AN12918

Wi-Fi Tx Power Table and Channel Scan Management for i.MX RT SDK

Rev. 5 — 6 July 2022 Application note

Document information

Information	Content
Keywords	Transmit (Tx) power levels, Tx power table, Wi-Fi channel list, data structure, CLI command
Abstract	Describes how to configure the Wi-Fi Tx power table and Wi-Fi channel list in the product software.

1 Revision history

Revision history

Rev	Date	Description
v.1	20200717	Initial version
v.2	20210113	**Modifications**: Extended the scope to IW416 device: • Section 2.2 "Supported chipsets": updated • Section 3.2 "Tx power table configuration": updated • Section 4.2 "Customization using the command line interface": updated
v.3	20210612	**Modifications**: • Section 2.2 "Supported chipsets": extended the scope to 88W8987 • Section 3.1 "Tx power table in OTP": updated • Section 3.3.2 "Customization using the command line interface": improved the format of the examples • Section 4.2 "Customization using the command line interface": improved the format of the examples
v.4	20220110	**Modifications**: • Section 3.2 "Tx power table configuration": . Renamed `txpowerlimit_2g_cfg` as `tx_pwrlimit_2g_cfg` . Renamed `txpowerlimit_5g_cfg` as `tx_pwrlimit_5g_cfg` . Renamed *wlan_txpwrlimit_cfg.c* as *wlan_txpwrlimit_cfg_WW.h* . Updated the path to *wlan_txpwrlimit_cfg_WW.h* file . Table 2 "Rate group information": added the groups 10 to 15 • Section 3.3 "Customization of Tx power table configuration": added a note and a reference to the regulatory region in the introduction • Section 3.3.1 "Customization using API calls": . Renamed `txpowerlimit_2g_cfg` as `tx_pwrlimit_2g_cfg` . Renamed `txpowerlimit_5g_cfg` as `tx_pwrlimit_5g_cfg` • Section 3.3.2 "Customization using the command line interface": . Renamed `txpowerlimit_2g_cfg` as `tx_pwrlimit_2g_cfg` . Renamed `txpowerlimit_5g_cfg` as `tx_pwrlimit_5g_cfg` • Section 4 "Channel list and scan type": . Renamed *wlan_txpwrlimit_cfg.c* as *wlan_txpwrlimit_cfg_WW.h*
v.5	20220706	**Modifications** • Section 3.2 "Tx power table configuration": changed the format of the configuration file in the code samples • Section 4 "Channel list and scan type" changed the format of the configuration file in the code samples • Table 4 "Default channel list and scan configuration": replaced 12-13 with 12-14 as range of channels for passive scan in 2.4 GHz bandwidth • Section 4.2 "Customization using the command line interface": changed the format of the configuration file in the code samples

2 Introduction

The Wi-Fi Tx power table defines the target transmit power levels for all operating conditions of the product. The transmit power levels are determined based on regulatory compliance, IEEE 802.11 requirements, and product design constraints. The general goal is to adjust the power table to achieve the highest transmit power level within these constraints.

The target power level is defined at the antenna connector and set per Wi-Fi channel, bandwidth and modulation.

The Wi-Fi channel list defines the channels allowed for the product. The channel list is determined by regulatory domain and country specific requirements and should be adjusted accordingly. For example, a product certified for use in Europe, can operate on channels 1-13 in the 2.4 band, whereas operation in US is restricted to channels 1-11.

Channel selection during product operation requires the radio to scan the channel list. There are two scan types that can be selected based on desired behavior.

2.1 Scope

This application note describes how to configure the Wi-Fi Tx power table and Wi-Fi channel list in product software.

It includes information on the APIs, data structures, and CLI commands that can be used to update the power table and channel list. It is recommended to review the basic product software architecture before using this document.

2.2 Supported chipsets

- 88W8801
- 88W8977
- IW416
- 88W8987

3 Tx power tables

3.1 Tx power table in OTP

The Wi-Fi Tx power table may optionally be programmed into the OTP memory on the radio.

If you are using an 88W8977-based wireless module, please check with the module vendor if the power table has already been programmed in the OTP memory and if the Region Enforcement bit is set.

Note: *The region enforcement bit does not have any effect in 88W8801-based wireless modules.*

If the power table is already programmed in the OTP memory and the Region Enforcement bit is set, then you cannot update the power table using the API defined in this document. Please note:

- The `get` command (which reads the power table) will return the power table defined in OTP.
- The `set` command (which sets the power table) will not update the power table and it will not report an error.

3.2 Tx power table configuration

The Tx power tables described in this section can be edited to customize the transmission power levels for each wireless channel as needed, based on system requirements and regulatory domain rules. In the following sequence, the steps to configure the channel and power level are explained.

The Tx power levels are set using `wlan_set_txpwrlimit` API, and queried using `wlan_get_txpwrlimit` API. These functions use the following data structures:

- `tx_pwrlimit_2g_cfg` (power levels in 2.4 GHz band)
- `tx_pwrlimit_5g_cfg` (power levels in 5 GHz band)

Both data structures are defined in the file:

<sdk_path>/components/wifi_bt_module/AzureWave/tx_pwr_limits/wlan_txpwrlimit_cfg_WW.h

The information within these structures allows the user to specify transmit power levels for specific:

- band
- channels
- data rate
- bandwidth

See below an example of `tx_pwrlimit_2g_cfg` and `tx_pwrlimit_5g_cfg` data structures.

Refer to *<sdk_path>/middleware/wifi/wlcmgr/wlan_tests.c* for an example of how the data structures are populated and used in the APIs for Tx power configuration.

```
static wlan_txpwrlimit_t
    tx_pwrlimit_2g_cfg =
     {
      (wifi_SubBand_t)0x00,
       1
      [0] =
        {
         .num_mod_grps = 7,
         .chan_desc =
          {
            .start_freq = 2407,
            .chan_width = 20,
            .chan_num   = 1,
           },
          .txpwrlimit_entry = {{0, 15}, {1, 15}, {2, 15}, {3, 14}, {4, 14}, {5,
 14}, {6, 13}},
           },
        };
#ifdef CONFIG_5GHz_SUPPORT
static wlan_txpwrlimit_t tx_pwrlimit_5g_cfg =
    {
      (wifi_SubBand_t)0x00,
      4,
      [0] =
        {
         .num_mod_grps = 9,
         .chan_desc =
           {
            .start_freq = 5000,
            .chan_width = 20,
            .chan_num   = 36,
            },
           .txpwrlimit_entry = {{1, 16}, {2, 16}, {3, 15}, {4, 15}, {5, 15}, {6,
 14}, {7, 14}, {8, 14}, {9, 13}},
        },
       [1] =
        {
          .num_mod_grps = 9,
          .chan_desc =
            {
             .start_freq = 5000,
             .chan_width = 20,
             .chan_num   = 100,
             },
            .txpwrlimit_entry = {{1, 16}, {2, 16}, {3, 15}, {4, 15}, {5, 15},
 {6, 14}, {7, 14}, {8, 14}, {9, 13}},
           },
      [2] =
          {
           .num_mod_grps = 9,
           .chan_desc =
            {
             .start_freq = 5000,
             .chan_width = 20,
             .chan_num   = 149,
             },
            .txpwrlimit_entry = {{1, 16}, {2, 16}, {3, 15}, {4, 15}, {5, 15},
 {6, 14}, {7, 14}, {8, 14}, {9, 13}},
           },
      [3] =
           {
            .num_mod_grps = 9,
            .chan_desc =
             {
              .start_freq = 5000,
              .chan_width = 20,
              .chan_num   = 183,
              },
             .txpwrlimit_entry = {{1, 0}, {2, 0}, {3, 0}, {4, 0}, {5, 0}, {6,
 0}, {7, 0}, {8, 0}, {9, 0}},
           },
   };
#endif
```

The main parameters in the `tx_pwrlimit_2g_cfg` and `tx_pwrlimit_5g_cfg` data structures are defined in Table 1.

Table 1. Main parameters in txpwrlimit data structures

Parameter	Description
`num_chans`	Number of wireless channels configured in this structure. Up to 13 channels for 2.4 GHz and up to 39 channel for 5 GHz are supported.
`num_mod_groups`	Number of rate groups to configure the power level for
`chan_num`	Channel number
`start_freq`	Starting frequency for a channel
`chan_width`	Channel bandwidth in MHz (remains 20 MHz)
`txpwrlimit_entry`	Specifies the power levels corresponding to rate groups
`txpwrlimit_config`	Configuration entry

The code sample from above sets Tx Power table for channel 1 for the 2.4 GHz band, and for channels 36, 100, 149 and 183 for the 5 GHz band. Each channel within the structure is associated to a configuration entry (parameter `txpwrlimit_config`), which includes the channel number and frequency, and the parameter `txpwrlimit_entry`, that sets the Tx Power table.

The Tx power table consists of all target power levels, organized by RF channel and rate group index. To reduce the size of the power table, multiple data rates are grouped into a single rate group. For example 24 Mbit/s and 36 Mbit/s legacy OFDM rates are combined in a single rate group, and will have the same target power level. See Table 2.

Table 2. Rate group information

Rate group	Description
0	CCK modulation (data rates: 1, 2, 5.5, 11 Mbit/s)
1	OFDM modulation (data rates: 6, 9, 12, 18 Mbit/s)
2	OFDM modulation (data rates: 24, 36 Mbit/s)
3	OFDM modulation (data rates: 48, 54 Mbit/s)
4	Channel bandwidth 20 MHz, 1 spatial stream, MCS: 0,1,2
5	Channel bandwidth 20 MHz, 1 spatial stream, MCS: 3,4
6	Channel bandwidth 20 MHz, 1 spatial stream, MCS: 5,6,7
7	Channel bandwidth 40 MHz, 1 spatial stream, MCS: 0,1,2
8	Channel bandwidth 40 MHz, 1 spatial stream, MCS: 3,4
9	Channel bandwidth 40 MHz, 1 spatial stream, MCS: 5,6,7
10	Channel bandwidth 20 MHz, 1 spatial stream, MCS: 8[1]
11	Channel bandwidth 40 MHz, 1 spatial stream, MCS: 8,9[1]
12	Channel bandwidth 80 MHz, 1 spatial stream, MCS: 0,1,2[1]
13	Channel bandwidth 80 MHz, 1 spatial stream, MCS: 3,4[1]
14	Channel bandwidth 80 MHz, 1 spatial stream, MCS: 5,6,7[1]
15	Channel bandwidth 80 MHz, 1 spatial stream, MCS: 8,9[1]

[1] 802.11ac supports these modulation groups.

For example, if for a given channel OFDM modulation at 54 Mbit/s rate is used, this refers to the rate group **3**.

The following code sample shows an example with the data structure `tx_pwrlimit_2g_cfg` where Tx power level is changed to 14 dBm for the channel 2 and rate group 3.

```
[1] =
       {
        .num_mod_grps = 10,
        .chan_desc =
         {
          .start_freq = 2407,
          .chan_width = 20,
          .chan_num   = 2,
          },
          .txpwrlimit_entry = {{0, 17}, {1, 18}, {2, 17}, {3, 14}, {4, 18}, {5,
 16}, {6, 14}, {7, 18}, {8, 16}, {9, 14}},
      },
```

In the example above, the power table for the rate group 3 is set to 14 dBm, and this value can be edited to fit the user needs. Notice that the number of elements in `txpwrlimit_entry` reflects the number specified by the parameter `num_mod_grps`.

Similarly for 5 GHz, the following code sample shows an example with the data structure `tx_pwrlimit_5g_cfg` for channel 36, channel bandwidth 40 MHz, and rate group 4 to set Tx power to 14 dBm.

```
static wlan_txpwrlimit_t tx_pwrlimit_5g_cfg =
     {
      (wifi_SubBand_t)0x00,
      4,
      [0] =
       {
        .num_mod_grps = 9,
        .chan_desc =
         {
          .start_freq = 5000,
          .chan_width = 20,
          .chan_num   = 36,
          },
    .txpwrlimit_entry = {{1, 16}, {2, 16}, {3, 15}, {4, 14}, {5, 15}, {6, 14},
 {7, 14}, {8, 14}, {9, 13}},
     },
```

After changing the power table, the SDK needs to be rebuilt and loaded to the platform, in order for the change to take effect.

The following is an example for 5 GHz and 80 MHz bandwidth.

```
static wlan_txpwrlimit_t tx_pwrlimit_5g_cfg =
  {
     (wifi_SubBand_t)0x00,
     4,
     [0] =
     {
        .num_mod_grps = 15,
         .chan_desc =
         {
            .start_freq = 5000,
            .chan_width = 20,
            .chan_num = 36,
          },
            .txpwrlimit_entry = {{0, 18},{1, 18},{2, 16},{3, 14},
            {4, 18},{5, 16},{6, 14},{7, 18},{8, 16},{9, 14},
            {10, 16},{11, 16},{12, 16},{13, 16},{14, 16}},
  }
```

Note: *In the example above,* `chan_width` *value remains 20 MHz but* `num_mod_grps` *value is updated for 80 MHz, and the pair for 40/80 MHz bandwidth is added to* `txpwrlimit_entry` *array.*

3.3 Customization of Tx power table configuration

Note: *When using a module provided by a third party, consult the module vendor for guidance on the transmit power limitations that were used for regulatory compliance. Setting the Tx power to levels beyond what the module is certified to support voids the modular certification on the device.*

When the board boots up, the default regulatory region is set to world wide (WW), and the default power level is set to 8 dBm for all channels.

You can change the Tx power levels either using the API calls or using the Command Line Interface.

The next sections detail the two methods.

3.3.1 Customization using API calls

The API used to set the power limit of the Wi-Fi device uses the data structures defined in the file *<sdk_root>/middleware/wifi/wlcmgr/wlan_tests.c*. To set the Tx power to the desired level, follow the steps in Section 3.2 "Tx power table configuration".

Use the driver APIs with the required arguments to set the Tx power table:

```
int wlan_set_txpwrlimit (wlan_txpwrlimit_t * txpwrlimit)
```

Where:

Parameter	Description
`[in] txpwrlimit`	A pointer to `wlan_txpwrlimit_t` structure to supply Tx Power Table configuration. Read more in Section 3.2 "Tx power table configuration".

Returns:

WM_SUCCESS: the call is successful

WM_FAIL: the call failed

Example:

The following example sets Tx power limit for 5 GHz bandwidth. The data structure `tx_pwrlimit_5g_cfg` is passed as parameter.

```
    ret = wlan_set_txpwrlimit(&tx_pwrlimit_5g_cfg);
    if (WM_SUCCESS != ret)
    PRINTF("Unable to set 5G TX PWR Limit configuration\r\n");
```

The current implementation provides a return status, that can be used to check whether the function call is successful or not.

Use the following function to **get** the Tx power table information:

```
int wlan_get_txpwrlimit (wifi_SubBand_t subband,
wifi_txpwrlimit_t * txpwrlimit)
```

Where:

Parameter	Description
`[in] subband`	Input parameter with the sub-band information detailed in Table 3.
`[Out] txpwrlimit`	A pointer to `wlan_txpwrlimit_t` structure used to supply Tx power limit configuration. Read more in Section 3.2 "Tx power table configuration".

Returns:

WM_SUCCESS: the call is successful

WM_FAIL: the call failed

Example:

The following example gets Tx power limit for a sub-band.

```
int ret = wlan_get_txpwrlimit(subband, &txpwrlimit);
  if (WM_SUCCESS != ret)
    {
      PRINTF("Unable to get Tx PWR Limit configuration\r\n");
     }
  else
  {
    PRINTF("Get txpwrlimit: sub_band=%x \r\n", txpwrlimit.subband);
    for (i = 0; i < txpwrlimit.num_chans; i++)
      {
        PRINTF("StartFreq: %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.start_freq);
        PRINTF("ChanWidth: %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.chan_width);
        PRINTF("ChanNum:   %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.chan_num);
        PRINTF("Pwr:");
    for (j = 0; j < txpwrlimit.txpwrlimit_config[i].num_mod_grps; j++)
       {
         if (j == (txpwrlimit.txpwrlimit_config[i].num_mod_grps - 1))
         PRINTF("%d,%d",
 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].mod_group,

 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].tx_power);
         else
         PRINTF("%d,%d,",
 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].mod_group,

 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].tx_power);
        }
      PRINTF("\r\n");
       }
      }
```

As input, this function takes the sub-band and the pointer to the `wlan_txpwrlimit_t` type structure (which corresponds to `tx_pwrlimit_2g_cfg` for 2.4 GHz and `tx_pwrlimit_5g_cfg` for 5 GHz band). The output includes:

- sub-band
- starting frequency
- channel width
- channel number
- power levels

The following is an example of system output:

```
# wlan-get-txpwrlimit 00
---------------------------------------
Get txpwrlimit: sub_band=0
StartFreq: 2407
ChanWidth: 20
ChanNum:   1
Pwr:0,15,1,15,2,15,3,14,4,14,5,14,6,13
```

Returns:

WM_SUCCESS: the call is successful

WM_FAIL: the call failed

Table 3. Sub-band definitions

Sub-band	Description
0x00	2G sub-band (2.4 GHz: channels 1-14)
0x10	5G sub-band0 (5 GHz: channels 36, 40, 44, 48, 52, 56, 60, 64)
0x11	5G sub-band1 ((5 GHz: channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144)
0x12	5G sub-band2 (5 GHz: channels 149, 153, 157, 161, 165, 172)
0x13	5G sub-band3 (5G: channels 183, 184, 185, 187, 188, 189, 192, 196; 5G: channel 7 ,8, 11, 12, 16, 34)

3.3.2 Customization using the command line interface

By default, *wifi_cert* sample application which supports set/get Tx power limit command line interface is available only for i.MX RT1060. This section provides the steps to add the command line interface using *wifi_cli* sample application.

- Edit the file *<sdk_root>/middleware/wifi/wlcmgr/wlan_tests.c* in the SDK, and add the following line:

```
{"wlan-set-txpwrlimit", NULL, test_wlan_set_txpwrlimit},
```

The example below shows the added line in **bold**.

```
static struct cli_command tests[] = {
        .
        .
        .
        {"wlan-set-txpwrlimit", NULL, test_wlan_set_txpwrlimit},

}
```

- Check that the two structures `tx_pwrlimit_2g_cfg` and `tx_pwrlimit_5g_cfg` are correctly set. Refer to Section 3.2 "Tx power table configuration".
- Define the handler for the CLI command `wlan-set-txpwrlimit` to set Tx power table:

```
static void test_wlan_set_txpwrlimit(int argc, char **argv)
{
   int rv = wlan_set_txpwrlimit(&tx_pwrlimit_2g_cfg);
   if (rv != WM_SUCCESS)
   PRINTF("Unable to set 2G TX PWR Limit configuration\r\n");
   else
   PRINTF("Successfully configured 2G TX PWR Limit\r\n");
   #ifdef CONFIG_5GHz_SUPPORT
   rv = wlan_set_txpwrlimit(&tx_pwrlimit_5g_cfg);
   if (rv != WM_SUCCESS)
   PRINTF("Unable to set 5G TX PWR Limit configuration\r\n");
   else
   PRINTF("Successfully configured 5G TX PWR Limit\r\n");
   #endif
}
```

Finally, run the following command from the command line interface and check that the output is as shown below:

```
# wlan-set-txpwrlimit
Successfully configured 2G TX PWR Limit
Successfully configured 5G TX PWR Limit
```

The current SDK implementation does not include the CLI commands to **get** the TX power levels but it is possible to add the feature as detailed hereafter.

- Edit the file *<sdk_root>/middleware/wifi/wlcmgr/wlan_tests.c*
- Find the tests structure and add the following line:

```
{"wlan-get-txpwrlimit", "<subband>", test_wlan_get_txpwrlimit},
```

The example below shows the added line in **bold**.

```
static struct cli_command tests[] = {
    .
    .
    .
  {"wlan-get-txpwrlimit", "<subband>", test_wlan_get_txpwrlimit},
};
```

- Edit the command usage function that defines the instructions printed when the help command is executed:

```
static void dump_wlan_get_txpwrlimit_usage()
{
  PRINTF("Usage:\r\n");
  PRINTF("wlan-get-txpwrlimit <subband> \r\n");
  PRINTF("\r\n");
  PRINTF("\t Where subband is: \r\n");
  PRINTF("\t 0x00 2G subband  (2.4G: channel 1-14)\r\n");
#ifdef CONFIG_5GHz_SUPPORT
  PRINTF("\t 0x10 5G subband0 (5G: channel 36,40,44,48,\r\n");
  PRINTF("\t                           52,56,60,64)\r\n");
  PRINTF("\t 0x11 5G subband1 (5G: channel 100,104,108,112,\r\n");
  PRINTF("\t                           116,120,124,128,\r\n");
  PRINTF("\t                           132,136,140,144)\r\n");
  PRINTF("\t 0x12 5G subband2 (5G: channel 149,153,157,161,165,172)\r\n");
  PRINTF("\t 0x13 5G subband3 (5G: channel 183,184,185,187,188,\r\n");
  PRINTF("\t                           189, 192,196;\r\n");
  PRINTF("\t                  5G: channel 7,8,11,12,16,34)\r\n");
#endif
}
```

- Define the handler for the CLI command `wlan-get-txpwrlimit` to get Tx power limit:

```
static void test_wlan_get_txpwrlimit(int argc, char **argv)
{
   wifi_SubBand_t subband;
   wlan_txpwrlimit_t txpwrlimit;
   int i, j;
if (argc != 2)
   {
    dump_wlan_get_txpwrlimit_usage();
    return;
   }
   subband = (wifi_SubBand_t)strtol(argv[1], NULL, 16);

   if (subband != SubBand_2_4_GHz
#ifdef CONFIG_5GHz_SUPPORT
     && subband != SubBand_5_GHz_0 && subband != SubBand_5_GHz_1 &&
 subband != SubBand_5_GHz_2 &&
     subband != SubBand_5_GHz_3
#endif
    )
    {
    dump_wlan_get_txpwrlimit_usage();
    return;
     }

   int rv = wlan_get_txpwrlimit(subband, &txpwrlimit);
   if (rv != WM_SUCCESS)
   PRINTF("Unable to get TX PWR Limit configuration\r\n");
else
   {
   PRINTF("Get txpwrlimit: sub_band=%x \r\n", txpwrlimit.subband);
   for (i = 0; i < 1; i++)
    {
    PRINTF("StartFreq: %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.start_freq);
    PRINTF("ChanWidth: %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.chan_width);
    PRINTF("ChanNum:   %d\r\n",
 txpwrlimit.txpwrlimit_config[i].chan_desc.chan_num);
    PRINTF("Pwr:");
    for (j = 0; j < txpwrlimit.txpwrlimit_config[i].num_mod_grps; j++)
     {
      if (j == (txpwrlimit.txpwrlimit_config[i].num_mod_grps - 1))
      PRINTF("%d,%d",
 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].mod_group,
      txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].tx_power);
      else
      PRINTF("%d,%d,",
 txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].mod_group,
      txpwrlimit.txpwrlimit_config[i].txpwrlimit_entry[j].tx_power);
      }
     PRINTF("\r\n");
    }
   }
}
```

- Rebuild the SDK and execute the command `wlan-get-txpwrlimit`.

The three code samples below show examples of wlan-get-txpwrlimit command outputs.

```
# wlan-get-txpwrlimit 00
Get txpwrlimit: sub_band=0
StartFreq: 2407
ChanWidth: 20
ChanNum:   1
Pwr:0,15,1,15,2,15,3,14,4,14,5,14,6,13
```

```
# wlan-get-txpwrlimit 10
Get txpwrlimit: sub_band=10
StartFreq: 5000
ChanWidth: 20
ChanNum:   36
Pwr:1,16,2,16,3,15,4,15,5,15,6,14,7,14,8,14,9,13
```

```
# wlan-get-txpwrlimit 12
Get txpwrlimit: sub_band=12
StartFreq: 5000
ChanWidth: 20
ChanNum:   149
Pwr:1,16,2,16,3,15,4,15,5,15,6,14,7,14,8,14,9,13
```

4 Channel list and scan type

The command line interface is provided in *wifi_cert* sample application to set/get the channel list and scan type. Note that *wifi_cert* application is enabled only for i.MX RT1060 platform.

The default channel list and scan configuration are described in Table 4.

Table 4. Default channel list and scan configuration

Bandwidth (GHz)	Channels	Scan
2.4	1-11	Active
2.4	12-14	Passive
5	36-48	Active
5	52-64	Passive
5	100-144	Passive
5	149-165	Passive

With a passive scan, the client radio listens on each channel for beacons sent periodically by an AP; this method usually takes more time than the active scan. During an active scan, the client radio transmits a probe request and listens for a probe response from an AP.

The channel list and scan type are set using `wlan_set_chanlist` API. This function uses `chanlist_2g_cfg` and `chanlist_5g_cfg` data structures, both defined in *<sdk_root>/middleware/wifi/wlcmgr/wlan_txpwrlimit_cfg_WW.h*.

`chanlist_2g_cfg` is used for 2.4 GHz band (see below) and `chanlist_5g_cfg` is used for 5 GHz.

```
static wlan_chanlist_t chanlist_2g_cfg = {
   2,
   [0] =
     {
      .chan_num                    = 1,
      .chan_freq                   = 2412,
      .passive_scan_or_radar_detect = false,
     },
   [1] =
     {
      .chan_num                    = 12,
      .chan_freq                   = 2467,
      .passive_scan_or_radar_detect = true,
     },
};
```

The parameters used in those structures are:

Parameter	Description
num_chan	Number of channels showed in the list. The number must be the same as the number of chan_info elements.
channel_num	Number of the channel
chan_freq	Frequency of the channel
passive_scan_or_radar_detect	Informs the driver whether the channel is a passive channel (Band B/G) or a DFS channel (Band A) for which radar detection will be done. If set to "True", only passive scanning will be done for the channel. True: Passive Scan/DFS channel False: Active scanning

The following code sample shows chanlist_5g_cfg data structure (for 5 GHz band):

```
static wlan_chanlist_t chanlist_5g_cfg = {
    2,
    [0] =
      {
       .chan_num                    = 36,
       .chan_freq                   = 5180,
       .passive_scan_or_radar_detect = false,
       },
    [1] =
      {
       .chan_num                    = 100,
       .chan_freq                   = 5500,
       .passive_scan_or_radar_detect = true,
      },
};
```

Two channel scan configurations are defined (num_chans parameter is set to 2):

- channel 36, frequency 5180, using active scan
- channel 100, frequency 5500, using passive scan

There are two ways to set/get the scan type:

- using the API
- using the command line

The following sections describe both methods.

4.1 Customization using API calls

Use the driver APIs with the required arguments to perform the set operation wlan_set_chanlist.

```
int wlan_set_chanlist(wlan_chanlist_t *chanlist)
```

Where:

Parameter	Description
[in] chanlist	A pointer to wlan_chanlist_t structure to supply the channel list configuration. This structure is explained below.

The function which sets the channel list and is defined in the file *<sdk_root>/middleware/wifi/wlcmgr/ wlan.c*.

Returns:

WM_SUCCESS: the call is successful

WM_FAIL: the call failed

The following is an example of use of wlan_set_chanlist; the function takes the aforementioned structures wlan_chanlist_t as input parameter.

For 2.4 GHz:

```
ret = wlan_set_chanlist(&chanlist_2g_cfg);
if (ret != WM_SUCCESS)
PRINTF("Cannot set Channel List 2G\r\n");
else
PRINTF("Successfully set 2G Channel List\r\n");
```

For 5 GHz:

```
ret = wlan_set_chanlist(&chanlist_5g_cfg);
if (ret != WM_SUCCESS)
PRINTF("Cannot set Channel List 5G\r\n");
else
PRINTF("Successfully set 5G Channel List\r\n");
```

As shown in the sample codes, the implementation provides a return status for the function to check whether the function call is successful or not.

Use the driver APIs with the required arguments to perform the get operation `wlan_get_chanlist`.

```
int wlan_get_chanlist(wlan_chanlist_t *chanlist)
```

Where:

Parameter	Description
`[out] chanlist`	A pointer to `wlan_chanlist_t` structure to get the channel list configuration.

The function which sets the channel list and is defined in file located in *<sdk_root>/middleware/wifi/wlcmgr/wlan.c*.

Returns:

WM_SUCCESS: the call is successful

WM_FAIL: the call failed

Note: *The channels that are configured using this API should be from the list of channels under World Wide Safe Mode (WWSM).*

The following is an example of use of wlan_get_chanlist; the function takes the aforementioned structures wlan_chanlist_t as output parameter.

```
wlan_chanlist_t chanlist;
memset(&chanlist, 0x00, sizeof(wlan_chanlist_t));
int rv = wlan_get_chanlist(&chanlist);
if (rv != WM_SUCCESS)
    PRINTF("Unable to get channel list configuration\r\n");
else {
      int i;

 PRINTF("----------------------------------------------------------------
\r\n");
      PRINTF("Number of channels configured: %d\r\n",
 chanlist.num_chans);
      PRINTF("\r\n");
      for (i = 0; i < chanlist.num_chans; i++){
         PRINTF("ChanNum: %d\t", chanlist.chan_info[i].chan_num);
         PRINTF("ChanFreq: %d\t", chanlist.chan_info[i].chan_freq);
         PRINTF("%s",
 chanlist.chan_info[i].passive_scan_or_radar_detect ? "Passive" :
 "Active");
         PRINTF("\r\n");
       }
     }
```

As shown in the sample codes, the implementation provides a return status for the function to check whether the function call is successful or not.

4.2 Customization using the command line interface

By default, the current implementation does not include the CLI commands to set the scan type. This section shows the steps needed to add such feature.

- Edit the file: *<sdk root>/middleware/wifi/wlcmgr/wlan_tests.c*
- Add the following command:

```
{"wlan-set-chanlist", NULL, test_wlan_set_chanlist},
```

The example below shows the added line in **bold**.

```
static struct cli_command tests[] = {
.
.
.
{"wlan-set-chanlist", NULL, test_wlan_set_chanlist},
};
```

- Define the channel list structure with the required values for 2G and 5G, as shown below

For 2.4 GHz

```
static wlan_chanlist_t chanlist_2g_cfg = {
    2,
    [0] =
       {
         .chan_num                    = 1,
         .chan_freq                   = 2412,
         .passive_scan_or_radar_detect = false,
        },
    [1] =
       {
        .chan_num                    = 12,
        .chan_freq                   = 2467,
        .passive_scan_or_radar_detect = true,
        },
};
```

For 5 GHz

```
#ifdef CONFIG_5GHz_SUPPORT
static wlan_chanlist_t chanlist_5g_cfg = {
    2,
    [0] =
       {
        .chan_num                    = 36,
        .chan_freq                   = 5180,
        .passive_scan_or_radar_detect = false,
        },
    [1] =
       {
        .chan_num                    = 100,
        .chan_freq                   = 5500,
        .passive_scan_or_radar_detect = true,
        },
};
#endif
```

- Define the handler function that is triggered when the user executes the command `wlan-set-chanlist`

```
static void test_wlan_set_chanlist(int argc, char **argv)
   {
    int ret = WM_SUCCESS;

    ret = wlan_set_chanlist(&chanlist_2g_cfg);
    if (ret != WM_SUCCESS)
       PRINTF("Cannot set Channel List 2G\r\n");
    else
       PRINTF("Successfully set 2G Channel List\r\n");

#ifdef CONFIG_5GHz_SUPPORT
    ret = wlan_set_chanlist(&chanlist_5g_cfg);
    if (ret != WM_SUCCESS)
        PRINTF("Cannot set Channel List 5G\r\n");
    else
        PRINTF("Successfully set 5G Channel List\r\n");
#endif
}
```

- Rebuild the SDK and run the command `wlan-set-chanlist` and read the output.

```
# wlan-set-chanlist
Successfully set 2G Channel List
Successfully set 5G Channel List
```

This code sample confirms that the channel list and scan information have been set.

To **verify** the channel list setting, you need to create the wlan-get-chanlist command by following the procedure detailed hereafter.

- Edit the file *<sdk_root>/middleware/wifi/wlcmgr/ wlan_tests.c*
- Find the tests structure and add the following line:

```
{"wlan-get-chanlist", NULL, test_wlan_get_chanlist},
```

The example below shows the added line in bold.

```
static struct cli_command tests[] = {
    .
    .
    .
     {"wlan-get-chanlist", NULL, test_wlan_get_chanlist},
};
```

- Define the handler for `wlan-get-chanlist` command

```
static void test_wlan_get_chanlist(int argc, char **argv)
{
   wlan_chanlist_t chanlist;
   memset(&chanlist, 0x00, sizeof(wlan_chanlist_t));
   int rv = wlan_get_chanlist(&chanlist);
   if (rv != WM_SUCCESS)
     PRINTF("Unable to get channel list configuration\r\n");
   else {
     int i;

 PRINTF("----------------------------------------------------------------
\r\n");
     PRINTF("Number of channels configured: %d\r\n",
 chanlist.num_chans);
     PRINTF("\r\n");
     for (i = 0; i < chanlist.num_chans; i++){
         PRINTF("ChanNum: %d\t", chanlist.chan_info[i].chan_num);
         PRINTF("ChanFreq: %d\t", chanlist.chan_info[i].chan_freq);
         PRINTF("%s",
 chanlist.chan_info[i].passive_scan_or_radar_detect ? "Passive" :
 "Active");
         PRINTF("\r\n");
     }
   }
}
```

- Rebuild the SDK and run the command wlan-get-chanlist. The output will be similar to the one shown below.

```
# wlan-get-chanlist
----------------------------------------------------------------
Number of channels configured: 4
ChanNum: 1      ChanFreq: 2412  Active
ChanNum: 12     ChanFreq: 2467  Passive
ChanNum: 36     ChanFreq: 5180  Active
ChanNum: 100    ChanFreq: 5500  Passive
```

5 Acronyms and abbreviations

Table 5. Acronyms and abbreviations

Acronyms	Definition
AP	Access Point
CLI	Command Line Interface
CRDA	Central Regulatory Domain Agent
EEPROM	Electrically Erasable Programmable Read-Only Memory
FW	Firmware
IE	Information Element
OTP	One Time Programmable
TRPC	Transient receptor potential, canonical
WLAN	Wireless Local Area Network

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Tables

Contents

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Date of release: 6 July 2022
Document identifier: AN12918