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XBee 3 802.15.4 Release Notes

XBee 3 802.15.4

Version 200D - June 4, 2021

INTRODUCTION

These release notes document changes made to the 802.15.4 firmware on the XBee 3 RF modules.

- [Product Information](#)
- [Documentation](#)
- [Support](#)

SUPPORTED PRODUCTS

- XB3-24 - XBee 3 2.4 GHz radio module
 - Micro (MMT)
 - Surface Mount (SMT)
 - Through Hole (THT)

KNOWN ISSUES

1. If a remote radio's buffer is full due to RTS holding off incoming data, any remote AT command to this node will fail to generate a remote AT Command response. [*XBHAWKDP-247*]
2. Self-addressed OTA updates may be unreliable. When updating a local device, the serial firmware update process should be used. [*XBHAWK-337*]
3. Sending an explicit transmission (either via a 0x11 API frame or MicroPython `xbee.transmit()` function call) will always use the default endpoints, cluster ID, and profile ID. [*XBHAWKDP-617*]
4. While performing intensive file system operations, there is a chance that incoming RF data will be lost. [*XBHAWK-473*]
5. If a MicroPython application using the `idle_radio` feature puts the module to sleep while the radio is idle, the module will be unable to send or receive transmissions until the module is reset. This can be avoided by re-enabling the radio (if it is idle) immediately before going to sleep, then disabling it again upon wake. [*XBHAWKDP-770*]

UPDATE CONSIDERATIONS

XCTU (XBee Configuration and Test Utility) is recommended for updating the firmware of your radio module to the latest firmware version: www.digi.com/xctu

OTA firmware updates use the same storage space as the file system and MicroPython code. Initiating an OTA firmware update will erase the file system of the target device. After performing an OTA firmware update, you can subsequently perform an OTA file system update to push a MicroPython application.

The file system will need to be formatted after a firmware update before it can be utilized. If a serial firmware update was performed, the file system and bundled code on the device is retained but can only be accessed by the version of firmware that was active at the time it was formatted.

Example: If the file system was formatted for version 2005, it would not be accessible after a serial firmware update to 2006. To make use of the file system, it should be formatted for version 2006. If instead the file system is left untouched and the firmware is serially downgraded back to 2005, the file system from before the firmware update would be accessible.

OTA firmware and bootloader update support was added in version 2002. **You must perform a serial update to firmware version 2002 or later and bootloader version 166 or later to be able to perform subsequent OTA firmware and bootloader updates.**

A firmware update from 2001 to any later release results in loss of configuration. As a result, the updated software will operate with default settings. **After the update from 2001, configuration will need to be set via the serial port.**

Updating from version 2002/2003 to 2005 will reset the radio to factory default. This update is destructive and all network configuration settings will be lost. Updating from version 2002/2003 directly to 2006 will retain configuration.

Performing a software downgrade to version 2003 or older will restore the device to default. If performing a downgrade, configuration will need to be set via the serial port.

Update from Update to Update Method Configuration Retained?

2001	Any	Serial only	No
2002 - 2003	2005	Serial only	No
2002 - 2003	2006 or newer	Serial or OTA	Yes
2005	2006 or newer	Serial or OTA	Yes

The following files are included in XBee 3 RF firmware releases:

- Firmware
 - GBL: Firmware image for gateways and OEM serial updates
 - OTA: Firmware image for OTA firmware updates
 - OTB: Firmware + bootloader image for OTA updates
 - EHX: Encrypted firmware for Legacy X-CTU
 - EHX2: Encrypted firmware for XCTU-NG

- Configuration
 - MXI: Legacy X-CTU configuration file
 - XML: XCTU-NG configuration file

UPDATE BEST PRACTICES

Digi recommends the following best practices:

1. Test the new release in a controlled environment with your application before you update production devices.
2. Unless otherwise noted, apply updates in the following order:
 1. Device firmware
 2. Modem firmware
 3. Configuration
 4. Application

Digi recommends Digi Remote Manager for automated device updates. For more information, go to <https://www.digi.com/products/iot-platform/digi-remote-manager>.

If you prefer manually updating one device at a time, follow these steps:

Serial firmware updates:

Invoke the bootloader using one of two methods:

- Issue the %P AT Command
- [Using hardware flow control lines](#)

Interface with the bootloader at 115200 baud and transfer a bootloader or firmware image as per the [user guide](#).

An [XBee MultiProgrammer](#) is available for serial firmware updates in a production environment.

OTA firmware/file system updates:

Refer to the [user guide](#) for information on performing an OTA firmware and file system update.

The OTA firmware update process for XBee 3 is the same across all supported RF firmwares and utilizes ZCL frames. To perform an OTA bootloader update, use the supplied *.OTB file, which is a combined firmware + bootloader image. The *.OTA file is just the firmware.

The [XBee Network Assistant](#) can be used to manage your network and optimize it's configuration prior to performing an OTA update.

TECHNICAL SUPPORT

Get the help you need via our Technical Support team and online resources. Digi offers multiple support levels and professional services to meet your needs. All Digi customers have access to product documentation, firmware, drivers, knowledge base and peer-to-peer support forums.

Visit us at <https://www.digi.com/support> to find out more.

CHANGE LOG

200D - XBee 3 802.15.4 (June 4, 2021)

- This is a recommended release
- [Bootloader version: 1.11.2](#)
- Hardware revision M

ENHANCEMENTS

1. Changes to support a new hardware revision of the Xbee3 module. The hardware revision can be determined by querying the %C AT command. Modules with a %C value of 2 or greater cannot run firmware versions prior to this release.
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200C - XBee 3 802.15.4 (November 13, 2020)

- This is a recommended release
- [Bootloader version: 1.8.1](#)
- Hardware revision N

BUG FIXES

1. Fixed watchdog timeout issue for a sleeping end device when sending RF data at the trailing end of a wake period. [XBHAWKDP-771]
-

200B - XBee 3 802.15.4 (August 28, 2020)

- This is a recommended release
- [Bootloader version: 1.8.1](#)
- Hardware revision M

NEW FEATURES

1. The `modem_status.receive()` and `modem_status.callback()` functions have been added to the `xbee` module in MicroPython, allowing MicroPython applications to respond to modem status messages generated by the module.
2. The `receive_callback()` function has been added to the `xbee` module in MicroPython, allowing MicroPython applications to register a callback to handle incoming RF packets.
3. The `xbee_connect()` function has been added to the `ble` module in MicroPython, which allows XBees to connect via Bluetooth to other XBees.
4. The `idle_radio()` function has been added to MicroPython, allowing modules to put the radio in an idle state when RF receptions are not needed in order to further reduce power usage.
5. The `ucryptolib` MicroPython module has been added allowing for hardware accelerated AES encryption/decryption in user applications.

ENHANCEMENTS

1. The `sleep_now()` function when using the pin wake option will now sleep regardless of the current state of the SLEEP_RQ line. The function can also be used to go to sleep without setting a timeout which

consumes slightly less power than sleeping with a timeout. If using pin wake, the SLEEP_RQ line will only wake the radio on a falling edge. This allows the module to sleep when a one-shot pulse is used for wakeup. [XBHAWK-527], [XBHAWK-518]

2. Expanded sleepy end device I/O sampling capability, when **IF** is set to zero allows I/O samples to be sent before the device sleeps and occurring thereafter every wake cycle specified by **IR** sample rate. [XBHAWKDM-829]
3. The Over-Voltage detection has changed to allow the module to continue to operate but will limit the RF power level **PL** setting to a value of 3 when the operating voltage reaches 3.7 volts or higher. If the module is in API mode, it will emit Over-Voltage modem status frames periodically as long as the operating voltage remains above 3.7 volts. [XBHAWKZB-1656]
4. Enhanced the sleeping end device join sequence for channel and network ID reassignment **A1** bits 0 and 1 options to reduce the overall joining time. [XBHAWKDP-768]

SECURITY FIXES

- N/A

BUG FIXES

1. Fixed issue when **P5** - **P9** are set as digital outputs were being pulled up instead of driven high or low during sleep. [XBHAWK-524]
2. Fixed an issue where the module would lock up if encryption was enabled, if the module was cyclically sleeping, and if data was being received rapidly. [XBHAWKDP-733]
3. Fixed I/O sampling feature for sleeping end device where it now sends samples based on the **IF** setting. [XBHAWKDP-737]
4. Fixed I/O sampling sleeping end device issue when **RR** is greater than zero caused indirect messages to be missed. [XBHAWKDP-764]
5. Fixed sleep issue where MicroPython `sleep_now()` and cyclic sleep **SM** options 4 and 5 was limited to 65,535 milliseconds. [XBHAWKZB-1701]
6. Fixed a problem with losing access to the serial port by changing the configuration of P7 from 1 to 4. This action had the effect of driving SSEL low, causing an interrupt which switched operation from the UART port to the SPI port. [XBHAWKDP-767] Workaround when using older versions of this code is to set P5, P6, or P8 to a value other than 1, apply the changes (ATAC), and then set P7 to 4. By using this sequence, the SPI is already disabled before P7 is set to 4 so that the interrupt to switch to the SPI port cannot happen.

200A XBee 3 802.15.4 (April 30, 2020)

- This is a required release
- [Bootloader version: 1.8.1](#)
- Hardware revision L

NEW FEATURES

1. An OTA server can now be specified with the **US** command. If **US** is non-zero, OTA updates will only be accepted from a server whose 64-bit address matches the value of **US**.
2. Bluetooth Low Energy (BLE) GAP scan and advertisements in MicroPython

- The `digi.ble` module is now available in MicroPython.
 - GAP scan (advertisement discovery) and custom advertisement is supported.
 - GAP advertise (custom advertisement).
 - GAP connect.
 - GATT client operations.
 - See the [MicroPython Programming Guide](#) for additional details.
 - See the [Digi XBee PyCharm IDE plugin](#) and [XBee Mobile SDK](#) for examples.
3. The **BI** command has been added, which determines the name that appears in the BLE advertisement data. If **BI** is set to the default value (0x20; ASCII space character), the default “XBee3 802.15.4” name will be used. [*XBHAWKDP-703*]
 4. The **BP** command has been added to allow adjustment of the BLE advertisement power level using options 0 - 3:
 - 0 = -20 dBm
 - 1 = -10 dBm
 - 2 = 0 dBm
 - 3 = 8 dBm
 5. The `WDT` class has been added to the `machine` MicroPython module. This allows for the system to detect a hung or poorly behaved application in certain scenarios and recover. The Digi implementation differs from upstream in that it has modified defaults and allows a selection of recovery strategies.
 - See the [MicroPython Programming Guide](#) for additional details.
 - An example of use can be found on our [github repo](#).

ENHANCEMENTS

1. Multiple changes have been made to the over-the-air firmware update process to bring it into alignment with the ZCL specification that it is based on. Refer to the user guide section on OTA updates for more information.
2. A firmware or filesystem OTA update can now be scheduled for a certain time or delay. When performing an OTA firmware update, the radio will schedule the update to occur based on the `currentTime` and `upgradeTime` fields in the upgrade end response.
3. OTA updates are now more likely to succeed in challenging network conditions. When an OTA update client doesn't receive a response to a request or receives an invalid response, it will attempt the request again.
4. Increased the amount of RAM available to the MicroPython interpreter to allow for more complex applications.
5. If a password is included in a secure session logout frame, the password will be ignored and the logout completed instead of generating an error.
6. Some configuration options within XCTU have been rearranged and new sections added to improve usability.
 - **R?** command has been added to XCTU configuration, this command identifies the power variant (PRO or Non-PRO) of the device.
 - **VL** command has been added to XCTU configuration, this command provides some details about the hardware and software.

SECURITY FIXES

1. Fixed issue where the Secure Session authentication is not randomized if BLE is not enabled. *[XBHAWK-416]*
 - See [security notice knowledge base article](#) for additional information.

BUG FIXES

1. Fixed issue where setting SPI pins to outputs would reset the module. *[XBHAWKDP-709]*
2. Resolved an issue where a device could unexpectedly reset if multiple nodes in the same network were simultaneously sending broadcasts. *[XBHAWKDP-722]*
3. Resolved an issue where switching from short to long addressing by changing addressing parameters in API mode would not properly recalculate the maximum payload sizes for subsequent transparent mode operation. *[XBHAWKDP-728]*

MicroPython:

4. The MicroPython machine class can now differentiate between several different types of reset causes. See [Digi Micropython Programming Guide](#) for a complete list of reset causes. *[XBHAWKDP-713]*
5. `ATPY^` now correctly interrupts a MicroPython script which has disabled keyboard interrupts using `micropython.kbd_intr(-1)`. *[XBPY-446]*
6. The MicroPython REPL no longer continuously prints “soft reboot” if autostart is disabled after the script starts and the script performs a soft reset. *[XBPY-795]*
7. Calling `os.remove()` will properly trim the file system and reclaim space. *[XBHAWK-407]*

2006 XBee 3 802.15.4 (September 30, 2019)

- [Bootloader version: 1.8.1](#)
- Hardware revision K

NEW FEATURES

1. Secure Session
This expansion to the Digi Trustfence allows you to establish a Secure Session between two XBee modules using SRP authentication. Data payloads sent across a secure session can be encrypted, providing trusted end-to-end encryption of secure data, even on an unencrypted network. *[XBHAWKDP-657]*
 - To protect against unauthorized remote configuration, set a Secure Session password and enable bit 1 of the **SA** command. Once configured this way, remote configuration can only be performed when a secure session is established and command option bit 4 is set in the 0x17 Remote AT Command options field. *[XBHAWKDP-656]*
 - To protect serial RF data output, configure a Secure Session password and enable bit 2 of the **SA** command. Once configured this way, serial RF data will only be emitted when a secure session is established and the Transmit Options bit 4 is set in an outgoing 0x10 or 0x11 frame. *[XBHAWKDP-670]*

ENHANCEMENTS

1. **DM** command expanded to allow disabling SRP authentication for secure session.
2. **FS INFO** has been enhanced with a new command parameter: **FS INFO FULL**

- This provides information about the placement order of files in the file system.
 - This will also indicate if there are any deleted files or unused directory slots.
3. Removing a file from the File System will reclaim space if the removed file was located at the end of the file system. This will also cause space taken by adjacent deleted files to be reclaimed as well.
 4. The XBee ANSI C library has been refreshed and fully supports the XBee 3:
https://github.com/digidotcom/xbee_ansi_library

BUG FIXES

1. Resolved an issue that was preventing configuration from being retained when performing a firmware update. Updating from version 2003 or 2005 to version 2006 will properly transfer the device configuration. [*XBHAWKDP-692*]
 2. Resolved an issue where an interrupt-driven event that occurs while entering sleep could cause unexpected behavior. [*XBHAWKDP-688*]
 3. Resolved an issue that would cause the On/nSleep pin to behave unexpectedly if the DTR line was disabled and SPI_nSSEL was being used for pin sleep. [*XBHAWKDP-687*]
 4. 802.15.4 RF traffic is no longer disrupted during a BLE authentication attempt [*XBHAWKDP-683*]
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2005 XBee 3 802.15.4 (August 23, 2019)

- [Bootloader version: 1.8.1](#)
- Hardware revision J

NEW FEATURES

1. Added Bluetooth Low Energy (BLE) Support
 - BLE can be enabled by setting **BT** to **1** and setting a BLE Salt + Verifier.
 - For BLE to operate, the PHY will switch between BLE and RF as-needed. While BLE is actively using the PHY, incoming 802.15.4 RF packets will be missed. To avoid this loss, retries (**RR** command) on the 802.15.4 RF must be utilized.
2. Added support for the 0x2D Data Relay Frame
3. Added location parameters to configuration. These are intended for use with Digi Remote Manager and Network Assistant to track a device's location based on GPS coordinates saved to flash. These location fields are user-defined and accept up to 15 ASCII characters:
 - **LX** = Location X - Longitude
 - **LY** = Location Y - Latitude
 - **LZ** = Location Z - Elevation
4. Added **DM** command which can be used to disable OTA firmware updates. [*XBHAWKDP-643*]

ENHANCEMENTS

1. The `ticks_us()` function has been added to MicroPython, allowing microsecond-resolution timing. [*XBHAWK-217*]
2. MicroPython has been updated and is now based off of the 1.11 release of the MicroPython project. [*XBPY-384*]

3. Reduced the time it takes to enter pin sleep by approximately 5ms. [XBHAWKDP-637]
4. The default CCA threshold has been increased to -50dBm and additional CCA checks have been added to improve reliability in a heavily congested environment. [XBHAWKDP-542]
5. The number of MAC-Layer retries has been increased from 3 to 5; retry timing has also been optimized.
6. Improved reliability of detecting very short pulses on DTR when configured for pin sleep. [XBHAWK-247]

BUG FIXES

1. Resolved an issue where restoring non-default configuration after a reset could cause devices to leave the network unexpectedly. [XBHAWK-175]
 2. Resolved an issue where receiving too many packets while the device is in MicroPython mode and not handling them with `xbee.receive()` would cause the device to lock up. [XBHAWK-179]
 3. Resolved an issue where calling `xbee.sleep_now(pin_wake=True)` in MicroPython would make the `pin_wake` parameter permanently True. [XBHAWKDP-612]
 4. Resolved an issue that would cause a device to crash if it had an invalid configuration and attempted to send an I/O sample upon boot. [XBHAWKDP-622]
 5. Resolved an RS-485 issue where option **D7**=6 or 7 would not take effect until after reset or power cycle. [XBHAWKDP-627]
 6. Entering a duplicate entry in custom defaults will now override the previous entry. You no longer need to clear custom defaults before making changes. [XBHAWK-75]
 7. Resolved an issue that would cause a pin configured for ADC input to not take full effect until after a power cycle, which may have caused some inaccuracies in ADC measurements. [XBHAWK-242]
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2003 XBee 3 802.15.4 (April 10, 2019)

- [Bootloader version: 1.8.1](#)
- Hardware revision H

NEW FEATURES

1. MicroPython support
 - Digital I/O
 - ADC input
 - PWM output
 - I2C serial interface
 - Transmit and receive RF packets
 - Network Discovery
 - MicroPython sleep support (**SM** option 6 has been added to support this)
2. File System support
 - Includes support for OTA File System updates. This utilizes the same method as OTA firmware updates.
 - Local file system access via the **FS** AT Command.
 - XCTU can be used to easily navigate the file system of local and remote modules.

ENHANCEMENTS

1. Legacy 802.15.4 XBee radios (S1 and S2C) are now able to associate as end devices to an XBee 3 PAN coordinator. [*XBHAWKDP-457*]

SECURITY FIXES

1. Bootloader - Improved ECDSA signature check which provides protection against fraudulent firmware update images. [*XB3BOOT-52*]
 - Note: The bootloader cannot be downgraded

BUG FIXES

1. Resolved an issue where the device would enter into SPI mode if UART DOUT was floating upon boot. [*XBHAWKDP-526*]
2. Resolved an issue that required I/O lines to be set twice before the pin state would follow. [*XBHAWKDP-532*]
3. Enabling cyclic sleep while using the default **SP** value of 0 would cause the device to sleep and never wake. The device will now stay awake until a non-zero **SP** value is provided. [*XBHAWKDP-565*]
4. Resolved an issue that could cause the OTA update server to reset unexpectedly when updating a remote node in an unencrypted network. [*XBHAWKDP-517*]
5. Resolved issue where a module operating in SPI with pin sleep enabled will not wake properly via the SSEL pin. [*XBHAWKDP-578*]
6. Resolved an issue where a coordinator was unable to send data after a reset. [*XBHAWKDP-570*]
7. Resolved an issue where an unassociated end device set up for cyclic sleep would not sleep. [*XBHAWKDP-571*]
8. Resolved an issue where a device would delay sending RF messages for ~ 1 second after changing the network channel. [*XBHAWKDP-576*]
9. The ON_SLEEP pin was not accurately showing when the module was ready to receive data after waking from sleep. [*XBHAWK-119*]

2002 XBee 3 802.15.4 (September 26, 2018)

- Bootloader version: 1.6.6
 - This version of the bootloader is required to support 802.15.4 version 2002 and later.
 - The locations and sizes of the application, the storage slot, and the configuration changed between bootloader version 1.6.6 and the previously released bootloader (1.1.x). This was done to optimize storage space to allow for the largest possible MicroPython application size. This means that configuration information will be lost upon upgrading to version 1.6.6 of the bootloader.
- Hardware revisions E-G

NEW FEATURES

1. Sleep support has been added
2. Indirect messaging has been added
3. Full I/O support has been added
 - Digital Input and Output

- Analog Input (10-bit ADC)
 - PWM output
 - I/O sampling
 - I/O Line Passing
4. SPI support (through AT commands **P5-P9** for SMT and **D1-D4, P2** for TH)
 5. Added support for custom defaults, which will allow you to specify which command parameters are assigned by default when the device is restored to factory default.
 - This can be useful for setting certain parameters such as **BD** and **ID** that are critical for proper operation while still allowing the user to revert to the customer defaults with an **RE** command.
 6. Active Scan (**AS**) and Energy Detect (**ED**) has been added
 7. 41 new AT Command for greater flexibility and control, refer to the user guide for full list.
 8. Voltage and temperature sampling
 - Overvoltage detection via modem status frame when operating in API mode
 9. Security options now available (through the **EE** and **KY** AT commands)
 - Encryption is 128-bit AES with counter (CTR) mode
 10. 802.15.4 Coordinator and End Device support (**A1, A2, DP, and CE** commands)

Bootloader:

11. OTA firmware update support.
12. OTA bootloader update support when combined with application image.

ENHANCEMENTS

1. Improved I/O support offering more IO lines (**D0-D9, P0-P2**) and greater versatility
 - Enhanced I/O support is enabled by setting **AO** to 0 or 1
 - Enhanced I/O support will output I/O sample data as a 0x92 API frame
 - Legacy I/O support (compatible with S1 802.15.4 and S2C 802.15.4) is enabled by default (**AO** is set to 2)
 - Set/Read output timeout values for line passing available through AT commands **T0-T9** and **Q0-Q2**
2. Improved throughput and latency compared to S2C and S1
3. New transmission frames are available for API compatibility with DigiMesh/Zigbee:
 - New transmission frames 0x10 and 0x11 that give transmit status 0x8B
 - New receive frames 0x90 and 0x91; output frame type be configured using the **AO** command
4. A configuration CRC has been added via the **CK** command. This allows you to verify device configuration or to detect unexpected changes.
5. Added a sleep option (**SO** bit 8) to force the device to wake for the entire **ST** duration.

Bootloader:

6. LZMA compression, which reduces image size by about 30%.
7. Improved bootup time (now instantaneous compared with about 2 seconds previously).

BUG FIXES

1. **NP** now assumes long addressing will always be used when calculating maximum payload size.
 2. Watchdog reset functionality has been added.
 3. Serial break is now more accurately detected when entering command mode via reset + serial break.
 4. **VL** command now correctly reports the bootloader version.
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2001 XBee 3 802.15.4 (January 19, 2018)

- Hardware revisions: A-D
- Bootloader version: 1.1.8

NEW FEATURES

- Initial release

ENHANCEMENTS

- Refer to the [XBee 3 802.15.4 migration guide](#) for more information on the enhancements made to the 802.15.4 firmware on XBee 3 compared to the 802.15.4 firmware on the S1 and S2C XBee modules.
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