SIPCache: A Distributed SIP Location Service for Mobile Ad-Hoc Networks

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July 20, 2006
Introduction

► Many wired Internet Services assign special roles to some participants
  ▶ Routing
  ▶ Domain Name Service (DNS)
  ▶ Session Initiation Protocol (SIP)
► Hard to do in ad-hoc networks because:
  ▶ The list of participants change
    ▶ Nodes move away
    ▶ New nodes arrive
  ▶ Nodes fail
  ▶ Nodes have limited battery power
Session Initiation Protocol (SIP)

- Composed of different services
  - **Location Service** Defines bindings between Address of Records (AOR) and contact address(es)
    - AOR User ID
    - Contact Addresses IP, phone number,...
  - Bindings stored in Domain Registrars
  - **Other services** Availability, Negotiation of communication parameters...

- Many applications
  - e.g. advertises users interests
    - Wants to play chess on-line
    - Wants to chat about FIFA World Cup
Using the Location Service

Motivation
Previous Work
SIPCache
Evaluation
Conclusions
SIP in MANETs

- Where to store the mapping between an user and an address (binding)?

  **Push**  When connecting, the user stores the binding in every device
  - Requires periodic updates to push the binding to devices joining later

  **Pull**  Users flood to learn the binding for some ID
  - Requires one flood per query

  **Hybrid**  Stores replicas in a small number of devices
  - Expected to reduce the number of nodes forwarding each query
Distributed SIP (dSIP)

- SIP for MANETs
- Replicates server components on every node
- Uses the same API as SIP
  - Compatible with legacy SIP applications
- Uses the *Pull* model
- No message forwarding
  - All nodes must be in range of each other
PCache

- An algorithm to replicate data in ad-hoc networks
- Replicas are stored only at some of the participants
  - Considering the geographical distribution of the nodes
  - Number of replicas adapts to the network density
- Uses a smart algorithm for broadcasting (Pampa)
- Only generates messages by request of the participants
- Three operations
  **Dissemination**  Replicates data
  **Query**  Queries for the value associated with a key
  **Gathering**  Queries for data satisfying some condition
dSIP + PCache = SIPCache

- SIPCache: a distributed SIP location service for MANETs
- Bindings are replicated using PCache dissemination
  - Stored in a limited number of nodes, depending on network density
- Retrieved using PCache queries
  - Simulation shows that many of the bindings can be found in the 1-hop neighborhood of any node
  - Bounds the number of nodes forwarding a message
- Users see “who’s around” with the gathering operation
  - A limited flood of the gathering message retrieves a large proportion of the bindings
Distance of the replies

- When each node stores 10% of the advertised items
  - Replies between 1 and 1.4 hops away
    - Most of the queries just need to be propagated to 1-2 hops away
- When nodes are able to store all bindings
  - Average below 1
- PCache adapts the diameter of the search
Completeness of data gathering

- Condition is satisfied by 10% of the bindings
- Query propagated 2 hops away from the source
- When each node stores 10% of the advertised items
  - Results depend on the number of nodes
    - Influences the number of bindings available in the neighborhood
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Traffic

- Compares the gains of SIPCache against naïve pull
- \( x \) is the number of queries for one item
- In general, PCache performs better
- Losses in some gathering operations are due to an excessive number of replies
  - Are attenuated with the gains in other operations
Conclusions

- Centralized implementations of Internet services are inadequate for MANETs
  - Distribution and replication are fundamental to achieve scalability and reliability
- PCache has shown to efficiently replicate data
  - Accounts with node density
  - Requires a low number of messages
- SIPCache provides an implementation of SIP for MANETs compatible with legacy applications