



## **Z-Stack Location Profile**

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0.1	Created.	02/14/2006
0.2	Changed X & Y coordinates to 16 bit	04/26/2006
0.3	Changed the Collect and Cycle times in the Blind Node Config message. Added the strongest Reference Nodes information.	05/23/2006
0.4	Minor editorial and formatting changes.	06/26/2006
0.5	Add clusters 0x0019 for efficient OTA traffic pattern while collecting RSSI.	10/26/2006

## TABLE OF CONTENTS

<b>1.</b>	<b>LOCATION PROFILE.....</b>	<b>1</b>
1.1	INTRODUCTION .....	1
1.2	DEFINITIONS .....	1
<b>2.</b>	<b>LOCATION DEVICES.....</b>	<b>2</b>
2.1	REFERENCE NODE (DEVICE ID: 0x0010) .....	2
2.2	BLIND NODE (DEVICE ID: 0x0011) .....	2
2.3	LOCATION DONGLE (DEVICE ID: 0x0012) .....	2
<b>3.</b>	<b>LOCATION MESSAGES.....</b>	<b>3</b>
3.1	MESSAGES .....	3
3.1.1	<i>XY-RSSI Request (Cluster ID: 0x0011) .....</i>	<i>3</i>
3.1.2	<i>XY-RSSI Response (Cluster ID: 0x0012).....</i>	<i>3</i>
3.1.3	<i>Blind Node Find Request (Cluster ID: 0x0013).....</i>	<i>3</i>
3.1.4	<i>Blind Node Find Response (Cluster ID: 0x0014).....</i>	<i>4</i>
3.1.5	<i>Reference Node Configuration (Cluster ID: 0x0015).....</i>	<i>4</i>
3.1.6	<i>Blind Node Configuration (Cluster ID: 0x0016).....</i>	<i>5</i>
3.1.7	<i>Reference Node Configuration Request (Cluster ID: 0x0017) .....</i>	<i>5</i>
3.1.8	<i>Blind Node Configuration Request (Cluster ID: 0x0018).....</i>	<i>5</i>
3.1.9	<i>RSSI Blast (Cluster ID: 0x0019).....</i>	<i>5</i>
<b>4.</b>	<b>MONITOR &amp; TEST INTERFACE.....</b>	<b>6</b>
4.1	MESSAGES .....	6
4.1.1	<i>Outgoing Messages.....</i>	<i>6</i>
4.1.2	<i>Incoming Messages.....</i>	<i>6</i>

## 1. Location Profile

### 1.1 Introduction

This system is implemented as a ZigBee profile and can be discovered through ZigBee Device Object Service Discovery messages.

### 1.2 Definitions

The following parameters make up the Location Profile:

Profile ID:	0xC003
Device IDs:	0x0010 - Reference Node
	0x0011 - Blind Node
	0x0012 - Location Dongle (Commissioning Tool)
Cluster IDs:	0x0011 - XY-RSSI Request
	0x0012 - XY-RSSI Response
	0x0013 - Blind Node Find Request
	0x0014 - Blind Node Find Response
	0x0015 - Reference Node Configuration
	0x0016 - Blind Node Configuration
	0x0017 - Reference Node Request Configuration
	0x0018 - Blind Node Request Configuration
	0x0019 - RSSI Blast

This profile employs the MSG service type (Application Framework). Section 3 details the frame format (MSG) for each cluster ID. For convenience, the 3 different device types utilize endpoints 210-12; but different well-known endpoints can be used or an application can be implemented to discover which endpoints are being utilized.

## 2. Location Devices

### 2.1 Reference Node (Device ID: 0x0010)

The Reference Node is a mains-powered device with RxOnWhenIdle so that it is always available for a Blind Node query of its stable location (X/Y coordinates).

### 2.2 Blind Node (Device ID: 0x0011)

The Blind Node is a mobile device that could be battery powered and sleeping. This device will query Reference Nodes within radio range (i.e. 1-hop neighbors) for their position and the received signal strength of the corresponding messages with each. This device will only work on a CC2431 or similar part with the Location Engine hardware.

### 2.3 Location Dongle (Device ID: 0x0012)

This device is used by a PC application (a commissioning tool or any application connected via serial or USB) to exchange over-the-air (OTA) messages with the Blind Nodes and Reference Nodes. The PC application can drive the location process by requesting the Blind Node's position, or it can passively receive reference and Blind Node position reports. The PC application can also be used to configure the Blind and Reference Nodes.

### 3. Location Messages

#### 3.1 Messages

The ZigBee messages defined in this profile are of service type MSG. All multi-byte fields are transmitted low byte first.

##### 3.1.1 XY-RSSI Request (Cluster ID: 0x0011)

Send this to trigger an XY-RSSI Response message. This message should be sent shortly/immediately after sending a burst of RSSI Blast messages in order to retrieve the coordinates and average RSSI radio link strength with Reference Nodes that are within 1-hop radio range. Note that if this message is sent with a radius greater than 1, then the RSSI is not applicable - only the XY content would be useful. This message doesn't have a body to the message.

##### 3.1.2 XY-RSSI Response (Cluster ID: 0x0012)

This message is sent in response to the XY-RSSI request message. The RSSI average value includes the RSSI of the RSSI Request message itself, and then the RSSI average is zeroed in preparation for another series of blasts. Thus, if a blast was never sent, the RSSI average is just the RSSI value of the request message.

Byte Index	Description	Value
0 & 1	Reference Node's X position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters If this field contains 0xFFFF, the Reference Node hasn't been configured
2 & 3	Reference Node's Y position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters If this field contains 0xFFFF, the Reference Node hasn't been configured
4	RSSI Average of any RSSI Blast broadcasts and that of the request message itself.	0 – 255

##### 3.1.3 Blind Node Find Request (Cluster ID: 0x0013)

Send this message to a Blind Node to force it to perform a location find (if a Blind Node is properly configured to perform finds as often as necessary for its intended use, then the XY-RSSI Request should suffice). The response to this message will be sent by the Blind Node when the location find process is complete, which could take seconds, depending on the total network traffic. This message doesn't have a body to the message, but just a cluster ID.

### 3.1.4 Blind Node Find Response (Cluster ID: 0x0014)

This message is sent out of the Blind Node in response to the “Blind Node Request” message.

Byte Index	Description	Value
0	Status	0 – Success 1 – Not enough Reference Node responding
1 & 2	Blind Node’s calculated X position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters
3 & 4	Blind Node’s calculated Y position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters
5	Number of Reference Nodes used in calculation	0 – 8
6 & 7	Closest (based on RSSI) Reference Node’s short address	0x0000 – 0xFFFFA, 0xFFFFE is invalid
8 & 9	Closest Reference Node’s X position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters
10 & 11	Closest Reference Node’s Y position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters
12	Closest Reference Node’s RSSI	

### 3.1.5 Reference Node Configuration (Cluster ID: 0x0015)

Send this message to the Reference Node to set its configuration items. This message is also sent from the Reference Node in response to the “Reference Node Configuration Request”.

Byte Index	Description	Value
0 & 1	Reference Node’s X position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters
2 & 3	Reference Node’s Y position	Bits 15-2 – whole meters Bits 1-0 – 0.25 meters

### 3.1.6 Blind Node Configuration (Cluster ID: 0x0016)

Send this message to the Reference Node to set its configuration items. This message is also sent from the Blind Node in response to the “Blind Node Configuration Request”.

Byte Index	Description	Value
0	Blind Node’s A parameter. “A” is defined as the absolute value of the average power in dBm received at a close-in reference distance of one meter from the transmitter, assuming an omni-directional radiation pattern.	
1	Blind Node’s N parameter, which is the path loss index that describes the rate at which the signal power decays with increasing distance from the transmitter.	
2	Operating Mode	0 – Polled. Waits for Blind Node Requests to do a find & rsp 1 – Automatically initiate a location find and response.
3 & 4	Collect Time – the number of milliseconds to wait for Reference Node Responses after sending the request.	In 100 millisecond increments
5 & 6	Cycle Time – Low byte first. The number of milliseconds to wait before starting the calculation cycle. Only valid in the Auto Operating Mode.	In 100 millisecond increments
7 & 8	Report Short Address – low byte first. Destination address for Blind Node Response messages in AUTO mode. In POLL mode, the response is returned to the requestor’s address.	0x0000 – 0xFFFF
9	Report Endpoint – Destination endpoint for Blind Node Response message in AUTO mode.	
10	Minimum Reference Nodes to use to calculate location.	1 – 16

### 3.1.7 Reference Node Configuration Request (Cluster ID: 0x0017)

Send this message to a Reference Node to request its configuration. The response to this request is the Reference Node Configuration message (Cluster ID 0x0015). This message doesn’t have a body to the message.

### 3.1.8 Blind Node Configuration Request (Cluster ID: 0x0018)

Send this message to a Blind Node to request its configuration. The response to this request is the Blind Node Configuration message (Cluster ID 0x0016). This message doesn’t have a body to the message.

### 3.1.9 RSSI Blast (Cluster ID: 0x0019)

Broadcast this message with a radius of 1, several times in relatively short succession to trigger Reference Nodes within radio range to average the RSSI (received signal strength indication) of the blast of broadcasts received. This message doesn’t have a body to the message.



## 4. Monitor & Test Interface

### 4.1 Messages

The following messages use the MT System App Msg (SYS\_APP\_MSG) to communicate with Location Dongle application. It can send and receive Location messages (previous section).

#### 4.1.1 Outgoing Messages

The PC (or any application using MT) can send messages (over-the-air) by using the MT System Application Message (SYS\_APP\_MSG) with the following data format:

Byte Index	Description	Value
0 & 1	Destination address – low byte first – of the outgoing message	0x0000 – 0xFFFF
2	Destination endpoint of the outgoing message	0x00 – 0xFF
3 & 4	Cluster ID – low byte first - of the outgoing message	0x0000 – 0xFFFF
5	Length of the outgoing message (next field)	0x00 – 0xFF
6 – n	Outgoing (over-the-air) Message. Use Section 3 for the format of this message.	Section 3 message formats

#### 4.1.2 Incoming Messages

The PC (or any application using MT) will receive incoming messages (over-the-air) by using the MT System Application Message (SYS\_APP\_MSG) with the following data format:

Byte Index	Description	Value
0	Application Endpoint	For this application it will be 203
1 & 2	Source address – low byte first – of the received message	0x0000 – 0xFFFF
3	Source endpoint of the received message	0x00 – 0xFF
4 & 5	Cluster ID – low byte first - of the received message	0x0000 – 0xFFFF
6	Length of the received message	0x00 – 0xFF
7 – n	Received (over-the-air) Message. Use Section 3 for the format of this message.	Section 3 message formats