Security Framework for Decentralized Shared Calendars

Jagdish Prasad Achara

Research Master of Computer Science (Specialty : Services, Security and Networks)

24 juin 2011

Nancy-Université
Université Henri Poincaré

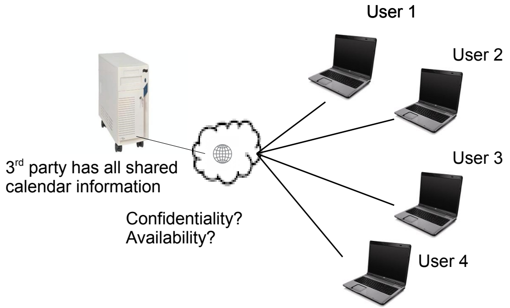
Outline

Outline

1. Introduction
   - Decentralized & third party independent shared calendar
   - About DeSCal
   - Problem Statement & Motivations
   - Challenges & Contributions
2. Security Requirements of DeSCal
3. State of the art
4. Proposed Security Framework
   - Security Framework Design Requirements
   - Security Framework Description
   - An illustrating example
   - Securing the communication between users
   - Discussion
5. Implementation on iPhone OS
6. Possible Directions of Future Work

Decentralized & third party independent shared calendar

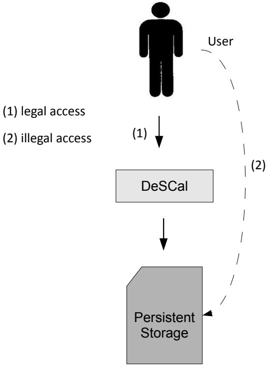
- Shared Calendar ?
- Why decentralized & third party independent ?
  - Support for Ad-Hoc networks (802.11 networks).
  - No single point of failure.
  - Secrecy/confidentiality of shared calendar events.
  - Availability of data.



About DeSCal

- Considering the usefulness of such a decentralized shared calendar, DeSCal (abbreviation of **De**centralized **S**hared **Cal**endar) is proposed by us.
- What is DeSCal ?
- An administrator of an event and his role ?
- A user can take two types of operation in DeSCal :
  1. Cooperative operation : On **shared calendar** to 'Insert', 'Delete' & 'Edit' events.
  2. Administrative operation : On his **access control policy** to allow/deny other users to 'Read', 'Delete' & 'Edit' his events.
- The design of DeSCal consists of four modules :
  1. Coordination module : needs **cooperative log**
  2. Access Control module : needs **administrative log** or **admin log** in short
  3. P2P/Ad-Hoc Network
  4. User Interface
- DeSCal replicates whole shared calendar state (Shared Calendar, Cooperative log, Policies, Admin logs) for fault tolerance, availability and crash recovery.

Problem Statement & Motivations



- Motivations
  - Providing confidentiality to replicated shared calendar events.
  - Securing the communication between users.

Challenges & Contributions

- Challenges
  - DeSCal's characteristic features ?
  - Decentralized 'Read' access control ?
  - Dynamic group of users..

- Contributions
  - Proposed a required security framework.
  - Its implementation on iPhone OS.

Outline

Security Requirements of DeSCal

- Providing confidentiality to replicated shared calendar events.
  - In Shared calendar, cooperative log, policy and admin log ?

- Securing the communication between users.
  - Group communication ?

Outline

State of the art

With the absence of central authority, security of 1) replicated data & 2) messages exchanged between peers, is a challenging task.

- Overview
  - Other decentralized shared calendars and collaborative environments.
  - Securing replicated data.
  - Secrecy by splitting.

Outline

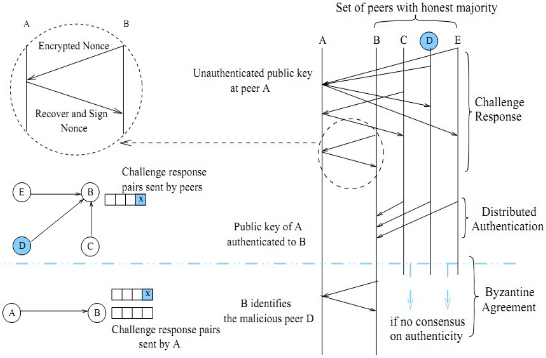
Security Framework Design Requirements

- DeSCal's characteristic features e.g., fault tolerance, availability, crash recovery, dynamic access control must not be lost.
- On top of coordination and access control models already employed by DeSCal.
- Must preserve broadcast group communication of DeSCal.

Security Framework Description

It uses public key cryptography where authentication of public key is compulsory.

- Pathak & Iftode's protocol



Security Framework Description

- Encryption Notations used :
  - Symmetric : $E_{K_e}(e)$ and $D_{K_e}(e)$
  - Asymmetric : $\{m\}_{K_u}$ and $\{m\}_{K_u^{-1}}$
- Description based on all possible happenings :
  - User-generated happenings
    1. Inserting a new event
    2. Deleting an existing event
    3. Editing an existing event
    4. Grant Read right
    5. Revoke Read right
    6. Grant/Revoke Delete/Edit right (**Not Relevant**)
  - System-wide happenings
    1. A new user joins the shared calendar group.
    2. An existing user leaves the group.
    3. A user goes off-line and then, comes on-line again.
- How fault tolerance is achieved in DeSCal ?
- Surviving a crash.
- How availability of data is ensured ?

Security Framework Description

- Inserting a new event

$$e' = E_{K_e}(e), \{K_e\}_{K_{Owner}}, \{K_e\}_{K_{AuthUser1}}, \{K_e\}_{K_{AuthUser2}}, ...$$

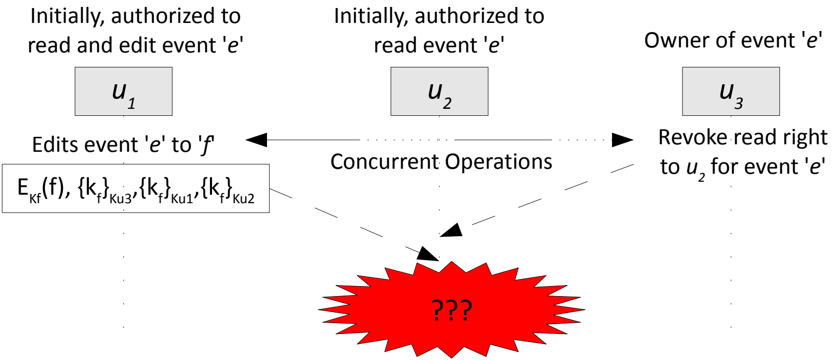
$$e' = E_{K_e}(e), \{K_e\}_{K_{Owner}}$$

- Granting 'Read' right

$$i = \{K_e\}_{K_{u_1}}, \{K_e\}_{K_{u_2}}$$

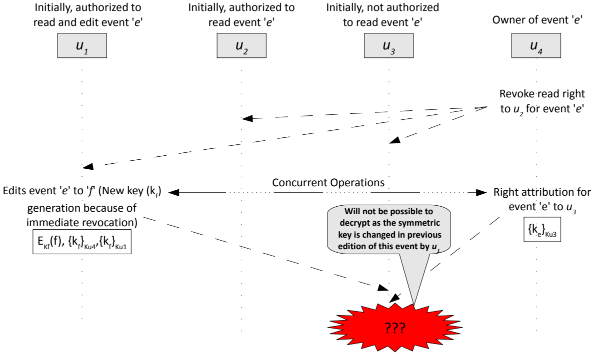
Security Framework Description

- Concurrency Issues
  - ‘Read’ right revocation and ‘Edit’ concurrent operations



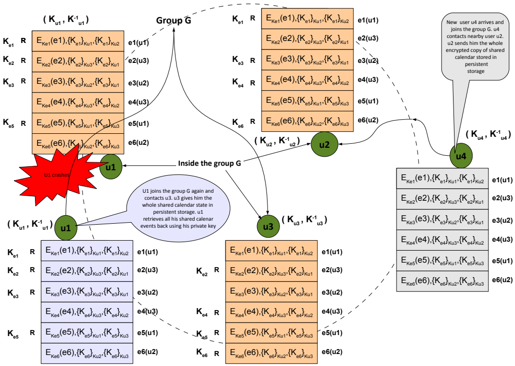
Security Framework Description

- Concurrency Issues
  - ‘Read’ right grant and ‘Edit’ concurrent operations



An illustrating example

- An illustrating example



Securing the communication between users and Discussion

- Securing the communication

$$m' = \{m,\ counter\}$$

$$m'' = \{m', sig\}\ where\ sig = \{hash(m')\}_{K_{u_i}^{-1}}$$

- Discussion

Outline

Implementation on iPhone OS

- RSA algorithm for asymmetric encryption and public/private key pair of size 1024 bits.
- For symmetric encryption, AES-128.

FIGURE: Calendar, Event Detail, Policy and Available Peers view

Implementation on iPhone OS

FIGURE: Selection of various attributes to insert a new rule in policy

Outline

Possible Directions of Future Work

- Possible Directions of Future Work
  - Verification and Analysis of security framework.
  - Standardize the communication protocol.
  - Policy for users to join the shared calendar group.
  - Some works (CP–ABE, Broadcast Encryption) to be explored if they can be used to satisfy security requirements of DeSCal while preserving its characteristic features.