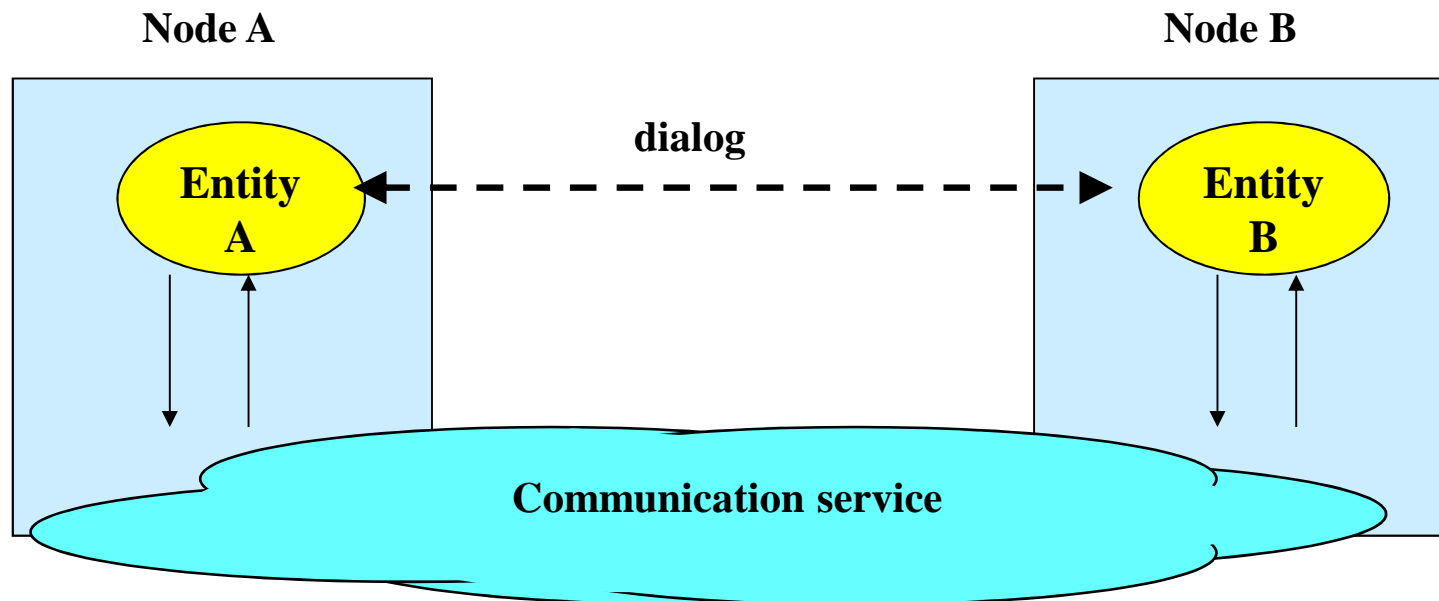# Réseaux

Prof. Fabio Martignon

Fundamentals of Protocols and Communication Services

Communication Service

- ☐ Given two or more remote entities …
- ☐ … a *communication service* provides information transfer between the entities

Node A

Node B

dialog

Entity A

Entity B
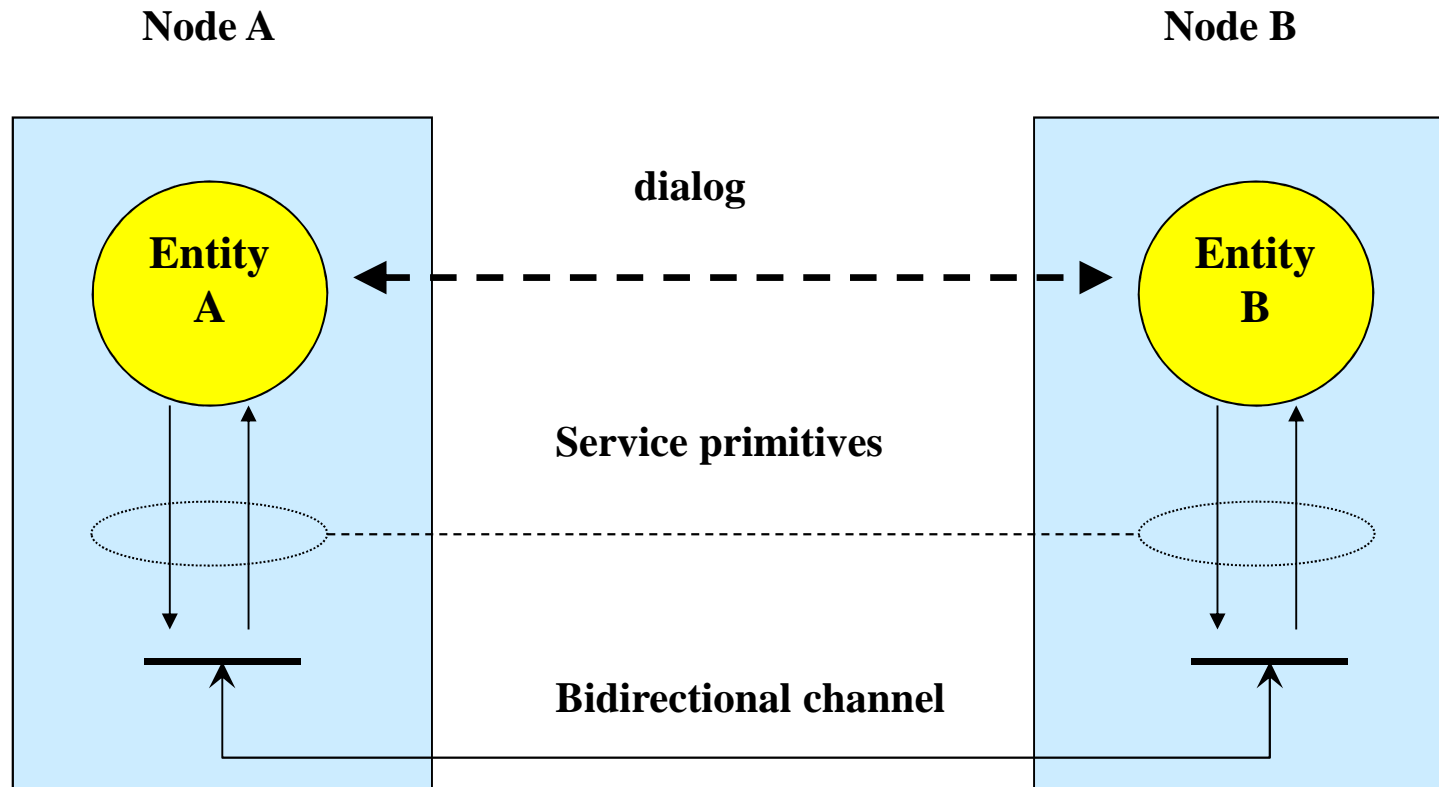
Communication service

Communication Service

☐ Manages the exchange of information between two entities

☐ In general, it transfers information units:
  - words
  - bits
  - bunch of bits (frames or packets)
  - files
  - Multimedia flows

Entity A

Entity B
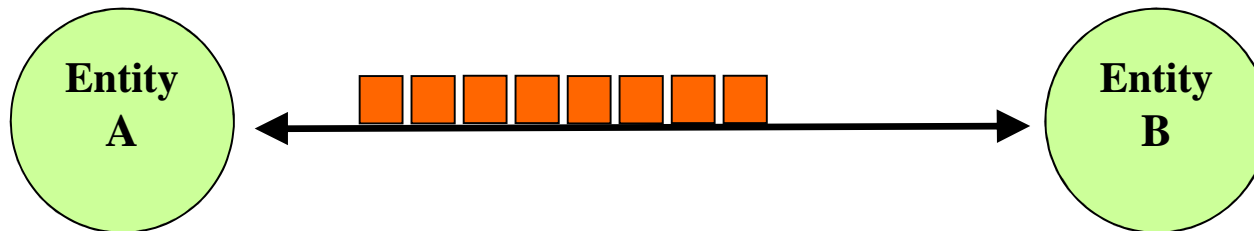
Communication Service

☐ May be described through *service calls* named *service primitives*

☐ The service primitives can be used to:
- *Describe the service*
- *Request the service*
- *Gather info on the service*

☐ The service primitives are characterized by:
- *The type of info to transfer*
- *The destination address*
- *The features of the required service*
- etc.

The Service Primitives
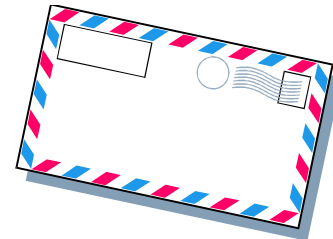
Types of Communication Services
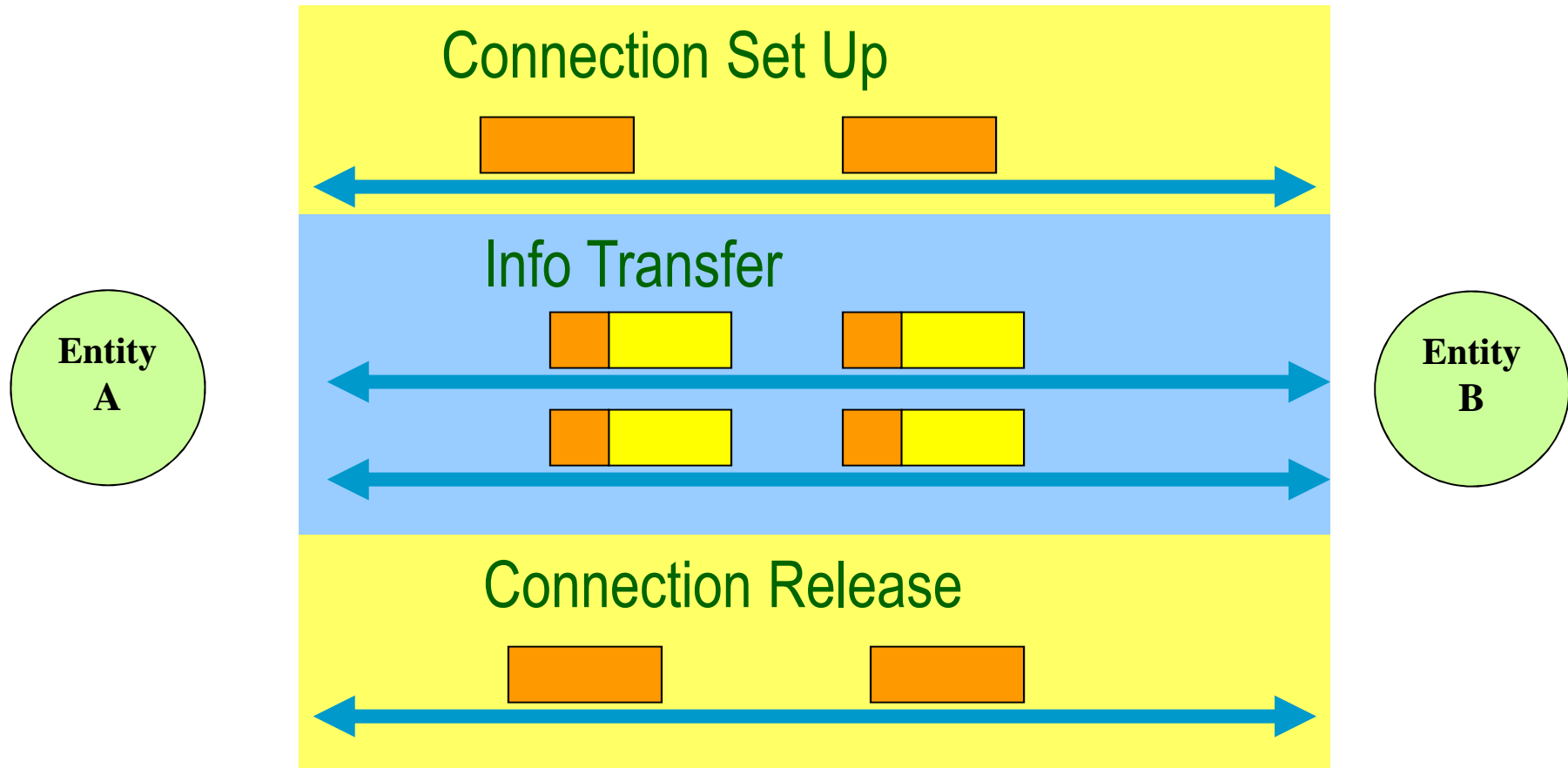
☐ Connection Oriented

   1) Connection Set Up

   2) Data transfer

   3) Connection Release

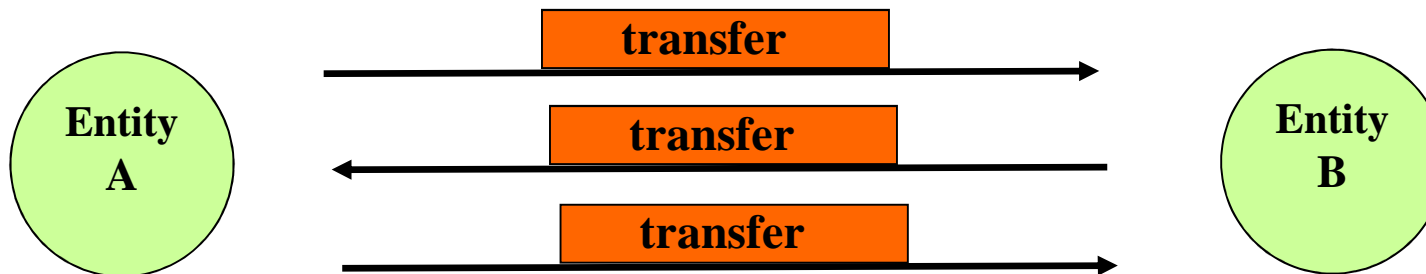☐ Connectionless
- All in one
- Asynchronous

Connection Oriented Services

Connectionless Services

☐ Lack of set up coordination among entities

☐ different transfer sessions between the same entities may not be related

☐ problems in implementing the typical connection oriented services (VoIP)

Layers

☐ Two entities at the same level may offer a communication service to *upper layer* entities

Layer *Functions*

☐ The communication service provided to the upper layer is "richer" thanks to specific *functions* implemented at the lower layer
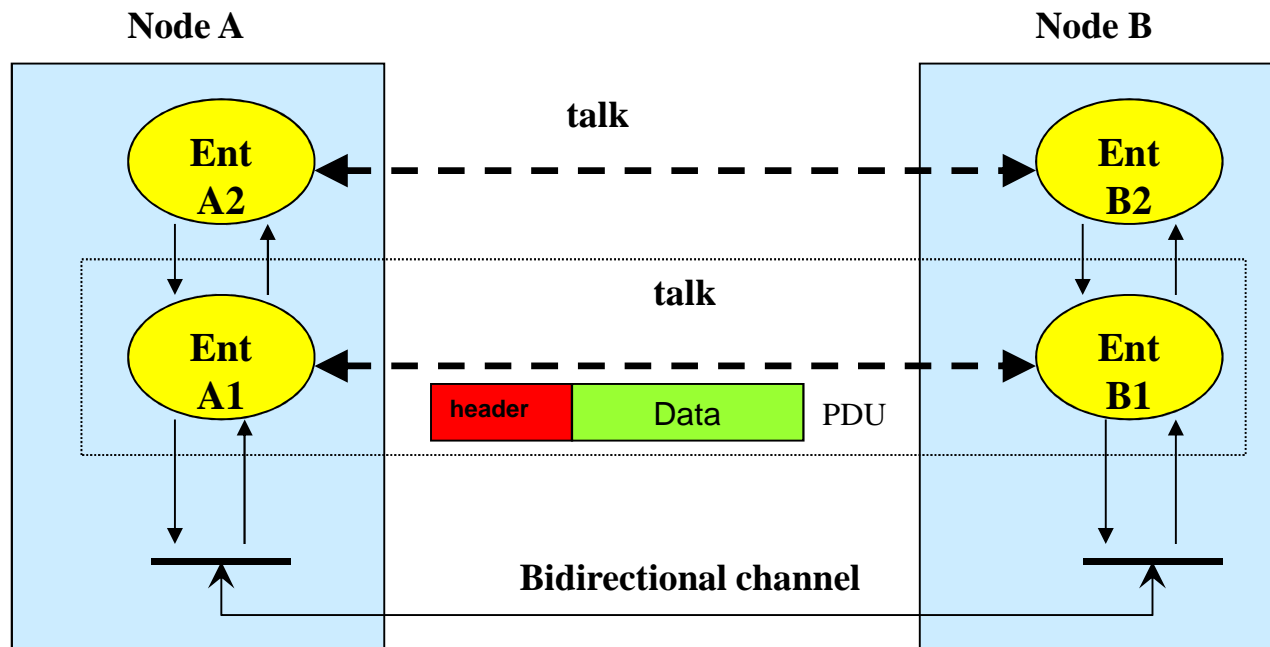
Communication Protocols

- Entities at the same level cooperate to provide *upper layer* entities with a communication service
- Entities at the same level exchange messages
- Protocol:
  - *Set of rules which handle the communication among entities at the same level*
    - Message format
    - Information on the service
    - Info transfer procedure
    - etc.

Packet Data Units (PDU)

- ☐ Information Units used within a protocol by entities at the *same level*

- ☐ PDUs may comprise:

  - **Signalling information (header)**

  - **Data received by upper layers (payload)**

header	payload

Layered Architecture

☐ Complex Communication Services may be organized in layers
- From a layer handling the bits …
- … to a layer handling files and/or more complex objects and protocols

layer 5	**layer** 5
layer 4	**layer** 4
layer 3	**layer** 3
layer 2	**layer** 2
layer1	**layer** 1

Protocol "Layers"

Networks are complex!

☐ many "pieces":

 ■ hosts

 ■ routers

 ■ links of various media

 ■ applications

 ■ protocols
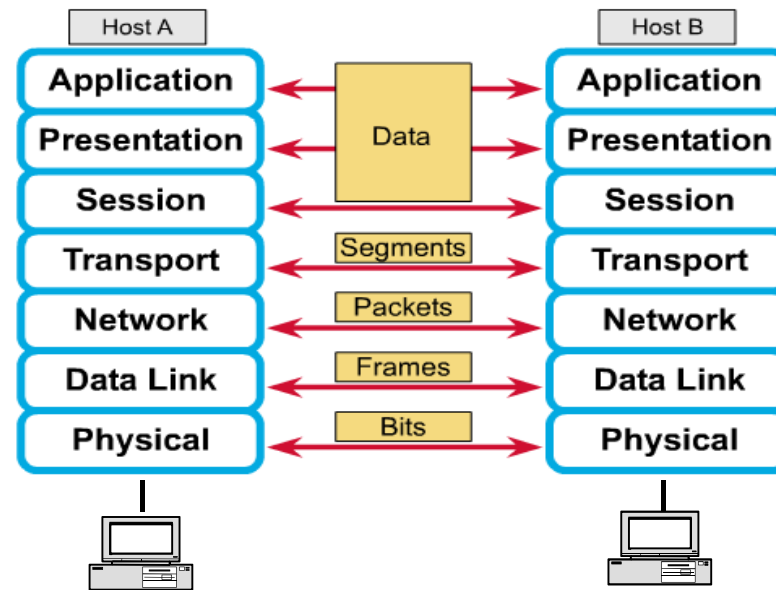
 ■ hardware, software

Question:

Is there any hope of *organizing* structure of network?

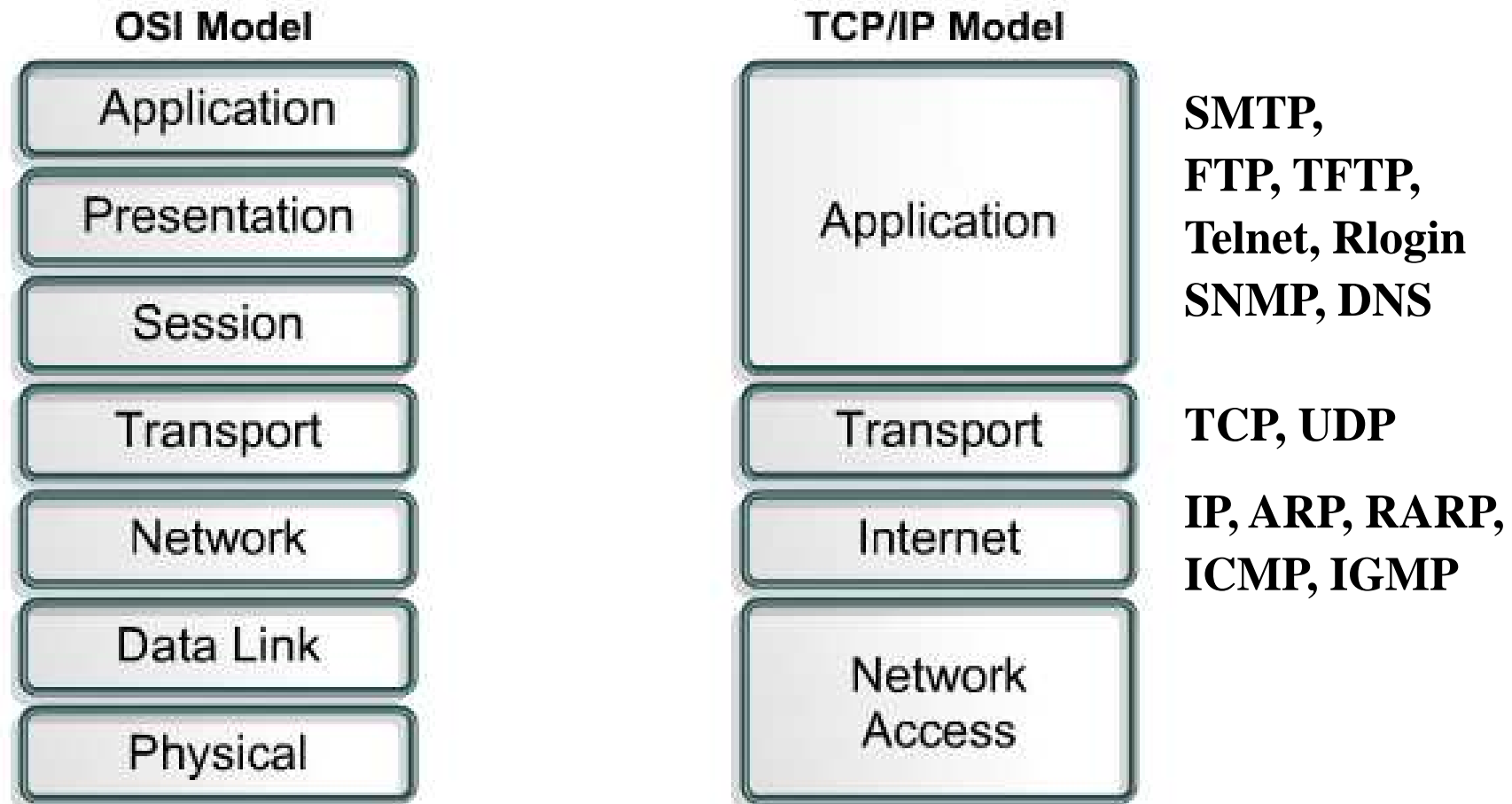Or at least our discussion of networks?

Layered Architecture: PROs

- ☐ Reduces complexity
- ☐ Standardized Interfaces
- ☐ Fosters Modularity and Interoperability
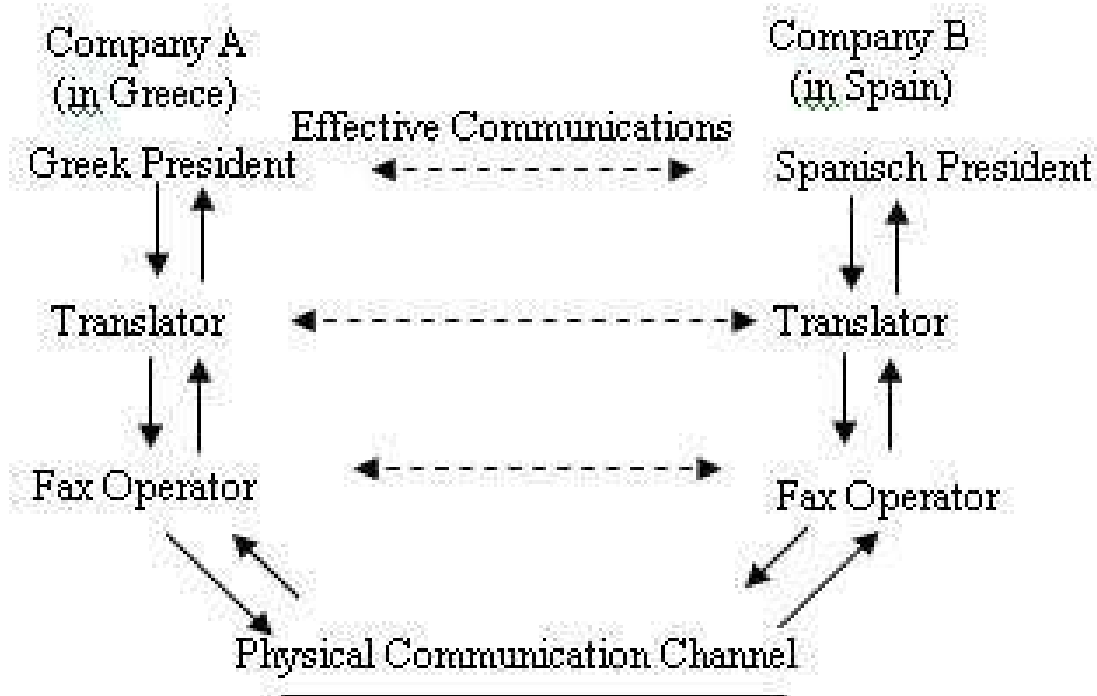- ☐ Ease Up Teaching

- ☐ OSI Model
   (1974)

TCP/IP Suite vs OSI Model

OSI Model

| Application |
| Presentation |
| Session |
| Transport |
| Network |
| Data Link |
| Physical |

TCP/IP Model

| Application |
| Transport |
| Internet |
| Network Access |

SMTP, FTP, TFTP, Telnet, Rlogin SNMP, DNS

TCP, UDP

IP, ARP, RARP, ICMP, IGMP

Company Organization (Layering example in real life)

☐ a series of steps

Layering example

Company A
(in Greece)

Company B
(in Spain)

Effective Communications

Greek President ←- - - - - - - - - → Spanisch President

Translator ←- - - - - - - - - → Translator

Fax Operator ←- - - - - - - - - → Fax Operator

Physical Communication Channel
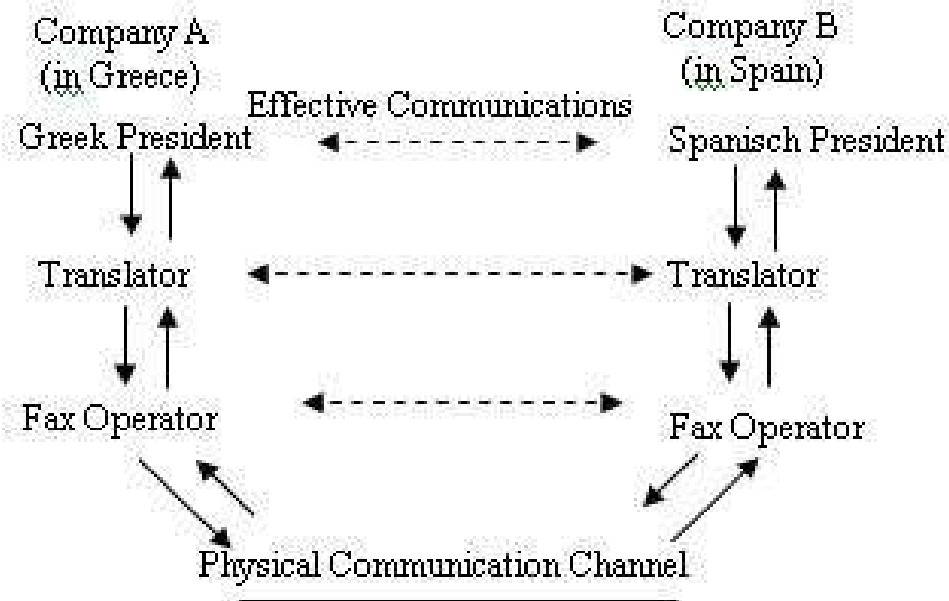
Layers: each layer implements a service
- via its own internal-layer actions
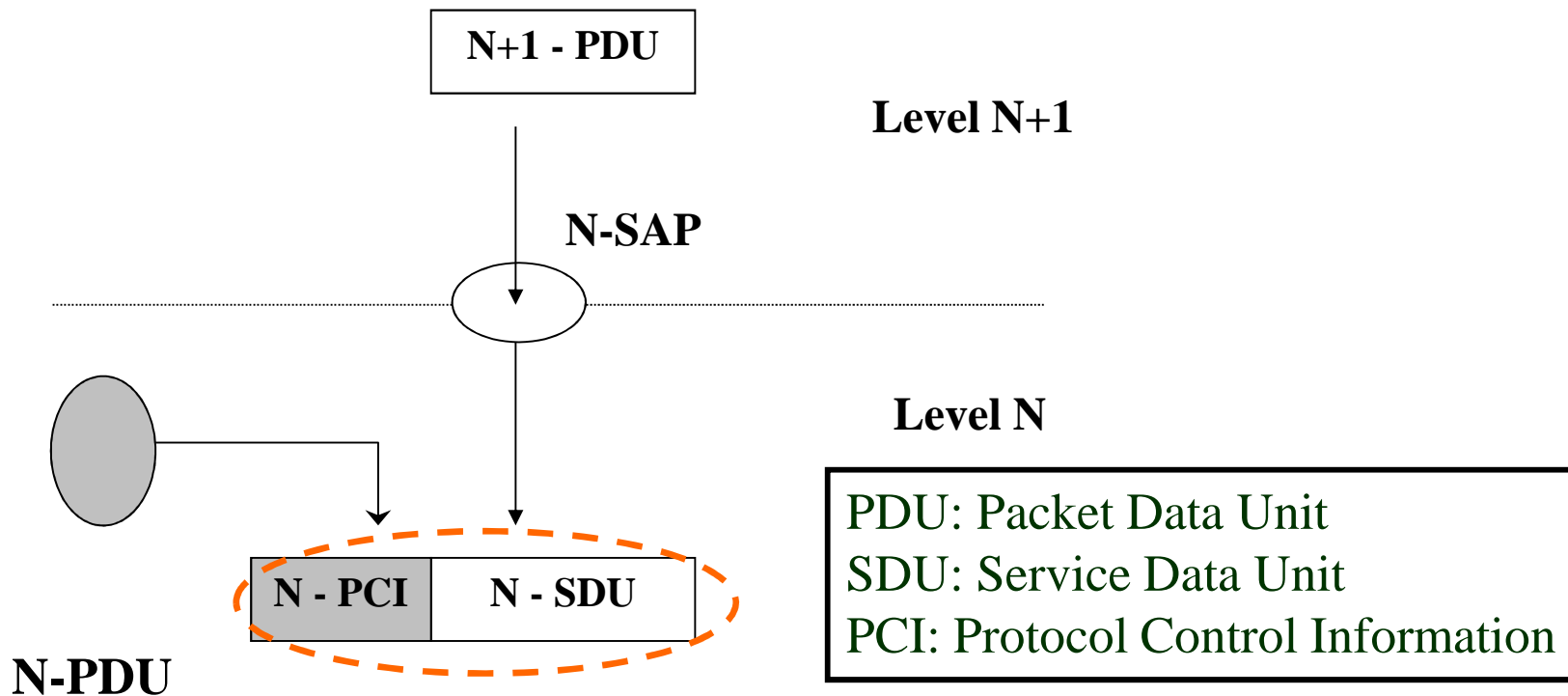- relying on services provided by layer below

Why layering?

Dealing with complex systems:

- ☐ explicit structure allows identification, relationship of complex system's pieces
    - ■ layered reference model for discussion
- ☐ modularization eases maintenance, updating of system
    - ■ change of implementation of layer's service transparent to rest of system
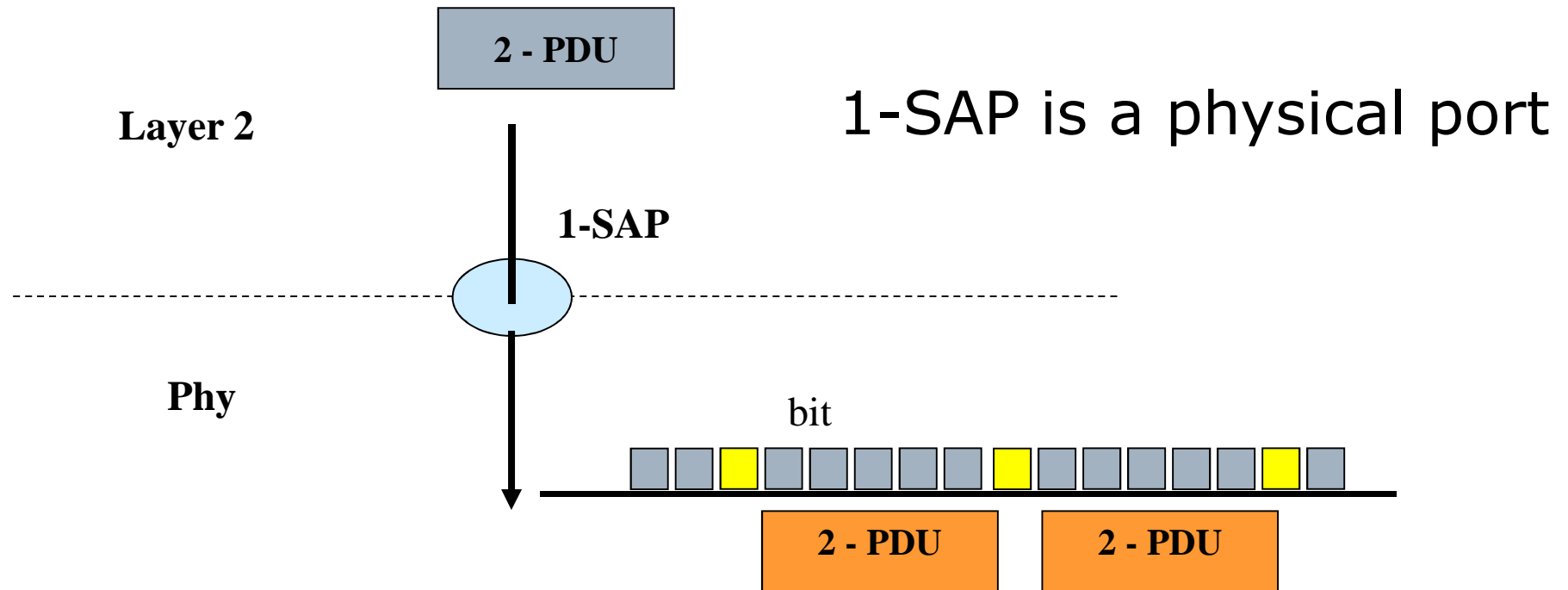   - ■ e.g., change in Fax operator procedure doesn't affect rest of system

Layer To Layer Interface

☐ The services offered by a given layer is characterized by a *Service Access Point (SAP)*
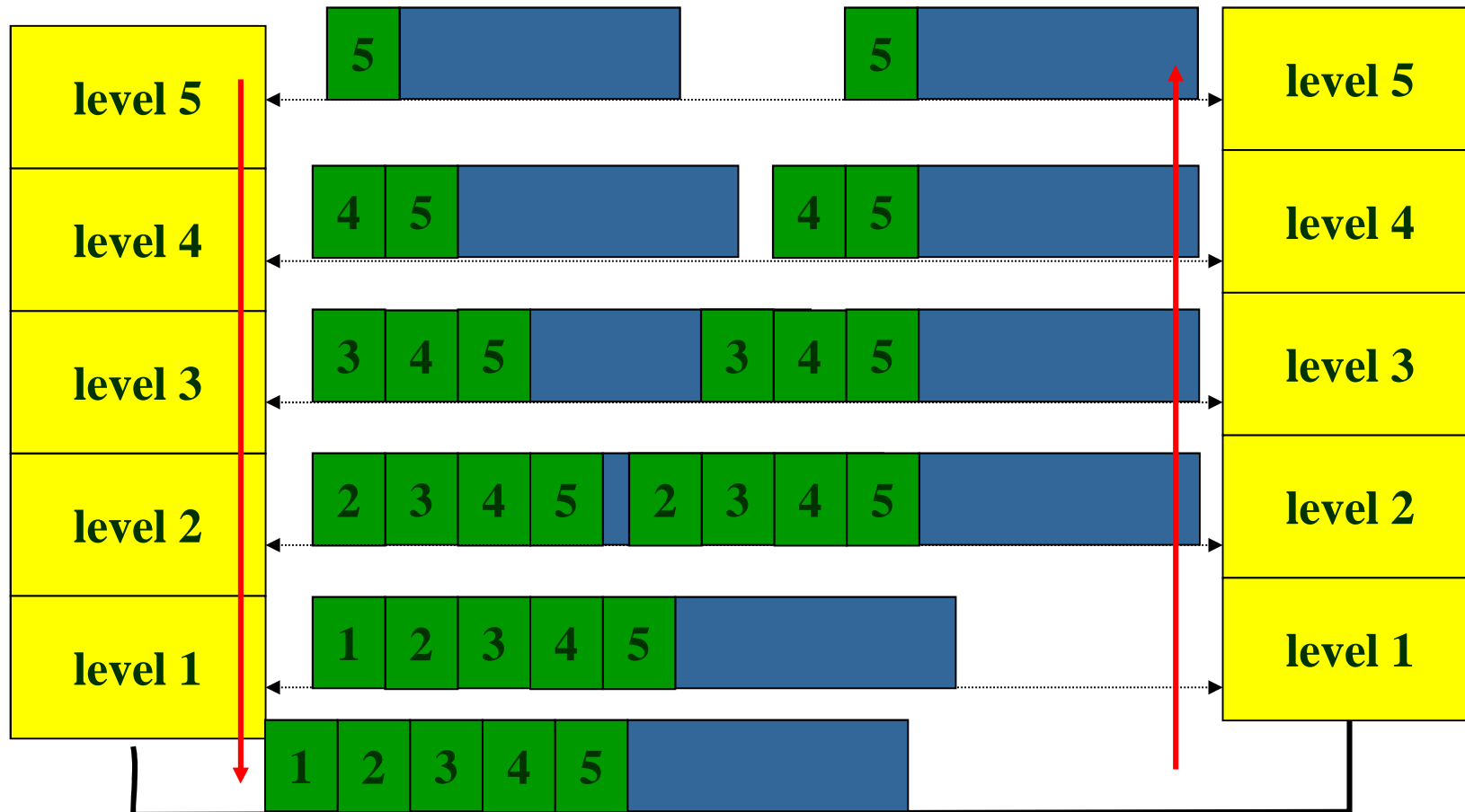
N+1 - PDU

Level N+1

N-SAP

Level N

N - PCI	N - SDU

N-PDU

PDU: Packet Data Unit
SDU: Service Data Unit
PCI: Protocol Control Information

Layer To Layer Interface

- ☐ The lowest layer is the Physical one
- ☐ Phy-PDU = bit flows

2 - PDU

Layer 2

1-SAP is a physical port

1-SAP

Phy

bit
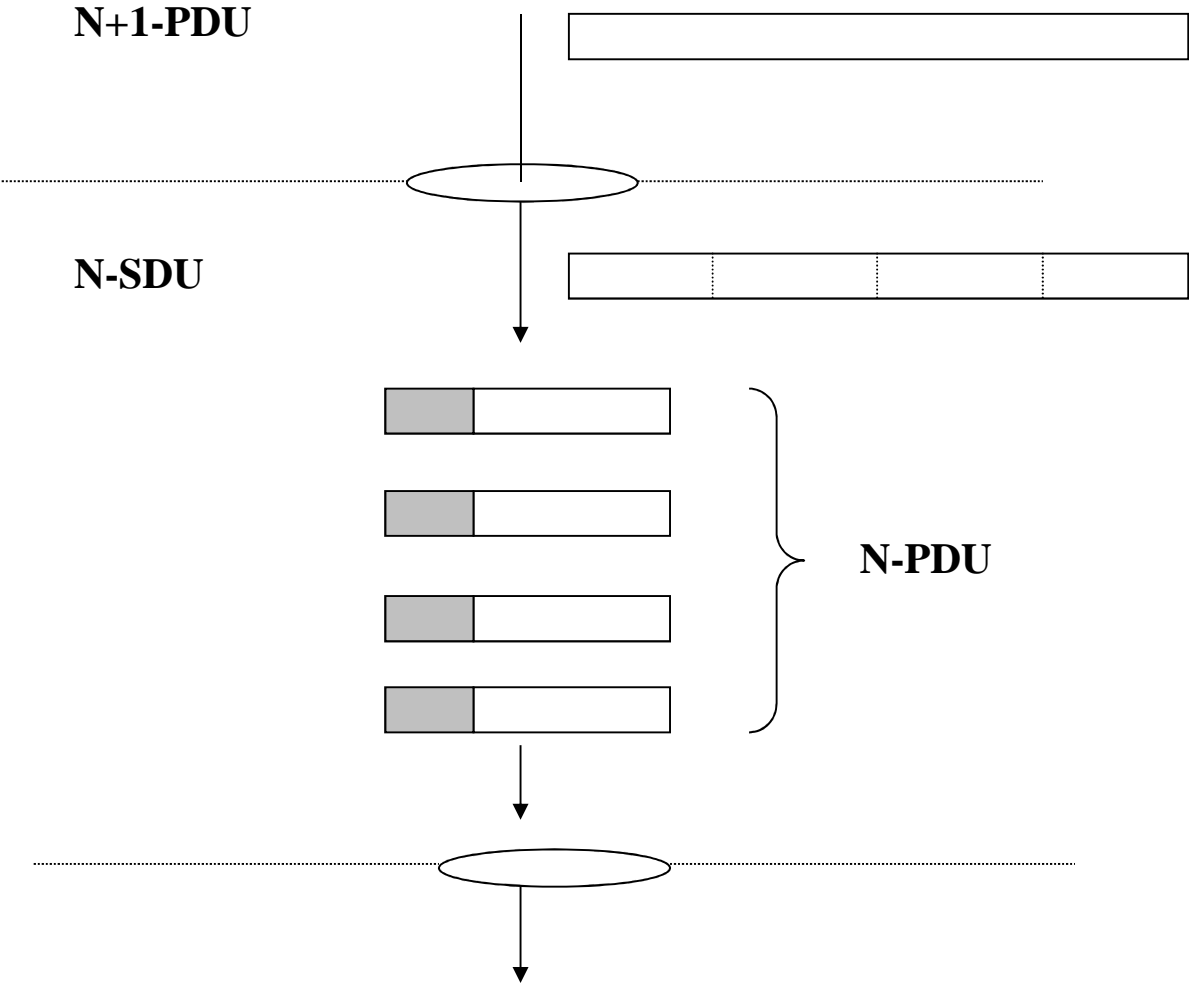
2 - PDU   **2 - PDU**
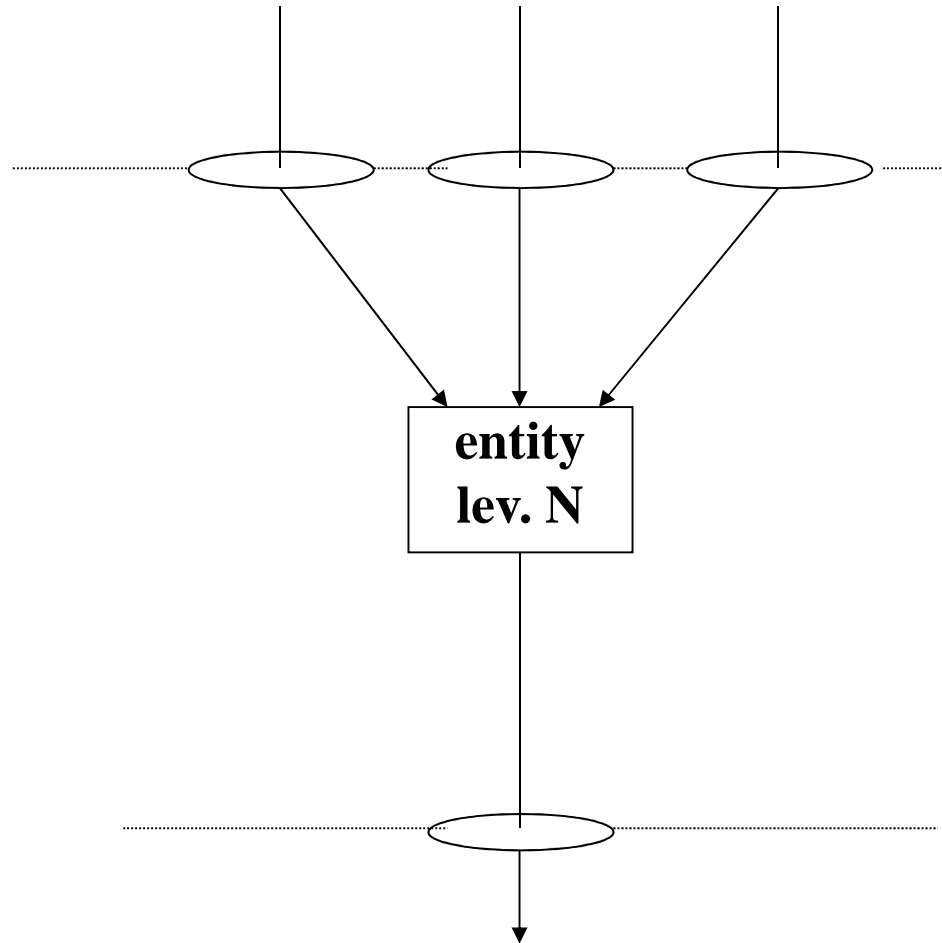
General Architecture

Functions

☐ Can be divided into:
- ■ Adaptation functions
  - ■ multiplexing
  - ■ segmentation
- ■ Enhancement functions
  - ■ Error control
  - ■ Sequencing

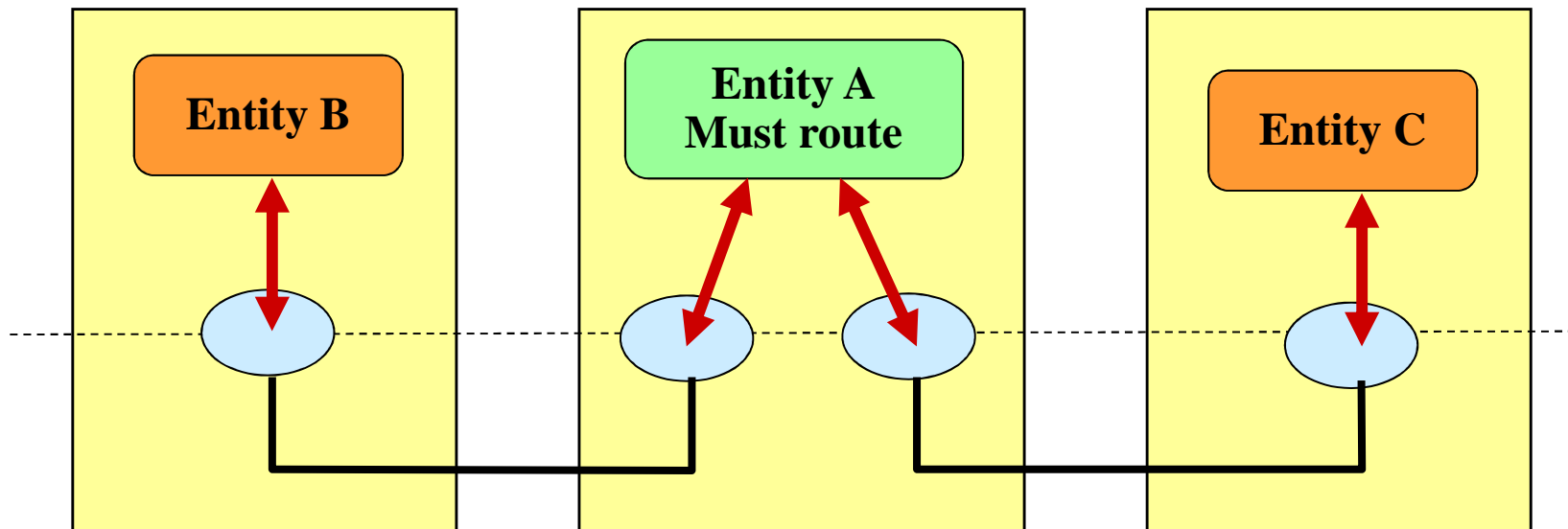# Segmentation

N+1-PDU

N-SDU
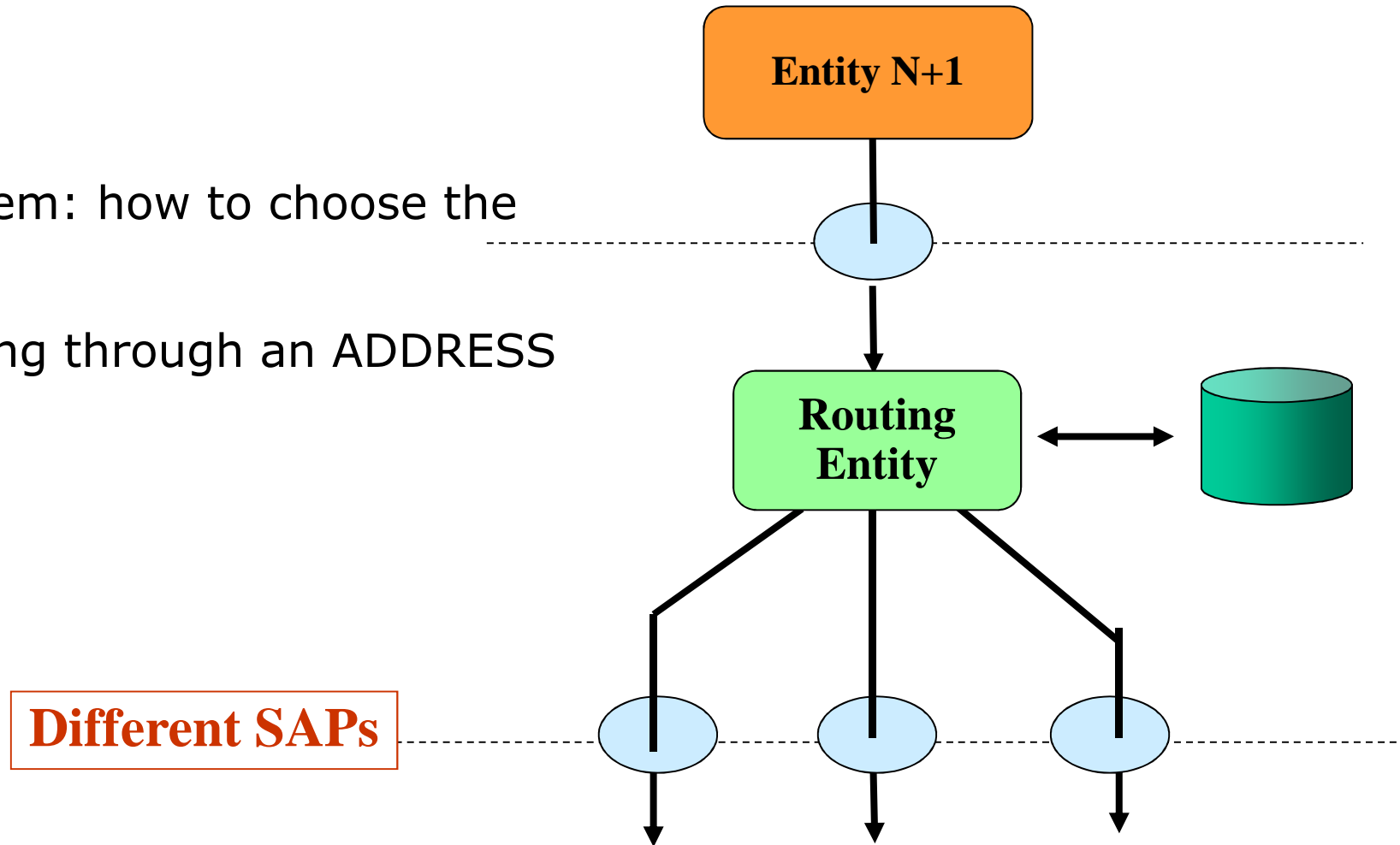
N-PDU

Multiplexing

entity
lev. N

Networking Functions

- ☐ A given entity can communicate with multiple entities at the same level
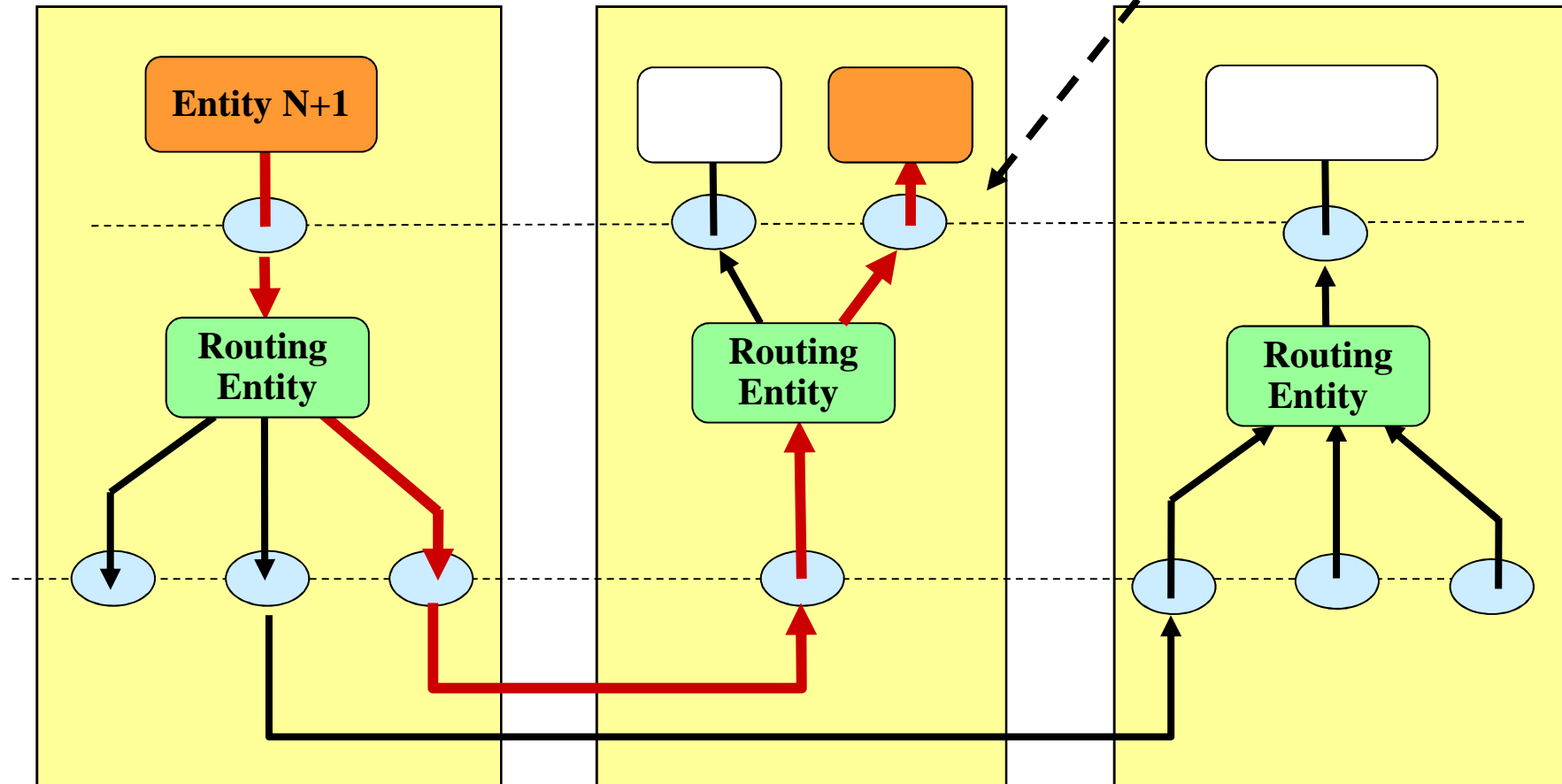- ☐ Need of Routing functionalities (SAP choice)

Routing

◆ Problem: how to choose the partner

◆ Routing through an ADDRESS

Different SAPs

Entity N+1

Routing Entity
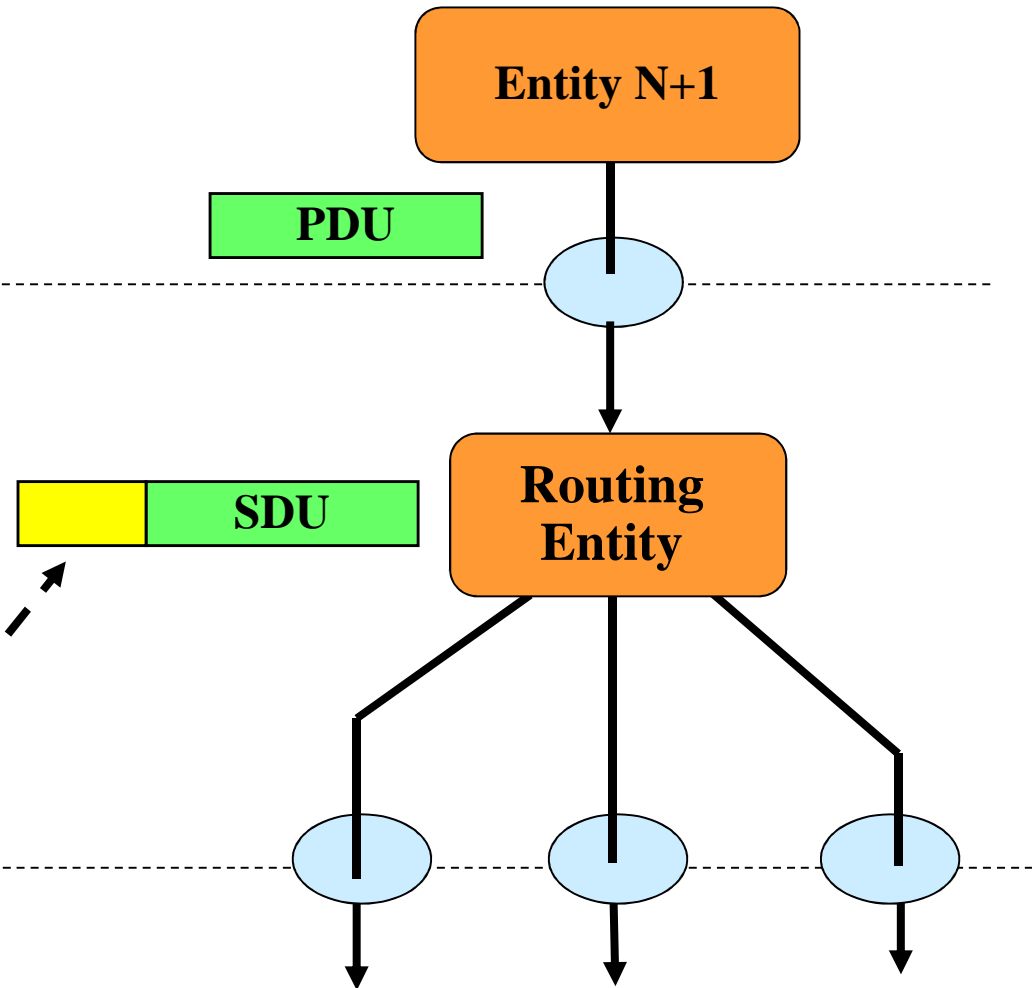
Addressing

◆ Identifies the destination N-SAP

Addressing & Forwarding

The PDU is passed downwards with the parameter **ADDRESS**

The ADDRESS is used to route the PDU **(choose the SAP)**

The ADDRESS is inserted in the PDU for further routing needs

Entity N+1

PDU
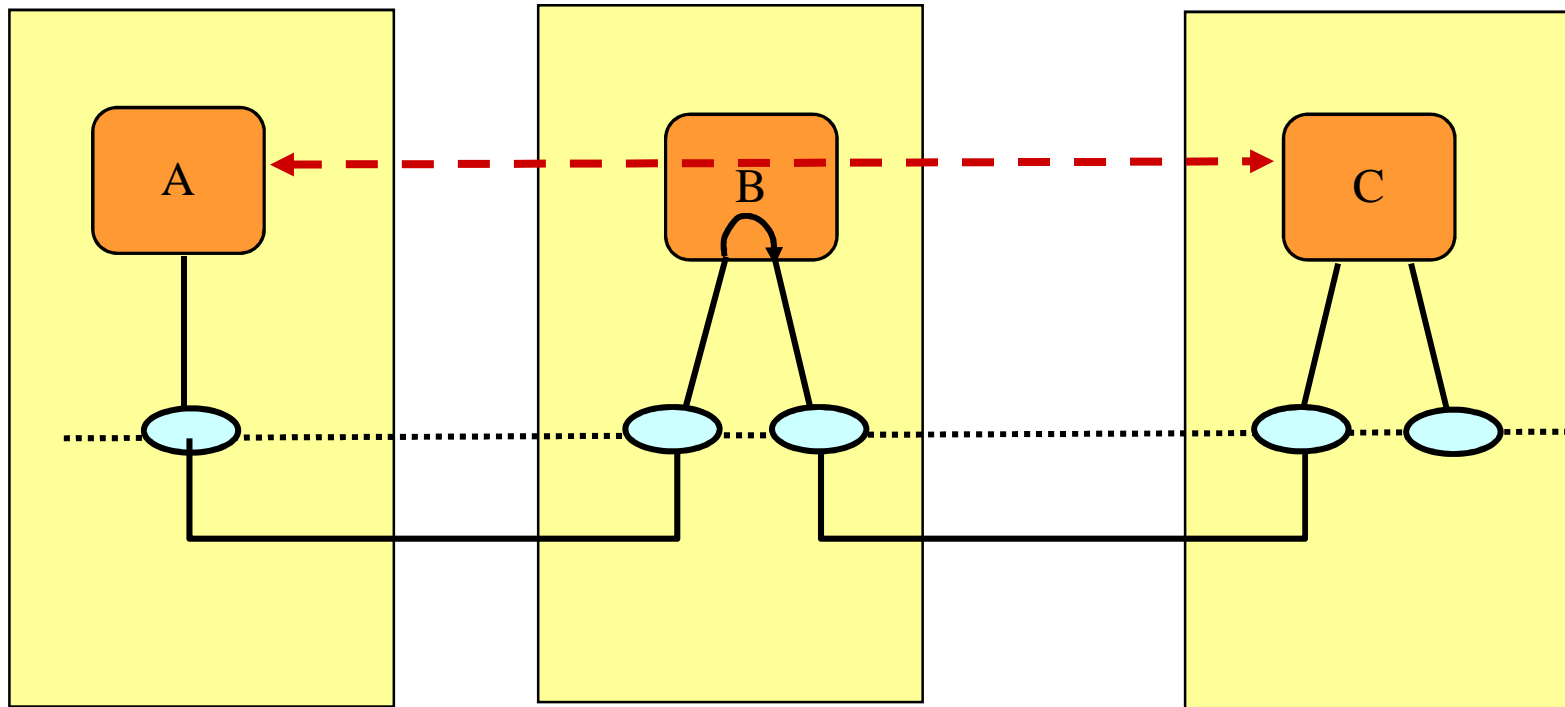
SDU

Routing Entity

Addressing

- ☐ Address: SAP identifier, unique among those of the same level

- ☐ Types of addresses:
    - ☐ unicast: single SAP
    - ☐ multicast: groups of SAPs
    - ☐ broadcast: all the SAPs

Forwarding

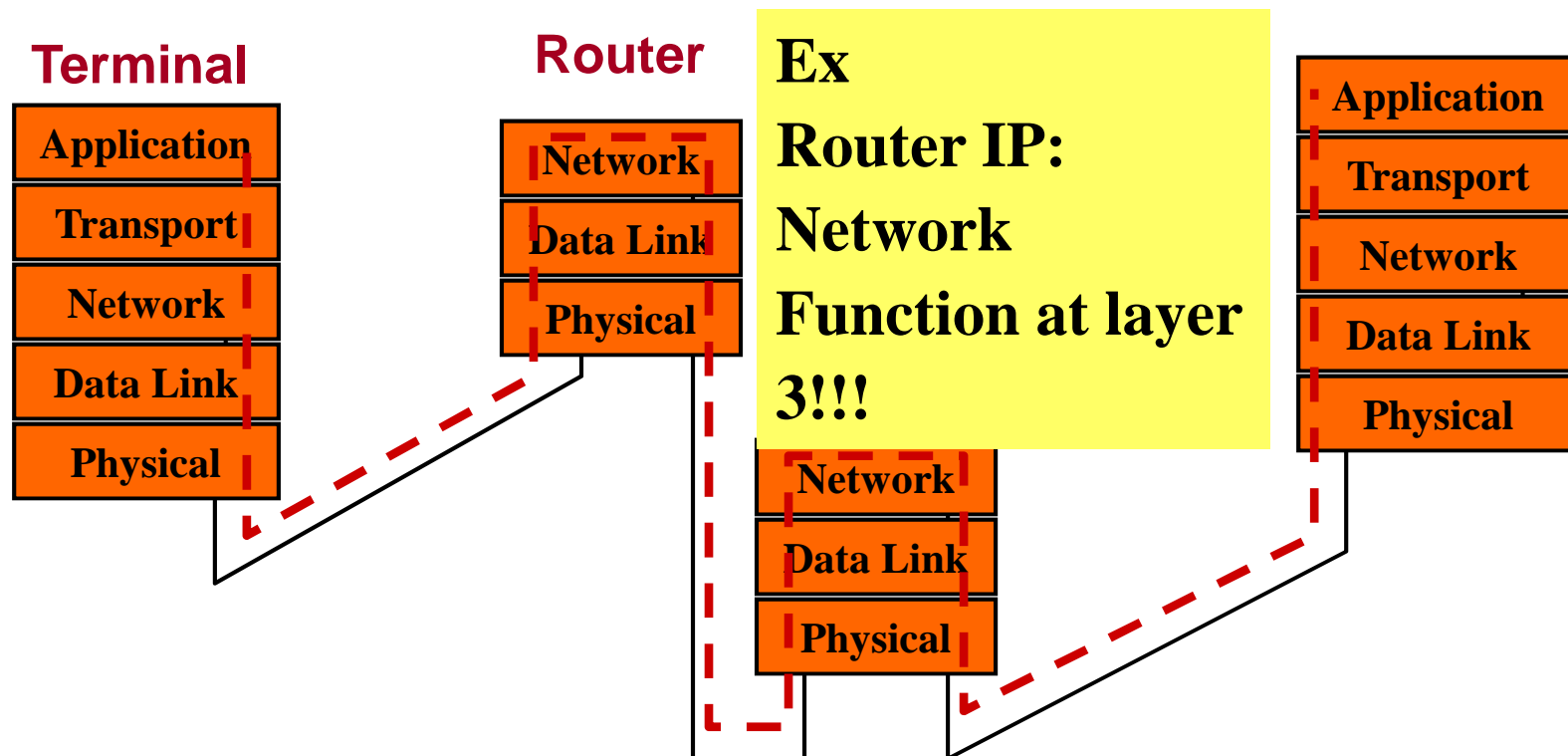☐ Once the SAP is chosen the PDU must be forwarded

Routing Tables

- ☐ Exit SAP chosen on the basis of the routing tables

Routing Table	
destination	Exit SAP

- ☐ Info gathering through routing protocols

Route To Destination (1)

- ☐ Through multiple nodes
- ☐ Network nodes go up to the network layer only

Terminal

Application
Transport
Network
Data Link
Physical

Router

Network
Data Link
Physical

Network
Data Link
Physical

**Ex
Router IP:
Network
Function at layer 3!!!**

Application
Transport
Network
Data Link
Physical

Route To destination (2)

- ☐ Routing function may be implemented at lower/upper layers
- ☐ LAN Switch

Terminal

| Application |
| Transport |
| Network |
| Data Link |
| Physical |

Switch

| Data Link |
| Physical |

| Data Link |
| Physical |

Ex Switch: Net functions at layer 2!!!

| Application |
| Transport |
| Network |
| Data Link |
| Physical |

Route To destination (3)