Defining a Distributed Architecture for Smart Energy Aware Systems

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SEAS

■ European Project

■ Goal
  • Enables better energy resource managements (both production and consumption)

■ Provides the means to do it
  • Universal language enabling automatic machine-to-machine communications
  • Innovative architecture enabling efficient, dynamic and real-time management
Energy context

- Need for energy, steadily growing
- Heterogeneous Energy Sources
- Case of Electricity
  - Number of devices is gradually increasing
  - Rigid top-down structure
  - Problem:
    - Electricity demand will increase
    - Upgrading distribution network capacity is very costly
  - New inputs:
    - Decreasing prices of renewable technologies for local production
    - Growth of micro-generation production to take into consideration

⇒ Require to modify the current structure
New distribution structure

- Not changing the current structure
- However, make it work in unison with other systems
Landscape of model communities

- Several standards, systems, platforms and architectures available

- Several devices, hardware and communication technologies used
  - Sometimes proprietary

- Scattered standardization efforts and isolated implementation
  - Lead to a fragmented landscape
Need for new models

- Opening and interconnecting the silos
- Hand back the decision keys to end-users

⇒ Appearance of open markets for energy management

- Internet appears as the best candidate
  - Redundancy and resilience
  - Core network decentralized with distributed intelligence
  - Provide enough flexibility to be dynamic
  - Simplify the functioning of new markets
  - Several efforts for security
Unveil requirements

**Architecture:**
- Scalable
- Dynamic
- Secure
- Automated

**Knowledge Model with Semantic**

**Should enable:**
- Data collection from different types of nodes
- Energy management at different levels
- Hierarchy communications
- Consumer/prosumer involvement in management decision
- Finding and searching for given parties (nodes and/or services)
- Monetary transactions between parties
- Demand-Response mechanism
- Almost real-time communications
SEAS Reference Architecture Model (S-RAM)

- Introduction of the Group Manager (a Management Device)
- From a Metering Infrastructure to a Distributed Architecture

Local Node Management

- Flexibility
- Privacy
- Scalability

Distributed Core

- Flexibility
- Dynamic
- Management
- Information spreading

Hierarchy mode

- Scalability

SEAS Group

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SEAS Group
SEAS Reference Architecture Model (S-RAM)
Architecture Requirements & Advantages

- **Requirements**
  - Address all SEAS Entities
  - Automatic discovery of SEAS Entities
  - Authentication and authorization of participating SEAS Entities
  - Secure communications
  - Secure transactions

- **Adaptable Architecture**
  - Compatible with existing standards
  - Nodes / GMs can be “moved” without breaking the architecture
  - May evolve with hardware enhancement

- **Hybrid Architecture**
  - Structured peer-to-peer and client/server models
  - Efficiently search for a given resource/information
  - Optimizing entities interactions/requests
  - Facilitating data analysis
Estimation of Photovoltaic Panel Production

- **Simple scenario**
  - Measure production:
    - Several possibilities
    - Fairly simple
    - EU visualizes its production

- **Estimate future production?**
  - Inform the grid
    - Better knowledge of load shedding capabilities
    - Send demands accordingly
  - Inform the EU
    - Better consumption planning

- **How to realize it?**
GASP PoC (1/2) – S-RAM

Messages exchanged uses SEAS Knowledge Model

1. Register to Registration Server(s)
2. Search for available Services
3. Exchange information with chosen Service Provider
Results

Weather vs Production

Consumption vs Production

Power (Watts)

Time (hour)

8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00

power

cloudiness [%]
Conclusion

- **SEAS**
  - Provides ICT tools to interconnect energy actors
  - Helps better manage, optimize and coordinate energy consumption, production and storage

- **Proof-of-Concept**
  - Energy Management system
    - Receives estimation production
    - Better plans energy needs
    - Inform the grid on future capabilities/needs

- **S-RAM**
  - Deploy new and innovative services
  - Make it available for a large mass
  - Semantic information helps entities better understand and interpret received information
  - Requires future implementation, test and extension
Questions ?