

Point-to-Point Protocol (PPP)

- 1) The Point-to-Point Protocol (PPP) uses a lifecycle shown in the state diagram in figure 4. Draw a diagram that associates the frames exchanged between endpoints as every step in the state diagram.

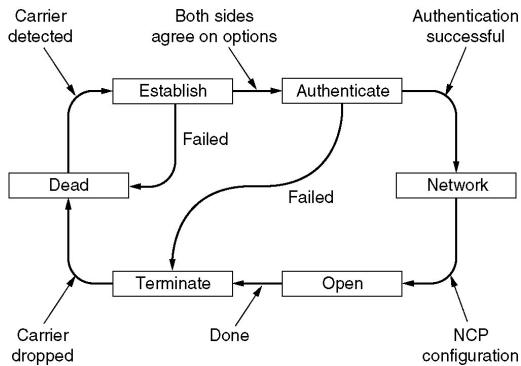


Figure 1: PPP State diagram

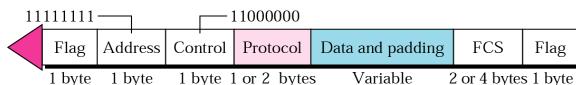


Figure 2: PPP Frame Layout

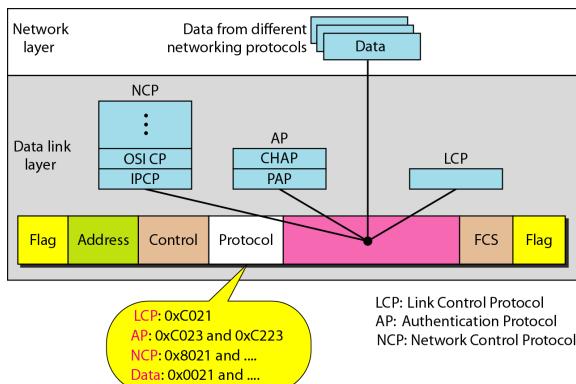
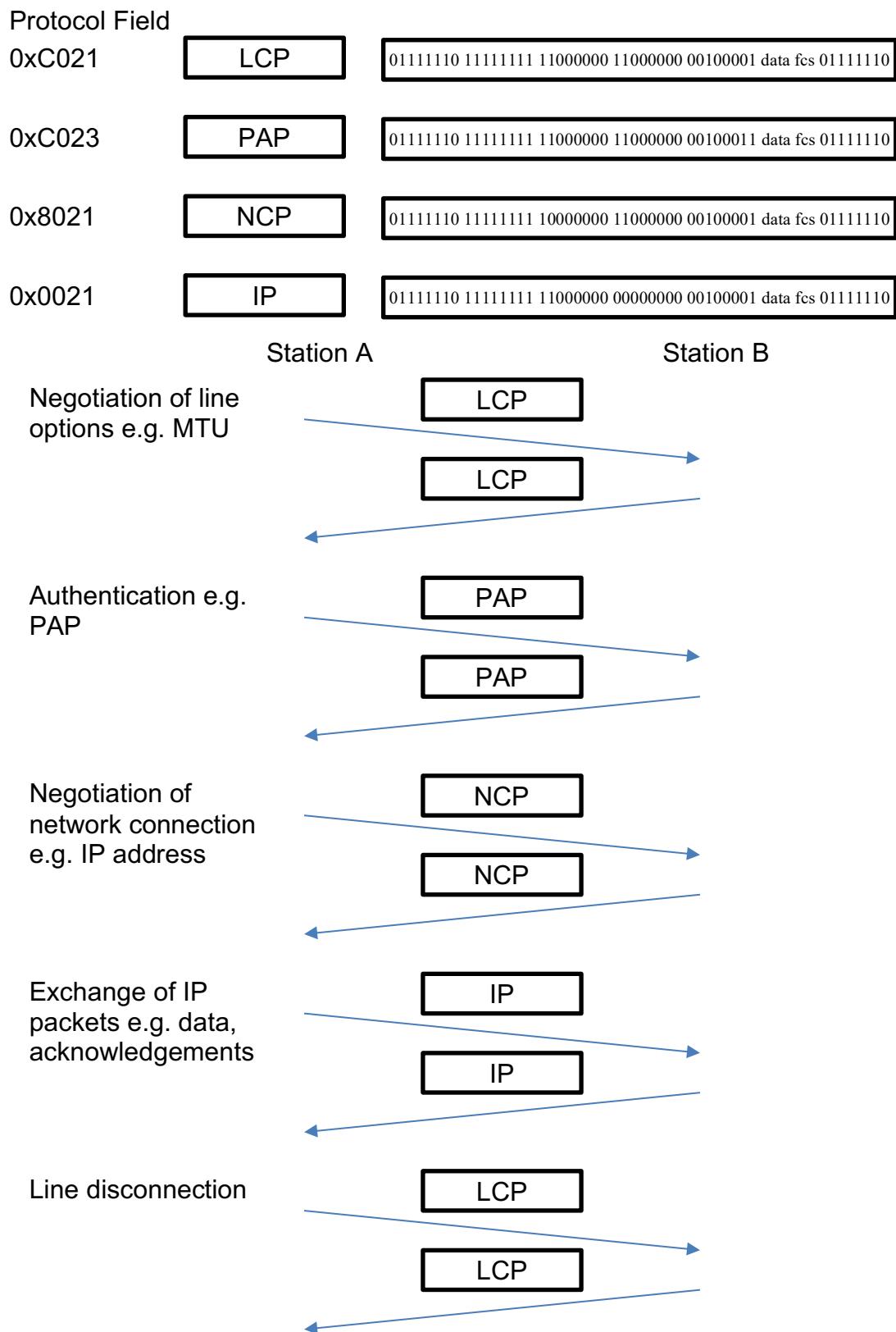


Figure 3: PPP Protocol byte

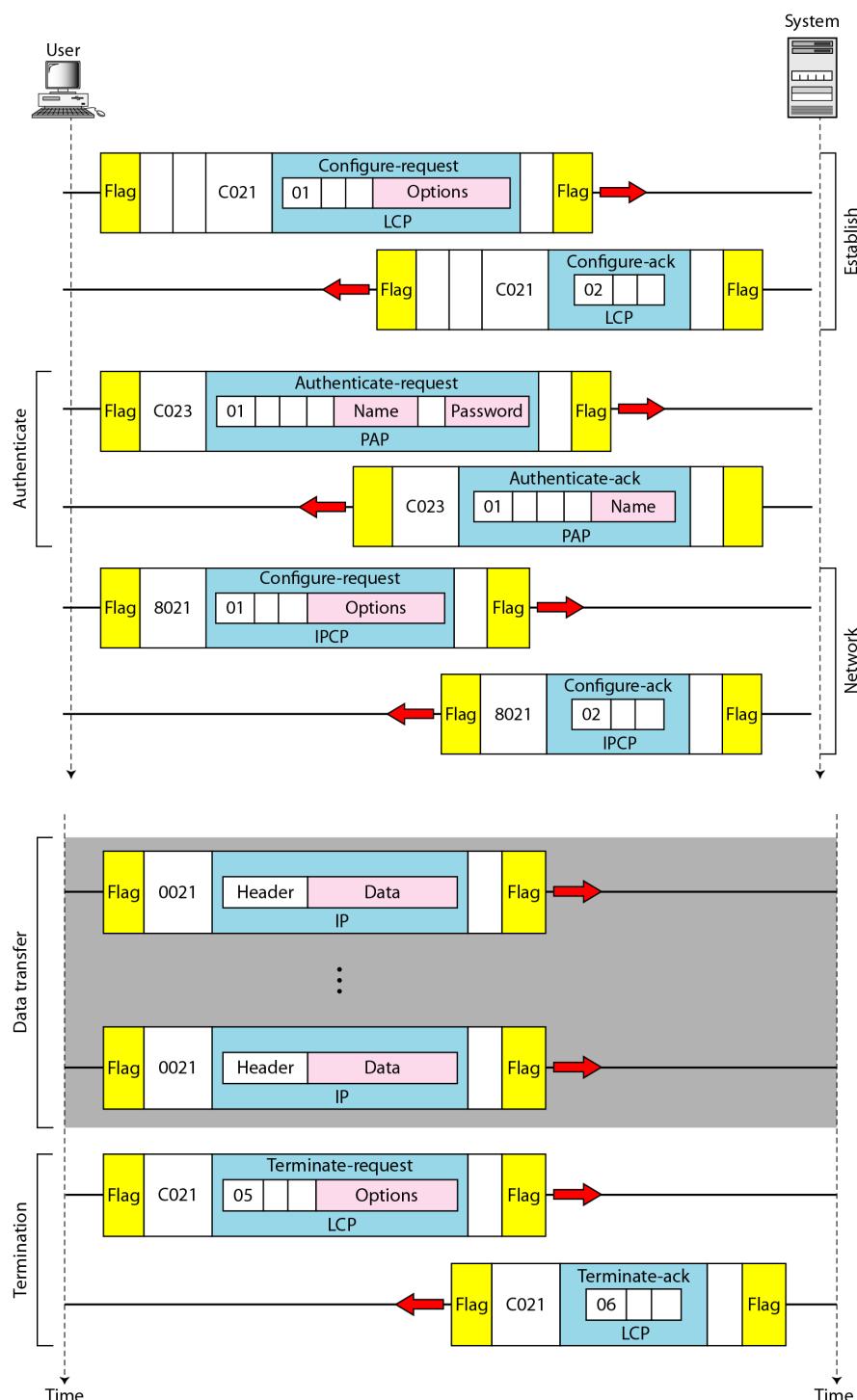
Every frame in PPP will have the following format:

01111110 11111111 11000000 <Protocol> <Data> <FCS> 01111110

Ignoring Data and FCS checksum fields because they will be specific to every frame and connection, the frames will be



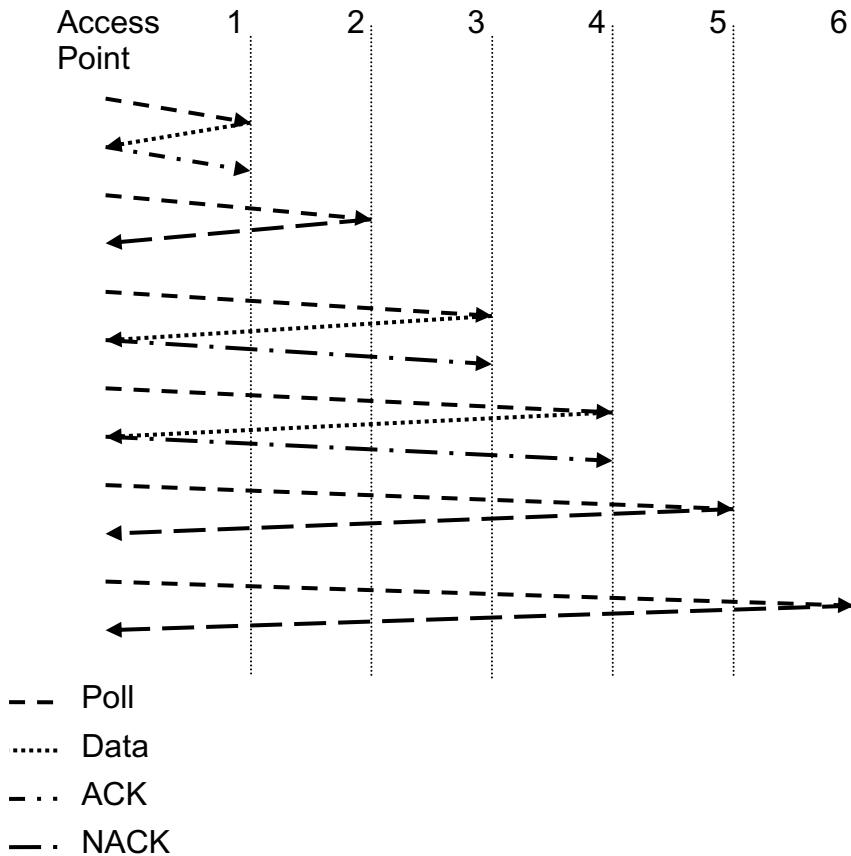
Or from Forouzan:



Polling, TDMA & CDMA

2) Poll

Assume that a wireless network consists of a wireless access point and a set of 6 mobile stations. The wireless access point polls the individual mobile stations for data to transmit. Stations 1, 3, and 4 have data to transmit; stations 2, 5 and 6 have no data to transmit. Show in a diagram the traffic that is exchanged over the wireless medium between the access points and the stations.



3) Time Division Multiple Access (TDMA)

A network employing TDMA uses 50ms time slots. The available slots are split up between 6 stations. During a period of 3 seconds, stations 1, 5 and 6 have data to transmit. Calculate the usage of the available bandwidth for TDMA with and without a reservation access method. Assume that it takes 60us for the reservation frame to be transmitted and that it is negligible in the calculation of the bandwidth usage. Demonstrate the usage in a diagram.

Usage:

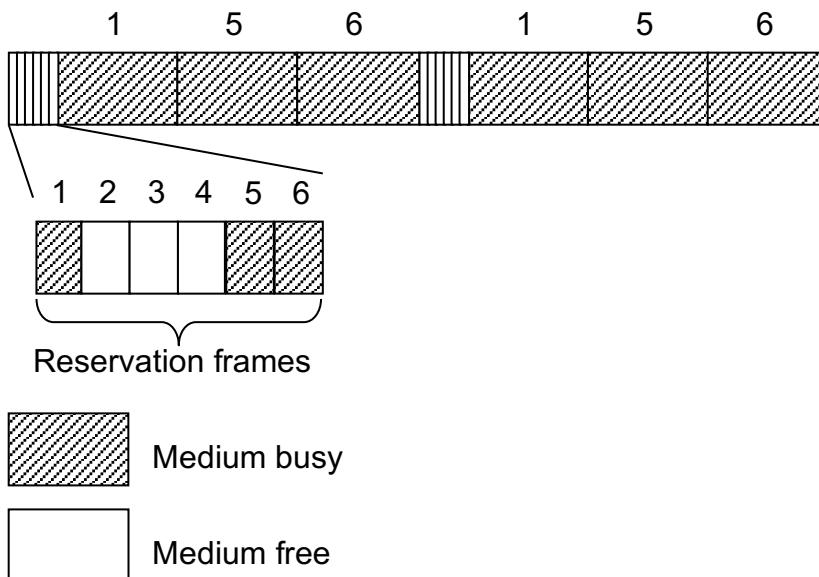
Statically assigned TDMA: 50% of the bandwidth

TDMA with reservation: close to 100%

Statically assigned TDMA



TDMA with reservation



4) Code Division Multiple Access (CDMA)

Assume a network with three mobile phones, stations 1, 2 and 4, and a base station, station 3. The three mobile phones want to send 011, 101 and 100 respectively; the base station is silent. A 0 is encoded as -1, a 1 is encoded as +1 and silence is represented by 0. Give the signal that the base station receives.

Chip Sequences:

Station 1: +1 +1 -1 -1
 Station 2: +1 -1 +1 -1
 Station 3: +1 +1 +1 +1
 Station 4: +1 -1 -1 +1

Station	Bit	Code	Chip Sequence				Signal
1			+1	+1	-1	-1	
	0	-1					-1 -1 +1 +1
2			+1	-1	+1	-1	
	1	+1					+1 -1 +1 -1
3			+1	+1	+1	+1	
	-						0 0 0 0
4			+1	-1	-1	+1	
	1	+1					+1 -1 -1 +1
							+1 -3 +1 +1

Station	Bit	Code	Chip Sequence				Signal
1			+1	+1	-1	-1	
	1	+1					+1 +1 -1 -1
2			+1	-1	+1	-1	
	0	-1					-1 +1 -1 +1
3			+1	+1	+1	+1	
	-						0 0 0 0
4			+1	-1	-1	+1	
	0	-1					-1 +1 +1 -1
							-1 +3 -1 -1

Station	Bit	Code	Chip Sequence				Signal
1			+1	+1	-1	-1	
	1	+1					+1 +1 -1 -1
2			+1	-1	+1	-1	
	1	+1					+1 -1 +1 -1
3			+1	+1	+1	+1	
	-						0 0 0 0
4			+1	-1	-1	+1	
	0	-1					-1 +1 +1 -1
							+1 +1 +1 -3

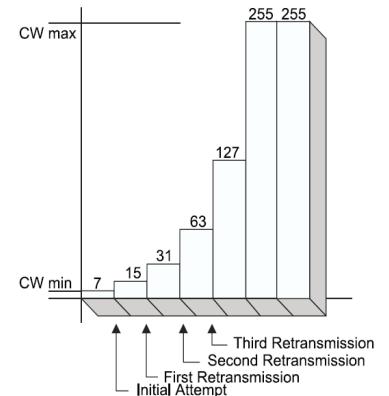
The signal received by the base station is

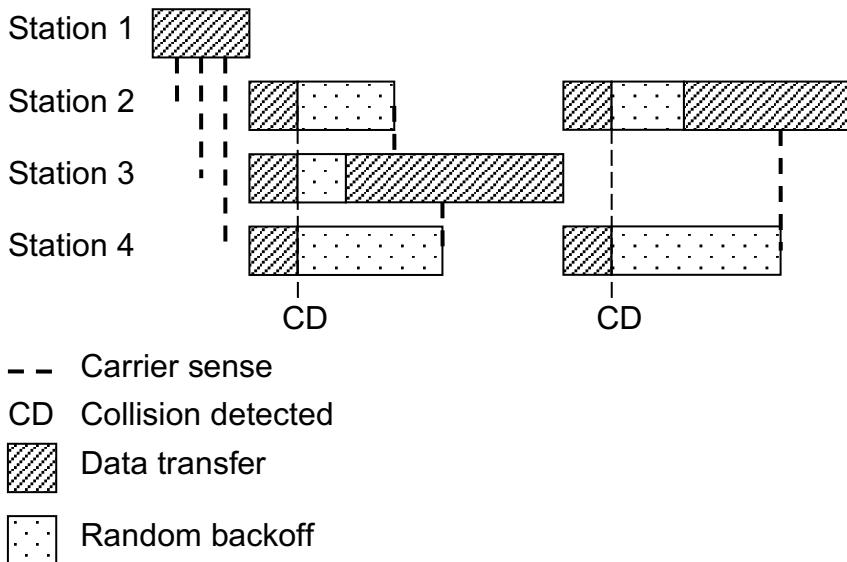
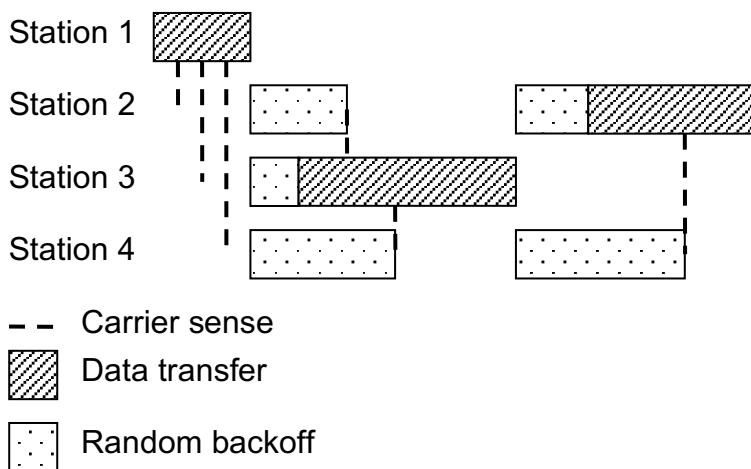
$$+1 -3 +1 +1 -1 +3 -1 -1 +1 +1 +1 -3$$

CSMA/CD & CSMA/CA

5) Carrier Sense Multiple Access (CSMA)

Both, CSMA with Collision Detection (CSMA/CD) and CSMA with Collision Avoidance (CSMA/CA) use binary exponential backoff. Assume that four stations 1, 2, 3 and 4 want to send data and the transmission of a frame has just been completed. Show in a diagram how the four stations compete for the medium and the times that are involved, using both a) CSMA/CD and b) CSMA/CA.



CSMA/CD**CSMA/CA**

- 6) Contrast the use of the available medium when using an approach such as TDMA with an approach using CSMA/CD with regards to use of the medium, coordination between stations, scalability and flexibility, etc.

Stations using an approach such as TDMA will need to be synchronised closely and the arrangements of time slots is static i.e. if the number of stations has to be changed, the communication has to be halted, the protocol new initialised and then restarted. These types of protocols scale badly to some degree because with a large number of nodes, the period between slots for a particular node may be significant. One of the most significant drawback of static allocations of TDMA though is the waste of allocated slots if stations do not have information to transmit and the medium is idle for the time.

In CSMA/CD in contrast, stations compete for the medium and if the number of stations is relatively low or individual stations have to transmit information rarely i.e. the competition for the medium is low, stations gain access to the medium easily and the medium may be used efficiently.

A drawback of the CSMA/CD approach is that if the competition for the medium is high i.e. a large number of stations or frequent transmissions, collisions may occur frequently and stations may take long back-off periods frequently, which results in a waste of the capacity of the medium.

Sample Exam Question

- a) Carrier Sense Multiple Access (CSMA) with Collision Detection (CD) is being used as mechanism for medium access control in a wired network.
 - i) Explain the competition for the medium using CSMA/CD and discuss why collision detection is used instead of collision avoidance in wired networks.
 - ii) Contrast CSMA/CD against an access method of your choice on an example of 3 nodes wanting to transmit over a wired network. Use diagrams to visualize the chronological exchange of the frames.