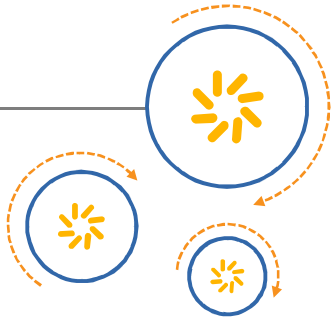
Qualcomm Technologies, Inc.



Qualcomm® BlueCore™ Unified 28e Firmware

Release Note

80-CG031-1 Rev. AA

February 28, 2018

Qualcomm Technologies, Inc.
5775 Morehouse Drive
San Diego, CA 92121
U.S.A.

Revision history

Revision	Date	Description
AA	February 2018	Initial release of BlueCore Unified 28e Firmware Release Notes. Alternative document number CS-00409218-RN.

SOFTWARE RELEASE DISCLAIMER

THIS RELEASE IS PROVIDED "AS IS" AND Qualcomm Technologies International, Ltd. (“QTIL”) CAUTIONS YOU TO DETERMINE FOR YOURSELF THE SUITABILITY OF USING THIS RELEASE. TO THE FULLEST EXTENT PERMITTED BY LAW, QTIL DISCLAIMS AND EXCLUDES ALL WARRANTIES, REPRESENTATIONS, CONDITIONS AND OTHER TERMS OF ANY KIND, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTIES OF TITLE, MERCHANTABILITY, SATISFACTORY QUALITY OR FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OF THE RELEASE. FOR ALL APPLICABLE TERMS, INCLUDING LIMITS ON LIABILITY, YOU ARE REFERRED TO QTIL’s STANDARD TERMS OF SUPPLY, LICENSE AGREEMENT OR OTHER AGREEMENT BETWEEN YOU AND QTIL OR QTIL’S AFFILIATE UNDER WHICH THIS RELEASE IS SUPPLIED.

Contents

Tables

1 Introduction

This document describes the production release of the BlueCore Unified 28e Firmware release for integration with the QTIL ADKs.

This firmware version is a unified version and includes the following:

- Bidirectional pipe stream (allows VM access to DSP streams and other things)
- Ability to amend USB serial number for OTA DFU (prior knowledge of serial)

Table 1-1 lists the build names and build IDs for the available versions of Unified 28e Firmware.

Table 1-1 Firmware versions

Version	Full build name	Build ID
CSR8670	gdn_16unified_fl_bt5.0_u28e_1802121023_ble_encr128	13606
CSR8675	rck_16unified_fl_bt5.0_u28e_1802121023_ble_encr128	13605

When the HCI command `Read_Local_Version_Information` is run, several values are returned, including the HCI revision value. The build ID is returned in this field.

Table 1-2 lists the ICs that are suitable for use with this firmware release.

Table 1-2 IC Part numbers

Integrated circuit	Ball grid array part number	WLCSP part number
CSR8670 Rev C	CSR8670C-IBBH-R	CSR8670C-ICXT-R
CSR8675 Rev C	CSR8675C-IBBH-R	CSR8675C-ICXT-R

2 Release functionality

2.1 All ICs

Table 2-1 lists the functions common to all ICs.

Table 2-1 IC Common functions

Feature or function	Description
System	▪ Micro Controller Unit (MCU) with VM ▪ Bluetooth v5.0 ▪ Support for a memory management unit (MMU) and a memory protection unit (MPU) ▪ 16 Mb eFlash ▪ External quad Serial Peripheral Interface (SPI) flash ▪ External serial SRAM ▪ Deep sleep clocking from driving Crystal (XTAL) with low power (external slow clock not required)
Audio	▪ Supports up to six digital microphone interfaces ▪ Stereo DAC and audio routing ▪ Stereo ADC and audio routing ▪ Analog microphone interfaces ▪ Sidetone ▪ Digital Signal Processor (DSP) functionality ▪ SPDIF, in 16-bit mode, with automatic rate detection and coded audio support
Battery charger	▪ Normal trickle and fast charge modes ▪ Higher charge currents ▪ USB charging enumeration ▪ Pre-calibrated charger, up to 4.35 V
Power management	▪ Low (voltage) Drop-Out (LDO) for digital supply ▪ LDO for analog supply ▪ LDO for AUX supply ▪ Two switch mode power supplies ▪ 3.3 V USB regulator ▪ Power switching between Vbat and USB

Feature or function	Description
Interfaces	▪ Universal Asynchronous Receiver Transmitter (UART) ▪ USB 2.0 (full-speed) ▪ Dedicated 16 Programmable Input/Outputs (PIOs) ▪ Upper 16 PIOs (shared with other interfaces) ▪ AIOs ▪ SPI debug and programming interface ▪ DFU ▪ SPDIF ▪ SPI lock for customer code security ▪ RGB LED drivers ▪ Simple LCD display ▪ Six capacitive touch sensor inputs ▪ Support for quad SPI flash

2.1.1 CSR8670 only

Table 2-2 lists the functions specific to CSR8670.

Table 2-2 CSR8670 specific functions

Feature or function	Description
Audio	One configurable Pulse Code Modulation (PCM), Inter-Integrated Circuit Sound (I²S), or SPDIF interface

2.1.2 CSR8675 only

Table 2-3 lists the functions specific to CSR8675.

Table 2-3 CSR8675 specific functions

Feature or function	Description
Audio functionality	▪ Two PCM or I²S interfaces ▪ Simultaneous functionality for SPDIF, PCM, and I²S ports ▪ 24-bit support on audio interfaces ▪ Mix at most two ADC channels for use as sidetone ▪ Individual sidetone gains and enables
LED – PIO functionality	▪ LED pins can be configured as PIO or LED ▪ LED functionality can be enabled or disabled using the `LedConfigure()` function

2.2 Standard Bluetooth functionality

The software complies with the *Bluetooth Core v5.0 Specification*. No new Bluetooth feature is being released as compared to the previous ADK 4.3 release.

2.3 Additional functionality

The following functionality has been added to Unified 28e Firmware:

- Bidirectional pipe stream (allows VM access to DSP streams and other things)
- Ability to amend USB serial number for OTA DFU (prior knowledge of serial)

2.4 Changes relative to previous release

The Unified 28e firmware implements several features and fixes issues over and above that is reported in Unified 28d firmware. These are briefly explained in the sections below.

2.4.1 Bidirectional pipe stream

BlueCore firmware uses the stream subsystem to connect data streams between various modules like VM application, DSP, Host interfaces etc., using `StreamConnect()` trap. The stream(s) that allow VM application to connect to various existing streams and is managed by the VM application is called the VM managed stream. However, the flow of data to/from the DSP ports was completely agnostic of the application and was managed by the firmware internally. This feature allows the application to read or write data directly from the DSP using a new stream called 'Pipe Stream'. The pipe stream however is very generic and can be used by the VM application to connect to other existing streams too in the firmware.

2.4.2 Ability to amend USB serial number for OTA DFU

There are USB string descriptors namely Manufacturer, Product and Configuration strings which are configured in system PS Key. There was no support in the firmware to update these string descriptors dynamically from the VM application. This feature extends the ability of the BlueCore firmware to register the above mentioned USB string descriptors via existing trap - `UsbAddStringDescriptor()`. During enumeration when host sends `GET_DESCRIPTOR` request to read any of these string descriptors, BlueCore firmware will respond with dynamically registered string descriptor if registered, otherwise it is read from PS Key.

2.5 Configuration notes

2.5.1 For Bidirectional pipe stream

No impact on the configuration.

2.5.2 For Ability to amend USB serial number

NO PSKey change introduced this feature. Only change is the description update for trap `USBAddStringDescriptor()`.

3 Qualification status

The Unified 28e Firmware for CSR8670 and CSR8675 would be reusing the *Bluetooth Core Specification v5.0* listed under QDL D028090 for ADK 4.3 qualification. The subset ID under the qualification being “103807”.

4 Known issues

Table 4-1 lists currently known issues for this release.

Table 4-1 Known issues

Bug ID	Description
B-49592	In noisy radio conditions, BlueCore restricts the type and size of data packet that it transmits to increase the overall throughput. In exceedingly noisy environments, the smallest packets are not being selected. This leads to reduced throughput and the risk of the link disconnecting. In practice, the link typically becomes unusable for other reasons before this is an issue.
B-53036	On BlueCore ICs, when stereo audio (such as FM audio) is routed through I²S, it is possible for the left and right channels to be out of phase with each other by a single sample. It is intermittent whether this phase discrepancy occurs when an audio flow is set up (for example, when FM audio is enabled). After the audio flow is configured, the phase offset of the two channels remains constant until the audio is re-configured in some way. This can only occur when either of the following applies: ▪ The I²S slot length is equal to the number of bits per sample in the internal audio format. Perfect phase can be achieved reliably only if 'left justify delay' (Bit [1] of PSKEY_DIGITAL_AUDIO_CONFIG or PSKEY_DIGITAL_AUDIO2_CONFIG, depending on the interface) is not set. The I²S slot length is greater than the number of bits. Perfect phase can be achieved reliably only when the 'left justify delay' bit is set.
B-53074	If PSKEY_USB_PIO_PULLUP is set to USB_PULLUP_NONE, the firmware performance can be impaired seriously until a pullup is applied to the USB D+ line.
B-54012	When BlueCore is the master of a link and it initiates a disconnect procedure during authentication, BlueCore can fail to send an authentication complete event to its host.
B-62361	If the host attempts to send a USB bulk transfer to BlueCore with a size greater than 1023, data loss occurs. BlueCore loses a single bulk packet for each multiple of 1024 bytes sent. To prevent this, the host must ensure that each bulk USB transfer sent to BlueCore is less than 1024 bytes. For example, with a maximum packet size of 64 for the bulk endpoint, the host can send up to 15 packets of 64 bytes before sending a short packet to terminate the transfer.
B-66906	When BlueCore is responding to secure simple pairing, and the local host initiates a disconnect procedure, BlueCore can fail to send a simple pairing complete event to the host.

Bug ID	Description
B-67171	If BlueCore is connected to multiple peers, and two SCO or eSCO negotiations are initiated simultaneously (by BlueCore, by the remote devices, or by a mix of both) then problems can occur on connection or disconnection of the SCO link. Typical symptoms are as follows: ▪ Receiving a disconnection complete event with the reason code of unspecified error immediately after the connection complete event when bringing up an SCO link ▪ Seeing `LMP_not_accepted remove_(e)SCO_link_req invalid_lmp_parameters` sent over the air when the SCO or eSCO link disconnection is attempted ▪ If running upper layers on a chip, the firmware terminates with `PANIC_STREAM_GONE_MISSING` This issue was incorrectly reported as fixed by the 23h firmware release. While some causes of this issue were addressed in 23h relative to previous releases, some instances of this issue remain.
B-79251	When Radiotest stereo loop-back is used on BlueCore, audio distortion is observed within 4 minutes. This distortion disappears after another 4 minutes. This distortion is a feature of the way the loop-back test is implemented in the firmware. It does not occur in normal operation. The firmware fix significantly increases the onset time of the distortion by increasing the delay between input and output. This increases the loop-back latency by just over 2 ms.
B-81479	Problems can occur if BlueCore is asked to pair with multiple remote devices simultaneously. The most common symptom is to receive the hardware error `0x4c (FAULT_LM_SPURIOUS_TIMEOUT)`. It is believed that there could be other symptoms as well. As a workaround, where possible, the host should avoid multiple simultaneous pairings. This situation is quite rare in practice.
B-85252	When transmitting data after a period of idleness, any delay in changing the mode to that specified by the first state in the `Powerstate` table counts towards the duration of that state. In the extreme case, where the latency associated with the current mode is greater than the duration of the first state in the `Powerstate` table, after transmitting data, the device might appear to spend no time at all in the first state before moving to a subsequent state. As a workaround, ensure that the duration of the first state in the `Powerstate` table is greater than the maximum latency associated with any other state.
B-156554	In Soundbar Sink application configurations, a minor issue regarding very long button press indications can be observed when holding down a button on an infra-red (IR) remote control. If the IR control is using the RC5 protocol, it is possible that very long button presses (that is, between 5 and 10 seconds) can be interpreted as multiple button press indications of a shorter duration. This issue occurs infrequently and seems to be related to the quality of the signal path. A study was performed. The findings were that, if the remote control was pointed directly at the IR Rx and a button was pressed continuously, then normally only one indication results. However, if there is a poor quality path from the remote control to the IR Rx (for example, the remote control is pointing away from the IR Rx), then extra indications can result, sometimes at periods of less than 1 second. If the path is direct and short (that is, of very high quality), then very rarely (for example, over several minutes of performing long button presses) an extra indication can result. The normal use of remote controls is to perform individual presses (even volume adjustment tends to take only a few seconds). As long as the remote control is pointed at the sink, the incidence rate of extra button presses is going to be low and probably barely detectable by the end user.

Bug ID	Description
B-162402	On CSR8675, `PSKEY_COEX_PIO_UNITY_PLUS_BT_PERIODIC` cannot use even PIO pins to configure Unity-3 `BT_PERIODIC` signaling. Instead, odd PIO pins can be used.
B-210749	Transferring large data from any of the following source stream to partition sink stream using transform may cause the BlueCore firmware to freeze for the span of this transform life time. ▪ Stream File source ▪ Stream partition source ▪ Stream I^2C source ▪ Stream ringtone source ▪ Stream region source Some of the symptoms observed are: ▪ Hardware watchdog timeout. ▪ Glitches in the audio, like ringtone. ▪ VM becomes non responsive, etc.
B-217580	For the use cases that BlueCore supports, stream USB class and vendor does not reserve buffers optimally.
TF-14837	During performance testing of Connectionless Slave Broadcast for the CSRA6312x, CSRA6321x, CSRA6322x, CSRA64111, CSRA6421x devices, two instances of `PANIC_HOSTIO_DATA_OUT_BUFFER_ERROR` were seen. Engineering analysis has identified that the device or devices in question were performing page scanning when the error occurred. Furthermore, the nature of the error indicates the likelihood of an as-yet-unidentified issue with object lifetimes, such as a `use-after-free()`. Since the page scan and host interface implementations are common across multiple products, other devices may also be impacted.
B-263389	When a CSB listener also happens to have an ACL link with a CSB broadcaster, where it is the master of the ACL link, the audio playback at the CSB listener suffers blackouts.
B-260680	Bluecore device set to `DM_SM_SEC_MODE_CONFIG_ALWAYS_TRY_MITM` doesn't try MITM protected pairing if not explicitly requested by local device during pairing, even when IO capabilities on both sides are capable for MITM protected pairing. Hence Application currently needs to accurately feed the security requirement, while pairing, to ensure enforcement of MITM despite indicating early on to always try MITM.
B-259089	If a slave device in a Qualcomm® Bluetooth Low Energy link receives an `LL_CONNECTION_UPDATE_IND`, `LL_CHANNEL_MAP_IND` or `LL_PHY_UPDATE_IND` Link Layer Control PDU with invalid parameters, it will attempt to apply the parameters. This could result in the host getting a spurious LE PHY Update Complete or LE Connection Update Complete event with Success status followed by the link being disconnected with Instant Passed or Connection Timeout reason.

5 Issues resolved relative to unified-28d

Table 5-1 lists resolved issues for this release.

Table 5-1 Resolved issues

Bug ID	Description
B-255586	In rare circumstances when ACL data is being received simultaneously from multiple remote devices and an ACL link is disconnected then the device can become unresponsive. The scenario is unusual, and the race is extremely narrow. It has been found in Qualcomm internal testing. This problem has never been reported from the field despite having been present for over a decade. Two possible signatures of this failure are the panic codes `PANIC_HOSTIO_OUT_OF_ORDER_CLEAR` and `PANIC_HOSTIO_DATA_OUT_BUFFER_ERROR`.
B-229203	Attempting to set events that are unsupported by the Controller will fail, returning Invalid_HCI_Command_Parameters. Note: erratum E8689 has introduced a new requirement to the specification to mandate that controllers must accept and ignore event mask bits they don't understand. Previously the behaviour was undefined in the specification and in other places in the HCI specification it's an error to use RFU (Reserved for Future Use) values.
B-256416	In very rare situations, a device may fail to complete a connection parameter update procedure or become unresponsive while attempting it.
B-255999	Integrity checking of PDUs received over the air could be improved.
B-261257	LE links with a connection interval that is a multiple of a SCO link 'T' value may occasionally be dropped in the presence of other periodic events.

6 Supported serial quad flash devices

lists the serial flash devices. The serial flash devices are sanity tested in this release. Full functionality test was done only on GD25LQ32D part and is marked in green colour in the table.

Table 6-1 Serial quad flash devices supported/tested with firmware

Manufacturer	4 Mbit	8 Mbit	16 Mbit	32 Mbit	64 Mbit
EON			EN25Q16A		EN25QH64A
				EN25S32	
GD			GD25Q16		
				GD25LQ32C GD25LQ32D	GD25LQ64
Macronix					
			MX25U1635E	MX25U3235F	MX25R6435F
SST					
			SST26WF016B		
Winbond				W25Q32FV	W25Q64JV
		W25Q80EW	W25Q16FW		
Micron					
			N25Q016A11E		
Spansion				S25FL132K	
Amic					
Adesto				AT25SF321	
					AT25SL641
ISSI			IS25LQ016B		
				IS25WP032	

Document references

Document	Reference
Bluetooth Core Specification v5.0	www.bluetooth.org
BlueCore Unified 28d Firmware Release Note	80-CG031-1/CS-00409218-RN

Terms and definitions

Term	Definition
ACL	Asynchronous Connection-oriented
ADC	Analog to Digital Converter
BlueCore	Group term for the range of QTIL Bluetooth wireless technology ICs
CSB	Connectionless Slave Broadcast
DAC	Digital to Analogue Converter
DSP	Digital Signal Processor
eSCO	Extended SCO
HCI	Host Controller Interface
IC	Integrated Circuit
ID	Identifier
LDO	Low (voltage) Drop-Out
LMP	Link Manager Protocol
MCU	Micro Controller Unit
MMU	Memory management unit
MPU	Memory protection unit
PCM	Pulse Code Modulation
PIO	Programmable Input/Output
PS	Persistent Store
QTIL	Qualcomm Technologies International, Limited
SCO	Synchronous Connection-Oriented
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VM	Virtual Machine
XTAL	Crystal