Politecnico di Torino

Master degree in
Computer Engineering

Context Aware and Device Dependent Interaction in Smart Environments

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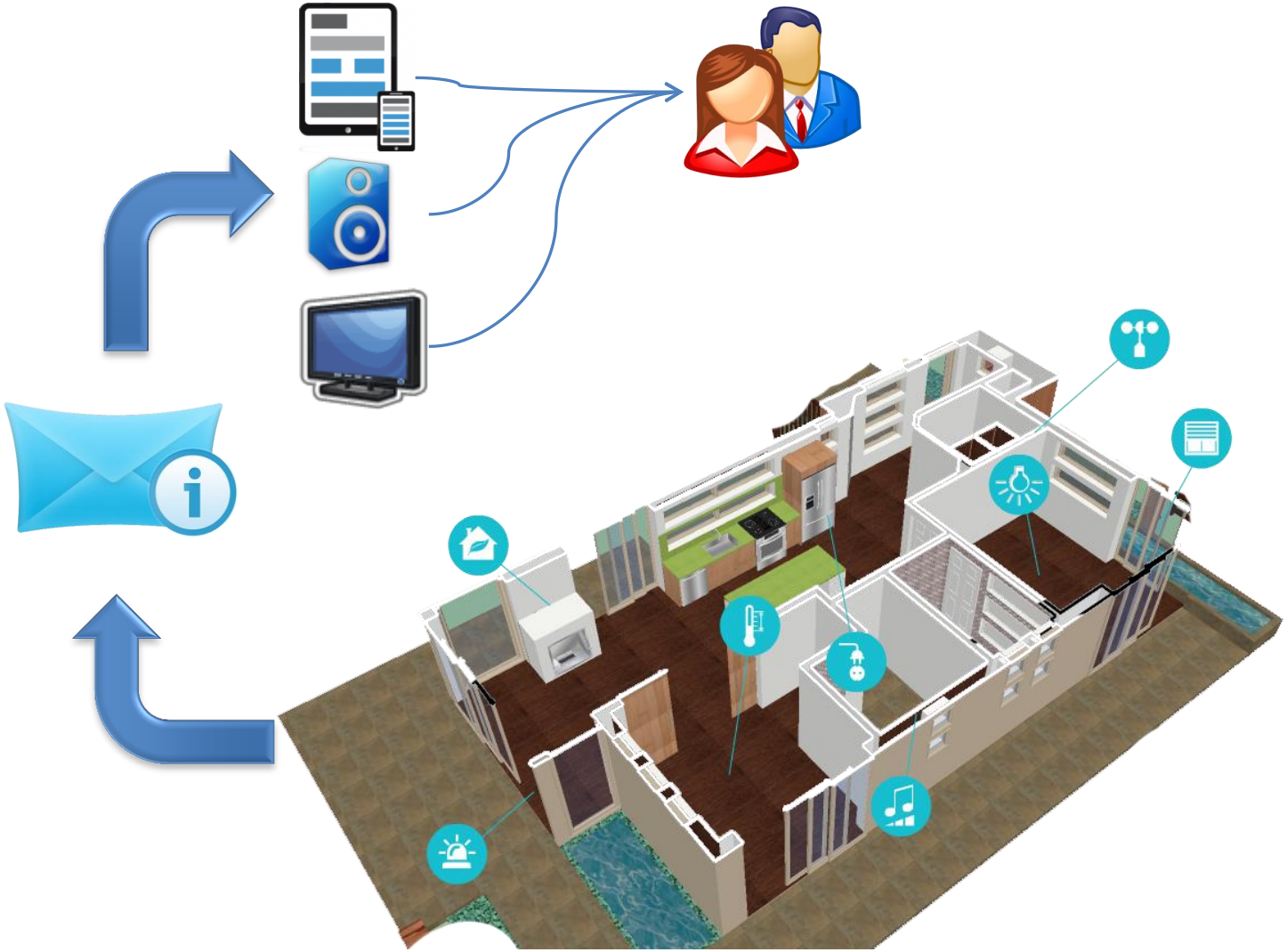
Outline

- Introduction
- Thesis work
  - Data Modelling
  - Software Development
- Scenario Test Case
- Conclusions

Goal:

- An intelligent notification system for smart homes
- Take into account the surrounding context to select end user devices and send them generated messages



Steps:

- create a data modelling infrastructure able to represent information about the context (domain of interest)

- develop a software to elaborate data model information and deliver house related messages to the appropriate end users device

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Data Modelling

Data Modelling

- Definition of the Domain of Interest
  - Users
  - User Devices
  - Smart Home
  - Message Categories

- Ontology-Based Modelling
- Exploration of existing ontology for contex modelling

Notont
the Notification Ontology

- 4 directly imported ontologies
  - Locont
  - Device
  - DogOnt
  - Core
- 27 overall imported ontologies
- 1385 classes

Notont – User Modelling

- Activity (e.g. eating, sleeping)
- Accessibility (e.g. freeable_hands)
- Location (e.g. livingroom, kitchen)
- Obtrusiveness (e.g. mobile_only, no_audio)
- End-User-Devices (e.g. smartphone, tablet)
- Message Categories (e.g. AppliancesAlert)

Notont – Device Modelling

- Physical Features (e.g. screen size, camera)
- Capabilities (e.g. audio and video reproduction)

Notont – House Modelling

- Architectural aspects (e.g. wall, window)
- Appliances (e.g. oven, HVAC system)
- Devices (e.g. smart tv, HiFi system)
- Furniture (e.g. couch, table)

Notont – Message Category Modelling

- Priority (e.g. lower_level, highest_level)
- Attributes (e.g. min_temperature_value)

Notont – Information modelling

- Information as Class instance
- Instance data properties
- Connections by means of object properties
  - A single .owl file as data model

Scenario Test Case

- 2 users (Luca, Giulia)
- 3 devices (LG Nexus 4, Samsung Galaxy Nexus, Samsung Galaxy Tab 10”)
- 1 smart home (temperature and humidity sensors, smart plugs, door sensors,Hifi system)
- 6 message category (EnvironmentalComfort, PowerOverThreshold, EnergyManagement, AppliancesUsage, AppliancesAlert, SecurityAlert)

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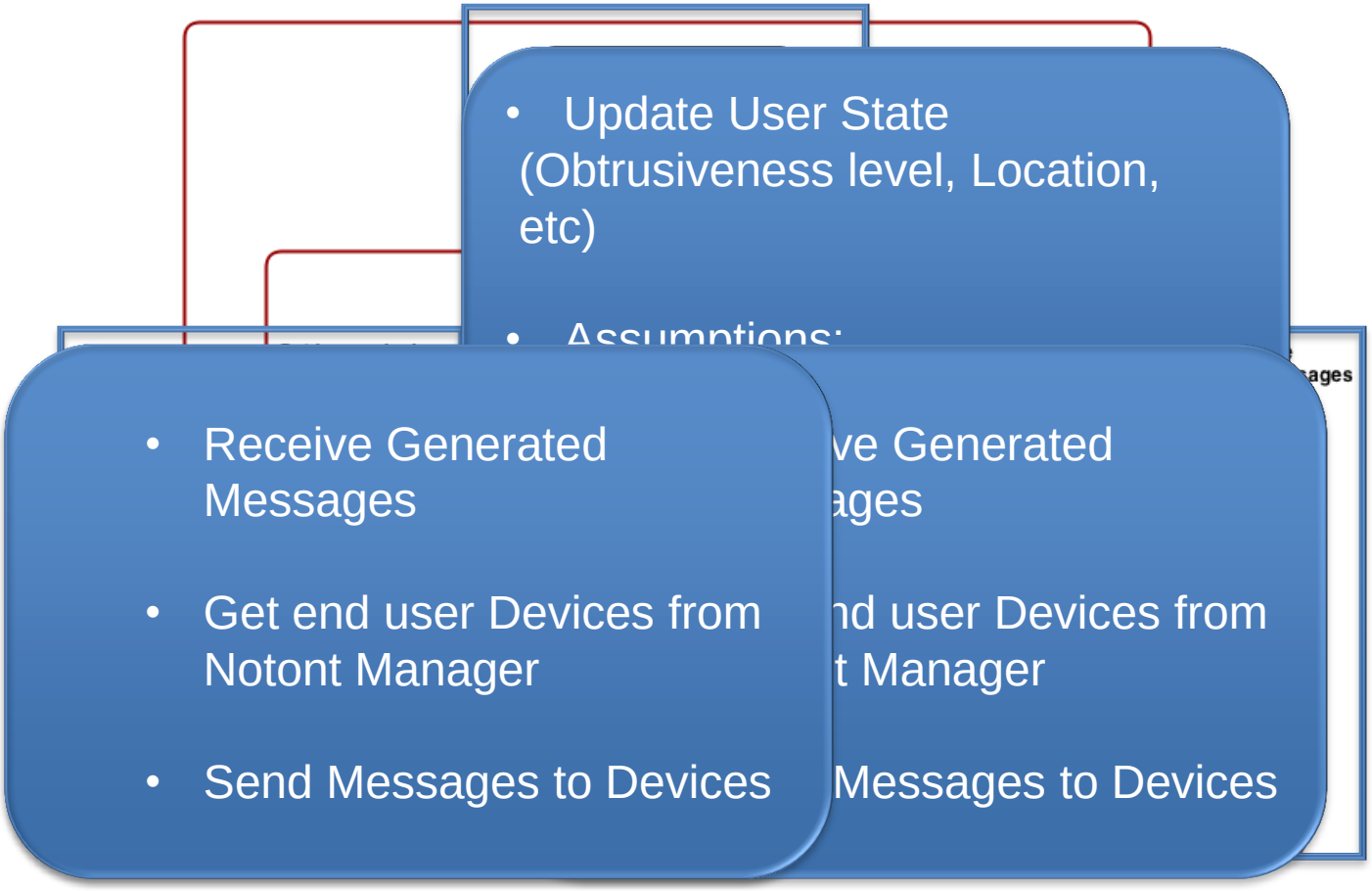
Software Development

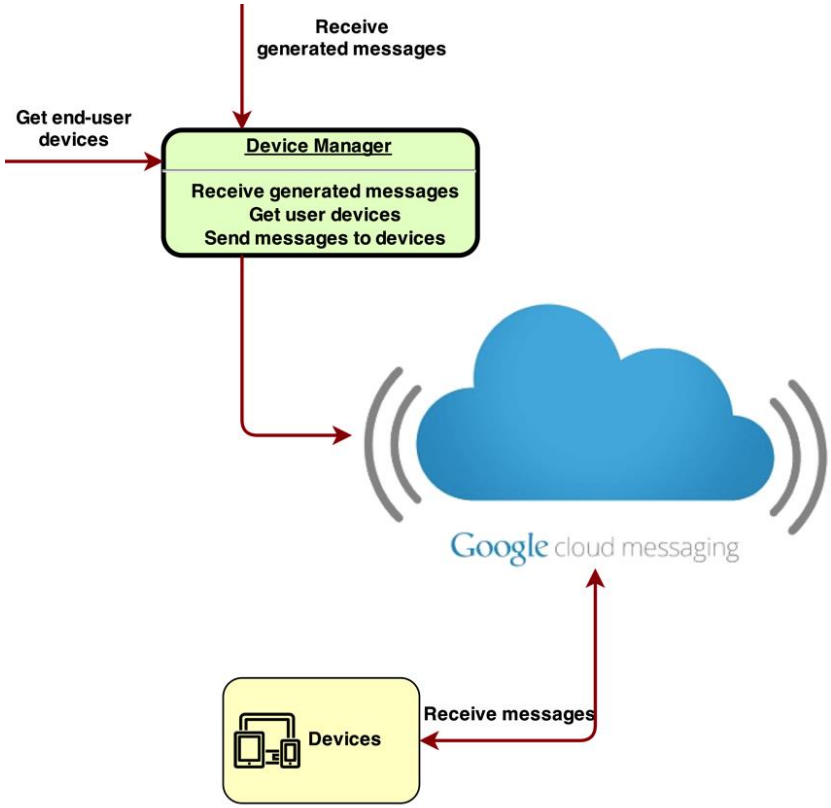
Software Development

- Data Model Management
  - Notont Manager
- User Interfacing
  - UserManager
- House Interfacing and Message Generation
  - House Message Manager
- Device Message Delivery
  - Device Manager

NINS: Notont-based Intelligent Notification System



NINS – Device Manager



- Android – Based Devices
- Gcm Service
- Mobile application on Devices

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Scenario Test Case

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Video

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Conclusions

Conclusions

- Notont – Notification Ontology
  - Formal representation of context information in Smart Environments
  - Inferring of the most suitable end user device
- NINS – Notont-based Intelligent Notification System
  - Data model Management
  - House and User interfecing
  - Sending messages to devices

Future Works

- Test in a real home setting
- Usage of the context to infer “how” send a message to end users devices
- Increase supported devices

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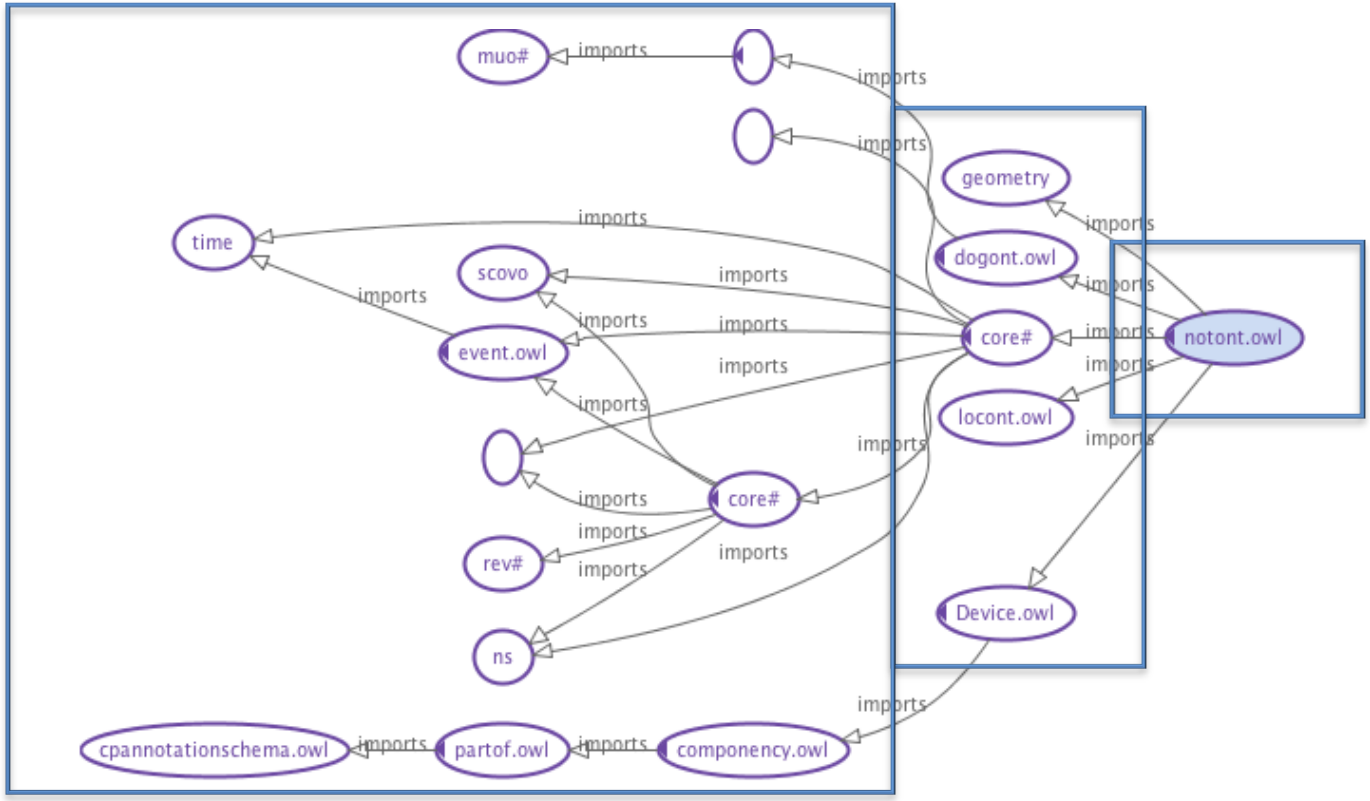
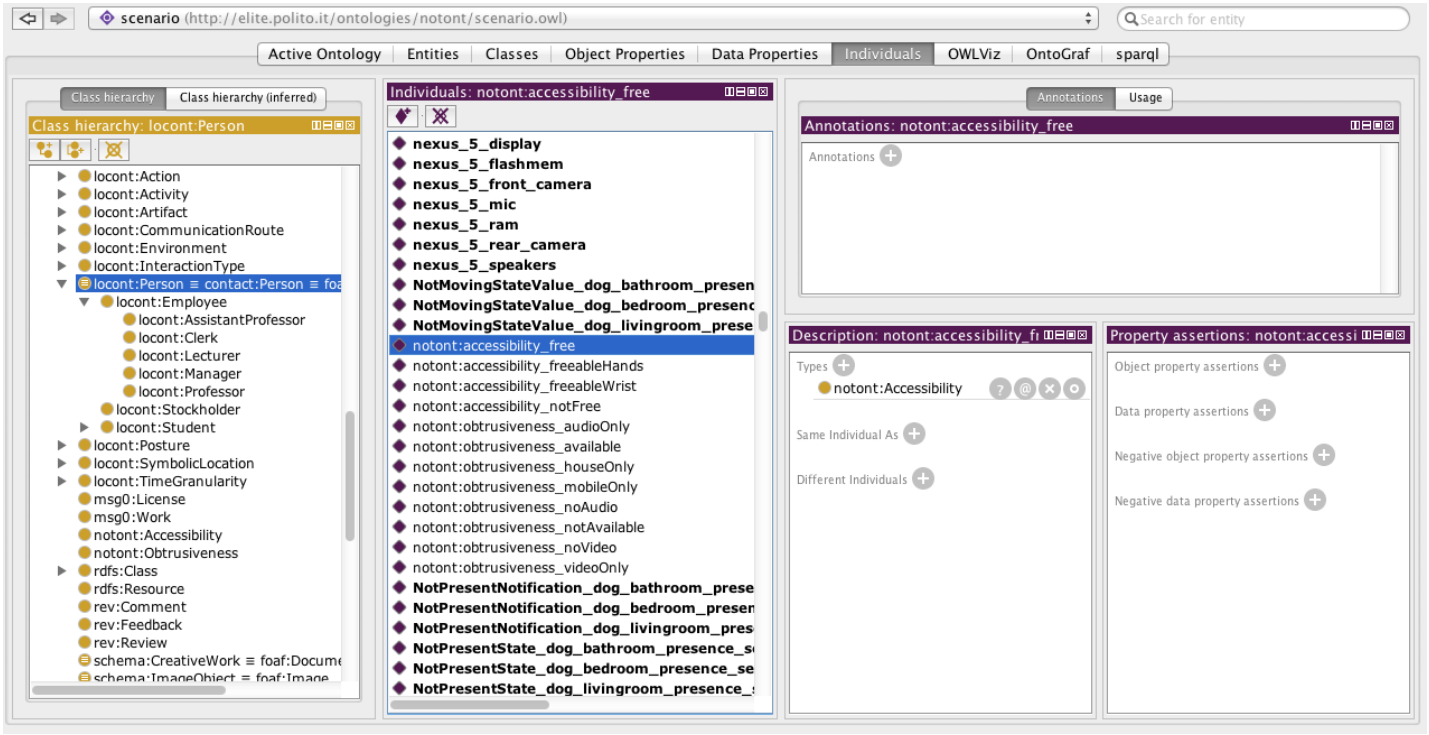
Thank You!

Notont
the Notification Ontology



Notont & scenario modelling



Scenario: Giulia modelling

```
<!-- http://elite.polito.it/ontologies/notont/scenario.owl#giulia -->
    <owl:NamedIndividual rdf:about="&scenario;giulia">
        <rdf:type rdf:resource="&locont;Employee"/>
        <foaf:birthday rdf:datatype="&xsd;date">1987-02-26</foaf:birthday>
        <foaf:familyName rdf:datatype="&xsd;string">Brambilla</foaf:familyName>
        <foaf:firstName rdf:datatype="&xsd;string">Giulia</foaf:firstName>
        <foaf:nick rdf:datatype="&xsd;string">Giuly</foaf:nick>
        <notont:hasObtrusivenessLevel rdf:resource="&notont;obtrusiveness_available"/>
        <core:preference rdf:resource="&scenario;AppliancesAlert"/>
        <core:preference rdf:resource="&scenario;AppliancesUsage"/>
        <core:preference rdf:resource="&scenario;EnvironmentalComfort"/>
        <core:preference rdf:resource="&scenario;SecurityAlert"/>
        <locont:hasCurrentActivity rdf:resource="&scenario;activity_giulia"/>
        <locont:hasCurrentSymbolicLocation rdf:resource="&scenario;kitchen"/>
        <locont:usingArtifact rdf:resource="&scenario;galaxyTab"/>
        <locont:usingArtifact rdf:resource="&scenario;nexus4"/>
    </owl:NamedIndividual>

   <!-- http://elite.polito.it/ontologies/notont/scenario.owl#activity_giulia -->
    <owl:NamedIndividual rdf:about="&scenario;activity_giulia">
        <rdf:type rdf:resource="&locont;Eating"/>
    </owl:NamedIndividual>
```

Query the model – Giulia's activity

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX locont: <http://webmind.dico.unimi.it/CARE/locont.owl#>

SELECT ?activity ?activityType  WHERE {

?person foaf:firstName "Giulia"^^xsd:string.
?person locont:hasCurrentActivity ?Activity.

?activity rdf:type ?activityType.
?activityType rdfs:subClassOf* locont:Activity.
}
```

Android user application