DECENT: A Decentralized Architecture for Enforcing Privacy in Online Sociclai Networks

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Online Social Networks

- Revolutionized the way people interact
- Hundreds of millions of users across the world
- Huge collection of personal information

❖ The lack of user privacy:
- ➢ Users are not in control of their private data**. The social network provider has full access to the user's data.**
- ➢ Not enable a user to set fine-grained policies for access control
  - ✓ **e.g. No policy can be defined for comments.**
- ➢ Network provider's constantly changing and oblique privacy policies.

Contributions

❖ Design: a decentralized OSN architecture that:
- ➢ Provides flexibility in data management through OOD;
- ➢ Uses an appropriate and advanced cryptographic scheme
  - ✓ supports efficient access revocation
  - ✓ fine-grained policies on each piece of data;
- ➢ Combines confidentiality, integrity, and availability by using the functionalities of a DHT.

❖ Prototype: We develop a prototype of DECENT (the wall and newsfeed functionalities)
- ➢ and evaluate its performance through simulation and experiments on PlanetLab.

Requirments

❖ **Functional Model:**

To provide a flexible, general model of operations such as posting content and viewing, commenting on, we define
- ➢ A container object that has two components:
  - ✓ The main content
  - ✓ a list of comments/annotations, represented as references to other container objects.

❖ **Security Requirements:**
- ➢ Confidentiality: Content should be accessible to only those who are authorized.
- ➢ Integrity: Content should remain authentic. Note that storage nodes are untrusted and may try to perform unauthorized updates to the stored data.
- ➢ Availability: User content should remain available, even if the owner is offline, and despite potential malicious attempts to destroy the data.
- ➢ Flexible Policies: Fine grained access e.g.,"(friend AND co-worker) OR family"
- ➢ Relationship Privacy: Relationships between users should remain hidden from third parties that may have no relationship with the object owner.

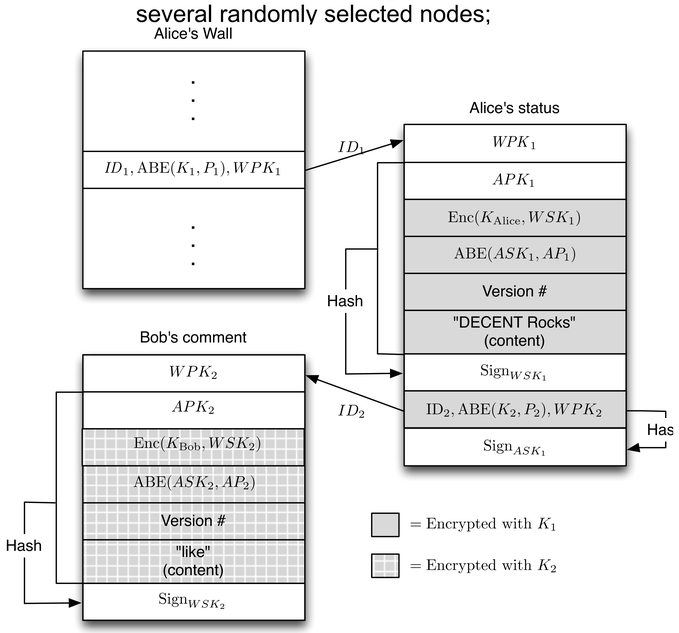
System Architecture

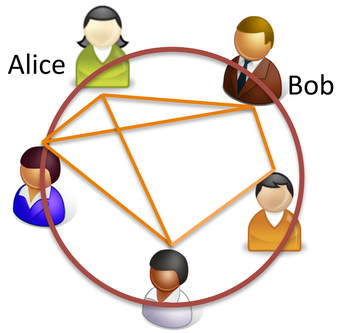
DECENT is a decentralized OSN, which employs a DHT to store and retrieve data objects created by their owners. Each object is encrypted to provide confidentiality.

❖ **Access Policies**:
- ➢ Read policy: an attribute-based policy that describes the attribute combination required for a user to decrypt an object's data.
- ➢ Write policy: an identity-based policy, which generally is set to the owner of the object.
- ➢ Append policy: describes who may add a comment/annotation to the object. It is also an attribute-based policy.

❖ **Cryptographic Protection:**

Each user becomes a key authority, issuing different encryption keys to social contacts based on their attributes.
- ➢ Attribute-based encryption (ABE)
  - ✓ A public-key encryption scheme where each encrypted item is associated with a policy.
  - ✓ A key can decrypt an encrypted item if its set of attributes satisfies the item's policy.
- ➢ Hybrid encryption mode: the message is encrypted with a randomly chosen symmetric encryption key,
- ➢ Supports immediate revocation by the use of the EASiER scheme [1].
- ➢ Two extensions on EASiER scheme:
  1. Threshold secret sharing can be used to split the proxy functionality among several randomly selected nodes;





❖ **Distributed Hash Table (DHT):**
- ➢ Objects in DECENT are stored in the DHT using the object ID as the key.
- ➢ To ensure availability despite node churn and malicious attacks, several replicas of an object are maintained.
- ➢ Write policy prevents malicious users from creating modifications that will be accepted by the readers, as they cannot produce a correct signature.
- ➢ DECENT DHT supports an append request, which is used to add a comment reference to an existing object.

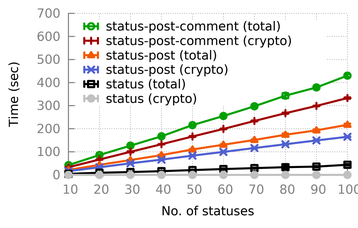
Implementation and Evaluation

❖ Cryptographic schemes:
- ➢ EASiER for ABE,
- ➢ AES for symmetric encryption,
- ➢ DSA for signatures,
- ➢ RSA to encrypt the write policy signature key.

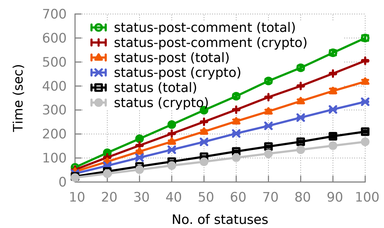
❖ The underlying DHT:
- ➢ FreePastry with Euclidean network topology was used for simulation,
- ➢ Kademlia [2], for the experiments on PlanetLab

Simulation

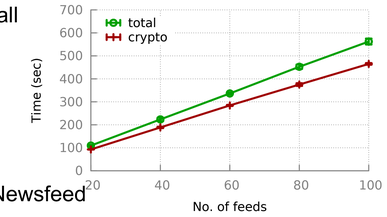
❖ The simulation was run on a peer-to-peer network of 10 000 nodes.
❖ Measure the performance of viewing a user's newsfeed and wall with varying numbers of status messages, posts, and comments.



a. View My Wall



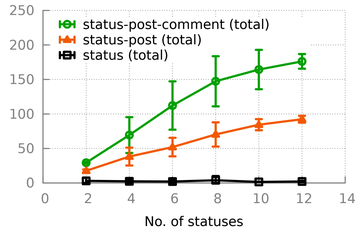
b. View Others' Wall



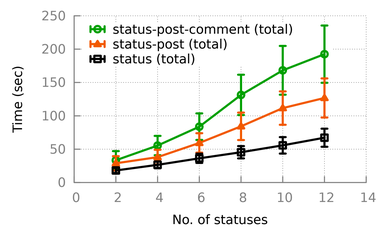
c. View Newsfeed

Experiments on PlanetLab

❖ The same experiments on 15 PlanetLab nodes to get an idea of DECENT's performance in a real deployment.



a.View My Wall



b. View Others' Wall

Future Work

❖ Adding features to DECENT
❖ Improving performance and resilience through optimized cryptographic techniques, caching, and replication.

References

[1] S. Jahid, P. Mittal, and N. Borisov, "EASiER: Encryptionbased access control in social networks with efficient revocation," in ASIACCS, 2011.
[2] L. M. Aiello, M. Milanesio, G. Ruffo, and R. Schifanella, "An identity-based approach to secure P2P applications with Likir," Peer-to-Peer Networking and Applications, vol. 4, pp. 420–438, 2011.

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