Off Grid Communications with Android:

Meshing the Mobile World

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/whoami

- ~ software engineer for the last 12 years
- Spent too much time working inside faraday cages
- Got bored writing my own bad code, figured it would be more fun to poke holes in other people's work
- I like to:
  - break / embed / repurpose things
  - solder things into other things
  - stare at asm
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- @m0nk_dot

/team & project

- SPAN is an Open Source research project initially funded by the MITRE Corporation for use in Emergency Preparedness and Response situations
- Team:
  - Jeff Robble (mistr.stoker@gmail.com) - (MITRE) Lead Developer and currently running the MITRE effort
  - Nick Modly - (MITRE) Visualizations
  - Oliver Chong - (MITRE) Routing Algos and Security

MITRE

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Will he start already?

- What is a MANET?
- Why do I care about mesh networks?
- What is the SPAN project?
- Finally something technical - the guts of a mesh
- Baseball & Terrorism
- </end_session>

- TL;DR:
  - www.omg-pwnies.com
  - https://github.com/monk-dot

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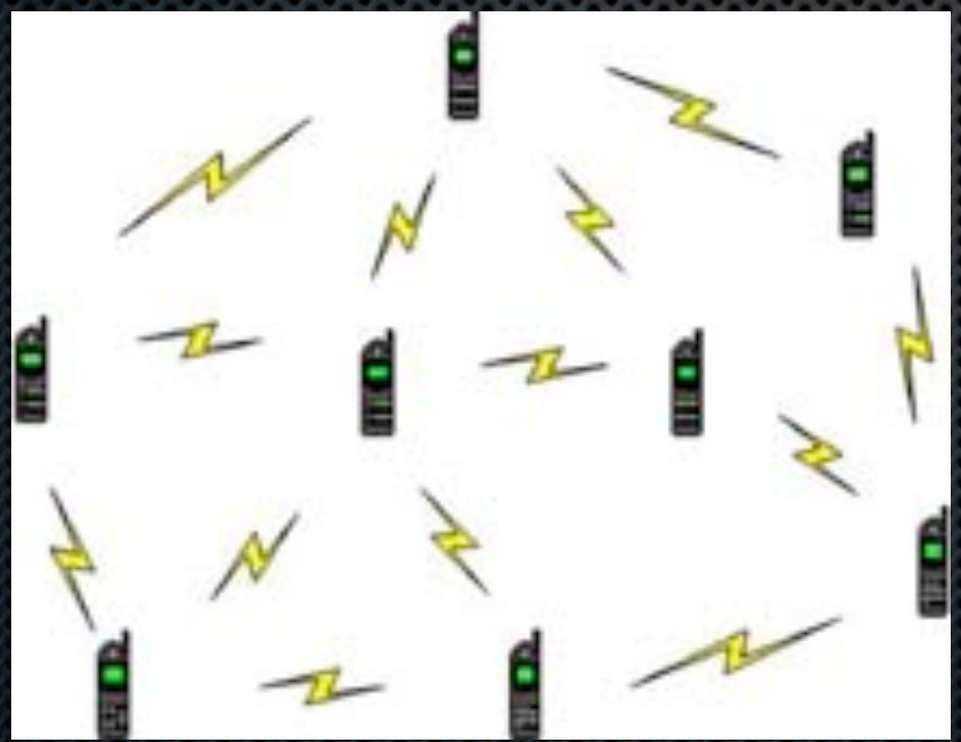
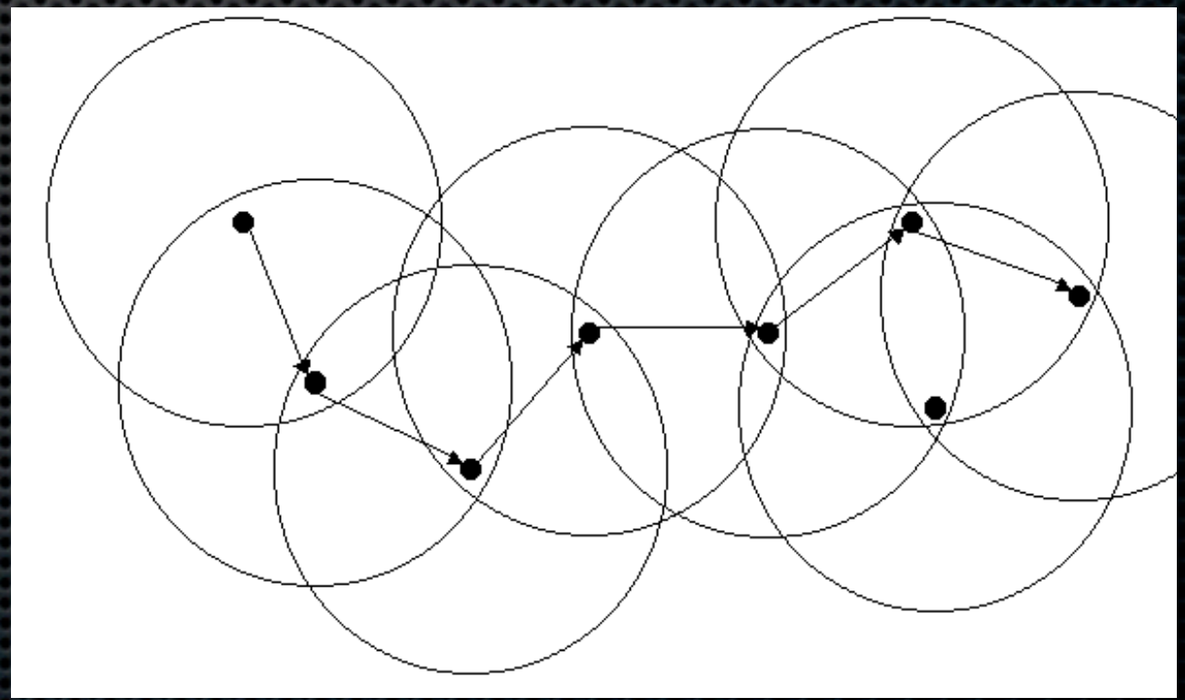
Daddy, What's a Mesh Network?

- It's exactly like graph theory except:
  - Nodes are shiny electronic gadgets that run out of battery and move around a bunch
  - Vertices are unstable and based on arbitrary signal strength
  - The pics are uglier





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Ok, but why?

- WHY:
  - Fukushima, Haiti, Katrina, ...
  - Arab Spring
  - Normal <insert cellular company here> Service
- Physical infrastructure is prone to failure, networks shouldn't be
- Share information when networks are broken or untrustworthy
- Infrastructure is a single point for data sniffing and filtering
- Headless networks are cool!

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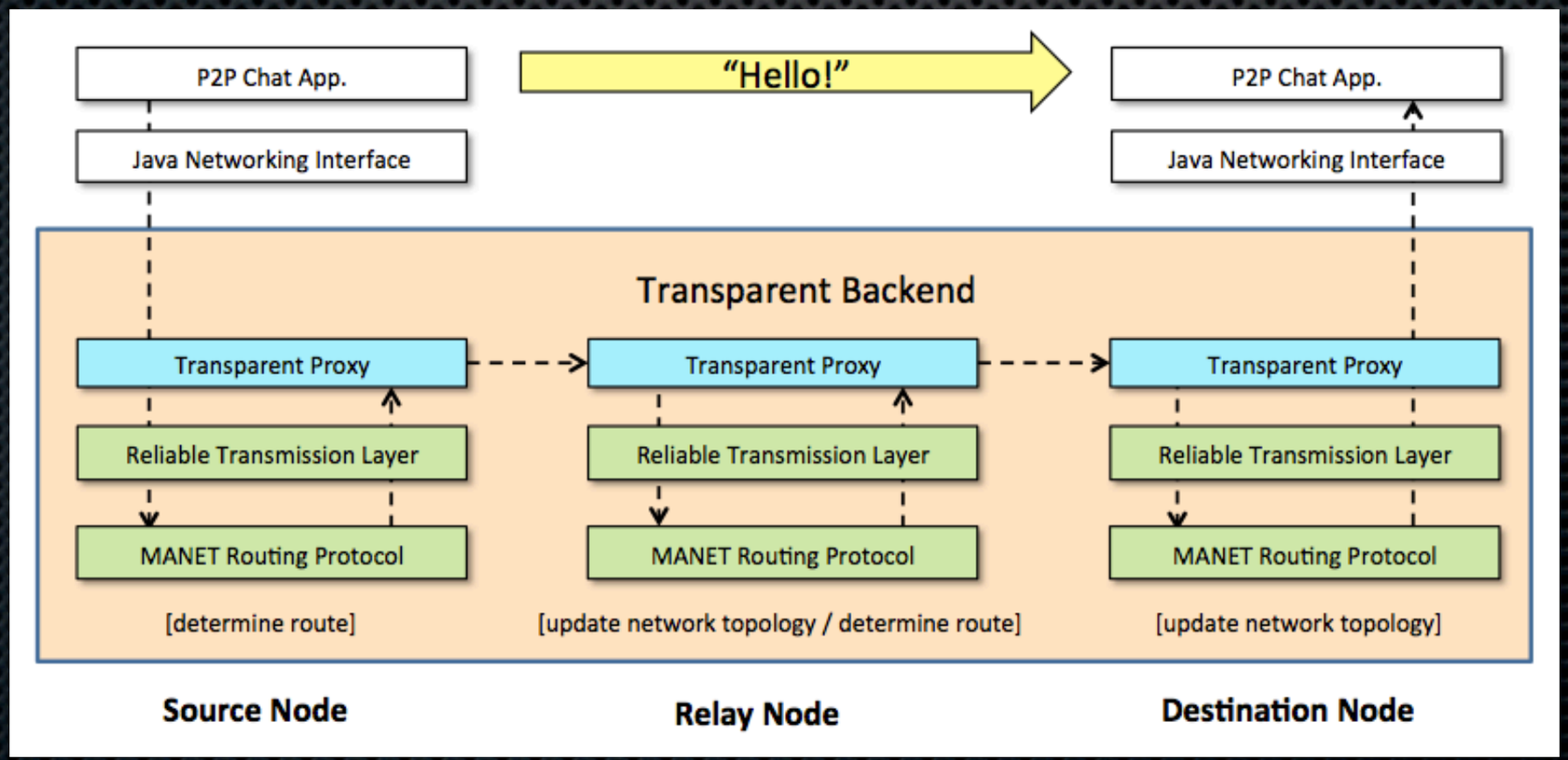
The SPAN Project

- There are too many headaches involved in starting MANET research before you actually get to the hard problems
- Simple framework implementation for MANET - Smart Phone AdHoc Networking
- A transparent proxy so normal applications just work
- Initially a MITRE funded research project, now open source



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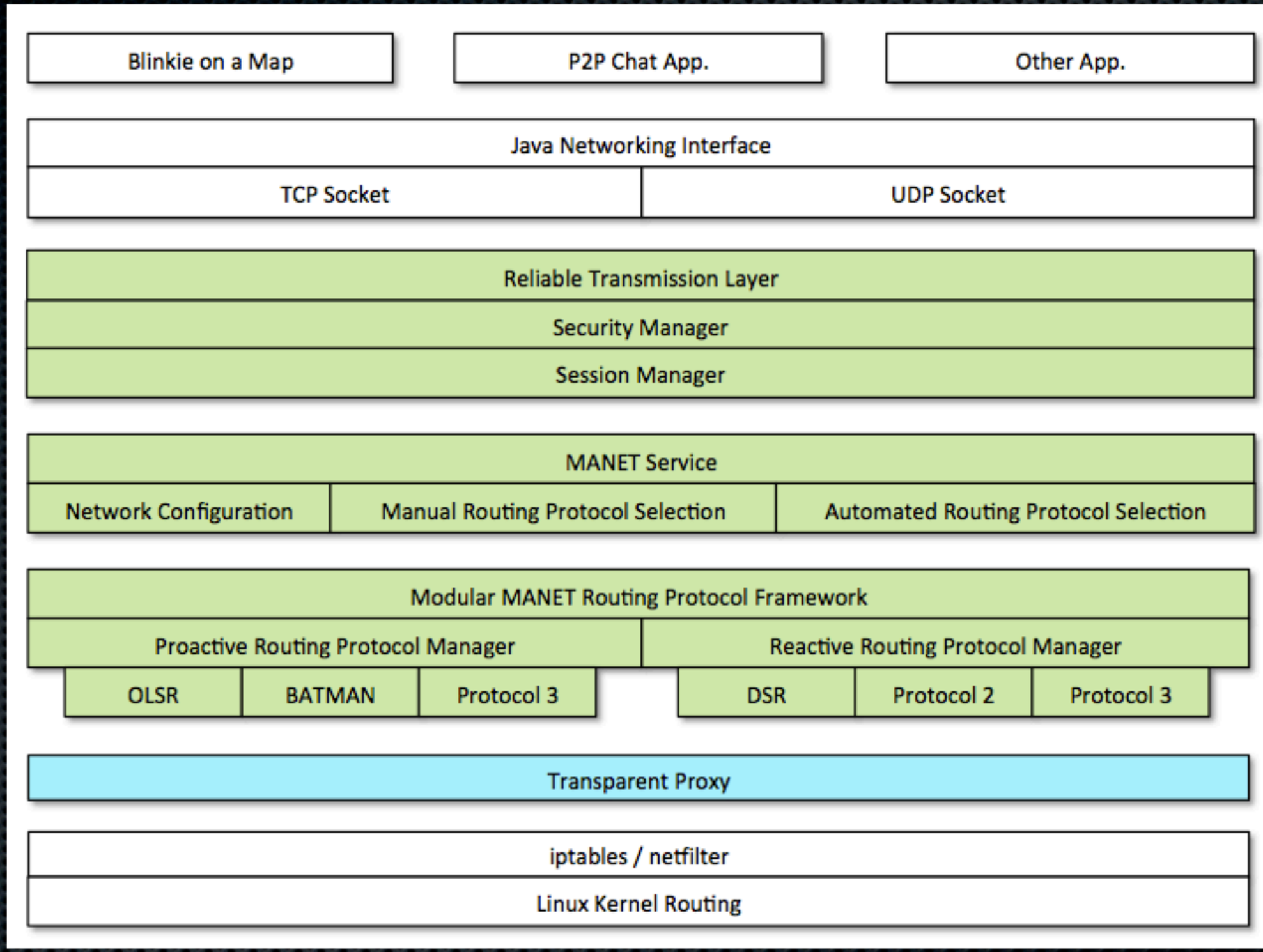
The Stack



Hard problems that shouldn't be hard

- WiFi chip manufactures:
  - Broadcom 4329 - Samsung Galaxy Nexus, Samsung Nexus S 4G, Nokia Lumia 900, older iPhones, Asus Transformer Prime, many more
  - Broadcom 4330 - Samsung Galaxy TAB 10.1, Samsung Galaxy S II / Epic Touch 4G, iPhone 4S, many many more
  - TI WL1285C - Motorola Razr / MAXX
  - Qualcomm - A ton of Android Phones
  - Murata - iPhone 5 (possibly a re-brand)
- Vendors that muck with open source projects and lock things down (for a reason normally)
  - Sprint / AT&T / Verizon / HTC / Motorola / Blah Blah Blah

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Ok, will my _X_ phone work?

- We need to be able to lock the WiFi Chip out of managed mode
  - You know how your phone sometimes scans for networks to join? We need to keep the chip in that mode

- Android kernel needs Wireless Extensions support enabled
  - Q: Why would you turn this off?
  - (A: To fight unpaid tethering)

- In short, if you can jailbreak / root your phone, run C & Java code and can somewhat control the WiFi hardware then yes, it will work (Android / iOS / Arduino / Linux / Windows /

Hard Problems that are in fact hard

- Routing
  - Proactive vs. Reactive
  - Sensor based routing
  - Other mesh & routing projects
    - OLSRd
    - SERVAL / BATMAN
    - Byzantium Mesh
    - FreiFunk
- Network Scale / Speed and Power consumption
- MANET configuration - PACMAN?
- Security

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I sleep in packets

- Mobile Devs want to save battery life so...
  - By default Android likes to filter and trash UDP packets when the screen is off.
  - First, we tried grabbing a wake lock and dimming the screen ourselves (this is what is commonly known as an ugly hack)
  - Then we found this:
    - dhd_pkt_filter_enabled=0 in the WiFi kernel module
    - Solved!

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??? Security ???

- Securing a mesh is awkward
- The SERVAL project has a fairly cool way of using the public key as the device address but devices still requires manual configuration
- We can use the MAC to auto-generate an IPv6 address, but it breaks the SERVAL paradigm
- We can use NFC / Bluetooth / Whatever to exchange keys when a device joins a network but that massively shortens the distance between nodes
- Enclaves across untrusted nodes
- Enclaves over internet bridges

<Odd_Problem>

- Both the Samsung Galaxy Nexus and the Epic Touch 4G devices we were testing with contained the BCM4330 chipset
- They could join the same network but once ~10 ET4G devices joined, the SGN phones just disappeared
- After many headaches, we found the devices were broadcasting at different wavelengths / waveforms and at different signal strengths
- The ET4G devices were actually creating a sort of white noise that cancelled the lower power transmission out
- These are the odd problems from software controlled power / signal strengths

</Odd_Problem>

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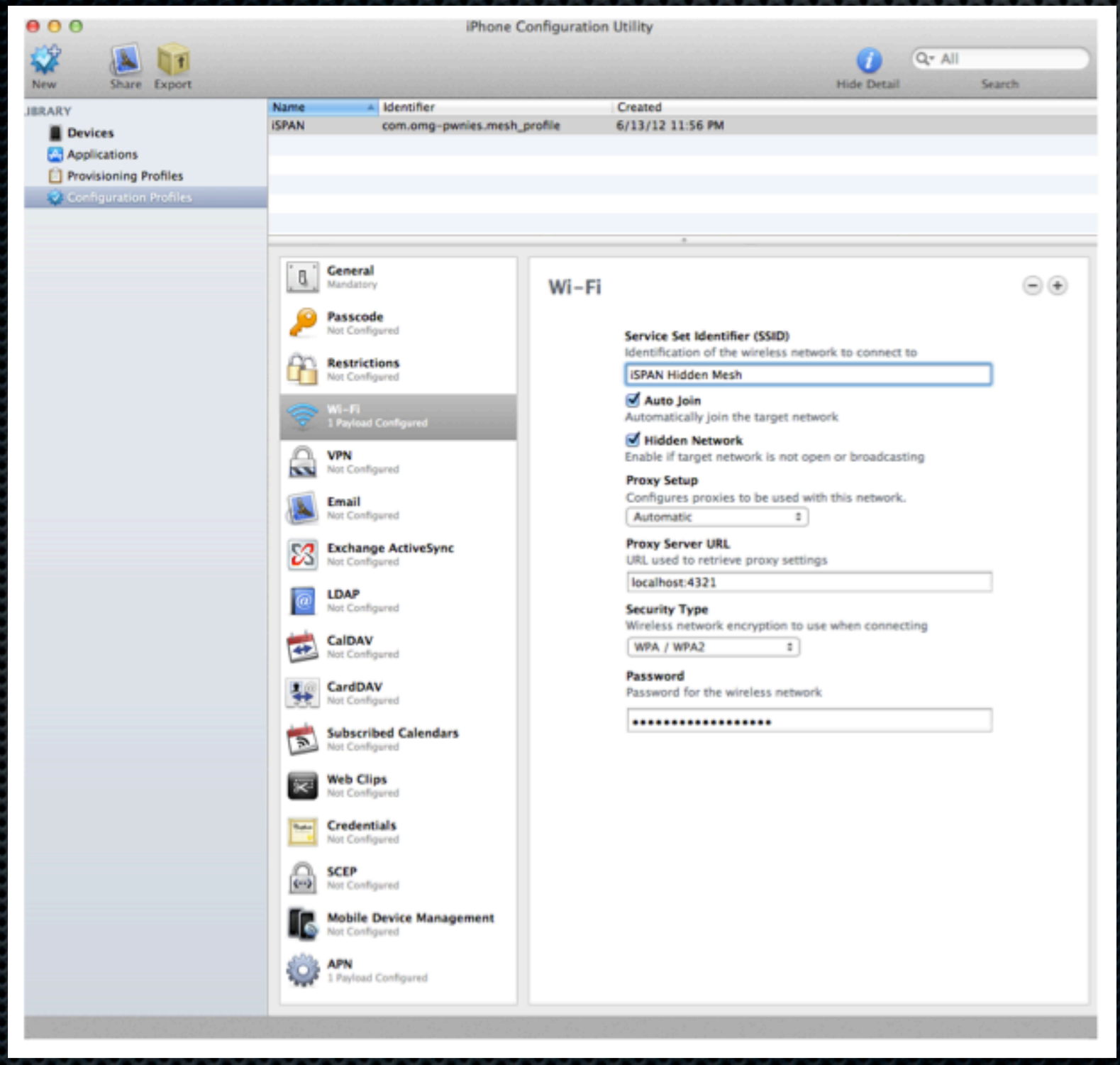
What about iOS?



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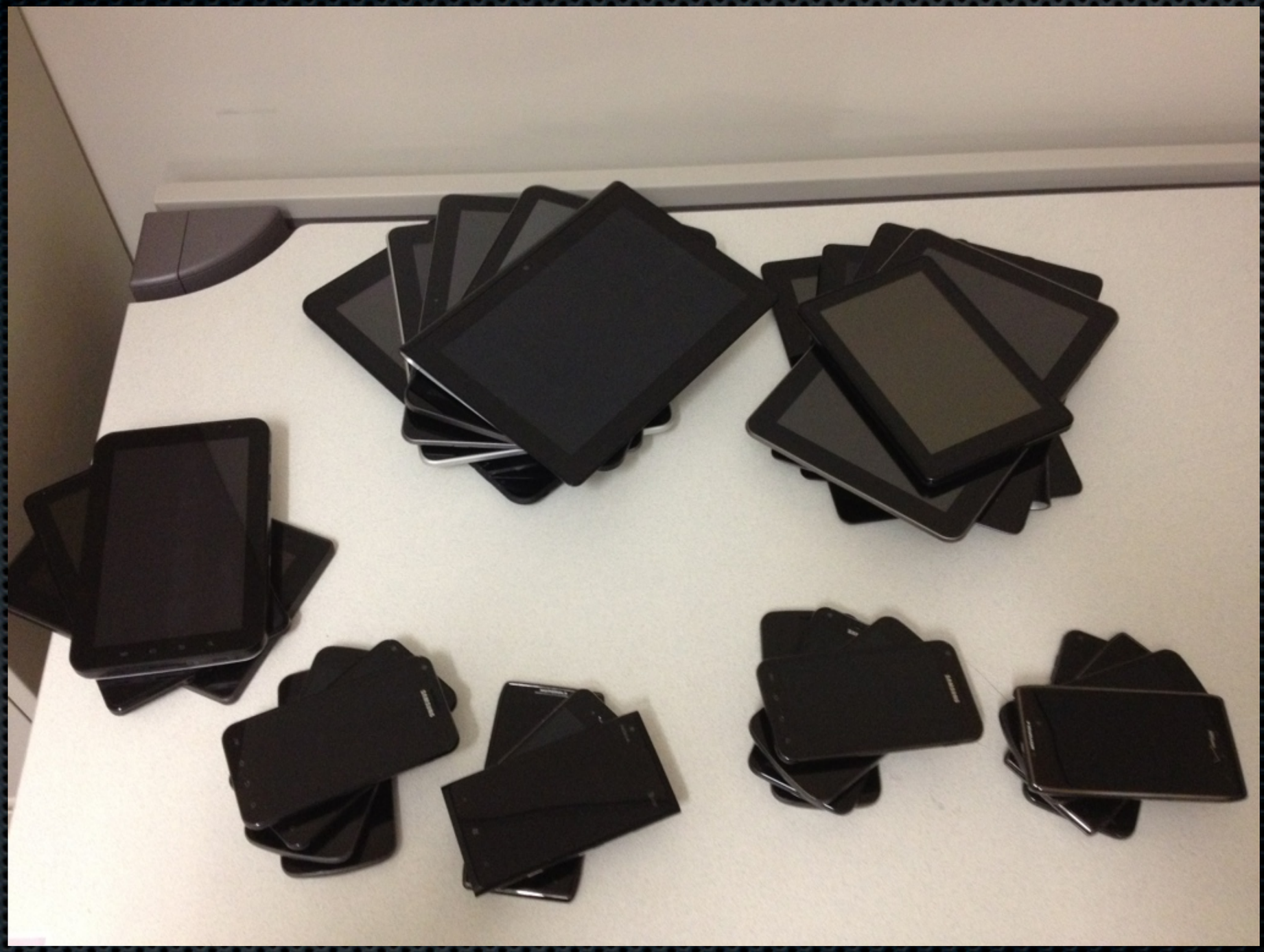
A Short story in 7 Pictures & 9 Words



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Terrorists love Baseball

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Hotels hate me

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Snipers hate Engineers

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Questions? Comments?

https://github.com/monk-dot

http://www.omg-pwnies.com

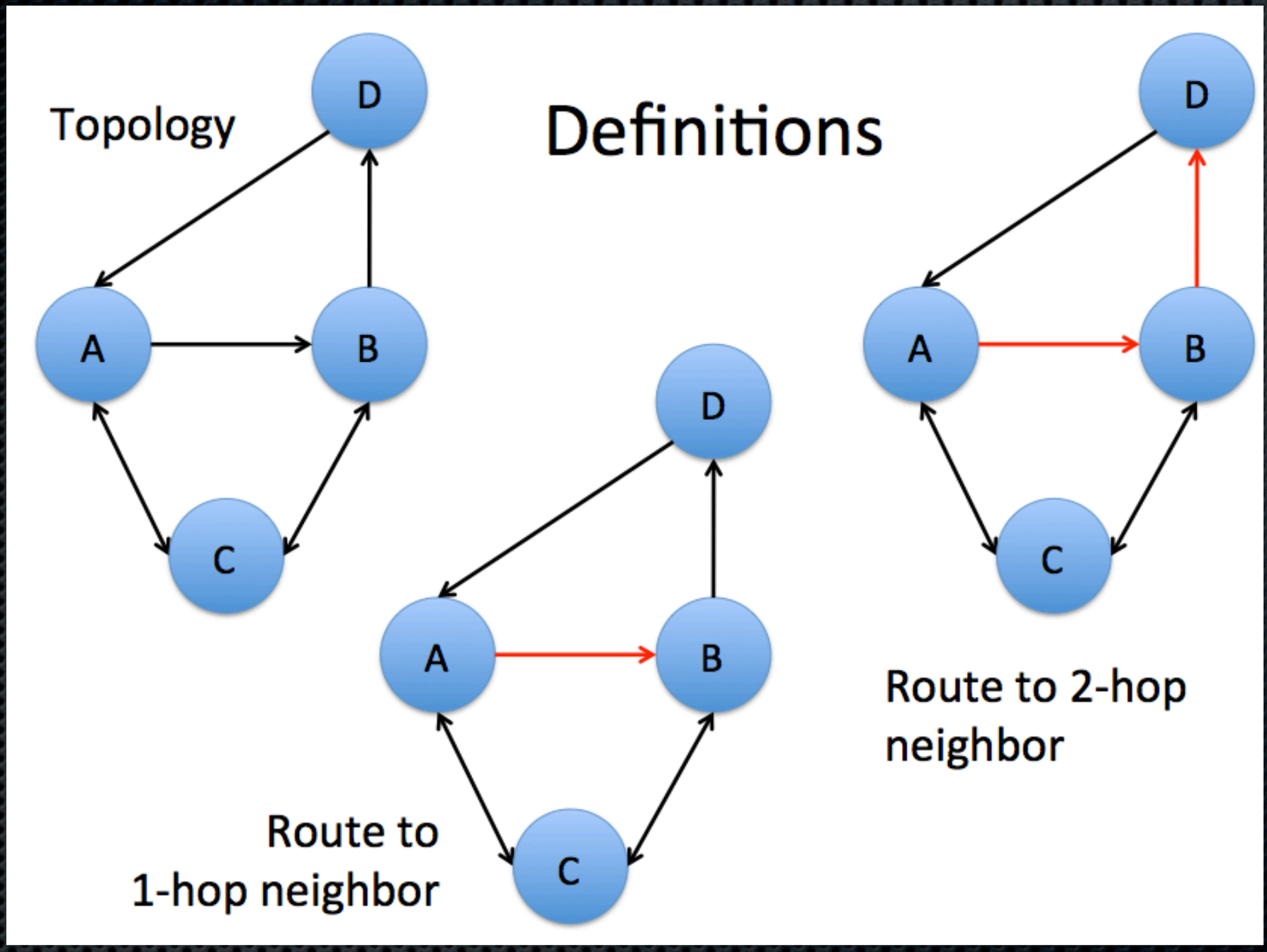
- </talk>

The Links

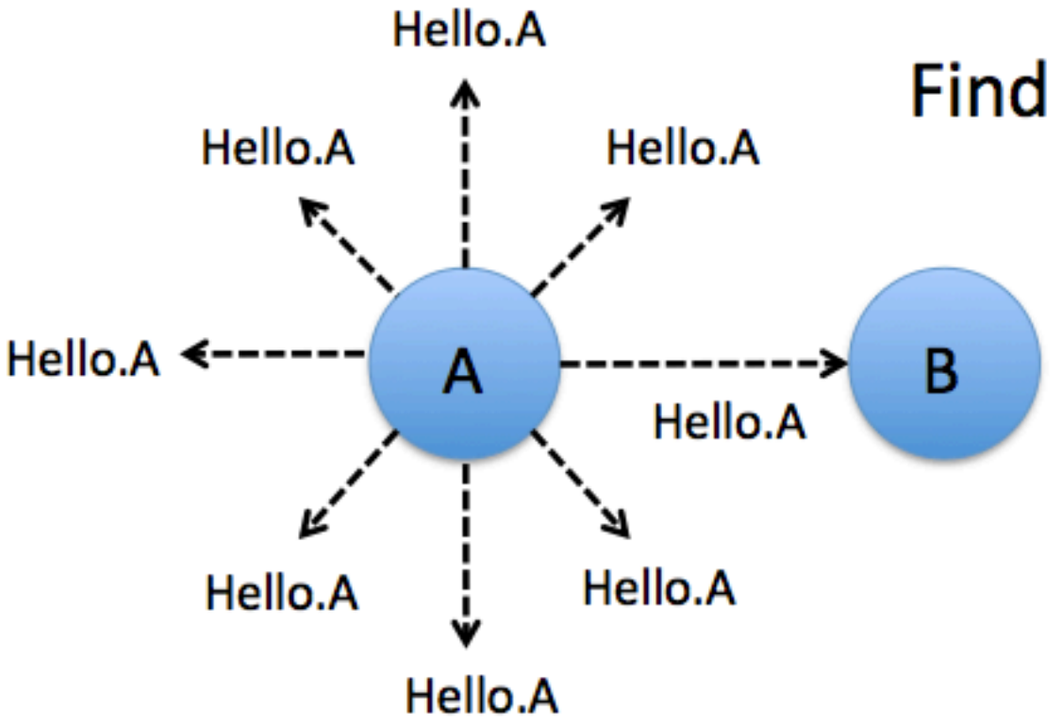
- http://code.google.com/p/android-wifi-tether/
- http://www.olsrd.org
- http://www.servalproject.org
- http://berlin.freifunk.net
- http://project-byzatium.org

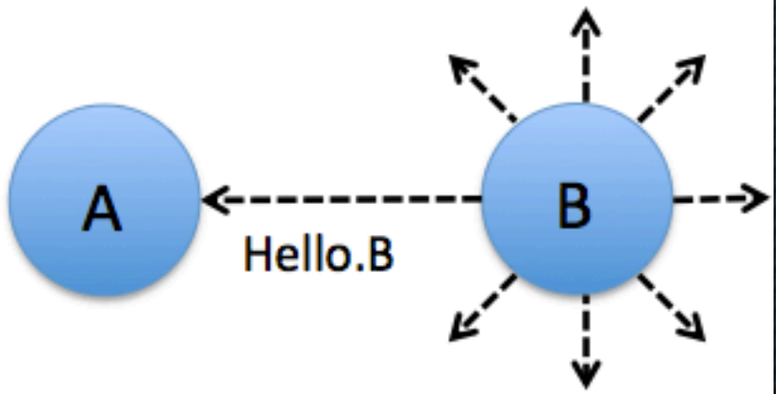
Backup Slides

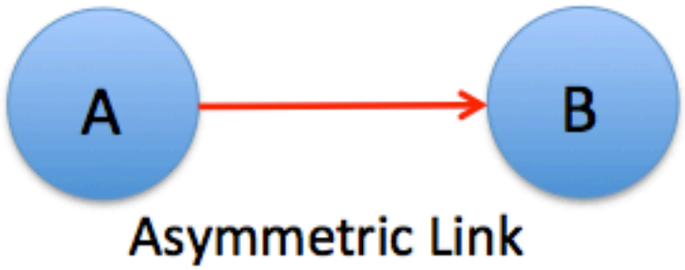
Routing Protocol Pics (or it didn't happen)



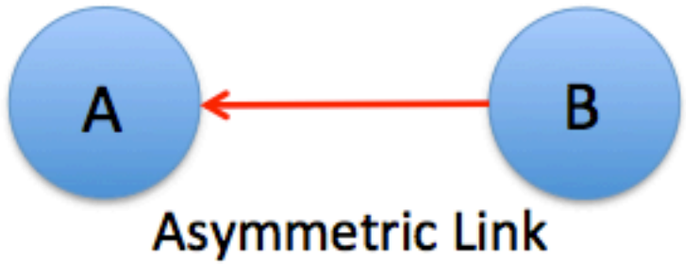
Find 1-hop neighbors







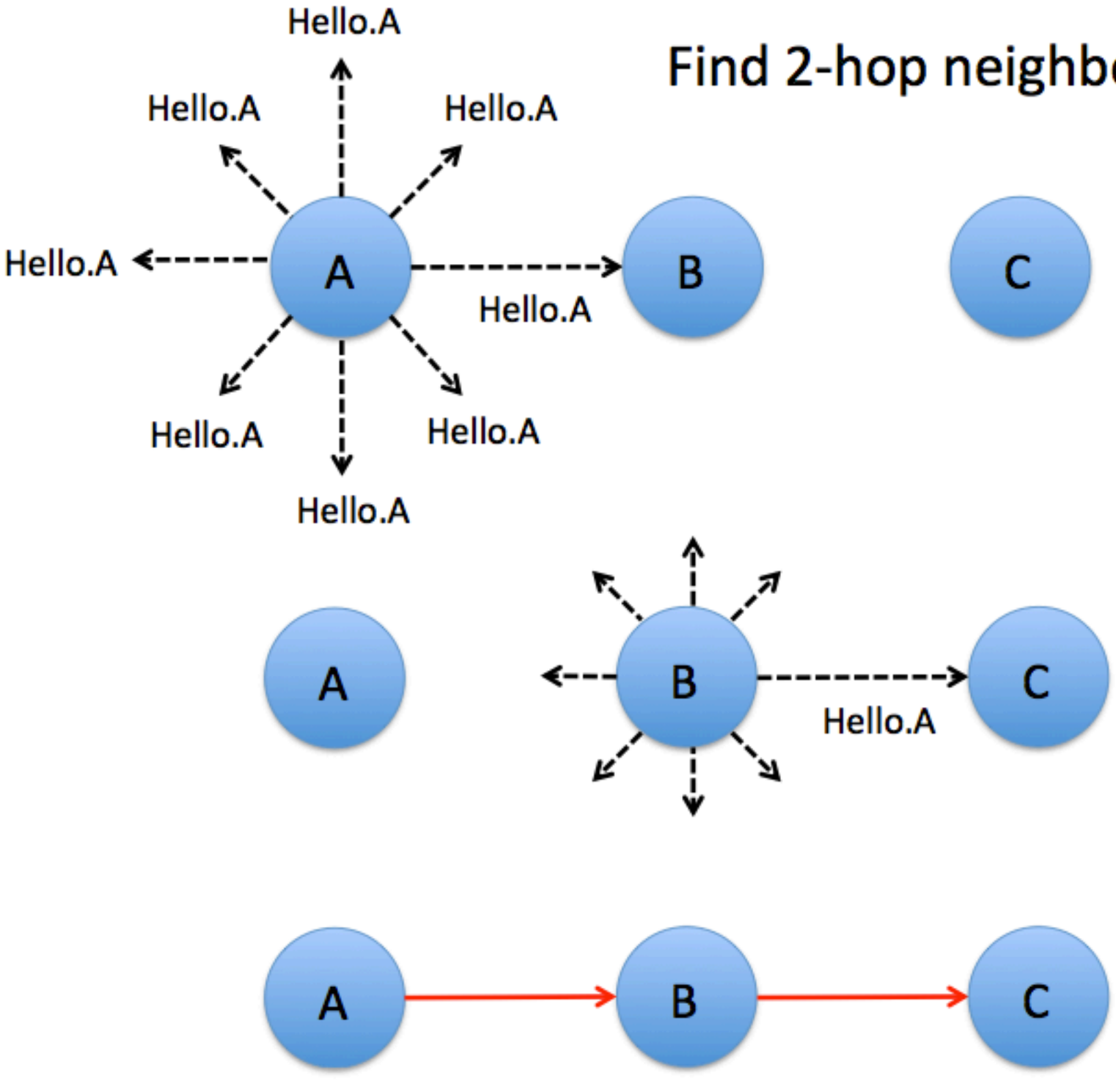
Asymmetric Link



Asymmetric Link

Symmetric Link

Find 2-hop neighbors



Multi-Point Relay