DATA LINK CONTROL PROTOCOLS

Requirement & Objectives for Effective data Communication

- Frame synchronization
- Flow Control
- Error Control
- Addressing
- Control & Data on the Same Link
- Link Management

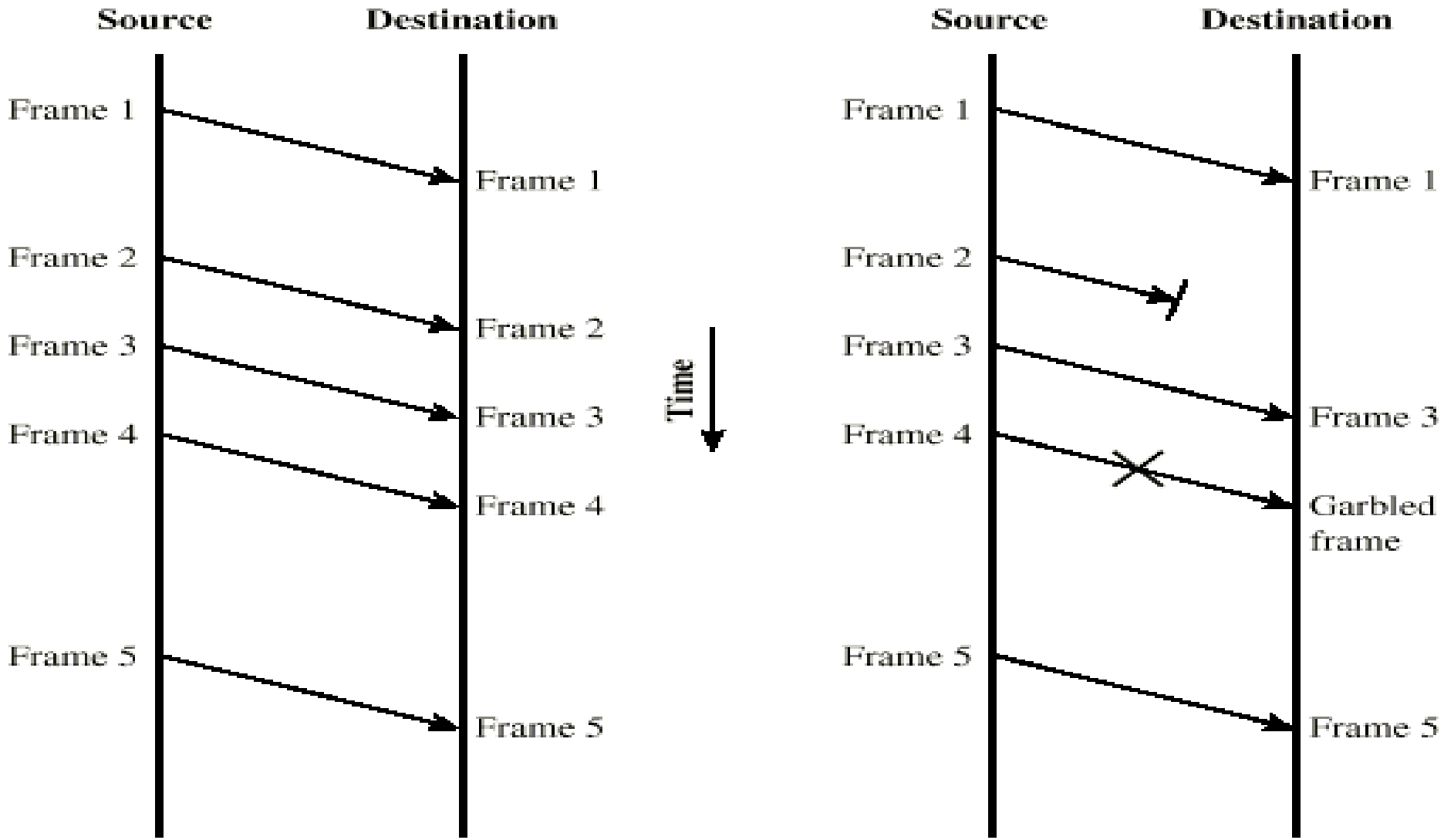
Data Link Layer – Primary Functions

- Flow control – regulate flow of data from sender to receiver
- Error control – detect and correct errors
- Framing – recognizing beginning and end of frames (blocks, packets)

Flow Control

- Ensuring the sending entity does not overwhelm the receiving entity
  - Preventing buffer overflow
- Transmission time
  - Time taken to emit all bits of a frame onto the medium (proportional to length of frame)
- Propagation time
  - Time for a bit to traverse the link between sender and receiver

Model of Frame Transmission



(a) Error-free transmission

(b) Transmission with losses and errors

Stop and Wait Flow Control

- Source transmits frame
- Destination receives frame and replies with acknowledgement
- Source waits for ACK before sending next frame
- Destination can stop flow by not sending ACK
- Works well for a few large frames

Fragmentation

- Large block of data may be split into small frames
  - Limited buffer size
  - Longer the transmission, more likely error. If error, must retransmit entire frame
  - Prevents one station occupying medium for long periods
- Stop and wait becomes inadequate

Link Utilization

- B = R x (d/V)

  B-length of the link in bits

  R – data rate

  d – length or distance of the link

  V – velocity of propagation

- a = B/L

  a – variable

  L – number of bits in the frame

  - a<1

Link Utilization

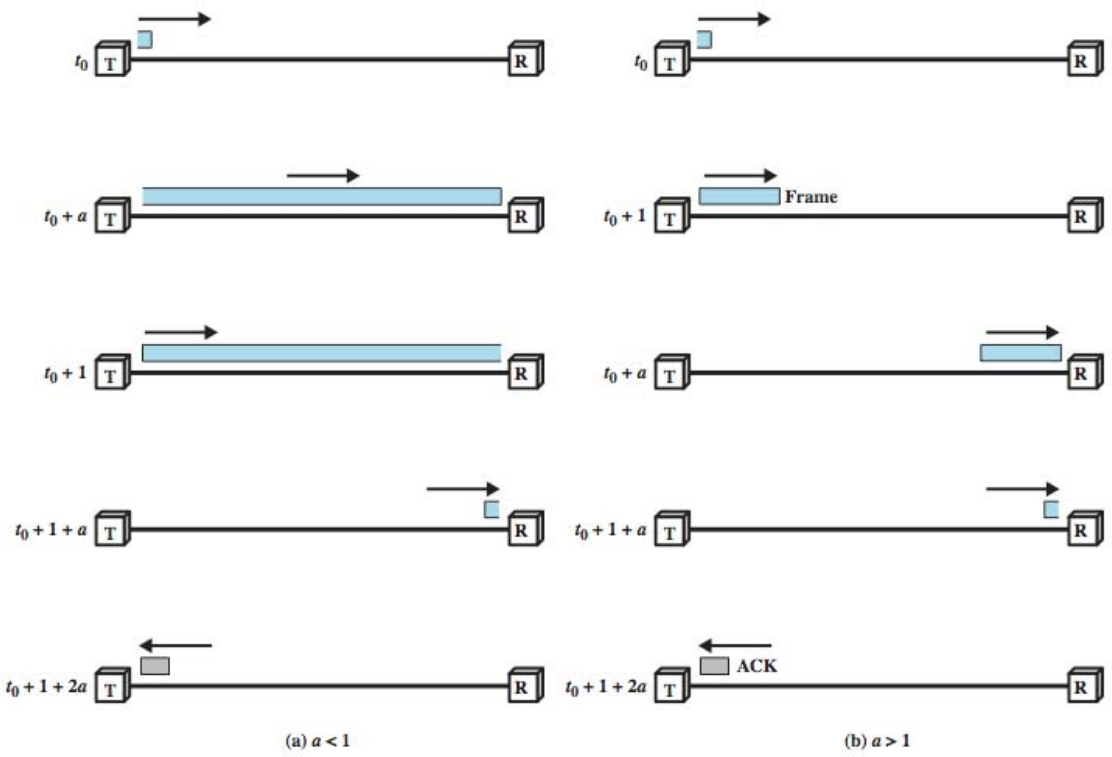


Figure 7.2 Stop-and-Wait Link Utilization (transmission time = 1; propagation time = a)

Drawback- Stop and Wait

- a<1
  - ❖ propagation time is less than transmission time
  - ❖ first bit of the frame has arrived at the destination

    before source has completed the transmission of frame

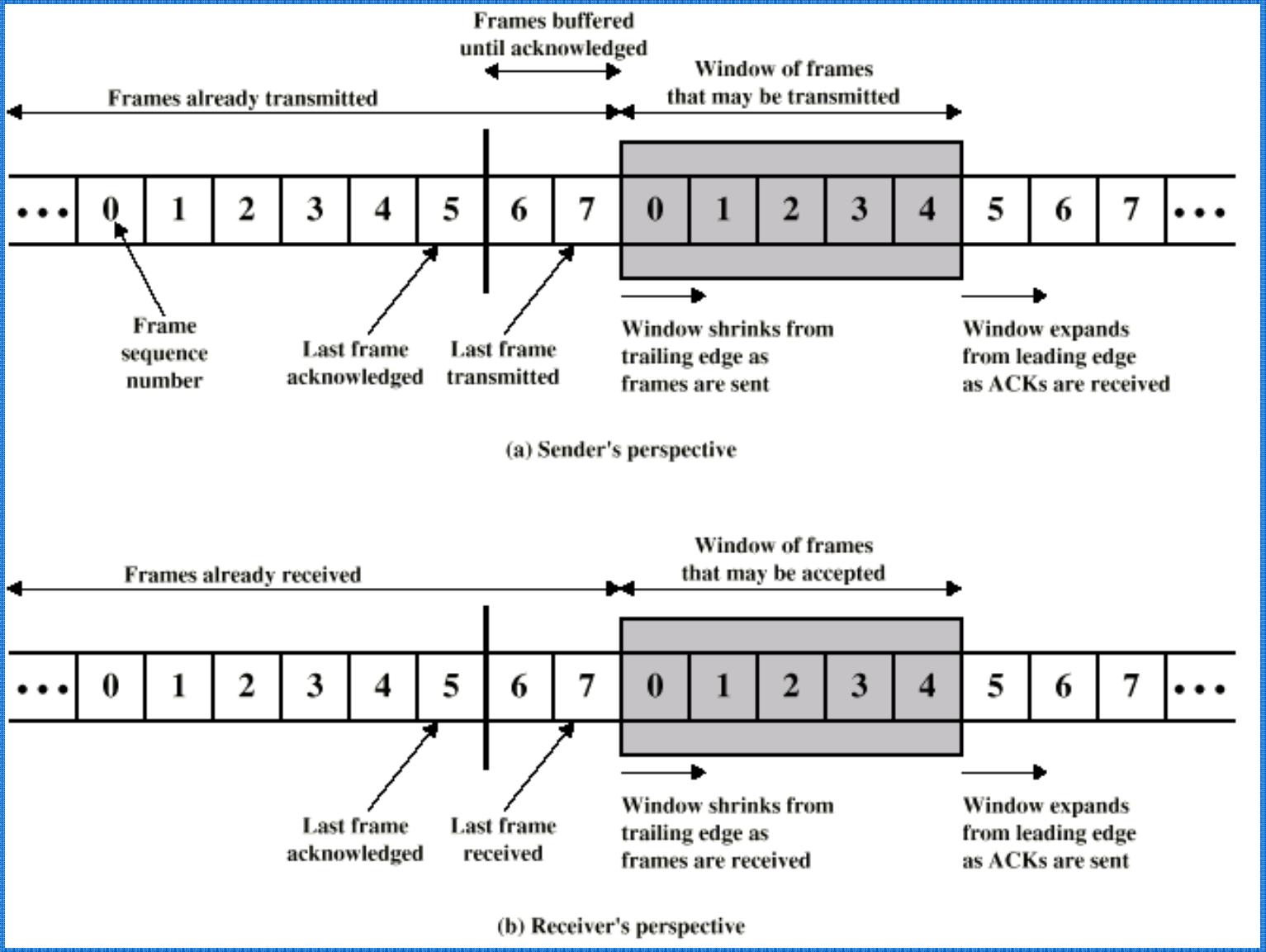
The link is inefficiently utilized

- a>1
  - ❖ Propagation time greater than transmission time
  - ❖ Sender completes the transmission of frame before it reaches the destination

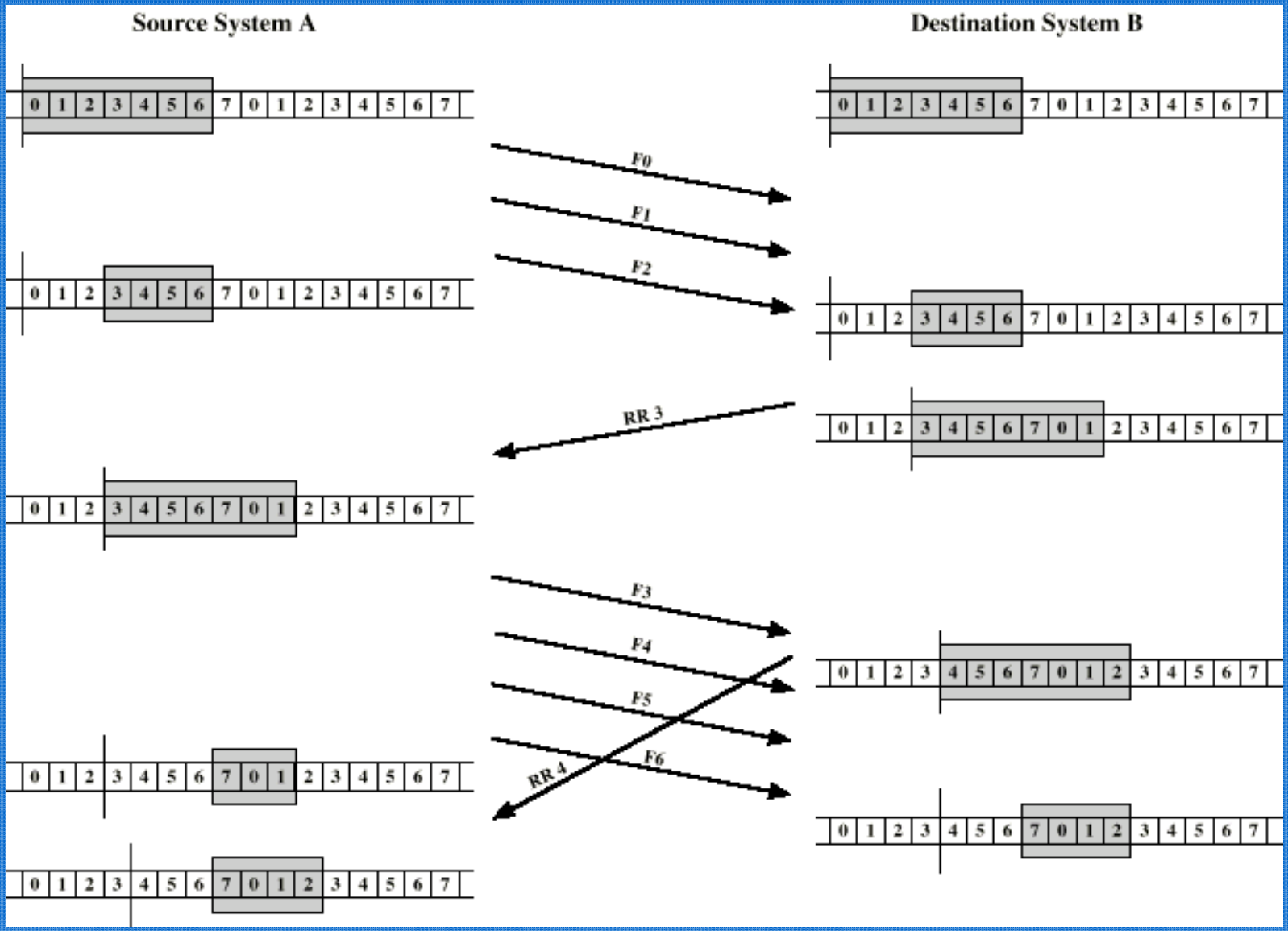
Sliding Windows Flow Control

- Allow multiple frames to be in transit
- Receiver has buffer W long
- Transmitter can send up to W frames without ACK
- Each frame is numbered
- ACK includes number of next frame expected
- ACK can also be used to acknowledge multiple frames

Sliding Window Diagram



Example Sliding Window



- Piggybacking
  data and acknowledgement sent together

- RNR –receive not ready (RNR5)

- Sliding window is more efficient than stop and wait flow control
  - ❑ transmission link is treated as pipeline filled with frames in the transit