Connecting the Unconnected
free is good

Edoardo Biagioni
University of Hawaii at Manoa
Information and Computer Sciences

AllNet project

Ad-Hoc Networking

- old idea (1990s)
- Alice's device talks to Bob's device talks to Charlie's device talks to ….
- until we build a useful network

In 2017 we all carry two-way radios!!!!

Conventional vs. Free

- can mobilize large capital investments
- incentives for reliability
- central planning
- fixed infrastructure
- **very successful**
- follows money

- can serve the underserved
- incentives to contribute
- well-understood need
- flexible deployment
- some success
- **follows people**

problems with free

- **relies on network effect**
  - works best when many people use it
- “tragedy of the commons”
  - most people prefer to use more, contribute less
- no large investments
  - hard to build infrastructure
  - cannot use for long-distance high-volume communications
- all responsible, nobody responsible
  - can others see my messages?

advantages of free

- free!
- decentralized decision-making
  - end-users make decisions
  - end-to-end architecture
- portable infrastructure
  - **end-users bring devices where needed**

Devices follow People

- still works when infrastructure is down
- as long as devices can be powered

- **supports emergency communication**

Ad-Hoc and Delay Tolerant

- messages are stored and forwarded by intermediate devices
- forwarding may be immediate or delayed
- devices may carry messages: **sneakernet**
  - inefficient – multiple message retransmissions
  - but acceptable for low-rate communication: text messages!
- infrastructure not required

P2P networking
Real-Life challenges

- WiFi has an ad-hoc mode
  - but ad-hoc WIfi **not supported on iOS or Android**
  - unless the device is rooted!
- so bluetooth where possible, other technologies in the future
- can use WiFi network *not connected to the Internet*
  - local infrastructure

Leveraging the Internet

- needs to work well without the Internet
- needs to work better when there is Internet!

- distributed implementation: **internet-connected devices self-organize** so my device knows where it can pick up its messages
  - similar to email, but self-organizing
  - Distributed Hash Table

AllNet status

- works well on Linux, including ad-hoc WiFi mode and Internet
- works on Internet-connected Apple and Windows desktops

`http://alnt.org/`

- works on iOS, including multipeer (peer-to-peer) and Internet

  `allnet-xchat`

- preliminary implementation for Android

Challenges and **Solutions**

- distributed identification
- anyone may snoop
- resource depletion
  - battery
  - storage
  - bandwidth
- unreliable

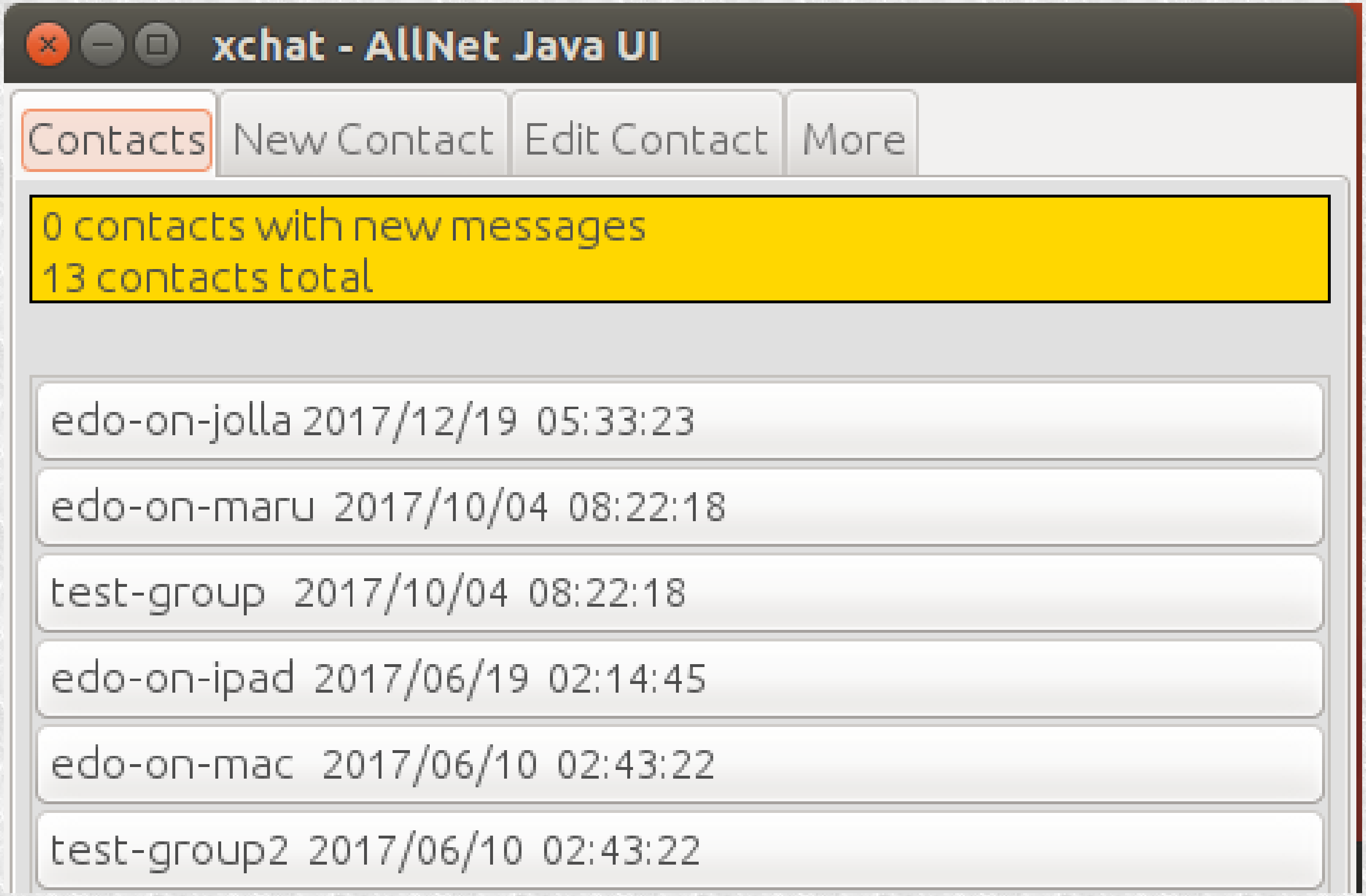
- use a shared secret for initial ID
- encrypt messages
- prioritize traffic
  - my own first
  - my friends' next
  - then others'
- meaningful packets

Experience

- Internet messaging used daily over the Internet
  - by a small group
- so far, P2P mostly used for testing
- mobile devices run apps for short periods only
  - fetch data when run, not when convenient

- **mostly delivers messages reliably**

in a distributed setting
it is easy to create test accounts!



0 contacts with new messages
13 contacts total

edo-on-jolla 2017/12/19 05:33:23

edo-on-maru 2017/10/04 08:22:18

test-group 2017/10/04 08:22:18

edo-on-ipad 2017/06/19 02:14:45

edo-on-mac 2017/06/10 02:43:22

test-group2 2017/06/10 02:43:22

Contact Creation

- distributed
  - I could claim to be Justin Bieber!
- we **meet through a secret known only to us**
- secret chosen by system
- secret only used once
  - ok if compromised after key exchange

AllNet Technology

- messages encrypted, authenticated
- sender-based message prioritization
- self-selected, non-unique, location-independent device identifiers (“addresses”)
- anonymous acks
- distributed, anonymous social network

- **mobile differs from wired networking!**

Anonymous Acks 1/2

- each personal message has an unencrypted header, or “envelope”, and encrypted content
- unencrypted header includes a **message ID**
- encrypted content includes the **ack**

Anonymous Acks 2/2

- (encrypted) ack hashes to (unencrypted) message ID
- anyone receiving ack hashes it, to compare it to received message IDs
- **only receiver can ack**
- anyone can match ack to message

Incentives to Contribute

- could have competitive **games** for “who contributes more to others' transmissions”
  - a distributed currency
- **games** could leverage the anonymous social network
  - the network effect used to incentivize
- must be free to choose how much to contribute
- default is to contribute at least a little
  - e.g. 1%

Future Work
2018/01/01

- better evaluate multihop and delayed ad-hoc
- **collaboration with Pacific Disaster Center**
- complete Android implementation
- add ad-hoc wherever and however possible
- cellphone walkie-talkie

free is good

- but needs minimal support from OS authors
  - Android is Linux, but no API for P2P wifi
  - iOS Multipeer is restricted to iOS devices
- distributed decision-making
- **network follows people**

`http://alnt.org/`