### **Reference Models**

#### **Overview**

- What functionality should we implement at which layer?
  - This is key design question
  - Reference models provide frameworks that guide us.

### **OSI "7 layer" Reference Model**

- A principled, international standard, to connect systems
- Influential, but not used in practice.

7	Application	
6	Presentation	
5	Session	
4	Transport	
3	Network	
2	Data link	
1	Physical	

- Provides functions needed by users
- Converts different representations
- Manages task dialogs
- Provides end-to-end delivery
- Sends packets over multiple links
- Sends frames of information
- Sends bits as signals

#### **Internet Reference Model**

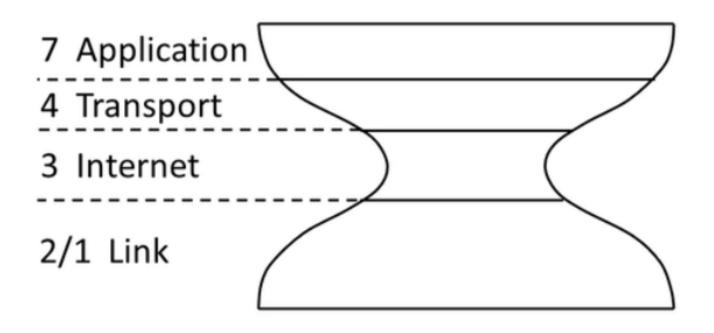
 A four layer model based on experience; omits some OSI layers and uses IP as the network layer

Application
Transport
Internet
Link

- Programs that use network service
- Provides end-to-end data delivery
- Send packets over multiple networks
- Send frames over a link

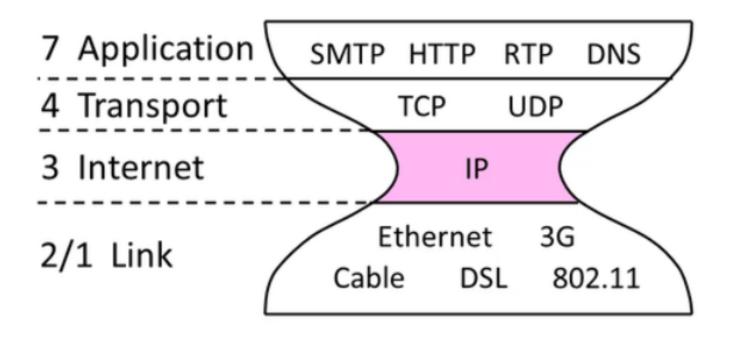
# **Internet Reference Model (2)**

With examples of common protocols in each layer



### **Internet Reference Model (3)**

- IP is the "narrow waist" of the internet
- Supports many different links below and apps above



### **Standard Bodies**

- Where all the protocols come from!
- Focus is on interoperability

Body	Area	Examples
ITU	Telecom	G.992, ADSL
		H.264, MPEG4
IEEE	Communications	802.3, Ethernet
		802.11, WiFi
IETF	Internet	RFC 2616, HTTP/1.1
		RFC 1034/1035, DNS
W3C	Web	HTML5 standard
		CSS standard

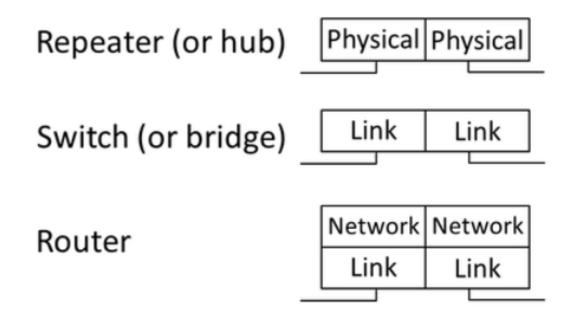
# **Layer-based Names**

• For units of data:

Layer	Unit of Data
Application	Message
Transport	Segment
Network	Packet
Link	Frame
Physical	Bit

# **Layer-based Names (2)**

For devices in the network:



# **Layer-based Names (2)**

For devices in the network:

Proxy or middlebox or gateway

Арр	Арр	
Transport	Transport	
Network	Network	
Link	Link	

But they all look like this!



### **A Note About Layers**

- They are guidelines, not strict
  - May have multiple protocols working together in one layer
  - Maybe difficult to assign a specific protocol to a layer