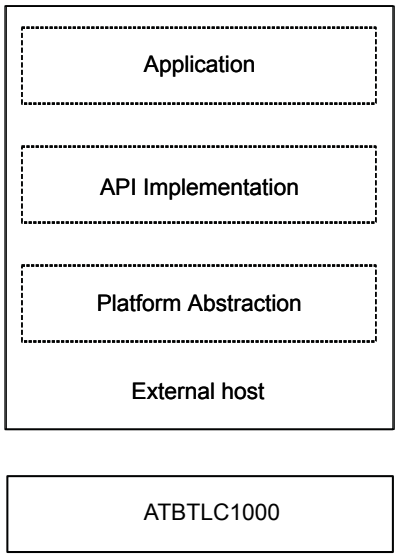
ATBTLC1000 Platform Porting Guide User's Guide

Overview

This document guides the user to port the Application Peripheral Interface (API) into a new platform.

Figure 1. BLE API OVERVIEW



The lowest layer of Bluetooth Low Engery (BLE) API is a platform abstraction layer, which abstracts all the functionalities required from the platform. The API is ported to new platforms by adding a new implementation targeting this platform.

The application must provide the `at_ble_init_config_t` structure as a parameter to `at_ble_init` and `at_ble_init_config_t`, which includes `at_ble_platform_api_list_t` structure with all required platform APIs function. Before calling `at_ble_init` platform, this must be initialized and all platform APIs must be ready for usage. Platform initialization includes the configuration of the bus (Universal Asynchronous Receiver/Transmitter (UART)), General Purpose IO (GPIO), and system timers.

Hardware Resources Required

The recommended hardware resources for 4-wire mode are as follows:

1. UART with hardware flow control such as Receiver (Rx), Transmitter (Tx), Request to Send (RTS), and Clear to Send (CTS).
2. 2-GPIO pins for controlling the ATBTLC1000 chip enable and wake-up.
3. 2-Timers (hardware/software) required at 1 ms resolution for controlling the bus activity and events.
4. External wake-up interrupt for the host wake-up to receive the data from ATBTLC1000 (The host goes to Sleep mode, when there is no activity).

© 2017 Microchip Technology Inc.

The recommended hardware resources for 6-wire mode configuration are as follows:

1. Primary UART pins (Tx0 and Rx0) and Secondary UART pins (Rx1, Tx1, RTS1 and CTS1).
2. 2-GPIO pins for controlling the ATBTLC1000 chip enable and wake-up.
3. 2-Timers (hardware/software) required at 1 ms resolution for controlling the bus activity and events.
4. External wake-up interrupt for the host wake-up to receive the data from ATBTLC1000.
5. Additional hardware resource required is UART1 (Rx0 and Tx0).

Table of Contents

1. ATBTLC1000 Initialization

This section provides the information on platform initialization and platform callback, which are required for ATBTLC1000 initialization.

1.1 Platform Initialization

The `platform_init` API initialize the ATBTLC1000 and the host MCU UART with required initial baud rate and configure the ATBTLC1000 wake-up pin, chip enable pin, and the host wake-up interrupt pin.

1.2 Platform Callback Register

This section describe all the required platform APIs function to declare inside the `at_ble_platform_api_list_t` structure. For more information refer to `asf\thirdparty \wireless\ble_sdk\src\platform.c` file.

1.2.1 Platform Send Data API

```
void (*at_ble_send_sync)(uint8_t *, uint32_t);
```

Ensure to set the pointer to function, which provides (Universal Synchronous/Asynchronous Receiver/ Transmitter (USART)) data that sends from the library to the ATBTLC1000 in synchronous manner, in which the function must block until transmission is completed. The function must check the "Wake-up pin level". If the Wake-up pin is set to low, then it is required to set it to high before sending any data to the ATBTLC1000.

1.2.2 Platform Receive Data API

```
void (*at_ble_recv_async)( void (*)(uint8_t));
```

Ensure to set the pointer to function, which provides asynchronous receive byte from the ATBTLC1000 to the library, in which the function must return immediately. This function must receive a callback, which is called on receiving new byte as parameter. Once a byte is received from the ATBTLC1000, the callback function must be called with this byte as parameter. This function must be called for each byte in order to receive and propagate it to the library. If `at_ble_recv_async` is not called, the platform is unable to read from the hardware and flow control mechanism, which inturn stops the data transfer from the ATBTLC1000.

1.2.3 Wake-up and Chip Enable Pin Control API

```
void (*at_ble_gpio_set)(at_ble_gpio_pin_t, at_ble_gpio_status_t);
```

Ensure to set the pointer to function, which provides GPIO set value. This function must receive `at_ble_gpio_pin_t enum` value to identify the GPIO pin and must receive `at_ble_gpio_status_t`

to set the value. Refer to "*Hardware Flow Control 4-Wire Mode Interface Details - ATBTLC1000 MR and ZR Modules* for details on pin numbering in *BluSDK Release Notes*.

```
typedef enum
```

```
{AT_BLE_CHIP_ENABLE
```

```
AT_BLE_EXTERNAL_WAKEUP
```

```
} at_ble_gpio_pin_t;
```

1.2.4 Platform Timer API

This section provide the information on Platform Timer API.

```
void (*at_ble_create_timer)(void (*)(void *));
```

- Ensure to set the pointer to function, which is used to register new callback function for new shot hardware timer. This must receive callback function as a parameter
  Note: Hardware Timer must have 1 ms granularity.
- It must return the handler for the timer, which is used with start/stop/delete functions

  ```
  void (*at_ble_delete_timer)(void *);
  ```

- Ensure to set the pointer to function that is used to release the timer allocated by `at_ble_create_timer`
- It must receive timer handle as a parameter.

  ```
  void (*at_ble_start_timer)(void *, uint32_t);
  ```

- Ensure to set the pointer to function that is used to start the timer asynchronously for n milliseconds given in the second parameter. Once it is timeout, the registered callback must be activated
  - The first parameter is the timer handle
  - The second parameter is the time in milliseconds

  ```
  void (*at_ble_stop_timer)(void *);
  ```

- Ensure to set the pointer to function that is used to stop the timer. It must receive timer handle as a parameter

1.2.5 Platform Sleep API

```
void (*at_ble_sleep)(uint32_t);
```

Ensure to set the pointer to function that is used to block for n milliseconds and given as parameter.

1.2.6 Platform 6-Wire Mode Hardware Flowcontrol UART Switch API

```
void (*at_ble_reconfigure_usart)(void);
```

- Ensure to set the pointer to function that is used to reconfigure the UART during `at_ble_init` API call
- This function is a temporary function and more information on this is provided in Temporarily Required Function/Support

1.2.7 Platform Signal API

This section provide the information on Platform Signal API.

```
void *(*at_ble_create_signal)(void);
```

- Ensure to set the pointer to function that is used to create new signal, used for synchronization between threads
- This function must return the signal handle, which is used to trigger, reset or delete the signal

```
void *(*at_ble_delete_signal)(void*);
```

- Ensure to set the pointer to function that is used to release the signal allocated by `at_ble_create_signal`
- It must receive the signal handle as parameter

```
void *(*at_ble_trigger_signal)(void*);
```

- Ensure to set the pointer to function that is used to trigger the signal allocated by `at_ble_create_signal`
- It must receive the signal handle as parameter

```
void *(*at_ble_reset_signal)(void*);
```

- Ensure to set the pointer to function that is used to reset the signal allocated by `at_ble_create_signal`
- It must receive the signal handle as parameter

```
void *(*at_ble_wait_for_signal)(uint32_t, void**);
```

- Ensure to set the pointer to function which blocks any signal in the parameter signal list. So that the platform can switch the context to another operating system (OS). This function is required for cooperative multitasking Real-time Operating System (RTOS). If not required, set it to NULL
  - The first parameter is the number of signals the function monitors
  - The second parameter is an array of signals that handle the function monitoring

Note: For non-OS based system, there is a default implementation of signal functions that implements the signals as simple Boolean flags.

2. Temporarily Required Function/Support

For enabling the flow control, use `at_ble_reconfigure_usart` API to switch the primary UART to another UART and must be removed after HW fix. For more details refer http://www.microchip.com/wwwproducts/en/atbtlc1000.

Note: This function is required only for 6-Wire mode configuration.

For details on hardware connections required for 4-Wire and 6-Wire mode configuration, refer *BluSDK Release Notes*.

For 6-Wire mode, `bus_flow_control_enabled flag` of `at_ble_init_config_t` must be true and for 4-Wire configuration, it must be false.

The recommended 6-Wire mode configuration requires 2 UART's.

- One UART with flow control enabled is used during the normal operation
- Another UART (primary UART) without flow control is used during the initialization

Note: The `at_ble_reconfigure_usart` API can be used to switch the primary UART to another UART.

2.1 Complier Support

BluSDK library support following compilers:

- GCC
- IAR
- KEIL

2.2 Architecture Support

BluSDK library support following cortex architectures:

- Cortex M0+
- Cortex M3
- Cortex M4

3. Document Revision History

Rev A - 07/2017

Section	Changes
Document	• Updated from Atmel to Microchip template. • Assigned a new Microchip document number. Previous version is Atmel 42526 revision C. • ISBN number added.

The Microchip Web Site

Microchip provides online support via our web site at http://www.microchip.com/. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Customer Change Notification Service

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at http://www.microchip.com/. Under "Support", click on "Customer Change Notification" and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a

violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Legal Notice

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BeaconThings, BitCloud, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Heldo, JukeBlox, KeeLoq, KeeLoq logo, Kleer, LANCheck, LINK MD, maXStylus, maXTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, RightTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and Quiet-Wire are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, CryptoAuthentication, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KleerNet, KleerNet logo, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PureSilicon, QMatrix, RightTouch logo, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2017, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-5224-1890-0

Quality Management System Certified by DNV

ISO/TS 16949

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: http://www.microchip.com/support Web Address: www.microchip.com **Atlanta** Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455 **Austin, TX** Tel: 512-257-3370 **Boston** Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088 **Chicago** Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075 **Dallas** Addison, TX Tel: 972-818-7423 Fax: 972-818-2924 **Detroit** Novi, MI Tel: 248-848-4000 **Houston, TX** Tel: 281-894-5983 **Indianapolis** Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380 **Los Angeles** Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800 **Raleigh, NC** Tel: 919-844-7510 **New York, NY** Tel: 631-435-6000 **San Jose, CA** Tel: 408-735-9110 Tel: 408-436-4270 **Canada - Toronto** Tel: 905-695-1980 Fax: 905-695-2078	**Asia Pacific Office** Suites 3707-14, 37th Floor Tower 6, The Gateway Harbour City, Kowloon **Hong Kong** Tel: 852-2943-5100 Fax: 852-2401-3431 **Australia - Sydney** Tel: 61-2-9868-6733 Fax: 61-2-9868-6755 **China - Beijing** Tel: 86-10-8569-7000 Fax: 86-10-8528-2104 **China - Chengdu** Tel: 86-28-8665-5511 Fax: 86-28-8665-7889 **China - Chongqing** Tel: 86-23-8980-9588 Fax: 86-23-8980-9500 **China - Dongguan** Tel: 86-769-8702-9880 **China - Guangzhou** Tel: 86-20-8755-8029 **China - Hangzhou** Tel: 86-571-8792-8115 Fax: 86-571-8792-8116 **China - Hong Kong SAR** Tel: 852-2943-5100 Fax: 852-2401-3431 **China - Nanjing** Tel: 86-25-8473-2460 Fax: 86-25-8473-2470 **China - Qingdao** Tel: 86-532-8502-7355 Fax: 86-532-8502-7205 **China - Shanghai** Tel: 86-21-3326-8000 Fax: 86-21-3326-8021 **China - Shenyang** Tel: 86-24-2334-2829 Fax: 86-24-2334-2393 **China - Shenzhen** Tel: 86-755-8864-2200 Fax: 86-755-8203-1760 **China - Wuhan** Tel: 86-27-5980-5300 Fax: 86-27-5980-5118 **China - Xian** Tel: 86-29-8833-7252 Fax: 86-29-8833-7256	**China - Xiamen** Tel: 86-592-2388138 Fax: 86-592-2388130 **China - Zhuhai** Tel: 86-756-3210040 Fax: 86-756-3210049 **India - Bangalore** Tel: 91-80-3090-4444 Fax: 91-80-3090-4123 **India - New Delhi** Tel: 91-11-4160-8631 Fax: 91-11-4160-8632 **India - Pune** Tel: 91-20-3019-1500 **Japan - Osaka** Tel: 81-6-6152-7160 Fax: 81-6-6152-9310 **Japan - Tokyo** Tel: 81-3-6880- 3770 Fax: 81-3-6880-3771 **Korea - Daegu** Tel: 82-53-744-4301 Fax: 82-53-744-4302 **Korea - Seoul** Tel: 82-2-554-7200 Fax: 82-2-558-5932 or 82-2-558-5934 **Malaysia - Kuala Lumpur** Tel: 60-3-6201-9857 Fax: 60-3-6201-9859 **Malaysia - Penang** Tel: 60-4-227-8870 Fax: 60-4-227-4068 **Philippines - Manila** Tel: 63-2-634-9065 Fax: 63-2-634-9069 **Singapore** Tel: 65-6334-8870 Fax: 65-6334-8850 **Taiwan - Hsin Chu** Tel: 886-3-5778-366 Fax: 886-3-5770-955 **Taiwan - Kaohsiung** Tel: 886-7-213-7830 **Taiwan - Taipei** Tel: 886-2-2508-8600 Fax: 886-2-2508-0102 **Thailand - Bangkok** Tel: 66-2-694-1351 Fax: 66-2-694-1350	**Austria - Wels** Tel: 43-7242-2244-39 Fax: 43-7242-2244-393 **Denmark - Copenhagen** Tel: 45-4450-2828 Fax: 45-4485-2829 **Finland - Espoo** Tel: 358-9-4520-820 **France - Paris** Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79 **France - Saint Cloud** Tel: 33-1-30-60-70-00 **Germany - Garching** Tel: 49-8931-9700 **Germany - Haan** Tel: 49-2129-3766400 **Germany - Heilbronn** Tel: 49-7131-67-3636 **Germany - Karlsruhe** Tel: 49-721-625370 **Germany - Munich** Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 **Germany - Rosenheim** Tel: 49-8031-354-560 **Israel - Ra'anana** Tel: 972-9-744-7705 **Italy - Milan** Tel: 39-0331-742611 Fax: 39-0331-466781 **Italy - Padova** Tel: 39-049-7625286 **Netherlands - Drunen** Tel: 31-416-690399 Fax: 31-416-690340 **Norway - Trondheim** Tel: 47-7289-7561 **Poland - Warsaw** Tel: 48-22-3325737 **Romania - Bucharest** Tel: 40-21-407-87-50 **Spain - Madrid** Tel: 34-91-708-08-90 Fax: 34-91-708-08-91 **Sweden - Gothenberg** Tel: 46-31-704-60-40 **Sweden - Stockholm** Tel: 46-8-5090-4654 **UK - Wokingham** Tel: 44-118-921-5800 Fax: 44-118-921-5820