NRC7292 SW PKG Release Note

(v1.3.4_rev01)

Ultra-low power & Long-range Wi-Fi

Ver 1.0
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NEWRACOM, Inc.

NRC7292 SW PKG Release Note (v1.3.4_rev01)
Ultra-low power & Long-range Wi-Fi

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1 Overview

Newracom's NRC7292 is world's first IEEE 802.11ah solution in the market. The IEEE 802.11ah is the new Wi-Fi standard targeting at various IoT applications. NRC7292 offers three different modes, host, standalone, and AT command mode. The host mode needs external host like a Raspberry Pi3 used in Newracom's EVK. In this mode, NRC7292 offers 11ah Wi-Fi connectivity. Unlike a host mode, users can write their applications with APIs provided along with a standalone package and build its binary with SDK and runs on NRC7292. By using various peripheral interfaces in NRC7292, users can read sensor data and send it to the server through 11ah network. NRC7292 also provides AT commands. Users can use the AT commands to utilize the 11ah Wi-Fi.

This document describes the NRC7292 software package release version 1.3.3 for the host mode.

2 Contents of software release package

The software release package contains all the necessary components including the firmware binaries, source codes, scripts, and documents to make use of the latest features. Figure 2.1 and Table 2.1 show the directory structure and contents of the package, respectively. 'host_kr_mic' package supports 925.5Mhz – 929.0Mhz channel in KR. Please reference 'UG-7292-003-S1G_Channel.docx'

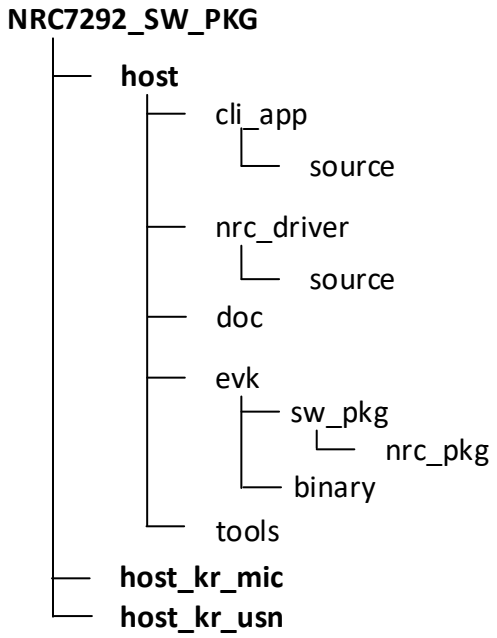

Figure 2.1 NRC7292 software release package directory

Table 2.1 Contents of NRC7292 software release package

Directory	Description
host/cli_app	cli_app is a C-based application program user can use CLI commands on Raspberry PI3 by using this app application document and source code are included so user can build and apply it to their host platform
host/nrc_driver	nrc_driver is Linux driver for NRC7292 source code is included so user can modify the source code for their own host platform
host/evk/sw_pkg	this directory contains user guide document and software package nrc_pkg is for 11ah. all the scripts, driver and firmware for host-mode EVK are included in the package
host/evk/binary	this directory contains firmware, driver and cli_app
host/doc	document files
host/tools	tools

The information of the binaries released in this package is as follows.

- Firmware
  - Name : nrc7292_cspi.bin
  - Location : host/evk/binary
  - Version : 1.3.4_rev01
  - Build date : Dec. 20, 2021
- Linux driver
  - Name : nrc.ko
  - Location : host/evk/binary
  - Version : 4.14.70 (Linux Kernel Version)
  - Build date : Dec. 20, 2021
- CLI application
  - Version : 2.7
  - Location : host/evk/binary
  - Build date : Dec. 20, 2021

3 SW Release Package

3.1 Features in version 1.3.4

Followings are features included in NRC7292 software release.

- **11ah features**
  - 1,2,4 MHz Channel Width (v1.0.0)
  - 1MH duplicated PPDU (v1.0.0)
  - Short Guard Interval (v1.0.0)
  - NDP Control frame (v1.0.0)
  - Hierarchical TIM and TIM compression (v1.0.0)
  - S1G Beacon (v1.0.0)
  - S1G BSS Operation (v1.0.0)
  - S1G_1M, S1G_Short PPDU (v1.0.0)
  - 1SS MCS 0-7 and MCS10 (v1.0.0)
  - 2MHz duplicated PPDU (>= 4MHz) (v1.0.0)
  - Target Short Beacon Transmit Time (TSBTT) (v1.0.0)
  - TIM Operation (v1.0.0)
  - Color indication for >= 2MHz PPDU (v.1.1.0)
  - NDP Probe Request (v.1.1.0)
  - PV1 MAC header (v.1.1.0)
  - Dynamic vendor IE (Information Element) (v1.2.0)
  - WPA3-OWE (v1.2.0)
  - WPA3-SAE (v1.2.0)
  - Power save (v1.3.4)
  - WDT(Watchdog Timer) Reset (v1.3.4)
  - AP/STA Recovery after WDT Reset (v1.3.4)
  - WPS-PBC (Push button configuration) (v1.3.4)
  - CSA (Channel Switch Announcement) (v1.3.4)
  - Auto BA (Block Ack) (v1.3.4)
  - Max Aggregation – up to 16 (v1.3.4)

- BSS Max Idle (v1.3.4)
- Airplane Mode (v1.3.4)

- **Network stack features**
  - Concurrent mode (v.1.1.0)
  - SoftAP (v.1.1.0)
  - Tree-based mesh using concurrent mode (v1.2.0)
  - 11s mesh (v1.3.3)
  - Self Configuration on AP (v1.3.4)
  - Mesh enhancement – support MAP concurrent (v1.3.4)

- **System features**
  - Loopback Enhancement (v1.3.4)
  - Simple Driver for SPI verification (v1.3.4)

3.2 Resolved issues

Table 3.1 presents resolved issues since version 1.2.0.

Table 3.1 Resolved issues

Version	Description
v1.2.0	**Transmission failure** Wrong length calculation in the certain MCS and MPDU length combination
	Low throughput performance during the initial 10 sec after connection
	Long scan time Scan channels not in the scan list
	Fail to get IP through DHCP IAID (Identity Association Identifier) conflict during DHCP procedure
v1.2.1	**Incorrect value of “show uinfo” command – beacon_interval and short_bi**
	Target assert occurred when executing the cli_app while target is receiving response buffer allocation issue

	Target assert occurred in WPA2 protected frame destined to disassociated STA
	Wrong preamble type of "show config" command
	Wrong SNR value displayed in 1MHz BW when running "show signal"
v1.2.2	**CLI app sometimes output mismatched version information**
	Segmentation fault occurred when executing "show signal" command
	Response of "show signal" command become later than version 1.2.0
	Target firmware version mismatch between target firmware log and cli_app
v1.2.3	**"show signal start" command occur error when using interval option**
	Target firmware hung-up when execute "show uinfo" command
	Station information of "show uinfo" command was corrupted
	Station information remains even after bss_max_idle
	PING error happen when frame is particular size sometimes the data missing when the packet size is aligned to byte boundary
	cli_app response is late during I/F down CLI app cannot receive response from target when I/F is down
	Target firmware output error message when received many packets in short term queue for system task exhausted due to lots of frame in short time
	Support SNR/RSSI per STA on AP Mode Not considering about multiple STAs for SNR/RSSI reports
v1.2.4	**Fixed-VIF-Index-handling**
	Mapping US Full Channel
	Cli_app response is late during I/F down
	Station can't reconnect to AP when WPA3-OWE
	Remove-kernel-warning
	Display error about bss_idle_max_period of "show uinfo" Wrong information of bss_idle_max_period displayed in "show uinfo" command

	The value of twt of "show uinfo" command is always 1
	MIC failure occurred when station send multicast frames at the timing of GTK rekey
	WPA3 station can't receive broadcast frames
	BEACON-LOSS happened in STA mode Station occasionally fails to receive Beacon signal when WPA3 is enabled
	Cli_app cannot display per-station RSSI and SNR
	Target firmware output error message when execute "show mac tx|rx stats" Target firmware prints out "Unknown command" after the execution of cli_app
	Unexpected counter value in 'show mac rx' "OK frame bytes" presents a valid value even when "OK frames" is 0
	AP doesn't send deauthentication frames to non-associated station when WPA2/WPA3
	Sometimes 0 is written to the Beacon Interval field in the Beacon frame
	Sometimes wrong length information is written to the Probe Request frame
	Fail to receive broadcast frame in some case
	Target firmware crash happened while running Tree-based mesh
	Uplink/Color indication field is not set correctly
	Duplicated packet is forwarded due to error in Sequence Number Manager
	WIM_SCAN channel list stack overflow
	Sometimes Short Beacon is not transmitted
	Wrong information is written to Beacon Interval field in Probe Request frame
	Error found in callback of HSPI handller
	NDP Probe Request flooding due to retransmission
	Wrong number is written to Duration filed due to calculation error
	Wrong condition statements in some functions regarding umac stainfo
	Beacon needs to adapt S1G config on any change made.
	Wrong VIF index access on concurrent operation
	Warning log are outputted when station connects and disconnects repeatedly in

v1.2.5	**heavy traffic**
	Improve show signal command output
	Segmentation fault occurs in show signal command
	Can't get transmitting opportunity equally when send very short packet continuously
	Sometimes last MCS of statistics indicates 8
	Long carrier sense time is set in some US channel
	Host warning when key is found but frame is unprotected
	Wrong value written to duration field in A-MPDU packet
	Memory leakage occurred when inserting and removing the host drive module repeatedly
	Fixed host warning when key is found but frame is unprotected
v1.2.6	**Kernel oops occurs when unload driver after changing Dynamic Vendor IE**
	Unable to disable bss_max_idle period
	Target assert happened when executing the "show uinfo 0" command in the cli_app after connection of 10th station or more
	Target assert when executed the "show signal" command
	Cipher type value was invalid in TX frame sent to target firmware from host just after station is disconnected
	Target assert happened when 400 stations (Increased up to 700 station)
v1.2.7	**Can't get transmitting opportunity equally when send very short packet continuously**
	Kernel Oops occurs when unload driver after changing Dynamic Vendor IE in Beacon
	"Tx Power" value in "cli_app show config" does not change even if the Tx_gain is changed
	cssid value in "cli_app show uinfo" is wrong
	TX_Gain is overwritten by 10 when hostapd/wpa_supplicant starts
	Noise is generated around 916MHz during loading driver
	Assert while deleting key in WPA2 on Standalone mode

	Fixed Warning log "Wrong index" is outputted when relay device sends data frames to AP
v1.2.8	**STA INFO of "show uinfo" is not displayed properly in certain situation**
	AP sends unencrypted packets at timing when station disconnected
	Indefinite value is displayed in kernel log when unloading the drive
	False detection occurs in recovery function
	Buffer of Tx queue are not freed when unloading the driver
	Buffer mismatch occurs on target firmware when receiving specific size data
	Warning log "Wrong index" is outputted when relay device sends data frames to AP
v1.2.9	**"show uinfo" command result is "FAIL" when no station connect to AP**
	nrc_recovery_wdt_clear handler is not executed
	Target assert happened when station connects and disconnects repeatedly in heavy traffic
	Lower SNR value is displayed compared with the previous version
	System fault occurs on TFW when execute cli_app "show" command in heavy traffic
	AP side memory is depleted when station sends massive multicast frames continuously
	MAC address of show uinfo command is zero before connect to AP
v1.2.10	**AP sends unencrypted packets at timing when station disconnected**
	Occurrence condition of Tx Triggered Detection
	"show signal" command result is "FAIL" when no station connect to AP
	Wireless frames are leaked at every recovery timing even if send CW
	Incorrect value in primary channel width subfield in S1G Operation element when operation bandwidth is 1MHz?
	"cli_app show uinfo 0" shows no ssid when the ssid includes '\' and its length is 32
	Fix pending skbs on wake_tx_queue() on nrc driver
v1.2.11	**Location of 1 MHz primary channel within the 2 MHz primary channel**

	Occurrence condition of Tx Triggered Detection
	Incorrect value in primary channel width subfield in S1G Operation element when operation bandwidth is 1MHz
	Incorrect bandwidth rate frames are sent after station moves to AP
v1.2.12	**“assoc_s1g_channel” of “show uinfo” command is cleared when interface down**
	“Uplink-ind” value of “show config” is different
v1.2.13	**Warning occurs in __ieee80211_scan_completed when the scan is aborted from MAC80211** duplicated ieee80211_scan_completed() call
	Improve Dynamic Vendor Specific IE function Limit length of Vendor Specific IE to 252bytes
	Warning occurs in rx_h_bss_max_idle_period when station receives association response frames of other destination Drop NDP/Ctrl frames except NDP_PREQ before Hook
v1.2.14	**Warning occurs in rx_h_bss_max_idle_period when station receives association response frames of other destination** NDP Probe request frame pass to host then host occurred warning condition in STA mode
v1.2.15	**Fix Spectrum Mask result log of Manufacturing tools**
v1.2.16	**“cli_app set gi long” not working**
	Assert occurred when sending NDP probe request packet
	Unable to transmit data frames permanently caused by background scanning during traffic
v1.2.17	**Fix set max TX power of each channel, bandwidth and MCS**
v1.2.18	**AP does not send probe response to NDP probe request**
	Kernel panic occurred when disconnected due to Beacon loss
v1.2.19	**Host recovery happens when scan_ssid=1**
	Segmentation Fault happens when execute cli_app by 4 MHz bandwidth
v1.3.0	**Wrong maximum number of aggregations**
	Beacon interval calculation in Beacon monitoring

	Issue on WPA2 key processing
	Wrong procedure of handling NDP frame
	Adaptation of AID in SoftAP
	Issue on STA disabled HT
	Buffer flow control issue caused by scan during in traffic
v1.3.1	**Robust Frames(ARP and DHCP) with MCS10 is not enabled while using WPA2**
	Fix backward compatibility issues for newly added sysconfig values
	Fix cli_app show recovery stats, show detection stats
v1.3.2	**Fix kernel warning occurs in _c_spi_read_regs when loading the driver after power-up**
	Treat 00:00:00:00:00:00 as invalid MAC Address when it is read from Serial Flash
	Keep Alive Packet Interval is fixed correctly based on BSS MAX Idle time
	Add HSPI Clock Recovery
	Fix Association Timeout Issue. Set Fragment Number to be 0
	Added Timeout Interval Element(TIE) support for PMF
v1.3.3	**Bugfix of NDP Probe Request**
	Fully support BSS Max Idle Period on NRC driver
	Bugfix of NDP modem sleep
	Fix 32MHz Clock Harmonic
v1.3.4	**Bugfix of RELAY throughput**
	Bugfix of updating TSF Completion Field
	Memory optimization with S1G Channel Table
	Stabilization of Modem Recovery
	Bugfix of rmmod operation
	Bugfix of addba/delba for block ack session
v1.3.4_rev01	**fix compile time error for spi-ft232h.c for 5.7 and newer kernels**
	Fix kernel version compatibility issues

3.3 Changed items

Table 3.12 presents changed items since version 1.2.0.

Table 3.2 Changed items

Version	Description
v1.2.4	**Duty cycle** Set duty cycle to limit the emission of transmission time (only test purpose)
	TX power control Set different transmit power on each MCS
	WPA2 in concurrent mode To support WPA2 security in concurrent mode
	HW Timestamp on Probe Response To use more accurate timing reference
	Low TX power (1~5) To support low TX output power such as 1~5dBm Previous version only support TX power 5~30dBm even when TX gain set to 1~5
	CFL performance improvement To support low TX output power such as 1~5dBm
	Insert TIM IE when PVB is zero in Beacon frame Not clearly defined in 11ah standard but necessary for 11ah interoperability (HaLow) test
	Improve TX EVM performance Stabilize TX EVM performance by changing initial value of RF/PMS parameter
	DTIM period from configuration file DTIM period was fixed to 1 for test purpose but changed it to get from the configuration file
v1.2.5	**Redefine data structure and memory map in the external serial flash memory** Add signature & crc32 in slot header for integrity
	A-MPDU on VIF 1 To support A-MPDU packet on VIF 1 interface

	NDP probing in 4MHz BW To support NDP probing request in 4MHz BW
	Option to use calibration data Add CLI command in cli_app to select to or not to use calibration data
v1.2.6	**Option of 'auto' for guard interval setting** Automatically select guard interval based on the transmission success rate
	Target recovery function Recovery function triggered when a packet is scheduled but not finished within a specific time
	Remove unnecessary wait time To improve display time of the "show signal" command
	Encapsulate AID information into TX frame sent from host To resolve the issue that AP sends unencrypted packets at timing when station is disconnected
v1.2.7	**CLI command for aggregation size threshold**
	CLI command for test recovery, recovery stats, detection stats
	Target firmware recovery and Host recovery
v1.2.8	**Sort MAC address in order in umac stainfo command**
	Update "show config" command in cli_app
	Add "test assert" command in cli_app To provide a method to test the recovery function
	Enable rate control for VIF 1
v1.2.11	**Enable mesh only when CONFIG_MAC80211_MESH enabled** MAC80211 has the build option to enable mesh, CONFIG_MAC80211_MESH. This change enables mesh only when CONFIG_MAC80211_MESH enabled on Kernel.
	Add Debug on TX destined to STA in wrong state
v1.2.12	**CLI command for GPIO configuration**
	Reduce spurious level at 960MHz frequency
	Check valid MAC address stored in the memory before using it
v1.2.16	**Handle MAC address 1 for concurrent mode (VIF1)**

	Use two MAC addresses 0 (for VIF0) and 1 (for VIF1) when two addresses are available in the flash memory. If only one address is available in the memory, generate another MAC address from the one in the memory.
v1.2.17	**TX power control based on MCS, channel, bandwidth enabled by default** Previous cli_app command of "autotxgain" removed (see chapter 8)
v1.2.18	**Enhance calibration scheme to improve EVM and spectrum mask performance**
v1.3.0	**NDP blockack support**
	Support MX25V8035F flash memory
	Support MAX31875R0 temperature sensor
	Handle the macaddr1 in serial flash for VIF1
	Add PS-API module
v1.3.1	**Support KR MIC band (925.5-930.5) in host_kr_mic package**
	Delay a start of beacon monitoring
	Add API for user_config area
	Add sysconfig 'bdf_use' value (use the board data use or not)
	Support Hidden SSID (on AP/STA)
	Change temperature compensation value
v1.3.2	**RX gain table, RSSI offset, LNA Swithcing point, 2Mhz mode threshold value**
v1.3.3	**Support Background Scan**
	Change default CPU (from CM0 to CM3)
	Support Hidden SSID
	Support KR Wireless MIC Band
v.1.3.4	**Support Power Save (modem sleep and deep sleep)**
	Support BSS Max Idle
	Support AMPDU using block ack session (up to 16 MPDU in AMPDU)
	Support CSA (Channel Switch Announcement)
	Support Mesh MAP concurrent
	Support WPA-PBC

	Support WDT Reset
	Support Self Configuration on AP
V1.3.4_rev01	**duty cycle support**
	Update start.py (self_config related update, replace service to systemctl, ndp_preq default value change (1 to 0))

3.4 Known issues in the release package

Table 3.3 presents all know issues in the version 1.3.4

Table 3.3 Known issues

Category	Description
Host Mode	Not Support 6 US CHs for hostapd CH capacity reason (Not supported CH : 100(BW_1M, 925.5MHz), 104(BW_1M, 926.5MHz), 108(BW_1M, 927.5MHz), 112(BW_2M, 927MHz), 116(BW_4M, 926MHz)
MESH	DHCP failure or delay in multi-hop MBSS Note: recommend using static IP in more than 3-hop MBSS