Smart Information Systems and Devices for Better Energy Management and User Awareness

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- **Smart meters** for “fine grain” monitoring of consumption and production (e.g., 1Hz electricity sampling, DH water temperatures, etc..)

- **IoT-based middleware** for efficient data communication

- **Cloud computing** system for efficient distributed data post-processing and storage

- Apps and web-pages for rich and interactive visualization of energy figures to promote **user awareness**
FLEXMETER
• Develop a cost effective smart metering system (HW/SW) for multiple energy vectors (electricity, heating, water, etc..)
• Deploy new services and business models: Energy aggregators, non-intrusive load monitoring, load balancing, energy forecasting, storage management

EDEN
• Leverage user awareness instruments (GUIs, web apps) to enable energy management
• Develop GUI for prosumers and energy managers (e.g. building performance comparison and benchmarking)
• Exploit thermal energy monitoring (District Heating) as case study
FLEXMETER: Concept

Project goals:
- Design and develop a cost effective and flexible smart metering infrastructure
- Demonstrators:
  - Torino (Italy)
  - Malmoe (Sweden)

System architecture

Data flow

Data gathering
- Metering equipment
- Concentrators

Transmission
- Communication devices
- Protocols

Servers
- Data servers
- Application servers

Applications and services
- Software application

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Objectives

- **Interoperability**: different meters with different communication protocols (MBus, W-Mbus 169 or 868 MHz)
- **Low cost** of installation and management
- **Modularity**: upgrade with new services
- **Scalability**: install new meters with minimal effort
- **Replicability**: the system is open to devices of different manufacturers
- **Data transmission**: different requirements for the various utilities (water, DH, electricity)
FLEXMETER: Software

- Demand-response for the user
- Demand-response for the network
- MW/SW platform

Substation - smart meter integration
- Electric Storage
- Fault detection

Substation - smart meter communication

Multiservice interoperability

Building concentrator

Gateway-device communication
User interfacing

Gateway control center

Prosumer 1
- Electric Meter
- Gas Meter
- Water Meter
- Heating Meter

Prosumer i
- Electric Meter
- Gas Meter
- Heating Meter

Prosumer n
- Electric Meter
- Water Meter
- Heating Meter

MV/LV Substation 1
- Electric Meter

MV/LV Substation j
- Electric Meter

MV/LV Substation n
- Electric Meter

Central cloud system

Cloud platform

Energy consumption data analysis (e.g., NIALM)

Real-time data processing

DSO services

Other services

Energy aggregator

Load and generation forecasting

User

- Demand-response for the user
- Demand-response for the network
- MW/SW platform

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ANALYSIS OF THE MV/LV NETWORK

- Load profiling
- NIALM technology

- Fault statistics
- # of customers and prosumers
- Mean and peak power demand
- Maintenance and renovation foreseen activities
FLEXMETER: Services for the Prosumer

MV/LV NETWORK

- Building concentrators
- MV/LV substations

Customers

- Historical data analysis
- DG presence
- Existing smart meter characteristics (faults, data transmission problems..)
FLEXMETER: Features

- Flexible and smart multi-metering (electricity, water, gas, district heating) architecture based on cheap COTS for plug&play implementation
  - Sharing the costs of the system using common devices (e.g., gateways)

- Offering of advanced services to the users, to the DSOs and to the other utilities, and enhancing the possibilities of the retail market

- Improve basic features that can be offered by utility companies
  - Online-available user profiles, online consumption data, suggestions for consumption optimization, basic predictions for future consumption

- Impact on provider and consumer sides
  - Reduce costs for the utility company to read the data
  - Real-time services to the user
  - Fault detection and network load balancing
EDEN: Concept

Project goals:

- Develop a system to collect, represent and share energy information of incremental complexity, making accessible and transparent the info related to the "things" around us
- Demonstrators:
  - Five regions in Italy
**EDEN: Platforms**

- **The first level platform (Data)** collects the data generated by "smart objects".

- **The second level platform (Publication)** is characterized by the representation of the data related to the needs of the various stakeholders involved.

- **The third level platform (Social)** provides visibility and meaning to the collected data, helps in creating awareness and stimulating sustainable behavior in citizens and public and private stakeholders.

- **The fourth level platform (Smart Data)** powers the database maintained by the local government and offers methodologies for data aggregation and displaying capabilities to the benefit of individual citizens and communities.
EDEN: Thermal Monitoring Interfaces

Probe selection

Temperature plots
• Energy signatures represent instantaneous heating power vs. external temperature
• Overall building energy performance and anomalies (if present) are displayed
Comparison of energy signatures (red is better)

Building energy comparison
EDEN: Features

- Exploit building and district level KPIs for energy performance evaluation and comparison

- Encourage the management and the efficient use of public goods through data and services on an urban scale

- Pursue the maximum interconnection between actors in the energy management by exchanging relevant data in an efficient manner

- Create a usable instrument for public administrations to detect energy performance of buildings and districts and propose dedicated interventions promoting better governance of territories

- Promote user engagement in better energy behaviors
Conclusions

- Projects FLEXMETER and EDEN adopt enabling technologies (ICT) at the service of citizens, communities and government needs.

- They combine technologies with social matters.

- They are part of the implementation of the Torino Smart City master plan (SMILE).
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