**Unit 01.02.02
CS 5220:
COMPUTER COMMUNICATIONS**

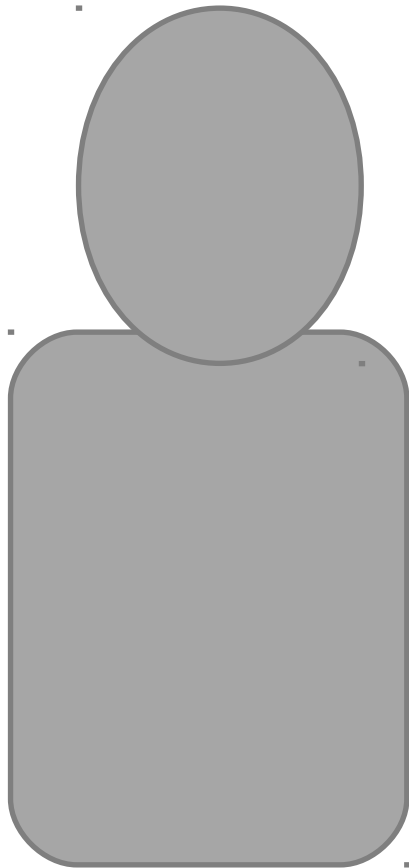OSI Unified View of Protocols and Services

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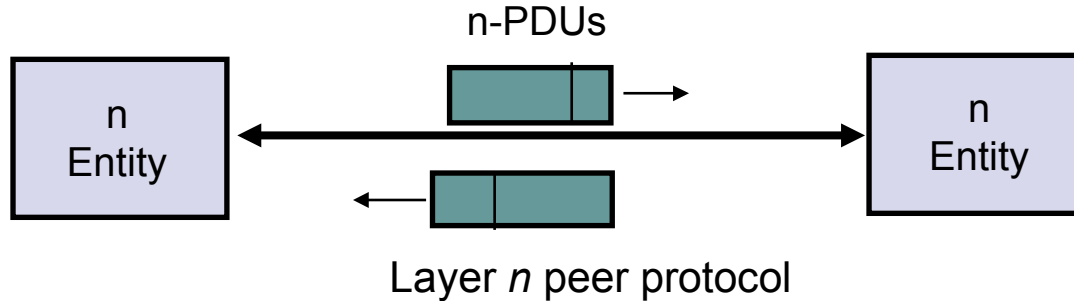
OSI Unified View: layers

- A layer is a set of related communication functions managed and grouped together

- Layer n in one machine interacts with layer n in another machine to provide a service to its upper layer $n +1$

- The entities comprising the corresponding layers on different machines are called *peer processes.*

- The processes at layer n are referred to as layer n entities.

OSI Unified View: Protocols

- The machines at the same layer use a set of precise and unambiguous rules called the *layer-n protocol*.
- Layer-*n* peer processes communicate by exchanging *Protocol Data Units* (PDUs)

n-PDUs

| n Entity | ←———————————→ | n Entity |

Layer *n* peer protocol

OSI Unified View: Services

- Communication between peer processes is virtual and actually indirect

- Layer *n+1* transfers information by invoking the services provided by layer *n*

- Services are available at *Service Access Points (*SAP's)

- Each layer passes data & control information to the layer below it until the physical layer is reached and transfer occurs

- The data passed to the layer below is called a *Service Data Unit* (SDU); SDU's are *encapsulated* in PDU's

Layers, Services & Protocols
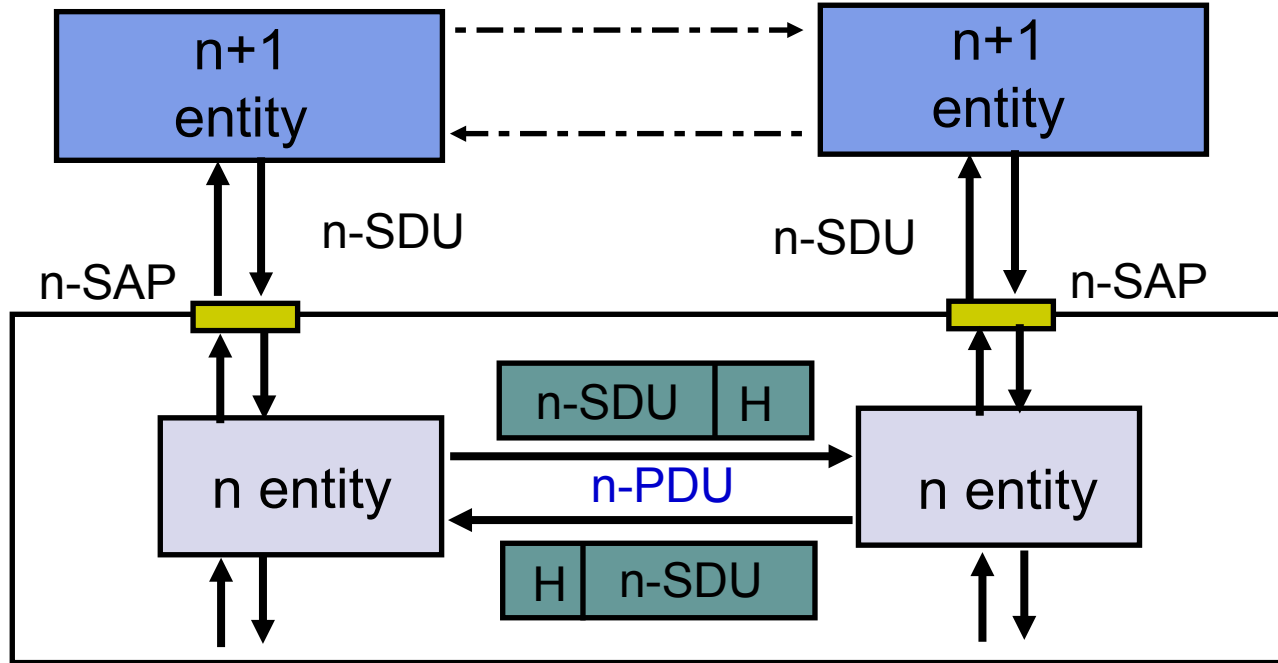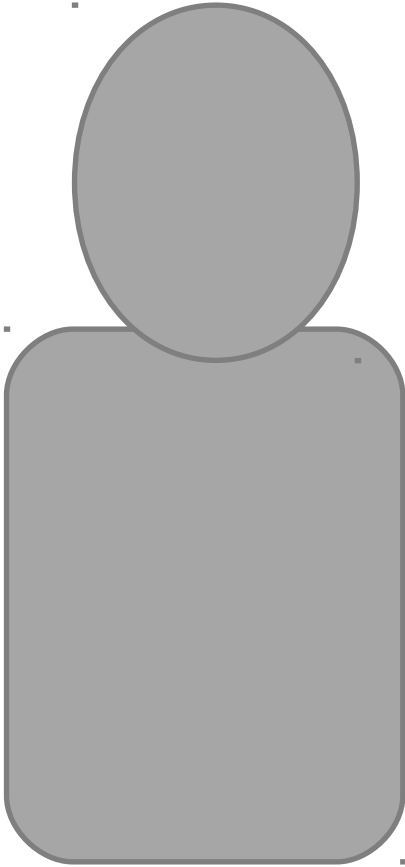
Encapsulation

Layer n [SDU]
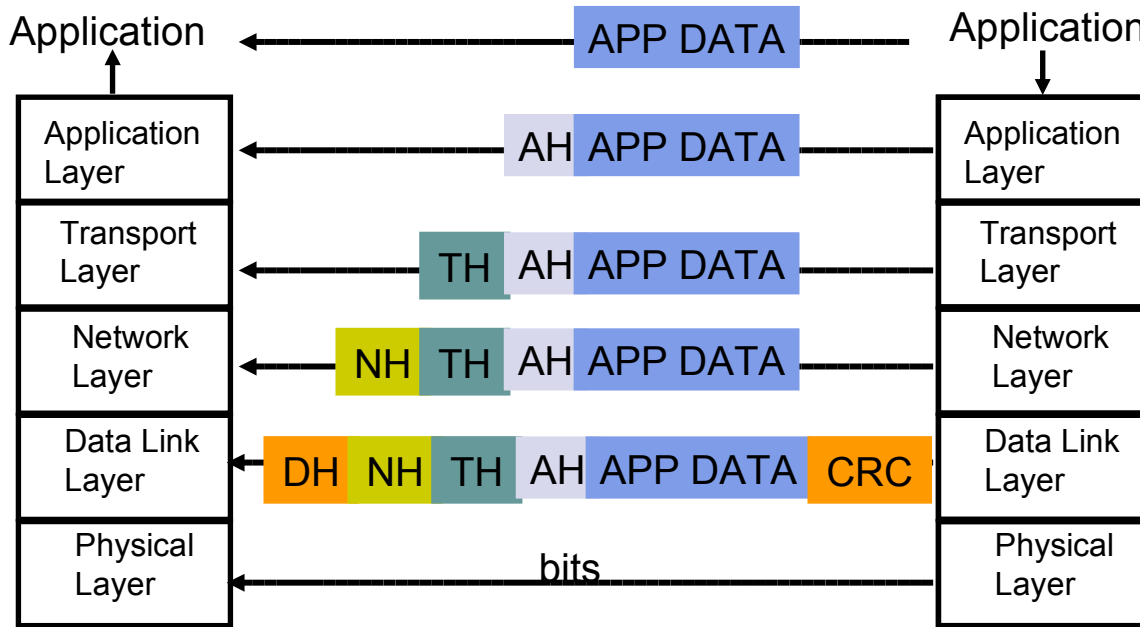
Payload

Layer $n+1$ [header][SDU][Trailer]
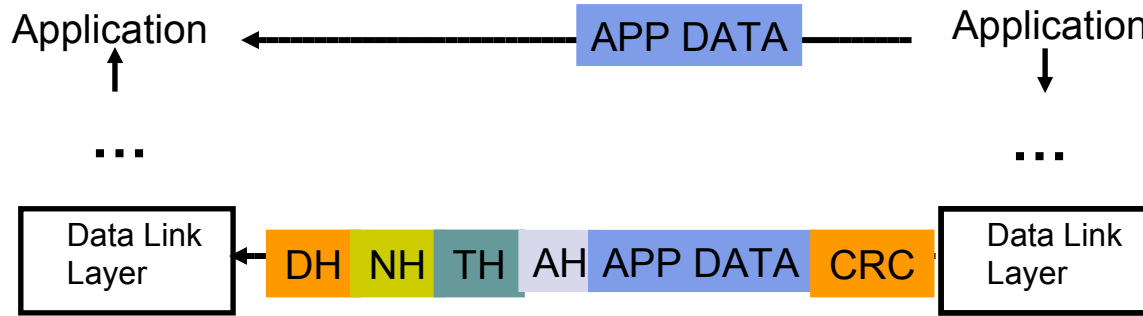
PDU at layer n+1

Headers & Trailers

- Each protocol uses a header that carries addresses, sequence #...

Bandwidth Utilization

$$\text{Utilization} = \frac{\text{APP DATA}}{\text{APP DATA + HEADERS + CRC}}$$
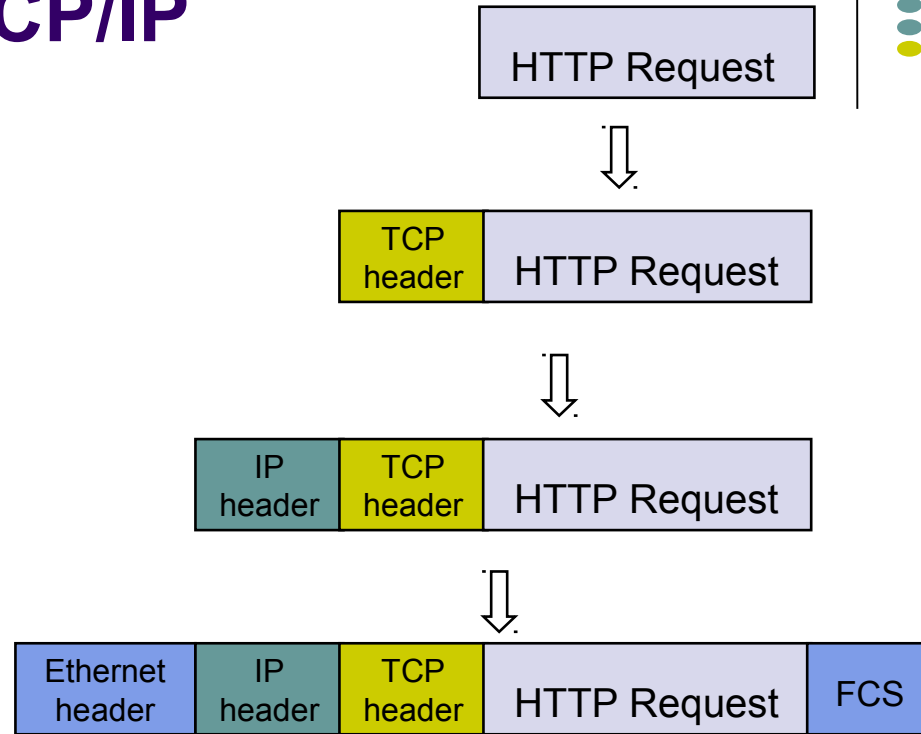
Encapsulation in TCP/IP

TCP Header contains source & destination port numbers

IP Header contains source and destination IP addresses; transport protocol type

Ethernet Header contains source & destination MAC addresses; network protocol type

HTTP Request

⇩

| TCP header | HTTP Request |

⇩

| IP header | TCP header | HTTP Request |

⇩

| Ethernet header | IP header | TCP header | HTTP Request | FCS |

Segmentation & Reassembly

- A layer may impose a limit on the size of a data block that it can transfer

- Thus a layer-*n* SDU may be too large to be handled as a single unit by layer-(*n-1*)

- Sender side: SDU is segmented into multiple PDUs

- Receiver side: SDU is reassembled from sequence of PDUs

(a) Segmentation

n-SDU

n-PDU   n-PDU   n-PDU

(b) Reassembly

n-SDU

n-PDU   n-PDU   n-PDU
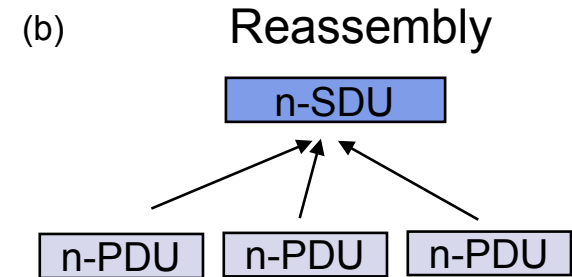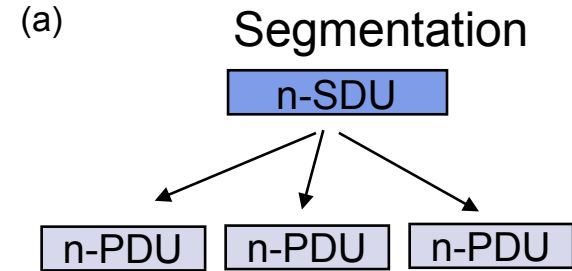
# Connectionless & Connection-Oriented Services
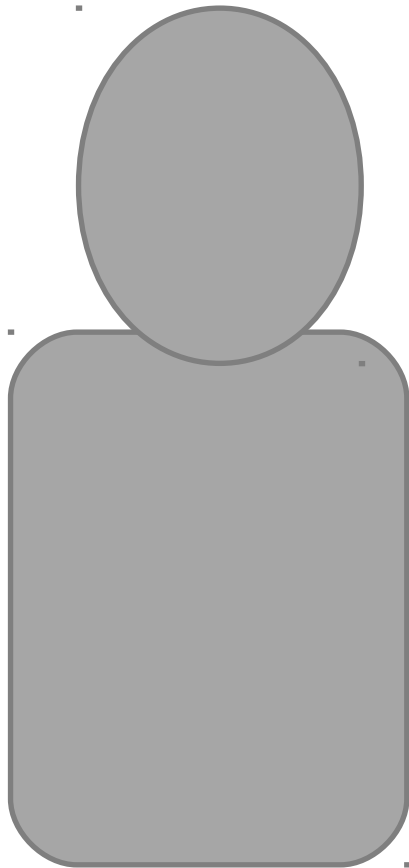
- Connection-Oriented
  - Three-phases:
    1. Connection setup between two SAPs to initialize state information
    2. SDU transfer
    3. Connection release
  - E.g. TCP, ATM

- Connectionless
  - Immediate SDU transfer
  - No connection setup
  - E.g. UDP, IP

Why Internetworking?

- To build a "network of networks" or Internet
  - operating over multiple, coexisting, different network technologies
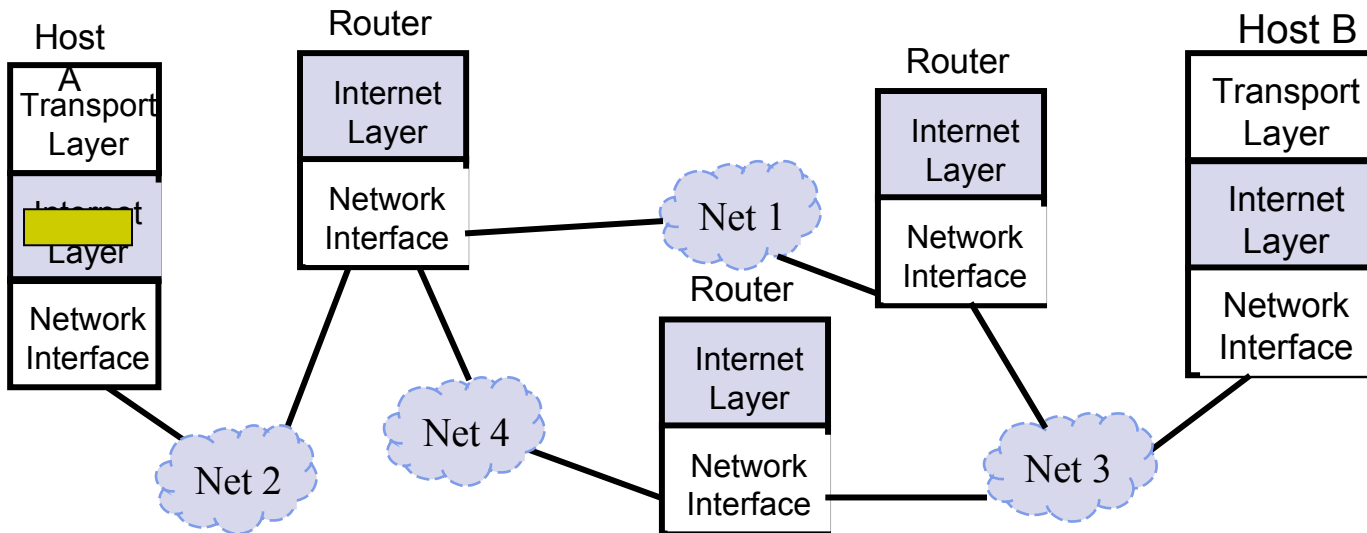 - providing ubiquitous connectivity through IP packet transfer
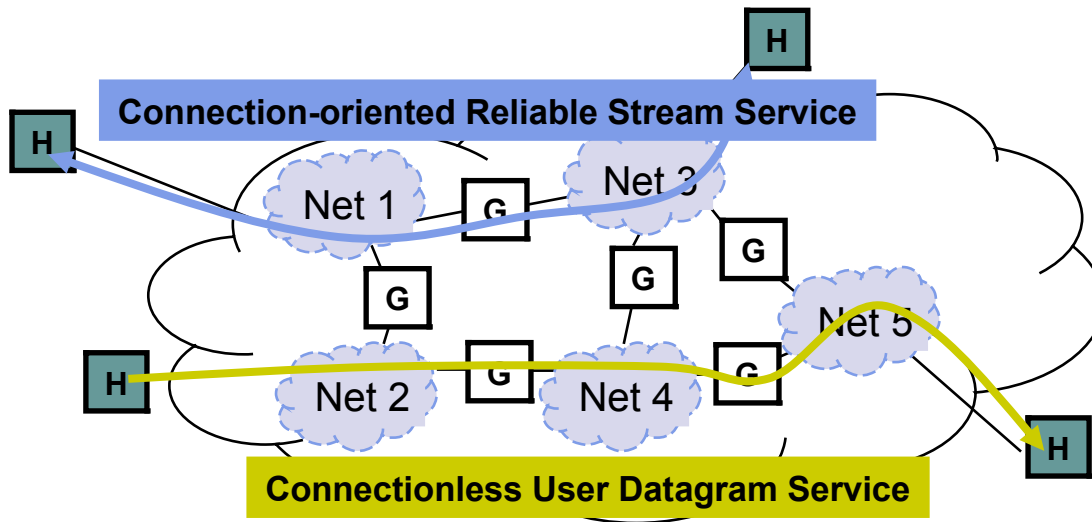
Internet Protocol (IP) Approach

- IP packets transfer information across Internet

Host A IP → router→ router…→ router→ Host B IP

Lesson Summary

- The unified view enables a common understanding of the protocols and services found in different layers.