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CS455 Data Communications
Homework #4
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1. A series of information frames with a mean length of 1440bits is to be transmitted across the following data links using an idle RQ protocol. If the velocity of propagation of the links is 2x108 ms-1, determine the link efficiency (utilization) for each type of link.

$$T_{ix} = \frac{N(bitsInFrame)}{R(bitrateBPS)} \qquad T_p = \frac{S(meters)}{V(velocity)} \qquad U = \frac{1}{1+\frac{2*T_p}{T_{ix}}}$$

(i) a 40 km link with negligible transmission errors and a data transmission rate of 9600 bps

$$T_{ix} = \frac{1440bits}{9600bps} = 0.15 \qquad T_p = \frac{40*10^3 m}{2*10^8 \frac{m}{\sec}} = 0.0002 \qquad U = \frac{1}{1+\frac{2*0.0002}{0.15}} = 0.9973$$

(ii) a 1200m link with negligible transmission errors and a data transmission rate of 10 Mbps.

$$T_{ix} = \frac{1440bits}{10*10^6 bps} = 0.0000144 \qquad T_p = \frac{1200m}{2*10^8 \frac{m}{\sec}} = 0.000006 \qquad U = \frac{1}{1+\frac{2*0.0000144}{0.000006}} = 0.1724$$

2. With the aid of frame sequence diagrams, describe the difference between an idle RQ and a continuous RQ error control procedure. For clarity, assume that no frames are corrupted during transmission.

In idle RQ, each frame waits for the acknowledgement of the previous frame before transmitting. Once the primary sends a frame, a timer is started. When the secondary receives a frame, it sends an acknowledgement of the frame back to the primary. When the primary receives the frame acknowledgement, the timer is stopped and the next frame is sent out. If either a frame or acknowledgement is lost or a timer has elapsed, that frame is retransmitted and the wait for acknowledgement continues. See figure 1 for an example of idle RQ data transmission.

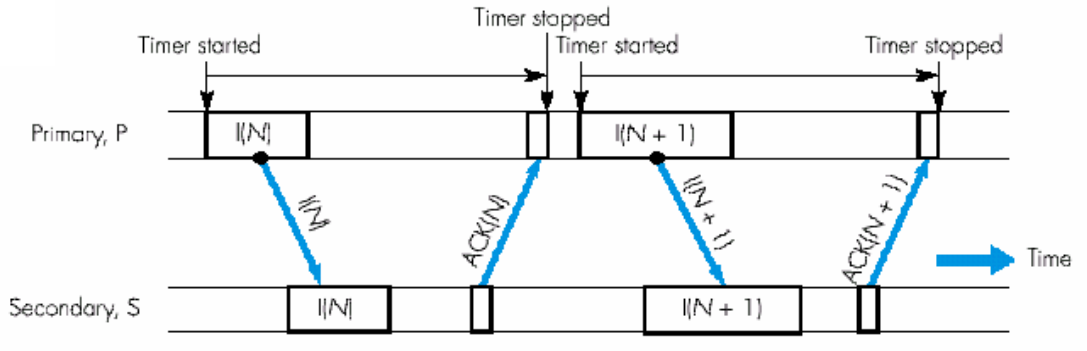

Figure 1: Idle RQ

In continuous RQ, the primary sends I-frames without waiting for acknowledgements from the secondary and stores a copy of the frames sent in a retransmission list. When the secondary receives a frame, it sends out an acknowledgement. If a frame is received out of sequence, the secondary puts the frame into a receive list until the sequence is re-established. If the receive list is filled before the sequence is returned, a frame un-acknowledgement is sent back to the primary. The primary then has two options to retransmit depending on the retransmission strategy: Selective Repeat and Go-Back-N. With Selective Repeat, only frames with errors are retransmitted. With Go-Back-N, all unacknowledged frames going back to the last correctly acknowledged frame is retransmitted. See figure 2 for an example of continuous RQ data transmission.

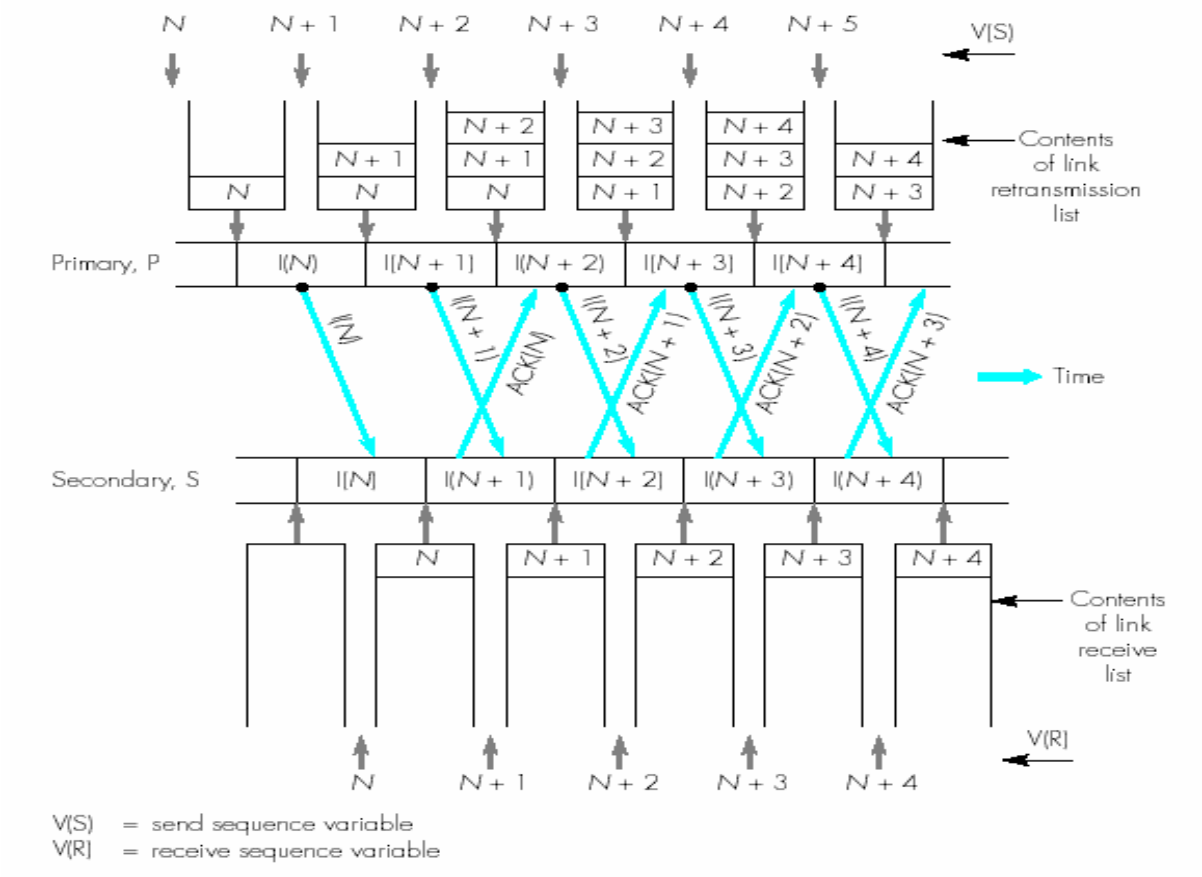

Figure 2: Continuous RQ

3. Discriminate between the send window and receive window for a link and how they are related with:

The send window has a size of K determined by a function of the maximum frame size, available buffer storage, link propagation delay, or transmission bit rate. The send window is kept on the primary side and keeps a list of sent frames. The receive window has a size determined by the number of frame buffers required at the secondary. The receive window is stored on the secondary side and keeps track of received frames.

(i) a selective repeat retransmission scheme,

Selective repeat has a send window of K, and a receive window of K. The receive window is of size K to cope with out-of-order frames. Unlike go-back-N control, if a frame is received out-of-order, the frame is stored in the receive window in the location it is expected in. The frame window control will not adjust until the missing frame is received, but the secondary will not discard the frames that fit within the receive window reducing the need to retransmit frames.

(ii) a go-back-N control scheme.

Go-Back-N has a send window of K, but a receive window of only 1. Go-Back-N needs a frame of only one because it will discard all frames that are not in sequence. If frame 0 is received, the secondary will expect the next frame to be sent being frame 1. If any other frame other than frame 1 is received, the secondary will discard that frame and wait for frame 1. The secondary will not continue until frame 1 is received. This is go-back-N because the primary will have to resend all frames that discarded back to the last correctly acknowledged frame.