

CPSC 317 COMPUTER NETWORKING

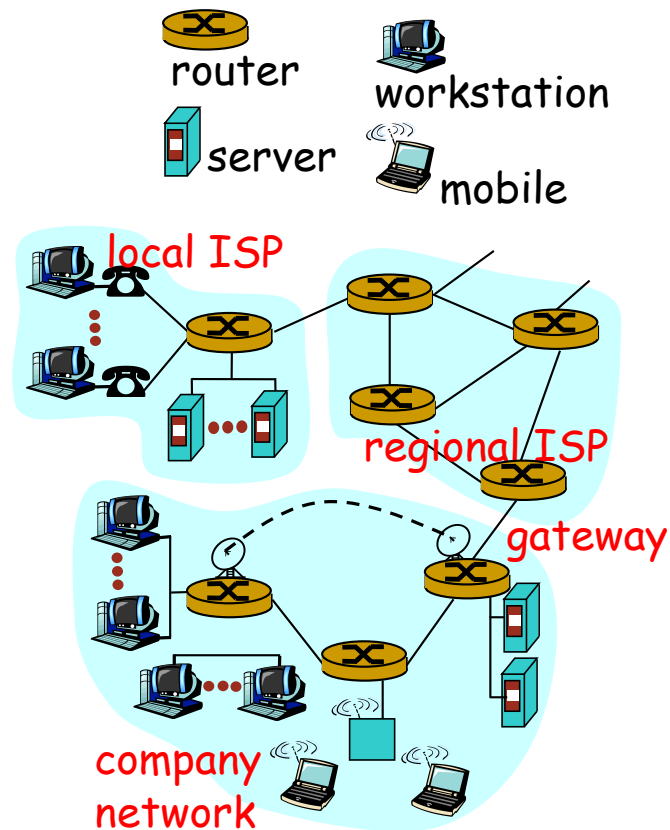
Module 1: Design of the Internet – Day 2 – Switching and Protocols

1

LEARNING GOALS

- A. Explain what the Internet is, and how (generally) it is put together
- B. Describe the advantages and disadvantages of packet vs circuit switching
- C. Define the term protocol in the context of a computer network
- D. Explain why protocols are modeled using finite state machines and what states, actions, and events are
- E. List the layers of the Internet protocol stack, in their proper order, and what functions each layer performs
- F. Explain encapsulation and the structure of packets flowing in the Internet

AS A NETWORK OF NETWORKS, THE INTERNET HAS MANY ROUTERS



PACKET SWITCHING AND ROUTERS

- To get a packet to its recipient, each machine sends it to the router that is believed to be closest to the destination
 - Similar to a road intersection
- Router looks up destination address in a forwarding table to determine next hop
- There may be several possible paths to take

CIRCUIT VS PACKET SWITCHING REVISITED

- When using circuit switching, the decision about the route that the data will take from source to destination is made once when the connection is established
- When using packet switching, this decision is made for every packet
- Does this have any impact on reliability?
- Does this have any impact on performance?

CLICKER QUESTION

Assume A creates a 100kbps circuit to B, and A sends data at an average rate of 25kbps. What is A's utilization of the network resources? Express your answer as a percent.

CLICKER QUESTION

Assume A creates a 100kbps circuit to B, and A sends data at an average rate of 25kbps.

Can the network use these idle resources for other traffic?

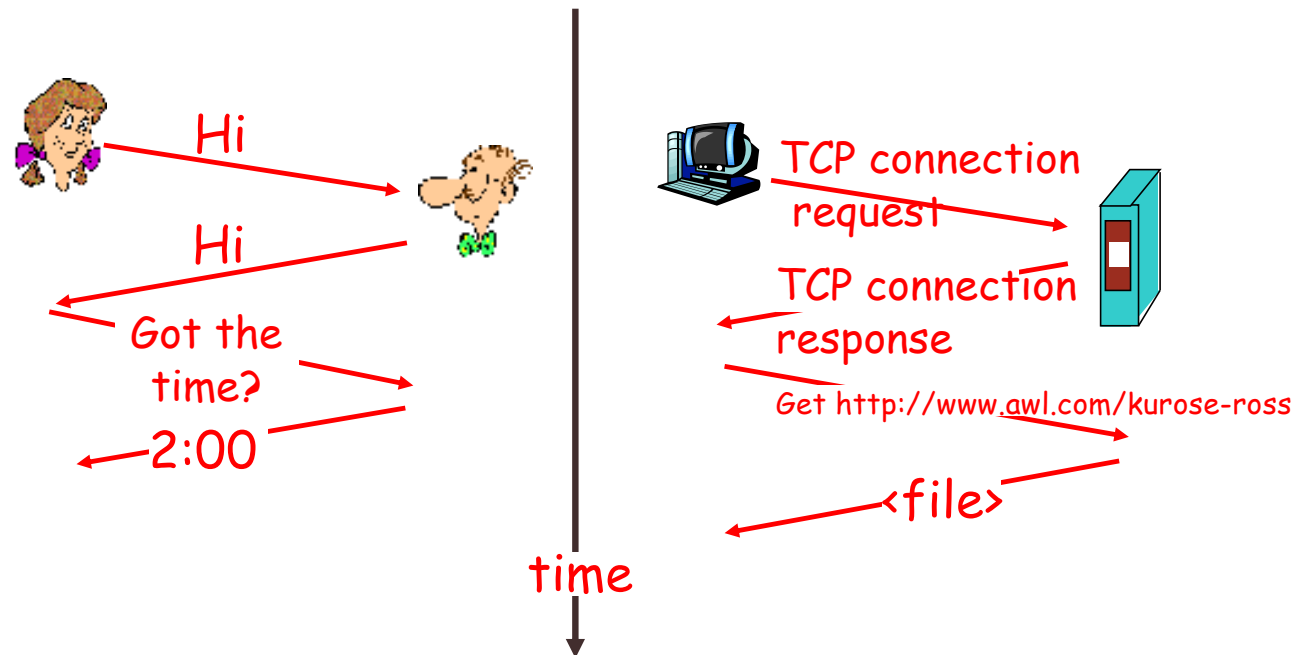
- A. Yes
- B. No

PROTOCOLS

- A **protocol** defines:
 - Roles of communicating entities
 - Format of messages
 - Order of messages
 - Actions taken on the transmission, receipt of a message, or other event
- A fully-defined protocol must provide a proper action for any event in any state

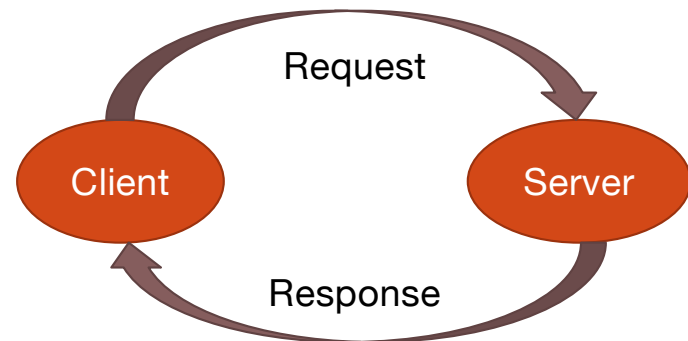
WHAT'S A PROTOCOL?

a human protocol and a computer network protocol:

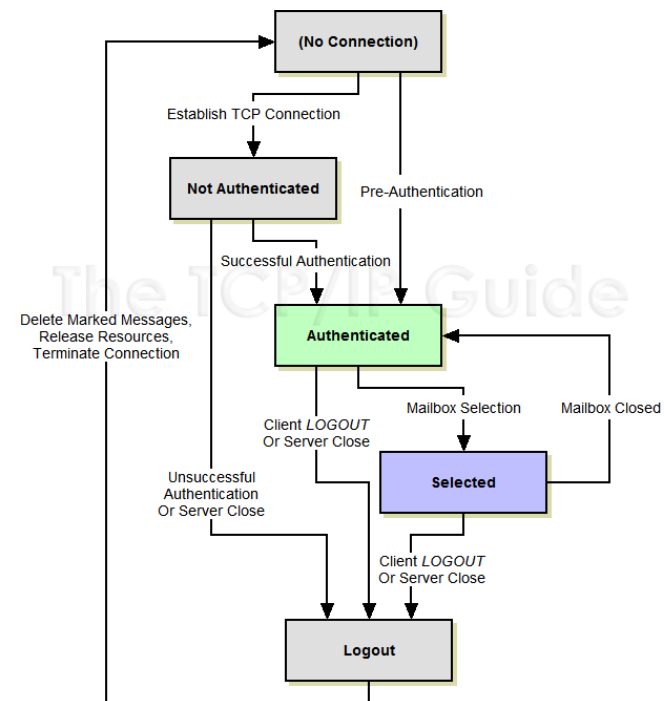
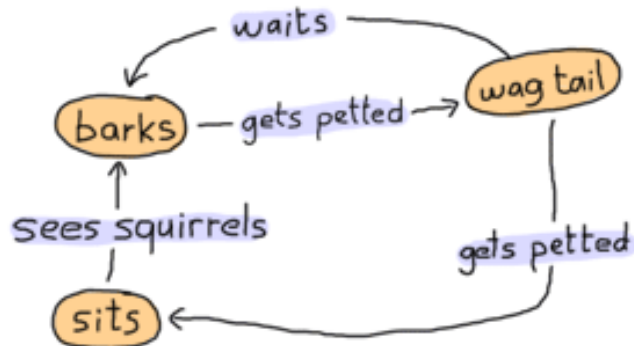


REQUEST-RESPONSE PROTOCOLS

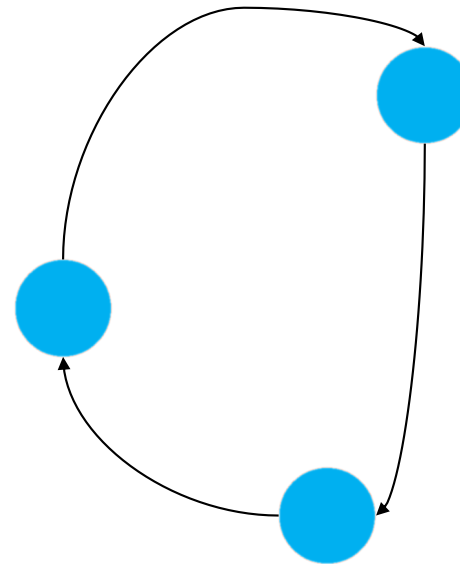
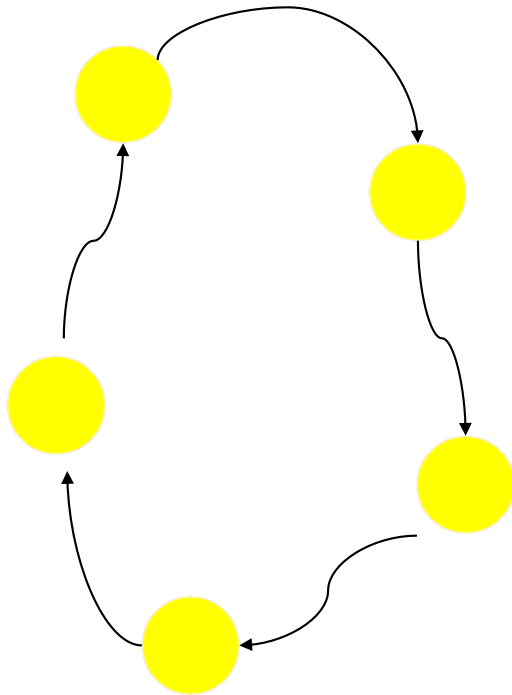
- Many protocols on the Internet are request-response protocols
 - Requestor (usually client) sends a request
 - Receiver (usually server) sends a response
 - Well-defined rules for whose turn it is
- Some rules can be complicated
 - Server is slow to respond
 - Size of request or response can vary



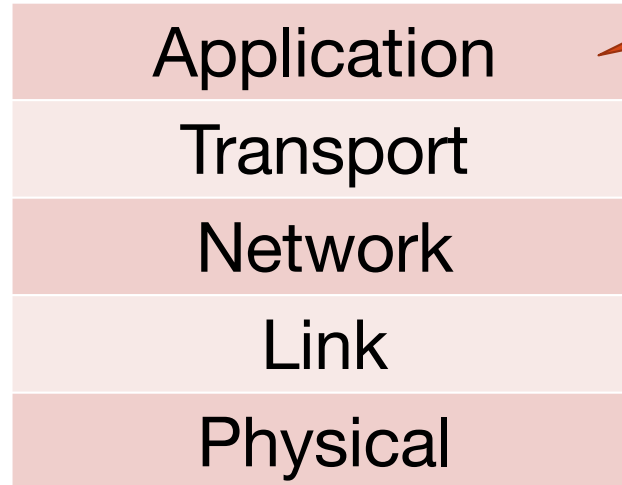
MODELLING PROTOCOLS: FINITE STATE MACHINES



LINKED FINITE STATE MACHINES

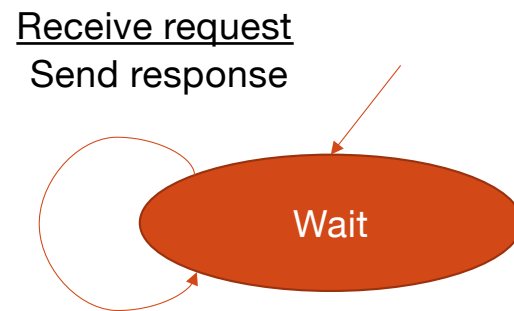


PROTOCOL STACK

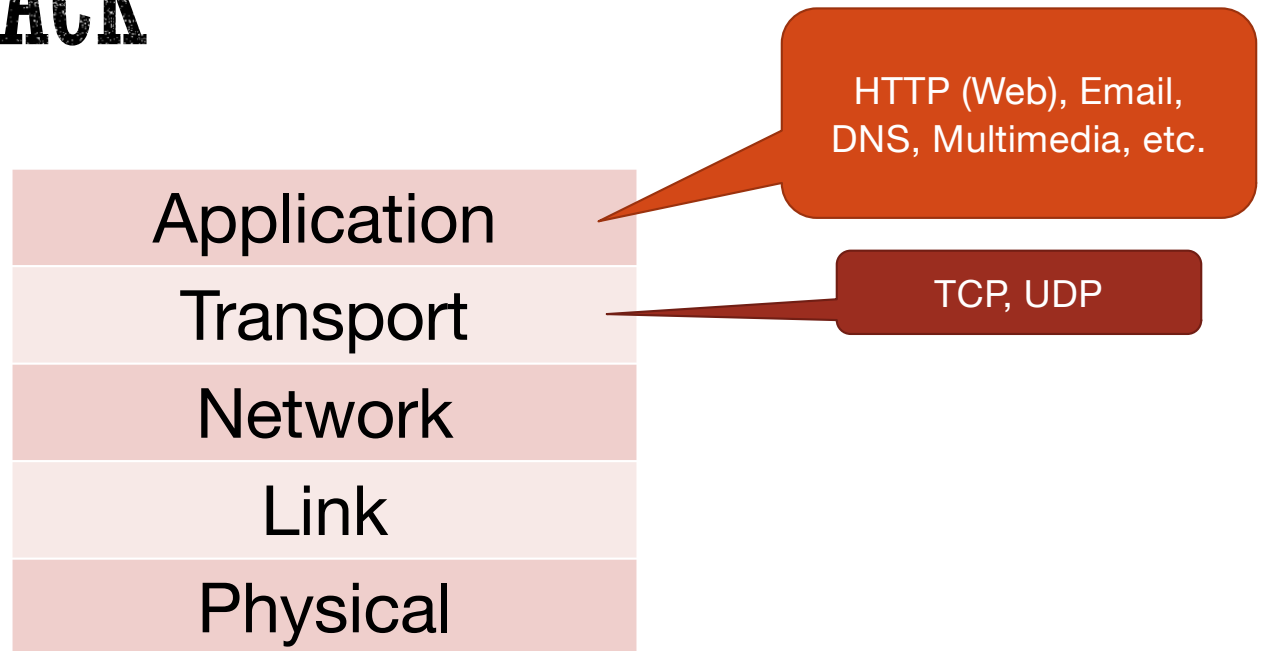


HTTP (Web), Email,
DNS, Multimedia, etc.

WEB SERVER STATE MACHINE

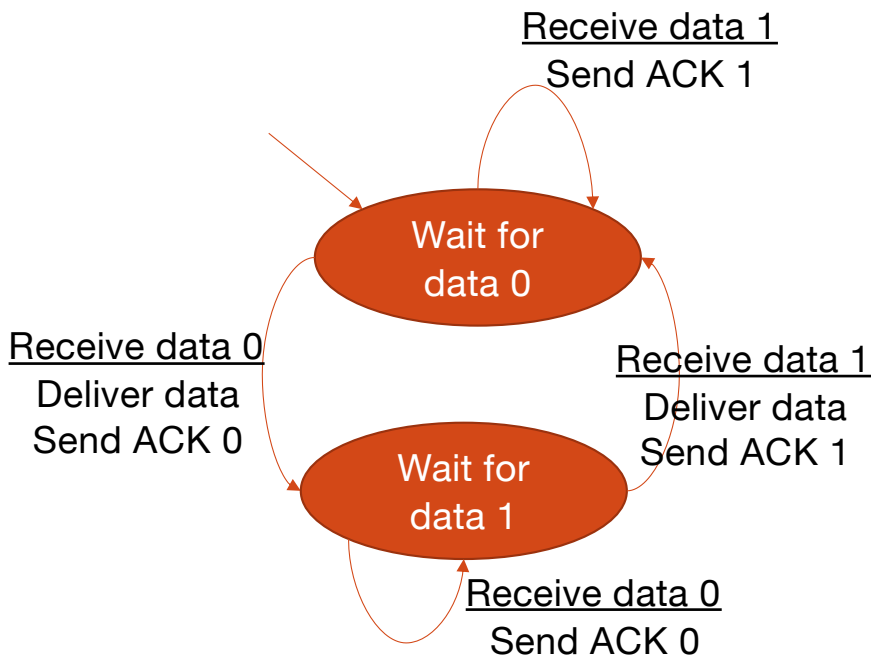


PROTOCOL STACK

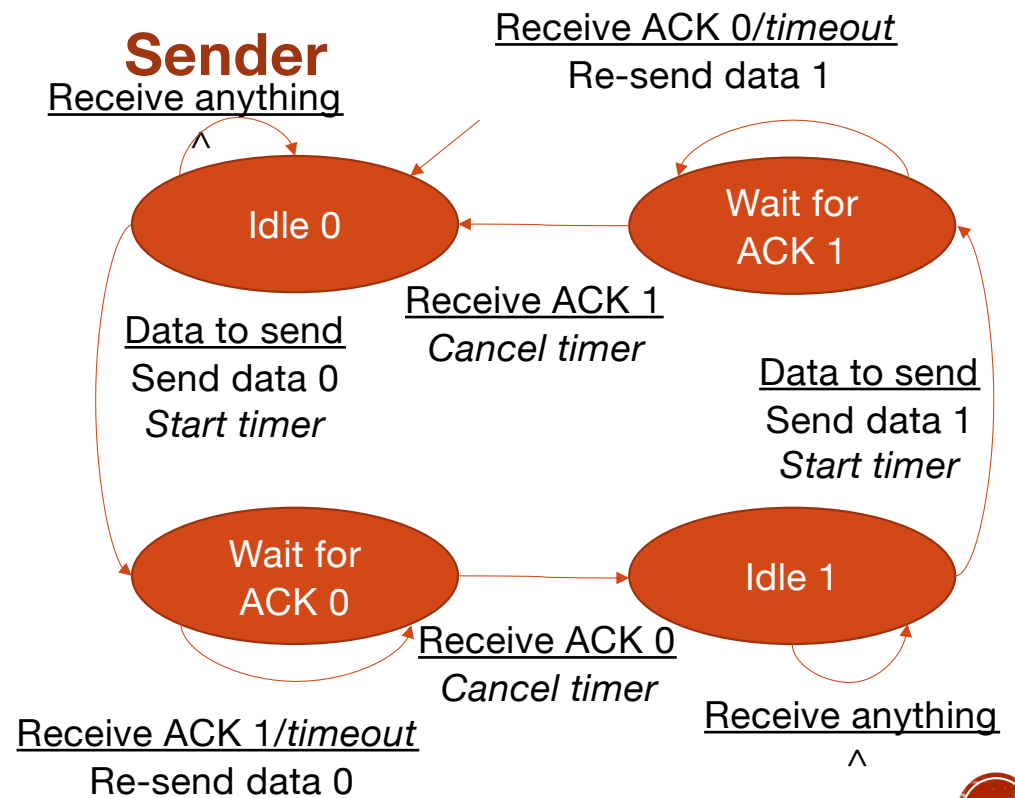


A SIMPLE TRANSPORT PROTOCOL

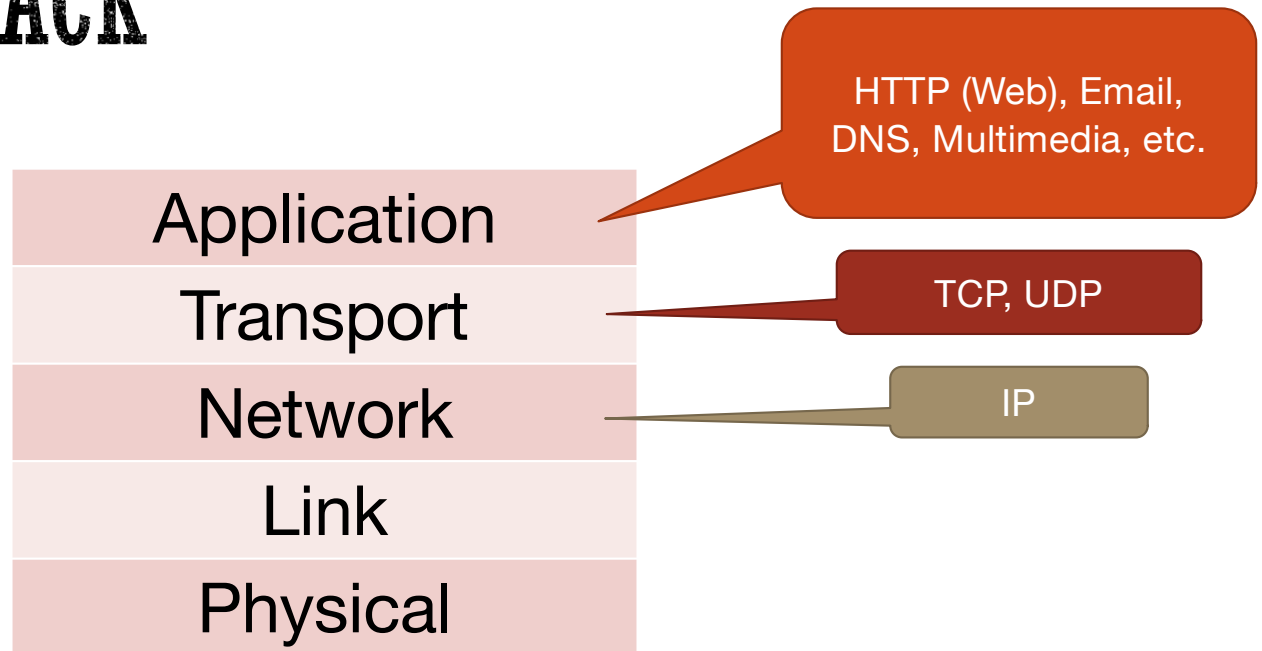
Receiver



CPSC 317 2023W2 © 2021

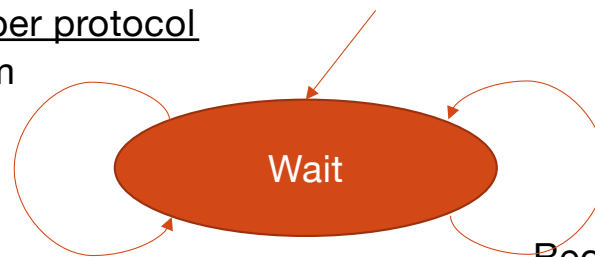


PROTOCOL STACK



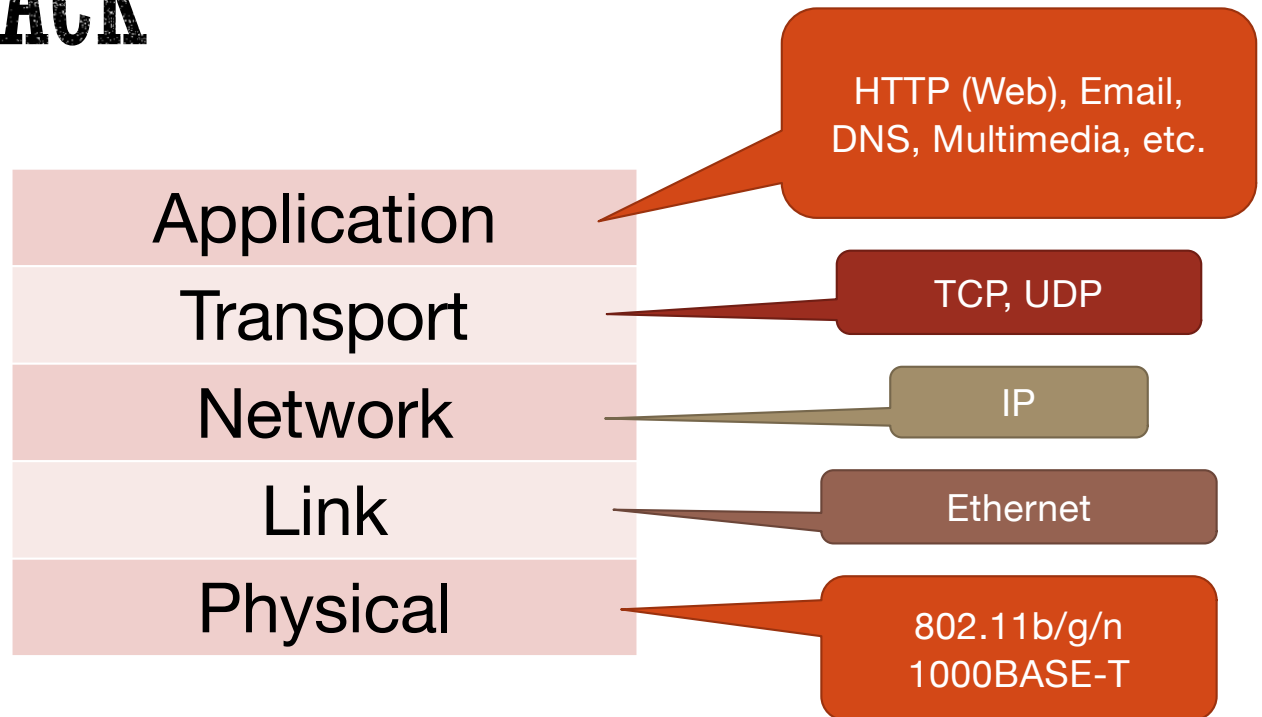
IP STATE MACHINE

Receive segment from upper protocol
Send datagram



Receive datagram from lower layer
Deliver to upper protocol

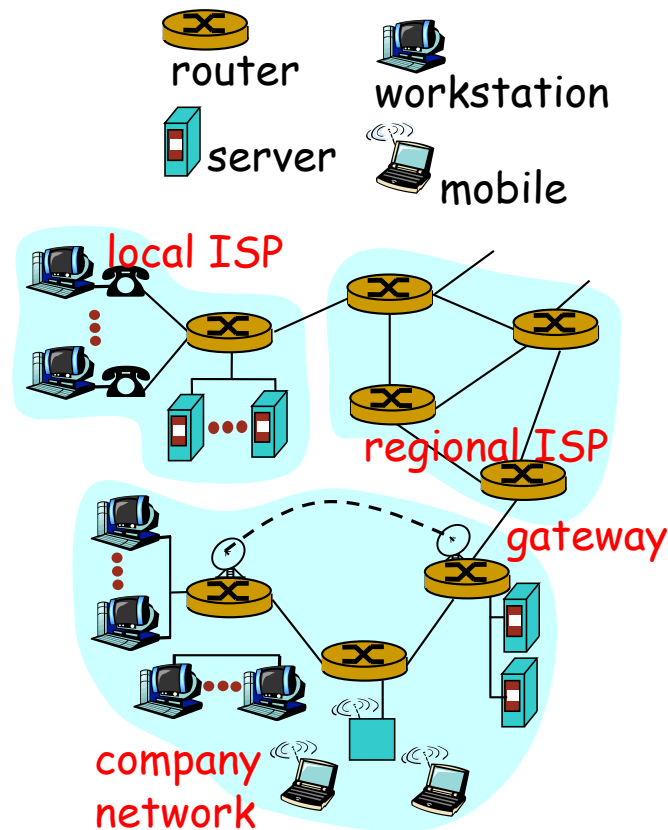
PROTOCOL STACK



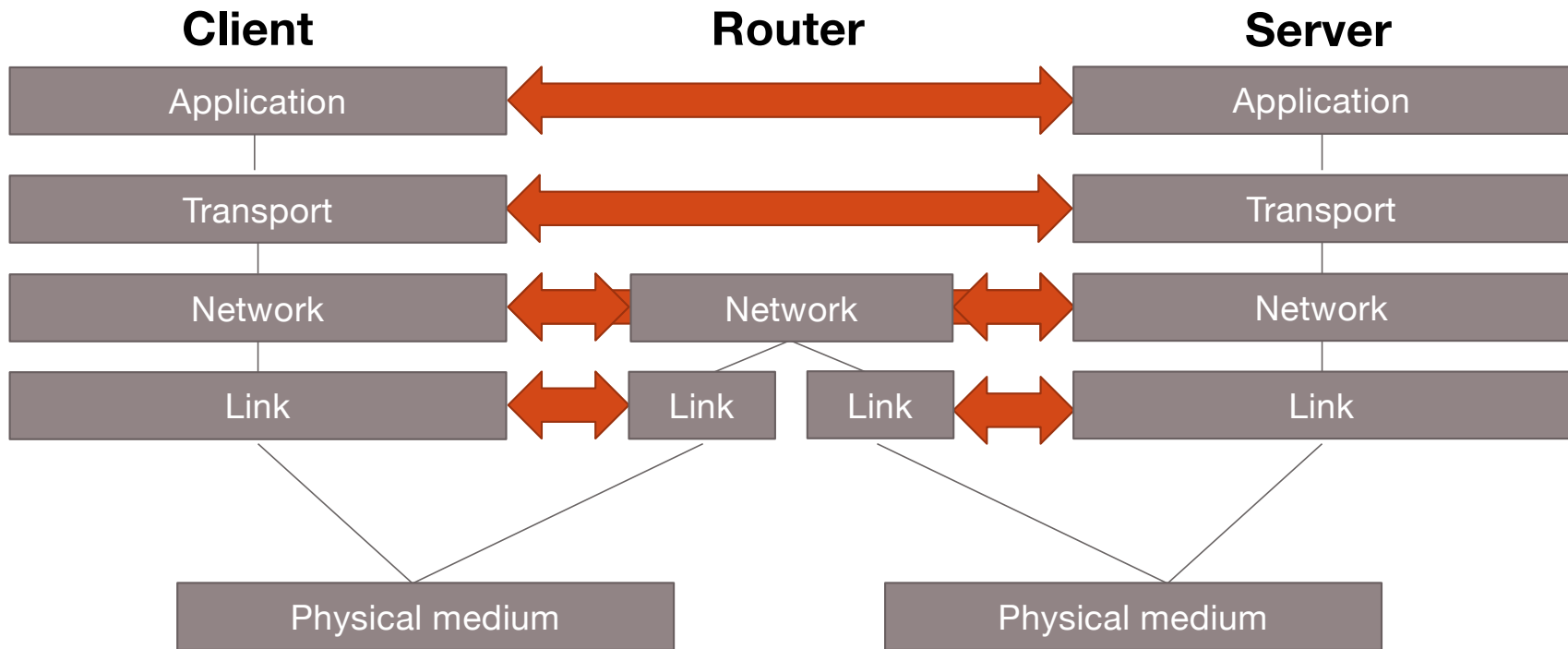
SENDING DATA THROUGH THE STACK



AS A NETWORK OF NETWORKS, THE INTERNET HAS MANY ROUTERS



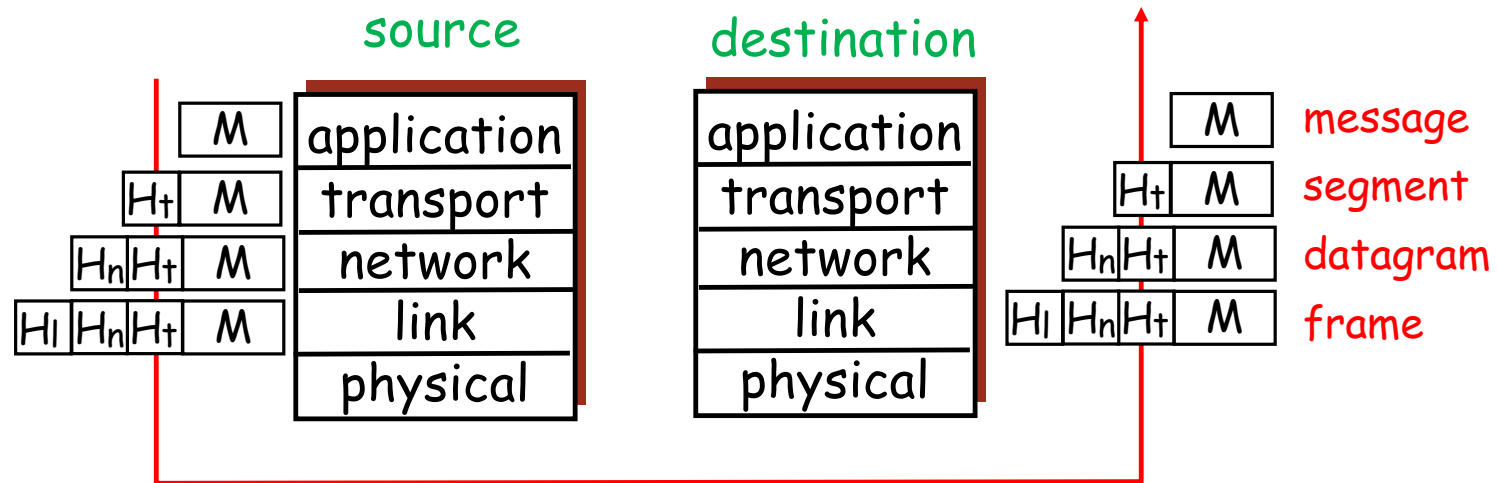
SENDING DATA THROUGH THE STACK

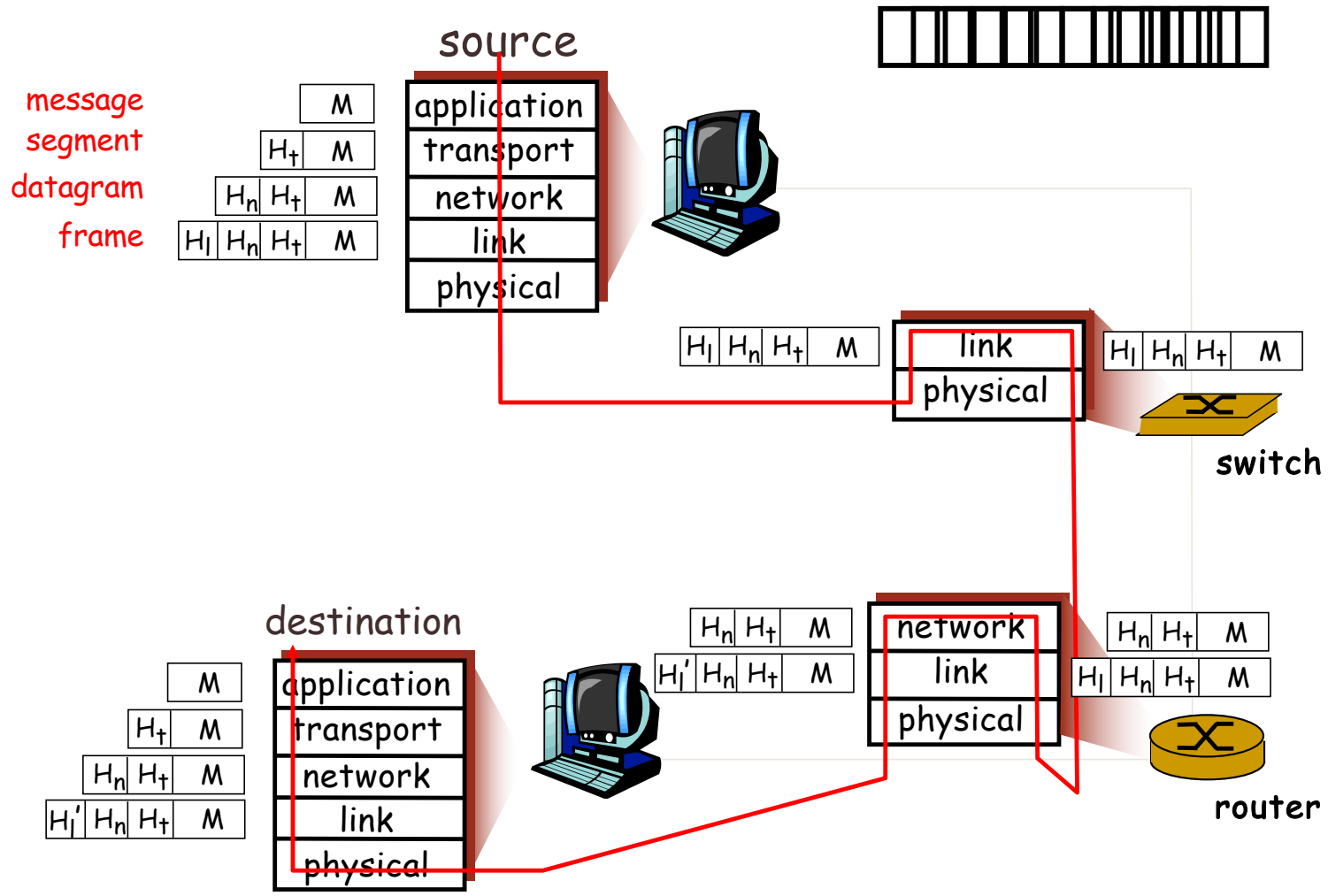


PROTOCOL LAYERING AND DATA

Each layer takes data from above

- adds header information to create new data unit
- passes new data unit to layer below





PROTOCOL STACK: RESPONSIBILITIES

- Transport layer:
 - Identifies process on machine
 - Maybe resource within process (e.g., browser tab)
 - Ensures data arrives in order (if required)
 - Recovers lost data (if required)
- Network layer:
 - Routes datagrams through routers to destination machine
- Link layer:
 - Routes frames to adjacent machines (“direct” connection)
- Physical layer:
 - Encodes data appropriately for the physical medium

SUMMARY OF MODULE 1

- The Internet is a network of networks
 - End systems and routers
- How is data sent?
 - Data is chopped into packets
 - Each packet has its destination address
- Protocol stack
 - Each layer is responsible for a function
 - A protocol layer, in an abstract way, “talks” to a corresponding layer in another machine at the same level
 - Each layer requests services from the layer below it

IN-CLASS ACTIVITY

- Form yourselves into groups (1 – 9 students per group)
- You should be able to chat conveniently in your group
- Go to PrairieLearn
- Click on Assessments
- Start the ICA12 assessment (Protocol Layers)
- Talk in your group about the answers
 - Hearing other students ideas
 - Explaining your ideas to others