Operating Systems

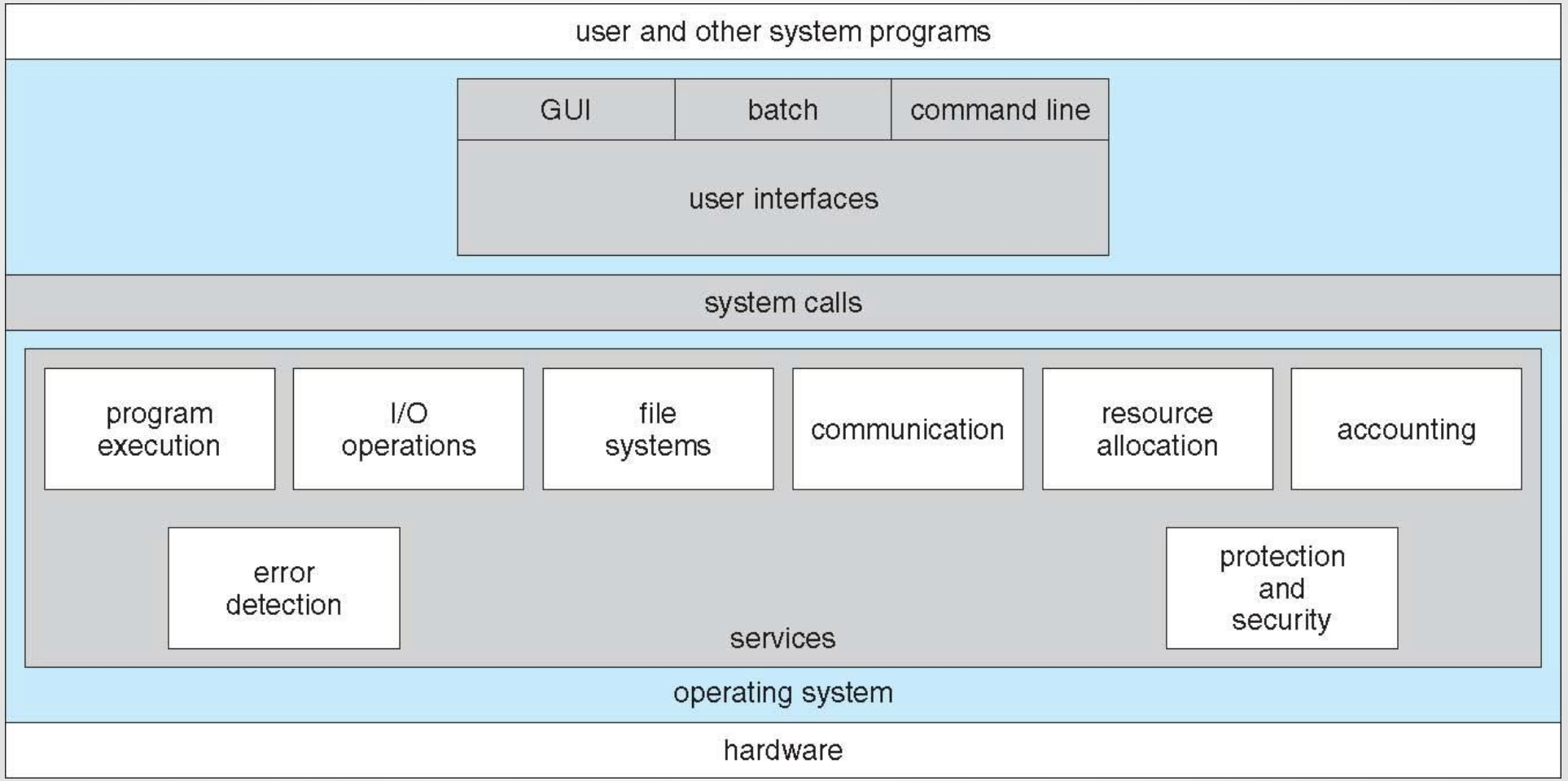
Lecture 3

Operating system structure

Summary

- This lecture shows services of an operating system:
  - Process management.
  - Memory management.
  - File management subsystem.
  - I/O subsystem.
  - Attached memory subsystem.
  - Communication nad networking services.
  - Protection and security.
  - UI and system programs

Operating system services



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Silberschatz, Galvin and Gagne ©2013

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Process management

- **PROGRAM**: a piece of code stored on external memory. Program is a passive entity.
- **PROCESS**: a program, which is running. Processes are active and there can be several processes at a time, which are created from the same program code.
- **TASK**: can be one or more processes.

Process management

- Process management subsystem is responsible for:
  - Creation and termination of processes.
  - Scheduling (processor assignment), freezing and resuming of processes.
  - Mechanisms for synchronization and communication between processes.
  - Lock avoidance and recovery (may be not implemented).
- Depending on implementation, it may be also responsible for threads mamagement.

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Memory managment

- Memory managment subsystem tracks which areas of the memory space are free, which are busy and who owns them.
- It is responsible for allocating/deallocating memory for processes.
- It also takes care of a virtual memory.
- In a multiprogram environment it decides, which programs should be loaded into memory at a given time.

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File management

- Operating system performs:
  - Basic operations on files and directories.
  - File access operations.
  - File content placement in the memory.
  - Content storage on attached, non volatile memory.
- It hides implementation details from the user.

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I/O subsystem

- It consists of:
  - Modules tor managing particular devices, hiding their implementation details
  - Unified interface for accessing such modules
  - Module for buffering and reading in advance from the cache memory.

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Attached memory subsystem

- Responsible for managing attached memory devices (usually disk drives).
- It tracks available and occupied areas, assigns memory and schedules attached memory calls.
- It is used by file subsystem and virtual memory.

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Communication and networking

- Communication subsystem allows two or more processes to exchange data.
  - It includes communication in both a single machine or between different machines.
- Exemplary communication methods for processes on the same machine (UNIX):
  - Message queues
  - Pipes
  - Shared memory

Communication and networking

- Networking subsystem is used for communication between computers connetcted with a network.
  - Although networking itself consists in sending/receiving data, some higher-level OS synctions can be implemented on top of it, for instance networked distributed filesystems.

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Protection

- Multi-user operating system must manages users.
- It includes policies, which describe which users can use certain computer system resources and how they are allowed to do it.

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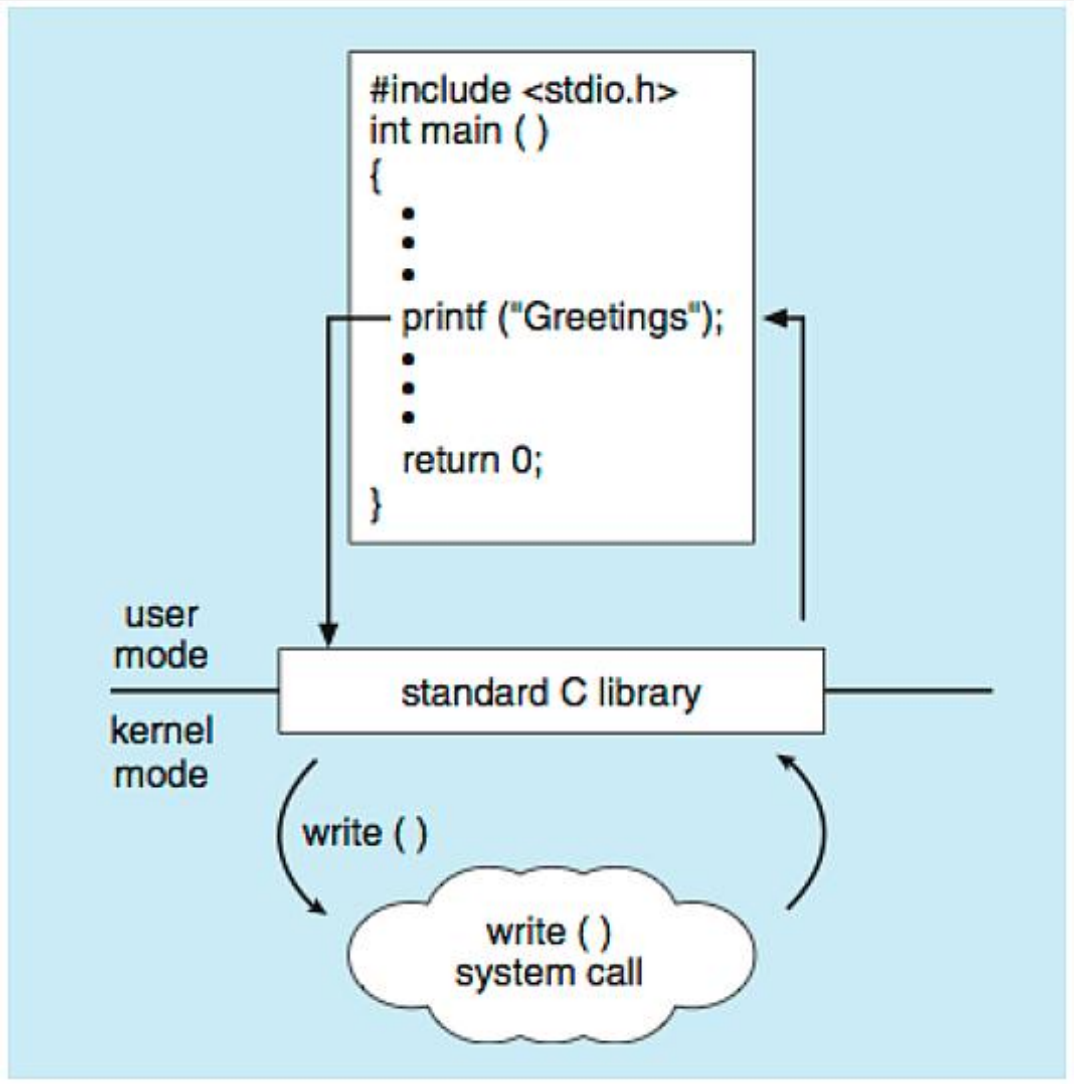
UI and system programs

- Operating system must provide a way to communicate with a user.
  - An UI environment
    - Command Line Interface (CLI)
      - Usuallu supported by additional system programs, which allow for instance file manipulation.
    - Graphical User Interface (GUI)
      - May be implemented as a part of operating system (Windows, MacOS) or as an additional service (X-Window System in Unixes).

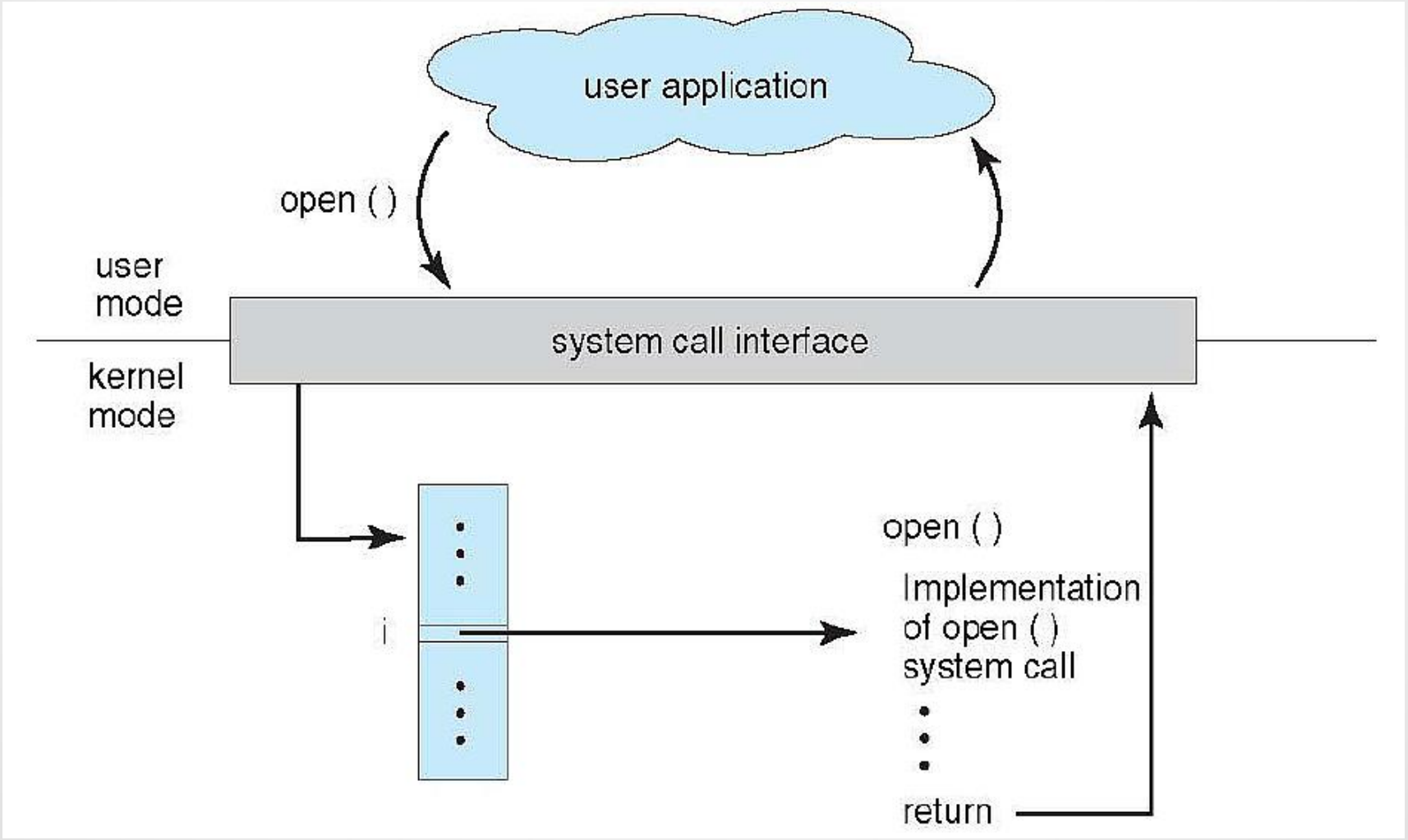
Standard library and system calls

- It also must provide a library of functions, which allow user programs to use its features (standatd system function library):
  - Process manipulation (creation, running, interruption of othe process, process status detection, resuming a process, memory assignment and deallocation, ...).
  - File manipulation (dreate, delete, open for read or write, read from file, write to a file, operations on file attributes, ...).
  - Device manipulation (logically connect/disconnect a device, write/read to/from device, operations on attributes, …).
  - System information.
  - Communication (between processes on one machine, between processes on different machines, etc.).

Standard C library



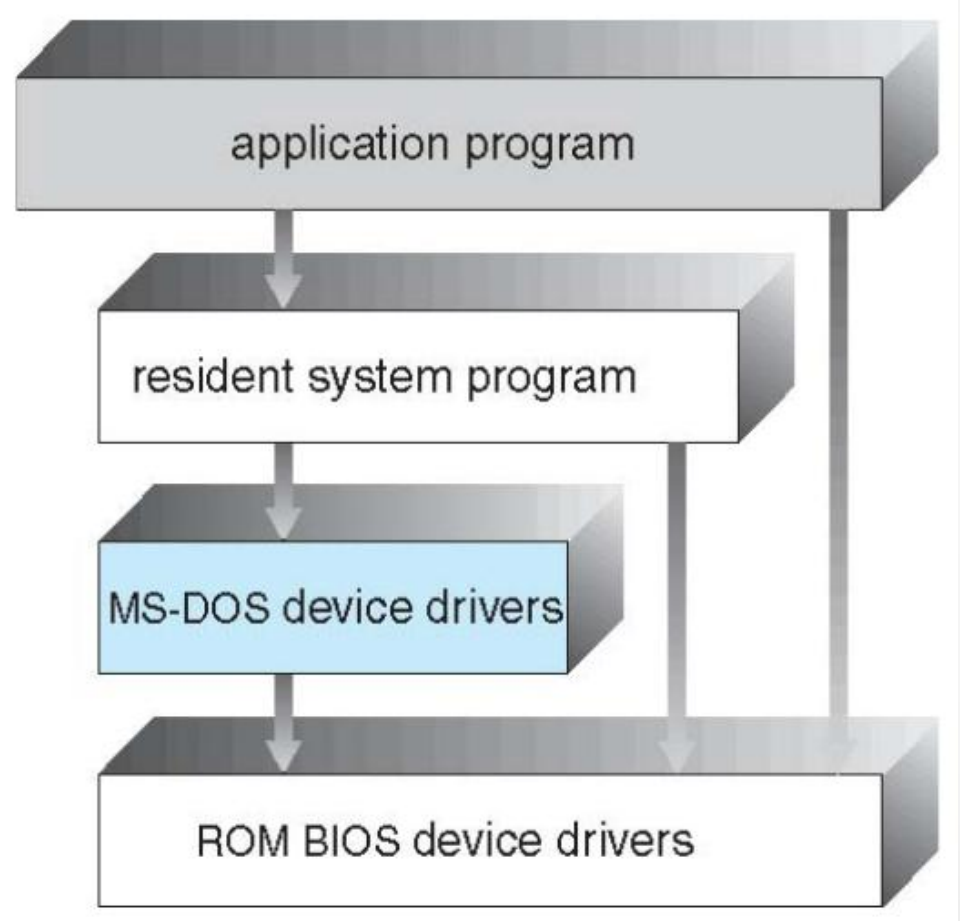
API – System Call – OS Relationship



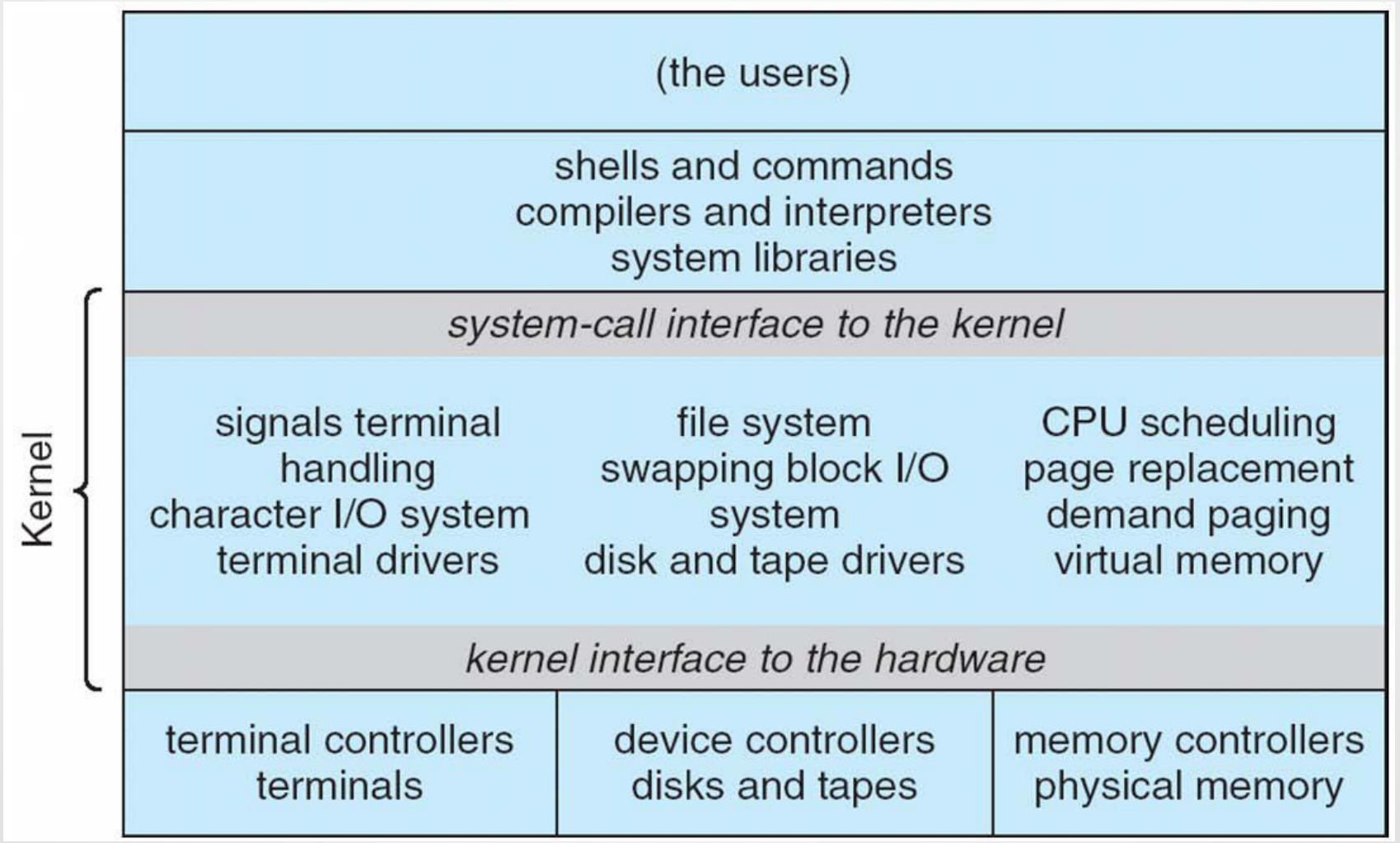
Implementations

- All the subsystems may be included and implemented in a different way.

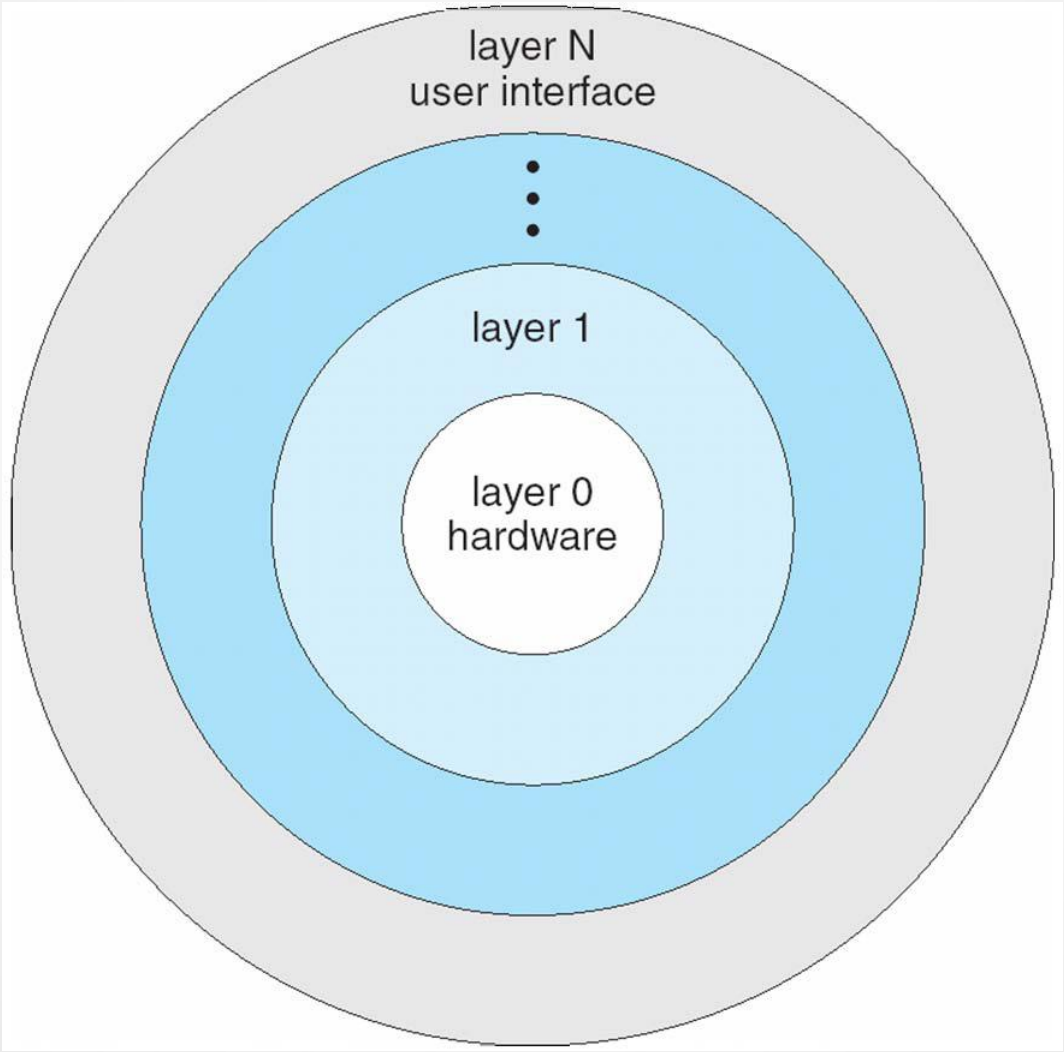
Simple structure: MS DOS



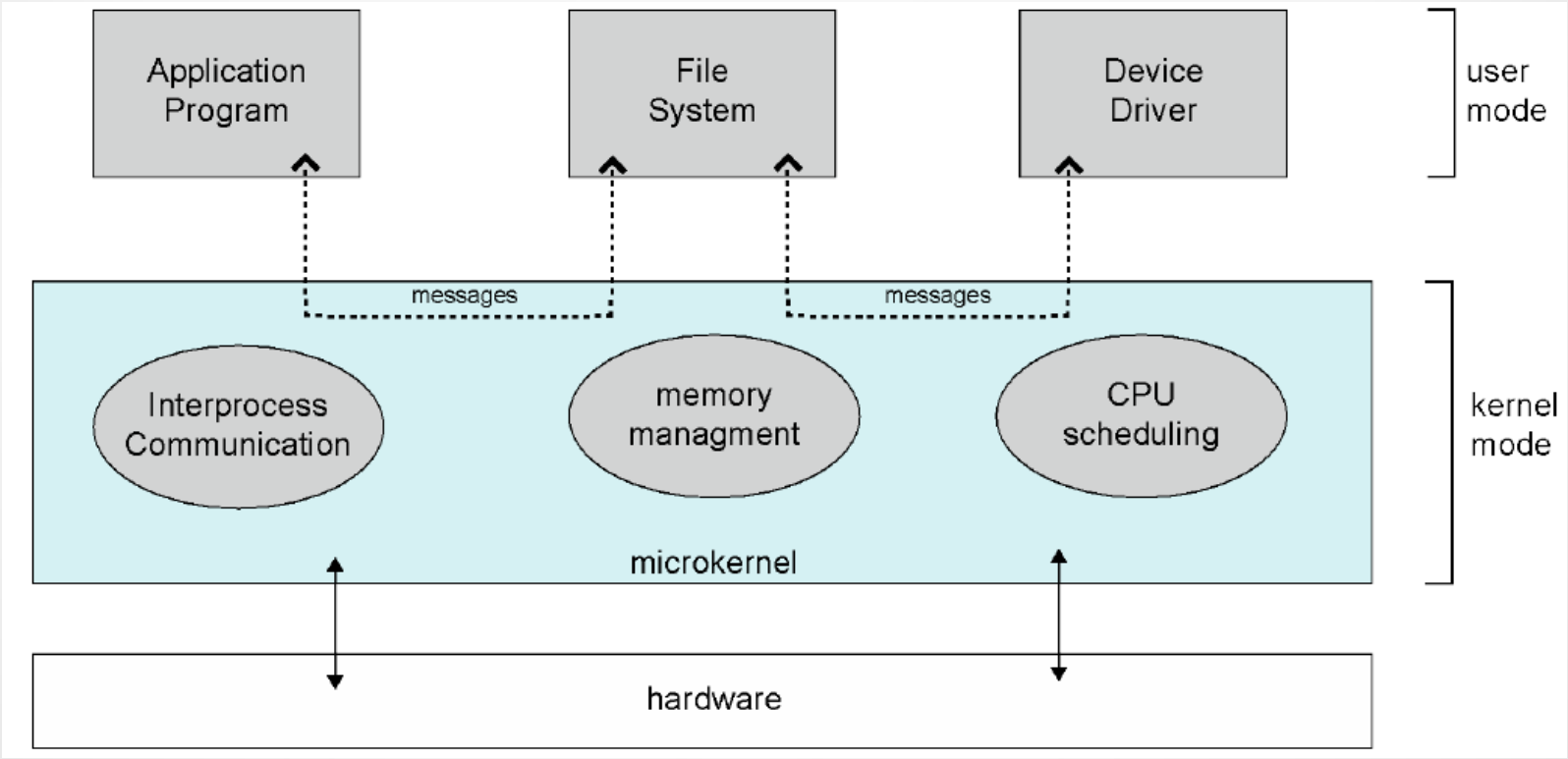
Traditional UNIX scheme



Layered approach



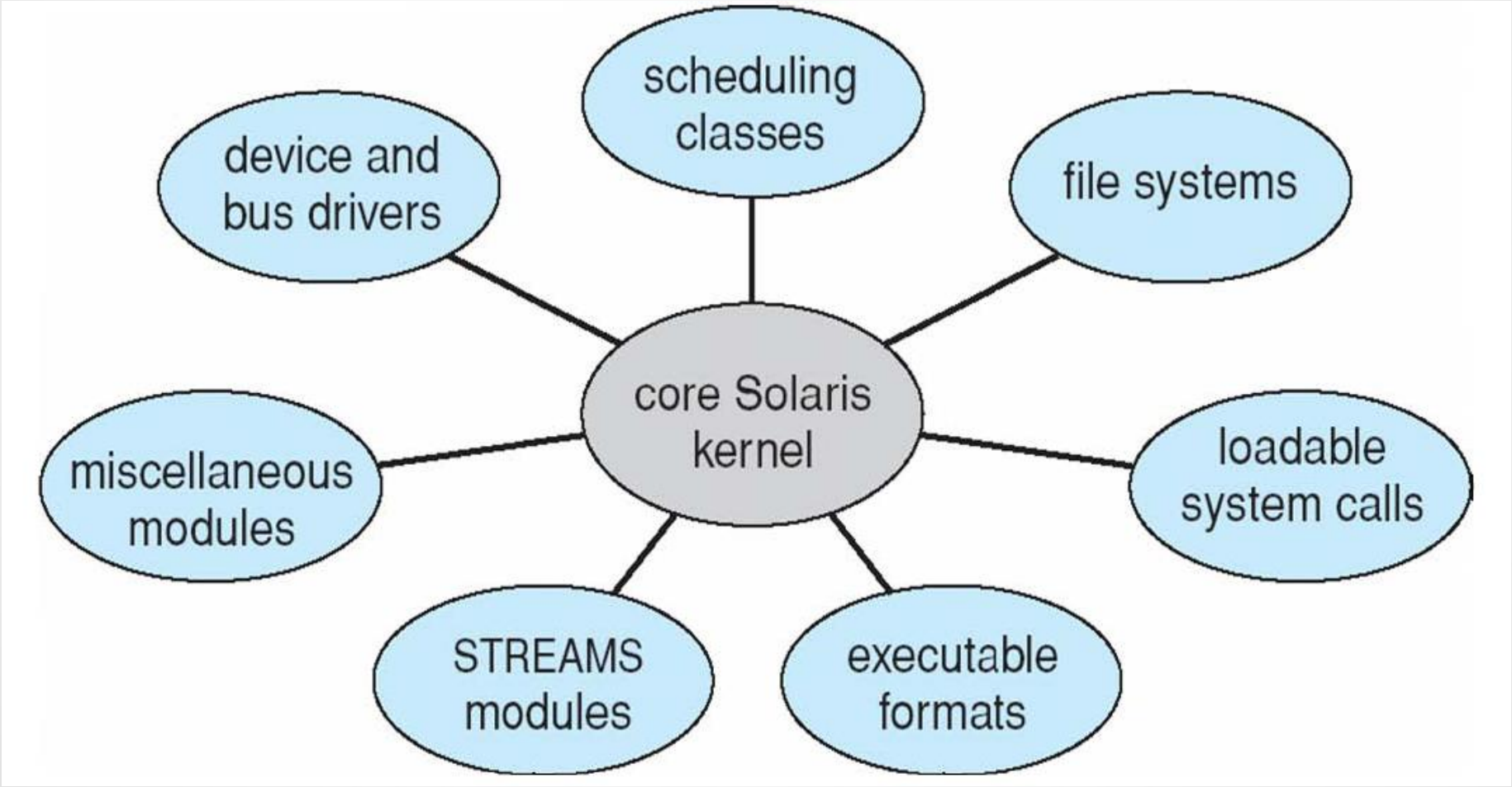
Microkernel architecture



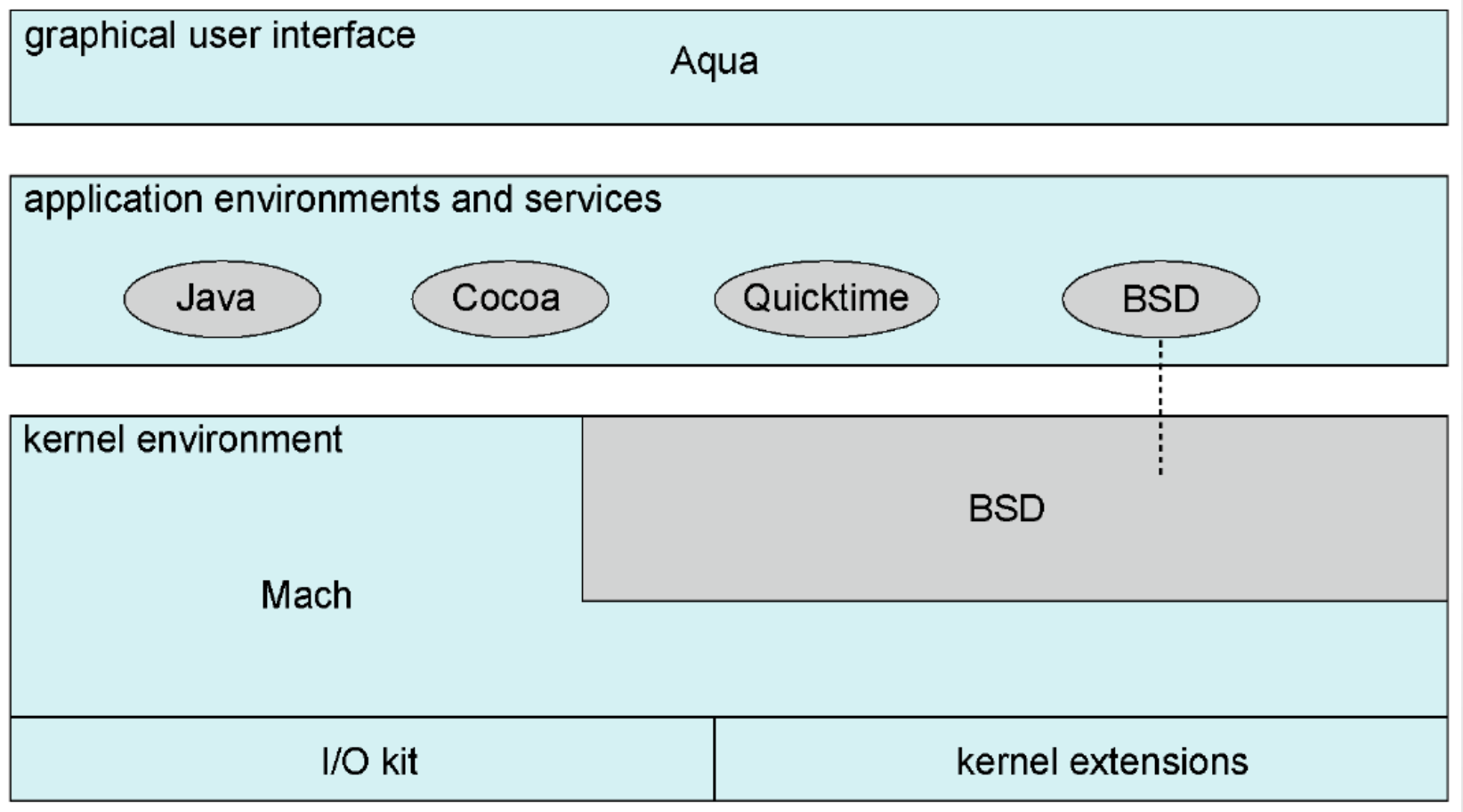
Microkernel architecture

- Benefits:
  - Easier to extend a microkernel
  - Easier to port the operating system to new architectures
  - More reliable (less code is running in kernel mode)
  - More secure
- Detriments:
  - Performance overhead of user space to kernel space communication

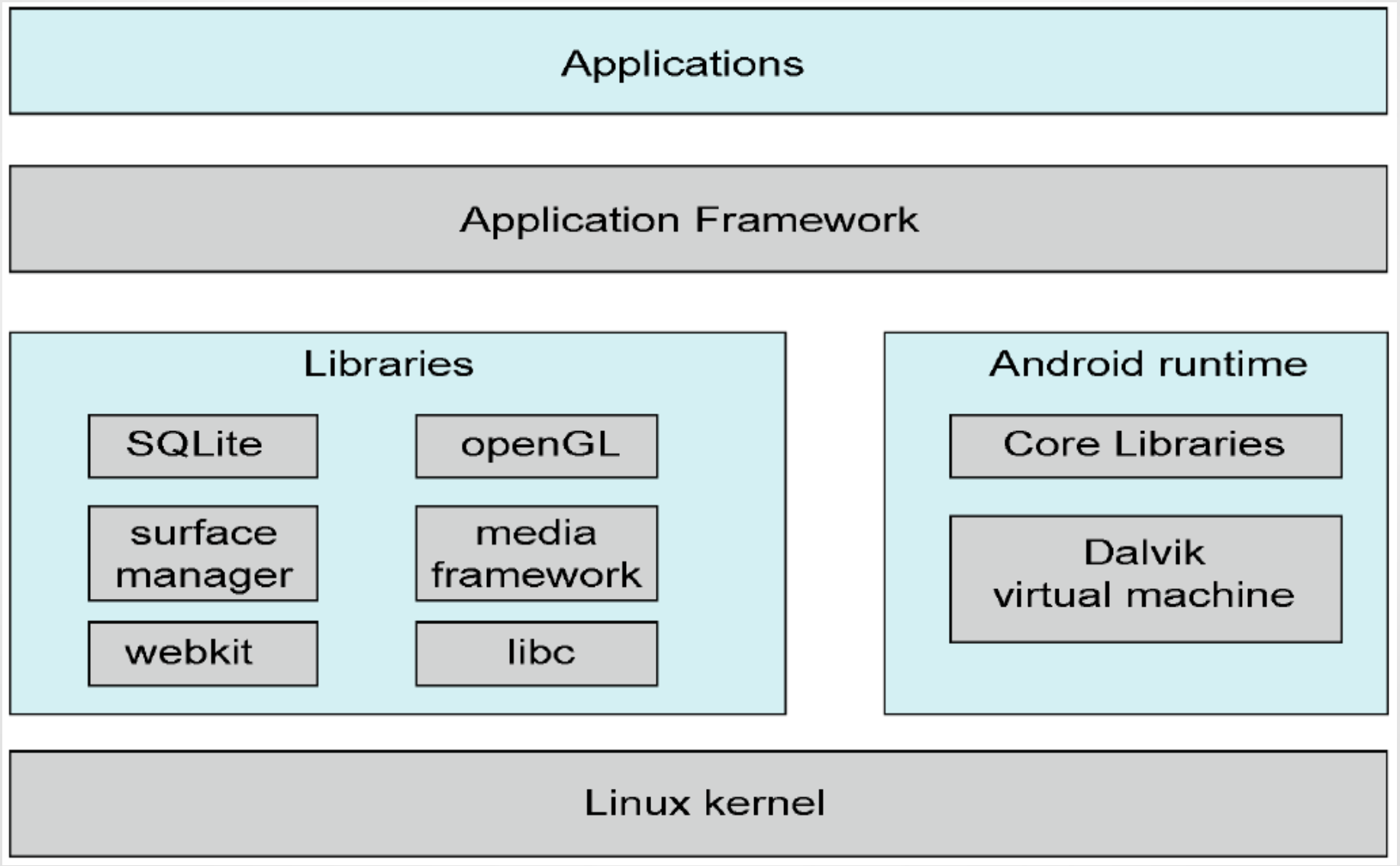
Solris modular approach



Hybrid solutions: Mac OS X



Hybrid solutions: Android



Thank You