ManetPRO: An Evaluation Testbed for Protocol Evaluation

Wireless Ad-Hoc Router

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By

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Objectives

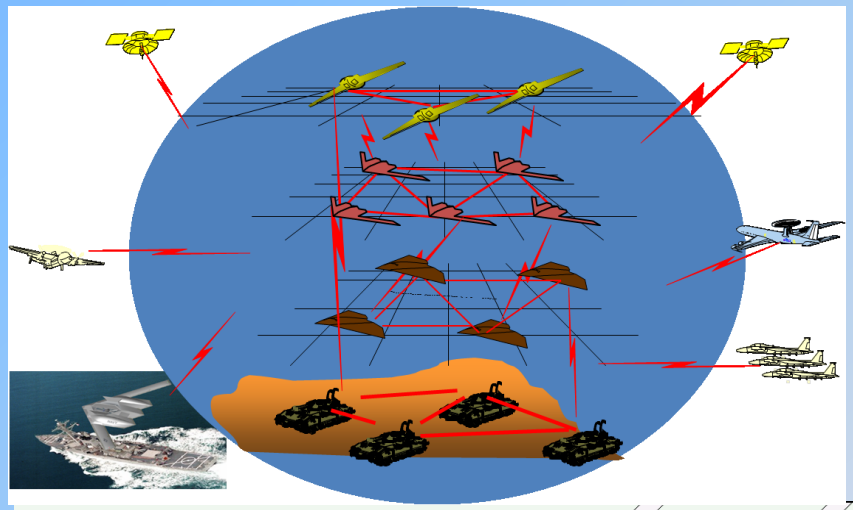
- To do research on the following areas:
  - Ad-hoc routing protocols
  - Routing updates and packet forwarding in Linux kernel
  - WLAN device drivers in Linux
- Integrate and develop wireless ad-hoc router

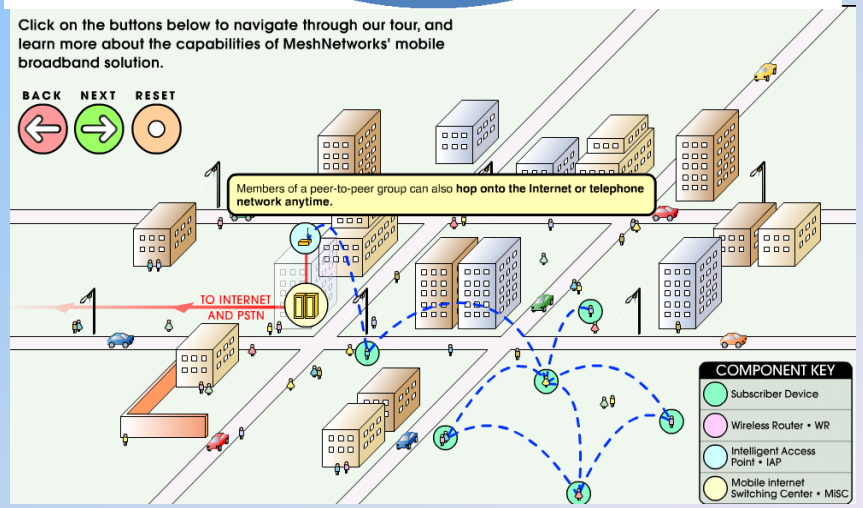
Project Necessity

- MANET technology
- MANET applications
- Why real Wireless ad-hoc router?

Project Necessity: MANET Technology And Applications

- Technology
  - Infrastructureless
  - Self-Organized
  - Multi-Hop
  - Self-Healing
- Applications
  - Instant Applications
    - Firing, earthquake, military, etc
  - Load-Balancing





Project Necessity: Why real Wireless ad-hoc router?

- Most research on MANETs are based on Simulation/Emulation, due to Lack of:
  - Supported tools/utilities in Linux/Unix
  - New wireless network modelling for analyzing and doing research in MANET communication protocols, AND these network models are also NOT supported in Linux/Unix
  - Developing real MANET devices require low-level system programming
    - Device drivers for wireless cards
    - Routing updates, packet forwarding in Linux kernel

Project Necessity: Why real Wireless ad-hoc router?

- Benefits of developing real Wireless ad-hoc routers
  - Core components in MANETs
    - Deployment of MANET testbed for real-time evaluation
    - Development of real-time MANET applications
  - Linux-based open-source platform
    - Flexibility in maintenance, development
    - Understanding, experience
      - » Students, lecturers, developers, etc
  - PC/Laptop-based Wireless router
    - Cost-effective approach

Scopes of Projects

- Contents
- Methodology
- Implementation

Scopes of Projects: Contents

- MANET technology: routing
  - Re-active or on-demand routing
  - Pro-active or table-driven routing
  - Hybrid routing
- Linux kernel
  - Routing updates
  - Packet forwarding
- Linux device driver
  - WLAN cards
- Integration and development of Wireless ad-hoc router
- Why Linux?
  - Open-source network protocol stack
- Why WLAN for MANET?
  - Universal technology
  - Supporting QoS
  - Variety of manufacturers for WLAN devices (APs, cards, etc)

Scopes of Projects: Methodology

INITIAL INTENTION [2010]

- Ad-Hoc Routing
  - Re-active vs. Pro-active vs. Hybrid
- Linux Kernel
  - Routing updates & Packet forwarding
- Device Driver
  - madwifi: http://madwifi-project.org/ for Atheros chipsets
  - Atheros chipsets: 5210 (a), 5211 (a+b), 5212 (a+b+g)
- Approach
  - Like APE testbed: http://apetestbed.sourceforge.net/
  - Using source code of APE to transform above ad-hoc routing protocols and high-level tools/utilities USE *madwifi* device driver INSTEAD OF *orinoco_cs/ wavelan2_cs* drivers
    - Interface Supporting: Only PCMCIA
    - Hermes/Prism-2 Based Chipsets [Lucent/Agere, Intersil or Symbol firmware]
    - Manufacturers: Out-of-Date [orinoco_cs, warelan_cs]
    - ORINOCO IEEE 802.11 WaveLAN cards ARE NOT supported/ sold anymore!

Scopes of Projects: Methodology

HOWEVER

- Madwifi
  - Linux driver for 802.11a/b/g Cardbus/PCI/MiniPCI cards using Atheros chipsets
    - http://atheros.rapla.net/
  - Current versions
    - Linux Kernel 2.4.23+
      - madwifi-0.9.4.tar.gz
    - Linux Kernel 2.6.x (2.6.25)
      - madwifi-0.9.4-current.tar.gz
  - Wireless tools
      - wireless_tools.28.pre10.tar.gz
  - madwifi itself is open source but depends on the proprietary Hardware Abstraction Layer (HAL) that is available in binary form only!

Scopes of Projects: Methodology

NOW [2012]

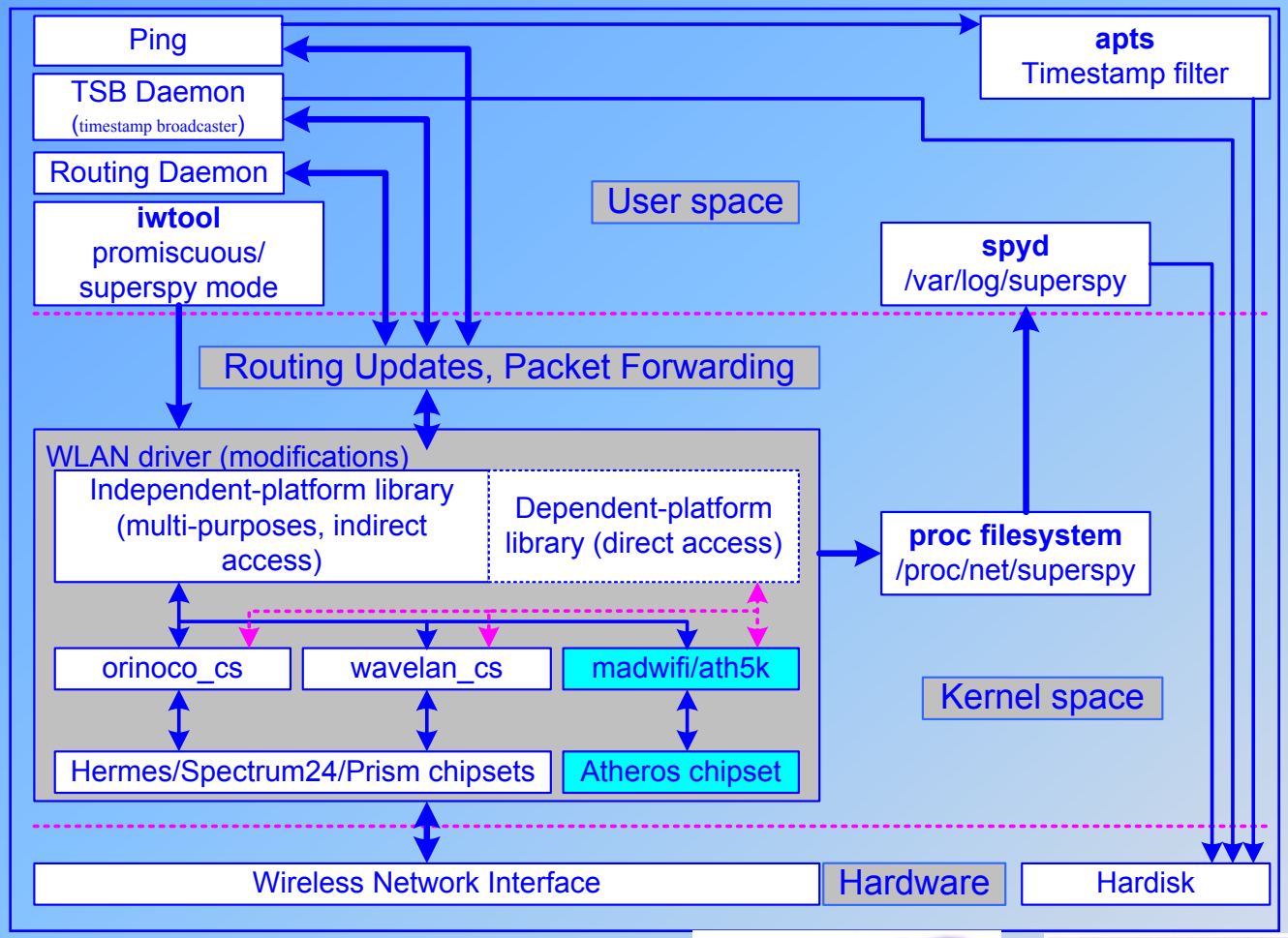
- Device Driver
  - ath5k: http://madwifi-project.org/wiki/About/ath5k for Atheros chipsets
  - New and emerging driver (integrating into recent Linux kernel)
    - From Linux kernel 2.6.30 or later
      - http://lxr.free-electrons.com/source/drivers/net/wireless/ath/ath5k/ath5k.h?v=2.6.33
  - Does not depend on HAL (based on OpenHAL), ath5k now just calls hardware functions directly
- WLAN cards
  - TP-LINK TL-WN350G NT Wireless 54M PCI Adapter
    - AR2417-AR5007G
  - D-link DWA-G610 (DWL-G650) PCMCIA/Cardbus
    - revC 5213s-AR5004

Scopes of Projects: Methodology

NOW [2012]

- Ad-hoc routing
  - OLSR, www.olsr.org , currently olsrd 0.6.3 released
  - Allow for use of dynamically linked plugins for accessing necessary functions in olsrd to process and generate packets, to maintain communication sessions
  - Using source code of Ad-hoc Protocol Evaluation (APE) to transform high-level tools/utilities USE *ath5k* device driver INSTEAD OF *orinoco_cs/ wavelan2_cs* drivers
    - http://apetestbed.sourceforge.net/

Scopes of Projects: Methodology



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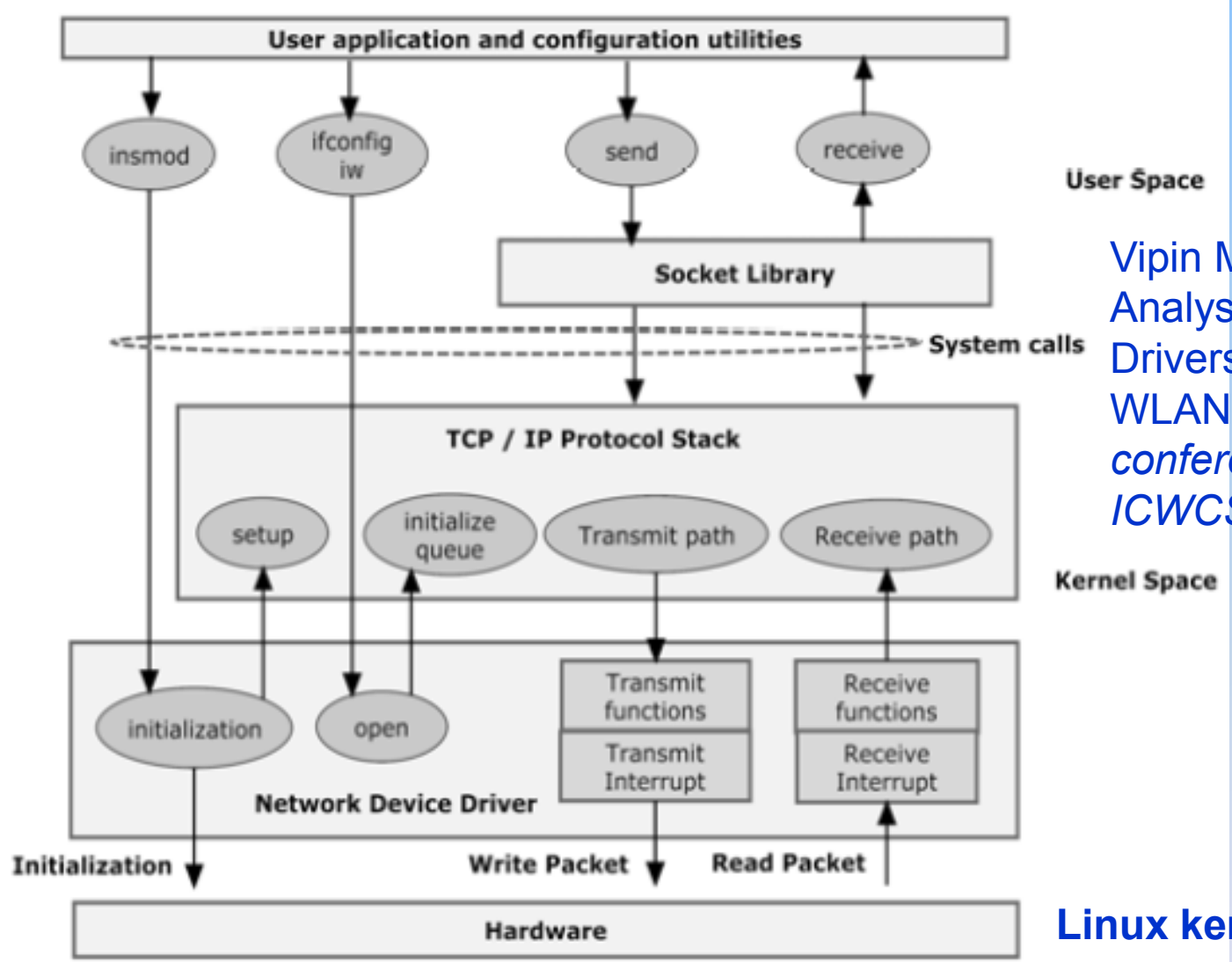
Scopes of Projects: Methodology

- Other Development Packages
  - Linux kernel archives http://www.kernel.org/
  - Linux PCMCIA http://pcmcia-cs.sourceforge.net/
  - WLAN linux resources http://www.hpl.hp.com/personal/Jean_Tourrilhes/Linux/Wireless.html
  - Wifi Linux http://users.linpro.no/janl/hardware/wifi.html
  - Build network router on Linux http://www.ibm.com/developerworks/linux/library/l-emu/
  - Linux wireless routers
    - http://martybugs.net/wireless/router.cgi
    - http://www.rage.net/wireless/wireless-howto.html

Implementation

- Our approach:
  - Modify ath5k driver directly on the Linux kernel, make patch and build the kernel for manetPRO distribution
  - Integrate ad-hoc routing protocols (OLSRD)
  - Integrate tools/utilities in APE testbed for statistical wireless data

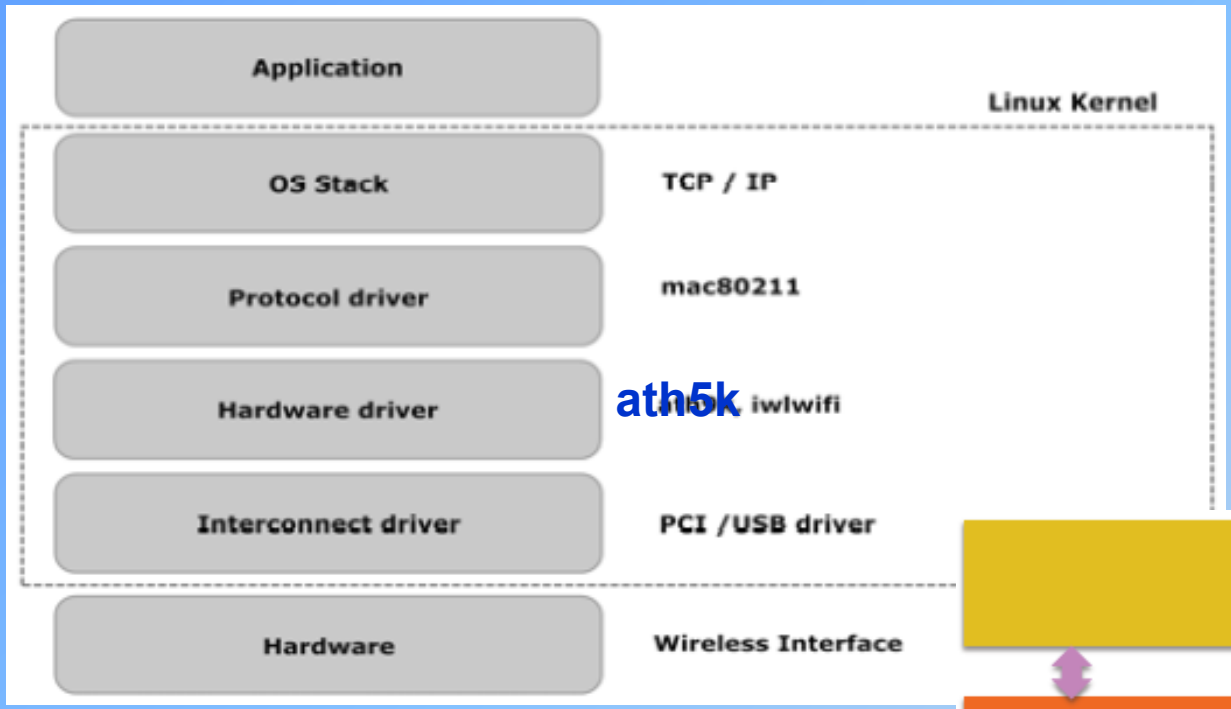
Implementation



Vipin M., and Srikanth S., Analysis of Open Source Drivers for IEEE 802.11 WLANs, in *IEEE conference proceeding of ICWCSC 2010*

Linux kernel interaction

Implementation

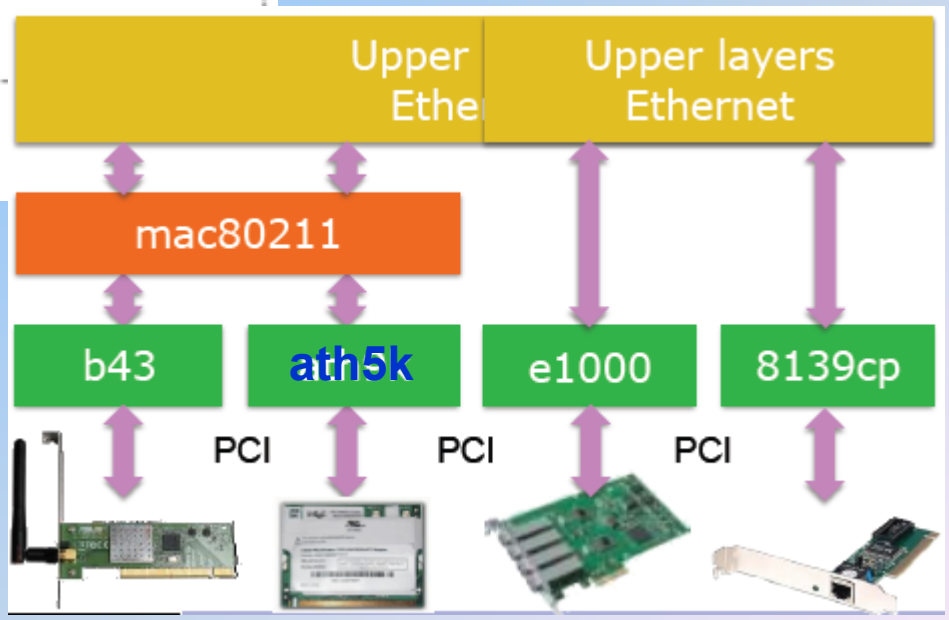


Linux kernel stack

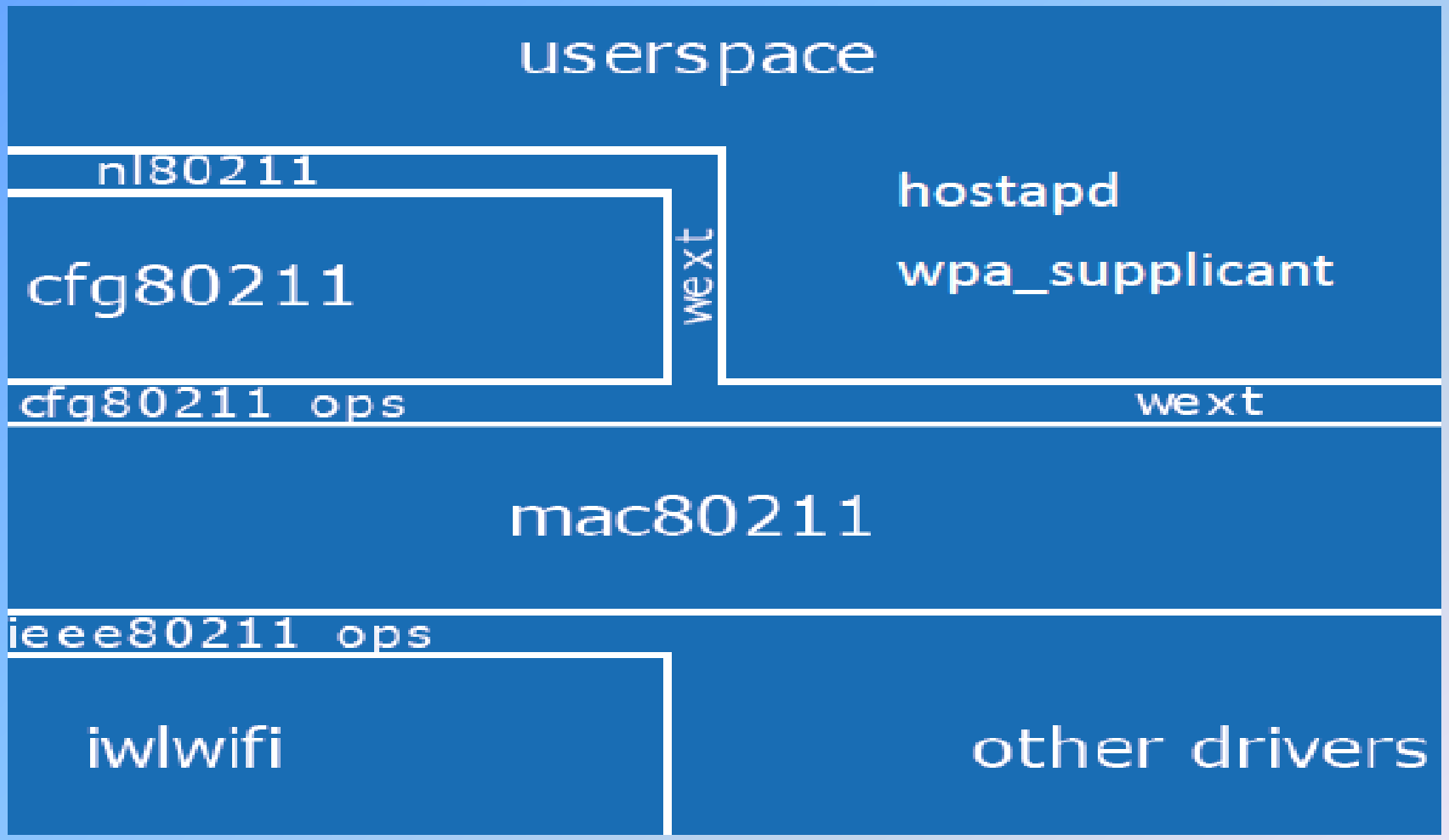
Vipin M., and Srikanth S., Analysis of Open Source Drivers for IEEE 802.11 WLANs, in *IEEE conference proceeding of ICWCSC 2010*

Francesco Gringoli, “A glimpse into the Linux Wireless Core: From kernel to firmware”

Wrapper “mac80211”



Implementation



Daniel Camps Mur , “Linux Wi-Fi open source drivers- mac80211, ath9k/ath5k”

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Architecture of APE Distribution Source Code

- ../dist (buildroot, busybox, …)
- ../kernel (kernel, driver, patches)
- ../src (APE source, tools)
  - ../src/analysis
  - ../src/<protocol_routing_name>
  - ../src/runtime
    - ../src/runtime/protocol-setup
  - ../src/screnarios

Integrate Modified Drivers to APE

- In iwtool.c

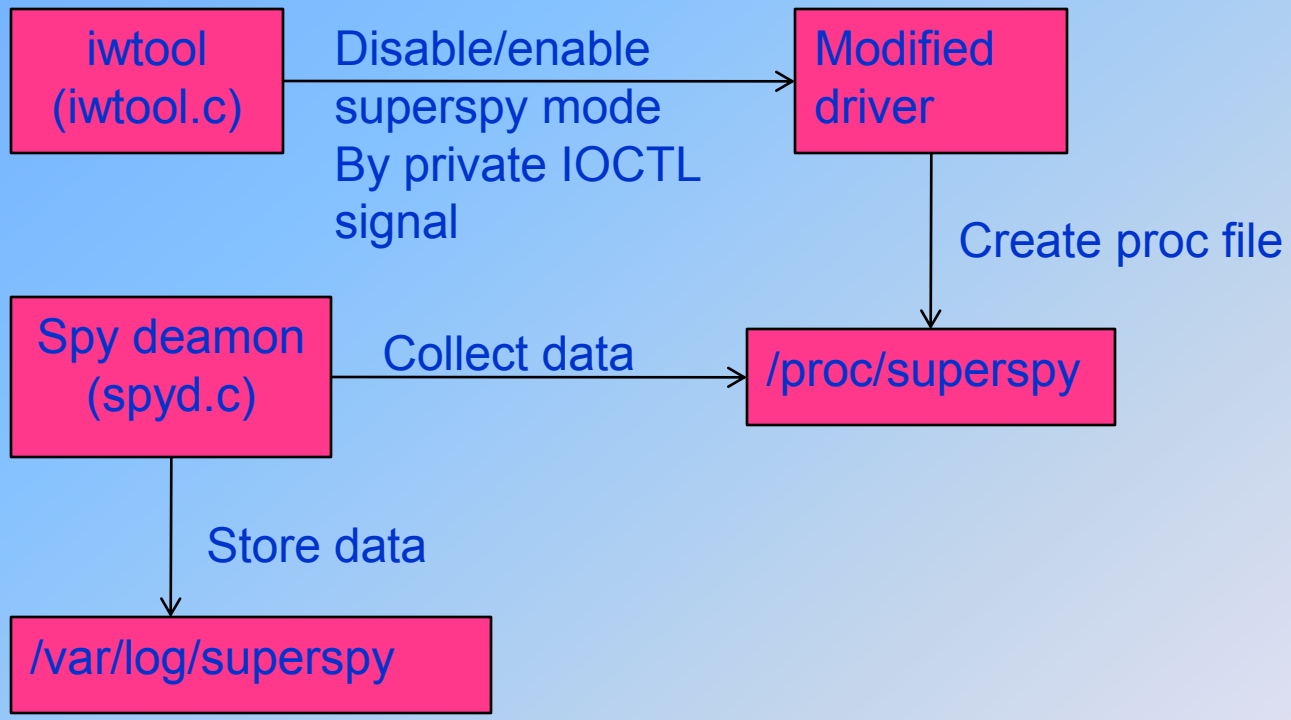
```
#if WIRELESS_EXT <= 12

#ifndef SIOCIWFIRSTPRIV
#define SIOCIWFIRSTPRIV      SIOCDEVPRIVATE
#endif

#endif /*WIRELESS_EXT <= 12 */

#define IOCTL_SPROMISC       SIOCIWFIRSTPRIV+0xA
#define IOCTL_DPROMISC       SIOCIWFIRSTPRIV+0xB
#define IOCTL_SSUPERSPY      SIOCIWFIRSTPRIV+0xC
#define IOCTL_DSUPERSPY      SIOCIWFIRSTPRIV+0xD
```

Integrate Modified Drivers to APE



Related Work

- MANET Routing
  - IETF MANET charter
    - *www.ietf.org/html.**charters/manet-charter**.html*
- Linux-based WLAN device drivers
  - http://www.nongnu.org/orinoco/
  - http://www.linux-wlan.org/
  - http://hostap.epitest.fi/
  - http://sourceforge.net/projects/spectrum24/
  - http://at76c503a.berlios.de/
  - http://madwifi.org/
  - http://sourceforge.net/projects/ipw2200/

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