CRC

Find the CRC for the data blocks 100100 with the divisor 1101?

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CRC Generation at sender side

1. Find the length of the divisor 'L'.
2. Append 'L-1' bits to the original message.
3. Perform binary division operation.
4. Remainder of the division = CRC.

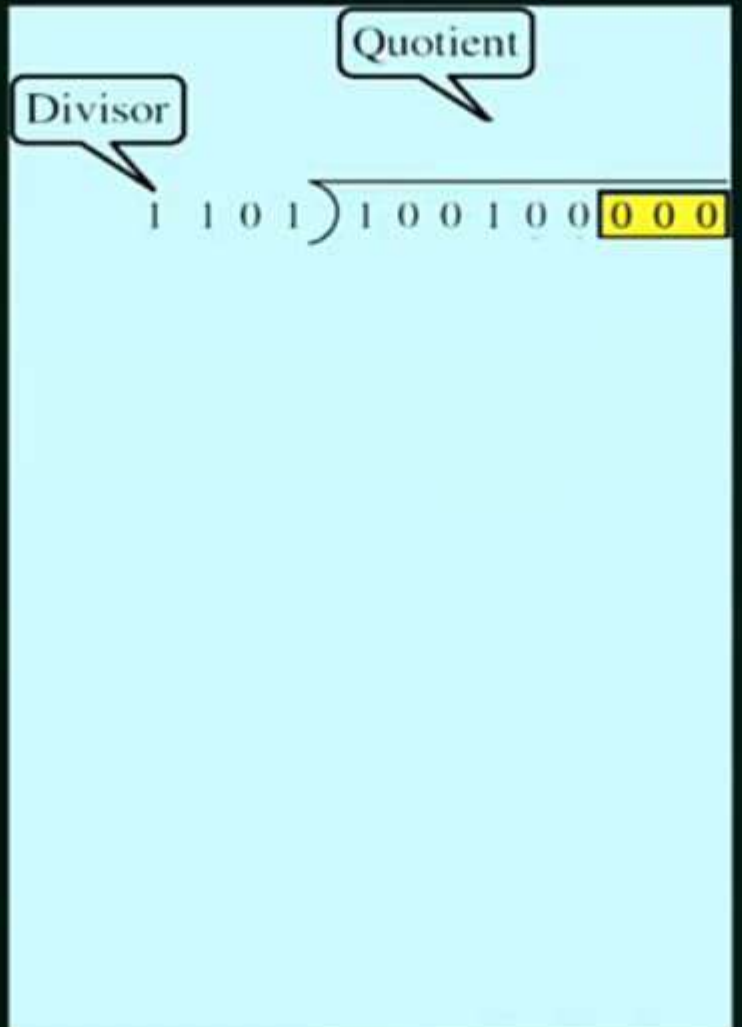
Note:

The CRC must be of L-1 bits.

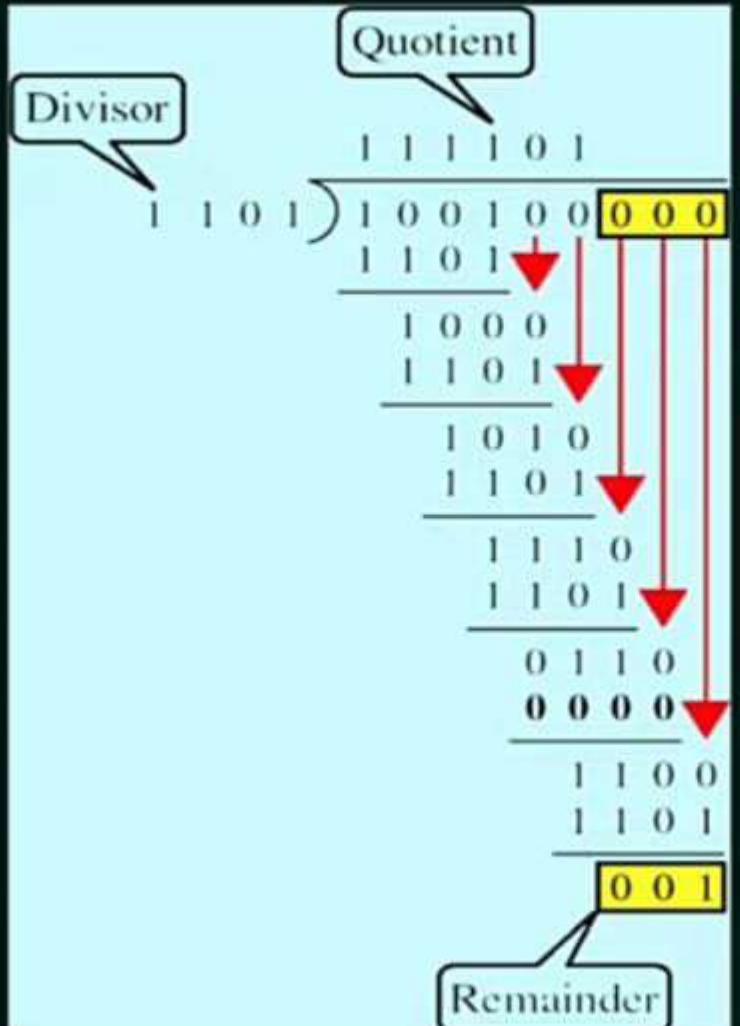
A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

CRC

L= 4; So, 3 0's are appended to the message.



CRC



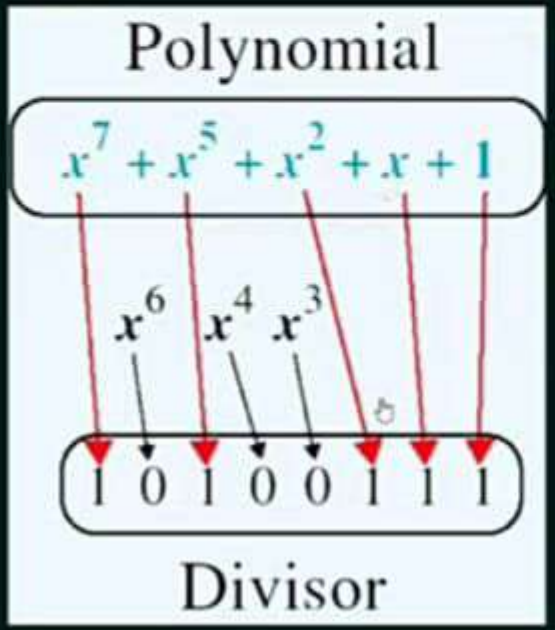
CRC: 001

Data Transmitted: 100100001

CRC

Find the CRC for 1110010101 with the divisor x^3+x^2+1?

Hint:

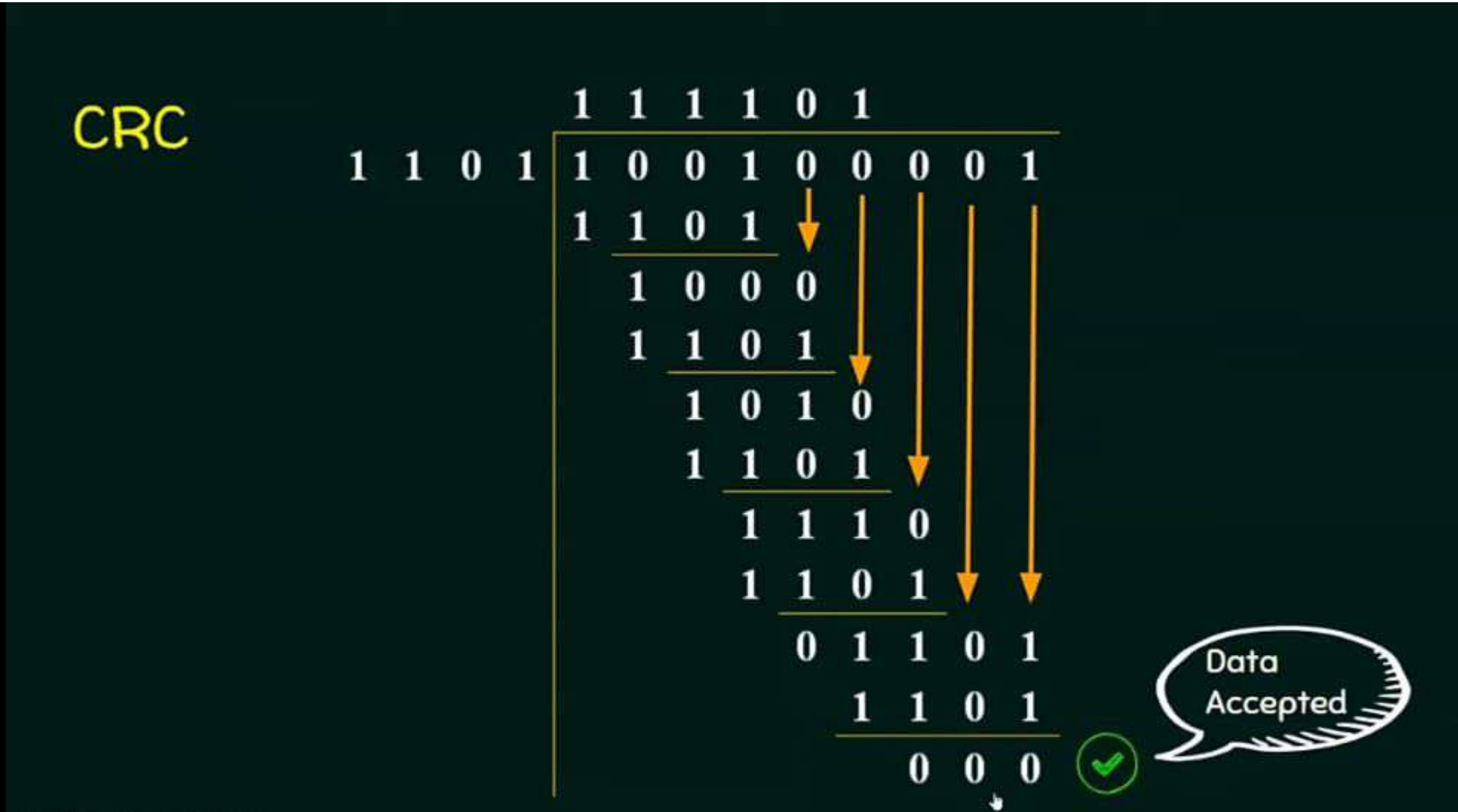


CRC

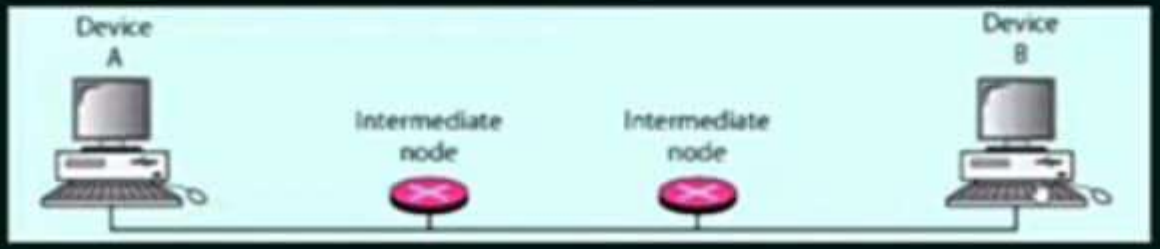
CRC: 001
Data Transmitted: 100100001

CRC

Data Received by the receiver : 100100001


CRC
1 1 1 1 0 1
1 1 0 1 | 1 0 0 1 0 0 0 0 1
1 1 0 1
1 0 0 0
1 1 0 1
1 0 1 0
1 1 0 1
1 1 1 0
1 1 0 1
0 1 1 0 1
1 1 0 1
0 0 0
Data Accepted

Flow control



Flow control

- ★ Speed matching mechanism.
- ★ Flow control coordinates the amount of data that can be sent before receiving an acknowledgment.
- ★ Flow control is a set of procedures that tells the sender how much data it can transmit before it must wait for an acknowledgement from the receiver.
- ★ Receiver has a limited speed at which it can process incoming data and a limited amount of memory in which to store incoming data.
- ★ Receiver must inform the sender before the limits are reached and request that the transmitter to send fewer frames or stop temporarily.

Stop-and-Wait Protocol

- ★ Stop – and – Wait protocol is data link layer protocol for transmission of frames over noiseless channels.
- ★ It provides unidirectional data transmission with flow control facilities but without error control facilities.
- ★ The idea of stop-and-wait protocol is straightforward.
- ★ After transmitting one frame, the sender waits for an acknowledgement before transmitting the next frame.

Primitives of Stop-and-Wait Protocol

Sender side

Rule 1 : Send one data packet at a time.

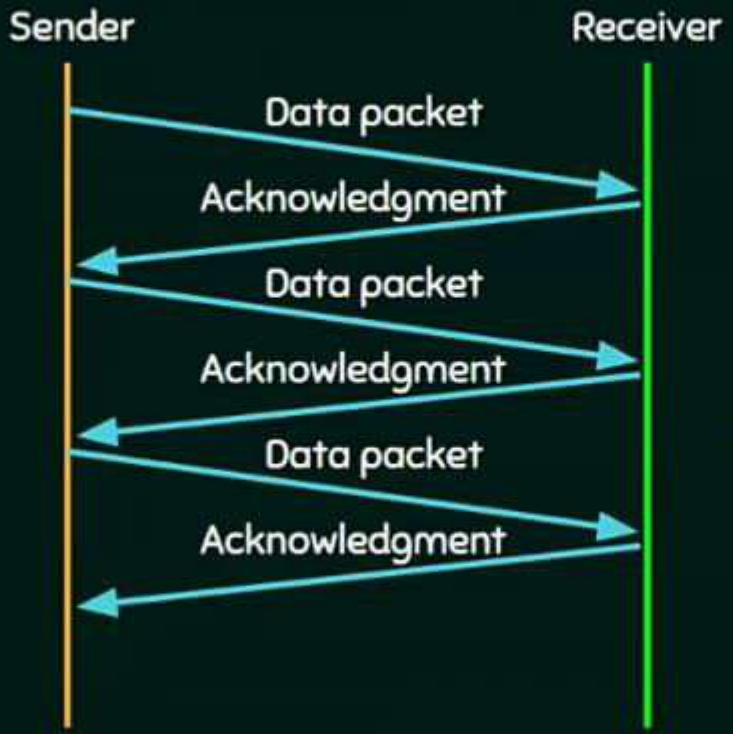
Rule 2 : Send the next packet only after receiving ACK for the previous.

Receiver side

Rule 1 : Receive and consume data packet.

Rule 2 : After consuming packet, ACK need to be sent (Flow Control).

Stop-and-Wait Protocol



Problems of Stop-and-Wait Protocol

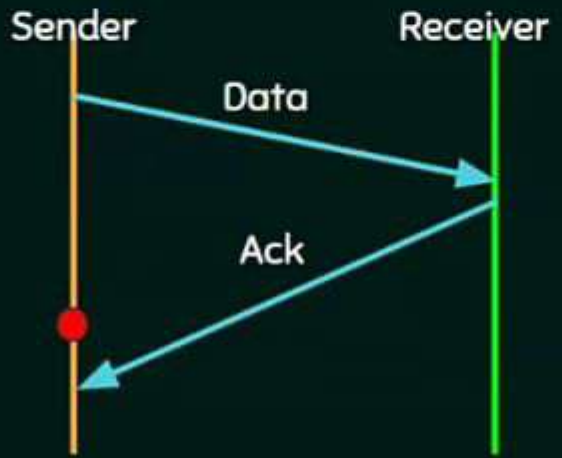
1. Problems due to lost data.
   - ★ Sender waits for ack for an infinite amount of time.
   - ★ Receiver waits for data an infinite amount of time.

Problems of Stop-and-Wait Protocol

2. Problems due to lost ACK.
   - ★ Sender waits for an infinite amount of time for ack.

Problems of Stop-and-Wait Protocol

3. Problems due to delayed ACK/data.
   - ★ After timeout on sender side, a delayed ack might be wrongly considered as ack of some other data packet.



Problems of Stop-and-Wait Protocol

1. Problems due to lost data.

   Sender waits for ack for an infinite amount of time.

   Receiver waits for data an infinite amount of time.

2. Problems due to lost ACK.

   Sender waits for an infinite amount of time for ack.

3. Problems due to delayed ACK/data.

   After timeout on sender side, a delayed ack might be wrongly considered as ack of some other data packet.

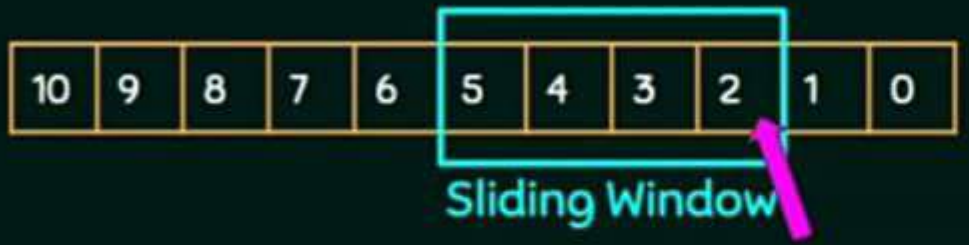
Stop-and-Wait ARQ Protocol

- ★ Idea of stop-and-wait protocol is straightforward.
- ★ After transmitting one frame, the sender waits for an acknowledgement before transmitting the next frame.
- ★ If the acknowledgement does not arrive after a certain period of time, the sender times out and retransmits the original frame.
- ★ Stop-and-Wait ARQ = Stop-and-Wait + Timeout Timer + Sequence number

Go-Back-N ARQ

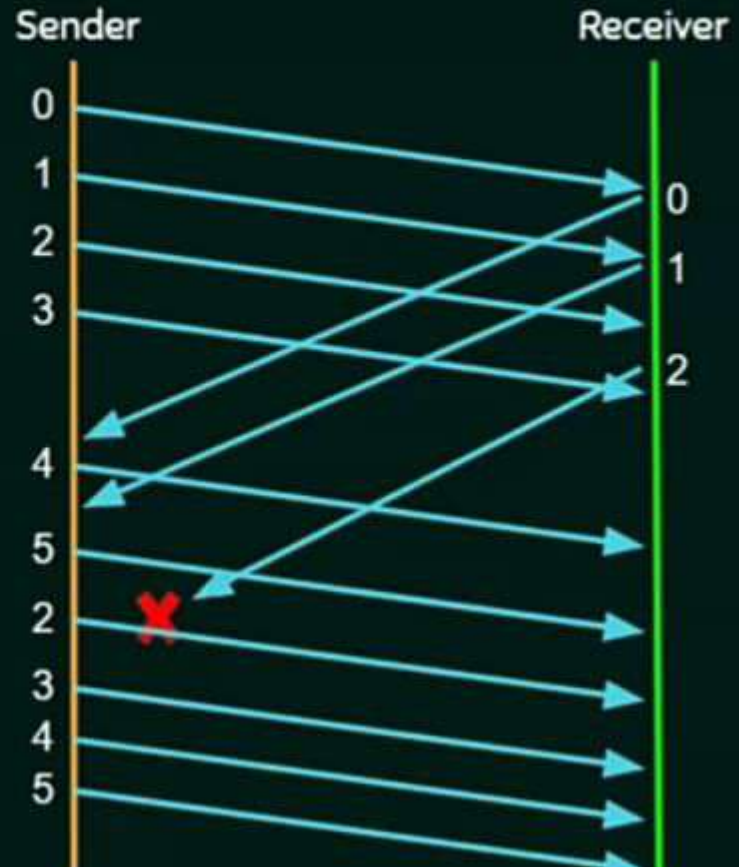
- ★ Go - Back - N ARQ uses the concept of protocol pipelining i.e. the sender can send multiple frames before receiving the acknowledgment for the first frame.
- ★ There are finite number of frames and the frames are numbered in a sequential manner.
- ★ The number of frames that can be sent depends on the window size of the sender.
- ★ If the acknowledgment of a frame is not received within an agreed upon time period, all frames in the current window are transmitted.

Working of Go-Back-N ARQ

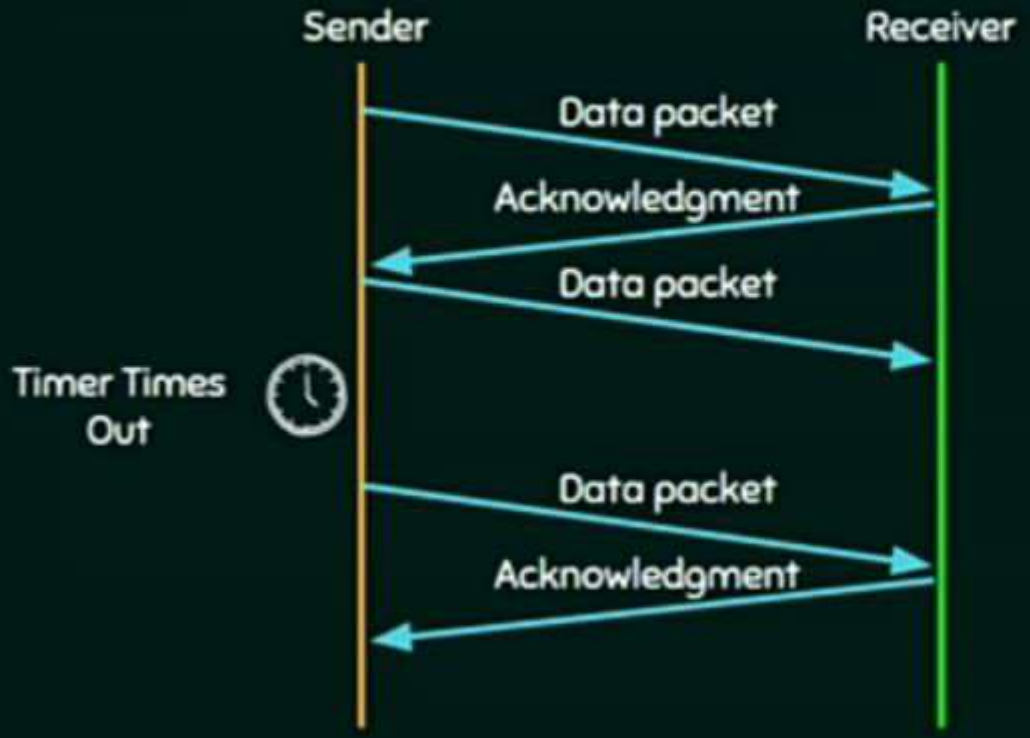


Go-Back to 2

Window Size: 4



Stop-and-Wait ARQ Protocol



Stop-and-Wait ARQ – Drawbacks

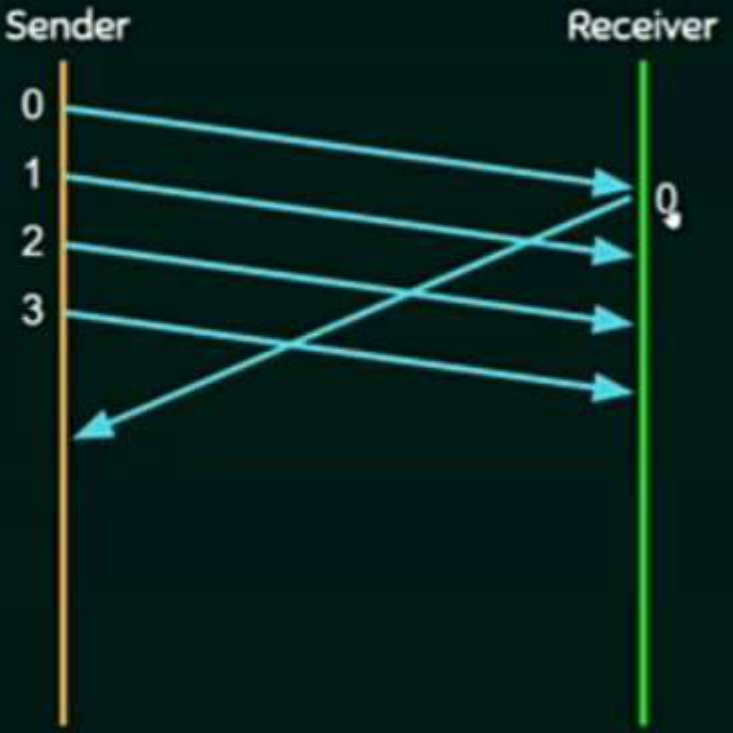
- ★ One frame at a time.
- ★ Poor utilization of bandwidth.
- ★ Poor Performance

Sliding window protocol

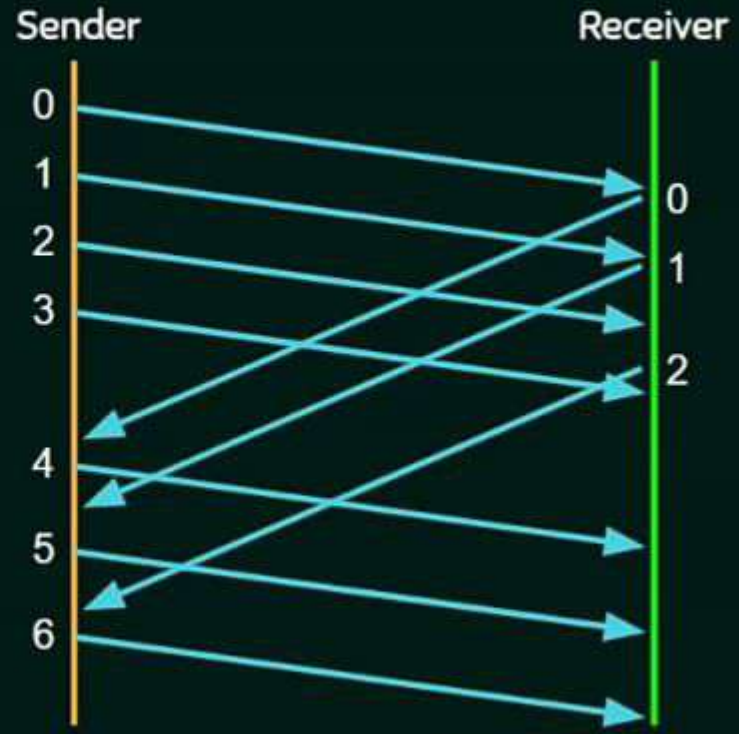
- ★ Send multiple frames at a time.
- ★ Number of frames to be sent is based on Window size.
- ★ Each frame is numbered -> Sequence number.

WORKING OF SLIDING WINDOW PROTOCOL

Window Size: 4



WORKING OF SLIDING WINDOW PROTOCOL



Window Size: 4

CRC

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