Network Technology - Physical Layer

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Contents

1 Survey over network technologies

The network technologies can be divided into:

- Communication using *wires* The data is converted into high or low frequencies and is tranmitted via AC signals.
- Communication using *radio signals* The data is converted into high or low frequencies and is tranmitted via radio wave signals.
- Communication by *light signals* The information is converted into optical signals within the range of visible light.

2 Cable Technologies

2.1 Ethernet

The ethernet is one of the mostly used networking technologies in the world. It is developed by *Xerox PARC* in the early 1970 to connect the *ALTO* computer to a printer. Several computers can be connected using *coaxial copper cable, twisted pair or fiber optic cabling.*

The medium (cabling) is called a *Segment.* The computers connected to this Segments are called *nodes.* They communicate with each other using *frames.* Frames are chunks of data. They contain for example the source adress and the destination adress and the information that is to be submitted.

If a node receives a frame containing a destination adress differing from its own one, the frame will be ignored. Thus, the frame will be read by all nodes. A message to all nodes can be send using the broadcast adress. Thus, the frame will be read by all nodes.

When one node sends data, every other node listens. When two nodes transmit data at the same time, a collision appears. They interrupt the transfer and wait for a random time and restart sending the data.

2.1.1 Advantages of Ethernet

- Easy integration of new components
- Easy to understand
- Very common

2.1.2 Disadvantages of Ethernet

- Distance can only be up to 100m

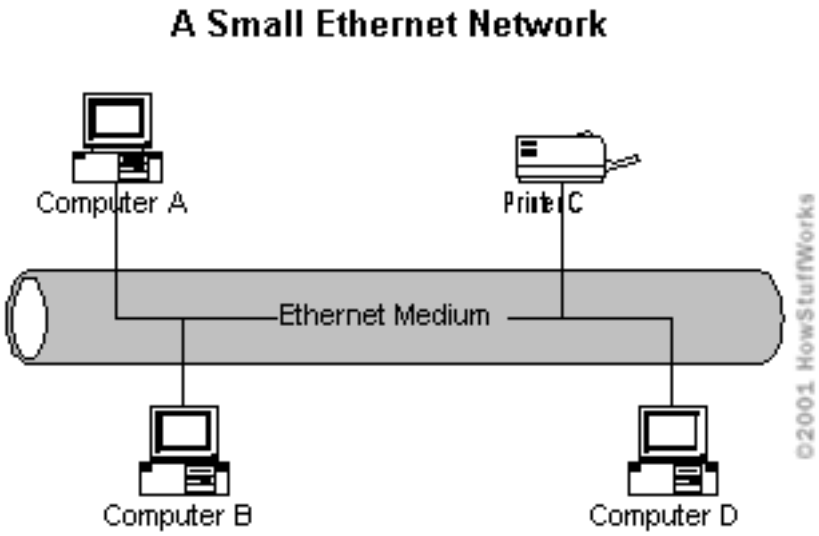

Figure 1: Ethernet Bus Topology

2.2 FDDI - Fiber distributed data interface

FDDI is another token-passing technology (like IBMs Token Ring) that operates over a pair of fibre optic rings with each ring passing a token in opposit directions. The Network allows a speed upto 100 Mbps (Token Ring 4 or 16 Mbps). FDDI has got the same problems the former IBM Token Ring got, because both are more expensive and more difficult to administer.

1. The ring initializes by creating a token, which is a special type of frame that gives a station permission to transmit.
2. The token circles the ring like any frame until it encounters a station that wishes to transmit data.
3. This station then "captures" the token by replacing the token frame with a data-carrying frame, which encircles the network.
4. Once that data frame returns to the transmitting station, that station removes the data frame, creates a new token and forwards that token on to the next node in the ring.

3 Wireless Technologies

3.1 Wireless LAN

Wireless Lan is not bound to one protocol like all IEEE-802-Networks. However, possible problems, caused by *Bit Error Rate* (BER) and the huge delay of transfer

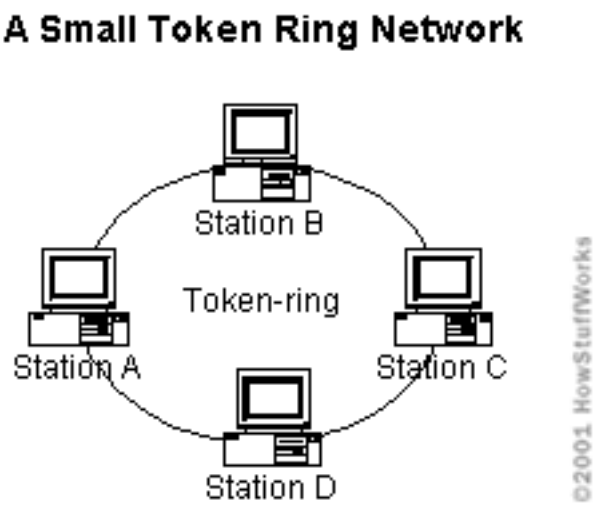

Figure 2: Ring Topology

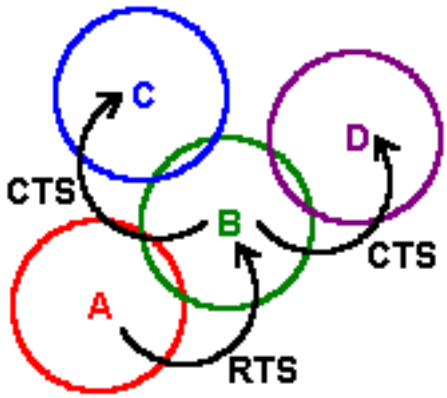

Figure 3: Wireless lan: Cell Topology

3.1.1 Data security

Fullfilling that purpose there is already one standard integrated. To be sure, that there is no possibility for unallowed listening and interfering(spoiling), the bind-spread-proceed is used to divide the signal into a wide frequency sprectrum.

The Traffic is also encrypted with WEP(Wired Equivalency Privacy) and the Userdates with the RC4-algorithm with a 40 or 128 Bit Key. However, WEP is set to not to be especially secure, another solution might be necessary.

3.1.2 Signal interfering

A wireless transmitterstation cannot determine a signal-collusion, one signal covers the ones of the other stations. the Distributed Coordination Function(DCF) distributes the rule of the statuions. The Collision Detection, known from the ethernet versions, is not useful, because there is no possebillity to differentiate a collision of a signal from a disturbances. Furthermore Collision Avoidance is practiced. it works with RTS/CTS-Procedure(Ready To Send/Clear To Send) Transmitter A sends, once reconned an clear channel, an RTS-Signal to receiver B, if B declares this one as clear it send an CTS-signal back und to all other reachable station too, the channel is resvered for B and can be used for Transfers for a determined Transmission time.

3.2 *Bluetooth*

Its a *wireless* connectivity via Radio-frequencies(2,45 gHz) to connect PCs, Keyboards, Cellphones etc.. The speed is 721 Kilobits per second in one direction, with 57.6 Kbps in the other. (1 Mbit)

3.2.1 Why use *Bluetooth*?

It's wireless. When you travel, you don't have to worry about keeping track of a briefcase full of cables to attach all of your components, and you can design your office without wondering where all the wires will go. It's inexpensive.

You don't have to think about it. *Bluetooth* doesn't require you to do anything special to make it work. The devices find one another and strike up a conversation without any user input at all.

3.2.2 Signal interfering

To avoid interfering with other systems *Bluetooth* is sending a very weak signal about 1 milliwatt. (Cellphones = 3 WATT!!) Because of this, the range of *Bluetooth* is limited to 10 Meters in a building and up to 30 meters outside.

Now you may think: But what happens if more than 1 *Bluetooth* device is sending. Dont they interfere? The answer: No, because it is using a special technique called spread-spectrum frequence hopping. In this technique, a device will use 79 individual, randomly chosen frequencies within a designated range, changing from one to another on a regular basis. In the case of *Bluetooth*, the transmitters change frequencies 1,600 times every second. Thus the risk of intefering devices is very low.

Conclusion: *Bluetooth* is very good for a personal area network(PAN or Piconet). But not good for using in Local Area networks because it is too slow.

3.3 HiperLAN

HiperLAN(High Performance Radio LAN) is an European Standard (ETSI) within 5-GHz frequency scope. Type 1 specifies an wireless ehternet with 24 MBit/s.

Further variations of the HiperLAN are:

1. *Wireless ATM* with 20 MBit/s operating within a 5 GHz scope
2. *HiperACCESS* is a Wireless Local Loop with 20 MBit/s operating within a 5 GHz scope
3. *HiperLINK* is a wireless point to point technique with 155 MBit/s at using a 17 GHz band

3.4 HomeRF

HomeRF (Home Radio Frequency) - thin and cheaper than IEEE-802.11 for homeusers. There is the possibility of voice transfer with the shared Wireless Access Protocol(SWAP)

3.5 OpenAIR

OpenAir - wireless Net-Standard before IEEE-802.11 invented by Proxim.

4 Specification comparison

Name	IEEE	Speed	range min(inside)	max (outside)
BNC	IEEE 802.3	1MBit/s	-	185m
Ethernet	IEEE 802.3	10 or 100 MBit/s	-	100m
Token Ring	IEEE 802.5	up to 16 MBit/s	-	610m
FDDI	IEEE 802.10	100MBit/s	-	1km
WLAN	IEEE 802.11b	11MBit/s	100m	300m
Bluetooth	IEEE 802.15	1MBit/s	10m	30m