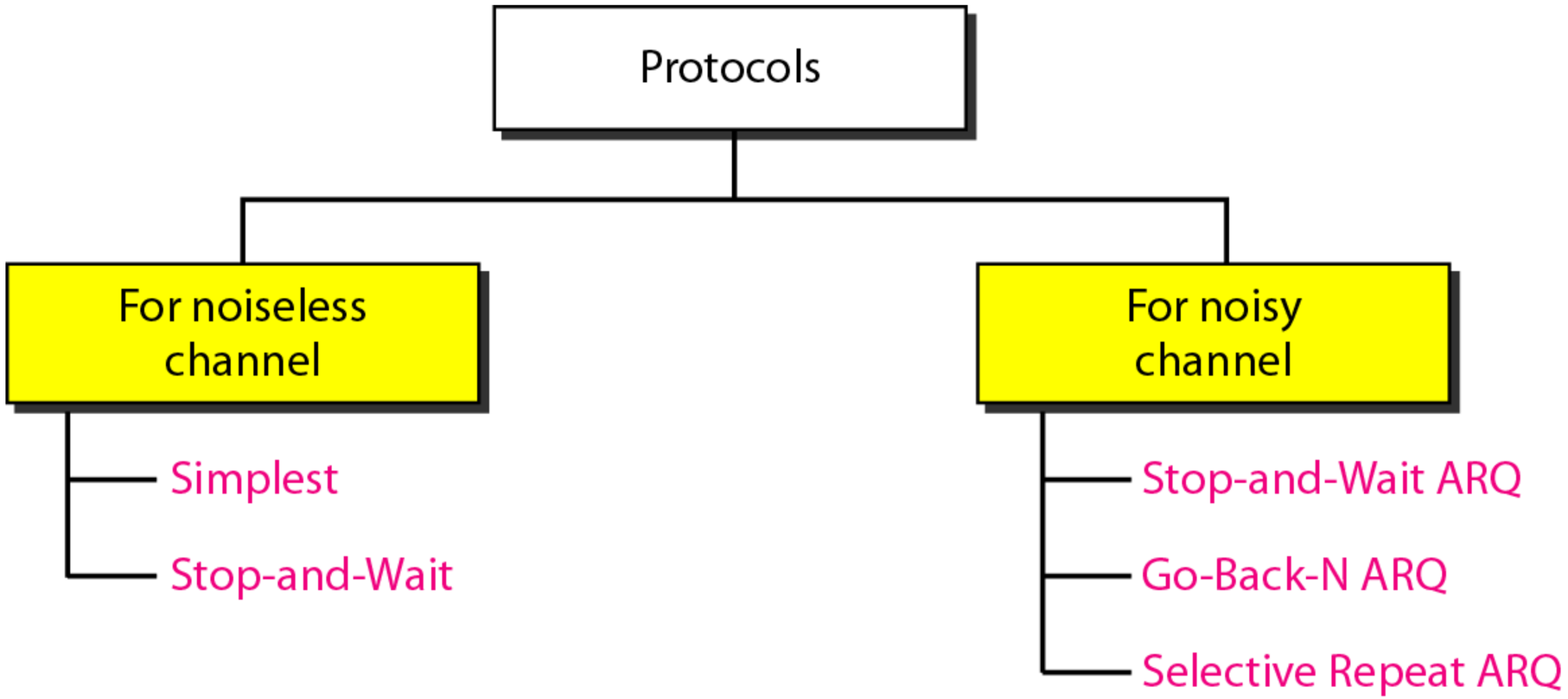
Data Link Layer Protocols

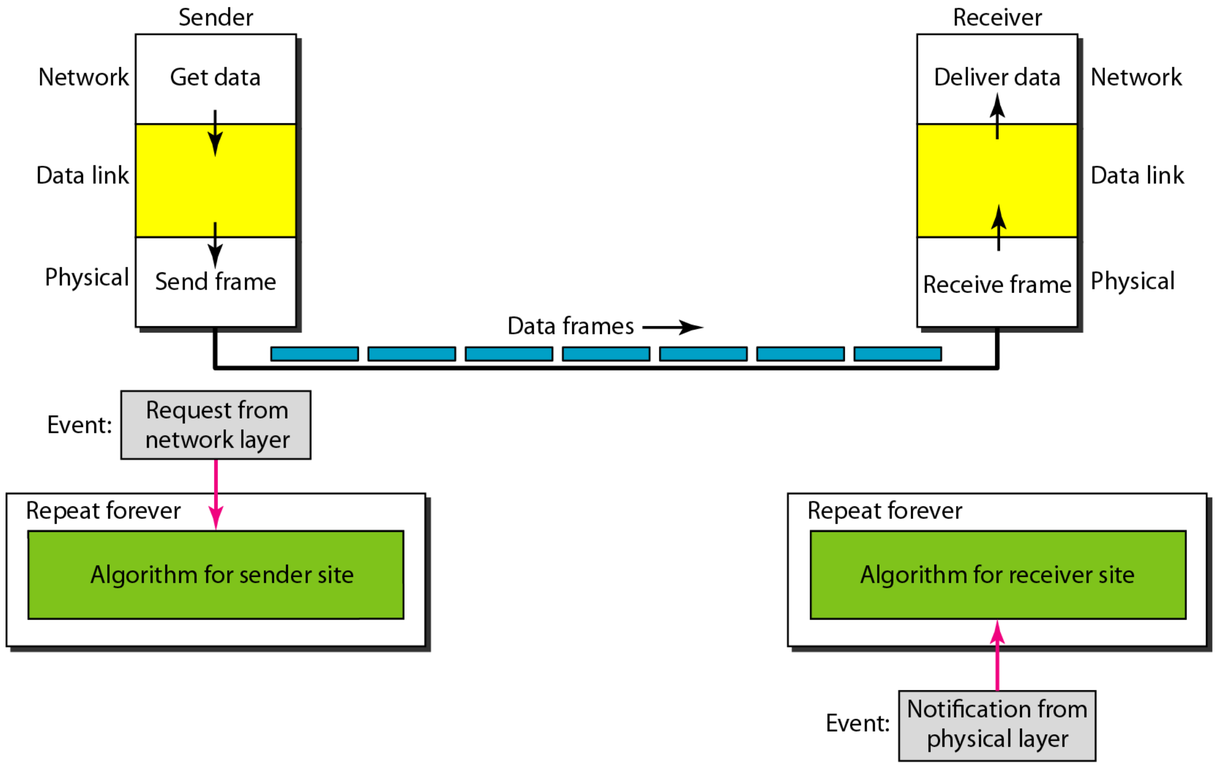
Adapted from lecture slides by Behrouz A. Forouzan

Data Link Protocols



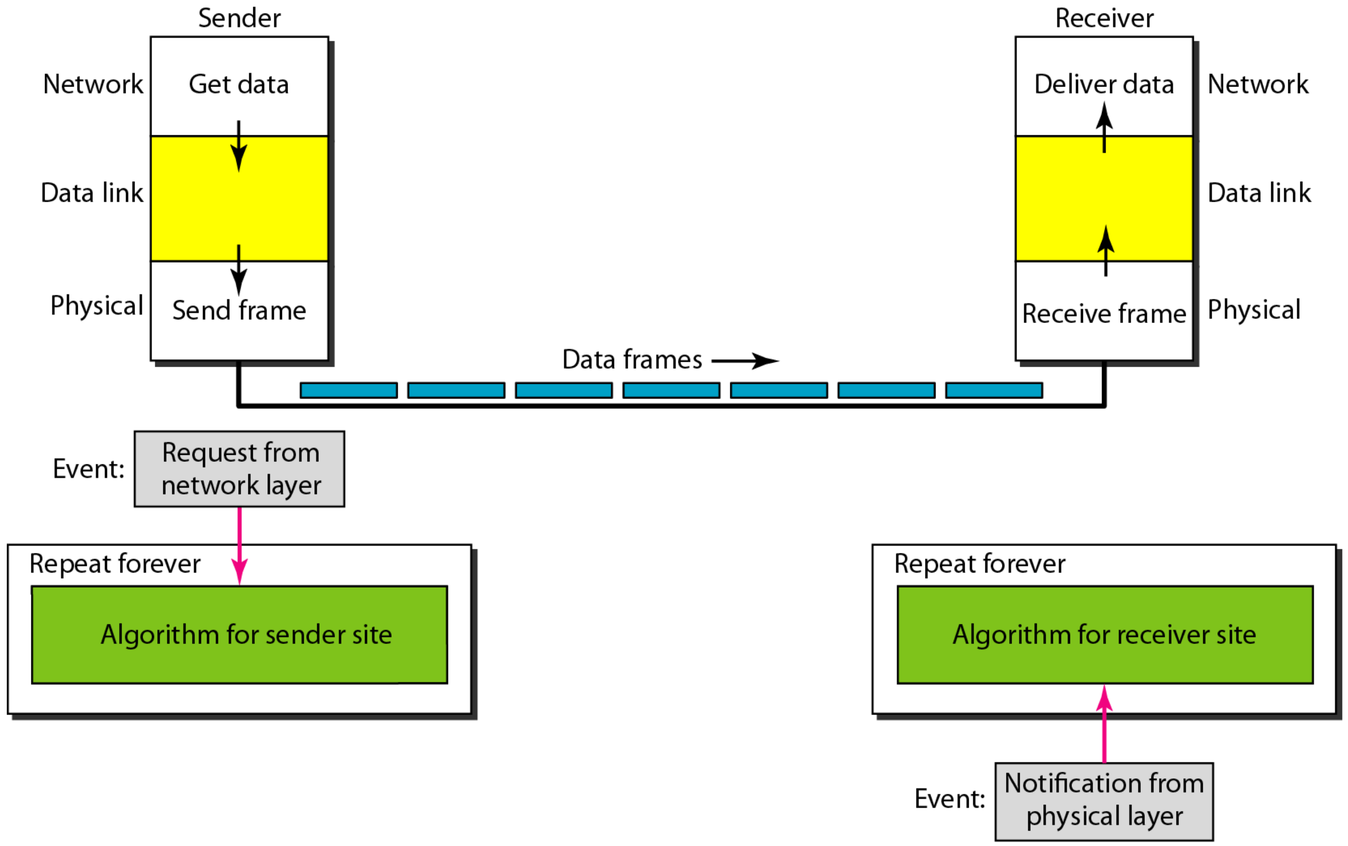
Protocols for Noiseless Channel

- Assuming channel is error free
  - Not realistic…
- No need for error control



"Simplest" Mechanism

- Assuming
  - Noiseless channel
  - Unlimited buffer and speed for the receiver



"Simplest" : Pseudo Code

- Sender

```
1  while(true)                          // Repeat forever
2  {
3    WaitForEvent();                    // Sleep until an event occurs
4    if(Event(RequestToSend))           //There is a packet to send
5    {
6       GetData();
7       MakeFrame();
8       SendFrame();                    //Send the frame
9    }
10 }
```

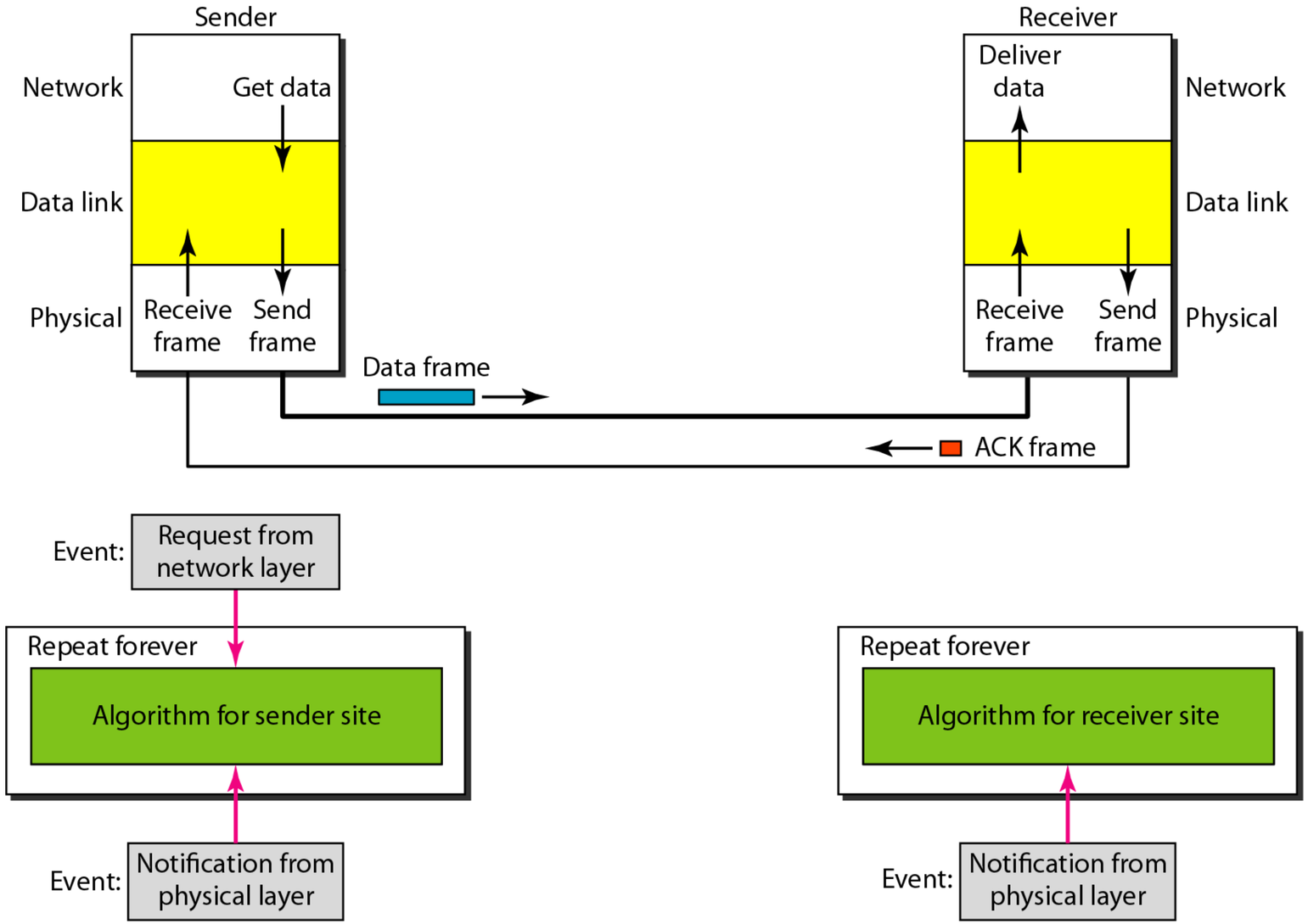
- Receiver

```
1  while(true)                          // Repeat forever
2  {
3   WaitForEvent();                     // Sleep until an event occurs
4   if(Event(ArrivalNotification))      //Data frame arrived
5   {
6       ReceiveFrame();
7       ExtractData();
8       DeliverData();                  //Deliver data to network layer
9   }
10 }
```

Stop-and-Wait Mechanism

- Still noiseless channel
- Receiver has limited buffer
  - Requires flow control
- Sender sends one frame at a time and wait for an acknowledgment

Stop-and-Wait: Overview



Stop-and-Wait: Pseudo Code

- Sender side

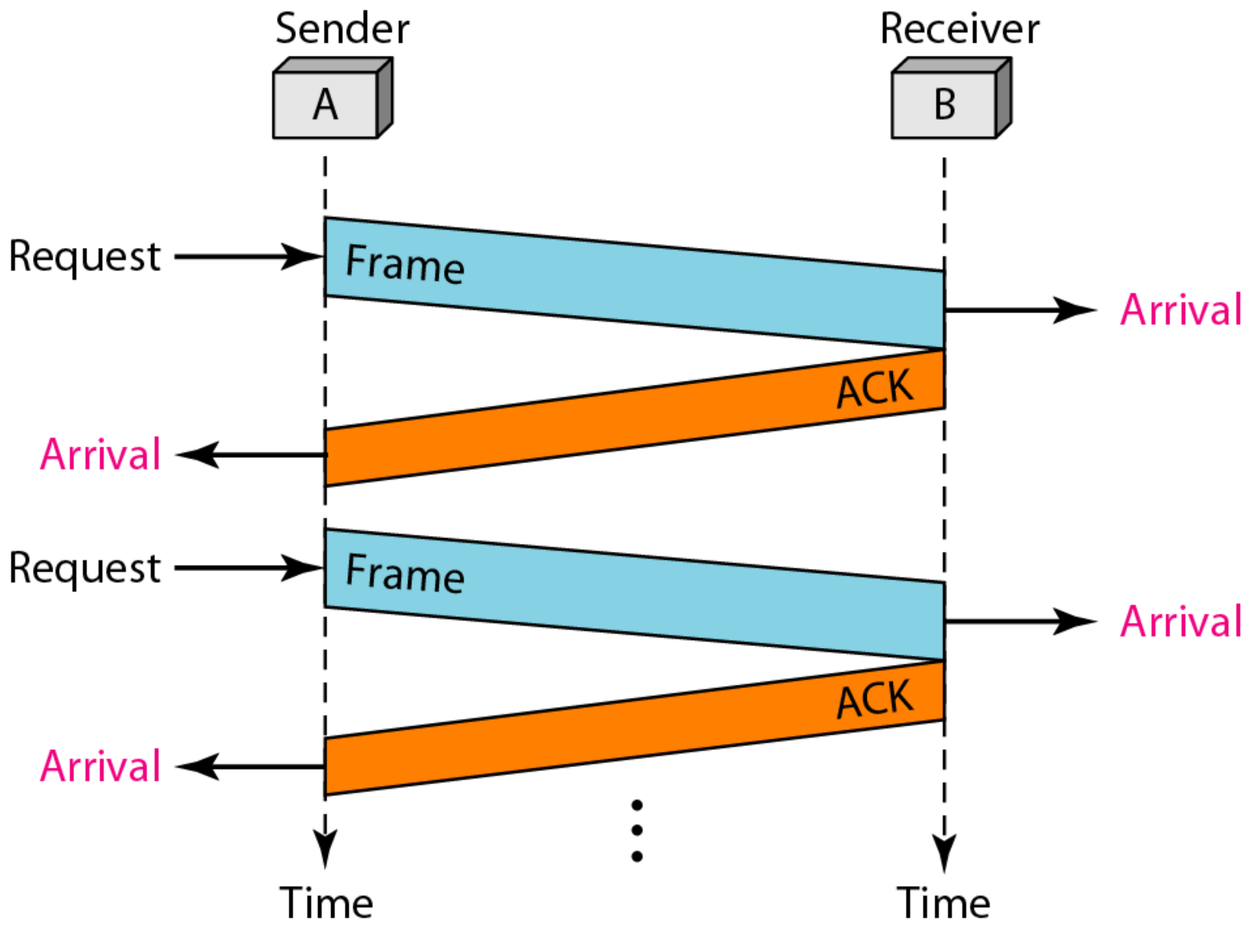
```
 1  while(true)                          //Repeat forever
 2  canSend = true                       //Allow the first frame to go
 3  {
 4    WaitForEvent();                    // Sleep until an event occurs
 5    if(Event(RequestToSend) AND canSend)
 6    {
 7       GetData();
 8       MakeFrame();
 9       SendFrame();                    //Send the data frame
10       canSend = false;                //Cannot send until ACK arrives
11    }
12    WaitForEvent();                    // Sleep until an event occurs
13    if(Event(ArrivalNotification)      // An ACK has arrived
14     {
15       ReceiveFrame();                 //Receive the ACK frame
16       canSend = true;
17     }
18  }
```

Stop-and-Wait: Pseudo Code

- Receiver side

```
 1  while(true)                          //Repeat forever
 2  {
 3    WaitForEvent();                    // Sleep until an event occurs
 4    if(Event(ArrivalNotification))     //Data frame arrives
 5    {
 6       ReceiveFrame();
 7       ExtractData();
 8       Deliver(data);                  //Deliver data to network layer
 9       SendFrame();                    //Send an ACK frame
10    }
11  }
```

Stop-and-Wait: Flow Diagram



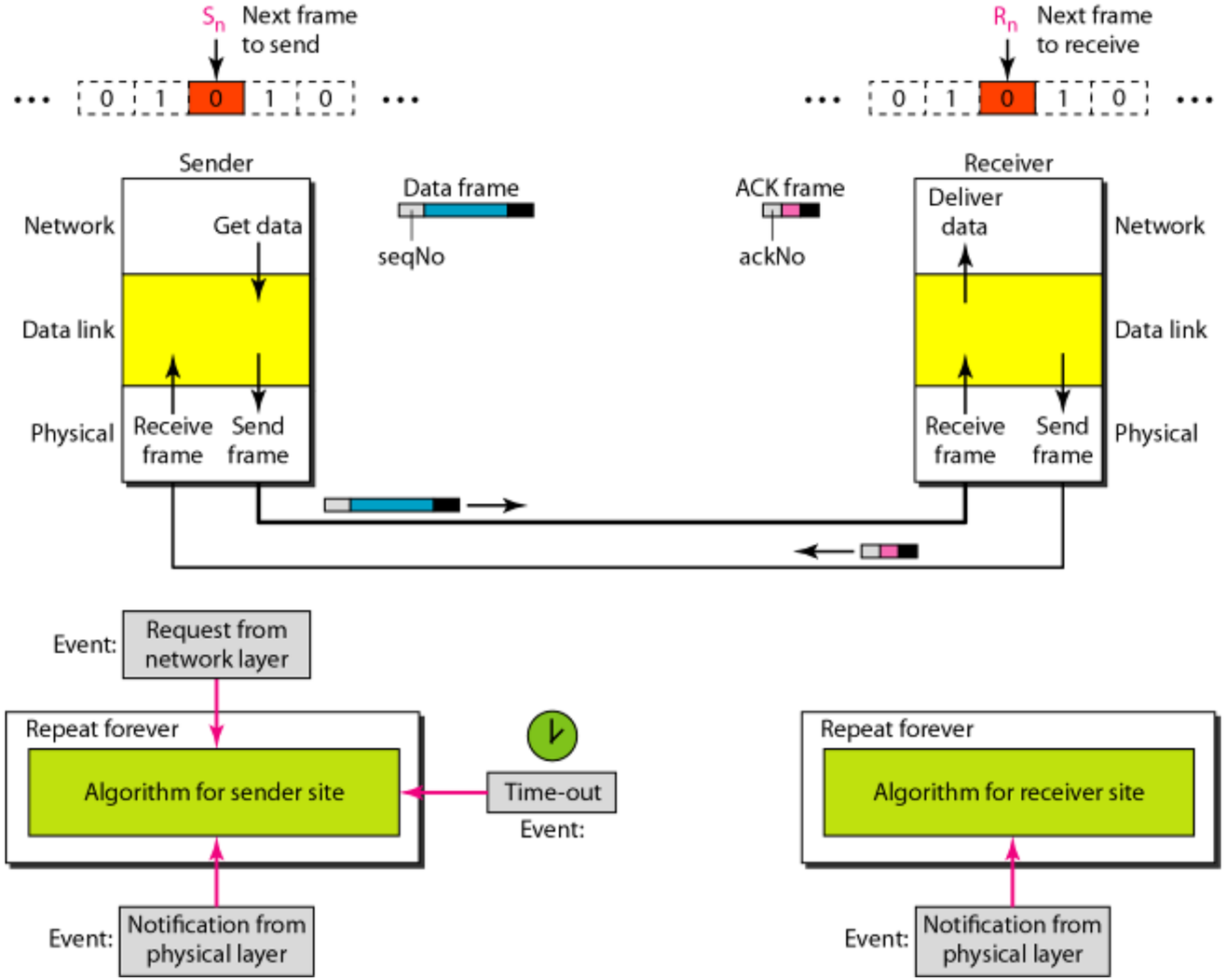
Noisy Channel

- Realistic
  - Error can and will happen
  - Require error control
- Mechanisms:
  - Stop-and-Wait ARQ
  - Go-Back-N ARQ
  - Selective Repeat ARQ

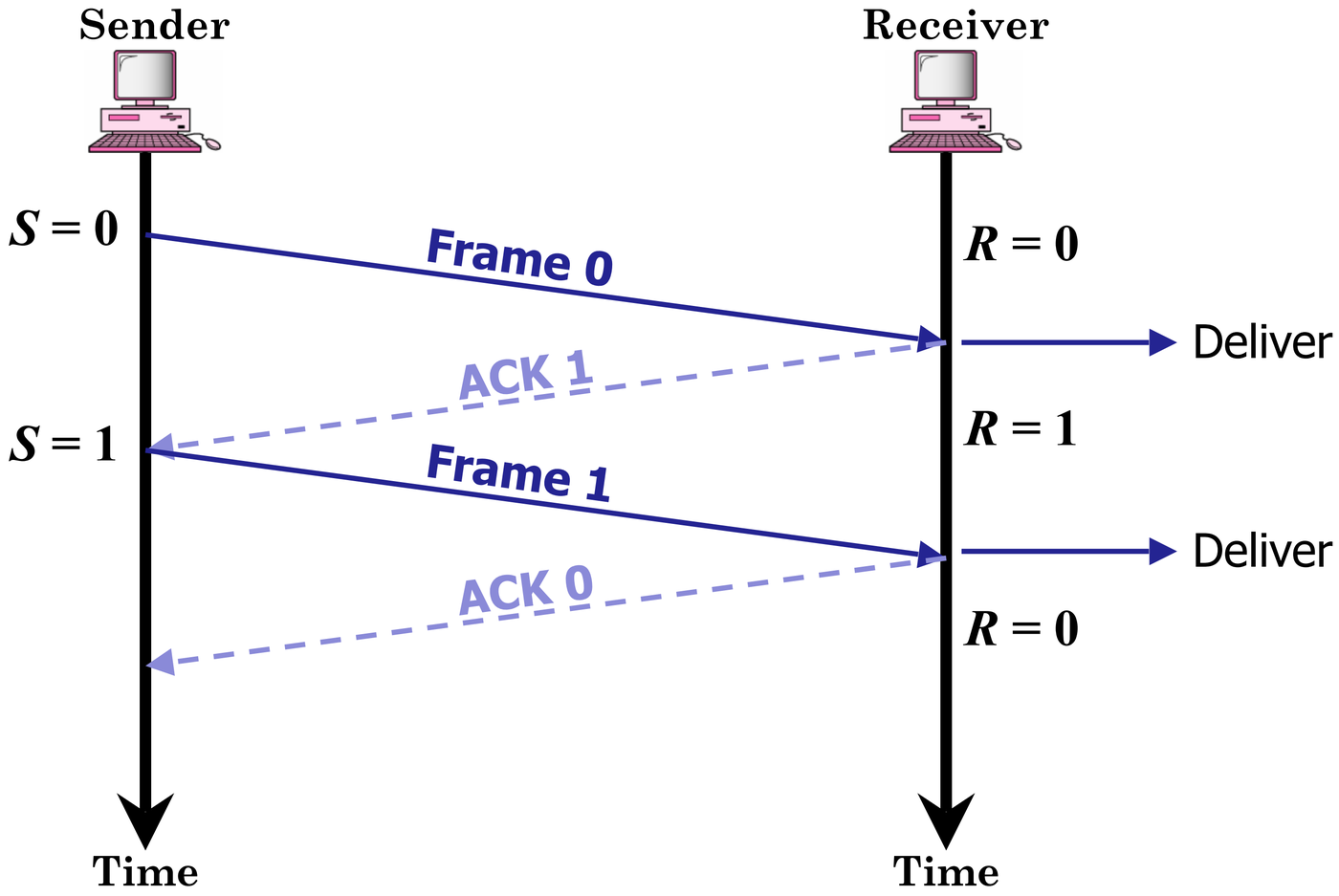
Stop-and-Wait ARQ

- Sender keeps a copy of sent frame until successful delivery is ensured
- Receiver responds with an ack when it successfully receives a frame
- Both data and ack frames must be numbered
- When sender does not receive an ack within certain time, it assumes frame is lost, then retransmits the same frame.

Stop-and-Wait ARQ



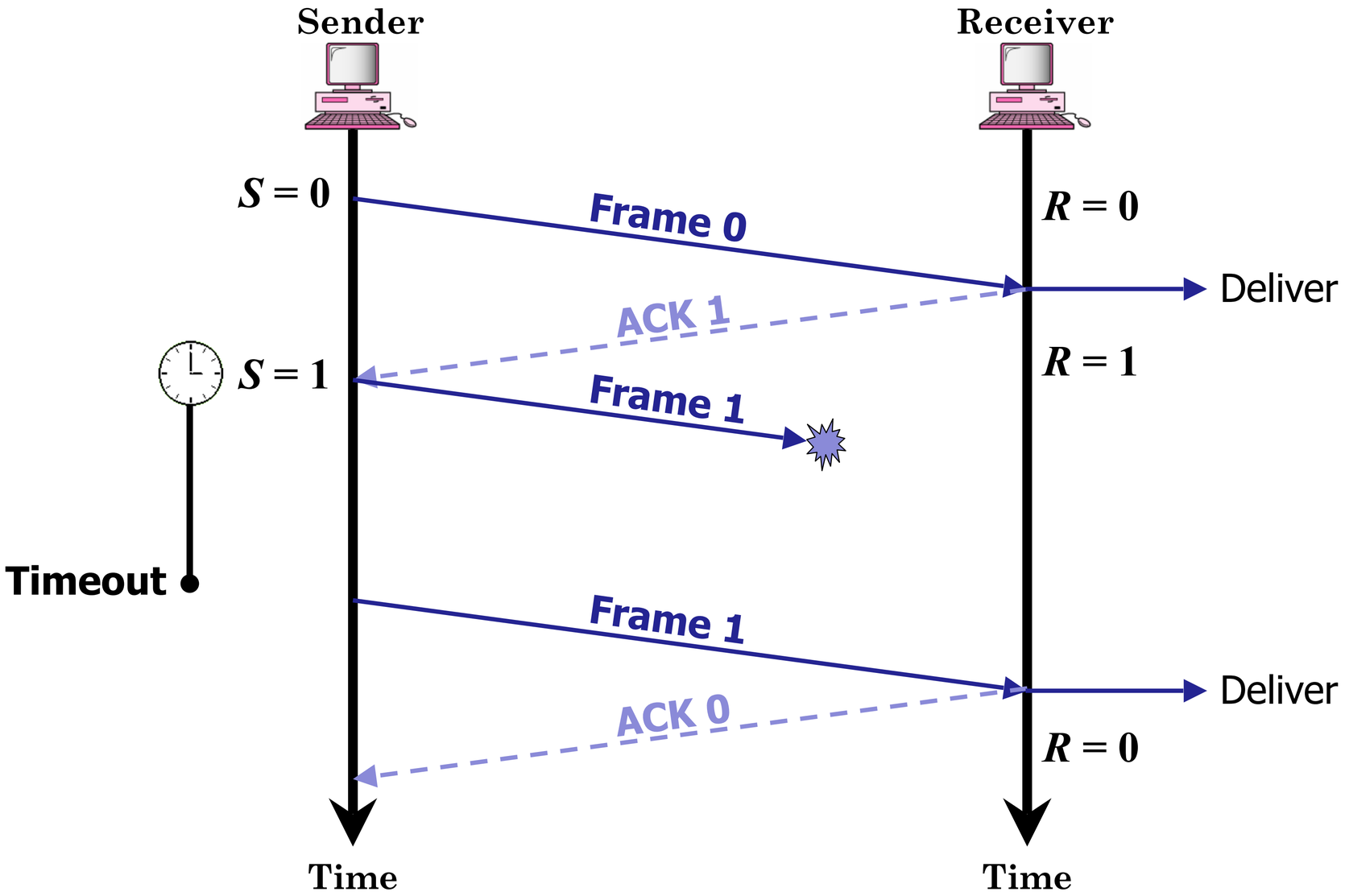
Flow Diagram: Normal Operation



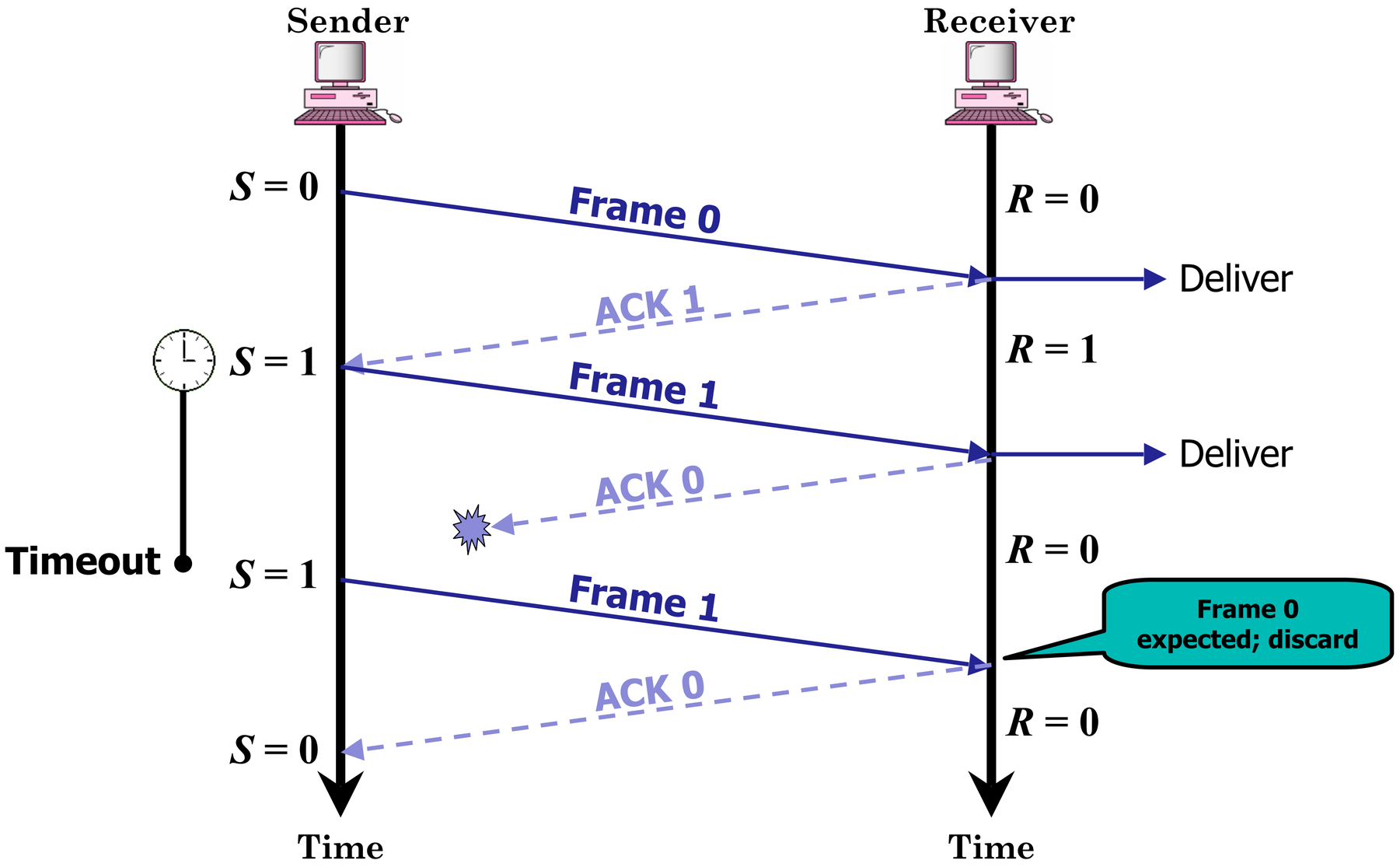
☺ Thinking Corner

- Why data frames need to be numbered?

Flow Diagram: Lost Frame



Flow Diagram: Lost ACK



☺ Thinking Corner

- Why ACK frames need to be numbered?

Flow Diagram: Delayed ACK