Homenet 4 HackerBoards

Exploring alternate link layers in world with
no ethernet and **overused** wifi.

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Babel Working Group
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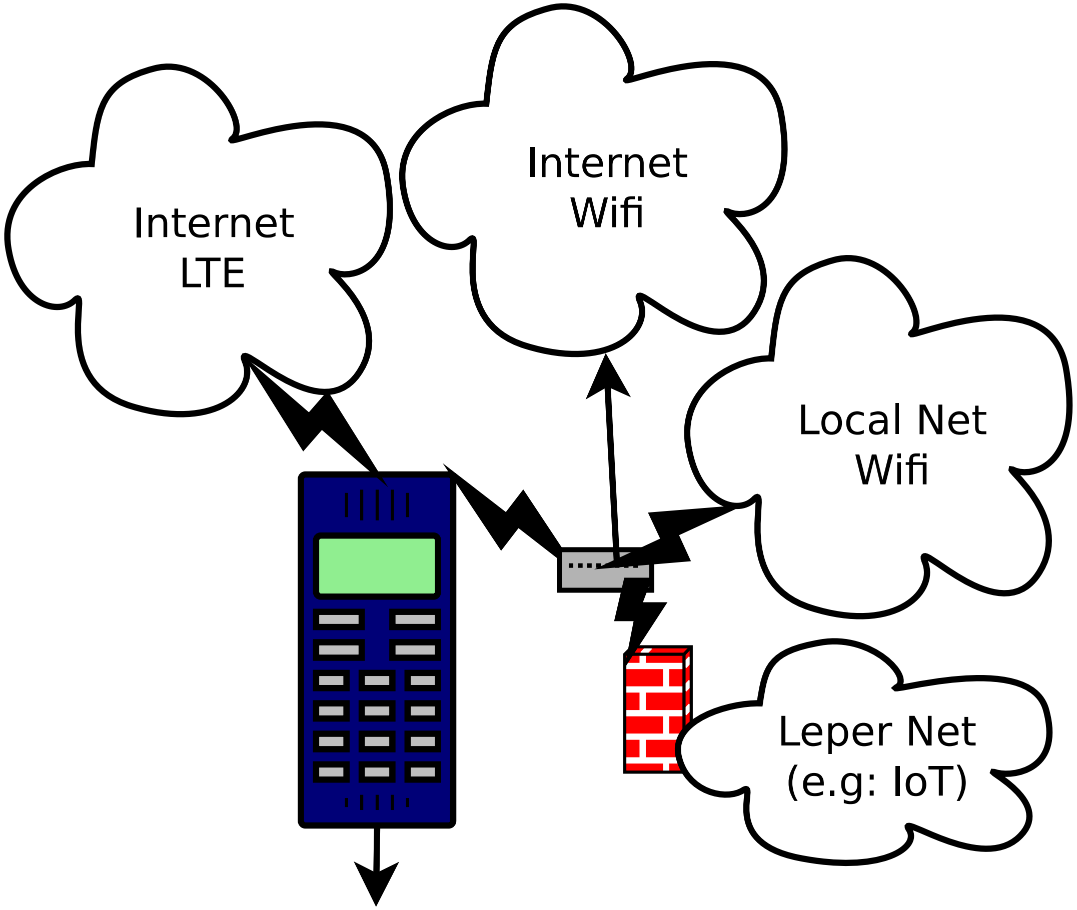
The end of ethernet?



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Observations

- Wireless has become the predominant net access method.
- Many devices need power all the time (duh!)
- Battery operated devices (e.g. cellphones, laptops, tablets) spend ~half their time plugged into power
- Micro-USB-OTG connectors are a defacto standard
  - Supplies 2A, 5v power (7.5W) and ~480Mbit data
  - Upcoming: USB-3.1c: 100W – and 10GBIT data!!
- For comparison POE is 48v, 25W and 1Gbit

Note: Wifi Sucks

- Although I work primarily on the make-wifi-fast project these days… adding FQ and AQM technology to that stack…

  … the best way I can think of to keep wifi fast for when you need it…

  IS TO NOT USE WiFi!!

  WHEN DEVICES DON'T HAVE TO!! (system updates, when you are connected to power over usb, etc, etc)

Stupidity, inside

- 100Mbit HDMI ethernet interface (unused)
- USB interface (used for power only)
- 802.11n wifi (behind a giant radiation shield)

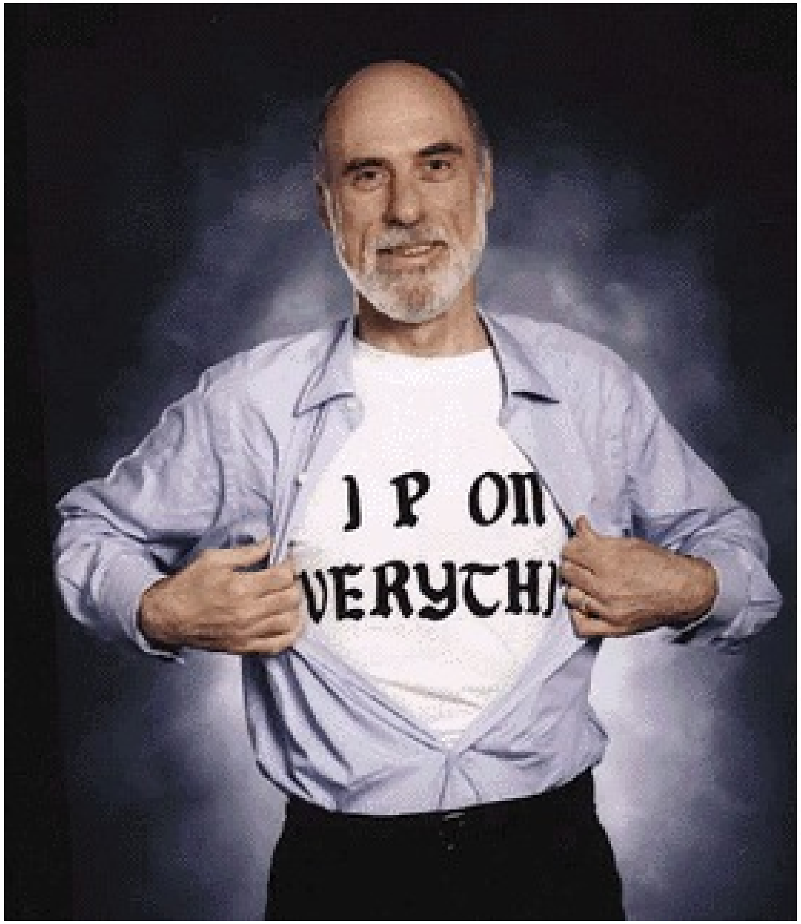
Why did ethernet HDMI fail?

- Only 100Mbit
- Lack of drivers and chipset support
- Paranoia about copy protection
- Address assignment issues – how?
- Routing – non existent. Bridging – inadvisable
- Service discovery – handled by the native HDMI protocols
- No demand, no standards, no market
- Skip that ethernet enabled Monster cable!

USBNET – the lost Link Layer

- IP over USB-OTG available on all operating systems since 1998
- 20-200Mbit performance for IP (usb2)
- Co-exists with other services on the same bus
- Used for USB “tethering” in particular to create local hotspots.
- Billions and Billions of USB ports “out there”
- But… local, personal connectivity only for most USBNET implementations.
- Can we make usbnet a first class networking layer?

YES! Homenet over USB works!



What is a hackerboard?

- Raspberry Pi created the category, 100s now exist. Typical cost: $40 dollars for a quad core ARM, today.
- Common OSes are debian, android. Windows soon! There’s Minix, and RTOSes, as well...
- To shave on cost, most currently do not have a GigE Phy. A significant percentage are wifi-only, and powered via USB. Nearly all (except the pi) support usbnet over OTG, also.
- It’s not just hackerboards with this infrastructure!

  These are the chips going into millions of TVs, compute sticks, embedded devices, cars, settop boxes, drones, IoT gateways, and so on...

Typical Hackerboard Specs

- Cost: $2-50 dollars
- 1+ Ghz Arm or Intel Bay trail CPU
- 1 Watt power consumption
- 1-4 cores, 1-2GB RAM
- 4-8GBytes mmc flash storage
- Wifi + USB, ethernet + USB, etc.
- Lots of GPIO ports
- See hackerboards.com for news

Today. Where will it be in 3 years?

Alternate link layer Issues

- USB link layer issues
  - Address assignment
  - Routing
  - Service discovery
- Homenet SOLVES all these problems
  - Mostly running code today
  - Other specs settling

Address assignment issues

- Most hackerboards/tethers provide ipv4 dhcp only
  - Static ipv4, arbitrarily assigned (192.168.7.X) (beaglebone), no default gw
  - Static ipv4, arbitarily assigned, default gw (conflict), NAT, usb tethers
  - No IPv6
- USBNET is a P2P bus overlay, and you can have a lot of them
  - no need for an entire /64 – a 128 suffices
- Local address assignment MUST work with partial connectivity (ULA generation announcements?)
- DHCP-PD needed to get prefixes (somewhere) for global connectivity, or leveraging HNCP.
- SLAAC, DHCPv6 need prefixes assigned
- HNCPD works today.
- Addresses then need to make it to the larger network via routing protocol

Babel over USBNET Issues

- It “just worked”
- Sane address assignment needed
- Anycast
  - Yea! Anycast Works!
    - Static services can be anywhere on a network
    - IPvX identifiers can be persistent no matter where plugged in
  - Boo! Anycast Works!
    - Duplicate address detection/assignment needs HNCP
- Usbnet creates random mac addresses
  - Linux systemd then creates random interface names (add globbing to babeld?)
  - Leverage wifi Mac for router_id generation?
- Network Mangler has many false assumptions
- Default link costs the same as ethernet
  - Cost of 96 (for usbnet, 10,100,1000,10000 ethernet)
    - USBNET Still almost always better than WIFI or LTE!
  - Same issues for virtual machines
  - Better metrics are needed

USBNET Service Discovery

- MDNS works locally over IPv6 on usbnet already
- Hybrid Proxy code sort of working
- MDNS to DNSsd push specification settling
  - Low on usable code
- UPnP?

Misc Tips

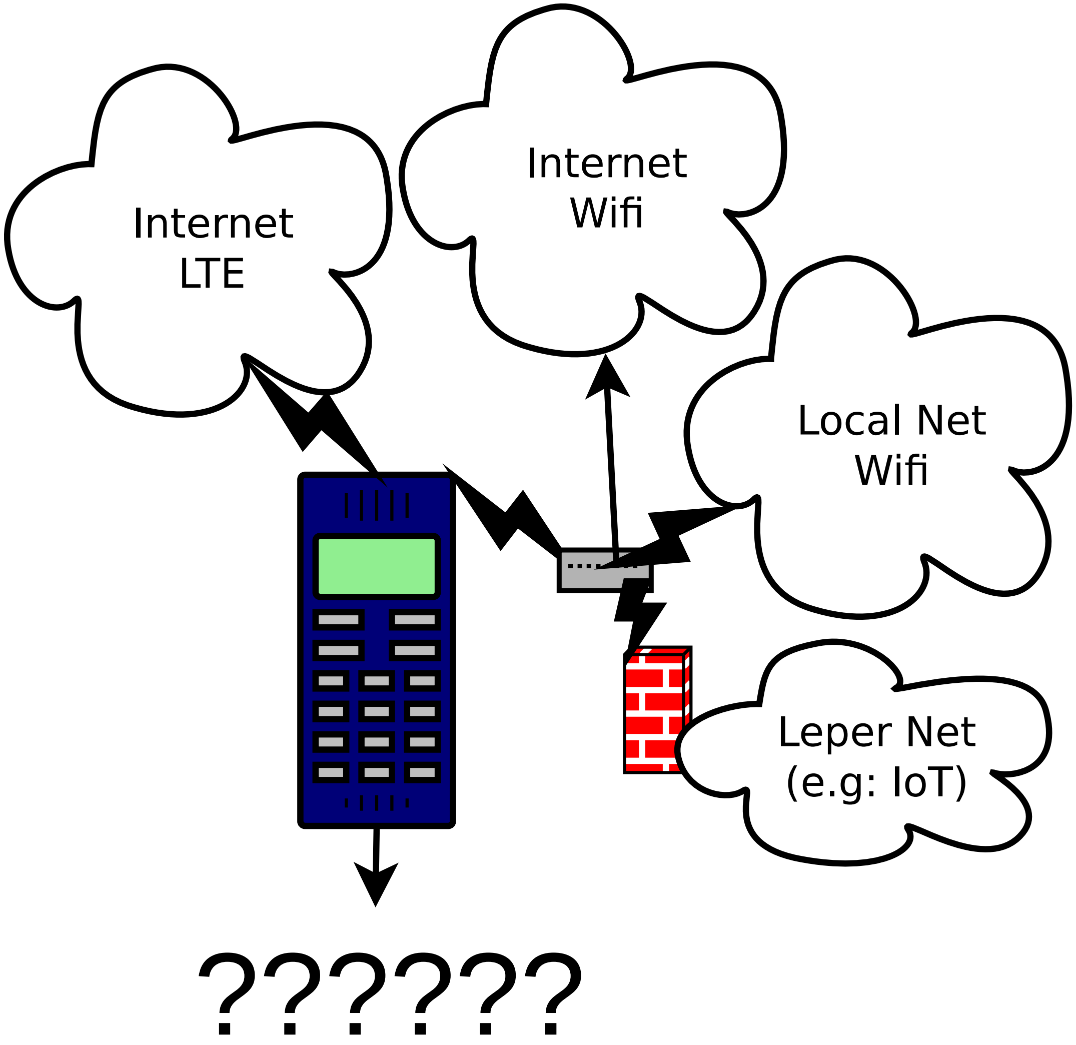
- New device on/events tend to take the link up/down
- Must power these devices with a usb3 port at minimum
- fq_codel “just works” on usb net
- Look for devices with modern kernels
- Have fun!

Next Steps

- What is required for Android/ChromeOS support?
  - Modern Linux kernels (IPv6SUBTREES)
  - Rewrite core routing/proxy/address daemons in Java?
  - DHCPv6-PD from cell providers?
- Other Oses?
  - Polish openwrt and debian support
  - OSX mostly there
    - Need source specific routing support
  - Windows?
  - IOS?

Question

- Is making babel work well on alternate link layers a goal of this WG?
- If so, which?
  - USB?
  - PowerLine?
  - Thunderbolt?
  - Bluetooth?
  - 6lo?
  - 802.11ad?
  - LiFi?
  - Tunnels?
  - ?


Internet
LTE
Internet
Wifi
Local Net
Wifi
Leper Net
(e.g: IoT)
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