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An Energy Request Scheme for Power Management in Autonomous WSN

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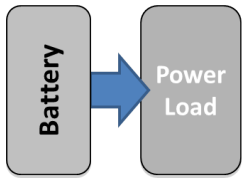
leti & list

The quest of ever-living WSN



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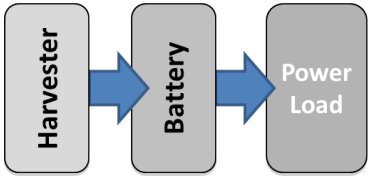

- Wireless Sensor Nodes need to harvest energy from their environment to reach better energy autonomy

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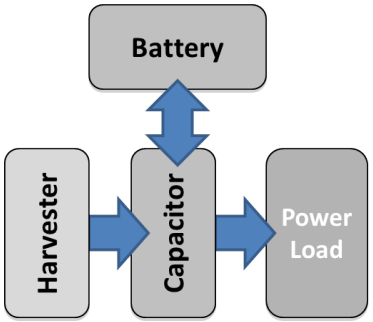

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- Using energy directly while harvested provides higher power efficiency

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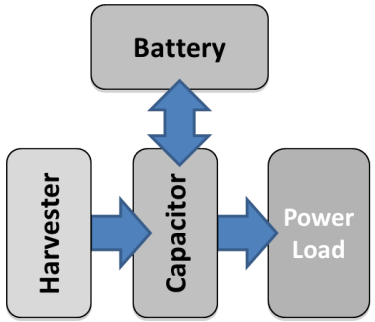

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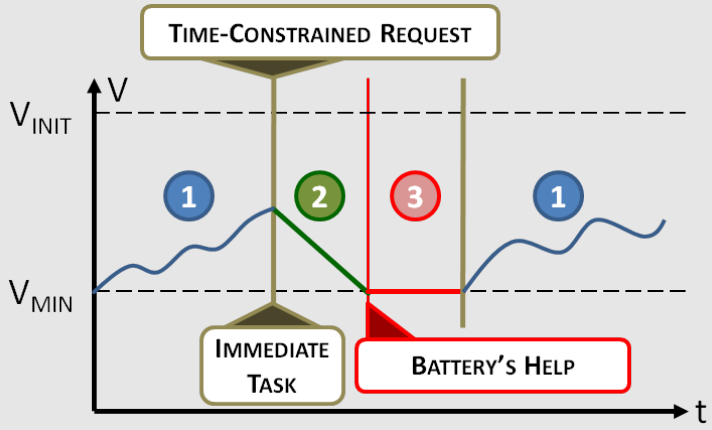
- Using energy directly while harvested provides higher power efficiency

Nodes should schedule their tasks to follow energy environment variations

- Why ? To maintain high power efficiency and prevent stress on the battery
- How ? with energy requests/acknowledgements between the application core and the power management unit

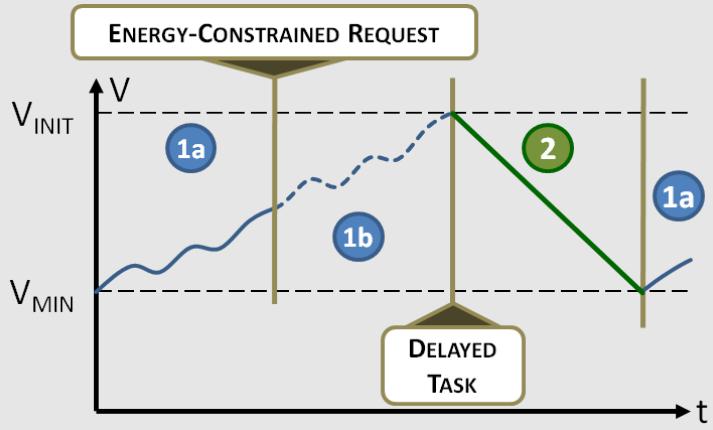
Requests to abstract energy state

Time Constrained Requests



- Immediately acknowledged
- Energy is drawn out of the battery to maintain minimal voltage level

Energy Constrained Requests



- Waiting for energy to be harvested
- Acknowledgement is sent once enough energy has been stored

Requests to abstract energy state

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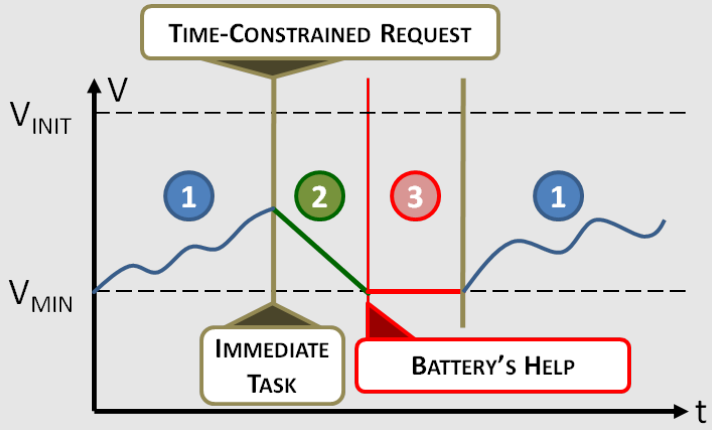

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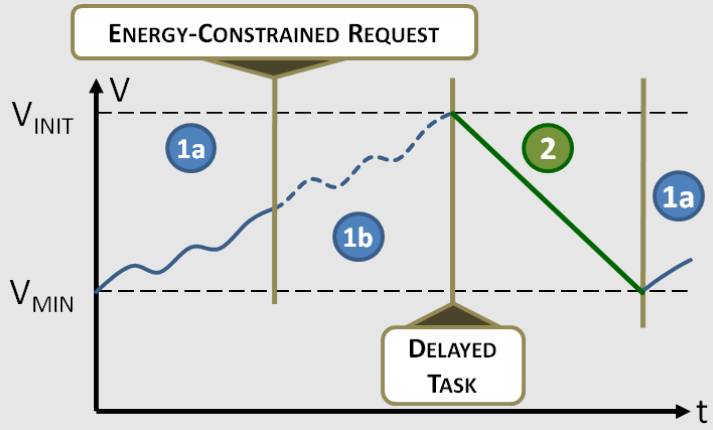

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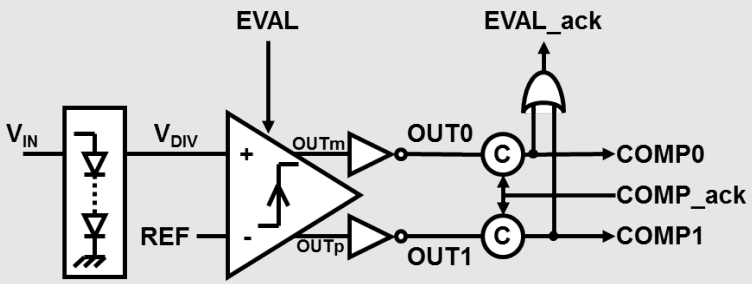
How to determine energy states ?

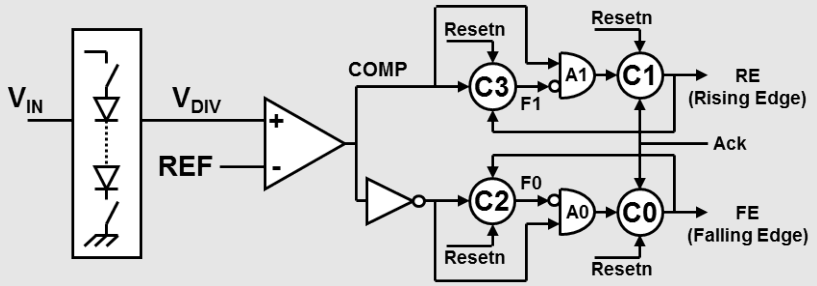
Monitoring storage devices' energy state

Active monitoring



- Using a latched comparator
- 1-bit asynchronous QDI token per evaluation
- Convenient for low voltage varying devices (e.g. batteries)

Passive monitoring

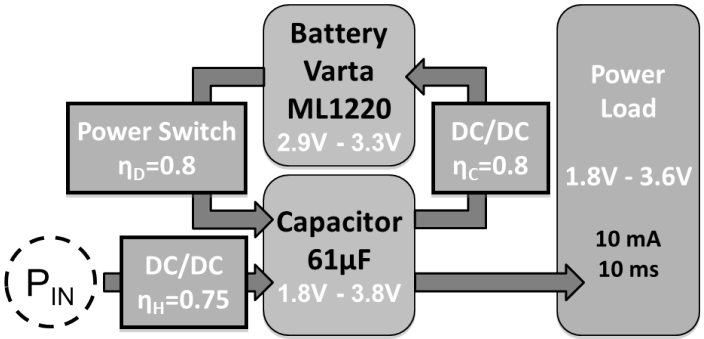


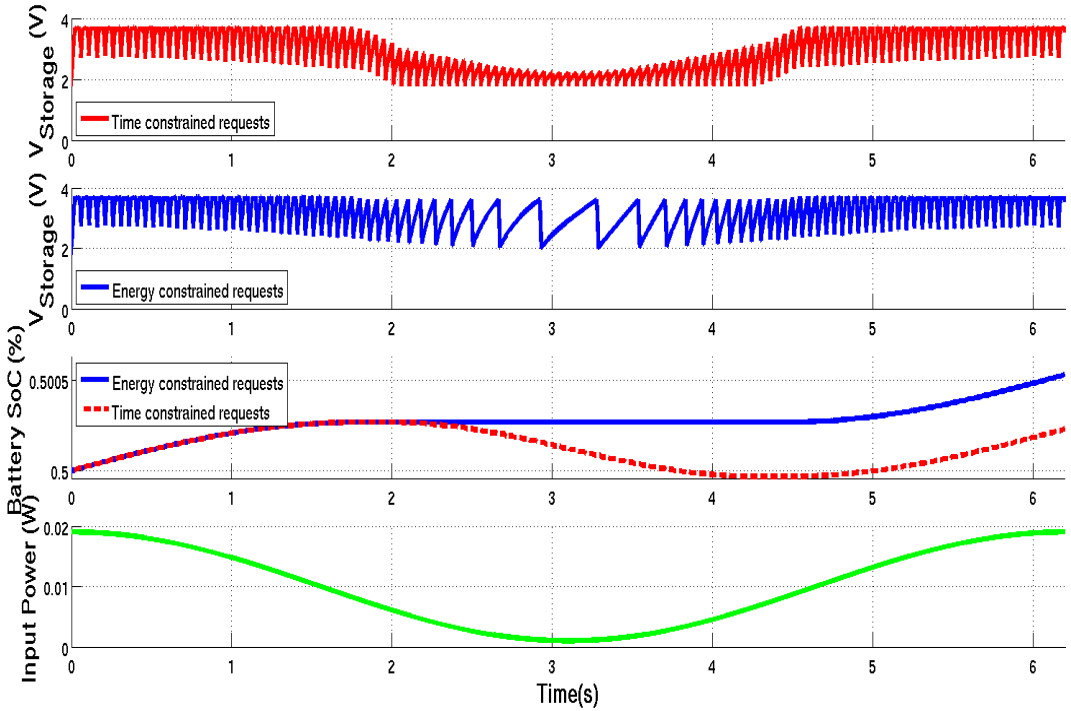
- Using a continuous comparator
- 1-bit asynchronous QDI token per threshold's crossing
- Suitable for faster voltage varying devices (e.g. capacitors)

Energy-driven duty cycle

Impact of the request's type against a varying harvesting profile

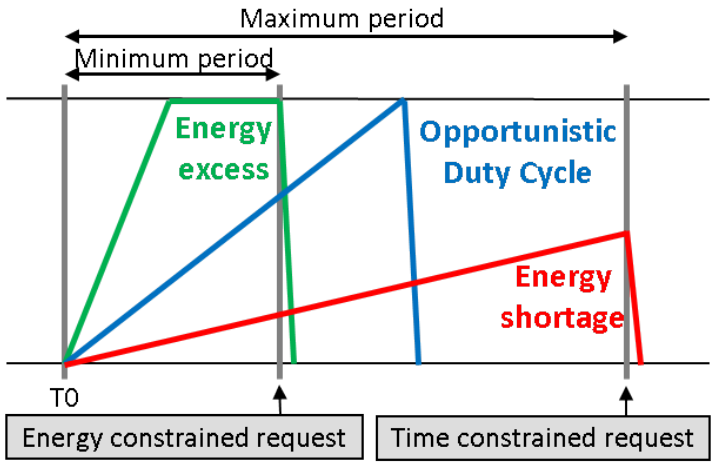
- Target duty cycle fixed according to $< P_{IN} >$
- Time-Constrained requests Vs. Energy-Constrained requests





Harvesting aware power management

- T_{min} setups the minimum idle period
- T_{max} defines a deadline for the task
- A predefined period for adaptive duty cycling



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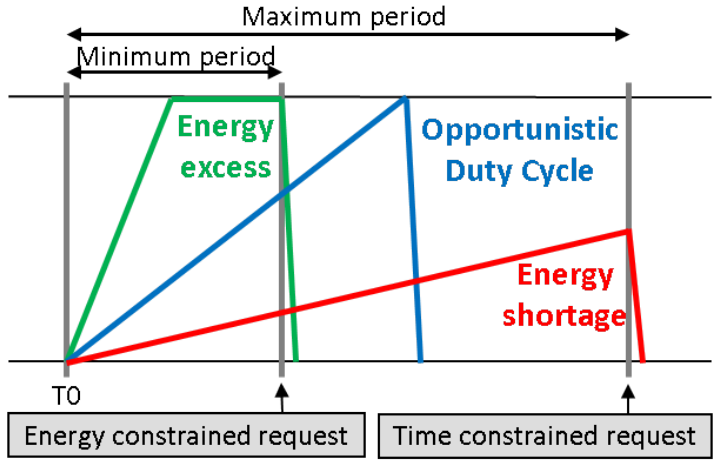

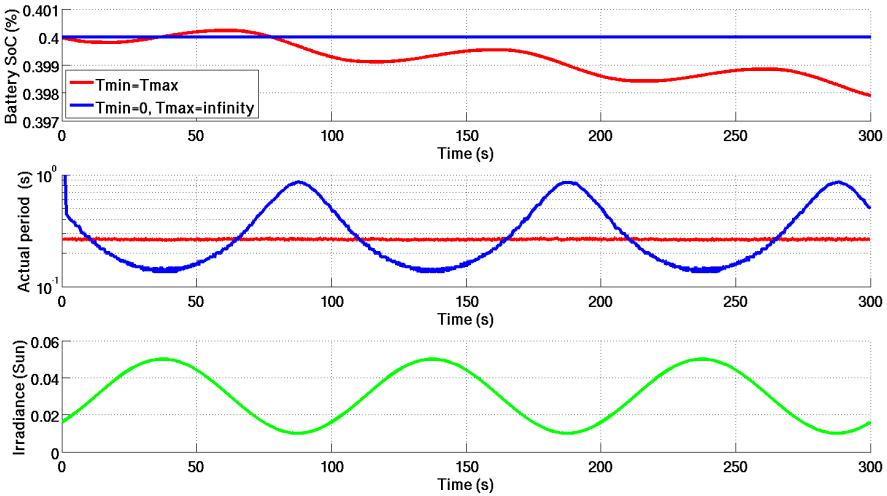

"$T_{min} = T_{max}$" $\Rightarrow$ Fixed duty cycle

"$T_{min} << T_{max}$" $\Rightarrow \nearrow$ harvesting awareness

From the application point of view

Configuring T_{min} and T_{max} provides control to the user onto the battery state of charge

Conclusions and future works

- Light-weigth harvesting aware power management
- User-to-node control of the battery charge/discharge cycles
- Enhanced battery and node lifetime

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What's on the TODO list ?

- Evaluation of the delay/time compromise impact on the global energy budget
- Design of a generic asynchronous energy controller architecture
- Evaluation of the gains for complex node architectures

Merci pour votre attention.

Thanks for your attention.

Vielen Dank für Ihre Aufmerksamkeit.