Data Usage Control in Smart Farming

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May 08, 2014
Geospatial World Forum, Geneva, Switzerland
Fraunhofer Gesellschaft

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Applied Research in Software Engineering:

- Bridging the gap between University and Industry
- Application-oriented basic research
- Contract research for industry (and government)
Farming Tomorrow – It Becomes Smart
Farming Tomorrow –
It Becomes Smart

- Physical objects become a digital life (things, living objects (Plants, Animals), people)
  - produce data (by observation using sensors)
  - have a history (enabling prediction)
  - are influenced by data (using actuators)
    - context-dependent and location aware
    - in real time and across software system borders

- Innovations tomorrow mainly achieved by
  - Interconnected and integrated software systems
  - Data is one of the most valuable assets

→ Smart Farming
Living Lab Smart Farming
A Testbed for Smart Farming Research

Software Engineering Live Monitors

Agricultural Diorama

User Interaction Panel

Configuration Panel
Living Lab Smart Farming
Interconnected Software Systems

Applications
- Farm Management System

Platforms / Infrastructures
- Context Broker
- FloRLP
- IND2UCE Android
- Policy Management Point
- Weather Data

Users / Stakeholders
- Farmer
- Legal Authority
- Obstacle
- Operator
- Person
- Standardization Body

Vehicles
- Harvester
- Husky Robot
- Mower
- Virtual Tractor

Sensors
- Camera Tracking
- GPS Tracking
- Weather Sensors

Implements
- Hayrake

Mobile
- Growers Notebook
- Harvesting
- Remote Control

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Why Usage Control?

**Sensitive Data** in business
- Intellectual property
- Business data
- Personal data
- Geospatial data

**Data leaks**
- damage business reputation
- cause financial losses (e.g. Sony PlayStation credit card incident)

What happens after data is released?
Data Usage Control

- **Usage control** for data is required
  - **Access control is not enough!**
  - Fine-grained policies specify how data is handled **after access has been granted**
  - Enables compliance with privacy, auditing, and accountability regulations (e.g., EU Data Protection Directive, or Sarbanes–Oxley Act)

- **Keep control over your data**
  - after initial access was granted
  - after data left the origin system
  - across system borders
USAGE Control

AC rules concerning past and present

Restrictions on future data usage

Provisions + Obligations = Usage Control
Usage Control

- **Tracking of data flow**: “Do not redistribute account information”

- Additional **information sources** (e.g. context): “data can only be displayed on company’s premises”

- **Expressive Policy Language (OSL)**
  - **Cardinality** operators: “data can be read only twice“
  - **Temporal** operators: “data must be deleted after one month”
Example: Usage Control Policy

```
<paramMatch name="target" value="10.128.14.157" />
<paramMatch name="taint" value="16" type="dataUsage" />
<paramMatch name="data2" value="details=Harvesting" type

</trigger>

<condition>
  <not>
    <repMax limit="1">
      <true/>
    </repMax>
  </not>
</condition>

<authorizationAction name="default">
  <inhibit />
</authorizationAction>

<executeAction name="notify">
  <parameter name="msg" value="Upload to FloRLP is only all
  <parameter name="level" value="3" />
</executeAction>

<executeAction name="notify">
  <parameter name="msg" value="requirements$externalmonitor$co
  <parameter name="level" value="7" />
</executeAction>

<executeAction name="notify">
  <parameter name="msg" value="architecture$externalmonitor$co
  <parameter name="level" value="7" />
</executeAction>

<executeAction name="notify">
  <parameter name="msg" value="security$externalmonitor$co
  <parameter name="level" value="7" />
</executeAction>
```
Example: Harvesting Data

Usage of business data is protected!

Opened the file "130219-151201_CeBIT 2013 Field.txt" as utf-8/lf (for Linux/Android).
Data Usage Control Framework

*Enforcement for all layers of abstraction*

- Challenges:
  - Distributed Policy Evaluation
  - Centralized Policy Management
  - Context-awareness
  - Usable policy specification
  - Model-based usage control engineering
Data Usage Control Framework
Key Takeaways

Mission Accomplished!
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