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# XBee 3 DigiMesh Release Notes

### XBee 3 DigiMesh

### Version 300D - June 4, 2021

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## INTRODUCTION

These release notes document changes made to the DigiMesh 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. The Diagnostic counts for transmissions (**EA** and **TR**) are not always as expected because sometimes there is an extra network retry. *[XBHAWKDM-200]*

2. The **FT** flow control threshold may not be calculating number of bytes properly. If **FT** is set to too low of a value (less than 0x20), CTS will assert indefinitely. *[XBHAWKDM-611]*

3. If a data transmission is attempted immediately after boot, there is a chance that the packet will be dropped. A small delay after a power cycle should alleviate this issue. *[XBHAWKDM-659]*

4. Duplicate packets can occur if streaming unicast data across multiple synchronous sleep cycles. *[XBHAWKDM-739]*

5. Self-addressed OTA updates may be unreliable. When updating a local device, the serial firmware update process should be used. *[XBHAWK-337]*

**MicroPython:**

6. Data loss may be encountered if a large amount of data is pasted into the raw REPL at a high baud rate. If pasting a large amount of data, it's recommended to use a serial baud rate of 230400 or lower or to paste the data in smaller (<5kB) chunks. *[XBHAWK-131]*

# 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 3003, it would not be accessible after a serial firmware update to 3004. To make use of the file system, it should be formatted for version 3004. If instead the file system is left untouched and the firmware is serially downgraded back to 3003, the file system from before the firmware update would be accessible.

OTA firmware and bootloader update support was added in version 3001. **You must perform a serial update to firmware version 3001 or later and bootloader version 166 or later to be able to perform subsequent OTA firmware and bootloader updates.**

A firmware update from 3000 to any later release results in loss of configuration. As a result, the updated software will operate with default settings. **After the update from 3000, configuration will need to be set via the serial port.**

Downgrading to version 3001 or 3000 will reset the radio to default. If performing a downgrade, configuration will need to be set via the serial port.

| Update from | Update to | Update Method | Configuration Retained? |
|---|---|---|---|
| 3000 | Any | Serial only | No |
| 3001 or newer | Any 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.

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# CHANGE LOG

# 300D - XBee 3 DigiMesh 2.4 (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.

# 300B - XBee 3 DigiMesh 2.4 (August 14, 2020)

- This is a optional/recommended/required release
- Bootloader version: 1.8.1
- Hardware revision L

## NEW FEATURES

1. Sleep Immediate (*SI*) command was added for synchronously sleeping networks. This allows a synchronously sleeping network to save battery life by putting the whole network asleep before *OW* time expires. The network stays synchronized because sleeping early does not affect the wake time. This gives some flexibility to save significant battery life in a network that may occasionally need a long wake time, but not usually.

2. 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.

3. 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.

4. The `xbee_connect()` function has been added to the `ble` module in MicroPython, which allows XBees to connect via Bluetooth to other XBees.

5. 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.

6. The `ucryptolib` MicroPython module has been added allowing for hardware accelerated AES encryption/decryption in user applications.

## ENHANCEMENTS

1. Pending commands (commands that don't give immediate results e.g. *ND*), no longer need to be completed before a non-pending command can execute, provided that non-pending command is *not* entered from command mode. This means that it is either an API AT command, a remote AT command, or an AT command accessed from micropython. The purpose of this enhancement is to improve the performance of gateway software, especially in a synchronously sleeping network. *[XBHAWKDM-814]*

2. 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]*

3. 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]*

4. 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]*

### SECURITY FIXES

1. This release patches a security issue whereby the user can force the counter in counter mode encryption to be repeated.

### 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 sleep issue where MicroPython `sleep_now()` and cyclic sleep **SM** options 4 and 5 were limited to 65,535 milliseconds. *[XBHAWKZB-1701]*

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## 300A - XBee 3 DigiMesh 2.4 (April 30, 2020)

- This is a recommended release
- Bootloader version: 1.8.1
- Hardware revision K

### 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. 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 DigiMesh RF packets will be missed. To avoid this loss, retries on the DigiMesh RF must be utilized. The default **RR** (unicasts retries) and **MT** (broadcast Multi-Transmits) are sufficient to prevent data loss in most situations.

3. 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.

4. 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 DigiMesh 2.4" name will be used. *[XBHAWKZB-1534]*

5. 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

6. 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 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.

7. The XBee ANSI C library has been refreshed and fully supports the XBee 3: https://github.com/digidotcom/xbee_ansic_library

## BUG FIXES

1. The Default Device Type ID (**DD** command) was set to a legacy value for XBee 3 DigiMesh. This has now been corrected; the new default value for **DD** is 0x140000.

2. During a successful OTA update, a transmission status (0x89) message with an error no longer occurs on a query next image response or an upgrade end response. Instead, both transmissions from the server will receive a successful transmission status. *[XBHAWK-380]*

3. Resolved a module lock-up issue triggered by concurrent transmissions and flash operations. *[XBHAWKDM-808]*

4. Resolved a bug where several bytes would be prepended/removed from relay frames sent to/from MicroPython. *[XBHAWKDM-819]*

5. Streaming broadcast transparent data across multiple synchronous sleep periods now avoids loss of data *[XBHAWKDM-823]*

**MicroPython:**

6. Resolved an issue that would cause a conflict if MicroPython read an I/O line at the same time as the XBee application (e.g. **IR** is set and an `ADC.read()` occurs). *[XBHAWKDM-800]*
7. ATPY^ now correctly interrupts a MicroPython script which has disabled keyboard interrupts using `micropython.kbd_intr(-1)`. *[XBPY-446]*
8. 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]*
9. Calling `os.remove()` will properly trim the file system and reclaim space. *[XBHAWK-407]*

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# 3004 - XBee 3 DigiMesh 2.4 (September 30, 2019)

- Bootloader version: 1.8.1
- Hardware revision J

## 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. *[XBHAWK-59]*
   - 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. *[XBHAWKDM-768]*
   - 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. *[XBHAWKDM-775]*
2. 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

## ENHANCEMENTS

1. Expanded the **DM** command to include options for disabling OTA firmware updates and SRP authentication for secure session. *[XBHAWKDM-756]*
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. Improved reliability of detecting very short pulses on DTR when configured for pin sleep. *[XBHAWK-247]*

### BUG FIXES

1. Resolved an issue where an interrupt-driven event that occurs while entering sleep could cause unexpected behavior. *[XBHAWKDM-781]*
2. 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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## 3003 - XBee 3 DigiMesh 2.4 (July 12, 2019)

- Bootloader version: 1.8.1
- Hardware revision H

### NEW FEATURES

1. Added support for the 0x2D Data Relay Frame

### ENHANCEMENTS

1. Asynchronous Cyclic Sleep with Pin Wake (**SM** option 5) will now always wake for a minimum of **ST** time in response to a falling edge on nDTR/SLEEP_RQ.
2. The `ticks_us()` function has been added to MicroPython, allowing microsecond-resolution timing.
3. MicroPython has been updated and is now based off of the 1.11 release of the MicroPython project.

### BUG FIXES

1. Resolved an issue where calling xbee.sleep_now(pin_wake=True) in MicroPython would make the pin_wake parameter permanently True. *[XBHAWKDM-746]*
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 that would cause MicroPython to become unresponsive when pasting a large amount of data while entering and exiting paste mode. *[XBHAWK-179]*
4. Resolved RS-485 issue where option **D7**=6 or 7 would not take effect until after reset or power cycle. *[XBHAWKDM-751]*
5. 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]*
6. 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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## 3002 - XBee 3 DigiMesh 2.4 (April 10, 2019)

- Bootloader version: 1.8.1
- Hardware revision G

### NEW FEATURES

1. Support for Synchronized Cyclic Sleep has been added
    - Synchronized Cyclic Sleep can be enabled by setting **SM** to 7 or 8.
    - If there are any XBee S1 modules in the XBee 3 synchronous sleep network, **C8** bit 3 **must** be set. Otherwise, it should be clear.
2. 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)
3. 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. Asynchronous Cyclic Sleep with Pin Wake (**SM** option 5) will always wake for a minimum of **ST** time in response to a falling edge on nDTR/SLEEP_RQ.

### 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 a sleep time longer than 37 seconds would cause the device to reset unexpectedly. *[XBHAWKDM-684]*

2. Resolved an issue where the device would enter pin sleep when both DTR and SSEL were disabled. *[XBHAWKDM-477]*

3. **CE** Option 4 (non-routing, indirect messaging poller) was missing from the XML file. *[XBHAWKDM-686]*

4. Resolved an issue where setting an I/O line as a digital output would only take effect when set twice. *[XBHAWKDM-632]*

5. The ON_SLEEP pin was not accurately showing when the module was ready to receive data after waking from sleep. *[XBHAWK-119]*

6. Resolved an issue where transmitting messages to an address that did not start with Digi's OUI (0013A2xx) would block all transmissions, causing the radio to become unresponsive. These invalid packets are now discarded rather than queued. *[XBHAWKDM-529]*

7. Resolved an issue with a synchronous sleep radio sleeping for days when unicasts are being sent at the time the radio is scheduled to go to sleep. *[XBHAWKDM-737]*

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## 3001 - XBee 3 DigiMesh 2.4 (September 26, 2018)

- Bootloader version: 1.6.6
  - This version of the bootloader is required to support DigiMesh version 3001 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-F

### NEW FEATURES

1. Asynchronous Sleep support has been added
2. Indirect messaging for point-to-point messages 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 has been added

**Bootloader:**

5. OTA firmware update support.
6. OTA bootloader update support when combined with application image.

### ENHANCEMENTS

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

### BUG FIXES

1. Serial traffic upon boot is no longer interpreted as a serial break. Command mode should not be inadvertently entered as a result.
2. RSSI PWM output levels are now correct.

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## 3000 - XBee 3 DigiMesh 2.4 (March 28, 2018)

- Bootloader version: 1.1.8
- Hardware revisions A-C

### NEW FEATURES

Initial Release

### ENHANCEMENTS

Enhancements compared with DM2.4 on XBee S2C and S1: 1. Much smaller footprint

2. Expanded channel selection
3. Lower operating receive current
4. Higher TX power on channel 26 for PRO and no channel 26 power cap for non-PRO
5. **C8** Compatibility command added. Bit 2 (0x04) enables 128-bit encryption for operation with S2C and S1 devices. All other **C8** bits are reserved.
6. **PP** now outputs maximum output power in dBm based on current settings rather than a fixed value.
7. **R?** command indicates region number (read only).
    - 0 indicates USA region and full power (equivalent to S2C PRO).
    - 1 indicates Europe region with limited power (equivalent to S2C non-PRO).
8. **BD** now includes standard baud rates 0x9 (460800bps) and 0xA (921600bps). Custom baud rate can now be set up to 0xEC400 (967680bps).

- Refer to the XBee 3 DigiMesh migration guide for more information on the enhancements made to the DigiMesh 2.4 firmware on XBee 3 compared to the DigiMesh 2.4 firmware on the S1 and S2C XBee modules.

## SECURITY FIXES

1. Enhanced counter mode encryption that protects against replay attacks
    - 256-bit AES encryption when using counter mode
    - Optional legacy 128-bit AES with ECB for backwards compatibility (configured with the **C8** command, bit 2)

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