# 16m RS

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Venue: TGm SDD: Relay

Re: TGm SDD: Relay; in response to the TGm Call for Contributions and Comments 802.16m-08/040 for Session 58

Base Contribution:

This is the base contribution.

Purpose:

To be discussed and adopted by TGm for the 802.16m SDD

Notice:

Release:

Patent Policy:

# Overview

- This contribution provides input for the following invited topics for relay
  - Relay Model (transparent, non-transparent, etc.)
  - Scheduling (centralized vs. distributed)
  - Control and Data plane functions
- Procedures, terms and definitions are borrowed from 16j, wherever it is possible.

# Relay model: non- Transparent vs. Transparent

- 16j supports both models. Definitions from 16j
  - **3.107 non-transparent RS:** A non-transparent RS transmits DL frame-start preamble, FCH, MAP message(s) and channel descriptor (DCD/UCD) messages.
  - **3.108 transparent RS:** A transparent RS does not transmit DL frame-start preamble, FCH, MAP message(s) or channel descriptor (DCD/UCD) messages.
- We propose that at least the non-transparent RS model should be included in 16m
- A non-transparent RS provides coverage extension, which is not possible with the transparent model

# Proposed SDD Text

## 15 Support for multi-hop relay

## 15.x non-Transparent Relay

A non-transparent relay is supported, where the relay transmits its SCH, BCH, and USCCH. Transmission of SCH and BCH by Relay and 16m BS are aligned.

# Centralized vs. Distributed Scheduling

- Centralized scheduling
  - allows only BS to have the scheduling function and alleviates any scheduling implementation on the RS. This is useful for making a simple RS.
  - BS needs to send USCH for all the hops, could cause overhead
- Distributed scheduling
  - allows RS to schedule for its link and provides better radio usage
  - The distribution of scheduling functionality makes RS more complex
- We propose to have both type of scheduling
- For a common two-hop case, centralized scheduling allows simple RS
- For multi hop case, distributed scheduling

# Proposed SDD Text

## 15.X Scheduling

In centralized scheduling, the BS schedules transmission on all the links between MS and the BS. In distributed scheduling, the BS and the intermediate RS schedules transmission on their links. Both centralized and distributed scheduling are supported.

# Data and control plane functions

# Introduction

- Current SDD draft (08-003r4) supports two frame structures for Relay. The use of bi-directional frame structure (option 2) is not clear. Whether it is used for network coding or RS will operate on two separate segments/frequencies. Based on the use cases, some of the functions will vary (such as HARQ, power control, interference management etc.) based on the selected frame structure.

- The functions which are dependent on the above two items are not discussed here.

- Some of the functions are dependent on the type of RS model, scheduling or security. For example, in case of the distributed scheduling how the RS will determine USCH for its links?

- The functions, which are needed in different types of frame structure, RS model, scheduling and security, are discussed here.

- The exact procedure may differ. Therefore a high level procedure is provided.

- As per 16m RS adhoc decision, we are trying to reuse procedures from 16j.

# Data and control plane functions

- Addressing and Data forwarding
- ARQ function
- RS Network Entry
- MS Network Entry through RS
- SON should cover RS also, including plug and play, power saving, etc.
- Mobile RS
- Path management
- Topology discovery
- Security

# ARQ Function

- 16j has defined three ARQ modes
- End to End ARQ
  - No ARQ function on the intermediate RS
- Two link ARQ mode
  - ARQ between BS and access RS, and between acces RS and MS
- Hop by hop ARQ mode
  - ARQ between each pair of adjacent stations
- 16m TG needs to decide, which of these mode or modes are needed.
- We propose end to end for the centralized scheduling and hop by hop for the distributed scheduling.

# RS Network Entry

- RS Network Entry should be similar to MS network entry.
- However, the following additional steps are needed
  - Access station selection
  - Path creation and tunnel establishment
  - Transfer and configure operational parameters
- If RS is managed RS, then the following steps are needed
  - Establish IP connectivity
  - Establish time of day
  - Transfer operational parameters

# MS Network Entry through RS

- MS Network entry procedure could be distributed between RS and BS
- MS may perform access station selection based on hop count/E2E metrics.
- RS should handle the initial link adjustment with MS.
- Rest of the MS network entry procedure such as connection establishment, authentication, registration should be process between MS and BS
- 16m MS should be aware of its point of attachment and may follow different functions

# SON for RS

- SON features should be applicable to RS also
- RS is desired to be deployed on a need basis without re-planning of the network.
- The TG is suggested to develop the RS SON features also. Some of the desired features for RS are
  - Preamble selection
  - power saving
  - power control
  - interference control
  - Registration/De-registration
  - Neighbor discovery (both RS and BS)

# Mobile RS

- Mobile RS is one of the feature that 16m Relay Ad-hoc group has concluded for further discussion
- Mobile RS can be deployed on Train, Buses to provide better coverage and optimized handover for its sub-ordinate MSs.
- It is also desired to cause least interference to its neighbors during its mobility
- Unnecessary complexity should be avoided for the Mobile RS:
    - It should be non-transparent
    - It should be the last hop

# Topology Discovery

- The BS needs to know the access RS and the path to an access RS for an MS. This is called topology discovery.

- BS receives initial registration message (e.g. RNG-REQ), it needs to differentiate
  - whether the message is coming directly from an MS/RS, or
  - whether the message is coming through another RS which is already attached to the BS.

- In the later case, the BS needs to know which RS.

# Path Management

- Path management is desired in case of more than 2 hops
- A BS and intermediate RSs should know the path for forwarding data to MS in the DL direction from an BS to an access RS
- The path management is constrained by the tree topology ( an RS shall have only one super ordinate RS)
- The path calculation algorithm is implementation specific
- We only need to provide procedures for the path management.

# Proposed SDD Text (1/3)

15 Support for multi-hop relay

15.x Control and Data Plane Functions

15.x.1. Addressing and data forwarding

*{refer to the latest revision of C80216m-08_1261 for the proposed text}*

15.x.2. ARQ Functions

There are two ARQ modes. The first mode is an end-to-end ARQ mode, which is performed between a BS and an MS. This mode is used for centralized scheduling. The second mode is a hop-by-hop ARQ, which is performed between each adjacent stations. Two adjacent stations could be BS, RS or MS.

15.x.3. RS Network Entry

RS Network Entry follows the same steps as MS network entry. However, the following additional steps are needed

– Access station selection
– Path creation and tunnel establishment
– Transfer and configuration of operational parameters

If RS is managed RS, then the following steps are needed

– Establish IP connectivity
– Establish time of day
– Transfer operational parameters

# Proposed SDD Text (2/3)

## 15.x.4. MS Network Entry

MS Network entry procedure could be distributed between RS and BS. RS should handle the initial link adjustment with MS. Rest of the MS network entry procedure such as connection establishment, authentication, registration is processed between MS and BS. 16m MS is aware of its point of attachment (BS and RS) and accordingly may follow different functions.

## 15.x.5. SON for RS

SON is supported for RS. The following SON features are supported:

– Preamble selection
– power saving
– power control
– interference control
– Registration/De-registration
– Neighbor discovery (both RS and BS)

## 15.x.6. Mobile RS

Mobile RS provides coverage improvement and handover optimization for its subordinate MS. During its mobility, it should not cause interference to its neighbors. Mobile RS can only be a non-transparent access RS.

# Proposed SDD Text (3/3)

## 15.x.7. Topology Discovery

BS establishes topology of all the RS and MS connected through it. During initial ranging BS determines that the station sending initial ranging is directly accessing the BS, or is accessing through another RS. Once the ranging is complete, the BS saves the location of the station with respect to the access RS. The BS knows the tree chain from itself to any other station connected through it.

## 15.x.8. Path Management

Path management is desired in case of more than 2 hops. A BS and intermediate RSs should know the path for forwarding data to MS in the DL direction from a BS to an access RSs.

## 15.x.9. RS Security

*{refer to the latest revision of C80216m-08_1380 for the proposed text}*