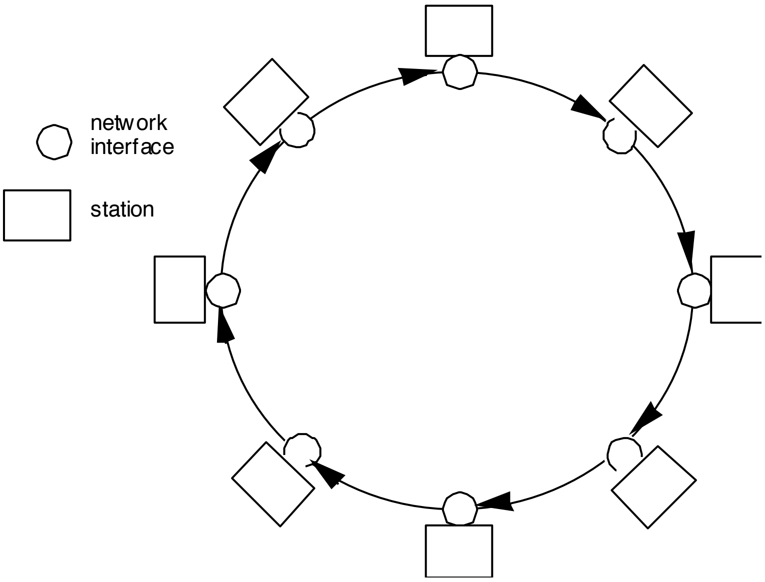
TOKEN RING (TOR)

Protocol definition

Network topology

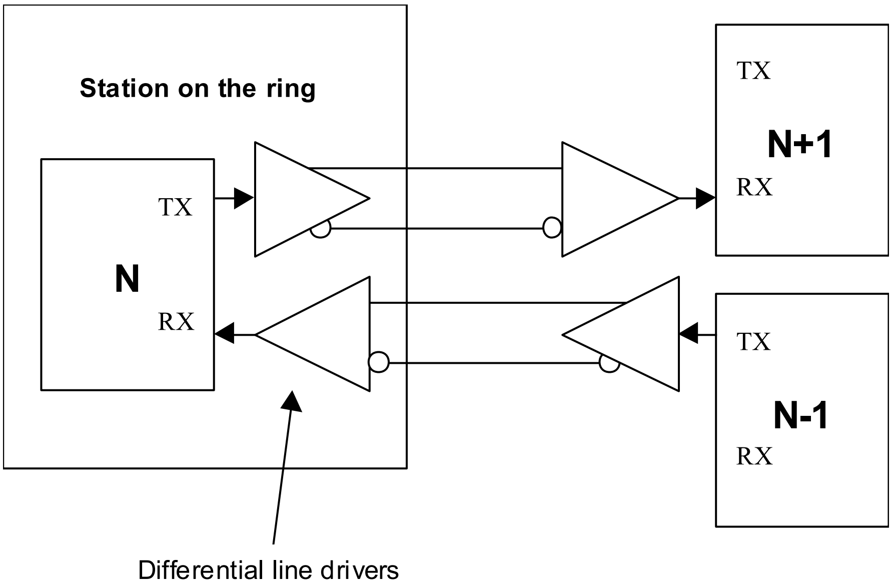
Our Token Ring network is inspired from (but not compatible with) the IEEE802.5 Token Ring. As in the original Token Ring, our network is based on simplex point-to-point transmission lines between neighbours stations on the ring:



Network topology

A single token is travelling on the network. Only the station that owns it may send frames. Frames are removed from the ring by the sender station.

The line between stations uses an asynchronous transmission with 8 data bit, 1 stop bit and no parity. As shown in the fig. be low, a single asynchronous port is required: the receiver part of the port is connected to the previous station on the ring, whereas the transmitter part is connected to the next station. Too avoid ground loops, the transmission is differential. If both directions were connected to the same device, the transmission would be according to the RS422 standard (a differential version of RS232).

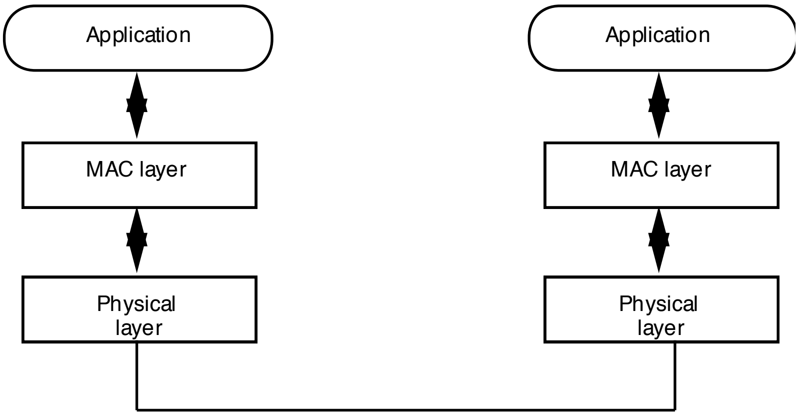


Asynchronous differential transmission on the token ring

Network architecture

The Token Ring network features only two layers:

- the physical layer as described above,
- the MAC (Medium Access Control Layer) freely inspired from the IEEE802.5 protocol.



Protocol layers in the Token Ring network

The MAC layer allows two applications within two stations to exchange information packets.

Physical layer services

The Physical Layer provides a single service with 2 service primitives to the MAC layer:

- PH_DATA_REQUEST (*frame*)

  Request to transmit the frame *frame* on the line segment towards the next station on the one way ring.

- PH_DATA_INDICATION (*frame*)

  Indication that the frame *frame* has been received from the previous station on the ring.

MAC layer services

The MAC layer provides a non-reliable connectionless data transfer service to the applications.

The available service primitives are listed below:

- MAC_DATA_REQUEST (*station*, *SAPI*, *data*)

  Request to transmit *data* towards a peer application defined by the station address *station* and the SAPI *SAPI*.

- MAC_DATA_INDICATION (*station*, *SAPI*, *data*)

  Indication that *data* have been received from a peer application defined by its station address (*station*) and its *SAPI*.

- MAC_LIST_REQUEST (*SAPI*)

  Request to get the list of stations ready to receive data on the SAPI *SAPI*.

- MAC_LIST_RESPONSE (*SAPI*, *station_i*, ...)

  Response to the request above: the station addresses listed have applications listening on the specified *SAPI*.

- MAC_START_REQUEST (*SAPI*)

  An application informs its MAC layer entity that it is ready to exchange data through the SAP defined by *SAPI*.

- MAC_END_REQUEST (*SAPI*)

  An application informs ist MAC layer that is not more willing to exchange data through the SAP defined by SAPI.

- MAC_ERROR_INDICATION ()

  Indication that data could not be delivered as expected

- MAC_NEW_TOKEN ()

  Allows an application to generate a new token. Required to initialise the network.

Addressing

Two types of addresses are used:

- **Station address:**

  This address (between 1 and 14) must be configured in each station. The address 16 is a broadcast address. Station addresses must be managed by the network manager.

- **Application address:**

  An application is bound to a SAP (*Service Access Point*) identified by a SAPI (*SAP Identifier*) (between 0 and 7). Two communicating applications use the same SAPI.

  The chat application uses SAPI 0.

MAC layer protocol

For simplicity reasons, the protocol does not deal with most of the error cases.

Frame type and frame format

Two types of frames are used:

- **Data frames:**

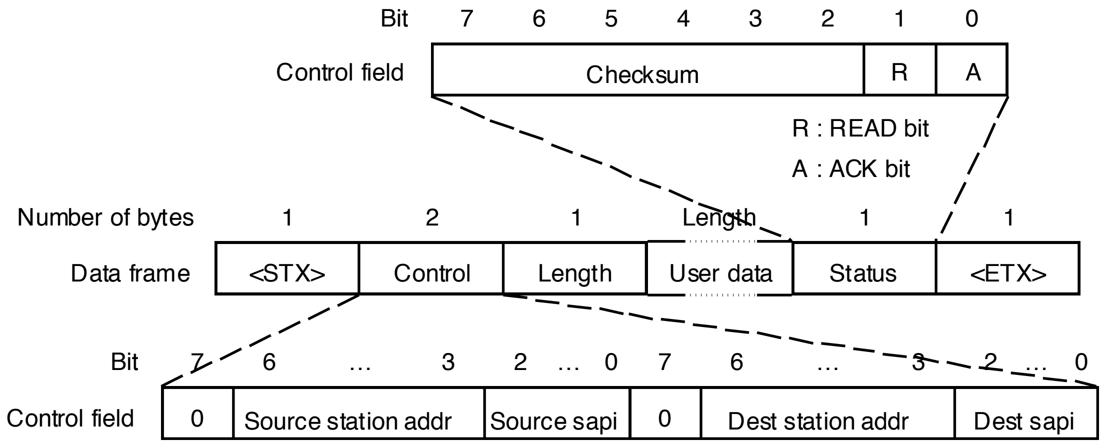
  A data frame contains application data (i.e. data generated by an application and destined to another application).

- **Token:**

  The token is used to:

  - to control the right “to talk” on the network,
  - to broadcast the list of applications (defined by the couple (*station*, *SAPI*)) ready to receive data.

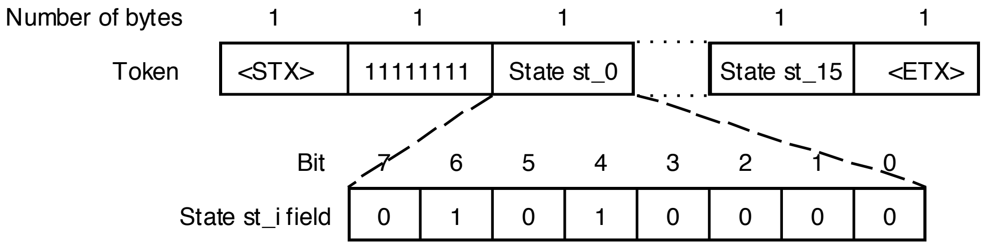
The format of a data frame is defined in the following figure:



Structure of a data frame

The READ and ACK bits are always generated as logical “0” by the source station. The READ bit is set to 1 by the receiving station to indicate that it has been able to read the frame. The ACK bit is set to 1 by the receiving station if the error control procedure as shown that the frame was successfully (i.e. without transmission error) transmitted.

The Checksum field contains the l6 LSB (Least Significant Bits) of the sum of all octets of the field User Data.



Bit j of field Stat st_ i = 1 -> An application in station i is willing to accept data on SAPI j

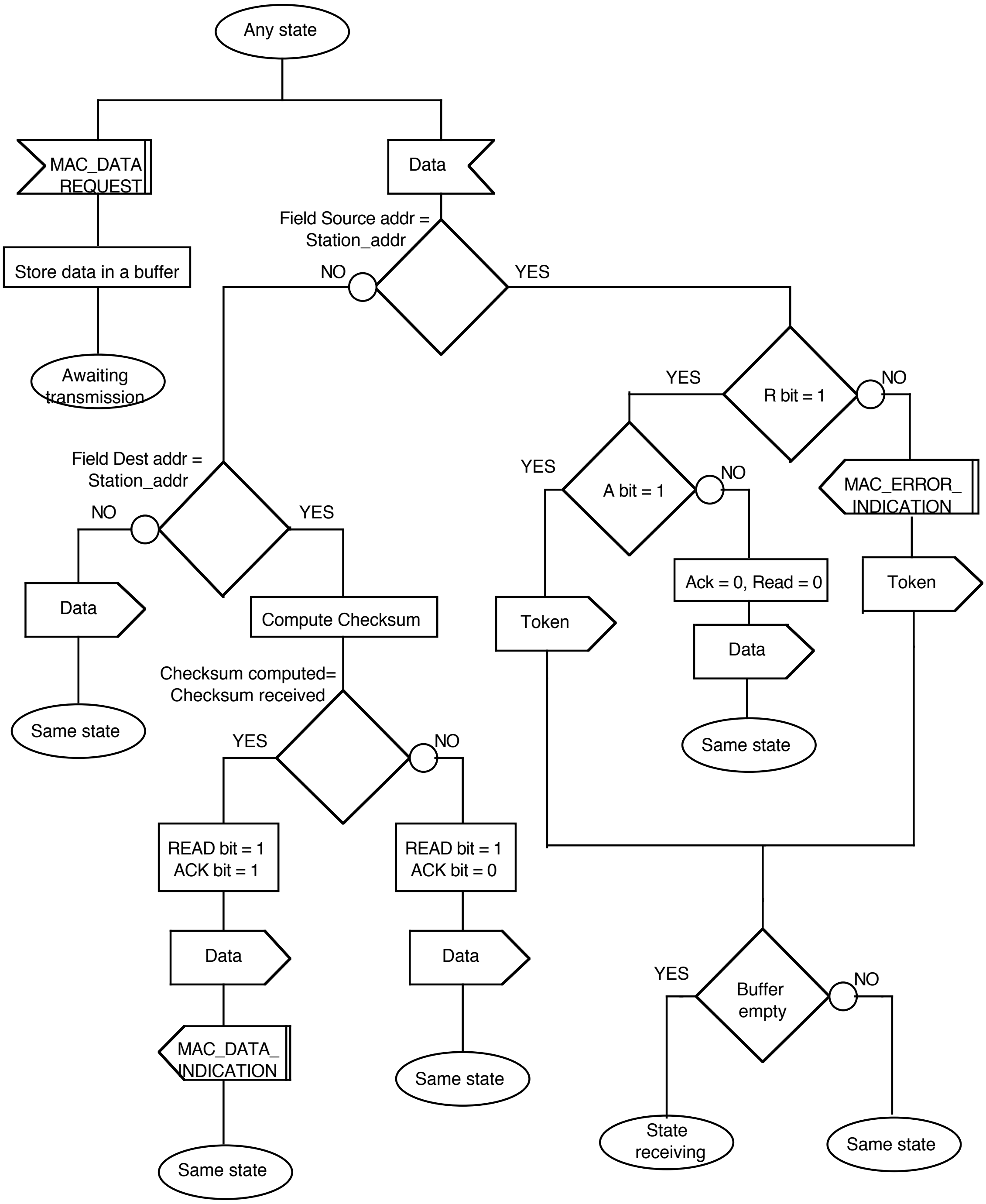
Bit j of field Stat st_ i = o -> An application in station i is NOT willing to accept data onSAPI j

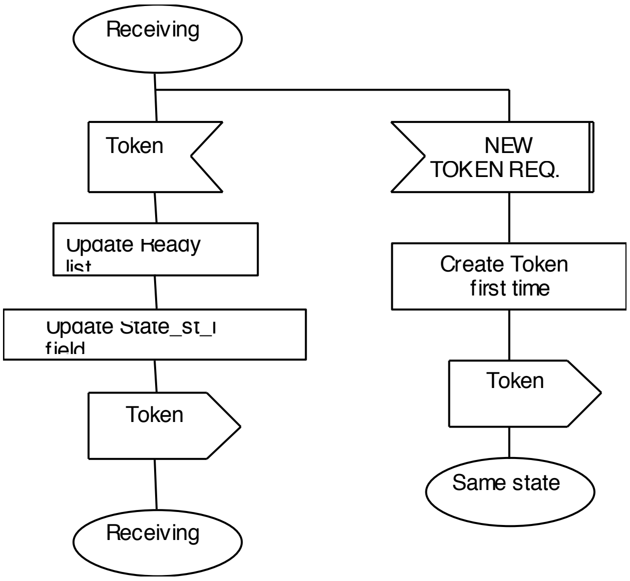
Token frame format

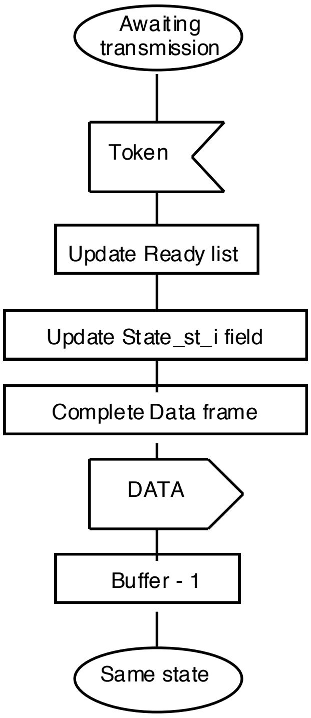
SDL (*Specification and Description Language*) diagrams

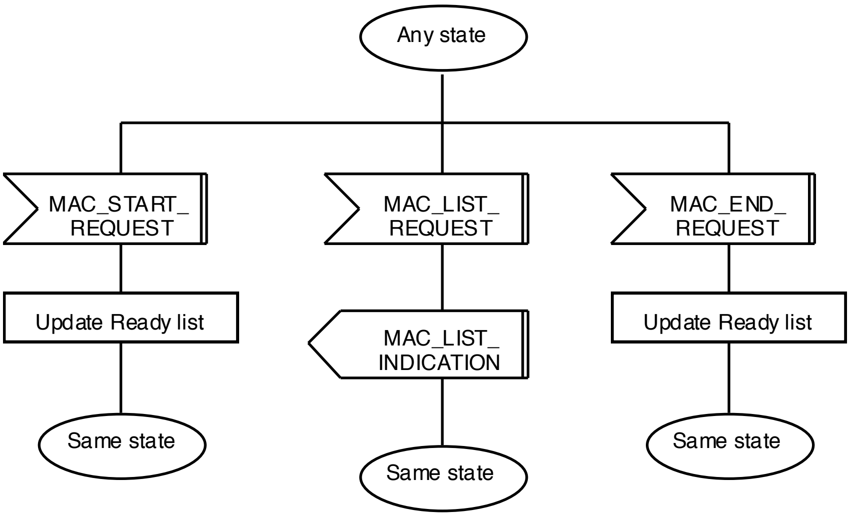
A station can be in one of the following states:

- Receiving,
- Awaiting transmission.




Receiving
Token
Update Ready list
Update State_st_i field
Token
Receiving
NEW TOKEN REQ.
Create Token first time
Token
Same state


Awaiting transmission
Token
Update Ready list
Update State_st_i field
Complete Data frame
DATA
Buffer - 1
Same state


Any state
MAC_START_ REQUEST
Update Ready list
Same state
MAC_LIST_ REQUEST
MAC_LIST_ INDICATION
Same state
MAC_END_ REQUEST
Update Ready list
Same state