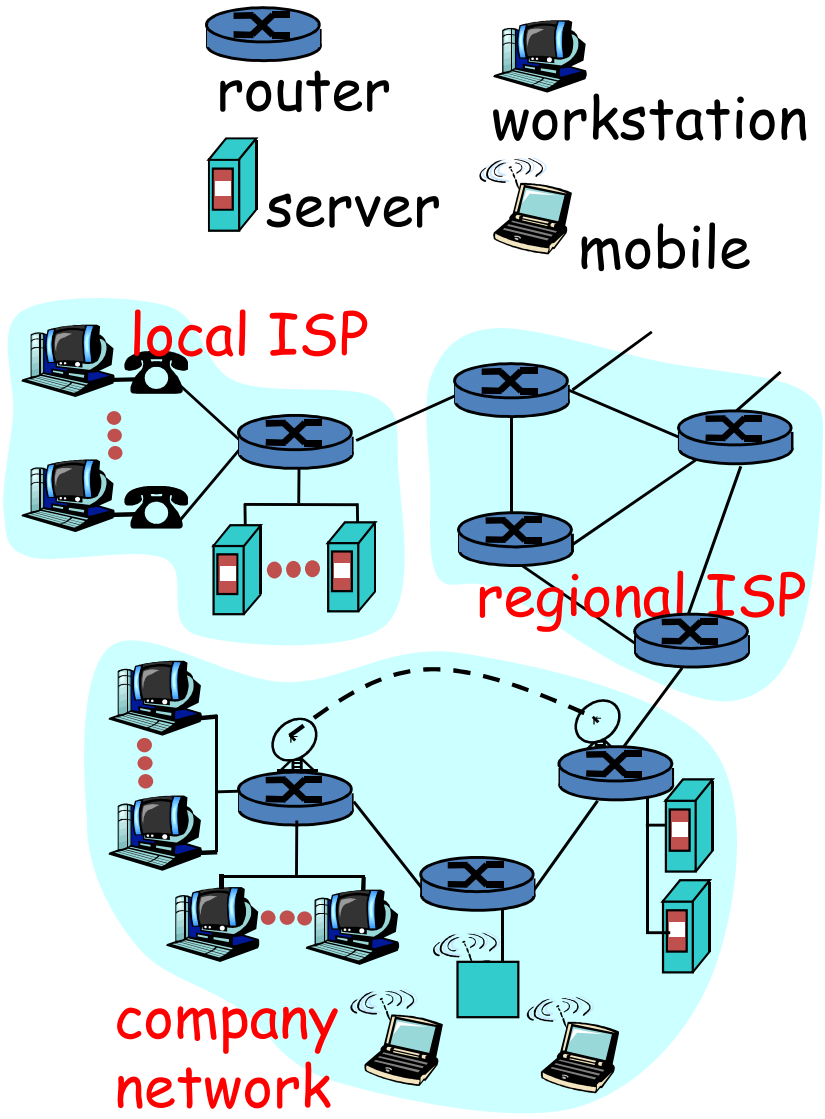
# Introduction to Networks & the Internet

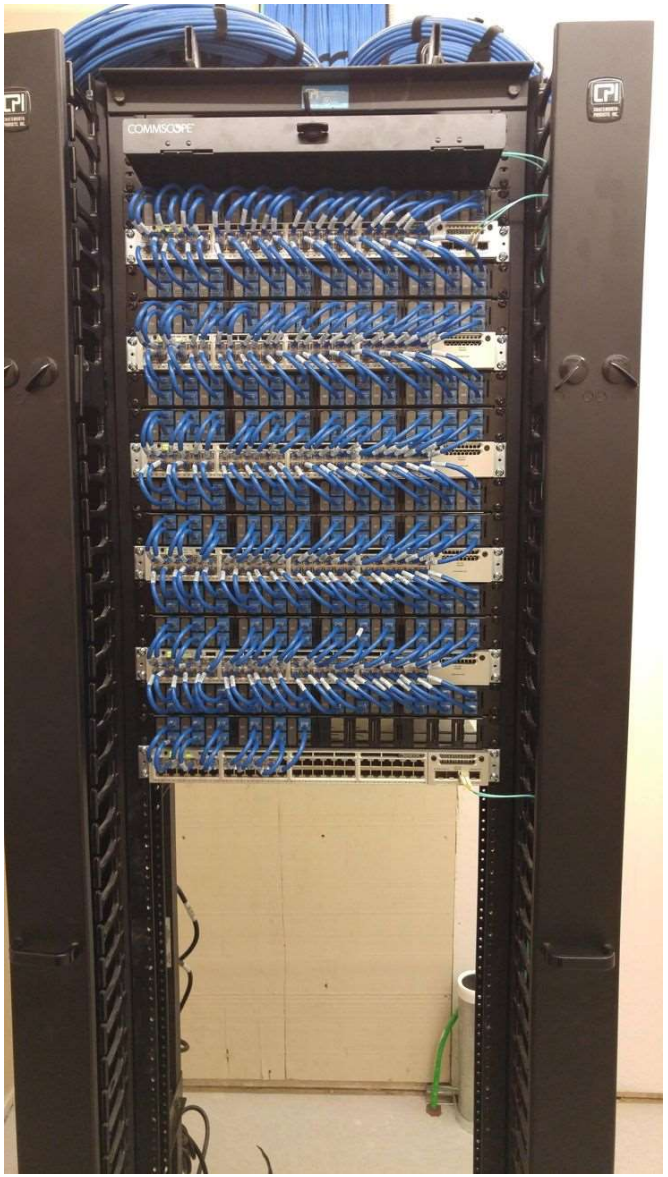
- Our aim in this lecture is to
  - see the "big picture" view of networking, we will be going into each of the areas in detail in later lectures.
  - learn some of the terminology used in networking, which we will see throughout the course.
- We will be looking at
  - network components and their roles
  - protocols
  - how data travels through a network
  - the structure of the Internet
  - layered protocol architecture of the Internet
  - a brief history of the Internet

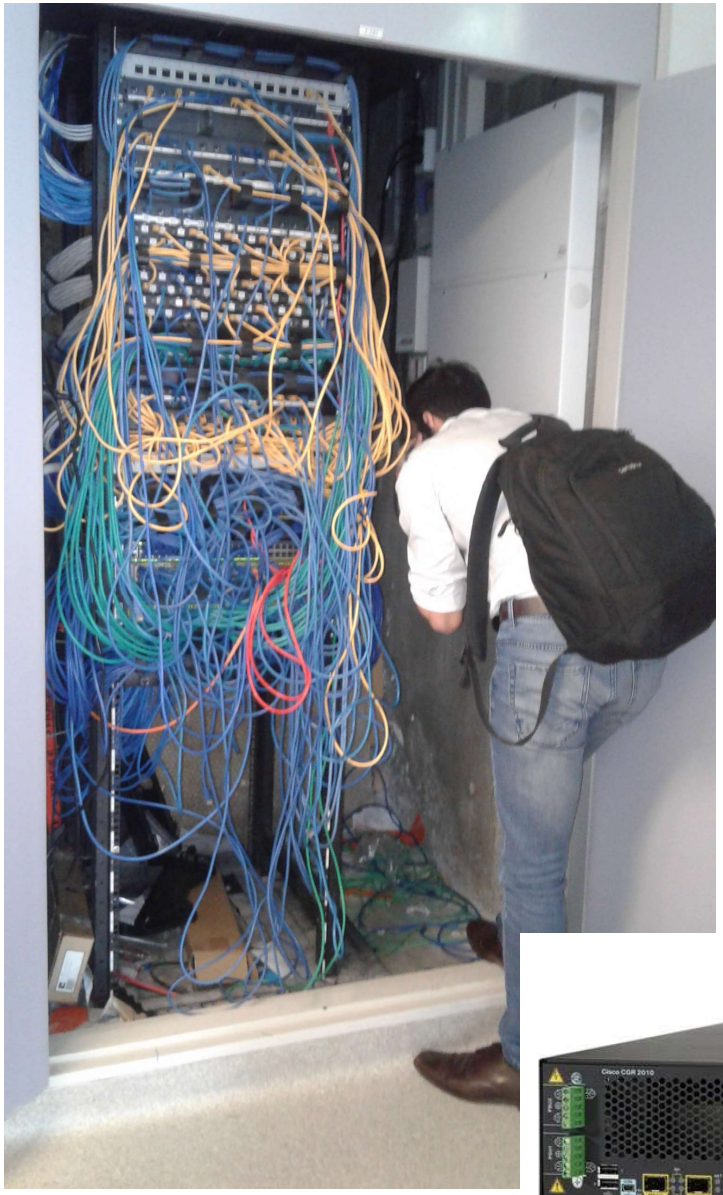
**Reading:**
**Kurose & Ross: Ch 1**
**extra info on website**

# Network nuts & bolts

- The purpose of networking is to communicate information
- Networks consist of:
  - hardware infrastructure
    - hosts (end-systems)
    - routers (switches)
    - links (capacity "bandwidth" b/s)





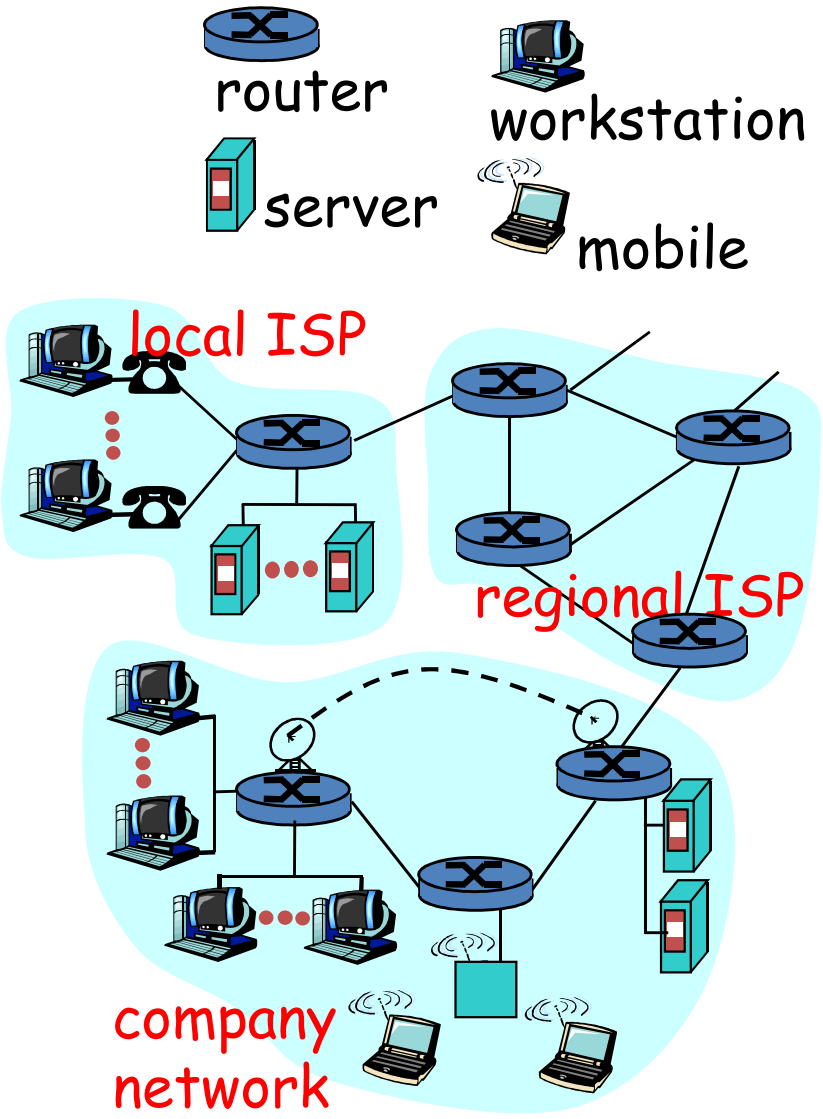



Switch

Router

Links have …

capacity “bandwidth”



# Protocols

- Rules for exchanging messages
- Define format of messages and action(s) taken when a message is received.
- TCP/IP for the Internet
- HTTP for the Web

**A lot of our course will be focused on protocols.**

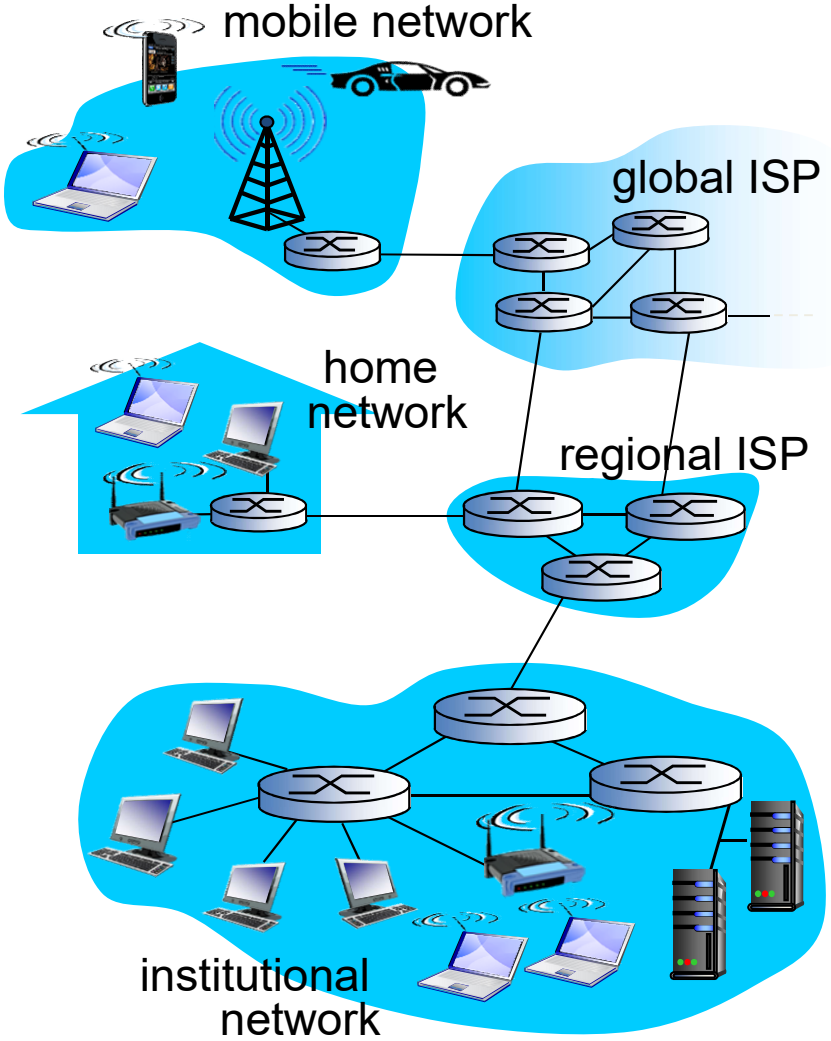
# WANs, LANs & Internets

- A Local Area Network is a network of geographically close computers.
  - Ethernet
  - High bandwidth (1 Mbps -> 1 Gbps)
  - Low latency (mSec)
  - Low error rate (< 1 in 10^14)
  - Short geographical reach (<5km, usually less)
  - Sometimes broadcast
- A Wide Area Network is a network connecting geographically distant computers.
  - High latency (100 mSec >)
  - Higher error rates (1 in 10^4)
  - Span more than one organisation
  - AARNET, the Internet
- Note: in communication K=10^3 M = 10^6 G=10^9

- If we connect networks together, we get an internet.
  - The glue that holds them together are routers and common network protocols
  - intranets are internets within an organisation.

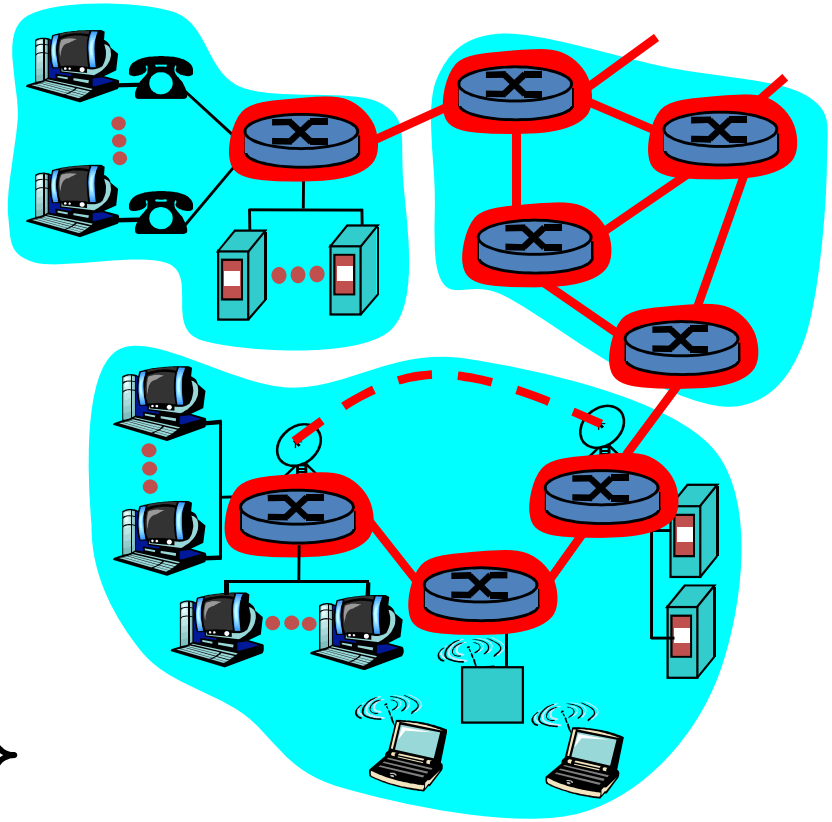
# How data travels

- Hosts connected to network router by
  - ADSL
  - Cable modem
  - Wireless
  - Ethernet
  - Cellular
- Network applications send data.
- Protocols attach information in headers and help devices talk to each other.
  - Where to send data.
  - How to send data (reliable delivery, best effort).



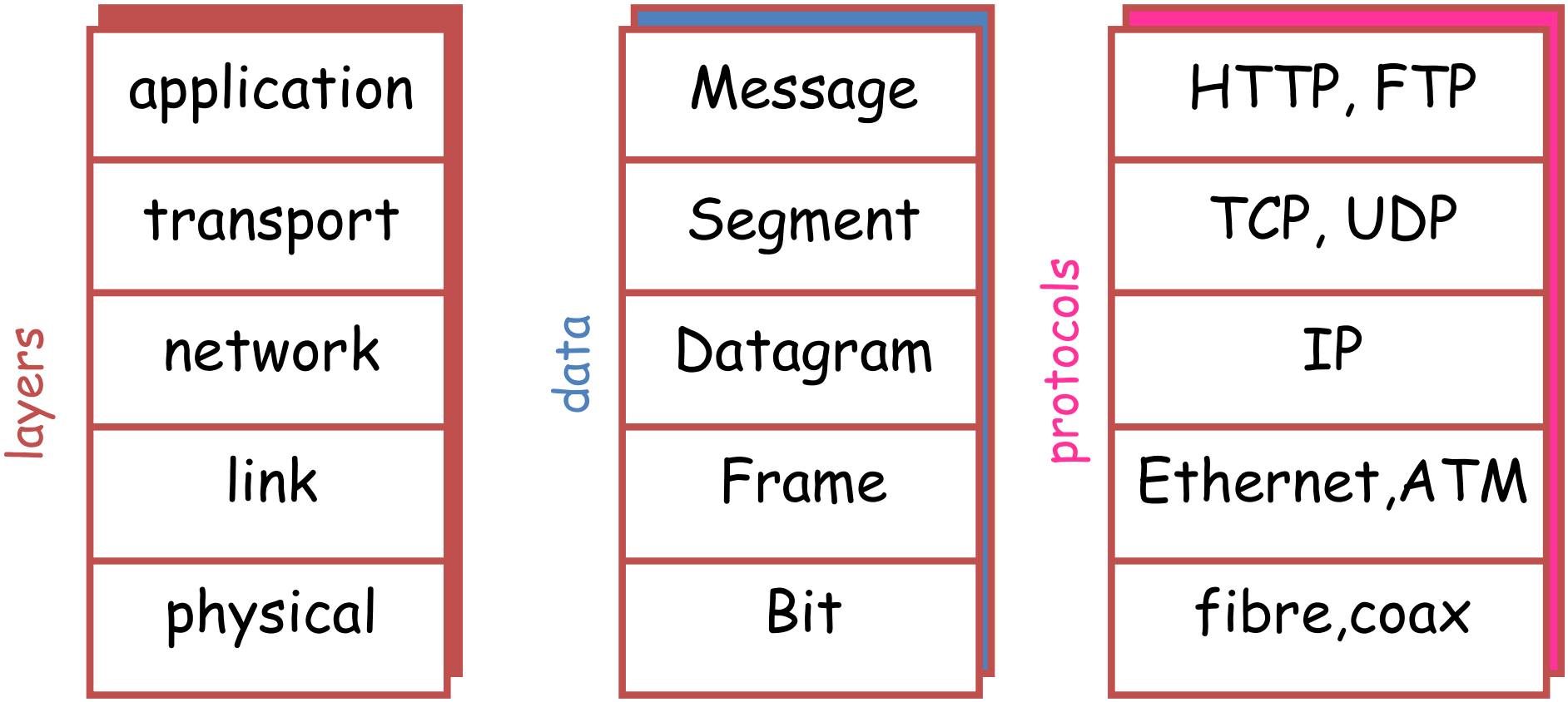
# How data travels – two models

- routing
  - circuit switching
    - **resources (bandwidth, switch) reserved. Idle when not in use**.
    - Known, guaranteed performance.
    - Must set up circuit.
  - packet switching
    - **Resources used as needed.**
    - Good for bursty traffic
    - Contention may occur.
    - Data may have to be dropped (need to deal with this!).
    - No guarantees on delays, bandwidth.

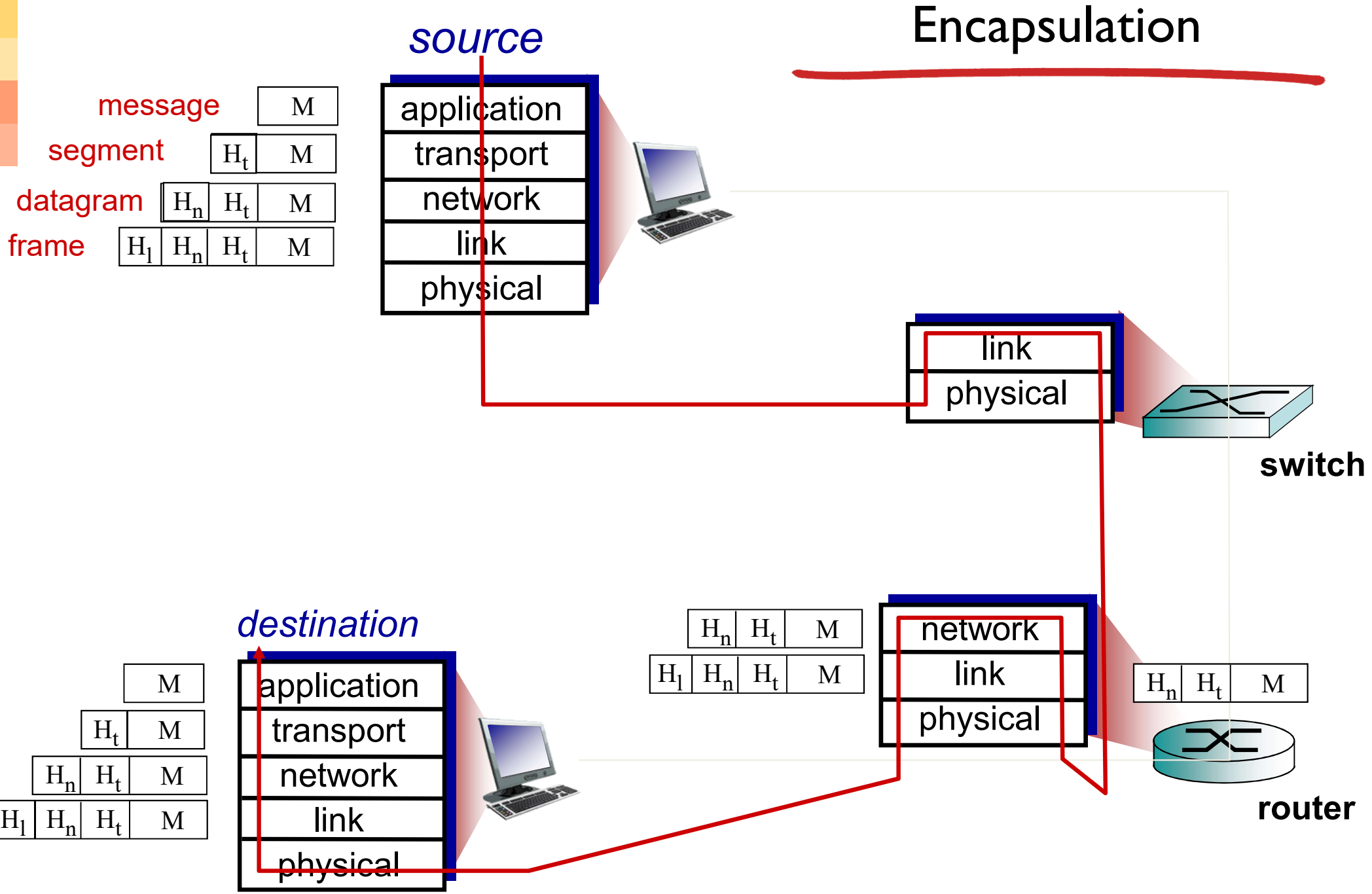


# Protocol Layers

- There is a lot going on! Can we organise it in some way?
- The layer model breaks up the various tasks into services provided by different service layers.



# Encapsulation



# Measuring Performance

- Propagation delay
- Transmission delay
- Queuing delay
- Processing delay

# Measuring Performance

- Latency and Bandwidth
  - Which offers faster data transfer a pigeon or a network?
  - http://news.bbc.co.uk/2/hi/africa/8248056.stm
  - https://www.youtube.com/watch?v=6EIKwz74Ta4

  - Propagation delay
  - Transmission delay
  - Queuing delay
  - Processing delay

- The National broadband network has potential speeds of 100 Mbps download and 40 Mbps upload. What is the smallest size USB a pigeon would need to carry on this route to match the NBN data rate in a file transfer

# A brief history of the Internet