Computer Networks

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1 Introduction

We reviewed our discussions on various homogeneous networks before starting Network Layer.

Summary of Networks discussed	
Type of Networks	Remarks
Point to Point	General PPP network architecture
Shared medium	General (wired and wireless), Example : Ethernet, Token Ring , FDDI, wifi
Switched Networks	Extension to shared medium networks. Example : switched Ethernet

We defined all multiple access protocol as belonging to one of three categories: channel partitioning protocols, random access protocols, and taking-turns protocols To define taking turns, we introduce **ring topology** in comparison with already familiar typologies.

Figure 1: Star topology

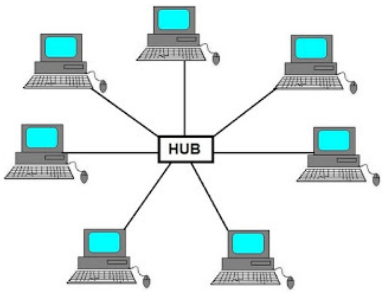

Figure 2: Bus topology

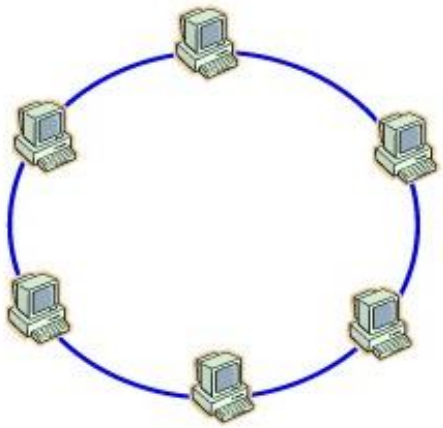

Figure 3: Ring topology.

2 Ring

We introduce **taking turn** protocol by considering Ring topology. Since it is a shared medium (Fig:3) it must have a MAC protocol, namely, token ring and FDDI protocol

Token Ring A small, special-purpose frame known as a token is exchanged among the nodes in some fixed order. For example, node 1 might always send the token to node 2, node 2 might always send the token to node 3, and node N might always send the token to node 1. When a node receives a token, it holds onto the token only if it has some frames to transmit; otherwise, it immediately forwards the token to the next node.
Pros - . Token passing is decentralized and therefore highly efficient.
Cons - 1. the failure of one node to pass token can crash the entire channel.
2. Every node has to wait for the token

Fiber distributed data interface (FDDI) can be defined in terms of token ring with difference in transfer as follows:

In token ring, the frame sent will take full circle and then it will be absorbed by the sender.

In FDDI, the frame is taken off by the receiver

3 internet

Until this section we have been looking at homogeneous networks, Network layer is useful is understand connections between different types of networks. We have reasons to purse this since any scalable form of network cannot be of one type. We need different networks to communicate with each other, a model which is called internet.
Thus, internet, can be seen as some collection of networks inter-connected.
This requires a new device to connect different networks and a new address to have a uniformity amongst different network frame structures.
Inter-network connection is achieved through devices called routers and a new addressing scheme called inter-network protocol(IP).

Need for IP: Link layer MAC address will not work in heterogeneous network since MAC address do not have any hierarchical structure. The distribution of MAC addresses across the network is random and completely unrelated to topology. Routes grouping would be impossible.

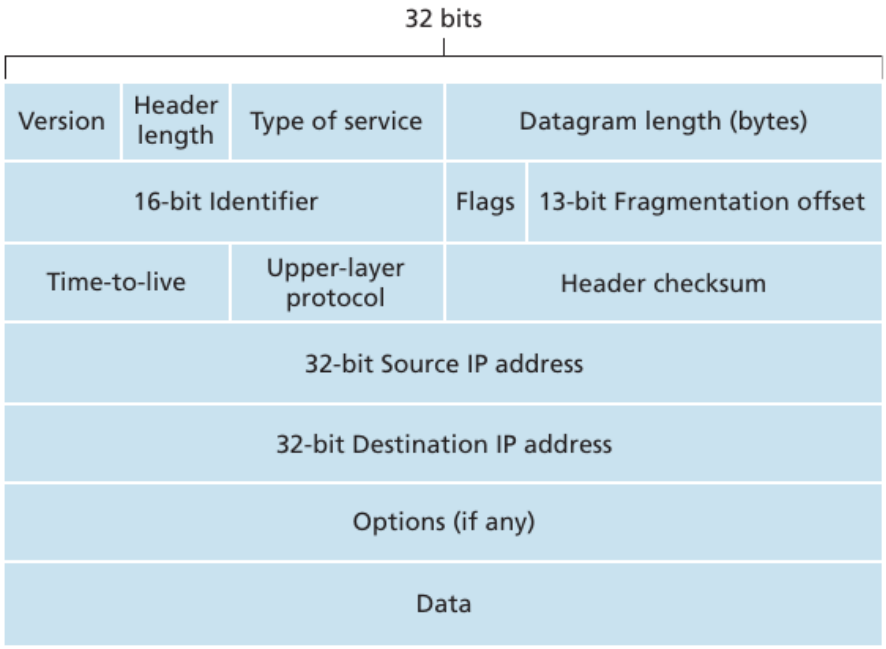

Figure 4: IP frame structure

on the other hand, IP addresses are allocated hierarchically, so a router can group routes by address prefixes.

IP frame structure:

Version : These 4 bits specify the IP protocol version of the datagram. By looking at the version number, the router can determine how to interpret the remainder of the IP datagram.

Header length : these 4 bits are needed to determine where in the IP datagram the data actually begins. typical IP datagram has a 20-byte header, which is converted into words. Number of words are represented through the 4 bits.

Type of service: allow different types of IP datagrams

Datagram length: This is the total length of the IP datagram (header plus data), measured in bytes. Since this field is 16 bits long, the theoretical maximum size of the IP datagram is 65,535 bytes.

TTL : The time-to-live (TTL) field is included to ensure that datagrams do not circulate indefinitely (due to, for example, a long-lived routing loop) in the network. This field is decremented by one each time the datagram is processed by a router. If the TTL field reaches 0, the datagram must be dropped.

Source and Destination address : Source and destination IP addresses. When a source creates a datagram, it inserts its IP address into the source IP address field and inserts the address of the ultimate destination into the destination IP address field.

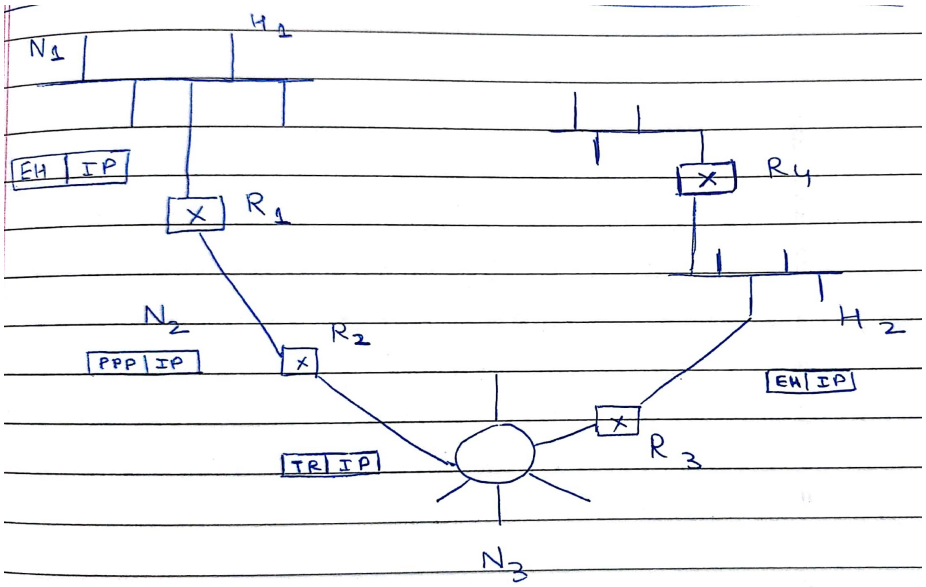

Figure 5: internetwork

4 Heterogeneous Network connection

We connect various networks, N1, N2, N3, N4 through routers R1, R2, R3, R4. We have the following additions :
1. Every node has an IP address.
2. Every router interface has an IP address.
Now, since we have different types of networks, we need to transfer out IP packet from H1 to H4 through different frame structures in every network.

The IP packet is fragmented into payload of every frame type in its route. 1. R1 receives an Ethernet frame with the IP packet in its payload(note: since one IP packet can be very large it may take several Ethernet packets to make up for one IP packet)
2. R2 receives a point to point frame with its payload as described above.
3. R3 receives a token ring frame
4. R3 sends an Ethernet frame which is received by H2