

Error Control and Detection

Fundamentos de Redes

**Mestrado Integrado em
Engenharia de Computadores e Telemática
DETI-UA**

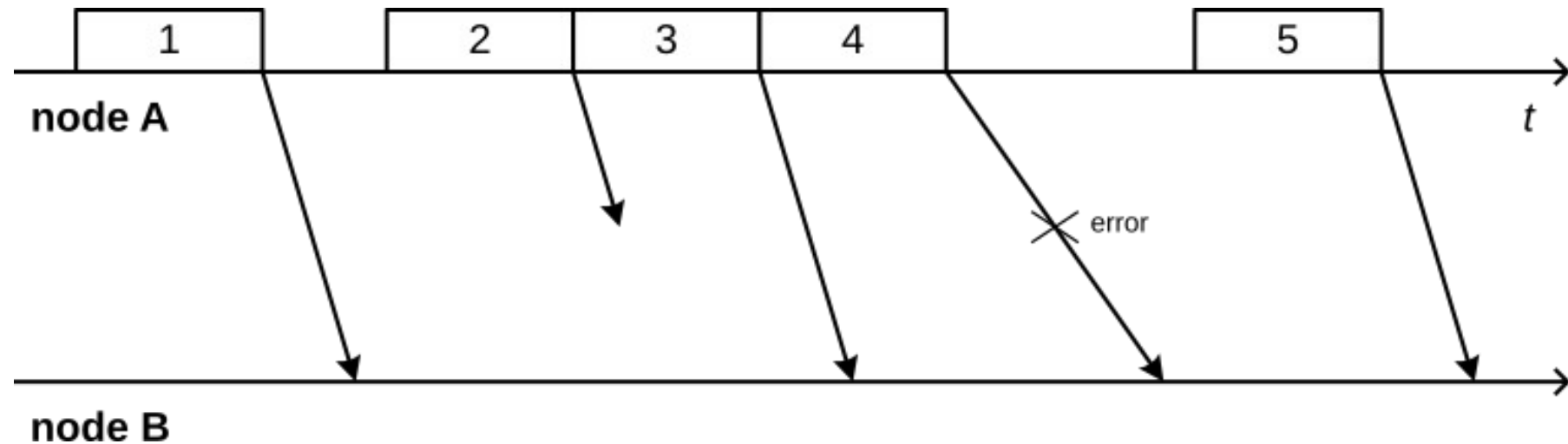
Error Control in a Communication Channel

- Causes:
 - Corrupted packets (data received with errors);
 - Lost packets;
 - Packets received out of order.
- Solutions:
 - Sender and receiver must be able to coordinate between them to re-transmit a lost or corrupted packet.
 - Retransmit protocols: ARQ (Automatic Repeat reQuest).



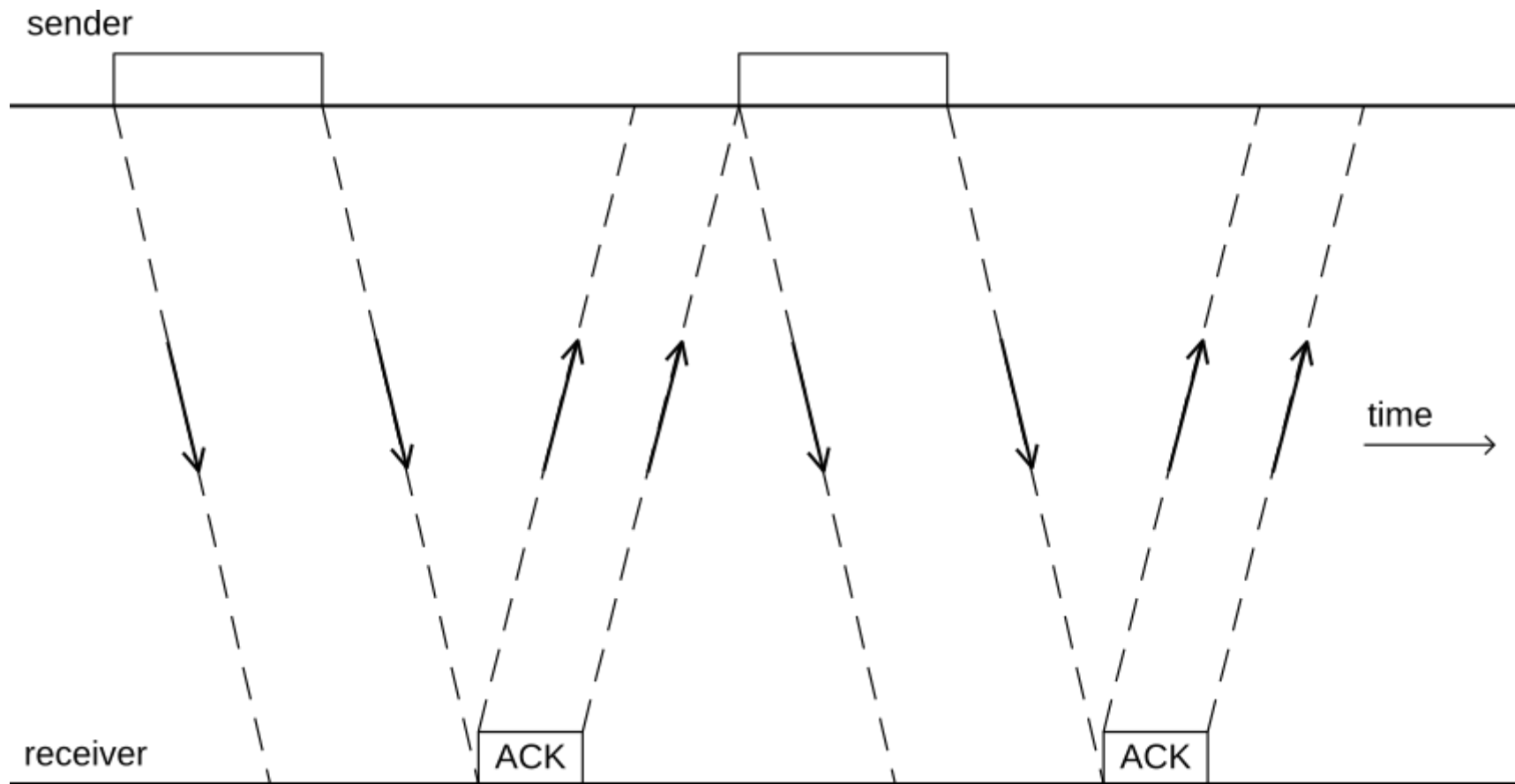
Error Control Assumptions

- Errors are always detected;
- Frames/packets may have variable (limited) delays:
- Some frames/packets may be lost.



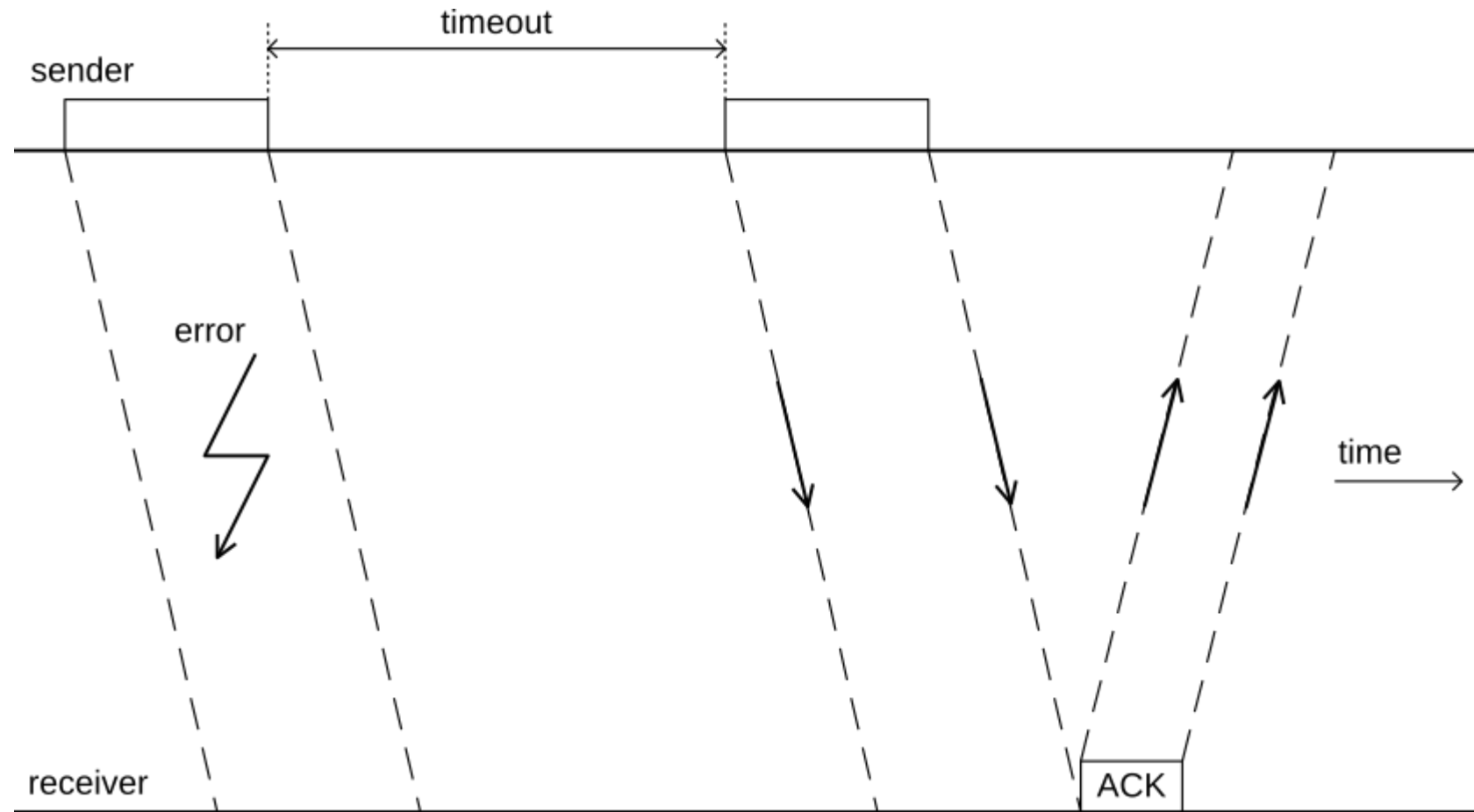
Stop-and-Wait (SW)

- Operation without errors:



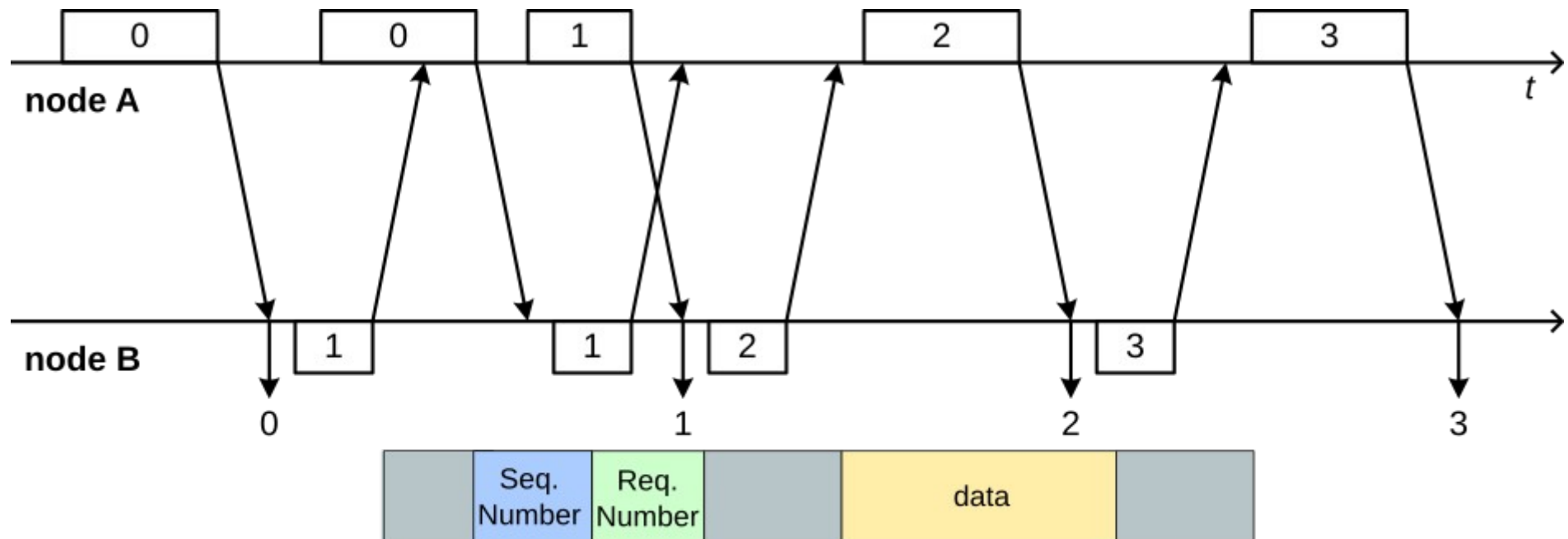
Stop-and-Wait (SW)

- Operation with error and recover:



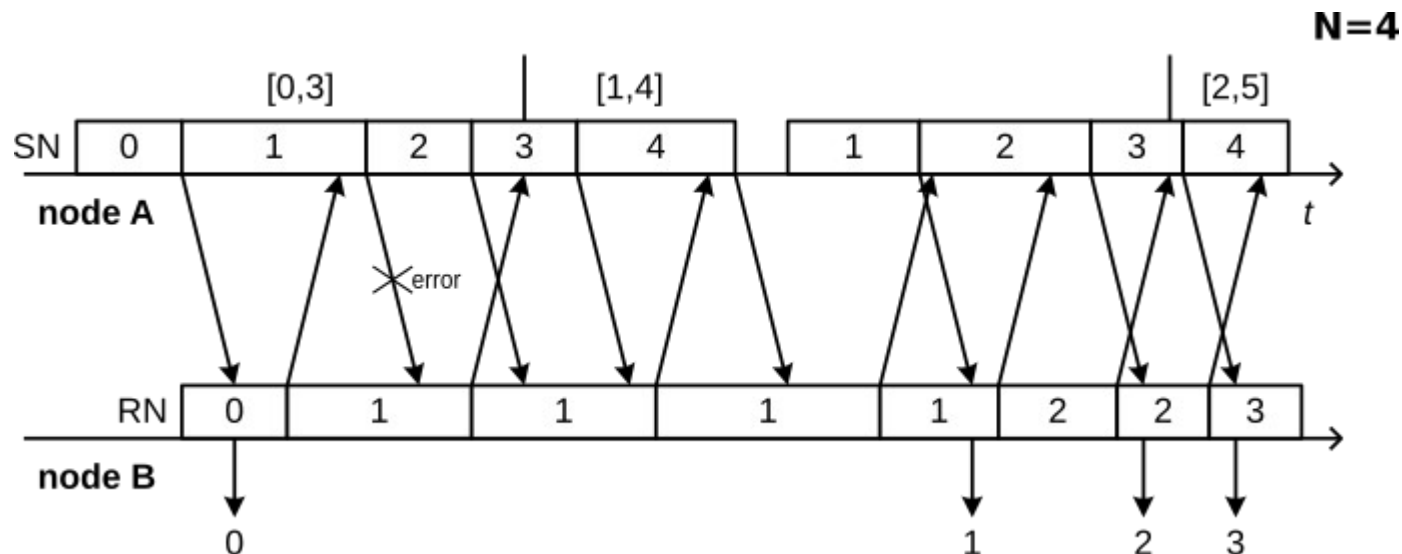
Stop-and-Wait (SW)

- Messages have a sequence number and a request number.
 - The sequence number identifies the messages sent.
 - The request number allow the receiver to notify the sender about the received message and next message expected.



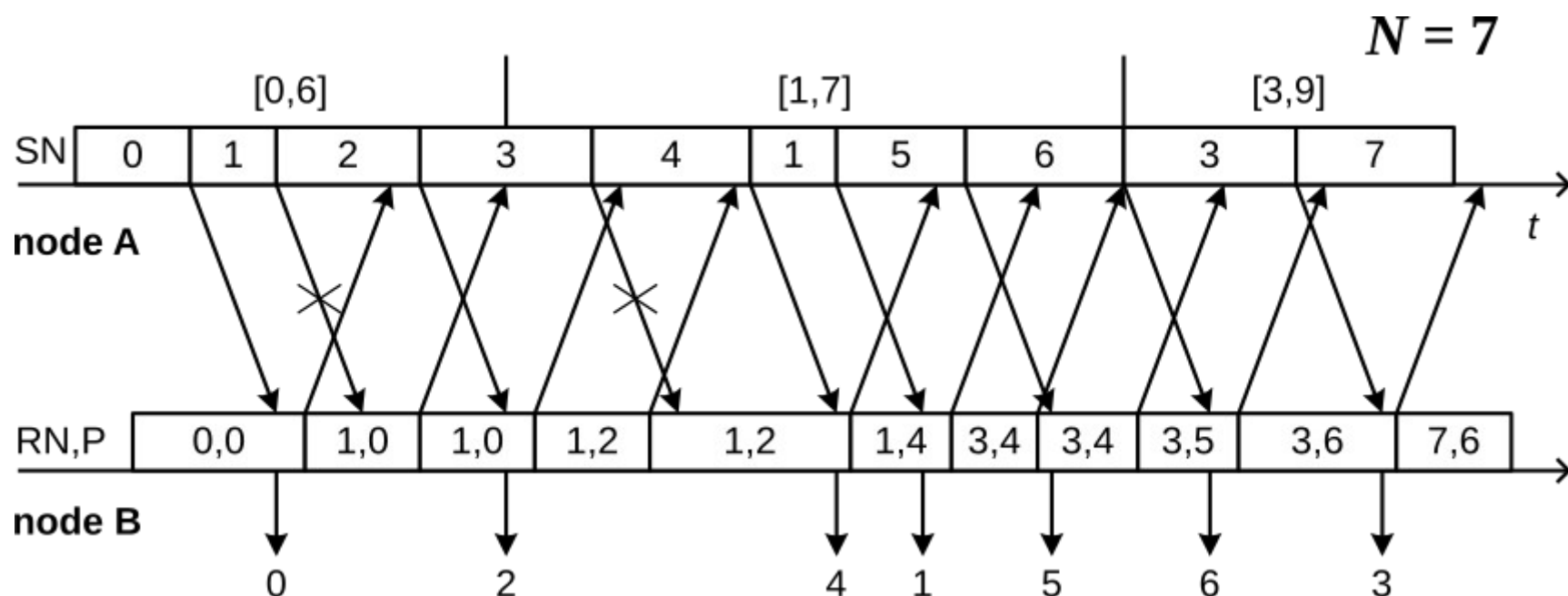
Go-Back-N (GB-N)

- The sender is allowed to send more than one message before receiving the confirmation of reception of the previous messages.
 - Window with size N – N defines the number of messages that may be sent without confirmation of reception of the first.
- The sender, after a timeout, resends the first message without confirmation of reception and all of the following.
- The receiver, after receiving all messages until a sequence number equal to n ($SN=n$), accepts only the message with $SN=n+1$.
 - Drops all the others.
- The receiver, responds with a request number (RN) to identified the next message not received.
 - Implicitly, indicates that all messages up to RN were correctly received.



Selective Repeat (SR)

- The sender is allowed to send more than one message before receiving the confirmation of reception of the previous messages.
 - Window with size $N - N$ defines the number of messages that may be sent without confirmation of reception of the first.
- The sender, after a timeout, resends a message without confirmation of reception.
- The receiver, after receiving all messages until a sequence number equal to n ($SN=n$), accepts to receive all messages with $SN>n$ and $SN \leq N+n$.
- The receiver, responds with a request number (RN) to identified the next message not received, and the higher payload/message number correctly received (P).



Error Detection

- Performed at multiple Layers.

- Nowadays the (new protocols) tendency is to be performed only at the physical/link layer and application layer.
 - Has a performance impact.
 - E.g., IPv4 supports it, IPv6 does not.

- Methods

- CRC (Cyclic-Redundancy Check)
 - Based on the theory of cyclic error-correcting codes.
 - Adds a fixed-length check value to messages.
 - Requires of a generator polynomial.
 - The binary message with the CRC field is divided by the generator polynomial.
 - No errors imply remainder equal to zero.
- Checksums and hash/digest values
 - Generated by a predefined function that receives as input all message bits.
 - Value is appended to message.

