ZigBee Device Messaging Specification

Version: 1.21

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1 Document Information

1.1 Glossary

Item	Definition
CIE	Control and Indicating Equipment
IAS	Intruder Alarm System
LED	Light Emitting Diode
ZigBee	IEEE 802.15.4 –2003. A low power Ethernet Networking Protocol. http://www.zigbee.org/
ZCL	ZigBee Cluster Library. ZigBee Document 075123r03ZB (or newer).
ZDO	ZigBee Device Object, which exists on endpoint 0 of all devices.

1.2 Revision History

Revision Number	Revised By	Major Revised Issues
1.0	Curtis Patzer	original
1.1	Curtis Patzer	Added NCZ3011, NCZ3041, NCZ3201
1.2	Brad Kelly	Reformatting and Revision for First Release
1.21	Curtis Patzer	Added “Changing Other Device Settings”

2 Disclaimer

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3 Sensor Device Overview

The NYCE Control wireless sensor devices employ ZigBee Clusters and messaging based on the ZigBee Home Automation Profile 1.1 specification. While the devices are not certified as HA1.1 compliant, they follow the standard in most respects. They do not use any Manufacturer-specific clusters, or messages, and support all required ZDO commands. They do, however, use some cluster attributes in ways that the ZCL does not intend.

As of this document's release date, all NYCE sensors implement the IAS Zone Cluster server, and after joining an HA Profile network, expect to be engaged by the IAS CIE (usually implemented on the coordinator). The specifics of joining and enrollment will be discussed in Section 4.

The NCZ-3041/43 Motion Sensors use attributes from the Occupancy Sensor cluster as a means to configure operating parameters for the sensors. The NYCE NCZ-3014 Garage Sensor and NCZ-3031 Asset Sensor use manufacturer – specific attributes defined in the IAS Zone Cluster. See Section 7 for details.

The NYCE Control sensor devices also support the Basic, Identify and Poll Control clusters.

Endpoint	**Clusters**
1	Basic, Power Configuration, Identify, IAS Zone, Poll Control
2	Occupancy Sensing (NCZ-3041/3043 only)
4	Temperature Measurement

NYCE sensor devices are Sleepy End Devices, which generally remain asleep unless awakened by an external or network reporting event. The sensor devices poll their parents on a regular basis to see if any messages are waiting, and will switch to a quick nap cycle if waiting upon message responses. For this reason, asynchronous commands sent to a sensor device by the coordinator will not be received unless the device is awakened. A good strategy is for the coordinator to send any commands to the device immediately after receiving a status message or poll (data request).

4 Keyfob Device Overview

The NYCE Control wireless keyfob devices employ ZigBee Clusters and messaging based on the ZigBee Home Automation Profile 1.1 specification. While the devices are not certified as HA1.1 compliant, they follow the standard in most respects. They do not use any Manufacturer-specific clusters, messages or attributes, and support all required ZDO commands. NYCE keyfobs implement the IAS Zone Cluster server and IAS ACE Cluster client, and after joining an HA Profile network, expect to be engaged by the IAS CIE (usually implemented on the coordinator). The specifics of joining and enrollment will be discussed in the next section. Details of the cluster commands used will be discussed in Section 8.

The NYCE keyfobs also provide minimal support for the Basic cluster.
All clusters are implemented on Endpoint 1.

NYCE keyfobs are remote devices, meaning they are sleepy end devices, which make no effort to remain in their parent's child tables. As such, they expect to rejoin the network before transmitting a command if more than a few seconds has elapsed since the last transmission. This strategy allows the keyfob to freely roam around the network, and to even go out of network range for long periods of time without significantly affecting the perceived response of the device.

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5 Device Pairing (Joining a Network and Enrolling)

The following describes the interaction between the coordinator and sensor device or keyfob while the device is joining and enrolling.

1. Coordinator allows devices to join (PJOIN).
2. Sensor or keyfob scans all ZigBee channels and caches descriptions of all joinable networks.
3. Sensor or keyfob attempts to join the first network in its list (Association).
4. If the join is not successful, or the coordinator does not send a network key to the device, it will try to join the network again. If that fails, it will go on to the next network in its list.
5. Once the sensor or keyfob succeeds in joining a network and obtaining the network key, it will then send a Device Announce broadcast.
6. The sensor or keyfob then sends a Match Descriptor Request for HA Profile, IAS Zone Cluster to the coordinator.
7. The device verifies that the Match Descriptor Response indicates that the IAS Zone Cluster client is supported. If it is not, then the device leaves the network.
8. If the Match Descriptor Response does not arrive within approximately 15 seconds, then the device will leave the network and try to join the next network in its list.
9. It is expected that the coordinator will discover that the device supports the IAS Zone cluster server. The sensor device waits for the Coordinator to set the device's IAS Zone Cluster::IAS_CIE_ADDRESS_ATTRIBUTE (ID = 0x0010) with the address of the CIE. If this does not happen within approximately 30 seconds, the device leaves the network, and tries to join the next network in its list.
10. After the Coordinator sets the device's IAS_CIE_ADDRESS_ATTRIBUTE, the device will send an IAS Zone::Enroll Request message to the CIE.
11. In response, the CIE should send an IAS Zone::Enroll Response message, whereby it assigns the device its Zone ID.
12. The device sets its IAS Zone::Zone State attribute value to 1 to indicate that it is enrolled. It also stores the Zone ID value received in the Enroll Response message.
13. At this point pairing is complete. The device is ready to send IAS Zone::ZoneStatusChangeNotification messages to the Coordinator.

NYCE sensors and keyfobs implement all required IAS Zone attributes. These attributes can be read by the coordinator during device discovery.

All Nyce sensors implement Poll Control Cluster server. If a coordinator wishes to use this cluster to control device attributes during operation, or as a periodic 'health' message, then create a binding for Poll Control cluster on the device. This will cause the device to start sending periodic CheckIn messages.

6 Sensor Device Status Messages

NYCE sensor devices send status information using the IAS Zone::Zone Status message:

- The Alarm1 bit (0x0001) indicates a sensor event (i.e. window/door open, garage door open, etc…). For the NCZ-3041 and NCZ-3043 sensors, the Alarm2 (0x0002) bit is used instead of the Alarm 1 bit.
- The Battery bit (0x0008) indicates a low battery situation.
- The Restore Reports bit (0x0020) is always set to indicate that the sensor will send an updated status when the sensor event has cleared.
- The Trouble bit (0x0040) is set just before the battery will fail. The device will stop functioning soon after.

NYCE sensor devices send a new status message whenever the status changes. Also, if a device loses connection with the network, or if it is power cycled, the sensor device will send the current status after rejoining the network. If the coordinator wants to receive a periodic status message indicating that the sensor device is functioning correctly, the coordinator can configure periodic reporting on the Zone Status attribute.

7 Changing Sensor Device Settings

NYCE motion sensor devices use the Occupancy Sensing cluster attributes to configure sensor parameters. Other sensors use Manufacturer Specific attributes for sensor configuration. The coordinator can successfully read or write the following attributes when the sensor device is awake:

For NCZ-3014 Garage Sensor:

- IAS Zone::Manufacturer specific (mfg id=0x10b9) attribute (0x3010) sets the Settling Time (seconds). Default value is 3 seconds.

For NCZ-3031 Asset Sensor:

- IAS Zone::Manufacturer specific (mfg id=0x10b9) attribute (0x3011) sets the Sensitivity. A value of 0 selects low sensitivity, and a value of 2 selects high sensitivity.
- IAS Zone::Manufacturer specific (mfg id=0x10b9) attribute (0x3012) sets the Duration (seconds). Default value is 0 seconds. This is the minimum time the device must stay in a state before reporting that state. So, if a device is in the ‘stationary’ state, it must sense movement for this amount of time before indicating movement. Then, once in the ‘movement’ state, the device must sense no movement for this amount of time before it will report being stationary.

For NCZ-3041 and NCZ-3043 Motion Sensors:

- Occupancy Sensing::OccupiedToUnoccupiedDelay attribute (0x0010) sets the delay time after a motion event before the sensor can report No Motion. Note that after motion occurs, for the first half of this delay time, the device will ignore any subsequent motion. For the second half, it will sense motion, and either restart the timeout period if motion is detected, or send a status message indicating No Motion if the entire delay period elapses without detecting motion.
- Occupancy Sensing::UnoccupiedToOccupiedDelay attribute (0x0011) sets a delay between when motion is first detected, and when the device will send a status message reporting motion. This interval is meant to be used as a sampling window for setting a sensitivity threshold.
- Occupancy Sensing::UnoccupiedToOccupiedThreshold attribute (0x0012) sets the sensitivity threshold. This is a value between 1 and 255, with 1 being least sensitive. The granularity of the sensitivity value depends on the length of the sampling window (i.e. the UnoccupiedToOccupiedDelay value).

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8 Changing Other Device Settings

NYCE sensor devices are sleepy end devices, so their sleep behaviour must be understood to use them effectively in a ZigBee network. The following table lists default settings for Poll Control Cluster attributes:

Poll Control Attribute	**Default Setting**
CheckIn Interval	120 minutes
Long Poll Interval	5 minutes
Short Poll Interval	0.5 seconds

Using these values, along with minimal reporting and ZoneStatusChangeNotification messages should enable a Nyce sensor to operate for several years on battery power. Note that as reporting frequency and number of reported attributes increases, expected battery life decreases. The same can also be said for CheckIn Interval.

Nyce does not recommend reducing the Long Poll Interval below 5 minutes, except temporarily during periods of prolonged configuration. Increasing it above 5 minutes will increase battery life, but then the sensor runs the risk of being removed from its parent's child device table.

The Poll Control Cluster's CheckIn command is a convenient way to provide coordinators and other devices with a window during which they may reliably configure sensors. The trade-off for increased CheckIn frequency is reduced battery life. We have observed that once the CheckIn Interval is set below 20 minutes, battery life is significantly reduced.

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9 Sensor Device User Interface

NYCE Control sensor devices have a user interface consisting of a single push button, and a tri-colour LED (green, red, or orange). This is the default user interface implementation:

Button Press	LED w/Press	Action	LED Action	Description
2 times	●● (green)	Network Status	●●● (red) ●●● (green) ●●● (yellow)	Not Joined Joined Joined, but Network Error
4 times	●●●● (green)	Join Network	●●● (green) or ●●● (yellow) ●●● (yellow,yellow,green) ●●● (yellow,green,green) ●●● (green) or ●●● (red)	Already Joined Searching for Network Joining Network Configuring Device Joined Successfully Device Failed in Join Process
6 times	●●●●●● (green)	Leave Network	●●● (red)	Network Leave Complete
8 times	●●●●●●●● (green)	Forced Re-Join	●●● (yellow)	Rejoin the network in search of another parent
10 times	●●●●●●●●●● (green)	Factory Default	●●● (red) ●●●●● (green)	Network Leave Complete Factory Defaults Restored
Press and Hold > 1s	● (green)	Test Mode	●●● (red) ●●● (green) ●●● (yellow)	Not Joined Joined Joined, but Network Error
			● (yellow)	Wrong Button Press
		Power Up	●●● (red) 3s delay, then ●●● (green) 3s delay, then ●●● (yellow)	Not Joined Joined Device in Re-Join

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10 Keyfob Device Commands and Status Messages

***** TBD as of this document's release date**

11 Keyfob Device User Interface

***** TBD as of this document's release date**

