Private Anonymous Messaging With Friends!

Ruchith Fernando

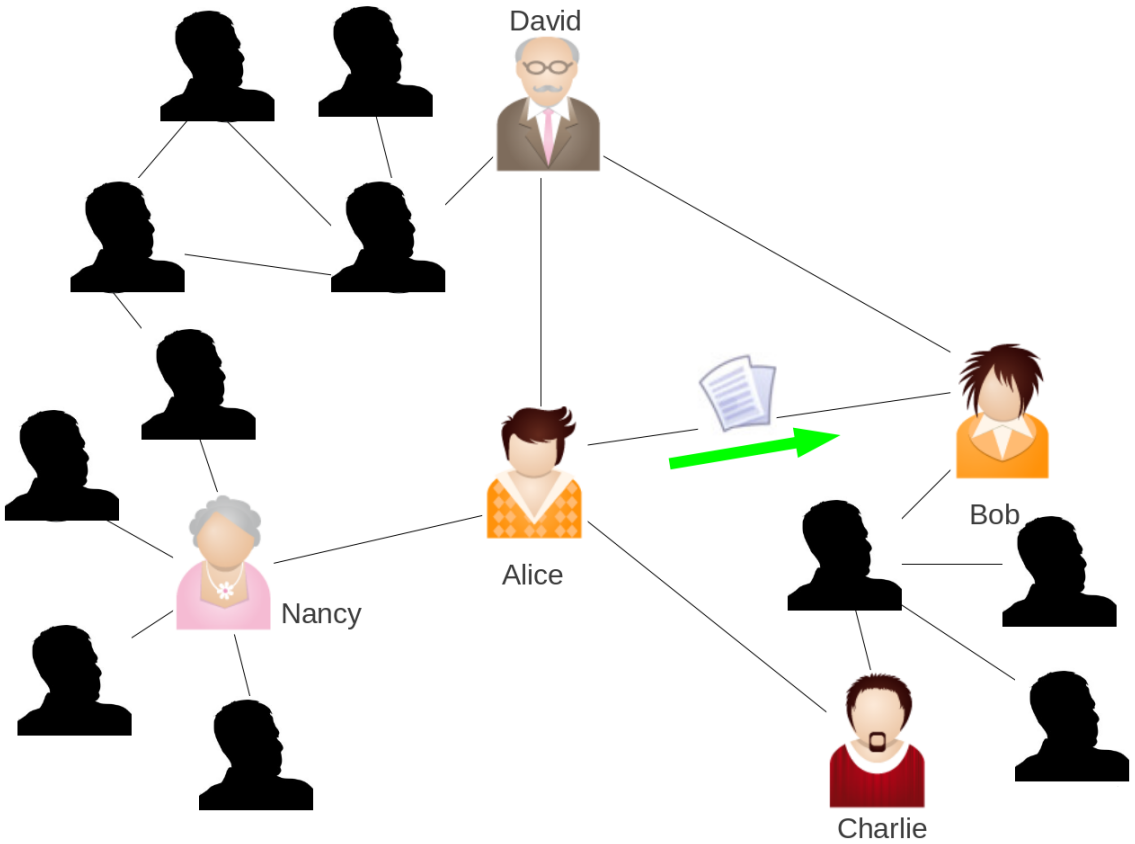
Purdue University

April 26, 2011

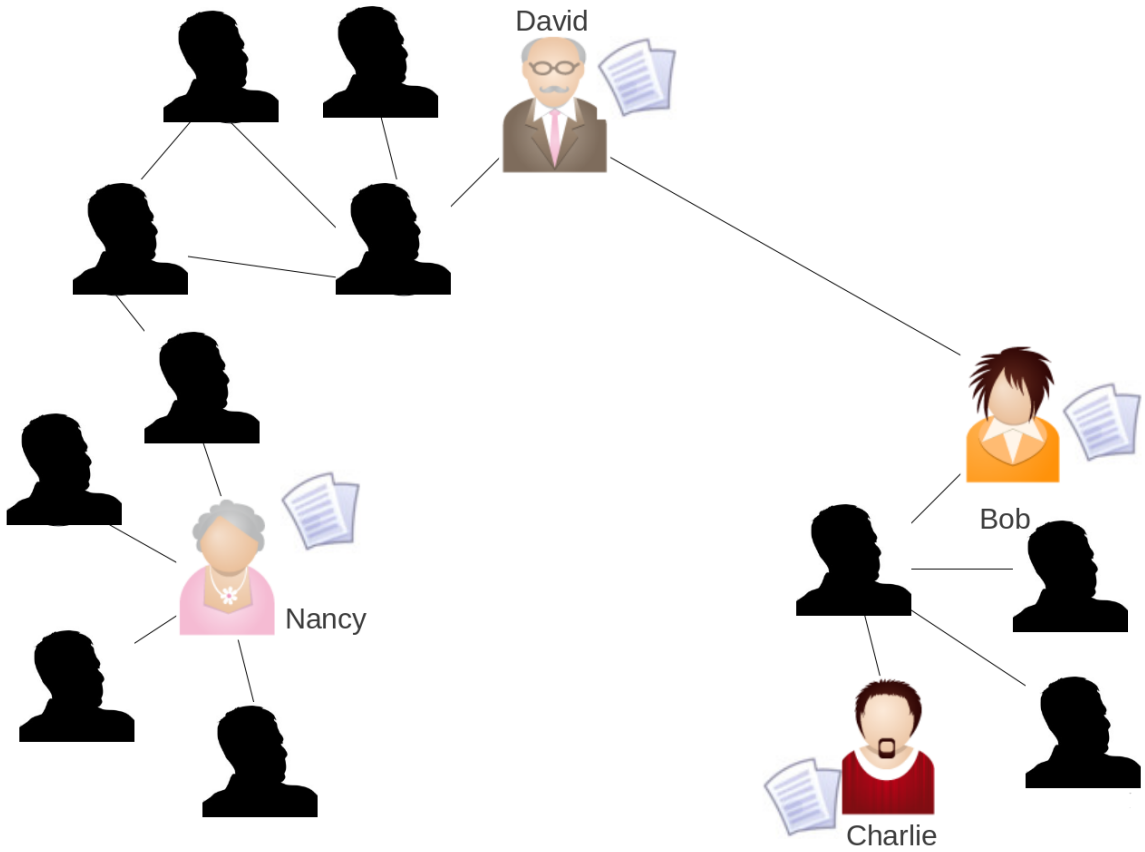
Problem

- A user wants to send a message to all his current contacts
- Even if they are **offline!**
- **Only** trusts his/her immediate contacts
- A contact can re-distribute messages on requests

Problem



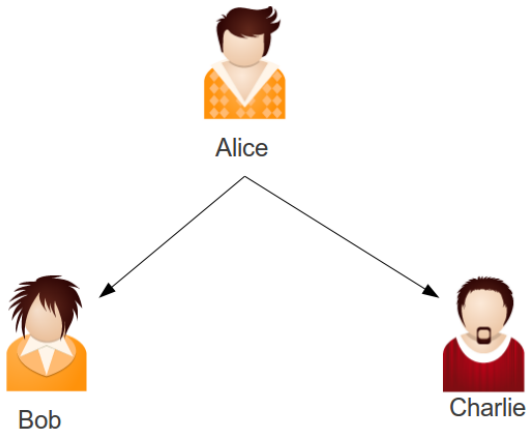
Problem



Proposed Solution

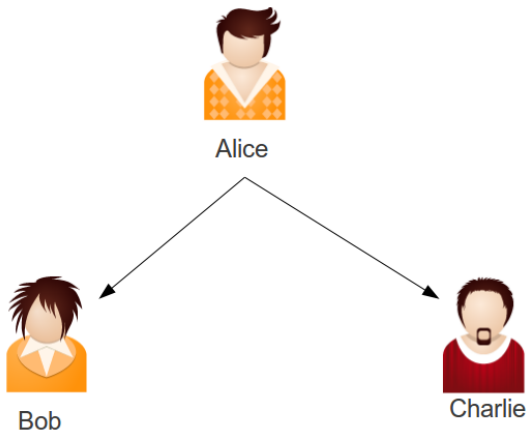
- Modify HIBE (Hierarchical Identity Based Encryption with Constant Size Ciphertext, Boneh et.al)
- Each contact is issued a private key (only private channel for key exchange)
- Contacts generate **anonymous** public keys using their private keys
- Broadcast update request to be processed by other contacts
- Re-key mechanism with **public** data (no private channel requirement)

Hierarchical Identity Based Encryption



- Identities:
  - Alice: I_1
  - Bob: I_1, I_{2_1}
  - Charlie: I_1, I_{2_2}
- $e : \mathbb{G} \times \mathbb{G} \rightarrow \mathbb{G}_1, |\mathbb{G}| = p$
- $params = (g, g_1, g_2, g_3, h_1, h_2), g_1 = g^{\alpha}, \alpha \in \mathbb{Z}_p$
- $mk = {g_2}^{\alpha}$

Hierarchical Identity Based Encryption



- Alice :
  - $K_{priv\,alice} = KeyGen(I_1, params, mk)$
  - $K_{pub\,alice} = I_1$
- Bob :
  - $K_{priv\,bob} = KeyGen(I_1, I_2, params, K_{priv\,alice})$
  - $K_{pub\,bob} = I_1, I_{2_1}$
- To encrypt for Bob
  $CT = Encrypt(msg, I_1, I_{2_1}, params)$

Changes to HIBE

- Update $Encrypt()$ to work with ${h_1}^{l_1}{h_2}^{l_{2_1}} = ID$
- To encrypt for Bob
  $CT = Encrypt'(msg, ID, params)$
- On re-key update α and only generate minimum public data for existing contacts.

Usage : Encryption

- Contact: First level identity (I_{r_1}) and private key
- A contact issues him/herself a second level identity with a **random** I_{r_2}
- Broadcsts a request for data ($<user,\ ID_r>$) where $ID_r = {h_1}^{I_{r_1}} {h_2}^{I_{r_2}}$
- Any other contact of the *user* can respond to the request, by encrypting with $params_{user}$:
  $CT = Encrypt'(msg, ID_r, params_{user})$

Usage : Revocation

- If the *user* removes a contact
- Re-key : Parameters
  - Generate a new master key : $\alpha' \in \mathbb{Z}_p$, ${g_2}^{\alpha'}$
  - $params_{user}$ update : Only $g_1 = g^{\alpha'}$
- Re-key : Contact private key
  - $K_{priv} = ({g_2}^{\alpha'} \cdot ({h_1}^{l_1} \cdot g_3)^r, g^r, {h_2}^r, {h_3}^r) = (C_1, C_2, C_3)$
  - Only C_1 need to be published along with l_1
  - Indexed by blinded $ID_{contact}$

Implementation

- http://code.google.com/p/anon-encrypt/
- Using Java Pairing Based Cryptography Library (JPBC)[1]
- Implemented as a library
- Demo application

[1] http://gas.dia.unisa.it/projects/jpbc/

Demonstration

DEMO!