Operating Systems Issues in Mobile Computing

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Outline of Presentation

- Categorize the issues and solutions
- Revelant Work
  - Power Management Techniques
  - OS architecture
  - File System
  - Broadcast Disk
- Summary
- Project ideas

Issues affecting OS due to mobility

- Resource restrictions
- Finite energy sources
- Variable performance and reliability in connectivity
- Mobility in a distributed systems increases the tension between autonomy and interdependence.

Solutions

- Algorithms for reduction in power consumption.
  - CPU.
  - Disk.
  - Screen.
- Disconnected file systems.
- Caching, hoarding, consistency management.
- Adaptive mobile environments.
  - Application
  - Extensible Operating system
  - Applications aware + operating system

Revelant Work

- Disconnected file system: Coda
- Application-Aware Adaptation: Odyssey
- Broadcast Disks
- Unix extension for Mobile Computing
- Support for data sharing: Bayou architecture:

Power Conservation Techniques

- CPU Power Consumption.
  - Reduce energy by dynamically control of the system clock speed and supply voltage by the operating system scheduler.
- Hard Drive Power Consumption
  - Scheduling of Spindown events to control power consumption.
- Wireless Broadcast
  - Techniques for organization and access methods to save power.
- Power Management Support in Unix.
  - Match power consumed to the activity level of a particular device.

Additions to Unix to support a Power Management Framework

- A power management mechanism within the Device Drivers.
  - Device driver control the access to the physical device.
  - A device driver can be placed on a *suspended* state when there is no activity.
  - A device drive can be made up of various components.
  - Capacity to request more power, if needed. management should be handled.
- Kernel entity that provides the supervisory mechanisms and policies.
  - Aware of physical and logical device dependencies
  - Supports operations for user to adjust frequency of device scans, threshold values and modify dependencies.
- Device Driver Interface and Device Kernel Interface
  - Operations to Suspend/resume and on/off

CPU Power Consumption

- Power in CPU and memory $\propto CV^2F$.
- Metric for CPU energy performance $MIPJ = MIPS/WATTS$.
  - 1984: 2-MIPS 68020 (12.5Mhz) 2 Watts for $MIPJ = 1$.
  - 1994: 200-MIPS Alpha 40 Watts for $MIPJ = 5$.
  - Motorola 68349 6-MIPS 300mW for $MIPJ = 20$.
- Algorithms that balance CPU usage between periods of high utilization and idle time.

CPU Scheduling Experiments

- Simulation based on trace data.
- Identification of "hard" and "soft" sleep events.
- Algorithms evaluated:
  1. OPT: Completely optimistic.
  2. FUTURE: Uses a short window into the future.
  3. PAST: Looks to a short window in the past for CPU information.
- Results:
  1. More power savings obtained if work is spread out
  2. PAST with 50ms window saves 50% power in a 3.3 volt CPU and up to 70% in 2.2 volt CPU.
  3. Energy saving depends on the length of the window and minimum CPU clock rate.

Disk Drive Power Management

- Maker of hard disk recommend a fixed time threshold for spinning-down (3-5 min)
- Techniques to obtain a power reduction:
  - Fine grained approach to spinning-down.
  - Past knowledge activity to predict spindown and spinup.

Results of Disk Drive Experiments

- Experiments based on trace data.
- Minimal consumption with a delay of 2-3 seconds.
- Savings of 90 percent compared to no spindown and factor of 4 with respect to $3 - 5$ minutes.
- A 6.2 seconds of idle spinning was equal to the a spinup in terms of power consumption.
- Frequent spindow introduce a delay to the user. At 2 second spindown delay introduces 15-30 seconds of user delay per hour.