

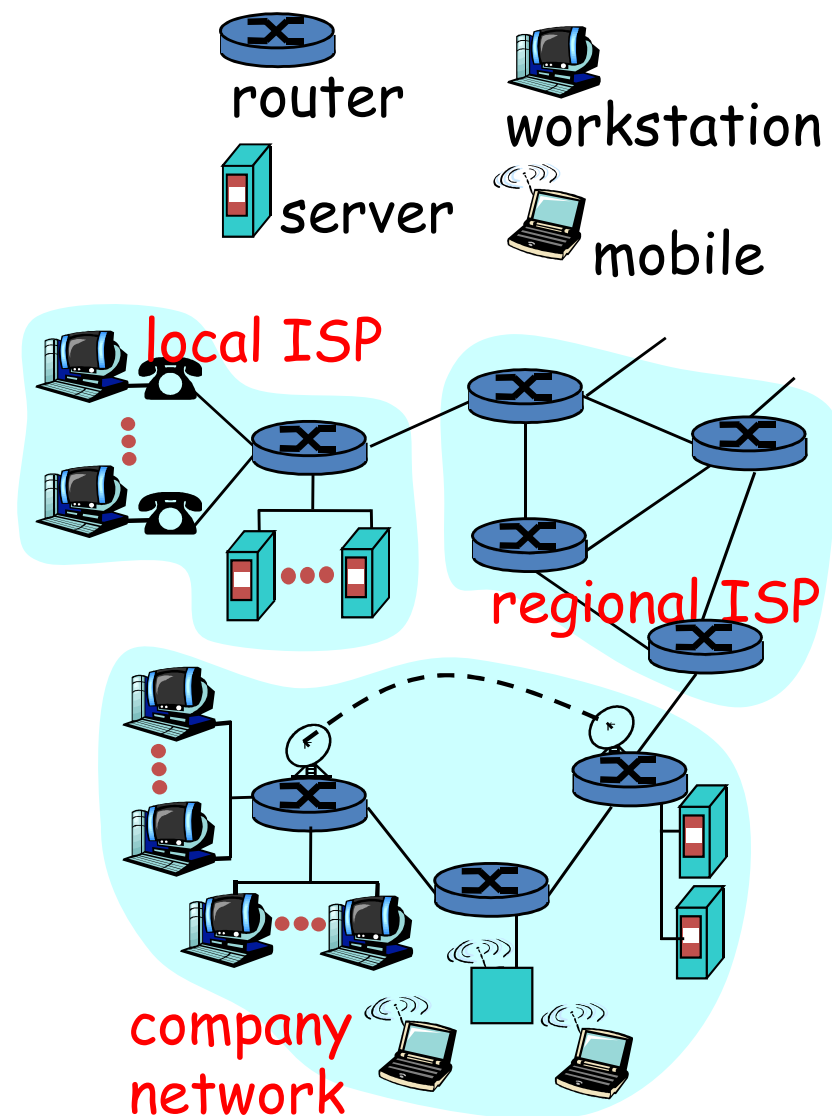
# Introduction to Networks & the Internet

- 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

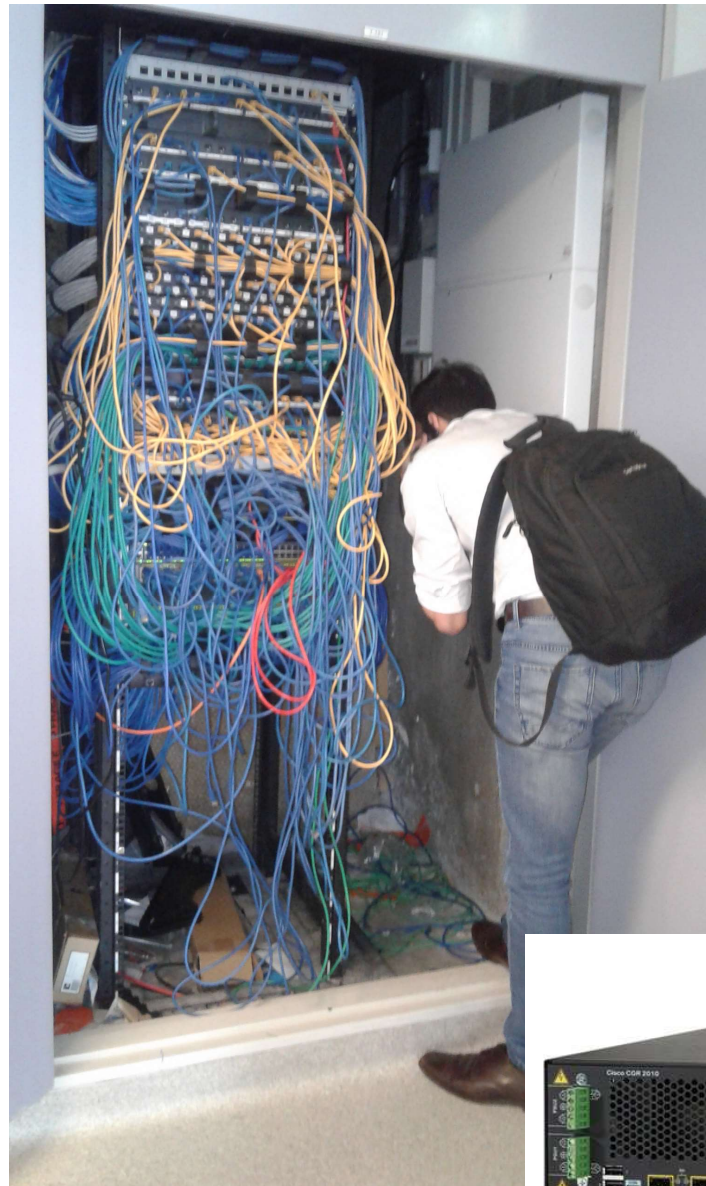
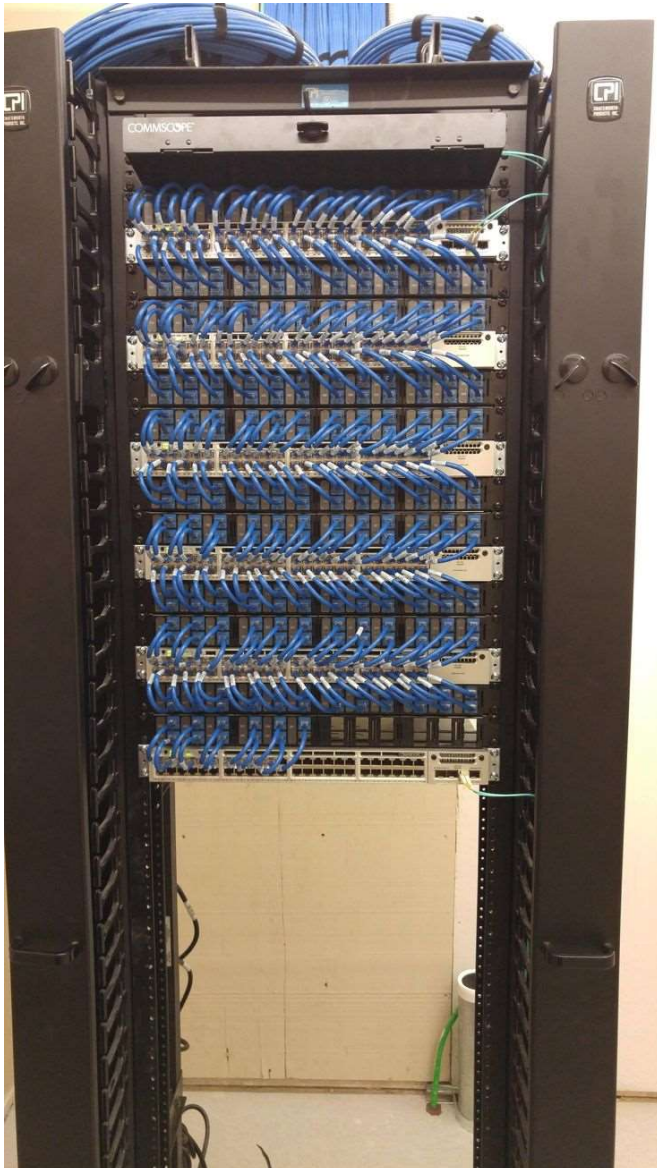
**Reading:**  
**Kurose & Ross: Ch 1**  
**extra info on website**

## 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)



# Computer Networking and Applications



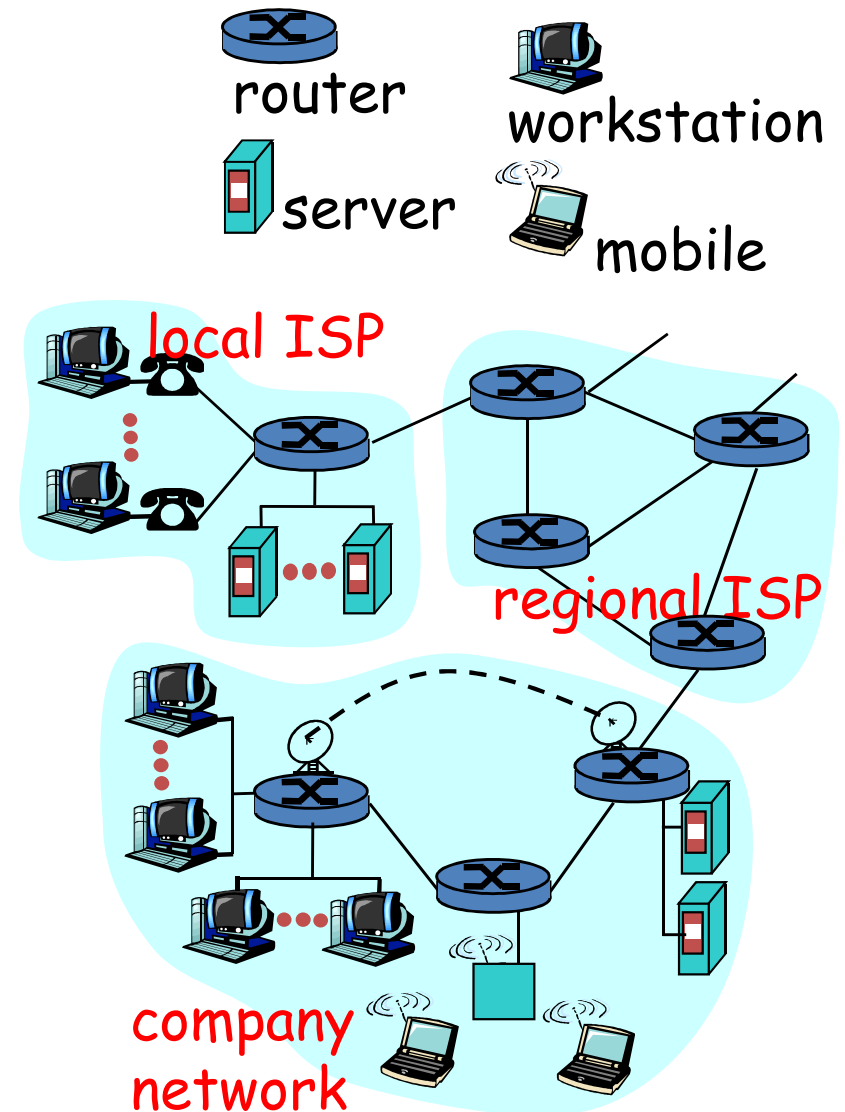
Switch



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.**

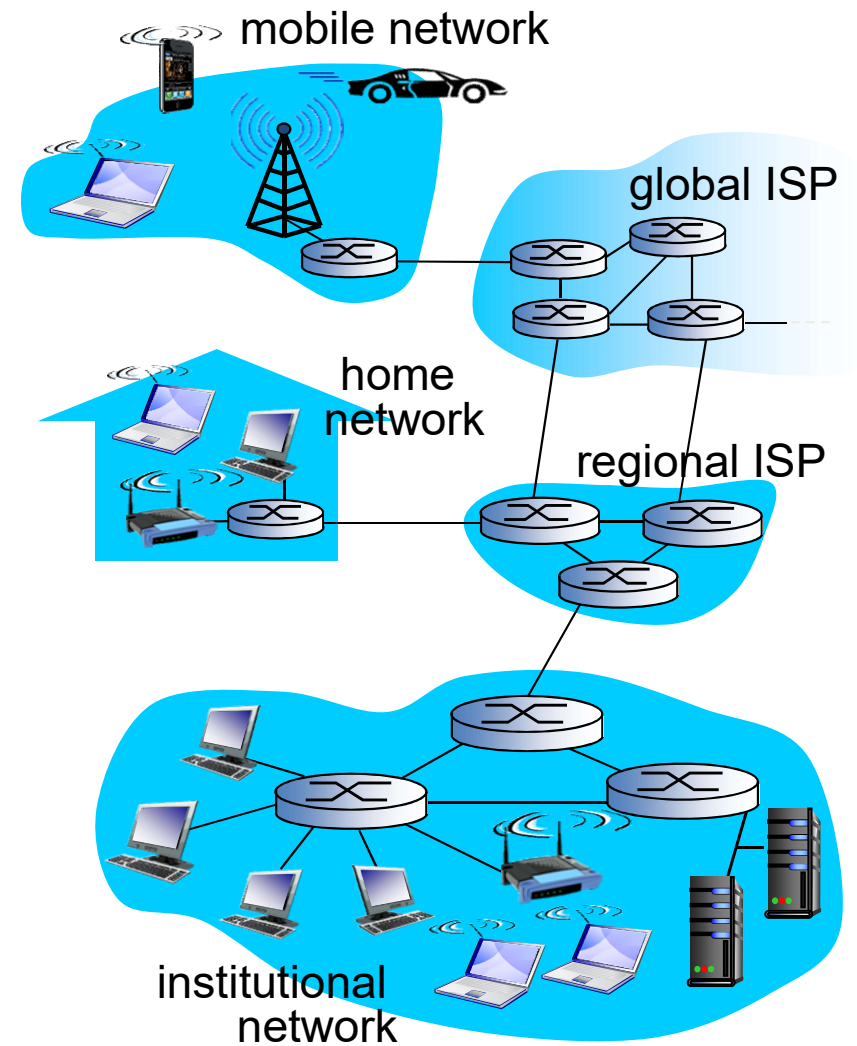


## WANs, LANs & Internets

- A **Local Area Network** is a network of geographically close computers.
  - Ethernet
  - High bandwidth (1 Mbps  $\rightarrow$  1 Gbps)
  - Low latency (mSec)
  - Low error rate ( $< 1$  in  $10^{14}$ )
  - Short geographical reach ( $< 5$ km, usually less)
  - Sometimes broadcast
- 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.
- 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  
 $K=10^3$   $M = 10^6$   $G=10^9$

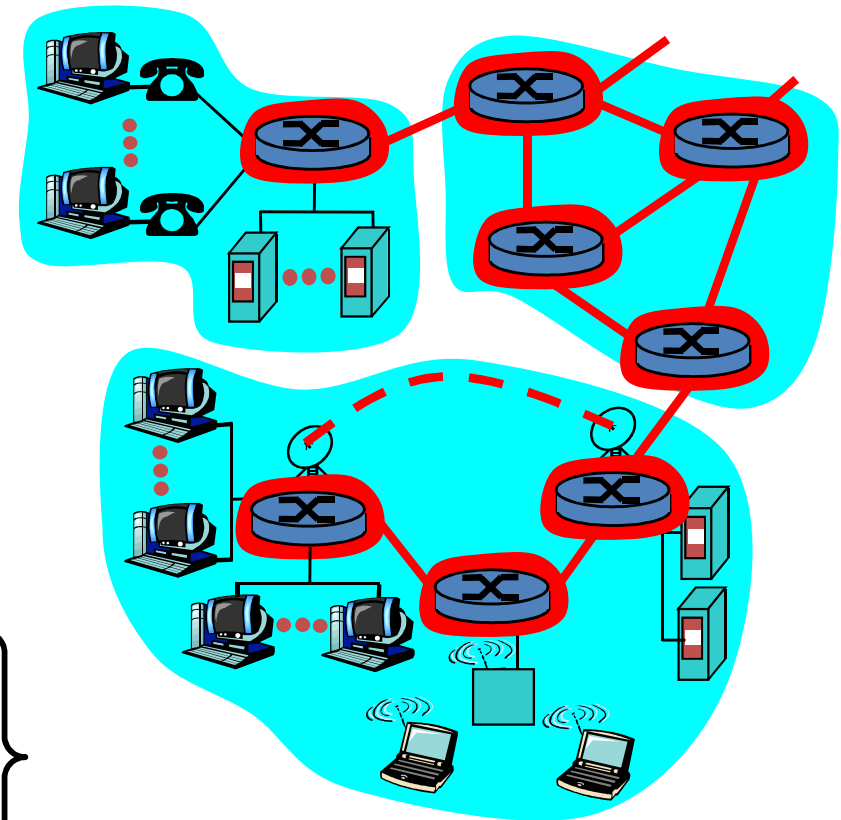
## How data travels

- 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

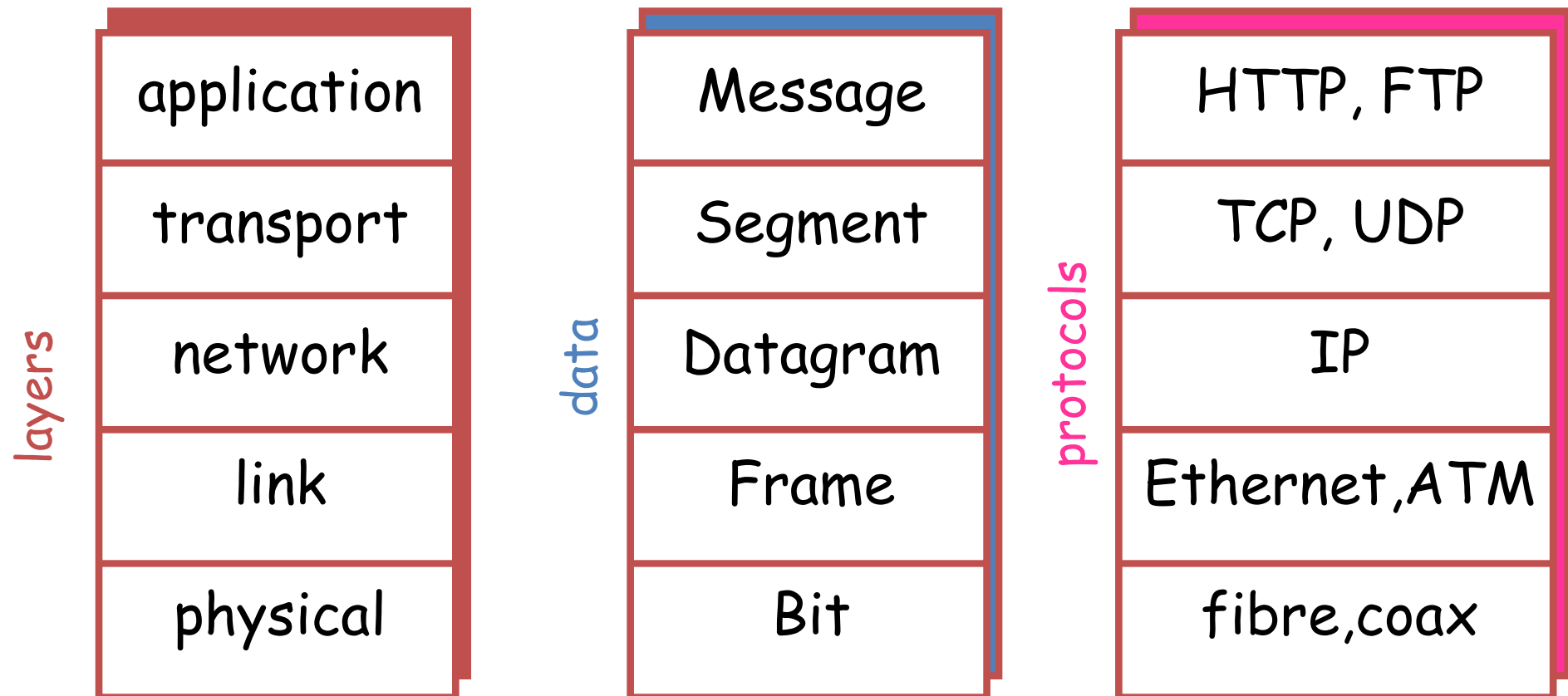
- routing
  - circuit switching
    - **resources (bandwidth, switch) reserved. Idle when not in use.**
    - Known, guaranteed performance.
    - Must set up circuit.
  - packet switching statistical multiplexing gains
    - **Resources used as needed.**
    - Good for bursty traffic
    - Contention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



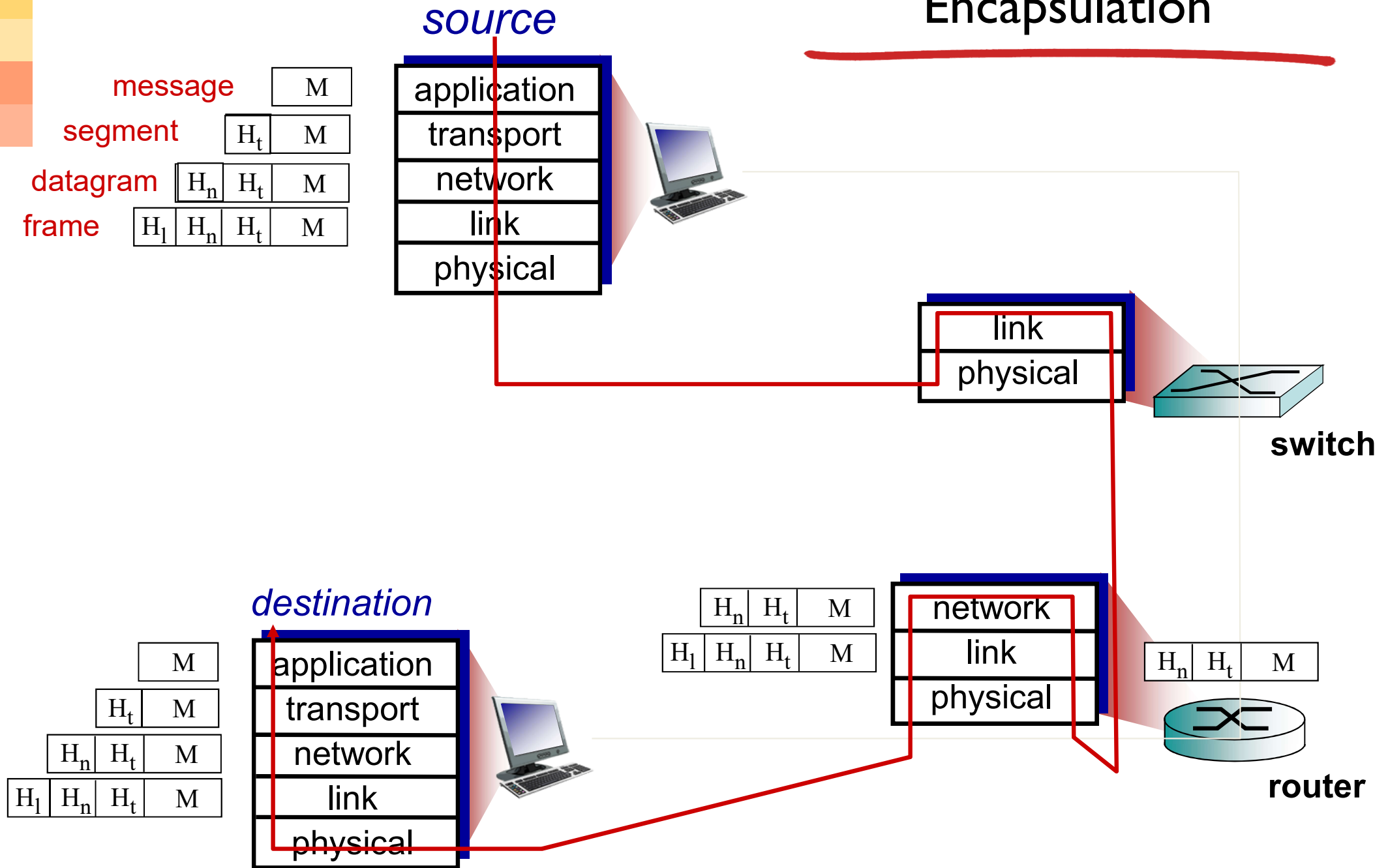


## Protocol Layers

- 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=6ElKwz74Ta4>
  - 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

1962 Paul  
Baran  
proposes  
packet  
switching

1974  
Cerf &  
Kahn  
define  
TCP/IP

1984  
Domain  
name  
system  
introduced

1990  
Australian  
Academic  
Research  
Network  
(AARNet)  
formed

1969  
DARPA  
funds  
ARPANET

1982  
TCP/IP  
adopted  
on  
ARPANET  
(Internet  
is born)

1985  
Australian  
Comp Sci  
Network  
links to  
Internet

1995  
General  
public  
'discovers'  
the Internet