

# Network : Internet Application

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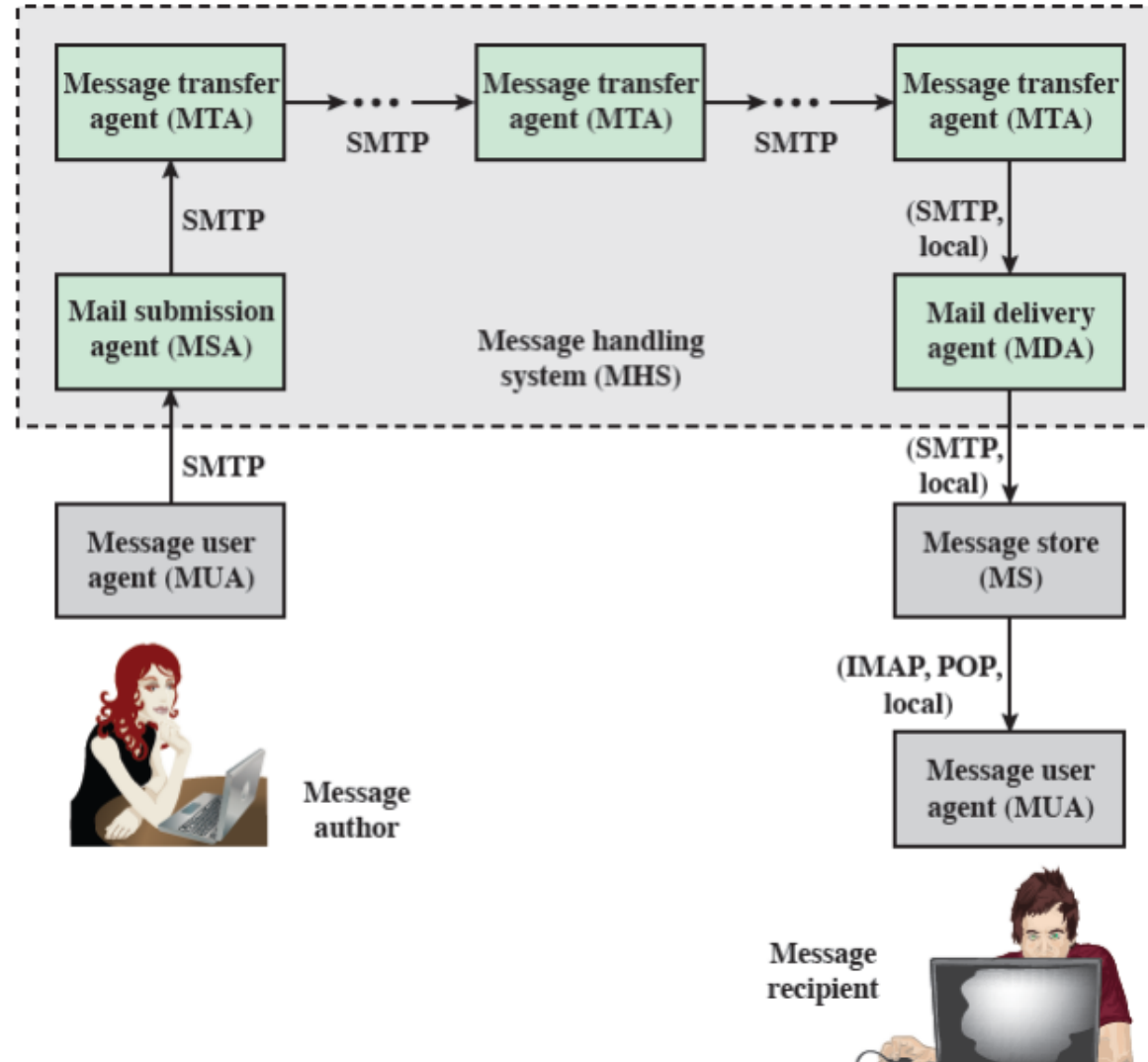
# — Reference

William Stalling, Data and Computer Communications 10/E, Prentice Hall

# — Email, DNS, and HTTP

- Electronic mail
  - a facility that allows users at workstations and terminals to compose and exchange messages
- Internet mail architecture (RFC 5598) consists of
  - a user world, in the form of Message User Agents (MUA)
  - the transfer world, in the form of the Message Handling Service (MHS), which is composed of Message Transfer Agents (MTA)
- Domain Name Server (DNS) : RFC 1034,1035
  - a directory lookup service that provides a mapping between the name of a host on the Internet and its numerical address

# Internet Mail Architecture



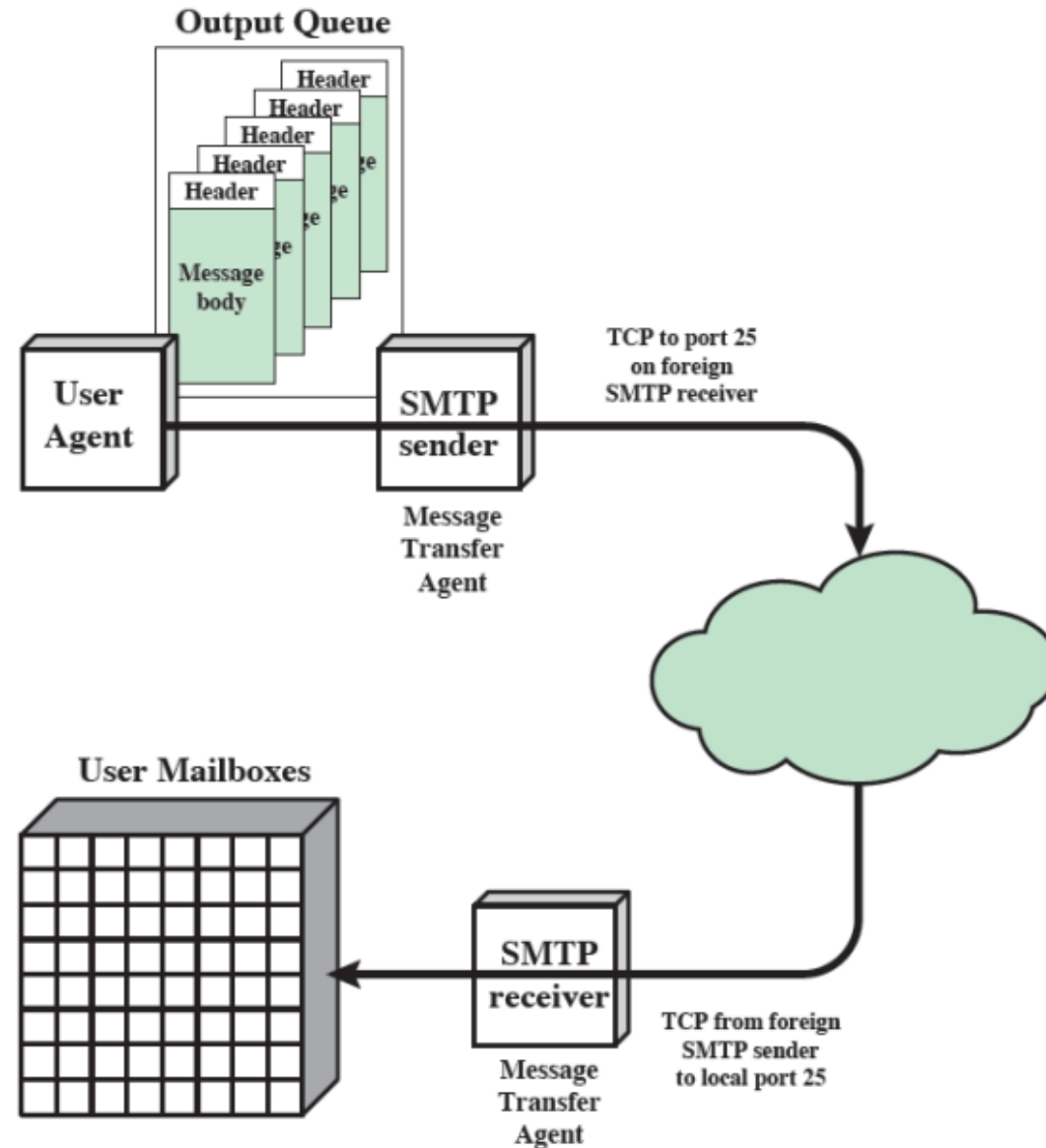
# — Internet Mail Standards

- Post Office Protocol (POP3) : RFC 1939
  - allows an e-mail client to download an e-mail from a server
- Internet Mail Access Protocol (IMAP) : RFC 3501
  - provides stronger authentication than POP3 and provides other functions not supported by POP3, so synchronized replication
- Simple Mail Transfer Protocol (SMTP) : RFC 821
  - protocol used for transfer of mail from a user agent to an MTA and from one MTA to another
- Multipurpose Internet Mail Extensions (MIME)
  - supplements SMTP and allows the encapsulation of multimedia messages inside of a standard SMTP message

# — SMTP

- Aims to transfer mail between hosts in the TCP/IP suite
- Not concerned with the format or content of messages themselves, but with exceptions as
  - it standardizes the message character set as 7-bit ASCII
  - it adds log information to the start of the delivered message that indicates the path the message took
- SMTP adapts RFC 822, which defines a format for text messages that are sent using electronic mail
  - an envelope : contains whatever information is needed to accomplish transmission and delivery
  - contents : comprise the object to be delivered to the recipient

# SMTP Mail Flow



# — Limitations of SMTP/822

- SMTP/822
  - cannot transmit executable files or binary objects
  - cannot transmit text data that includes national language characters
  - may reject mail messages over a certain size
  - some implementations do not adhere completely to the SMTP standards defined in RFC 821
  - SMTP gateways that translate between ASCII and EBCDIC do not use a consistent set of mappings, resulting in translation problems



# — MIME (1)

- Extension to the RFC 822 framework that
  - is intended to address some of the problems and limitations of the use of SMTP and RFC 822 for electronic mail
- Includes the following elements:
  - five new message header fields are defined, which may be included in an RFC 822 header
  - a number of content formats are defined, thus standardizing representations that support multimedia electronic mail
  - transfer encodings are defined that enable the conversion of any content format into a form that is protected from the mail system

# MIME (2)

- MIME header fields
  - MIME-version
  - content-type
  - content-transfer-encoding
  - content-ID
  - content-description

## Content-transfer-encoding

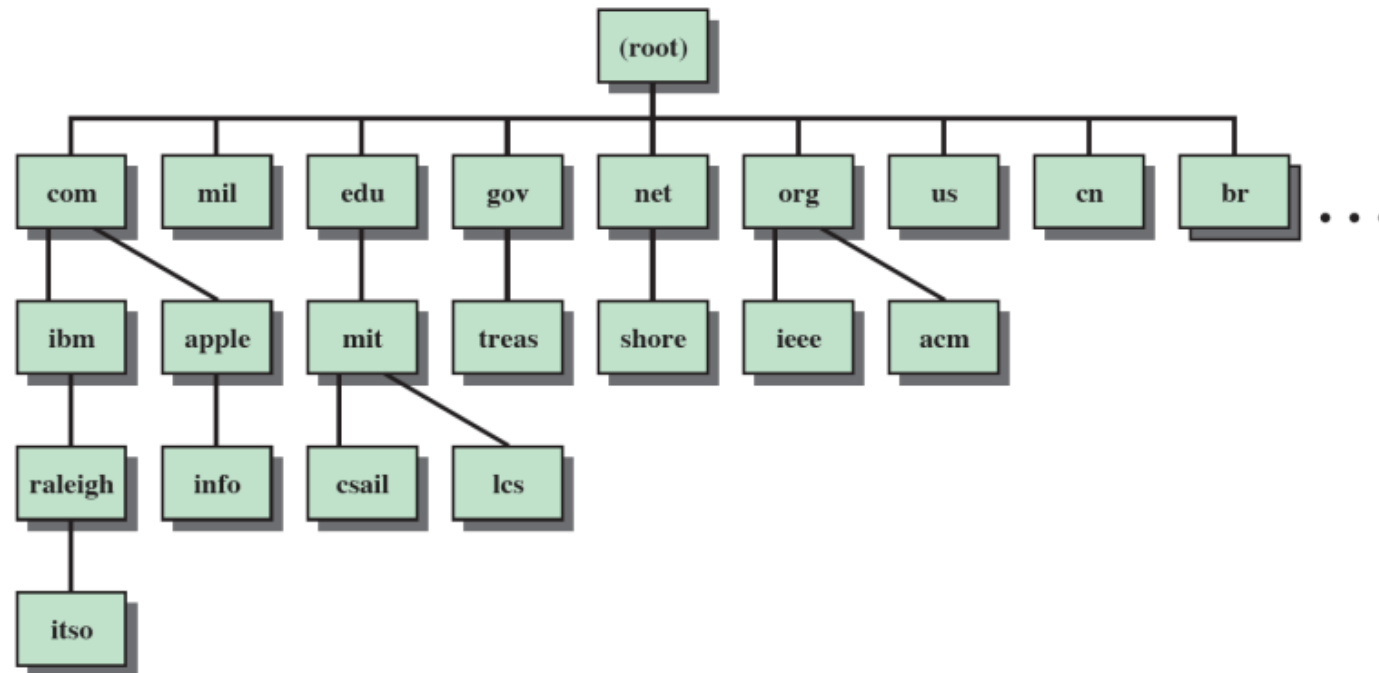
<b>7bit</b> ↵	The data are all represented by short lines of ASCII characters.↵
<b>8bit</b> ↵	The lines are short, but there may be non-ASCII characters (octets with the high-order bit set).↵
<b>binary</b> ↵	Not only may non-ASCII characters be present but the lines are not necessarily short enough for SMTP transport.↵
<b>quoted-printable</b> ↵	Encodes the data in such a way that if the data being encoded are mostly ASCII text, the encoded form of the data remains largely recognizable by humans.↵
<b>base64</b> ↵	Encodes data by mapping 6-bit blocks of input to 8-bit blocks of output, all of which are printable ASCII characters.↵
<b>x-token</b> ↵	A named nonstandard encoding.↵

# — Internet Directory Service (DNS)

- A directory lookup service that provides a mapping between the name of a host and its numerical address
  - essential to the functioning of the Internet
  - defined in RFCs 1034 and 1035
- Four elements comprise the DNS:
  - domain name space
  - DNS database
  - name servers
  - resolvers

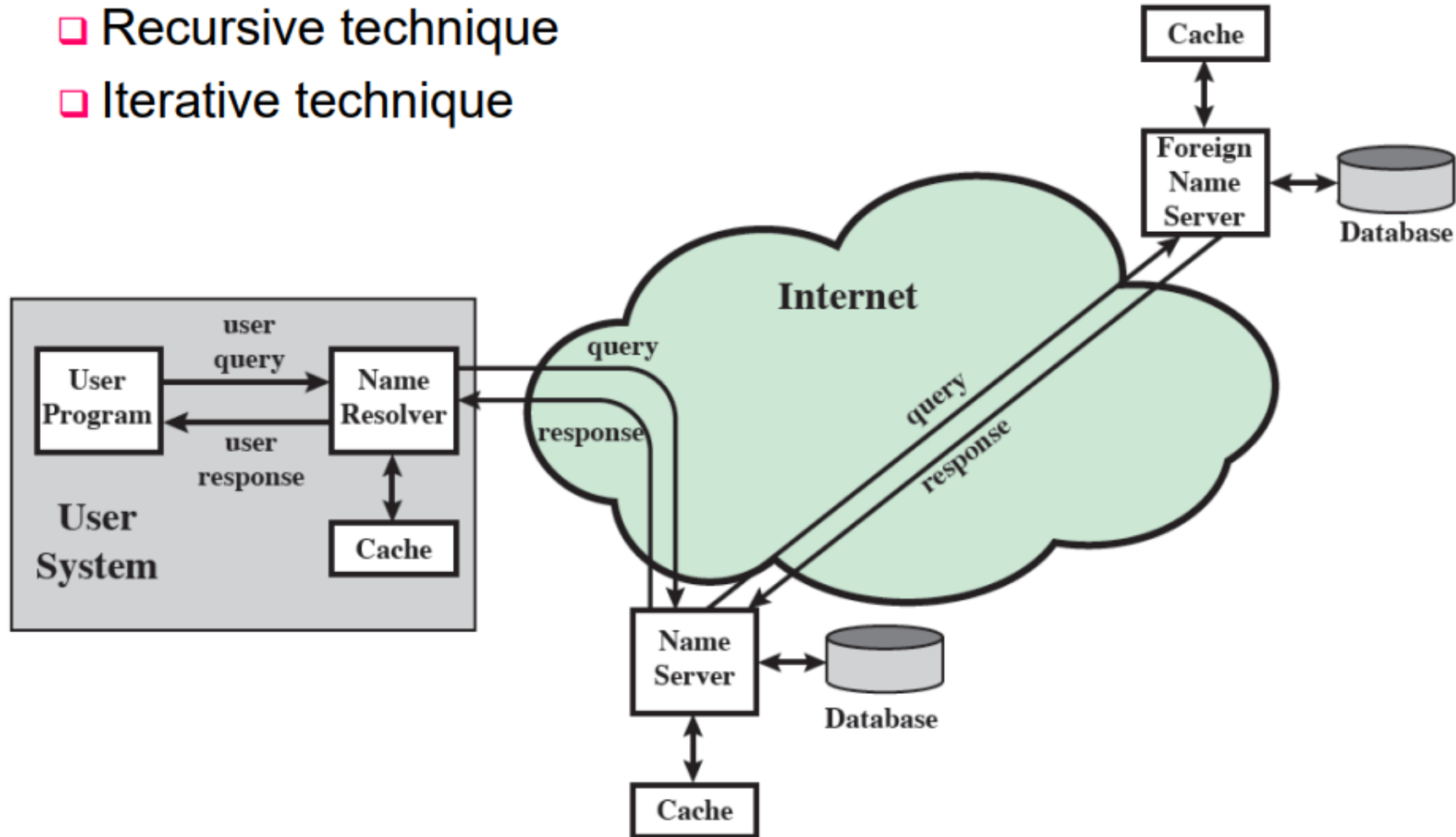
# Domain

- Refers to a group of hosts that are under the administrative control of a single entity
  - organized hierarchically, so that a given domain may consist of a number of subordinate domains
  - names are assigned and reflect the hierarchical organization



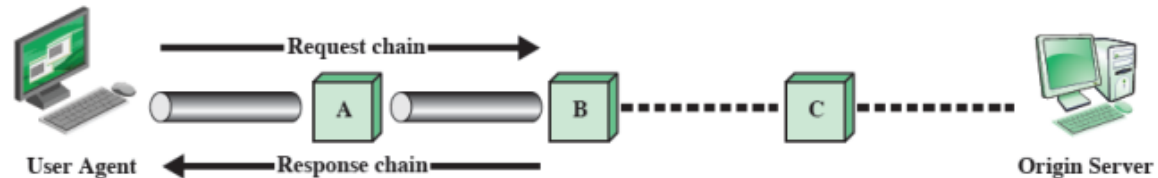
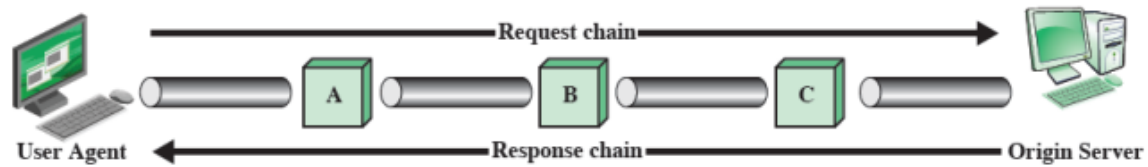
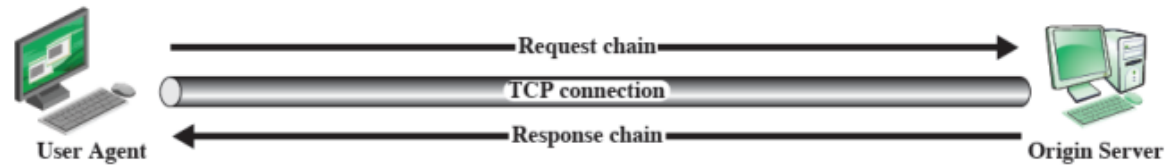
# DNS Name Resolution

- ❑ Recursive technique
- ❑ Iterative technique



# HTTP

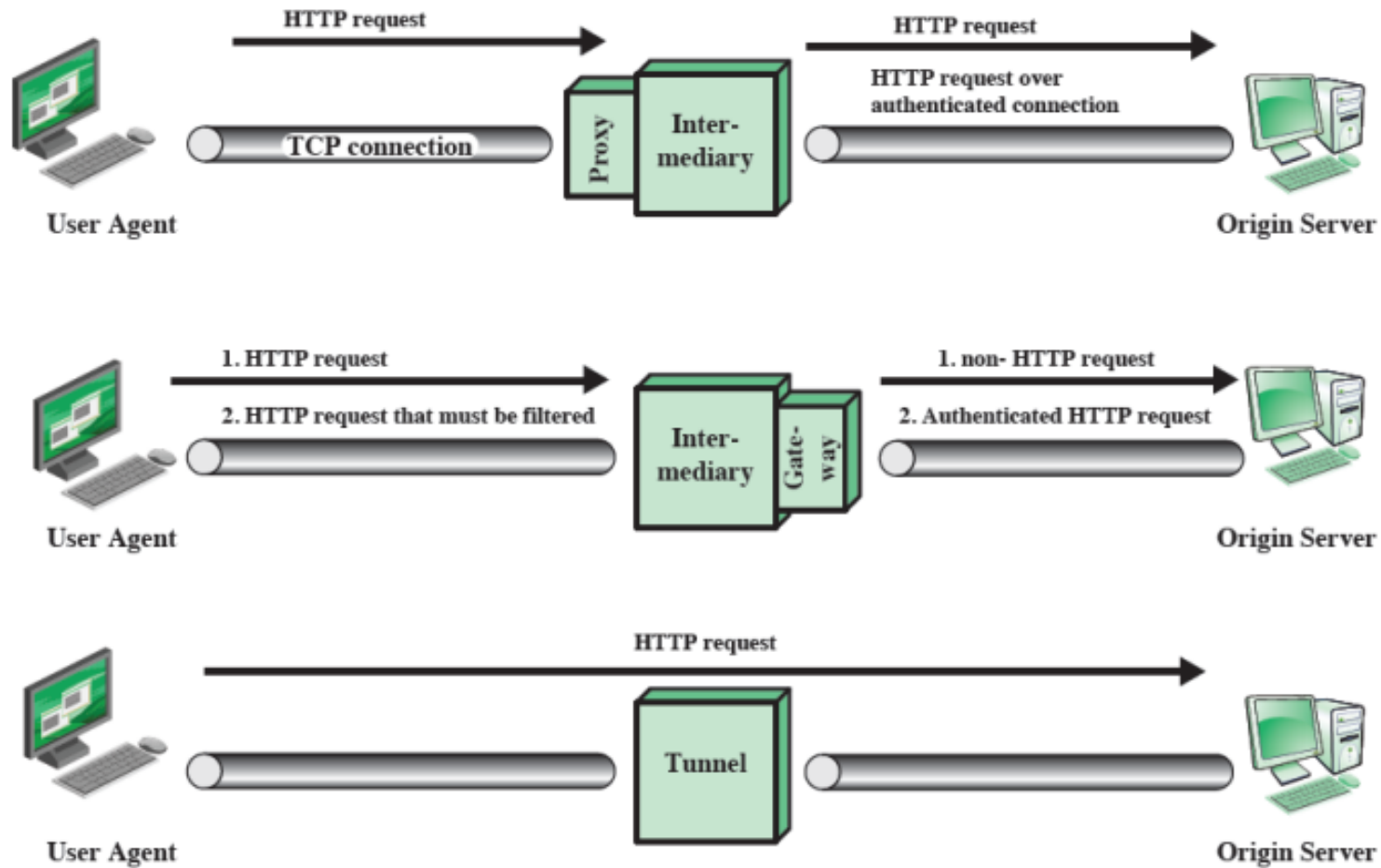
- Transaction-oriented client/server protocol
  - most typical use is between a Web browser and a Web server
  - makes use of TCP to provide reliability



# — Proxy

- It is a kind of forwarding agent
  - receiving a request for a URL object, modifying the request, and
  - forwarding the request toward the server identified in the URL
- Acts as a server in interacting with a client and as a client in interacting with a server
- Scenarios that call for the use of a proxy:
  - security intermediary (such as a firewall)
  - different versions of HTTP (the proxy can implement both versions and perform the required mapping)

# Intermediate HTTP Systems

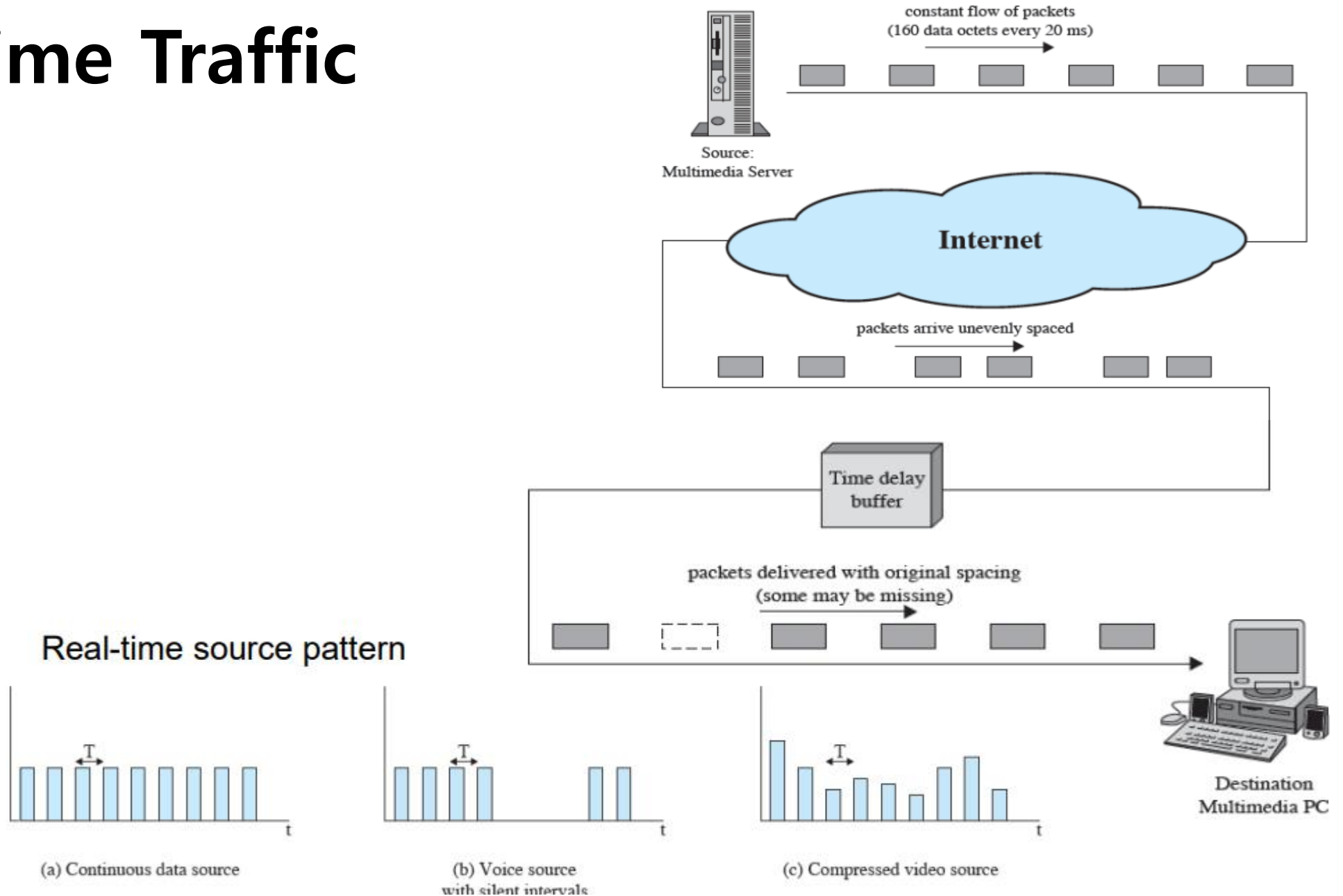




# — Internet Multimedia Support

- Requirements for real-time communication
  - low jitter
  - low latency
  - ability to easily integrate non-real-time and real-time services
  - adaptable to dynamically changing network and traffic conditions
  - high effective capacity utilization
  - good performance for large networks & large numbers of connections
  - modest buffer requirements within the network
  - low overhead in header bits per packet
  - low processing overhead per packet within the network and at the end system

# Real-time Traffic



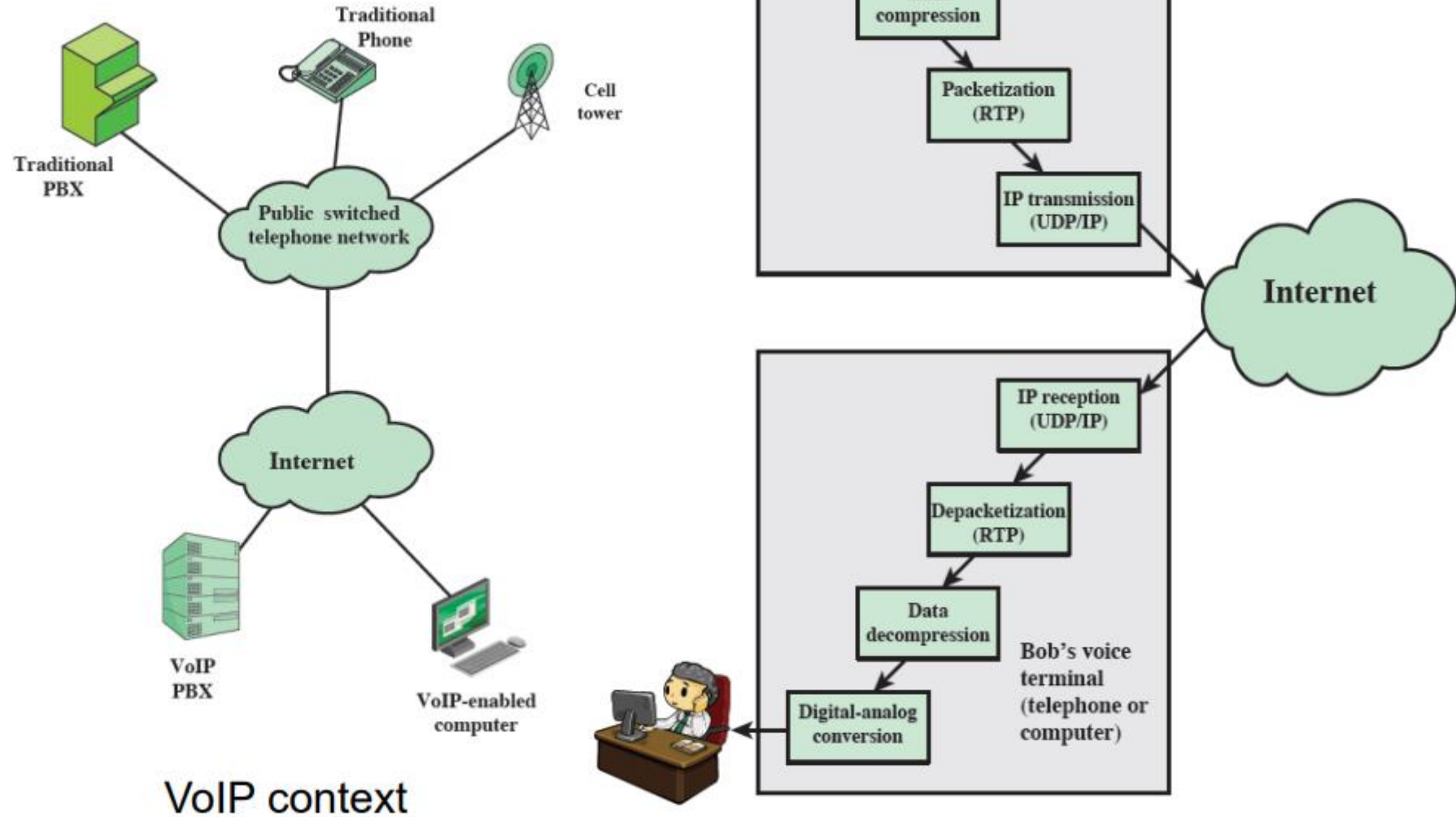
# — Hard vs Soft Real-time Applications

- Hard RT (Real Time)
  - have zero loss tolerance
  - a deterministic upper bound on jitter and high reliability takes precedence over network utilization considerations
- Soft RT
  - can tolerate the loss of some portion of the communicated data
  - impose fewer requirements on the network. So permissible to focus on maximizing network utilization, even at the cost of some lost or misordered packets

# — Voice over IP (VoIP)

- The transmission of speech across IP-based network
- Has two main advantages over traditional telephony
  - cheaper to operate than an equivalent PSTN system
  - readily integrates with other services, such as WWW access with telephone features through a single PC
- VoIP signaling
  - before voice can be transferred using VoIP a call must be placed
  - the calling user supplies the phone # of a URI which then triggers a set of protocol interactions resulting in the placement of the call
  - the heart of these is the Session Initiation Protocol (SIP)

# VoIP Processing



# — Real-time Transport Protocol (RTP)

- Best suited to soft real-time communication
  - lacks the necessary mechanisms to support hard real-time traffic
- RTP (RFC 3550) supports the transfer of real-time data among a number of participants in a session
  - a session is a logical association among two or more RTP entities that is maintained for the duration of the data transfer
  - it is defined by:
    - RTP port number
    - RTCP port number
    - Participant IP addresses

# RTP Architecture

- Two protocols that make up RTP are:
  - RTP : data transfer protocol
  - RTCP : control protocol
- Protocol architecture

