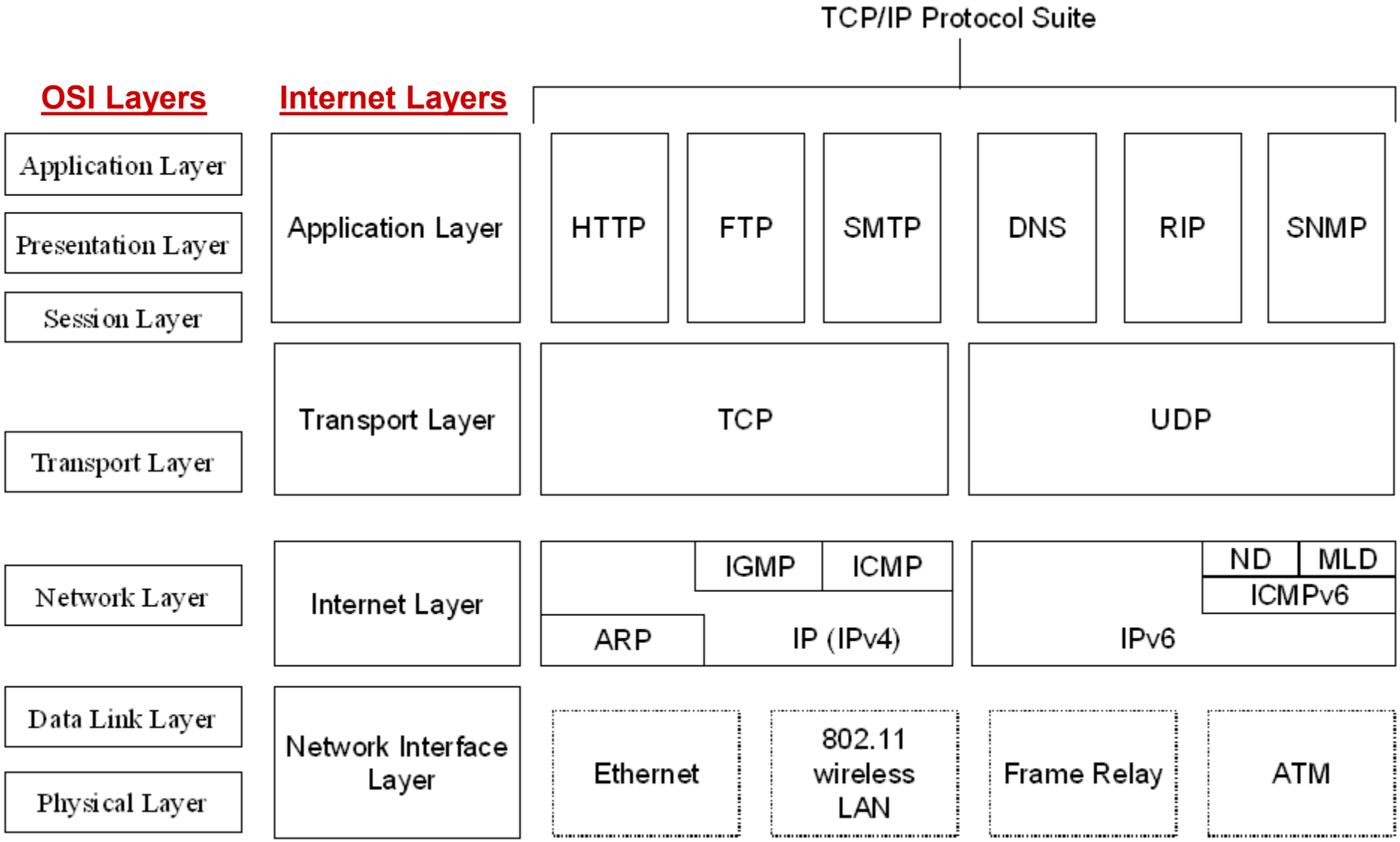
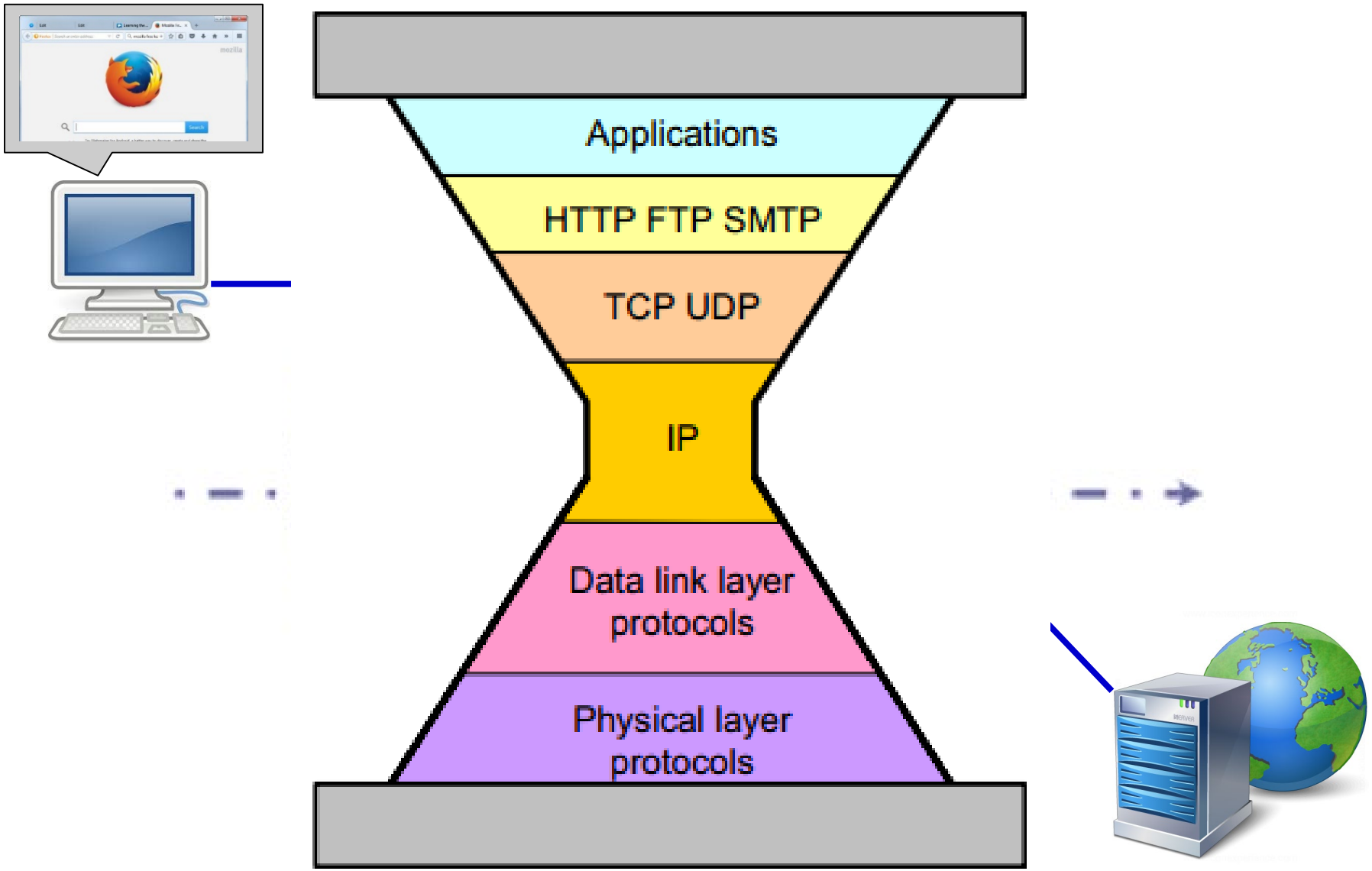
Layered Architecture

Required reading: Kurose 1.5

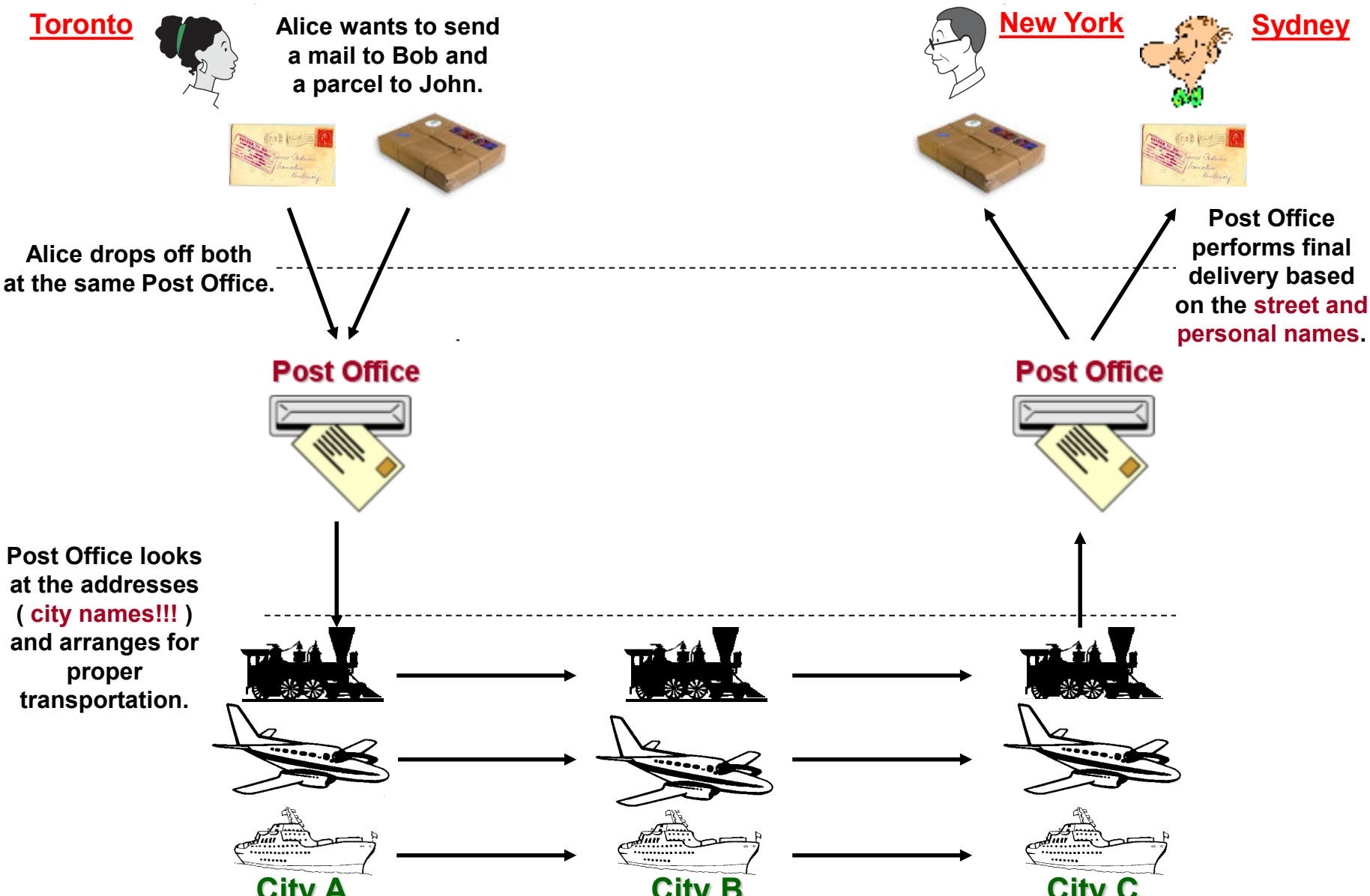
EECS 3214, Winter 2020
Instructor: N. Vlajic


TCP/IP Protocol Suite
OSI Layers
Internet Layers
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
Application Layer
Transport Layer
Internet Layer
Network Interface Layer
HTTP
FTP
SMTP
DNS
RIP
SNMP
TCP
UDP
IGMP
ICMP
ARP
IP (IPv4)
ND
MLD
ICMPv6
IPv6
Ethernet
802.11 wireless LAN
Frame Relay
ATM

Protocol / Layering Basics



Protocol Basics: Why Layering??



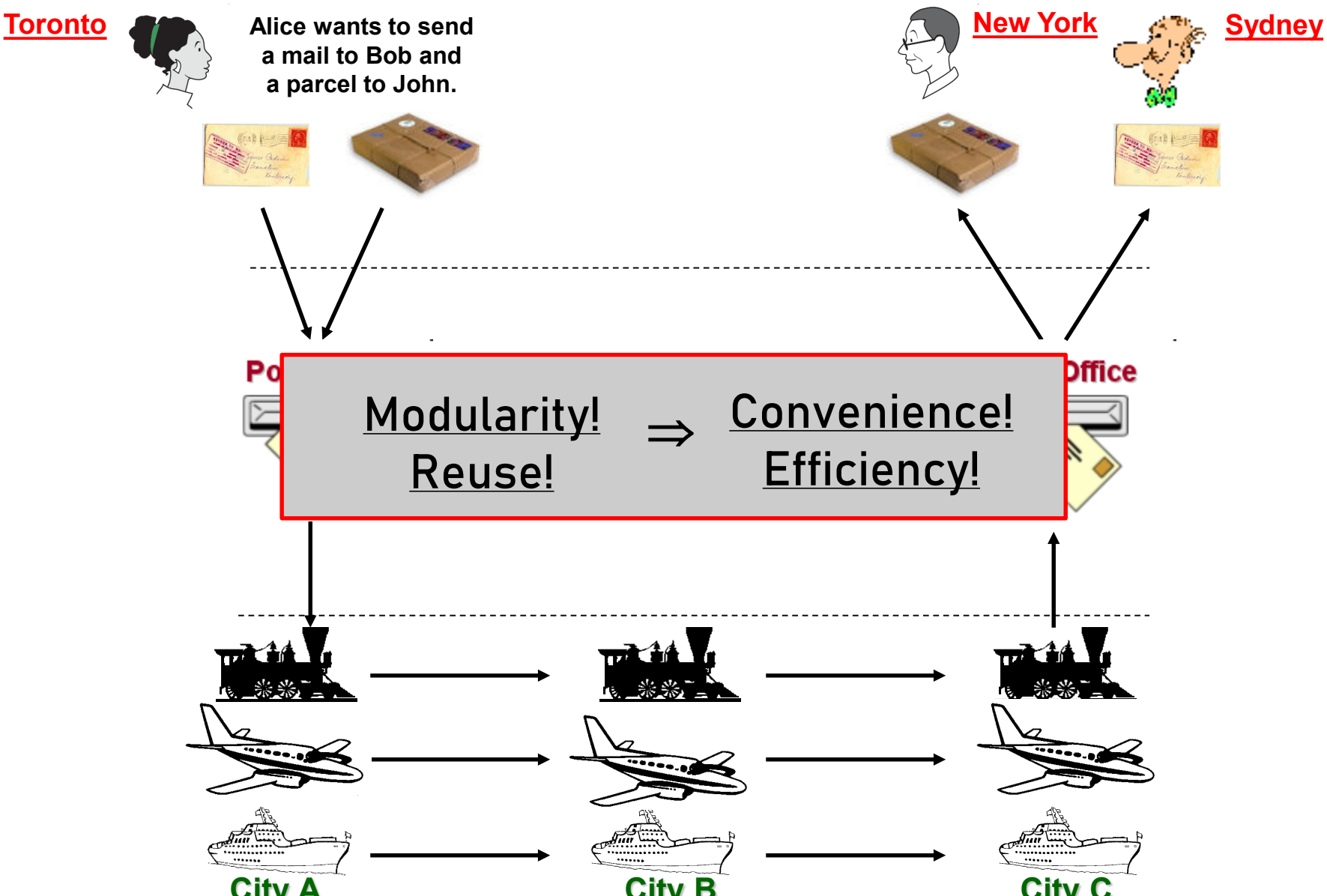
⚠ Important: Some sections of our website will be unavailable this weekend while we perform scheduled overnight maintenance. Read the details

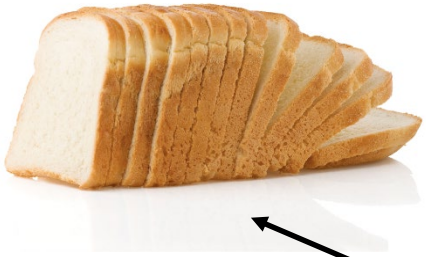
Submit a bid to transport mail with Canada Post

Canada Post requires air and ground transportation services to deliver mail to various locations across the country. Submit a proposal for the contract using the downloadable PDF file.

https://www.canadapost.ca/cpc/en/our-company/business-opportunities/contracts-for-your-business/transportation-contracts.page?

Protocol Basics: Why Layering??



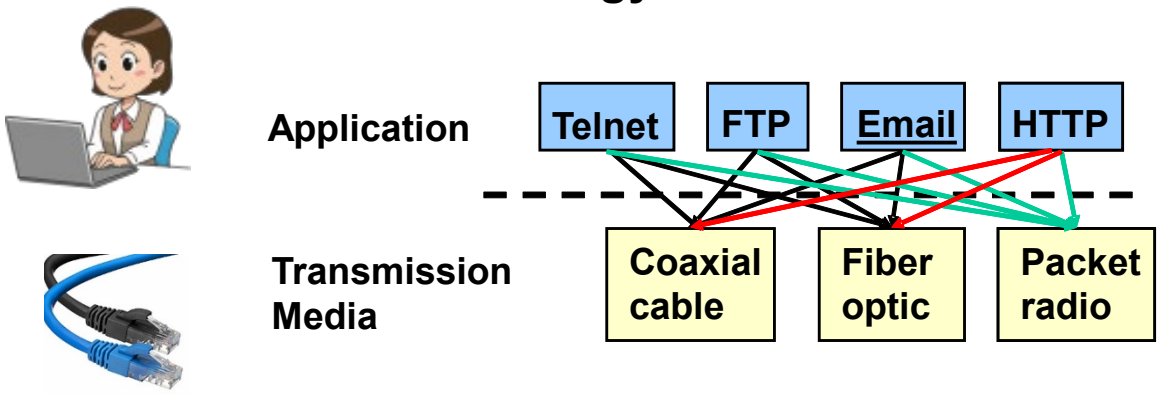



Loblaws

Protocol Basics: Why Layering??

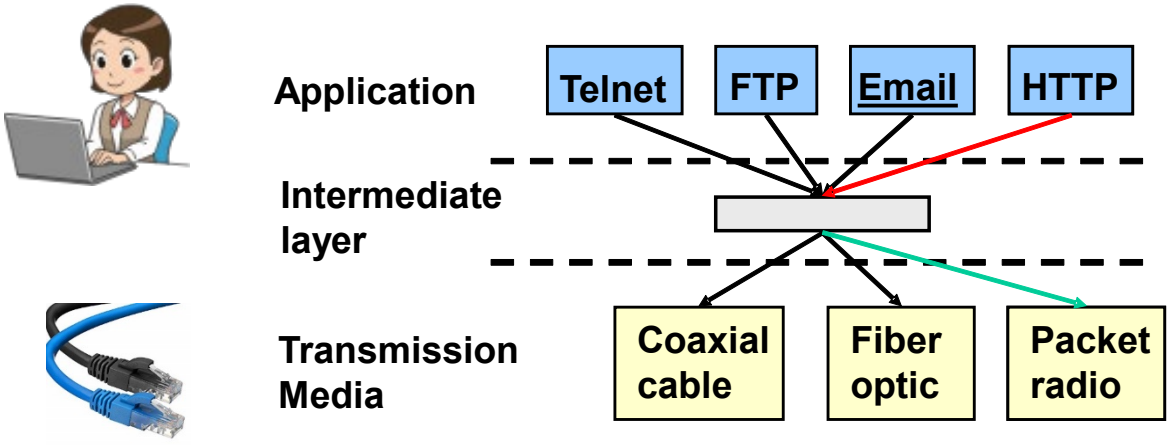
No Layering

- each new application has to be re-implemented for every network technology!



Layering

- intermediate layer(s) provide a unique abstraction for various network technologies



Protocol Basics: Why Layering??

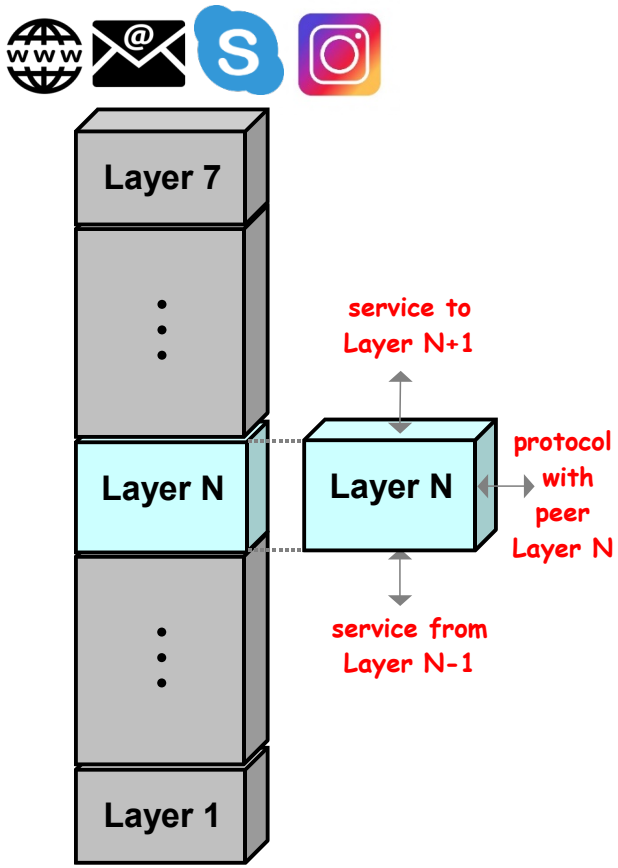
Example [development of a Web browser]

Browser developer does **not** have to worry about …
- whether end devices uses wired/wireless connection
- how packets are going to be routed through the internet
- what to do if a packet gets lost …

Browser developer has to worry about …
- how to request and receive
- how to optimize displaying of pages

Layered Internet Architecture

Protocol Layering – grouping of related communication functions into hierarchical set of layers

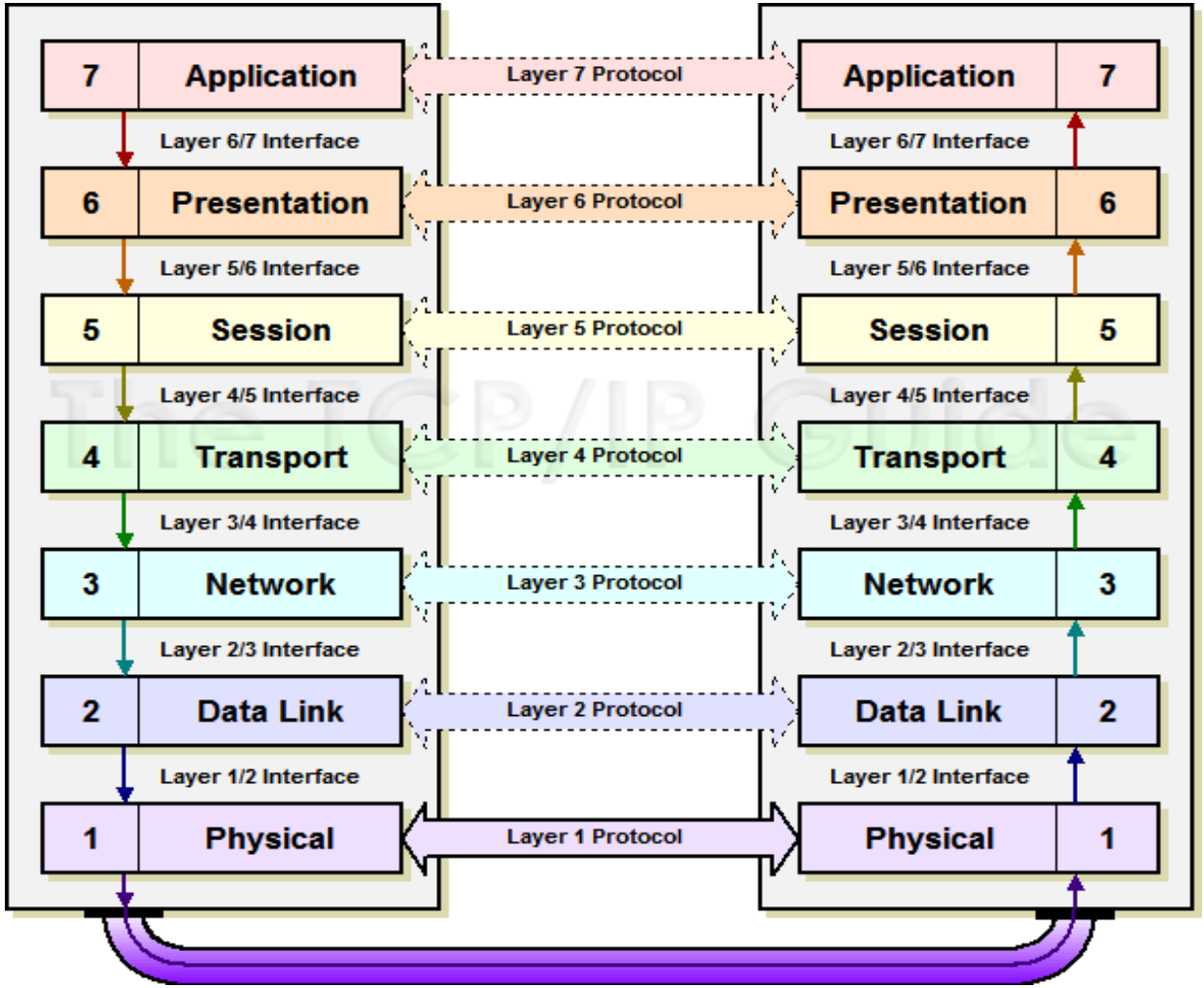


- each layer:
  - (1) performs a relates subset of functions required for communication with another system
  - (2) relies on next lower layer to perform more primitive functions
  - (3) provides service to next higher layer
  - (4) implements a protocol for communication with peer layer in other systems
- vertical communication – communication between adjacent layers – requires mutual understanding of what services and/or information lower layer must provide to layer above
- horizontal communication – communication between software or hardware elements running at the same layer on different machines – relies on a protocol

Horizontal communication between peer processes is virtual, (indirect).

Layered Internet Architecture (cont.)

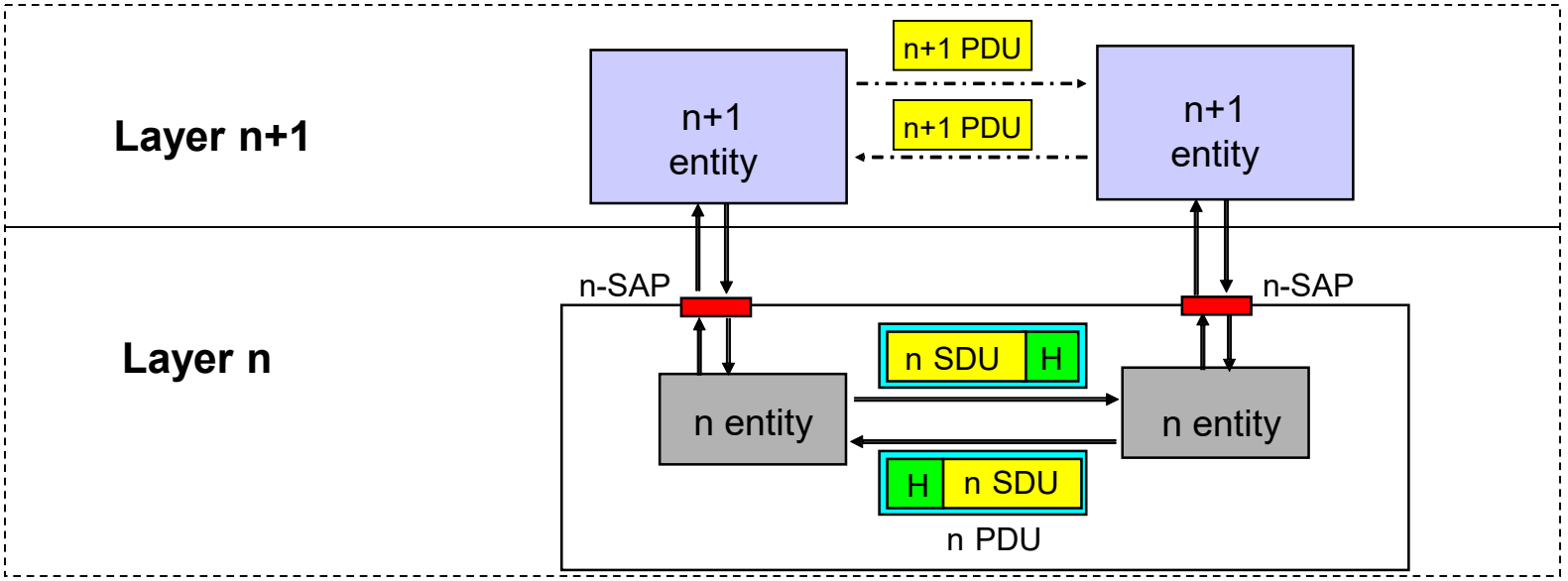
Protocol – **set of rules that govern data comm. between peer entities**



Layered Internet Architecture (cont.)

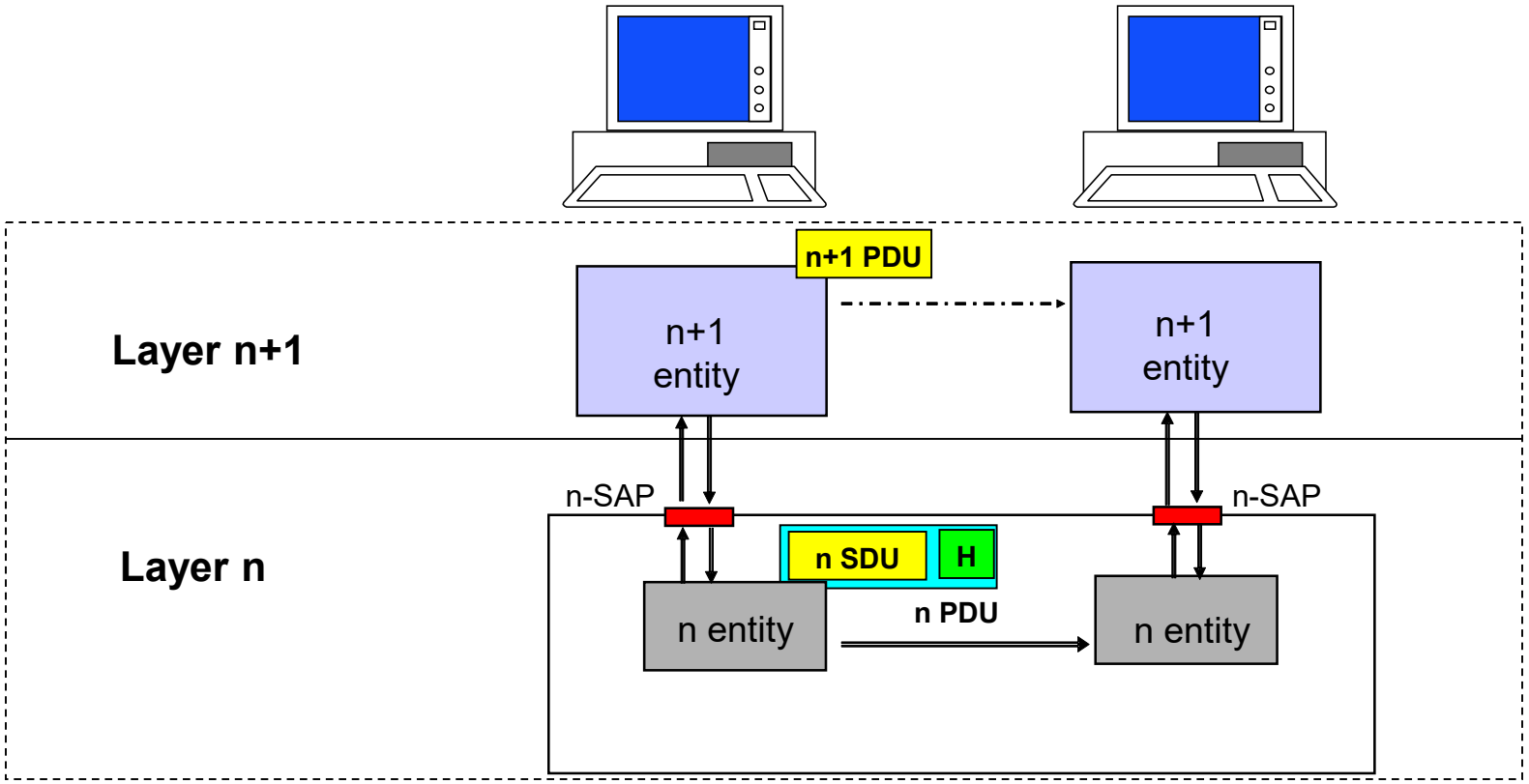
Layer n Service – **can be accessed through Service Access Points (SAP's) aka Layer n interface, and generally is provided to Protocol Data Units (PDU) aka packets of Layer n**

- **layer n+1 PDU = layer n SDU (SDU = Service Data Unit)**
- **layer n process adds control information (header) to its SDU to produce layer n PDU – encapsulation!**
- **layer n does not interpret or make use of information contained in its SDU!**



Layered Internet Architecture (cont.)

Example **[layering / encapsulation]**



This process is repeated between any two adjacent pair of (vertical) layers.

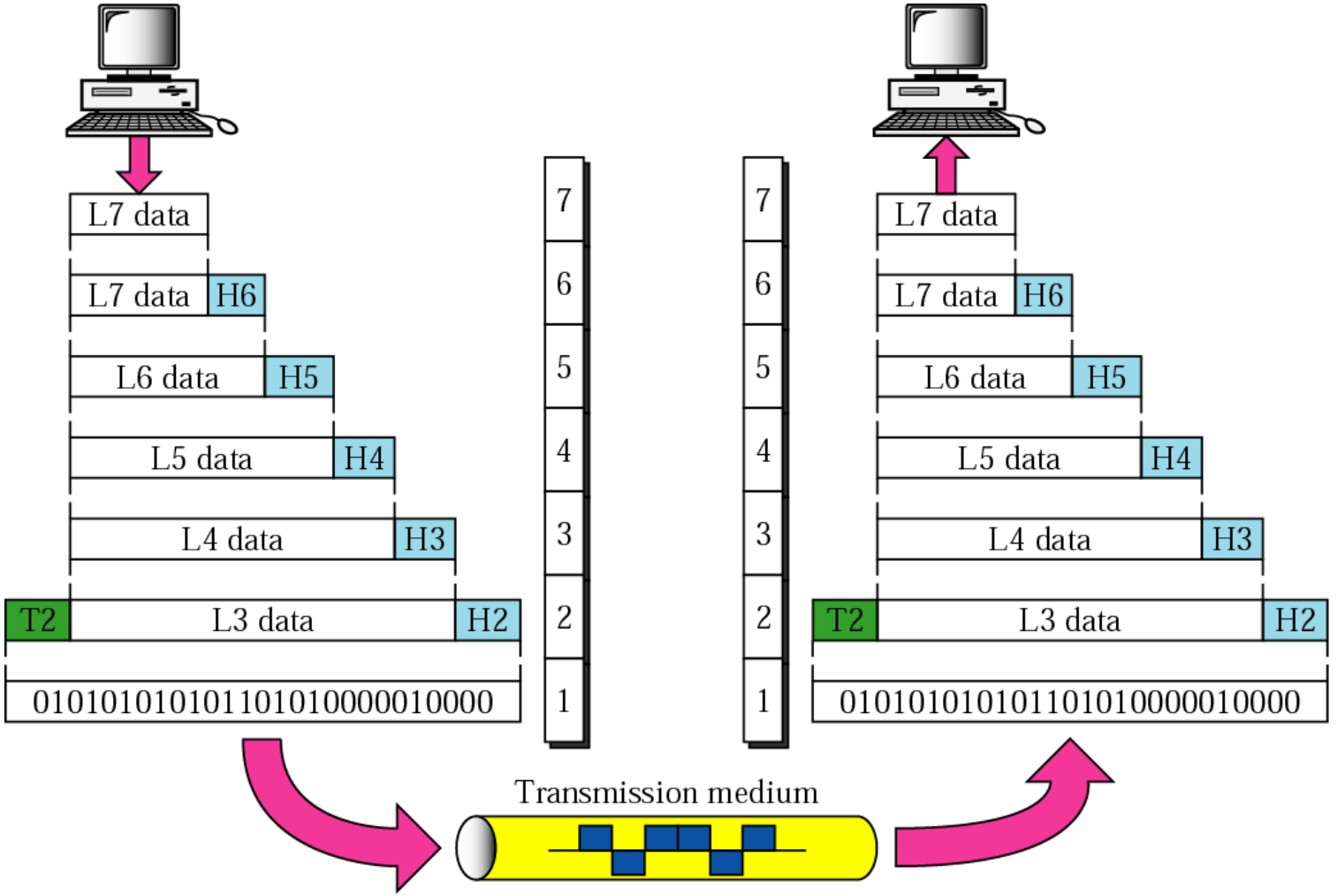
Layered Internet Architecture (cont.)

Example **[layering / encapsulation - animation]**

https://www.practicalnetworking.net/series/packet-traveling/osi-model/

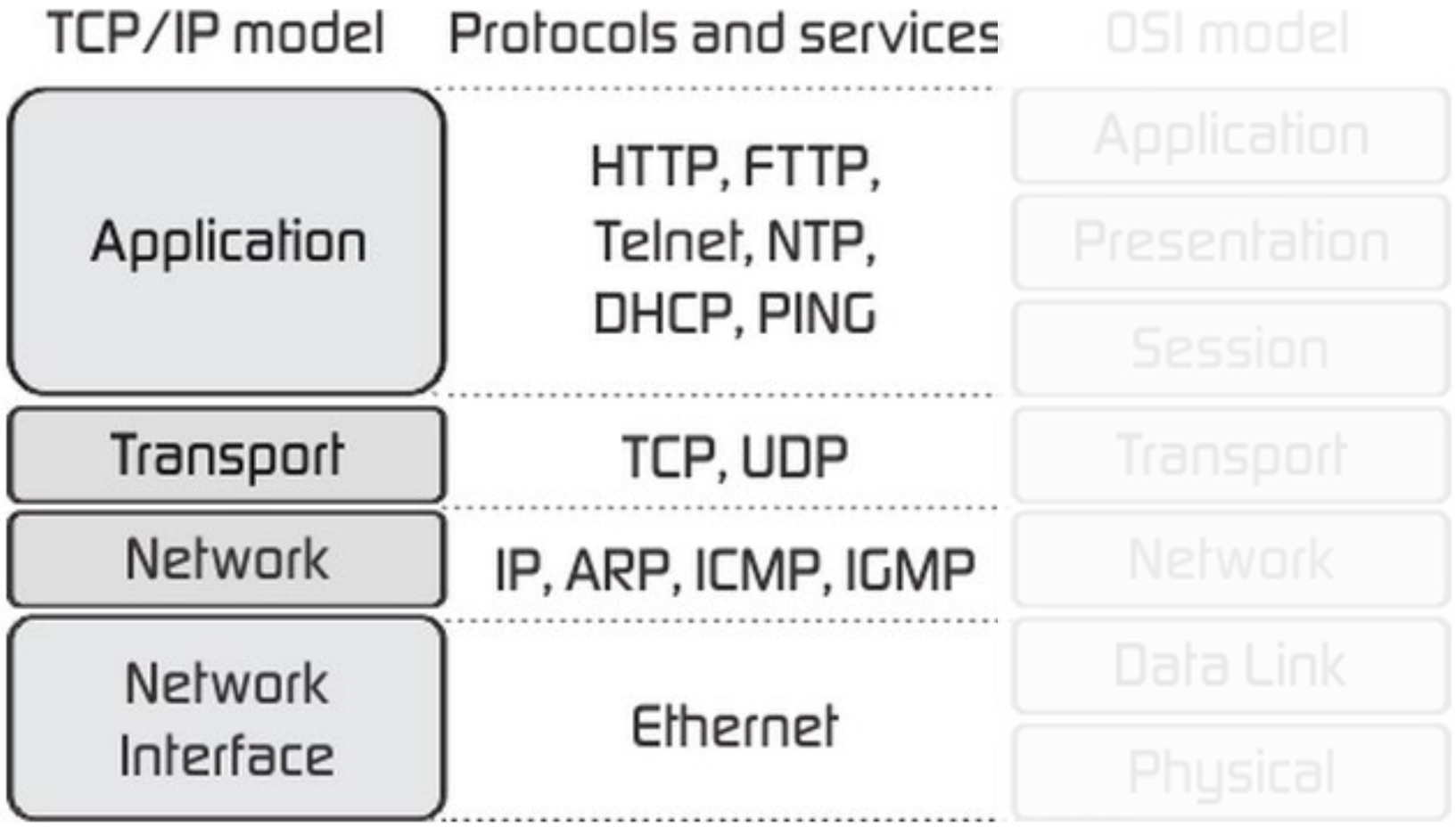
Layered Internet Architecture (cont.)

Example **[layering / encapsulation across all the layers]**



Layered Internet Architecture (cont.)

TCP/IP vs. OSI Model

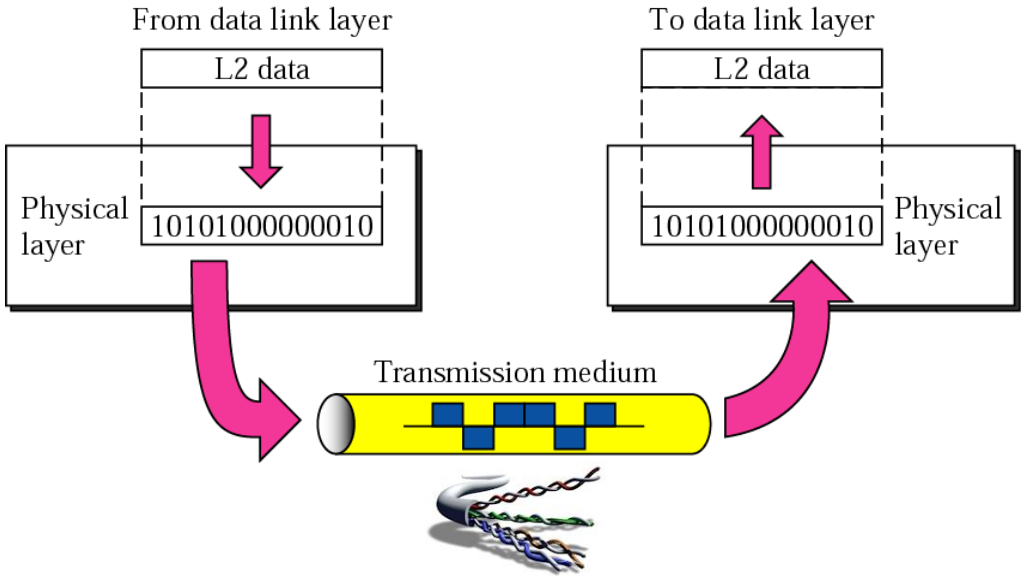


Layered Internet Architecture (cont.)

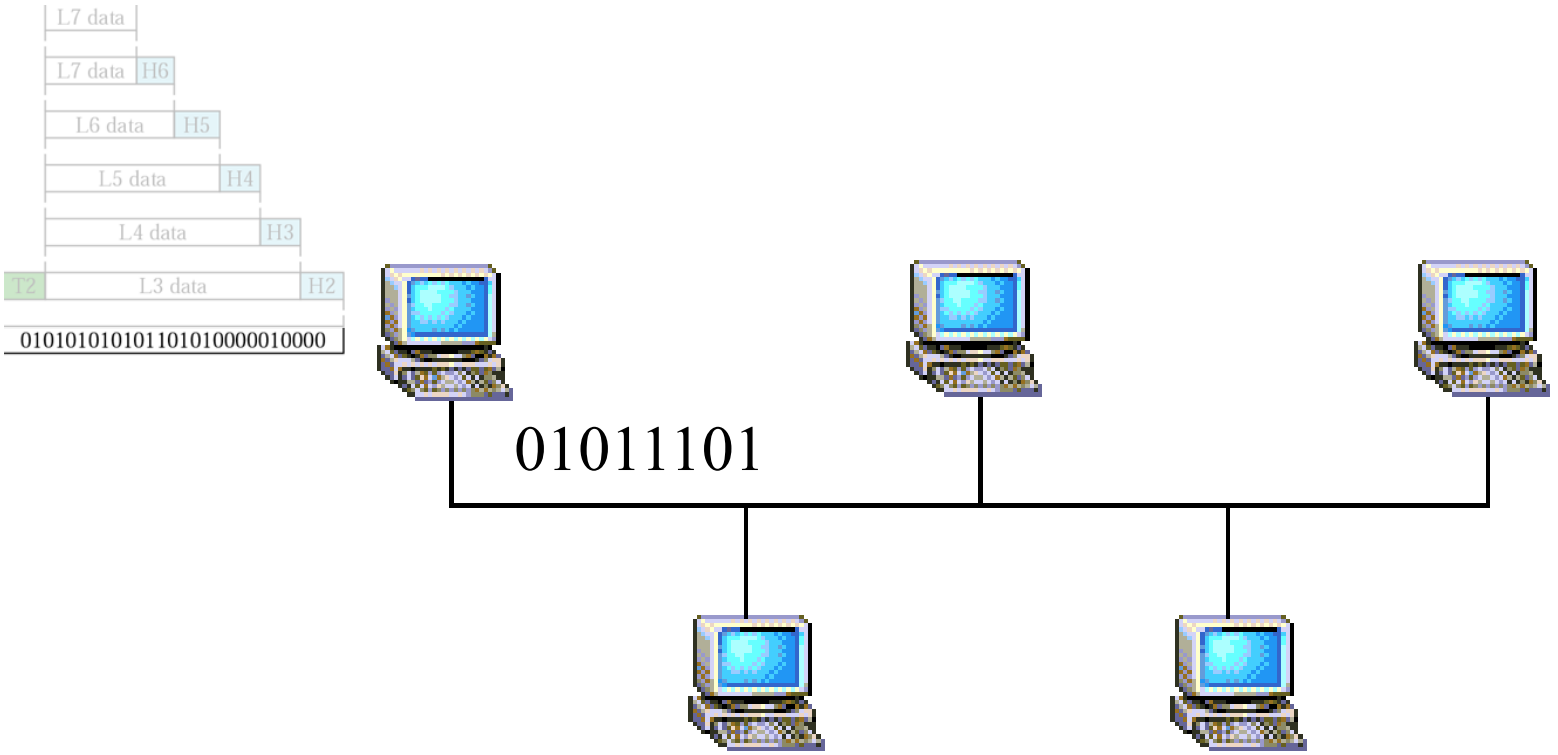
1. Physical Layer - **coordinates transmission of bit-stream over physical medium, including**

- **representation of bits: to be transmitted, bits must be encoded into signals – electrical or optical; P.L. defines type of encoding – how 0s and 1s are changed to signals (e.g. 1 = +1V, 0 = -1V)**
- **bit length – data rate: P.L. defines how long a bit lasts and, accordingly, number of bits sent each second**

(different values for copper wire, coaxial cable, fiber-optics, …)



Layered Internet Architecture (cont.)



Sending 0 and 1 well is useful. But what if:

1) Multiple machines share the same communication medium?
(where should these bits go??)

2) Some of the bits get corrupted by noise?