Multiple access protocols

Research

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13 May 2023

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CHAPTER 1 MULTIPLE ACCESS PROTOCOLS:

1.1 Introduction:

In a computer network, the data link layer is modified to send data between two devices, called nodes. The layer is divided into parts such as data link control and multiple access protocols.
Logical data link control refers to the higher layer, which controls flow and error management in the data link layer. In parallel, the bottom layer is adjusted to manage and scale back collisions or multiple channel access. As a result, it is also known as multiple access resolutions or media access control.

1.2 Multiple Access Protocols:

The advantages of multiple access protocols include global time optimization, collision depreciation, and avoidance of give-and-take.

Let's suppose that there are kids in a classroom. When a teacher asks a question, every student in the room immediately starts to react at the same moment (concurrently transmitting the information). Due to that data/information overlapping or data loss, all the children answer at the same moment. Therefore, it is the duty of a teacher (multiple access protocols) to guide the students and help them develop a single answer.

1.3 Types of Multiple access Protools:

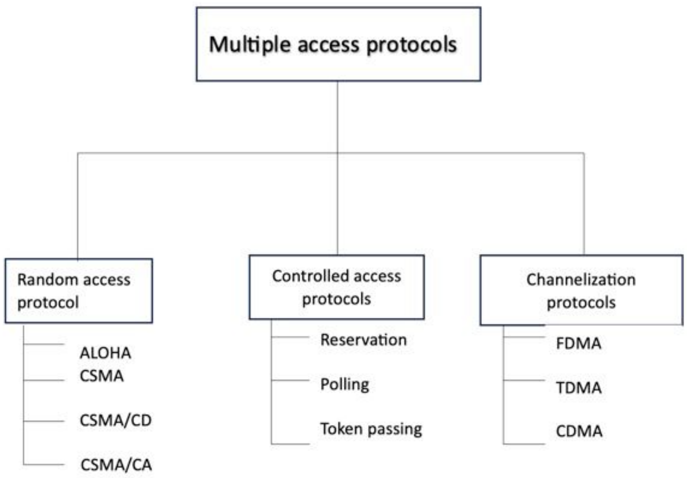

Figure 1.1

CHAPTER 2 RANDOM ACCESS PROTOCOLS:

2.1 RANDOM ACCESS PROTOCOLS

Consider a phone conversation, for example. Calling someone confirms your connection with the person you're looking for and allows anyone to call anyone. So here all users are given similar priority regardless of where they send data/information about the state of the media, regardless of whether the station is idle or busy. This means that if your friend is chatting with someone else on the phone, you will not be able to connect/connect if you are currently busy. All users have the same priority, so you can't drop your friend's current call or establish a call.

The direct access protocol has the following characteristics:

1. *First, there is no time limit to send data/information to your friends without time limit.*
2. *There are many stations that transmit data and information. Random access protocols are further classified into four different categories:*

2.2 Types of random access protocols

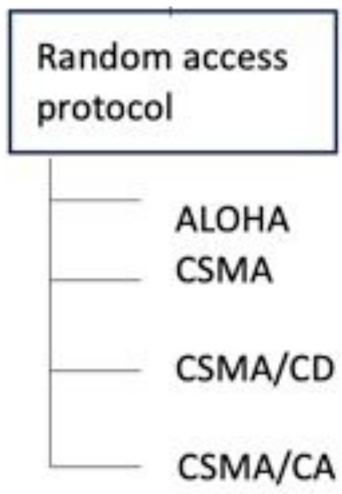

Figure 2.1

2.2.1 ALOHA METHOD

Also known as the ALOHA protocol or ALOHA methodology, it is a simple communication medium that allows any transmitting station or source within the override network to transmit data or information when it is ready to transmit a frame. It tends to be successful, and once a frame reaches its destination, subsequent frames can be sent. Note, however, that if a data or information frame is not received at the receiver due to a collision, the frame will be retransmitted until it successfully arrives at the receiver. There's two types of aloha and they are

2.2.2 ALOHA METHOD TYPES

- ***Classical aloha method:*** Data transmission with Pure Aloha allows you to send data randomly. H. Any number of stations can transmit data at any time. Pure Aloha's timestamps are continuous and essentially globally synchronized with all other stations. Pure Aloha has a maximum efficiency of 18.4%. Pure Aloha's collision status is that the total is not reduced by half.

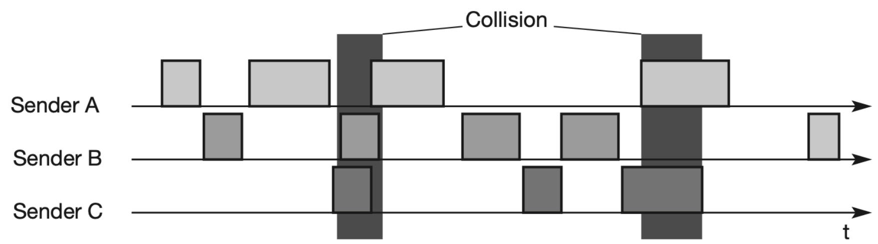

Figure 2.2 Mobile communication by Jochen Schiller

- ***Slotted Aloha method:*** Slotted Aloha data transfers can randomly transfer data at the start of any time slot. Slotted Aloha timestamps are discrete and essentially universally synchronized. Slotted Aloha has a maximum efficiency of 36.8%. Slotted Aloha's collision status are essentially halved total and double the efficiency of pure Aloha.

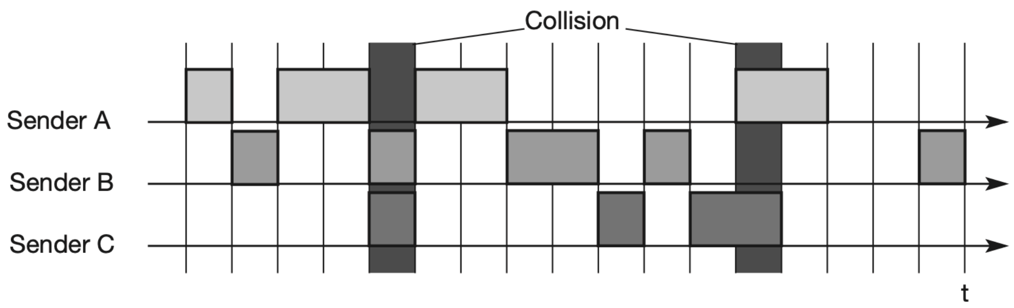

Figure 2.3 Mobile communication by Jochen Schiller

2.2.3 CSMA(CARRIER SENSE MULTIPLE ACCESS) METHOD

The carrier sense multiple access (CSMA) protocols have been widely used in both wired and wireless LANs. These protocols provide enhancements over the pure and slotted ALOHA protocols. The enhancements are achieved through the use of the additional capability at each user station to sense the transmissions of other user stations. The carrier sense information is used to minimize the length of collision intervals. For carrier sensing to be effective, propagation delays must be less than packet transmission times. Two general classes of CSMA protocols are non-persistent and p-persistent.

Several versions of CSMA exist :

- **non-persistent CSMA**, stations sense the carrier and start sending immediately if the medium is idle. If the medium is busy, the station pauses a random amount of time before sensing the medium again and repeating this pattern.
- **p-persistent CSMA** systems nodes also sense the medium, but only transmit with a probability of p, with the station deferring to the next slot.
- **1-persistent CSMA systems**, all stations wishing to transmit access the medium at the same time, as soon as it becomes idle. This will cause many collisions if many stations wish to send and block each other

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CHAPTER 3 CONTROLLED ACCESS PROTOCOLS

3.1 CONTROLLED ACCESS PROTOCOLS

Using a controlled access protocol, stations get information from each other to see what they are allowed to send. This allows him only one node to send at a time to control message collisions on the shared medium. These are 2 of the controlled access methods:

3.2 Controlled access protocols types:

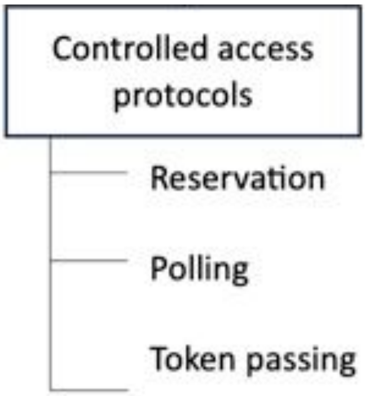

Figure 3.1

3.2.1 Reservation method:

An even more fixed pattern that still allows some random access is exhibited by reservation In a fixed scheme N mini-slots followed by N·k data-slots form a frame that is repeated. Each station is allotted its own mini-slot and can use it to reserve up to k data-slots. This guarantees each station a certain bandwidth and a fixed delay. Other stations can now send data in unused data-slots as shown. Using these free slots can be based on a simple round-robin scheme or can be uncoordinated using an Aloha scheme. This scheme allows for the combination of, e.g., isochronous traffic with fixed bit- rates and best-effort traffic without any guarantees.

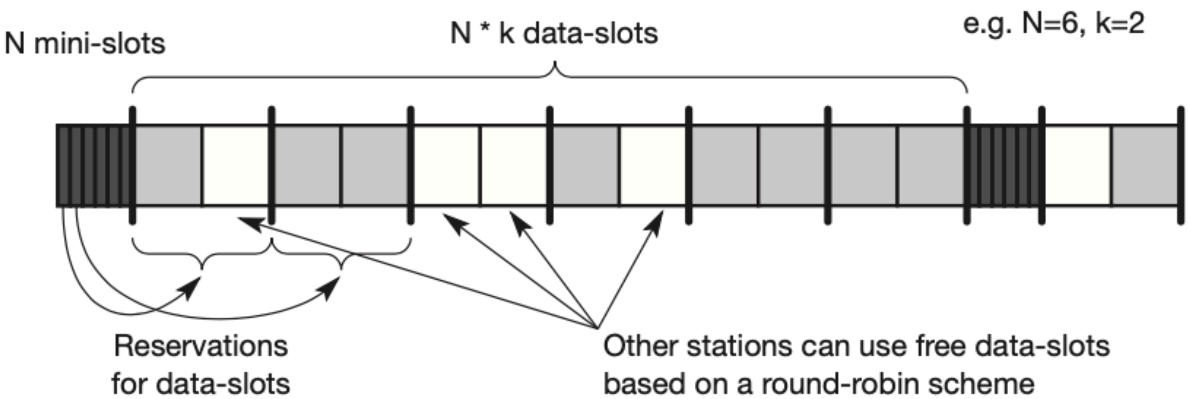

Figure 3.2

In this figure a condition with 5 stations and 5 slot reservations available. Though in this given first interval only 1,3 and 4 are able to make the reservation and in another second interval, only 1 could make it.

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3.2.2 Polling method:

Where one station is to be heard by all others (e.g., the base station of a mobile phone network or any other dedicated station), polling schemes (known from the mainframe/ terminal world) can be applied. Polling is a strictly centralized scheme with one master station and several slave stations. The master can poll the slaves according to many schemes: round robin (only efficient if traffic pat- terns are similar over all stations), randomly, according to reservations (the classroom example with polite students) etc. The master could also establish a list of stations wishing to transmit during a contention phase. After this phase, the station polls each station on the list. Similar schemes are used, e.g., in the Bluetooth wireless LAN and as one possible access function in IEEE 802.11 systems

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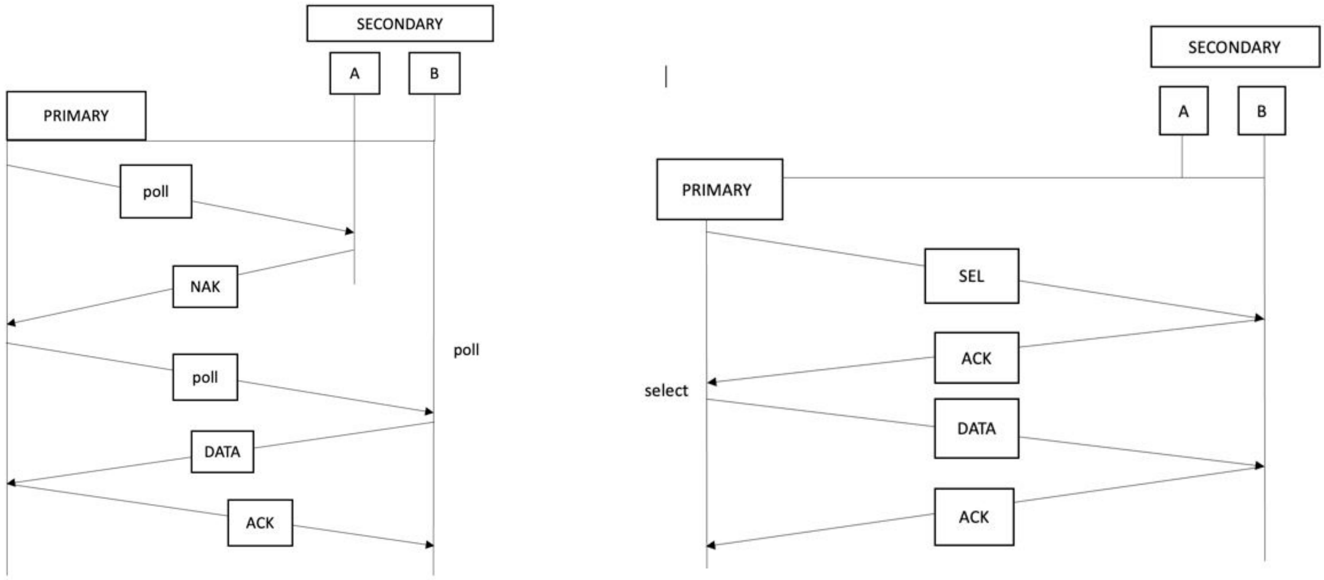

Figure 3.3 Polling methods

CHAPTER 4 CHANNELIZATION ACCESS PROTOCOLS

4.1 CHANNELIZATION ACCESS PROTOCOLS

Channelization refers to the division of a communication channel into multiple smaller sub-channels or slots to allow concurrent transmissions by different devices. This technique helps improve the efficiency and capacity of the channel by allowing multiple devices to transmit simultaneously without interfering with each other.

4.2 TYPES OF CHANNELIZATION ACCESS PROTOCOLS

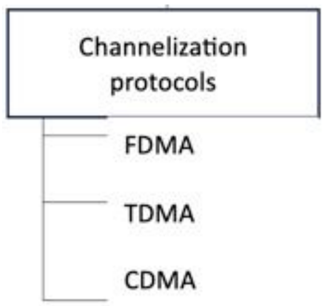

Figure 4.1

4.2.1 Frequency Division Multiple Access FDMA

TDMA is a technique where multiple users share the same frequency band by dividing it into different time slots. Each user is allocated a specific time slot during which they can transmit their data. The time slots are typically very short and are repeated periodically. The advantage of TDMA is that it allows multiple users to use the same frequency band without interfering with each other as long as their time slots do not overlap. It is widely used in second-generation (2G) cellular systems like GSM (Global System for Mobile Communications).

4.2.2 Time Division Multiple Access TDMA :

FDMA is a technique where multiple users share the available frequency spectrum by dividing it into different frequency bands. Each user is allocated a unique frequency band for their communication. The frequency bands are non-overlapping, and each user can transmit their data simultaneously using their allocated frequency band. FDMA is commonly used in analog communication systems, such as older analog cellular networks like the Advanced Mobile Phone System (AMPS). It is also used in some digital communication systems like the first-generation (1G) cellular networks.

5.CONCLUSION

5.1 DIFFERENCE BETWEEN ALOHA AND CSMA METHODS

Feature	**Aloha**	**CSMA**
Medium	Radio waves	Wired or wireless communication channels
Channel Access	Devices can transmit at any time	Devices listen to the channel before transmitting
Collision Detection	No collision detection mechanism	Collision detection mechanism used
Backoff Mechanism	No specific backoff mechanism	Backoff algorithm to handle collisions
Efficiency	Higher efficiency due to channel sensing and collision detection	Lower efficiency due to potential collisions and retransmissions
Throughput	Lower throughput compared to CSMA	Higher throughput compared to Aloha
Scalability	Limited scalability for large networks	Scalable for large-scale networks
Examples	Pure Aloha, Slotted Aloha	Ethernet networks (CSMA/CD), Wi-Fi networks (CSMA/CA)

Table 5.1

5.2 DIFFERENCE BETWEEN RESERVATION AND POLLING METHODS

Feature	**Reservation**	**Polling**
Medium	Shared communication medium	Shared communication medium
Control Mechanism	Centralized control	Centralized or distributed control
Reservation Phase	Dedicated phase for reserving time slots	No dedicated reservation phase
Transmission Order	Devices transmit in reserved time slots	Devices transmit based on polling schedule
Efficiency	Higher efficiency due to dedicated slots	Lower efficiency due to polling overhead
Scalability	Limited scalability for large networks	Better scalability for large networks

Synchronization	Requires synchronization among devices	Requires synchronization or coordination
Latency	Lower latency due to dedicated slots	Higher latency due to polling
Examples	Time Division Multiple Access (TDMA)	Token Ring, Polling in computer networks

Table 5.2

5.3 DIFFERENCE BETWEEN FDMA AND TDMA METHODS

Feature	**TDMA**	**FDMA**
Channel Division	Channel divided into time slots	Channel divided into frequency bands
Time Slots	Devices transmit in assigned time slots	Each device has exclusive frequency band
Time Synchronization	Devices synchronized to a common timing reference	No strict time synchronization required
Frequency Division	No frequency division within a time slot	Each frequency band allocated to a device
Interference	Minimized as devices transmit in different time slots	Minimized as devices use different frequency bands
Spectrum Efficiency	Higher efficiency due to dynamic time slot allocation	Lower efficiency as frequency bands are fixed
Flexibility	Flexible allocation of time slots	Limited flexibility in frequency band allocation
Examples	GSM (Global System for Mobile Communications)	Analog cellular networks (AMPS, NMT)

Table 5.3

References

- ***Wireless communications principle ad practice by Theodore s.rappaport***
- ***Mobile - Communications - Jochen Schiller***
- ***Wireless communications and networking by vijay garg***

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