HowTo Enable Customized Tx Power by rate and Limit v2

2019/4/1 version V2

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1. Introduction

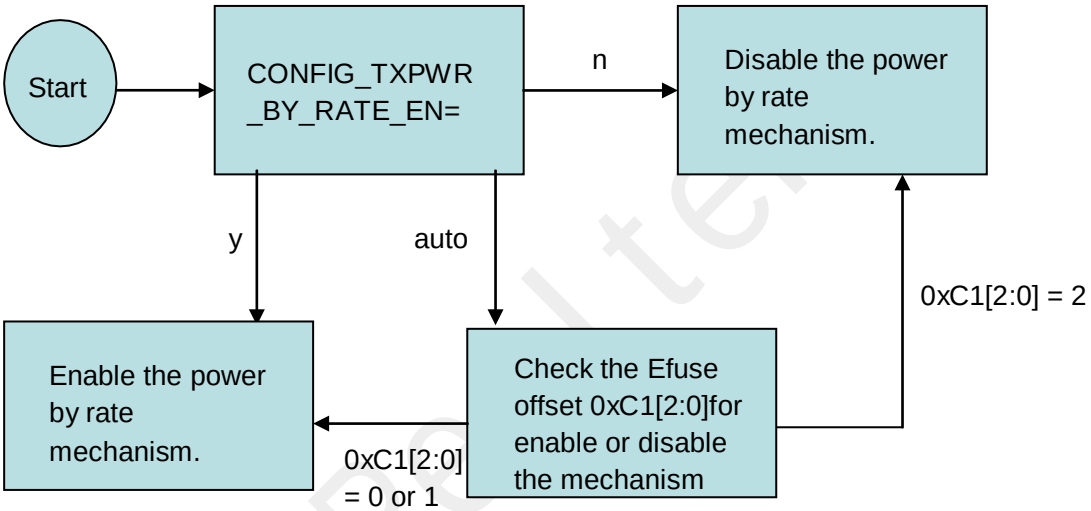
This document introduces how to enable the Tx-power-by-rate and power-limit mechanisms in Realtek wifi driver. In the second part of this document, we will also guide customer load an external file and it provides a possibility of customizing the power tables in a system.

The driver will follow below process for handling those two mechanisms.

2. How to enable the Tx-power-by-rate and Tx-power-limit mechanisms

2.1. Enable the Tx-power-by-rate mechanism

The flow chart of tx-power-by-rate setting:



You can find the compile flag “CONFIG_TXPWR_BY_RATE_EN” in Make file, and please find the description as below:

CONFIG_TXPWR_BY_RATE_EN =

1. n ; Force disable the power-by-rate mechanism.
2. y ; Force enable the power-by-rate mechanism.
3. auto ; Driver will check the Efuse setting and determine the mechanism will be disabled or enabled.

The definition of efuse byte offset 0xC1[2:0]:

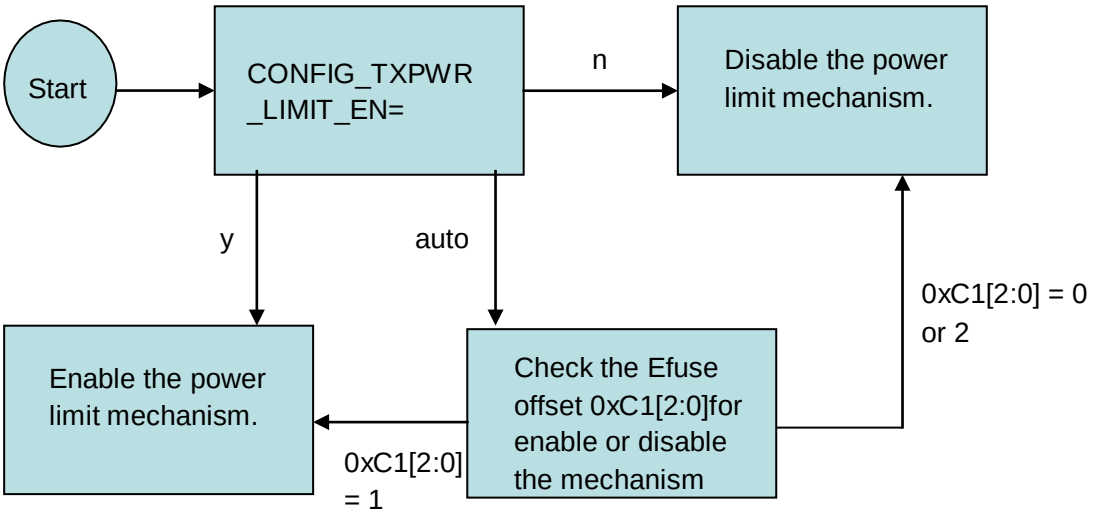
0h: driver-defined maximum power offset for longer communication range.
(refer to Power by rate table)

1h: Power limit table-defined maximum power offset range
(refer to Power by rate table and Power limit table to take the smaler index value)

2h: not support power offset by rate
(Don't refer to Power by rate table)

2.2. Enable the Tx-power-limit mechanism

- The flow chart of tx-power-limit setting:



You can find the compile flag "CONFIG_TXPWR_LIMIT_EN" in Make file, and please find the description as below:

CONFIG_TXPWR_LIMIT_EN =

1. n ; Force disable the power-limit mechanism.
2. y ; Force enable the power-limit mechanism.
3. auto ; Driver will check the Efuse setting and determine the mechanism will be disabled or enabled.

The definition of efuse byte offset 0xC1[2:0]:

0h: driver-defined maximum power offset for longer communication range.
(refer to Power by rate table)

1h: Power limit table-defined maximum power offset range
(refer to Power by rate table and Power limit table to take the smaler index value)

2h: not support power offset by rate
(Don't refer to Power by rate table)

3. Loading external files for the power-table by modifying the Makefile

Realtek provides the method to load the power-by–rate and power-limit tables from external files. This method also provide a possibility for customer to fine tune the RF output power for better performance and complying with the RF related regulation which is defined by the local government at the same time.

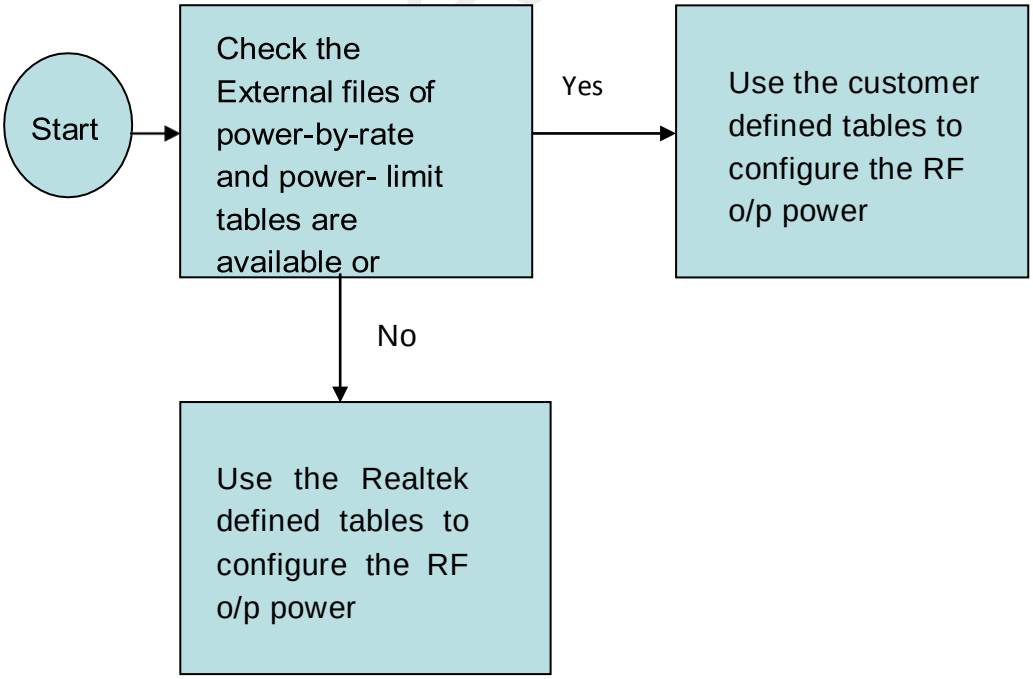
This section will introduce how to put those two tables into the system step by step but it will not explain how to generate the power-tables in this document. If customer wants to know more details about the content of those tables, please contact with the HW provider if necessary.

Before starting to introduce the way for loading the power-tables from external files, please check the “Notes” in the end of this document first.

3.1. The flow chart of loading external tx-power tables

Realtek WiFi driver has TX-power-by-rate-table and TX-power-limit-table which is involved to adjust the RF output power and to limit the maximum RF output power in each channel with different transmission rate. The maximum transmission power depends on local government regulations which may follow the criterion of FCC, ETSI or MKK.

Depending on the different RF performance of the HW, customization Tx-power-tables provides a possibility for any customer to modify the Tx-power-by-rate-table (PHY_REG_PG.txt) and Tx-power-limit-table (TXPWR_LMT.txt) for any reason and the flow chart of this process is showing as below:



3.2. Configuration steps

Please make sure compile flags are defined well before setting below parameters.

(1) Load parameter from file – by modifying Makefile.

- Modify the CONFIG_LOAD_PHY_PARA_FROM_FILE to y
-

```
CONFIG_LOAD_PHY_PARA_FROM_FILE = y
```

(2) Copy file to specified folder:

Make new folder under the path which have read permissions.

Ex: /lib/firmware/

Move “PHY_REG_PG.txt” and “TXPWR_LMT.txt” to above folder.

(3) Set the configurations in the Makefile

Step-1: Enable power-by-rate and power-limit function

Please find the details in section 2 of this document.

Step-2: Unmark below flag in the Makefile

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH=\"/lib/firmware/\”
```

(4) For assigning an absolute path of the power tables in the system, please check below settings showing in the “Makefile” of the new driver.

```
========Ignore the chip’s name as default in a new driver============
ifeq ($(CONFIG_LOAD_PHY_PARA_FROM_FILE), y)
EXTRA_CFLAGS += -DCONFIG_LOAD_PHY_PARA_FROM_FILE
#EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH=\"/data/misc/wifi/phy_para/\"
endif
============================================================
```

4. Load-time parameters for power-by-rate and power-limit function

Realtek driver provides a method to enable/disable the power-by-rate and power-limit function by changing the load-time parameters and customer can even set the specific folder path for the external power-tables via this method.

- Enable/disable power-by-rate and power-limit by command:

```
insmod 8812au.ko rtw_tx_pwr_lmt_enable=1 rtw_tx_pwr_by_rate=1
rtw_phy_file_path=”/lib/firmware/” rtw_decrypt_phy_file=0
```

Note :

If the setting in the “Makefile” is different from the load-time parameters, driver will use the

Load-time method as the final setting.

- Parameter Notes:

(1) rtw_tx_pwr_lmt_enable

rtw_tx_pwr_lmt_enable = 0; // 0: Disable
rtw_tx_pwr_lmt_enable = 1; // 1: Enable
rtw_tx_pwr_lmt_enable = 2; // 2: Depends on efuse

(2) rtw_tx_pwr_by_rate:

rtw_tx_pwr_by_rate = 0; // 0: Disable
rtw_tx_pwr_by_rate = 1; // 1: Enable
rtw_tx_pwr_by_rate = 2; // 2: Depends on efuse

(3) rtw_phy_file_path:

rtw_phy_file_path="/lib/firmware/", path /lib/firmware/ is the location of tx power related file.

(4) rtw_decrypt_phy_file:

rtw_decrypt_phy_file = 0; //File is not encrypted
rtw_decrypt_phy_file = 1; //File is encrypted

5. Read Tx-power-by-rate and power-limit Table

(1) Tx power by rate Table

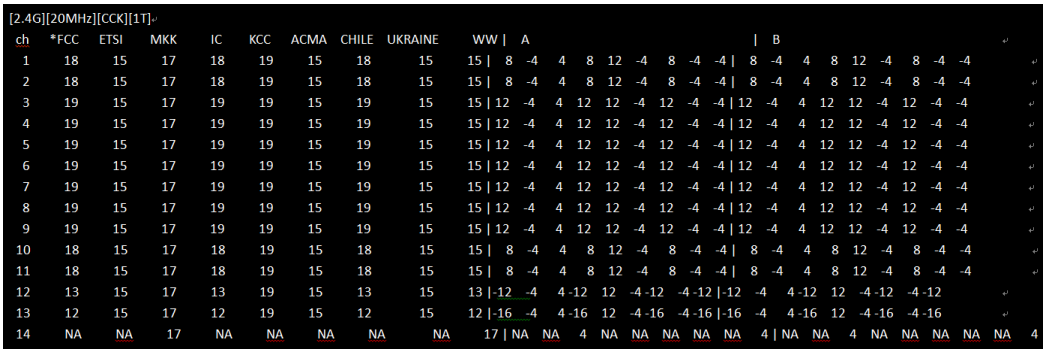
```
cat /proc/net/rtl8821ds/wlan0/tx_power_by_rate
```

```
[2.4G][A]
    CCK:   18   19   20   21                                  |  8  12  16  20
   OFDM:   17   18   19   20   21   22   22   22             |  4   8  12  16  20  24  24  24
 HT_1SS:   16   17   18   19   20   21   22   22             |  0   4   8  12  16  20  24  24
VHT_1SS:   14   15   16   17   18   19   20   21   22   22  | -8  -4   0   4   8  12  16  20  24  24
[2.4G][B]
    CCK:   18   19   20   21                                  |  8  12  16  20
   OFDM:   17   18   19   20   21   22   22   22             |  4   8  12  16  20  24  24  24
 HT_1SS:   16   17   18   19   20   21   22   22             |  0   4   8  12  16  20  24  24
VHT_1SS:   14   15   16   17   18   19   20   21   22   22  | -8  -4   0   4   8  12  16  20  24  24
[5G][A]
   OFDM:   17   18   19   20   21   22   22   22             |  4   8  12  16  20  24  24  24
 HT_1SS:   16   17   18   19   20   21   22   22             |  0   4   8  12  16  20  24  24
VHT_1SS:   14   15   16   17   18   19   20   21   22   22  | -8  -4   0   4   8  12  16  20  24  24
[5G][B]
   OFDM:   17   18   19   20   21   22   22   22             |  4   8  12  16  20  24  24  24
 HT_1SS:   16   17   18   19   20   21   22   22             |  0   4   8  12  16  20  24  24
VHT_1SS:   14   15   16   17   18   19   20   21   22   22  | -8  -4   0   4   8  12  16  20  24  24
```

The result is shown on above picture. The left part in picture is absolute power value corresponding modulation, and right part represents difference power index, 4 index equal 1 dB. For example, CCK 11M on 2.4G pathA has 18 dBm power and 8 index difference (8/4=2 2dB) between CCK 11M and base rate (MCS7).

(2) Tx power limit table

```
cat /proc/net/rtl8821ds/wlan0/tx_power_limit
```



[2.4G][20MHz][CCK][1T]

ch	*FCC	ETSI	MKK	IC	KCC	ACMA	CHILE	UKRAINE	WW | A									| B								
1	18	15	17	18	19	15	18	15	15 | 8	-4	4	8	12	-4	8	-4	-4 | 8	-4	4	8	12	-4	8	-4	-4
2	18	15	17	18	19	15	18	15	15 | 8	-4	4	8	12	-4	8	-4	-4 | 8	-4	4	8	12	-4	8	-4	-4
3	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
4	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
5	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
6	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
7	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
8	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
9	19	15	17	19	19	15	19	15	15 | 12	-4	4	12	12	-4	12	-4	-4 | 12	-4	4	12	12	-4	12	-4	-4
10	18	15	17	18	19	15	18	15	15 | 8	-4	4	8	12	-4	8	-4	-4 | 8	-4	4	8	12	-4	8	-4	-4
11	18	15	17	18	19	15	18	15	15 | 8	-4	4	8	12	-4	8	-4	-4 | 8	-4	4	8	12	-4	8	-4	-4
12	13	15	17	13	19	15	13	15	13 | -12	-4	4	-12	12	-4	-12	-4	-12 | -12	-4	4	-12	12	-4	-12	-4	-12
13	12	15	17	12	19	15	12	15	12 | -16	-4	4	-16	12	-4	-16	-4	-16 | -16	-4	4	-16	12	-4	-16	-4	-16
14	NA	NA	17	NA	NA	NA	NA	NA	17 | NA	NA	4	NA	NA	NA	NA	NA	4 | NA	NA	4	NA	NA	NA	NA	NA	4

The result is shown on above picture. The left part in picture is absolute power value corresponding channel and regulation, and right part represents difference power index for each Tx path. For example, CCK(1/2/5.5/11) has 19 dBm limitation on channel 3 due to FCC regulation. On the other hand, 12 difference value in index for path A represents CCK(1/2/5.5/11) has 3 db difference between CCK AND base rate (MCS7)

6. Tx-power-by-rate and power-limit mechanisms in old design

6.1. Compile flags in old driver

For backward compatible reason, the old compile flags still work in new driver but we strongly recommend using the setting mentioned above section 2 instead.

For the old compile flags, there are three combinations in the old driver and we list comparison tables between old and new flags. But we still suggest that customer check the real behavior of driver with the vendor. Please find the details as below:

(1)

Old compile flags	New compile flags
CONFIG_CALIBRATE_TX_POWER_BY_REGULATORY = n CONFIG_CALIBRATE_TX_POWER_TO_MAX = n	CONFIG_TXPWR_BY_RATE_EN = n CONFIG_TXPWR_LIMIT_EN = n

(2)

Old compile flags	New compile flags
CONFIG_CALIBRATE_TX_POWER_BY_REGULATORY = n CONFIG_CALIBRATE_TX_POWER_TO_MAX = y	CONFIG_TXPWR_BY_RATE_EN = y CONFIG_TXPWR_LIMIT_EN = n

(3)

Old compile flags	New compile flags
CONFIG_CALIBRATE_TX_POWER_BY_REGULATORY = y CONFIG_CALIBRATE_TX_POWER_TO_MAX = n	CONFIG_TXPWR_BY_RATE_EN = y CONFIG_TXPWR_LIMIT_EN = y

6.2. Configuration steps in old driver

If you can't find below compile flag, that means the driver is an old one and it will follow the old design which means driver keep "chip's name" at the end of the folder path automatically.

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
```

If below parameter is set with the old design,

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH=\"/lib/firmware/\"
```

Which means you should put the power-tables in below folder path of the system

/lib/firmware/rtl8812a

1. Folder name for each supported chip.

A. rtl8188e
B. rtl8812a
C. rtl8821a
D. rtl8723b
E. rtl8192e

6.3. Configuration steps in new driver using old design

If customer wants to keep the old design (keeps the chip's name as one part of the path of power tables.) in new driver, please unmark the compile flag "#EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER" for the purpose and here comes the result as below.

```
=====The "chip's name" will be considered as one part of the path===========
ifeq ($(CONFIG_LOAD_PHY_PARA_FROM_FILE), y)
  EXTRA_CFLAGS += -DCONFIG_LOAD_PHY_PARA_FROM_FILE
  EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
  EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH=\"/data/misc/wifi/phy_para/\"
  endif
```

If below parameter is set with the old design,

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH=\"/lib/firmware/\"
```

put the power-tables in below folder path of the system
/lib/firmware/rtl8812a

6.4. Load-time parameters in old design

There are three examples in this section for showing how to set the parameters correctly with the old and new driver. (1)shows the setting with old driver. Section (2) and (3) shows how to set the parameters in the new driver for old and new design approaches.

(1) The parameters /w an old driver

- Check the setting of compile flags in “Makefile”.

If You can’t find below compile flag, that means the driver is an old one and it will follow the old design (driver automatically keeps the chip’s name as one part of the path of power tables.)

Ex: linux_v5.1.4_17880.20160616.

For the folder path of power-tables.

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
```

- input below command:

```
insmod 8812au.ko rtw_tx_pwr_lmt_enable=1 rtw_tx_pwr_by_rate=1
rtw_phy_file_path=”/lib/firmware/” rtw_decrypt_phy_file=0
```

- Put PHY_REG_PG.txt and TXPWR_LMT.txt to below path.

/lib/firmware/rtl8812a

(2) The parameters /w an old driver and using the new design as the approach

- Check the setting of compile flags in “Makefile”.

Please check below flag is marked.

```
#EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
```

- input below command:

```
insmod 8812au.ko rtw_tx_pwr_lmt_enable=1 rtw_tx_pwr_by_rate=1
rtw_phy_file_path=”/lib/firmware/” rtw_decrypt_phy_file=0
```

- Put PHY_REG_PG.txt and TXPWR_LMT.txt to below path.

/lib/firmware/

(3) The parameters /w an old driver and using the old design as the approach

- Check the setting of compile flags in “Makefile”.

Please check below flag is unmarked.

```
EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER
```

- input below command:

```
insmod 8812au.ko rtw_tx_pwr_lmt_enable=1 rtw_tx_pwr_by_rate=1
rtw_phy_file_path=”/lib/firmware/” rtw_decrypt_phy_file=0
```

- Put PHY_REG_PG.txt and TXPWR_LMT.txt to below path.

/lib/firmware/rtl881

Note 1:

There is no way to change below setting via “load-time parameter” method. It means the chip’s name will be a part of the folder path or not can only be decided by modifying the Makefile.

==========

EXTRA_CFLAGS += -DREALTEK_CONFIG_PATH_WITH_IC_NAME_FOLDER

==========.

7. Q & A:

Q1: How to check the status of power-by-rate and power- limit function.

A1:

Input below command:

```
# cat /proc/net/rtl8189fs/wlan0/tx_power_ext_info
```

The result will be:

target_tx_power: from registry / from power by rate / unavailable
tx_power_by_rate: enabled / disabled, loaded / unloaded, file / default
tx_power_limit: enabled / disabled, loaded / unloaded, file / default

Example 0, power by rate and power limit are disabled

target_tx_power: unavailable
tx_power_by_rate: disabled, unloaded, default
tx_power_limit: disabled, unloaded, default

Example 1, power by rate and power limit are enabled and loaded from default table(embedded in driver):

target_tx_power: from power by rate
tx_power_by_rate: enabled, loaded, default
tx_power_limit: enabled, loaded, default

Example 2, power by rate and power limit are enabled and loaded from file:

target_tx_power: from power by rate
tx_power_by_rate: enabled, loaded, file
tx_power_limit: enabled, loaded, file

Notes :

(1)External TX power table will be generated by the agent who sells wifi chip to customers.
(2)Store Tx-power-by-rate-table and Tx-power-limit-table in a read only partition in the system is a good idea to avoid damage.
(3)Tx-power-by-rate-table and Tx-power-limit-table cannot be removed when the image is upgrade or is reset to default