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Energy Potential Detection for Autarkic Smart Object Design in Facility Logistics

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Energy Potential Detection for Autarkic Smart Object Design in Facility Logistics

- Introduction
- Motivation
  - Internet of Things
  - Smart Objects
  - Micro Energy Harvesting
  - Wireless Sensor Networks
- Detection System
  - Idea
  - Test Setup
- Results
- Conclusion and Outlook

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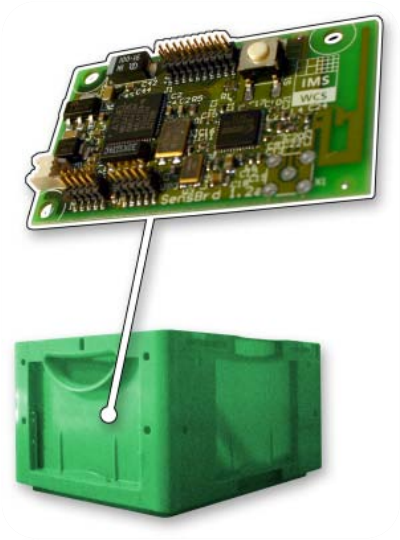
Energy Potential Detection for Autarkic Smart Object Design in Facility Logistics

- Project „AWiDAlog“
  - Research Project funded by European Union
  - German-Russian Coorporation
- Fraunhofer Society
  - Institute for Material Flow and Logistics
  - Department for Autonomous Transport Systems
- VEK-21
  - Spin-Off Moscow Institute of Electronics and Mathematics (MIEMS)
  - Wireless Sensor Networks, Computer Systems and Virtual Reality

Energy Potential Detection for Autarkic Smart Object Design in Facility Logistics

- Internet -> Logistics
- Data -> Physical Packages
- Decentralized Control System
- AutoID



- Entities in the IoT
- Communication Unit
- Sensor, Actor
- Interact

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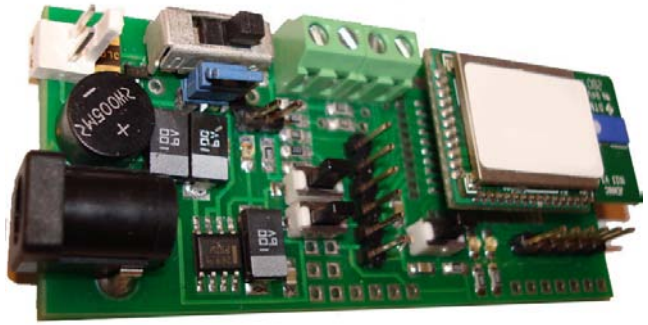
- Wireless Sensor Network
  - Nodes/Motes with Sensors
  - Communication Unit
  - Typical Network Topologies
  - Autarky -> Reduced Consumption
- Energy Supply
  - Wired Power Supply
  - (Rechargeable) Batteries
  - Capacitors
  - **Micro Energy Harvesters**

Jennic
TECHNOLOGY FOR A CHANGING WORLD



VEK-21
Imagination. Inspiration. Innovation.

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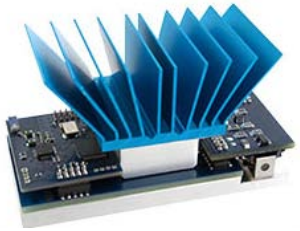
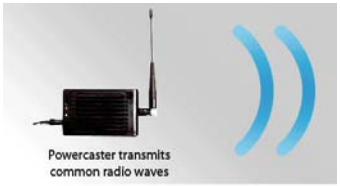
- Light
  - Sunlight
  - Electric light
  - Photo Effect
- Kinetic/Vibration
  - Electrodynamic
  - Electrostatic (MEMS)
  - Piezoelectric
- Thermal Gradients
  - Seebeck/Peltier Effect
- Wind
- Radio Waves





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- Development of a container monitoring system with the ability to detect:
  - potentials for Micro-Energy-Harvesting for a methodical MEH selection
  - (environmental stress on the transported goods)
  - (measure the logistical performance of conveyor systems)

- Prototype of a container monitoring system
  - 3 containers equipped with Wireless Sensor Nodes and sensors
  - 1 stationary node (coordinator)
  - Software for data analysis

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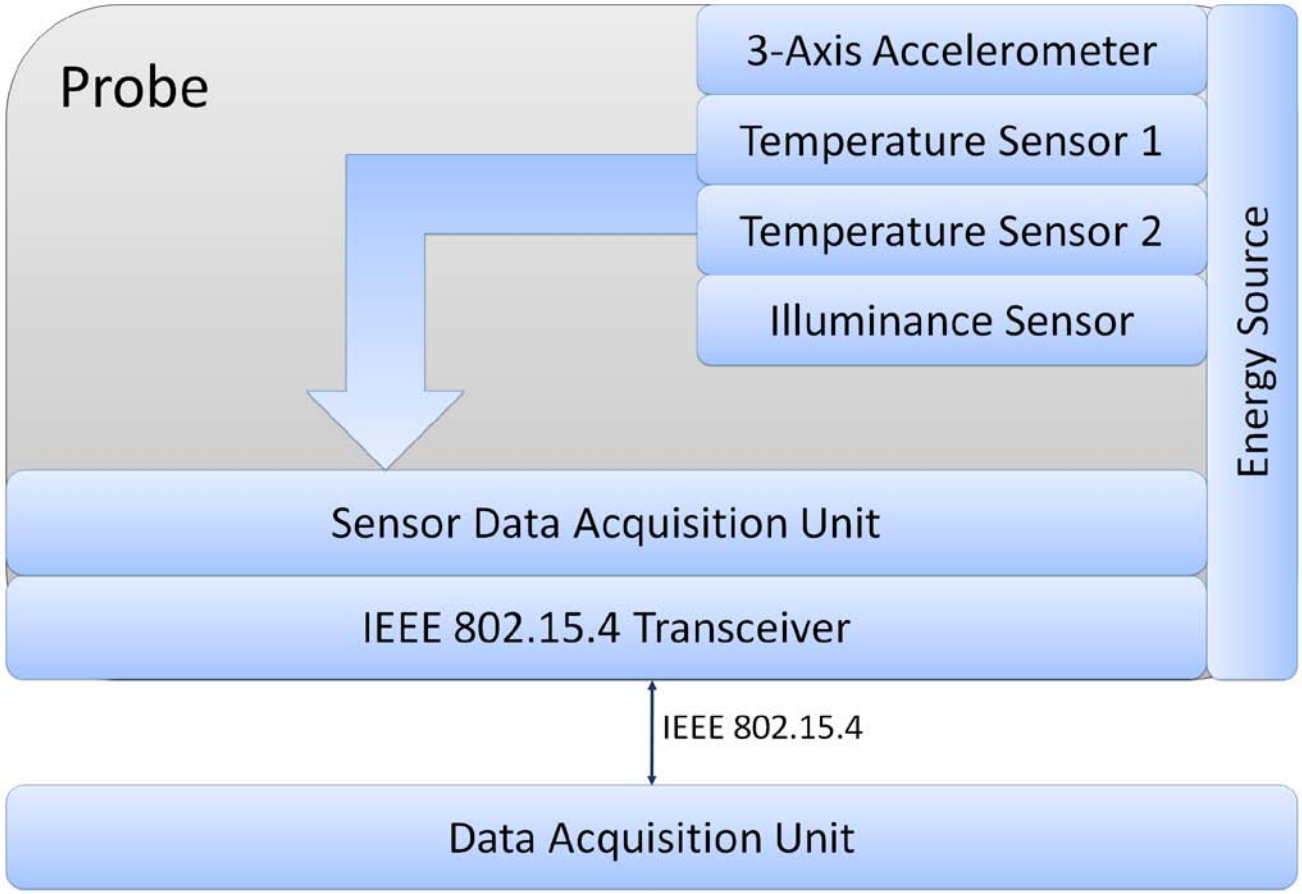

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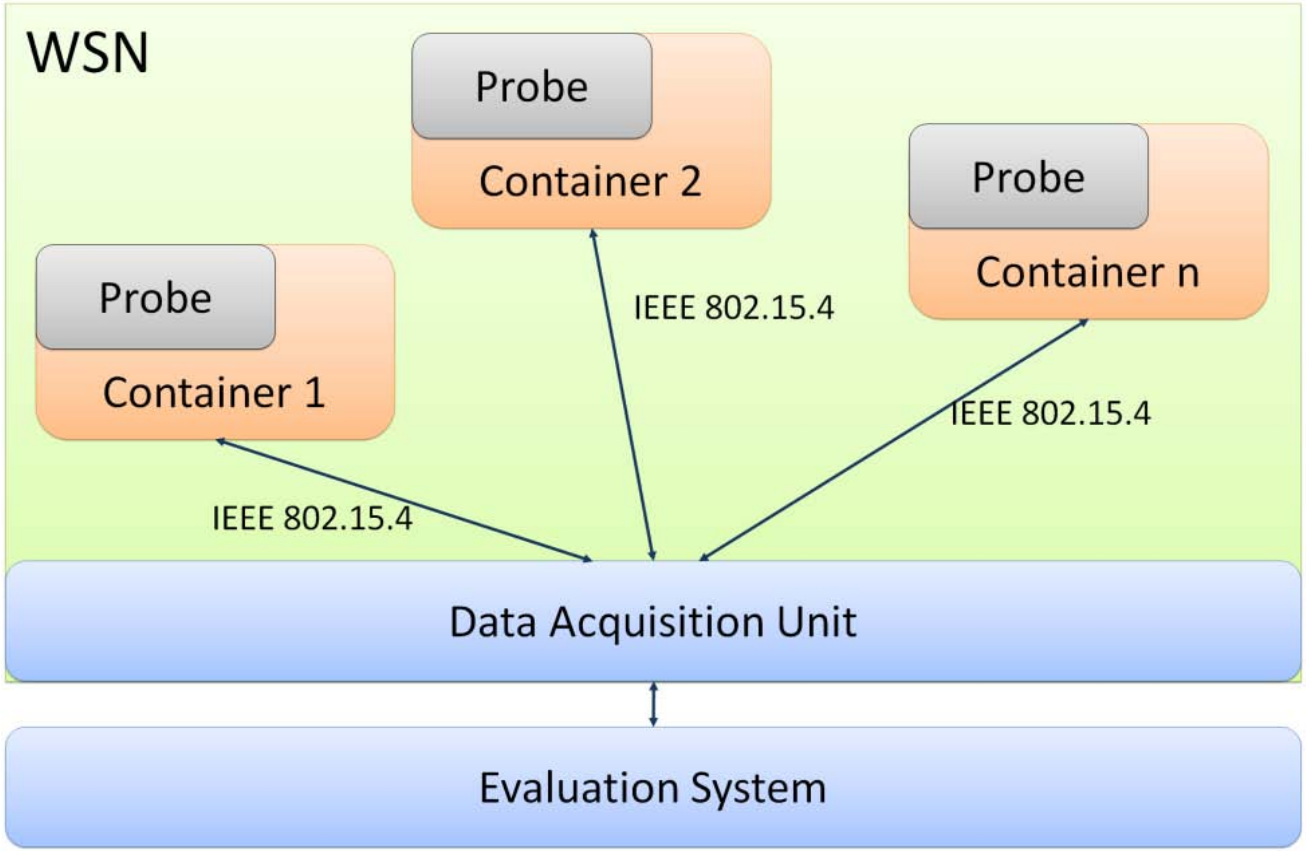

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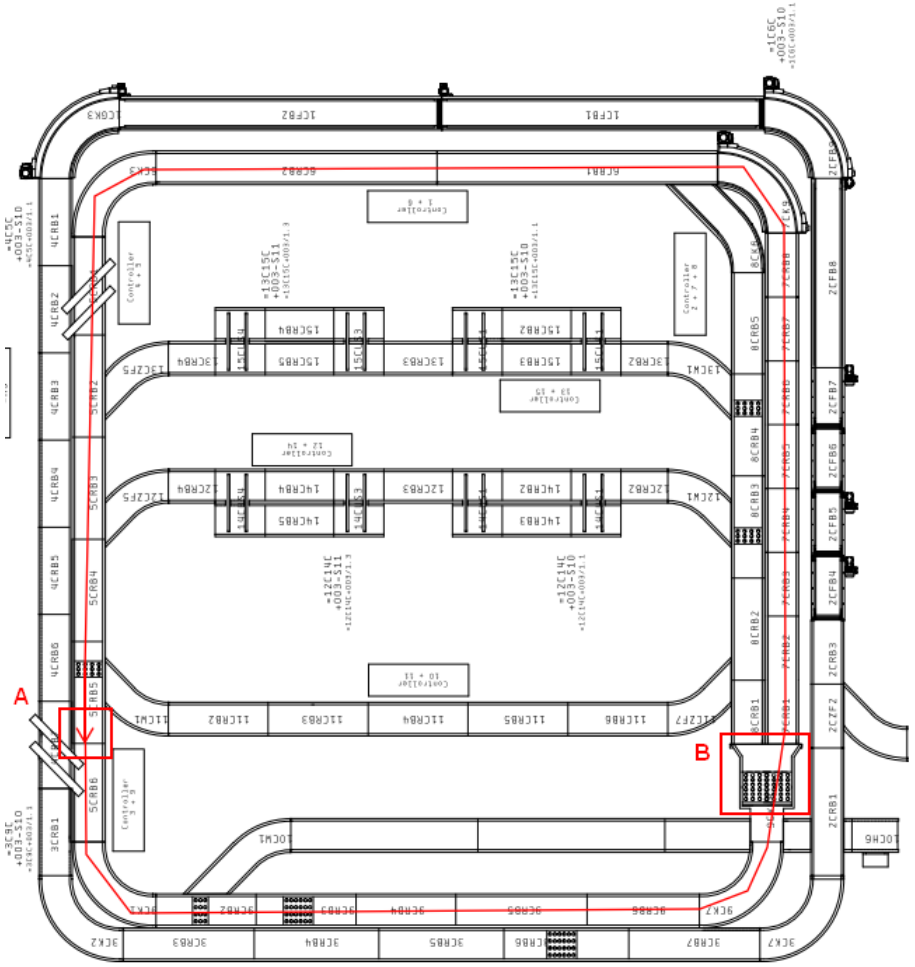

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Parameter	Value	Description
Sampling Rate	600	samples per second
mass	14kg	container mass plus load
length	40mm	assumed length of the thermo harvester
area	$20mm^2$	assumed area of the thermal harvester
λ	401	thermal conductivity constant
panel size	$0.02m^2$	area of the photodetector
light source	tube light	spectrum of the light source

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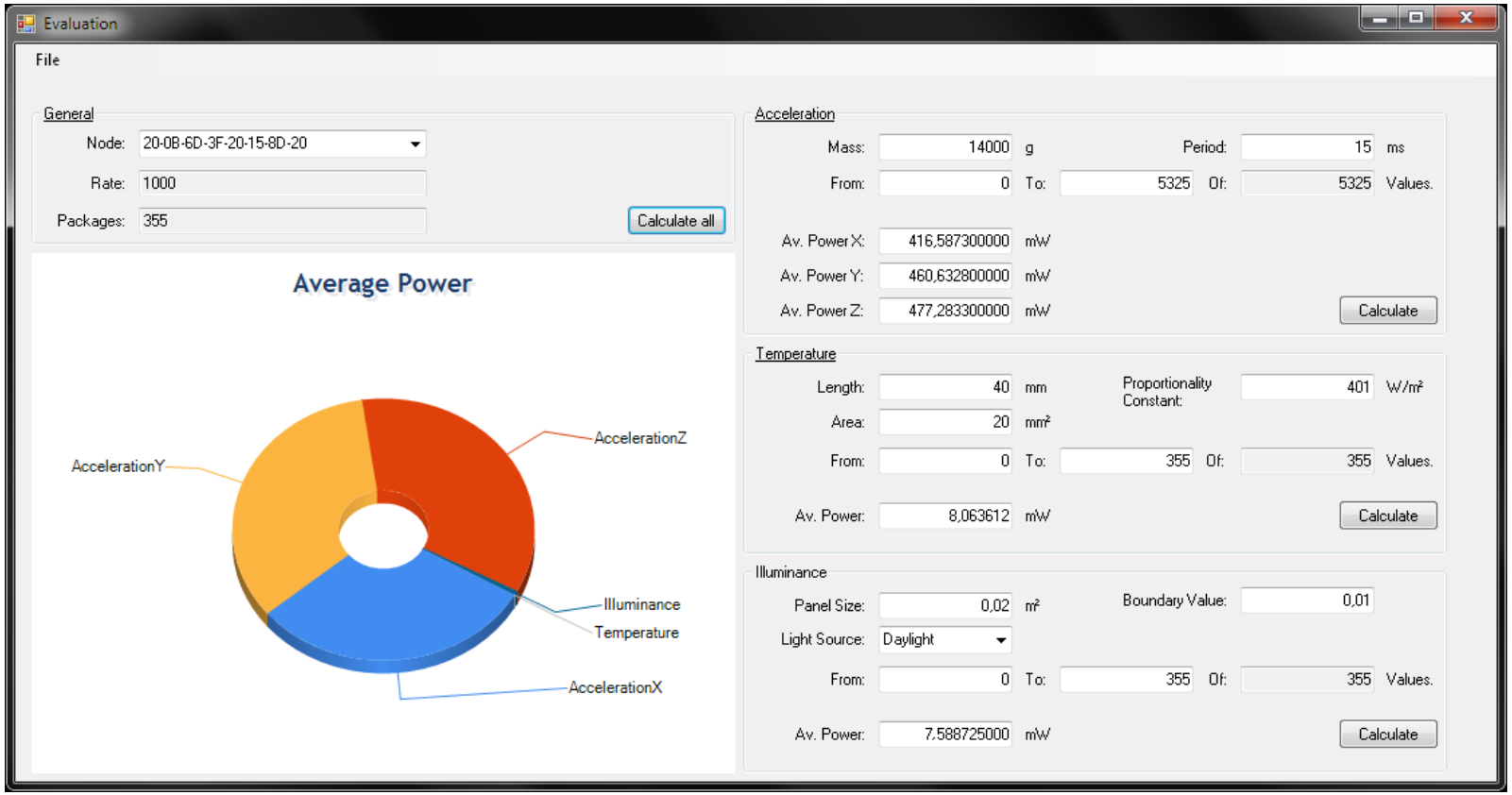

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Source	P_{det}	Eff.[9]	P_{eff}[mW]	$I_{@3.3V}$[mA]
Acceleration X	61,28	1 %	0,6128	0,1857
Acceleration Y	508,03	1 %	5,0803	1,5395
Acceleration Z	88,15	1 %	0,8815	0,2671
Illumination	19,42	15 %	2,9131	0,8828

Additional loss due to Bandwidth limitations

Potential application of MEH

- Assumed Current:
  - Sleep = 0.1mA
  - Active = 1.0mA
  - Transmit = 20mA
- Mixture of MEH applicable with limited Transmission cycles and sophisticated power management

Energy Potential Detection for Autarkic Smart Object Design in Facility Logistics

- Fourier Transformation for Vibration Harvester
- Broad Database with efficiency values of MEH
- Database of typical spectrums
- ToF ranging
- Implement mesh architecture
- Autarkic small load carrier
- Validation by comparison with real Harvesters

Thank you for your attention!
Any questions?

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