

Energy in Mobile and Ubiquitous Computing

The main problem is to match:

- Batteries - progress in battery technology is slow;
- Devices - more powerful devices consume more energy;
- Applications;
- Users.

What is Consuming Energy?

- **CPU** - highly variable as a power drain;
- **Storage** - power costs of accessing persistent storage are small;
- **Network** - networking can be a significant source of power consumption, specially because it also involves the CPU;
- **Screen** - the screen is a major power drain;

How to Optimize Energy Consumption?

- **Energy-aware OSs**: main idea is to reduce energy consumption by unifying resource and energy management, and by using collaboration between the OS and applications;
 - Disable unused hardware components;
 - Provide fairness between applications using credit systems;
 - Use power forecasting to do scheduling.

Cinder - Energy-Aware OS

- **Cinder** is an energy-aware OS build on top of the HiStart exokernel that exploits device-level accounting and power modelling;
- Cinder allocates energy to applications using two abstractions:
 - **Reserves** (batteries) - a pool of energy that can be used by applications;
 - **Taps** - special-purpose threads whose only role is to transfer energy between reserves;
- When an application consumes a resource, the Cinder kernel **reduces the values of the corresponding reserve** and its **scheduler only allows threads to run if they have enough reserves**.

PowerScope - Power Modeling

- Map energy to code procedures;
- **PowerScope** is a tool that identifies applications behaving as energy sinks;
- Uses statistical sampling to collect traces.