

# Root File System

final component of embedded system software is the root file system (or rootfs)

- ▶ rootfs has
  - ▶ kernel
  - ▶ configuration (OS and app) files
  - ▶ system software (shell, ls, more)
  - ▶ one or more applications (apps)

# Rootfs Media

- ▶ file system can be stored on/in
  - ▶ some drive (floppy, hard, CompactFlash, CD)
  - ▶ RAM (initialized by bootloader)
    - in Linux lingo, **initrd** — initial ram disk
  - ▶ ROM (such as EEPROM on a board)

# Rootfs Formats

- ▶ logically, a disk drive is just a sequence of blocks (or sectors)
- ▶ a **file system** (or FS) is the format for how disk files are represented in that sequence
- ▶ simple FS: a set of files (original DOS)  
modern FS includes directories, files, and meta-data

# Rootfs Examples

- ▶ MSDOS, VFAT, NTFS, HPFS – various DOS/Windows
- ▶ ext2/ext3 – native Linux
- ▶ ISO 9660 – original file system for CompactDisk
- ▶ Reiserfs, JFS – high-end server (SGI, IBM)
- ▶ JFFS, ROMFS, CRAMFS – special-purpose embedded
- ▶ NFS – network file system

# How Do You Build a Root FS?

- ▶ find a location (spare partition, empty drive, file)
- ▶ create filesystem
- ▶ build directory structure: Filesystem Hierarchy Standard (FHS)
- ▶ copy cross-compiler generated libraries in `/lib`
- ▶ create numerous configuration files in `/etc`
- ▶ make the appropriate device files
- ▶ add system executables (`ls`, `more`, `ifconfig`, etc.)
- ▶ add applications executables (`httpd`, `myapp`, etc.)

# Location: Disk Drive Partitions

- ▶ disk drives are block devices that can be randomly addressed
- ▶ typically they are composed of one or more partitions
  - ▶ `fdisk` – common utility to manipulate partitions
  - ▶ partitions have 'type' which is used by bootloader
- ▶ each partition is a subset of the disk's blocks
- ▶ how those blocks are used to represent files and directories is the filesystem

# Location: Alternatives

- ▶ some block devices (floppies) generally consist of exactly one partition; so the whole disk is used
- ▶ newer devices (CompactFlash, CD-RW) also have file systems which may be specialized for the characteristics of the device (ISO 9660, for example)
- ▶ loopback devices:
  - ▶ modern OSes support 'virtual' drives by using a file to emulate a partition
  - ▶ one of the easiest ways to build/manipulate small file systems
- ▶ special tools also exist: `genext2fs`, `mkisofs`, `gencramfs`