Computer Networks
Class Notes

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Broadcast Systems:

Broadcasting involves the passing of a message to multiple nodes connected by the same medium.

Wired (Ethernet) LAN

As was discussed in the previous class, one type of Broadcast system is Ethernet LAN.

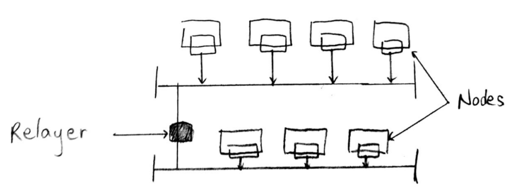
1 Topology of Ethernet LAN:

There are a number of protocols by which Ethernet LAN can be implemented. It is essential that uniformity of protocol is maintained within the network. Ethernet LAN can be implemented in the following ways:

1.1 Bus Topology:

The assumption made in this implementation is that every node knows every other node's MAC address.

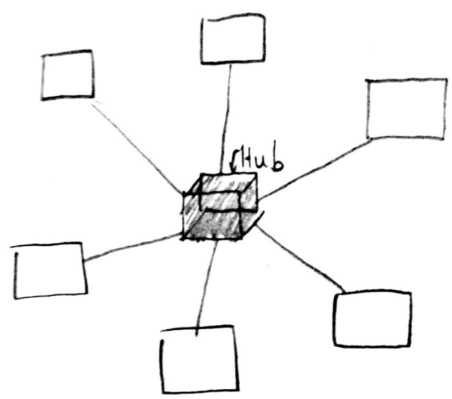
Figure 1: Connection between two buses



Two buses can be connected via a relayer, which takes a signal from one bus, amplifies it and passes it to the next bus. One disadvantage of this implementation is that any noise present in the network will also be amplified.

1.2 Hub Topology:

Figure 2: Hub Topology



Here the hub relays the signal to all nodes without decoding the packet.

1.3 Switch Topology:

Unlike the hub, the switch governs the working of the network. The Switch has the ability to process packets before relaying them. The information collected after the decoding process is updated on the switch's table and thus, gives the switch the ability to forward packets with more accuracy than in the Bus and Hub implementations. Details of this process will be discussed below. An implementation of the Switch topology, also referred to as **Packet Switching**, must contain the following components:

a)Nodes

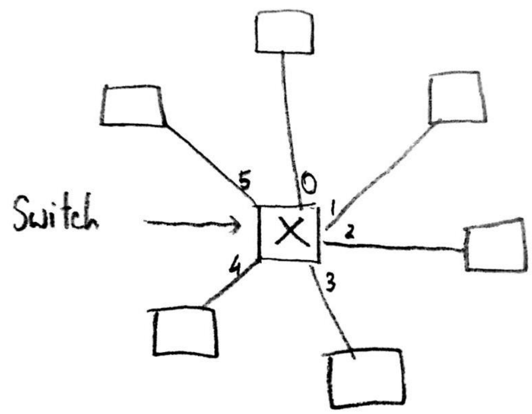
b)Physical Medium

c)Switch

Packet Switching can be implemented by the following protocols:

1.3.1 Datagram/Connectionless approach:

Figure 3: Packet Switching



The interface (labelled 0-5) are the ports on the switch through which the nodes are connected. In this approach the switch table contains three columns: **MAC address, Interface Number, Time**.

When a switch receives a packet from a node it decodes the packet, finds the sender address within it, and updates the table with that sender address and the corresponding interface from which the switch received the packet. The time the packet was received by the switch is also updated on the table. This process is known as automatic table update. The entry in the table will be erased after a certain time t has elapsed.

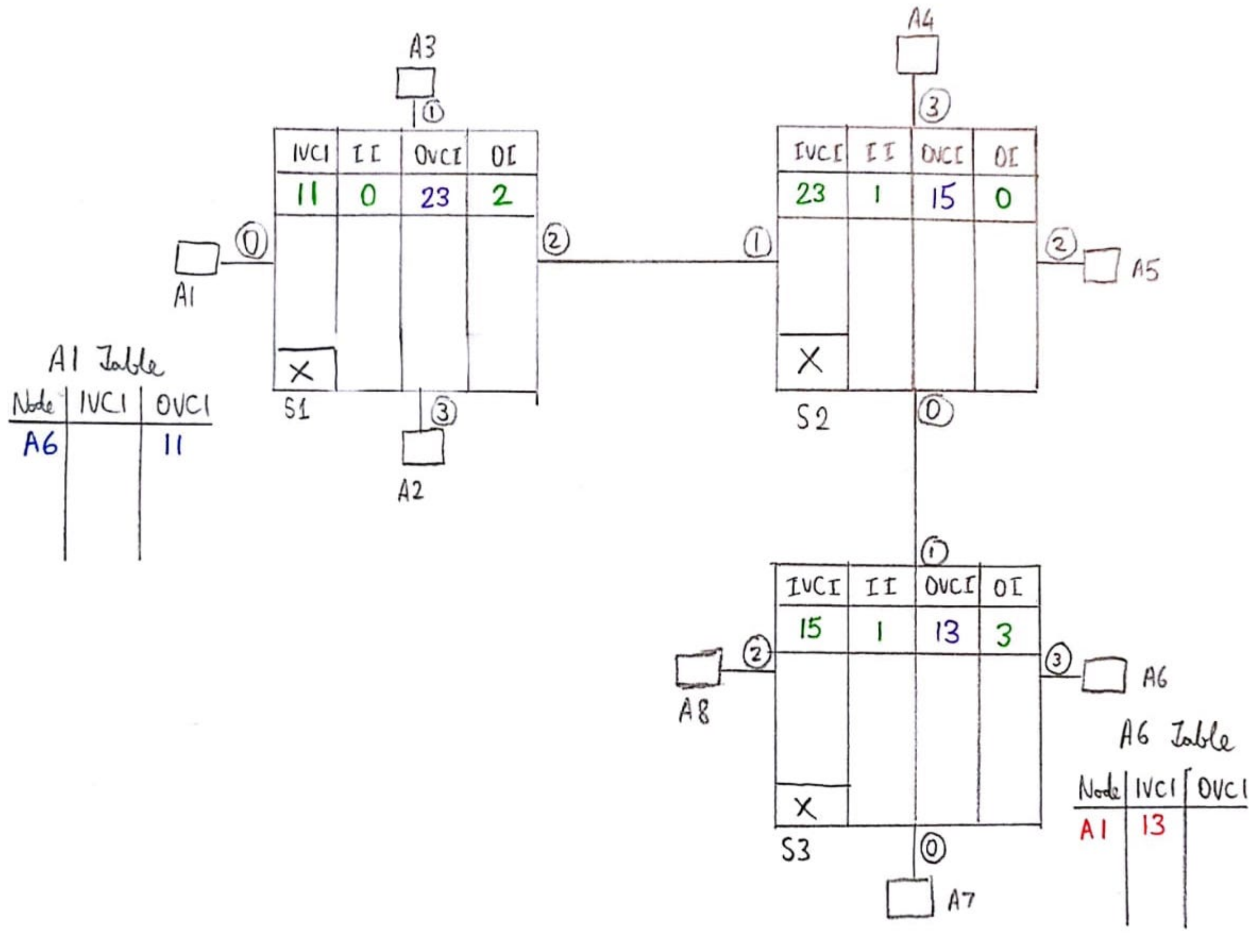
Following this, the packet is broadcast to all the interfaces if the switch does not know the interface of the destination address.

Once the table is filled, the switch will know the corresponding interface of every node address. The switch will then have the ability to decode any packet, read the destination address and forward the packet only to the destination address's corresponding interface.

In this approach the sending of the frame does not depend on the connection status of the receiver node.

1.3.2 Connection Oriented approach

Figure 4: Establishing of connection from A1 to A6



Assumption made here: The Network Administrator knows the location of each node.

In this approach a packet can only be shared once a connection has been established between the sender and the receiver.
Given below is the process by which the connection is established.

Notation:

IVCI: Incoming Virtual Circuit Identifier

II: Incoming Interface

OVCI: Outgoing Virtual Circuit Identifier

OI: Outgoing Interface

In this example, a packet is being sent from A1 to A6

Step 1:
Switch 1 updates the II column with the value 0 since a packet is coming from A1 which is connected to Switch 1 through Interface 0 . The OI column is updated with the value 2 since the packet has to go to A6 which is connected to Switch 1 through Interface 2. Switch 1 also assigns a number of its choice in the IVCI column. Every IVCI entry in a given switch's table must be unique.

The switches that lie in the A1-A6 path will also update their II and OI columns with respect to the interfaces through which the connection is being established. In this example: S2 updates II as 1 since a packet from A1 would enter from Interface 1. S2 updates OI as 0 since a packet going to A6 would leave through Interface 0. The IVCI will be assigned in each switch in the same way it was in Switch 1.

Step 2:
Each node has a table of its own where it assigns an IVCI and OVCI to each of the other nodes in the network . Here A6 updates its table by assigning an IVCI of its choice (here, 13) for A1.

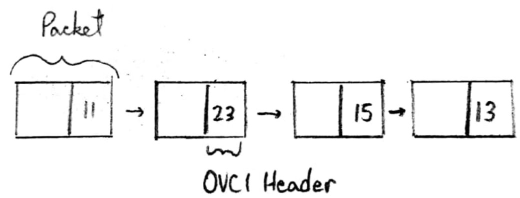
Step 3:
The OVCI of each switch's table is then updated as the IVCI of the table that succeeds it. Switch 3 updates its OVCI as 13 in this example, since the IVCI of A6's table is 13. S2 updates it as 15 since S3's IVCI is 15, and so on.

Step 4:
A1 updates its table by assigning 11 (S1's IVCI) as an OVCI for A6

Now the connection between A1 and A6 has been established.

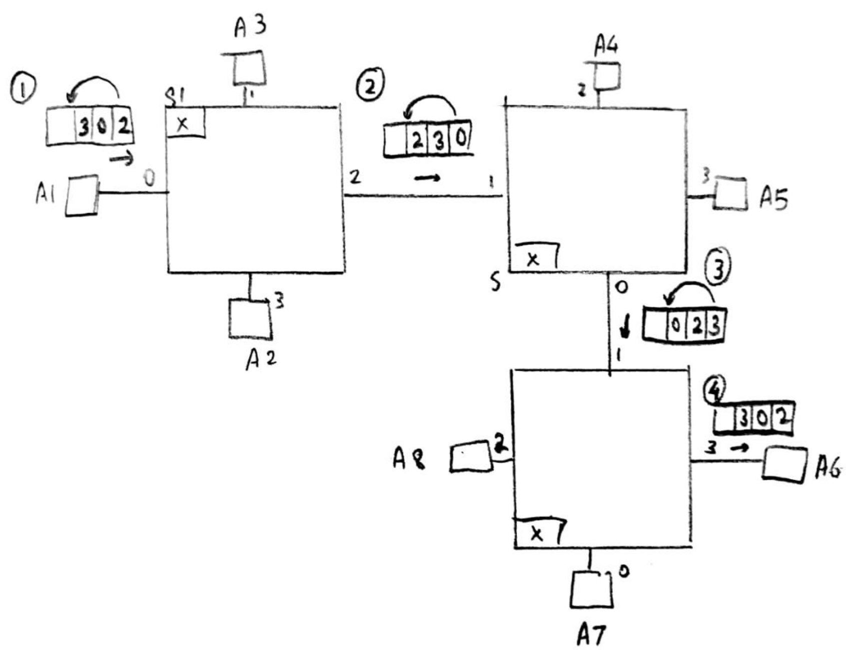
When a packet is being sent from A1 to A6 there is an additional OVCI header attached to it. When leaving A1 the OVCI header is set to 11. It then enters S1, which reads the OVCI header and from the packet, searches for that value in the IVCI column. Following this, S1 finds the interface through which the packet must be sent by checking the IVCIs corresponding OI value. Before sending the packet out, S1 replaces the value in the packets OVCI header with S1's OVCI. This process is repeated till the packet reaches A6.

Figure 5: Change in OVCI header as packet is sent from A1 to A6



1.4 Source Routing:

Figure 6: Connection between two buses



In this case the packet has a header which works as a revolving **stack of the Outgoing interfaces**. The last entry in the header at a given point is the outgoing interface that needs to be taken for that particular switch. Having passed through the switch, the OI number will be pushed to the end of the stack.

This information is provided by the Network Administrator.

Note: While we have discussed Packet Switching from the perspective of Ethernet LAN, this protocol can be extended to various other networking systems such as:

a)X.25

b)Frame Relay

c)Asynchronous Transfer Mode (ATM)

2 Wireless LAN or WLAN

There are two kinds of implementations of WLAN:

a)WiFi (802.11)

b)3G/4G/LTE

Components:

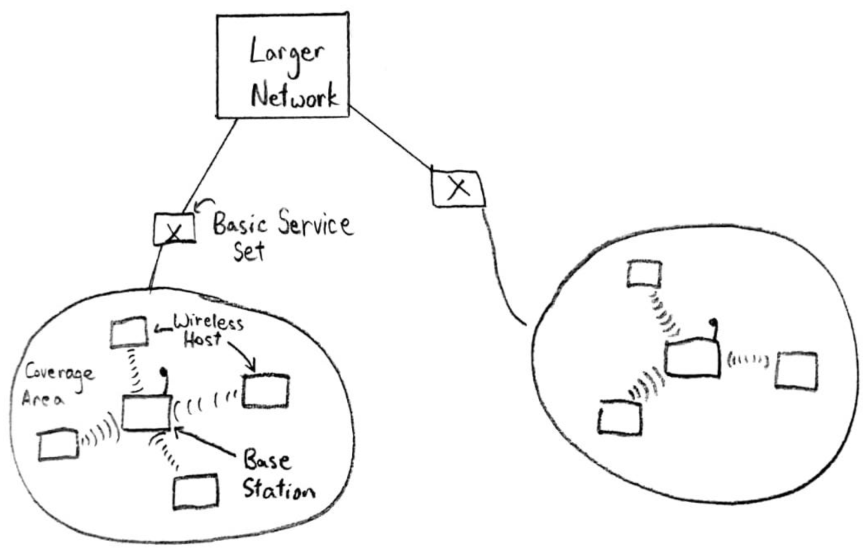
1. Wireless Host
These are the nodes of the network

2. Wireless links
Since the medium is wireless the following problems come into play:
a) Signal dispersion
b) Error in transmission
c) Signal interference

3. Base Station
For WiFi these are access points. For 3G/4G/LTE they are towers.

4. Network Infrastructure (Shown in diagram)

Figure 7: WLAN Network Infrastructure



In the next class we will cover what Basic service sets are and go over Medium access protocols for WLAN.