Electronic Mail

Lecture 10: Electronic mail

On completion, the student will be able to:

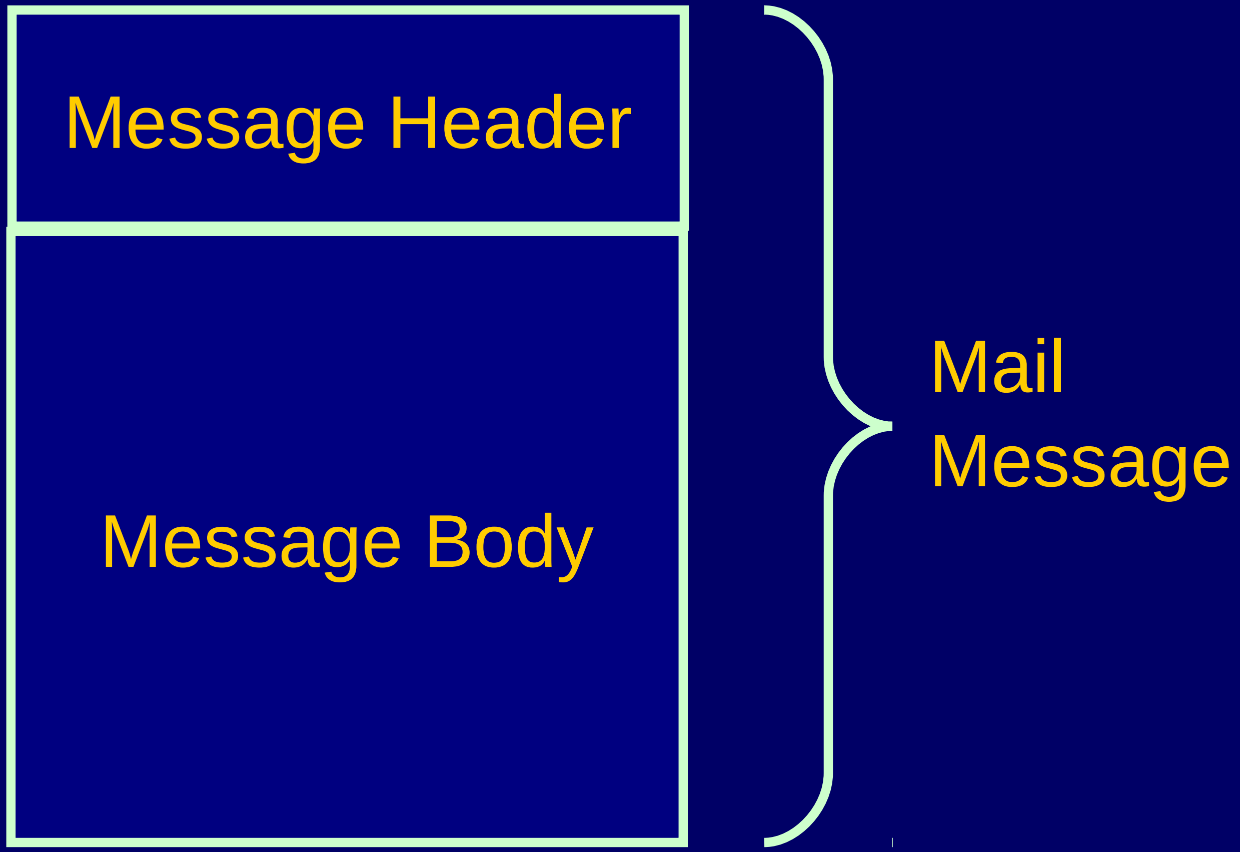
- Describe the overall architecture of the email system.
- Explain the functions of user agents and message transfer agents.
- Explain the functions of SMTP and MIME protocols.
- Demonstrate the sending of mail using raw SMTP commands.
- Interpret the email header fields.
- Explain the function of the POP3/IMAP protocol.

Electronic Mail

- Most widely used application on the Internet.
- For sending mails:
  - Simple Mail Transfer Protocol (SMTP)
  - Multi-purpose Internet Mail Extension (MIME)
- For receiving mails:
  - Post office protocol version 3 (POP3)
  - Internet mail access protocol (IMAP).

Simple Mail Transfer Protocol

- Based on RFC 821.
- Transmits simple text messages only.
  - ➢7-bit ASCII format.
- Uses information written on envelope of mail.
  - ➢Message header.
  - ➢Contains recipient address and other information.
- Does not look at contents.
  - ➢Message body.



Message Header

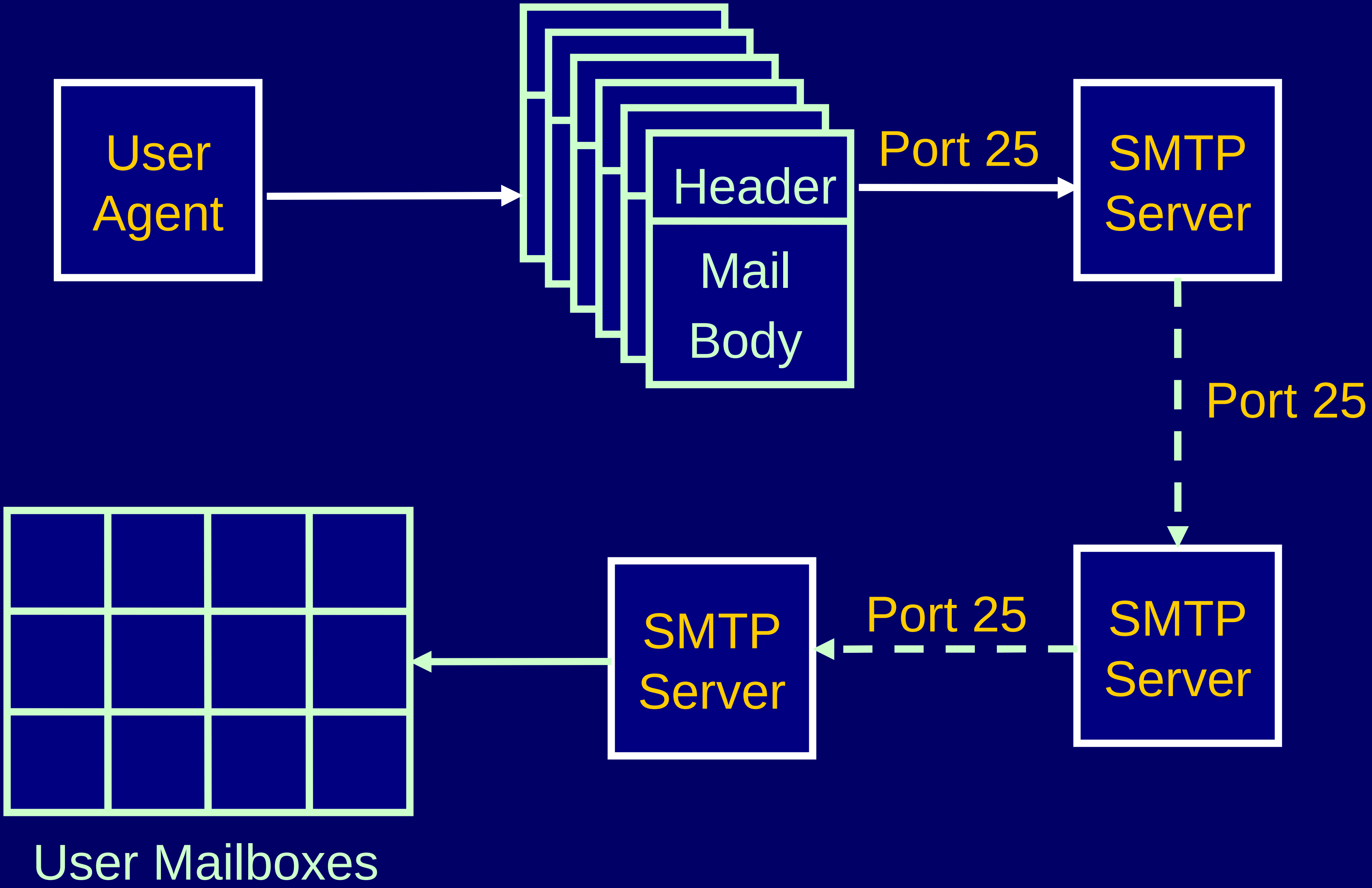
Message Body

Mail Message

Basic Operation

- Mail is created by user agent program (mail client).
- Messages queued and sent as input to SMTP sender program.
  - Typically a server process.
  - Daemon on UNIX.
    - sendmail or qmail

SMTP Mail Flow



Mail Message Contents

- Each queued message has:
  - Message text
    - RFC 822 header with message envelope and list of recipients.
    - Message body, composed by user.
  - A list of mail destinations
    - Derived by user agent / SMTP server from header.
    - May require expansion of mailing lists.

SMTP Sender

- Takes message from queue.
- Transmits to proper destination host.
  - ➢Via SMTP transaction.
  - ➢Over one or more TCP connections to port 25.
- When all destinations processed, message is deleted.

Optimization

- If message is sent to multiple users on a given host, it is sent only once.
    - ➢Delivery to users handled at destination host.
- If multiple messages are ready for given host, a single TCP connection can be used.
    - ➢Saves overhead of setting up and dropping connection.

Possible Errors

- Host unreachable
- Host out of operation
- TCP connection fail during transfer
- Faulty destination address
  - ➢User error
  - ➢Target user address has changed
  - ➢Redirect if possible
  - ➢Inform user if not

Sender can re-queue mail

- ➢Give up after a period

SMTP Protocol - Reliability

- Used to transfer messages from sender to receiver over TCP connection.
  - Uses port number 25.
- Attempts to provide reliable service.
- No guarantee to recover lost messages.
- No end-to-end ACK to sender.
- Error indication report not guaranteed.

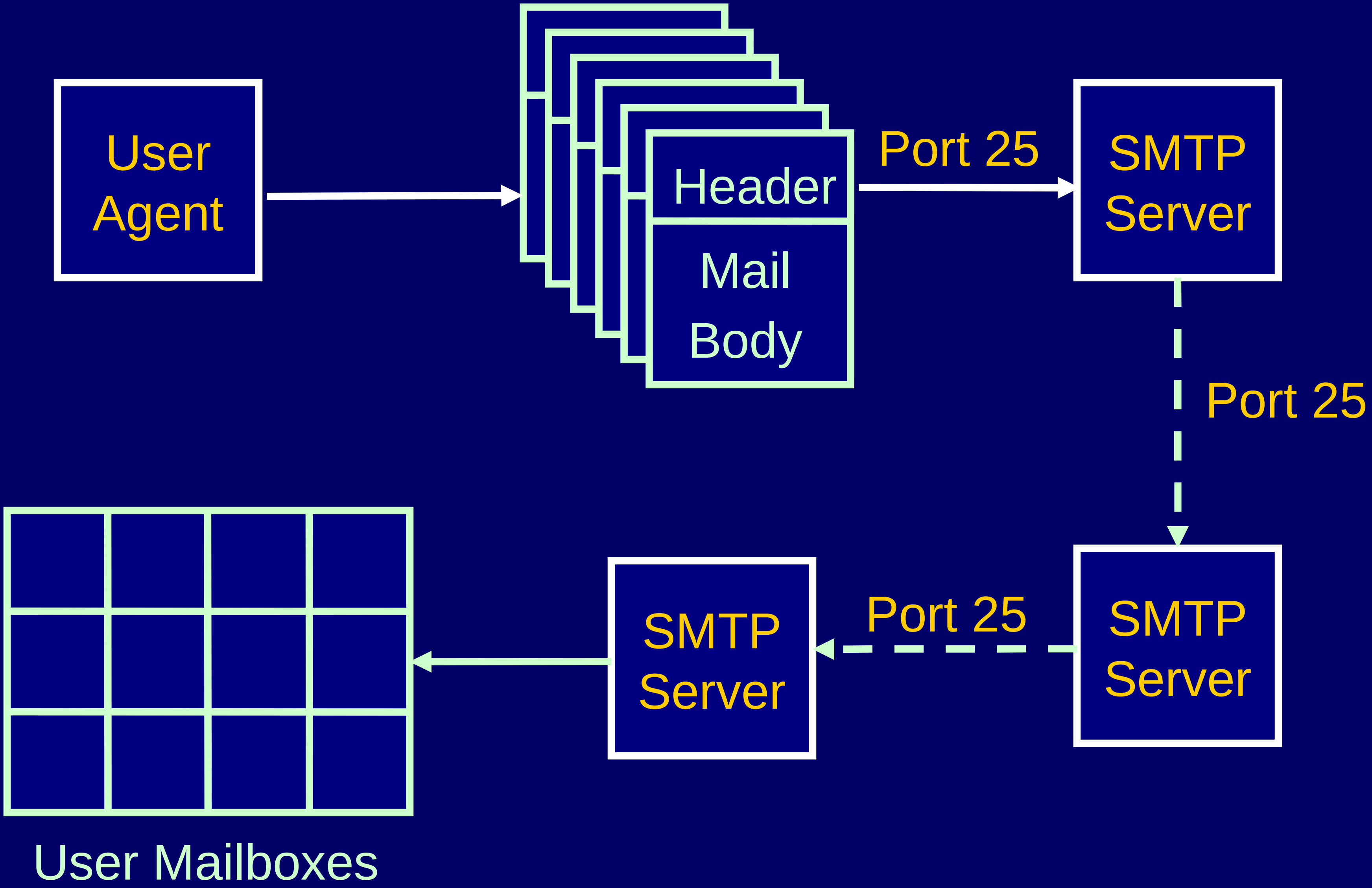
SMTP Receiver

- Accepts arriving message.
- Places in user mailbox or copies to outgoing queue for forwarding.
- Receiver must:
  - Verify local mail destinations.
  - Deal with errors
    - Transmission
    - Lack of disk space

SMTP Forwarding

- Mostly direct transfer from sender host to receiver host.
- May go through intermediate mail servers via forwarding capability.
    - ➢Sender can specify route.

SMTP Mail Flow



SMTP System Overview

- Commands and responses exchanged between sender and receiver.
- Initiative with sender.
  - Establishes TCP connection.
- Sender sends commands to receiver.
  - e.g. HELO <domain><CRLF>
- Each command generates exactly one reply.
  - e.g. 250 requested mail action ok; completed.

SMTP Replies

- Starts with 3-digit code.
- Leading digit indicates category.
  - 2xx -- Positive completion reply
  - 3xx -- Positive intermediate reply
  - 4xx -- Transient negative completion reply
  - 5xx -- Permanent negative completion reply

Operation Phases

- Connection setup
- Exchange of command-response pairs
- Connection termination

a) Connection Setup

- Sender opens TCP connection with receiver.
- Once connected, receiver identifies itself.

  220 <domain> service ready
- Sender identifies itself.

  HELO
- Receiver accepts sender’s identification.

  250 OK
- If mail service not available, the second step above becomes:

  421 service not available

b) Mail Transfer Commands

- The MAIL FROM command identifies originator.
  - Gives reverse path to be used for error reporting.
  - Receiver returns 250 OK or appropriate failure / error message.

- One or more **RCPT TO** commands identify recipients for the message.
  - ➢Separate reply for each recipient.
- The **DATA** command transfers message text.
  - ➢End of message indicated by a line containing just period (.)

c) Closing Connection

- Two steps:
  - Sender sends QUIT and waits for reply.
  - Then initiate TCP close operation.
- Receiver initiates TCP close after sending reply to QUIT.

An Example SMTP Session

- How to connect to an SMTP server?

  telnet servername 25

  - A TCP connection gets established over port number 25.
  - The telnet client and the mail server can now start a dialogue.

An Example SMTP Session

```
S: 220 hotmail.com Simple Mail Transfer Service Ready
C: HELO yahoo.com
S: 250 hotmail.com

C: MAIL FROM: <isg@yahoo.com>
S: 250 OK

C: RCPT TO: <myfriend@hotmail.com>
S: 250 OK

C: RCPT TO: <somebody@rediffmail.com>
S: 250 OK
```

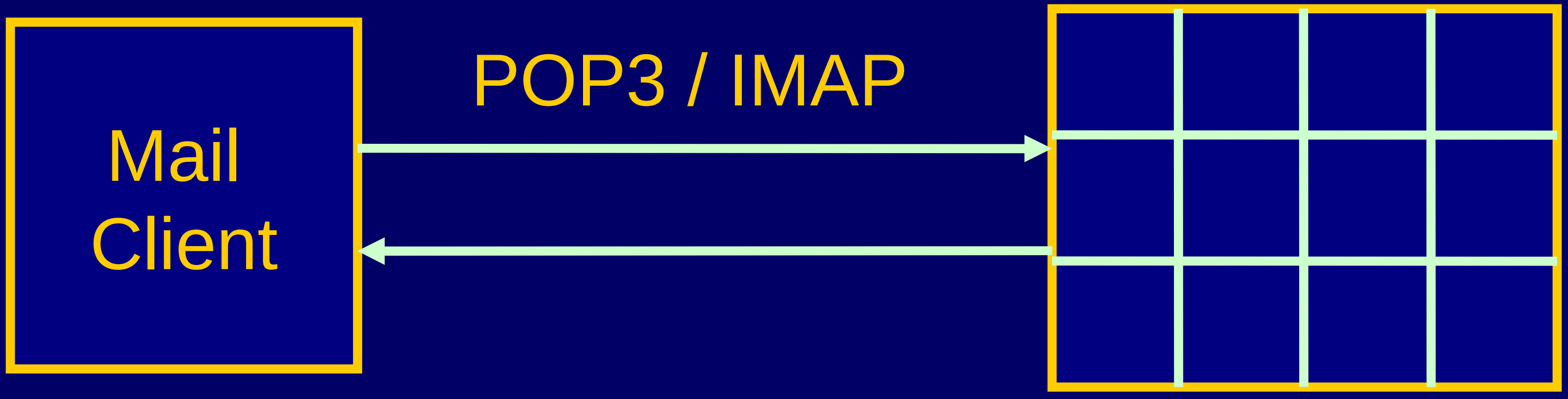
An Example SMTP Session

```
C: DATA
S: 354 Start mail input; end with (.)
C: … actual contents of the message …
C: ………
C: ………

C: .
S: 250 OK


C: QUIT
S: 221 hotmail.com Service closing transmission
    channel
```

Mail Access Protocols

- Two mail access protocols are widely used:
  - Post Office Protocol, version 3 (POP3)
  - Internet Mail Access Protocol version 4 (IMAP4).

What do they do?



POP3 / IMAP

Mail Client

User Mailboxes

on SMTP server

POP3

- The client POP3 software is installed on the recipient machine, and the server POP3 software installed on mail server.
  - ➢The client (user agent) opens a connection with the server on TCP port number 110.
  - ➢Sends user name and password.
  - ➢Can access the mails, one by one.

POP3 (contd.)

- Two modes:
  - Delete mode – mails deleted as they are read
  - Keep mode – mails remain in the mailbox
- POP3 has commands for:
  - Log in
  - Log out
  - Fetch messages
  - Delete messages

IMAP4

- Provides the following extra features:
  - A user can check the email header before downloading.
  - A user can search the contents of the email for a specific string prior to downloading.
  - A user can create, delete, or rename mailboxes on the mail server.
  - A user can create a hierarchy of mailboxes in a folder for email storage.

Multipurpose Internet Mail Extension (MIME)

- SMTP cannot transmit non-text messages.
  - Solutions (like uuencode) exists on some systems, but are not standardized.
- Cannot transmit text that includes international characters (e.g. â, å, ä, è, é, ê, ë).
  - Need 8 bit ASCII.

- Servers may reject mail over certain size.
- Some SMTP implementations do not adhere to standard.
  - CRLF, truncate or wrap long lines, removal of white space, etc.

Overview of MIME

- **Five new message header fields:**
  - **MIME-version**
  - **Content-type**
  - **Content-transfer-encoding**
  - **Content-Id**
  - **Content-description**
- **A number of *content types* and *transfer encoding* formats have been defined.**

Content Types

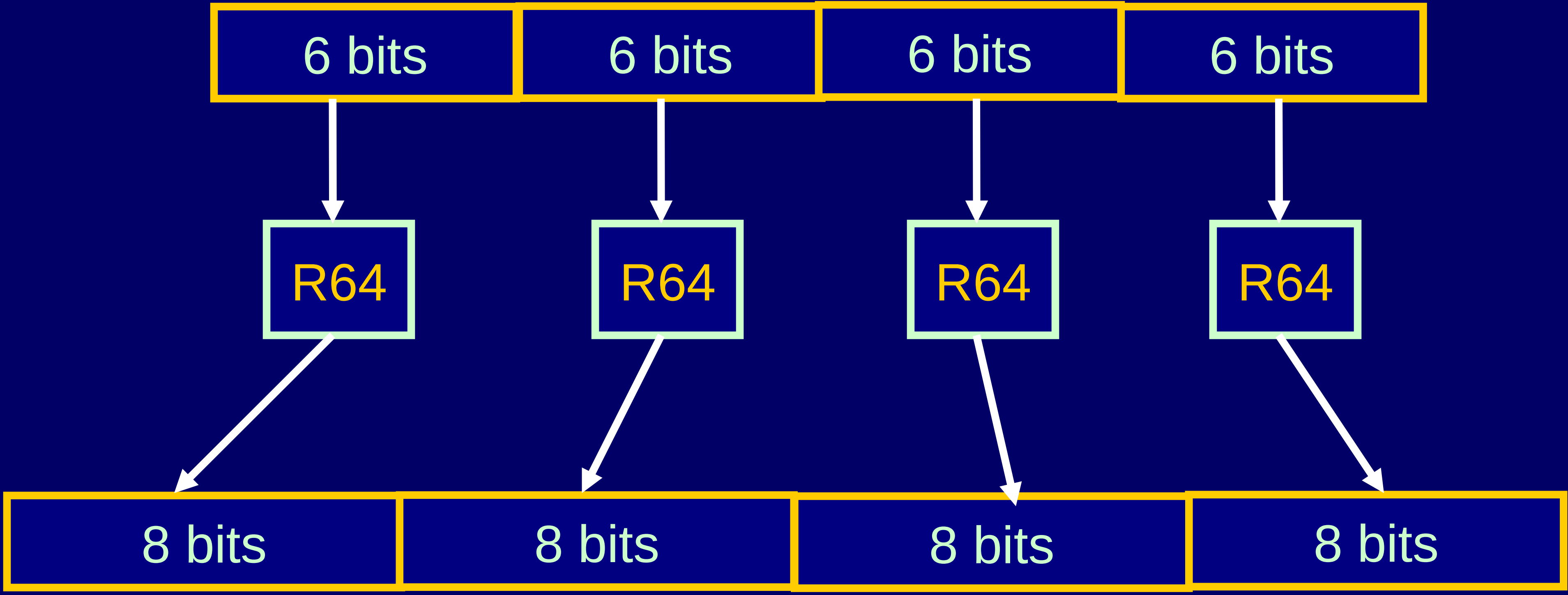
- Text body
- Multipart
  - Mixed, Parallel, Alternative
- Message
  - RFC 822, Partial, External-body
- Image
  - jpeg, gif
- Video
  - mpeg
- Audio
  - Basic
- Application
  - Postscript
  - octet stream

MIME Transfer Encodings

- Specifies how the mail body is wrapped for transmission.
- Content transfer encoding field can have six possible values.
  - 7bit, 8bit, binary: no encoding done for these three.
    - Provide information about nature of data.

- Quoted-printable
  - Data mostly printable ASCII characters.
  - Non-printing characters represented by hex code.
- Base64
  - Maps arbitrary binary input onto printable output.
- X-token
  - Named nonstandard encoding.

Base64 Encoding



- Expands the message by 33%.
- Uses the symbols A..Z, a..z, 0..9, +, /

MIME Header Example

```
From: Indranil Sengupta <isg@iitkgp.ac.in>
To: Jaswinder Ahuja <jassi@cadence.com>
Subject: Simple Message
MIME-Version: 1.0
Content-type: multipart/mixed; boundary="simple boundary"

This is the preamble. It is to be ignored, though it is a handy place for
mail composers to include an explanatory note.--simple boundary

This is implicitly typed plain text. It does NOT end with a linebreak.
-- simple boundary
Content-type: text/plain; charset=us-ascii

This is explicitly typed plain ASCII text. It DOES end with a linebreak.

--simple boundary--
This is the epilogue. It is also to be ignored.
```

Another MIME Example

```
From: Indranil Sengupta <isg@iitkgp.ac.in>
To: Jaswinder Ahuja <jassi@cadence.com>
Subject: Formatted text mail
MIME-Version: 1.0
Content-type: multipart/alternative; boundary=boun42

--boun42
Content-type: text/plain; charset=us-ascii

... plain text version of message goes here ...

--boun42
Content-type: text/enriched

... RFC1896 text/enriched version of the same message goes   here
...
--boun42--
```

End of Lecture 10