3. SELECTIVE REPEAT ARQ

Go-Back-N ARQ simplifies the process at the receiver site. The receiver keeps3 track of only one variable, and there is no need to buffer out-of-order frames; they are simply discarded. However, this protocol is very inefficient for a noisy link. In a noisy link a frame has a higher probability of damage, which means the resending of multiple frames. This resending uses up the bandwidth and slows down the transmission. For noisy links, there is another mechanism that does not resend N frames when just one frame is damaged; only the damaged frame is resent. This mechanism is called Selective Repeat ARQ. It is more efficient for noisy links, but the processing at the receiver is more complex.

Sender and Receiver Windows

The configuration of the sender and its control variables for Selective Repeat ARQ is the same as those for Go-Back-N ARQ. But the size of the window should be at most one-half of the value 2^m. The receiver window size must also be this size. This window, however, specifies the range of the accepted received frame. In other words, in Go-Back-N, the receiver is looking for one specific sequence number; in Selective Repeat, the receiver is looking for a range of sequence numbers. The receiver has two control variables R_F and R_L to define the boundaries of the window. Figure 12 shows the sender and receiver windows.

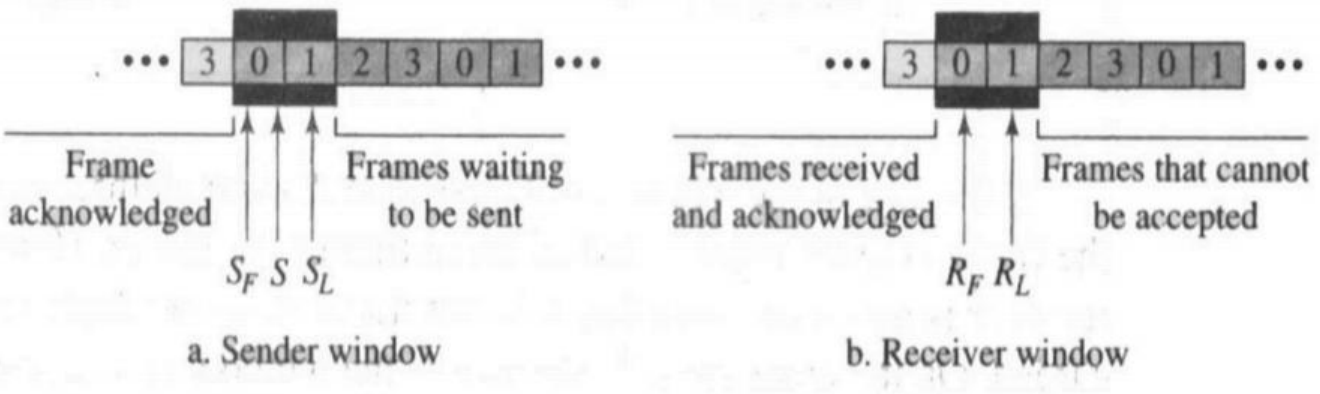

Figure 12 Selective Repeat ARQ, sender and receiver windows

Selective Repeat ARQ also defines a negative acknowledgment (NAK) that reports the sequence number of a damaged frame before the timer expires.

Operation

Figure 13 show the operation of the mechanism of Selective Repeat ARQ with an example of a lost frame.

Frames 0 and I are accepted when received because they are in the range specified by the receiver window. When frame 3 is received, it is also accepted for the same reason. However, the receiver sends a NAK 2 to show that frame 2 has not been received. When the sender receives the NAK 2, it resends only frame 2, which is then accepted because it is in the range of the window.

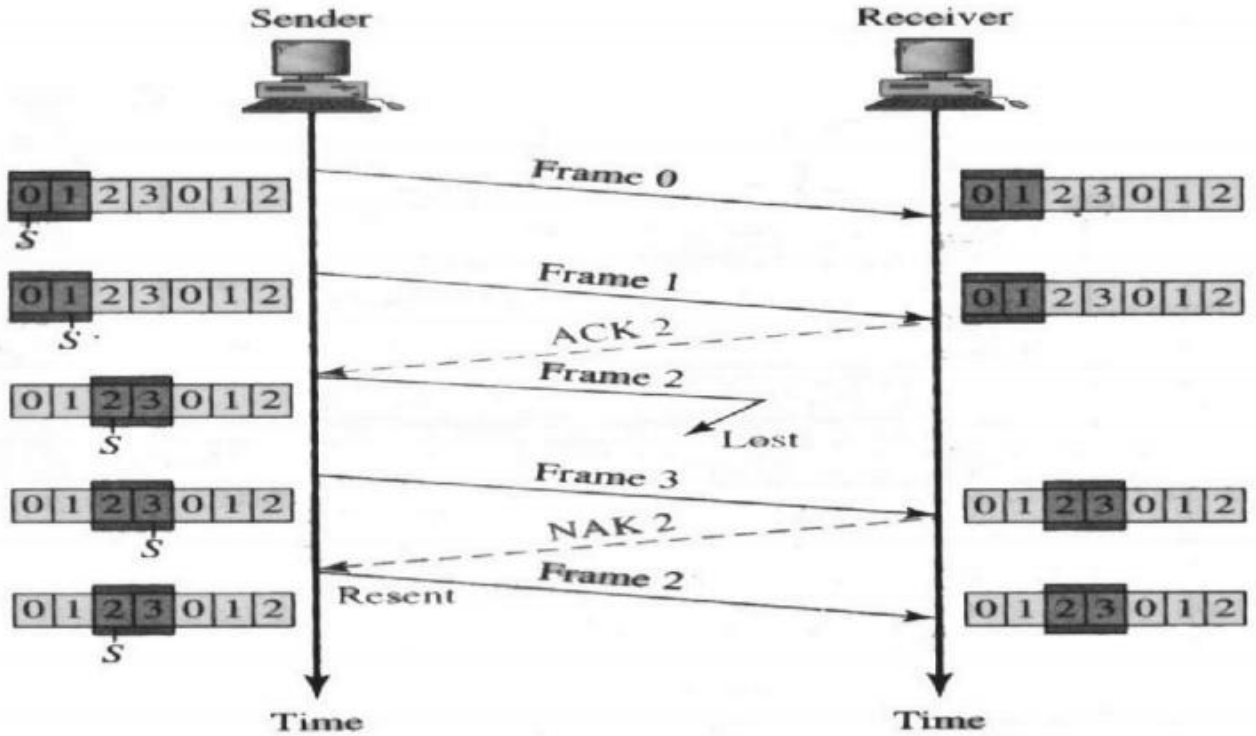

Figure 13 Selective Repeat ARQ, lost frame

Sender Window Size

We can now show why the size of the sender and receiver Windows must be at most one-half of 2^m. For an example, we choose m = 2, which means the size of the Window should be $2^m/2$ or 2. Figure 14 compares a window size of 2 with a window size of 3.

If the size of the window is 2 and all acknowledgments are lost, the timer for frame 0 expires and frame 0 is resent. However, the window of the receiver is now expecting frame 2, not frame 0, so this duplicate frame is correctly discarded. When the size of the window is 3 and all acknowledgments are lost, the sender sends a duplicate of frame 0. However, this time, the window of the receiver expects to receive frame 0 (0 is part of the Window), so it accepts frame 0, not as a duplicate, but as the first frame in the next cycle. This is clearly an error.

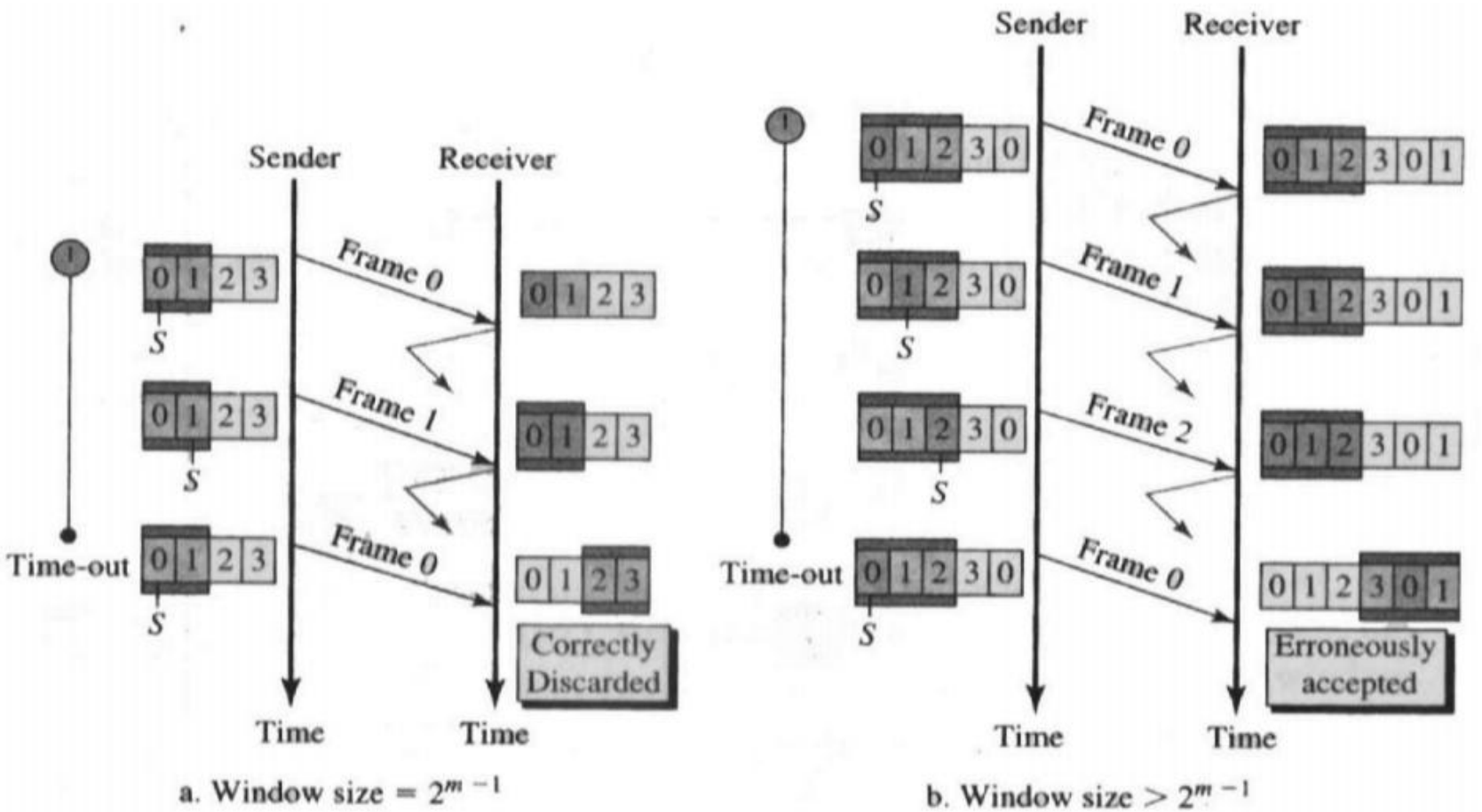

Figure 14 Selective Repeat ARQ, sender window size

Bidirectional Transmission and Piggybacking

As in the case of Stop-and-Wait ARQ and the Go-Back-N ARQ, Selective Repeat ARQ can also be bidirectional. We can use piggybacking to improve the efficiency of the transmission. However each direction needs both a sender window and a receiver window.