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

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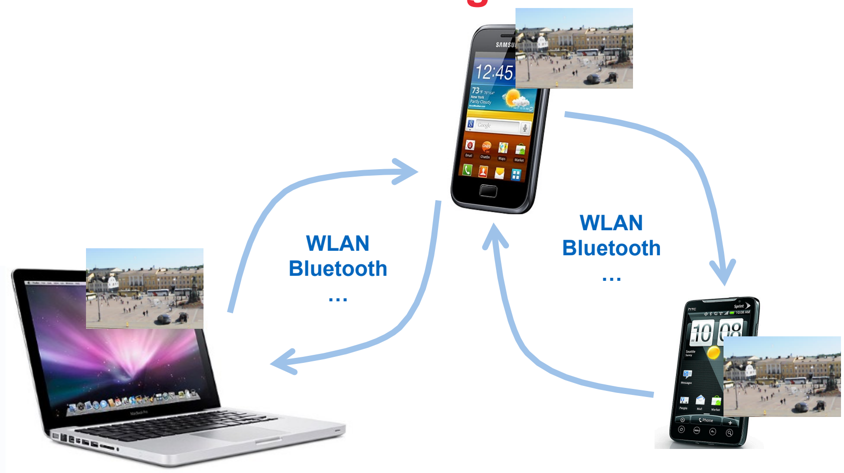
http://www.netlab.tkk.fi/~jo/

21 October 2014

Neighborhood Networking: Decoupling Users from the Cloud

- Keeping content where is matters
- Reducing dependencies on remote services and the network paths to those

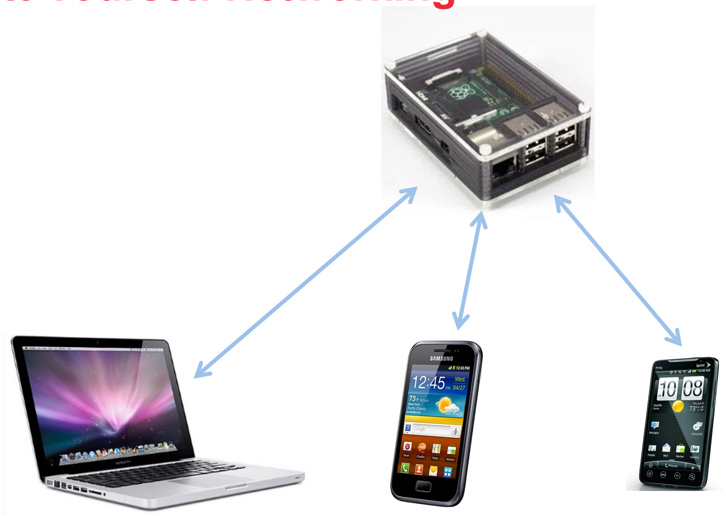
Do-It-Yourself Networking



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

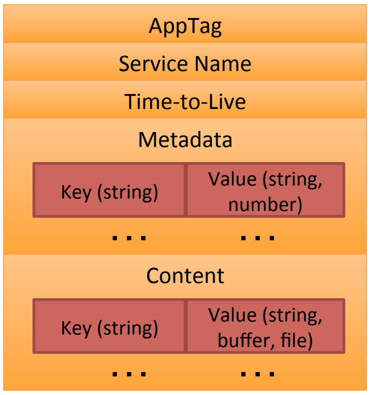


1) Networking platform
2) Applications
3) Embracing Legacy Devices

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



AppTag

Service Name

Time-to-Live

Metadata

Key (string) | Value (string, number)

. . . . . .

Content

Key (string) | Value (string, buffer, file)

. . . . . .

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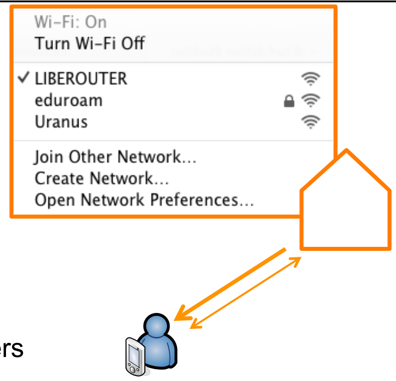
Liberouter



Wi-Fi: On
Turn Wi-Fi Off
✓ LIBEROUTER
eduroam
Uranus
Join Other Network…
Create Network…
Open Network Preferences…

- 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

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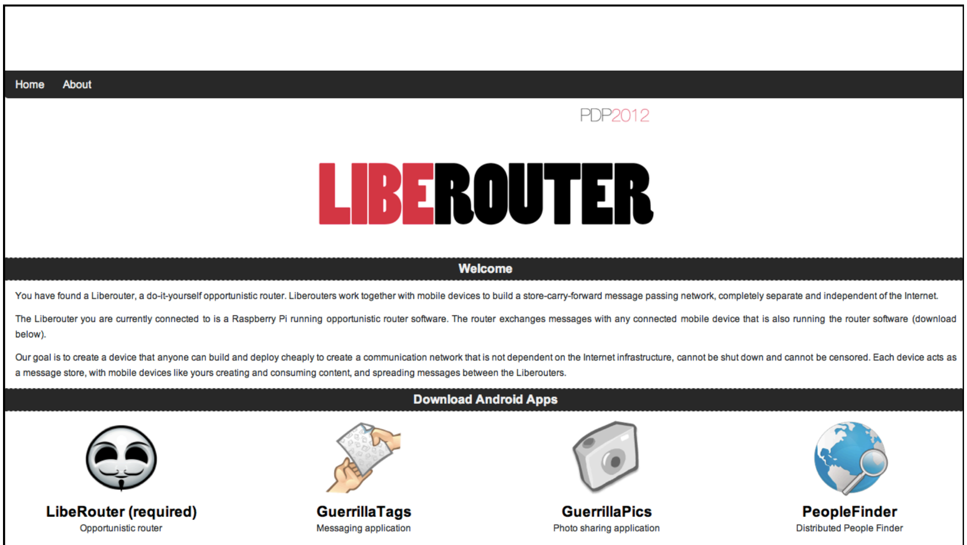


LIBEROUTER

Welcome

You have found a Liberouter, a do-it-yourself opportunistic router. Liberouters work together with mobile devices to build a store-carry-forward message passing network, completely separate and independent of the Internet.

The Liberouter you are currently connected to is a Raspberry Pi running opportunistic router software. The router exchanges messages with any connected mobile device that is also running the router software (download below).

Our goal is to create a device that anyone can build and deploy cheaply to create a communication network that is not dependent on the Internet infrastructure, cannot be shut down and cannot be censored. Each device acts as a message store, with mobile devices like yours creating and consuming content, and spreading messages between the Liberouters.

Download Android Apps

LibeRouter (required)
Opportunistic router

GuerrillaTags
Messaging application

GuerrillaPics
Photo sharing application

PeopleFinder
Distributed People Finder

1) Networking platform

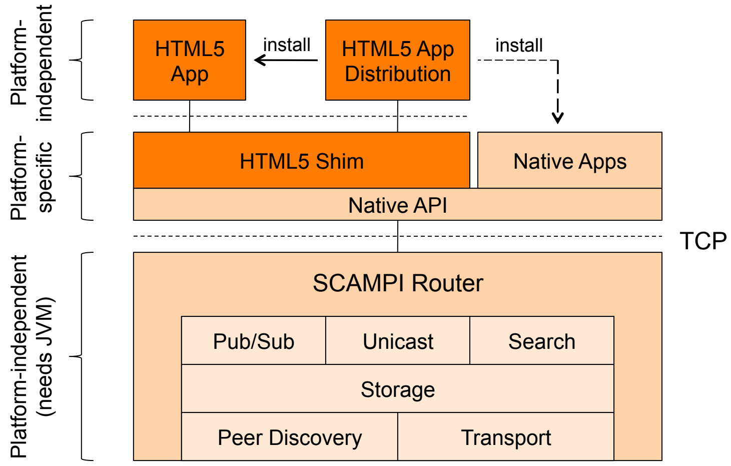
2) Applications

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



Platform-independent

HTML5 App ← install — HTML5 App Distribution — install → Native Apps

Platform-specific

HTML5 Shim | Native Apps

Native API

TCP

Platform-independent (needs JVM)

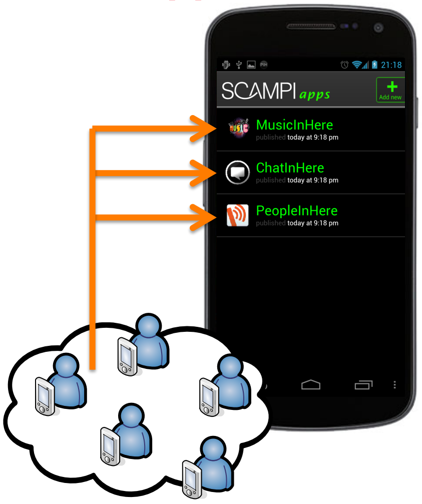
SCAMPI Router

Pub/Sub | Unicast | Search

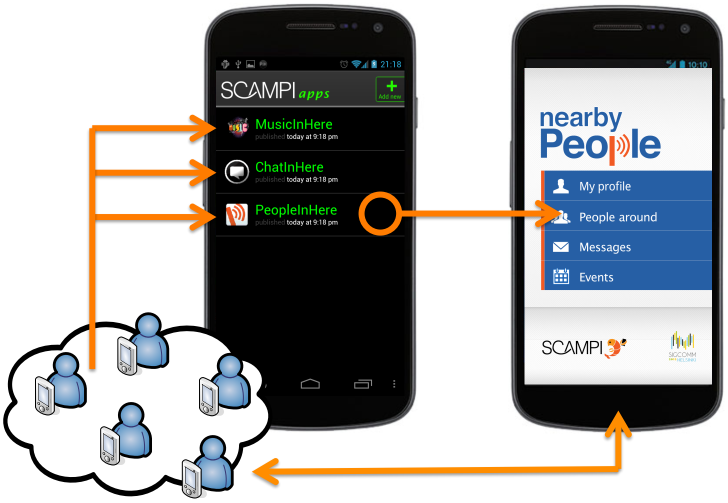
Storage

Peer Discovery | Transport

SCAMPI Apps


21:18
SCAMPI apps
Add new
MusicInHere
published today at 9:18 pm
ChatInHere
published today at 9:18 pm
PeopleInHere
published today at 9:18 pm

SCAMPI Apps



SOME APPLICATIONS

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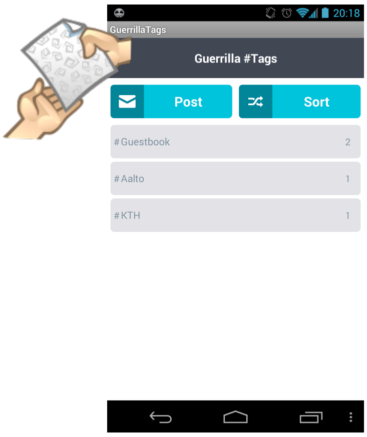
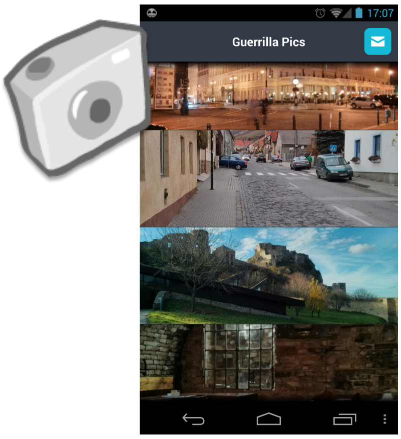
Simple Messaging & Sharing Apps



Guerrilla #Tags

#Guestbook	2
#Aalto	1
#KTH	1



Guerrilla Pics

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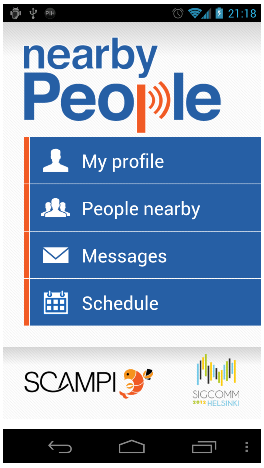
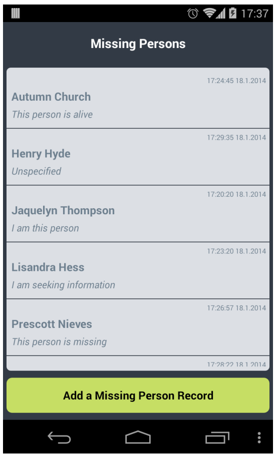
nearbyPeople

- 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”



17:37

Missing Persons

17:24:45 18.1.2014
Autumn Church
This person is alive

17:29:35 18.1.2014
Henry Hyde
Unspecified

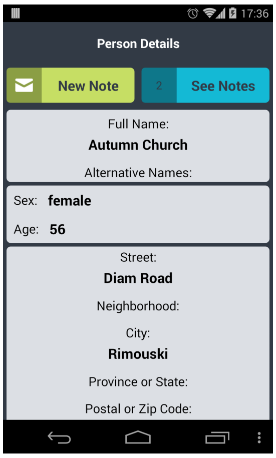
17:20:20 18.1.2014
Jaquelyn Thompson
I am this person

17:23:20 18.1.2014
Lisandra Hess
I am seeking information

17:26:57 18.1.2014
Prescott Nieves
This person is missing

17:28:22 18.1.2014

Add a Missing Person Record



17:36

Person Details

New Note | 2 See Notes

Full Name:
Autumn Church

Alternative Names:

Sex: **female**

Age: **56**

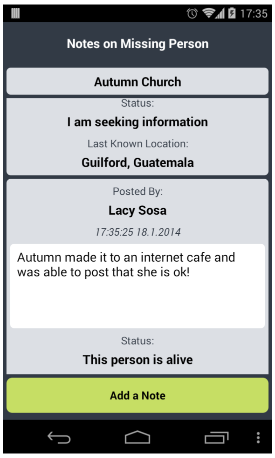
Street:
Diam Road

Neighborhood:

City:
Rimouski

Province or State:

Postal or Zip Code:



17:35

Notes on Missing Person

Autumn Church

Status:
I am seeking information

Last Known Location:
Guilford, Guatemala

Posted By:
Lacy Sosa
17:35:25 18.1.2014

Autumn made it to an internet cafe and was able to post that she is ok!

Status:
This person is alive

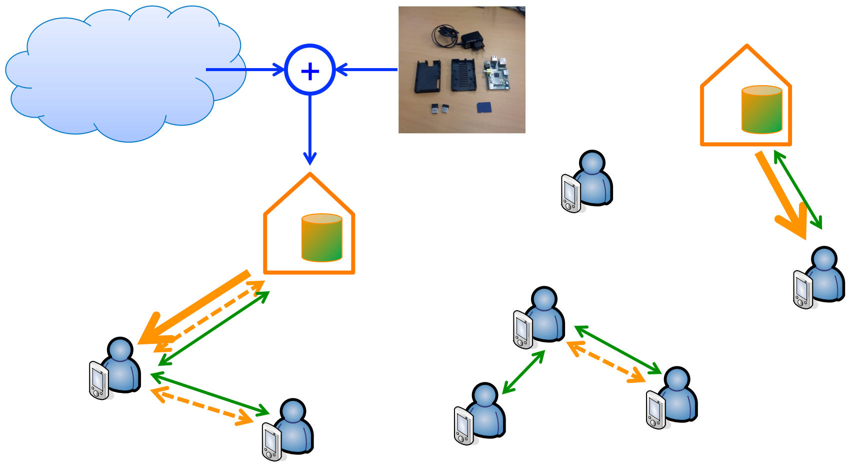
Add a Note

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…



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3) Embracing Legacy Nodes

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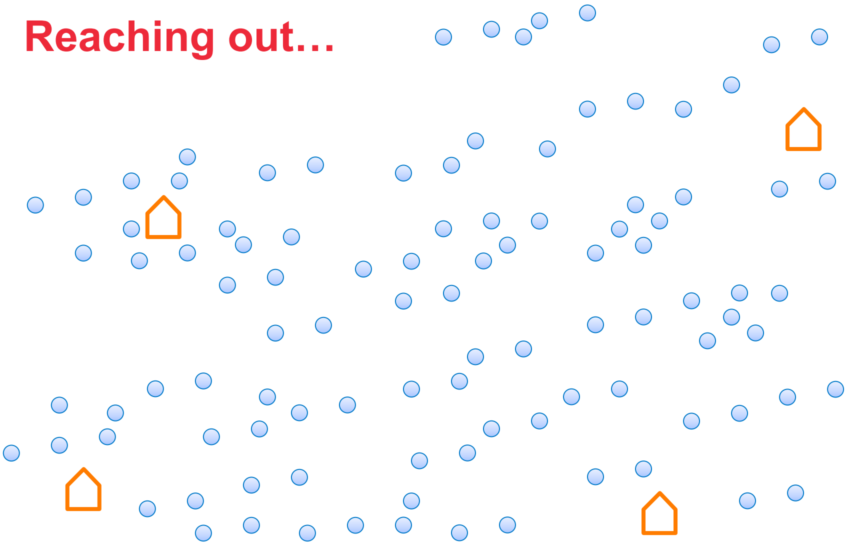
Reaching out…



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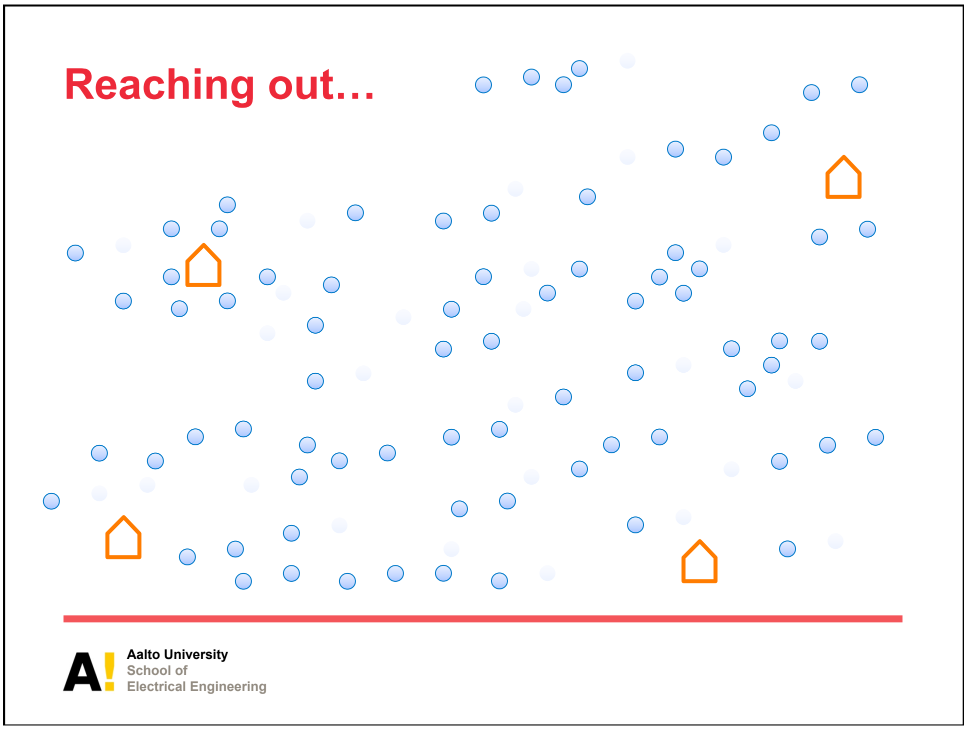

Reaching out…

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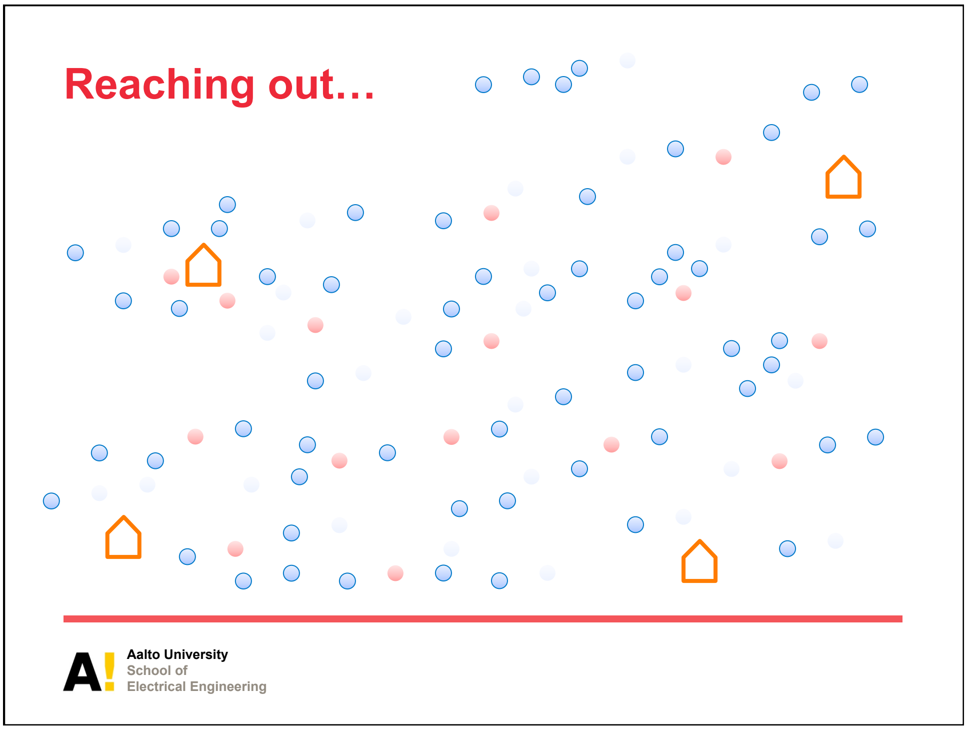

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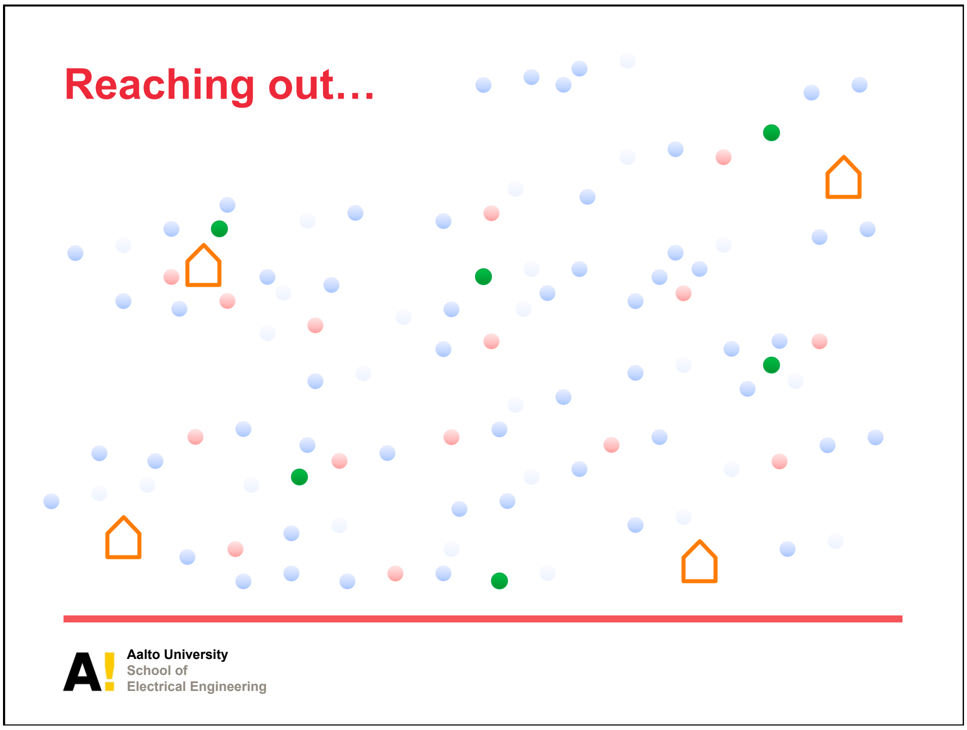

Reaching out…

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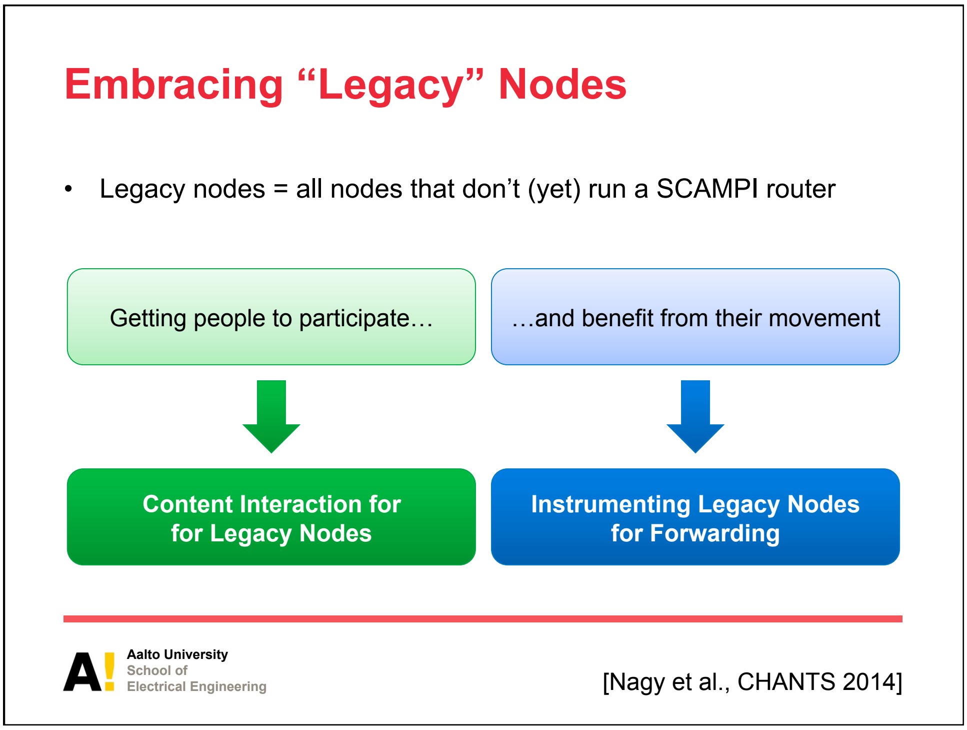

Embracing “Legacy” Nodes

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

Getting people to participate…

Content Interaction for for Legacy Nodes

…and benefit from their movement

Instrumenting Legacy Nodes for Forwarding

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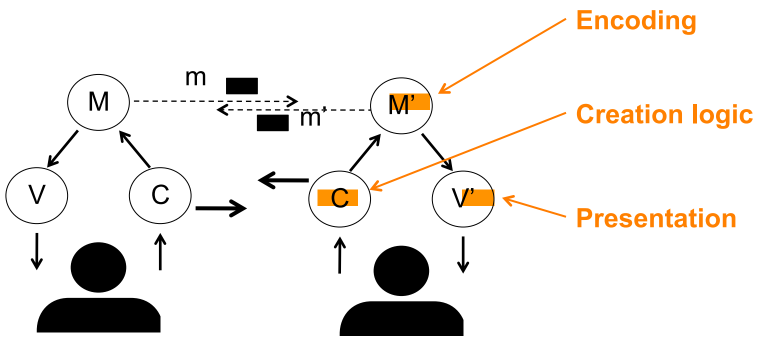
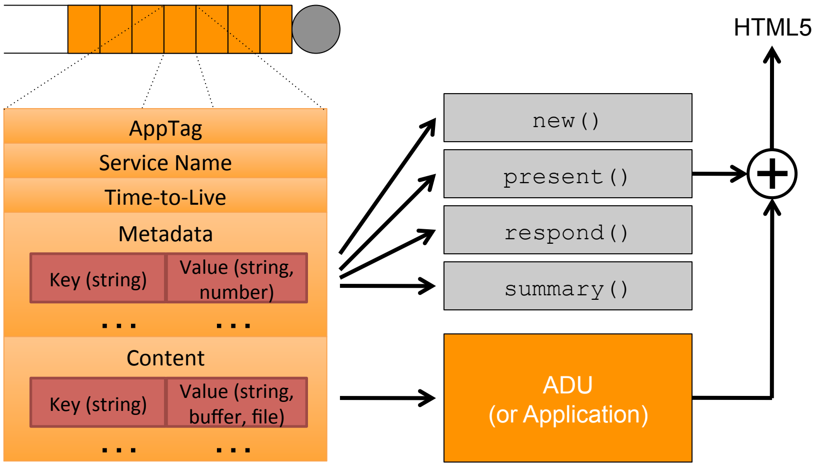
[Nagy et al., CHANTS 2014]

Simple Application Model



Content Interaction



HTML5

AppTag
Service Name
Time-to-Live
Metadata

Key (string)	Value (string, number)
. . .	. . .

Content

Key (string)	Value (string, buffer, file)
. . .	. . .

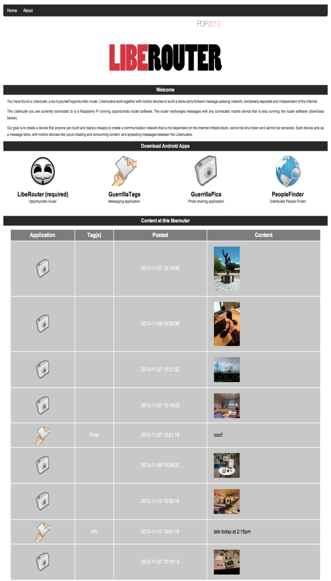
new()
present()
respond()
summary()

ADU
(or Application)

[Nagy et al., under submission]

Content interaction

- Web-based access to locally stored unecnrypted messages
  - Content overview
  - Individual message rendering
  - Creating “responses”
  - Creating new messages
- Summary
  - App icon
  - Thumbnail or similar
  - Topic / threading
  - App-specific grouping



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Opportunistic router

GuerrillaTags
Messaging application

GuerrillaPics
Photo sharing application

PeopleFinder
Distributed People Finder

Content at this liberouter

Application	Tag(s)	Posted	Content
		2013-11-27 12:19:46	
		2013-11-09 19:25:36	
		2013-11-27 12:21:32	
		2013-11-27 12:16:02	
	Final	2013-11-27 12:21:19	cool!
		2013-11-09 19:26:02	
		2013-11-13 15:05:18	
	info	2013-11-13 15:01:16	talk today at 2:15pm
		2013-11-27 12:19:12	

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: $N_l \in \{0, 1, 5, 10\} \times N_d$

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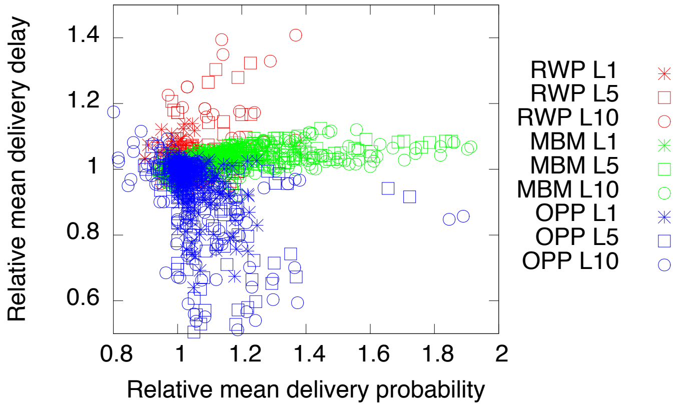
Quick Look at Evaluation



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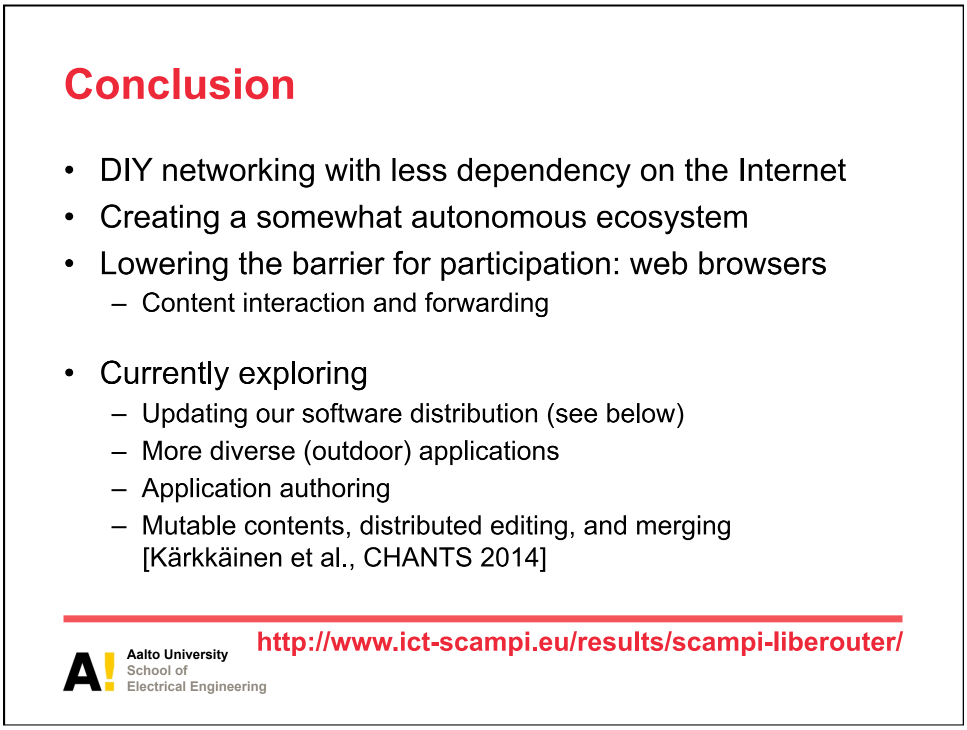

Conclusion

- 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/

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