TD2 - Networks and protocols

TI602

In this tutorial, we are interested in the different transmission parameters computation and Ethernet frames structure and exchange.

Case study

We are interested in an online shooter video game platform where players control characters and compete in 3D space. Characters can interact with the environment and with other characters by attacking each other. This platform runs on a local network infrastructure, each player accesses the game on a machine on which his client application is running. A central server manages the synchronization of the game's views and actions: a client application sends data to the servers at a fairly high frequency on the position of the player's character, movements and the actions executed by the latter (in particular on the other players characters). The server after receiving this information, made a computation based on the actions and movements done (received) and distributes the updates to the other machines so that everyone can see everyone's state almost in real time locally on their machine. In this kind of games, the speed of the messages as well as the optimization of resources is very important in order to guarantee an optimal gaming experience (maximum data transmitted correctly and low latency for a view close to real time).

Part 1

The latency of a client is defined by the time a message takes to go from a player (client) machine to the server and go back to the player machine (round-trip time).

Bellow some network transmission parameters definitions:

Propagation time is the time a signal takes to cross a given medium of a given length, limited by its propagation speed (depends on the type of the medium) and its length.

Data emission rate is the amount of data provided by a computer in a given time unit before the transmission, limited by the capacity of this later and its network card.

Emission time is the time necessary for the emission of a given amount of data, limited by the data emission rate

Data transfer rate is the amount of data that is moved from a source to a destination in a given time unit, limited by the bandwidth of the medium and the data emission rate.

Transfer time is the time necessary for the transfer of a given amount of data, limited by the data transfer rate

1. In our previous configuration (star topology using a switch), we use cables with a propagation speed S = 100,000 km/s. The data emission rate is 10 Mbps, and the minimum frame length is 64 bytes.

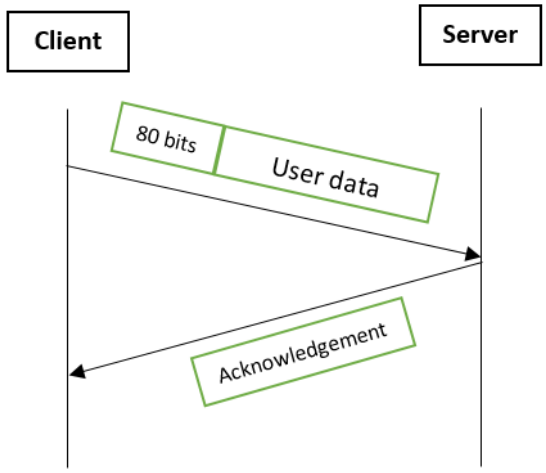
   a. What is the emission time of a 64 bytes frame

   b. Compute D, the max diameter (distance between the two most distant machines sharing the same cable) of the network in order to CSMA/CD technique works properly.

   c. For a higher emission rate requirement, an Ethernet network type with of 100Mbit/s has been studied. What is would be the maximum diameter possible in this case?

   d. What solution could have been proposed so that CSMA/CD works while preserving the diameter of the network.

2. A player client transfers a 15Kbits message to the server for each update. With a frame length of 1000 bits, 80 bits of headers and each frame is acknowledged with an 88 bits acknowledgment frame before being able to transfer the next frame.



Assuming that the switch processes a frame in 1ms and has the same emission rate as the other machines 100Mbit/s, the emission rate = reception rate all cables length is the diameter computed above, what are :

   a. The propagation time between a station and the switch (Pt)

   b. The emission time of a frame from a client to the server (Et)

   c. Assuming that a machine takes the same time to receive a frame as to send it (emission time), compute the transfer time of a frame (with ack) Tt

   d. Total transfer time (Ttotal) of the application message

   e. The actual (useful) transfer rate (Ur)

Part 2

Using the given frame format, decode the following Ethernet frame (these frames are given without the preamble, SFD and FCS).

a. Determine the values of all the fields present and theirs meaning.
b. Who sent the frame ? why ?

FF FF FF FF FF FF 08 00 20 02 45 9E 08 00 00 01 08 00 06 04 00 01 08 00 20 02 45 9E 81 68 FE 06 00 00 00 00 00 00 81 68 FE 05 08 00 20 02 45 9E 08 00 20 07 0B 94 08 06 00 01 08 00 06 04 00 02 08 00 20 07 0B 94 81 68 FE 05 08 00 20 02 45 9E 81 68 FE 06