

# Data Link Control

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# TCP/IP Protocol Suite

- 5 Application
- 4 Transport
- 3 Network
- 2 Data Link
- 1 Physical

- Physical characteristics of interface
- Stream of Bits (e.g., 001010100100)
- Line config. (e.g., point-to-point)
- Topology (e.g., bus, star)
- Transmission mode (e.g., half-duplex, full-duplex)
- Encoding
- Error detection (and correction)

# TCP/IP Protocol Suite

- 5 Application
  - 4 Transport
  - 3 Network
  - 2 Data Link
  - 1 Physical
- Line Discipline
  - Flow Control
  - Error Control

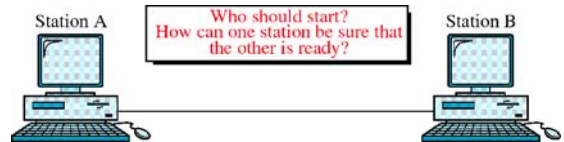
# Data Link Control

- Line Discipline** → Who Should send data and When ?
- Flow Control** → How much data may be sent?
- Error Control** → How can errors be Detected and correct?

# Data Link Control

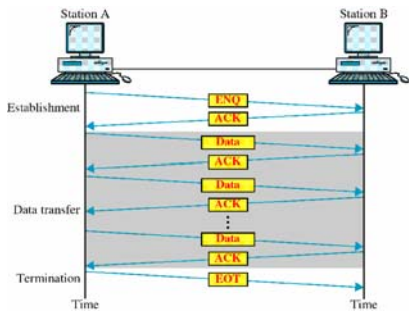
- Line Discipline** → ENQ / ACK  
Poll / Select
- Flow Control
- Error Control

# Line Discipline: ENQ/ACK



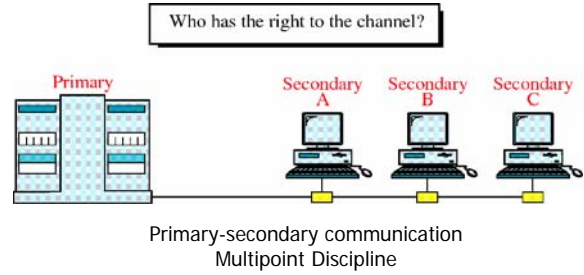
Peer-to-peer communication

## Line Discipline: ENQ/ACK



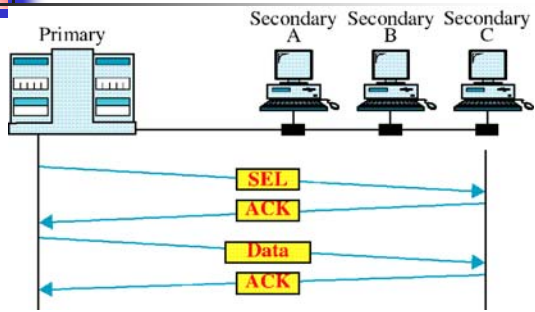
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## Line Discipline: Poll/Select



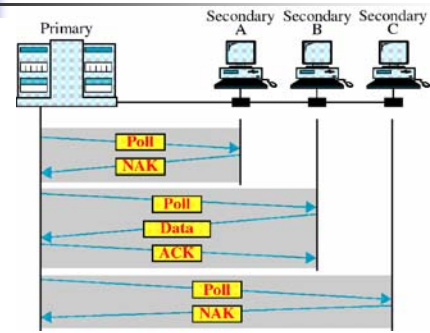
8

## Select



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## Poll



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## Data Link Control

Line Discipline

Flow Control

Error Control

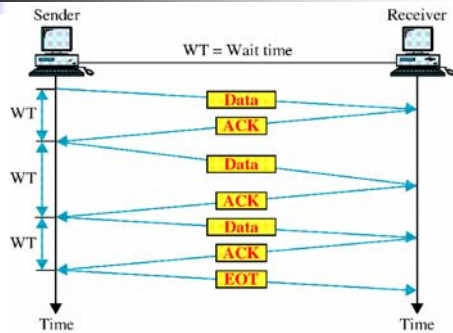
*a set of procedures used to restrict the amount of data that the sender can send*

**Stop-and-wait**  
(one frame at a time)

**Sliding window**  
(several frames at a time)

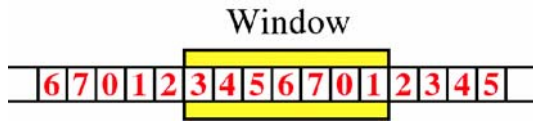
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## Stop-and-wait



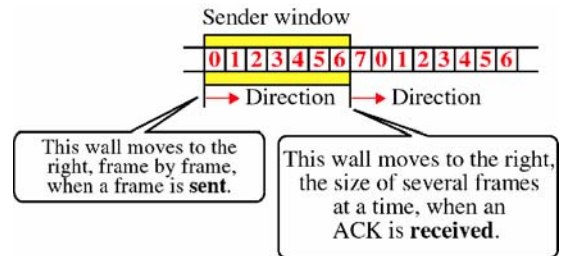
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## Sliding window



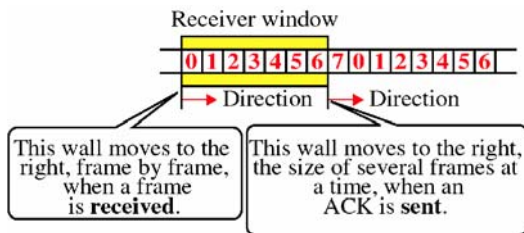
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## Sender sliding window



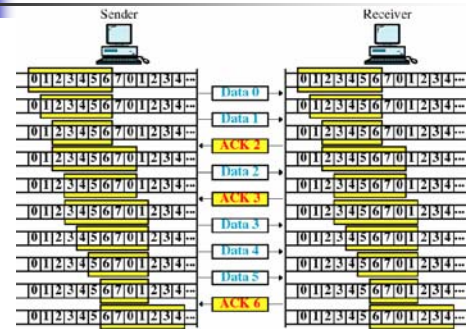
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## Receiver sliding window



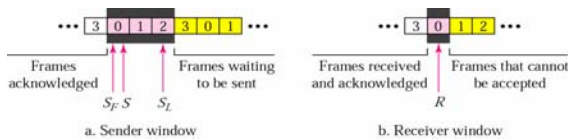
15

## Example of sliding window



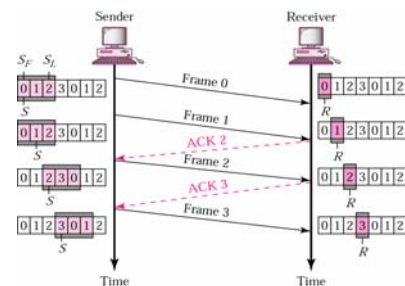
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## Control variable



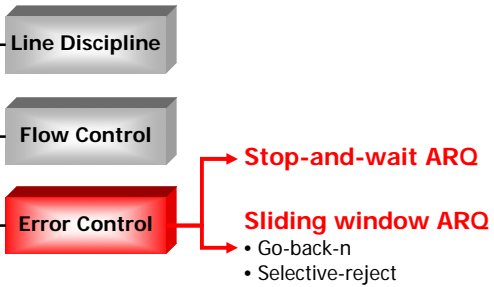
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## Example of sliding window



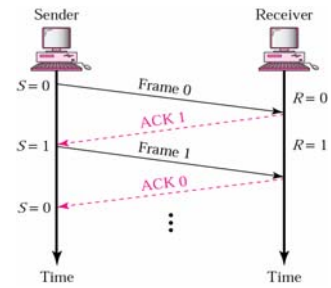
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## Data Link Control



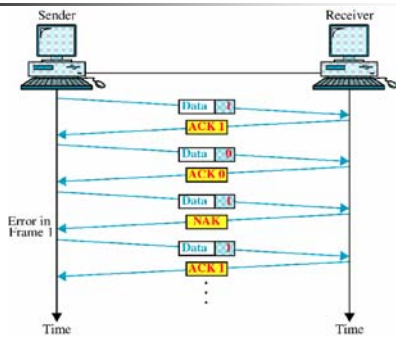
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## Stop-and-wait ARQ: Normal Operation



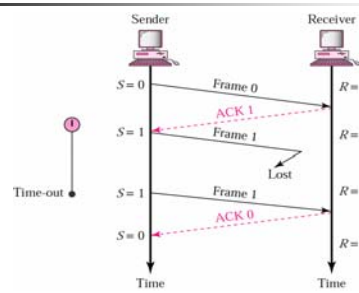
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## Stop-and-wait ARQ: Damaged frame



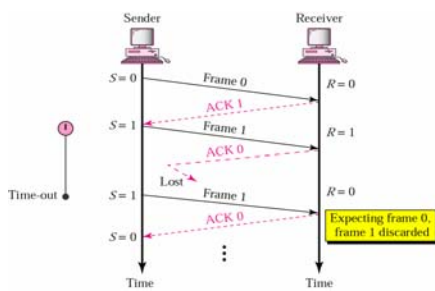
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## Stop-and-wait ARQ: Lost data frame



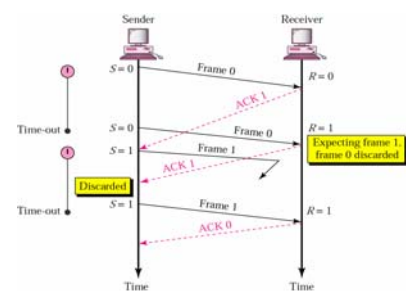
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## Stop-and-wait ARQ: Lost ACK frame



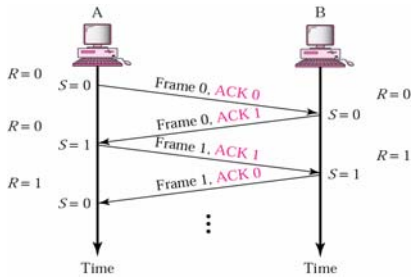
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## Stop-and-wait ARQ: Delay ACK



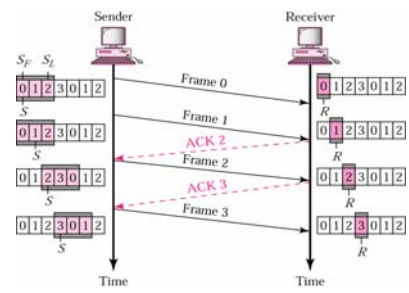
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## Stop-and-wait ARQ: Piggybacking



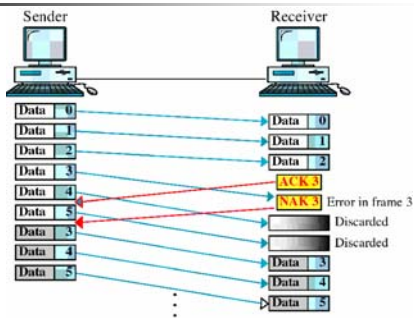
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## Sliding Window Go-back-n: Normal Operation



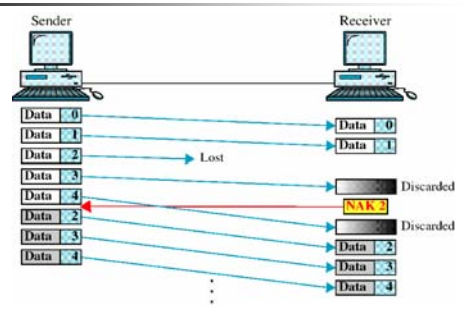
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## Sliding Window Go-back-n: Damaged data frame



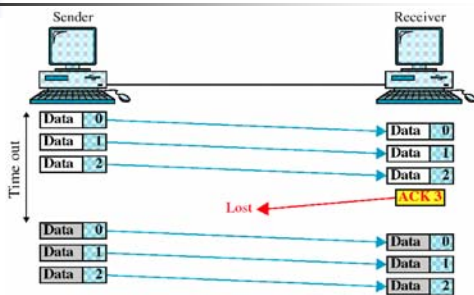
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## Sliding Window Go-back-n: Lost Data Frame



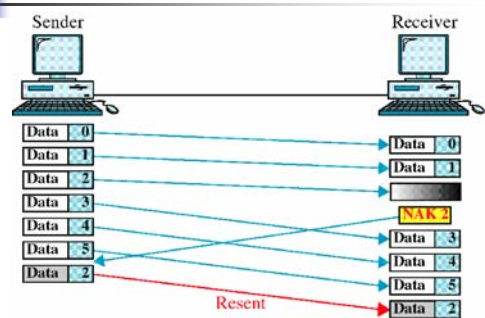
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## Sliding Window Go-back-n: Lost ACK



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## Sliding Window Selective-reject: Damaged data frame



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## Sliding window ARQ Comparison

- Go-back-n
  - Simple
  - More practical
- Selective-reject
  - Complex  
(sorting, storage, extra select frame logic)
  - Better performance