A Web Browser-based Application Interaction Framework for Autonomous Neighborhood Networks

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Neighborhood Networking: Decoupling Users from the Cloud

• Keeping content where is matters

• Reducing dependencies on remote services and the network paths to those
Do-It-Yourself Networking

Mobile devices alone may not be enough

- Device-to-device communication is tricky
  - Mobile OSes and APIs designed for connecting to infrastructure

- How to bootstrap mobile devices?
  - Want to avoid dependency on the web

- Just using people’s mobiles may not be very reliable
  - Fluctuation in device density during the day, week, year
  - Potentially shorter range, battery constraints

- More predictable storage locations desirable
  - Apps need to keep their data somewhere
Do-It-Yourself Networking

1) Networking platform
2) Applications
3) Embracing Legacy Devices
SCAMPI Networking Platform

- Message-based interactions
  - Self-contained ADUs (arbitrary size)
  - Metadata
  - Lifetime
- Unicast / multicast / broadcast
- Publish / subscribe
- Search using metadata
- Geo-based content sharing (Floating Content)

### SCAMPI Message

<table>
<thead>
<tr>
<th>AppTag</th>
<th>Service Name</th>
<th>Time-to-Live</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Metadata</th>
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<tbody>
<tr>
<td>Key (string)</td>
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<tr>
<td>...</td>
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</table>

<table>
<thead>
<tr>
<th>Content</th>
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<tr>
<td>Key (string)</td>
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<td>...</td>
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</tbody>
</table>

Liberouter

- Basic features
  - WLAN access point
  - Captive portal
  - SCAMPI router
  - Storage node
  - Can mesh with other liberouters
- Applications
  - Android liberouter distribution
  - Native SCAMPI (Java) applications
  - HTML5 SCAMPI-enabled
1) Networking platform
2) Applications
3) Embracing legacy nodes
Deploying applications

- App Stores (native)
  - Native apps: access to device features
  - Store operator as a gatekeeper
    - + quality control, trust
    - Internet dependency, delay, potential censorship
- Web Apps (HTML5)
  - Limitations due to frameworks
  - Usually require always-on Internet connectivity
- An app is essentially a (signed) bag of bits
  - Use messaging for distribution

SCAMPI Apps

<table>
<thead>
<tr>
<th>Platform-independent (needs JVM)</th>
<th>Platform-specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCAMPI Router</td>
<td>Native Apps</td>
</tr>
<tr>
<td>Pub/Sub</td>
<td>Unicast</td>
</tr>
<tr>
<td>Search</td>
<td>Storage</td>
</tr>
<tr>
<td>Peer Discovery</td>
<td>Transport</td>
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</tbody>
</table>

HTML5 App Distribution

HTML5 Shim

HTML5 App

Native API

TCP
SCAMPI Apps
SOME APPLICATIONS

Simple Messaging & Sharing Apps
nearbyPeople

- Exploiting ephemeral communities
- Share a personal profile with interests in the background
- Observe how information from others comes in
- Exchange messages with people of interest
- Organize get-togethers around a common event

Distributed “Google People Finder”

- Person Details
  - Full Name: Autumn Church
  - Age: 56
  - Street: Diam Road
  - City: Rimouski
  - Postal or Zip Code:
- Notes on-Missing Person
  - Autumn Church
  - I am seeking information
  - Last Known Location: Guilford, Guatemala
  - Posted by: Lucy Sears
  - Status: This person is alive
Common Application Properties

- Applications label object with AppTag and Service Name
- Exchange identifiable objects
- Objects carry (and may accumulate) (full) state
- Objects may be aggregated by the application
- Objects can be grouped (name, thread, …)

- Objects can be processed and acted upon individually
- There is no required ordering relationship
  - Timestamps for ordered display, overriding older data

What we have now…
1) Networking platform
2) Applications
3) Embracing Legacy Nodes

Reaching out...
Reaching out…
Embracing “Legacy” Nodes

- Legacy nodes = all nodes that don’t (yet) run a SCAMPI router

Getting people to participate…

…and benefit from their movement

Content Interaction for for Legacy Nodes

Instrumenting Legacy Nodes for Forwarding

[Nagy et al., CHANTS 2014]
Simple Application Model

Content Interaction

[Nagy et al., under submission]
Content interaction

- Web-based access to locally stored unencrypted messages
  - Content overview
  - Individual message rendering
  - Creating “responses”
  - Creating new messages

- Summary
  - App icon
  - Thumbnail or similar
  - Topic / threading
  - App-specific grouping

Forwarding with Legacy Nodes

- Browsers = modestly powerful storage devices
  - Cookies: 4096 bytes per cookie, ~150 cookies per domain
  - Web storage: 2.6 – 5.2 MB per domain

- All liberouters form one domain
  - Cookies will be sent and accepted
  - Web storage will be accessible

- Translate messages into
  - Cookies (if they are small)
  - Storage objects (if they are larger)
  - Use SHA-1 hashes of content for unique naming

Yields a “Backbone” Between liberouters

[Nagy et al., CHANTS 2014]
Quick Look at Evaluation

3 scenarios in ONE simulator

1. Random Waypoint
   - 1x1km area
   - (10, 20, 50) DTN nodes
   - 8 or 16 APs

2. Shortest Path Map Based Movement (SPMBM)
   - Helsinki downtown area [Pitkänen et. al. 2010]
   - (50, 100, 200) pedestrians (restless tourists)
   - 11–325 stationary APs

3. OPP
   - like 2. above with (10, 20, 50, 100)% of devices acting as APs

Number of legacy nodes: \( N_l \in \{0, 1, 5, 10\} \times N_d \)
Conclusion

• DIY networking with less dependency on the Internet
• Creating a somewhat autonomous ecosystem
• Lowering the barrier for participation: web browsers
  – Content interaction and forwarding

• Currently exploring
  – Updating our software distribution (see below)
  – More diverse (outdoor) applications
  – Application authoring
  – Mutable contents, distributed editing, and merging
    [Kärkkäinen et al., CHANTS 2014]

http://www.ict-scampi.eu/results/scampi-liberouter/