Where have we been?
Where are we now?
What is coming?
What else is needed?
Other issues
Questions?

Tux on the Air
The State of Linux Wireless Networking

John W. Linville

Ottawa Linux Symposium

23 July 2008

Where have we been?
Where are we now?
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Who am I?

Where have we been?
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Thanks

Mini-summit in Ottawa

- Travel Support
    - Intel
    - Canonical

- Vendor Representatives
    - Broadcom
    - CSR
    - Intel
    - Marvell
    - Ralink

- Community Developers

Where have we been?
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Birds of a Feather

Wireless BoF
Today @ 5:45pm
Rockhopper

"They just want their hardware to work..." – Jeff Garzik

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Full MAC Hardware
Soft MAC Hardware
ieee80211/ieee80211softmac
mac80211

Full MAC Hardware

- Appear to kernel as ethernet devices
- Use large firmware image (increased cost)
- Require wireless configuration mechanism (e.g. SSID)
- Not prone to regulatory tampering
- Vendor support was adequate

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Full MAC Hardware
Soft MAC Hardware
ieee80211/ieee80211softmac
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Soft MAC Hardware

- Use minimal firmware – cheaper!
- Rely on CPU for most MAC layer functions
- Need software at the CPU for those functions!

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Full MAC Hardware
Soft MAC Hardware
ieee80211/ieee80211softmac
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ieee80211/ieee80211softmac

- Support component for ipw2100/ipw2200
- Adapted from earlier hostap driver code
- Only supported design of those devices
- ieee80211softmac component added by Johannes Berg
- Design deemed sub-optimal by developers...

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Full MAC Hardware
Soft MAC Hardware
ieee80211/ieee80211softmac
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mac80211

- Devicescape released source code of what became mac80211
- Feature-rich, popular with wireless developers
- Soon adopted by new "soft MAC" drivers
- Several code problems identified esp. locking issues
- Quickly adopted by Jiri Benc, assisted by Michael Wu, Johannes Berg, and others
- Merged upstream in 2.6.22, drivers followed later

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Driver status
Patch Activity
How does someone get the code?
Website

Current Drivers

Driver	Hardware Vendor	Uses mac80211?
adm8211	ADMTek	Y
ath5k	Atheros	Y
b43	Broadcom	Y
b43legacy	Broadcom	Y
iwl3945	Intel	Y
iwl4965	Intel	Y
libertas	Marvell	N
p54pci	Intersil	Y
p54usb	Intersil	Y
...	...	...

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Current Drivers (continued)

Driver	Hardware Vendor	Uses mac80211?
rndis_wlan	Various	N
rt2400pci	Ralink	Y
rt2500pci	Ralink	Y
rt2500usb	Ralink	Y
rt61pci	Ralink	Y
rt73usb	Ralink	Y
rtl8180	Realtek	Y
rtl8187	Realtek	Y
zd1211rw	ZyDAS	Y

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Drivers In Progress

- tiacx (TI chipset)
    - ported to early version of mac80211
    - questions raised about reverse engineering process
    - may need legal work similar to what SFLC did for ath5k

- agnx (Airgo chipset)
    - reverse-engineered w/ "clean room" process
    - specs and partially functional driver available
    - developers needed

- (continued)

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Drivers In Progress (continued)

- at76_usb (Atmel USB chipset)

    - driver originated in linux-wlan project
    - ported to mac80211 (but broken in process)
    - developers needed

- mrv8k (Marvell chipset)

    - existing driver based on net80211
    - mac80211 port actively underway (developers needed)
    - same driver might support 802.11n devices as well
    - Marvell is sponsoring development of new driver!

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Unlikely Drivers

- Hardware vendors come and go...
- Most drivers are reverse engineered
  - Reverse engineering takes motivation and skill
  - Smaller market means fewer potential developers
  - Unpopular hardware unlikely to get a driver
- Case in point: InProComm IPN2220

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Patch Activity

- Wireless LAN development is very active
- Only Intel has provided direct developer services (so far)...
- Linville Signed-off-by: is proxy for wireless LAN
  - 4.3% of patches in 2.6.24 (5th highest)
  - 5.0% of patches in 2.6.25 (5th highest)
  - 5.6% of patches in 2.6.26 (4th highest)

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Development Trees

- Development is done using git

- Multiple trees for different purposes

  - wireless-2.6 for pushing fixes for current release
  - wireless-next-2.6 for queueing updates for next release
  - wireless-testing for ongoing development

- Most users should use wireless-testing and ignore other trees

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The compat-wireless-2.6 project

- Some are wary of running upstream kernels...
- Most distro kernels are somewhat back-level
- compat-wireless-2.6 supports kernels as old as 2.6.21
    - Scripts, patches, compatibility code
    - Current wireless-testing snapshot
    - Built against user's kernel
- Some distros (e.g. Ubuntu) package compat-wireless-2.6
- Project might be going away...

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Fedora

- Easiest if distro packages kernels for you
- Fedora kernels have been kept up-to-date w/ wireless-testing
- Recent policy changes will slow wireless updates in Fedora
- Rawhide kernels should still be current w/ wireless-testing

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Website

- Linux Wireless wiki
- http://www.linuxwireless.org
- Information for users, hardware vendors, and developers

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Replacing Wireless Extensions with CFG80211
"Access Point" mode
Mesh networking
Multi-Queue Support

Wireless Extensions Considered Harmful

- Series of ioctl calls mapped to specific attributes
- Vague on details for behaviours, timing, ordering, etc.
- Attributes not grouped for atomic operations – racy
- Proven difficult to extend w/o breaking userland ABI
- Transparent implementation encourages code duplication in drivers

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Replacing Wireless Extensions with CFG80211
"Access Point" mode
Mesh networking
Multi-Queue Support

cfg80211 should...

- Provide cleaner API to both drivers and userland
- Provide logical parameter grouping to support atomicity
- Minimize configuration code in individual drivers
- Remain extensible and maintainable for a long time

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Replacing Wireless Extensions with CFG80211
"Access Point" mode
Mesh networking
Multi-Queue Support

"Access Point" mode

- Access points coordinate wireless LAN traffic
- AP hardware is typically similar or identical to clients
- Older designs required AP firmware for this function
- Soft-MAC designs typically only require CPU software for AP mode
- The mac80211 component can provide this support – hopefully soon!

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Replacing Wireless Extensions with CFG80211
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Mesh networking
Multi-Queue Support

Mesh networking

- Mesh mode enables extended range w/o dedicated infrastructure
- Idea popularized by OLPC project
- Cozybit provided mac80211-based implementation
- Linux has a feature not available on "other" OS!

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Replacing Wireless Extensions with CFG80211
"Access Point" mode
Mesh networking
Multi-Queue Support

Multi-Queue Support

- Quality of Service support (802.11e/WMM)
- Wired LANs are evolving similar technologies
- Current work from David Miller enables multi-queue TX!

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Better Power Management
lib80211
NAPI Interrupt Mitigation

Suspend and Resume

- Current model: drivers save/restore own state
- Flawed for mac80211 due to connection management
- mac80211 unaware of suspend/resume
  - drivers use deregister/reregister work-around
  - work-around is unreliable and slow
- mac80211 needs to be aware of suspend/resume

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Better Power Management
lib80211
NAPI Interrupt Mitigation

Power Saving Mode

- 802.11 defines power saving mode for managed stations
- mac80211 makes no use of this feature – wastes battery
- mac80211 needs to use this feature

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NAPI Interrupt Mitigation

lib80211

- Reduce code duplication between full MAC drivers
- Some could be shared with mac80211 as well

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Better Power Management
lib80211
NAPI Interrupt Mitigation

NAPI Interrupt Mitigation

- Mitigate cost of interrupt processing – higher performance
- NAPI no longer tied to specific net interface – OK for mac80211
- 802.11n and/or embedded devices may stand to benefit

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Firmware Licensing
Vendor Participation
Regulatory Issues

Firmware Licensing

- Many devices require firmware to operate
- "Other" OS drivers embed firmware in driver binary
  - "Other" OS driver licenses unclear about firmware
  - No separate license for the firmware
- Many vendors provide liberal licenses for firmware images
  - Intel and Ralink are examples of good citizens
  - Broadcom is not such an example...
- You are encouraged to support good citizens with your dollars
  - This includes "no firmware required" devices as well!

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Firmware Licensing
Vendor Participation
Regulatory Issues

Vendor Participation

- Some vendors provide no support (e.g. Broadcom)
- Others provide documentation, source, etc (e.g. Ralink, Realtek)
- A few provide dedicated developers (e.g. Intel, and now Atheros)
- Vote with your dollars!

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Regulatory Issues

- Spectre of regulation often cited by recalcitrant vendors
- Unfortunately, these fears are not entirely unfounded...
    - Regulations vary greatly between jurisdictions
    - Hardware vendors are expected to ensure compliance
    - Non-compliance can mean huge business losses
- Still, some vendors find ways to support us
- Reward those vendors when making purchasing decisions

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