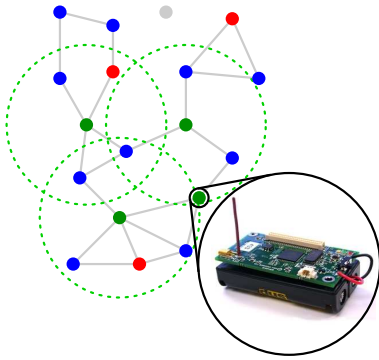


Towards a System Architecture for Power-Aware Implementation of Embedded Systems

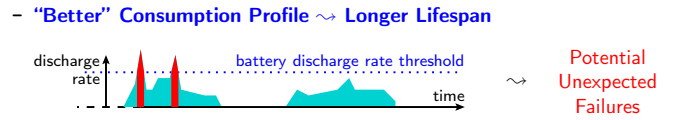
Nicolas BERTHIER Florence MARANINCHI Laurent MOUNIER

Context: Wireless Sensor Networks



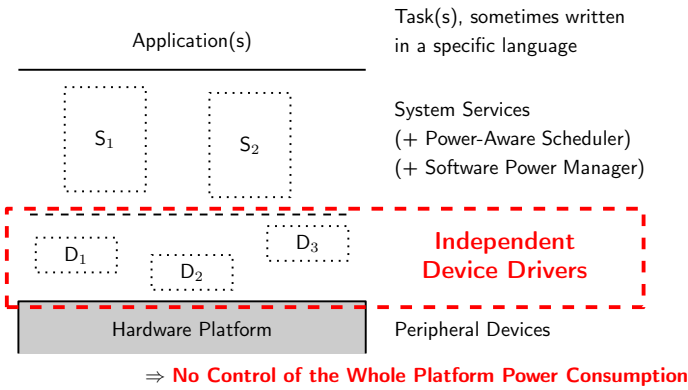
- **Constraints**
 - Small memory size
 - Low computation speed
 - Distributed systems
 - ...
 - **Battery-operated** platforms
- ⇒ **Requires Energy-Efficiency**

Problem: Battery-Awareness

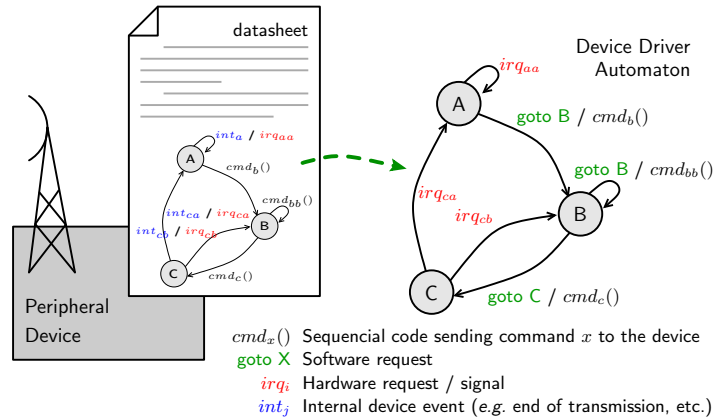


- **"Better" Consumption Profile ~ Longer Lifespan**
 - **WSN Application Programmers Need Good Abstractions**
- A WSN application (algorithms, communication protocols, etc.) *should* be battery-aware... but the target platform (a single *node* of the network) *may* be abstracted to ease implementation: programmers could rely on Operating System support in order to achieve better energy efficiency.
- ⇒ **How can we build an Operating System enforcing battery-awareness of WSN applications?**

Power-Aware Operating Systems Architecture



Device Driver Development

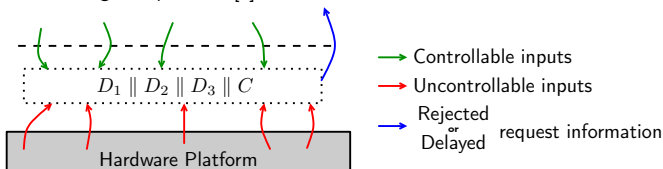


Contribution: Control of the Whole Platform

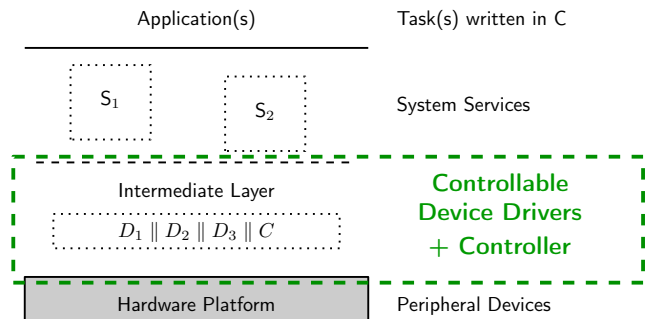
- **Ensuring Global Properties**
- Ensuring global properties of a whole platform boils down to control the behavior of all its peripherals:
- We may wish to forbid two devices to be simultaneously in an energy-greedy state.
- For instance, we could forbid switching on a sensor while starting to listen for a radio message: this would reduce the maximum amount of current drawn from the battery, then lead to a more battery-friendly consumption profile.
- ⇒ **Controller Synthesis Problem**

- Controllable Drivers

Using *controllable drivers*, i.e. drivers for which we can inhibit or delay some inputs. One can synthesize (manually or automatically) a controller enforcing properties about the state of the global platform [2]:



- System Architecture Proposal



- Current Prototype Implementation

Targeting WSN430 platform (Available platform and network simulators [1]). Development of device drivers and controllers:

- Synchronous implementation of the intermediate layer:
 - Notion of *platform reaction*
 - Better expressiveness for global property specification
- Further work: automatic synthesis of controllers

[1] WSN430 sensor node. <http://worldsens.citi.insa-lyon.fr>.

[2] P. J. G. Ramadge and W. M. Wonham. The control of discrete event systems. *Proceedings of the IEEE*, 77(1):81-98, 1989.