Configuring eHome Systems

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Outline

- Terms and Motivation
- Component based Frameworks
- eHomeConfigurator
- Functionality Configuring
- Conclusion/Outlook
Results/Conclusion

Functionality Configuring eHomeConfigurator

Frameworks

eHome

Motivation

Distributed IP-based Service Platform

Residential Gateway (HW)

Service Gateway (SW)

Open-Closed-Sensor

Thermometer

Ammeter

Photo Sensor

Rollerblind

Heater

Lamp

USB

Camera

Siren

Motion Detector

Camera

Lamp

X10

Motion Detector

Multi-User

Interface Devices

Provider (remote)

Digital Content

Applications

Services

Infotainment

Security

Consumption

3/19

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Top Level Services

- **Lighting**
  - usual light control based on switches and buttons

- **Lighting Motion**
  - light control with movement sensors

- **Security**
  - intrusion detection, local alarm, notification

- **Music Follows Person**
  - person detection -> corresponding music

- **All On/ All Off**
Environments
Environments

- X10
- USB-Webcams
- person detection via switch panel
- EIB
- person detection via RFID
- own cleware USB Lego controller
- person detection via color of Lego puppets

Motivation
Frameworks
eHomeConf
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Results/Conclusion

26.01.2007
Motivation Configuring-Support
Motivation Configuring Support
Motivation Configuring-Support
Development Process
Repetitive development to repetitive configuring

Needs:
- Reusability
- Configurability
-> Component based Development
Simple Security Service

- Intrusion via X10 movement detectors
  - siren attached to X10 switch
  - email message with picture from webcam
Component based Frameworks

- Manual coding of simple security service on various frameworks:

<table>
<thead>
<tr>
<th>Framework</th>
<th>Drivers</th>
<th>Services</th>
<th>Glue</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jini</td>
<td>5793</td>
<td>1249</td>
<td>548</td>
<td>7590</td>
</tr>
<tr>
<td>Rio</td>
<td>3226</td>
<td>665</td>
<td>915</td>
<td>4806</td>
</tr>
<tr>
<td>Openwings</td>
<td>7191</td>
<td>1819</td>
<td>13720</td>
<td>22730</td>
</tr>
<tr>
<td>OSGi</td>
<td>3794</td>
<td>826</td>
<td>356</td>
<td>4976</td>
</tr>
</tbody>
</table>

- In this case approx.: 4000 LOC/ month
- too much for mass deployment
- Further testing on OSGi
- Configuring support needed
eHomeConfigurator - Specifying

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10/19
eHomeConfigurator - Specifying

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Security Service
Id: 14
Type: top
URL: ehsecurity.jar

Requires (1)
requires (1)
requires (1)
intrusion
alarm
alarm activation
eHomeConfigurator - Specifying eHome Systems

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Configuration Meta Model

Java code for model and graph-specification is generated with Fujaba via MDA-methods.
eHomeConfigurator - Configuring

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Results/Conclusion
Functionality Configuring

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eHomeConfigurator - Configuring

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Please select which services you want to install in your eHome, their default strategies concerning the room selection and the strategies concerning the installation of additional devices.

Furthermore, please note that you will be able to select and deselect each room individually later on in this wizard.

Dependent services will be installed automatically!

<table>
<thead>
<tr>
<th>Service</th>
<th>Install</th>
<th>Select All Locations</th>
<th>Necessary Devices</th>
<th>Required Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Security Service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>All Off Service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>All On Service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Music Follows Person</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Light Motion Service</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stop
Next
eHomeConfigurator - Configuring eHome Systems

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eHomeConfigurator - Configuring

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You can now tweak the room selection for each service by individually selecting and deselecting each location of your eHome.
When you're finished, please push the next button to run the automatic configuration process and configure your eHome system.

Below you will find a list of all locations and the services which are running in them. After selecting one of those services, a list of the directly controlled devices will be displayed, as well as alternate services.
To swap the service in the selected room, simply push the 'swap' button.
In order to replace all instances of the service, push the 'swap all' button.
Please note that it might not be possible to swap the service in every room since it might interfere with other services running there. These rooms will be left out.
Results/Conclusion

EHomeConfigurator - Configuring

EHome Configurator - Configuring eHome Systems

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Result Configuring: Appliances

[Diagram of a software interface with various appliances and devices configured within different rooms.]

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Results/Conclusion
Result Configuring: Deployment
Result Configuring: Deployment
Functionalties/ Semantic Labels

- alarm
  - refines email
  - refines acoustic
  - refines visual

- alarm.email
- alarm.acoustic
- alarm.visual

- Sufficient for functionality composition
- Interface matching not covered
Functionality Configuring

Visual Alarm Service
Id: 11
Type: composition
URL: ehvisualalarm.jar

provides (-1) requires (1)

visual

Illumination Control Service
Id: 3
Type: composition
URL: ehilluminate.jar

provides (-1) optional (1) requires (1)

illuminate

control lamp

Lego Lamp Control
Id: null
Type: null
URL: ehlegolampcontrol.jar

controls

provides (-1)

Lego Lamp
Man.: uno

control lamp

X10 Lamp Control Service
Id: 1
Type: elementary
URL: ehx10lampcontrol.jar

controls

provides (-1)

X10 Lamp Socket
Man.: Marmitec

control lamp

X10

Motivation

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Functionality Configuring

Visual Alarm Service
Id: 11
Type: composition
URL: ehvisualalarm.jar

Illumination Control
Service
Id: 3
Type: composition
URL: ehilluminate.jar

Visual Alarm Service - object
uses
Illumination Control - object
uses
Lego Lamp Control - object
controls

Lego Lamp Control
Id: null
Type: null
URL: ehlegolampcontrol.jar

Lego Lamp Control
Man.: uno

Lego Lamp
Man.: uno

Visual Alarm Service

Illumination Control
Service

control lamp

control lamp

control lamp

control lamp

X10 Lamp Control
Service
Id: 1
Type: elementary
URL: ehx10lampcontrol.jar

X10 Lamp Socket
Man.: Marmitec

legodemo

control lamp

control lamp

controls

provides (-1)

requires (1)

controls

provides (-1)

requires (1)

controls

provides (-1)

requires (1)

provides (-1)

requires (1)

provides (-1)

requires (1)

provides (-1)

requires (1)
Service-Installation

For all top level services do
1. instanciate ServiceObject
2. devices (appliances)
3. do composition
4. install new services
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Service-Installation

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- X10 Switch Panel
  - House Code: 1 - attribute

- Bedroom
  - has serv. object
  - has selected

- Lighting Service
  - is instanciated as
  - contains

- Illumination Control
  - uses

- Switch Panel Selector
  - uses

1. instanciate ServiceObject
2. devices (appliances)
3. do composition
4. install new services
Service-Installation

For all top level services do
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Motivation
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### Implementation Effort eHomeConfigurator

#### Simple Security in eHomeConfigurator

<table>
<thead>
<tr>
<th>Service</th>
<th>Logic LOC</th>
<th>Glue LOC</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ehsecurity</td>
<td>158</td>
<td>100</td>
<td>258</td>
</tr>
<tr>
<td>ehilluminate</td>
<td>144</td>
<td>107</td>
<td>251</td>
</tr>
<tr>
<td>ehintrusiondetector</td>
<td>117</td>
<td>101</td>
<td>218</td>
</tr>
<tr>
<td>ehemail</td>
<td>80</td>
<td>110</td>
<td>190</td>
</tr>
<tr>
<td>clewarecontrol</td>
<td>253</td>
<td>126</td>
<td>379</td>
</tr>
<tr>
<td>ehlegomovementdetector</td>
<td>137</td>
<td>100</td>
<td>237</td>
</tr>
<tr>
<td>ehlegomotioncontrol</td>
<td>320</td>
<td>127</td>
<td>447</td>
</tr>
<tr>
<td>ehlegolampcontrol</td>
<td>144</td>
<td>140</td>
<td>284</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1353</strong></td>
<td><strong>911</strong></td>
<td><strong>2264</strong></td>
</tr>
</tbody>
</table>

- Saving > 50 %
- all components reusable
- integrated service usually 2 days
- still too much gluecode (metafile errors!)
Conclusion/ Outlook

- simplification of eHome system software development needs:
  - component based programming
  - configuring support
    - regard semantic aspects

- future work
  - parametric contracts replacing function labels -> capture more semantics
  - glue code reduction