Special Purpose Operating Systems

Module 6

Overview

- Open-source and Proprietary Operating System
- Fundamentals of
  - Distributed Operating System
  - Network Operating System
  - Embedded Operating Systems
  - Cloud and IoT Operating Systems
  - Real-Time Operating System
  - Mobile Operating System
  - Multimedia Operating System
- Comparison between Functions of various Special-purpose Operating Systems.

Open-source and Proprietary Operating System

Open-source Software

- Open-source software (OSS) is computer software that is released under a license in which the copyright holder grants users the rights to use, study, change, and distribute the software and its source code to anyone and for any purpose.
- Open-source software may be developed in a collaborative public manner.
- Open-source software is a prominent example of open collaboration

Open-source Operating System

- Linux
- Android
- Ubuntu
- Unix
- FreeBSD
- Fedora
- CentOS
- Minix
- …

Proprietary software

- Proprietary software, also known as non-free software, is computer software for which the software's publisher or another person reserves some rights from licensees to use, modify, share modifications, or share the software.
- It sometimes includes patent rights.

Proprietary Operating Systems

- Microsoft Windows
- macOS
- Chrome OS
- PS3 OS
- …

Distributed Operating System

Distributed Operating System

- A distributed operating system is system software over a collection of independent, networked, communicating, and physically separate computational nodes.
- They handle jobs which are serviced by multiple CPUs.

Distributed Operating System

- Each individual node holds a specific software subset of the global aggregate operating system.
- Each subset is a composite of two distinct service provisioners.
  - The first is a ubiquitous minimal kernel, or microkernel, that directly controls that node's hardware.
  - Second is a higher-level collection of system management components that coordinate the node's individual and collaborative activities.
- These components abstract microkernel functions and support user applications.

Distributed Operating System

- Design considerations
  - Transparency
  - Inter-process communication
  - Process management
  - Resource management
  - Reliability
  - Availability
  - Performance
  - Synchronization
  - Flexibility

Examples

- https://digitalthinkerhelp.com/distributed-operating-system-tutorial-with-their-types-examples/

Network Operating System

Network Operating System

- Network Operating System is a computer operating system that facilitates to connect and communicate various autonomous computers over a network.
- An Autonomous computer
  - is an independent computer that has its own local memory, hardware, and OS
  - is self capable to perform operations and processing for a single user.
  - can either run the same or different OS

Network Operating System

- The Network OS mainly runs on a powerful computer, that runs the server program.
- It facilitates the security and capability of managing the data, user, group, application, and other network functionalities.
- The main advantage of using a network OS is that it facilitates the sharing of resources and memory amongst the autonomous computers in the network.
- It can also facilitate the client computers to access the shared memory and resources administered by the Server computer.
- The Network OS is mainly designed to allow multiple users to share files and resources over the network.

Network Operating System

- The Network OS is not transparent in nature.
- The workstations connected in the network are aware of the multiplicity of the network devices.
- The Network Operating Systems can distribute their tasks and functions amongst connected nodes in the network, which enhances the system overall performance.
- It can allow multiple access to the shared resources concurrently, which results in efficiency.
- One of the major importance of using a Network OS is remote access.

Network Operating System

- It facilitates one workstation to connect and communicate with another workstation in a secure manner.
- For providing security, it has authentication and access control functionality.
- The network OS implements a lot of protocols over the network, which provides a proper implementation of the network functionalities.
- One drawback of Network OS is its tightly coupled nature in the network.
- Some examples of Network OS are Novel Netware, Microsoft Windows server (2000, 2003, 2008), Unix, Linux, etc.

Embedded Operating Systems

Embedded Operating Systems

- An embedded operating system is an operating system for embedded computer systems.
- Embedded operating systems are computer systems designed for a specific purpose, to increase functionality and reliability for achieving a specific task.
- Resource efficiency comes at the cost of losing some functionality or granularity that larger computer operating systems provide, including functions which may not be used by the specialized applications they run.
- Depending on the method used for multitasking, this type of OS is frequently considered to be a real-time operating system, or RTOS.
- Embedded systems are mostly used as Real-time operating systems.
- QNX, WinCE, and VxWorks are the most widely used embedded operating systems today.

Embedded Operating Systems

- All embedded systems contain a processor and software.
- There must be a place for software to store the executable code and temporary storage for run-time data manipulations.
- These take the form of ROM and RAM respectively.
- All embedded systems must also contain some form of inputs and outputs to function.
- Within the exception of these few common features, the rest of the embedded hardware is usually unique and varies from application to application.

Embedded Operating Systems

- The hardware running an embedded operating system can be very limited in resources, therefore embedded design of these operating systems may have a narrow scope tailored to a specific application in order to achieve desired operation under these constraints.
- The embedded operating system that organizes and controls the hardware usually determines the rest of the embedded hardware needed.

Embedded Operating Systems

- In order to take better advantage of the processing power of the CPU, software developers may write critical code directly in assembly.
- This machine efficient language can potentially result in gains in speed and determinism at the cost of portability and maintainability.
- Often, embedded operating systems are written entirely in more portable languages, like C, however.

Embedded Operating Systems

- An important difference between most embedded operating systems and desktop operating systems is that the application, including the operating system, is usually statically linked together into a single executable image.
- Unlike a desktop operating system, the embedded operating system does not load and execute applications.
- This means that the system is only able to run a single application.

Cloud and IoT Operating Systems

Cloud Operating Systems

- A cloud operating system is a type of operating system designed to operate within cloud computing and virtualization environments.
- A cloud operating system manages the operation, execution and processes of virtual machines, virtual servers and virtual infrastructure, as well as the back-end hardware and software resources.
- A cloud operating system may also be called a virtual operating system.

Cloud Operating Systems

- A cloud operating system primarily manages the operation of one or more virtual machines within a virtualized environment. Depending on the virtual environment and cloud services in use, the functionality of cloud operating systems varies.
- For example, a cloud operating system developed to be used within a computing-specific environment will manage the processes and threads of a single or cluster of virtual machines and servers. Similarly, a light-end cloud OS might provide end users with pre-installed applications and services, accessed through an Internet browser.
- Microsoft Windows Azure and Google Chrome OS are among current examples of cloud operating systems.

Cloud OS (read more)

- https://www.jigsawacademy.com/blogs/cloud-computing/cloud-operating-system/

IoT Operating Systems

- IoT operating systems allow users to perform the basic functions of a computer within an internet-connected device.
- IoT operating systems are embedded within IoT devices and connect to a greater network of devices.
- These operating systems provide similar functionality to that of a computer by delivering processing capacity for memory and data storage purposes.
- These systems can run and process all software run on the device.
- IoT operating systems connect to IoT device management software.

IoT Operating Systems

- IoT Operating Systems must:
  - Provide the ability to embed the system within an internet-connected device
  - Manage the software run on the device
  - Process and store memory and data
- IoT Operating Systems Examples
  - Nucleus RTOS
  - Amazon FreeRTOS
  - TinyOS
  - Windows 10 IoT
  - Tizen

Real-Time Operating System

Real-Time Operating System

- A real-time operating system (RTOS) is an operating system (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays.
- Processing time requirements (including any OS delay) are measured in tenths of seconds or shorter increments of time.
- A real-time system is a time-bound system which has well-defined, fixed time constraints.
- Processing must be done within the defined constraints or the system will fail.
- They either are event-driven or time-sharing.
  - Event-driven systems switch between tasks based on their priorities, while time-sharing systems switch the task based on clock interrupts.
- Most RTOSs use a pre-emptive scheduling algorithm.

Real-Time Operating System

- A key characteristic of an RTOS is the level of its consistency concerning the amount of time it takes to accept and complete an application's task; the variability is 'jitter'.
- A 'hard' real-time operating system (Hard RTOS) has less jitter than a 'soft' real-time operating system (Soft RTOS).
- The late answer is a wrong answer in a hard RTOS while a late answer is acceptable in a soft RTOS.
- The chief design goal is not high throughput, but rather a guarantee of a soft or hard performance category.
- An RTOS that can usually or generally meet a deadline is a soft real-time OS, but if it can meet a deadline deterministically it is a hard real-time OS.

Real-Time Operating System

- An RTOS has an advanced algorithm for scheduling.
- Scheduler flexibility enables a wider, computer-system orchestration of process priorities, but a real-time OS is more frequently dedicated to a narrow set of applications.
- Key factors in a real-time OS are minimal interrupt latency and minimal thread switching latency; a real-time OS is valued more for how quickly or how predictably it can respond than for the amount of work it can perform in a given period of time.

Mobile Operating System

Mobile Operating System

- A mobile operating system is an operating system for mobile phones, tablets, smartwatches, smart speakers, or other mobile devices.
- Mobile operating systems combine features of a personal computer operating system with other features useful for mobile or handheld use, and usually including a wireless inbuilt modem and SIM tray for telephony and data connection.
- By Q1 2018, over 383 million smartphones were sold with 86.2 percent running Android and 12.9 percent running iOS.

Mobile Operating System

Mobile Operating System

Mobile Operating System

Mobile Operating System

Multimedia Operating System

Difference between Open source Software and Proprietary Software

https://www.geeksforgeeks.org/difference-between-open-source-software-and-proprietary-software/

What is an embedded operating system?

https://www.techtarget.com/iotagenda/definition/embedded-operating-system

Network operating system

https://www.slideshare.net/JohnCarloCatacutan/network-operating-system-56205652

What is an IoT Operating System?

https://www.enterprisenetworkingplanet.com/data-center/iot-operating-system/

What Is a Real-Time Operating System (RTOS)?

https://www.windriver.com/solutions/learning/rtos

Mobile operating system ppt

https://www.slideshare.net/gsantosh031/mobile-operating-system-ppt

https://www.slideshare.net/anantlodha/mobile-operating-systems-37395046