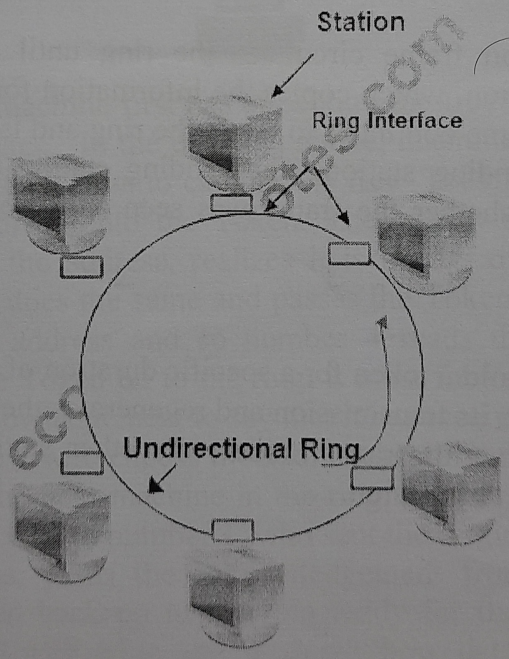
Token Ring (IEEE 802.5)

Token ring is the IEEE 802.5 standard for a token-passing ring in Communication networks. A ring consists of a collection of ring interfaces connected by point-to-point lines *i.e.* ring interface of one station is connected to the ring interfaces of its left station as well as right station. Internally, signals travel around the Communication network from one station to the next in a ring.

- ✓ These point-to-point links can be created with twisted pair, coaxial cable or fiber optics. Each bit arriving at an interface is copied into a 1-bit buffer. In this buffer the bit is checked and may be modified and is then copied out to the ring again. This copying of bit in the buffer introduces a 1-bit delay at each interface.

- ✓ In Token Ring all stations are connected in a ring and each station can directly hear transmissions only from its immediate neighbor. Permission to transmit is granted by a message (token) that circulates around the ring. A token is a special bit pattern (3 bytes long). There is only one token in the network.



A Ring Network

- ✓ Token-passing networks move a small frame, called a token, around the network. Possession of the token grants the right to transmit. If a node receiving the token in order to transmit data, it seizes the token, alters 1 bit of the token (which turns the token into a start-of-frame sequence), appends the information that it wants to transmit, and sends this information to the next station on the ring. Since only one station can possess the token and transmit data at any given time, there are no collisions.

- ✓ There are two operating modes of ring interfaces. There are listen and transmit. In listen mode, the input bits are simply copied to output with a delay of 1- bit time. In transmit mode the connection between input and output is broken by the interface so that is can insert its own data. The station comes in transmit mode when it captures the token.

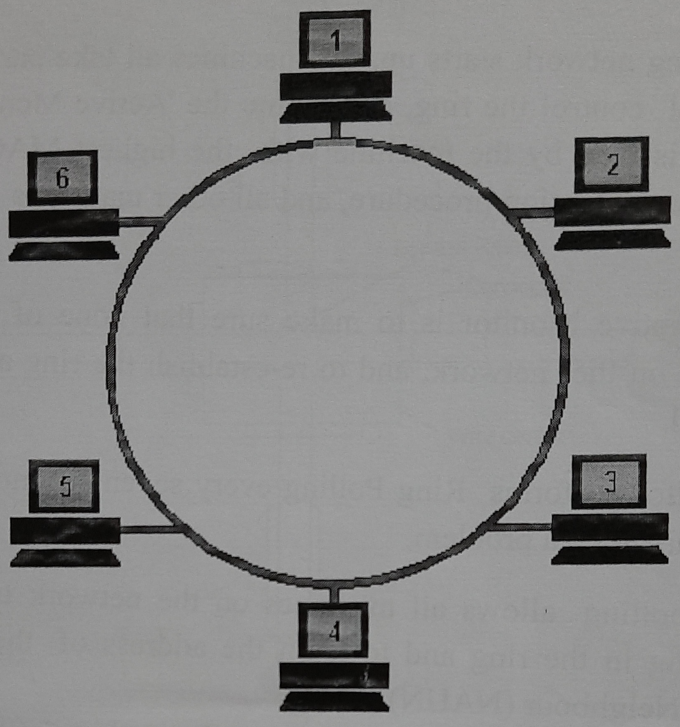
- ✓ The frames are acknowledged by the destination in a very simple manner. The sender sends frames to receiver with ACK bit 0. The receiver on receiving frames, copies data into its buffer, verifies the checksum and set the ACK bit to 1. The verified frames come back to sender, where they are removed from the ring.

- ✓ The information frame circulates the ring until it reaches the intended destination station, which copies the information for further processing. The information frame continues to circle the ring and is finally removed when it reaches the sending station. The sending station can check the returning frame to see whether the frame was seen and subsequently copied by the destination.

- ✓ A station can hold a token for a specific duration of time. During this time, it has to complete its transmission and regenerates the token in ring. Whenever a station finishes its transmissions, the other station grabs the token and starts its own transmission.

The Basic operation

Token ring speed can be 4Mbps to 16Mbps.



To use the network, a machine first has to capture the free Token and replace the data with its own message. In the example above, machine 1 wants to send some data to machine 4, so it first has to capture the free Token. It then writes its data and the recipient's address onto the Token. The packet of data is then sent to machine 2 who reads the address, realizes it is not its own, so passes it on to machine 3. Machine 3 does the same and passes the Token on to machine 4. This time it is the correct address and so number 4 reads the message. It cannot, however, release a free Token on to the ring, it must first send the frame back to number 1 with an acknowledgement to say that it has received the data. The receipt is then sent to machine 5 who checks the address, realizes that it is not its own and so forwards it on to the next machine in the ring, number 6. Machine 6 does the same and forwards the data to number 1, who sent the original message. Machine 1 recognizes the address, reads the acknowledgement from number 4 and then releases the free Token back on to the ring ready for the next machine to use. That's the basics of Token Ring and it shows how data is sent, received and acknowledged, but Token Ring also has a built in management and recovery

system which makes it very fault tolerant. Below is a brief outline of Token Ring's self maintenance system.

Token Ring Self Maintenance

When a Token Ring network starts up, the machines all take part in a negotiation to decide who will control the ring, or become the 'Active Monitor' to give it its proper title. This is won by the machine with the highest MAC address who is participating in the contention procedure, and all other machines become 'Standby Monitors'.

The job of the Active Monitor is to make sure that none of the machines are causing problems on the network, and to re-establish the ring after a break or an error has occurred.

The Active Monitor performs Ring Polling every seven seconds and ring purges when there appears to be a problem.

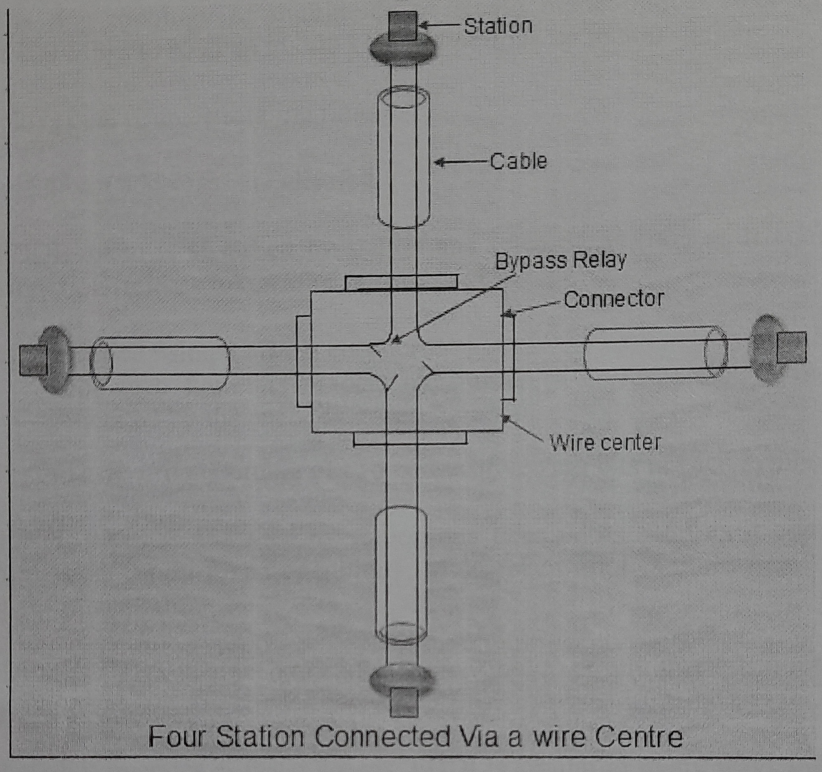
- ✓ The ring polling allows all machines on the network to find out who is participating in the ring and to learn the address of their Nearest Active Upstream Neighbour (NAUN).
- ✓ Ring purges reset the ring after an interruption or loss of data is reported.

Each machine knows the address of its Nearest Active Upstream Neighbour. This is an important function in a Token Ring as it updates the information required to re-establish itself when machines enter or leave the ring.

When a machine enters the ring it performs a lobe test to verify that its own connection is working properly, if it passes, it sends a voltage to the hub which operates a relay to insert it into the ring.

If a problem occurs anywhere on the ring, the machine that is immediately after the fault will cease to receive signals. If this situation continues for a short period of time it initiates a recovery procedure which assumes that its NAUN is at fault, the outcome of this procedure either removes its neighbour from the ring or it removes itself.

Handling cable breakage in ring networks



Four Station Connected Via a wire Centre

• If the cable breaks, the entire ring network goes down. This can completely stop the propagation of token in the ring.

• This problem can be solved by using wire centre as shown in fig.

• This wire centre bypasses the terminal that has gone down in following manner:

- ✓ Each station is connected to wire center by a cable containing two twisted pairs, one for data to station and one for data from the station.
- ✓ Inside the wire center are bypass relays that are energized by the current from the stations.
- ✓ If the ring breaks or a station goes down loss of drive current will release the relay and bypass the station.