Automatic repeat request(ARQ)

In it , when an error is detected, a request is made for the retransmission of that signal . Therefore, a feedback channel is required for sending the request for retransmission. The ARQ system differ from the FEC systems in three important respects as under:

1) Less number of check bits are required.

2) A return channel and additional hardware is required .

3) The bit rate of forward transmission must make allowance for the backward repeat transmission.

Basic ARQ system

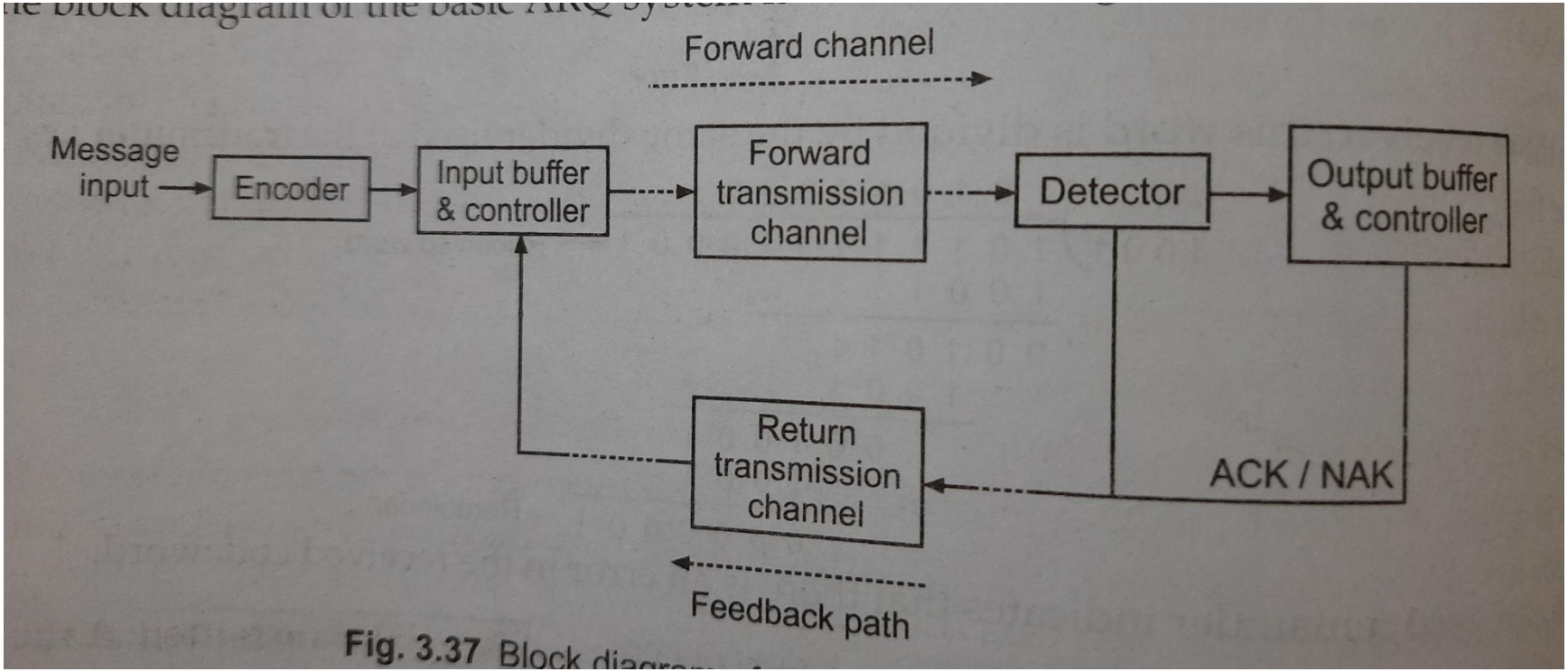


Fig. 3.37 Block diagram

The encoder produces code words for each message signal at its input. Each code word at the encoder output is stored temporarily and transmitted over the forward transmission channel.

At the destination, a decoder will decode the code words and look for errors. The decoder will output a positive acknowledgement (ACK) if no errors are detected and it will output a negative acknowledgement (NAK) if errors are detected.

On receiving a negative NAK signal via the return transmission path, the controller will retransmit the appropriate word from the words stored by the input buffer. It may be retransmitted only once or it may be retransmitted twice or more number of times. The output controller and buffer on the receiver side assemble the output bit stream from the code words accepted by the decoder.

Data link control

- Data must be checked and processed before they can be used.
- The rate of such processing is often slower than the rate of transmission.
- For this reason , each receiver has a buffer to store incoming data until they are processed.
- If buffer begin to fill up, the sender must slow or halt transmission.

Flow Control

a) Necessary when data is being sent faster than it can be processed by receiver

b) Computer to printer is typical setting

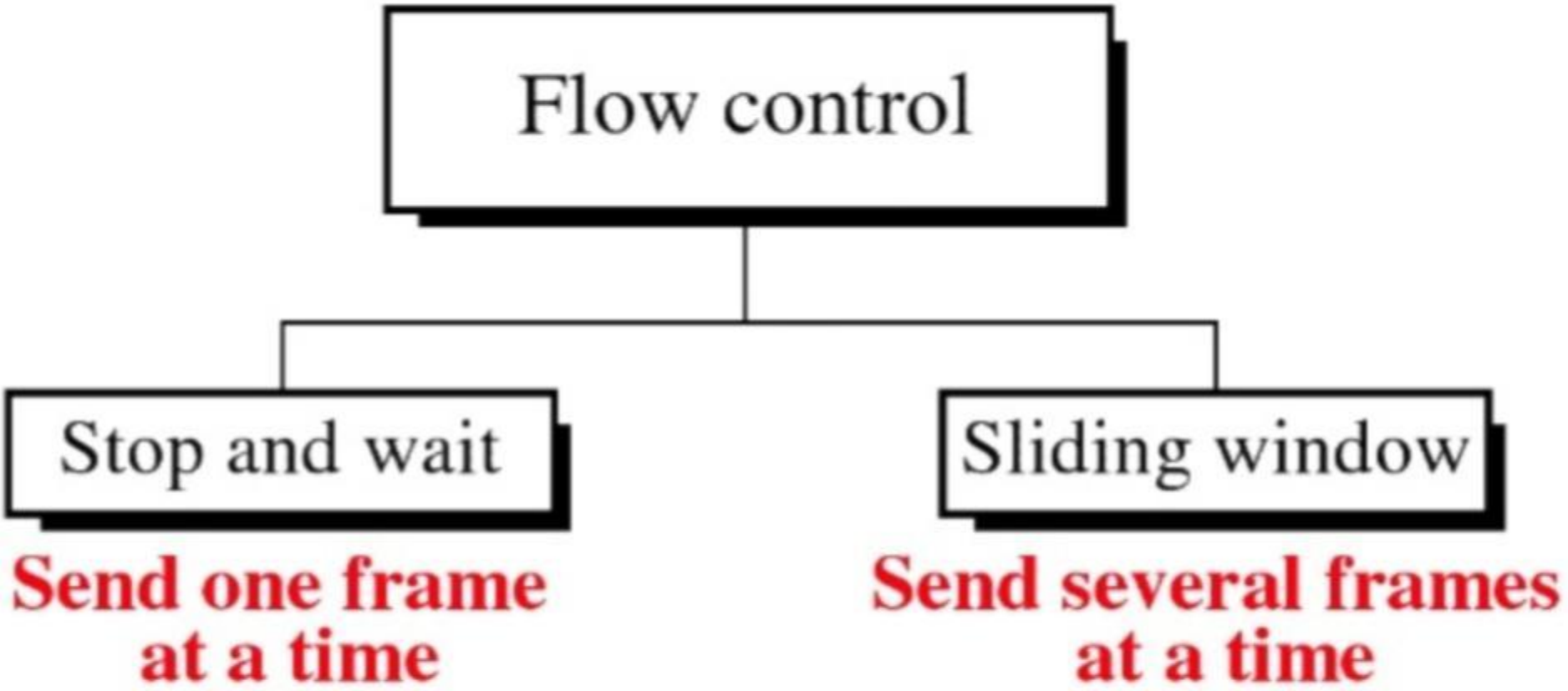
c) Can also be from computer to computer, when a processing program is limited in capacity

d) Flow control is needed since the sending entity should not overwhelm the receiving entity

- Recipient needs some time to process incoming packets
- If sender sends faster than recipient processes, then buffer overflow occurs
  - flow control prevents buffer overflow

Note

Flow control refers to a set of procedures used to restrict the amount of data that the sender can send before waiting for acknowledgment.


Flow control
Stop and wait
Sliding window
Send one frame at a time
Send several frames at a time

Stop and Wait Flow Control

a) Source transmits frame

b) Destination receives frame and replies with acknowledgement (ACK)

c) Source waits for ACK before sending next frame

d) Destination can stop flow by not sending ACK

e) Works well for large frames

f) Inefficient for smaller frames

Stop and Wait Flow Control

- However, generally large block of data split into small frames
  - Called "Fragmentation"
    - Limited buffer size at receiver
    - Errors detected sooner (when whole frame received)
      - On error, retransmission of smaller frames is needed
    - Prevents one station occupying medium for long periods

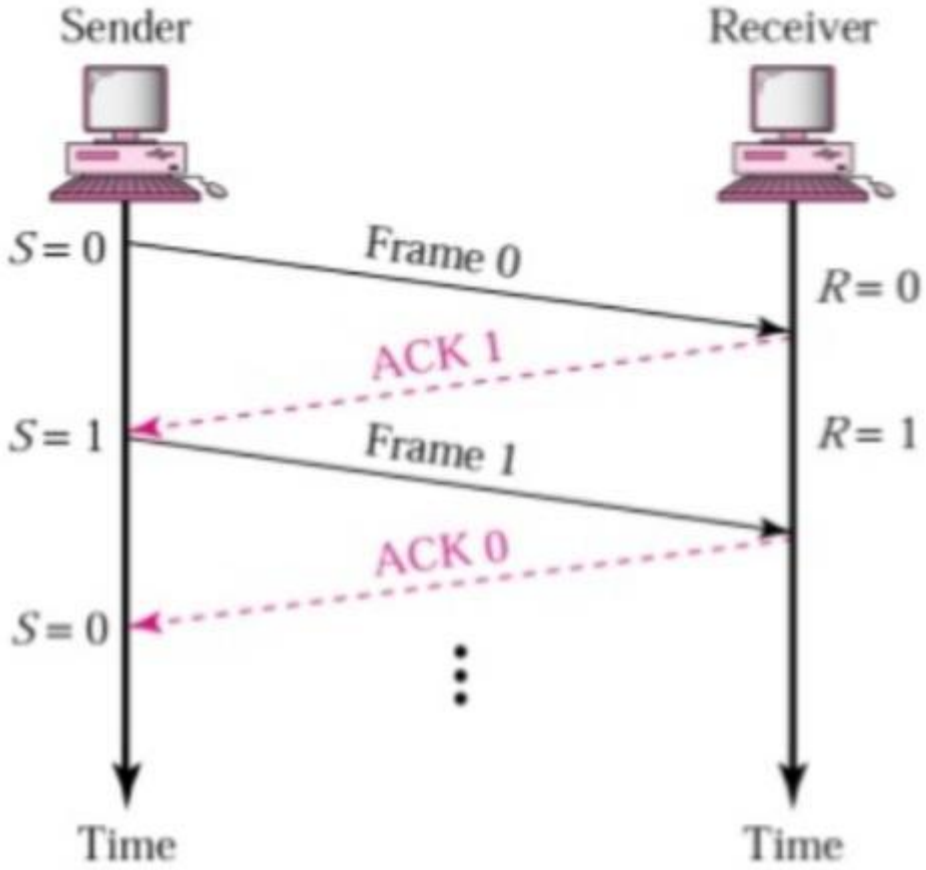
Stop-and-Wait ARQ

Cases of Operations:

1. Normal operation
2. The frame is lost
3. The Acknowledgment (ACK) is lost
4. The Ack is delayed

Stop-and-Wait ARQ

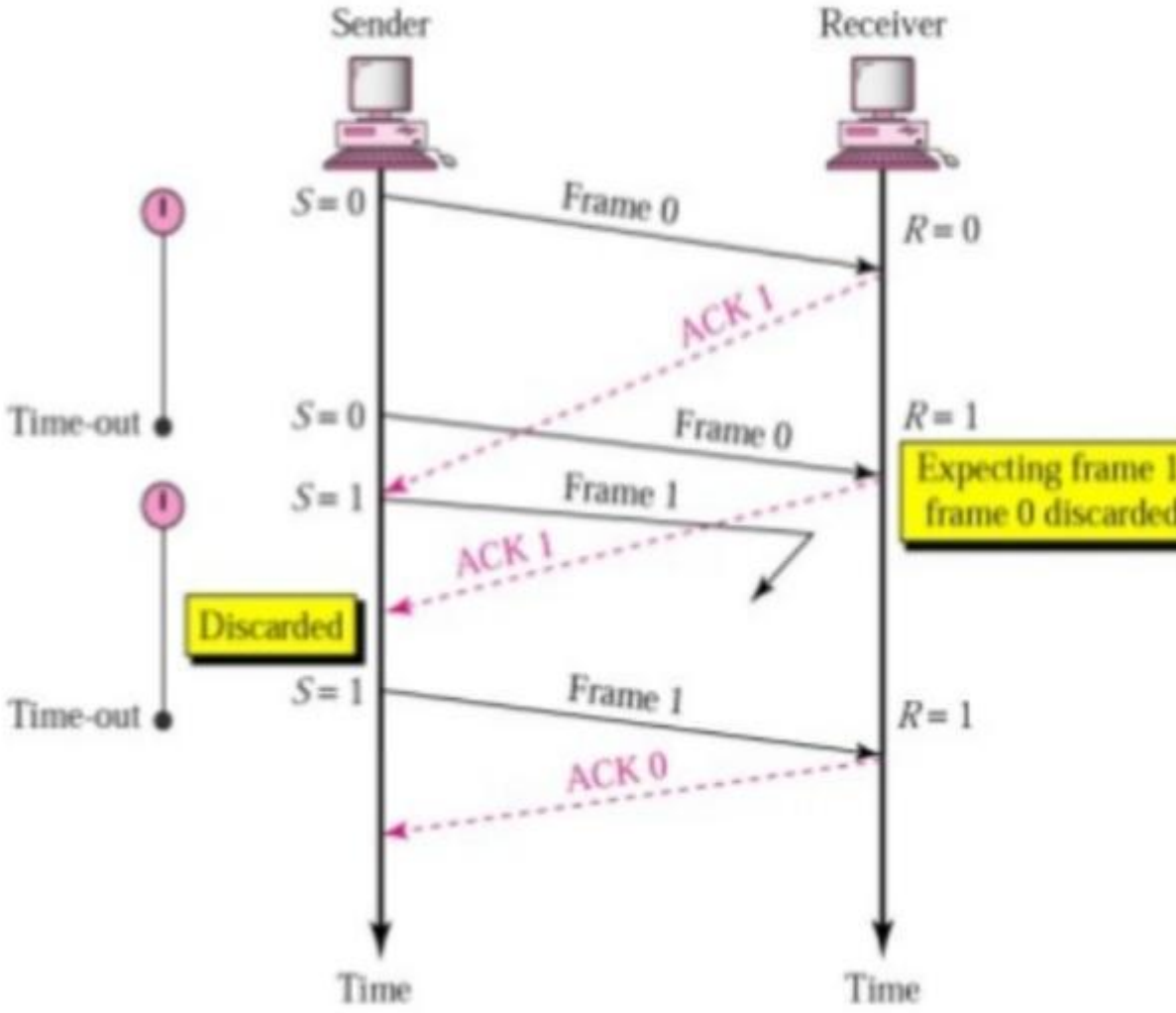
- *The sender will not send the next frame until it is sure that the current one is correctly receive*
- *sequence number is necessary to check for duplicated frames*



Stop-and-Wait ARQ

4. Delayed ACK and lost frame

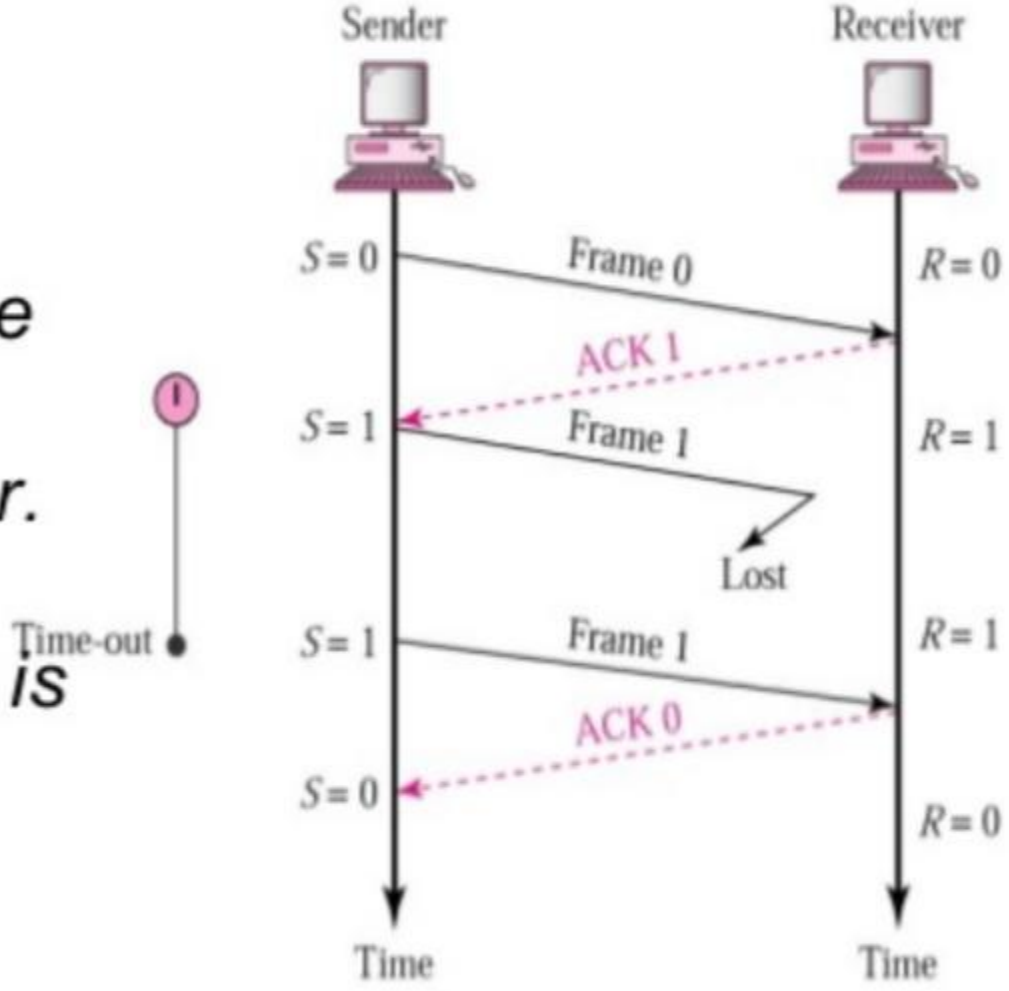
- *Importance of frame numbering*



1. Stop and Wait ARQ

2. Lost or damaged frame

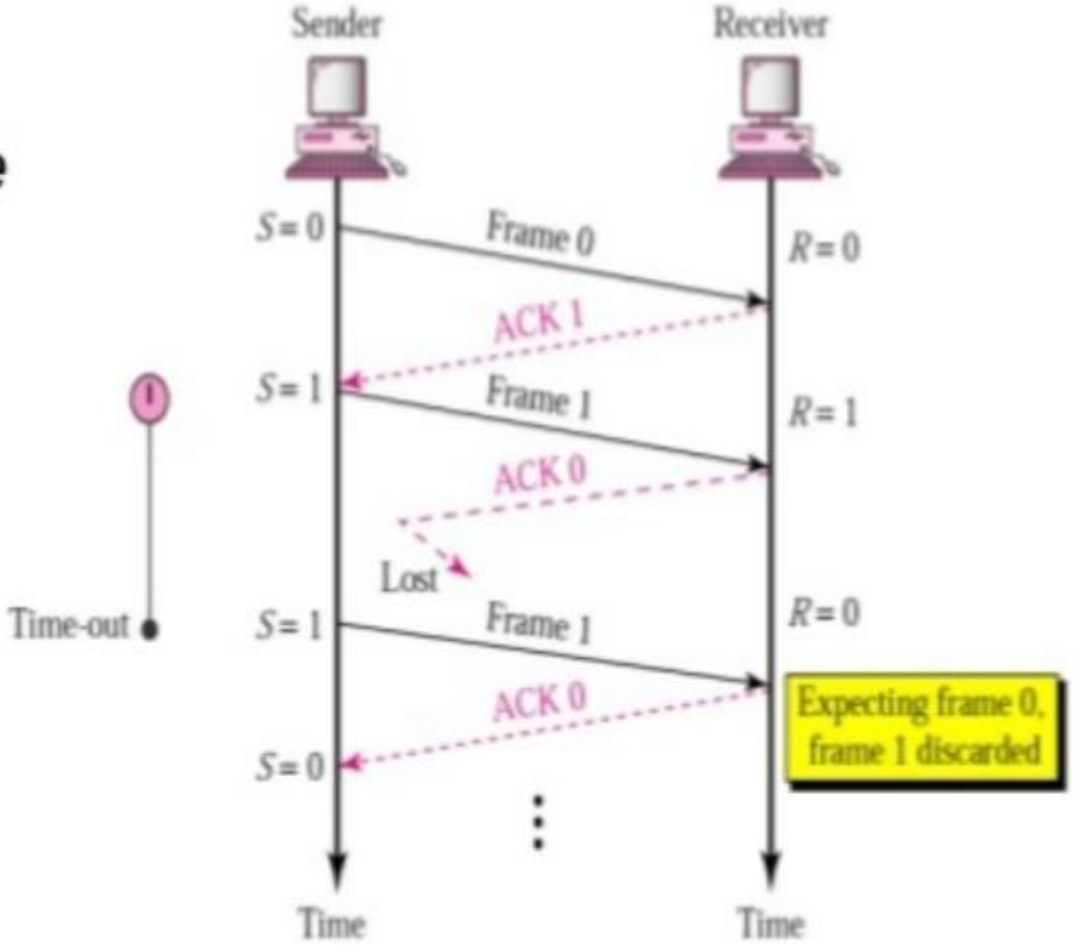
- *A damage or lost frame treated by the same manner by the receiver.*
- *No NACK when frame is corrupted / duplicate*



Stop-and-Wait ARQ

3. Lost ACK frame

- *Importance of frame numbering*



Sliding Window Flow Control

a) The problem of "Stop and Wait" is not be able to send multiple frames

b) Sliding Window Protocol allows multiple frames to be in transit

c) Receiver has buffer of W (called window size) frames

d) Transmitter can send up to W frames without ACK

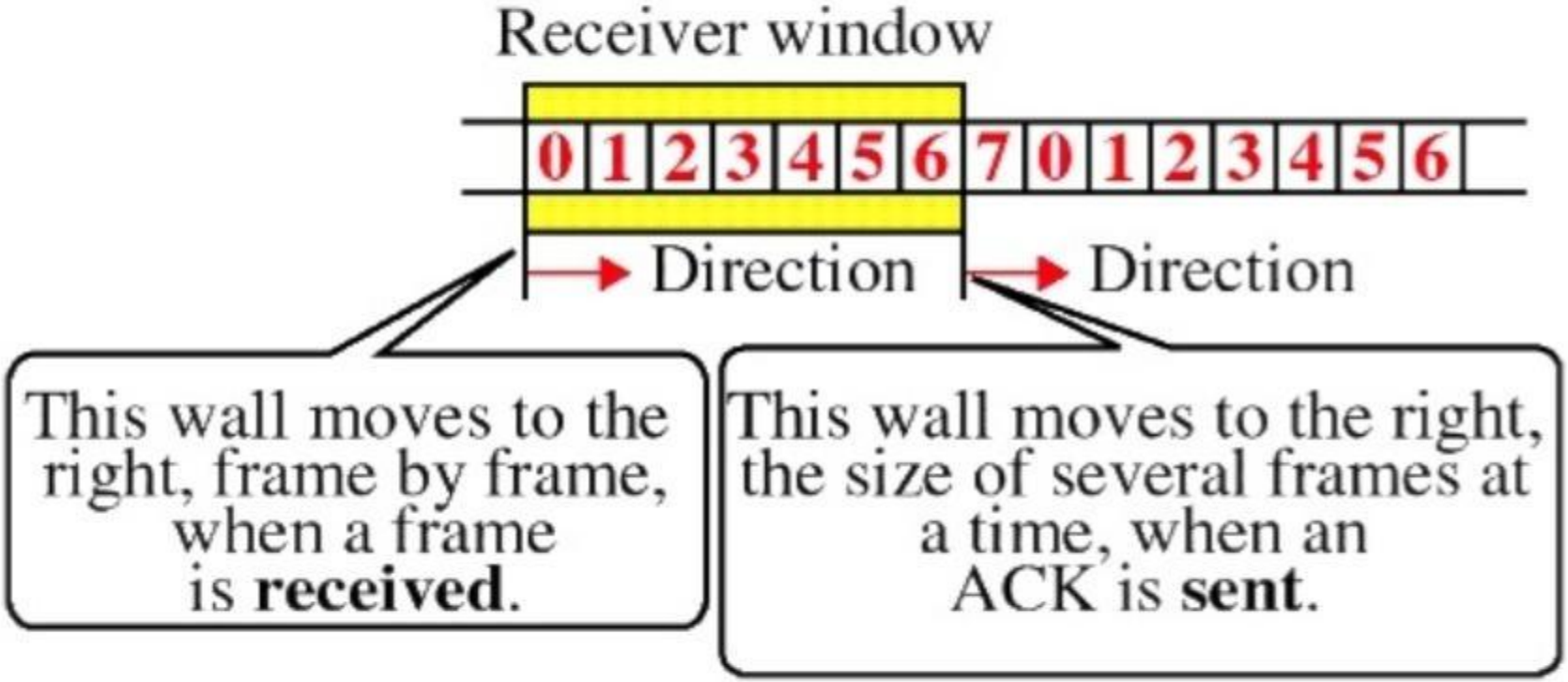
e) Each frame is numbered

- Sequence number bounded by size of the sequence number field (k bits)
- thus frames are numbered modulo 2^k ($0 \ldots 2^{k-1}$)

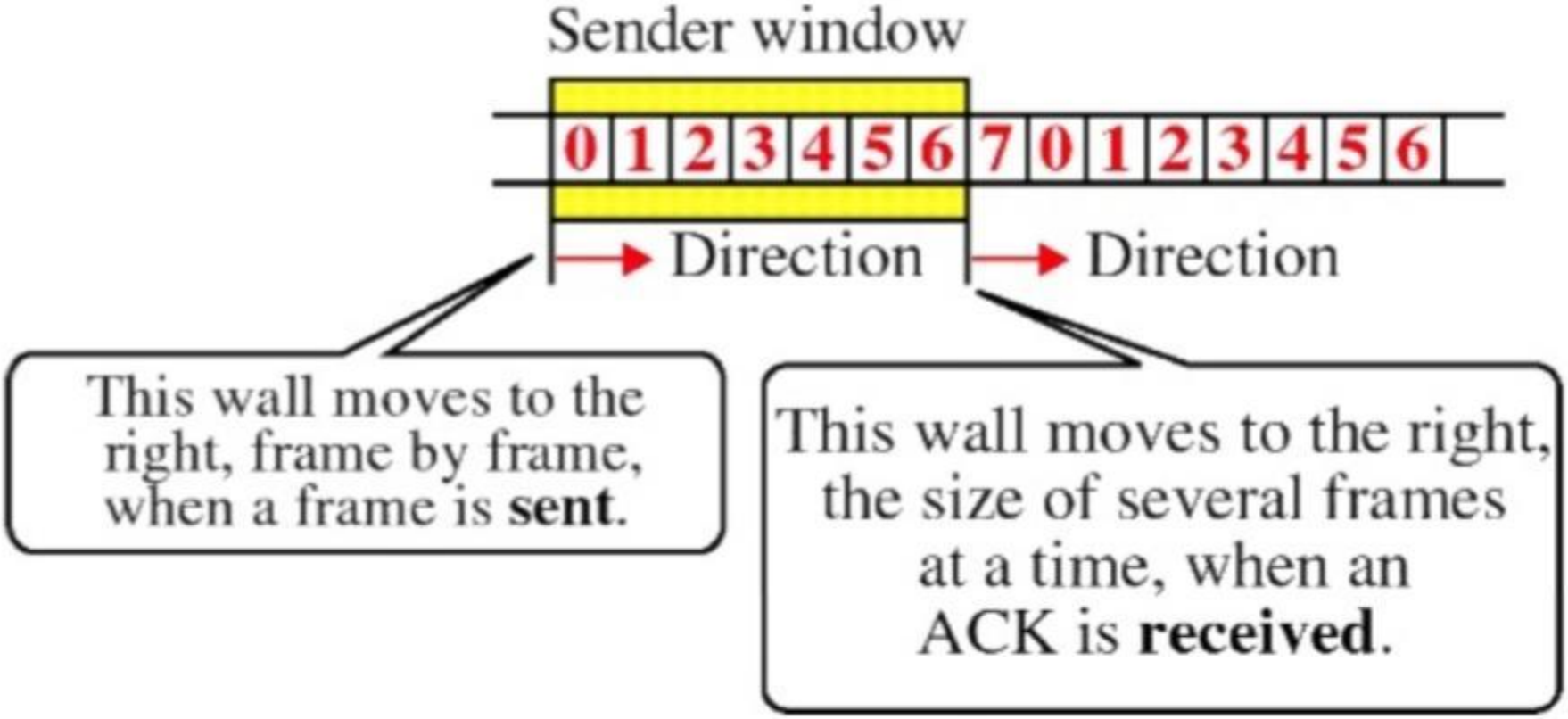
a) ACK includes number of next frame expected

Sliding Window

Receiver Sliding Window



Sender Sliding Window



Sliding Window Example