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Title	Incremental Approach for MMR Network Topology Discovery
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Abstract	This document provides text descriptions for relay path mgmt and routing sections defined in ToC of IEEE 802.16j-06/026r2
Purpose	
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# Incremental Approach for MMR Network Topology Discovery

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## Introduction

In current 802.16j architecture, the MMR network topology is a tree-like hierarchy, and the communication connection is established with the selected path within the tree layer-by-layer. All the connections, no matter they are tunnel CIDs, or basic CIDs, have a binding relationship with existing MMR topology. We can use the pre-established connection and their topological property for the new node entry process. For example, when a RS receives RNG-req from multiple new nodes, it encapsulates RNG-req messages into the pre-established connections, and forwards the data upstream to BS. While BS receives the tunneled RNG-req, it would handle the entry process accordingly, and tunnel RNG-rsp back to the RS. Then the tunnel-end-point RS de-caps the tunnel and sends RNG-rsp messages to each new node. Note that the pre-established connection is not only used for RNG-req/rsp, it is actually also used for all the messages in entry process such as SBC and REG-req/rsp.

Due to that the pre-established connection is associated with an existing path, when BS receives the tunneled RNG-rsp from the new nodes, it would learn the new topology by combining the pre-established path and the newly attached nodes, and to form a new path in its routing database. As the MMR tree is built up layer-by-layer, it provides an incremental way to construct routing database and path/CID binding which eventually cover all the nodes in MMR tree.

The following sections describe the details how to use pre-established connection recursively to support MMR network topology discovery. In this approach, it only requires store tunnel CID or basic CID in all intermediate RS, and it does not change any entry process defined 802.16e-2005.

## 1. Initial entry and incremental topology creation

The following procedure systematically describes how BS learns MMR topology using pre-established connections and the attachment of new node; and how BS creates the new connection to the new node for the future topology discovery.

1. New node sends RNG-req with initial ranging CID, to the selected RS
2. The selected RS receives RNG-req and encapsulates it with other RNG-req messages (from other new node, if any) into tunneled data burst, and sends it upstream
3. Upon received tunneled data, BS handles RNG-req following the standard entry procedure, and then tunnels all RNG-rsp into data burst and sends it back to the designated RS. From the received CID and new node information, BS can create a new path in its routing database
4. Using the same procedure described above, BS and the designated RS would tunnel all the messages back and forth for the rest operations associated with ranging, capacity negotiation, security and registration from the new node.
5. After the new node gets into normal operation mode, if it is a RS node, BS should create a new path and populate path/CID binding data to all the RS along this new path. This makes the new path and new CIDs available for the future topology discovery.
6. In this process, only tunnel CID or basic CID need to be stored in all intermediate RS.

## 2. Call flow for incremental network entry and topology discovery

The following is a figure to show the call flow of incremental network entry under and topology discovery. The described functional flow is applicable to both RS entry and MS entry. The description also reflects the routing database updates and path/CID binding relationship.

In this example, after RS1 attachment, the BS would create a tunnel connection for RS1. The RS2 entry process is tunneled between BS and RS1. Similarly, BS creates a tunnel connection for RS2, and MS entry process is tunneled between BS and RS2.

Note that the messages in this figure are only for illustrative purpose.

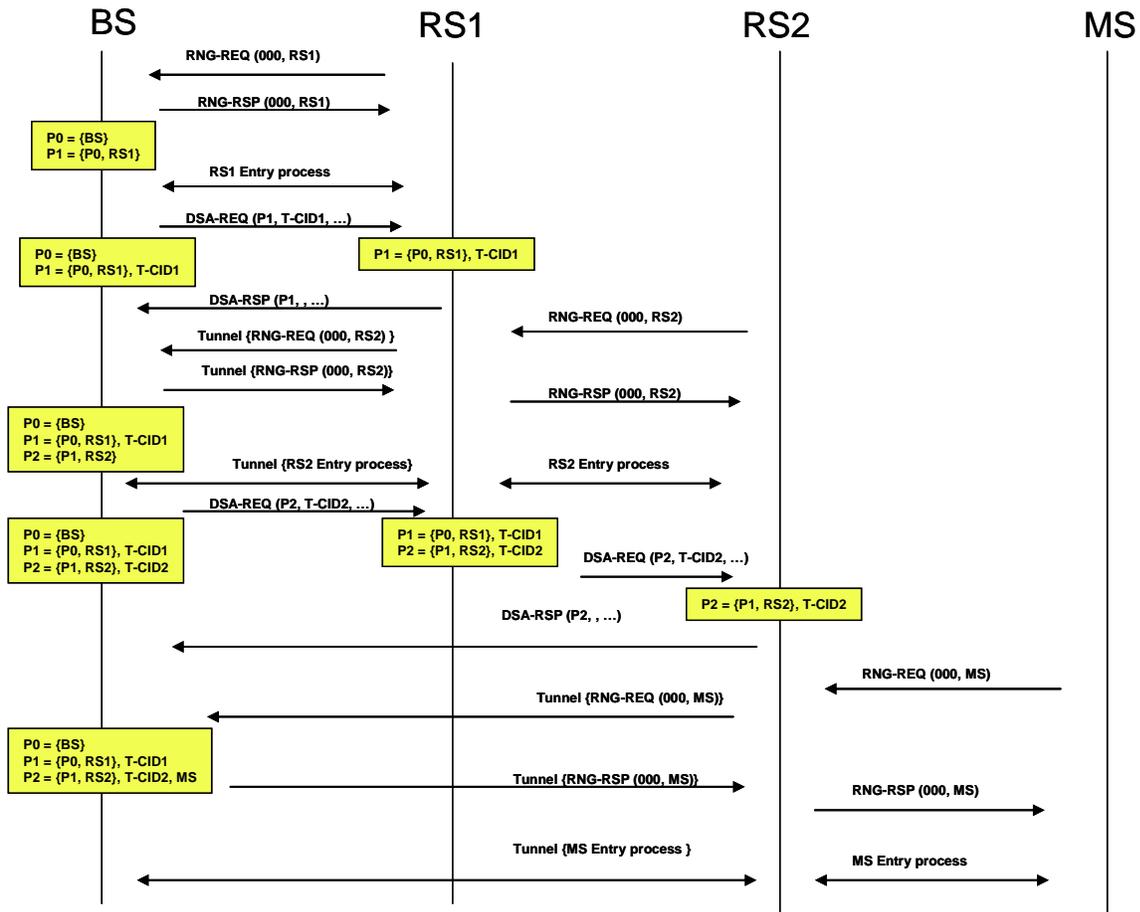


Fig 1. MMR topology discovery using tunnel connection

### 3. Proposed text changes

+++++++ start text proposal ++++++

[Insert the followings in sections of 6.3.25]

### **6.3.25.x MMR Initial entry and incremental topology discovery**

The following procedure systematically describes how BS learns MMR topology using pre-established connections and the attachment of new node; and how BS creates the new connection to the new node for the future topology discovery.

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4. Using the same procedure described above, BS and the designated RS would tunnel all the messages back and forth for the rest operations associated with ranging, capacity negotiation, security and registration from the new node.
5. After the new node gets into normal operation mode, if it is a RS node, BS should create a new path and populate path/CID binding data to all the RS along this new path. This makes the new path and new CIDs available for the future topology discovery.
6. In this process, only tunnel CID or basic CID need to be stored in all intermediate RS.

+++++++ End of text proposal ++++++