Preserving User Privacy from Third-party Applications in Online Social Networks

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Agenda

• Privacy Issues of 3rd-party Apps
• Countermeasures
• Access Control Framework
• Policy Model
• Conclusions

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Privacy Issues

• An all-or-nothing policy for application-to-user interactions
  – User has to grant the app *full* access, even if the app only needs partial data

• Users are not aware of the application’s real needs
Privacy Issues (cont.)

- Coarse-grained opt-in/out privacy control does not let user specify policies for each piece of data.
- Some permissions are given by user’s friend who installed the app, without user’s knowledge.
## Countermeasures

<table>
<thead>
<tr>
<th>Summary</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Generalization</td>
<td>Convert private data to a privacy-nonsensitive form</td>
<td>Have been widely accepted in recent solutions</td>
</tr>
<tr>
<td><strong>User-specified Privacy Preference</strong></td>
<td>Allow user to express their preference more flexibly</td>
<td></td>
</tr>
<tr>
<td>Communication Interceptor</td>
<td>Intercept requests, exert user preferences, and return sanitized or dummy data</td>
<td>Lose functionality and integrity</td>
</tr>
<tr>
<td>Information Flow Control</td>
<td>Confine app execution and mediate information flow</td>
<td>Enable post-authorization</td>
</tr>
<tr>
<td><strong>User-to-application Policy Model</strong></td>
<td>Provide a complete policy model for users to define, use and manage their own policies</td>
<td></td>
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Goal

• Protect inappropriate exposure of users’ private information to untrusted 3\textsuperscript{rd} party apps

• Propose an policy model for controlling application-to-user activities
  – More flexible
    • further utilize the relationships and the social graph in OSN
  – Finer grained
    • e.g., per resource vs. per resource type, distinction of different types of access

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Framework Overview

• Prevent applications from learning user’s private information while still maintaining the functionality
• Leave private information within OSN system and allow external servers of applications to retrieve non-private data

<table>
<thead>
<tr>
<th>Data Classification</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>unnecessary &amp; private</td>
<td>do not permit</td>
</tr>
<tr>
<td>unnecessary &amp; non-sensitive</td>
<td>user’s choice</td>
</tr>
<tr>
<td>essential &amp; non-sensitive</td>
<td>transmittable outside of OSN</td>
</tr>
<tr>
<td>essential &amp; private</td>
<td>processable within OSN</td>
</tr>
</tbody>
</table>
Proposed Architecture

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Application Components

• Internal component
  – High trustworthy; can handle private data
  – Can be provided by OSN and 3rd-party entities

• External component
  – Provided by 3rd-party entities
  – Low trustworthy; cannot consume private data
Communications

<table>
<thead>
<tr>
<th>Communication Type</th>
<th>OSN provided</th>
<th>3rd-party provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication w/ system calls</td>
<td>M1</td>
<td>M2</td>
</tr>
<tr>
<td>Communication w/ non-private data</td>
<td>M3</td>
<td>M4</td>
</tr>
</tbody>
</table>

Communication between components only through OSN-specified APIs

- Communication w/ system calls
- Communication w/ non-private data
- Communication w/ private data (not allowed)
Relationship-based Access Control w/ Apps

He didn’t install the app

friend

install

follow

colleague

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Policy Specifications

• \(<\text{action, target, (start, path rule)}, 2^\text{ModuleType}>\nu
  – \text{action} specifies the type of access
  – \text{target} indicates the resource to be accessed
  – \text{start} is the position where access evaluation begins, which can be either \text{owner} or \text{requester}
  – \text{path rule} represents the required pattern of relationship between the involved parties

  e.g., “install”, “friend·install”
Policy Specifications

- `<action, target, (start, path rule), 2^{ModuleType}>`
  - *action* specifies the type of access
  - *target* indicates the resource to be accessed
  - *start* is the position where access evaluation begins, which can be either *owner* or *requester*
  - *path rule* represents the required pattern of relationship between the involved parties
  - *ModuleType* = \{M1, M2, M3, M4, external\}, \(2^{\text{ModuleType}}\) indicates the set of app module types allowed to access
Example: App Request Notification

• `<app request, _, (target user, install), {M1, M2, M3, M4, external}>`
  – For apps she installed; Protect her data

• `<app request, _, (requester, install∙friend), {M1, M2}>`
  – For apps she installed; Protect her friends’ data

• `<app request, _, (target user, friend∙install), {M1, M2}>`
  – For apps her friends installed; Protect her data
Example: Accessing User’s Profile

• <access, dateofbirth, (owner, install), \{M1, M2\}>
  – DOB is private

• <access, keystroke, (owner, install), \{external\}>
  – Keystroke is non-private
  – Keystroke information is crucial for fulfilling functionality

• <access, emailaddress, (owner, friend·install), \{M1, M2, M3, M4\}>
  – Protect his friends’ data
Conclusions

• Presented an access control framework
  – Split applications into different components with different privileges
  – Keep private data away from external components

• Provided a policy model for application-to-user policies
  – Specify different policies for different components of the same application
Q&A

Questions?

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