Computer Networks Class Notes

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October 3rd, 2018

1 Recap

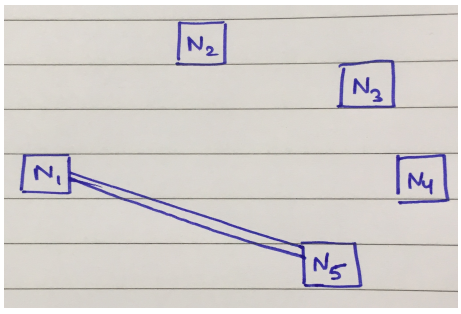
Link Layer (along with the physical layer) is responsible for the transmission of bits over a link and collecting those streams of bits in the form of frames. But in order to successfully transmit these packets, the following five problems need to be tackled:
1. Framing
2. Error Detection
3. Reliable Communication
4. Flow Control
5. Medium Access Control

(These problems and their approaches have been discussed previously.)

So far, in our discussion of the above, we have assumed that there are only 2 nodes connected by a transmission medium, that is, there is a direct link that exists between them (a.k.a point to point link). Even for the MAC problem we have assumed that there is a connection between 2 nodes even though there are multiple nodes sharing that medium.

2 Specific Infrastructure

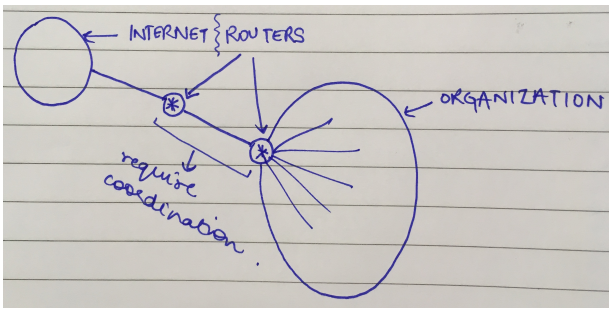
Let us consider the following Special Case:



In the diagram above, there are multiple nodes sharing the medium but only N_1 and N_2 have a direct link which means no other node is using this link.
Coordination between the nodes that are linked (w.r.t the approaches being used) is required. This means, say, if N_1 is using CRC then N_2 should be using CRC too.
MAC problem is not to be worried about in this case.

(*note: *RFC-Request for Comments* are the official documents of several communication protocols which define the rules, syntax, semantics and synchronization of communication and possible error recovery methods. These are handled and drafted by organizations like IEEE, IETF, ICANN)

What are some of the real life situations where in only 2 nodes are sharing a medium?
Some special cases for this would include:
1. Laptop connected through ethernet cable
2. 2 laptops connected



But the most popular case is that of Dial up connections.
It is based on PPP - Point to Point Protocol which is essentially when there are 2 nodes and 1 direct link.

(*note: There is a specific RFC for PPP. *HDLC- High-Level Data Link Control* Protocol is similar to PPP.)

3 PPP Protocol

The 2 nodes using PPP exchange information while taking care of the following conditions:
1. Framing - Present
2. MAC - Not Required
3. Reliable Communication - Not Provided

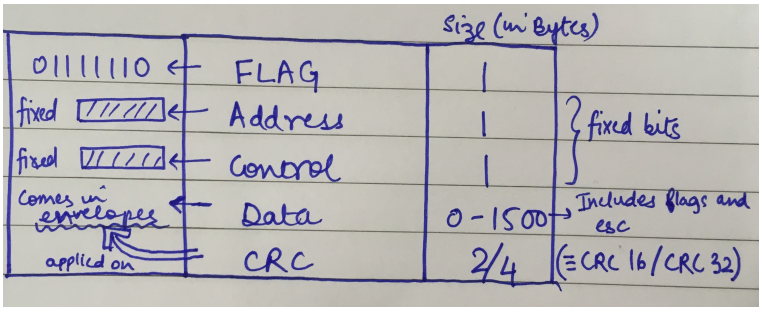
Due to this, if the data gets corrupted then the receiving node will not know. So how can we recover from an error?

These nodes have a link which is usually error free but this does not guarantee that no error will occur. But if the error occurs, it is handled by some upper layers which employ Reliable Communication(RC). These services (Framing, Error Detection, RC, etc) are being used by the upper layers all the way to the Application Level. Therefore, if the upper layer detects error or does not receive the packet, it will send a request.
Not using RC in the lower layer increases efficiency increases but if an upper layer is using it, it makes up for the error that can occur.
4. Error Detection - Present
5. Flow Control - Not Provided

(*note: Error will only occur at the physical layer since transmission takes place here. If there are many errors, then the error should be detected at lower layers.)

In short, PPP protocol constitutes:
1. Framing - Byte Stuffing
2. Error Detection - CRC

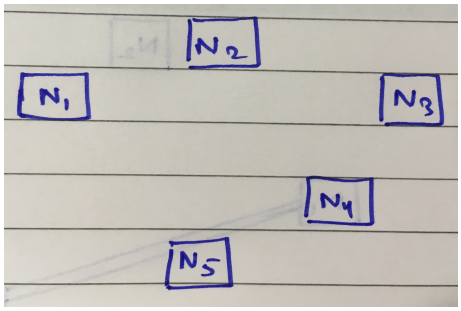
The following is the PPP frame structure:



From the above, we can say:
Total bytes = 1007 bytes
Also the above information is sent in the form of a string which has the order:
Flag, Address, Control, Data, CRC

With this we come to an end of Direct Link.

4 Shared Link



These several nodes share the same medium and this is known as a Broadcast System.
They are connected either through a wire or are wireless and each has different topologies.

Some of the Broadcast Systems are:

Wired	**Wireless**
Ethernet (LAN)	WiFi
Token Ring (LAN)	3G
FDDI-Fiber Distributed Data Interface(LAN)	

When a node wants to connect to another node in a shared medium, then the receiving node should know that it is the chosen one. Here, the address of a node is required. At link layer it is the MAC address.

About the Link Layer Address/MAC Address:
1. A MAC address is for NIC (Network Interface Card)/Adapter.
2. A MAC address is a 48 bit number
It is denoted/described in hexadecimal as follows:
XX:XX:XX:XX:XX:XX
Here, the first 4 characters are fixed for a particular country/region (done by IEEE/IETF).
This address is globally unique.

(*note: Promiscuous Mode - Tapping into the channel and listening and storing all information being shared)

In order to send a message to all nodes in the shared medium, the following Broadcast MAC address is used:
FF:FF:FF:FF:FF:FF

4.1 Ethernet (802.3)

Features of Ethernet:
1. This is a Broadcast System.
2. Type: LAN (Local Area Network, that is, it is limited in terms of Geographic area)
3. Wired System (that is, a Physical wire exists)
Types of wires for different ethernets:
Ex, 10BaseT and 100BaseT , where,
T is Twisted Wire
10/100 is bandwidth
Base is base transmission: Digital Signal

It constitutes:
1. Medium Access Control : CSMA/CD
2. Framing
Reliable Transmission and Flow Control are not provided.

(*tip: WiFi uses RC cause of the prevalence of noise in the medium)