

# **NRC7292 Evaluation Kit**

## **User Guide**

### **(CLI Application)**

**Ultra-low power & Long-range Wi-Fi**

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**NEWRACOM, Inc.**

## **NRC7292 Evaluation Kit User Guide (CLI Application)**

### **Ultra-low power & Long-range Wi-Fi**

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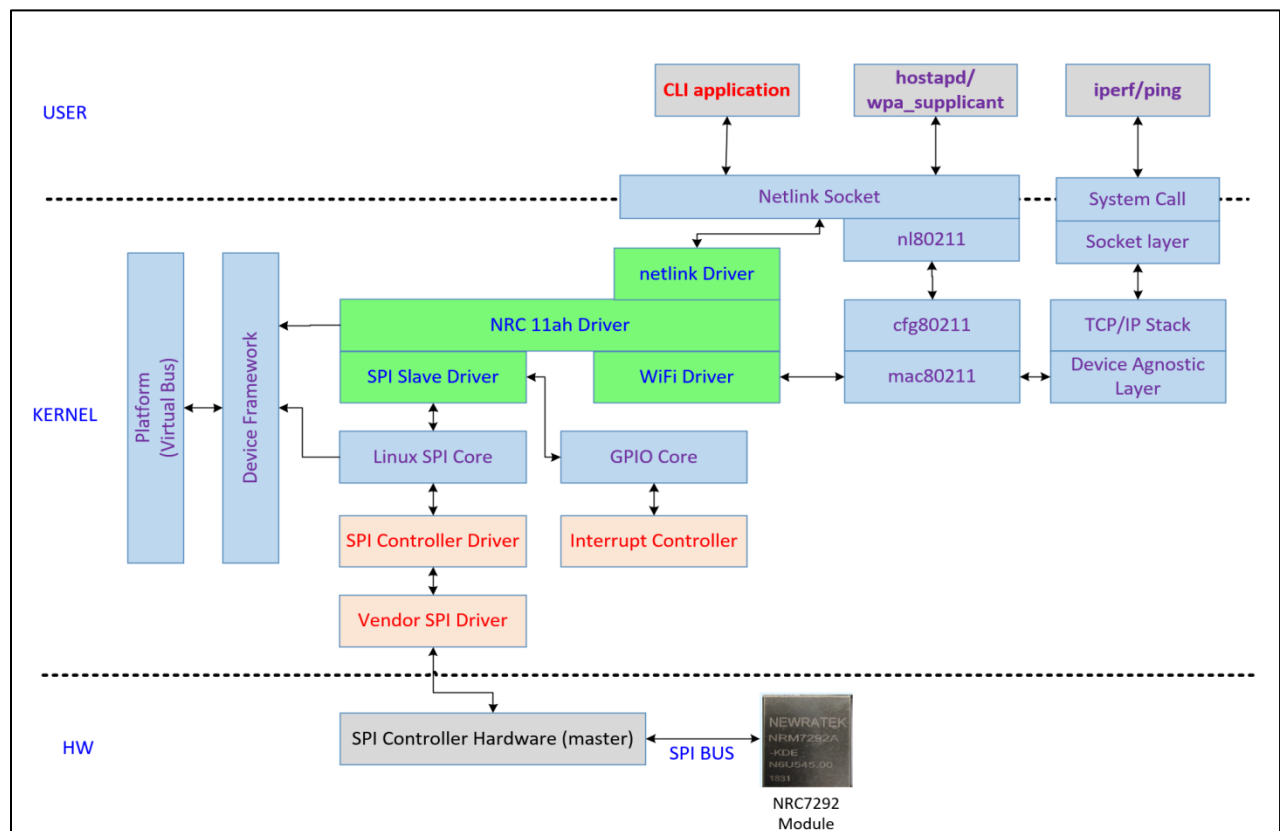
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# 1 Overview

This document introduces NRC7292 command line interface (CLI) application. The user can utilize the CLI application to check basic information for firmware, monitor channel quality; such as: received signal strength indicator (RSSI), signal to noise ratio (SNR), adjust transmit power, and configure NRC7292 to run in specific operating condition. The source code of this application is offered to user's so users can build an executable file suitable for the host.

## 1.1 Software structure of CLI application

As shown in Figure 1.1, the CLI application is a user-level application program. The CLI application uses Netlink library to communicate with NRC 11ah driver running on a Linux kernel. The CLI command initiated by the user and goes to the NRC 11ah driver and then to NRC7292 via host serial peripheral interface (HSPI).



**Figure 1.1 Software structure of CLI application**

## 1.2 Build CLI application

A user can build the source code of CLI application with Makefile which is provided along with the source code. Once the user successfully builds it, the user can find "cli\_app" executable file in the same directory where the user runs Makefile.

```
pi@raspberrypi:~/cli_app $ make clean;make
libcli_app.a
cli_app
pi@raspberrypi:~/cli_app $
```

Figure 1.2 Build CLI application

## 1.3 Start CLI application

"NRC>" prompt appears if a user executes "cli\_app", then the user can enter in a CLI command into the prompt.

```
pi@raspberrypi:~/nrc_pkg/script $ ./cli_app
=====
Newracom Command Line Application (2.10.1)
=====
NRC> █
```

Figure 1.3 Execution of CLI application



“help” is a useful command which displays all the CLI commands with its usages as shown in Figure 1.4.

```

NRC> help
=====
help
write <address> <data>
exit
show version
show config [vif_id]
show edca
show uinfo [vif_id]
show ampdu | show ampdu clear
show signal {start|stop} [interval] [number]
show maxagg
show duty
show autotxgain
show cal_use
show recovery stats
show detection stats
show temp
show wakeup_pin
show wakeup_source
show sta [vif_id] {all|aid [aid_index]}
show tx_time
show cca_thresh
show stats simple_rx
show mac clear
show mac tx stats
show mac tx clear
show mac rx stats
show mac rx clear
set gi {short|long|auto}
set maxagg {AC(0-3)} <Max(0-8(1Mhz),0-16(2,4Mhz),0:off)> {size:default=0}
set config {ack(0,1)} {agg(0,1)} [mcs]
set rc {on|off} [vif_id] [mode]
set duty {on|off} {duty window} {tx duration} {duty margin}
set cal_use {on|off}
set txpwr {value(1~30)}
set wakeup_pin {Debounce(on|off)} {PIN Number(0~31)}
set wakeup_source rtc gpio hspi
set addba [tid] {mac address}
set delba [tid] {mac address}
set rts {on|off|default} <threshold> <vif_id>
set tx_time <CS time> <Blank time>
set drop [vif id] [mac address] {on|off}
set tsensor [GPIO for SCL] [GPIO for SDA]
set self_config {Country(KR,US...)}{BW}{dwell time}
set cca_thresh {CCA threshold(unit:dBm, -100~-70)}
test mcs [mcs index]
gpio read [pin number]
gpio write [pin number] [0|1]
gpio direction [pin index] {[0(input)|1(output)]}
gpio pullup [pin index] {[0(off)|1(on)]}
=====
:show CLI tree
:write a 32-bit value to memory
:exit program
:show version
:show configuration
:show EDCA parameters
:show UMAC information
:show/clear AMPDU count
:show rssi/snr, {options} are only valid in cli_app prompt
:show max aggregation
:show duty cycle
:show autotxgain
:show cal_use
:show recovery
:show detection
:show temp
:show wakeup pin configuration
:show wakeup source configuration
:show station information
:show tx time about <CS time> <Blank time>
:show cca_thresh(unit: dBm)
:show received packet information
:clear TX/RX Statistics
:show TX Statistics
:clear TX Statistics
:show RX Statistics
:clear RX Statistics
:set guard interval
:set aggregation
:set ack, aggregation, mcs
:set rate control
:set duty cycle
:set cal_use
:set txpwr
:set wakeup pin for deepsleep
:set wakeup source for deepsleep
:set addba tid / send addba with mac address
:set delba tid / send delba with mac address
:set rts on/off
:set tx_time about <CS time> <Blank time>
:set drop frames from configured mac address
:set temperature sensor scl, sda
:set self_config
:set cca threshold
:set mcs
:gpio read
:gpio write
:read/write gpio direction
:read/write gpio pullup enable|disable
=====
OK

```

Figure 1.4 “help” CLI command

To stop the CLI application, a user can use “exit” command.

```

NRC> exit
=====
Exit Newracom Command Line Application
=====
pi@raspberrypi:~/nrc_pkg/script $

```

Figure 1.5 Exit of CLI application

## 2 CLI Commands

The categories of CLI commands is described in the below. The user can use the phy, set, and test CLI commands only for test purposes.

**Table 2.1 Category of CLI commands**

Category	Description
show	display statistics, status, signal, etc.
set	set MAC-layer parameters
test	set test parameters
write	Write a 32-bit value to memory
gpio	write/read gpio, set gpio dirction & pullup

### 2.1 show

#### 2.1.1 show version

Display Firmware version, gerrit/master number and board revision

**Parameters**

N/A

#### 2.1.2 show config [vif\_id]

Display device configurations including device mode, MAC address, frequency, bandwidth, etc.

**Parameters**

vif\_id : interface ID (default 0, vif\_id can be 0 or 1 when the concurrent mode is enabled)

#### 2.1.3 show edca

Display EDCA parameters per access category (AC)

**Parameters**

N/A

#### 2.1.4 show uinfo [vif\_id]

Display 11ah capability information

**Parameters**

vif\_id : interface ID (default 0, vif\_id can be 0 or 1 when the concurrent mode is enabled)

### 2.1.5 show ampdu [clear]

Display statistics for aggregated MPDU (AMPDU)

#### Parameters

clear : clear all statistics

### 2.1.6 show sta <vif id> <all|aid <aid index>>

Display station information

#### Parameters

vif id : virtual interface identification

all | aid <aid index> : 'all' shows information of whole connected stations. 'aid <aid index>' shows information of the specified station.

### 2.1.7 show signal [start|stop] [interval] [number]

Display channel quality information (RSSI and SNR)

#### Parameters

start : start periodic display with interval (Ex. show signal start 1: display RSSI & SNR every 1 second)

stop : stop displaying

interval : period in second unit (default 1 second)

number : number of samples to display

#### Returns

```
NRC> show signal
MAC addr : 8c:0f:fa:00:2b:0e    rssi    : 9          snr    : 25
OK
```

Total : total number of samples displayed

average : average value of RSSI and SNR

std\_dev : standard deviation

```
NRC> show signal start
OK
NRC> Mac Addr : 8c:0f:fa:00:2b:0e      rssi: 9      snr: 26

Mac Addr : 8c:0f:fa:00:2b:0e      rssi: 9      snr: 26
Mac Addr : 8c:0f:fa:00:2b:0e      rssi: 9      snr: 26
Mac Addr : 8c:0f:fa:00:2b:0e      rssi: 9      snr: 26

show signal stop
-----
[MAC Addr]: 8c:0f:fa:00:2b:0e
[Total]   : 23
[RSSI]
  average : 1.565
  std_dev : 3.411
[SNR]
  average : 4.522
  std_dev : 9.855
-----
OK
```

### 2.1.8 show maxagg

Display aggregation status per AC

#### Parameters

N/A

```
NRC> show maxagg
[STA AID: 1]
AC_BK: OFF (16, 0 bytes), BA session: NO
AC_BE: OFF (16, 0 bytes), BA session: YES
AC_VI: OFF (16, 0 bytes), BA session: NO
AC_VO: OFF (16, 0 bytes), BA session: YES
OK
```

### 2.1.9 show duty

Show status of duty cycle function

If it is on, it shows duty window, tx duration, and remain tx duration time in usec

※ This command only could be applied for Japan promotion council.

#### Parameters

N/A

#### Returns

Duty cycle : off

or

Duty cycle : on

Duty window : 60000000

Tx duration : 5000000

Remain tx duration : 5000000

### 2.1.10 show autotxgain

Show status of autotxgain function

If it is on, it shows Tx power index for each MCS

#### Parameters

N/A

Auto txgain : off

or

Auto txgain : on

Tx power index for MCS 0 : 22

Tx power index for MCS 1 : 21

Tx power index for MCS 2 : 20

Tx power index for MCS 3 : 19

Tx power index for MCS 4 : 19

Tx power index for MCS 5 : 18

Tx power index for MCS 6 : 17

Tx power index for MCS 7 : 16

Tx power index for MCS 10 : 23

### 2.1.11 show cal\_use

Display RF calibration usage status

#### Parameters

N/A

### 2.1.12 show cca\_thresh

Display CCA threshold value

#### Parameters

N/A

```
NRC> show cca_thresh
-70
OK
```

### 2.1.13 show recovery stats

The count statistics of recovery function entered

#### Parameters

N/A

### 2.1.14 show detection stats

The count statistics of detection function entered, which are tx triggered

#### Parameters

N/A

### 2.1.15 show temp

The temperature of temperature sensor. If temperature sensor is not existed, it displays 'Not Support'.

#### Parameters

N/A

```
NRC> show temp
Temperature           : 0x21(33)
OK
```

### 2.1.16 show tx\_time

Show tx\_time parameters.

#### Parameters

N/A

```
NRC> show tx_time
CS time               : 988
TX delay              : 100
OK
```

### 2.1.17 show wakeup\_pin

Get configuration of wakeup gpio pin from deep sleep mode

#### Parameters

N/A

```
NRC> show wakeup_pin
Debounce : off          Pin number : 11
OK
```

### 2.1.18 show wakeup\_source

Get configuration of wakeup source from deep sleep mode

#### Parameters

N/A

```
NRC> show wakeup_source
Wakeup source          : RTC GPIO HSPI
OK
```

### 2.1.19 show stats simple\_rx

Display received packet information

#### Parameters

N/A

#### Returns

RSSI : received signal strength indication

CS\_Cnt : number of carrier sense counted

PSDU\_Succ : number of PSDU count successfully received (SIG CRC OK)

MPDU\_Rcv : number of MPDU count received

MPDU\_Succ : number of MPDU count successfully received (FCS OK)

SNR : signal to noise ratio

**※ The PSDU\_Succ counts NDP packets. However, the MPDU\_Rcv does not count NDP packet. In addition, The PSDU\_Succ regards A-MPDU packet as 1 packet.**

```
NRC> show stats simple_rx
-----
RSSI                : -27
CS_Cnt              : 595182
PSDU_Succ           : 2603
MPDU_Rcv            : 1134
MPDU_Succ           : 1046
SNR                 : 31
-----
OK
```



### 2.1.20 show mac clear

Clear MAC-layer TX and RX statistics

#### Parameters

N/A

### 2.1.21 show mac tx stats

Display MAC-layer TX statistics

#### Parameters

N/A

#### Returns

```
NRC> show mac tx stats
-----
MAC TX Statistics (OK count:24728, RTX count:259, last MCS:0)
-----
- AC[BK]      : OK(      0/      0) RTX(      0/      0)
- AC[BE]      : OK(    228/   28426) RTX(    214/   25084)
- AC[VI]      : OK(      0/      0) RTX(      0/      0)
- AC[VO]      : OK(    823/   84826) RTX(     45/   4565)
- AC[BC]      : OK(  23677/  805039) RTX(      0/      0)
- AC[GP]      : OK(      0/      0) RTX(      0/      0)
-----
- TYPE[MGMT]   : OK(    820/   83730) RTX(     45/   4565)
- TYPE[CTRL]   : OK(      0/      0) RTX(      0/      0)
- TYPE[DATA]   : OK(    231/   29522) RTX(    214/   25084)
- TYPE[BEAC]   : OK(  23678/  805066) RTX(      0/      0)
-----
- MCS[ 0]      : OK(    168/   19824) RTX(     36/   4248)
- MCS[ 1]      : OK(      0/      0) RTX(      0/      0)
- MCS[ 2]      : OK(     37/    6168) RTX(      0/      0)
- MCS[ 3]      : OK(      0/      0) RTX(      0/      0)
- MCS[ 4]      : OK(      0/      0) RTX(     59/   6962)
- MCS[ 5]      : OK(      0/      0) RTX(     55/   6490)
- MCS[ 6]      : OK(      0/      0) RTX(      4/    472)
- MCS[ 7]      : OK(      0/      0) RTX(     57/   6726)
- MCS[10]      : OK(  24525/  892353) RTX(     48/   4751)
-----
OK
```

OK (number of packets successfully transmitted / total aggregated bytes successfully transmitted)

RTX (number of packets retransmitted / total aggregated bytes retransmitted)

**✘ AC[GP] : GP stands for general purpose. This is used to send a frame which is the highest priority. This is a vendor-specific function.**

## 2.1.22 show mac rx stats

Display MAC-layer RX statistics

### Parameters

N/A

### Returns

```
NRC> show mac rx stats
-----
MAC RX Statistics (OK count:4673, NOK count:12, last MCS:10)
-----
- AC[BK]      : OK(      0/      0) NOK(      0/      0)
- AC[BE]      : OK(    3778/   5319311) NOK(     12/   16672)
- AC[VI]      : OK(      0/      0) NOK(      0/      0)
- AC[VO]      : OK(     895/   38776) NOK(      0/      0)
- AC[BC]      : OK(      0/      0) NOK(      0/      0)
- AC[GP]      : OK(      0/      0) NOK(      0/      0)
-----
- TYPE[MGMT]   : OK(     889/   38332) NOK(      0/      0)
- TYPE[CTRL]   : OK(      0/      0) NOK(      0/      0)
- TYPE[DATA]   : OK(    3784/  5319755) NOK(     12/   16672)
- TYPE[BEAC]   : OK(      0/      0) NOK(      0/      0)
-----
- MCS[ 0]     : OK(     58/   17980) NOK(      0/      0)
- MCS[ 1]     : OK(      1/    130) NOK(      0/      0)
- MCS[ 2]     : OK(     21/   31710) NOK(      0/      0)
- MCS[ 3]     : OK(      5/    6114) NOK(      0/      0)
- MCS[ 4]     : OK(     29/   43790) NOK(      0/      0)
- MCS[ 5]     : OK(     11/   12318) NOK(      1/    1510)
- MCS[ 6]     : OK(     137/  206870) NOK(      3/    4530)
- MCS[ 7]     : OK(    3488/  4997538) NOK(      7/   10570)
- MCS[10]     : OK(     923/   41637) NOK(      1/      62)
-----
OK
```

OK (number of packets successfully received / total aggregated bytes successfully received)

NOK (number of packets received but discarded / total aggregated bytes discarded)

**※ NOK : Even though the MPDU is successfully received, it can be discarded due to duplication or address mismatch.**

**2.1.23 show mac tx clear**

Clear MAC-layer TX statistics

**Parameters**

N/A

**2.1.24 show mac rx clear**

Clear MAC-layer RX statistics

**Parameters**

N/A

## 2.2 set

### 2.2.1 set gi <short|long|auto>

Set Guard Interval

#### Parameters

short : Short Guard Interval

long : Long Guard Interval (default)

auto : Change the guard interval from long to short automatically in MCS7

### 2.2.2 set maxagg <ac> <maxagg> {options}

Set maximum number of MPDU of AC in AMPDU

(AP)

```
set maxagg ac maxagg           // set maxagg for all-sta
```

```
set maxagg ac maxagg maxsize   // set maxagg and maxsize for all-sta
```

```
set maxagg ac maxagg vif aid   // set maxagg for specifi aid
```

(STA)

```
set maxagg ac maxagg           //set maxagg
```

```
set maxagg ac maxagg maxsize   //set maxagg and maxsize
```

#### Parameters

ac : access category

maxagg : number of MPDU in AMPDU (0-8(1Mhz), 0-16(2,4Mhz), 0: off)

maxsize: aggregation threshold size (default : 0)

vif : virtue interface identification

aid: association identification

### 2.2.3 set config <ack> <agg> <mcs>

Set MAC-layer configuration

#### Parameters

ack : ack mode (0: no ack, 1: ndp ack, 2: normal ack) (default: ndp ack)

agg : aggregation (AMPDU) (0: off, 1:on)

mcs: 0~7, 10 (10 can be used only in 1MHz bandwidth)

### 2.2.4 set rc <on|off> [vif\_id]

rate control on / off

#### Parameters

on : enable rate control (automatic selection of MCS based on the link condition) (default)

off : disable rate control (user can select MCS manually by using “test mcs” command)

### 2.2.5 set duty <on|off> {duty window in usec} {tx duration in usec} {exclude mgmt}

Set duty cycle

#### Parameters

on|off : enable|disable duty cycle function (default; off)

duty window : specify duty cycle window in usec. (default: 60 sec)

tx duration : specify allowed tx duration within duty cycle window in usec. (default: 5 sec)

exclude mgmt : 0 (MGMT Frame not sent after duty cycle) or 1 (MGMT Frame sent after duty cycle)

*(ex) duty window 10000000 (10sec) and tx duration 1000000 (1sec) will be set to access the channel 1 second during every 10 seconds.*

※ This command only could be applied for japan.

### 2.2.6 set cal\_use <on|off>

Set RF calibration usage on|off, if available RF calibration is existed.

#### Parameters

on|off : enable|disable RF calibration usage

### 2.2.7 set cca\_thresh <value>

set CCA threshold value

#### Parameters

value: CCA threshold value

```
NRC> set cca_thresh -70
-70
OK
```

### 2.2.8 set txpwr <value>

Set tx power

#### Parameters

value: 1~20

**※ This command only could be applied when autotxgain is off.**

### 2.2.9 set wakeup\_pin <debounce> <pin index>

Configure a wakeup-gpio-pin when system state is uCode or deepsleep

#### Parameters

debounce : on|off

pin index : 0~31

### 2.2.10 set wakeup\_source <wakeup\_sources>

Configure wakeup sources when system state is deepsleep.

#### Parameters

wakeup\_sources : rtc gpio hspi

※ It is possible to assign multiple sources (ex) set wakeup\_source rtc gpio

### 2.2.11 set addba [tid] {mac address}

set addba tid / send addba with mac address

#### Parameters

tid: Traffic Identifier

mac address : mac address

### 2.2.12 set delba [tid] {mac address}

set delba tid / send delba with mac address

#### Parameters

tid: Traffic Identifier

mac address : mac address

### 2.2.13 set rts <on|off|default> <threshold> <vif\_id>

Enable/disable RTS, set RTS threshold

**Parameters**

threshold : RTS & CTS threshold in Byte

vif\_id : virtue interface identification

Ex1) send RTS regardless of packet length (set rts on 0 0)

Ex2) no use of RTS (set rts off 0 0)

Ex3) set RTS threshold (set rts default 1000 0)

**2.2.14 set tx\_time <CS time> <Blank time>**

set tx\_time about <CS time> <Blank time>

**Parameters**

CS time: Carrier sensing time. Listen before talk (in us)

Blank time: Tx pause time (in us)

**2.2.15 set drop [vif id] [mac address] {on|off}**

set drop frames from configured mac address

**Parameters**

vif\_id : virtue interface identification

mac address: drop frames from mac address

on|off: Enable disable drop mac address

**2.2.16 set tsensor [GPIO for SCL] [GPIO for SDA]**

set temperature sensor scl, sda

**Parameters**

SCL: GPIO for SCL (default 31)

SDA: GPIO for SDL (default 30)



### 2.2.17 set self\_config <Country> <BW> <dwel time>

set self\_config

#### Parameters

Country : Country Code. KR, US, EU.....

BW: scan channel bandwidth (1M, 2M, 4M)

dwel time: scan time for CCA (10 ~ 1000 ms)

## 2.3 test

### 2.3.1 test mcs <value>

Set MCS

#### Parameters

value : 0~7, 10 (10 can be used only in 1MHz bandwidth)

## 2.4 gpio

The GPIO CLI commands listed below can be used to configure GPIO options to read from and write to GPIO pins. Note that GPIO command usage is valid for non-dedicated GPIO pins only. Refer to the NRC7292 Technical Reference Manual for the list of dedicated GPIO pins.

### 2.4.1 gpio read <pin index>

Read the value (0: low / 1: high) from a GPIO pin.

#### Parameters

pin index: GPIO pin index

### 2.4.2 gpio write <pin index> <value>

Write a value (0: low / 1: high) to a GPIO pin.

#### Parameters

pin index: GPIO pin index

value: 0: low / 1: high

### 2.4.3 gpio direction <pin index> [direction]

Get or set the direction (0: input / 1: output) of a GPIO pin.

#### Parameters

pin index: GPIO pin index

(For set command only) direction: 0: input / 1: output

### 2.4.4 gpio pullup <pin index> [pull-up option]

Get or set the pull-up option (0: disable / 1: enable) for a GPIO pin.

#### Parameters

pin index: GPIO pin index

(For set command only) pull-up option: 0: disable / 1: enable

### 3 Revision History

Revision No	Date	Comments
Ver 1.0	02/26/2019	Initial version for customer release created
Ver 1.1	03/25/2019	Add CLI commands (2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 0, 0, 0, 0, 2.1.24, 2.1.20, 2.2.1, 2.2.2) Removed CLI commands ("show rx <start   stop> <duration>", "phy txpower <value>")
Ver 1.2	10/03/2019	CLI commands description updated
Ver 1.3	11/01/2019	Add set duty, show duty, set autotxgain, show autotxgain commands
Ver 1.4	11/18/2019	Add response example about show 28signal start/stop
Ver 1.5	12/05/2019	Add response example about set cal_use & show cal_use
Ver 1.6	12/13/2019	Add 'auto' option for "set gi <short long auto>" command
Ver 1.7	12/19/2019	Add "test recovery <interval> <count>", "show recovery stats", "show detection stats" command Add parameter for "set maxagg {ac} {maxagg} {size(optional, 0: default)}" and "set txpwr [val]"
Ver 1.8	12/27/2019	Add 'test assert' option for recovery testing
Ver 1.9	01/17/2020	Add gpio, gprf commands
Ver 1.10	04/13/2020	Remove a 'set autotxgain' command
Ver 1.11	04/22/2020	Add 'show temp'
Ver 1.12	05/30/2020	Add 'set/show wakeup_pin', 'set/show wakeup_source'
Ver 1.13	08/03/2020	Add 'set/show bdf_use', 'test ucode'
Ver 1.14	03/10/2021	2.2.21 set rst and 2.3.5 test country jp commands added
Ver 1.15	04/13/2021	Remove gpio/gprf, test recovery/ucode/assert
Ver 1.16	10/19/2021	Add gpio command Update maxagg command
Ver 1.17	12/10/2021	Update maxagg paramter range
Ver 1.18	12/10/2021	set txpwr value range
Ver 1.19	05/20/2022	Remove "read", "show bdf_use", "set bdf_use", "test country jp" Add "write", "show sta", "show tx_time", "show cca_thresh", "set cca_thresh"