Application Note for RTL819X System

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Change History

Version	Date	Remarks
1.0	2009/11/17	Initial Release
1.1	2010/1/14	Add comments
1.2	2010/1/29	Add mib of WAPI
1.3	2010/2/24	Add new configuration API support
1.4	2010/4/7	Add mib Add configuration file support
1.5	2010/5/4	Correct explanation of mib
1.6	2010/5/31	Add mib of manual WMM
1.7	2011/3/14	Add dual-band configuration & DFS
1.8	2011/7/27	Add multiple AP profile support
1.9	2011/9/14	Add comments for proc/stats
1.10	2011/9/29	Add LED type
1.11	2011/10/19	Add mib for band priority and special channel plan
1.12	2012/3/1	Add support for 8188RE
1.13	2012/5/2	Correct aggregation mib
1.14	2012/5/10	Delete the description for band priority and special channel plan. Add description for multiple profile.
1.15	2012/5/30	Modify comments for mibs “led_type” and “wifi_specific”
1.16	2012/7/31	Add 2.4G channel plan table. Add new regdomain value (14,15) for global and world-wide.
1.17	2012/9/10	Add mib for 802.11ac
1.18	2012/9/26	Add mib for VHT rate classify
1.19	2012/11/21	Modify the usage of deny_legacy
1.20	2012/12/19	Add mib of disable_ch1213
1.21	2012/12/28	Add mib of pa type
1.22	2013/1/8	Add LED type Add limitation for 8812E
1.23	2013/4/26	Add adaptivity test related mib
1.24	2013/5/10	Modify LED type for 8812E and 8192ER
1.25	2013/9/27	Modify LED setting for 8812E
1.26	2013/11/21	Correct default values for WMM mibs
2.0	2014/02/17	Initial Release
2.1	2014/03/04	Add mib for disable 92E ldpc and degrade 3dB in 1T rates when both tx2path and tx power limit enable.

2.2	2014/03/31	Add missing mibs Update description of mibs pa_type, ther, and xcap Update Russian 5G channel
2.3	2014/06/03	Update channel table. Deprecate region domain SPAIN, FRANCE, MKK1, MKK2, and MKK3.
2.4	2014/06/24	Add section 5.3 to describe mix security feature for client mode Remove MIB "phyBandSelect"
2.5	2014/09/24	Modify comment of mib "ldpc_92e"

Table of Contents

1. Introduction

This document introduces the usage and system architecture of Realtek Wi-Fi driver and all related software. This section includes the current supported Wi-Fi features, the 2.4GHz and 5GHz channel plan. The goal of this document is to help software developers to port Realtek WiFi to their target platform more effectively.

1.1. Feature Lists

- 802.11 a/b/g/n/ac compatible
- AP mode and client mode support
- Security support 64/128 bits WEP, WPA, and WPA2 (TKIP and AES-CCMP)
- Auto rate adaptive
- Wireless MAC address filter
- Broadcast SSID control
- IAPP (802.11f) support
- Auto channel selection
- Driver based MP functions
- WDS function support
- Universal repeater mode support
- WMM supported for AP mode
- Support WLAN ASIC of 8192CE, 8188RE, 8192DE, 8188ER, 8812E, and 8192ER
- WPS function support
- WAPI function support
- Set WMM parameters manually

1.2. Channel Plan

1.2.1. 2.4G Channel Plan

regulation domain **(mib *regdomain* value)**	**supported channels**
FCC (1)	1,2,3,4,5,6,7,8,9,10,11
IC (2)	1,2,3,4,5,6,7,8,9,10,11
ETSI (3)	1,2,3,4,5,6,7,8,9,10,11,12,13
SPAIN (4) (deprecated)	1,2,3,4,5,6,7,8,9,10,11,12,13
FRANCE (5) (deprecated)	10,11,12,13
MKK (6)	1,2,3,4,5,6,7,8,9,10,11,12,13,14
ISREAL (7)	3,4,5,6,7,8,9,10,11,12,13
MKK1 (8) (deprecated)	1,2,3,4,5,6,7,8,9,10,11,12,13,14
MKK2 (9) (deprecated)	1,2,3,4,5,6,7,8,9,10,11,12,13,14
MKK3 (10) (deprecated)	1,2,3,4,5,6,7,8,9,10,11,12,13,14
NCC (11)	1,2,3,4,5,6,7,8,9,10,11
RUSSIAN (12)	1,2,3,4,5,6,7,8,9,10,11,12,13
CN (13)	1,2,3,4,5,6,7,8,9,10,11,12,13
GLOBAL (14)	1,2,3,4,5,6,7,8,9,10,11 passive scan: 12,13,14
WORLD-WIDE (15)	1,2,3,4,5,6,7,8,9,10,11 passive scan: 12,13

Note: When wifi is used as client mode, it will only listen AP Beacon during scanning in passive channel except it found hidden AP existed. When wifi is used as AP mode and configure to "auto" channel, it will not select the passive channel.

1.2.2. 5G Channel Plan

regulation domain (mib *regdomain* value)	**supported channels – DFS enabled**	**supported channels – DFS disabled**
FCC (1)	36,40,44,48,52,56,60,64,100,104,108, 112,116, 136,140,149,153,157,161,165	36,40,44,48,149,153,157, 161,165
IC (2)	36,40,44,48,52,56,60,64,149,153,157, 161	36,40,44,48,149,153,157, 161
ETSI (3)	36,40,44,48,52,56,60,64,100,104,108, 112,116,120,124,128,132,136,140	36,40,44,48
SPAIN (4) (deprecated)	36,40,44,48,52,56,60,64,100,104,108, 112,116,120,124,128,132,136,140	36,40,44,48

FRANCE (5) (deprecated)	36,40,44,48,52,56,60,64,100,104,108, 112,116,120,124,128,132,136,140	36,40,44,48
MKK (6)	36,40,44,48,52,56,60,64,100,104,108, 112,116,120,124,128,132,136,140	36,40,44,48
ISREAL (7)	36,40,44,48,52,56,60,64,100,104,108, 112,116,120,124,128,132,136,140	36,40,44,48
MKK1 (8) (deprecated)	34,38,42,46	34,38,42,46
MKK2 (9) (deprecated)	36,40,44,48	36,40,44,48
MKK3 (10) (deprecated)	36,40,44,48,52,56,60,64	36,40,44,48
NCC (11)	56,60,64,100,104,108,112,116,136,140, 149,153,157,161,165	56,60,64,149,153,157,161, 165
RUSSIAN (12)	36,40,44,48,52,56,60,64,132,136,140,149 ,153,157,161,165	36,40,44,48,149,153,157, 161,165
CN (13)	36,40,44,48,52,56,60,64,149,153,157,161 ,165	36,40,44,48,149,153,157, 161,165
GLOBAL(14)	36,40,44,48,52,56,60,64,100,104,108,112 ,116,136,140,149,153,157,161,165	36,40,44,48,149,153,157, 161,165
WORLD-WIDE(15)	36,40,44,48,52,56,60,64,100,104,108,112 ,116,136,140,149,153,157,161,165	36,40,44,48,149,153,157, 161,165

2. Configuration

System configuration is used for store parameters for various features. RTL8192cd driver and software package provides three methods to configure parameters. One is through configuration files, one is through "iwpriv" command to set MIB directly, and the other one is via iwconfig/iwlist command.

Configuration files method creates configuration files to store parameters in file system in user space. Through scripts or software utility, these parameters will be read from the configuration files, maps value to related MIB value and then set to driver by "iwpriv" command.

Using "iwpriv" to set MIB directly and using iwconfig/iwlist command don't need to create configuration files. When using "iwpriv" command, the parameters map to MIB directly.

2.1. Configuration Files

The driver can be configured via a *configuration file* each time an interface is up. Before using configuration file method, be sure to turn on this function in kernel configuration:
Select *"Network device support ---> Wireless LAN (non-hamradio) ---> Config File support"*; then rebuild kernel image.

The configuration file is located at /etc/Wireless/RTL8192CD.dat with *Sytax:* <wlan_interface>_<mib_command> , e.g. wlan0_ssid=xxxx.
Bellows are the rules to compose the configuration file.

1. Add '#' in front of comment lines.
2. Space is NOT allowed between <wlan_interface> and <mib_command>.
3. If the user needs to configure MIB values with special characters, e.g. '#', the value of <mib_command> MUST be **quoted** E.g. wlan0_ssid="#XXXXX@##$$%%"
4. <wlan_interface>: wlan interface, e.g., wlan0, wlan0-va0. However, please **DO NOT** configure **WDS** interfaces because WDS is configured in wlan0 interface.
5. <mib_command>: MIB commands, e.g., ssid=xxxx, please refer to table "MIB command table" and following "Extended MIB command table"
6. MIB value should be also configured for each virtual interface separately.
7. Each time an interface is up, the configuration file will be loaded.

Extended MIB command table (available only if Config File support is turned on):

Name	Meaning	Value	Default	Comment
hwaddr	MAC address of WLAN interface	12 hex digits, e.g. 00e04c8192a1	0	

2.2. MIB

RTL8192cd driver provide MIB interface to get/set parameters by “iwpriv” command. Below lists “iwpriv” MIB commands format and all MIB parameter table.

1. Set_mib description:

   Usage: “iwpriv <iface> set_mib name=value1[,value2,value3…]”

   Iface: “wlan0”

   (1) Value can be a single field or multiple fields separated by ‘,’ without any space between fields. Detail parameter may be referred the following table.

   (2) If the value is the type of byte array, the format of value will be a string of ASCII of 0~f, which using 2 ASCII standing for one byte. For example, when set Tx power of CCK for path A, it will be “iwpriv wlan0 set_mib pwrlevelCCK_A=08080909090a0a0a0b0b0b0c0c”

2. Get_mib description:

   Usage: “iwpriv <iface> get_mib name”

   Iface: “wlan0”

Name	Meaning	Value	Default	Comment
channel	Operation frequency used	0 for auto channel, 1-14 for 11b/11g, 36-165 for 11a		
ch_low	The lowest channel to scan and use	1-14 for 11b/11g, 36-165 for 11a		
ch_hi	The highest channel to scan and use	1-14 for 11b/11g, 36-165 for 11a		
pwrlevelCCK_A	CCK Tx power level for 14 channels (28 hex digits) for path A	RF module dependent		Type of byte array
pwrlevelCCK_B	CCK Tx power level for 14 channels (28 hex digits) for path B	RF module dependent		Type of byte array
pwrlevelHT40_1S_A	40MHz mode HT OFDM 1 spatial stream Tx power level for 14 channels (28 hex digits) for path A	RF module dependent		Type of byte array
pwrlevelHT40_1S_B	40MHz mode HT OFDM 1 spatial stream Tx power level for 14 channels (28 hex digits) for path B	RF module dependent		Type of byte array
pwrdiffHT40_2S	40MHz mode HT OFDM 2 spatial stream Tx power difference between HT40_1S for 14 channels (28 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array
pwrdiffHT20	20MHz mode HT OFDM Tx power difference between HT40_1S for 14 channels (28 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array
pwrdiffOFDM	Legacy OFDM Tx power difference between HT40_1S for 14 channels (28 hex digits). Bit[3:0] for path A.	RF module dependent		Type of byte array

	Bit[7:4] for path B.			
Pwrlevel5GHT40_1S_A	40MHz mode HT OFDM 1 spatial stream Tx power level for 5G 196 channels (392 hex digits) for path A	RF module dependent		Type of byte array
Pwrlevel5GHT40_1S_B	40MHz mode HT OFDM 1 spatial stream Tx power level for 5G 196 channels (392 hex digits) for path B	RF module dependent		Type of byte array
Pwrdiff5GHT40_2S	40MHz mode HT OFDM 2 spatial stream Tx power difference between HT40_1S for 5G 196 channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array
Pwrdiff5GHT20	20MHz mode HT OFDM Tx power difference between HT40_1S for 5G 196 channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array
Pwrdiff5GOFDM	Legacy OFDM Tx power difference between HT40_1S for 5G 196 channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array
pwrdiff_20BW1S_OFDM1T_A	Pwower Index Difference between BW20-1S and BW40-1S. Bit[7:4]: Path A 2G Offset, Range –8~7. Pwower Index Difference between OFDM-1Tx and BW40-1S. Bit[3:0]: Path A 2G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_40BW2S_20BW2S_A	Pwower Index Difference between BW40-2S and BW40-1S. Bit[7:4]: Path A 2G Offset, Range –8~7. Pwower Index Difference between BW20-2S and BW20-1S. Bit[3:0]: Path A 2G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_20BW1S_OFDM1T_A	Pwower Index Difference between BW20-1S and BW40-1S. Bit[7:4]: Path A 5G Offset, Range –8~7. Pwower Index Difference between OFDM-1Tx and BW40-1S. Bit[3:0]: Path A 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_40BW2S_20BW2S_A	Pwower Index Difference between BW40-2S and BW40-1S. Bit[7:4]: Path A 5G Offset, Range –8~7. Pwower Index Difference between	RF module dependent (for 8812)		Type of byte array

	BW20-2S and BW20-1S. Bit[3:0]: Path A 5G Offset, Range –8~7.			
pwrdiff_5G_80BW1S_160BW1S_A	Pwower Index Difference between BW80-1S and BW40-1S (UpSide Ch + LowSide Ch)/2. Bit[7:4]: Path A 5G Offset, Range –8~7. Pwower Index Difference between BW160-1S and BW80-1S (UpSide Ch + LowSide Ch)/2. Bit[3:0]: Path A 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_80BW2S_160BW2S_A	Pwower Index Difference between BW80-2S and BW80-1S. Bit[7:4]: Path A 5G Offset, Range –8~7. Pwower Index Difference between BW160-2S and BW160-1S. Bit[3:0]: Path A 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_20BW1S_OFDM1T_B	Pwower Index Difference between BW20-1S and BW40-1S. Bit[7:4]: Path B 2G Offset, Range –8~7. Pwower Index Difference between OFDM-1Tx and BW40-1S. Bit[3:0]: Path B 2G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_40BW2S_20BW2S_B	Pwower Index Difference between BW40-2S and BW40-1S. Bit[7:4]: Path B 2G Offset, Range –8~7. Pwower Index Difference between BW20-2S and BW20-1S. Bit[3:0]: Path B 2G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_20BW1S_OFDM1T_B	Pwower Index Difference between BW20-1S and BW40-1S. Bit[7:4]: Path B 5G Offset, Range –8~7. Pwower Index Difference between OFDM-1Tx and BW40-1S. Bit[3:0]: Path B 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_40BW2S_20BW2S_B	Pwower Index Difference between BW40-2S and BW40-1S. Bit[7:4]: Path B 5G Offset, Range –8~7. Pwower Index Difference between	RF module dependent (for 8812)		Type of byte array

	BW20-2S and BW20-1S. Bit[3:0]: Path B 5G Offset, Range –8~7.			
pwrdiff_5G_80BW1S_160BW1S_B	Pwower Index Difference between BW80-1S and BW40-1S (UpSide Ch + LowSide Ch)/2. Bit[7:4]: Path B 5G Offset, Range –8~7. Pwower Index Difference between BW160-1S and BW80-1S (UpSide Ch + LowSide Ch)/2. Bit[3:0]: Path B 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
pwrdiff_5G_80BW2S_160BW2S_B	Pwower Index Difference between BW80-2S and BW80-1S. Bit[7:4]: Path B 5G Offset, Range –8~7. Pwower Index Difference between BW160-2S and BW160-1S. Bit[3:0]: Path B 5G Offset, Range –8~7.	RF module dependent (for 8812)		Type of byte array
preamble	CCK preamble type	0 – long preamble, 1 – short preamble		
trswitch	Enable T/R switch	0 – disable, 1 – enable		
disable_ch14_ofdm	Disable OFDM sending and receiving in channel 14. It will also prevent auto channel to choose ch14.	0 – enable, 1 – disable		
disable_ch1213	Prevent auto channel to choose ch12 and ch13	0 – enable, 1 – disable		
pa_type	Support 8812 different pa type	0 – skyworth-5022, 1 – RFMD-4501 / skyworth-85703 2 – SKYWORKS_5023 3 – RTC5634 16 – Internal PA	0	
xcap	Crystal Capacitor value	0~62(0x3E)		0 stands the value is not calibrated yet.
tssi1	Tx signal strength value of path A	0 – 255		0 stands the value is not calibrated yet.
tssi2	Tx signal strength value of path B	0 – 255		0 stands the value is not calibrated yet.
ther	Thermal value	For 8188C/8192C/8192D: 7 < ther <= 0x1d Others: 7 < ther <= 0x32		0 stands the value is not calibrated yet.
MIMO_TR_mode	MIMO mode assignment	1 – 1T2R, 3 – 2T2R, 4 – 1T1R	3	
tx2path	Enable tx using 2 path to send 1T rate	0 – disable, 1 – enable	1	
bcn2path	Enable 2 path to send beacon	0 – disable, 1 – enable		

add_cck1M_pwr	Add power to CCK 1M rate	0 – disable, Other – the power added to CCK 1M in unit of power level		
ssid	SSID	"string_value", SSID with 32 characters in max		
defssid	If don't give SSID in Ad-hoc client mode and no IBSS available, it will start an IBSS with SSID given here.	"string_value", SSID with 32 chars in max	"defaultSSID"	
bssid2join	Besides SSID, designate target BSSID to join	xxxxxxxxxxxx (12 digits mac address)		Type of byte array
bcnint	Beacon interval in ms	20-1024	100	
dtimperiod	DTIM period	1-255	1	Suggest to set 1 because patent issue
swcrypto	S/w encryption enabled/disabled	0 – disable, 1 – enable		
aclmode	Access control mode	0 – disable, 1 – accept, 2 – deny		
aclnum	Set number of ACL	Suggest set '0' whenever driver is re-initialized		
acladdr	Set access control address	xxxxxxxxxxxx (12 digits mac address)		When acl is added, the aclnum will be increased automatically.
oprates	Operational rates	Bit0-bit11 for 1,2,5.5,11,6,9,12,18,24,,36,48,54 M	0xfff	
basicrates	Basic rates	Bit0-bit11 for 1,2,5.5,11,6,9,12,18,24,,36,48,54 M	0xf	
regdomain	Regulation domain	1-15 (FCC, IC, ETSI, SPAIN, FRANCE, MKK, ISREAL, MKK1, MKK2, MKK3, NCC, RUSSIAN, CN, GLOBAL, WORLD-WIDE)	1	Please refer the 2.4G channel plan table in detail.
txpwr_lmt_index	Set specific region domain for tx power limit	0 – use mib regdomain for tx power limit, Other – the specific region domain index for tx power limit		
autorate	Auto rate adaptive	0 – disable, 1 – enable	1	
fixrate	Fixed Tx rate	Bit0-bit11 for 1,2,5.5,11,6,9,12,18,24,,36,48,54 M Bit12-Bit27 for MCS0,MCS1,…,MCS15 (Bit31 + 0) for NSS1-MCS0 (Bit31 + 1) for NSS1-MCS1 (Bit31 + 2) for NSS1-MCS2 … (Bit31 + 10) for NSS2-MCS0 (Bit31 + 11) for NSS2-MCS1 (Bit31 + 12) for NSS2-MCS2 …etc		Refer when auto rate is disabled

disable_protection	Forcedly disable protection mode	0 – auto, 1 – disable protection		Normally when 11g is used, driver will auto detect if legacy (11b) device is existed. When 11n is used, driver will auto detect if legacy (11b/g) device is existed. If yes, it will enable protection mode automatically.
disable_olbc	Forcedly OLBC detection	0 – auto, 1 – disable protection		Normally 11g AP should detect OLBC. If disabled, AP will enter protection mode only when legacy device associated.
deny_legacy	Deny the association from legacy STA for corresponding band	1 – 11b, 2 – 11g, 4 – 11a, 8 – 11n		Set the corresponding legacy band of STA to deny
prob_info_enable	Enable wlan driver to collect probe request information	0 – disable, 1 – enable		Cat /proc/wlan0/probe_info to see the collect results
fast_roaming	Client mode fast roaming	0 – disable, 1 – enable		
lowestMlcstRate	Use lowest basic rate to send multicast and broadcast	0 – disable Bit0-bit11 for 1,2,5.5,11,6,9,12,18,24,,36,48,54 M Bit12-Bit27 for MCS0,MCS1,…,MCS15		
stanum	Limit max associated sta number	0-32. 0 – disable (not limit).		
authtype	802.11 Authentication type	0 – open system, 1 – shared key, 2 – auto	2	
encmode	Encryption mode	0 – disabled, 1 – WEP64, 2 – TKIP, 4 – AES(CCMP), 5 – WEP128		Set to 2 always under WPA/WPA2 mode
wepdkeyid	WEP default Tx key	0-3		
psk_enable	PSK mode	0 – disable, 1 – WPA, 2 – WPA2, 3 – WPA/WPA2 mixed		
wpa_cipher	WPA PSK cipher suite	2 –TKIP, 8 – AES(CCMP), 10 – TKIP/AES mixed		
wpa2_cipher	WPA2 PSK cipher suite	2 –TKIP, 8 – AES(CCMP), 10 – TKIP/AES mixed		
passphrase	PSK key	32 characters or 64 hex digits		
gk_rekey	Group key update time	0 – disable, >1 – enable		Time unit is second
802_1x	Flag of using 802.1x	0 – disable, 1 – enable		When 802.1x is enabled, the Auth daemon must be invoked
default_port	Default state of 802.1x control port	0 – data packet is not allowed to		Refer when 802_1x is

<table>
<tr><td></td><td></td><td>pass through until 802.1x authentication is ok
1 – data packet is allowed pass through even 802.1x authentication is not ok</td><td></td><td>set to 1</td></tr>
<tr><td>wepkey1</td><td>WEP key1</td><td>10 hex digits for WEP64, 26 hex digits for WEP128</td><td></td><td>Type of byte array</td></tr>
<tr><td>wepkey2</td><td>WEP key2</td><td>10 hex digits for WEP64, 26 hex digits for WEP128</td><td></td><td>Type of byte array</td></tr>
<tr><td>wepkey3</td><td>WEP key3</td><td>10 hex digits for WEP64, 26 hex digits for WEP128</td><td></td><td>Type of byte array</td></tr>
<tr><td>wepkey4</td><td>WEP key4</td><td>10 hex digits for WEP64, 26 hex digits for WEP128</td><td></td><td>Type of byte array</td></tr>
<tr><td>opmode</td><td>Operation mode (AP or client)</td><td>16 – AP, 8 – Infrastructure client, 32 – Ad-hoc client</td><td>16</td><td></td></tr>
<tr><td>hiddenAP</td><td>Hidden AP enable/disable</td><td>0 – disabled, 1 – enabled</td><td></td><td></td></tr>
<tr><td>rtsthres</td><td>RTS threshold</td><td>0-2347</td><td>2347</td><td></td></tr>
<tr><td>fragthres</td><td>Fragment threshold</td><td>256-2346</td><td>2346</td><td></td></tr>
<tr><td>shortretry</td><td>Short retry limit</td><td>1-255</td><td>3</td><td></td></tr>
<tr><td>longretry</td><td>Long retry limit</td><td>1-255</td><td>3</td><td></td></tr>
<tr><td>expired_time</td><td>Client inactivity time in 10ms</td><td>>100</td><td>30000</td><td>Time unit is 10 ms.</td></tr>
<tr><td>led_type</td><td>WLAN LED type</td><td><b>For 8188RE, 8192CE, 8192DR</b>
<table>
<tr><th></th><th>LED0</th><th>LED1</th></tr>
<tr><td>0</td><td>tx</td><td>rx</td></tr>
<tr><td>1</td><td>enable/tx/rx</td><td>n/a</td></tr>
<tr><td>2</td><td>link</td><td>tx/rx (d,m)</td></tr>
<tr><td>3</td><td>link/tx/rx (d,m)</td><td>n/a</td></tr>
<tr><td>4</td><td>link</td><td>tx/rx (d)</td></tr>
<tr><td>5</td><td>link/tx/rx (d)</td><td>n/a</td></tr>
<tr><td>6</td><td>enable</td><td>tx/rx (d)</td></tr>
<tr><td>7</td><td>enable/tx/rx (d)</td><td>n/a</td></tr>
<tr><td>8</td><td>11a tx/rx (d)</td><td>11g tx/rx (d)</td></tr>
</table>
0-1 – hw control
2-8 – sw control
d – count data frames
m – count management frames

<b>For 8188RE, 8192CE</b>
<table>
<tr><th></th><th><b>LED2</b> (GPIO8)</th></tr>
<tr><td>11</td><td>link/tx/rx (d,m)</td></tr>
<tr><td>12</td><td>enable/tx/rx (d)</td></tr>
<tr><td>15</td><td>link/tx/rx (d)</td></tr>
<tr><td>16</td><td>assoc/tx/rx (d)</td></tr>
<tr><td></td><td><b>LED2</b> (GPIO10)</td></tr>
<tr><td>13</td><td>link/tx/rx (d,m)</td></tr>
<tr><td>17</td><td>enable/tx/rx (d)</td></tr>
</table>
11-17 – sw control
d – count data frames</td><td></td><td></td></tr>
</table>

<table>
<tr><td></td><td></td><td>m – count management frames

<b>For 8192DR</b>
<table>
<tr><td></td><td><b>LED2</b> (GPIO10)</td></tr>
<tr><td>50</td><td>enable/tx/rx (d)</td></tr>
<tr><td>52</td><td>link/tx/rx (d,m)</td></tr>
<tr><td></td><td><b>LED1</b> (GPIO9)</td></tr>
<tr><td>51</td><td>link/tx/rx (d,m)</td></tr>
</table>
50-52 – sw control
d – count data frames
m – count management frames

<b>For 8188ER/8192ER</b>
<table>
<tr><td></td><td><b>LED0</b> (GPIO5)</td></tr>
<tr><td>3</td><td>link/tx/rx (d,m)</td></tr>
<tr><td>5</td><td>link/tx/rx (d)</td></tr>
<tr><td>7</td><td>enable/tx/rx (d)</td></tr>
</table>
3-7 – sw control
d – count data frames
m – count management frames

<b>For 8812E/8812AR-VN</b>
<table>
<tr><td></td><td><b>LED1</b></td></tr>
<tr><td>3</td><td>link/tx/rx (d,m)</td></tr>
<tr><td>5</td><td>link/tx/rx (d)</td></tr>
<tr><td>7</td><td>enable/tx/rx (d)</td></tr>
</table>
3-7 – sw control
d – count data frames
m – count management frames

<b>For 8881A</b>
<table>
<tr><td></td><td><b>LED0</b></td></tr>
<tr><td>3</td><td>link/tx/rx (d,m)</td></tr>
<tr><td>5</td><td>link/tx/rx (d)</td></tr>
<tr><td>7</td><td>enable/tx/rx (d)</td></tr>
</table>
3-7 – sw control
d – count data frames
m – count management frames</td><td></td><td></td></tr>
<tr><td>iapp_enable</td><td>IAPP enable/disable</td><td>0 – disable, 1 – enable</td><td></td><td></td></tr>
<tr><td>block_relay</td><td>Block packet relaying between associated clients</td><td>0 – relay, 1 – block relay and drop, 2 – block relay and indicate to bridge</td><td></td><td></td></tr>
<tr><td>deny_any</td><td>Deny the association SSID of “any” including upper and lower cases</td><td>0 – disable, 1 – enable</td><td></td><td></td></tr>
<tr><td>crc_log</td><td>Calculate CRC error packets</td><td>0 – disable, 1 – enable</td><td></td><td></td></tr>
<tr><td>wifi_specific</td><td>Do WiFi logo test specific check</td><td>0 – disable, 1 – enable, 2 – auto</td><td>2</td><td>0 for performance</td></tr>
</table>

				mode; 1 for WiFi mode, 2 for auto mode. PS. For 8192DR 1x1 concurrent mode and 8188E, please set 1 to pass WiFi logo test.
disable_txsc	Tx shortcut enable/disable	0 – enable, 1 – enable		
disable_rxsc	Rx shortcut enable/disable	0 – enable, 1 – enable		
disable_brsc	Bridge shortcut enable/disable	0 – enable, 1 – enable		
keep_rsnie	Don't clean RSN IE while reinitialize the interface	0 – erase, 1 – keep		
guest_access	Restrict client to internet access only	0 – disable, 1 – enable		
band	Band selection	1 – 11b, 2 – 11g, 4 – 11a, 8 – 11n 64 – 11ac	3	
cts2self	Use cts2Self for protection mode	0 – no, 1 – yes	1	
wds_enable	WDS enable/disable	0 – disable, 1 – enable		
wds_pure	Flag to enable pure WDS mode that don't broadcast beacon and don't accept any station	0 – disable, 1 – enable		
wds_priority	Give WDS packets higher priority	0 – disable, 1 – enable		
wds_num	Set number of WDS	Suggest set '0' whenever driver is re-initialized		
wds_add	Set mac address of peer WDS AP and the rate sent to the peer WDS AP	xxxxxxxxxxxx (12 digits mac address). The max entry could be added is 8 in default configuration. After mac address, there is a 32-bit variable to give the rate. Bit0-bit11 for 1,2,5.5,11,6,9,12,18,24,,36,48,54 M Bit12-Bit27 for MCS0,MCS1,…,MCS15		When mac address is added, the wds_num will be increased automatically.
wds_encrypt	WDS encryption mode	0 – disabled, 1 – WEP64, 2 – TKIP, 4 – AES (CCMP), 5 – WEP128		
wds_wepkey	WDS WEP default key	10 hex digits for WEP64, 26 hex digits for WEP128		Type of byte array
wds_passphrase	WDS PSK key	32 characters or 64 hex digits		
nat25_disable	Disable NAT2.5 transformation in client mode	0 – enable, 1 – disable		
macclone_enable	Enable MAC clone from the first incoming packet	0 – disable, 1 – enable		
dhcp_bcst_disable	Flag of adding broadcast flag into DHCP request	0 – enable, 1 – disable		
add_pppoe_tag	Add extra tag in PPPoE packets by NAT2.5	0 – disable, 1 – enable	1	When set to 0, NAT2.5 can only support one session buildup at the same time.
clone_mac_addr	Assign the target MAC to clone	xxxxxxxxxxxx (12 digits mac		Type of byte array

		address)		
nat25sc_disable	NAT2.5 shortcut enable/disable	0 – enable, 1 – disable		
show_hidden_bss	Show hidden BSS in site survey	0 – disable, 1 – enable		
ack_timeout	Set ACK timeout value	0-255		0 means using standard value. In unit of us.
private_ie	Send and get private IE	At most 64 hex digits byte array		
groupID	Group ID of virtual AP (multiple SSID)	0-65535		When AP (including root and virtual) set the same group ID, the wlan traffics could be relayed. Root interface: wlan0 Virtual interface: wlan0-va0~wlan0-va3.
vap_enable	Tell driver if multiple AP function is enabled or disabled	0 – disable, 1 – enable		If multiple AP is enabled, this mib must be set to 1.
func_off	Temporary disable wlan function	0 – normal, 1 – wlan off		
qos_enable	Support WMM and QoS	0 – disable, 1 – enable		
apsd_enable	Support WMM APSD function	0 – disable, 1 – enable		
apsd_sta_be	Enable client mode BE queue	0 – disable, 1 – enable		This mid is only valid when apsd_enable is 1(enable)
apsd_sta_bk	Enable client mode BK queue	0 – disable, 1 – enable		This mid is only valid when apsd_enable is 1(enable)
apsd_sta_vi	Enable client mode VI queue	0 – disable, 1 – enable		This mid is only valid when apsd_enable is 1(enable)
apsd_sta_vo	Enable client mode VO queue	0 – disable, 1 – enable		This mid is only valid when apsd_enable is 1(enable)
wsc_enable	Support WiFi Protection Setup	Bit0 for client mode, Bit1 for AP mode		
pin	PIN setting for WPS	“string_value” with 8 characters in max		
supportedmcs	Supported MCS rates	Bit 0-15 for MCS0, …, MCS15	0xffff	
basicmcs	Basic MCS rates	Bit 0-15 for MCS0, …, MCS15		
use40M	Support 40M bandwidth in 11n mode	0 – 20M 1 – 40M 2 – 80M		
2ndchoffset	Control sideband offset	1 – secondary channel is below the primary channel, 2 – secondary channel is above the primary channel	1	
shortGI20M	Support short GI in 20M bandwidth	0 – disable, 1 – enable		
shortGI40M	Support short GI in 40M bandwidth	0 – disable, 1 – enable		
stbc	Support Space Time Block Coding	0 – disable, 1 – enable		

ldpc	Enable ldpc	0 – disable, 1 – enable	1	
ampdu	Support packet aggratation	0 – disable, 1 – enable		
lgyEncRstrct	Restrict legacy encryption in N mode	Bit 0: WEP, Bit 1: TKIP		
coexist	Support 20M/40M coexistant mode	0 – disable, 1 – enable		
txnoack	Enable Tx without receiving ACK	0 – disable, 1 – enable		
debug_err	Flag of DEBUG_ERR() macro	Bit value defined in 8185ag_debug.h (in hex)	ffffffff	
debug_info	Flag of DEBUG_INFO() macro	Bit value defined in 8185ag_debug.h (in hex)	0	
debug_warn	Flag of DEBUG_WARN() macro	Bit value defined in 8185ag_debug.h (in hex)	0	
debug_trace	Flag of DEBUG_TRACE() macro	Bit value defined in 8185ag_debug.h (in hex)	0	
ledBlinkingFreq	Multiple of wlan LED blinking frequency.	1~100	1	This value will be referred only when mib value of 'led_type' is greater than 1.
wapiType	WAPI mode	0 - Disable 1 - Certificate 2 – PSK	0	
wapiPsk	WAPI PSK	Up to 32 characters		
wapiPsklen	WAPI PSK length	0~32		
wapiUCastKeyType	Unicast key update mode	1 – Disable 2 – Time based 3 – Packet based 4 – Mix mode(Rekey when time or packet number exceeds threshold)		This object selects a mechanism for rekeying the unicast key.
wapiUCastKeyTimeout	Timeout threshold of time-based unicast key update mechanism	Unit: sec.		
wapiUCastKeyPktNum	Packet number threshold of packet based unicast key update mechanism			
wapiMCastKeyType	Multicast key update mode	1 – Disable 2 – Time based 3 – Packet based 4 – Mix mode(Rekey when time or packet number exceeds threshold)		This object selects a mechanism for rekeying the multicast key.
wapiMCastKeyTimeout	Timeout threshold of time-based multicast key update mechanism	Unit: sec.		
wapiMCastKeyPktNum	Packet number threshold of packet based multicast key update mechanism			
manual_edca	Enable / disable EDCA use manual values	0: disable, 1: enable	0	
sta_bkq_acm	Enable / disable AP broadcasting BK queue under ACM	0: disable, 1: enable	0	It is useless in general case
sta_bkq_aifsn	Set AIFS slot number for BK queue broadcasted by AP	1~7	7	Its value in flash is sum of SIFS and total

				slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, sta_bkq_aifsn=7 under 11g/n, AIFS is 9*7+16 = 79 us.
sta_bkq_cwmin	Set minimal contention window period for BK queue broadcasted by AP	1~10	4	Slot time will be 2^n-1, 15, by default.
sta_bkq_cwmax	Set maximal contention window period for BK queue broadcasted by AP	1~10	10	Slot time will be 2^n-1, 1023, by default.
sta_bkq_txoplimit	Set TXOP limit for BK queue broadcasted by AP	0~256	0	
sta_beq_acm	Enable / disable AP broadcasting BE queue under ACM	0: disable, 1: enable	0	
sta_beq_aifsn	Set AIFS slot number for BE queue broadcasted by AP	1~7	3	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, sta_beq_aifsn=3 under 11g/n, AIFS is 9*3+16 = 43 us.
sta_beq_cwmin	Set minimal contention window period for BE queue broadcasted by AP	1~10	4	Slot time will be 2^n-1, 15, by default.
sta_beq_cwmax	Set maximal contention window period for BE queue broadcasted by AP	1~10	10	Slot time will be 2^n-1, 1023, by default.
sta_beq_txoplimit	Set TXOP limit for BE queue broadcasted by AP	0~256	0	
sta_viq_acm	Enable / disable AP broadcasting VI queue under ACM	0: disable, 1: enable	0	
sta_viq_aifsn	Set AIFS slot number for VI queue broadcasted by AP	1~7	2	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n.

				For example, sta_viq_aifsn=2 under 11g/n, AIFS is 9*2+16 = 34 us.
sta_viq_cwmin	Set minimal contention window period for VI queue broadcasted by AP	1~10	3	Slot time will be 2^n-1, 15, by default.
sta_viq_cwmax	Set maximal contention window period for VI queue broadcasted by AP	1~10	4	Slot time will be 2^n-1, 7, by default.
sta_viq_txoplimit	Set TXOP limit for VI queue broadcasted by AP	0~256	188	Follow SPEC in 11b
sta_voq_acm	Enable / disable AP broadcasting VO queue under ACM	0: disable, 1: enable	0	
sta_voq_aifsn	Set AIFS slot number for VO queue broadcasted by AP	1~7	2	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, sta_voq_aifsn=2 under 11g/n, AIFS is 9*2+16 = 34 us.
sta_voq_cwmin	Set minimal contention window period for VO queue broadcasted by AP	1~10	2	Slot time will be 2^n-1, 7, by default.
sta_voq_cwmax	Set maximal contention window period for VO queue broadcasted by AP	1~10	3	Slot time will be 2^n-1, 3, by default.
sta_voq_txoplimit	Set TXOP limit for VO queue broadcasted by AP	0~256	102	Follow SPEC in 11b
ap_bkq_aifsn	Set AIFS slot number for BK queue used by AP	1~7	7	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, ap_bkq_aifsn=7 under 11g/n, AIFS is 9*7+16 = 79 us.
ap_bkq_cwmin	Set minimal contention window period for BK queue used by AP	1~10	4	Slot time will be 2^n-1, 15, by default.
ap_bkq_cwmax	Set maximal contention window period for BK queue used by AP	1~10	10	Slot time will be 2^n-1, 1023, by

				default.
ap_bkq_txoplimit	Set TXOP limit for BK queue used by AP	0~256	0	
ap_beq_aifsn	Set AIFS slot number for BE queue used by AP	1~7	3	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, ap_beq_aifsn=3 under 11g/n, AIFS is 9*3+16 = 43 us.
ap_beq_cwmin	Set minimal contention window period for BE queue used by AP	1~10	4	Slot time will be 2^n-1, 15, by default.
ap_beq_cwmax	Set maximal contention window period for BE queue used by AP	1~10	6	Slot time will be 2^n-1, 63, by default.
ap_beq_txoplimit	Set TXOP limit for BE queue used by AP	0~256	0	
ap_viq_aifsn	Set AIFS slot number for VI queue used by AP	1~7	1	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, ap_viq_aifsn=1 under 11g/n, AIFS is 9*1+16 = 25 us.
ap_viq_cwmin	Set minimal contention window period for VI queue used by AP	1~10	4	Slot time will be 2^n-1, 15, by default.
ap_viq_cwmax	Set maximal contention window period for VI queue used by AP	1~10	3	Slot time will be 2^n-1, 7, by default.
ap_viq_txoplimit	Set TXOP limit for VI queue used by AP	0~256	188	Follow SPEC in 11b
ap_voq_aifsn	Set AIFS slot number for VO queue used by AP	1~7	1	Its value in flash is sum of SIFS and total slot time. SIFS is 10 us when 11a/b/g and 16 us when 11n. Slot time is 20 us when 11a/b and 9 us when 11g/n. For example, ap_voq_aifsn=1 under 11g/n, AIFS is 9*1+16

				= 25 us.
ap_voq_cwmin	Set minimal contention window period for VO queue used by AP	1~10	3	Slot time will be 2^n-1, 7, by default.
ap_voq_cwmax	Set maximal contention window period for VO queue used by AP	1~10	2	Slot time will be 2^n-1, 3, by default.
ap_voq_txoplimit	Set TXOP limit for VO queue used by AP	0~256	102	Follow SPEC in 11b
band5GSelected	Restrict 5G channel usage to specific bands	BIT0: 0 – disable band 1 usage, 1– enable band 1 usage BIT1: 0 – disable band 2 usage, 1– enable band 2 usage BIT2: 0 – disable band 3 usage, 1– enable band 3 usage BIT3: 0 – disable band 4 usage, 1– enable band 4 usage	0x0f	
macPhyMode	Set dual or single MAC/PHY mode	0 – Single MAC/PHY, 2 – Dual MAC/PHY	2	Please refer to section "Dual-band configuration"
txbf	Enable Tx Beamforming function	0 – disable, 1 – enable	1	
txbfer	Enable Tx Beamformer	0 – disable, 1 – enable	1	This mib is only valid when txbf is 1
txbfee	Enable Tx Beamformee	0 – disable, 1 – enable	1	This mib is only valid when txbf is 1
supportedvht	Set Tx/Rx MCS map of VHT Capabilities element which carried in beacon, probe response, association request, response. Definition follows Draft P802.11ac_D3.0, 8.4.2.160.3 VHT Supported MCS Set field	0xfffa – Support 2SS MCS0~9, 1SS MCS0~9 0xfff5 - Support 2SS MCS0~8, 1SS MCS0~8 0xfffe - Support 1SS MCS0~9, 2SS not support 0xfffc - Support 1SS MCS0~7, 2SS not support	0xfffa	1SS Support b[1:0] = 0: MCS0~7 1: MCS0~8 2: MCS0~9 3: not support 2SS Support b[3:2] = 0: MCS0~7 1: MCS0~8 2: MCS0~9 3: not support
vht_txmap	Set VHT Tx rate map for rate adaptive algorithm	0xfffff – Support 2SS MCS9~0, 1SS MCS9~0 0x7ffdf –Support 2SS MCS8~0, 1SS MCS8~0 0x3fcff - Support 2SS2 MCS7~0, 1SS MCS7~0 0xfcff: Support 2SS2 MCS5~0, 1SS MCS7~0	0xfffff	b[9:0]: 1SS MCS9~0 b[19:10]: 2SS MCS9~0,
adaptivity_enable	Enable adaptivity test support	0: disable, 1: enable		If trying to pass adaptivity test in ETSI

				domain, this mib should be set to 1.
edcca_thd	Energy threshold for adaptivity test	Unit is dBm if 100 minus this value. For example, default value is –55dBm.	45	
mesh_enable	Enable mesh function	0 – disable, 1 – enable		
mesh_ap_enable	Enable access point function	0 – disable, 1 – enable		This mib only valid when mesh_enable is 1. Mesh_ap_enable is 0 means pure mesh mode.
mesh_id	Mesh ID	"string_value", with 32 characters in max		This mib only valid when mesh_enable is 1
mesh_privacy	Enable mesh data encryption	0 – disable, 4 – AES(CCMP)		This mib only valid when mesh_enable is 1
mesh_passphrase	Mesh PSK key	32 characters or 64 hex digits		
mesh_max_neightbor	The number of neighbor one mesh node can have.	0~15	15	This mib only valid when mesh_enable is 1
mesh_igmp_enable	Enable mesh igmp snooping	0 – disable, 1 – enable	1	This mib only valid when mesh_enable is 1
meshaclmode	Access control mode between mesh nodes	0 – disable, 1 – accept, 2 – deny		This mib only valid when mesh_enable is 1
meshaclnum	The number of ACL	0~128		This mib only valid when mesh_enable is 1 and meshaclmode is 1 or 2
meshacladdr	The array of mac address of mesh nodes to be deny or accept	The content of this mib depends on the value of meshaclnum. If meshaclnum is 1, this mib contains one xxxxxxxxxxxx (12 digits mac address). If meshaclnum is 2, this mib contains two xxxxxxxxxxxx (12 digits mac address), totally 24 digits.		This mib only valid when mesh_enable is 1 and meshaclmode is 1 or 2
disable_DFS	Disable DFS function	0 – enable DFS, 1 – disable DFS	0	
gbwcmode	Set group bandwidth control mode	0 – disable group bandwidth control function, 1 – The Tx and Rx bandwidth to or from address in gbwcaddr are restricted by gbwcthrd_tx and gbwcthrd_rx, 2 – The Tx and Rx bandwidth to or from address NOT in gbwcaddr are restricted by gbwcthrd_tx and		

		gbwcthrd_rx, 3 – The total Tx bandwidth to all address is restricted by gbwcthrd_tx 4 – The total Rx bandwidth from all address is restricted by gbwcthrd_rx 5 – The total Tx and total Rx bandwidth to or from all address are restricted by gbwcthrd_tx and gbwcthrd_rx		
gbwcnum	Set number of group bandwidth control address	0~64		This mib is only valid when gbwcmode is other then 0 (disable)
gbwcaddr	Set group bandwidth control address	xxxxxxxxxxxx (12 digits mac address)		This mib is only valid when gbwcmode is other then 0 (disable). When gbwcaddr is added, the gbwcnum will be increased automatically.
gbwcthrd_tx	Set Tx bandwidth threshold in unit of kbps	0 – disable Tx bandwidth control, Other – Tx bandwidth threshold in unit of kbps	30000	This mib is only valid when gbwcmode is other then 0 (disable)
gbwcthrd_rx	Set Rx bandwidth threshold in unit of kbps	0 – disable Rx bandwidth control, Other – Rx bandwidth threshold in unit of kbps	30000	This mib is only valid when gbwcmode is other then 0 (disable)
use_efuse	Enable loading hw setting (power index, thermal, etc.) from efuse	0 – disable, 1 – enable		
ap_profile_enable	Enable/Disable multiple AP profile support	0 – disable, 1 - enable	0	
ap_profile_num	Set profile number	Number of profile to set	0	When "ap_profile_add" is called, the “ap_profile_num" will be increased by 1 automatically. So, suggest to set this number to '0' first, and then issue command "ap_profile_add" to add profile subsequently
ap_profile_add	Add AP profile	*Note		

sortbyprofile	Enable sort by profile	0 – disable, 1 - enable	0	This mib is only valid when ap_profile_enable is 1(enable). When sortbyporfile is 1(enabled), wlan driver will sort the profiles by SSID, and connect to APs according to the order of profiles. If sortbyporfile is 0(disable), wlan driver will connects to the AP in the profile list with the best signal strength.
global_vlan	Enable vlan function globally	0 – disable, 1 – enable		
is_lan	Set WAN or LAN port	0 – WAN port, 1 – LAN port	1	This mib is only valid when global_vlan is 1(enable).
vlan_enable	Enable vlan function for this port	0 – disable, 1 – enable		This mib is only valid when global_vlan is 1(enable).
vlan_tag	Enable tag	0 – no tag, 1 – tag		This mib is only valid when global_vlan is 1(enable).
vlan_id	Set vlan id	1~4095		This mib is only valid when global_vlan is 1(enable).
vlan_pri	Set vlan priority	0~7		This mib is only valid when global_vlan is 1(enable).
vlan_cfi	Set vlan CFI	0 – disable, 1 – enable		This mib is only valid when global_vlan is 1(enable).
countrycode	Enable/Disable 802.11d feature	0 – disable, 1 – enable	1	Currenty 802.11d is only supported in 5GHz band. Therefore this MIB always has value 0 in 2.4GHz band.
countrystr	Country string	“string_value”, 2 characters in max	“US”	This MIB is valid only when countrycode is 1 OR tpc_enable is 1
tpc_enable	Enable/Disable 802.11h TPC feature	0 – disable, 1 – enable	1	802.11h TPC is only supported in 5GHz band. Therefore this MIB always has value 0 in 2.4GHz band.

tpc_tx_power	The transmit power carried in the TPC report element	Two's complement integer value in units of dBm	12	This MIB is valid only when tpc_enable is 1
tpc_link_margin	The link margin carried in TPC report element	Two's complement integer value in units of dBm		This MIB is valid only when tpc_enable is 1
lpwc	The local power constraint carried in the power constraint element	Unsigned integer value in units of dBm		This MIB is valid only when tpc_enable is 1
min_tx_power	The minimum transmit power carried in power capability element	Two's complement integer value in units of dBm		This MIB is valid only when tpc_enable is 1.
max_tx_power	The maximum transmit power carried in power capability element	Two's complement integer value in units of dBm	20	This MIB is valid only when tpc_enable is 1.
ldpc_92e	Enable/Disable 92E ldpc	0 – disable, 1 – enable	0	Get detail usage in section 7.44 of "Kernel_2_6_SDK_User_Guide.doc"
disable_txpwrlmt	Disable tw power limit function	0 – enable tx power limit, 1 – disable tx power limit		
disable_txpwrlmt2path	Degrade 3dB (6 tx power index) in 1T rates when tx2path and tx power limit are both enable.	0 – disable, 1 – enable	0	This mib should set to 1 when the power limit table already consider the 3dB gain of tx2path.

Note1: The default value of MIB will be '0' if it is not specified.

Note2: The values set to EDCA manually will be applied after driver close and up

2.3. iwconfig/iwlist

The driver supports iwconfig and iwlist (Wireless Tools v29) for getting or setting wlan configurations. Before use this feature, please do build the kernel image as following Kernel configuration:

Select *"Network device support ---> Wireless LAN (non-hamradio) ---> Wireless Extensions v18 support"* and *"Network device support ---> Wireless LAN (non-hamradio) ---> Wireless Tools v29 support"*; then rebuild kernel image.

2.3.1. iwconfig

configure a wlan interface.

Usage: "iwconfig <wlan_*interface*>"

"iwconfig <wlan_*interface*> [essid *X*] [mode *M*] [freq *F*] [channel *C*] [ap *A*] [rate *R*] [rts *RT*] [frag *FT*] [enc *E*] [key *K*] [retry *R*]"

wlan_interface: wlan interface, e.g., wlan0
"iwconfig --help"
"iwconfig --version"

Parameters of **iwconfig**

Name	**Meaning**	**Value**	**Access**	**Comment**
essid	ESSID	any string, e.g. iwconfig essid "My SSID"	GET/SET	
mode	operating mode of the device	*Ad-Hoc*, *Managed* (client mode), *Master* (AP mode), *Repeater*, *Monitor*	GET	
freq	operating frequency	frequency in GHz	GET/SET	
channel	operating channel value	channel value	GET/SET	
ap	MAC address	e.g. *00:e0:4c:01:23:45*	GET	
rate/bit[rate]	maximum available bit rate	bit rate in Mb/s	GET	
rts[_threshold]	RTS threshold	packet size or off	GET/SET	
frag[mentation_threshold]	fragmentation threshold	packet size; off: based on driver setting	GET/SET	
key/enc[ryption]	WEP key settings	mode: open/restricted; keys in 10 or 32 hex-digit	GET	
retry	retry limits	number of retrys	GET	

Notes 1: for more detailed information, please refer to the manual of iwconfig.

Notes 2: Because *'iwconfig'* cannot fully cover all the configurations of the AP, we suggest the users using *'iwpriv'* descript in section 2.2 to setup the AP.

2.3.2. iwlist

Get wireless information from a wlan interface
Usage: "iwlist <wlan_*interface*> <*keyword*>"
"iwlist --help"
"iwlist --version"
wlan_interface: wlan interface, e.g., wlan0

<keywords> of **iwlist**

Name	**Meaning**	**Value**	**Comment**
scanning	site survey of neighboring WLAN devices	list of Access Points and Ad-Hoc cells in range.	
channel/frequency	supported channel and frequency	frequencies in GHz corresponding to the channels	varied as domain region changed
bitrate/rate	supported rate and extended supported rate announced in beacon	supported bit-rates in Mb/s	HT rates are not listed by iwlist
keys/encryption	WEP encryption information	key sizes, list of available keys and current transmit key	
ap/accsspoints/pe	Associated peer list	list of associated peers	

ers			
auth	Authentication capabilities	WPA, WPA2, CIPHER-TKIP, CIPHER-CCMP	

Notes 1: for more detailed information, please refer to the manual of iwlist.

Notes 2: Because *'iwlist'* cannot fully cover all the configurations of the AP, we suggest the users using *ioctl* descript in section 17.3 to retrieve settings of the AP.

3. Basic Driver Operation and Setting

3.1. Basic Driver Operation

3.1.1. Bring up Interface

After inserting driver module, we can use the following command to bring up WLAN interface.

Usage: "ifconfig <iface> up"

iface: "wlan0"

3.1.2. Set MAC Address

Use the following command to change WLAN interface MAC address.

Usage: "ifconfig <iface> hw ether <addr>"

iface: "wlan0"

addr: "xxxxxxxxxxxx", for example, MAC address 00:23:45:67:89:ab maps to "0023456789ab"

3.1.3. Down Interface

Use the following command to bring down WLAN interface.

Usage: "ifconfig <iface> down"

iface: "wlan0"

3.2. Basic Driver Setting

As described previously, there are three methods to configure parameters in this package. One of these is using "iwpriv" to set MIB directly to driver. The following sections show some examples of basic driver setting.

3.2.1. 802.11 b/g/n mode

1. Related MIB:

(1) "band": This parameter is bit mask of band selection. The value of this parameter could be set to 1 to use 802.11b band, set to 2 to use 802.11g band, set to 8 to use 802.11n band, or set to 11 to use 802.11 b/g/n bands.

(2) "use40M": This parameter means 11n channel bonding. The value of this parameter could be set to 0 to use 20MHz channel, or set to 1 to 40MHz channel.

2. 802.11b mode example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib band=1
iwpriv wlan0 set_mib deny_legacy=0
iwpriv wlan0 set_mib use_40M=0
ifconfig wlan0 up
```

3. 802.11g mode example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib band=2
iwpriv wlan0 set_mib deny_legacy=1
iwpriv wlan0 set_mib use_40M=0
ifconfig wlan0 up
```

4. 802.11n mode example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib band=8
iwpriv wlan0 set_mib deny_legacy=3
iwpriv wlan0 set_mib use_40M=1
ifconfig wlan0 up
```

5. 802.11 b/g/n mode example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib band=11
iwpriv wlan0 set_mib deny_legacy=0
iwpriv wlan0 set_mib use_40M=1
ifconfig wlan0 up
```

3.2.2. Channel

1. Related MIB:

(1) "channel": This parameter means WLAN channel number. The value of this parameter could be set to 0 to use auto channel, set to 1-14 for 11b/11g, or set to 36-165 for 11a. See the channel plan in Section 1.2.

2. WLAN auto channel example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib channel=0
ifconfig wlan0 up
```

3.2.3. SSID

1. Related MIB:
   (1) "ssid": This parameter means WLAN SSID. The value of this parameter could be set to specific string you want.
2. WLAN ssid example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib ssid=Realtek_AP_Test
ifconfig wlan0 up
```

3.2.4. TX Rate

1. Related MIB:
   (1) "autorate": This parameter means TX rate adaptive enable/disable. The value of this parameter could be set to 0 to disable rate adaptive, or set to 1 to enable rate adaptive.
   (2) "fixrate": This parameter means the fixed TX rate when "autorate" is disable. The value of this parameter is a bit map value that bit 0-11 for rate 1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54M and bit 12-27 for rate MCS0, MCS1, …, MCS15.
2. WLAN auto rate example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib autorate=1
iwpriv wlan0 set_mib fixrate=0
ifconfig wlan0 up
```

3. WLAN fixed rate example with wlan0 interface:

   Use MCS7 rate as the fixed rate and it maps to bit 19. The value of this bitmap is 0x80000 that it converts to 524288 on decimal.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib autorate=0
iwpriv wlan0 set_mib fixrate=524288
ifconfig wlan0 up
```

3.2.5. Hidden AP

1. Related MIB:
   (1) "hiddenAP": This parameter means hidden AP enable or disable. The value of this parameter could be set to 0 to disable hidden AP, set to 1 to enable hidden AP.
2. WLAN hidden AP example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib hiddenAP=0
ifconfig wlan0 up
```

3.2.6. No Encryption

1. Related MIB:
   (1) "authtype": This parameter means WLAN authentication type. The value of this parameter could be set to 0 to use open system, set to 1 to use shared key, or set to 2 to use both automatically.
   (2) "encmode": This parameter means WLAN security mode. The value of this parameter is set to 0 to disable encryption.
   (3) "802_1x": This parameter means 802.1X enable/disable. The value of this parameter is set to 0 to disable 802.1X.
2. WLAN No Encryption example with wlan0 interface:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib authtype=0
iwpriv wlan0 set_mib encmode=0
iwpriv wlan0 set_mib 802_1x=0
ifconfig wlan0 up
```

4. Dual-band Configuration

Dual-band functions are only supported by RTL8192D series. To enable Dual MAC/PHY mode, please turn on the option, “RTL8192D dual-MAC-dual-PHY mode”, in Linux kernel configuration. For Dual MAC/PHY mode, wlan0 is for 5G only, wlan1 is for 2G only.

4.1. Related MIB

1. “macPhyMode”: setting the wlan interface to be started as Dual MAC/PHY (1T1R Concurrent Mode) or Single MAC/PHY (2T2R Selective Mode)
2. “band”: setting the band for wlan interfaces. For example: 5G: 12 (A+N), 2G: 11 (B+G+N)
3. “channel”: setting a correct channel according to the band setting.

More dual-band related MIB are listed in bellow table.

macPhyMode	Set dual or single MAC/PHY mode	0 – Single MAC/PHY, 2 – Dual MAC/PHY	2	Please refer to section “Dual-band configuration”
channel	Operation frequency used	0 for auto channel, 1-14 for 11b/11g, 36-165 for 11a		
band	Band selection	1 – 11b, 2 – 11g, 4 – 11a, 8 – 11n	wlan0:12 wlan1:11	
pwrlevel5GHT40_1S_A	40MHz mode HT OFDM 1 spatial stream Tx power level for 196 (channel 1~196) channels (392 hex digits) for path A	RF module dependent		Type of byte array. E.g. Channel 36 should use the 36’th byte.
pwrlevel5GHT40_1S_B	40MHz mode HT OFDM 1 spatial stream Tx power level for 196 (channel 1~196) channels (392 hex digits) for path B	RF module dependent		Type of byte array. E.g. Channel 36 should use the 36’th byte.
pwrdiff5GHT40_2S	40MHz mode HT OFDM 2 spatial stream Tx power difference between HT40_1S for 196	RF module dependent		Type of byte array. E.g. Channel 36 should use the 36’th byte.

	(channel 1~196) channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.			
pwrdiff5GHT20	20MHz mode HT OFDM Tx power difference between HT40_1S for 196 (channel 1~196) channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array. E.g. Channel 36 should use the 36'th byte.
pwrdiff5GOFDM	Legacy OFDM Tx power difference between HT40_1S for 196 (channel 1~196) channels (392 hex digits). Bit[3:0] for path A. Bit[7:4] for path B.	RF module dependent		Type of byte array. E.g. Channel 36 should use the 36'th byte.

Note 1: if the value is the type of byte array, the format of value will be a string of ASCII of 0~f, which using 2 ASCII standing for one byte. For example, when set Tx power of pwrlevel5GHT40_1S_A, it will be

“iwpriv wlan0 set_mib
pwrlevel5GHT40_1S_A=00000000000000000000000000000000000000000000000000000000000
0000000000028282828282828282828282828282828282828282828282828282828280000000000
0000000000000000000000000000000000000000000000000000000000000028282828282828282
8282828282828282828282828282828282828282828282828282828282828280000000000000000
2828282828282828282828282828282828000000000000000000000000000000000000000000000
00000000000000000”

4.2. Examples

4.2.1. Setting as 5G Single MAC/PHY selective mode

1. disable all wlan interfaces

   > ifconfig wlan0 down

2. setting related mibs

   a. setting single MAC/PHY

   > iwpriv wlan0 set_mib macPhyMode=0

   b. setting band as A+N mode

   > iwpriv wlan0 set_mib band=12

   c. setting channel, e.g channel 44

> iwpriv wlan0 set_mib channel=44
d. setting other mib if necessary, such as 40M bandwidth, encryption, etc.

3. enable wlan interface
   > ifconfig wlan0 up

4.2.2. Setting as 2G Single MAC/PHY selective mode

1. disable all wlan interfaces
   > ifconfig wlan0 down
2. setting related mibs
   a. setting single MAC/PHY
   > iwpriv wlan0 set_mib macPhyMode=0
   b. setting band as B+G+N mode
   > iwpriv wlan0 set_mib band=11
   c. setting channel, e.g channel 6
   > iwpriv wlan0 set_mib channel=6
   d. setting other mib if necessary, such as 40M bandwidth, encryption, etc.
3. enable wlan interface
   > ifconfig wlan0 up

4.2.3. Setting as the Dual MAC/PHY concurrent mode

1. disable all wlan interfaces
   > ifconfig wlan0 down
   > ifconfig wlan1 down
2. setting related mibs
   a. setting dual MAC/PHY
   > iwpriv wlan0 set_mib macPhyMode=2
   > iwpriv wlan1 set_mib macPhyMode=2
   b. setting wlan0 band as A+N mode, setting wlan1 band as B+G+N mode
   > iwpriv wlan0 set_mib band=12
   > iwpriv wlan1 set_mib band=11
   c. setting channel, e.g 5G channel 44, 2G channel 6
   > iwpriv wlan0 set_mib channel=44
   > iwpriv wlan1 set_mib channel=6
   d. setting other mib if necessary, such as 40M bandwidth, encryption, etc.

3. enable wlan interface

```
> ifconfig wlan0 up
>ifconfig wlan1 up
```

5. Security Policy

This section describes the security policy of WLAN by introducing security related MIB.

5.1. WEP

5.1.1. Related MIB

1. “authtype”: This parameter means WLAN authentication type. The value of this parameter could be set to 0 to use open system, set to 1 to use shared key, or set to 2 to use both automatically.
2. “encmode”: This parameter means WLAN security mode. The value of this parameter is set to 1 to use WEP 64 bit encryption. Set to 5 to use WEP 128 bit encryption.
3. “wepdkeyid”: This parameter means WEP default key id. The value of this parameter is set to 0~3 to decide which key id to use.
4. “wepkey1” ~ “wepkey4”: These parameters indicate value of the related WEP key id. The value is set to 10 hex digits for WEP64, 26 hex digits for WEP128

5.1.2. WEP 64 example

This example shows example for using WEP 64 bits encryption.

1. “authtype”: Set to 2 to use open system or shared key automatically.
2. “encmode”: Set to 1 to use WEP 64 encryption.
3. “wepdkeyid”: Set to 0 to use “wepkey1” as default key.
4. “wepkey1”: These parameters store the value of the related WEP key id. For example, the value of “wepkey1” is “0987654321” 10 characters in HEX.

5.1.3. WEP 128 example

This example shows example for using WEP 128 bits encryption.

1. “authtype”: Set to 2 to use open system or shared key automatically.
2. “encmode”: Set to 5 to use WEP 128 encryption.
3. “wepdkeyid”: Set to 0 to use “wepkey1” as default key.
4. “wepkey1”: These parameters store the value of the related WEP key id. For example, the value of “wepkey1” is “12345678901234567890123456” 26 characters in HEX.

5.2. WPA/WPA2 PSK

5.2.1. Related MIB

1. "encmode": This parameter means WLAN security mode. The value of this parameter is set to 2 to use WPA/WPA2 mode.
2. "802_1x": This parameter means 802.1X enable/disable. The value of this parameter is set to 0 to disable 802.1X.
3. "psk_enable": This parameter is WPA PSK mode. The value of this parameter is set to 1 to use WPA encryption, or set to 2 to use WPA2 encryption, or set to 3 to use WPA/WPA2 mixed mode encryption.
4. "wpa_cipher": This parameter means WPA cipher type. The value of this parameter is set to 2 to use TKIP, or set to 8 to use AES, or set to 10 to use AES/TKIP mixed mode.
5. "wpa2_cipher": This parameter means WPA2 cipher type. The value of this parameter is set to 2 to use TKIP, or set to 8 to use AES, or set to 10 to use AES/TKIP mixed mode.
6. "passphrase": This parameter means WPA PSK value. The value of this parameter is 32 characters or 64 hex digits.

5.2.2. WPA AES example

This example shows how to use following MIB setup WPA AES encryption.

1. "encmode": Set to 2 to use WPA/WPA2 mode.
2. "802_1x": Set to 0 to disable 802.1X.
3. "psk_enable": Set to 1 to use WPA encryption.
4. "wpa_cipher": Set to 8 to use AES.
5. "passphrase": This parameter stores the value of the related WPA key. For example, the value of "passphrase" is "87654321" 8 characters.

5.2.3. WPA TKIP example

This example shows how to use following MIB to setup WPA TKIP encryption.

1. "encmode": Set to 2 to use WPA/WPA2 mode.
2. "802_1x": Set to 0 to disable 802.1X.
3. "psk_enable": Set to 1 to use WPA encryption.
4. "wpa_cipher": Set to 2 to use TKIP.
5. "passphrase": This parameter stores the value of the related WPA key. For example, the value of "passphrase" is "87654321" 8 characters.

5.2.4. WPA2 AES example

This example shows how to use following MIB to setup WPA2 AES encryption.

1. “encmode”: Set to 2 to use WPA/WPA2 mode.
2. “802_1x”: Set to 0 to disable 802.1X.
3. “psk_enable”: Set to 2 to use WPA2 encryption.
4. “wpa2_cipher”: Set to 8 to use AES.
5. “passphrase”: This parameter stores the value of the related WPA2 key. For example, the value of “passphrase” is “87654321” 8 characters.

5.2.5. WPA2 TKIP example

This example shows how to use following MIB to setup WPA2 TKIP encryption.

1. “encmode”: Set to 2 to use WPA/WPA2 mode.
2. “802_1x”: Set to 0 to disable 802.1X.
3. “psk_enable”: Set to 2 to use WPA2 encryption.
4. “wpa2_cipher”: Set to 2 to use TKIP.
5. “passphrase”: This parameter stores the value of the related WPA2 key. For example, the value of “passphrase” is “87654321” 8 characters.

5.2.6. WPA/WPA2 AES mixed mode example

This example shows how to use following MIB to setup WPA/WPA2 AES mixed mode encryption.

1. “encmode”: Set to 2 to use WPA/WPA2 mode.
2. “802_1x”: Set to 0 to disable 802.1X.
3. “psk_enable”: Set to 3 to use WPA/WPA2 mixed encryption.
4. “wpa_cipher”: Set to 8 to use AES.
5. “wpa2_cipher”: Set to 8 to use AES.
6. “passphrase”: This parameter stores the value of the related WPA/WPA2 mixed mode key. For example, the value of “passphrase” is “87654321” 8 characters.

5.2.7. WPA/WPA2 TKIP mixed mode example

This example shows how to use following MIB to setup WPA/WPA2 TKIP encryption.

1. “encmdoe”: Set to 2 to use WPA/WPA2 mode.
2. “802_1x”: Set to 0 to disable 802.1X.
3. “psk_enable”: Set to 3 to use WPA/WPA2 mixed encryption.
4. “wpa_cipher”: Set to 2 to use TKIP.
5. “wpa2_cipher”: Set to 2 to use TKIP.

6. “passphrase”: This parameter stores the value of the related WPA/WPA2 mixed mode key. For example, the value of “passphrase” is “87654321” 8 characters.

5.2.8. WPA/WPA2 auto mixed mode example

This example shows how to use following MIB to setup WPA AES encryption.

1. “encmode”: Set to 2 to use WPA/WPA2 mode.
2. “802_1x”: Set to 0 to disable 802.1X.
3. “psk_enable”: Set to 3 to use WPA/WPA2 mixed encryption.
4. “wpa_cipher”: Set to 10 to use AES/TKIP.
5. “wpa2_cipher”: Set to 10 to use AES/TKIP.
6. “passphrase”: This parameter stores the value of the related WPA/WPA2 mixed mode key. For example, the value of “passphrase” is “87654321” 8 characters.

5.3. Mix Security Setting for Client Mode

In wireless client mode, our SDK support mix security setting, which is convenient to user, that only the passphrase and wep key need to be set for connecting to the remote AP. The encryption method used by the client is automatically chosen according to the encryption method and cipher suites of the remote AP which the user want to connect to. Users don’t bother to specify a particular encryption method and therefore alleviate the cumbersome of setting process.
The client would choose the highest security setting supported by remote AP. The rule is: when AP is using WPA or WPA2, the SDK will use MIB “passphrase“, and choose the encryption method and a cipher suite according to the order AES > WPA2 > OTHER that the AP have supported; when AP is using WEP, the SDK will use MIBs “wepdkeyid “ and “wepkey1”~“wepkey4” to connect to it; when AP is an open system, the client just connect to it directly. For example:
If AP is using WPA2/WPA - AES/TKIP, the client will use WPA2-AES to connect.
If AP is using WPA - AES/TKIP, the client will use WPA-AES to connect.
If AP is using WPA2/WPA-TKIP, the client will use WPA2-TKIP to connect.
Though, the AP setting of the last of two examples above is not allowed nowadays.

To enable this feature, please go to “make menuconfig” and enable the option “Client mix security Support” as follows:

```
[*] Config kernel (NEW)    --->
     Device Drivers    --->
        Network device support    --->
           Wireless LAN    --->
              [*]    Client Mode support
                [*]          Client mix security Support
```

5.3.1. Related MIB

Only following MIBs matter when mix security support is enabled.

1. “passphrase”: This parameter means WPA PSK value. The value of this parameter is 32 characters or 64 hex digits.
2. “wepdkeyid”: This parameter means WEP default key id. The value of this parameter is set to 0~3 to decide which key id to use.
3. “wepkey1” ~ “wepkey4”: These parameters indicate value of the related WEP key id. The value is set to 10 hex digits for WEP64, 26 hex digits for WEP128

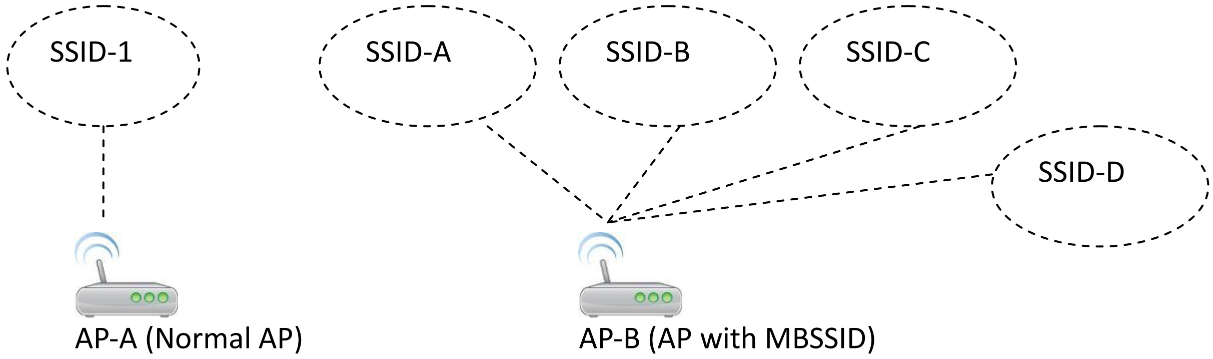
6. Dynamic Frequency Selection (DFS)

DFS is enabled if Linux kernel configuration "DFS support" is enabled. To obey regulation, DFS channels can ONLY be selected by auto-channel selection. The user can see "Auto (DFS)" on the channel column on web UI. If the user want to force the DUT set in a DFS channel for evaluation purpose, one should set console command with "**flash set WLAN0_CHANNEL <*channel #*>**", and then reboot. See 5G channel plan in section 1.2.2.

Note: Alternatively, the user can use http://192.168.1.254/syscmd.asp to input the command.

7. Multiple BSSID

In the usual, the Access-Point (AP) has one SSID, we can regard it as a wireless LAN (WLAN). If an AP has feature of multiple-BSSID (MBSSID) and enable the feature with 4 SSIDs, the AP has four WLANs. Use below figure as an example: When Wi-Fi client scanned the APs, there are five WLANs scanned by the Wi-Fi client, but there are only two real APs in the environment.



The feature of MBSSID would let one AP to look like more than one, so the feature sometimes also is called virtual access point (VAP).

7.1. Related MIB

1. "vap_enable": This parameter is used to turn MBSSID on/off. The value of this parameter is set to 0 to turn off MBSSID feature, and is set to 1 to turn on MBSSID feature

MBSSID feature would create several interfaces which depend by user setup in the system. The first interface is called root-AP interface (wlan0), and the other interfaces are called VAP interfaces (wlan0-va0, wlan0-va1…and etc).

Some settings of VAP interfaces use the same settings with root-AP such like radio parameters, and some settings of VAP interfaces should be disable such like WDS parameters. The other settings of VAP interfaces usually do not need to modify, but some parameters should be set its value with different interface (Please see below table)

Name	**Meaning**	**Value**	**Default**	**Comment**
ssid	SSID	"string_value", SSID with 32 characters in max		
opmode	Operation mode (AP)	16 – AP	16	This should be always AP.
block_relay	Block packet relaying between associated clients	0 – relay, 1 – block relay and drop, 2 – block relay and indicate to bridge		
authtype	802.11 Authentication type	0 – open system, 1 – shared key, 2 – auto	2	
encmode	Encryption mode	0 – disabled, 1 – WEP64, 2 – TKIP, 4 – AES(CCMP), 5 – WEP128		Set to 2 always under WPA/WPA2 mode
wepdkeyid	WEP default Tx key	0-3		
psk_enable	PSK mode	0 – disable, 1 – WPA, 2 – WPA2, 3 – WPA/WPA2 mixed		
wpa_cipher	WPA PSK cipher suite	2 –TKIP, 8 – AES(CCMP), 10 – TKIP/AES mixed		
wpa2_cipher	WPA2 PSK cipher suite	2 –TKIP, 8 – AES(CCMP), 10 – TKIP/AES mixed		
802_1x	Flag of using 802.1x	0 – disable, 1 – enable		When 802.1x is enabled, the Auth daemon must be invoked
wepkey1	WEP key1	10 hex digits for WEP64, 26 hex digits for WEP128		Type of byte array
wepkey2	WEP key2	10 hex digits for WEP64, 26 hex digits for WEP128		Type of byte array
wepkey3	WEP key3	10 hex digits for WEP64, 26 hex digits for WEP128		Type of byte array
wepkey4	WEP key4	10 hex digits for WEP64, 26 hex digits for WEP128		Type of byte array

7.2. Example of Setup

7.2.1. Enable MBSSID feature and Open two VAP interfaces

```
ifconfig wlan0-va0 down
ifconfig wlan0-va1 down
ifconfig wlan0 down
iwpriv wlan0 set_mib vap_enable=1
ifconfig wlan0 up
ifconfig wlan0-va0 up
ifconfig wlan0-va1 up
brctl addif br0 wlan0-va0
brctl addif br0 wlan0-va1
```

7.2.2. Stop one VAP interface

```
ifconfig wlan0-va1 down
brctl delif br0 wlan0-va1
```

7.2.3. Disable MBSSID feature and stop two VAP interfaces

```
ifconfig wlan0-va0 down
ifconfig wlan0-va1 down
ifconfig wlan0 down
brctl delif br0 wlan0-va0
brctl delif br0 wlan0-va1
iwpriv wlan0 set_mib vap_enable=0
ifconfig wlan0 up
```

7.2.4. Set VAP SSID

The other setup processes are alike as Chapter 5 and Chapter 6, but setup commands need to change interface name. Here, use MIB-“ssid” in VAP0 to be an example:

```
ifconfig wlan0-va0 down
iwpriv wlan0-va0 set_mib ssid=Realtek_AP_VAP0_Test
ifconfig wlan0-va0 up
```

7.3. Important Notes

- Wi-Fi Interface limitation:
  - If user wants to use MBSSID feature, the root-AP (wlan0) interface must not be stopped.
  - User should use “func_off” to enable/disable Wi-Fi functions on root-AP.
- Hardware limitation: Max size of MBSSID is 8 including root-AP.
- Software limitation:
  - User could modify the definition —“RTL8192CD_NUM_VWLAN” to change the number of supported VAP. The max size of MBSSID is “RTL8192CD_NUM_VWLAN” + 1.
  - The value of “RTL8192CD_NUM_VWLAN” should be smaller than 8(hardware limitation)

and bigger than -1.

- If user wants VAP to be independent with other VAPs, user should implement blocking method between VAPs. The method should be implemented by user in different system.

8. WMM

This section describes the WMM (Wireless Multimedia) feature and the related configuration.

8.1. Feature Description

WMM is a Wi-Fi Alliance interoperability certification, based on the IEEE 802.11e standard. It provides basic Quality of service (QoS) features to IEEE 802.11 networks. WMM prioritizes traffic according to four Access Categories (AC) - voice, video, best effort, and background. However, it does not provide guaranteed throughput. It is suitable for simple applications that require QoS, such as Voice over IP (VoIP) on Wi-Fi phones (VoWLAN).

The Wi-Fi Alliance has added Power Save Certification (WMM-APSD) to the WMM specification. Power Save uses mechanisms from 802.11e and legacy 802.11 to save power (for battery powered equipment) and fine-tune power consumption. The certification provides an indication that the certified product is targeted for power critical applications like hand-phones and portable power devices.

8.2. Related MIB

1. “qos_enable”: This parameter means WMM enable/disable. The value of this parameter could be set to 0 to disable WMM, or set to 1 to enable WMM.
2. “apsd_enable”: This parameter means WMM-APSD enable/disable. The value of this parameter could be set to 0 to disable WMM-APSD, or set to 1 to enable WMM-APSD.

9. WDS

9.1. Feature Description

The WDS (Wireless Distribution System) is wireless interconnection of 802.11 APs. It uses MAC address of peer APs to create wireless connection to expand network topology instead of wired cable that is most used in distribution system.

The AP which enables WDS is just like traditional AP that can accept wireless clients. The APs which create WDS connection must use the same channel. And the disadvantage of WDS is throughput will be halved for clients which connect wirelessly.

In Realtek WLAN system architecture, we can support 8 WDS number in current configuration.

9.2. Related MIB

1. “wds_enable”: This parameter means WDS enable/disable. The value of this parameter could be set to 0 to disable WDS, or set to 1 to enable WDS.
2. “wds_pure”: This parameter means WDS pure mode. The AP which enable WDS pure mode will not broadcast beacon and will not accept any station to connect. The value of this parameter is set to 0 to disable WDS pure mode, or set to 1 to enable WDS pure mode.
3. “wds_priority”: This parameter gives WDS packets higher priority. The value of this parameter could be set to 0 to disable WDS packets higher priority, or set to 1 to enable WDS packets higher priority.
4. “wds_num”: This parameter means WDS setting numbers. The value of this parameter is set to 0 if driver is re-initialized and adds by one if adding a new WDS setting.
5. “wds_add”: This parameter is used for setting MAC address of peer WDS AP and the rate sent to the peer WDS AP. The value of this parameter includes two parts. The first part is 12 digits MAC address. After MAC address, there is a 32-bit variable to give the rate that bit 0-11 for 1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54M and bit 12-27 for MCS0, MCS1, …, MCS15.
6. “wds_encrypt”: This parameter means WDS encryption mode. The value of this parameter could be set to 0 to disable encryption, set to 1 to use WEP 64 bit encryption, set to 2 to use TKIP, set to 4 to use AES, or set to 5 to use WEP 128 bit encryption.
7. “wds_wepkey”: This parameter indicates value of the WDS WEP default key. The value is set to 10 hex digits for WEP64 or 26 hex digits for WEP128.
8. “wds_passphrase”: This parameter indicates value of the WDS PSK key. The value is set to 32 characters or 64 hex digits.

9.3. WDS Example

These examples show how to use following MIB to setup WDS environment with different encryption types. We assume there are two AP, one is AP A and another is AP B. And we will setup WDS connection between AP A and AP B. The MAC address of AP A is 01:23:45:67:89:AA. The MAC address of AP B is 01:23:45:67:89:BB. The WLAN interface of both AP is wlan0.

9.3.1. WDS with No Encryption Example

The AP A needs to setup the following MIB. Assume the encryption of WDS connection is no encryption and the transmission rate is set to auto. The wds_add MIB need to set the WDS peer's MAC address, that is, use MAC address of AP B in this example.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=0
iwpriv wlan0 set_mib wds_add=0123456789BB,0
ifconfig wlan0 up
```

The AP B needs to setup the following MIB.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=0
iwpriv wlan0 set_mib wds_add=0123456789AA,0
ifconfig wlan0 up
```

9.3.2. WDS with WEP 64 bit Encryption Example

The AP A needs to setup the following MIB. Assume the encryption of WDS connection is WEP 64 bit encryption and the transmission rate is set to auto. The wds_add MIB need to set the WDS peer's MAC address, that is, use MAC address of AP B in this example.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=1
iwpriv wlan0 set_mib wds_wepkey=12345
iwpriv wlan0 set_mib wds_add=0123456789BB,0
ifconfig wlan0 up
```

The AP B needs to setup the following MIB.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=1
iwpriv wlan0 set_mib wds_wepkey=12345
iwpriv wlan0 set_mib wds_add=0123456789AA,0
ifconfig wlan0 up
```

9.3.3. WDS with AES Encryption Example

The AP A needs to setup the following MIB. Assume the encryption of WDS connection is AES and the transmission rate is set to auto. The wds_add MIB need to set the WDS peer's MAC address, that is, use MAC address of AP B in this example.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=4
iwpriv wlan0 set_mib wds_passphrase =12345678
iwpriv wlan0 set_mib wds_add=0123456789BB,0
ifconfig wlan0 up
```

The AP B needs to setup the following MIB.

```
ifconfig wlan0 down
iwpriv wlan0 set_mib wds_enable=1
iwpriv wlan0 set_mib wds_pure=0
iwpriv wlan0 set_mib wds_priority=1
iwpriv wlan0 set_mib wds_num=0
iwpriv wlan0 set_mib wds_encrypt=4
iwpriv wlan0 set_mib wds_passphrase =12345678
iwpriv wlan0 set_mib wds_add=0123456789AA,0
```

```
ifconfig wlan0 up
```

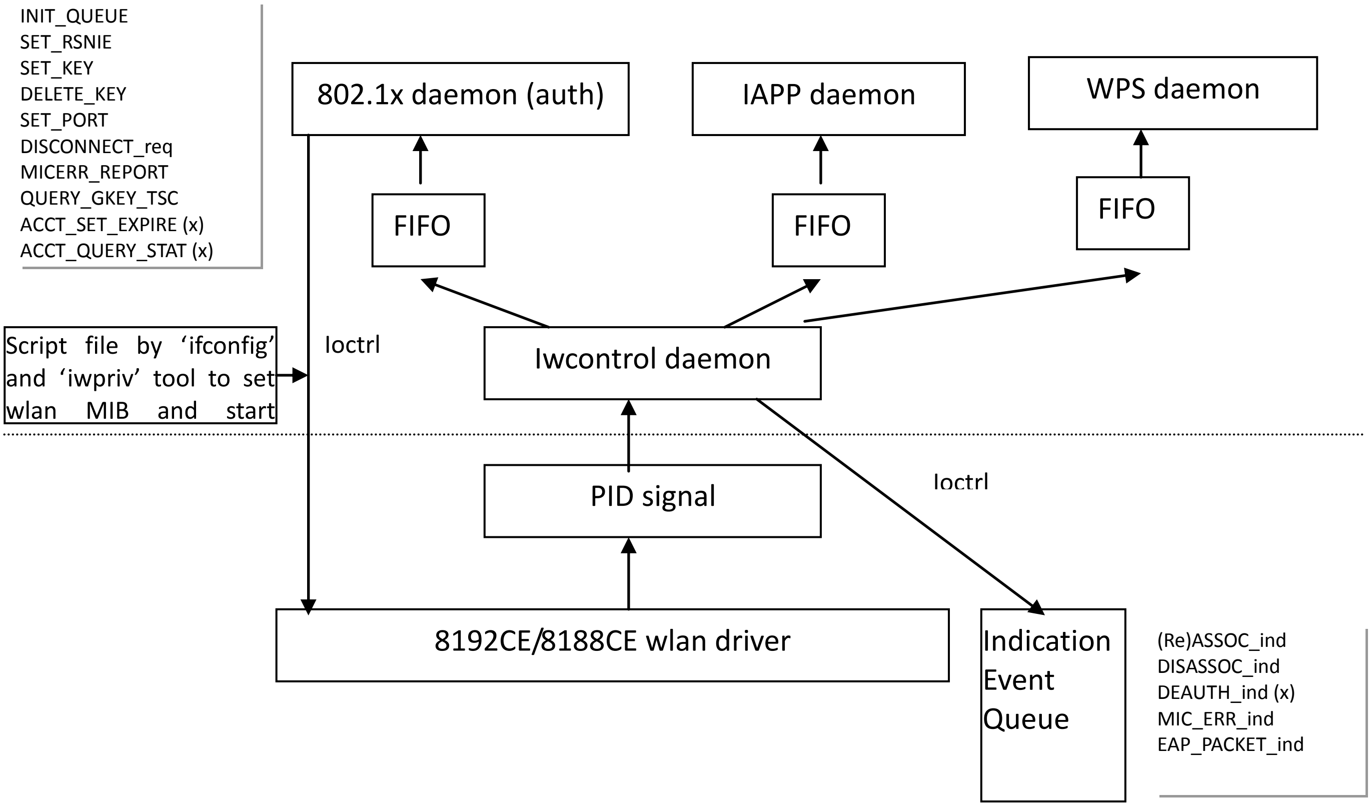
9.4. Important Notes

After configuring WDS successfully, system will add a new interface wlan0-wds0 which maps to wds_number=0. Currently, our system supports 8 wds number now.

10. 802.1X

10.1. System Architecture

Below block diagram shows the system architecture of the RTL819X driver and software package.



10.2. 802.1X Related Daemons Introduction

10.2.1. iwcontrol Daemon Introduction

As the block diagram of the system architecture shows, the iwcontrol daemon should be started after 802.1X, IAPP, or WPS daemon is running. We can start iwcontrol daemon by running the following command.

"iwcontrol <wlan_interface> …"
wlan_interface: wlan interface, e.g., wlan0

The iwcontrol daemon will parse the pid files in "/var/run" and create FIFO files to do IPC with WPS, IAPP, and 1x daemon. And multiple wireless interfaces can be supported in iwcontrol parameters.

10.2.2. 802.1X Daemon Introduction

As the block diagram of the system architecture shows, the iwcontrol daemon should be started after 802.1X, IAPP, or WPS daemon is running. We can start 802.1X daemon by running the following command.

"auth <wlan_interface> <lan_interface> auth <wpa_conf> &"
wlan_interface: wlan interface, e.g., wlan0
lan_interface: lan interface, which connects to Radius server, e.g., br0
auth: denote to act as authenticator
wpa_conf: path of wpa config file, e.g., /var/wpa-wlan0.conf

The 802.1X daemon will create PID file "/var/run/auth-wlanx.pid" for each 802.1X daemon. And multiple 802.1x daemons will be created for different wireless interfaces.

10.3. 802.1X Start Procedure

The start procedure is to start the 802.1X and iwcontrol daemons. Before starting the 802.1X daemon, it should configure the 802.1X related parameters and decide the role of the authentication procedure. After the parameters are configured, it will call flash utility to generate configuration file.

"flash wpa <wlan_interface> < wpa_conf > <wlan_interface>"
wlan_interface: wlan interface, e.g., wlan0
wpa_conf: path of wpa config file, e.g., /var/wpa-wlan0.conf

Then it should start the 802.1X and iwcontrol daemons by previous described commands. We can use "ps" command to check if these two daemon started successfully. The last step of the procedure is to use brctl utility to configure the correct network interface information to connect to the radius server.

10.4. WPA Config File

10.4.1. Config File Related Parameters

The parameter format in wpa config file is like "keyword = value". Below table shows wpa parameters in wpa config file.

keyword	value	Comment
encryption	0 – disable, 1 – WEP, 2 – WPA, 4 – WPA2 only, 6	

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	– WPA2 mixed	
ssid	"string_value", 1-32 char	
enable1x	0/1 – disable/enable 1x Radius authentication	Refer when encryption is set to 0, 1
enableMacAuth	0/1 – disable/enable MAC authentication	
SupportNonWpaClient	0/1 – disable/enable none WPA client support when WPA is set	This feature is not supported now
wepKey	1 – WEP64, 2 – WEP128	Refer when encryption is set 1 (wep)
wepGroupKey	set "" as default	No use
authentication	1 – Radius, 2 – PSK (pre-shared key)	
unicastCipher	1 – TKIP, 2 – AES	
wpa2UnicastCipher	1 – TKIP, 2 – AES	
usePassphrase	0 – use psk value as key in raw data, 1 – use passphrase algorithm to convert psk value	
psk	"string_value", if usePassphrase=0 (raw data), it should be 64 hex digits. If usePassphrase=1, the string length should be >=8 and <=64.	
groupRekeyTime	Group key re-key time	No use
rsReAuthTo	The time in second which force client to do re-auth to the server. Set to 0 to disable this function.	
rsPort	UDP Port number of radius server	Normally 1812 is used
rsIP	IP address of radius server (e.g., 192.168.1.1)	
rsPassword	"string_value", password of radius server with 31 char in max	
rs2Port	UDP Port number of radius server set 2	Normally 1812 is used
rs2IP	IP address of radius server (e.g., 192.168.1.1) set 2	
rs2Password	"string_value", password of radius server with 31 char in max set 2	
rsMaxReq	Max retry number of request packet with radius server	Set 3 as default
rsAWhile	Timeout time (in second) of waiting rsp packet of radius server	Set 5 as default
accountRsEnabled	0/1 – disable/enable accounting radius server	
accountRsPort	UDP Port number of accounting radius server	
accountRsIP	IP address of accounting radius server	
accountRsPassword	"string_value", password of accounting radius server with 31 char in max	
accountRsUpdateEnabled	0/1 – disable/enable the feature of statistic update with accounting server	
accountRsUpdateTime	Update time in seconds	
accountMaxReq	Max retry number of request packet with accounting radius server	

accountAWhile	Timeout time (in second)of waiting rsp packet of accounting radius server	
MaxPmksa	Maximum cache number of PMKSA	0 is default, then PMK cache mechanism is not enabled. If not 0, AP will maintain tuples of (station MAC address, pmksa) until reboot. When exceed limit, the oldest entry will be flushed.

10.5. 802.1X Example

The following section shows WAP config file samples for the 802.1x deamon using.

We assume the IP address of the radius server is 172.20.10.2. The port number of the radius server is 1812. The password of the radius server is 12345678.

10.5.1. 802.1X with WPA AES Example

```
encryption = 2
ssid = "RTK_AP"
enable1x = 1
enableMacAuth = 0
supportNonWpaClient = 0
wepKey = 2
wepGroupKey = ""
authentication = 1
unicastCipher = 2
wpa2UnicastCipher = 3
usePassphrase = 1
psk = "12345678"
groupRekeyTime = 86400
rsReAuthTO = 0
rsPort = 1812
rsIP = 172.20.10.2
rsPassword = "12345678"
rsMaxReq = 3
rsAWhile = 5
accountRsEnabled = 0
accountRsPort = 0
accountRsIP = 0.0.0.0
accountRsPassword = ""
accountRsUpdateEnabled = 0
accountRsUpdateTime = 0
```

```
accountRsMaxReq = 0
accountRsAWhile = 0
```

10.5.2. 802.1X with WPA2 AES Example

```
encryption = 4
ssid = "RTK_AP"
enable1x = 1
enableMacAuth = 0
supportNonWpaClient = 0
wepKey = 2
wepGroupKey = ""
authentication = 1
unicastCipher = 1
wpa2UnicastCipher = 2
usePassphrase = 1
psk = "12345678"
groupRekeyTime = 86400
rsReAuthTO = 0
rsPort = 1812
rsIP = 172.20.10.2
rsPassword = "12345678"
rsMaxReq = 3
rsAWhile = 5
accountRsEnabled = 0
accountRsPort = 0
accountRsIP = 0.0.0.0
accountRsPassword = ""
accountRsUpdateEnabled = 0
accountRsUpdateTime = 0
accountRsMaxReq = 0
accountRsAWhile = 0ifconfig wlan0 down
```

10.5.3. 802.1X with WPA/WPA2 AES/TKIP mixed mode Example

```
encryption = 6
ssid = "RTK_AP"
enable1x = 1
enableMacAuth = 0
supportNonWpaClient = 0
```

```
wepKey = 2
wepGroupKey = ""
authentication = 1
unicastCipher = 3
wpa2UnicastCipher = 3
enablePreAuth = 0
usePassphrase = 1
psk = "12345678"
groupRekeyTime = 86400
rsReAuthTO = 0
rsPort = 1812
rsIP = 172.20.10.2
rsPassword = "12345678"
rsMaxReq = 3
rsAWhile = 5
accountRsEnabled = 0
accountRsPort = 0
accountRsIP = 0.0.0.0
accountRsPassword = ""
accountRsUpdateEnabled = 0
accountRsUpdateTime = 0
accountRsMaxReq = 0
accountRsAWhile = 0
```

11. IAPP

As the block diagram of the system architecture shown in section 10.1, the iwcontrol daemon should be started after 802.1X, IAPP, or WPS daemon is running. We can start IAPP daemon by running the following command.

“iapp <lan_interface> <wlan_interface> &”

lan_interface: lan interface which IAPP deamon used to send IAPP packet, e.g., br0

wlan_interface: wlan interface, e.g., wlan0

The IAPP daemon will create PID file “/var/run/iapp.pid” for each IAPP daemon. And multiple IAPP daemons will be created for different wireless interfaces.

12. WPS

Please refer to *“Realtek_WPS_user_guide.doc”* for detail explanation and usages.

13. IGMP Snooping

According to IEEE 802.11 specification, the broadcast/multicast frames sent by an AP are not acknowledged by the STA. It implied the broadcast/multicast frame may not be received by the STA. When the wireless client joins a multicast group to play video streaming, missing multicast frames will cause the video picture indistinct.

In contrast with the broadcast/multicast frame, the unicast frame in which sender requires acknowledgement. The acknowledgement and retransmission mechanism can greatly reduce the possibility of frame lost in the receiver. When an AP does multicast-to-unicast translation, it will improve the quality of the streaming video. In this case, the AP must record which wireless client had joined which multicast group, and then sent translated unicast frames to those belong to this multicast group. Otherwise, the AP sent translated unicast frames to wireless clients that have not joined this multicast group. It would resume the network bandwidth of Wi-Fi, especially for the streaming video application.

Wi-Fi IGMP snooping, as implied by name, is a feature that allows an AP to listen on the IGMP conversation between Wireless clients and multicast server. By listening to these IGMP conversations the AP maintains a map of which wireless client need which IP multicast streams.

13.1. The process flow of IGMP snooping

Step1. After translating 802.11 frame to 802.3 Ethernet frame, do the following check:

(1) Is destination MAC address multicast address?
(2) Is the EtherType field of the MAC header 0x0800 (IPv4)?
(3) Is the Protocol field of the IPv4 header 0x02 (IGMP)?

If all above conditions are true, then move Step2. Otherwise, exit the process.

Step2. Check the content of IGMP packet (reference the function ___igmp_type_check)

(1) When receiving the IGMP packet belongs to the following type, then add the group multicast address to the corresponding wireless client’s multicast table.

- IGMP Type = 0x12 (IGMP_HOST_MEMBERSHIP_REPORT)
- IGMP Type = 0x16 (IGMPV2_HOST_MEMBERSHIP_REPORT)
- IGMP Type = 0x22 (IGMPV3_HOST_MEMBERSHIP_REPORT) and Group Record Type = 0x04 (IGMPV3_CHANGE_TO_EXCLUDE)

(2) When receiving the IGMP packet belongs to the following type, then remove the group multicast address from the corresponding wireless client’s multicast table.

- IGMP Type = 0x17 (IGMP_HOST_LEAVE_MESSAGE)
- IGMP Type = 0x22 (IGMPV3_HOST_MEMBERSHIP_REPORT) and Group Record Type = 0x03 (IGMPV3_CHANGE_TO_INCLUDE)

(3) When receiving the IGMP packet not belong to the above (1)(2) type, or the IP header

contain illegal content, then exit the process.

Step3. Update the wireless client's multicast table.

(1) Convert the group multicast IP address to the multicast MAC address

(2) Call ioctl() with ioctl cmd 0x8B80(SIOCGIMCAST_ADD) / 0x8B81(SIOCGIMCAST_DEL), multicast MAC address and source MAC address to update the corresponding wireless client's multicast table.

Step4. When the AP receives the multicast frame from other interface, it will check the multicast table for each wireless client. If the specific multicast MAC address exists in the certain wireless clients' multicast table, the AP will do multicast-to-unicast translation and send the translated unicast frame to these. If the specific multicast MAC address not found in the wireless client's multicast table, the AP will not send any frame to it.

13.2. Related MIB

1. "mc2u_disable": This parameter is used to turn the Wi-Fi IGMP snooping on/off. The value of this parameter is set to 0 to turn on Wi-Fi IGMP snooping function. The other value is to turn off Wi-Fi IGMP snooping function.

13.3. IGMP snooping Example

If you did not do multicast-to-unicast translation, you must turn off the Wi-Fi IGMP snooping function. After turning off, the AP will directly send the multicast frame without translating it. The corresponding commands, as below:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib mc2u_disable=1
ifconfig wlan0 up
```

If you want to turn on the Wi-Fi IGMP snooping function, you must do the following commands, as below:

```
ifconfig wlan0 down
iwpriv wlan0 set_mib mc2u_disable=0
ifconfig wlan0 up
```

14. Multiple AP profile

In wireless client mode, our SDK could provide the feature to set multiple AP profiles (e.g., SSID and security setting) into driver. When booting up, wlan driver will look for AP according to these profiles. If any one AP is found, it will associate to it with the configured security.
Before using this feature, please do build the kernel image as following kernel configuration:
Run kernel menuconfig in SDK. Enable Multiple AP profile support as follows:

```
Network device support    --->
   Wireless LAN (non-hamradio)    --->
      [*]     RTL8192C/D 802.11b/g/n support
      [*]     Client Mode support
      [ ]          Repeater Mode support
      [*]          Multiple AP profile Support
```

Enable "Client mode support" and then “Multiple AP profile support”. Save the kernel config and rebuild the image.

14.1. Related MIB

Name	Meaning	Value	Default	Comment
ap_profile_enable	Enable/Disable multiple AP profile support	0 – disable, 1 - enable	0	
ap_profile_num	Set profile number	Number of profile to set	0	When "ap_profile_add" is called, the “ap_profile_num" will be increased by 1 automatically. So, suggest to set this number to '0' first, and then issue command "ap_profile_add" to add profile subsequently
ap_profile_add	Add AP profile	*Note		
sortbyprofile	Enable sort by profile	0 – disable, 1 - enable	0	This mib is only valid when ap_profile_enable is 1(enable). When

				sortbyporfile is 1(enabled), wlan driver will sort the profiles by SSID, and connect to APs according to the order of profiles. If sortbyporfile is 0(disable), wlan driver will connects to the AP in the profile list with the best signal strength.

Note:

If wireless security is open system, its value format is:

ssid,sec_type,auth_type

ssid - SSID of associated AP, which length is from 1~32 bytes

sec_type - Security type. 0 - open, 1 - wep64, 2- wep128, 3 - wpa, 4 - wpa2

auth_type - Authentication type. 0 - open, 1 - shared key, 2 - auto. Please note, only in wep mode, you could set auth_type in 1 or 2.

Example:

Add AP profile with SSID=”open-ssid” and open authentication:

```
iwpriv wlan0 set_mib ap_profile_add="open-ssid",0,0
```

If wireless security is wep 64-bit encryption, its value format is:

ssid,sec_type,auth_type,default_key,key1,key2,key3,key4

default_key - Default Tx key id (0~4).

key1~key4: WEP key in 10 bytes hex string.

Example:

Add AP profile with SSID=”wep64-ssid”, open authentication and key in “111111111” hex

```
iwpriv wlan0 set_mib
ap_profile_add="wep64-ssid",1,0,0,"1111111111","1111111111","1111111111","1111111111"
```

If wireless security is wep 128-bit encryption, its value format is:

ssid,sec_type,auth_type,default_key,key1,key2,key3,key4

key1~key4: WEP key in 13 bytes hex string.

Example:

Add AP profile with SSID=”wep124-ssid”, open authentication and key in “111111111” hex

```
iwpriv wlan0 set_mib
ap_profile_add="wep128-ssid",2,0,0,"11111111111111111111111111",
    "11111111111111111111111111","11111111111111111111111111",,"11111111111111
111111111111"
```

If wireless security is wpa psk, its value format is:

ssid,sec_type,auth_type,cipher,psk

cipher: WPA cipher. 2 - TKIP, 8 - AES.

psk - WPA pre-shared-key in ASCII string (length 8~63). When length is set to 64, it will be thought as hex value,

and its binary value will be used directly without converting PSK in wifi driver.

Example:

Add AP profile with SSID=”wpa-ssid”, open authentication, TKIP with PSK in “1234567890”

```
iwpriv wlan0 set_mib ap_profile_add="wpa-ssid",3,0,2,"1234567890"
```

If wireless security is wpa2 psk, its value format is:

ssid,sec_type,auth_type,cipher,psk

Example:

Add AP profile with SSID=”wpa2-ssid”, open authentication, AES with PSK in “1234567890”

```
iwpriv wlan0 set_mib ap_profile_add="wpa2-ssid",4,0,8,"1234567890"
```

Note1: The maximum number of profile is set to 5.

Note2: In our SDK, the wlan profile mib is configured by ioctl (0x8b43) directly through Flash utility.
Not by iwpriv command described above.

14.2. How to debug

You may issue the following command from console to dump the all profile information and show which profile is used now as:

```
cat /proc/wlan0/mib_ap_profile
```

15. Mesh

According to 802.11s, each mesh nodes do passive scan (listen to beacon) to find other candidate mesh nodes, to witch peer link would be established. We compare Mesh ID and other mesh capabilities to search candidate mesh nodes. If we found, the peering procedures would be started. Only when the peering is successfully established, we then call these nodes “neighbor”, data can be transmitted to it. For mesh routing, 802.11s requires Hybrid Wireless Mesh Protocol, or HWMP be supported as a default routing protocol, which use MAC addresses (layer 2 routing) and uses a radio-aware routing metric for the calculation of best paths to every mesh nodes.

In our driver, we use a special interface “wlan-msh” for mesh connectivity, which should be open after the mesh-related MIB is correctly set. These mesh-related MIB setup mesh capabilities and decide which mesh network to join. Beside these MIB, which is listed in 15.1, every mesh nodes should also be setup with same band, control sideband and channel number. If the configuration is correct, mesh network will construct automatically. Several proc files can be used to check mesh connect status (See 15.4)

We use pathsel deamon to realize mesh routing protocol. Therefore, after the wlan-msh is open, we need to start the pathsel deamon as well. Section 15.2 shows how to start up the pathsel deamon. Section 15.3 shows some examples to setup the mesh network. All these mesh connect status can be retrieved using proc files for debugging or web display (See 15.4).

15.1. Related MIB

1. “mesh_enable”: set to 1 to enable mesh function, set to 0 to disable it. The following MIB are only valid when mesh_enable is 1.
2. “mesh_ap_enable”: set to 1 to enable access point function; set to 0 to disable it. If this parameter is 0, it means this mesh station is a pure mesh node (without access point).
3. “mesh_id”: a string with max 32 characters which is used to identify a mesh network according to 802.11s. We use this parameter to find candidate mesh nodes, to which we would try to establish peering.
4. “mesh_privacy”: set to 4 to enable mesh data encryption using WPA2(AES); set to 0 to disable it. Currently, mesh only support WPA2(AES) encryption.
5. “mesh_passphrase”: this parameter indicates value of the Mesh PSK key. The value is set to up to 32 characters or 64 hex digits. Mesh securities settings are independent to the settings used by AP. Be sure of all the mesh nodes use the exactly pre-shared key or the mesh nodes will be connected but data is unreachable.
6. “mesh_max_neightbor”: the number of peer link this mesh node can establish. You can set this parameter up to 15. The default value is 15. If current peer link count reaches the

mesh_max_neightbor, additional mesh peering would not be accepted.

7. "mesh_igmp_enable": set to 1 to enable mesh igmp function, set to 0 to disable it. The default value is 1.
8. "meshaclmode": Access control mode between mesh nodes. Set to 0 to disable ACL, set to 1 to accept, set to 2 to deny. Default is 0. "meshaclnum" and "meshacladdr" are valid only when this parameter is 1 or 2.
9. "meshaclnum": the number of ACL. Up to 128 ACL can be set.
10. "meshacladdr": the array of mac address of mesh nodes to be deny or accept. The content of this mib depends on the value of "meshaclnum". If "meshaclnum" is 1, this mib contains one xxxxxxxxxxxx (12 digits mac address). If "meshaclnum" is 2, this mib contains two xxxxxxxxxxxx (12 digits mac address), totally 24 digits. If there is one mesh node in the deny list or not in the accept list, the peer link to this mesh node would not be accept.

15.2. Pathsel Deamon

As mesh use pathsel deamon to create and maintain the mesh routing table. It should be start after mesh interface, "wlan-msh", is open.
Run following command to start pathsel daemon.

```
"pathsel -i wlan-msh -P -d"
```

The pathsel daemon will create a PID file "/var/run/pathsel-wlan-msh.pid". Please note that only one pathsel deamon need to be start even though we have more than one wireless interfaces. The command, "ps", can be used to check if the pathsel daemon started successfully.

15.3. Example

15.3.1. Enable Mesh

Step 1: Enable mesh function

```
iwpriv wlan0 set_mib mesh_enable=1
```

Step 2: Enable ap function (optional)

```
iwpriv wlan0 set_mib mesh_ap_enable=1
```

Step 3: Set Mesh ID

```
iwpriv wlan0 set_mib mesh_id=RTK_mesh_5g
```

Step 4: Enable mesh data encryption (optional)

```
iwpriv wlan0 set_mib mesh_privacy=4
iwpriv wlan0 set_mib mesh_passphrase=12345678
```

Step 5: Set ACL (optional)

```
iwpriv wlan0 set_mib meshaclmode=1
iwpriv wlan0 set_mib meshaclnum=2
```

```
        iwpriv wlan0 set_mib meshacladdr=00e04c424bd300e04c424bd5
Step 6: Start up wlan0 and wlan-msh interface
        ifconfig wlan0 up
        ifconfig wlan-msh up
        brctl addif br0 wlan0
        brctl addif br0 wlan-msh
Step 7: Start up pathsel deamon
        pathsel -i wlan-msh -P –d
```

15.3.2. Disable Mesh

```
Step 1: Stop pathsel deamon, the pid of pathsel deamon can be found using “ps” command
        kill <pid of pathsel deamon>
Step 2: Stop wlan0 and wlan-msh interface
        ifconfig wlan-msh down
        ifconfig wlan0 down
        brctl delif br0 wlan-msh
Step 3: Disable mesh function, and then bring up wlan0 interface
        iwpriv wlan0 set_mib mesh_enable=0
        ifconfig wlan0 up
```

15.3.3. Enable Dual-Band Mesh

```
Step 1: Set mesh-related MIB for both wireless interfaces
        iwpriv wlan0 set_mib mesh_enable=1
        iwpriv wlan0 set_mib mesh_ap_enable=1 (optional)
        iwpriv wlan0 set_mib mesh_id=RTK_mesh_5g
        iwpriv wlan0 set_mib mesh_privacy=4 (optional)
        iwpriv wlan0 set_mib mesh_passphrase=12345678 (optional)
        iwpriv wlan0 set_mib meshaclmode=1 (optional)
        iwpriv wlan0 set_mib meshaclnum=2 (optional)
        iwpriv wlan0 set_mib meshacladdr=00e04c424bd300e04c424bd5    (optional)

        iwpriv wlan1 set_mib mesh_enable=1
        iwpriv wlan1 set_mib mesh_ap_enable=1 (optional)
        iwpriv wlan1 set_mib mesh_id=RTK_mesh_2g
        iwpriv wlan1 set_mib mesh_privacy=4 (optional)
        iwpriv wlan1 set_mib mesh_passphrase=12345678 (optional)
        iwpriv wlan1 set_mib meshaclmode=1 (optional)
        iwpriv wlan1 set_mib meshaclnum=2 (optional)
        iwpriv wlan1 set_mib meshacladdr=00e04c424bd300e04c424bd5 (optional)

Step 2: Start up wlan0, wlan1 and wlan-msh interface
```

```
ifconfig wlan0 up
ifconfig wlan1 up
ifconfig wlan-msh up
brctl addif br0 wlan0
brctl addif br0 wlan1
brctl addif br0 wlan-msh
```

Step 3: Start up pathsel deamon

```
pathsel -i wlan-msh -P –d
```

15.3.4. Disable Dual-Band Mesh

Step 1: stop pathsel deamon, the pid of pathsel deamon can be found using “ps” command

```
kill <pid of pathsel deamon>
```

Step 2: stop wlan0, wlan1, and wlan-msh interface

```
ifconfig wlan-msh down
ifconfig wlan0 down
ifconfig wlan1 down
brctl delif br0 wlan-msh
```

Step 3: disable mesh function, and then bring up wlan0 and wlan1 interface

```
iwpriv wlan0 set_mib mesh_enable=0
iwpriv wlan1 set_mib mesh_enable=0
ifconfig wlan0 up
ifconfig wlan1 up
```

15.4. Debug and Web Information

CAT following files under ‘/proc/wlan0’ and ‘/proc/wlan1’(in dual-band mode) for debugging or web display:

1. “mesh_stats”: show mesh statistics and capabilities
2. “mesh_assoc_mpinfo”: show information of all mesh neighbors
3. “mesh_portal_table”: show all the mesh portal
4. “mesh_pathsel_routetable”: show mesh routing table
5. “mesh_proxy_table”: show mesh proxy table

In dual-band mode, the information in “mesh_portal_table”, “mesh_pathsel_routetable” and “mesh_proxy_table” would be same in both interfaces.

16. Mass Production

Please refer to *"8192C Linux Driver MP.doc"* for detail explanation and usages.

17. Other User Space Utilities

17.1. iwpriv Utility

17.1.1. Read WLAN register

Usage: "iwpriv <iface> read_reg <type,offset>"
iface: "wlan0"
type: b - for byte, w – for word, dw – for double word
offset: the register offset in hex

17.1.2. Write WLAN register

Usage: "iwpriv <iface> write_reg <type,offset,value>"
iface: "wlan0"
type: b - for byte, w – for word, dw – for double word
offset: the register offset in hex
value: value for write in hex

17.1.3. Read WLAN memory

Usage: "iwpriv <iface> read_mem <type,start,len>"
iface: "wlan0"
type: b - for byte, w – for word, dw – for double word
offset: the memory start address in hex
len: read length in hex

17.1.4. Write WLAN memory

Usage: "iwpriv <iface> write_mem <type,start,len,value>"
iface: "wlan0"
type: b - for byte, w – for word, dw – for double word

offset: the memory start address in hex
len: read length in hex
value: value for write in hex

17.2. Proc Files

Files under '/proc/wlan0':

6. "cam_info": dump h/w encryption cam content
7. "mib_xxx": show mib info
8. "sta_info": show all associated station info
9. "sta_keyinfo": show the encryption keys of all associated station info
10. "txdesc": show tx descriptor contents for queue 0 to queue 5
11. "rxdesc": show rx descriptor contents
12. "buf_info": show the internal buffer pointers and counts
13. "desc_info": show tx and rx descriptor pointers, indexes, and register contents
14. "stats": show Tx, Rx, and beacon statistics as follow:
    - *up_time – driver uptime*
    - *tx_packets – total tx packet numbers*
    - *tx_bytes – total tx byte counts*
    - *tx_retrys – total tx retry counts*
    - *tx_fails – total tx failed numbers*
    - *tx_drops – total tx dropped counts*
    - *rx_packets – total rx packet numbers*
    - *rx_bytes – total rx byte counts*
    - *rx_retrys – total rx retry counts*
    - *rx_crc_errors – total rx CRC error packet numbers*
    - *rx_errors – total rx error packet numbers (including CRC error, ICV error, etc.)*
    - *rx_data_drops – total rx data dropped counts other than sequence number issue*
    - *rx_decache – total rx data dropped counts due to sequence number duplicated*
    - *rx_fifoO – total rx fifo overflow counts*
    - *rx_rdu – total rx buffer under run counts*
    - *beacon_ok – total transmitted OK beacons*
    - *beacon_er – total transmitted failed beacons*
    - *freeskb_err – total error pointers of tx skb numbers*
    - *dz_queue_len – total queued packet numbers for sleeping sta*
    - *check_cnt_tx – internal tx status check counts*

- *check_cnt_rst – internal driver status check counts*
- *reused_skb – reused skb numbers*
- *skb_free_num – free skb numbers*
- *tx_average – average of tx flow*
- *rx_average – average of rx flow*
- *cur_tx_rate – current tx rate*

15. “mib_EDCA”: show the EDCA parameters will be applied when enabled
16. “*.txt“: MAC and PHY parameter files

17.3. IOCTL

IOCTL commands (for web display):

id	Meaning	Input	output	comment
0x8b30	Get station info	None	64 array of sta_info_2_web (note1)	
0x8b31	Get associated station number	None	1 word (2 bytes)	
0x8b32	Get version information	None	2 byte of version infomation	
0x8b33	Issue scan request	None	1 byte of result (-1:fail, 0: success)	
0x8b34	Get scan result and scanned BSS database	1 byte flag (get BSS database or not)	4 bytes of number of entries and array of bss_desc (note4) with flag set to 0	
0x8b35	Issue join request	bss_desc to join	1 byte of result (0: success, 1: scanning, 2: fail)	
0x8b36	Get join result	None	1 byte of result (note5)	
0x8b37	Get BSS info	None	Bss_info_2_web structure (note2)	This is used typically in client mode
0x8b38	Get WDS info	None	8 array of wds_info (note3)	

Note1:

```
typedef struct _sta_info_2_web {
	unsigned short	aid;
	unsigned char	addr[6];
```

```
        unsigned long tx_packets;
        unsigned long rx_packets;
        unsigned long expired_time;
        unsigned short      flags; // bit2 indicate whether this entry is valid, bit3 indicates if sta is in
sleeping
        unsigned char TxOperaRate; // current used tx rate in 500 k bps (e.g., 108 for 55M)
        unsigned char rssi; // received signal strength indication
        unsigned long link_time; // 1 sec unit
        unsigned long tx_fail;
        unsigned long tx_bytes;
        unsigned long rx_bytes;
        unsigned char network;
        unsigned char ht_info;
        unsigned char RxOperaRate; // current used tx rate in 500 k bps (e.g., 108 for 55M)
        unsigned char resv[3];
        unsigned char acTxOperaRate; // for AC capable WLAN IC
} sta_info_2_web;
```

Note2:

```
typedef enum _wlan_mac_state {
        STATE_DISABLED=0, STATE_IDLE, STATE_SCANNING, STATE_STARTED, STATE_CONNECTED,
STATE_WAITFORKEY
} wlan_mac_state;

typedef struct _bss_info_2_web {
        unsigned char state;       // defined in wlan_mac_state
        unsigned char channel;
        unsigned char txRate;
        unsigned char bssid[6];
        unsigned char rssi, sq;
        unsigned char ssid[33];
} bss_info_2_web;
```

Note3:

```
typedef struct _wds_info {
        unsigned char state;
        unsigned char addr[6];
        unsigned long tx_packets;
        unsigned long rx_packets;
        unsigned long tx_errors;
        unsigned char TxOperaRate;
} wds_info;
```

Note4:

```
struct ibss_priv {
        unsigned short      atim_win;    };
struct bss_desc {
        unsigned char bssid[6];
        unsigned char ssid[32];
        unsigned char *ssidptr;
        unsigned short      ssidlen;
        unsigned char meshid[32];
        unsigned char *meshidptr;
        unsigned short      meshidlen;
        unsigned int    bsstype;
        unsigned short      beacon_prd;
        unsigned char dtim_prd;
        unsigned long t_stamp[2];
        struct ibss_priv      ibss_par;
        unsigned short      capability;
        unsigned char channel;
        unsigned long basicrate;
        unsigned long supportrate;
        unsigned char bdsa[6];
        unsigned char rssi;
        unsigned char sq;
        unsigned char network;
};
```

Note5:

0xff: pending
2-4: success
others: fail

18. Hardware Limitation

18.1. Limitation

1. H/W encryption CAM size is 32
2. Multiple BSSID CAM size is 8
3. Tx SKB buffer must have 8 bytes space in tail for TKIP MIC
4. Support 31 wlan clients in current configuration for 8192CE/8188RE/8192DE/8812E and 63 wlan clients for 8188ER
5. Support 8 WDS number in current configuration