ETSI Smart Grid Workshop: April 5th - 6th, 2011

Home Energy Gateway: the Gatekeeper of Smart Grid

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Agenda

- Smart Grid, Energy Management & Privacy Concern
- Home Energy Gateway (HEG) Roles & Requirements
- HEG Reference design : overview
- HEG Reference design : software
- Summary & Standards Possible Future work on HEG
Smart Grid deployments offer great opportunities for Utilities to manage and control energy distribution to their customers.

But also give homeowners the possibility to better manage their energy usage: Home Energy Management.

Provide multiple technologies to connect house equipments like meters, appliances, thermostats, into Home Area Network and develop systems to monitor and control these networks (Energy Gateway and In-Home Display concepts).
One of the basis of Smart Grid is the peak current reduction

Customer domain is the place to achieve this goal

Demand Response (DR) advance mechanisms associated with smart appliances (e.g. intelligent washing machine,..) can reduce peak current by 30% (Load shifting concept or Load Shedding action)

Strong interaction between customer domain, electricity suppliers (DSO, TSO,..) and service providers (retailer, aggregator,..) is needed

Customer Privacy MUST BE protected
Home Energy Gateway is one of the answer to this customer privacy concern
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Home Energy Gateway: Other functions and Where?

- Residential Gateway
- Internet
- Utility Companies
  - Energy Saving Services
  - Monitor and Alert
- Consumer
  - Remote Control and Monitor
- Home Energy Gateway
  - In-Home Display
  - Home Displays, TV, Computer
  - Residential Gateway
    - Breaker, Valves, Smart Water, Smart Gas, Smart Electric
    - Solar Panel
    - Wind Turbine
    - Light
    - Appliances
    - Temperature

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The Home Energy Gateway:
- collects power consumption data from various sources
- manages demand/response policies
- controls activation/deactivation of HAN appliances
- generates dashboards to provide feedback about power usage
- provides control menus to control appliances
- provides an ubiquitous link to the WAN for remote control/readout
Home Energy Gateway (HEG) : Our initial requirements

► HEG = Smart Energy Platform + Home Automation platform + UI

► Smart Energy Platform : more visibility
1. Collects coarse-grained meter data (overall HAN electricity, water, gas usage)
2. Collects fine-grained appliance data (per device power usage)
3. Allows real-time utility alert delivery and real-time utility tariff plan deployment
4. Allows for utility driven load control

► Home Automation Platform : more visibility raises the need for more control
1. Allows for centralized control of home appliances
2. Allows for user driven load control (delayed start, dimming, remote on/off)

► Intuitive and ubiquitous UI : more visibility and control requires comprehensive user interfaces
1. Runs web standards to allow for remote user control and monitoring
2. Runs web security protocols to allow for trusted application downloads
3. Runs a rich graphical framework to allow for comprehensive and intuitive UIs
HEG: need scalability in features and performances

- to accommodate various (and evolving) connectivity requirements

- to be able to run web technologies allowing for ubiquitous (web server) and secure IP access (SSL)

- to be able post-process fine grained HAN power usage data (stored locally to address growing privacy concerns) and generate useful end customer dashboards

- to be able to generate rich and comprehensive user interfaces to accommodate for heterogenous viewing devices

- to allow for value add 3rd party applications on top of power usage gathering and home automation
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Home Energy Gateway: platform block diagram
Security features for energy gateways

• To address security, safety and privacy concerns, energy gateway manufacturers need to make sure:

  • signals leaving the house can not be eavesdropped
  • device boots on authenticated (signed) firmware
  • devices can support security protocols (incl. web security protocols)

• Those requirements can easily be supported on Freescale SoC

  • dedicated hardware support for AES128-based authenticated boot and signed/authenticated firmware
  • dedicated hardware acceleration for AES, 3DES, SHA, MD5, … encryption/decryption/hash algorithms
  • secure off-chip storage mechanisms
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As Freescale is not a “box” supplier, the challenge was to find the right partners (OS and Software) to be able to build a full demonstration Home Energy Gateway to Test and Validate use cases (e.g. HGI-RWD017-Rx Requirements for Home Energy Management and Control Service) and get feedback from this emerging market.

Future proof Home Energy Gateway may have different QS and Software elements.
## Ecosystem

<table>
<thead>
<tr>
<th>Product</th>
<th>Can be delivered for free ($)</th>
<th>Terms and conditions TBD w/ partners</th>
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</thead>
<tbody>
<tr>
<td><strong>remote User I/F</strong> (running on iHID - connected through WiFi to HEG)</td>
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<tr>
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<td><strong>Hardware</strong></td>
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</table>

### OS Support
- **Available in Dec ’10**

### HW Manufacturing
- **Available in Dec ’10**

### 802.11 b/g
- **Available in Dec ’10**
- **Zigbee**
- **SEMA**
- **Mbus-RF**
Ecosystem Software: UIs + application frameworks

- Flash-lite IHD on i.MXxx/QNX
- ‘Web’ UI running on e.g. iPod touch
- Silverlight IHD on i.MXxx/Windows Embedded Compact 7
Freescale/ProSyst/MicroDoc partnership

Home Energy Gateway demo

ZigBee SE 1.0 smart meter

Utility messages

ProSyst mBS (OSGi)

JVM

Linux

i.MX283

Database

Web server

ZigBee HA

Roadmap

Custom app

Robust and field proven OSGi framework

Supports remote management (SW lifecycle mgmt, remote configuration/monitoring)

Allows for OEM differentiation (downloadable apps)

One-stop shop software business model (JVM, firmware, HMI)

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KEY TAKE AWAYS
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Energy management is a tremendous growing market
- Home Energy Gateway is a big part
- Technology is close to be ready (HEG, display, smart meter, smart appliances, Solar panel, electric vehicle, HAN …)
- Every one is impacted by the energy / cost saving

Freescale in collaboration with different partners builds a Home Energy demonstration Gateway to test and validate different use cases elaborated by Standards leaders in this Industry (e.g. HGI, ETSI, ITU-T, NIST, ZigBee)
- Reference Platform available (schematics, Gerber, BSP)
Possible Future work for Standardization related to our HEG experience

► Too many physical interface choice:
  • Standards can help by recommending:
    ▪ WiFi
    ▪ ZigBee (SE & HA)
    ▪ PLC (Narrow Band and Broadband)
    ▪ Ethernet
    ▪ ….

► Define Security Criteria
► Define basic functions to set-up minimum interoperability between Smart Meter, Smart Appliances and HEG
► Define Power modes & consumption
► ….
THANK YOU!