Controlled Access Protocols in Computer Network

In controlled access, the stations seek information from one another to find which station has the right to send. It allows only one node to send at a time, to avoid collision of messages on shared medium.

The three controlled-access methods are:

1. Reservation
2. Polling
3. Token Passing

So **how are controlled access protocols different from random access protocols?**

The difference is, only that station can transmit the data which is approved by all other stations in that network. And we saw that in random access protocols the transmission is based on the availability of the transmission channel.

So, here in controlled access protocols only one station can transmit the data-frames at a time, which leads us to a collision-free transmission through the communication channel.

Let us now discuss the types of controlled access protocols. There are three types of Controlled access protocols:

1. Reservation
2. Polling
3. Token Passing

Reservation

Whenever we travel from a train or an airplane, the first thing we do is to reserve our seats, similarly here a station must make a reservation first before transmitting any data-frames.

This reservation timeline consists of two kinds of periods:

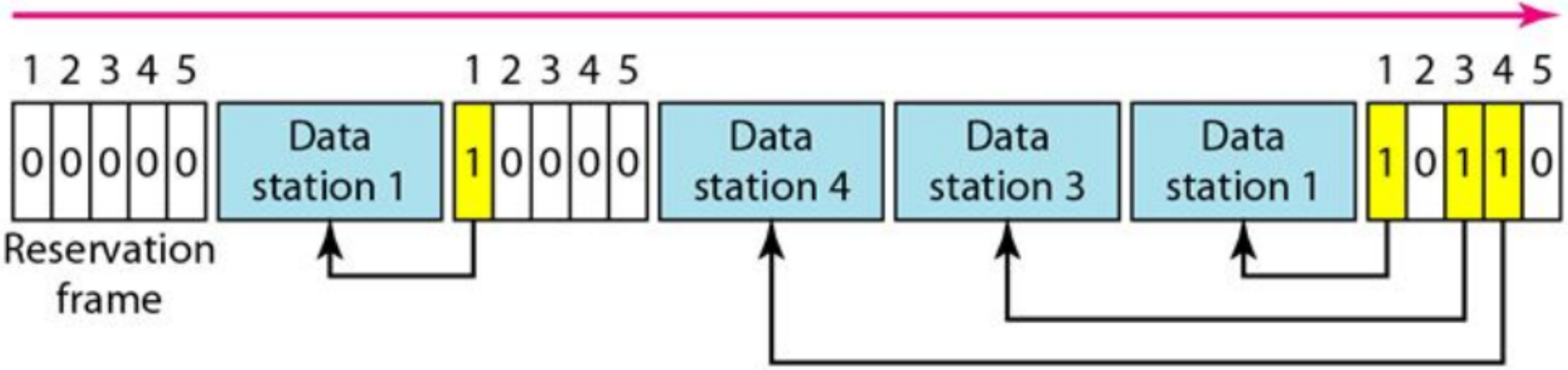
1. Reservation interval of a fixed time duration
2. Data transmission period of variable frames

Consider there are 4 stations then the reservation intervals are divided into 4 slots so that each station has a slot. Means if n number of stations are there then n slot will be allotted.

Now let us assume that these 4 stations are 4 friends, now is friend-1 speaks in his slot-1 then no other friend can speak at this time. Similarly, if station-1 transmits a 1-bit data-frame in slot-1 then at that time no other station can transmit its data-frames and they must wait for their time slot. After all the slots have transmitted and checked then each station knows which station now wishes for transmission.

The biggest advantage of this method is since all stations agree on which station is next to transmit then there are no possible collisions.

The illustration below shows a scenario with five stations with a five-slot reservation frame. here, in the time interval station 1,3,4 are the only stations with reservations and in the second interval station-1 is the only station with a reservation.


1 2 3 4 5
0 0 0 0 0
Reservation frame
Data station 1
1 2 3 4 5
1 0 0 0 0
Data station 4
Data station 3
Data station 1
1 2 3 4 5
1 0 1 1 0

Polling

Recall your school or college classroom, what was the first thing the teacher does after entering the class? The answer is roll call or attendance. Let's compare the scenario. The teacher calls roll number 1 and gets a response if he/she is present then switches to the next roll number, say roll number two and roll number 2 is absent, so the teacher gets no response in return or say a negative response. Similarly, in a computer network there is a primary station or controller (teacher) and all other stations are secondary (students), the primary station sends a message to each station. The message which is sent by the primary station consists of the address of the station which is selected for granting access.

The point to remember is that all the nodes receive the message but the addressed one responds and sends data in return, but if the station has no data to transmit then it sends a message called **Poll Reject or NAK** (negative acknowledgment).

But this method has some drawbacks like the high overhead of the polling messages and high dependence on the reliability of the primary station.

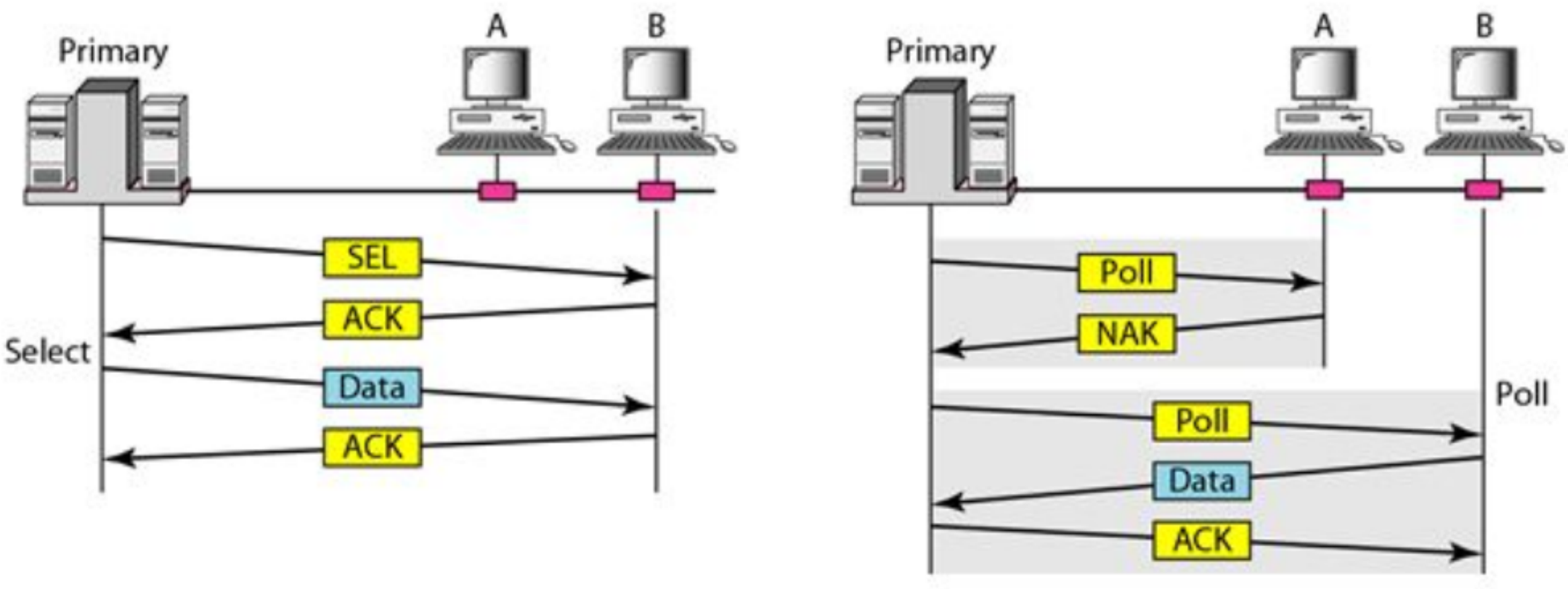
We calculate the efficiency of this method in terms of time for polling & time required for transmission of data.

Tpoll = time for polling

Tt = time required for transmission of data

So, **efficiency = Tt / (Tt + Tpoll)**

The primary device controls the link; the secondary devices follow its instructions. It is up to the primary device to determine which device is allowed to use the channel at a given time. The primary device, therefore, is always the initiator of a session. Consider the following figure.



If the primary wants to receive data, it asks the secondaries if they have anything to send, this is called poll function. If the primary wants to send data, it tells the secondary to get ready to receive; this is called select function.

Select:

The select function is used whenever the primary device has something to send. If it has something to send, the primary device sends it. It has to know whether the target device is prepared to receive or not. So the primary must alert the secondary to the upcoming transmission and wait for an acknowledgment of the secondary's ready status. Before sending data, the primary creates and transmits a select (SEL) frame, one field of which includes the address of the intended secondary.

Poll:

The poll function is used by the primary device to solicit transmissions from the secondary devices. When the primary is ready to receive data, it must ask (poll) each device in turn if it has anything to send. When the first secondary is approached, it responds either with a NAK frame if it has nothing to send or with data (in the form of a data frame) if it does. If the response is negative (a NAK frame), then the primary polls the next secondary in the same manner until it finds one with data to send. When the response is positive (a data frame), the primary reads the frame and returns an acknowledgment (ACK frame), verifying its receipt.

3. Token Passing:

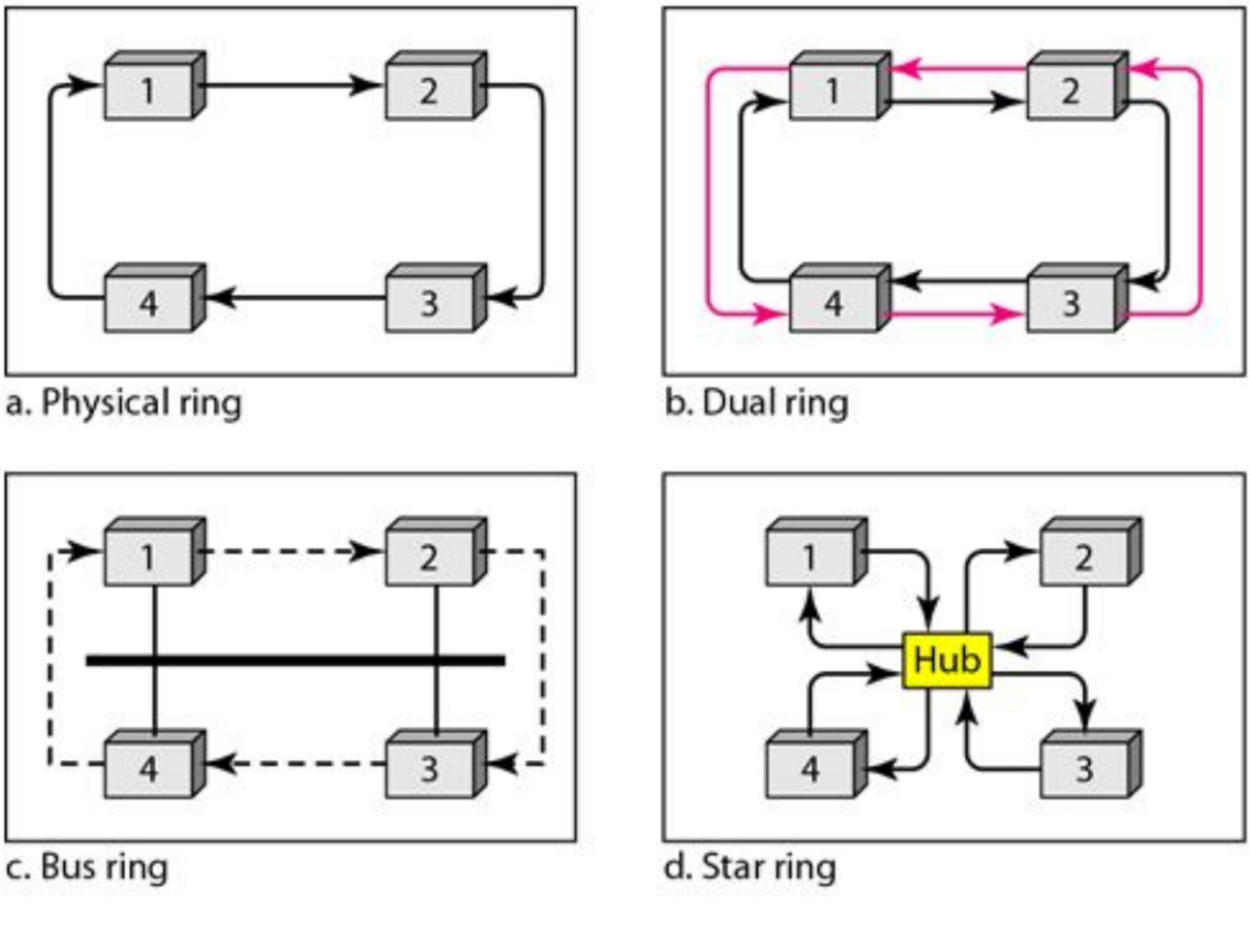
In the token-passing method, the stations in a network are organized in a logical ring. In other words, for each station, there is a predecessor and a successor. The predecessor is the station which is logically before the station in the ring; the successor is the station which is after the station in the ring. The current station is the one that is accessing the channel now. The right to this access has been passed from the predecessor to the current station. The right will be passed to the successor when the current station has no more data to send.

In this method, a special packet called a token circulates through the ring. The possession of the token gives the station the right to access the channel and send its data. When a station has some data to send, it waits until it receives the token from its predecessor. It then holds the token and sends its data. When the station has no more data to send, it releases the token, passing it to the next logical station in the ring. The station cannot send data until it receives the token again in the next round.

Token management is needed for this access method. Stations must be limited in the time they can have possession of the token. The token must be monitored to ensure it has not been lost or destroyed. For example, if a station that is holding the token fails, the token will disappear from the network. Another function of token management is to assign priorities to the stations and to the types of data being transmitted. And finally, token management is needed to make low-priority stations release the token to high priority stations.

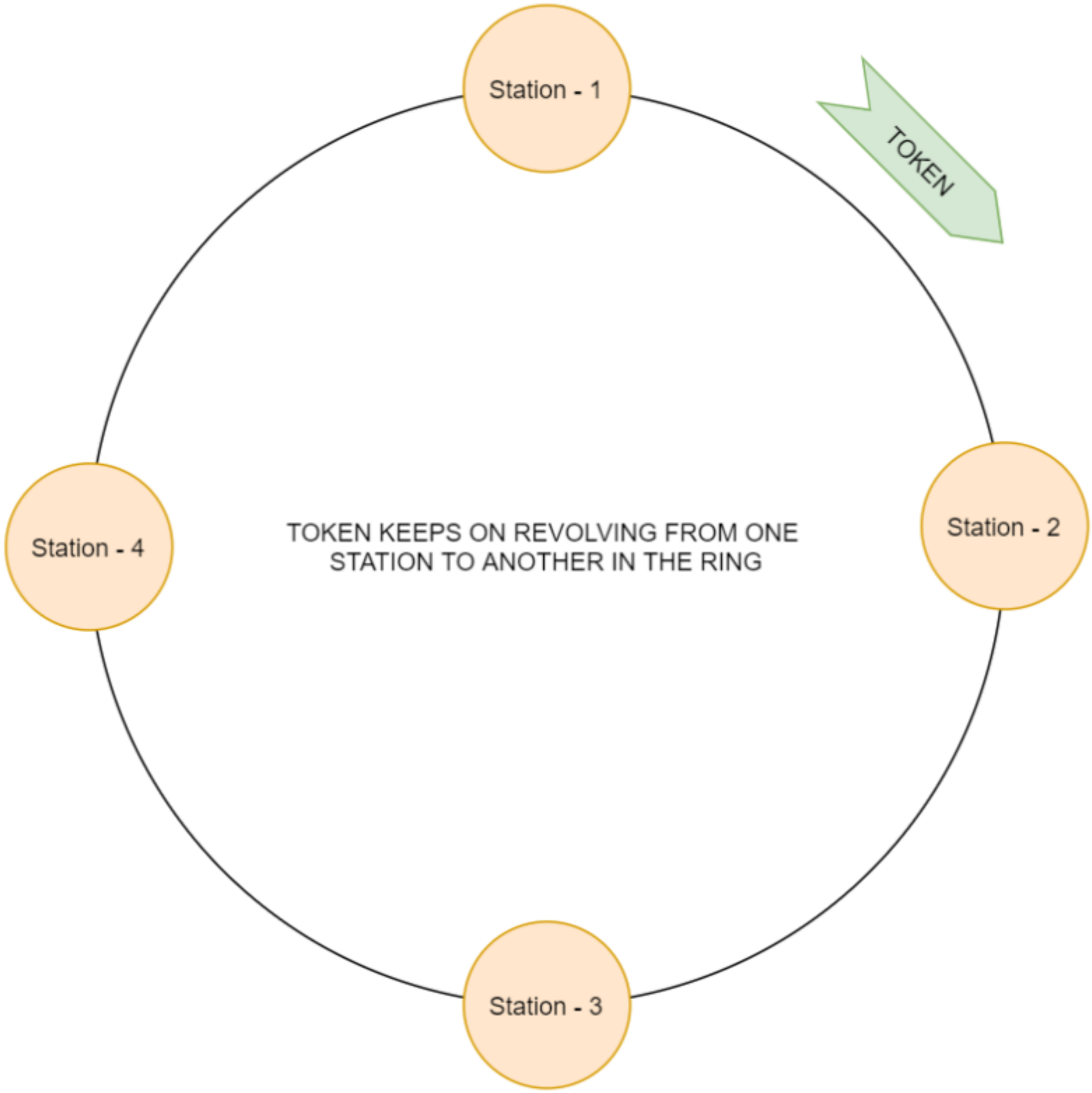
Logical Ring:

In a token-passing network, stations do not have to be physically connected in a ring; the ring can be a logical one. The following figure show four different physical topologies that can create a logical ring.



Token Passing

Now, say 4 people are sitting on a round table and only that person can speak who has the token. In computer networks a token is a special bit pattern that allows the token possessing system to send data or we can say that a token represents permission to transmit data. The token circulation around the table (or a network ring) is in a predefined order. A station can only pass the token to its adjacent station and not to any other station in the network. If a station has some data queued for transmission it can not transmit the data until it receives the token and makes sure it has transmitted all the data before passing on the received token.



Note: A token can only work in that channel, for which it is generated and not for any other.