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Source(s)	G.Q. Wang, Wen Tong, Peiying Zhu Hang Zhang, David Steer, Gamini Senarath, Derek Yu, Mo-Han Fong Nortel 3500 Carling Avenue Ottawa, Ontario K2H 8E9 Voice: 1-613-763-1315 [mailto:wentong@nortel.com] [mailto:pyzhu@nortel.com] Erwu Liu, Dongyao Wang, Gang Shen, Kaibin Zhang, Jimin Liu, Shan Jin Alcatel Lucent, R&I Shanghai, No.388, Ningqiao Road, Shanghai, P.R.C. Voice: 86-21-50551240-8194 Fax: 96-21-50554554 {Erwu.liu, Dongyao.Wang, Gang.A.Shen, Kaibin.Zhang, Jimin.Liu, Shan.Jin}@alcatel-sbell.com.cn Torsten Fahldieck Alcatel-Lucent R&I Holderaeckerstr.35, Stuttgart, Germany Voice: +4971182132163 Fax: +4971182132453 torsten.fahldieck@alcatel-lucent.de
Re:	A response to a Call for Technical Proposal, http://www.wirelessman.org/relay/docs/80216j-07_007r2.pdf
Abstract	This document provides text descriptions for routing and connection management sections defined in ToC of IEEE 802.16j-06/026r2
Purpose	To incorporate the proposed text into the P802.16j Baseline Document (IEEE 802.16j-

	06/026r1)
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MMR Network End-to-End Distributed Tunnel Connection Management

G.Q. Wang, Wen Tong, Peiying Zhu, Hang Zhang, Gamini Senarath,

David Steer, Derek Yu, Mo-Han Fong
Nortel
Erwu Liu, Torsten Fahldieck, Dongyao Wang, Shen Gang, Kaibin Zhang, Jimin Liu, Shan Jin
Alcatel-Lucent

1 Introduction

In MMR network, topological information creation (i.e., adjacent radio link and derived tree structure) is subject to the constraints of radio resource utilization (e.g., radio resource allocation, channel/link status, transmission power, bandwidth allocation, and global traffic situation). In the other word, the current radio resource situation would determine how a mobile node should attach to MMR and to whom it should attach to. Based on these constraints, the routing domain is formed and the routing path is selected.

In IEEE 802.16j-06/026r3 it has defined the concept of tunnel and related centralized tunnel connectivity management. The centralized tunnel management has the following characteristics:

End-to-end tunnel creation is subject to the radio resource control in centralized topology schema

In centralized routing schema, the tunnel scope is global in a single routing domain, where the end-to-end routing path is determined by BS.

The routing path consists of all the nodes which are visible from BS's routing database

But in distributed MMR network, some RS may involve radio resource allocation to the other nodes. For example, in baseline document 026r3, section 6.3.9.16.3.1, it defined RS group concept. A group of RSs can form a virtual group based on certain criteria. Within a virtual group, there is group leader RS which is responsible to allocate radio resource to other group members (i.e., leader RS transmits preamble/FCG/MAP to all other group members). Each RS group is assigned a multicast RSID as group ID, and BS will manage RS group collectively using the assigned group ID. This implies from BS perspective, it treats RS group as one routing object, and the details of the topology within the group may not be visible to BS. In the other word, the RS group provides a level of abstraction on radio resource and related topology, which is a black box to the BS. Hiding certain level information to BS is not only helpful to deal with the large-scale MMR network; as well it is benefit for mobility efficiency. For example, from the definition, all the group members may share the same radio resource. When a roaming RSm moves around RS group radio coverage area and frequently changes its access point to the RS group, there is no need to trigger global handover procedure. The local mobility is handled by leader RS by selectively forwarding the data to the specific member RS to which the roaming RSm is attaching to. This scenario is applicable to relay situation where RSm is installed on the train or moving vehicle.

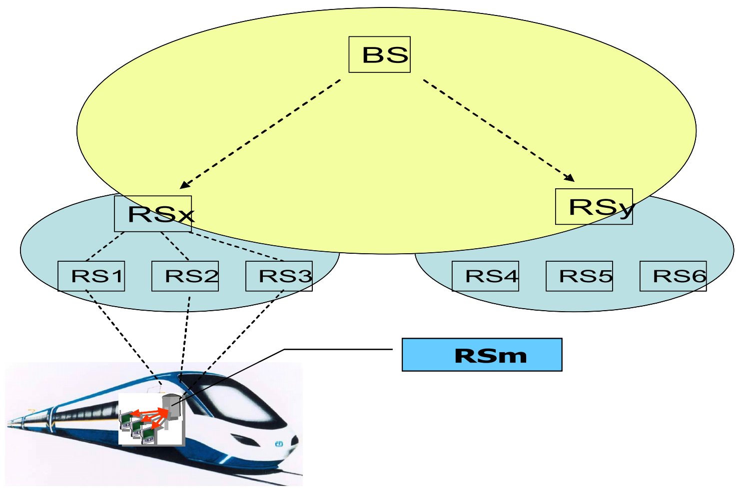

Figure 1. Multi-routing domain usage model

Figure 1 is an example showing tunnel management in a distributed relay system with multi-routing domain. MR-BS configured two RS groups with leader RSx and RSy, and assigned RS group ID to each group. In RS group, the leader RS, saying RSx, would allocate radio resource to group members such as RS1, RS2 and RS3.

Network entry: When RSm conducts network entry by selecting RS1, RS1 forwards RNG-Req to RSx following the typical procedure. When RSx receives RNG-req, it would forward RNG-req to BS by telling BS that RSm is attaching to RSx (i.e., using RSx's basic CID). BS then would create a path (BS, RSx, RSm) in its routing table. Note although physically RSm is attaching to RS1, but this link is not visible to BS.

Tunnel creation: When BS uses DSx to signaling a tunnel to RSm, it would select path (BS, RSx, RSm). Once DSx goes across the routing domain boundary, the RSx will update the path as (BS, RSx, RS1, RSm) for the tunnel creation. The tunnel CID may not be the same when the tunnel goes across the boundary (this is an implementation issue). If the tunnel CID is local to routing domains, then RSx shall allocate a new tunnel CID within its own domain, and create a mapping between the original tunnel CID and the new tunnel CID.

Data forwarding: In distributed tunnel case, the data forwarding is same as centralized tunnel system. Except that if the tunnel CIDs are different, CID swapping in the MAC header needs to be done at the boundary of

routing domains.
Figure 2 shows the working flow behavior at each RS which specifies how constraint-based routing is used to support end-to-end distribute connection management.

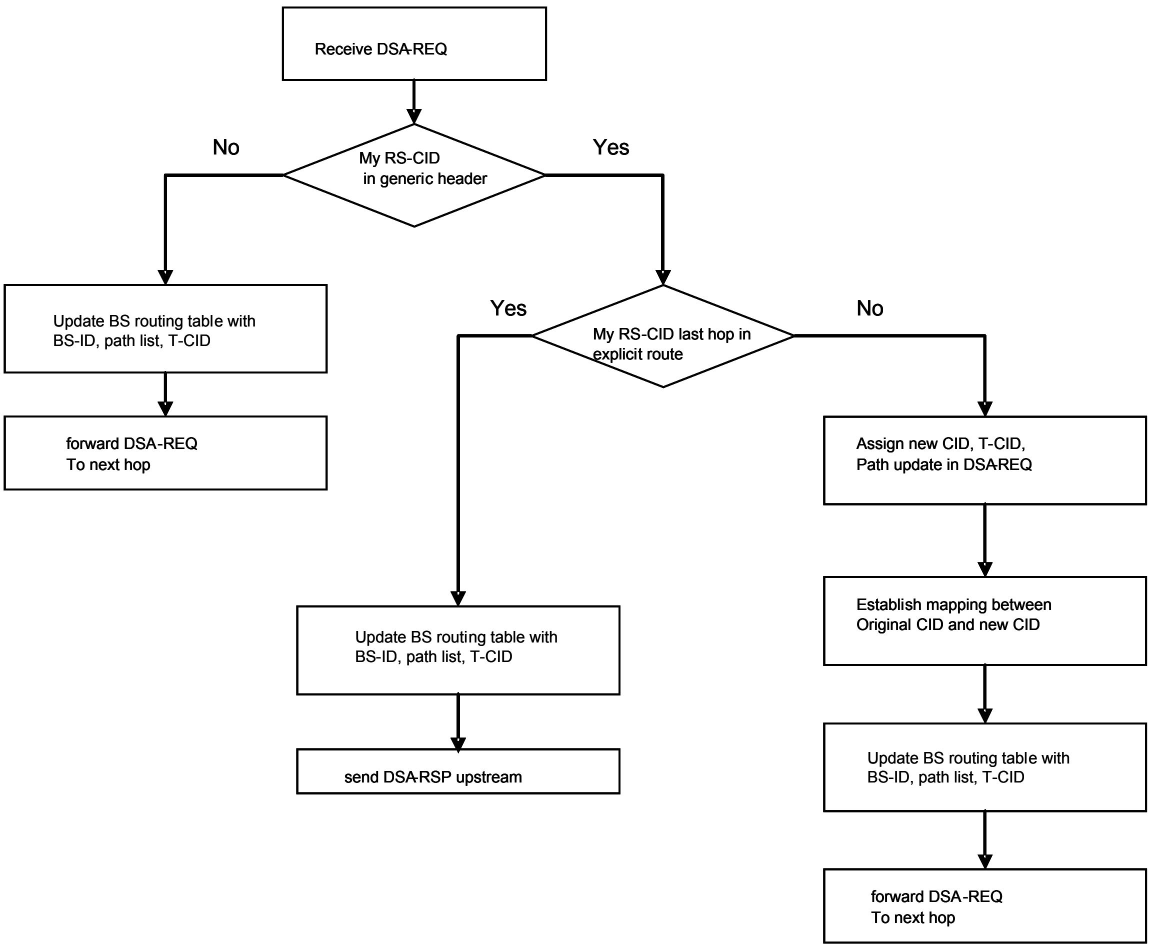

Figure 2. Constraint-based DSA signaling call flow for sectionized tunnel creation

2. Proposed text changes

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[Insert the followings after the end of section 6.3.3.8.1:]
6.3.3.8.1.2 Distributed tunnel management

Sectionized connection in distributed routing domain
In distributed routing control schema, there exist multiple routing domains. In each routing domain, the routing controller either resides on MR BS, or the RS cell head. In distributed manner, the routing path within each cell is determined individually by the routing controller with their own radio resource allocation and localized topology knowledge. In this case, the tunnel CID may only have local sense for connections within the defined domain. The end-to-end connection from BS to the designated RS is represented by the concatenation of localized tunnel CIDs, along the given path. When a data burst travels across the boundary of the routing domains, the boundary RS (i.e., RS cell head) shall replace the original tunnel CID by a new tunnel CID. This operation is called “tunnel CID swapping”.

Constraint-based Routing for sectionized tunnel
Similar to globalize tunnel management, constraint-based routing is also used to support sectionized tunnel connections within distributed routing domains. In distributed case, the explicit route and associated path ID are specified in signaling message such as DSx (x represents Add, Change or Delete) by BS. Different from globalize tunnel creation, in the initial explicit route, the BS only specifies its local topology, next cell routing domain boundary node and the destination node. In DSA message header, the initial tunnel-end-point RS CID is the next RS cell head and the body contains the transport tunnel CID (global or local). Upon received DSA, the RS cell head should check whether itself is the targeted destination node (by examining the explicit route), and should it create a new sectionized tunnel for the rest of the relay path. If it needs, the RS cell head should replace the next tunnel-end-point RS CID in generic MAC header, assign the new transport tunnel CID in DSA body, and update the explicit route accordingly. RS cell head may also create a mapping relationship between the original transport tunnel CID and the newly assigned transport tunnel CID. This procedure will be repeated cell-by-cell until the destination access RS in the explicit route is reached.

Forwarding by sectionized tunnel CID
If the tunnel CID is global, the data forwarding process is same as centralized tunnel management. In the local CID case, the tunnel CID in the header may be changed once the data packet goes across the routing boundary.

The determination of the new CID and the type of forwarding action is done by a forwarding table lookup. Similar to the centralized case the tunnel end point should determine the mapping/aggregation between tunnel CID and per-service-flow CID.

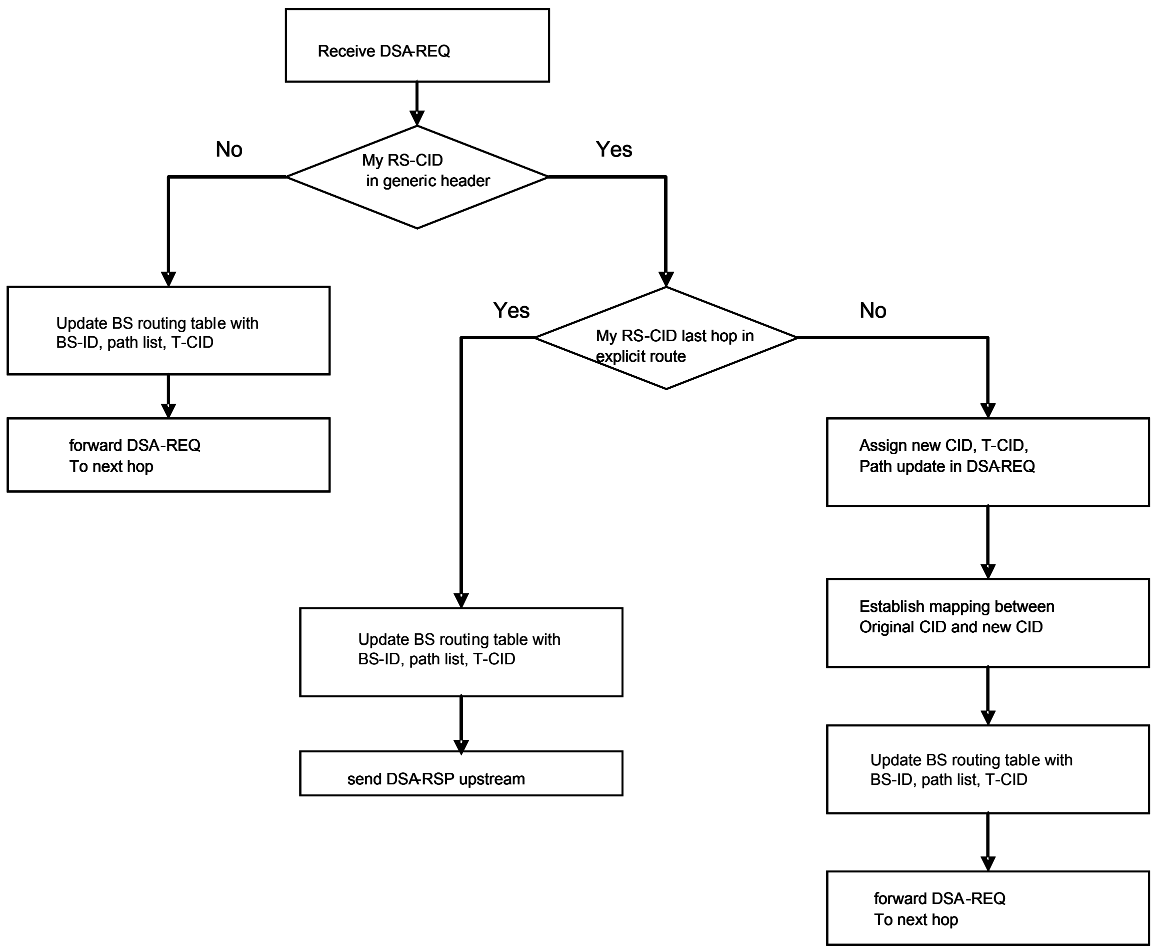

Figure 2. Constraint-based DSA signaling call flow for sectionized connection creation

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