A Privacy-Aware Localization Service for Healthcare Environments

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Overview

- Motivation and Idea
  - Data Owner controlled privacy policies
  - KopAL System and Requirements

- Policy languages for localization data

- Conclusion and Outlook
A Privacy-Aware Localization Service

Motivation and Idea
Privacy Definition:

“...the right of individuals to determine for themselves when, how and to what extent information about them is communicated to others.”

P. Ashley and G. Karjoth, 2003
Controlling Data Access Policies

**Data User controlled Policies**

- The **Data User** specifies and publishes the access and use policy for private data.
- The **Data Owner** has to trust this policy and releases his/her data.

**Data Owner controlled Policies**

- The **Data Owner** specifies the access and use policy for data.
- The **Data User** enforces this policy.

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**Data Owner**

<table>
<thead>
<tr>
<th>Privacy Promise</th>
<th>Data User</th>
<th>Data Owner</th>
<th>Data User</th>
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<tbody>
<tr>
<td>Private Data</td>
<td></td>
<td>(Private Data) policy</td>
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KopAL: Assistance for Patients with Dementia

- KopAL has been introduced by Sebastian Fudickar (PETRA2011, Workshop 1)
  - Electronic assistance for patients suffering from dementia
  - Emergency call function
  - Speech-based appointment reminder
  - Developed at Potsdam University, Germany
    http://www.cs.uni-potsdam.de/bs/research/al/index.html
KopAL: Assistance for Patients with Dementia

- Localization function in KopAL:
  - Localization of patients that have lost orientation
  - Notification of nursing staff about dangerous patient movement
  - Localization of lost or misplaced devices (requested by staff)
Data Privacy for Location Services

**Question:** How can the sensitive private location data of a patient be protected in the presence of different actors?

- Sensitive data stored as semi-structured XML-Documents
  - Location data
  - Access Policy
- (Distributed) Access Control Framework
  - Requests to resources must be evaluated at time of resource access
  - Deployment of trusted infrastructure
- Automated enforcement of authorisations

Data Privacy = Access Control + Usage Control
Workflow for Localization Assistance in KopAL

- Integrated management of access rights via Sticky-Policies
- The protected data are stored together with the usage policies as a Sticky Policy Object and can be referenced anytime by the system
Data Privacy for Location Services

Use-case requires predefined Policy-Set:

- **No access**
  - Position updates are not send and stored

- **Emergency only**
  - Position updates are send
  - Caretaker can access location if ‘Emergency Button’ is pressed on the device

- **Restricted access**
  - Position updates are send
  - Caretaker can access location to find misplaced device  (logging required?)
  - Caretaker is informed when person enters critical regions
Sticky Policies

- The Policy-Store holds:
  - Meta Policies
  - User-generated Policies

- Application data about the patient includes:
  - User-ID
  - Positioning Algorithm

- The Location-Update contains information about:
  - Location Data
  - Timestamp

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<th>Policy-Protected Location Update</th>
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<tr>
<td>Policy</td>
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<tr>
<td>Meta Policies</td>
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<td>User Specific Policies</td>
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<th>Location-Update</th>
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<tr>
<td>Location Data</td>
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<td>Localization Info</td>
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<td>Timestamp</td>
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A Privacy-Aware Localization Service

Policy Languages for Localization Data
- eXtensible Access Control Markup Language (XACML) developed by OASIS, current version 2.0
- Generic Policy Language, as well as Request/Response Language
Geopriv – Common Policy

- Developed by the Geopriv WG of the IETF, RFC 4745
- Targeted Policy Language for expression of localization policies
(Some) characteristics of Geopriv:

- Only positive authorisation rules allowed
- Complete ruleset needs to be evaluated
- No ability to explicitly specify purposes for data-use in policies
- Targeted expressions for location transformation (obfuscate, reduce precision, …)
- Policy combining is narrowly defined (generates the union over the matching permissions in the rule-set, returning the maximum value across the permission-set)

- Currently no known implementations
Location data object:
- Send periodically every 30 seconds
- Server only stores a short history of values
- Every location update contains complete policy
- Location update is encrypted using RSA
A Privacy-Aware Localization Service

Conclusion and Outlook
Conclusion

- Privacy friendly design
  - Coarse localization pattern
  - Short data retention periods
  - Policy protected data

- Minimal intrusion upon the user
  - Set up once, continuous protection
  - Patients can change their policy settings

- Extensions are under evaluation:
  - Invite other patients to signal presence
  - Use localization data to place reminders on wall terminals
  - ... (limited by patient needs)
A Privacy-Aware Localization Service

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