

I/O Management

- Interactive systems are often more concerned with I/O than computing
- I/O devices
 - Vary widely in functionality and speed
 - Standard software and hardware interfaces help to incorporate new devices
 - New devices are constantly introduced
- Device driver
 - Bridge between OS subsystems and I/O devices
 - Encapsulate device particularities delivering an uniform interface

I/O Hardware

- **Port**
 - Host connection point for I/O devices
- **Bus**
 - Shared set of wires and a protocol that allows several devices to be simultaneously connected to the host
- **Controller**
 - Controls the operation of ports, buses and devices
 - From simple electronics to complex processors
 - Interacts with host through registers
 - Control, status, data in/out
 - I/O ports, memory mapped, CPU register mapped

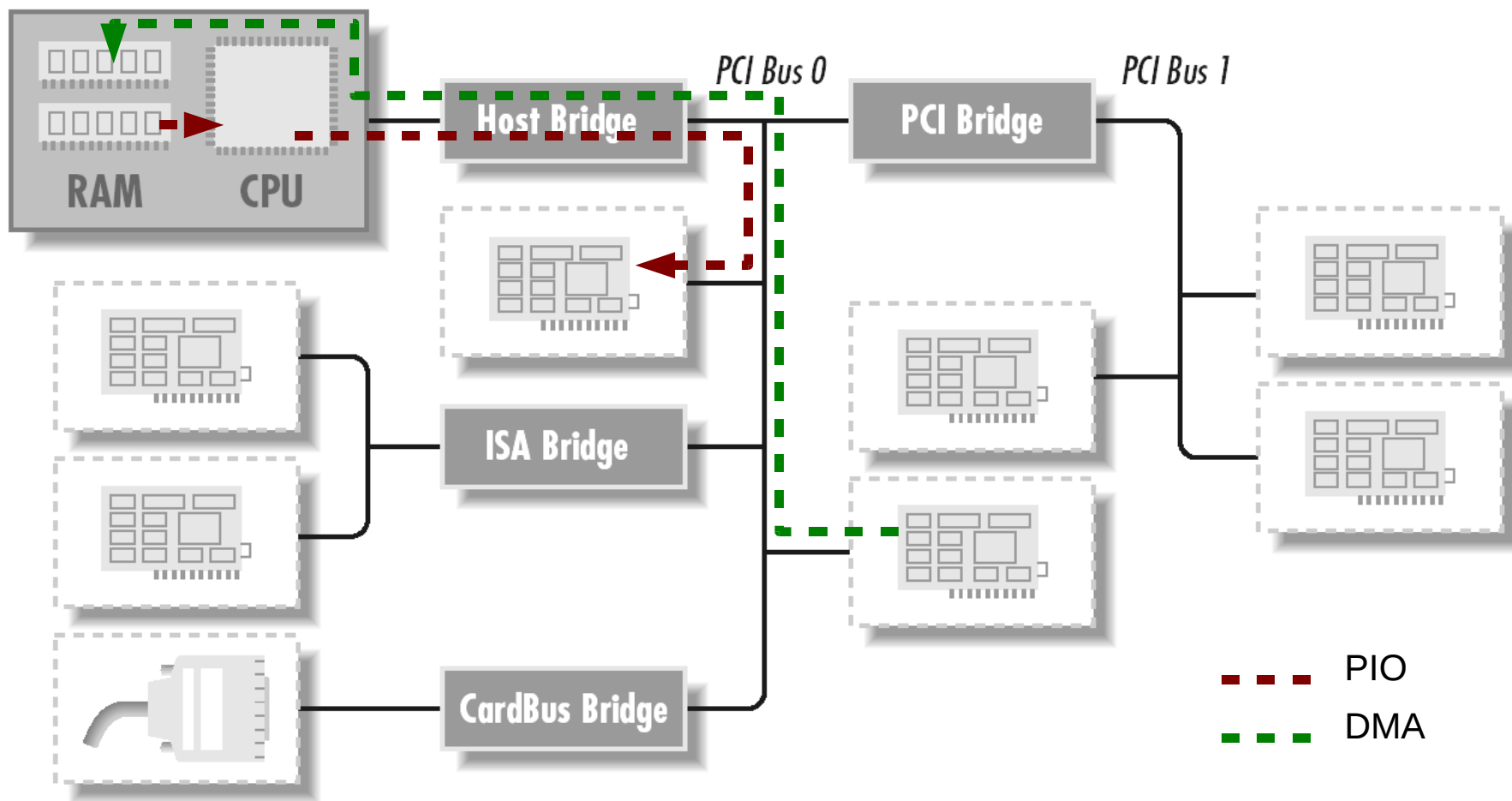
I/O Operation

- **Polling**
 - Host 'polls' status registers to determine the status of a device
 - Busy-waiting
 - Loop reading a status register
 - Overhead on multitask systems
 - Simplicity and efficiency on single-task systems
- **Interrupts**
 - Avoids busy-waiting
 - I/O device receives a service request and generates an interrupt when the request has been accomplished
 - Transparent to processes

I/O Data Transfers

- **Programmed I/O**
 - Data is transferred to/from I/O device by having the CPU to write/read data registers on the device controller
 - One word at a time
- **Direct Memory Access (DMA)**
 - Data is transferred by dedicated circuitry (DMA controller) without CPU assistance
 - Source and destination pointers + count
 - Multi-word (burst) transfers
 - Interrupt on completion or error
 - Concurs with CPU for memory
 - Pitfall
 - Address translation logical -> physical or DVMA

I/O Hardware



Application I/O Interface

- Indirect via I/O subsystems
 - A disk can be indirectly accessed through the files contained on it
 - A network adapter can be indirectly accessed through the TCP/IP stack (socket)
- Pseudo-file
 - Device drivers become handlers of operations on 'special files' that are plugged into the file system (/dev/mouse, /dev/hda, etc)
- Specific system calls
 - OS provides specific system calls to interact with I/O devices (eg ioctl on Unix)