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Computer Networking book

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Abstract

- The Internet is the largest engineered system in history, comprising millions of computers and communication devices, billions of users, and a vast array of Internet-connected "things".
- Despite its size and complexity, it is possible to understand how the Internet works, thanks to guiding principles and structures.
- The aim is to provide a modern introduction to computer networking, emphasizing principles and practical insights for understanding current and future networks.
- This overview includes:
  - Basic terminology and concepts in computer networking.
  - Examination of network hardware and software components, including end systems, network applications, links, switches, access networks, and physical media.
  - Understanding the Internet as a network of networks and how these networks interconnect.
  - Discussion on the core aspects of computer networks, such as delay, loss, and throughput, including simple quantitative models for end-to-end throughput and delay.
  - Key architectural principles in computer networking, including protocol layering and service models.
  - Overview of security challenges and types of attacks in computer networks, with strategies for enhancing security.
  - A brief history of computer networking to close the chapter.
- The chapter sets the context for the rest of the book, aiming to see "the forest through the trees" by providing a broad picture without losing sight of the detailed aspects of computer networking.

Contents

Chapter 1

Computer Networks and the Internet (1-78)

Lecture 1: 1-5

1.1 What Is the Internet

19 Feb

Definition 1.1.1 (public internet)**.** Specific computer network, a system that connects two or more computing devices to transmit and share information.

Definition 1.1.2 (computing device)**.** A functional unit that can perform substantial computations, including numerous arithmetic operations and logic operations without human intervention. A computing device can consist of a standalone unit or several interconnected units. It can also be a device that provides a specific set of functions, such as a phone or a personal organizer, or more general functions such as a laptop or desktop computer.

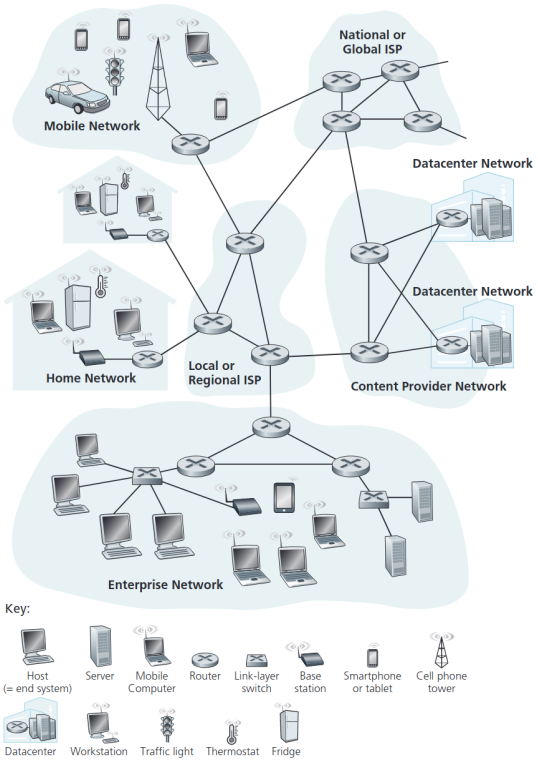
Definition (The internet)**.** It can be defined as "nuts and bolts" or as a "networking infrastructure".

> **Definition 1.1.3** (nuts and bolts)**.** Basic hardware and software components that make up the Internet.

> **Definition 1.1.4** (networking infrastructure)**.** Networking infrastructure that provides services to distributed applications. The hardware and software that enable network connectivity and communication between users, devices, apps, the internet, and more.

1.1.1 A nuts-and-Bolts Description

Figure 1.1: Some pieces of the internet



Definition 1.1.5 (Computer network). Interconnects billions of computing devices throughout the world [a].

[a] Since even devices different than computers are hooked to the Internet this term can be considered outdated

Note (what connects end systems). End systems are connected by communication links and packet switches.

Note (transmission rate). The transmission rate of a link is measured in bits/second

Definition (Packet switches). There are two main types:

- Routers,
- Link-layer switches

They forward packets to their ultimate destination

Definition 1.1.6 (Routers). Used in network core

Definition 1.1.7 (Link-layer switches). used in access networks

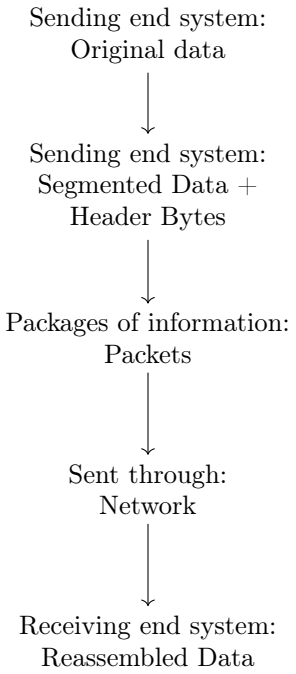


Figure 1.2: Data transmission process in a computer network

Definition 1.1.8 (route or path)**.** The path a packet takes from sender to receiver through communication links and switches.

Note (end systems)**.** End systems access the Internet using Internet Service Providers

Definition 1.1.9 (ISP)**.** A network of packet switches and communication links routers & link layer switches.

They provide network access to end systems, including residential broadband access such as cable modem, local area network access and mobile wireless access.

They also provide Internet access to content providers, connecting different servers.

There are lower and upper tier of ISP, they are all managed independently and run the IP protocol, conforming to naming and address conventions.

Definition (TCP & IP)**.** End systems, packet switches and other pieces of the internet run various protocols. TCP and IP are the two main one

Definition 1.1.10 (Transmission Control Protocol)**.** over a network. It is designed to send packets across the internet and ensure the successful delivery of data and messages over networks.

It organizes data so that it can be transmitted between a server and a client. It guarantees the integrity of the data being communicated over a network. Before it transmits data, TCP establishes a connection between a source and its destination, which it ensures remains live until communication begins. It then breaks large amounts of data into smaller packets, while ensuring data integrity is in place throughout the process.

Definition 1.1.11 (Internet Protocol)**.** Specify the format of the packets

Note (differences). IP obtains and defines the address of the application or device the data must be sent to. TCP is then responsible for transporting and routing data through the network architecture and ensuring it gets delivered to the destination application or device that IP has defined.

Note (IETF). Internet standards developed by the Internet Engineering Task Force.
Their standard documents are called **requests for comments**,

Lecture 2: 5-21

1.1.2 A service Description

21 Feb

Definition 1.1.12 (A service Description). An infrastructure that provides services to applications.

Definition (Distributed applications). Applications involving multiple end systems that exchange data with each other

> **Remark** (where they run). They run on end systems, they do not run in the packet switches in the network core.

Note. Alice wants to send a letter to bob.

Alice needs to put th letter in an envelope, write Bob's details such as the address and the ZIP code, seal the envelope, put a stamp on it and forward it to an official postal service.

Similarly, the Internet employs a socket interface which must be adhered to by the sending program for the Internet to route the data to the intended receiving program.

1.1.3 What Is a Protocol?

A human analogy

Figure 1.3: Human analogy