Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

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Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
- MTech from Indian Institute of Information Technology, Gwalior
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
- Google Scholar: https://scholar.google.com/citations?user=UZ_8yAMAAAAJ&hl=hi
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About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-8
- UNIT 3: Lecture No 9-13
- UNIT 4: Lecture No 14-10
- UNIT 5: Lecture No 20-25
- Lecture No 26-35 to Discuss Question Paper of Previous 5 Years
- Out of 35 Lectures: 10 will delivered by Professor From Foreign University

Data Link Layer

OUTLINE OF LECTURE 6

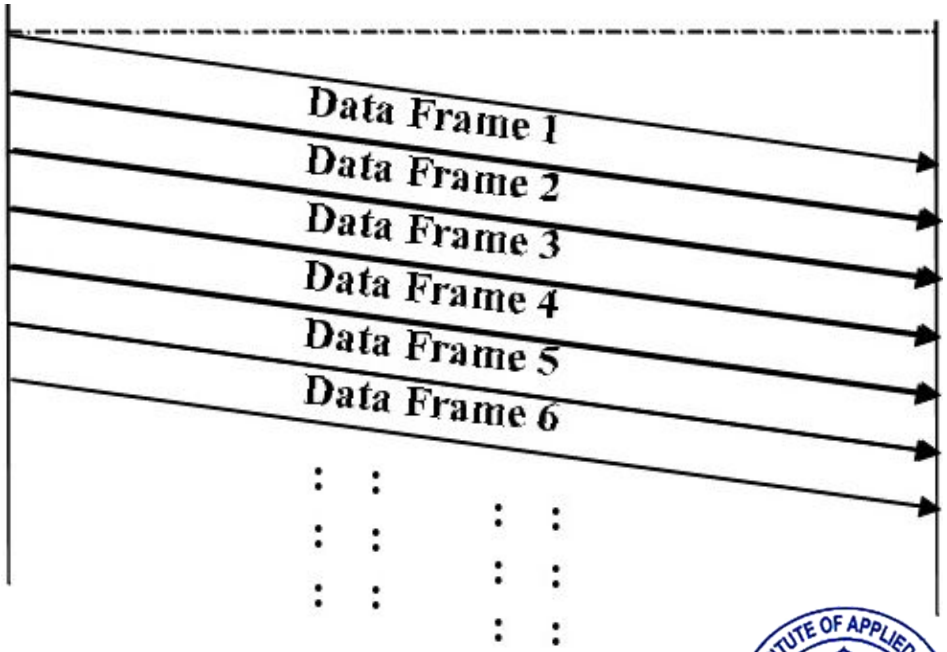
- Data Link Layer Protocol:
  - Elementary Protocol:
    - An Unrestricted Simplex Protocol
    - A Simplex Stop-and-Wait Protocol
  - Sliding Window protocol:
    - 1-Bit
    - Go-Back-N
    - Selective Repeat
- Hybrid ARQ

Elementary Data Link Protocols

- An Unrestricted Simplex Protocol
- A Simplex Stop-and-Wait Protocol

An Unrestricted Simplex Protocol

- Data is transmitted in only one direction.
- The sender uses a while loop and it continuously sends the data to the receiver.
- The receiver is always ready to receiver the frame.
- The problem of flooding created, in which the sender sends the data continuously to the receiver and a condition like flood is created at the receiver's end.



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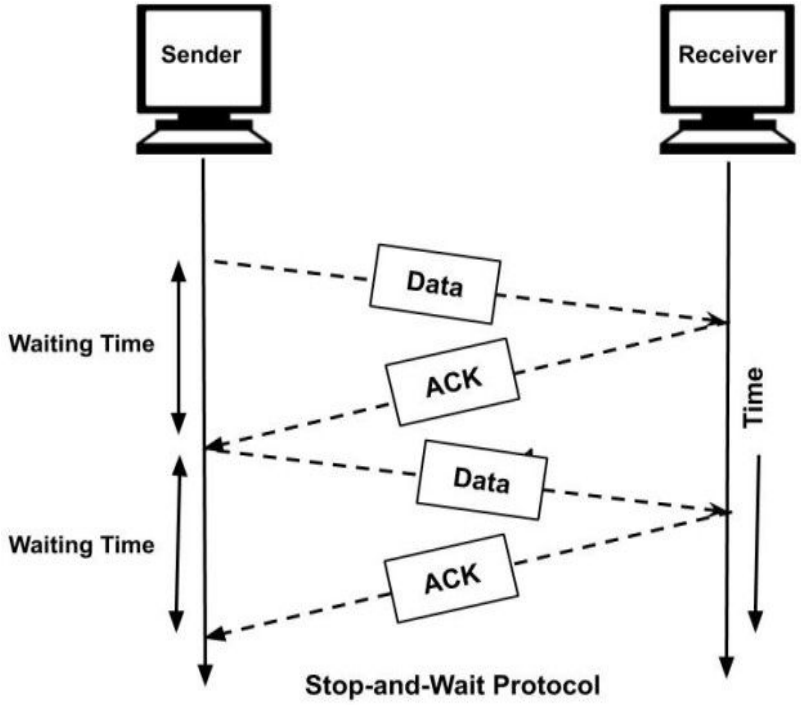
Stop-and-Wait Protocol

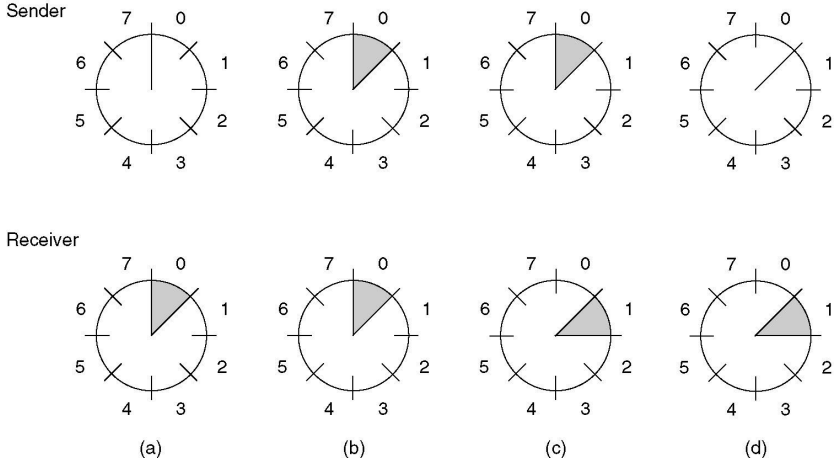
- To deal with the problem of flooding (in simplex protocol) in which the sender sends the data continuously to the receiver and a condition like flood is created at the receiver's end.
- To prevent this we use stop and wait protocol.
- The sender sends the frame and then wait until the acknowledgement is received by the receiver.
- This is called stop and wait protocol.



Sliding Window Protocols

- A One-Bit Sliding Window Protocol
- A Protocol Using Go Back N
- A Protocol Using Selective Repeat

One-Bit Sliding Window Protocol



A sliding window of size 1, with a 3-bit sequence number.

(a) Initially.

(b) After the first frame has been sent.

(c) After the first frame has been received.

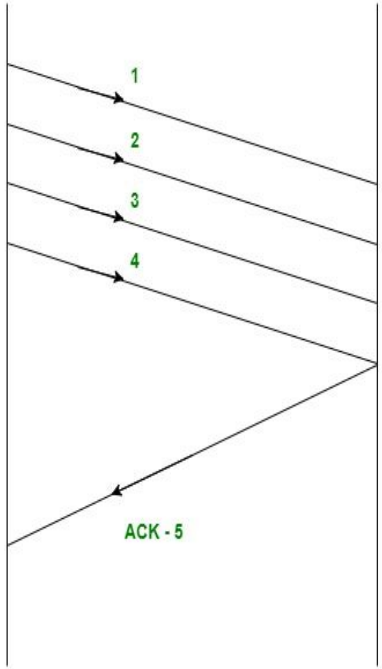
(d) After the first acknowledgement has been received

Go Back N Sliding Window Protocol

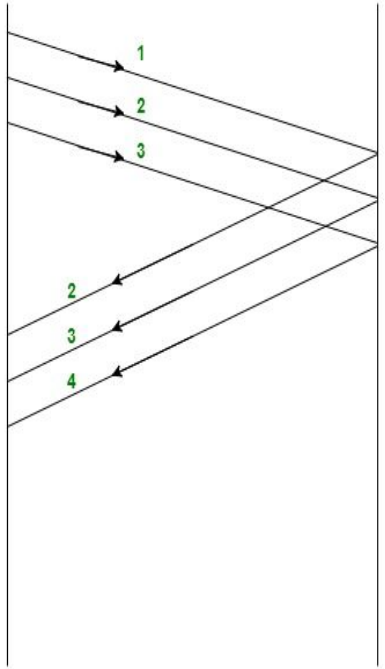
- In Go back N,
  - Sender window size = N. Example in Go back 10, sender window size will be 10.
  - Receiver window size is always 1 for any value of N.
- In Go back N,
  - Receiver maintains an acknowledgement timer for cumulative ack only.
  - Each time the receiver receives a new frame, it starts a new acknowledgement timer.
  - After the timer expires, receiver sends the cumulative acknowledgement for all the frames that are unacknowledged at that moment.

Types of Acknowledgement

- **Cumulative Ack**: One acknowledgement is used for many packets. The main advantage is traffic is less. A disadvantage is less reliability as if one ack is the loss that would mean that all the packets sent are lost.
- **Independent Ack**: If every packet is going to get acknowledgement independently. Reliability is high here but a disadvantage is that traffic is also high since for every packet we are receiving independent ack.

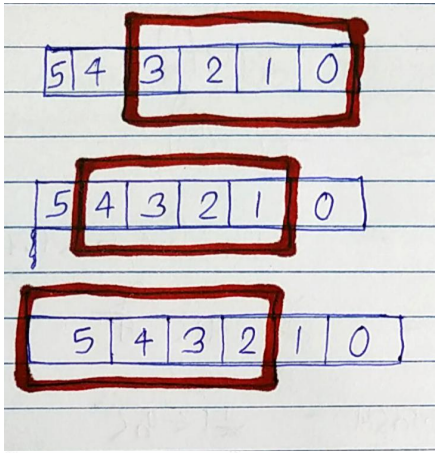


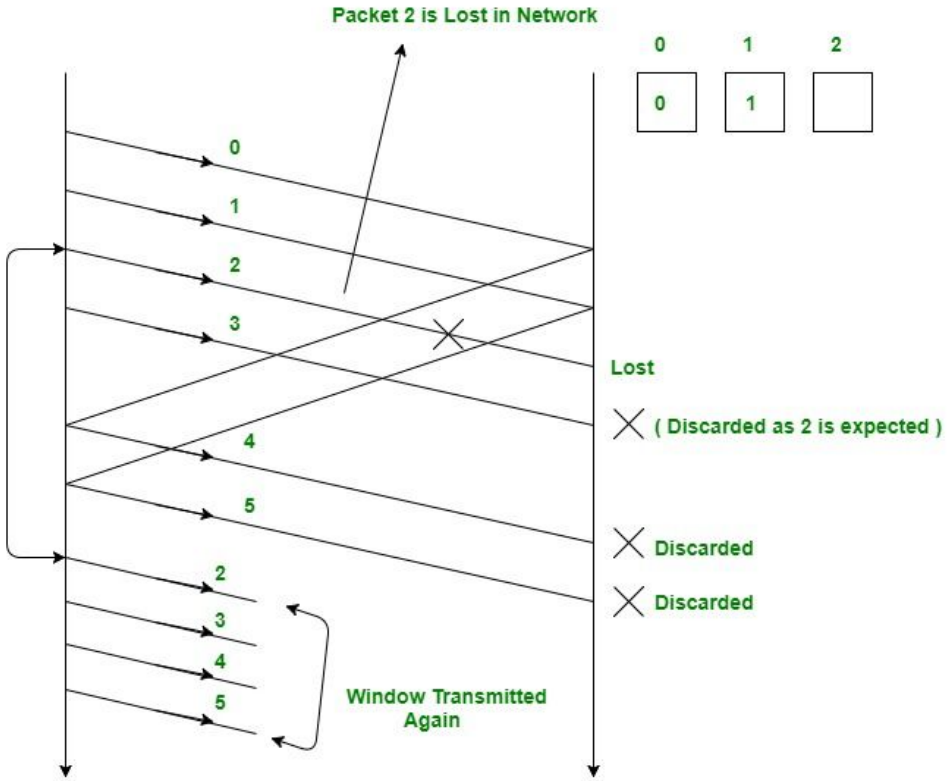
Cummulative



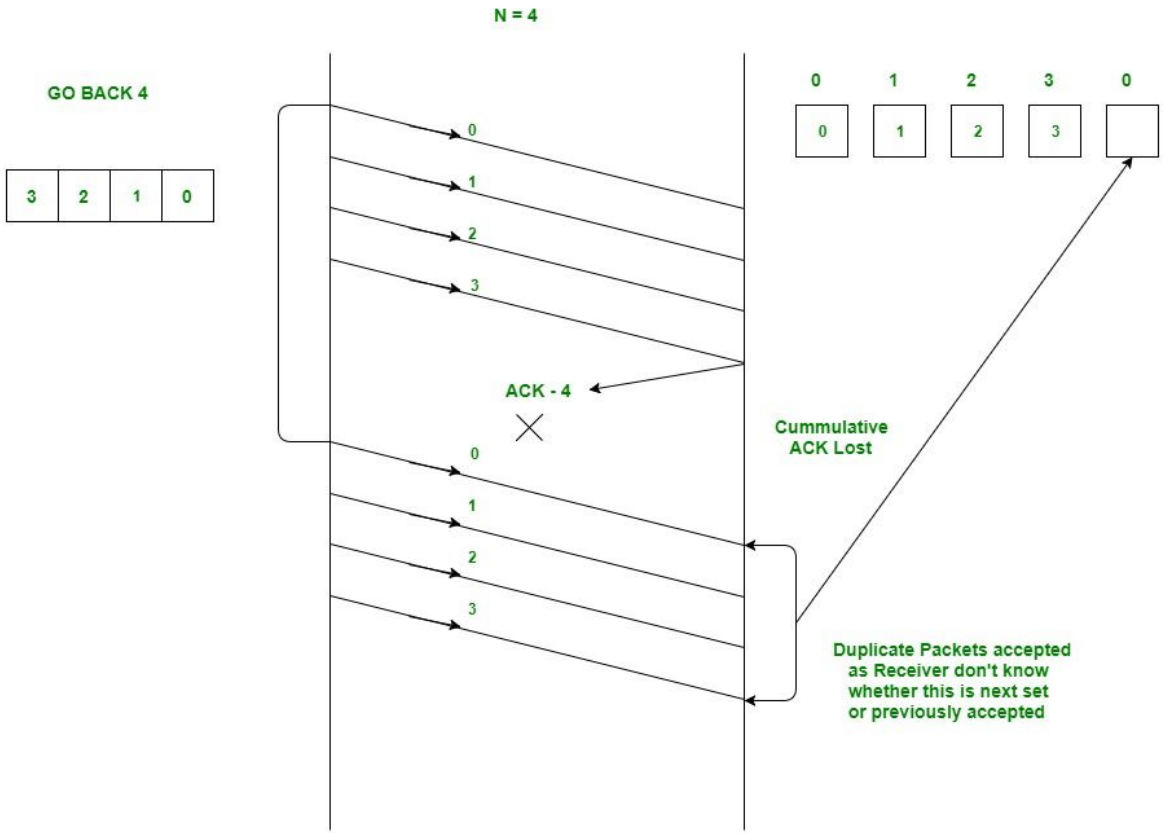
INDEPENDENT

Sliding Window Protocol Using Go Back 4

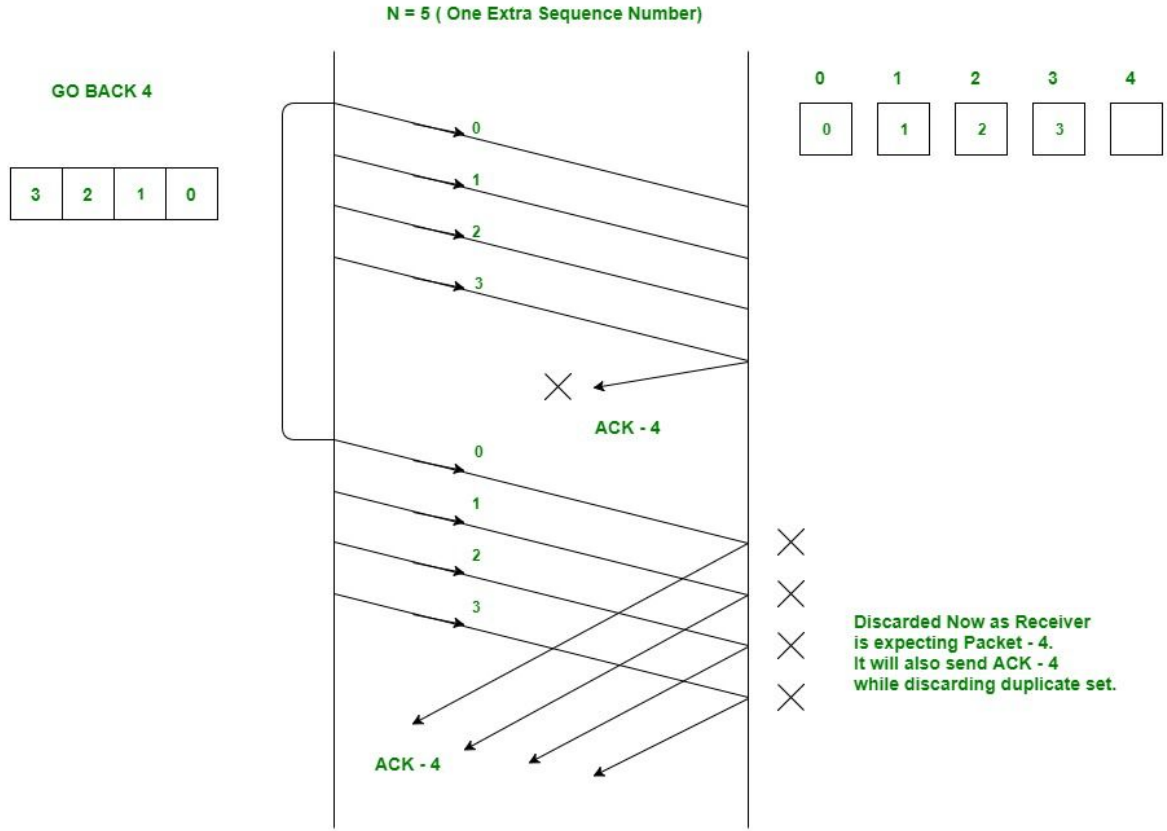




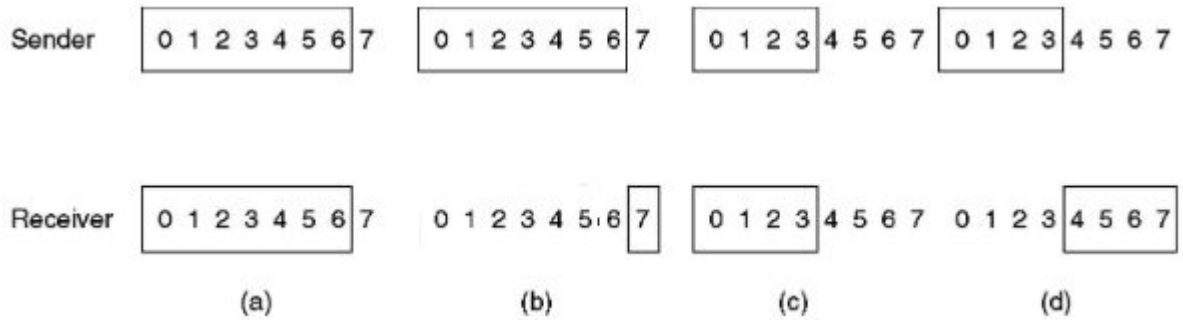
Sliding Window Protocol Using Go Back 4



Sliding Window Protocol Using Go Back 4



Sliding Window Protocol with Selective Repeat



(a) Initial situation with a window size seven.

(b) After seven frames sent and received, but not acknowledged.

(c) Initial situation with a window size of four.

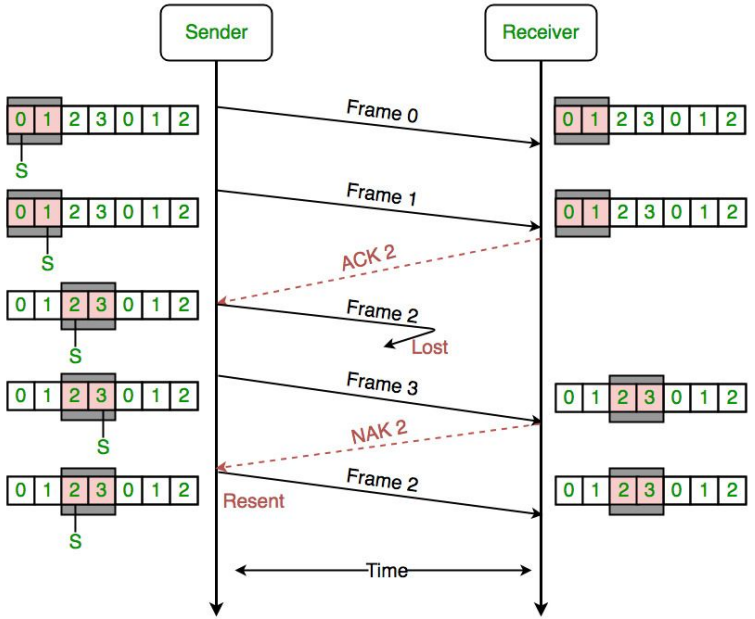
(d) After four frames sent and received, but not acknowledged

Sliding Window Protocol Using Selective Repeat

- The go-back-n protocol works well if errors are less, but if the line is poor it wastes a lot of bandwidth on retransmitted frames.
- Selective Repeat attempts to retransmit only those packets that are actually lost (due to errors) :
  - Receiver must be able to accept packets out of order.
  - Since receiver must release packets to higher layer in order, the receiver must be able to buffer some packets.

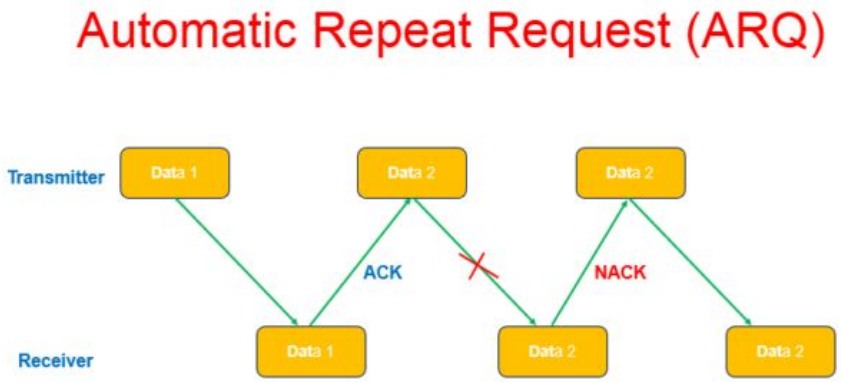
Sliding Window Protocol Using Selective Repeat

- This protocol(SRP) is mostly identical to GBN protocol, except that buffers are used at both the receiver, and the sender, each maintain a window of size.
- Sender's Windows (Ws) = Receiver's Windows (Wr).
- Sender can transmit new packets as long as their number is with W of all unACKed packets.
- Sender retransmit un-ACKed packets after a timeout – Or upon a NAK if NAK is employed.
- Receiver ACKs all correct packets.



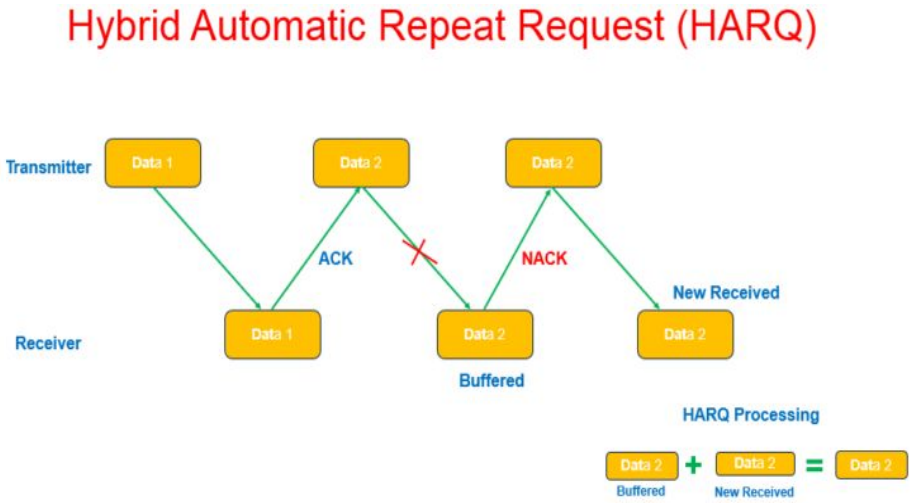
Simple Hybrid ARQ

- HARQ stands for Hybrid Automatic Repeat Request. **HARQ = ARQ + FEC** (Forward Error Correction)/Soft Combining.
- ARQ refers to Automatic Repeat Request i.e. if sender doesn't receive Acknowledgement (ACK) before timeout, the receiver discards the bad packet and sender shall re-transmits the packet. ARQ procedure is illustrated below :

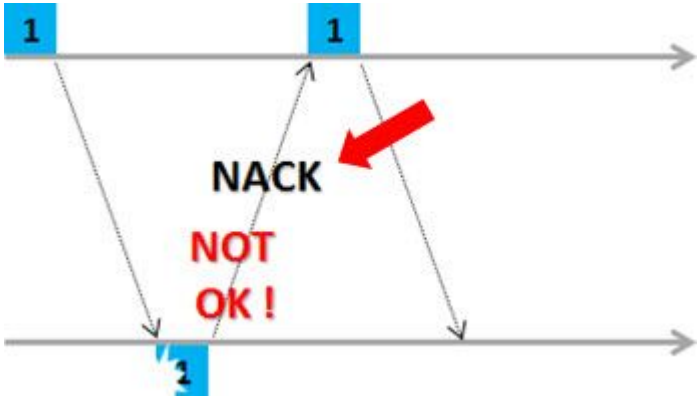


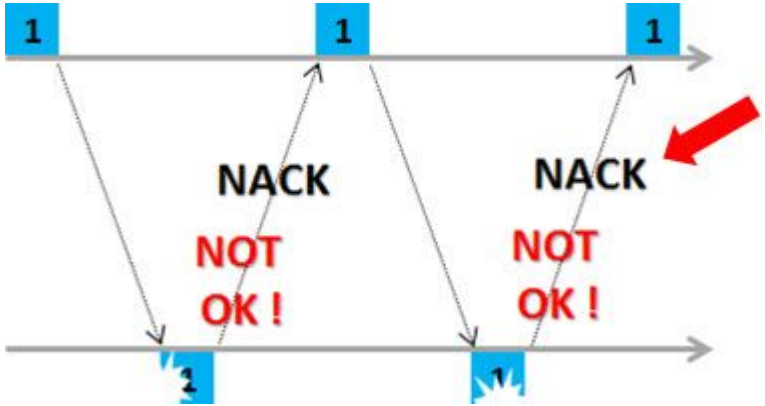
Simple Hybrid ARQ

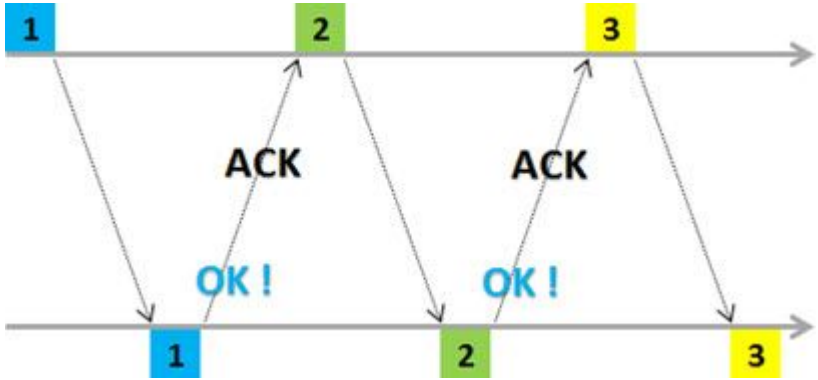
- Soft Combining is an error correction technique in which the bad packets are not discarded but stored in a buffer.
- The basic idea is that 2 or more packets received with insufficient information can be combined together in such a way that total signal can be decoded. HARQ procedure is as follows:



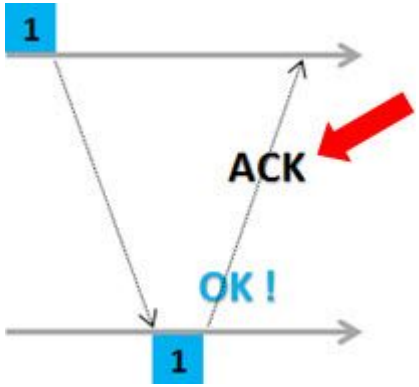
ARQ

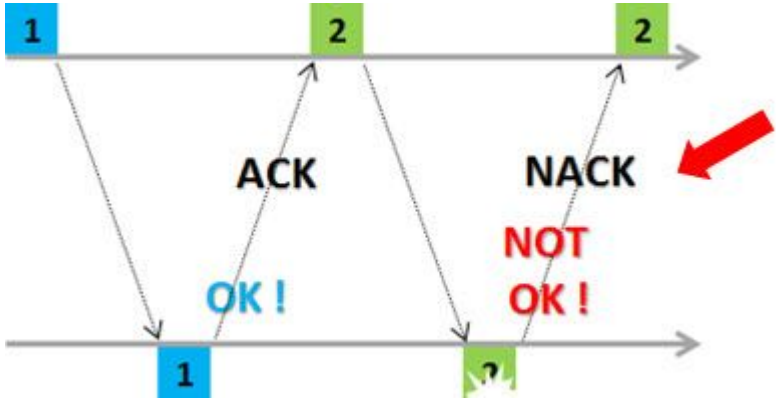


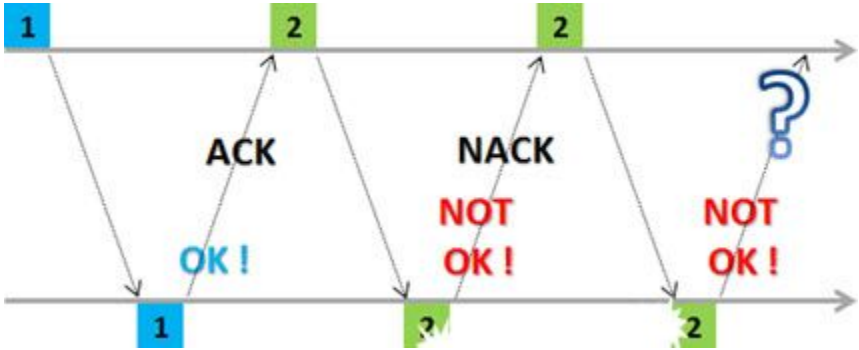


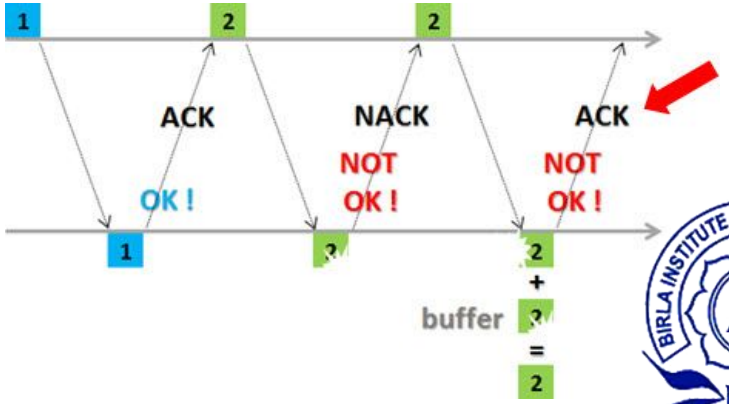


Hybrid ARQ









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OUTLINE OF TOMORROW LECTURE 7

- ARP
- RARP
- GARP
- Protocol verification:
  - Finite State Machine Models
  - Petri net models.