

Week 01: Computer Network Overview

Module I: Fundamentals of Network Communication

COIT11238 Networked Infrastructure Foundations

Networking and Information Security

The College of Information and Communications Technology

Central Queensland University, Australia

Term 1, 2023



Acknowledgement

The presentation slides for this unit use materials drawn from the provided resources of:

Cengage Learning Resources (2019)

Tomsho, G (2019), **Guide to Networking Essentials** (8th edn.),
Cengage Learning

As well as other materials from online resources.



Objectives

- Describe a computer in a network
- Explain computer hardware components
- Introduce operating systems
- Discuss computer networks and Internet



Outline

- 1 Networks are built from computers
- 2 Computer Hardware Components
- 3 Operating Systems
- 4 Computer Networks and the Internet
- 5 Summary



An Overview of Computer Concepts

Networks were created to facilitate communication between computing devices, which ultimately facilitates communication between people.

At the heart of a communication network is the **computer**.

- Most devices encountered when working with a network involve a computer
- Personal computers, workstations and network servers are most obvious computers running operating systems such as:
 - Windows, Linux, Unix, MacOS and so on.



Personal Computer

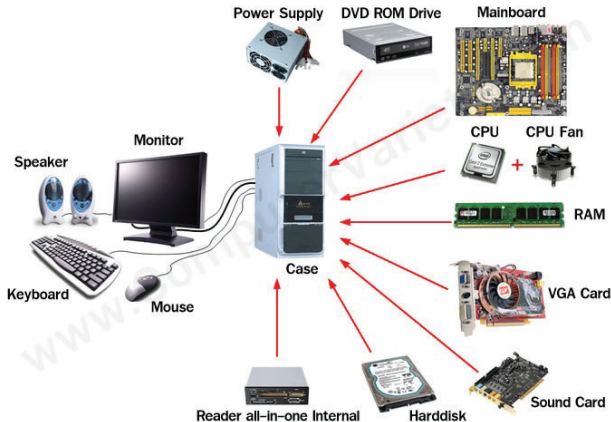


Outline

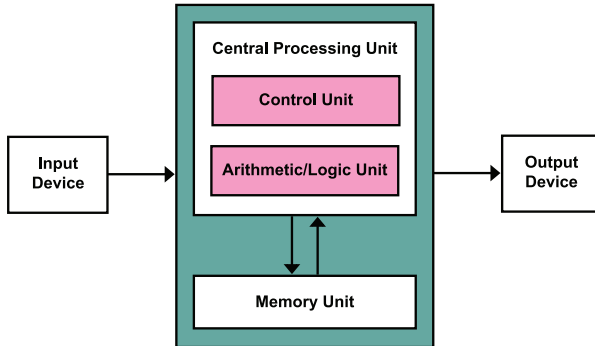
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Hardware Components In A Personal Computer



Von Neumann Architecture



Basic Functions of a Computer

- A computer's functions can be broken down into three basic tasks:

Input A user types the letter 'A' on the keyboard, which results in sending a code representing the letter 'A' to the computer

Processing The computer's CPU determines what letter was typed by looking up the keyboard code in a table

Output The CPU sends instructions to the graphics cards to display the letter 'A', which is then sent to the computer monitor



Storage Components

- Short-term Storage: Random Access Memory (RAM)
 - RAM is “working storage” because when power to the computer is turned off, the contents in RAM are gone.
 - The amount of RAM in a computer is crucial to the computer;s capability to operate efficiently.
- Long-term Storage
 - Long-term storage, such as hard discs, CDs/DVDs Solid state drives(SSDs), USB flash drives, maintains its data even when there's no power.
 - The amount of storage a computer needs depends on the type and quantity of files to be stored.



How data is stored

- Data on a computer is stored as binary digits (“bits” for short)
- A bit holds ‘1’ or ‘0’ value
- A pulse of 5 volts of electricity can represent a bit of ‘1’ and a pulse of 0 volts (the absence of voltage) can represent a bit of ‘0’.
- With fiber-optic cable, a bit of ‘1’ represented by the presence of light and a bit of ‘0’ by the absence of light
- A “**byte**” is a collection of 8 bits



Prefixes used for expressing bits and bytes

Table: Prefixes used for expressing bits and bytes

Prefix	Value
Kilo (K)	Million (10^6)
Giga (G)	Billion (10^9)
Tera (T)	Trillion (10^{12})
Peta (P)	Quadrillion (10^{15})
Exa (E)	Quintillion (10^{18})
Zeta (Z)	Sextillion (10^{21})
Yotta (Y)	Septillion (10^{24})

- Four major PC components:
 - **Motherboard**
 - **Storage device**
 - **RAM**
 - **Firmware**
- The Motherboard and its components
 - The motherboard is a network of wires and controlling circuits that connects all computer components
 - Key components of a mother board are labeled in the flowing figure and explained on the next slide following the figure

A PC Motherboard

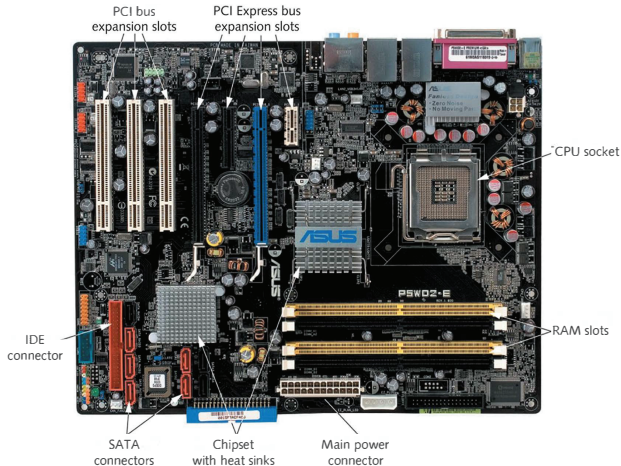


Figure: A PC Motherboard

Storage Device Fundamentals

- Hard Drive
 - Hard drive is the primary long-term storage component on a computer
 - Consists of magnetic disks called “platters” that store data in the form of magnetic pulses
 - Hard disks store the documents you use as well as the applications that open those documents
 - Also stores the OS your computer loads when it boots
- Solid State Drives
 - SSDs are used in place of hard drives due to speed and reliability
 - SSDs use flash memory
 - Contains no moving parts and has faster access times
 - SSDs are more expensive than hard drives and are often found in mobile devices
 - Also found in high-performance desktops and servers



RAM Fundamentals

- RAM is the main short-term storage component on a computer
- Because RAM requires continuous power to store data it is referred to as **volatile memory**
- RAM has no moving parts so accessing data in RAM is much faster than accessing data on a hard drive
- In general, the more RAM your system has the faster it will run



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What Is An Operating System

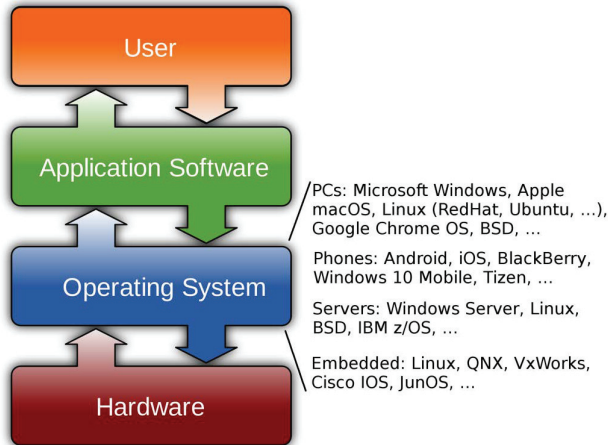


Figure: A Simple System Architecture

Definition

An operating system (OS) is system software that manages computer hardware, software resources, and provides common services for computer programs.

- A computer's operating system provides a convenient interface for users and applications to access computer hardware components.
- The next few slides will expand on the following OS concepts:
 - File systems
 - Processes and services
 - Kernel

The File System

- A file system is the method by which an OS stores, organizes, and manages access to files on a storage device (such as a hard drive)
- File systems have the following objectives:
 - Provide a convenient interface for users and applications to open and save files
 - Provide an efficient method to organize space on a drive
 - Provide a hierarchical filing method to store files
 - Provide an indexing system for fast retrieval of files
 - Provide secure access to files for authorized users



Hierarchical Filing Method

- Most file systems organise files in a hierarchy of folders or directories
- The top of the hierarchy is called the “**root**” of the file system
- Off the root of the file system can be files and folders, with folders containing files and additional folders (called subfolders)

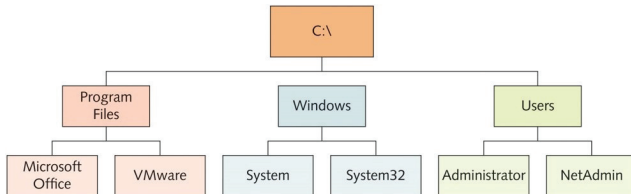


Figure: A hierarchical file system

Processes and Services

- A **process** is a program that is loaded into memory and run by the CPU
 - It can be an application or a program that communicates with and provides services to other processes (called a **service** in Windows and a **daemon** in Linux)
- Network services allow your computer and applications to perform tasks they otherwise couldn't
 - Example: When using a Web browser to access a Web server most people use a name rather than it's address. A name lookup is required before a Web browser can do it's main job. Domain Name Service (DNS) runs as a process to provide the name lookup service.



Processes and Services

- An OS can run many processes at the same time by using **multitasking**
- A computer multitasks by using a method called **time slicing**
 - occurs when a CPU's computing cycles are divided between more than one process
 - The act of changing to another process is called **context switching**
- Two types of multitasking:
 - Preemptive** the OS controls which process gets access to the CPU and for how long
 - Cooperative** the OS can't stop a process, a process maintains control until it satisfies its computing needs



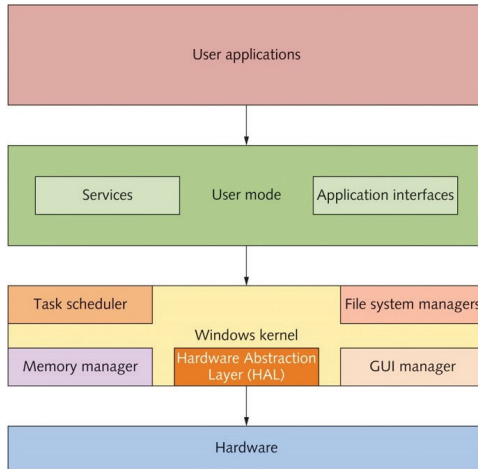
- Many applications are now designed so that different parts can be scheduled to run separately
- Each part that can be scheduled to run is called a **thread** (the smallest unit of software scheduled)
- A **multithreaded application** has two or more threads that can be scheduled separately for execution by the CPU
- **Multiprocessing** allows performing multiple tasks or threads simultaneously, each by a different CPU or CPU core

The Kernel

- The kernel performs the following tasks:
 - Schedules process to run, making sure high-priority processes are taken care of first
 - Manages memory to ensure that two applications don't attempt to use the same memory space
 - Makes sure I/O devices are accessed by only one process at a time
- OSs are designed in layers
 - The kernel is usually shown as the layer just above the hardware



The Windows OS Structure



Client and Server Operating System Overview

- Client OSs now include many features that were once only found on a server OS
- The determining factor of whether you need a server OS or a client OS is the role the computer will play in your network
- Client OSs usually come with client software, such as Web browsers, DNS and DHCP clients, and file-sharing clients
- Most server OSs include client software but have server components, such as Web servers, DNS and DHCP servers, and file-sharing servers



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Computer Networks and the Internet

A computer network consists of two or more computers connected by some kind of transmission medium, such as cables and/or air waves.

Definition

Internet: *collection of computer networks connected together using routers, where hosts and routers communicate using the Internet Protocol.*

Next week introduces computer networks, but for now let's look at some examples . . .



Example of A Home Network

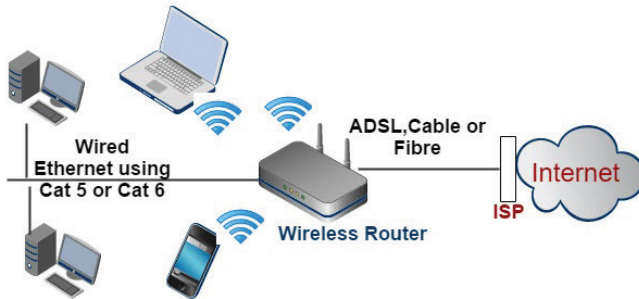


Figure: An example of home networking

Example of A University Campus Network

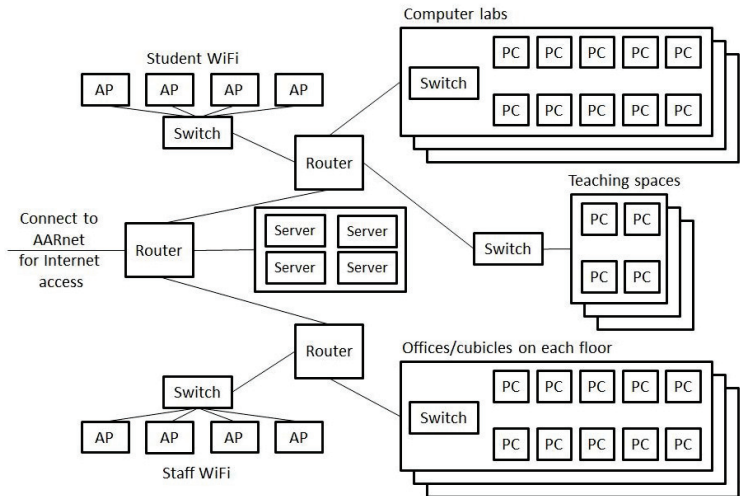
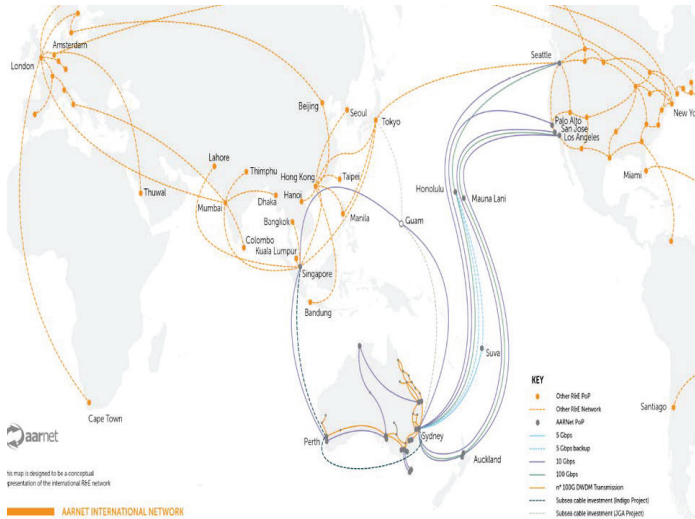


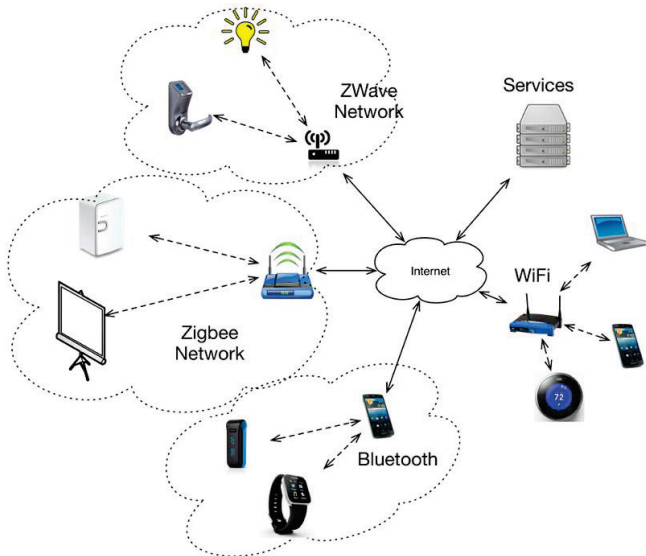
Figure: An example of university campus networking

- **AARNet** is the Internet Service Provider for universities in Australia
- Following two slides show maps of AARNet network in 2018
 - National
 - International
- Both image are copyright AARNet:
<https://www.aarnet.edu.au/network-and-services/the-network>





- Visit the TeleGeography Global Internet Map
- <https://global-internet-map-2018.telegeography.com/>
 - Shows major links between countries
 - Also their Submarine Cable Map:
<https://www.submarinecablemap.com/>



Components of A Computer Network

Computers PCs, laptops, phones, servers, . . .

Network devices Repeaters, modems, switches, routers, access points, . . .

Network media Copper, coax, fibre, WiFi, satellite,

Addressing MAC, IP, domains, . . .

Protocols IP, TCP, HTTP, DNS, SIP, . . .

Software browsers, game servers, email clients, chat apps, network OS, . . .



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Summary

- Computers in a network
 - PCs, servers and embedded devices
- Computer hardware components
 - Input, processing and output
 - Motherboard, hard drive and RAM
- Basic features of operating systems
 - Architecture, kernel and file systems
 - Processes and services
- Computer networks and Internet – Examples for computer networks
 - AARNet and Internet

