Module
5

Local Area Networks

Lesson

16

Contention Based LANs

OBJECTIVE

General

The lesson will discuss the contention based LANs

Specific

The focus areas of this lesson are:

The bus based LANs

The idea of ALOHA

The CSMA/CD scheme and the Ethernet

5.2.1 INTRODUCTION

The simplest and most popular of the LAN topology is the Bus, where all the users are connected to the bus. The bus is normally a high-speed media like Co-axial cable. Now-a-days shielded and unshielded twisted pair of wires is also used over shorter distances. Since all the users are connected to the same bus therefore, if any two or more users communicate simultaneously the messages collide. To prevent/minimize collisions a protocol is developed wherein before transmission every user checks whether the medium is free or not. If it is not free, they wait for their chance to get access. Sensing the medium before transmission or before accessing the medium is called Carrier Sense Multiple Access (CSMA). It might so happen that two users simultaneously find the medium free and start their transmissions. Obviously the packets of these two users will eventually collide on the medium and the communication has to be aborted. These two users and even other contending users then start waiting for the medium to be idle. As soon as the medium is free there is a rush from all the intending users which results in more collisions. To avoid this scenario, it is advisable that the users wait for random time before attempting to access the medium after it is sensed to be free. With random delays it is unlikely that the two users will come up to transmission simultaneously. Further after collision the two users may continue transmission uselessly and waste the medium. As soon as a collision is detected the users should stop further transmission increasing the availability of the medium. The users are, therefore, required to continue observing the medium not only before but even during transmission. It is easier for the users whose packets are collided to detect the collision. There are many techniques developed to detect collisions. Another step that improves the performance of the CSMA scheme is that the user who has detected the collision announces about it to others as a warning. This information is utilized by the other intending users in delaying their access

to the medium where the collision has just occurred. The entire scheme is popularly known as CSMA/CD.

5.2.2 ALOHA

In 1972 the University of Hawaii took up a plan to implement a computer network between the islands. Implementation had to be devoid of cables. Prof. Abramson thought of wireless or radio LAN which was named ALOHA. A single frequency was allocated to all the stations. Abramson solved the apparently improbable situation of several stations wanting to transmit at the same time through the single radio channel. He mathematically proved that 18% throughput can be achieved in theory. ALOHA was a very simple network with no wires and no access control. It is based on the principle of bursty traffic and hence probability of collision is less. Throughput and delay are the two parameters that determine the quality of the network.
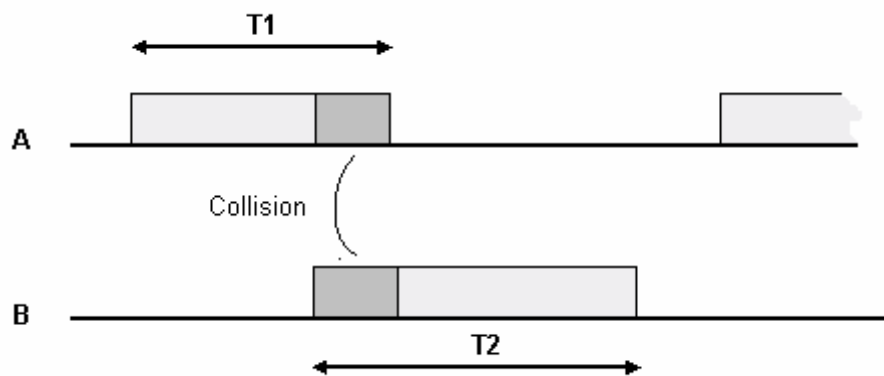

Figure 1 ALOHA

In normal ALOHA, the maximum wasted time is $T_1 + T_2$ i.e. 2 packet times, as during this time no transmission could take place. As it is a random access technique so time frequency or code is allocated. To improve upon the maximum wasted time in normal ALOHA, the time axis is divided in to slots of fixed width. The users can transmit as and when they wish however the transmission has to start at the start of the slot or epoch. As a result the wasted time is that of a single slot. This is half of that in normal ALOHA, so throughput is doubled, i.e. up to 36% throughput is obtained.
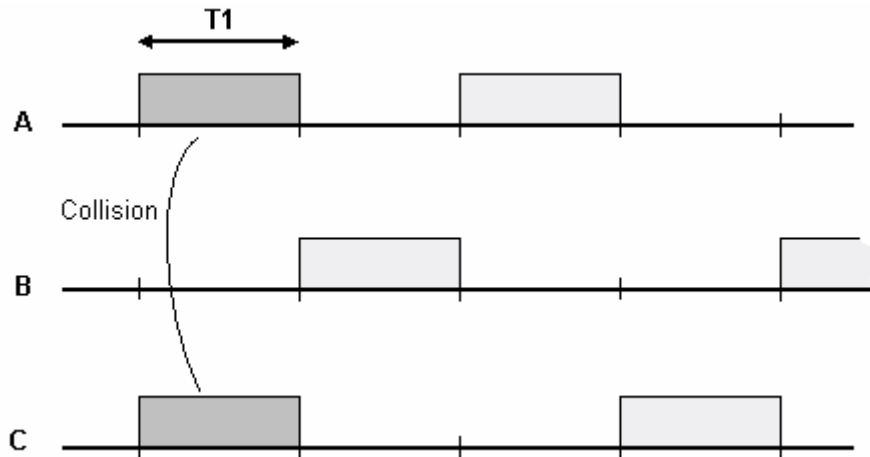
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Figure 2 Slotted ALOHA

☞ In mobile communication the user requests for a slot, using random access technique (ALOHA).

5.2.3 CSMA/CD AND ETHERNET

Broadcast system has a benefit that every station knows whether every station is transmitting at a given time instant. Each user listens before transmitting. If the channel is busy, the user waits and listens after some random time. This technique is known as Carrier Access Multiple Access (CSMA) technique. The word carrier refers to any signal present over the medium. In the communication engine at the station, the receiver will be ON all the time. If it is receiving something it will automatically stop the transmission.

☞*XEROX CORP. INVENTED THIS SYSTEM AND PATENTED IT. THE NAME ETHERNET WAS GIVEN BY XEROX CORP., INTEL CORP., AND DIGITAL*
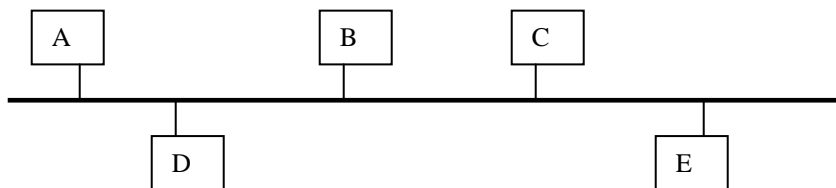

Figure 3 Collision in CSMA

EQUIPMENT COMPANY (DEC). THEY JOINTLY DESIGNED AND MANUFACTURED THE EQUIPMENT.

Theoretically CSMA has no blocking or collision, so throughput is 100 %. But in practice collisions do occur in situations as described below.

When the channel is free, more than one user who has data to transmit may simultaneously sense this. They may in this case begin transmission simultaneously and collisions occur. In another case when A starts transmission, E cannot sense that A is transmitting due to the propagating delay and starts transmission of its data. A collision then occurs. Collision in ALOHA is different from this collision, in that the latter one is point of time, but the former is distributed within the maximum propagation delay time.

The probability of collision increases as the number of users increases. Throughput thus depends on the traffic load. This is the main reason for CSMA providing somewhat inferior throughput than the theoretical 100 %. The difference between the actual throughput and theoretical throughput depends on the actual network implementation.

Objective Questions

16.1 Sensing the medium before transmission or before accessing the medium is called _____.

16.2 The theoretical throughput limit for pure ALOHA is _____and for slotted ALOHA is _____.

16.3 Which three companies were the first to introduce Ethernet?

Subjective Questions

16.11 Prove that theoretical throughput of slotted ALOHA is twice that of pure ALOHA.

16.12 Why do collisions occur in CSMA?

16.13 ow is contention resolved in CSMA/CD?

Level 2 Questions

16.21