Mobility and Address Freedom in AllNet

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Mobility is a headache

- Mobile providers must keep a Home Location Register to record a device's location
  - also usually a Visitor Location Register
- the problem: addresses (and phone numbers) no longer correspond to the point-of-attachment
- a layer of indirection is always required

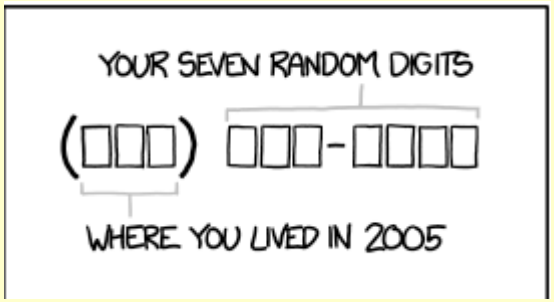
Addresses are (almost) obsolete

- unless your computer happens to be permanently connected to a wire

- Challenge: addresses are what makes routing manageable
  - how can we manage routing without point-of-attachment addresses?

Non-point-of-attachment addresses

- Indirection is needed to support mobility
- So an address is really an identifier
  - it identifies the device, not the location
- The location is obtained by doing a lookup in a global, usually distributed database
- https://xkcd.com/1129/



So the question really is

- How do we build this global, distributed database?
  - without any central points of failure
- The answer is different for:
  - the Internet (AllNet uses a Distributed Hash Table)
  - ad-hoc networks (AllNet uses broadcast)
- if possible, combine the Internet and ad-hoc

The rest of this talk

- the AllNet protocol
  - for communication among humans
  - whenever possible! e.g. Internet, Ad-hoc
- self-selected identifiers
  - what about duplicates?
    - we leverage packet signing to find out which are for us

But first: isn't broadcast evil?

- Yes and No
- ARP uses broadcasts on local networks, and is not evil as long as the network is small
- most ad-hoc networks are small
  - as they grow, likely someone is on the Internet
- BitCoin and BitMessage broadcast
  - but require proof-of-work to avoid DoS

AllNet overview

- started with the question:

  why can't my phone talk to your phone?
- and the answer: they should!

- with mobile devices, it is easy to exchange keys
  - authentication and encryption become easy

AllNet applications

- xchat: everyday chat over AllNet
  - had security before WhatsApp!
  - could be useful in emergencies and offline (hiking)
- exchange pictures directly, without relying on the cellphone service
- cellphone walkie-talkie

not all of this is implemented yet

AllNet networking

- send to every network you are connected to
- send to (and participate in) Distributed Hash Table/DHT when on the internet
  - (DHTs map bitstrings to content)
- data messages carry a messageID
  - message ack is sent encrypted, and hashes to the messageID
  - so ack can only be issued by final receiver

Yes, but what about addressing?

- AllNet addresses are self-selected bitstrings
  - length of bitstring is also selectable (<= 64 bits)
- addresses are used to decide what messages to try to verify and decrypt
- duplicate addresses are OK!
  - just mean I will verify a few more packets
  - and signature verification is quick

Summary

- AllNet addresses are used:
  - to decide which signed packets to verify
  - to decide where in the DHT to save and retrieve packets
- neither of these requires unique addresses

Locating an address in AllNet

- AllNet doesn't actually locate addresses
  - only forwards packets
- send to the DHT node corresponding to the address
- broadcast on attached local area networks
- broadcast within ad-hoc networks

a related topic: AllNet

Human-Readable Addresses

- Suppose I do want a unique address, similar to an email or a web address
  - edo@something (*edo* is Personal Name/PN)
- generate lots of keys, encrypt *edo* with each
  - the last 16/32/48/64 bits of the cyphertext must be found in the hash of the PN (that's why lots of keys)
  - these bits map to *something*, represented as word pairs: daily_time@go_car.for_computer.do_future

Human Readable Addresses

- it is relatively easy to generate AHRAs
  - though many keys must be generated for each
- and select one that is memorable
- it is much harder to generate a key to match an existing AHRA
- e.g. with 3 word pairs, attackers must generate 68,719,476,736 more keys than the owner

AHRA summary

- for now, AHRAs are used only to decide which broadcast packets to display
- e.g. to get a daily time message, subscribe to daily_time@go_car.for_computer.do_future
- or just remember daily_time@go_car
  - shorter is easier to remember, but easier to spoof

AllNet status

- Ad-Hoc communications and Voice-over-AllNet (VOA) available for Linux only
  - ad-hoc in android only available on rooted devices
  - but anyway, android is not yet available (4Q2017?)
- iOS is available! install allnet-xchat
- no picture exchange yet, and can still be slow
- AHRAs work for broadcasts

Summary: Mobility and Address Freedom

- Pick your own address!!
- mobility requires a global database anyway
- you might as well choose your own address
  - and keep it forever
  - or discard it after 10 minutes
    - https://10minutemail.com
- for both AllNet addresses and AHRAs

Why read the paper? (contributions)

- self-selected addresses are useful
  - can choose your own
  - less need for central authority
  - sometimes, unique addresses are not required
- user choice of the lifetime of the address
  - stability vs. anonymity
- AllNet Human Readable Addresses

A more formal summary

- Current addresses require uniqueness and hierarchical topology
  - and have poor support for mobility
- Mobility requires a global mapping of addresses to locations, for any kind of address
  - so, hierarchical topology is not as useful
- Signed packets: uniqueness not required

Can this apply to other systems?

- Mobility already requires a global database
- IP addresses for mobile systems are ephemeral
- some ID would be required to allow incoming connections – then a global database can map it to an actual location

- in short: YES! let's use (self-selected?) IDs

Some alternatives

- Relative addressing – “the nearest printer”
  - requires broadcast or a database
- Don't allow incoming connections
  - hard to provide services
- Use phone numbers as identifiers
  - have to pay to use, and availability is limited

AllNet Trace

- AllNet Trace helps us see who else is on the network

```
  0.002253s rtt,  0 d3.8f/16
  0.159654s rtt,  1 00.00/16
  0.215810s rtt,  1 dd.99/16
  0.337738s rtt,  1 80.00/16
  0.489997s rtt,  1 c0.00/16
```

```
$ bin/trace -i
   1:         0.000723s timestamp,    0.002281s rtt,  0 d3.8f/16
   1:         0.133257s timestamp,    0.164316s rtt,  1 00.00/16
   1:         0.164257s timestamp,    0.214654s rtt,  1 dd.99/16
   1:                                 0.352748s rtt,  1 c0.00/16
   1:                                 0.353152s rtt,  1 80.00/16
sent 1 packet, received 5, rtt min/mean/max is 0.002281/0.217430/0.353152s
```

Distributed Hash Table

- given a varying set of nodes N
- distribute keyed data among the nodes
  - data identified by a bitstring, called the key
- with no central point of failure

- several similar systems, 2001

Distributed Hash Table Design

- Each node keeps the address of a node in the other half of the key space
- and the other quarter of the same half
- and the other eight of the same quarter …

- this “finger table” is logarithmic in the DHT size

Using the DHT

- If I am closer to the key than any node in my finger table, key/value must be in my storage
- otherwise, send data or queries to the node in my finger table that is nearest the key
  - in a logarithmic number of steps, this gets the message to a node responsible for the key/value