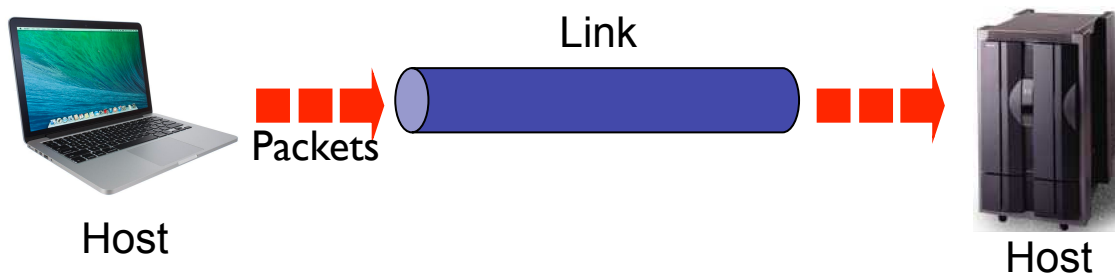


Networking Fundamentals



Network Connections

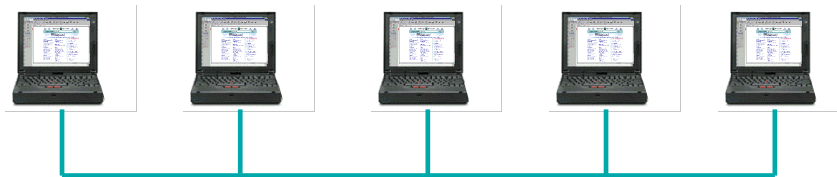


Connection Types

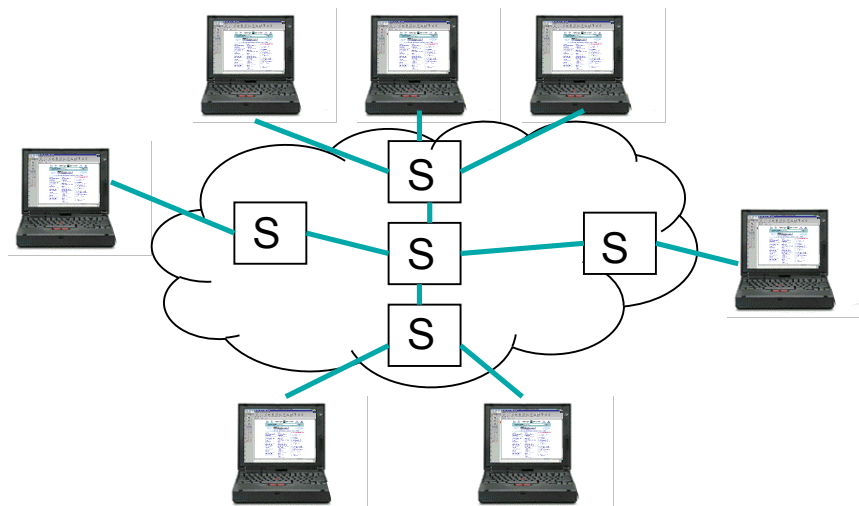
Point to Point



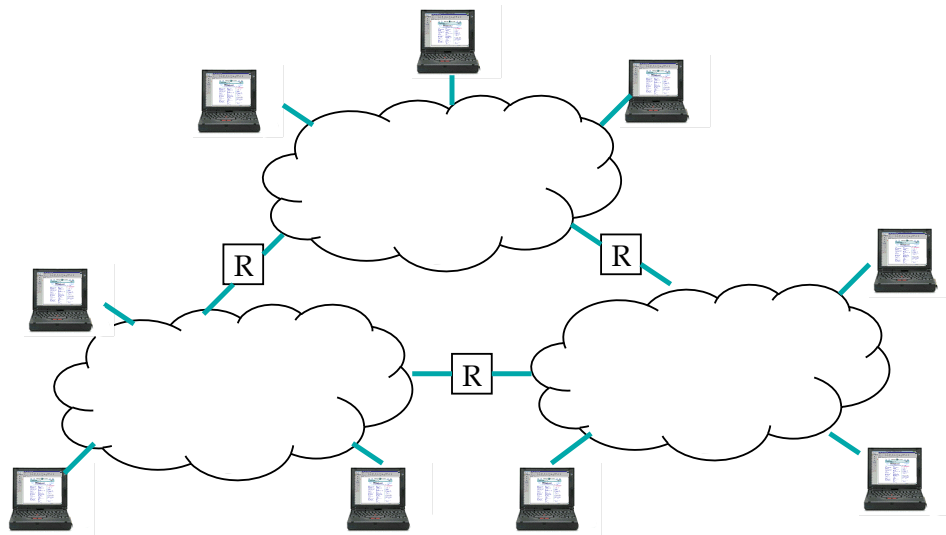
Multiple access (broadcast)



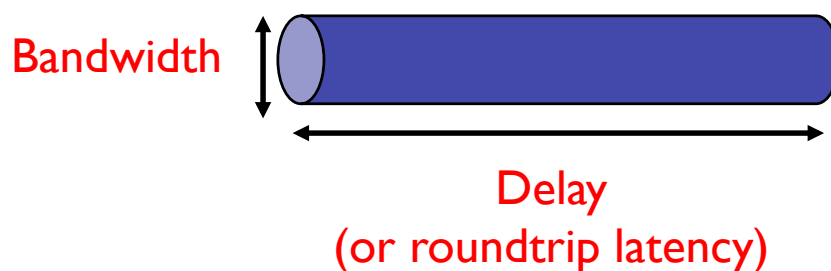
Switched Networks



Interconnection of Networks (Routers)



Network Performance



propagation delay = distance / speed of light

transmit time = message size / bandwidth

queue delay = time spent in router queues

latency = propagation + transmit + queue

Latency Examples

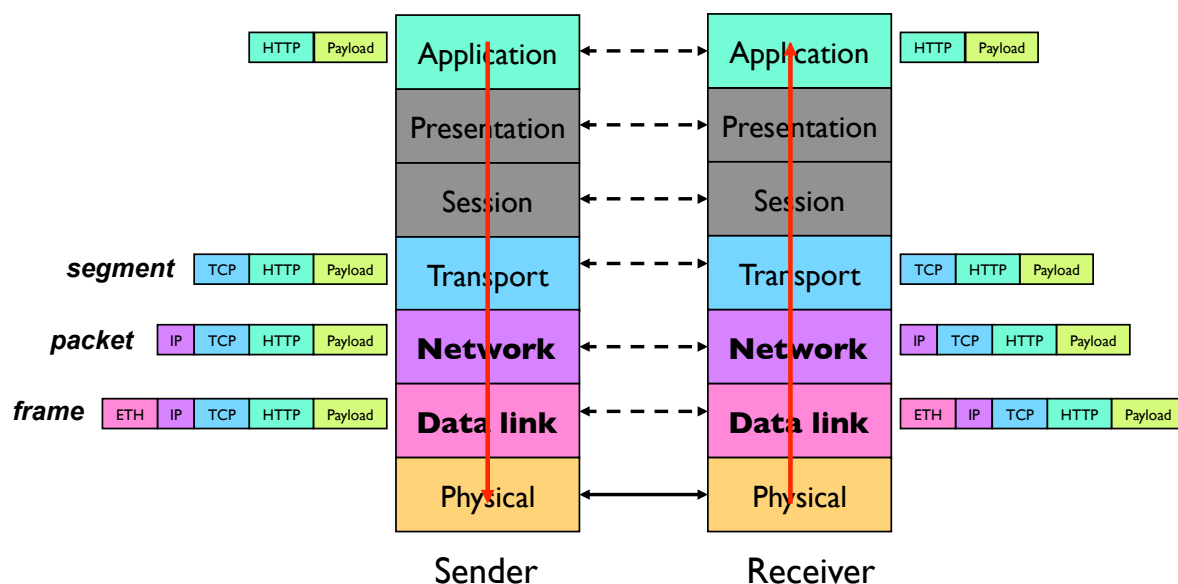
Total Latency for 1 byte object

	Prop delay: 1 ms	Prop delay: 100 ms
Bandwidth: 1 Mbps	1,008 μs	100,008 μs
Bandwidth: 100 Mbps	1,000 μs	100,000 μs

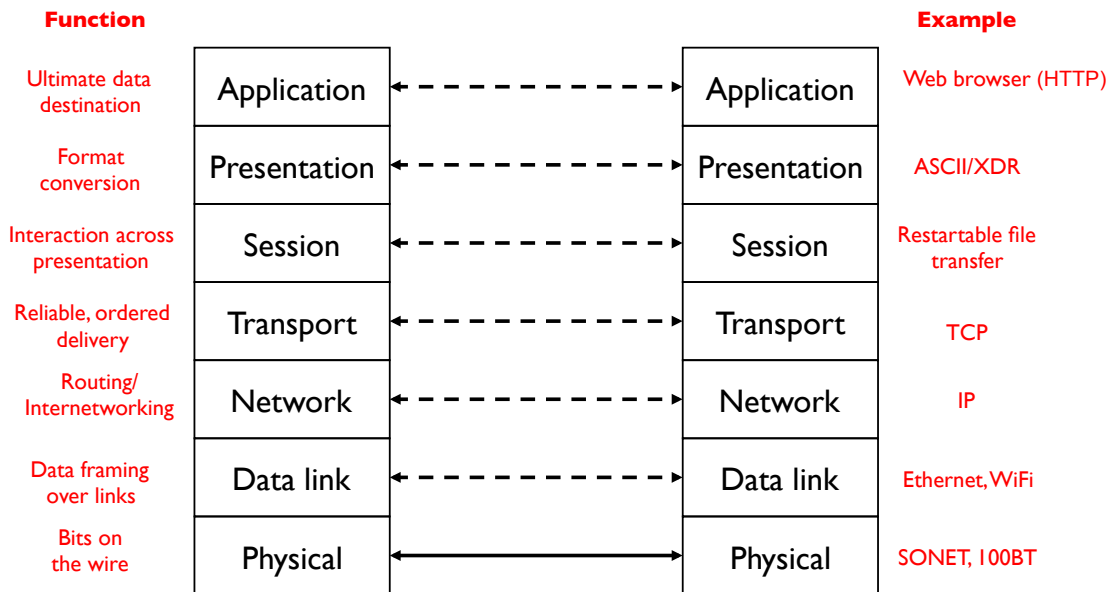
Total Latency for 10 MB object

	Prop delay: 1 ms	Prop delay: 100 ms
Bandwidth: 1 Mbps	80.001 s	80.1 s
Bandwidth: 100 Mbps	0.801 s	0.9 s

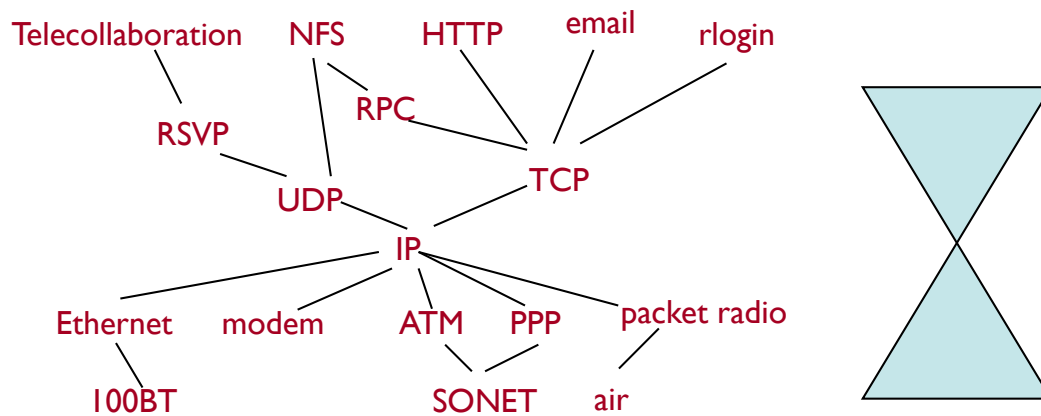
Protocol Encapsulation



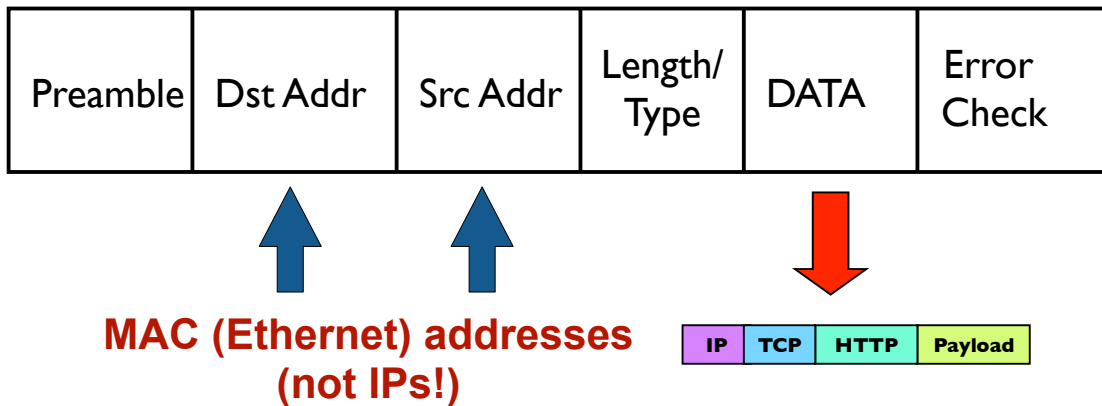
OSI Model



IP Hourglass



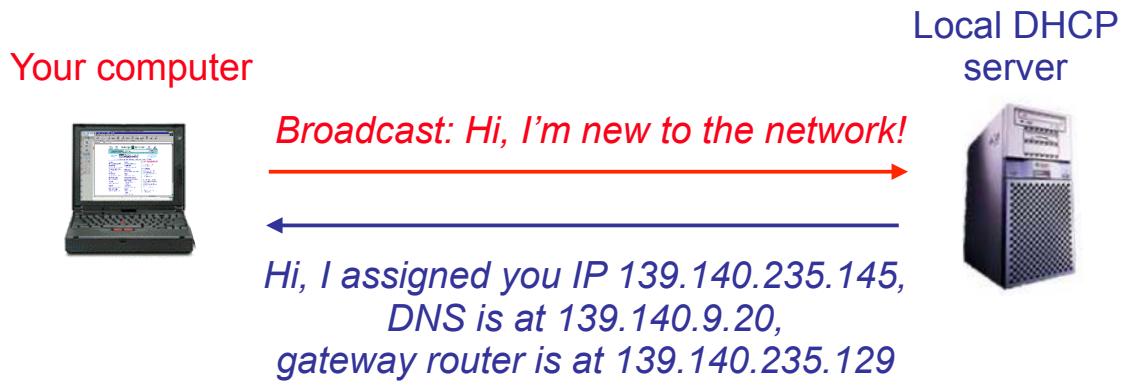
Ethernet (Data Link, Layer 2)



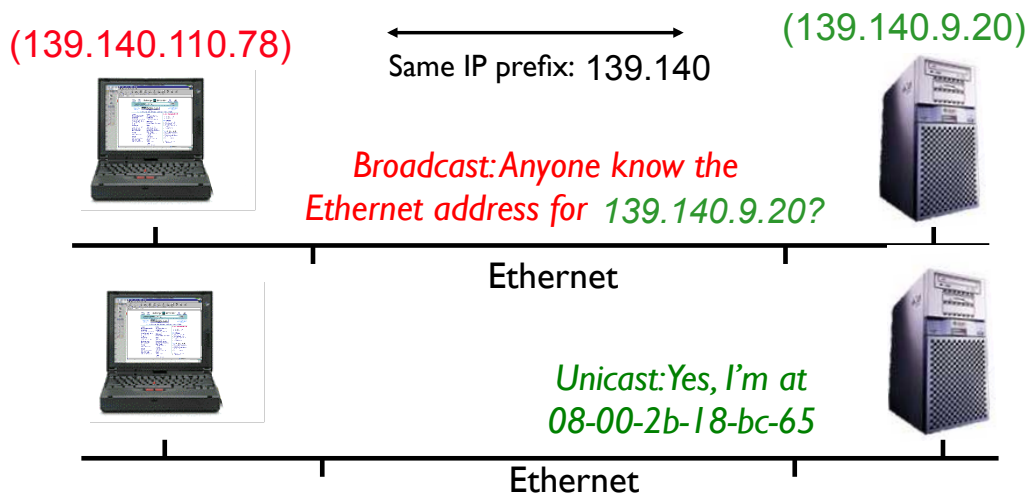
Internet Protocol (Network, Layer 3)

Version	HLen	TOS	Length		
Identification			Flags	Offset	
TTL		Protocol	Header Checksum		
Source IP Addr					
Destination IP Addr					
Options (variable)				Pad (variable)	
Data			TCP	HTTP	Payload

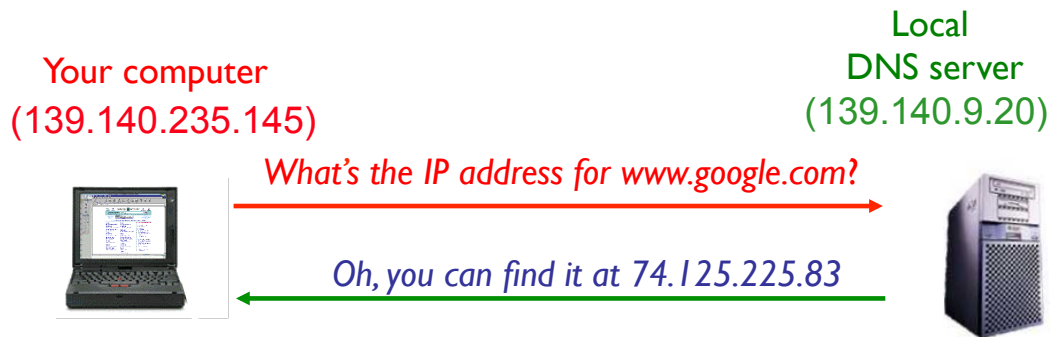
Dynamic Host Configuration Protocol (DHCP)



Address Resolution Protocol (ARP)



Domain Name System (DNS)



Routing

