ARQ Protocols

Where are we?

- Stop-and-Wait ARQ: "Safe" and "Live"

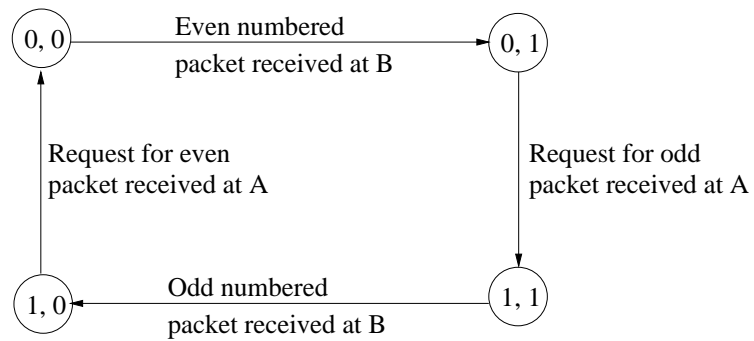Next:

- Can we implement Stop-and-Wait ARQ

- Is Stop-and-Wait ARQ efficient?
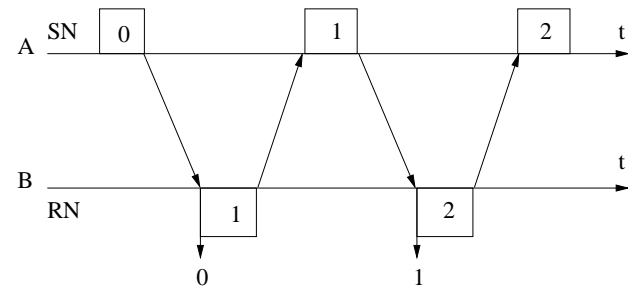
Sequence Numbers/Request Numbers
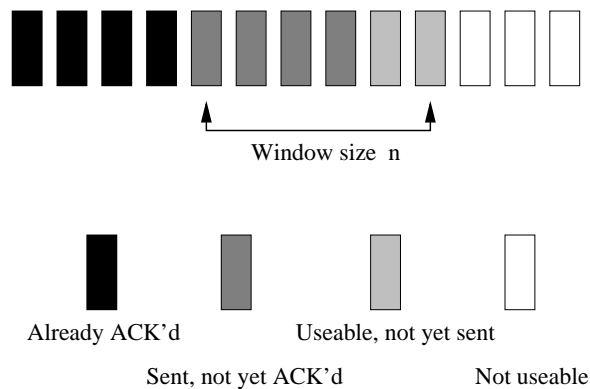
Stop-and-Wait ARQ Using Modulus 2

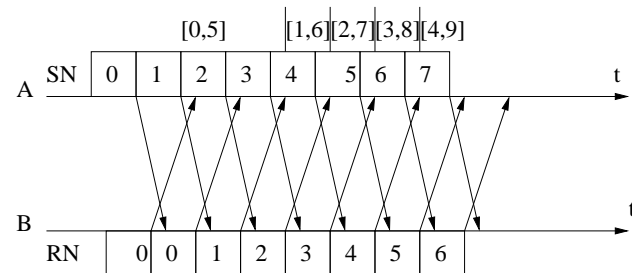0, 0 — Even numbered packet received at B → 0, 1

Request for even packet received at A

Request for odd packet received at A

1, 0 ← Odd numbered packet received at B — 1, 1

Is Stop-and-Wait Efficient?

A SN 0 1 2 t

B RN 1 2 t

0 1

Go-Back n ARQ

Window size n

Already ACK'd   Useable, not yet sent

Sent, not yet ACK'd   Not useable

Go-Back n ARQ

[0,5] [1,6][2,7][3,8][4,9]

A SN | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | t

B RN | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | t

Go-Back n ARQ

[0,5]   [1,6]   [2,7]

A SN | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | t

B RN | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 |

Go-Back n ARQ

[0,5]   [1,6]

A SN | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | t

B RN | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

Go-Back n ARQ

[0,5]

A SN | 0 | 1 | 2 | 3 | 4 | 5 | | | | | | | t

B t

RN | 0
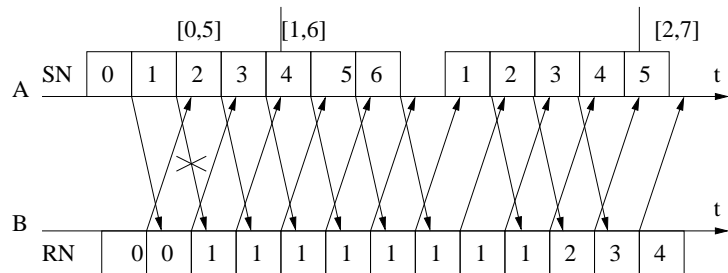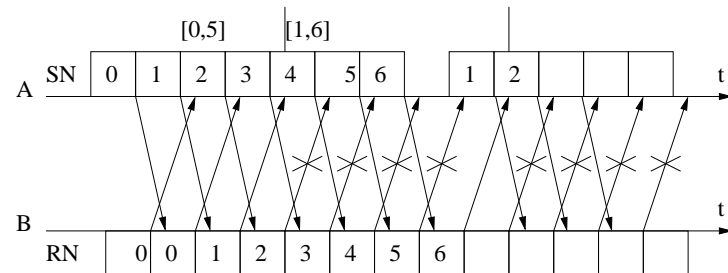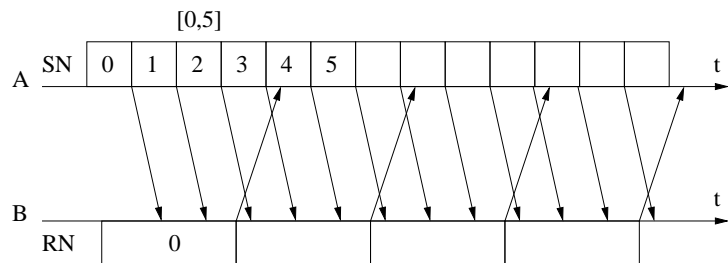
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Selective-Repeat ARQ: Sender

Window size n

Already ACK'd   Useable, not yet sent

Sent, not yet ACK'd   Not useable
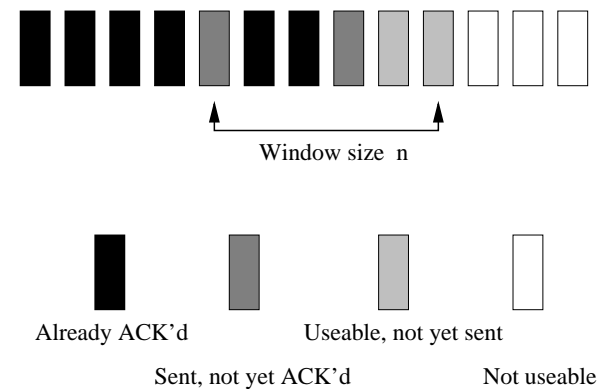
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Selective-Repeat ARQ: Receiver

Window size n

Out of Order (buffered)   Acceptable
but already ACK'd   (within window)

Expected, not yet received   Not useable

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Selective Repeat ARQ

[0,5]   [1,6]   [7,12]

A SN | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | | 1 | | 1 | | 7 | t

B t

RN | 0 | 0 | 1 | 1 | 3 | 4 | 5 | 6 | 7 | 7 | 2 | 2 | 2

[0,5] [1,6]   [7,12]
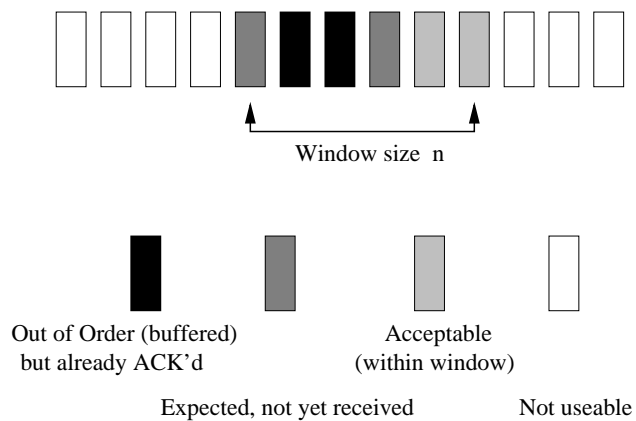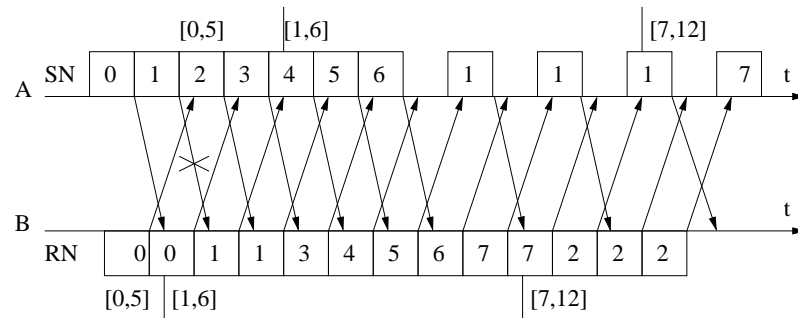
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Conditions for Modulus m

- Go-Back n ARQ: $m > n$

- Selective Repeat ARQ: $m \geq 2n$