Towards Modular Resource-Aware Applications
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Resource optimization

It doesn’t matter how many resources you have. If you don’t know how to use them, they will never be enough.
Smart Phone Network Traffic Reduction

Media player on a mobile phone, streaming music over the network
Smart Phone Network Traffic Reduction

Media player on a mobile phone, streaming music over the network

- Media Player
- VOIP Application
- Media Player
- 3G Driver
- Optimization
- 3G Driver
- Optimization
- Wifi Driver
- Optimization
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Workshop on Variability & Composition @ AOSD 2012

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Optimization and modularization requirements

- Perform **optimizations in various locations** within the system
- **Separate** optimization and functionality
- **Separate** functional and resource-usage **interfaces**
- **Know the behavior** and/or plans of other modules w.r.t. resource usage
Approach

- **Modular** optimization
- A model of resource utilization
- **Notation** to make dependencies among components explicit

![Diagram of Resource-aware component with provided and required resources/services and Resource-Utilization Model (RUM)]
Approach

- **Modular** optimization
- A **model** of resource utilization
- **Notation** to make dependencies among components explicit

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**Resource-aware component**

- **provided resources**
- **provided services**
- **required resources**
- **required services**
### Approach

- **Modular** optimization
- A **model** of resource utilization
- **Notation** to make dependencies among components explicit

![Diagram of Resource-aware component with Resource-Utilization Model (RUM)]
Approach

- **Modular** optimization
- A **model** of resource utilization
- **Notation** to make dependencies among components explicit

![Diagram of Resource-aware component with RUM model](image)
Smart Phone Network Traffic Reduction

Media Player Application (on a smart phone)

Resource-Utilization Model (RUM)

Optimizing Controller

Network Manager of a 3G Network

Resource-Utilization Model (RUM)

Power Supply
Smart Phone Network Traffic Reduction

Media Player Application (on a smart phone)

- **stopped**
  - stop
  - play
- **playing**
  - connection
    - [until next $m$ seconds are buffered]
  - [when $n$ seconds of the buffer is consumed]

- **paused**
  - pause
  - play

Optimizing Controller

- connection
- download
- disconnect
- connect

Network Manager of a 3G Network

- connect
- disconnect
- send
- receive

- **CELL DCH**
  - radio power $\approx 800$ mW
  - bandwidth $\approx 100$ Mbps

- **CELL FACH**
  - radio power $\approx 460$ mW
  - bandwidth $\approx 20$ Mbps

- **IDLE**
  - radio power $\approx 0$ mW
  - bandwidth $\approx 0$ Mbps

Power Supply
Conclusion

- Proposed a **notation for modeling** resource utilization of and interaction among components
- Showed **usefulness of this notation** using two case studies

Open Issues

- Suitable notations for RUMs
  - Discrete models sufficient?
  - Are state charts sufficient?

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