

Packet Delay

CS168 and EE122 GSIs past and present

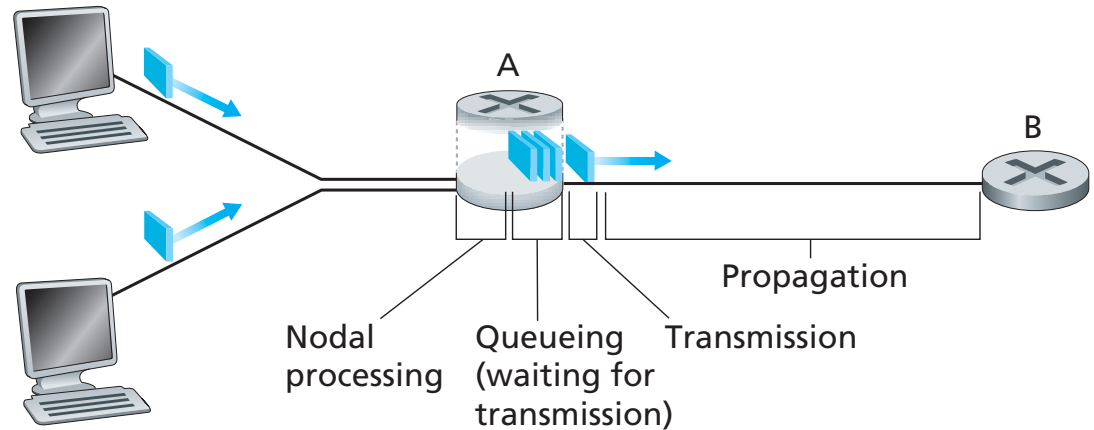
What We're Doing Today

- Review of delays
- Crash course on “virtual circuits”
- Work through worksheet in pairs

Nodal Delay

Sum of several types of delay

Processing delay
+
Queuing delay
+
Transmission delay
+
Propagation delay

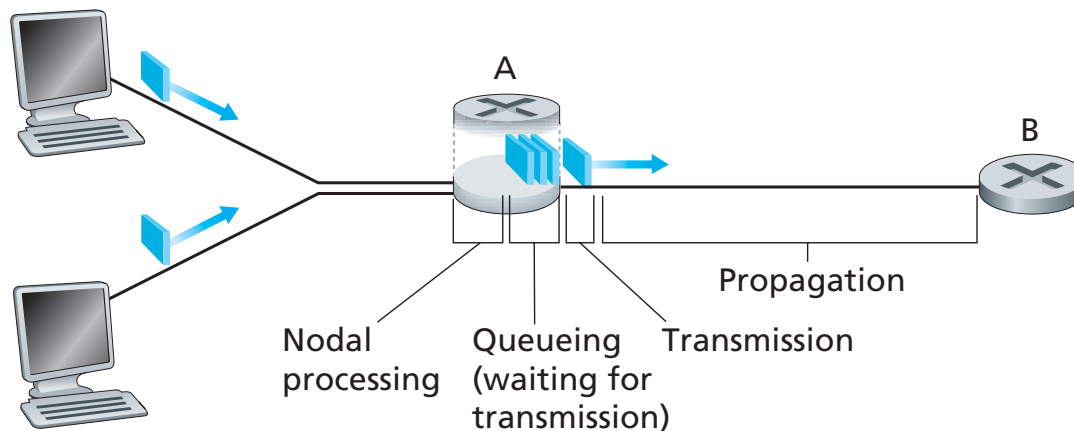


(Diagram from Kurose & Ross)

Delays

Processing Delay

- *Processing on reception*
- Examine header and determine where to send
- Error checking (maybe)

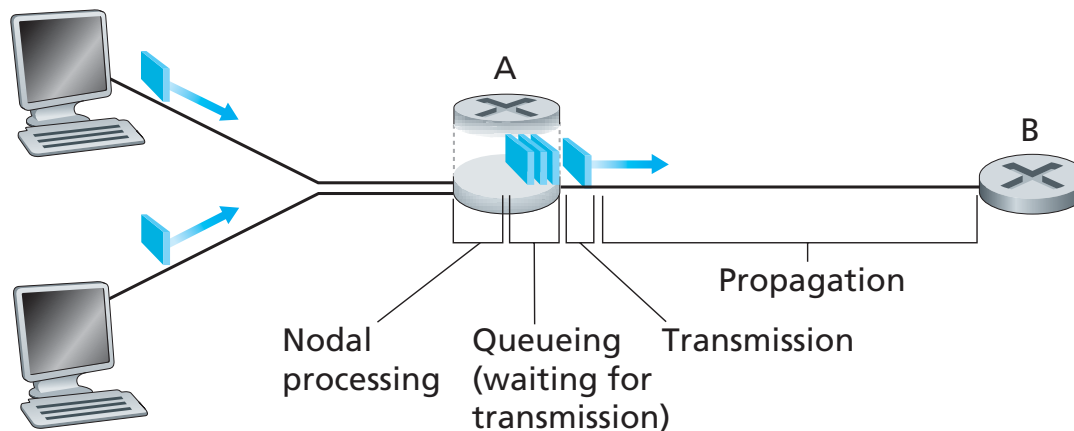


(Diagram from Kurose & Ross)

Delays

Queuing Delay

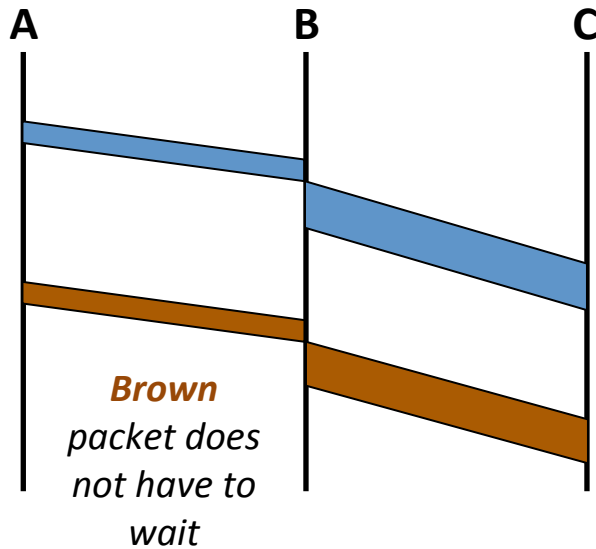
- *Time packet spends in buffer/queue*
- Only when arrival rate > service rate
- Especially significant when packet arrivals are *bursty*



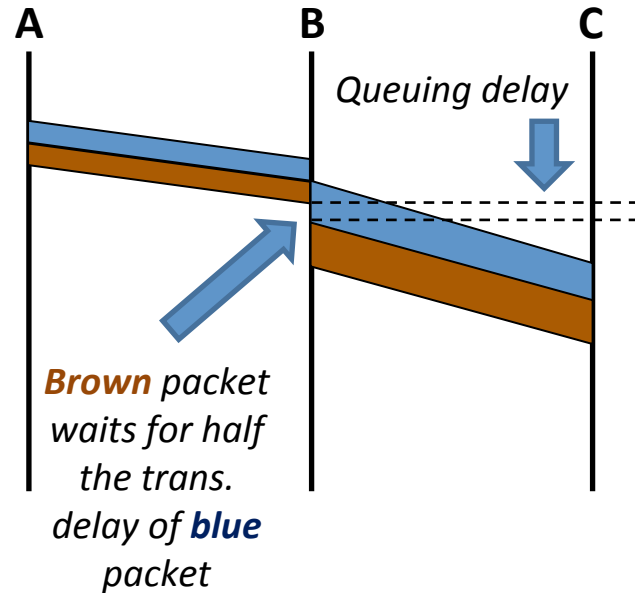
(Diagram from Kurose & Ross)

Queuing Delay

Queuing Delay: No

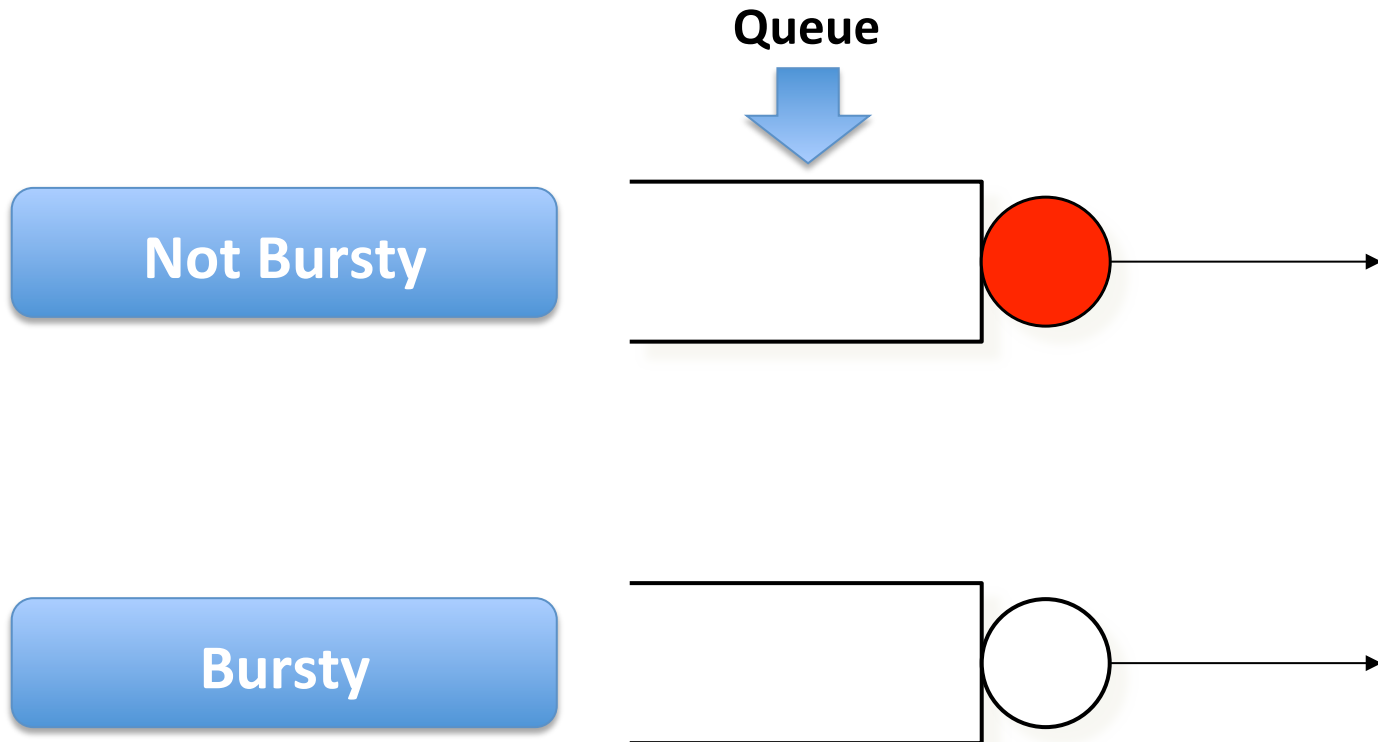


Queuing Delay: Yes



BC's transmission delay is twice that of AB

Sidenote: Burstiness



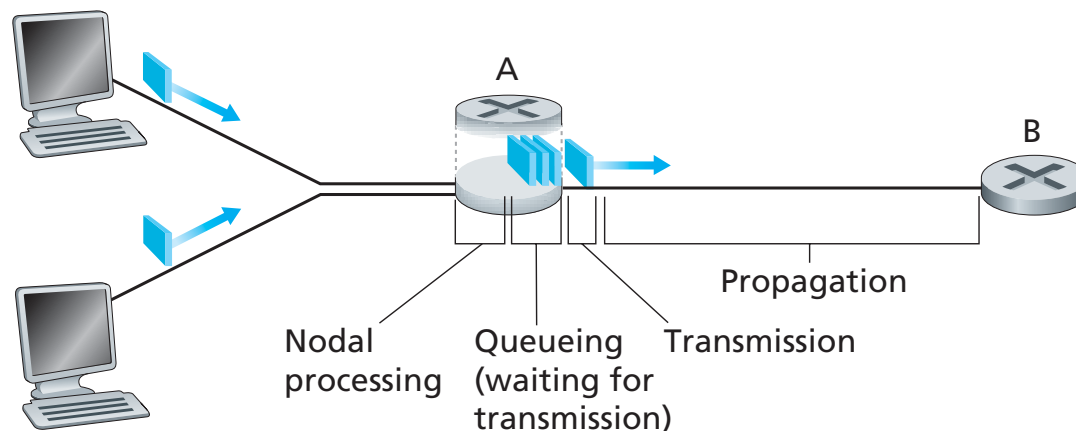
Delays

Transmission Delay

- *Time taken to push data onto link*
- Measured...
 - .. from when first bit of data pushed onto link
 - .. until last bit of data is pushed onto the link
- Limited by the link **Bandwidth**

Propagation Delay

- *Time taken by data to traverse link*
- Limited by the speed of light
- **Latency** of a link is the propagation delay to traverse the link

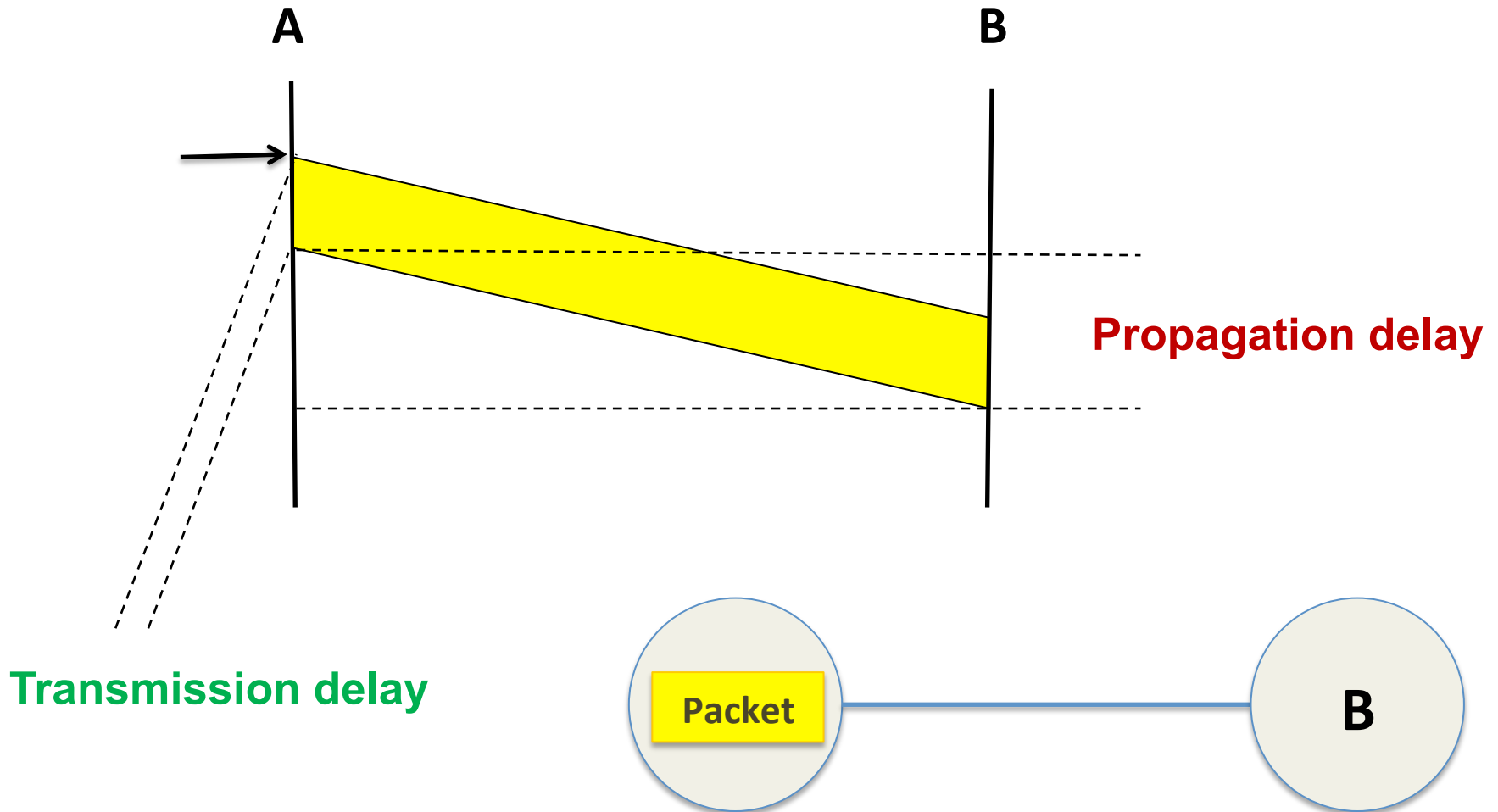


(Diagram from Kurose & Ross)

Transmission & Propagation

- How fast is my speech?
 - ~1000 ft/s (speed of sound)
 - ~125 words/minute
- What about Sean Shannon?
 - ~1000 ft/s (speed of sound)
 - ~655 words/minute
- How long would it take:
 - to hear me or Sean, if we shout “Help” (very loudly) from Stanford? (~40 miles [~200,000 feet] away)
 - me or Sean to dictate *War and Peace*? (~600,000 words)

Transmission & Propagation

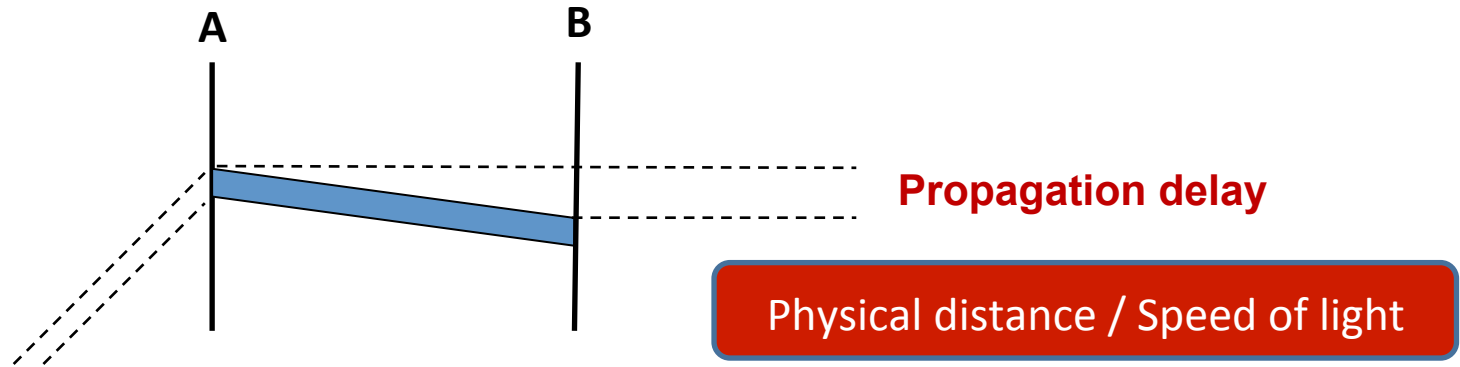


Beyond Nodal Delays

- End-to-End Delay
 - Just the sum of the nodal delays along a path
- Round Trip Time (RTT)
 - Time for packet to reach destination
 - .. and for response to return to source

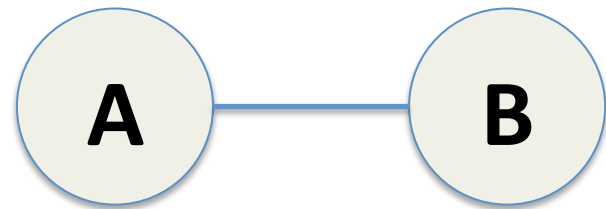


TL;DR Delays



Transmission delay

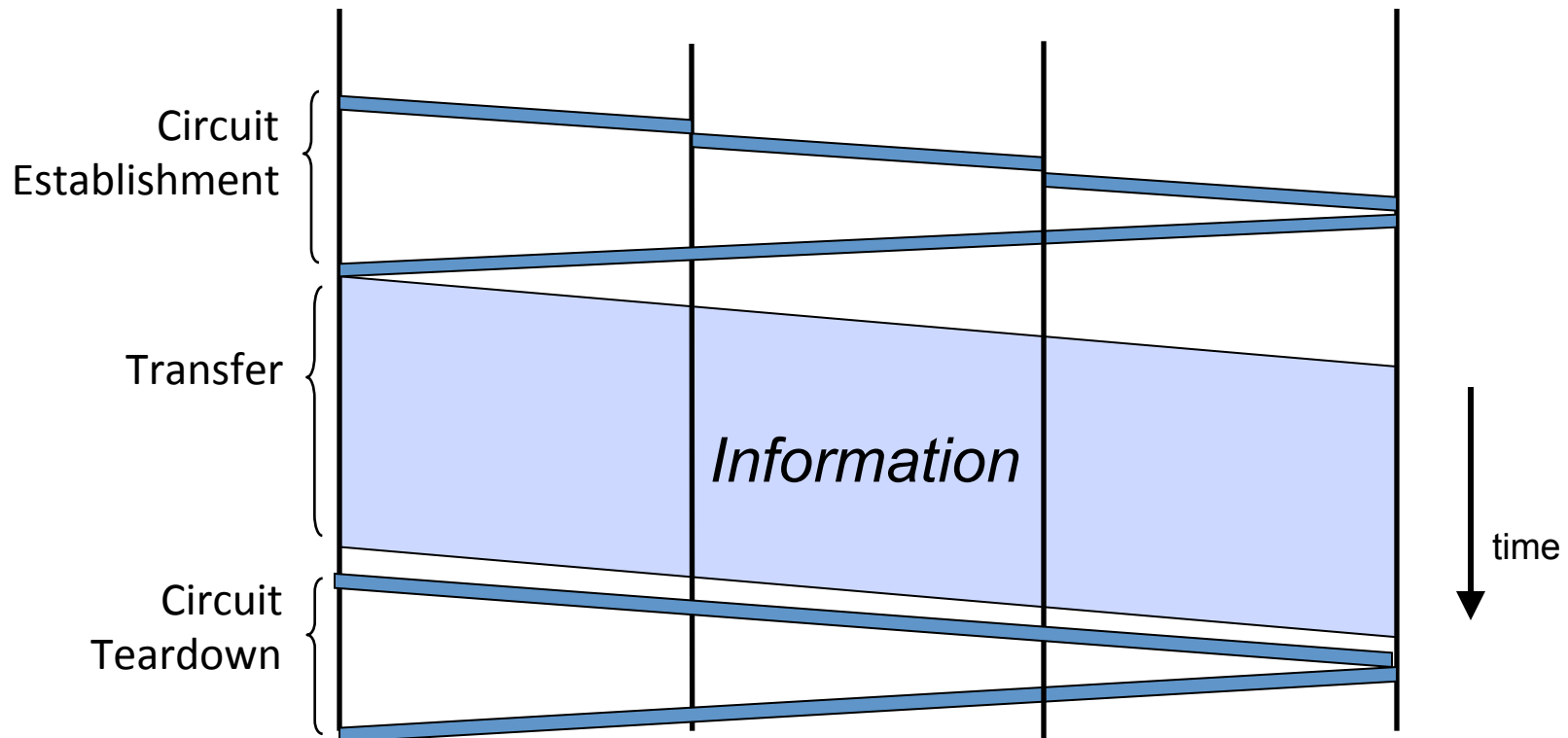
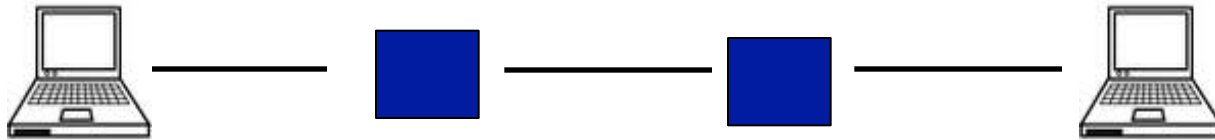
Size of transfer / Bandwidth of link



Virtual Circuits

- Covered more in section 4.2 of text
 - which you may not have read yet!
- With what you got in lecture and from section 1.3.2, here's what you need to know for the worksheet...
- Basic idea:
 - Make a packet switched network a bit more like a circuit switched network
 - How?

Virtual Circuits



(From lecture)

Virtual Circuits

- Circuit Establishment
 - Source sends a setup packet to switches along path/circuit toward destination
 - Switches along path set up connection
 - At end of path, destination sends confirmation back
- Transfer
 - Data sent along path/circuit
 - Note: Data sent along established circuit is cut-through!
 - Question: What is the transmission rate of the circuit?
- Circuit Teardown
 - Source sends teardown packet along path
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WORKSHEET!

1 Mbps = 10^6 bits per second

1 ms = 10^{-3} seconds

Speed of light (c) = $3 \cdot 10^5$ km/second

