NEW OPEN SOURCE PROJECT AT HGI FOR SMART HOME DEVICE ABSTRACTION TEMPLATES

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TOPICS

• Introduction to HGI (www.homegateway.org)
• Smart Home Abstraction Layer: Goals and architecture
• A tool to unify device modeling: The Smart Home Device Template (SDT)
• Working together on the SDT within the standards eco-system
• Moving from modeling to implementation
HGI’S MANDATE

• Publish operator requirements for broadband home
• Establish global ecosystem of companies addressing “the networked home” market
• Operational Goals
  • Focus on a few strategic topics (like smart home)
  • Promote interoperability
  • Represent all HGI members and influence standards for broadband
HGI’S GOALS FOR SMART HOME ARCHITECTURE & ABSTRACTION LAYER

1. Provide **unified APIs** for application developers to command, control and query home appliances

2. **Independence of underlying HAN technologies** so that an application developer doesn’t need to know anything about Zigbee, Z-Wave, wireless m-bus etc.

3. Enable applications to be **portable** across different HGI compliant devices

4. Enable **extendibility** of the system to support additional HAN technology without service interruption

5. Applications should be able to use a pass-through mechanism to use technology-specific functions
SMART HOME ARCHITECTURE
REFERENCE POINTS

- **RP1** – Device Abstraction Layer
  - The local interface that applications on the gateway use
- **RP2** – Device Driver Interface
  - The interface to integrate HAN technologies
- **RP4** – Remote Interface
  - The interface between an operator cloud platform and the gateway
- **RP7** – Cloud API
  - The interface provided to third parties from the operator cloud platform

RP1 requires a generic model of Smart Home devices. The SDT will provide such models in a platform independent way.

Cloud and Local Applications need to reference Device Information Models
RELATION TO OTHER SMART HOME AND IOT ACTIVITIES

• Every device automation solution and HAN technology makes use of **assumed/defined** models (known properties) for the connected devices, e.g. .
  – UPnP, EchonetLite, EnOcean, DECT ULE, KNX, ZigBee
• Instead of creating a „superset“ of those HAN models, can a modular extensible modeling template be defined to describe almost every device type?
• Unification is also required among other organizations working on device abstraction (e.g. AllSeen Alliance, CENELEC, Eclipse IoT, ETSI SmartM2M, IEEE P2413 IoT Architecture, OpenIoT, Open Interconnect Consortium)
GUIDING PRINCIPLES FOR THE SMART HOME DEVICE TEMPLATE

– Device description is in XML
– Try to avoid becoming too complex
– Mechanism for referencing other definitions required
– Rely on standard XML semantics
  • Description should be a valid XML document
  • Do not introduce additional semantics (e.g. `<import-device id="..."/>`)
  • Use of standard XML tools (parser, XSLT) should be possible
– Identify unit of re-use and abstraction
EXAMPLE MODULE CLASS

BooleanState for modelling underlying binary state

- Provides operations for reading and setting the state

```xml
<ModuleClass name="BooleanState">
  <Doc>…</Doc>
  <Actions>
    <Action name="get" type="boolean">
      <Doc>
        Obtain the current associated state.
      </Doc>
    </Action>
    <Action name="setTarget">
      <Doc>
        Obtain the current associated state.
      </Doc>
      <Arg name="value" type="boolean">
        <Doc>
          Desired value of the associated state.
        </Doc>
      </Arg>
    </Action>
  </Actions>
</ModuleClass>
```
EXAMPLE DEVICE MODULES

Power – candidate for BooleanState

Vendor can define „inline“ proprietary modules
— Simpler – reduces definition effort
— But little abstraction

• Use ModuleClasses to abstract within the domain
• Use standard ModuleClasses to abstract across domains
EXAMPLE DEVICE

A device with a power switch defined by DTAG ...

Details of device discovery to be determined, but device can be used by applications understanding:
- power
- BooleanState

XML Document:

```xml
<?xml version="1.0" encoding="iso-8859-1"?>
<Domain xmlns="http://hgi.org/xml/dal/1.0"
    xmlns:xi="http://www.w3.org/2001/XInclude"
    id="com.telekom">
<Imports>
    <xi:include parse="xml" href="http://hgi.org/dal-core.xml"/>
</Imports>
<Devices>
    <Device id="switch.power">
        <DeviceInfo>
            <Name>PowerSwitch</Name>
            <Vendor>Deutsche Telekom</Vendor>
        </DeviceInfo>
        <Modules>
            ... see previous slide ...
        </Modules>
    </Device>
</Devices>
</Domain>
```
STILL SOME OPEN POINTS
E.g. how to include semantics

Document

```xml
<ModuleClass name="power">
  <extends domain="hgi.dal.core"
           class="BooleanState"/>
</ModuleClass>
```

Vs.

```xml
<Module name="power">
  <extends domain="hgi.dal.core"
           class="BooleanState"/>
</Module>
```

An application needs to not only know about a device’ interface, but also about its semantics, as e.g. a BooleanState could be used for switches, door openers, blinds etc.

Semantics may either introduced on class level, or on concrete device level – to be decided (ModuleClass or Module).
CONCLUSIONS ON THE SDT

- To be approved by participating organizations (e.g. Broadband Forum, HGI, OneM2M, OSGi-A, Eclipse?)
- Template has an informal (text) and a formal section (machine-readable, probably XML based)
- Template is intended to be filled in / instantiated for specific Appliances by domain specific organizations and vendors

HGI defines the XSD template under Apache 2 rules.
SDT WILL BE PUBLISHED UNDER APACHE 2.0 LICENSE

• The SDT is a tool to model device characteristic. It does not contain any technology-specific information.

• HGI publishes only the SDT itself under Apache 2.0 license, no derivatives.

• Anyone who uses the SDT has all commercial flexibility of the Apache 2.0 license.

• SDT contributions must be made using Github
  – Traceability and authenticity of contributions and modifications
  – Similar model to OSGi Alliance

• HGI will publish intermediate results as needed (and approved)

• Any interested party may comment and propose changes

The royalty-free open source license model of the SDT is required to encourage contribution and commenting, and of course usage of the SDT.
WORKING TOGETHER ON THE SDT...

Any unification effort needs to accommodate the end to end value chain of Smart Home services to gain maximum impact.

Joint work on SDT
Map ontology template to OSGi technology
Jointly approaching domain specific organizations (verticals)

Edit and align a SDT
Liaise SDT to domain specific organizations

Operators
OEMs and vendors
Semiconductors

HAN technology owners and vendors

Instantiates SDT with their respective device characteristics

Application and platform developers

Joint work on SDT
Map SDT to BBF TRs (if needed)
Jointly approaching domain specific organizations (verticals)

Instantiates SDT with their respective device characteristics

Application and platform developers

Operators
OEMs and vendors
Semiconductors

Joint work on SDT
Map SDT to specific technologies:
• ETSI M2M REST APIs
• EEBus APIs

Jointly approaching domain specific organizations (verticals)

Application and platform developers

OEMs and vendors
Semiconductors

Application and platform developers

Operators
OEMs and vendors
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FROM SMART HOME DEVICE TEMPLATE TO APIs

• The SDT is a tool to formally specify device type characteristics
  – Current status: SDT is an XML schema

• The SDT then is used to create device models

• The device model XML documents then are used to create platform specific APIs (e.g. OSGi service platform)
  – Means and process are out of scope for HGI

• These APIs must then be implemented for the platform
  – API implementation’s main purpose is to map API invocations to HAN technology specific operations
**PROCESS STEPS AND STAKEHOLDERS**

1. **SDT (XML schema)**
   - HGI RWD050, in a joint effort with OSGi Alliance, OneM2M, Broadband Forum etc.

2. **Device Model (XML document)**
   - To be created by HAN appliance vendors / manufacturers, HAN technology owning organizations like Zigbee Alliance, ULE Alliance, EnOcean Alliance, Z-Wave Alliance

3. **Translation to Platform Specific API (PSA)**
   - To be specified by platform technology owners like OSGi Alliance, OneM2M
   - To be implemented by vendors of platform products
   - For open source platforms (e.g. Eclipse Smart Home, Alljoyn), translation can be specified and implemented by other entities too.

4. **Implementation of the PSA**
   - To be implemented by vendors of platform products
   - For open platforms like OSGi service platform, anyone can implement the API incl. device manufacturers, free programmers
ENVISIONED JOINT WORK W/ ECLIPSE VORTO PROJECT

• First informal information exchange took place
• HGI strongly supports the Eclipse Vorto project, and would appreciate the use of the SDT as Vorto information model basis to avoid yet another modeling method
• HGI also intends to have a formal liaison with Eclipse Foundation regarding IoT topics
• Joint work on the SDT to ensure applicability for Vorto
  – Apache 2.0 license of SDT allows for almost arbitrary use, and also enables anyone to contribute
THANK YOU VERY MUCH

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BACKUP
WHO ELSE CURRENTLY WORKING?
(NOT COMPLETE)

- **AllSeen Alliance**
  - Device/service discovery using RPCs over IP, See [docu. Wiki, Bylaws, IPR Policy](#)
  - Code and IPR under ISC license (like BSD) which is free for non-commercial use
- **Eclipse IoT Information Model Repository**
- **ETSI SmartM2M – Smart appliances ontology project**
- **IEEE P2413 “IoT Architecture”**
  - Define: descriptions various IoT domains and abstractions and device models
- **OpenIoT**
  - based on the W3C Semantic Sensor Networks ontology (ssn), the SPITFIRE ontology (spt) and the LSM vocabulary
- **Open Interconnect Consortium**
  - Certified systems use FRAND, code available under Apache 2.0, v1.0 Nov2014
- ... and more
HOW APPLICATIONS CAN „KNOW“ HOW TO ACT ON REAL APPLIANCES

Model real world appliances as descriptive structures

XML instance

```xml
<Modules>
  <Module name="proprietaryPower">
    <Actions>
      <Action name="on"/>
      <Action name="off"/>
      <Action name="state" type="string"/>
    </Actions>
  </Module>
  <Module name="power">
    <extends domain="hgi.dal.core"
           class="BooleanState"/>
  </Module>
</Modules>
```

Washing Machine
HOW APPLICATIONS CAN „KNOW“ HOW TO ACT ON REAL APPLIANCES

Model real world appliances as descriptive structures

Washing Machine

Appliance

XSD Template (Collection)

XML instance

Option A

Option n

XSD „module_1“

XSD „module_2“

binary
timestamp
real
enum
Msg-string

Option A

Option n

Option A

Option n

XML

<Modules>
  <Module name="proprietaryPower">
    <Actions>
      <Action name="on"/>
      <Action name="off"/>
      <Action name="state" type="string"/>
    </Actions>
  </Module>
  <Module name="power">
    <extends domain="hgi.dal.core" class="BooleanState"/>
  </Module>
</Modules>