Recent Investigations and Future Developments in the Wireless Front

Ricardo Carrano
Agenda

• 9.1 Recommendations
  – Some maybe 9.2, some maybe 8.2.1
• Princeton stuff
  – Not research, ready to go
• Libertas Thin Firmware
  – AP and o12s
• 8.2 Recommendations
Recommendations

• Implementation
• Diagnose
• Test
Implement Recommendations

- I1. Detect and Adapt: The Mesh Adaptation Daemon
- I2. Reduce the management traffic
- I3. Implement a better rate adaptation algorithm
- I4. Agnosticism of the presence service
- I5. Implement a new (PHY) Physical layer
- I6. Adjust costs (metric) in each of the PREQs
- I7. Improve Network Wide Broadcast spectrum efficiency
- I8. Improve ip addressing scheme in the mesh
- I9. New version of NetworkManager
- I10. Increase Route Expiration time
- I11. Change Contention Window Size
(I1) Detect and Adapt

• different animals
  – dense mesh and a sparse mesh
  – 1cc and Piratininga
  – Infra mode vs mesh mode
  – XO vs Active antenna
Mesh Adaptation Daemon

**IDLE DENSENESS**
- WHAT? count beacons
- HOW? increase CW

**ACTIVE DENSENESS**
- WHAT? count path responses
- HOW? increase CW, increase mcast/bcast rate

**CONGESTION**
- WHAT? backoff counter
- HOW? increase CW, increase mcast/bcast rate

**MOBILITY**
- WHAT? decrease route expiration time, decrease req_delay
- HOW? count path errors, denseness/congestion status, power status

**LINK QUALITY**
- WHAT? lower tx rate
- HOW? transmission errors (no ack), denseness/congestion status

**AC POWERED**
- WHAT? decrease A
- HOW? AC plugged in

**BATTERY POWERED**
- WHAT? increase A
- HOW? no AC

**LOW BATTERY**
- WHAT? stop forwarding frames
- HOW? low battery
Example heuristics

• Density vs Multicast Rate
  – In a dense mesh cloud we should increase the multicast/broadcast rate.
  – The higher the rate a frame is transmitted
    • the less airtime it consumes
    • the shorter the distance

• Power vs Metrics
  – If a node runs on battery, it should advertise worse metrics
(I2) Management traffic

• Management frames transport announcement information
  – Beacons
  – Probe Request/Response
Beacon Frequency

Aggregated beacon frequency (Hz)

![Beacon Frequency Graph](image-url)
Probe storms

![Graph showing probe requests, probe responses, retry, and acks (probe resp) over time.](image-url)
Probe storms
Reduce Management Traffic

• Decrease beacon frequency
  – From 10Hz to 1Hz

• Reduce probe traffic
  – Probe Response Retries
Rate Adaptation Logic (I3)

• XO can transmit frames at many data rates
  – 54, 48, 36, 24, 18, 12, 9, 6 Mbps (802.11g)
  – 11, 5.5, 2, 1 Mbps (802.11b)

• The higher the rate a frame is transmitted
  – the less airtime it consumes
  – the higher the probability of corruption
Rate Adaptation Logic

• ARF
  – If a given number of consecutive frames
    • Fail \(\Rightarrow\) decrease rate
    • Success \(\Rightarrow\) increase rate
  – Main issue
    • No distinction between losses due to noise and due to congestion
Making things worse
Making things worse
Metrics (16)

• Adjust values for metrics
  – Costs for PREQs (54, 36, 11 and 1Mbps)
  – Current values: 13, 28, 46, 64
  – Proposed values:
    • XO: (963, 1073, 1997, 12906)
    • Active antenna: (962, 1072, 1996, 12905)
    • Better yet: MAD (take other metrics into account)
      – Battery
      – Mobility
NWB efficiency (I7)

• A mesh need to be flooded
  – Some information has to achieve all the XOs
    • Presence information
    • Path discovery mechanism
  – We want to do it more efficiently than Simple Flood
    • SBA (Scalable Broadcast Algorithm)
Route Expiration Time (I10)

• After X seconds every path will be rediscovered
  – Flood the mesh cloud

• The tradeoff
  – Frozen vs Clogged
Colorful Graph
Mean Airtime Taken

Mean airtime consumption

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Route Expiration Time

– Currently this time is 10 seconds
– Recommended value is 20 seconds
– Better yet: again adapt: MAD
  • Mobility
  • Density
Contention Window (I11)

- Stations (XOs) that have data to transfer will wait for a random number of time slots before sending the frames
- The number of time slots is determined by the Contention Window
  - XO previous default: [7,15]
  - Suggested values: [31,1023]
Diagnose and Testing

- D1. The manually added path enigma
- D2. The Internal Flow control black hole

- T1. Test facilities
- T2. Test suite
- T3. Simulation environments
Princeton

• Hash cache
  – Much more efficient than squid
• TCP
  – More suitable for poor links
• PlanetLab
  – Deploy and manage school servers
Thin Firmware

• MAC Sublayer (PLME + MLME)
  – Thin Firmware (PLME only)
  – Thick Firmware (PLME + MLME)

• Authenticate, Deauthenticate, Associate, Disassociate, Reassociate, Beacon, Probe

• Currently Linux community leans towards softmac/thin firmware
The XO as an AP

• XO can be access points
• Thin firmware
  – Firmware
  – Driver
  – Hostap
o11s

- Unicast Forwarding
- {Broad,Multi}cast controlled flooding.
- Hybrid Wireless Mesh Protocol
- Airtime link metric
- Mesh Peer Links
- Per-neighbor rate adaptation
- Mesh beaconing and scanning
- Mesh ID
8.2 Recommendations

• Wireless crashes
  - New driver in 2.6.25
  - Action: Marvell released 22.p18
• No msh0
• Collaboration
  - Telepathy issues
  - Action: Generate logs and send them to Collabora
• Suspend related
  - udev?
  - Action: Cozybit is looking into the driver
• Duplicated AP
  - NetworkManager and Sugar
  - Action: Look into NM
References

- http://wiki.laptop.org/go/Path_DIScovery_MEchanism:Metrics
- http://wiki.laptop.org/go/XO_as_AP
Thanks for your time!
External Network

PORTAL
MP

MP
AP

MP

MP

STA

STA

STA

STA
ONE LAPTOP PER CHILD