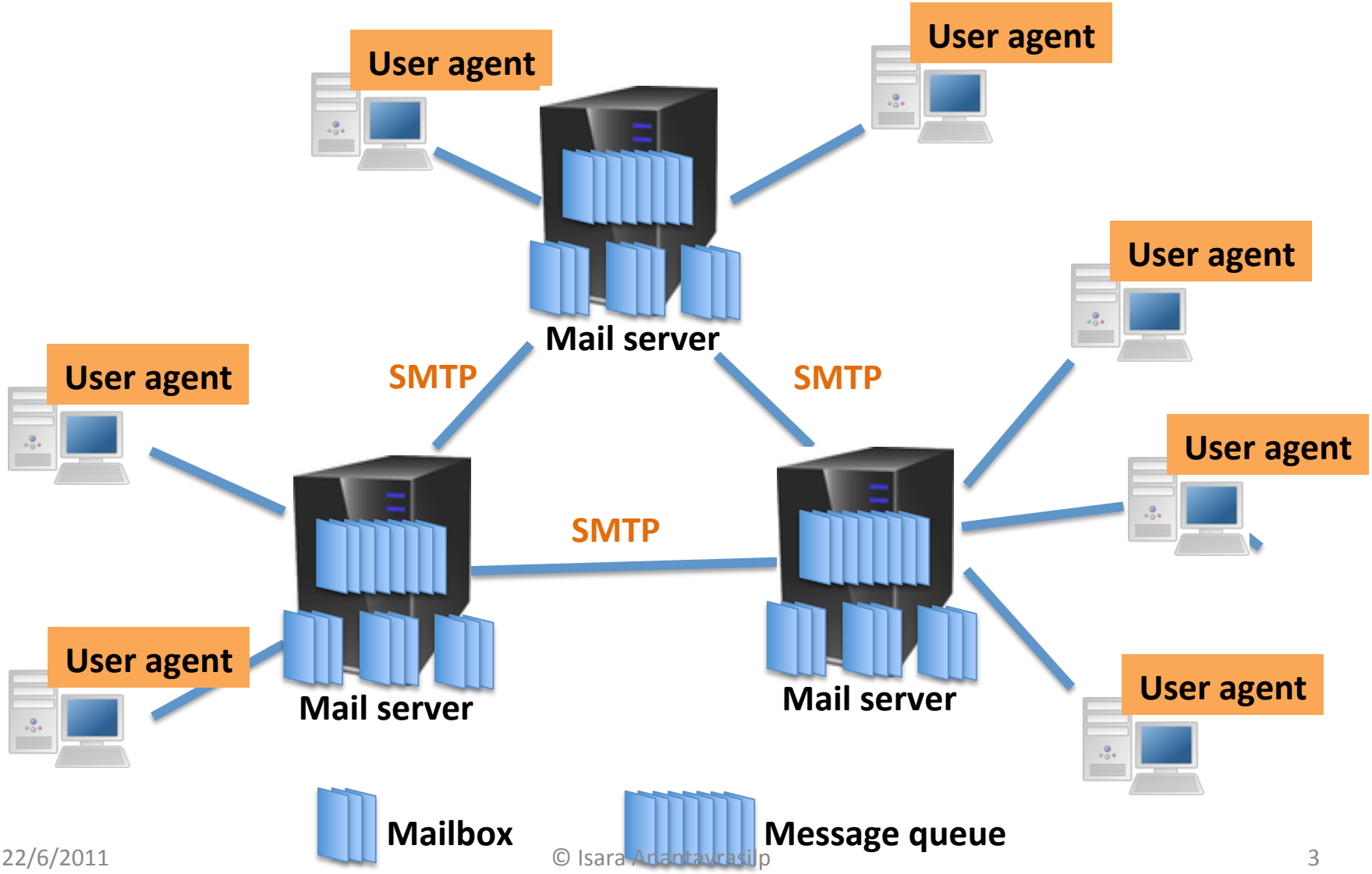
Email System



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Sending an Email

- An end-user, Alice, send a mail to another end-user, Bob, using a user agent program
- The user agent uses SMTP to send the mail to Alice's mail server
- Alice mail server places the mail into **message queue**
- Alice's mail server open a TCP connection to Bob's mail server and tries to send the mail to Bob's server
- If Bob's server is not available, the mail remains in the queue at Alice's server

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Receiving and Email

- After the mail is successfully sent, it will be waiting in Bob's **mailbox** at his mail server
  - A mailbox is comparable to a P.O. box
- Bob retrieves the mail from the mailbox when he wants
  - Also similar to P.O. box
- Note that SMTP does not use intermediate servers
- Sending host opens a direct socket to receiving host
  - This has something to do with MX record in the DNS

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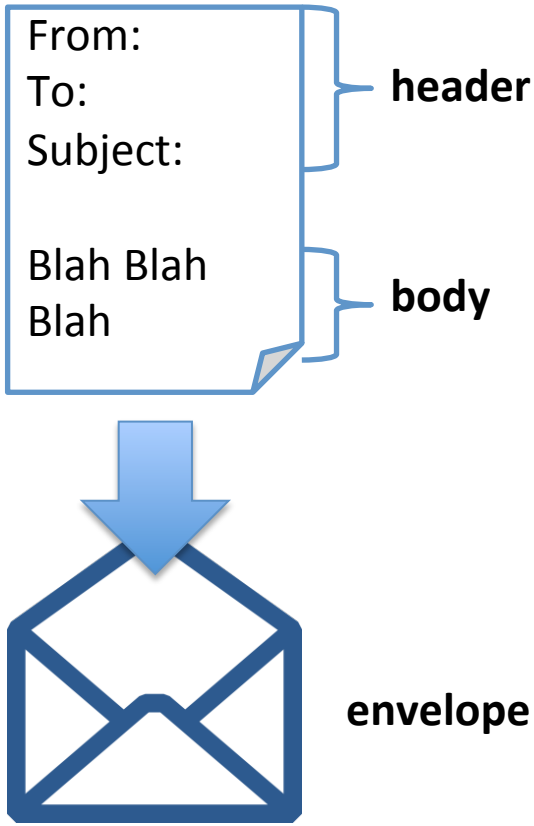
Receiving an Email (2)

- SMTP specifies only how to **send** and email to the mailbox
- Retrieving mails from the mailbox is the job of other protocols
- **Post Office Protocol version 3 (POP3)**
  - Simple protocol with limited functionalities
  - E.g., retrieve and delete mails
- **Internet Mail Access Protocol (IMAP):**
  - Designed for single-user with multiple machines
  - complex protocol with enhanced functionalities
  - E.g., organizing mails with subfolders, automatic mail synchronization
- **Webmail (HTTP)**: Allow you to connect to the mail box directly

Mail Format

- Envelope
  - Information for delivering the mail to the receiver
  - The email address is resolved by the DNS
  - MTAs use this info to route the message
- Header
  - Optional but generally used information
  - E.g., Sender:, To:, Subject:, CC:, Bcc:
- Body
  - The message
  - This part is for human only
  - 7-bit ASCII



Email Message

From: [redacted]
Subject: [redacted]
Date: June 14, 2011 2:35:44 PM GMT+07:00
To: [redacted]
Cc: [redacted] Isara Anantavrasilp , [redacted] and 1 more...
1 Attachment, 11.3 KB Save Quick Look

Hallo [redacted],

[redacted]

[redacted]

Mit freundlichen Grüßen,

[redacted]

Programmvo...lsx (11.3 KB)

Email Message – Raw

envelope

```
Return-Path: <fruth@fml.mw.tum.de>
Delivered-To: anantavr@nmail.informatik.tu-muenchen.de
Received: from maildmz2.informatik.tu-muenchen.de (localhost [127.0.0.1])
     by maildmz2.informatik.tu-muenchen.de (Postfix) with ESMTP id 5D13E3E238
     for <anantavr@in.tum.de>; Tue, 14 Jun 2011 09:36:17 +0200 (CEST)
Received: from mailrelay1.lrz-muenchen.de (mailrelay1.lrz-muenchen.de [129.187.254.106])
     by maildmz2.informatik.tu-muenchen.de (Postfix) with ESMTP id 4AA093E226
     for <anantavr@in.tum.de>; Tue, 14 Jun 2011 09:36:17 +0200 (CEST)
Received: from Firewall ([129.187.44.153] [129.187.44.153]) by mailout.lrz-muenchen.de with ESMTP
for anantavr@in.tum.de; Tue, 14 Jun 2011 09:35:50 +0200
Received: from mailfml2007.fml.mw.tu-muenchen.de ([129.187.174.97]:45920)
     by Firewall with esmtps (TLSv1:AES128-SHA:128)
     (Exim 4.69)
     (envelope-from <Fruth@fml.mw.tum.de>)
     id 1QWOA6-0006CA-00; Tue, 14 Jun 2011 09:35:46 +0200
Received: from MAILFML2007.fml.mw.tu-muenchen.de ([fe80::4959:5ffe:6e10:5354])
 by MAILFML2007.fml.mw.tu-muenchen.de ([fe80::4959:5ffe:6e10:5354%11]) with
 mapi; Tue, 14 Jun 2011 09:35:45 +0200
X-CTCH-RefID: str=0001.0A0B0205.4DF70F52.006A,ss=1,fgs=0
```

header

```
From: Fruth Andreas <Fruth@fml.mw.tum.de>
To: "[illegible]" <[illegible]@[illegible].de>
CC: "[illegible] ([illegible])" <[illegible].de>,
    [illegible] <[illegible]@in.tum.de>,
    Isara Anantavrasilp <anantavr@in.tum.de>,
```

Email Message – Raw (2)

header

```
From: Fruth Andreas <Fruth@fml.mw.tum.de>
To: "[illegible]" <[illegible]@[illegible].de>
CC: "[illegible] ([illegible])" <[illegible].de>,
    [illegible] <[illegible]@in.tum.de>,
    Isara Anantavrasilp <anantavr@in.tum.de>,
    [illegible] <[illegible]@in.tum.de>,
    "[illegible] ([illegible]@in.tum.de)"
 <[illegible]@in.tum.de>
Date: Tue, 14 Jun 2011 09:35:44 +0200
Subject: [illegible]
Thread-Topic: [illegible]
Thread-Index: AcwqZasp5mzwIxXQRw67KWBycOTE8Q==
Message-Id: <03E2BF009C166D42BBC59A95BE41E1EB014623C55C@MAILFML2007.fml.mw.tu-muenchen.de>
```

body

```
Accept-Language: de-DE
Content-Language: de-DE
X-MS-Has-Attach: yes
X-MS-TNEF-Correlator:
acceptlanguage: de-DE
Content-Type: multipart/mixed;
    boundary="_004_03E2BF009C166D42BBC59A95BE41E1EB014623C55CMAILFML2007fm_"
MIME-Version: 1.0

--_004_03E2BF009C166D42BBC59A95BE41E1EB014623C55CMAILFML2007fm_
Content-Type: multipart/alternative;
    boundary="_000_03E2BF009C166D42BBC59A95BE41E1EB014623C55CMAILFML2007fm_"
```

Note that both header and body are all text.

SMTP

- Designed to handle mail transfer
- Simple commands:
  - HELO, MAIL, RCPT, …
- Too simple:
  - Designed at the time when a "Mac" looks like this
  - Mail body can only be 7-bit ASCII
  - If you want to send anything more that English text, it has to be encoded in plain ASCII first
  - This is done using **MIME (Multipurpose Internet Mail Extensions)**

Apple IIe

Image: http://www.allaboutapple.com/

SMTP Connection

```
S: 220 smtp.example.com ESMTP Postfix
C: HELO relay.example.org
S: 250 Hello relay.example.org, I am
   glad to meet you
C: MAIL FROM:<bob@example.org>
S: 250 Ok
C: RCPT TO:<alice@example.com>
S: 250 Ok
C: RCPT TO:<theboss@example.com>
S: 250 Ok
C: DATA
S: 354 End data with
<CR><LF>.<CR><LF>
```

```
C: From: "Bob Example" <bob@example.org>
C: To: "Alice Example" <alice@example.com>
C: Cc: theboss@example.com
C: Date: Tue, 15 Jan 2008 16:02:43 -0500
C: Subject: Test message
C:
C: Hello Alice.
C: This is a test message with 5 header
   fields and 4 lines in the message body.
C: Your friend,
C: Bob
C: .
S: 250 Ok: queued as 12345
C: QUIT
S: 221 Bye
{The server closes the connection}
```

Source: http://en.wikipedia.org/wiki/Simple_Mail_Transfer_Protocol

MIME

- Extends the ASCII limitation of SMTP
- Defines encoding rules for non-ASCII message
- MIME also adds extra headers to a mail header including the following

Header	Meaning
MIME-Version	Identifying the MIME version
Content-Description	Specifies what is in the message
Content-Transfer-Encoding	Identifies how the body is encoded, e.g. Base 64, Quoted Printable, 7 Bit, 8 Bit und Binary
Content-Type	Identifies the type of the message content, e.g. `text`, `video/mpeg`, `audio/mp4`, `application/pdf`

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MIME Email – Text/HTML

```
--_000_03E2BF009C166D42BBC59A95BE41E1EB014623C55CMAILFML2007fm_
Content-Type: text/html; charset="iso-8859-1"
Content-Transfer-Encoding: quoted-printable

<html xmlns:v=3D"urn:schemas-microsoft-com:vml" xmlns:o=3D"urn:schemas-micr=
osoft-com:office:office" xmlns:w=3D"urn:schemas-microsoft-com:office:word" =
xmlns:m=3D"http://schemas.microsoft.com/office/2004/12/omml" xmlns=3D"http:=
//www.w3.org/TR/REC-html40"><head><meta http-equiv=3DContent-Type content=
=3D"text/html; charset=3Diso-8859-1"><meta name=3DGenerator content=3D"Micr=
osoft Word 12 (filtered medium)"><style><!--
/* Font Definitions */
@font-face
     {font-family:"Cambria Math";
     panose-1:2 4 5 3 5 4 6 3 2 4;}
@font-face
     {font-family:Calibri;
     panose-1:2 15 5 2 2 2 4 3 2 4;}
/* Style Definitions */
p.MsoNormal, li.MsoNormal, div.MsoNormal
     {margin:0cm;
     margin-bottom:.0001pt;
     font-size:11.0pt;
     font-family:"Calibri","sans-serif";}
```

MIME

Message (HTML)

MIME Email – Excel File

```
--_004_03E2BF009C166D42BBC59A95BE41E1EB014623C55CMAILFML2007fm_
Content-Type: application/vnd.openxmlformats-officedocument.spreadsheetml.sheet;
    name="Programmvorschlag F+E-Tagungen.xlsx"
Content-Description: Programmvorschlag F+E-Tagungen.xlsx
Content-Disposition: attachment;
    filename="Programmvorschlag F+E-Tagungen.xlsx"; size=11605;
    creation-date="Tue, 14 Jun 2011 09:33:18 GMT";
    modification-date="Tue, 14 Jun 2011 09:33:18 GMT"
Content-Transfer-Encoding: base64
```

Content-Type

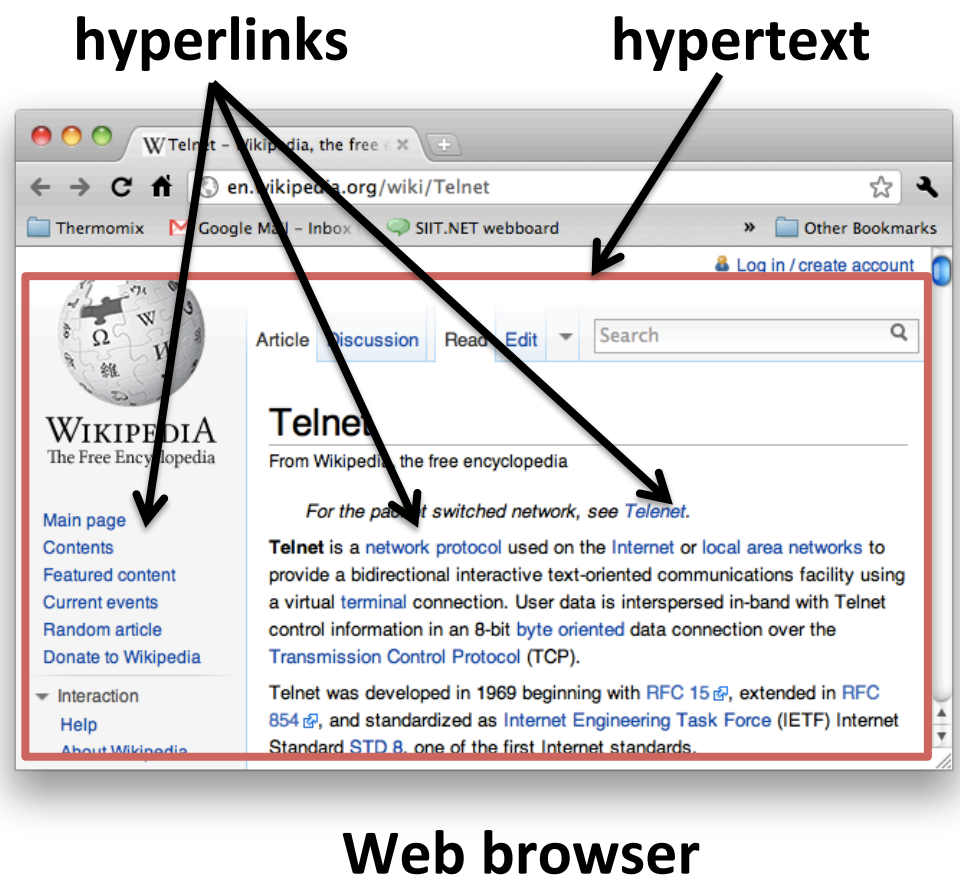
Content-Desc

Content-Disposition

Encoding


```
UEsDBBQABgAIAAAAIQCqUB8GhQEAAIQFAAATANwBW0NvbnRlbnRfVHlwZXNdLnhtbCCi2AEooAAC
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
```

Web Page



- A **web page** consists of many objects
  - **Hyperlinks**: Links to other pages
  - Images
  - Video
  - Javascript
- Document which contains hyperlink is called **hypertext**

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HTTP

- HyperText Transfer Protocol
- Client-server architecture
  - Client-side application
  - Server-side application
- Defines how client and server applications communicate to each other
- Stateless
- Client requests a web page using **universal resource locator (URL)** which consists of hostname and path name

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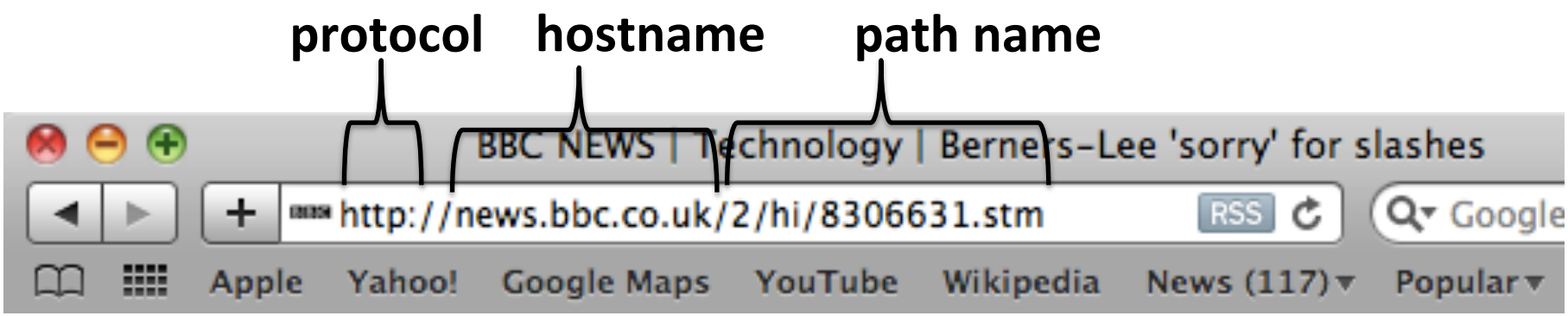
Universal Resource Locator (URL)

- Locate the correct resource on the Internet
- Consists of
  - Hostname
  - Path name
  - Protocol: `http:// ftp:// itunes:// mailto://`
- The host determines appropriate application through the specified protocol
- Berners-Lee: I am sorry for the useless //



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HTTP Connection

- Before a web page can be transferred, a TCP connection between client and server has to be established
- Multiple connections for a single web page is also possible

- HTTP Request
  Client → Server
- HTTP Response
  Server → Client

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HTTP Request and Response

- HTTP Request
  - Request syntax: `<Request command> <URL> <Version>`
  - Header: Additional request information
  - Example:

```
GET /ic/ HTTP/1.1
Host: www.kmitl.ac.th
```

- HTTP Response
  - Status line: Result of the request
    - `200 OK`: Request succeeded
    - `400 Bad Request`: Request is not understood by the server
    - `404 Not Found`: Request is not found
  - Header Line: Additional information
  - Entity body: The requested object (i.e. web page, image file)

HTTP with Telnet

Terminal — bash — 73×25

```
Last login: Mon Jun 13 19:30:56 on ttys001
MayhemMac:~ bigga$ telnet www.kmitl.ac.th 80
Trying 161.246.34.11...
Connected to chaokhun.crsc.kmitl.ac.th.
Escape character is '^]'.
GET /ic/ HTTP/1.1
Host: www.kmitl.ac.th

HTTP/1.1 200 OK
Date: Mon, 13 Jun 2011 12:38:42 GMT
Server: Apache
X-Powered-By: PHP/5.1.6
Connection: close
Transfer-Encoding: chunked
Content-Type: text/html

214b
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
<head>
<title>Welcome to KMITL International College</title>
<meta http-equiv="Content-Type" content="text/html; charset=windows-874">
<meta name="keywords" content="KMITL International College">
<meta name="description" content="">
<meta name="author" content="webmaster">
```

request and request header

response status and header

response body

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HTTP Connection

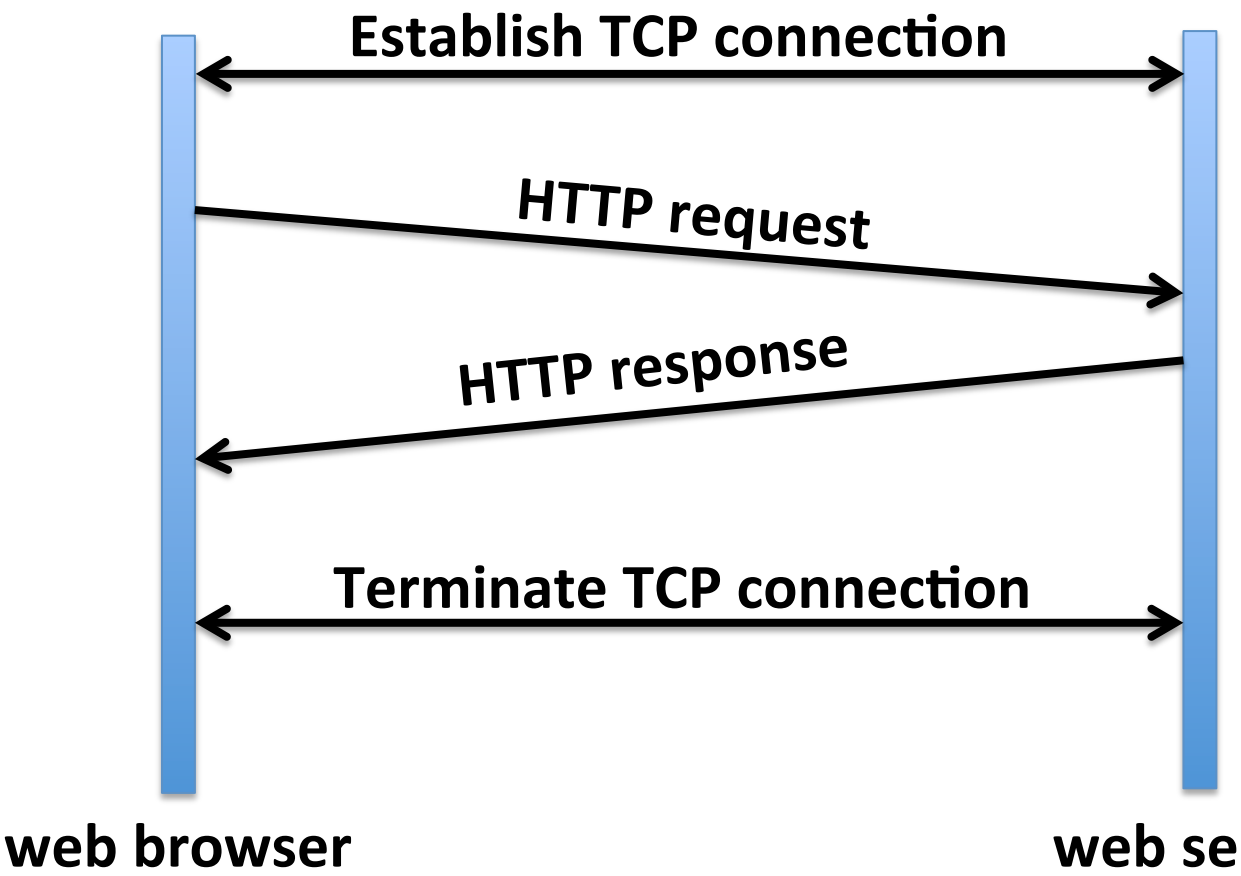
1. HTTP client initiates a TCP connection to a server
2. The client sends the HTTP request message
3. HTTP server retrieves the requested object and encapsulate it in the HTTP response message
4. The server send the message through the opened TCP connection
5. The server closes the connection
6. The client examines the message and display the object
7. If the object contains references to other objects (e.g. an HTML page contains images or videos), the entire process is repeated for each object

HTTP Connection (2)

objects

Javascripts or CSS files are objects too

HTTP Connection (2)



Non-persistent HTTP

One object is sent through a connection

Repeating these steps for each object is not efficient

HTTP 1.0

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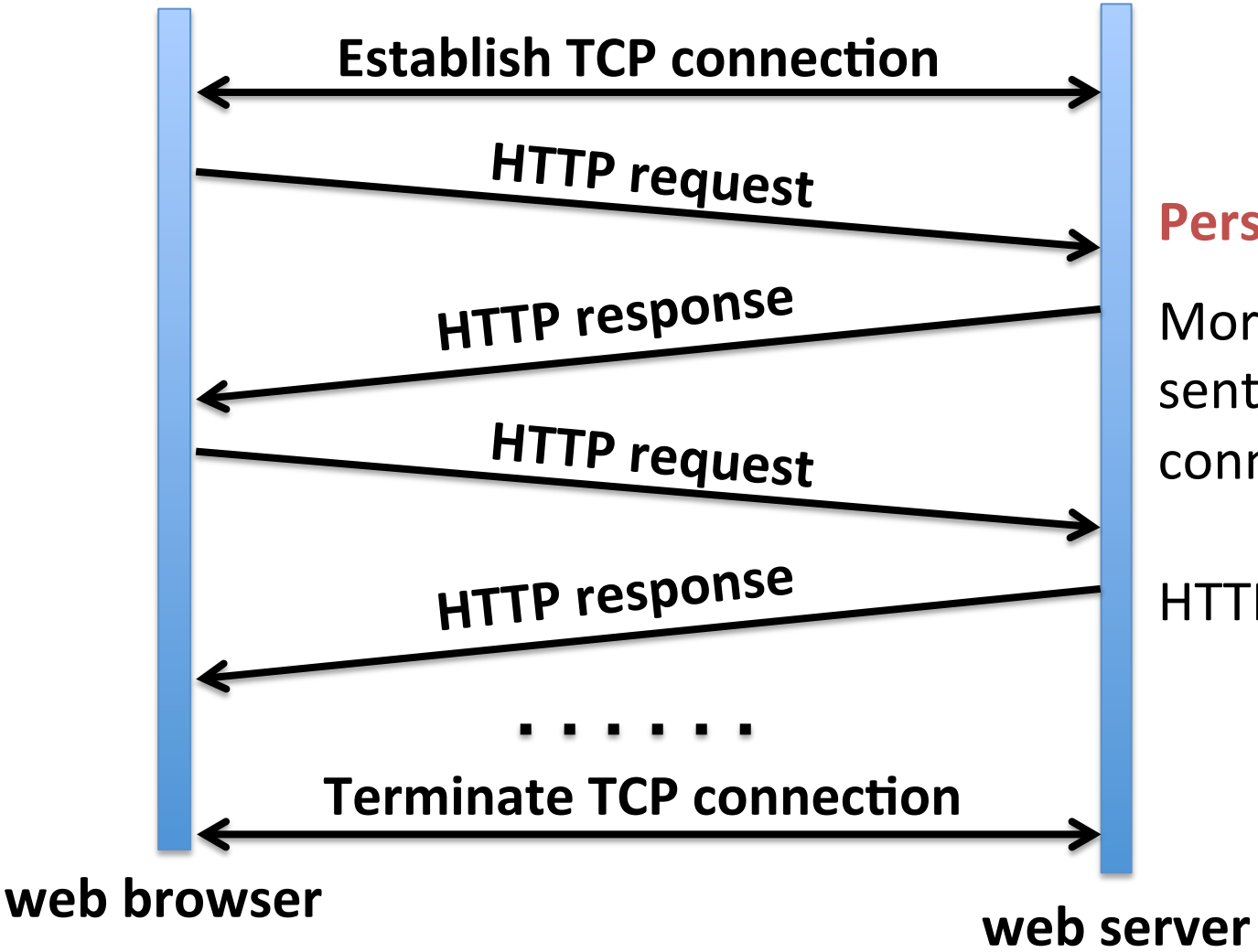
HTTP Connection (3)



Persistent HTTP

More than one objects sent through a connection

HTTP 1.1 default mode

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