

## **1. Research US Telecommunication Act of 1996 and summarize below:**

Ans-

### **Find what it was**

The goal of this new law is to let anyone enter any communications business -- to let any communications business compete in any market against any other. It will affect telephone service -- local and long distance, cable programming and other video services, broadcast services and services provided to schools. The Federal Communications Commission has a tremendous role to play in creating fair rules for this new era of competition [1]

### **Find what was changed in Telecom industry**

The telecommunications sector has witnessed dramatic reductions in costs in (i) transmission, using fiberoptic technology; (ii) switching and information processing because of reductions of costs of integrated circuits and computers. Cost reductions have made feasible many data- and transmission-intensive services.

Cost reductions usually allow for entry of more competitors and intensification of competition. However, in telecommunications, consumers have not reaped the full benefits of cost reductions and intensification of competition because of an antiquated regulatory framework that, ironically, was created to protect consumers from monopolistic abuses.

The telecommunications sector has witnessed progressive deregulation. The AT&T breakup in 1984 resulted in competition in manufacturing, long distance, and information services, while it kept the regime of regulated monopoly in local telephony.

In parallel, wireless telephony grew to great success. The "world wide web" emerged as a ubiquitous network "living" on top of the telephone network. Cable television achieved high penetration. New (and cheaper) wireless services (Personal Communications Services "PCS") and direct satellite broadcast are reaching the market. [2]

### **Find what results we had**

Yet immediately after the passage of the 1996 Act, telecommunication industries witnessed a deluge of mega mergers and acquisitions. This unprecedented merger wave resulted in a handful of conglomerates dominating industries that were previously separated by telecommunications regulations [3]

### **Find what affected broadband NWs**

The National Broadband Map shows that all parts of the country now have broadband service. Google, has provided competitive incentives for upgrading the speed of fixed broadband even further. Today, fixed broadband at 100 mbps download or greater is available to 65 percent of Americans.

Competition remains vigorous in mobile broadband, which has virtually universal availability with 97 percent of Americans able to choose among three or more mobile providers. These are evidence of the law's real economic and consumer benefits [4]

### **Find what relation between ILEC and CLEC**

ILEC" is the abbreviated form of "Incumbent Local Exchange Carrier," and "CLEC" is the short form of "Competitive Local Exchange Carrier."

Breakup of the monopoly of AT&T and the Bell Systems in 1984 that led to the formation of ILEC and CLEC soon after the Telecommunications Act of 1996.

ILEC which owns most of the loops and facilities, provides service to the public.

The CLEC is companies provide an alternative service to the ILEC within its territory. CLEC rents space from the ILEC. [5]

### **Find what we could have now since then**

We now have much better voice quality and data speed than that of previous decades. We also have world-wide broadcasting devices. Now we have better infrastructure to communicate and access information from any corner of the world. US telecommunication act of 1986 has given greater services in telecommunication sector. Also, laws of this act improved working of telecom companies. Overall, we can communicate and access information all over the world.

## **2. Describe Internet architecture today.**

Internet is a network of networks consists of multiple networks, through which we can do tasks such as email, data transfer, and access world wide web. Internet transmits data packet from one network to another network consisting of multiple computers using Internet Protocol.

There may be one single network or may be multiple networks. Similarly, some networks have no computers attached, while others can have hundreds of computers attached to it. We need a computer with router of internet gateways that is willing to transfer packets from one network to another.

If client calls his Internet Service provider (ISP) over a dial up telephone line, modem will converts the digital signals produced by computer to analog signals that can pass over telephone system. These signals are transferred to the ISP's point of presence (POP), where they are transferred to the ISP's regional network. There are multiple routers are present in ISP's regional network, then the packet is delivered to the host. Otherwise, it is handed over to the ISP's backbone operator.

If a packet given to the backbone is destined for an ISP or company served by the backbone, it is sent to the closest router and handed off there. In some cases, the packet may have to be sent to a competing backbone. To allow packets to hop between backbones, all major backbones connect at the network access point (NAP). NAP is consist of multiple routers, at least one per backbone. All routers are connected by LAN, so packets can be forwarded from any backbone to any other backbone [6]

## **3. List your local ISP and find Internet subscription plan and data rate that your ISP offers today.**

Local ISP in Chicago is RCN. It has following internet plans:

- 25 Mbps Internet  
Speed will be up to 25 Mbps. We can do surfing , email and online shopping and connect to social network and access photos
- 155 Mbps Internet  
Speed will be up to 155 Mbps. We can stream movies, watch shows, chat live
- 330 Mbps Internet  
Speed will be up to 330 Mbps. We can do gaming and streaming of movies
- Gig Internet

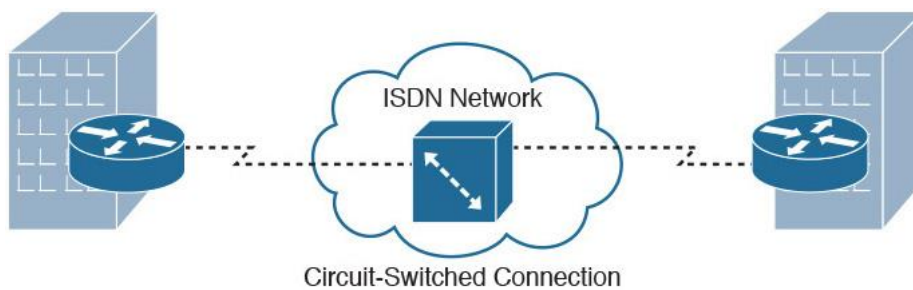
Speed will be up to 1000 Mbps. It is great for all home and connecting smart devices. It requires separate modem. [7]

#### **4. Describe Pros and Cons of circuit switching NW as today's PSTN and compare with the Internet as packet switch network.**

##### **Circuit Switching Network-**

Circuit switching has three parts as circuit establishment, data transfer and circuit disconnect. Dedicated physical communication path is present in circuit switching network. This path is maintained and terminated for every communication session.

Let us see example of how circuit switching network works. Parties involved in a phone call have a dedicated link between them for the duration of the call. When either party disconnects, the circuit is terminated, and data path is lost. The physical connection is established by sending system and then data is transferred between both systems.



##### **Advantages of Circuit Switching:**

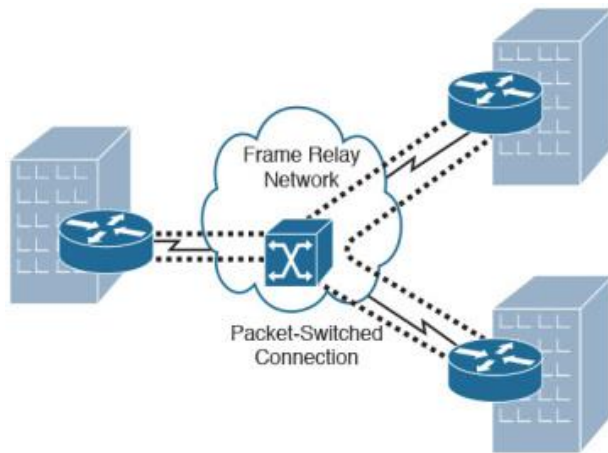
- The physical path/circuit established between both sender and receiver systems provides a guaranteed data rate.
- It is suitable for long continuous transmission as dedicated path is established.
- there is no waiting time at each switch hence, communication is without any delay

##### **Disadvantages of Circuit Switching:**

- Dedicated communication path requires more bandwidth.
- It cannot be used to transmit any other data even if the channel is free because of dedicated connection.
- As resources are allocated for the entire duration of connection, these are not available to other connections.
- Users have to pay for both distance and duration of connectivity

##### **Packet Switching Network-**

In packet switching network, data is converted in multiple packets which contain information of next and previous parts of packets and other controlled information like sender and receiver address and then it is sent to receiver.



Advantages of Packet Switching:

- Packets can move through multiple route in case of particular route is not available.
- Packet switching uses network efficiently instead of blocking communication path like circuit switching.
- Users have to pay only for time duration of connectivity instead of both distance and duration.
- It can achieve high data transmission rate.

Disadvantages of Packet Switching:

- Packets can be lost during transmission hence sequence number is required to identify.
- It takes transmission delay.
- Requires large amount of RAM to handle large packets. [8]

## 5. Abbreviated word and their full names

1. ISP – Internet Service Provider (ISP provides internet service to end users)
2. TCP – Transmission Control Protocol (TCP enables two hosts to establish a connection and exchange streams of data.)
3. IP – Internet Protocol
4. IETF- Internet Engineering Task Force (IETF is a large open international community of network designers, operators, vendors, and researchers)
5. RFC- Requests for Comments (RFC is a formal document from the IETF that is the result of committee drafting and subsequent review by interested parties.)
6. HTTP – HyperText Transfer Protocol (Application protocol for information systems)
7. SMTP – Simple Mail Transfer Protocol (Internet standard for electronic mail transmission)
8. P2P- Peer to Peer (architecture that partitions tasks or workloads between peers)
9. API- Application Programming Interface (set of subroutine definitions, protocols, and tools for building application software)
10. DSL- Digital Subscriber Line ( family of technologies that are used to transmit [digital data](#) over telephone lines.)

11. DSLAM – Digital Subscriber Line Access Multiplexer (network device, that connects multiple customer DSL interfaces to a high-speed digital communications channel using multiplexing techniques)
12. HFC – Hybrid Fiber Coax (Term that combines optical fiber and coaxial cable.)
13. CMTS – Cable Modem Termination System (A device used to provide high speed data services)
14. FTTH – Fiber to the Home (Installation and use of optical fiber from a central point directly to individual buildings)
15. AON – Active Optical Network (Distribute the signal using electrically powered network)
16. PON- Passive Optical Network (Point-to-multipoint FTTP network architecture used to enable a single optical fiber to serve up to 128 customers)
17. ONT- Optical Network Terminator (used to terminate the fiber optic line, demultiplex the signal into its component parts (voice telephone, television, and Internet access), and provide power to customer telephones.)
18. OLT – Optical Line Terminator (Coordinate the multiplexing between the conversion devices on the other end of that network)
19. LTE – Long Term Evolution (Standard for high-speed wireless communication for mobile devices)
20. UTP – Unshielded Twisted Pair (Unshielded wire twisted to avoid crosstalk interference)
21. LEO -Low Earth Orbiting
22. FDM – Frequency Division Multiplexing ( technique by which the total bandwidth is divided into a series of non-overlapping frequency sub-bands)
23. TDM – Time Division Multiplexing (method of transmitting and receiving independent signals over a common signal path by means of synchronized switches)

**6. Study ALOHA and slotted ALOHA protocols. Summarize how they work and what are the differences. Also discuss which protocol is improved one and why?**

ALOHA is system for coordinating access to shared communication channel. This method handles collision between multiple systems when they are trying to access channel for communication at same time.

Ans-

There are two types of ALOHA system.

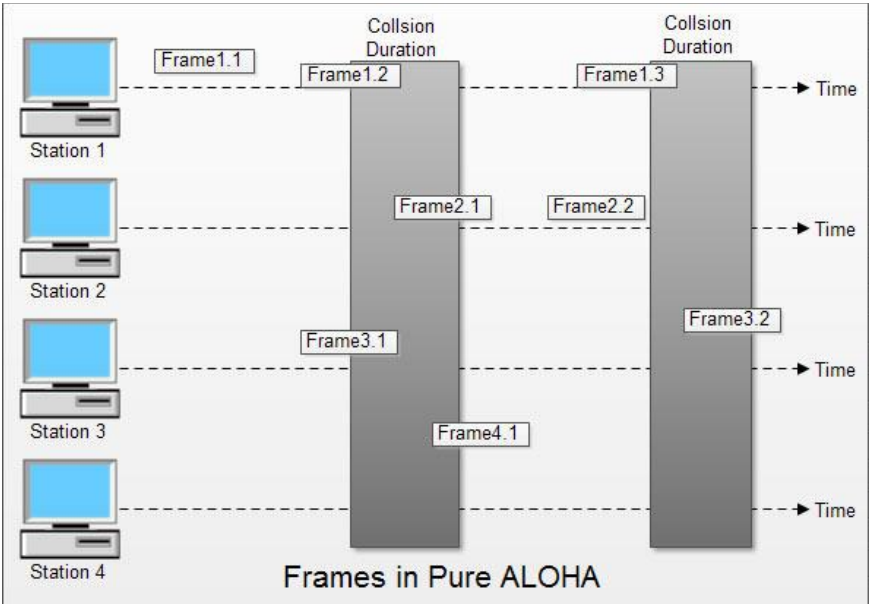
**1 – Pure ALOHA**

**2 – Slotted ALOHA**

**1- Pure ALOHA**

In this, stations send frames whenever they have data to send. There is collision and destruction of frames when two stations send frames at same time.

If station doesn't get any acknowledgement from receiver, it assumes that frame is destroyed and station sends that frame again after random amount of time. This waiting for random time avoids repeated collision of frames.



In fig., station1 and station 3 are trying to send frame at same time hence there will be collision and frames will be destroyed.

If first bit of a new frame overlaps with just the last bit of a frame almost finished, both frames will be destroyed and both will have to be retransmitted.

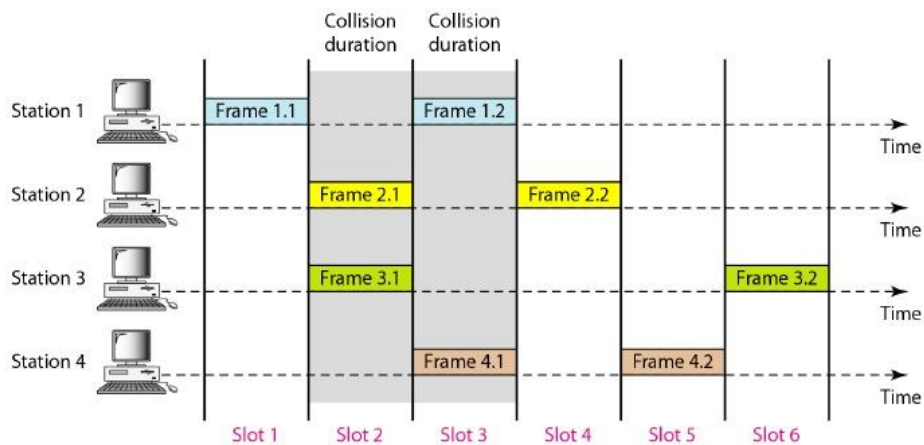
**2 – Slotted ALOHA**

In this, time of shared channel is divided in slots. The stations can send frame only at the beginning of the slot and only one frame can be sent in each slot. If one station misses out the starting of slot, it has to wait till next slot to send frame.

---

**Figure 12.6** *Frames in a slotted ALOHA network*

---



---

## 12.14

There is still possibility of frame collision in Slotted ALOHA if two station sends frame at the beginning of same time slot.

### Difference –

-Channel is divided in Slotted ALOHA but it is not the case with Pure ALOHA.

-Pure ALOHA system can send frame any time but Slotted ALOHA can send frame only at the beginning of slot.

Out of these two protocols, Slotted ALOHA system is improved. Due to division of communication channel it reduces the chances of collisions of frames to half of chances by Pure ALOHA.

## 7. List all physical media and their characteristics.

- 1- Guided Media
- 2- Unguided Media

### Guided Media-

#### 1- Twisted Pair

Wire twisted to avoid crosstalk interference. It may be shielded or unshielded. There are types of twisted pair cable.

UTP (Unshielded Twisted Pair) and STP (Shielded Twisted Pair).

UTP contains 8 wires or 4 pairs with 100meter maximum length and 4-100 mbps speed.

STP has lower electrical interference than UTP with 16-155 mbps speed.

## 2- Coaxial

In this, two conductors are separated by insulation

Thinnet coaxial cable- It uses British Naval Connector (BNC) on each end. Transmission speed is 10Mbps. Thinnet is part of the RG-58 family of cable. Maximum cable length is 185 meters.

Thicknet - Maximum cable length is 500 meters. Transmission speed is 10Mbps. Expensive and is not commonly used. (RG-11 or RG-8).

## 3. Fiber-optic

Data is transmitted using light rather than electrons. Usually there are two fibers, one for each direction. Speed is from 100Mbps to 2Gbps. This is the most expensive and most difficult to install, but is not subject to interference. Two types of cables are:

- Single mode cables for use with lasers has greater bandwidth and costs more.

- Multimode cables for use with Light Emitting Diode (LED) drivers. All signals appear to arrive at the same time. [9]

## Unguided Media -

Here information is transmitted by sending electromagnetic signals through free space and hence the name unguided media, as the signals are not guided in any specific direction or inside any specific medium.

## References-

[1] <https://www.fcc.gov/general/telecommunications-act-1996>

[2] <http://raven.stern.nyu.edu/networks/telco96.html>

[3] [https://www.researchgate.net/publication/281389845\\_The\\_Impact\\_of\\_the\\_Telecommunications\\_Act\\_of\\_1996\\_in\\_the\\_Broadband\\_Age](https://www.researchgate.net/publication/281389845_The_Impact_of_the_Telecommunications_Act_of_1996_in_the_Broadband_Age)

[4] <https://www.brookings.edu/blog/techtank/2016/02/08/was-the-1996-telecommunications-act-successful-in-promoting-competition/>

[5] [Difference Between ILEC and CLEC | Difference Between http://www.differencebetween.net/technology/communication-technology/difference-between-ilec-and-clec/#ixzz4t4Jm4M3Z](http://www.differencebetween.net/technology/communication-technology/difference-between-ilec-and-clec/#ixzz4t4Jm4M3Z)

[6] <https://sites.google.com/site/assignmentssolved/mca/semester3/mc0075/16>

[7] <https://www.rcn.com/chicago/high-speed-internet/#shop>



[8] <http://www.pearsonitcertification.com/articles/article.aspx?p=2481850&seqNum=3>

[9] <http://www.comptechdoc.org/independent/networking/cert/netphysical.html>

Diagrams – Google