Antenna Tool (ANT)
User guide

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2. Contents

3. Document history

Revision	Date	Author	Changes
0.1	02/2017	Hanit Turjeman	First draft version of the document
0.2	03/2017	Gregory Bugaevsky	Added association by BSSID
0.3	05/2017	Hanit Turjeman	Updated screenshots Added support for 9560/9461
0.4	06/2017	Hanit Turjeman	Added support for DCR 5166 new Extended HID sensor
0.5	07/2017	Hanit Turjeman	Added antenna isolation feature (DCR 5128)
0.6	09/2017	Hanit Turjeman	Removed antenna C
0.7	10/2017	Hanit Turjeman	Added support for 9462 Added “-password <PASS>” API
1.0	07/2018	Gil Volovich	Updated get NVM data feature
1.1	10/2018	Hanit Turjeman	Added support for DCR88 – Scan all Aps on a specific channel and present RSSI measurements.
1.2	12/2018	Gil Volovich	DCR 78- Added support for BIOS SPLC value display
1.3	12/2018	Gil Volovich	DCR 236 - Added support for BT BIOS SAR table display
1.4	03/2019	Nal Zazi	Updated tool to report Chains instead of Antennas
1.5	05/2019	Nal Zazi	Updated supported devices for BT RSSI Test
1.6	06/2019	Nal Zazi	DCR-456 – Added support for OEM version display

4. About this publication

4.1 Purpose

This document provides information about Intel® ANT application. This document describes ANT setup, installation, and user guidelines.

4.2 Intended Audience

This information is intended for Original Equipment Manufacturers (OEMs).

5. ANT description

5.1 Overview

The Antenna Tool (ANT) is a Command Line Interface (CLI) application used to associate with an access point and optionally perform a RSSI (Received Signal Strength Indicator) test.

ANT performs basic connectivity tests:

- Associating with AP.
- Measuring RSSI.

5.2 High level flows

- Association and RSSI test:
  - Connecting to NDIS device.
  - Present RF-Kill status
  - Associating to a specific AP (defined by the user).
  - Measuring RSSI (once RSSI is stable).
  - Displaying test results.
  - Disassociate from AP.
- Single channel scan and RSSI test (unassociated):
  - Disassociate from AP.
  - Connecting to NDIS device.
  - Present RF-Kill status
  - For each iteration (number of scans):
    - Scan all APs found on a specific channel (defined by the user).
    - Get RSSI measurements for each AP on each antenna.
  - Displaying test results.

5.3 Setup requirements

Supported hardware

- Intel® Wireless-AC 8260, 8265, 9260, 9560, 9461, 9462
- Intel® Wi-Fi 6 AX200 160MHz, AX201 160MHz

Operating system requirements

- Windows 10

6. Running

6.1 Prerequisites

- Supported Intel® Wireless NIC is connected to the setup.
- Intel® Wifi driver is installed and NIC is operational (enabled). ANT release doesn't include driver package.

6.2 Limitations

- ANT does not accept any unsupported command line parameters.
- Command line commands/parameters are not case sensitive except for SSID name (-network <ssid>).
- The SSID name should be surrounded by double quote marks if it contains space symbol.
- You have to disable/enable wireless NIC after all tests done because ANT changes default driver settings.
- An antenna option (one of the following: -ant_all, -antd, -ant1, -ant2) must be passed in order to enable RSSI testing.
- "-band" option changes the default band settings of the driver. By default, driver works in mixed mode (listens to all bands). If you don't need to change this behavior – don't apply "band" flag. In order to restore mixed band listening, you should run "ant –reset_driver".
- "Chains" reports list of chains, marked by driver as "active", after the first succeeded association. Notice, that driver will run detection algorithm only once, till next driver reset (disable/enable or fresh installation of a driver). Therefore, any chain manipulation after the first association and till next driver reset will not affect driver settings, and will not be reflected by ANT tool as well.

6.3 Steps to run ANT

- Power up the access point.
- Copy ANT layout to a local folder.
- Run ant.exe from a CMD window with the desired command line options:
    - Type "ant -?" for usage if you are not familiar with the tool.
    - Type "ant <command line parameters ...>" to run the tool.

❖ Running the tool with no parameters will display a help screen.

7. ANT functionalities

7.1 Association

Performing association with an access point (by SSID and optionally by BSSID).

Command line options:
ANT –network <ssid> [-bssid <bssid>] [-password <pass>] [-band <a|b|g>] [-enable_11n | -disable_11n] [-stay_assoc]
[-ant_isolation] [-delay <value>] [-aggressive] [-d | -debug <append | overwrite>] [–log <filename>]

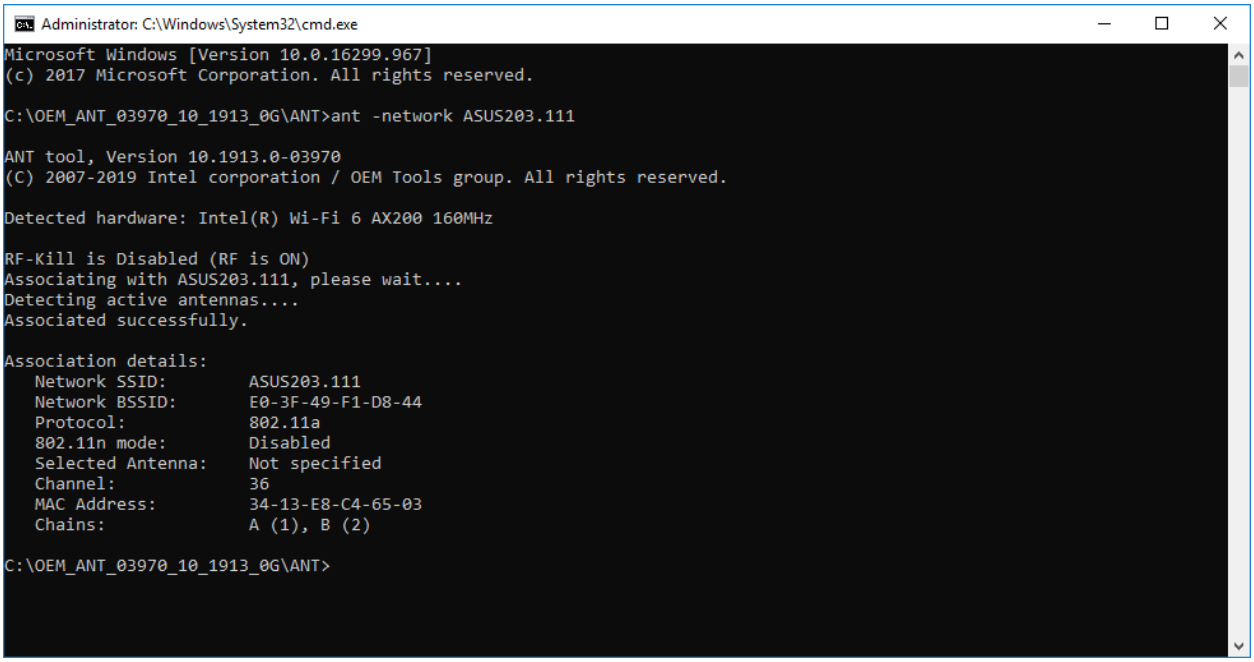

Figure 1: Association

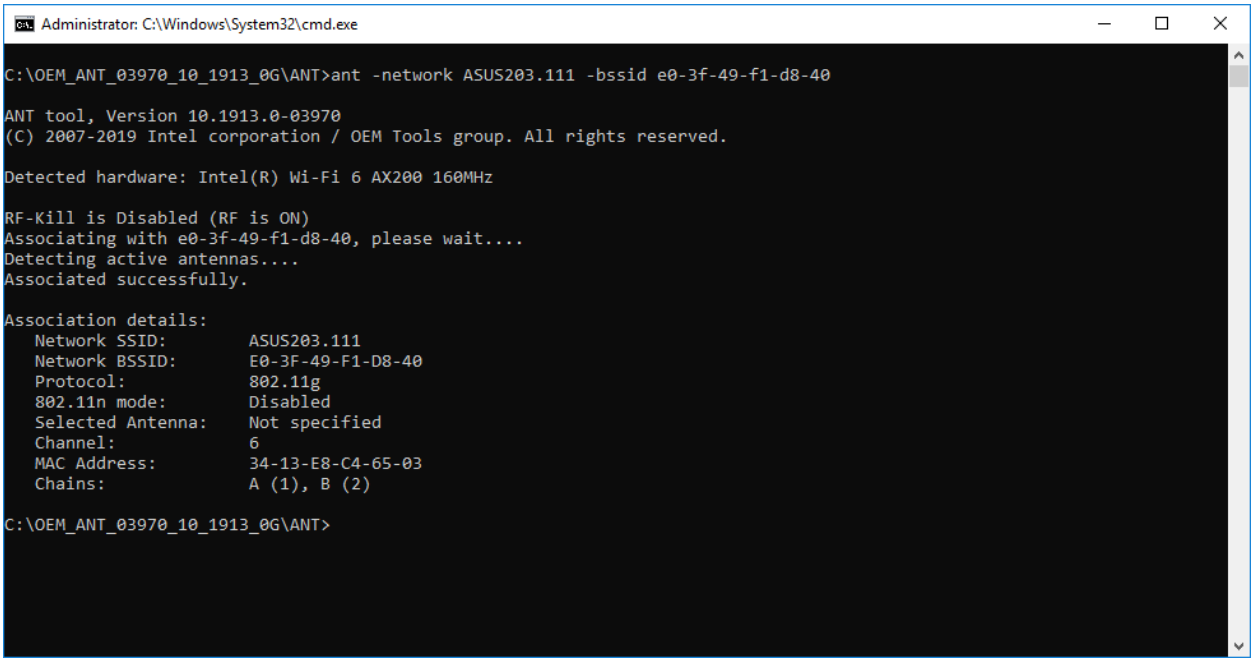

Figure 2: Association with BSSID

7.2 RSSI test

Performing association with an access point (by SSID and optionally by BSSID) and executes RSSI test.

Command line options:
ANT –network <ssid> [-bssid <bssid>] [-password <pass>] –antd|-ant1|-ant2 |-ant_all [-band <a|b|g>]
[-I <iterations>] [-th <threshold>] [-th_high <threshold>] [-stay_assoc] [-enable_11n | -disable_11n]
[-rssi_loops <loops count>] [-falloff <value>] [-stable_rssi_threshold <value>] [-ant_isolation]
[-delay <value>] [-aggressive] [-xml <a|o>] [-OutputXMLFile <filename>]
[-d | -debug <append | overwrite>] [–log <filename>]

- When the test is done, the NIC will be disconnected. Use [-stay_assoc] to stay associated.

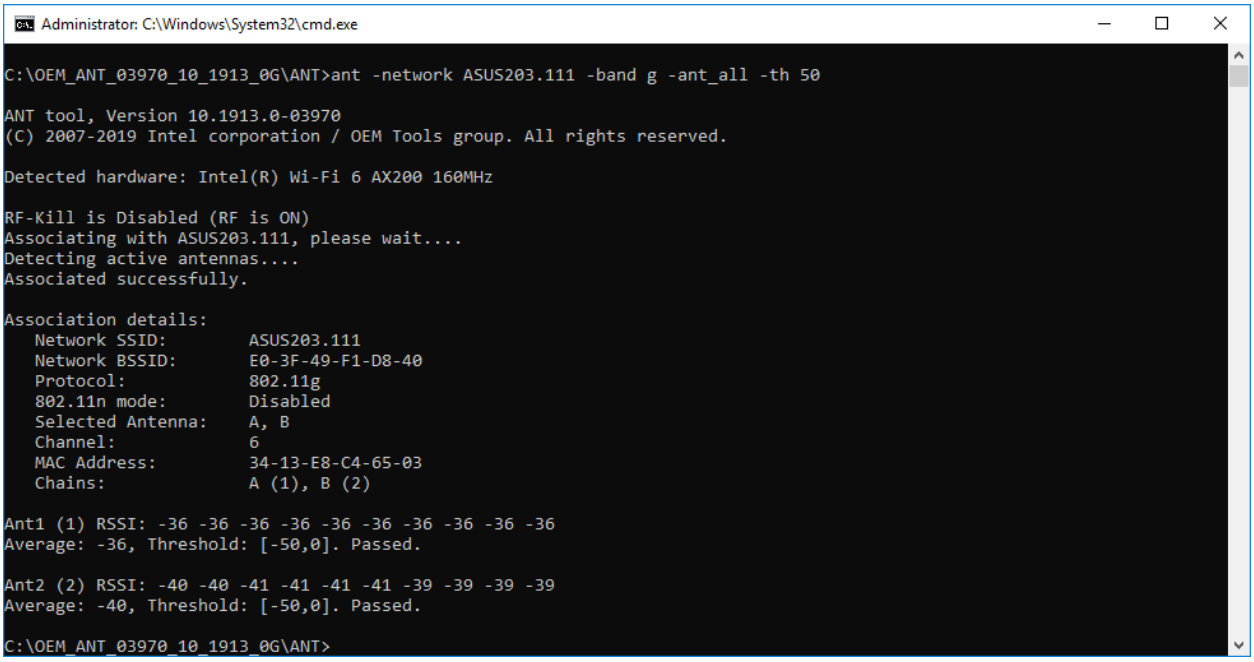

Figure 3: RSSI test

7.3 Delta test

Performs association with an access point and executes RSSI delta test between two chains.

Command line options:
ANT –network <ssid> [-bssid <bssid>] [-password <pass>] –deltaab|-deltaac|-deltabc <threshold> [-band <a|b|g>] [-stay_assoc] [-enable_11n | -disable_11n] [-rssi_loops <loops count>] [-falloff <value>] [-stable_rssi_threshold <value>] [-ant_isolation] [-delay <value>] [-aggressive] [-xml <a|o>] [-OutputXMLFile <filename>] [-d | -debug <append | overwrite>] [–log <filename>]

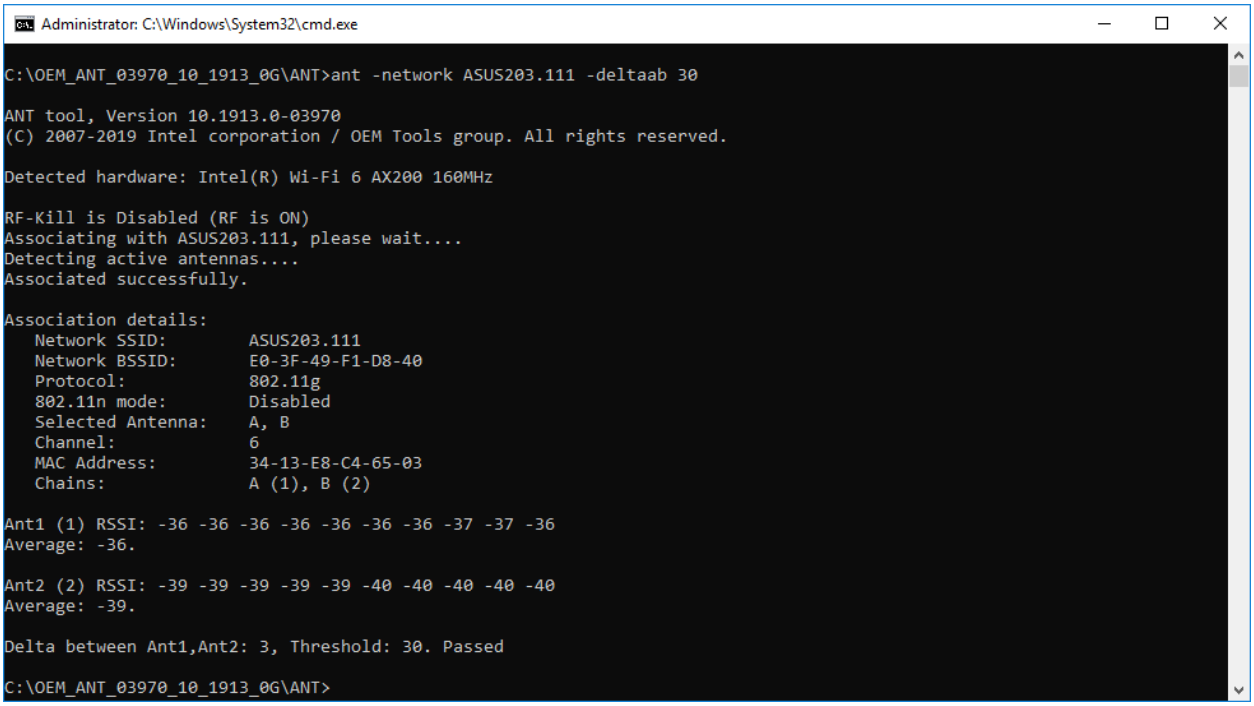

Figure 4: Delta test

7.4 Single channel scan and RSSI test

In single channel scan mode ANT is requested to survey defined channel and notify the user on APs found and their RSSI value per antenna. The user must provide the desired channel. The scan is active only, thus only active channels are supported.
Acceptable channels: 1-11, 36, 40, 44, 48, 149, 153, 157, 161 and 165
In addition, the user can specify:

- Iteration number of RSSI measurement (iteration number means number of scans):
    - Allowed values: 1 – 100. Default is 10.
- Time interval of every iteration in millisecond (ΔT –time between scans):
    - Allowed values: 200,400,600,800 and 1000. Default is 200.

While using scan mode, user shall consider the option that some APs will not be presented on the results table for all of the iterations. To find APs, ANT will trigger a probe request transmission and wait time of ~20ms on each iteration. ANT will present All APs in which it could capture their probe response during this 20 millisecond time, any beacon that would be received will also be added to the found APs list. Due to this behavior, APs which cannot Rx the Intel Device transmission, but are received by the Intel device, will only be represented on results table on few cases.

Scan result values for a specific iteration can be one of the following:

- RSSI value [-95…0]
- N/A – AP was not found.
- ERR – Scan was failed.

Command line options:
ANT –scan –channel <active channel number> [-rssi_loops <loops count>] –ant1|-ant2 |-ant_all
[-interval <time in ms>] [-th <threshold>] [-th_high <threshold>]
[-d | -debug <append | overwrite>] [–log <filename>]

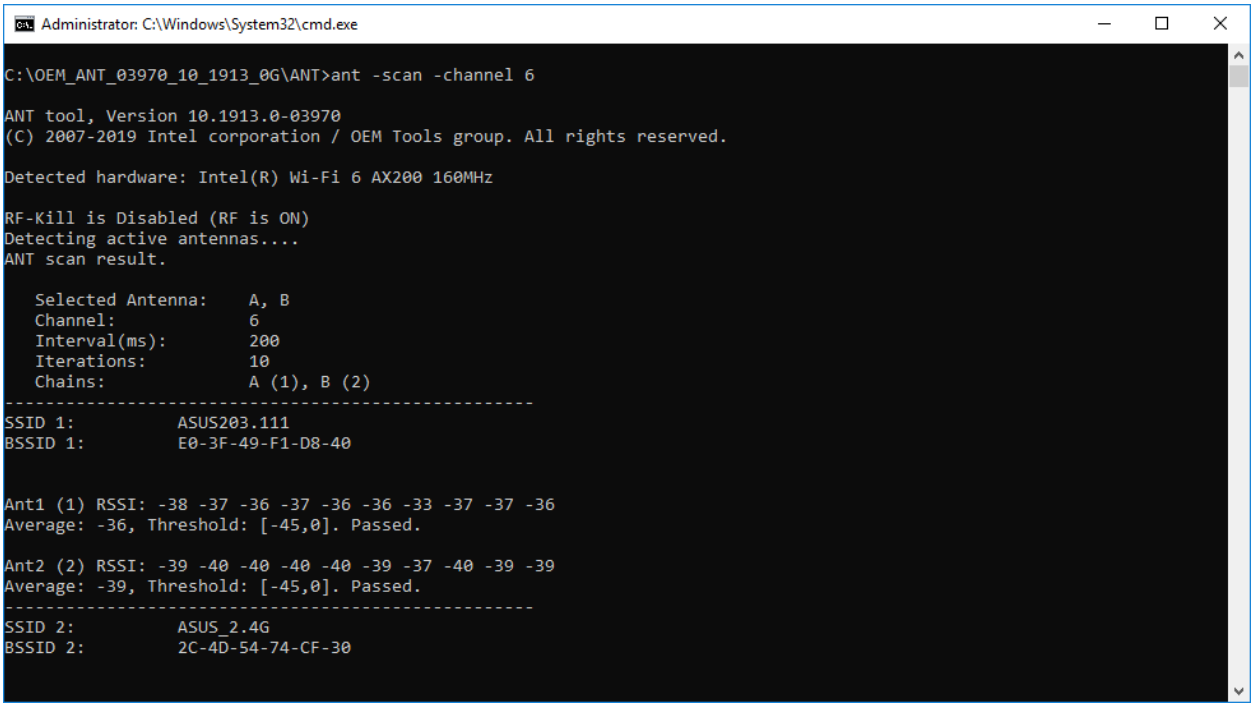

Figure 5: Single channel scan and RSSI test

7.5 Antenna isolation

Antenna isolation value represent the physical isolation between the two antennas. This value is calculated periodically by the Wi-Fi FW when Wi-Fi is associated to AP (**2.4 GHz only**) and BT is active.
Antenna isolation value is in dB.
Antenna isolation value is highly important in the context of Wi-Fi-BT Coex, when each core use a separate antenna.
In order to get antenna isolation value user should add the parameter “-ant_isolation” to association, RSSI or delta test. For examples: ANT –network <SSID> -ant_isolation

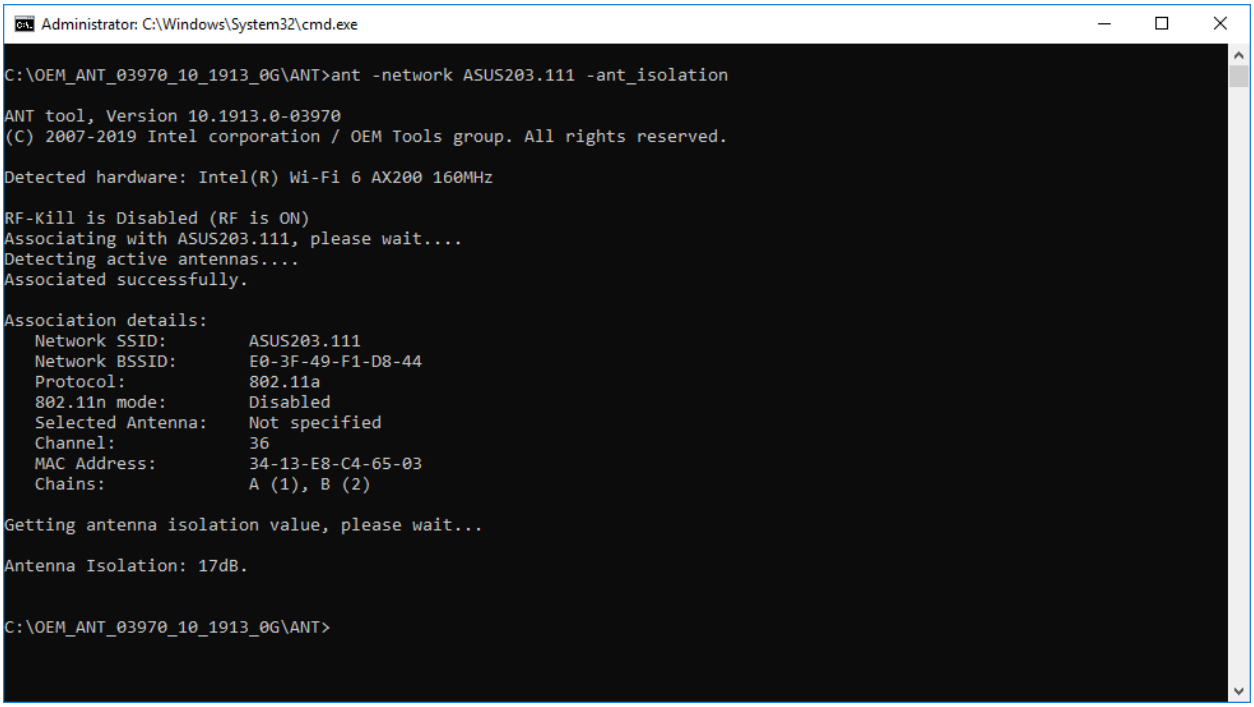

Figure 6: Antenna isolation value

7.6 Driver control

Allows to enable, disable or reset NIC's driver.

Command line options:

- Wi-Fi Driver: ANT –enable_driver|-disable_driver|-reset_driver
- Bluetooth Driver: ANT –enable_bt_driver|-disable_bt_driver

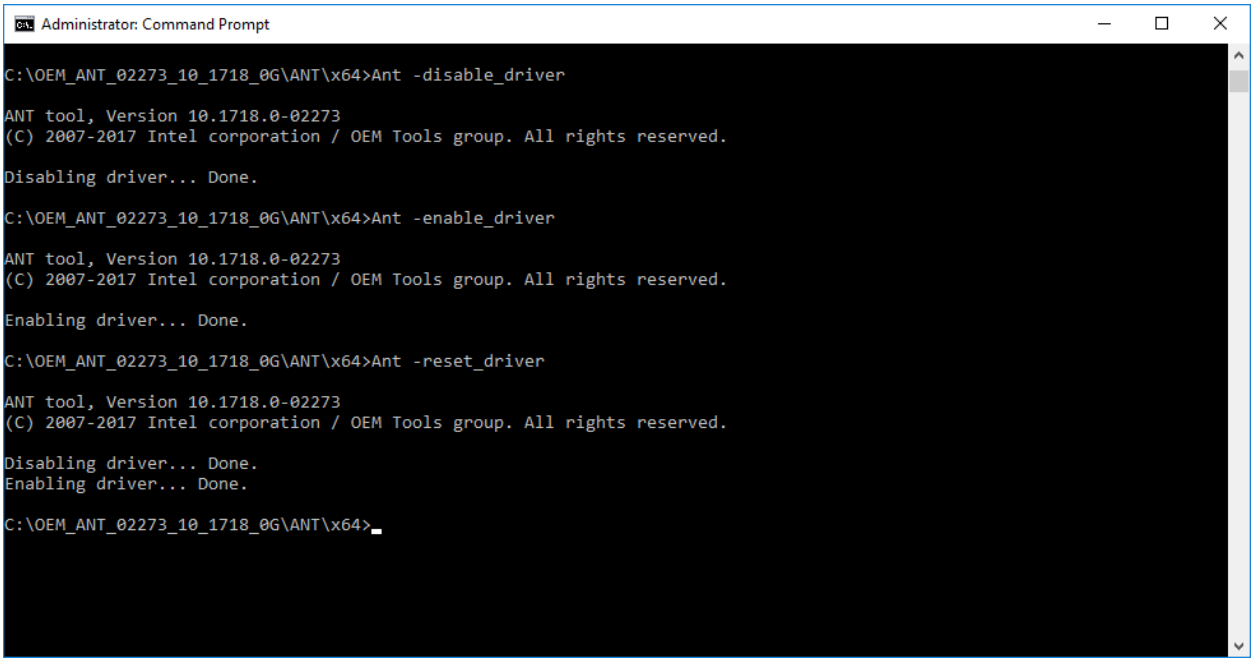

Figure 7: Driver control, Disable, Enable and Reset Wi-Fi driver

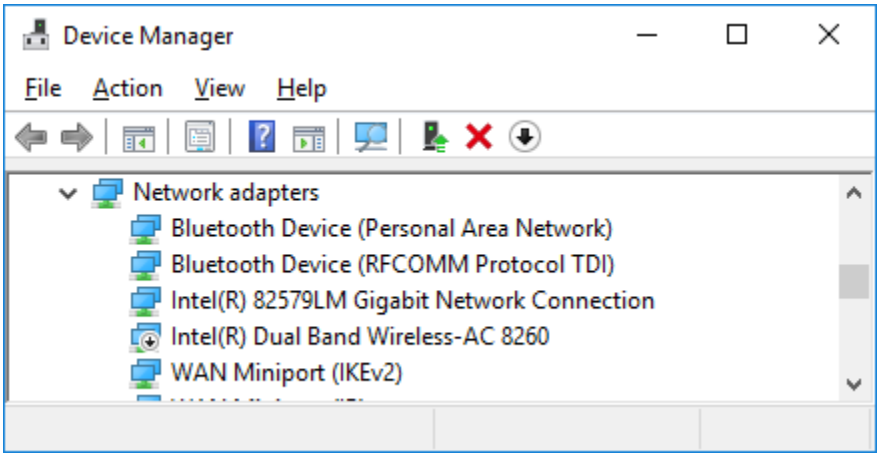

Figure 8: Driver control, Wi-Fi driver disabled

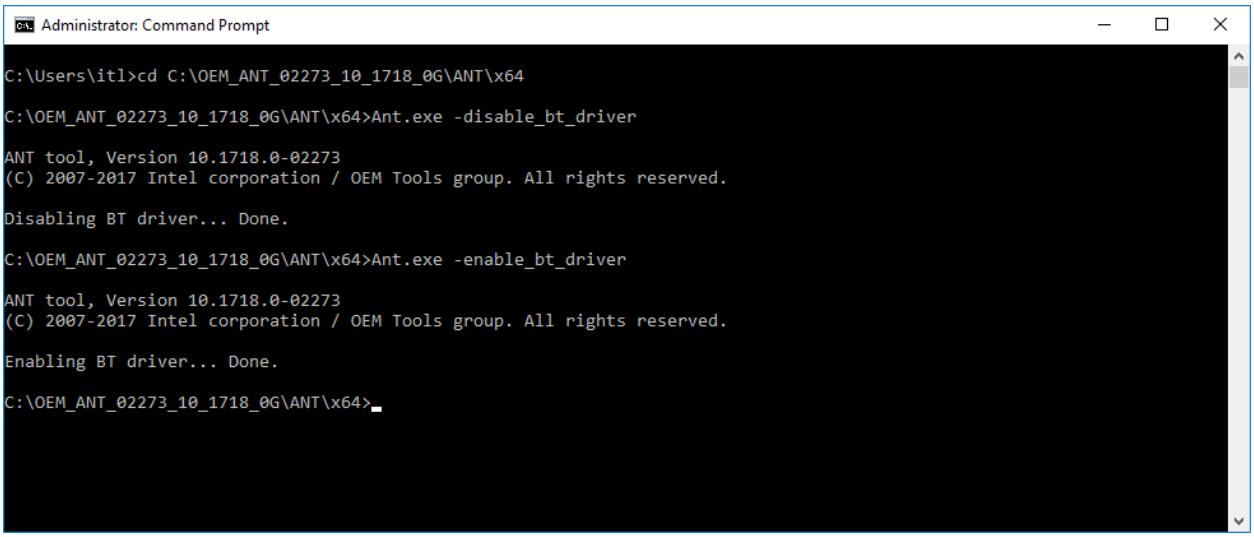

Figure 9: Driver control, Disable, Enable BT driver

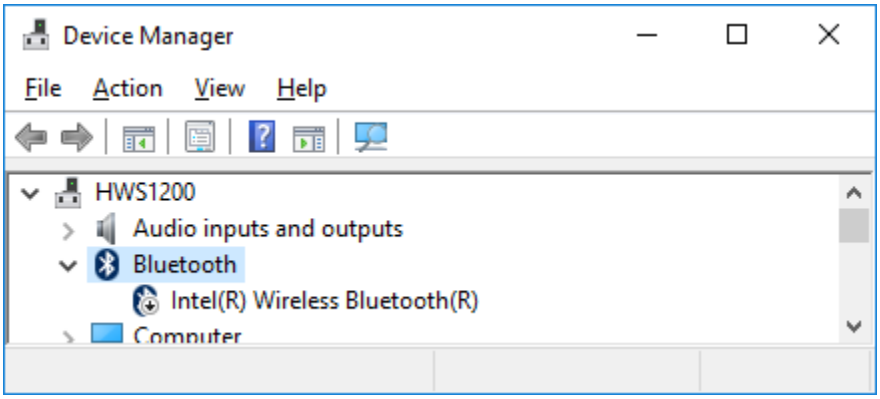

Figure 10: Driver control, BT driver disabled

7.7 HW RF Kill status

Returns the RF Kill switch status.

Command line options: ANT –get_rf_kill

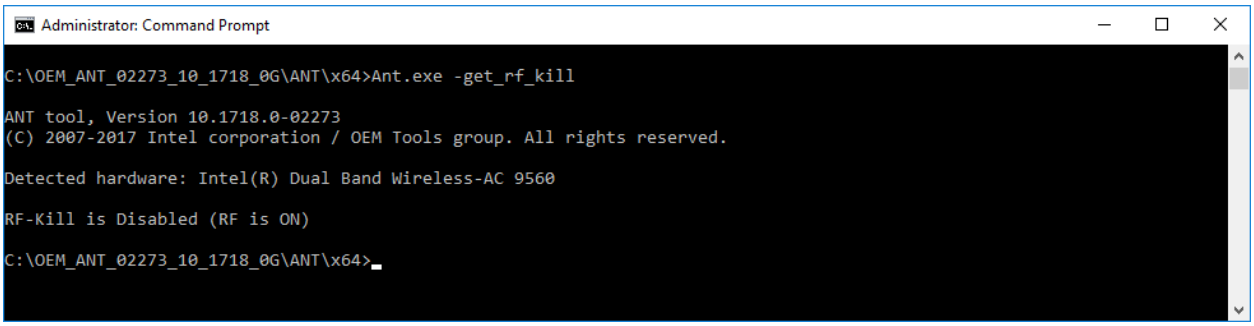

Figure 11: RF-Kill status

7.8 Check HW version

Shows / compares hardware version. Supported only for WP device.

Command line options:
ANT –get_hw_ver|-compare_hw_ver <HW_VERSION_COMPARING_WITH>

7.9 Check device ID

Shows device ID.

Command line options:
ANT –get_deviceid

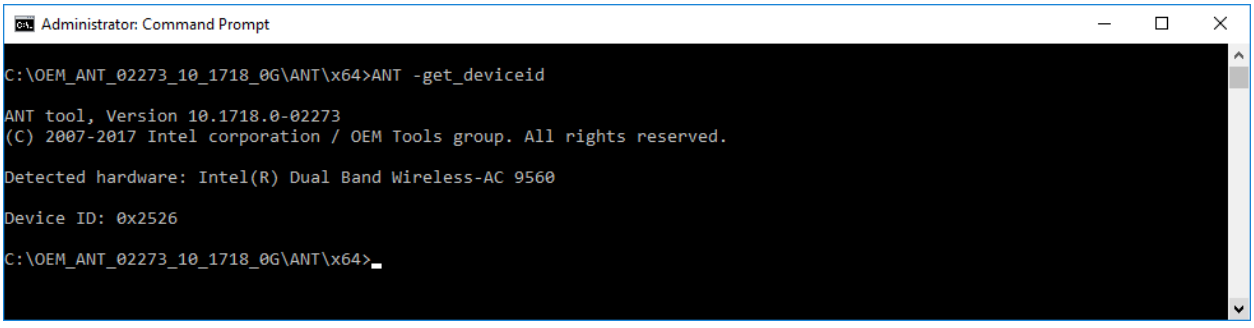

Figure 12: Device ID

7.10 Check subsystem ID

Shows subsystem ID.

Command line options:
ANT –get_subsystemid

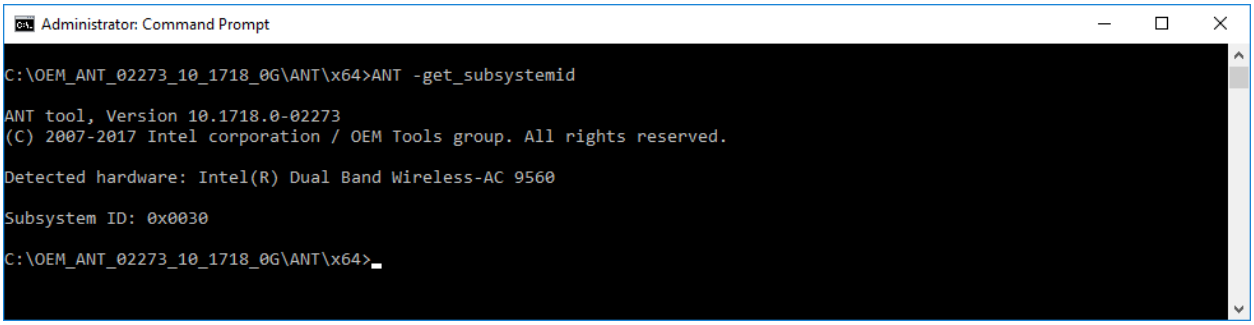

Figure 13: Subsystem ID

7.11 Check NVM image version

Shows NVM image version.

Command line options:
ANT –get_nvmimage

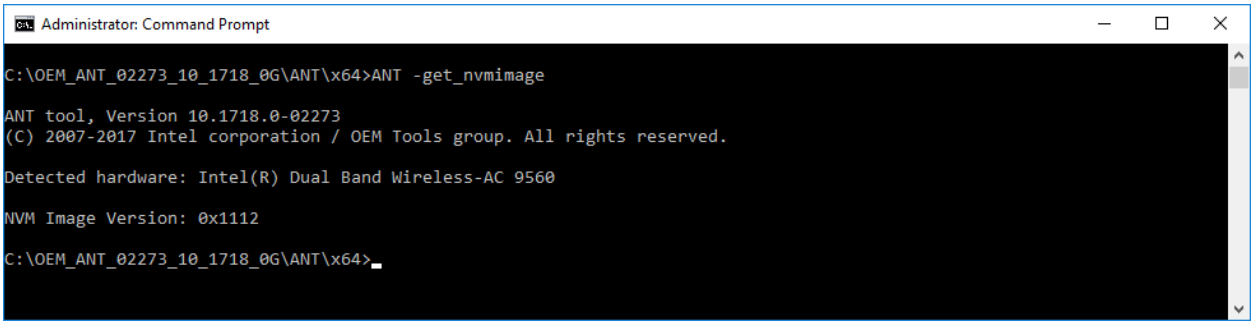

Figure 14: NVM image version

7.12 Check OTP OEM version

Shows OTPs OEM version.

Command line options:
ANT –get_oemversion

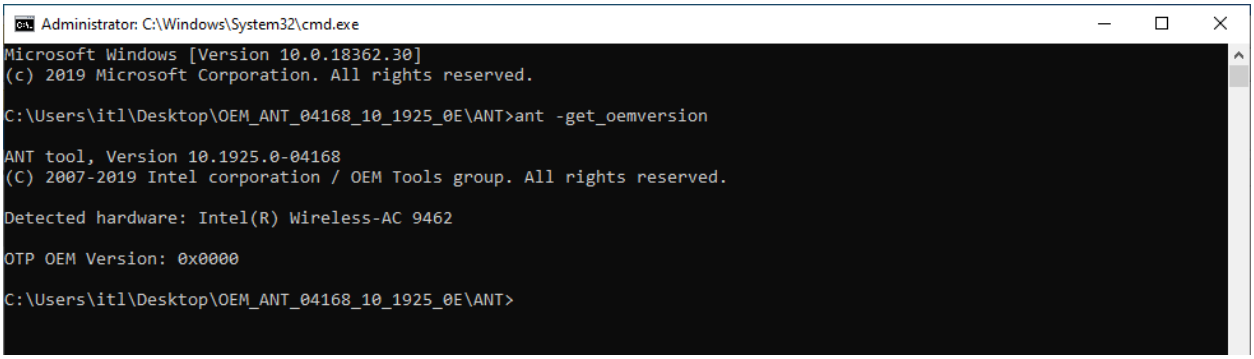

Figure 15: OTP OEM version

7.13 Check PCI revision ID

Shows HW revision ID.

Command line options:
ANT –get_pcirevid

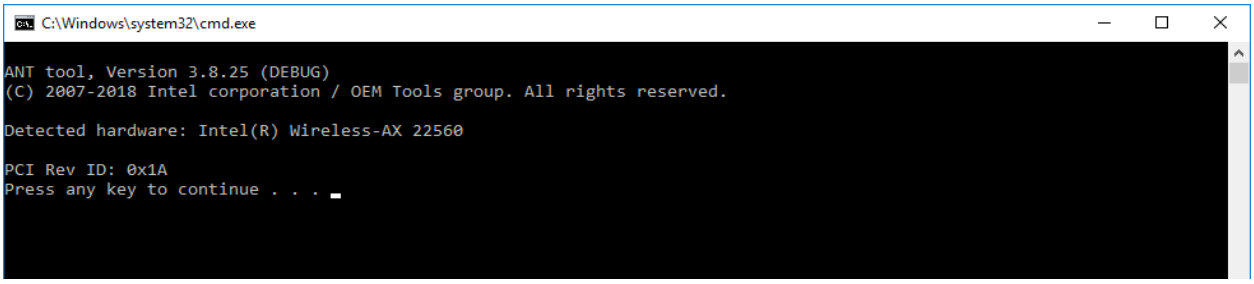

Figure 16: PCI revision ID

7.14 Check NVM data

Shows NVM data (all data described in 7.6 – 7.10 sections above).

Command line options:
ANT –get_device_data

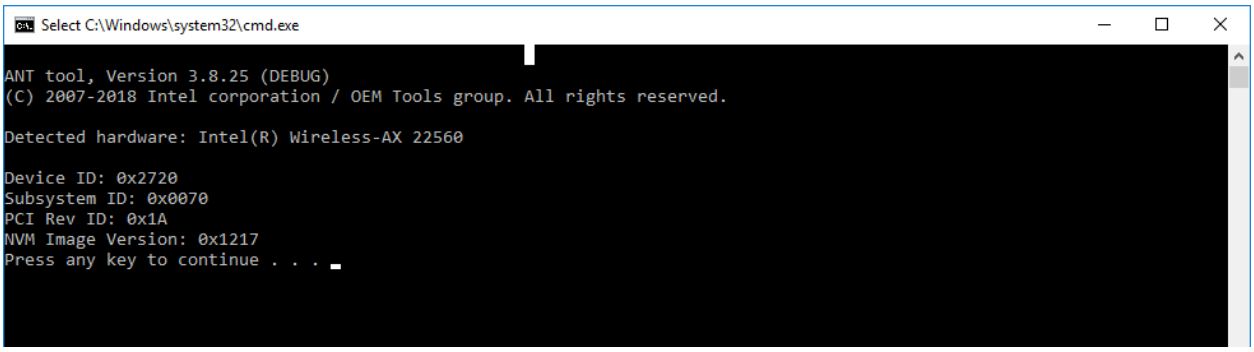

Figure 17: Get device data

7.15 Bluetooth RSSI test

Measuring RSSI via BT antenna (Listening ONLY to channel 0). Supported only for WP1, SdP and JfP1 devices.

Command line options:
ANT –BT

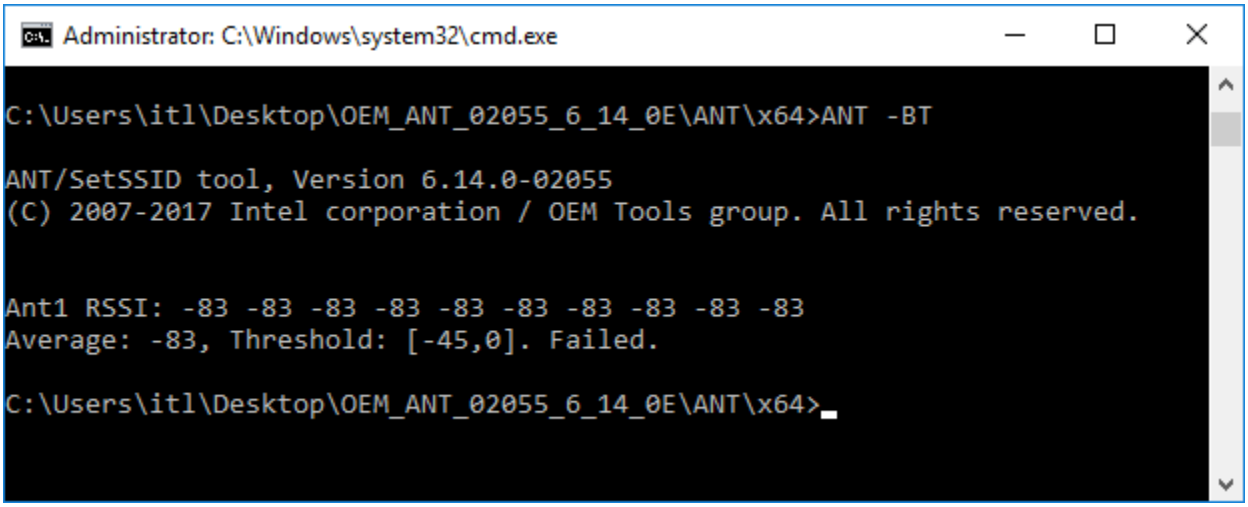

Figure 18: Test RSSI via Bluetooth antenna

7.16 Set MCC (Mobile Country Code)

Sets the requested MCC for 2 hours. If the MCC was changed during the 2 hours period, the remaining time will be decided according to first mcc request.
When the 2 hours period will expire the FW will be down for 15 minutes.

Command line options:
ANT –SetMcc <mcc>

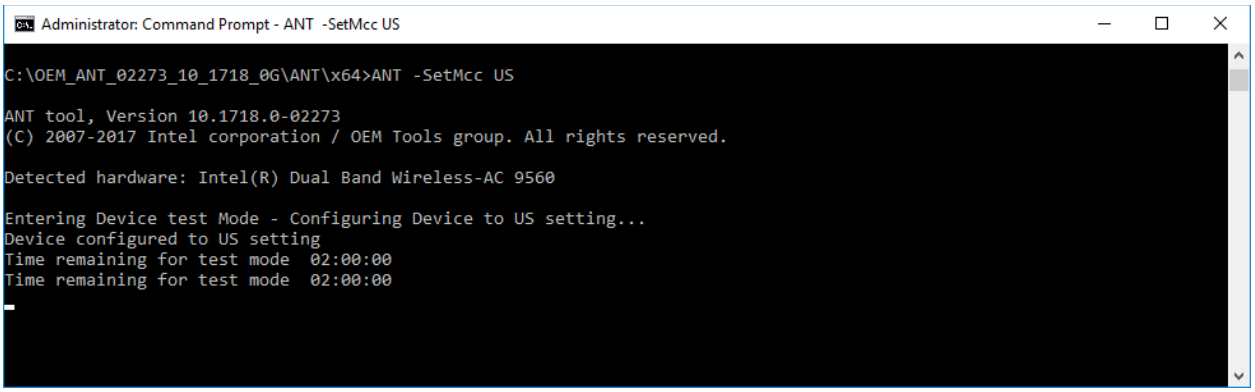

Figure 19: Set MCC

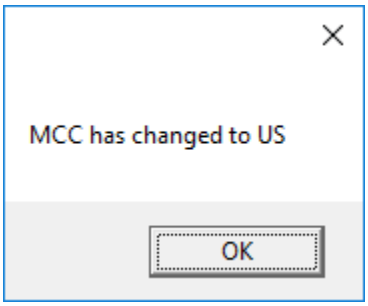

Figure 20: Set MCC, confirm message.

7.17 Query MCC

The query will return the following:

1. Current MCC
2. MCC source (OTP, DRS, MCC API…)

   If the source is from MCC API the additional information will be displayed:

   a) Device mode (active, not active, denial).
   b) Remaining time in the current mode (if in active or denial).

   An error level is returned (32 bits) with the following data:

   a) bits 0-15 – Current mcc (if not in active mode will be 0).
   b) bits 16-23 – Device mode (0 – active, 1 – not active, 2 – denial).
   c) bits 24-31 – elapsed time in current mode (in 30 seconds interval. Example: 1 – 30 seconds, 2 - 60 seconds ...)

Command line options:

ANT –QueryMCC

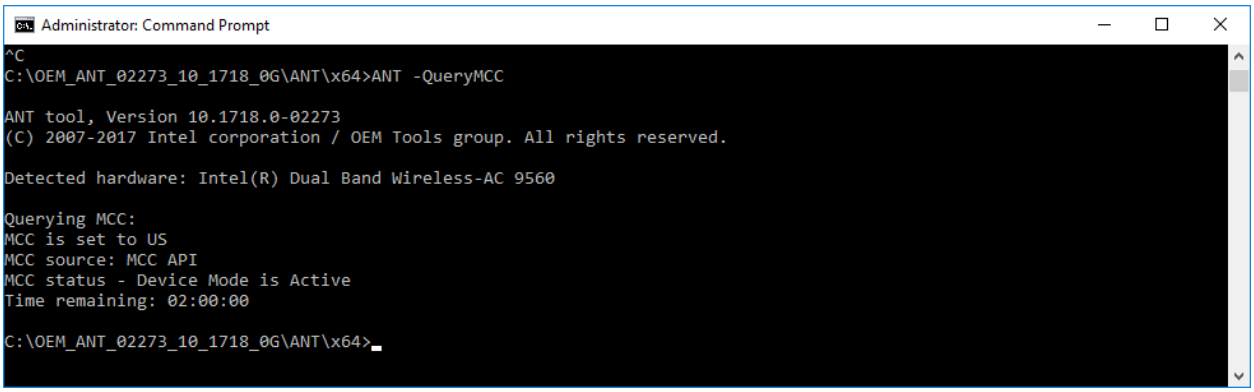

Figure 20: Query MCC

7.18 Get Lenovo pSensor Tx Limits

Showing the following information:

- Sensor type (Generic or Lenovo).
- Sensor sub type (WMI, HID, EXTENDED HID…)
- For “WMI” or “HID” sensor:
    - 2.4GHz Tx Power Limit
    - 5.2GHz Tx Power Limit
- For “EXTENDED HID” sensor:
    - For Chain A\B:
        - 2.4GHz
        - 5.2GHz 5150MHz-5350MHz
        - 5.2GHz 5350MHz-5470MHz
        - 5.2GHz 5470MHz-5725MHz
        - 5.2GHz 5725MHz-5950MHz

Command line options:
ANT –get_psensor_tx_limits

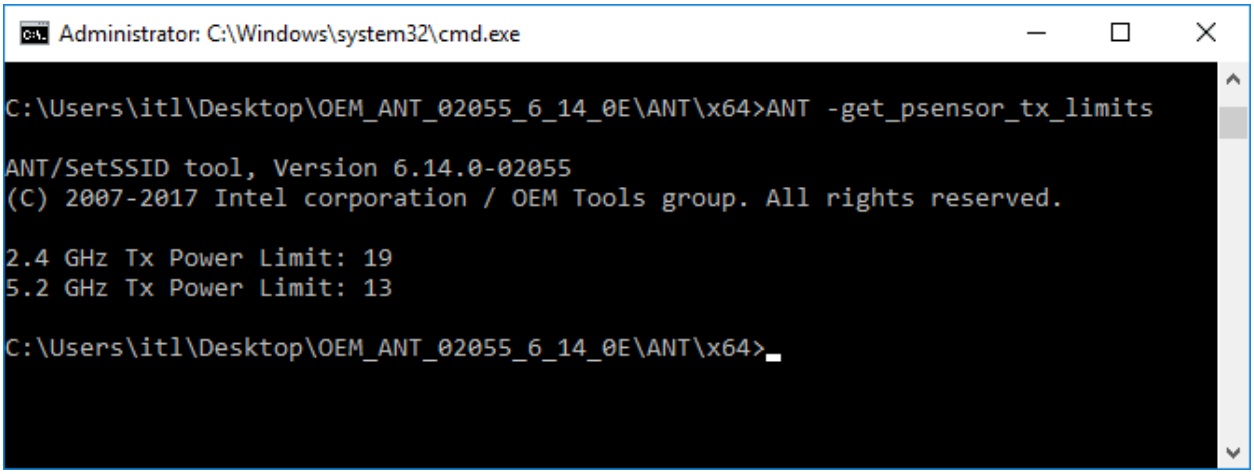

Figure 21: pSensor Tx limits “WMI” or “HID” sensor

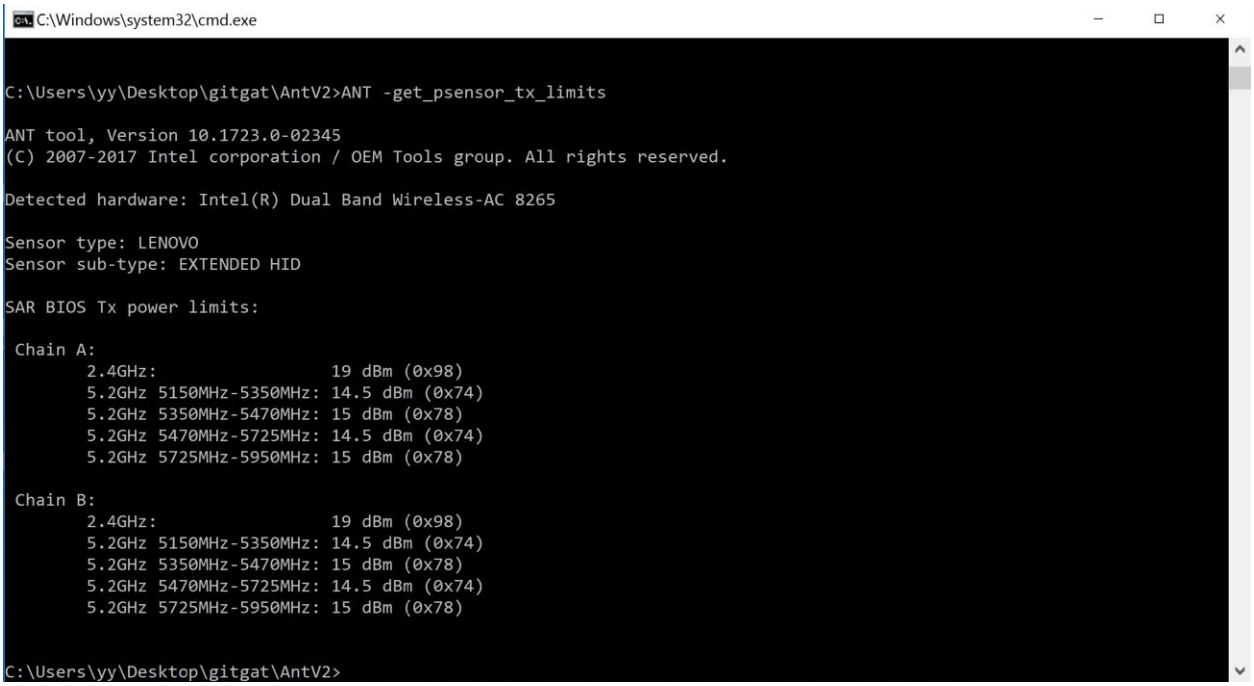

Figure 22: pSensor Tx limits “EXTENDED HID” sensor

7.19 Get BIOS SAR Table

Showing the following information for Chain A\B:

- 2.4GHz
- 5.2GHz 5150MHz-5350MHz
- 5.2GHz 5350MHz-5470MHz
- 5.2GHz 5470MHz-5725MHz
- 5.2GHz 5725MHz-5950MHz

Command line options:
ANT –get_bios_sar_table

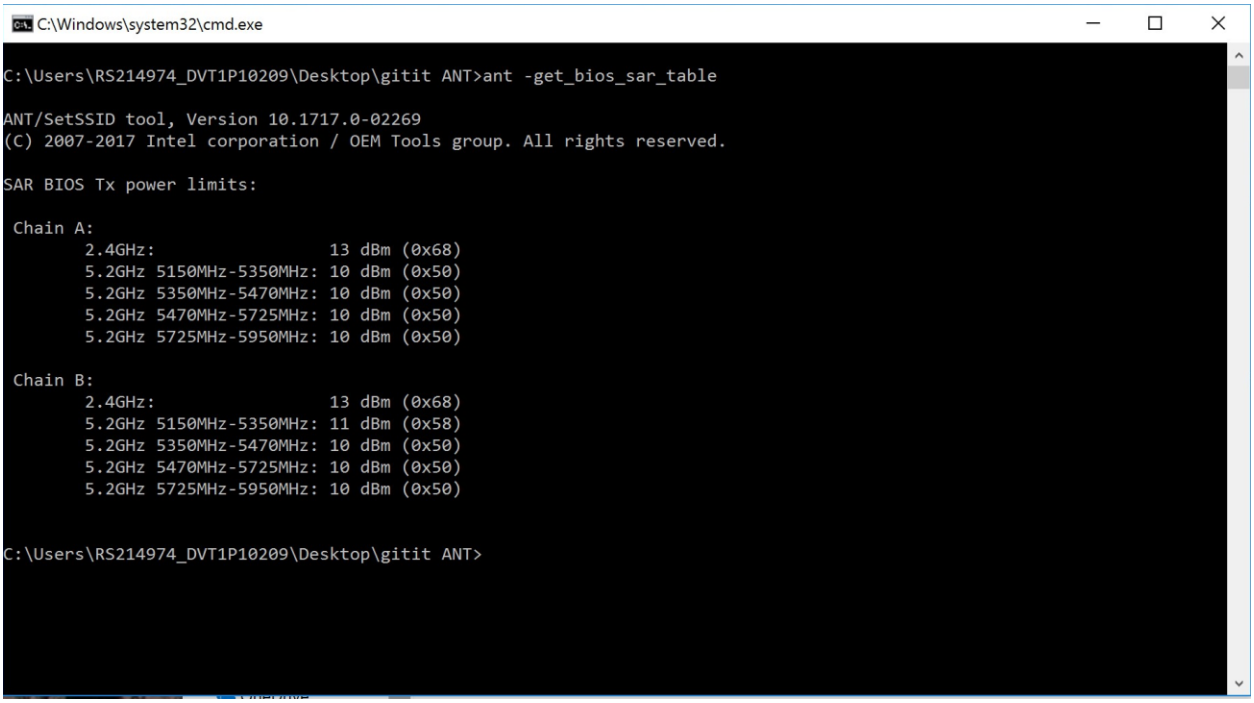

Figure 23: BIOS SAR table

7.20 Get Generic pSensor Tx Limits

Showing the following information:

- Sensor type (Generic or Lenovo).
- Sensor sub type (WMI, HID, EXTENDED HID…)
- Chain A/B SAR table in use.
- For Chain A\B:
    - 2.4GHz
    - 5.2GHz 5150MHz-5350MHz
    - 5.2GHz 5350MHz-5470MHz
    - 5.2GHz 5470MHz-5725MHz
    - 5.2GHz 5725MHz-5950MHz

Command line options:

ANT –get_psensor_full_tx_limits

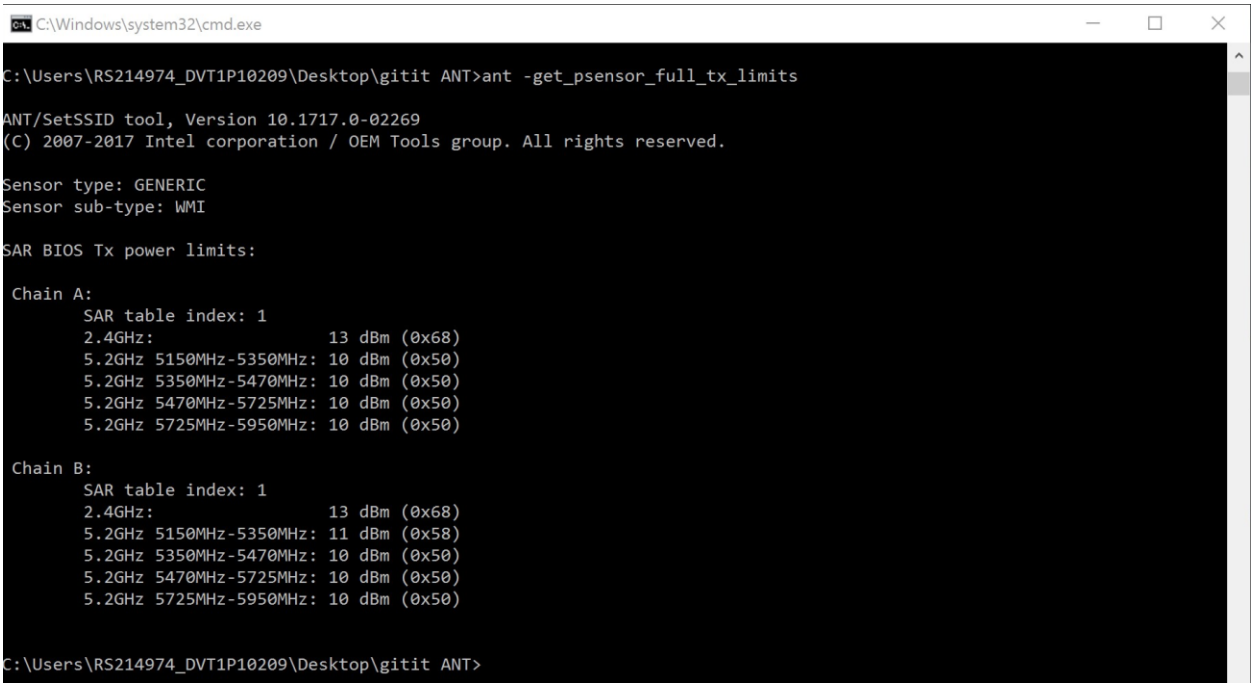

Figure 24: Generic pSensor Tx Limits

7.21 Get Tx Power Delta Limits

Showing the following information:

- GEO table Index.
- Per each band, Tx power delta:
  - Max power
  - Chain A
  - Chain B

Command line options:
ANT –get_tx_power_delta_limits

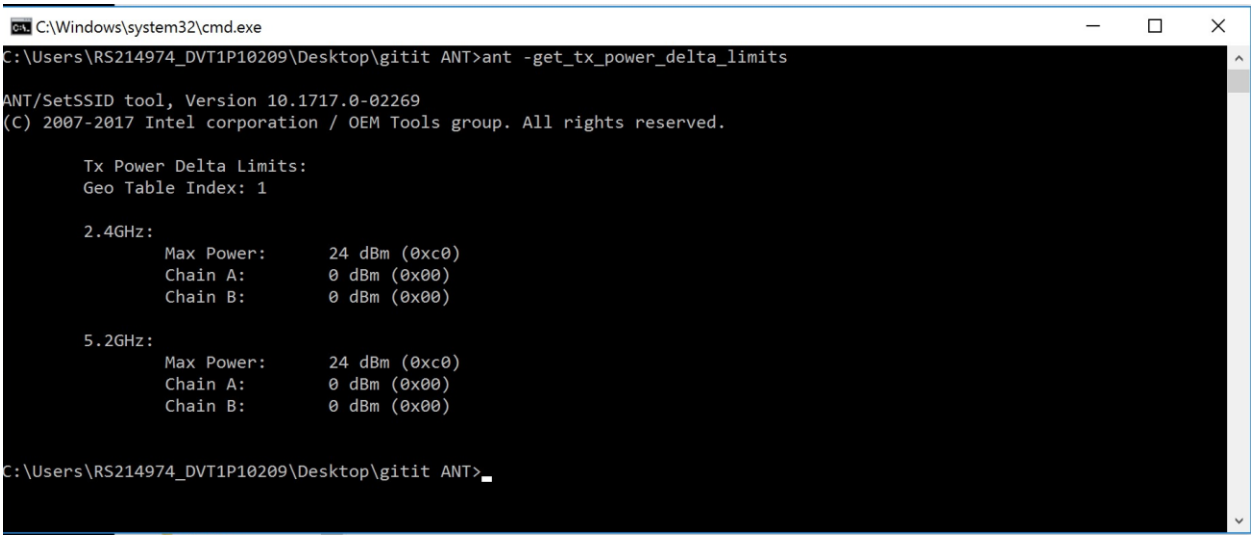

Figure 25: Tx Power Delta Limits

7.22 Get BIOS SPLC value

Shows the BIOS SPLC value.

Command line options:

ANT –get_bios_splc

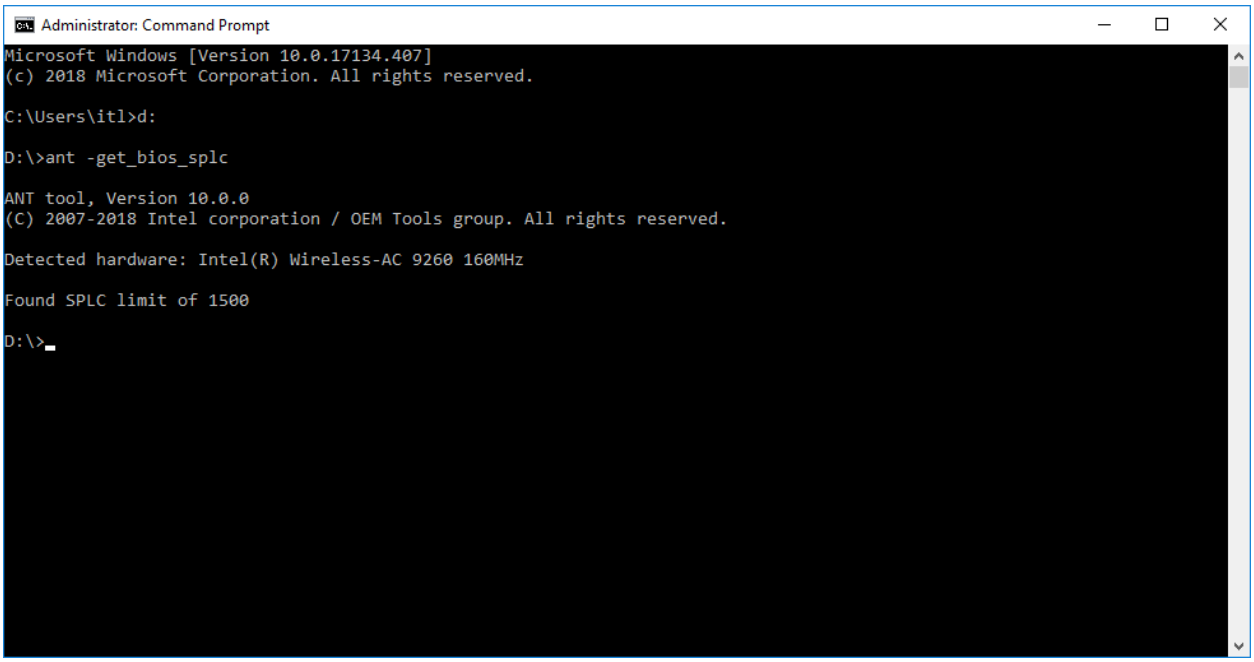

Figure 26: Tx BIOS SPLC value

7.23 Get BT BIOS SAR table

Shows the BT SAR values, as read by BT driver.

Command line options:

ANT -get_bt_bios_sar_table

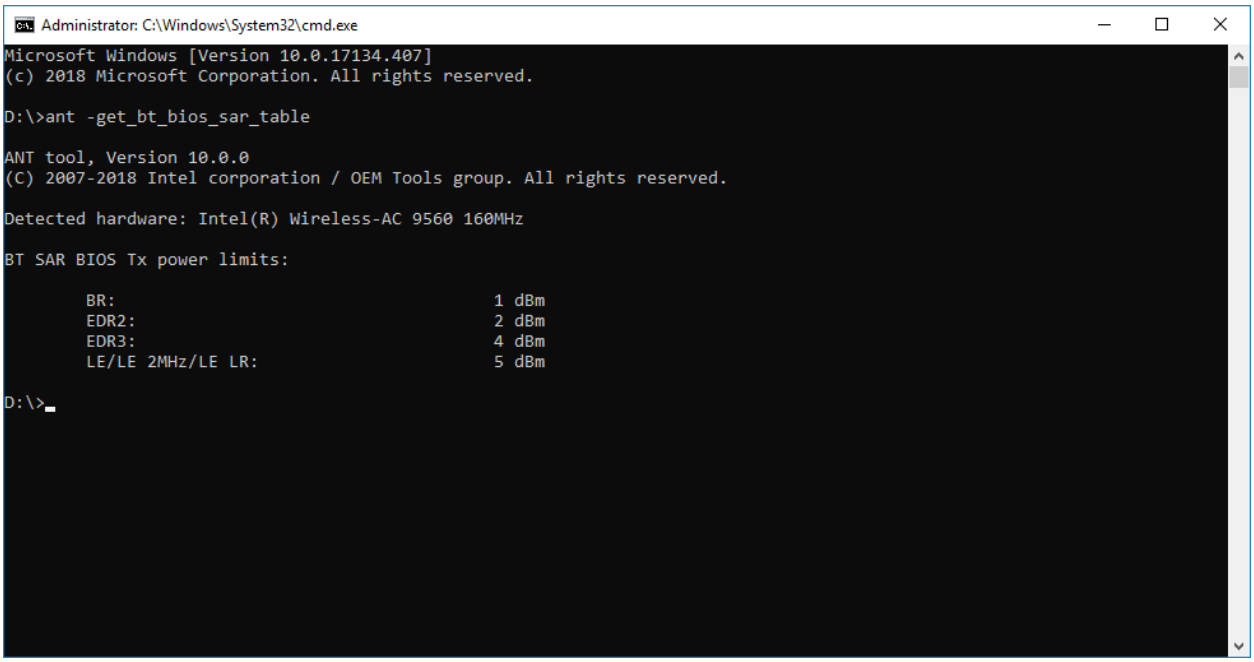

Figure 27: BT BIOS SAR table

- Low energy will display the minimum value between LE, LE 2MHz and LE LR.
- In case BT SAR is disabled in BIOS, OTP power values will be displayed

Command Line Interface

ANT supports command line interface through a console application.

7.24 Command Line Syntax

ANT.exe [-option1 <parameter1>] [-option2 <parameter2>] [-option3 <parameter3>] […]

For example: ANT –network ssid_name –ant_all

7.25 Options and Parameters

For RSSI test it is mandatory to define "-network <ssid>" parameter in order to specifies the AP to associate with.
For setting MCC it is mandatory to define "-SetMcc <mcc>" parameter.

The list below includes all the options and possible values supported by ANT.

Command line option	Allowed parameter values	Example/comments
-? | /? | -h |--help		Displays help
-network	<SSID>	Specifies the AP to associate with
-bssid	<BSSID>	Specifies the AP MAC address to associate with (Format XX-XX-XX-XX-XX-XX). ANT will look for APs with SSID specified by "-network" and between these will look for an AP with the given BSSID.
-password	<pass>	Defines the network security key (AP's password).
-band	<a|b|g>	Defines the desired band. NOTE: using the "-band" flag affects the scanning bands and may cause the third part applications not see all available stations around. In order to avoid this, use "ant –reset_driver" after finishing the tests.
-antd		Enables antenna diversity for all antennas
-ant1		Performs RSSI test on ant 1/A
-ant2		Performs RSSI test on ant 1/B
-ant_all		Performs RSSI test on all available antennas
-enable_11n		enable 11n mode

-disable_11n		disable 11n mode
-i	<1…100> Default value is 1	Defines the number of RSSI tests to run
-th	<10…200> Default value is 45	Defines the RSSI threshold value to use in the test. NOTE: Use a positive value eg.43, program will multiply by -1 result eg.-43)
-th_high	<0…200> Default value is 0	Defines the maximum RSSI threshold value to use in the test.
-deltaab	<0…200>	Defines delta threshold for delta test between A and B antennas
-rssi_loops	<1…100> Default value is 10	Defines the number of RSSI samples per test.
-stay_assoc		Cancels the disassociation process at the end of the ANT process.
-falloff	Default value is 3	Sets fall off parameter of waiting for stable RSSI. This is the weight ratio of accumulated RSSI compared to weight of current RSSI when waiting for a stable RSSI.
-stable_rssi_threshold	Default value is 1	Sets threshold for the diff between current RSSI and average RSSI when waiting for stable RSSI.
-delay	Default value is 1 msec	Sets delay, in msec between changing band/diversity/11n mode parameters and starting association.
-enable_driver		Enables the Intel® Wi-Fi driver
-disable_driver		Disables the Intel® Wi-Fi driver
-reset_driver		Resets the Intel® Wi-Fi driver
-enable_bt_driver		Enables the Bluetooth driver
-disable_bt_driver		Disables the Bluetooth driver
-get_rf_kill		Returns the status of HW RF-Kill
-xml	<o|a>	Extracts test output to xml file (supports only RSSI tests). A – Appends to an existing XML. O – Overwrite an existing XML (or creating new XML if not existing).
-OutputXMLFile	<filename> Default file name “AntennaAppSummary.xml”	Sets output XML file to be used by “-xml”.
-d | -debug	<append|overwrite>	Output logs to ‘antToolLog.log’. Overwrite will delete all file content
-log	<filename>	Extract significant values to file.
-BT		Measures BT RSSI from air
-SetMcc	<mcc>	Sets the requested mcc for 2 hours

		Example: ANT –SetMcc US
-QueryMcc		Returns the current MCC, MCC source and If the source is from MCC API
-wev_off		Disables MCC events.
-msg_box_off		Disables MCC popups messages.
-aggressive		Sends association requests once every 2 seconds until association succeeds or time out expires.
-get_hw_ver		Gets HW version. Supported only for WP device!
-compare_hw_ver	<HW_VERSION_COMPARING_WITH>	Compares HW version. Supported only for WP device! Example: ANT –compare_hw_ver 1.1.40
-get_deviceid		Gets device ID
-get_subsystemid		Gets subsystem ID
-get_nvmimage		Gets NVM image version
-get_oemversion		Gets OTP OEM version
-get_device_data		Gets device data
-get_pcirevid		Gets PCI revision ID
-get_psensor_tx_limits		Gets Lenovo pSensor Tx Limits. Returns 2.4 and 5.2 GHz Tx Power Limit in case of WMI or HID sensor. Returns TX limit values for Chain A and B: • 2.4GHz • 5.2GHz 5150MHz-5350MHz • 5.2GHz 5350MHz-5470MHz • 5.2GHz 5470MHz-5725MHz • 5. 5.2GHz 5725MHz-5950MHz In case of EXTENDED HID sensor.
-get_psensor_full_tx_limits		Gets Generic pSensor Tx Limits. Returns the Index of chain A/B SAR table in use and TX limit values for Chain A and B: • 2.4GHz • 5.2GHz 5150MHz-5350MHz • 5.2GHz 5350MHz-5470MHz • 5.2GHz 5470MHz-5725MHz • 5. 5.2GHz 5725MHz-5950MHz
-get_bios_sar_table		Gets BIOS SAR Table.

		Returns table for chain A and B: • 2.4GHz • 5.2GHz 5150MHz-5350MHz • 5.2GHz 5350MHz-5470MHz • 5.2GHz 5470MHz-5725MHz • 5. 5.2GHz 5725MHz-5950MHz
-get_tx_power_delta_limits		Gets Tx Power Delta Limits. Returns the index of the table in use and per each band, Tx power delta: • Max power • Chain A • Chain B
-old_ant_map		ANT was updated to detect HW type and note the relevant antenna port labeling. This option will use the legacy report data and format
-wifi_on		Enables Wi-Fi radio (Set radio state to true)
-ant_isolation		Shows the physical isolation between two antennas when Wi-Fi is associated to AP (2.4GHz only) and BT is active. Antenna isolation value is in dB.
-scan		Single channel scan mode.
-channel	< active channel number >	The scan is active only, thus only active channels are supported. Acceptable channels: 1-11, 36, 40, 44, 48, 149, 153, 157, 161 and 165
-interval	<time in ms>	Time interval of every iteration in millisecond (ΔT –time between scans). Allowed values: 0, 200, 400, 600, 800 and 1000. Default is `200ms`.

8. Error codes and return values

Error code #	Error description
0	Test passed
1	Test failed
2	Association failed
3	No appropriate installed driver was found
4	HW RF-Kill is enabled
5	HW RF-Kill is disabled
6	Bluetooth not supported
7	Hardware version not supported
8	MCC invalid time
9	MCC FW denial
10	MCC already set
11	Failed to enable Bluetooth driver
12	Failed to disable Bluetooth driver
13	No relevant BIOS table exist
14	FW was not configured with SAR BIOS settings
15	No sensor exist
16	Sensor type not supported
256	Invalid command line
257	Hardware initialization error
258	General error

9. Appendix

9.1 Acronyms

Acronym	Description
AP	Access Point
RSSI	Received Signal Strength Indicator
CLI	Command Line Interface
MCC	Mobile Country Code

9.2 Figures table