Designing Privacy-Aware Social Networks: A Multi-Agent Approach

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1. Why Privacy? (1)

- March 20, 2010
- Keri and Kurt, New Albany, Indiana, U.S.A.¹

- Nashua, New Hampshire, U.S.A.
- Victor Rodriguez, Mario Rojas and Leonardo Barroso
- 50+ break-ins
- > $100,000 ²

1. Why Privacy? (2)

Raising awareness about over-sharing
Please Rob Me
Check out our guest blog post on the CDT website.

I Can Stalk U
Raising awareness about inadvertent information sharing
2. Contextual Integrity

- H. Nissenbaum [Nissenbaum, 09]
- Privacy norms vary across and within social groups
- Contexts:
  - Roles
  - Activities
  - Norms
  - Values (or goals)
- Overlapping contexts
- Context-relative informational norms
  - Contexts, actors, attributes, transmission principles
3. PrivaClAS (1)

Privacy preservation in open and decentralized communities
[Krupa & Vercouter, 12]
3. PrivaCIAS (2)

Privacy preservation in open and decentralized communities

[Krupa & Vercouter, 12]

- **Privacy Enforcing Agent**
  - Social network layer
  - Privacy violation detection layer
  - Privacy enforcement layer

- **Privacy Enforcing Norms (PENs)**
  1. Respect the Appropriateness Laws.
  2. Sign the transmission chain before sending a message.
  3. Do not send information to distrusted agents.
  4. Delete information from violating or distrusted agents.
  5. Punish agents violating this norms (this one excluded).
3. PrivaCIAS (3)

Privacy preservation in open and decentralized communities

[Krupa & Vercouter, 12]

**Privacy Enforcing Agent**

- Social network layer
- Privacy violation detection layer
- Privacy enforcement layer

**Appropriateness Laws (A-Laws)**

1. *The transmission context corresponds to the nature of the transmitted information.*
2. *The users involved in the transaction enact roles in the transmission context.*
3. *Receiving users do not have incompatible relationships with the target.*
4. *The target’s preferences (policies) are respected.*
4. Incompatible Relationships (1)

- *Relationship*: the sum of all aspects defining the interaction in all overlapping contexts between two individuals

- *Relationship incompatibility*: conflict between two or more overlapping contexts
4. Incompatible Relationships (2)

*Defining Contexts*

- Moise organisational model [Hubner et al, 07]
- Structural dimension
  - *Roles*
  - *Links*
    - $l = \langle s, d, t, b \rangle$
    - *authority, communication, acquaintance*
    - Dynamic acquaintance links
- Normative dimension
  - Information types
  - $n = \langle l, l', d, dm \rangle$

$$C = \langle s, R, L, I, N \rangle$$
4. Incompatible Relationships (3)

Defining Contexts

Figure 1. A medical context.

Figure 2: Overlapping contexts.
4. Incompatible Relationships (4)  

Detecting Conflicts

• Permission, obligation
• Prohibition: defined by omission

• Given a transmission between 2 agents, we define conflicts:
  – given the users are connected through an authority link in one context and through a communication link in another, if the transmission is prohibited in the former context (i.e. on the authority link) and is permitted in the latter, a first degree conflict is triggered;
  – given the users are connected through communication links in two different contexts, and in one context the transmission is obliged, while in the other it is prohibited, a second degree conflict is triggered.
4. Incompatible Relationships (5)

The \((\text{target}, \text{receiver})\) relationship

- Given transmission \(t\)
- For all \textit{known} overlapping contexts
  - there is at least one such known context in which the target and the receiver enact roles connected through a communication link;
  - there is no such context in which transmission \(t\) is made on an authority link and is prohibited (includes checking for first degree conflicts);
  - given a second degree conflict between the target and the receiver, the total number of contexts that support \(t\) (\textit{i.e.} in which \(t\) is permitted) is greater than the total number of contexts in which \(t\) is prohibited.
5. A Photo-Sharing Social Network (1)

- Agent technologies:
  - Jason [Bordini et al, 07], CArtAgO\(^1\), Moise (JaCaMo)\(^2\)
  - JaCa-Android\(^3\)

![Diagram of PrivaCIAS Photo-Sharing Social Network for Android](http://cartago.sourceforge.net)

![Diagram of PrivaCIAS Photo-Sharing Social Network for Android](http://jacamo.sourceforge.net)

![Diagram of PrivaCIAS Photo-Sharing Social Network for Android](http://jaca-android.sourceforge.net)

Figure 3: The PrivaCIAS Photo-Sharing Social Network for Android.

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\(^1\) [cartago.sourceforge.net](http://cartago.sourceforge.net)

\(^2\) [jacamo.sourceforge.net](http://jacamo.sourceforge.net)

\(^3\) [jaca-android.sourceforge.net](http://jaca-android.sourceforge.net)
5. A Photo-Sharing Social Network (2)

The PrivaCIAS Node

Figure 4: The PrivaCIAS Node organization.
5. A Photo-Sharing Social Network (3)  

The PrivaCIAS Android App

Figure 5: The PrivaCIAS Android App.

Figure 6: A privacy violation warning.
6. Evaluation (1)

- Context knowledge decentralization
  - Public vs. private contexts
  - Sharing knowledge among roles inside a private context
  - Sharing knowledge with individuals inside/outside a private context

- Automatic conflict detection

Figure 7: Detecting conflicts.
6. Evaluation (2)

• First and second degree conflicts
  – *First degree conflicts*: emphasize the sensitiveness of a relationship
  – *Second degree conflicts*: emphasize the receivers of some given information

• The PrivaCIAS Photo-Sharing Social Network
  – Proof of concept application for the PrivaCIAS framework
  – JaCaMo
  – All the basic features of a social networking service
7. Conclusions

- Social contexts come in great variety and evolve over time
- Proactive approach for detecting incompatible relationships
- Developed a real-life photo-sharing social network
- Shift the burden of privacy preservation to organization designers
- Developing applications that improve user experience in social networks has already proven to be a market in itself
Thank you!

Q&A
References


