
BlueNRG-1 and BlueNRG-2 modular BLE stack

Main components	
BlueNRG-1	Bluetooth Low Energy wireless system-on-chip
BlueNRG-2	Bluetooth Low Energy wireless system-on-chip

Purpose and benefits

The BlueNRG-1 and BlueNRG-2 are very low power Bluetooth low energy (BLE) single-mode system-on-chip (SoC), compliant with Bluetooth specification. They extend the features of award-winning BlueNRG network processor, enabling the usage of the embedded ARM Cortex-M0 core for running the user application code.

The application running on BlueNRG-1 and BlueNRG-2 makes use of a production-ready BLE stack as library (linked to the application source code) provided in the device software development kits (SDKs). The BLE stack version may change from time to time without notice. The BLE stack is provided in library form because it is not intended for users to do modifications. Starting from the BLE stack version v2.1, a modular configuration of the stack is supported. The modularity of the BLE stack allows users to optimize the BLE stack memory footprint and RAM usage depending on the specific application needs.

The purpose of this design tip is to provide customers with a reference for how to configure the BLE stack.

Note that for details on how to determine the BLE stack version the reader should refer to the dedicated design tip “BlueNRG-1 and BlueNRG-2 BLE stack and Hardware versions” available on st.com.

The entire content of this design tip applies with no modifications both to BlueNRG-1 and to BlueNRG-2 devices when running BLE radio stack v2.1 and onwards.

Description

The dedicated preprocessor defined symbol *BLE_STACK_CONFIGURATION* is available in all the reference user applications within the device SDK and it is used for configuring the BLE stack with all supported features.

The following modular configurations are currently supported:

- BLE_STACK_FULL_CONFIGURATION - it supports the following features:
 - Controller Privacy enabled
 - LE Secure Connection enabled
 - Master role enabled
 - Data length extension enabled (valid only for BlueNRG-2 devices)
- BLE_STACK_BASIC_CONFIGURATION - it configures the BLE stack with a basic configuration:
 - Controller Privacy disabled
 - LE Secure Connection disabled
 - Master role disabled (only Peripheral/Slave role supported)
 - Data length extension disabled
- BLE_OTA_BASIC_CONFIGURATION - it supports Over-The-Air (OTA) FW upgrade Service support with Data length extension (valid only for BlueNRG-2 device):
 - Controller Privacy disabled
 - LE Secure Connections disabled
 - Master role disabled (only Peripheral/Slave role supported)
 - Data length extension enabled (only for BlueNRG-2 device)

BLE_STACK_BASIC_CONFIGURATION is the default option. If no value is defined for the preprocessor option the basic configuration is selected.

Users that would like to configure the BLE stack with another configuration shall explicitly set the preprocessor defined symbol *BLE_STACK_CONFIGURATION* to the value corresponding to the desired stack configuration.

Additionally the two configuration files *stack_user_cfg.c* and *stack_user_cfg.h* are also available in the device SDK and used for enabling the BLE stack modular approach.

One last note: Data length extension feature is disabled on each configuration related to a BlueNRG-1 device since this feature is not supported on this device.

Helper function `aci_hal_get_firmware_details` in DTM mode

In the BlueNRG-1 and BlueNRG-2 driver library the following helper function is available:

```
tBleStatus aci_hal_get_firmware_details (uint8_t *DTM_version_major, uint8_t
*DTM_version_minor, uint8_t *DTM_version_patch, uint8_t *DTM_version_variant, uint16_t
*DTM_Build_Number, uint8_t *BTLE_stack_version_major, uint8_t
*BTLE_stack_version_minor, uint8_t *BTLE_stack_version_patch, uint8_t
*BTLE_stack_development, uint16_t *BTLE_stack_variant, uint16_t
*BTLE_stack_Build_Number);
```

Note that this helper function is only available when the device is configured as a network coprocessor. For further details the reader should refer to the dedicated design tip “How to configure the BlueNRG-1 and BlueNRG-2 devices in network coprocessor mode” available on st.com.

The parameter `BTLE_stack_variant` returned from the `aci_hal_get_firmware_details` helper function reports to the user a bitmask of BLE stack features through the following flags:

- 0x0001: CONTROLLER_PRIVACY_ENABLED
- 0x0002: SECURE_CONNECTIONS_ENABLED
- 0x0004: CONTROLLER_MASTER_ENABLED
- 0x0008: CONTROLLER_DATA_LENGTH_EXTENSION_ENABLED
- 0x0010: LINK_LAYER_ONLY

Alternatively, customer can use the BlueNRG family GUI to gather the same information, as shown in the GUI screenshots in Figure 1 and with a zoom in Figure 2.

Figure 1: BlueNRG family GUI capture

The screenshot shows the BlueNRG GUI interface. The top panel displays the 'aci_hal_get_firmware_details' command. The bottom panel shows the output of the command, which is a list of parameters and their values. The output is as follows:

Param	Value	Literal	Info
Stack Size	0x12	HCL_COMMAND_SIZE	
Parameter Total Length	0x12		
Match_HCI_Command_Packets	0x01		The Number of HCI command packets which are allowed to be sent to the Controller from the Host.
CommandTimeout	0x12	HCL_HAL_GET_FIRMWARE_DETAILS	Duration of the command which caused this event.
Status	0x00		Success. For standard error codes see Bluetooth specification, Vol. 2, part D. For proprietary error code refer to Error code.
DTM_version_major	0x03		Major version number of the DTM application part.
DTM_version_minor	0x00		Minor version number of the DTM application part.
DTM_version_patch	0x00		Patch version number of the DTM application part.
DTM_Variant	0x01	UART	Transport layer mode (numbers not defined reserved for future use). Values: 0x0: UART 0x02: SPI
DTM_Build_Number	0x0000		Build number for DTM application part.
BTLE_stack_version_major	0x02		Major version number of BTLE stack.
BTLE_stack_version_minor	0x01		Minor version number of BTLE stack.
BTLE_stack_version_patch	0x00		Patch version number of BTLE stack.
BTLE_stack_development	0x00		Specific variant build Values: 0x00: Official release 0x01: Internal development release.
BTLE_stack_variant	0x0007	CONTROLLER_PRIVACY...	Bitmask of BTLE stack v2.2 in later variants (modular configurations options and link layer only) Flags: 0x0001: CONTROLLER_PRIVACY_ENABLED
BTLE_stack_Build_Number	0x0004		Build number for BTLE stack.

Figure 2: BlueNRG family GUI capture zoom

ACI_HAL_GET_FIRMWARE_DETAILS command complete event

Sent/Received Packets			Packet Details			
N.	Time	Type	Parameter	Value	Literal	
0	11:42:38.687	HCI_READ_LOCAL_VERSION_INFORMATION	Event Code	0x0E	HCI_COMMAND_COM...	
1	11:42:38.700	HCI_COMMAND_COMPLETE_EVENT	Parameter Total Length	0x12		
2	11:42:40.677	ACI_HAL_GET_FIRMWARE_DETAILS	Num_HCI_Command_Packets	0x01		The Number of HCI command packets which are all
3	11:42:40.707	HCI_COMMAND_COMPLETE_EVENT	Command_Opcode	0xFC01	ACI_HAL_GET_FIRMW...	Opcode of the command which caused this event.
			Status	0x00	Success	For standard error codes see Bluetooth specification.
			DTM_version_major	0x03		Major version number of the DTM application part
			DTM_version_minor	0x00		Minor version number of the DTM application part
			DTM_version_patch	0x00		Patch version number of the DTM application part
			DTM_variant	0x01	UART	Transport layer mode (numbers not defined reserved)
			DTM_Build_Number	0x0000		Build number for DTM application part
			BTLE_Stack_version_major	0x02		Major version number of BTLE stack
			BTLE_Stack_version_minor	0x01		Minor version number of BTLE stack
			BTLE_Stack_version_patch	0x00		Patch version number of BTLE stack
			BTLE_Stack_development	0x00	Official release	Specific variant build Values: 0x00: Official release 0x01: Development
			BTLE_Stack_variant	0x0007	CONTROLLER_PRIVAC...	Bitmask of BLE stack v2.1 or later variants (modular c
			BTLE_Stack_Build_Number	0xD56A		Build number for BTLE stack

Support material

Documentation
Datasheet BlueNRG-1: Bluetooth® low energy wireless system-on-chip Datasheet BlueNRG-2: Bluetooth® low energy wireless system-on-chip Programming Manual PM0257: BlueNRG-1, BlueNRG-2 BLE stack v2.x programming guidelines
Embedded Software
STSW-BLUENRG1-DK: BlueNRG-1, BlueNRG-2 DK SW package STSW-BNRGUI: BLUENRG family GUI

Revision history

Date	Version	Changes
06-Feb-2019	1	Initial release

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2019 STMicroelectronics – All rights reserved