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Carrier Sense Multiple Access With Collision Detection

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1 Introduction

The topic of this report is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). By using this protocol, data can be transmitted between nodes effectively in basic Ethernet network. The goal of the report is to introduce CSMA/CD, explain its process, and provide an overview of its nowadays role.

2 CSMA/CD

2.1 Introduction

CSMA/CD protocol is mostly used in basic Ethernet networks or LANs (Local Area Networks) for reliable communication among nodes.

In an early Ethernet basic topology, all computers are connected to the same transmission medium (bus) as figure 1 illustrates by physical cables. To be more specific, coaxial cables which has a half-duplex mode are used as the transmission channel [3,470]. This mode enables both connected devices to send or receive data; however, transmission only happens in one way, meaning while one is sending, the other can only receive. This type of data transmission is vulnerable to collisions because nodes are unaware of whether other nodes are transmitting data.

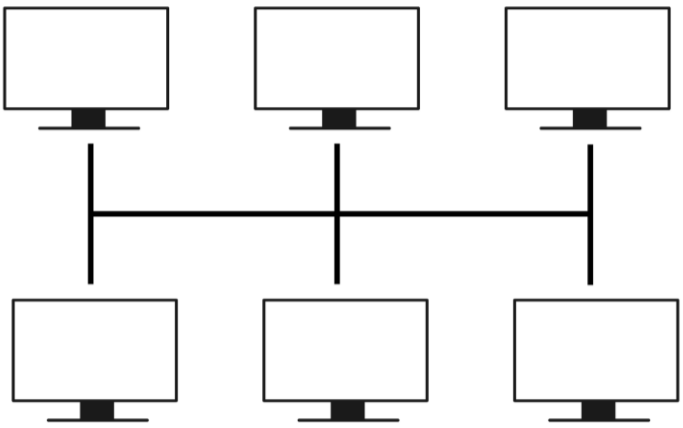

Figure 1. An example of the bus topology.

Furthermore, the bigger size of the network and the longer length of the transmission channel also raise the probability of collisions [1,125].

2.2 Definition

In order to solve the above problem, CSMA/CD was developed to control the traffic among nodes. The term can be broken into components as below [2,233]:

- CS (Carrier Sense) means that a host is able to senses whether the medium is currently available to transmit the data - thanks to a device attached to a network interface card called a receiver [1,120]. However, it cannot detect whether other nodes are also preparing for transmission. Therefore, there are possibilities that a collision occurs if two or more computers send its data at the same time [3,456].

- MA (Multiple access) means a topology that all nodes share a transmission channel. A bus topology is an example.

- CD (Collision detection) is a method to detect and progress with nodes' data involving in the collision.

2.3 Operation

The CSMA/CD process is described as the following steps:

- Firstly, the host uses the receiver to detect whether the line is idle.

- Secondly, if the line is free, the host begins to transmit its data immediately. If the line is busy, it waits until the line is idle and transmits data after 9.6 μs (almost immediately) [1,124].

- Thirdly, if a collision is detected by a participant, it sends a jamming signal so other nodes can also aware. Each node involving now stops transmitting and uses an algorithm called exponential backoff to calculate the waiting time. In details, a random number k will be chosen between 0 and 2^(n) - 1 (n is the

number of collisions experience). After that, the node waits for k × 51.2 μs before attempting all over again. The maximum value of n is 10, while the maximum of retransmissions is 16. After reaching the retransmission threshold, the transmitter aborts the process and reports the error [1,127].

3 Further discussion

3.1 Full-duplex

Full-duplex is similar to half-duplex: both enable transmission in both directions. However, instead of making nodes take turns to use the line, full-duplex allows both nodes to send and receive data at the same time. Nowadays common twisted-pair and fiber optic cable operate this mode; it not only increases the throughput but also eliminates most possible collisions. Therefore, CSMA/CD is no need.

3.2 Switch

Since being created, switches have replaced hubs and repeater in Ethernet LAN. Instead of sending data to all the connected nodes like hubs and repeater, switches form an address table themselves to coordinates the transmissions [2,234]. Besides, the full-duplex mode is also available on modern switches. Therefore, CSMA/CD is unnecessary in switched Ethernet [3,475].

4 Conclusion

After being developed, Ethernet itself continues to grow, holding its title as a dominant local area network technology. CSMA/CD played an important role since the original Ethernet LAN was created until full-duplex cable and switch were represent, which were considered to be significantly evolutions [3,470]. Today, while Ethernet is still widely used in data centers, CSMA/CD is now unpopular and becomes a part of computer network history [1,119].

References

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