Energy Aware IoT/Devices

Potential of Energy-Aware Devices and IoT for a Smart Energy Management

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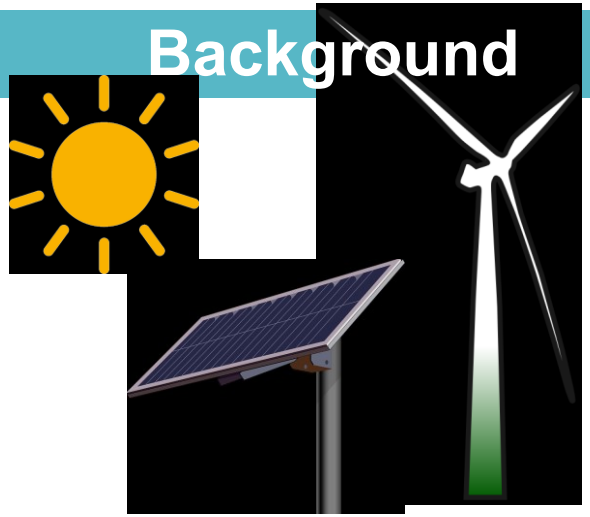
IEA Networking Event, 30. Oct. 2018

Background



Matching

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Sub-Metering

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Smart Energy Management Solutions

Energy Awareness
- Consumption
- Forecast
- Control

Overview

Energy Awareness

Technical aspects

Potential in different scenarios

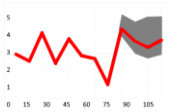
Conclusions

Our understanding of Energy Awareness

An energy aware device

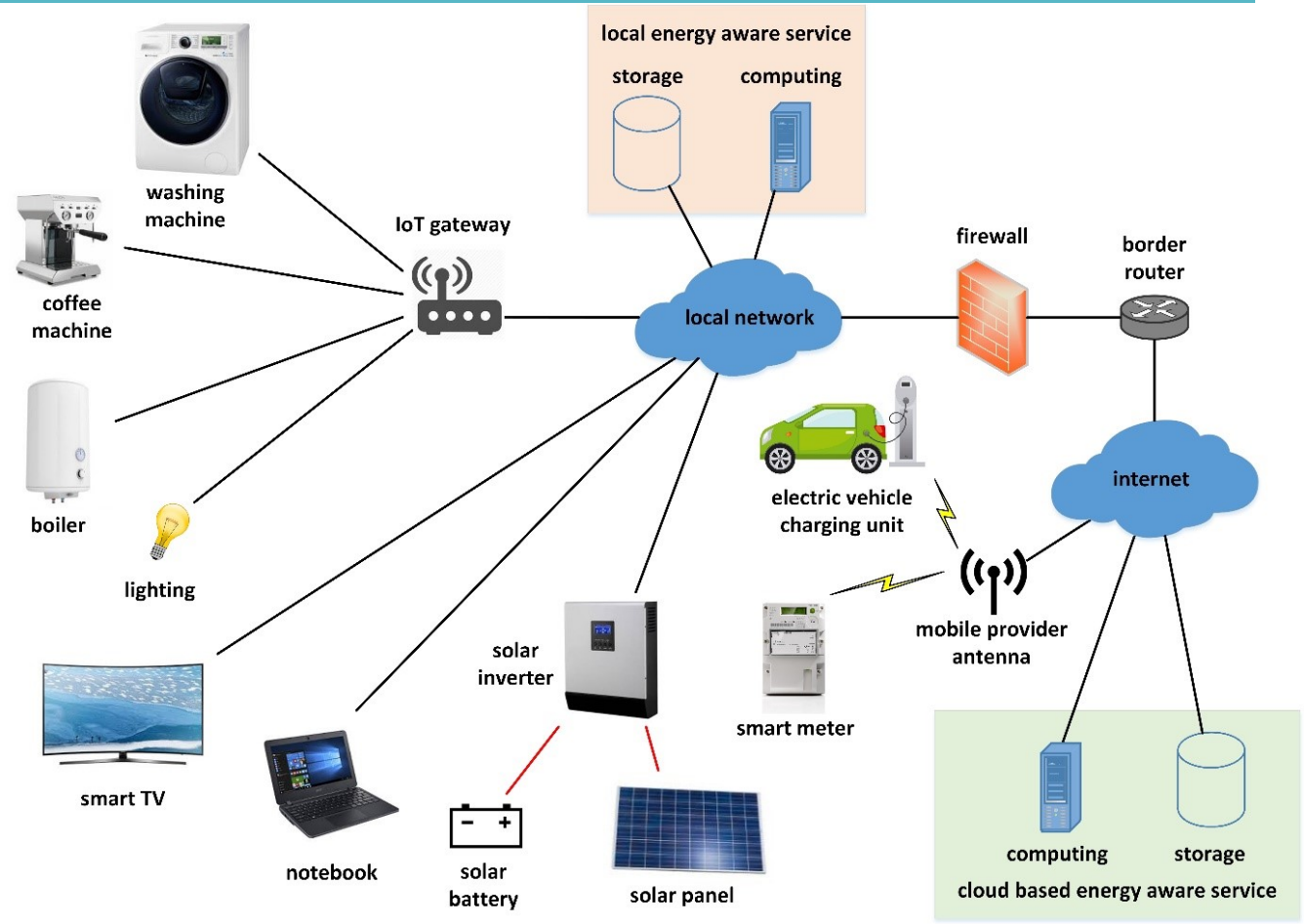
- Knows its own current energy consumption

- Knows its forecast for future energy need

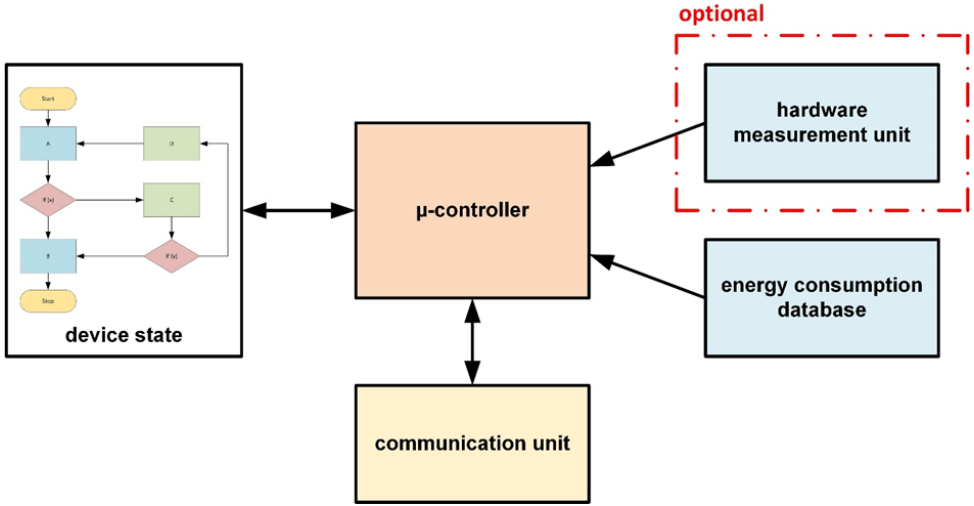


- Can be externally controlled

Architecture: Network



Architecture: Device



Energy awareness

- Database for power estimation, or
  Measurement hardware (accuracy 10%)
- Forecasting (state, schedule and flexibility)

Can be implemented on the existing µ-controller and communication hardware

Estimate of Additional Cost

	Cooking / Baking	Dish washer	Refrigerator / Freezer	Lighting	TV / Audio	Home Office	Washing Machine	Tumble dryer	Small devices	Electric boiler
Communication	$	0	$	$	0	0	0	0	$	$
Measurement	0	0	0	0	$	$	0	0	0	0
Compared to device										

Energy Saving

A detailed and real-time feedback of energy consumption can enable energy savings of up to 8%

Applies to:
- Potentially every device in the household

Needs:
- Current power consumption of the device
- Display for feedback

Enables:
- Detailed Knowledge of energy consumption
- Logging of energy consumption
- Energy consulting

Energy Saving: Low Benefits

Potential of savings	<½%	<½%	~5%
Will I change behaviour?	No	yes	?
Benefit of energy awareness	0	low	low

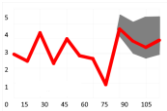
Benefit of energy aware devices is low:

- Low energy saving potential in general
- Hardly improves user's behaviour

µ-Grid

Energy management in a µ-Grid with the goal of a high degree of autonomy

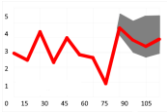
Applies to:	-	Devices with significant energy consumption
Needs:	-	Current power consumption of device
	-	Future power consumption (forecast)
	-	User interface & acceptance of external control
Enables:	-	Control of operating times of devices
	-	Optimisation of power consumption / storage



μ-Grid: Benefits given



Potential of shiftable energy	46%	17%	6%
Time-Period of shifting	day	hour	hour
User acceptance	Yes	?	No
Benefit of energy awareness	good	med	0

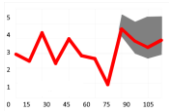

Benefit given for energy aware devices:
- for loads accepted for shifting
- considerable amount of energy available to manage

Balancing Power

Energy management in a Smart Grid to provide balancing energy in order to keep the grids frequency stable

Applies to:
- Devices with high connected load

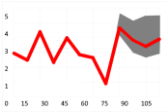
Needs:
- Actual power consumption of device
- Future power consumption (forecast)
- User interface & acceptance of external control
- Coordination of many devices over a large area



Enables:
- Control of operating times of devices
- Provide control power depending on possibilities of devices

Balancing Power: Benefits given

Avg. potential control power [MW]	210	330	110
Time-Period of shifting	day	day	hour
User Acceptance	Yes	?	No
Benefit of energy awareness	good	med	0



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General Benefits

Energy aware devices have general benefits:

- No disaggregation needed
- Low costs to implement energy awareness
- Forecast and controllability add new business opportunities

Benefits depend on the context of the problem to solve

Open Issues

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- Algorithms that use energy data from single devices
- Real potential of energy aware devices
- Forecasting ability for devices
- Protocols
- Business models

Thank you!