



**Application Note:  
Method For Discovering  
Network Topology**

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## 1. Purpose

This document describes a method for determining the network topology for any given network using a subset of the Z-Stack ZDO (Zigbee Device Object) layer APIs. Please read the ZStack Developer's Guide and the ZStack API document before continuing.

## 2. Method

By using **ZDP\_IEEEAddrReq()**, one can start the process by issuing this request to the PAN coordinator since it always has short address 0x0000. The ReqType parameter should be set to 1, to obtain the list of devices that have associated to the coordinator. The StartIndex parameter can be used if the list contains more devices that can fit into one message.

By registering for the IEEE address request callback at the application level (see Z-stack Developer's Guide section on ZDO Message Requests), one can obtain the list of associated devices which will include their short addresses, as well as the IEEE address of the coordinator. The NumAssocDev parameter in the IEEE address response structure represents the number of devices that are associated with the coordinator.

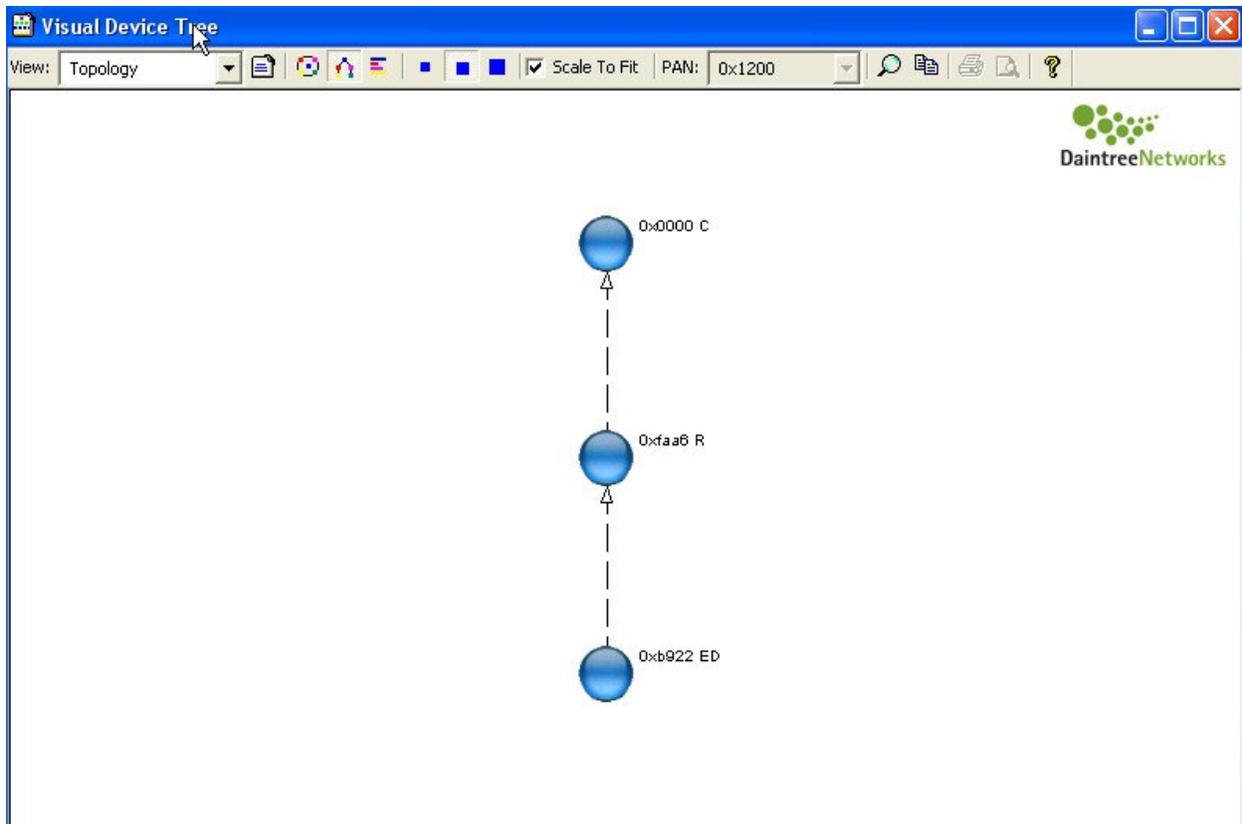
Once the first list from the coordinator is returned, one can repeat the above procedure targeted at each short address in the list. By iterating this procedure over all parents and children, the application will be able to "map out" the topology of the entire network.

## 3. Example using Z-Tool

In this example, the contrived network shown in Figure 1 was created, and visualized using the Daintree Sensor Network Analyzer application. The **NLME\_PermitJoiningRequest()** function was used on the coordinator device to force the formation of the network in this manner. By passing in the parameter of 0x00 to NLME\_PermitJoiningRequest, the user can deny other devices from associating to a particular router or coordinator. Passing in a parameter of 0xFF permits association.

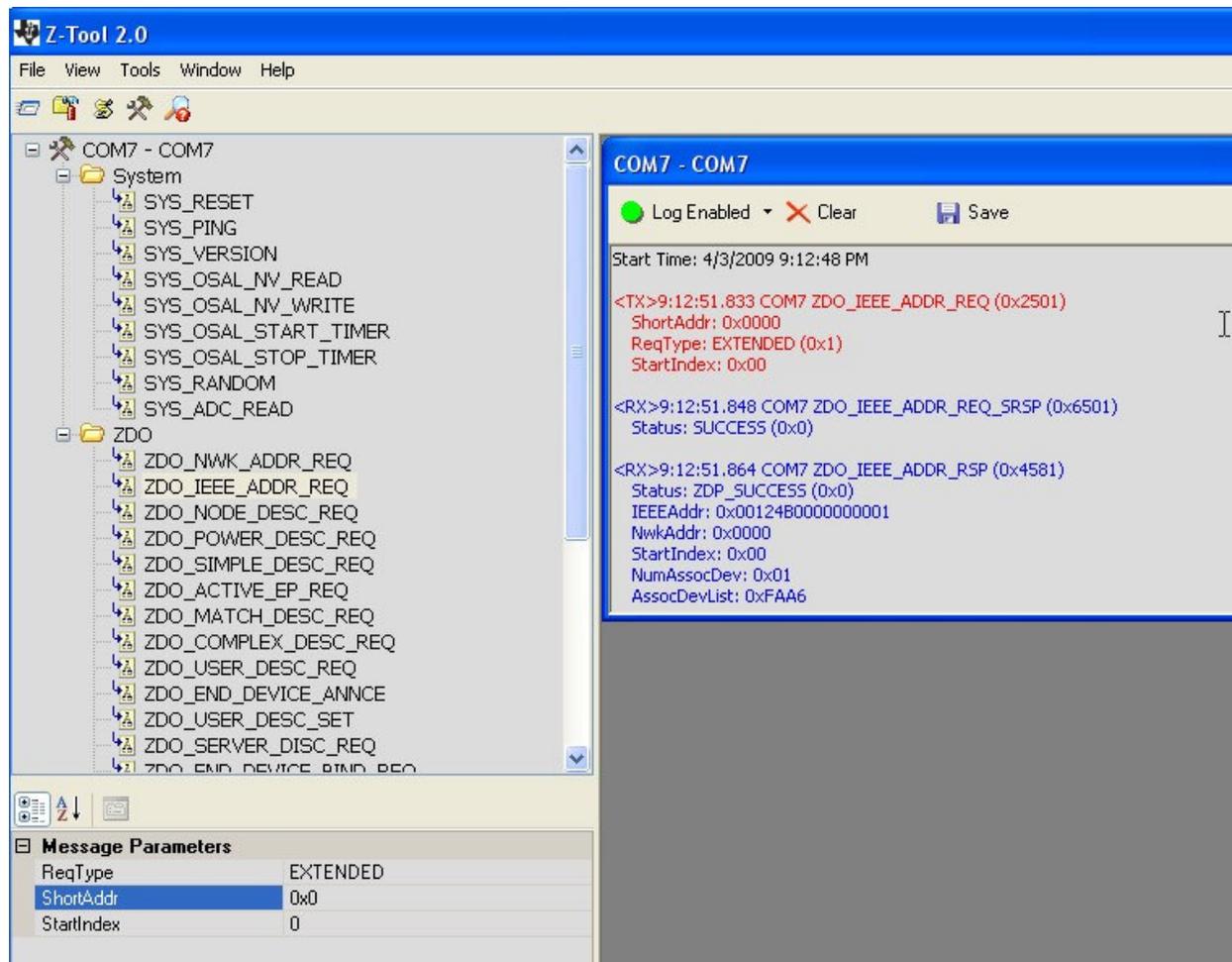
NOTE: The use of NLME\_PermitJoiningRequest in this example is used to force a joining topology and is not the normal use of this function. The NLME\_PermitJoiningRequest function is used to turn off associations in the coordinator or any router and should be used to allow and disallow new devices joining the network.

Sections 4 and 5 contain information about the packet flow and the information included in a ZDO IEEE Address Response packet.



**Figure 1. Network topology visualized using the Daintree SNA**

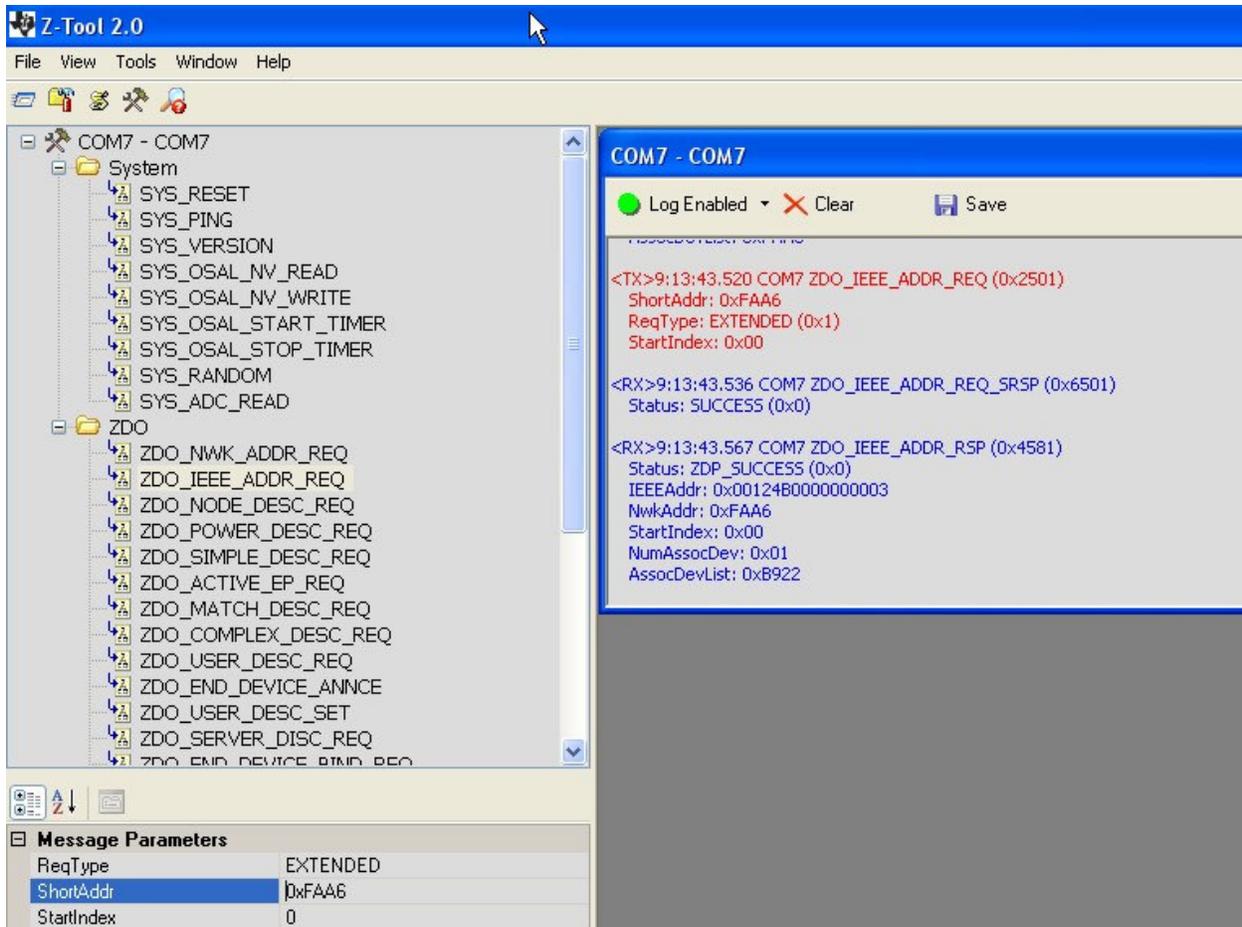
The method described above in Section 2 can be demonstrated by exercising the ZDO MT (Monitor Test) functions using Z-Tool (for Z-Tool help, select Help in the Z-Tool menu). These are compiled in via the MT\_ZDO\_FUNC and MT\_ZDO\_CB\_FUNC compile options (see the ZStack Compile Options document for further details).



**Figure 2. ZDO\_IEEE\_ADDR\_REQ to short address 0x0000 (Coordinator)**

Figure 2 shows a screen capture of an instance of Z-Tool connected to the coordinator. One should issue the ZDO\_IEEE\_ADDR\_REQ with the ShortAddr parameter set to 0, ReqType set to EXTENDED, StartIndex set to 0. The response is then displayed in Z-Tool, and we see that the coordinator has one device associated to it with short address = 0xFAA6 (AssocDevList: 0xFAA6).

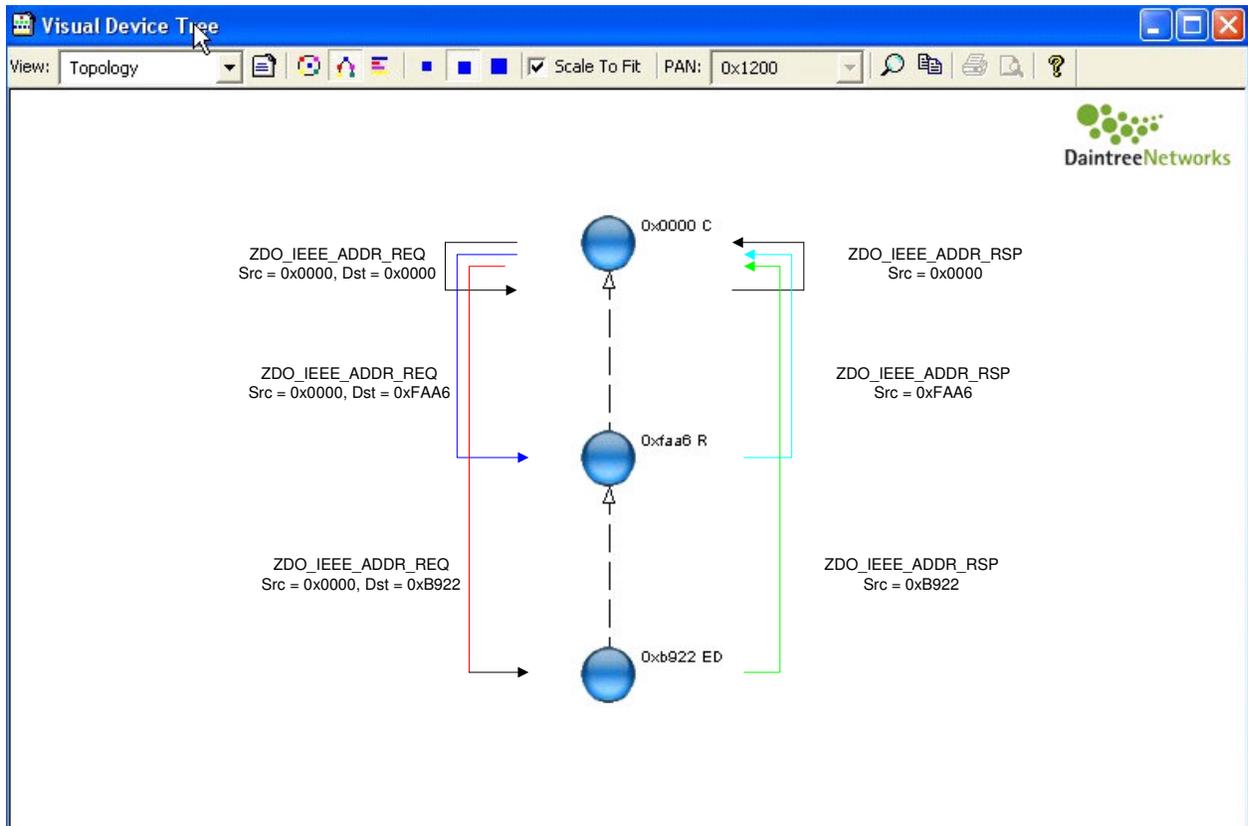
ZDO\_IEEE\_ADDR\_REQ is then issued to short address 0xFAA6, and we see that the router has one device associated to it with short address = 0xB922 (see Figure 3).



**Figure 3. ZDO\_IEEE\_ADDR\_REQ to short address 0xFAA6 (Router)**

ZDO\_IEEE\_ADDR\_REQ can then also be sent to short address 0xB922, and the user will see that no devices are associated with it. Thus, this is the end of the line, and the device discovery procedure is concluded.

## 4. Sequence Diagrams



**Figure 4. Sequence Diagram for ZDO\_IEEE\_ADDR\_REQ and ZDO\_IEEE\_ADDR\_RSP**

Figure 4 shows the chain of ZDO\_IEEE\_ADDR\_REQ calls on the left hand side of the device tree, and corresponding ZDO\_IEEE\_ADDR\_RSP calls on the right hand side.

## 5. Packet Details

Figure 5 shows the over-the-air packets that occur during these transactions, and Figure 6 shows a snapshot of one of the ZDO IEEE Address Response packets that is decoded by Daintree to show the associated device list of Router 0xFAA6.

38	18	21:13:39.214	+00:00:13.622	0xfaa6	0xffff	0xfaa6	0xfffc	Zigbee NWK	NWK Command: Link Status
39	18	21:13:40.604	+00:00:01.390	0x0000	0xffff	0x0000	0xfffc	Zigbee NWK	NWK Command: Link Status
40	18	21:13:43.200	+00:00:02.596	0x0000	0xfaa6	0x0000	0xfaa6	Zigbee APS Data	ZDP:IEEEAddrReq
41	18	21:13:43.202	+00:00:00.001					IEEE 802.15.4	Acknowledgment
42	18	21:13:43.213	+00:00:00.011	0xfaa6	0x0000	0xfaa6	0x0000	Zigbee APS Data	ZDP:IEEEAddrRsp
43	18	21:13:43.215	+00:00:00.002					IEEE 802.15.4	Acknowledgment
44	18	21:13:43.223	+00:00:00.008	0x0000	0xfaa6	0x0000	0xfaa6	Zigbee APS	APS Ack
45	18	21:13:43.224	+00:00:00.001					IEEE 802.15.4	Acknowledgment

Figure 5. Over-the-air Traffic

```

+ Frame 42 (Length = 43 bytes)
+ IEEE 802.15.4
- ZigBee NWK
  + Frame Control: 0x0048
  ... Destination Address: 0x0000
  ... Source Address: 0xfaa6
  ... Radius = 30
  ... Sequence Number = 0x45
- ZigBee APS
  + Frame Control: 0x40
  ... Destination Endpoint: 0x00
  ... Cluster Identifier: IEEEAddrRsp (0x8001)
  ... Profile Identifier: ZDP (0x0000)
  ... Source Endpoint: 0x00
  ... Counter: 0x10
- ZigBee ZDO
  ... Transaction Seq Number: 0x01
  - IEEE Address Response
  ... Status: Success (0x00)
  ... IEEE Address Of Remote Device: 00:12:4b:00:00:00:00:03
  ... NWK Address Of Remote Device: 0xfaa6
  ... Number Of Associated Devices: 1
  ... Start Index: 0
  - Associated Device List
  ... NWK Address of Associated Device 1: 0xb922
    
```

Figure 6. Router 0xFAA6's Associated Device List