

WP543/WPJ543

OpenWRT +  
Wireless 11n Drivers

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## Revision

Date	Description	Firmware	Drivers	BY
16 <sup>th</sup> Dec 2009	Initial Release	V1.11 B091217	Compex Firmware V2.06 B091111	TY

## Supported Boards

Boards	Radios - 2.4GHz	Radios - 5GHz
WP543/WPJ543	WLM200NX,WLM200N2, WLM200N2-23ESD, WLM200N2-26	WLM200NX,WLM200N5-23ESD, WLM200N5-26

## Objective

The objective of integrating Compex Firmware 802.11n wireless drivers into existing OpenWRT distributions is to ensure that customers can use the high quality 11n wireless radios developed by Compex, to attain even higher throughput and stability, while still retaining the features that they themselves have developed on OpenWRT.

All efforts would be made to ensure that the porting process is hassle-free. Test results by Compex would also be generated so as to allow customers to compare their modified firmware's performance with Compex modified OpenWRT firmware.

- Compex Firmware's 11n wireless drivers integrated with latest OpenWRT.
- Hassle free porting
- Test reports from Compex

## Features of Compex 802.11n Wireless Drivers

- Modes Available: Access Point / Station
- 5/10/20/40MHz Selection  
Using different bandwidths, interference can be mitigated in noisy environments. While using 5MHz, throughput (max) can be as high as 25Mbps, which is around the same as a 20MHz legacy card.
- WPA/WPA2  
WPA/WPA2 with AES is supported and tested.
- Country Code Selection  
Compex has integrated the channels list into the Country code, to its knowledge as best as possible, from feedback from customers as well as research into country's regulations.

- SuperChannel

The 802.11n wireless drivers also supported extended frequencies

2.4GHz (802.11g Band): 2.312 GHz to 2.502GHz

5GHz (802.11a Band): 4.92GHz to 6.1GHz.

- Dynamic Frequency Selection (DFS)  
DFS is supported on the 802.11n wireless drivers.
- Transmit Power Selection
- Multiple SSID Selection  
Creates up to 4 Virtual Access Points, with each Access Point a different encryption.
- Slottime/ACK Timeout/CTS Timeout Selection  
ACK Timeout is very important in outdoor scenarios. If you do not set the right ACK Timeout, outdoor scenario would not work and you would not get the right throughput
- Dynamic Slottime/ ACK Timeout/ CTS Timeout  
Compex's 802.11n wireless driver is able to dynamically select the optimum ACK Timeout according to changes in the outdoor environment. This will be very useful in the outdoor scenario, with Point-to-Point implementations for distances more than 800m.

# Loading of OpenWRT firmware

There are 2 methods to load OpenWRT firmware from boards with Compex Firmware.

## 1. From Compex Web Interface:

Select the OpenWRT firmware and put it into the Upgrading file option. After Please Wait, and then Reboot, OpenWRT firmware would be ready.

## 2. From Serial Console:

```
Please select : Exit
Main Menu
1 - Load Firmware
2 - Load Program
3 - BIOS Setup
4 - Fdisk Utility
5 - Update Flash <Binary Mode>
6 - Update Firmware <Image Mode>
7 - Reboot System
8 - Memory Test
9 - USB Flash

Please select : 6
Update Firmware <Image Mode>
Mini TFTP Server 1.0 <IP : 192.168.168.1>
Usage <Windows 2000/XP> :
tftp -i 192.168.168.1 put <filename>
```

- a. Press Esc to go into the Bootloader mode.
- b. Press 6 to Upgrade Firmware (Image Mode)
- c. Tftp the firmware obtained from Compex and load into the device.

```
Updating firmware, please wait .....
ate firmware successfully! Please reboot.
```

- d. After successfully upgrade the file, reboot.

## 3. From TFTP

- a. Press reset button first
- b. Plug in the Power.
- c. You are now in TFTP mode. TFTP the firmware obtained from Compex and load into the device.
- d. The LED will blink very fast when the firmware is loading. When the LED start to blink slowly, power down and power up again.
- e. The OpenWRT firmware is then loaded.



# Wireless Commands

```
File Edit Setup Control Window Help
sunbin full
config wifi-device wifi0
  option type atheros
  option channel 100
  option hwmode 11na+
  option country CZ

config wifi-iface
  option device wifi0
  option network lan
  option mode ap
  option ssid OpenWrt
  option encryption psk2
  option key abcd1234
~
~
```

An example of AP Setup

```
Tera Term - COM1 VT
File Edit Setup Control Window Help
config wifi-device wifi0
  option type atheros
  option channel 100
  option hwmode 11na+
  option country CZ

config wifi-iface
  option device wifi0
  option network lan
  option mode sta
  option ssid OpenWrt
  option encryption psk2
  option key abcd1234
~
~
```

An example of Station Setup

## a. 5/10/20/40MHz Selection

### 40 MHz Selection

1. Type “vi /etc/config/wireless”
2. For 40MHz in 5GHz,
  - a) Select Upper or Lower extension channels by using “option hwmode 11na+” or “option hwmode 11na-” both in AP and Station.
  - b) Select Channel in AP. Make sure that the channel corresponds to the extension channels that you have selected. If it does not correspond, the channels that will be selected randomly when you reboot.
  - c) You can see the extension channels of the particular channel by using “wlanconfig ath0 list chan”

```
root@OpenWrt:~# wlanconfig ath0 list chan
Channel 1 : 2412 Mhz 11ng C CU Channel 48 : 5240* Mhz 11na C CL
Channel 2 : 2417 Mhz 11ng C CU Channel 52 : 5260* Mhz 11na C CU
Channel 3 : 2422 Mhz 11ng C CU Channel 56 : 5280* Mhz 11na C CL
Channel 4 : 2427 Mhz 11ng C CU Channel 60 : 5300* Mhz 11na C CU
Channel 5 : 2432 Mhz 11ng C CU CL Channel 64 : 5320* Mhz 11na C CL
Channel 6 : 2437 Mhz 11ng C CU CL Channel 100 : 5500* Mhz 11na C CU
Channel 7 : 2442 Mhz 11ng C CU CL Channel 104 : 5520* Mhz 11na C CL
Channel 8 : 2447 Mhz 11ng C CU CL Channel 108 : 5540* Mhz 11na C CU
Channel 9 : 2452 Mhz 11ng C CU CL Channel 112 : 5560* Mhz 11na C CL
Channel 10 : 2457 Mhz 11ng C CL Channel 116 : 5580* Mhz 11na C CU
Channel 11 : 2462 Mhz 11ng C CL Channel 120 : 5600* Mhz 11na C CL
Channel 12 : 2467 Mhz 11ng C CL Channel 124 : 5620* Mhz 11na C CU
Channel 13 : 2472 Mhz 11ng C CL Channel 128 : 5640* Mhz 11na C CL
Channel 36 : 5180* Mhz 11na C CU Channel 132 : 5660* Mhz 11na C CU
Channel 40 : 5200* Mhz 11na C CL Channel 136 : 5680* Mhz 11na C CL
Channel 44 : 5220* Mhz 11na C CU Channel 140 : 5700* Mhz 11na C
root@OpenWrt:~#
```

Wlanconfig of EU Countries Code

3. The process is similar for 11ng+ or 11ng-
4. Type “reboot” to reboot the system to make the changes take effect.

### 20MHz/10MHz/5MHz Selection

1. Type “vi /etc/config/wireless”
2. For 20MHz in 5GHz,
  - a) Choose the hwmode to be 11na by typing “option hwmode 11na” both in AP and Station.
  - b) Select Channel in AP.
  - c) Type “option chanbw 0” for 20MHz in both AP and Station.

```

config wifi-device wifi0
option type atheros
option channel 100
option hmode 11n
option country CZ
option chanbw 0

config wifi-iface
option device wifi0
option network lan
option mode ap
option ssid OpenWrt
option encryption psk2
option key abcd1234

```

Setup in AP

```

config wifi-device wifi0
option type atheros
option channel 100
option hmode 11n
option country CZ
option chanbw 0

config wifi-iface
option device wifi0
option network lan
option mode sta
option ssid OpenWrt
option encryption psk2
option key abcd1234

```

Setup in Station

3. The process is similar for 11ng.
4. For 10MHz/5MHz,
  - “option chanbw 1” means 10MHz
  - “option chanbw 2” means 5MHz
5. Type “reboot” to reboot the system to make the changes take effect.

## b. WPA/WPA2 Setup

1. Type “vi /etc/config/wireless”
2. To set up WPA2 with Pre-Shared Key, Cipher AES, please type
  - a) “option encryption psk2”
  - b) “option key abcd1234” where abcd1234 can be what you choose.
  - c) If you want to set up WPA, choose psk.
3. Type “reboot” to reboot the system to make the changes take effect.

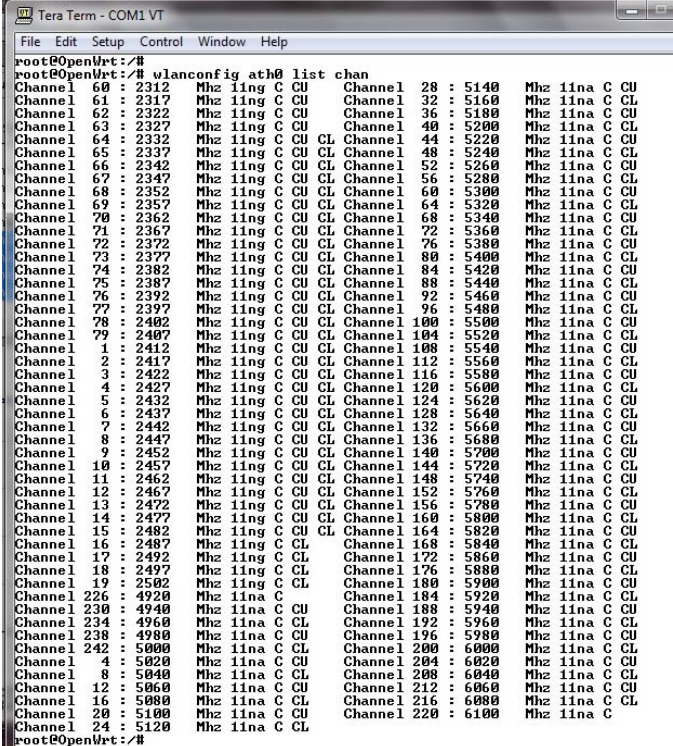
Note: Only AES is being tested, as TKIP would not give 11n high throughput.

## c. Country Code Selection

1. Type “vi /etc/config/wireless”
2. For country code “United States”, type “option country US” both in AP and Station. Make sure that they are in CAPITAL LETTERS.
3. Type “reboot” to reboot the system to make the changes take effect.

## d. SuperChannel

1. Type “vi /etc/config/wireless”
2. Change country code to SuperChannel. Type “option country DB” in both AP and Station.
3. Type “wlanconfig ath0 list chan” to see the channels supported.



```
root@OpenWrt:~# wlanconfig ath0 list chan
Channel 60 : 2312 Mhz 11ng C CU Channel 28 : 5140 Mhz 11na C CU
Channel 61 : 2317 Mhz 11ng C CU Channel 32 : 5160 Mhz 11na C CL
Channel 62 : 2322 Mhz 11ng C CU Channel 36 : 5180 Mhz 11na C CU
Channel 63 : 2327 Mhz 11ng C CU Channel 40 : 5200 Mhz 11na C CL
Channel 64 : 2332 Mhz 11ng C CU CL Channel 44 : 5220 Mhz 11na C CU
Channel 65 : 2337 Mhz 11ng C CU CL Channel 48 : 5240 Mhz 11na C CL
Channel 66 : 2342 Mhz 11ng C CU CL Channel 52 : 5260 Mhz 11na C CU
Channel 67 : 2347 Mhz 11ng C CU CL Channel 56 : 5280 Mhz 11na C CL
Channel 68 : 2352 Mhz 11ng C CU CL Channel 60 : 5300 Mhz 11na C CU
Channel 69 : 2357 Mhz 11ng C CU CL Channel 64 : 5320 Mhz 11na C CL
Channel 70 : 2362 Mhz 11ng C CU CL Channel 68 : 5340 Mhz 11na C CU
Channel 71 : 2367 Mhz 11ng C CU CL Channel 72 : 5360 Mhz 11na C CL
Channel 72 : 2372 Mhz 11ng C CU CL Channel 76 : 5380 Mhz 11na C CU
Channel 73 : 2377 Mhz 11ng C CU CL Channel 80 : 5400 Mhz 11na C CL
Channel 74 : 2382 Mhz 11ng C CU CL Channel 84 : 5420 Mhz 11na C CU
Channel 75 : 2387 Mhz 11ng C CU CL Channel 88 : 5440 Mhz 11na C CL
Channel 76 : 2392 Mhz 11ng C CU CL Channel 92 : 5460 Mhz 11na C CU
Channel 77 : 2397 Mhz 11ng C CU CL Channel 96 : 5480 Mhz 11na C CL
Channel 78 : 2402 Mhz 11ng C CU CL Channel 100 : 5500 Mhz 11na C CU
Channel 79 : 2407 Mhz 11ng C CU CL Channel 104 : 5520 Mhz 11na C CL
Channel 1 : 2412 Mhz 11ng C CU CL Channel 108 : 5540 Mhz 11na C CU
Channel 2 : 2417 Mhz 11ng C CU CL Channel 112 : 5560 Mhz 11na C CL
Channel 3 : 2422 Mhz 11ng C CU CL Channel 116 : 5580 Mhz 11na C CU
Channel 4 : 2427 Mhz 11ng C CU CL Channel 120 : 5600 Mhz 11na C CL
Channel 5 : 2432 Mhz 11ng C CU CL Channel 124 : 5620 Mhz 11na C CU
Channel 6 : 2437 Mhz 11ng C CU CL Channel 128 : 5640 Mhz 11na C CL
Channel 7 : 2442 Mhz 11ng C CU CL Channel 132 : 5660 Mhz 11na C CU
Channel 8 : 2447 Mhz 11ng C CU CL Channel 136 : 5680 Mhz 11na C CL
Channel 9 : 2452 Mhz 11ng C CU CL Channel 140 : 5700 Mhz 11na C CU
Channel 10 : 2457 Mhz 11ng C CU CL Channel 144 : 5720 Mhz 11na C CL
Channel 11 : 2462 Mhz 11ng C CU CL Channel 148 : 5740 Mhz 11na C CU
Channel 12 : 2467 Mhz 11ng C CU CL Channel 152 : 5760 Mhz 11na C CL
Channel 13 : 2472 Mhz 11ng C CU CL Channel 156 : 5780 Mhz 11na C CU
Channel 14 : 2477 Mhz 11ng C CU CL Channel 160 : 5800 Mhz 11na C CL
Channel 15 : 2482 Mhz 11ng C CU CL Channel 164 : 5820 Mhz 11na C CU
Channel 16 : 2487 Mhz 11ng C CL Channel 168 : 5840 Mhz 11na C CL
Channel 17 : 2492 Mhz 11ng C CL Channel 172 : 5860 Mhz 11na C CU
Channel 18 : 2497 Mhz 11ng C CL Channel 176 : 5880 Mhz 11na C CL
Channel 19 : 2502 Mhz 11ng C CL Channel 180 : 5900 Mhz 11na C CU
Channel 226 : 4920 Mhz 11na C Channel 184 : 5920 Mhz 11na C CL
Channel 230 : 4940 Mhz 11na C CU Channel 188 : 5940 Mhz 11na C CU
Channel 234 : 4960 Mhz 11na C CL Channel 192 : 5960 Mhz 11na C CL
Channel 238 : 4980 Mhz 11na C CU Channel 196 : 5980 Mhz 11na C CU
Channel 242 : 5000 Mhz 11na C CL Channel 200 : 6000 Mhz 11na C CL
Channel 4 : 5020 Mhz 11na C CU Channel 204 : 6020 Mhz 11na C CU
Channel 8 : 5040 Mhz 11na C CL Channel 208 : 6040 Mhz 11na C CL
Channel 12 : 5060 Mhz 11na C CU Channel 212 : 6060 Mhz 11na C CU
Channel 16 : 5080 Mhz 11na C CL Channel 216 : 6080 Mhz 11na C CL
Channel 20 : 5100 Mhz 11na C CU Channel 220 : 6100 Mhz 11na C
Channel 24 : 5120 Mhz 11na C CL
root@OpenWrt:~#
```

4. Type “reboot” to reboot the system to make the changes take effect.

## e. Transmit Power Selection

1. Type “vi /etc/config/wireless”
2. Type “option txpower 10” to change to 10dBm TX Power.
3. Type “reboot” to reboot the system to make the changes take effect.

## f. Multiple SSID Selection – Creation of Virtual Access Points

1. Type “vi /etc/config/wireless”
2. Follow the examples below to set up Virtual Access Points of different encryption.

```
-----  
config wifi-device wif10  
option type atheros  
option channel 149  
option hwmode 11n+  
option country US  
  
config wifi-iface  
option device wif10  
option network lan  
option mode ap  
option ssid OpenWrt  
option encryption psk2  
option key abcd1234  
  
config wifi-iface  
option device wif10  
option network lan  
option mode ap  
option ssid OpenWrt_1  
option encryption none  
  
-----  
config wifi-iface  
option device wif10  
option network lan  
option mode ap  
option ssid OpenWrt_2  
option encryption psk  
option key abcd2345  
  
config wifi-iface  
option device wif10  
option network lan  
option mode ap  
option ssid OpenWrt_3  
option encryption psk2  
option key abcd3456  
  
config wifi-iface  
option device wif10  
option network lan  
option mode ap  
option ssid OpenWrt_4  
option encryption psk2  
option key abcd4567  
-----
```

3. Type “reboot” to reboot the system to make the changes take effect.
4. Check whether VAPs are being created by using “iwconfig”

```
ath0 IEEE 802.11na ESSID:"OpenWrt" Nickname:""  
Mode:Master Frequency:5.745 GHz Access Point: 00:80:48:62:4D:71  
Bit Rate:243 kb/s Tx-Power:17 dBm Sensitivity=1/3  
Retry:off RTS thr:off Fragment thr:off  
Encryption key:205C-BBDE-870F-E9FD-772A-8D0C-E887-7D4D [2] Security  
node:open  
Power Management:off  
Link Quality=28/94 Signal level=-67 dBm Noise level=-95 dBm  
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
ath1 IEEE 802.11na ESSID:"OpenWrt_1" Nickname:""  
Mode:Master Frequency:5.745 GHz Access Point: 06:80:48:62:4D:71  
Bit Rate:0 kb/s Tx-Power:17 dBm Sensitivity=1/3  
Retry:off RTS thr:off Fragment thr:off  
Encryption key:off  
Power Management:off  
Link Quality=28/94 Signal level=-67 dBm Noise level=-95 dBm  
Rx invalid nwid:2 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
ath2 IEEE 802.11na ESSID:"OpenWrt_2" Nickname:""  
Mode:Master Frequency:5.745 GHz Access Point: 0A:80:48:62:4D:71  
Bit Rate:0 kb/s Tx-Power:17 dBm Sensitivity=1/3  
Retry:off RTS thr:off Fragment thr:off  
Encryption key:14E2-928D-1859-C03A-2A34-42DC-6147-019F [2] Security  
node:open  
Power Management:off  
Link Quality=28/94 Signal level=-67 dBm Noise level=-95 dBm  
Rx invalid nwid:1 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
ath3 IEEE 802.11na ESSID:"OpenWrt_3" Nickname:""  
Mode:Master Frequency:5.745 GHz Access Point: 0E:80:48:62:4D:71  
Bit Rate:0 kb/s Tx-Power:17 dBm Sensitivity=1/3  
Retry:off RTS thr:off Fragment thr:off  
Encryption key:263B-5BCA-A7BF-B58F-ECC1-FF5E-DA9D-F105 [2] Security  
node:open  
Power Management:off  
Link Quality=28/94 Signal level=-67 dBm Noise level=-95 dBm  
Rx invalid nwid:1 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
ath4 IEEE 802.11na ESSID:"OpenWrt_4" Nickname:""  
Mode:Master Frequency:5.745 GHz Access Point: 12:80:48:62:4D:71  
Bit Rate:0 kb/s Tx-Power:17 dBm Sensitivity=1/3  
Retry:off RTS thr:off Fragment thr:off  
Encryption key:6066-5D18-9D08-2896-E4B8-A245-C0B2-F2E6 [2] Security  
node:open  
Power Management:off  
Link Quality=28/94 Signal level=-67 dBm Noise level=-95 dBm  
Rx invalid nwid:1 Rx invalid crypt:0 Rx invalid frag:0  
Tx excessive retries:0 Invalid misc:0 Missed beacon:0
```

ath0 is the main AP, ath1,ath2, ath3, ath4 are VAPs.

## g. Slottime / ACK Timeout / CTS Timeout Selection

1. Type “vi /etc/config/wireless”
2. Type “option slottime 10” to change slottime to 10 for both AP and Station.
3. Type “option acktimeout 45” to change ACK Timeout to 45 for both AP and Station.
4. Type “option ctsttimeout 45” to change CTS Timeout to 45 for both AP and Station.

```
config wifi-device wifi0
    option type atheros
    option channel 149
    option hwmode 11a+
    option country US
    option slottime 10
    option acktimeout 45
    option ctsttimeout 45

config wifi-iface
    option device wifi0
    option network lan
    option mode ap
    option ssid OpenWrt
    option encryption psk2
    option key abcd1234
```

5. Type “reboot” to reboot the system to make the changes take effect.

## h. Dynamic Slottime / ACK Timeout / CTS Timeout Selection

1. Type “vi /etc/config/wireless”
2. Type “option dynack 20” to enable Dyanmic slottime/acktimeout/ctsttimeout.  
Choose “option slottime 100” for both AP and Station.  
Choose “option acktimeout 204” for both AP and Station.  
Choose “option ctsttimeout 204” for both AP and Station.  
This will let the algorithm starts from maximum value to go down. This has been tested to be effective.

```
config wifi-device wifi0
    option type atheros
    option channel 149
    option hwmode 11a+
    option country US
    option dynack 20
    option slottime 100
    option acktimeout 204
    option ctsttimeout 204

config wifi-iface
    option device wifi0
    option network lan
    option mode ap
    option ssid OpenWrt
    option encryption psk2
    option key abcd1234
```

3. Type “reboot” to reboot the system to make the changes take effect.

## Test Results

Conditions: WPJ543 with OpenWRT as AP, WPJ543 with OpenWRT as Station.

Both have WLM200NX as cards.

Both are linked up with attenuation = 70.

Use 5500MHz for 5GHz testing, 2437MHz for 2.4GHz

Encryption : WPA2-PSK + Cipher = AES

40MHz, 5GHz	92Mbps
20MHz, 5GHz	85Mbps
10MHz, 5GHz	46Mbps
5MHz, 5GHz	23Mbps
40MHz, 2.4GHz	94Mbps
20MHz, 2.4GHz	87Mbps
10MHz, 2.4GHz	46Mbps
5MHz, 2.4GHz	21Mbps

## FAQ's

### 1. Offsets in transmission power

Other than WLM200NX, WLM200N2 cards, any Compex manufactured card with more than 20dBm will be offset by the power that is more than 20dBm.

For eg. WLM200N5-26, is being offset by  $26-20 = 6\text{dBm}$ , which means that when you use "iwconfig" to see the transmission power, it will be shown as 20dBm, but in actual fact it is 26dBm.

Compex Radios	Offsets
WLM200NX	No
WLM200N2	No
WLM200N2-23 ESD	3dBm
WLM200N2-26	6dBm
WLM200N5-23 ESD	3dBm
WLM200N5-26	6dBm

### 2. How to see the version of the Compex modified OpenWRT firmware that you are using?

Type "uci get system.@system[0].version"

Current version is "abgn\_v111\_b091217"