

# Wifi 802.11n Support in Linux

**Vladimir Botka, PhD**

Software Developer

SUSE LINUX GmbH

[vbotka@suse.cz](mailto:vbotka@suse.cz)

# IEEE Std 802.11n<sup>®</sup> - 2009

- **October 2009 IEEE approved and published the 802.11n**
- **High throughput extension to the 802.11 standard**
- **Wireless adapters can achieve throughput up to 300 Mbps**
- **Physical layer data rates of 600 Mbps**

# Overview

- **Features**
- **Implementation**
- **Deployment**
- **Troubleshooting**

# Features

The slide features a solid blue background. In the center, the word "Features" is written in a white, sans-serif font. At the bottom of the slide, there are several horizontal white lines of varying lengths and thicknesses, creating a decorative effect.

# Overview of Features

- **Physical layer diversity techniques**
- **Channel bonding**
- **Frame aggregation**

# Overview of Features

## user space applications

nl80211

|

cfg80211

|

wext

mac80211

wifi driver

physical layer

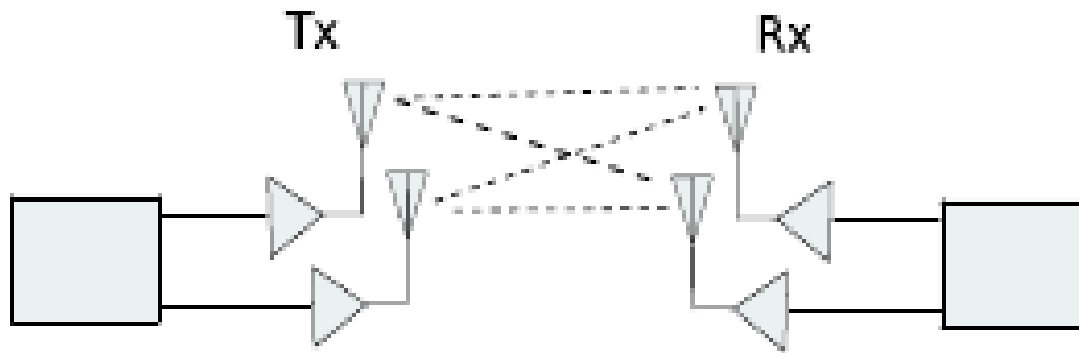
# Features

## Physical Layer Diversity Techniques

- **Radio is sending and receiving with multiple antennas**
- **Multiple-input and multiple-output (MIMO)**
- **Spatial multiplexing**
- **Maximum Ratio Combining (MRC)**
- **Improved Signal to Noise Ratio (SNR)**

# Features

## Physical Layer Diversity Techniques





# Features

## Channel Bonding

- **Single channel is 20MHz in width**
- **Two bonded channels are 40MHz wide**
- **Both in 2.4GHz and 5GHz spectrum**
- **Limited number of non-overlapping channels in the 2.4GHz band (1,6,11)**

# Features

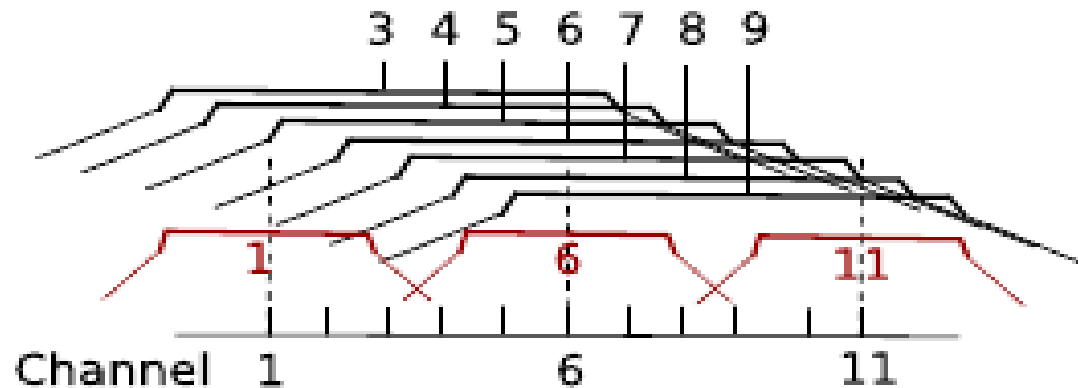
## Channel Bonding

- Channels in 2.4 GHz band with 22MHz bandwidth 802.11 b/g/n
- Only channels 1,6,11 without overlap

Channel	Frequency (MHz)
1	2412
2	2417
...	
14	2484

# Features

## Channel Bonding



# Features

## Channel Bonding

- **Channels in 5 GHz band with 20/40MHz bandwidth 802.11 a/n**
- **40 channels in the frequency range 4915 – 5825 (Mhz)**
- **Many different restrictions**
- **Countries apply their own rules**

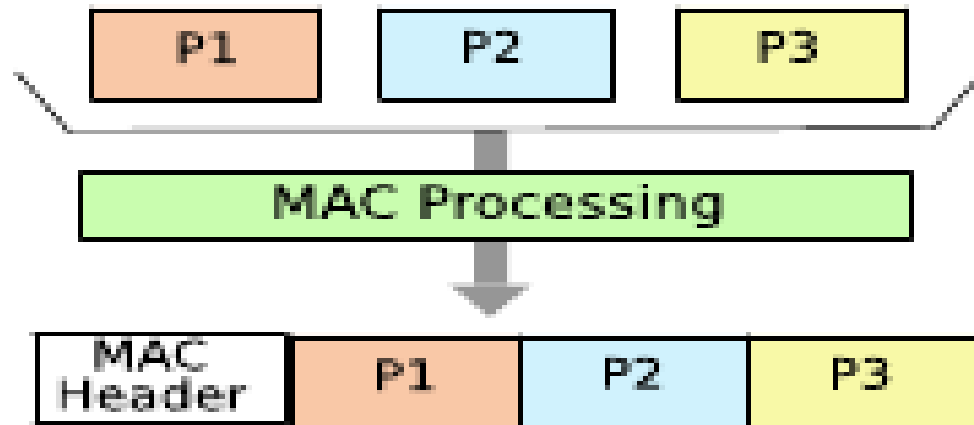
# Features

## Frame Aggregation

- **Media Access Control (MAC)**
- **Transmit more data frames with “Block ACK”**
- **Burst**
- **Reduced overhead**

# Features

## Frame Aggregation



# Features

## Summary

- **600Mbit/s physical transfer rate**
- **More antennas**
- **Max. 4 spatial streams using a 40MHz-wide channel**
- **Preferably in 5GHz band**

# Implementation

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# Overview of Implementation

- **kernel.org**
- **linuxwireless.org**
- **New core mac80211 and cfg80211 components**
- **In-kernel nl80211 configuration interface**
- **nl80211 user-space applications**

# Implementation

## Hardware

- **Physical layer (PHY) is implemented in the adapter**
- **Firmware delivered by the producer**
- <http://linuxwireless.org/en/users/Devices/>
- <http://intellinuxwireless.org/>

# Implementation

kernel.org

- **Source code development trees**  
**linux/kernel/git/pub/scm**
- **wireless-testing - On-going wireless integration tree**
- **iwlwifi - Intel Wireless WiFi Link driver**
- **net/wireless**
- **driver/net/wireless**

# Implementation

wireless-testing

- **linuxwireless.org**
- **mac80211** subsystem for SoftMAC wireless devices
- **cfg80211** new Linux wireless configuration API
- **nl80211** new 802.11 netlink interface public header

# Implementation

cfg80211

- Driver for wifi adapter can use cfg80211 operation callbacks and fill in the wiphy struct to store the device capabilities
- Bridges userspace and drivers

# Implementation

nl80211 user-space applications

- Intended to replace Wireless-Extensions used by
- iw – manipulate configuration of wireless devices
- crda – central regulatory domain agent
- hostapd – AP implementation with authentication
- wpa\_supplicant (with -Dnl80211)

# Deployment

# Overview of Deployment

- **iw utility to manipulate and configure wireless devices**
- **crda central regulatory domain agent**
- **wireless regulatory database**
- **changes to the configuration of openSUSE**



# Deployment

iw utility

## Can show and manipulate objects

- **phy** – physical layer of the device
- **dev** – network interface
- **reg** – regulatory database settings

# Deployment

iw utility can show/manipulate physical layer

```
# iw phy
```

```
<snip>
```

```
Frequencies:
```

```
* 2412 MHz [1] (15.0 dBm)
```

```
* 2417 MHz [2] (15.0 dBm)
```

```
* 2422 MHz [3] (15.0 dBm)
```

```
....
```

```
* 2457 MHz [10] (15.0 dBm)
```

```
* 2462 MHz [11] (15.0 dBm)
```

```
* 2467 MHz [12] (15.0 dBm) (passive scanning, no IBSS)
```

```
* 2472 MHz [13] (15.0 dBm) (passive scanning, no IBSS)
```

```
<snip>
```

# Deployment

iw utility can manipulate devices

```
# iw dev  
phy#0  
Interface wlan0  
ifindex 3  
type managed
```

# Deployment

iw utility can manipulate regulatory settings

**# iw reg set DE**

**# iw reg get**

**country DE:**

(2400 - 2483 @ 40), (N/A, 20)

(5150 - 5350 @ 40), (N/A, 20), NO-OUTDOOR, DFS

(5470 - 5725 @ 40), (N/A, 26), NO-OUTDOOR, DFS

# Deployment

crda central regulatory domain agent

- intended to be used by udev scripts
- triggered by the wireless kernel subsystem
- regulatory domain is read by crda from the regulatory.bin file

```
> cat /lib/udev/rules.d/85-regulatory.rules  
KERNEL=="regulatory*", ACTION=="change", SUBSYSTEM=="platform",  
  RUN+="/sbin/crda"
```

# Deployment

## wireless regulatory database

- **wireless-regdb.rpm**
- **Provides regulatory.bin file**
- **[wireless.kernel.org/download/wireless-regdb/](http://wireless.kernel.org/download/wireless-regdb/)**
- **Integrity of regulatory file is ensured by signing**

# Deployment

changes to the configuration of openSUSE

- `/etc/sysconfig/network/config`
- `WIRELESS_WPA_DRIVER='wext'` by default will be replaced with
- `WIRELESS_WPA_DRIVER='nl80211'` for wlan drivers that are nl80211 ready
- `WIRELESS_REGULATORY_DOMAIN=""`
- `Yast2` network changes

# Deployment

summary of changes in the user-space

**g-standard**

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**iwconfig**

**wpa\_supplicant -D wext**

**n-standard**

-----

**iw**

**wpa\_supplicant -D nl80211**

**crda**

**wireless-regdb**



# Troubleshooting

# Overview of Troubleshooting

- **NetworkManager, wpa\_supplicant, ifup/ifdown**
- **Interface setup to sniff the packets**
- **wireshark**
- **[bugzilla.novell.com](http://bugzilla.novell.com)**

# Troubleshooting

NetworkManager, wpa\_supplicant, ifup/ifdown

- [en.opensuse.org/SDB:Tracking\\_down\\_wireless\\_problems](http://en.opensuse.org/SDB:Tracking_down_wireless_problems)
- Try to reduce the complexity and localize the problem
- `/var/log/NetworkManager`
- `/var/log/wpa_supplicant`
- `/var/log/messages`

# Troubleshooting

## Set debug options

- **Wlan driver options**
  - > `modinfo iwlagm | grep parm`
- **Set debug option**
  - > `cat /etc/modprobe.d/50-iwlagm.conf`  
`options iwlagm debug=0xffffffff`

# Troubleshooting

Interface setup to sniff the packets

- > `iw dev wlan0 del`
- > `iw phy phy0 interface add mon0 type monitor`
- > `iw dev mon0 info`
- > `ifconfig mon0 up`
- > `tcpdump -i mon0 -w dump`

# Troubleshooting

## wireshark

- **wireshark.rpm**
- > **wireshark dump**

# Troubleshooting

[bugzilla.novell.com](http://bugzilla.novell.com)

**openSUSE**

**bug reports can be posted to**

**[bugzilla.novell.com](http://bugzilla.novell.com)**

**Have Fun !**



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