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## **XBee S2C Zigbee Release Notes**

### **XBee S2C Zigbee**

**Version 4061 - October 31, 2019**

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## **INTRODUCTION**

These release notes document changes made to the Zigbee and Zigbee Smart Energy firmware on the XBee S2C RF modules

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

## **SUPPORTED PRODUCTS**

- XBee S2C
  - XB24C
  - XB24CSE
- XBee-Pro S2C
  - XBP24C
  - XBP24CSE

## **KNOWN ISSUES**

1. When Source Routing is enabled (**AR** != 0xFF): To send a source routed transmission, the application should send a Create Source Route API frame (0x21) to the XBee to create a source route in its internal source route table. After sending the Create Source Route API frame, the application can send data transmission or remote command request frames as needed to the same destination, or any destination in the source route. Once data must be sent to a new destination (a destination not included in the last source route), the application must first send a new Create Source Route API frame. If a Create Source Route API frame does not precede a data frame, route discovery will be used. If route discovery fails, transmit status errors may occur. The XBee can buffer one source route that includes up to 25 hops (excluding source and destination).
2. If a 0x21 Create Source Route frame is sent, a watchdog reset may occur during data transmission if the source route is longer than 21 hops and many-to-one route broadcasts are not being sent (**AR** = 0xFF).

Source routing must be used with many-to-one routing.

3. If encryption is enabled and **KY** is set to a fixed value (non-zero) on routers which are configured as aggregators, doubly APS encrypted source routed packets may occur during association, which would fail to transmit beyond a sufficiently high hop count because the MAC command frame can only hold 127 bytes.
4. Energy Detect (**ED** command) does not currently accept a parameter value. If a parameter value is provided, the radio will reset unexpectedly. [*XBZBS2C-738*]
5. Upon startup, the output power level (**PL**) of the device will revert to the level set at when the module first formed/joined the network. To avoid excessive battery drain, ensure the desired **PL** parameter value is set before commissioning the node onto a network. [*XBZBS2C-780*]
6. If **P3** and **P4** are not configured for UART operation (**P3** and **P4** are not set to 1), the output state of these pins is not guaranteed and command mode will not be accessible through a serial break. Additionally, CTS will erroneously indicate that the UART is clear to send. [*XBZBS2C-619*]
7. Issuing a self-addressed remote AT command (0x17 frametype) will output a duplicate 0x97 command response frame that always indicates a 0x04 Tx Failure status. [*XBZBS2C-265*]
8. Regardless of the configuration of DIO8 (**D8**), if pin sleep is enabled (**SM** = 1 or 5) then DIO8 will be treated as a nSleep\_Rq line and toggle sleep. [*XBZBS2C-577*]
9. If RTS is enabled (**D6** = 1) and deasserted upon boot, network operation will be disrupted until RTS is asserted. [*XBZBS2C-495*]
10. The first wake period when using cyclic sleep will be 500ms longer than subsequent wake periods. [*XBZBS2C-698*]
11. A module operating in API mode with escapes (**AP**=2) will still accept an API frame that has escaped characters that are not escaped. (e.g. 0x13) [*XBZBS2C-574*]

## 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](http://www.digi.com/xctu)

To invoke the bootloader for firmware updates through command mode, you should issue an 'AT%P 5441' which will enter bootloader and retain settings. If you do not include the 0x5441 parameter value, the radio will restore to default upon reset.

If running firmware older than 4050: If your network hosts XBee S2C SMT PROs, and the network is operating on channel 26, you must move your network to another channel before updating firmware to 4050. Failure to do so will result in the following changes to the configuration of the XBee S2C SMT PROs after the update: 1. The configured setting of **SC** will be set to the 4050 default value of 0x7FFF. 2. If the device was joined and operating on channel 26 before the update, a coordinator will form a new network on a valid channel (11-25), and a router/end device will seek to join a network.

The following files are included in XBee S2C RF firmware releases:

- Firmware
  - EBL: Firmware image for gateways and OEM serial updates
  - EHX: Encrypted firmware for Legacy X-CTU
  - EHX2: Encrypted firmware for XCTU-NG

- MXI: X-CTU 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:**

To retain device configuration, you must invoke the XBee bootloader by issuing an **%P** command with a parameter value of '0x5441'; this indicates to the XBee that network and configuration settings should be retained through the subsequent update.

You can also invoke the bootloader [using hardware flow control lines](#) which will not retain device configuration after the serial firmware update.

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

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

*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 - Zigbee

### **4061 - Digi XBee S2C Zigbee (October 31, 2019)**

- This is a recommended release
- Zigbee Stack: EmberZNet 5.6.1.0 Zigbee-PRO stack

- SMT hardware revision T
- SMT PRO hardware revision V
- TH hardware revision M
- TH PRO hardware revision H

## ENHANCEMENTS

1. Enhanced the Network Watchdog to optionally allow routers and end devices to follow the coordinator if a PAN ID change occurs. [*XBZBS2C-721*]
  - This behavior can be enabled by setting Joining Device Controls bit 5 (**DC** | 0x20).
  - The Network Watchdog (**NW**) must be set to a non-zero value to activate this behavior.
  - New a modem status (0x42) has been added to indicate that the Network Watchdog has expired 3 times and scanning has commenced. This applies when Joining Device Controls bit 5 is set (**DC** | 0x20) or Device Option bit 7 is set (**DO** | 0x80).
2. New modem statuses have been added to identify when a PAN ID conflict has occurred. [*XBZBS2C-739*]
  - 0x3F: Emitted by a coordinator that has updated its PAN ID due to a conflict
  - 0x40: Emitted by a router that received a new PAN ID from the coordinator due to a conflict
  - 0x42: Emitted when the network watchdog timeout has expired three times (**NW** > 0)
3. Querying **KY** and **NK** behavior has changed [*XBZBS2C-722*]
  - When queried, **KY** and **NK** will return zero if the value of the key is zero; otherwise, for all other values it will give an OK response to indicate a key is present.
4. **NK** no longer returns 'ERROR' if it is set on an End Device or Router. The functionality of **NK** is still only applicable to the coordinator, but its entry is no longer gated by device role. [*XBZBS2C-628*]

## SECURITY FIXES

1. Changed the **DO** default to set bit 3, this will disable the NULL transport key which can allow a module with non-preconfigured link key (**KY** = 0) to join a network which is configured with a preconfigured link key (**KY** set to non zero). [*XBZBS2C-713*]

## BUG FIXES

1. Added debounce code to resolve an issue where toggling DTR would sometimes not wake the module from sleep. [*XBS1B-428*]
2. Fixed an issue that caused a cyclically sleeping end device to leave the network and re-associate upon waking if it had slept longer than 320 seconds. [*XBZBS2C-703*]

## 4060 - Digi XBee S2C Zigbee (September 29, 2017)

- Zigbee Stack: EmberZNet 5.6.1.0 Zigbee-PRO stack
- SMT hardware revision S
- SMT PRO hardware revisions T-U
- TH hardware revisions K-L
- TH PRO hardware revision G

## ENHANCEMENTS

- Added token recovery when corruption is detected on reset.

## BUG FIXES

1. Fixed issue where malformed 0x21 Create Source Route API frames would cause a watchdog reset

2. Radio now generates a TX Status API frame when sending multicast transmission to endpoint 0xE6
  3. When a module is configured for SPI, the CTS pin can now be configured as a digital output
  4. Fixed an issue where a zigbee sleeping End device would not re-associate to a power-cycled coordinator
  5. Child poll timeout was 256 minutes. Now timeout correlates with sleep settings.
  6. Removed spurious TX status API Frame during Network Watchdog timer resetting
  7. Fixed issue where the leading Command Mode guard time was not being observed. Could cause payloads with “+” character to be delayed in transmission.
  8. Fixed issue where the RSSI PWM line was not reinitialized properly after waking from sleep. Symptoms were an unusually low RSSI PWM signal after waking in spite of received messages until the device had its power reset.
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## 405F - Digi XBee S2C Zigbee (October 26, 2016)

- Zigbee Stack: EmberZNet 5.6.0.1 Zigbee-PRO stack
- SMT hardware revision R
- SMT PRO hardware revision S
- TH hardware revisions H-J
- TH PRO hardware revision F
- Programmable hardware revisions H-J

### BUG FIXES

1. Resolved problem with excessive current draw on a through hole module when **D2** is configured as an analog input and **D8** configured as DTR.
  2. Pull-down option on **D5** did not pull the pin down when **D5** was configured as disabled.
  3. Resolved problem with floating inputs on SMT module in SPI mode. Pins **D1-D4** and **P2** were configured as inputs with pull-ups but they were left floating (**PR** and **PD** had no effect.)
  4. Resolved a problem with serial break when in API mode; it will now send a RESET modem status.
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## 405E - Digi XBee S2C Zigbee (October 7, 2016)

- Zigbee Stack: EmberZNet 5.6.0.1 Zigbee-PRO stack
- SMT hardware revisions P-Q
- SMT PRO hardware revision R
- TH hardware revision H
- TH PRO hardware revision E
- Programmable hardware revision F

### ENHANCEMENTS

1. **ZS** value is now preserved when an **RE** command occurs; **KY** also shares this behavior.
2. To facilitate recovery from a wide area power outage on a large network, software now offsets the next join attempt by a random time interval to reduce collisions. This reduces the time for bringing the network back up and it also reduces the number of stranded devices that fail to join.

## SECURITY FIXES

1. Resolved problem with **EE** = 1 and **EO** = 1 (network key passed in the clear) so that a join network is successful. (Warning: this configuration is not recommended for deployed networks.)

## BUG FIXES

1. Resolved problem with end device rejoining the network through an XBee S2B router. This problem was encountered when the coordinator was set up for many-to-one routing (**AR** != 0) and then sleep mode was enabled on the end device. In such a case, the end device would disassociate from the XBee S2B router (as expected), but it would not reassociate.
2. Resolved an issue with the Acknowledgement request bit not being set on a coordinator realignment frame. This fix allows a 3rd party end device to rejoin an XBee S2C coordinator after it has been powered off.
3. Resolved issue with corrupted output on serial port after a long period of continuous receptions of API frames.
4. Resolved fragmentation issue with API packets larger than 84 bytes and baud rate of 38400bps or higher. Only about 120 of 500 packets were getting through. With the fix all 500 packets get through.
5. Analog readings were about 21 mV too high. When ADC pin was connected to ground the reading came out as 0x12 (which translates to 21 mV) rather than 0. This is now corrected so that the reading is 0 when ADC is connected to ground. This fix also prevents a grounded input from reporting a negative reading as 0x03FF.
6. Resolved issue with changing the Zigbee Stack Profile (**ZS**). It should tear down and re-form the network when it changes. But changing **ZS** didn't take effect and the network stayed up. A side effect of fixing this problem is that all current parameters are written to persistent storage when **ZS** changes. Therefore, the user should have the parameters set the way they are desired before the **ZS**\* change is applied. Also, **ZS** changes issued in command mode do not take effect until command mode exits, even if an **AC** command is issued.
7. Added logic to prevent configuration of OTA packet tracing (PTI Trace) on the TH module. **D1** and **P9** can only be set to 6 on a surface mount module.
8. Sleep time resolution is now implemented in milliseconds rather than quarter seconds.
9. A lockup issue associated with Many-to-one routing was resolved.
10. Changed default pullup setting for SPI lines to correct excessive sleep current at low temperatures.
11. Changing network parameters (**CE**, **KY**, **SC**, **ID**, **NK**, etc) causes a coordinator or joined device to leave the network after five seconds. Also, subsequent changes will restart the timer.
12. Resolved an issue that could causing doubly APS encrypted source routed packets to occur during device association.

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## 4059 - Digi XBee S2C Zigbee (August 19, 2015)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack
- SMT hardware revisions L-O
- SMT PRO hardware revisions N-Q
- TH hardware revisions C-F
- TH PRO hardware revisions B-D

- Programmable hardware revisions B-E

## NEW FEATURES

- **ED** Command - Energy Detect: Returns a list (hex values in -dB) of energies in found in the 802.15.4 channels. Proper usage is to repeat the **ED** command several times and note the minimum values per channel. Low values indicate energy (in -dB), high values indicate relative quiet. Because some networks only transmit on occasion, combine **ED** results with those from doing an **AS** command to determine which channels are 'inhabited' for a given neighborhood.

## ENHANCEMENTS

1. Improvements to source routing:
  - Source route table size increased to 40 entries
  - Source route hop count increased from 11 to 25
2. DIN, nDTR, nRTS (**P4**, **D8**, **D6**) now respond to **PR** and **PD** when configured as UART pins (1).
  - Default for **PR** changed to 0x1FBF.
  - Default for **PD** changed to 0x1FFF; **D8** will remain a floating input when configured as SLEEP\_RQ (the default).

## BUG FIXES

1. Resolved an issue that prevented devices from responding to a network discovery (**ND**) when source routing is enabled (**AR** != 0xFF).
2. The MXI file descriptions for the **AO** and **MP** commands has been updated.
3. Updated several I/O commands for the SMT variant:
  - **D1** can now be set to 6 (PTI\_Trace)
  - **P5** can no longer be set to 2 or 3
  - **P6** can no longer be set to 2 or 3
  - **P7** can no longer be set to 2 or 3
  - **P8** can no longer be set to 2 or 3
  - **P9** can no longer be set to 2, 3, or 5
4. Resolved issue where a partial I/O sample response frame triggered by **IR** could be sent out of the SPI port
5. Resolved an issue where a fragmented message was acknowledged to its sender but dropped for lack of space in the serial Tx Buffer.
6. Resolved delays in transmitting data from parent to end device if the end device lacked free buffer space.
7. Resolved issue where end devices that are pin sleeping would output duplicate received packets when communicating via SPI.
8. Resolved an issue that would cause duplicate I/O samples to be generated from a sleeping end device.
9. An issue that could cause radio lockup and packet loss during SPI communication is resolved.

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## 4055 - Digi XBee S2C Zigbee (October 31, 2014)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack
- SMT hardware revisions J-K
- SMT PRO hardware revisions K-M

## ENHANCEMENTS

1. This release supports power setting compensation for a new hardware revision of the XBee PRO S2C SMT. The updated hardware has a different power amplifier compared to previous revisions. As a result, you cannot load firmware older than 4055 on this new hardware revision.
  - The old S2C SMT PRO had a HV value of 0x21. The new S2C SMT has a HV value of 0x30.

## BUG FIXES

1. Transparent mode throughput was 15% of the rate observed with 4043. Throughput equal to that of 4043 has been restored.
2. Fragmented message fragments could have their message type overwritten if a message of a different message type were sent immediately afterwards. Rx message length was corrected for fragmented ZDO messages.

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## 4053 - Digi XBee S2C Zigbee (September 12, 2014)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack
- SMT hardware revisions H-I
- TH hardware revisions A-B
- TH PRO hardware revision A
- Programmable hardware revision A

## NEW FEATURES

1. Firmware supports the new S2C Throughhole/TH, otherwise known as the S2C DIP, as well as the S2C SMT. **HS** command returns the Hardware Series number 0x0202.
    - The MXI file function string now reads:
      - ZIGBEE PRO for HV=0x21
      - ZIGBEE Reg for HV=0x22
      - ZIGBEE TH PRO for HV=0x2D
      - ZIGBEE TH Reg for HV=0x2E
  2. An **RT** command was added for RTS timeout control:
    - If a configuration command change occurs (or certain diagnostic messages, etc.) while RTS flow control is enabled and RTS is deasserted, the XBee will hang (be unresponsive to remote commands or serial commands) until RTS is asserted. If this hanging is unacceptable, enable the RTS timeout, and the hang will end after the timeout elapses.
    - The parameter range is 0x00-0xFF
    - 0x00 is default (RTS timeout disabled)
    - 0x01-0xFF is in time units of 100 milliseconds (100 ms to 25.5 ms)
- Verbose Joining Mode is enabled with **DC**=0x10 and uses a new API frame, 0x98. See the User Manual for a full description.
  - Join Verification (**JV**) is supported on End Devices. Enable this for an end device to communicate with the Coordinator using APS encryption soon after association.
    - For older versions (4043 and earlier), there are two ways to emulate this behavior:
      1. Send a **IEEE\_addr\_req** to the coordinator before attempting to send APS encrypted messages to the Coordinator: [7E 00 19 11 01 FF FF FF FF FF FF FF FF 00 00 00 00 00 01 00 00 00 00 F3]
      2. Send a message from the Coordinator to the End Device. Thereafter the End Device will be able to send APS encrypted messages to the Coordinator.



## ENHANCEMENTS

1. **DC** and **DO** commands were moved to the networking section in the MXI file.
2. The Loopback clusterID can send 84 byte payloads.
3. **CR** command parameter range was changed from 1:63 to 0:63; a 0 setting yields an effective setting of the default value (3).
4. **DN** command now exits command mode after a successful response has been received.
5. **CB** = 1 now broadcasts Node Identification frames to more than just the Coordinator.
6. Command description have been added to the MXI file for **WH**, **PO**, **TO**, and **DC**.
7. Command mode will persist until a pending AT command times out, and then will be extended for a full command mode timeout interval.

## SECURITY FIXES

1. Routers can now join with **EE** enabled.
  - On older firmware, polling for **AI**=0 to see when a join had succeeded would be interfere with joining. A workaround for older firmware is to substitute waiting for the modem status message [ 7E 00 02 8A 00 75 ] which shows association has succeeded.

## BUG FIXES

1. SPI Tx was locking up. Handling for SPI polling by the master was added - one can assert nATTN and clock in a couple nonsense bytes like "0xFF 0xFF" to see if the XBee has data to Tx over the SPI.
2. Updated behavior of Cyclic Sleep with pin wake (**SM**=5). In the case where **SN**>1:
  - ~SLEEP was pulsing during each Off (**SP**) cycle, when it should do so after every On (**SN**\***SP**) time interval cycle
  - **SO2** option was not implemented, now it is
  - The ASSOC LED should pulse during the Off wake cycles
  - The **WH** time should be observed during the Off wake cycles
  - ON/nSLEEP should assert during an Off cycle if there is data
  - IO Sampling should occur during the Off cycle
3. **VL** command response's MfgStr returns 16 characters instead of 4.
4. **FR** returns 0x00 modem status instead of 0x01.
5. A coordinator now sends a Serial Loopback response immediately in response to a broadcast request.
6. For End Devices configured with **SN**>1, power was not being applied to the Power Amplifier during short wakes, which resulted in an unnecessary communication loss between end device and parent.
7. After the first use of the SPI interface, subsequent serial communications are to be exclusively done in SPI until the next power reset. This was not being enforced correctly.
8. Sending more than 64 bytes from coordinator to router with **EE**=1 was broken.
  - With 0x20 Tx options (use APS encryption) enabled, a status of 0x74 (message too long) was being returned for unicast packets with payloads of 64+ bytes.
9. Setting **D9**=5 no longer disables the associate LED when **SM**=1

10. Setting **D9**=4 or 5 no longer interferes with IO sampling
  11. DIO9 DIO functions fixed:
    - **D9**=4, ON/nSLEEP is now low regardless of sleep state
    - **D9**=5, ON/nSLEEP is now high regardless of sleep state
  12. Serial interrupt handlers have been redesigned to fix a problem where a Coordinator would hang in response to CTS/RTS flow control.
  13. **DO**=0x80 now works if entered after association has completed.
  14. With **EE** enabled, the first transmission of a 255 byte payload is no longer truncated by 5 bytes.
  15. With RS-485 enabled, de-asserts are now managed as expected.
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## 4043 - Digi XBee S2C Zigbee (October 30, 2013)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack
- SMT hardware revision G
- SMT PRO hardware revision J

### ENHANCEMENTS

1. Enabling **DO** bit 7 will modify the Network Watchdog (**NW**) to not leave network until the coordinator is found by detecting different **CH** or I/O setting.
2. Changed the SPI timeout for the SPI Clock rate to be set as low as 1Khz (previously 50Khz)

### BUG FIXES

1. Fixed OTA recovery issue where Bootloader ACK message was being truncated due to channel being switched too early for the ACK message to be sent to the target node.
  2. Fixed a 16-bit address Tx packet issue where it did not send the 64-bit address to destination device.
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## 4041 - Digi XBee S2C Zigbee (May 30, 2013)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack
- SMT hardware revision F
- SMT PRO hardware revisions H-I

### NEW FEATURES

1. Implemented binding and multicasting.
  - Implemented new **&X** command to clear the binding and group tables.
  - Implemented new Tx options for indirect addressing thru binding (0x04) and use multicast (0x08)

### ENHANCEMENTS

1. Channel 26 on a S2C Regular has its Tx Power capped at 3 dBm regardless of **PL/PM** settings.
2. TxOption 0x01 disables retries (and route repair). RxOption 0x01 indicates transmitter disabled retries.
3. **BD** range increased from 0-7 to 0-0x0A.

4. Non-standard baud rates are permitted but not guaranteed.
5. **NI, DN, ND** string parameters support upper and lower case.
6. Self-addressed fragmentable messages now return the self-addressed Tx Status code (0x23) instead of simply success (0x00).

## BUG FIXES

1. **ND** with string parameter no longer exits command mode after first response.
  2. **ND** with string parameter now ignores any subsequent responses after first response.
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## 4032 - Digi XBee S2C Zigbee (April 24, 2013)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack

## NEW FEATURES

1. Implemented Encrypted APS leave command,
  - The status for Encrypted APS leave command will be AT command response (0x88) frame type.
  - Tx packet format is as follows:
    - Api Tx Explicit Frame type = 0x11
    - Source End Point = 0xE6
    - Destination End Point = 0xE6
    - Cluster ID = 0x0023
    - Profile ID = 0xC105
    - Tx option = 0x20
    - Payload = [Transaction sequence number: 1 byte] [EUI64: 8 bytes]

## ENHANCEMENTS

1. Implemented 5 sec break for restoring device default settings.
  - The 5 sec break option is only enabled only if both DIN or DOUT are in GPIO\_PERIPHERAL mode
    1. otherwise it is presumed that the UART is disabled and those pins are being used for other functions.
2. Added **DO** option to disable ACK for both sleep and router devices.

## BUG FIXES

1. Router/End devices will only send I/O sample data packet if joined to a valid network.
  2. Fixed Self-Address packet failure when sending fragmented packets.
  3. Router/End devices will only send I/O sample data packet if joined to a valid network.
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## 4023 - Digi XBee S2C Zigbee (February 5, 2013)

- Zigbee Stack: EmberZNet 4.2.0 Zigbee-PRO stack

## NEW FEATURES

1. Added HIGH\_RAM\_CONCENTRATOR option via **DO**, host must send **AR=0** to update routes.

## ENHANCEMENTS

1. Added `NO_ACK_IO_SAMPLING` option via **DO** for sleepy devices. The default operation the sleepy device will remain awake until getting APS ACK or APS ACK retry timeout.
  - **DO:**
    - Bit0 - Enable Temperature Compensation Updates on S2B
    - Bit1 - Reserved for Smart Energy devices
    - Bit2 - 0/1 = First or Best Response
    - Bit3 - Disable NULL Transport Key (Coordinator Only)
    - Bit4 - Disable Tx Packet Extended Timeout
    - Bit5 - Disable ACK for End Device I/O Sampling (New)
    - Bit6 - Enable High Ram Concentrator (New)
2. Added the ability to do OTA recovery of a target which has reverted to default channel 13 due to some kind of OTA interruption during a normal OTA update. Here's the sequence required once a target has reverted to default channel 13:
  1. Send `AT%U`
    - Sends broadcast message to target to start OTA sequence.
  2. Do normal OTA sequence
    - Send F/W update packets to local/remote OTA cluster
  3. Send `AT%U <0>`
    - Send terminate OTA recovery command when completed with OTA update.
  - Note: If the coordinator is the source and updaters send `AT%U` command as a local AT command, otherwise send as a remote AT command.
3. Updated MXI file with **NW** and **JV** description.
4. The **AS** command now sends API zero length payload modem status message when **AS** command is completed. For transparent mode you'll get a after **AS** command is completed.

## BUG FIXES

1. Fixed sleepy device timeout issue when sleep period is set greater than 6 mins.
2. Fixed **AS** network scan lockup issue when using **II** command.
3. Fixed **NR** command not resetting radio properly.
4. Fixed Watchdog resets and flash verify write failures due to:
  - bad handling of rxbuffer overflows.
  - bad command processing when bailouts occur.
  - out of bounds write when processing a NI command response.
5. Fixed I/O sampling issue where getting duplicate samples if **ST** is set very low and **SN** set above 1.
6. Fixed serial loopback issue where there's no loopback response after a device initially joins the network.
7. Fixed issue, if **P3** or **P4** are set to anything other than default, the module will lock up upon receiving any remote AT command.
8. Fixed issue to always remain in API non-escaped mode when using SPI.
9. **JV/JN** response not being random between 2-8 seconds due to initial random number seed being static.
10. Fixed an issue when AT Coordinator sends to unknown address it would intermittently lockup when

trying to enter command mode.

11. Fixed end device retry count being incorrect when initially sending packet to unknown address after waking up.
12. End device taking excessive time to send fragmented packets.
13. Fixed serial Break issue where the parity not being set to default value when break detected.
14. When sending a TX request to yourself, the status frame indicated that the packet was successfully received (0x00) but should show that it is self addressed (0x23).

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## 4020 - Digi XBee S2C Zigbee (October 26, 2012)

- Zigbee Stack: EmberZNet 4.2.0 Zigbee-PRO stack

### NEW FEATURES

1. ATAS command is a previously-undocumented command to perform an “Active Scan” for networks by a coordinator or router.
  - The host receives multiple AT Response frames, with data in the following format:  

```
typedef struct { uint8_t as_type; uint8_t channel; uint16_t pan_be; uint8_t extended_pan_be[8]; uint8_t allow_join; uint8_t stack_profile; uint8_t lqi; int8_t rssi; } xbee_atas_response_t;
```
  - LQI (Link Quality Indicator) is unsigned, higher values are better. RSSI (Relative Signal Strength Indicator) is signed and lower values are better.

### ENHANCEMENTS

1. Updated MXI file with **NW** and **JV** description.

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## 401E - Digi XBee S2C Zigbee (April 6, 2012)

- Zigbee Stack: EmberZNet 4.2.0 Zigbee-PRO stack
- SMT hardware revision D
- SMT PRO hardware revision E

### NEW FEATURES

1. Added new formatted **VL** command.
2. CR command added to set PAN Id conflict report threshold.

### ENHANCEMENTS

1. Revised the **DO** command (bit3) to disallow the NULL Transport key from being sent from a coordinator.
2. Revised the **AS** command to work on all devices types: router, coordinator, and end device.
3. Updated **PO** description to include routers as it can be configured as a sleepy device.
4. Added function to clear TX Extended Timeout status.

5. Made change to spread **ND** responses over the **NT** time period (same as 2x70) and to keep sleepy device awake for the **NT** time period. Also added checks to assure Tx UART buffer has room for entire response so no data will be dropped.
6. New Association LED behavior has been implemented:
  - If the device is Authenticating as either a client or server, the LED will blink at a 50 msec rate.
  - If the device is a Coordinator, and the network has not yet formed, the LED will be off; otherwise if no one has authenticated yet, the LED will blink at a 500 msec rate.
  - If the device is a Router/End Device, and is scanning/associating, the LED will blink at a 100 msec rate; otherwise if the device is unassociated, the LED will be off.
  - Otherwise, if LT is zero, the LED will be on; and if LT is nonzero, the LED will blink at a (LT\*10) ms rate.
7. New DO (Device Options) command has been added to control a bitmask of options:
  - DO bit 0x01 enables the temperature compensation option. By default it is enabled. This option appears in all SE and ZB builds. Disabling Temperature Compensation reduces wake time overhead for sleeping end devices from 13 ms to 2 ms, but then transmit power may vary by as much as 8 dBm as a function of temperature.
  - DO bit 0x02 enables the join notification message option on the SE Coordinator. By default it is disabled. This option appears in the SE Coordinator builds. The other 6 bits of DO are held in reserve to support future boolean command options.
  - DO bit 0x04 enables best response option during joining. By default it is disabled, which selects the First Response option. First response will cause the node to join with the first network to send a beacon response. A change from the prior release is that the node will continue to dwell on the first response channel in an attempt to receive beacon responses from all neighbors on that same network as reported in the first beacon response. Best response will cause the node to search all channels in the SC mask before selecting a network to join.
8. AO=0x07 enables passthru of supported ZDO Requests
9. AO=0x0B enables passthru of binding requests
10. **SC** range was extended to include channel 26, **SC** default was left as 0x7FFF. However, if Channel 26 (0x8000) is present in the **SC** mask, then transmit power for all channels is capped at 3 dBm

## BUG FIXES

1. Fixed network watchdog issue where router would lockup with AI status of 0x2B (ASSOC\_DISCOVERING\_COORD).
2. Fixed Tx status message (0x8B) to properly indicate route discovery was done when getting network ACK failure.
3. Fixed **RO** command which was causing OTA data to be transmitted in multiple packets.
4. Made change to emberStackStatusHandler, to allow rejoining a network even though it may get status of EMBER\_JOIN\_FAILED, due to Ember stack notifying APP it did detect a network but it has different PANID.
5. Made change to report proper route/address discoveries in TX status.
6. Fixed problem for **ND+NI** commands to timeout properly and to handle **ND** self-response when **NO=2**.
7. Made change for sleepy device to report correct Modem status when leaving a network.
8. Fixed fragmentation APS message retry issue, to set the correct timeout when the extended timeout

option is enabled.

9. Fixed **DO** option to revert back to default values when ATRE is executed.
  10. Fixed **CE** issue for device to properly detect when it changes between router and coordinator.
  11. Fixed RAM corruption issue when source routing takes place when a device is trust center with encryption enabled.
  12. Fixed **RE** issue where the device serial port will lockup due to **AP** changing from API to command mode.
  13. Fixed flash **WR** issue, causing device to revert back to firmware defaults settings.
  14. Fixed associate LED issue, now is initially ON while its waiting to associate to the network.
  15. Fixed issue with exiting AT mode after changing to AP1 mode of operation.
  16. Fixed problem of API vs. AT mode where the device doesn't respond after sending API frame with **AP=0** command.
  17. Fixed problem of SPI not responding after the device wakes up.
  18. Fixed problem of excessive current being sunk by the DTR/SLEEP REQ line because of not being able to switch off the pull-down resistor.
- 

## 4016 - Digi XBee S2C Zigbee (August 19, 2010)

- Zigbee Stack: EmberZNet 4.2 build 53 (GA, certified)

### NEW FEATURES

1. Initial release of S2C
  2. New features (which were not available on S2 and S2B platforms):
    - Supports SPI slave mode as an alternative to the UART serial port, but usage of API mode is required.
    - Six software images (Coordinator AT, Coordinator API, Router AT, Router API, End device AT, and End Device API) were combined into a single software image that supports everything previously available in the six software images.
    - Fragmentation is now available in both API and transparent mode for unicasts. It continues to be unavailable for broadcasts.
    - **P3** (DOUT), **P4** (DIN), **D8** (SleepRq), and **D9** (On-Sleep) are now available for I/O sampling.
    - Both pull-up and pull-down resistors can now be applied to pins configured as digital inputs (3).
    - Since this software runs on the EM357, more flash (192K bytes) and RAM (12K bytes) are available. The extra RAM allows increased allocation of critical resources as follows:
      - Address table size: 20 entries
      - Routing table size: 80 entries
      - Route discovery table size: 16 entries
      - Source routes: 40 entries
      - Neighbor table size: 20 entries
      - Child table size: 20 entries
- 

## CHANGE LOG - Smart Energy

## 5132 - Digi XBee S2C Smart Energy (May 7, 2013)

- Zigbee Stack: EmberZNet 4.6.5.1 Zigbee-PRO stack

### NEW FEATURES

1. Implemented new **DC** command for additional device control, bitwise options are:
  - Bit0 - Enable Joiner Global Link key.
  - Bit1 - NWK Leave Request Not allowed.
2. Implemented new PLKE Modem status:
  - MODEM\_PLKE\_INITIATED = 0x14,
  - MODEM\_PLKE\_SUCCESS = 0x15,
  - MODEM\_PLKE\_TABLE\_FULL = 0x16,
  - MODEM\_PLKE\_NOT\_AUTHORIZED = 0x17,
  - MODEM\_PLKE\_INVALID\_TC\_REQ = 0x18,
  - MODEM\_PLKE\_TC\_UPDATE\_FAIL = 0x19,
  - MODEM\_PLKE\_BAD\_EUI64 = 0x1A,
  - MODEM\_PLKE\_LK\_REJECTED = 0x1B,
  - MODEM\_PLKE\_UPDATE = 0x1C,
  - MODEM\_PLKE\_CLEAR\_LK\_TABLE = 0x1D,
3. Implemented the ability to clear a Partner Link Key entry when the Link Key table becomes full. If the Link key table is full, a Tx transmit status of TX\_STATUS\_LK\_TABLE\_FULL (0x27) will be generated. When getting this status, the host can clear an entry to make room for a new device by doing the following sequence:
  - Use **KT** + command to read device Link key table entries.
  - Use **KD** + to delete an device entry to make room for a new partner (PLKE) device.
4. Device can now use short addressing when sending a packet, must set EUI64 to all 0xFF's and then specific a valid 16 bit address of the destination device.
5. Implemented **#S** command which returns a 16 bit CRC of the private key and the certificate data.

### ENHANCEMENTS

1. Channel 26 on a S2C Regular has its Tx Power capped at 3 dBm regardless of PL/PM settings.
2. Implemented new **DO** option to disable extended timeout for APS unicast message retries.

### SECURITY FIXES

1. Link key table now gets properly cleared when leaving network due to Management ZDO leave request.

### BUG FIXES

1. Fixed the **AS** command to provide properly formatted data when doing an active scan of the network.

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## 5122 - Digi XBee S2C Smart Energy (September 12, 2011)

- Zigbee Stack: EmberZNet 4.2.0 Zigbee-PRO stack



## NEW FEATURES

### 1. New features (which were not available on S2 and S2B platforms):

- The **IN** command was removed.
- **VL** command reports the datetimestamp of the build with a API frame cmdData string of: mmm dd  
yyyy hhmmss
- Module I/O commands were restored: D1, D2, D3, D4, D5, D6, D8, D9, RP, P0, P1, P2, P3,  
P4, PR, PD, V+; D0, D7, DB were already part of SE.
- **SC** range was extended to include channel 26, SC default was left as 0x7FFF. However, if  
Channel 26 (0x8000) is present in the **SC** mask, then transmit power for all channels is capped at  
3 dBm.
- **AO** = 0x07 enables passthru of supported ZDO Requests
- **AO** = 0x0B enables passthru of binding requests
- **EP** command was added show number of virtual page erasures in the SimEEPROM. When this  
value reaches twice (there are 2 virtual pages) the erasures tolerated by the SimEEPROM, the  
device should be replaced.
- NH limit was reduced from 30 to 11 to comply with the SE 1.x specification.
- New DO (Device Options) command has been added to control a bitmask of options:
  - DO bit 0x01 enables the temperature compensation option. By default it is enabled. This  
option appears in all SE and ZB builds. Disabling Temperature Compensation reduces wake  
time overhead for sleeping end devices from 13 ms to 2 ms, but then transmit power may  
vary by as much as 8 dBm as a function of temperature.
  - DO bit 0x02 enables the join notification message option on the SE Coordinator. By default  
it is disabled. This option appears in the SE Coordinator builds. The other 6 bits of DO are  
held in reserve to support future boolean command options.
  - DO bit 0x04 enables best response option during joining. By default it is disabled, which  
selects the First Response option. First response will cause the node to join with the first  
network to send a beacon response. A change from the prior release is that the node will  
continue to dwell on the first response channel in an attempt to receive beacon responses  
from all neighbors on that same network as reported in the first beacon response. Best  
response will cause the node to search all channels in the SC mask before selecting a  
network to join.
- ZU (the certificate public key) is now readable
- The value of KY will be retained even if a RE command is given.
- EO range is now 0..0xFF
- Factory Default Settings:
  - SN default was 0x01, was extended to 0x20 to increase default polling time tolerance for  
sleeping end devices
  - CE default is now 0x00 (default to Router mode)
  - EO default is now 0x08 (default to Router mode)
  - KY default is now 0x00 (set random on first startup)
  - NK default is now 0x00 (set random on first startup)

- TX Status messages where status is in error will now sometimes show a 16-bit address other than 0xFFFE. Before, they only showed 0xFFFE.
- A router's link key table will be reset when it leaves a network.
- **DO**, **ZI**, **ZU**, **ZV** have been added to the mxi files.

## **ENHANCEMENTS**

1. **CR** command added to set PAN Id conflict report threshold.
2. **KT** command added to dump a hashed link key table record with an index parameter.
3. New Association LED behavior has been implemented:
  - If the device is Authenticating as either a client or server, the LED will blink at a 50 msec rate.
  - If the device is a Coordinator, and the network has not yet formed, the LED will be off; otherwise if no one has authenticated yet, the LED will blink at a 500 msec rate.
  - If the device is a Router/End Device, and is scanning/associating, the LED will blink at a 100 msec rate; otherwise if the device is unassociated, the LED will be off.
  - Otherwise, if LT is zero, the LED will be on; and if LT is nonzero, the LED will blink at a (LT\*10) ms rate.
4. The **AS** command (active scan) was enabled for use with smart energy.

## **SECURITY FIXES**

1. **EE** command added as a read only command to mxi file.

## **BUG FIXES**

1. Some unsupported commands were removed from the mxi file as they are not implemented yet for SE.
2. **ZU** command now returns serially installed public key if it exists, otherwise returns manufacturing installed public key if it is initialized, otherwise returns 0x00.