

Data Link Layer: Sliding Window Protocols

Kameswari Chebrolu

All the figures used as part of the slides are either self created or from the public domain with either 'creative commons' or 'public domain dedication' licensing. The public sites from which some of the figures have been picked include:

<http://commons.wikimedia.org> (Wikipedia, Wikimedia and workbooks); <http://www.sxc.hu> and <http://www.pixabay.com>

Experience

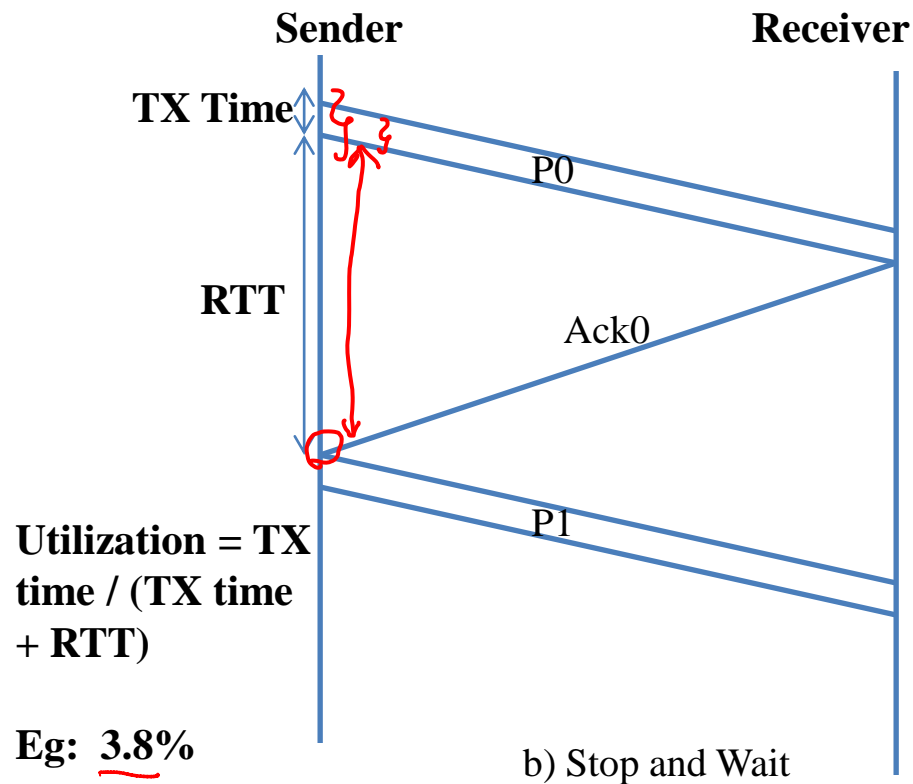
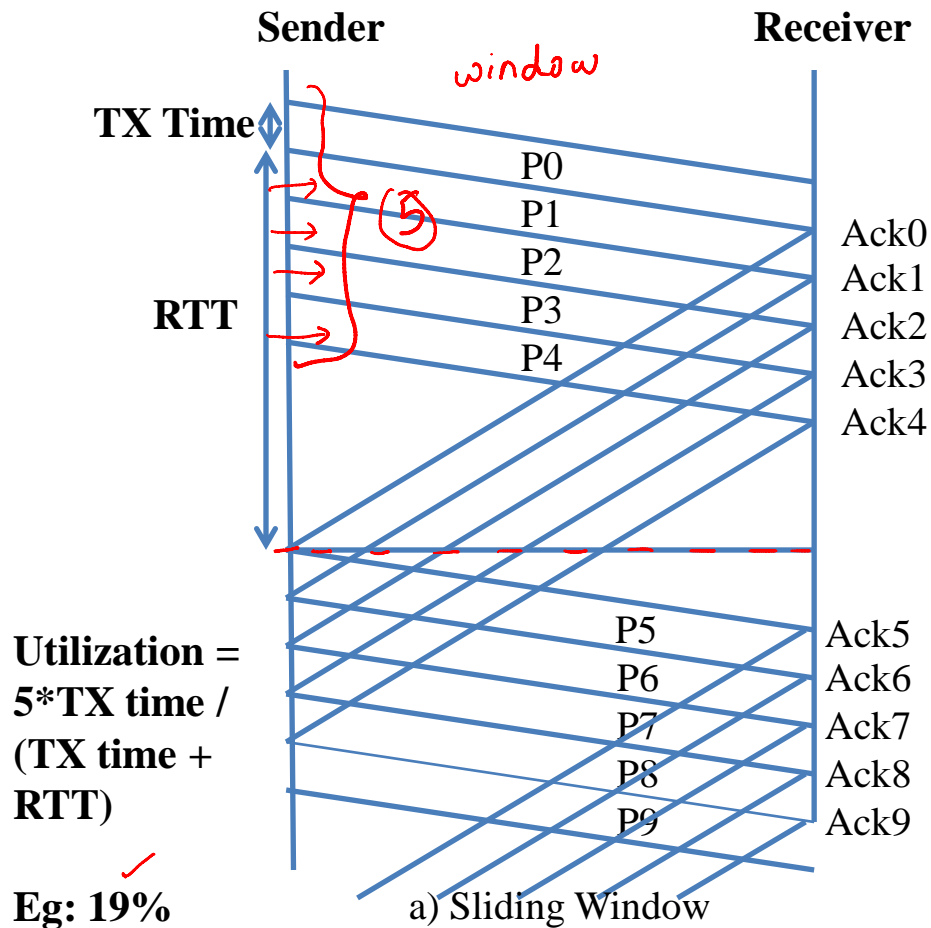
A man who carries a cat by the tail learns something he can learn in no other way.

-- Mark Twain

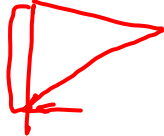
Recap

- Incrementally built the framework for a Reliable Data Transfer (RDT) protocol
 - Required Functionality
 - Stop and Wait Protocol: Works correctly but performance is poor
- Sliding Window Protocols: Can improve performance considerably

General Idea



Bandwidth-Delay Product

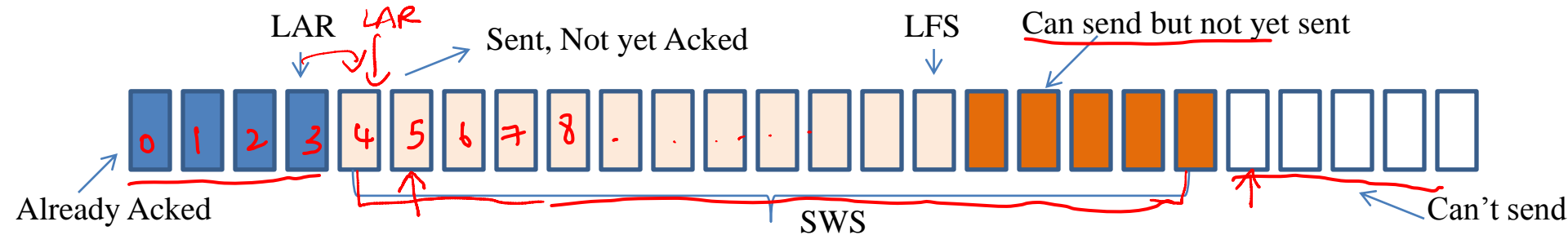
- Sender can send a maximum of W packets (window size) without waiting for an ACK
- What can the window size be?
 - To keep utilization maximum, sender can send ‘roughly’ upto Data-Rate*RTT before hearing an ack
 - Window size = Bandwidth * RTT bits
 - Divide by packet size to get the number of packets

Sliding Window

- At any given time, no more than W packets can be outstanding (their status not known at sender)
- As status of packets gets known at sender, the window of sequence number slides to encompass newer sequence numbers
 - Permits sender to send subsequent packets

Sender Side

- Assign a sequence number to each frame
- Maintain 3 variables:
 - Send Window Size (SWS): upper bound on number of outstanding frames
 - LAR: Seq. No of Last Acknowledgment Received; Advance LAR when ACK arrives
 - LFS: Sequence number of Last Frame Sent
- Maintain Invariant: $LFS - LAR \leq SWS$



Receiver Side

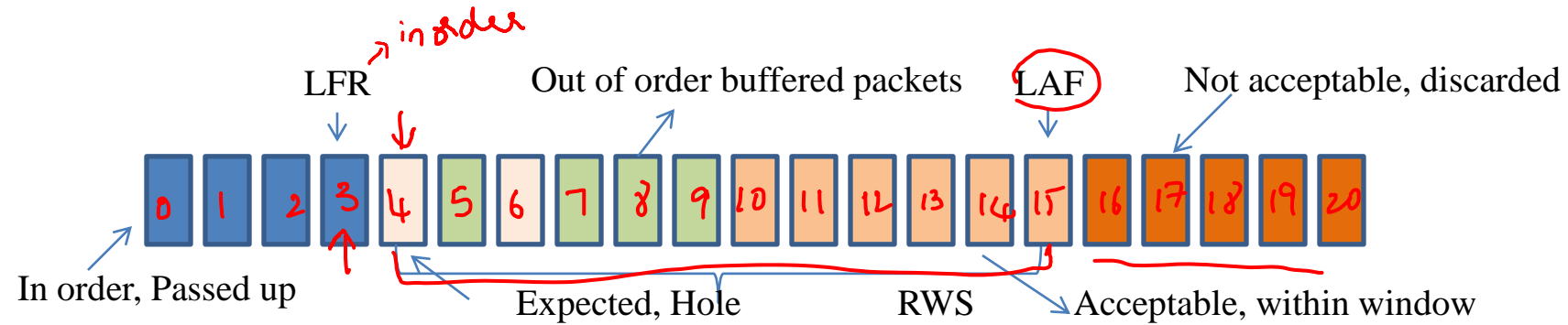
- Maintains the following three variables

- Received Window Size (RWS): upper bound on the number of out of order frames
- LAF denotes sequence number of last acceptable frame
- LFR denotes sequence number of last frame received

$RWS > SWS$?
 $RWS \leq SWS$
 $RWS = 1$?

Receiver accept only in order packets

- Set $LAF = LFR + RWS$



Consequences

$w=1$

- Need a range of sequence numbers (two won't suffice)
- Sender has to buffer more than one frame (buffer all transmitted but not yet acked)
- Receiver may also have to buffer (out of order frames) $rws \leq sws$
- Range of protocols based on sliding window
 - Go Back N, Selective Repeat, TCP
 - Actions taken on events (like frame/ack rcvd, duplicate ack, timeout etc) differ