Homenet 4 HackerBoards

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

IETF 96 Presentation
Babel Working Group
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The end of ethernet?
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, arbitrarily 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?
  - ?