Introduction

- The Internet is a structured, organised system. Before we discuss how it works and its relationship to TCP/IP, we first give a brief history of the Internet. Then we define the concepts of protocols and standards and their relationships to each other.

A brief History

- A network is a group of connected, communicating devices such as computers and printers.
- An internet (note the lowercase i) is two or more networks that can communicate with each other. The most notable internet is called Internet (uppercase I), composed of hundreds of thousands of interconnected networks.
  - 1967, ARPANET (Advanced Research Projects Agency Networks)
  - 1983, ARPANET splits into two networks: MILNET for Military users and ARPANET for non military users.
  - 1981, CSFNET a network sponsored by the National Science Foundation (NSF)
  - 1986, with the success of CSFNET, the NSF sponsored NSFNET, a backbone connected five supercomputers centres located throughout the United States.

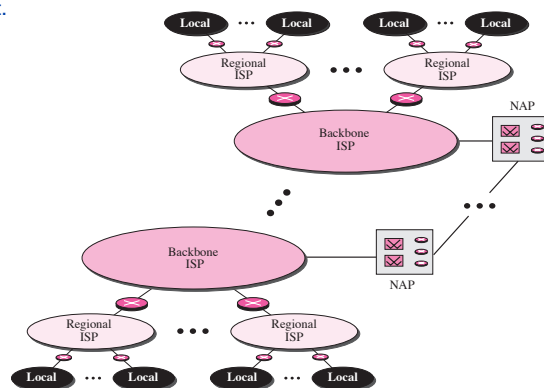## Transmission Control Protocol/ Internetworking Protocol (TCP/IP)

- Cerf and Kahn's landmark 1973 paper outlined the protocols to achieve end-to-end delivery of data. This was a new version of NCP. This paper on transmission control protocol (TCP) included concepts such as encapsulation, the datagram, and the functions of a gateway. A radical idea was the transfer of responsibility for error correction from the IMP to the host machine. This ARPA Internet now became the focus of the communication effort. Around this time responsibility for the ARPANET was handed over to the Defence Communication Agency (DCA).

- In October 1977, an internet consisting of three different networks (ARPANET, packet radio, and packet satellite) was successfully demonstrated. Communication between networks was now possible.
- Shortly thereafter, authorities made a decision to split TCP into two protocols: Transmission Control Protocol (TCP) and Internet Protocol (IP). IP would handle datagram routing while TCP would be responsible for higher level functions such as segmentation, reassembly, and error detection. The new combination became known as TCP/IP.

- In 1981, under a DARPA contract, UC Berkeley modified the UNIX operating system to include TCP/IP. This inclusion of network software along with a popular oper- ating system did much for the popularity of networking. The open (non-manufacturer- specific) implementation on Berkeley UNIX gave every manufacturer a working code base on which they could build their products.
- In 1983, authorities abolished the original ARPANET protocols, and TCP/IP became the official protocol for the ARPANET. Those who wanted to use the Internet to access a computer on a different network had to be running TCP/IP.

The Internet Today

- Today most end users who want Internet connection use the services of Internet service providers (ISPs). There are international service providers, national service providers, regional service providers, and local service providers. The Internet today is run by private companies, not the government.

Protocols

- Communication between two people or two devices needs to follow some protocol.
- A protocol is a set of rules that governs communication.
- For example, in a face-to-face communication between two persons, there is a set of implicit rules in each culture that define how two persons should start the communication, how to continue the communication, and how to end the communication.

- In computer networks, communication occurs between entities in different systems. An entity is anything capable of sending or receiving information. However, two entities cannot simply send bit streams to each other and expect to be understood. For communication to occur, the entities must agree on a protocol. A protocol defines what is communicated, how it is communicated, and when it is communicated. The key elements of a protocol are syntax, semantics, and timing.

- **Syntax**
  - Syntax refers to the structure or format of the data, meaning the order in which they are presented.
- **Semantics**
  - Semantics refers to the meaning of each section of bits.
- **Timing**
  - Timing refers to two characteristics: when data should be sent and how fast it can be sent.

Example: header frame Ethernet

7 bytes

10101010 ...

Syntax: 10101010...
Semantic: please synchronize...