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Title	**Multi-carrier Support in Relay**	
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Re:	SDD Change Request	
Abstract	This contribution specifies multi-carrier support in the RS.	
Purpose	For consideration and adoption into the 16m SDD document.	
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Multi-carrier Support in Relay

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Multi-carrier Operation in Deployments with Relay

In a multi-carrier deployment of 802.16m based system an ABS may operate in multicarrier mode where more than one RF carrier is utilized by a single instantiation of the MAC supporting AMSs also capable of operating on more than one RF carrier.

The RF carriers may all be fully configured or some may be partially configured. Section 19 defines “scenario 1” as the case where all RF carriers are fully configured and “scenario 2” as the case in which some of the RF carriers are partially configured.

In such multi-carrier system there is need for SDD to clarify how ARS’s may be used and support the multi-carrier operation.

We believe that ARSs should be used only to relay fully configured carriers as partially configured carriers are mainly targeted for high power broadcast only carriers which in most cases are synchronized to provide macro-diversity.When ARSs are deployed in a multi-carrier deployment individual ARSs can support multiple RF carriers or only a single RF carrier. An example of multi-carrier operation using a multi-carrier RS is shown in Figure 1. A more interesting and useful usage of ARS is when single carrier ARS’s are used to provide multi-carrier connections., Examples of this usage are conceptually shown in Figure 2. It should be noted that in Figure 2 RF carrier 1 and RF carrier 2 are assumed to be different RF carriers with different center frequencies and that multi-carrier operation across single-carrier ARSs does not involve cooperative relay transmissions or the use of virtual MIMO techniques.

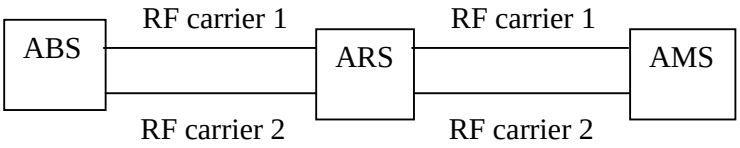

Figure 1 Multi-carrier operation accross multi-carrier ARS

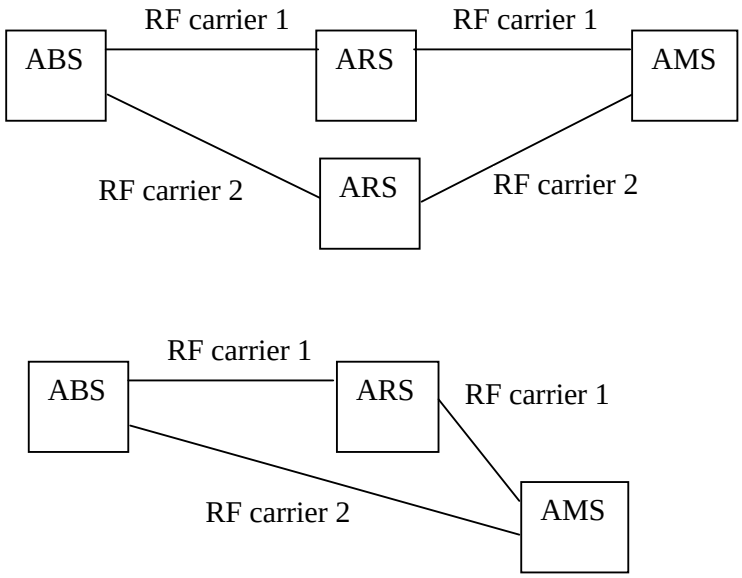

Figure 2 Multi-carrier operation using single-carrier ARSs

When ARSs operate in a multi-carrier deployment, data is transmitted on a given carrier for the entire path between the ABS and AMS. For example, an MPDU transmitted from the ABS to the ARS on RF carrier 1 is transmitted to the AMS on RF carrier 1.

When a multihop topology is used (distance between ABS and AMSs is 3 hops or more) all of the ARSs in a path handle the same RF carriers. That is, if the first hop ARS is a multi-carrier ARS configured to operate on RF carriers 1 and 2, the second hop ARSs attached to it are also multi-carrier ARSs configured to operate on RF carriers 1 and 2. Similarly if the first hop ARS is a single carrier ARS configured to operate on RF carrier 1, the subordinate ARSs attached to this ARS are also single-carrier ARSs configured to operate on RF carrier 1.

In order to avoid too much complexity and dependency of technical developments of multi-carrier and relay concepts some design restrictions may need to be enforced to facilitate practical solutions. For example for all multi-carrier ABS-AMS connections involving a ARS:

- Only Fully Configured Carrier are used
- Only MAC PDU segmentation is used
- Control information pertaining to the secondary carrier is transmitted on the secondary.

Text Proposal

[Insert the following text into section 15 of the SDD]

15.4.x Relay Support of Multi-Carrier Operation

In general all operational principals for multi-carrier operation apply to a system involving ARS's unless explicitly stated otherwise.

When ARSs are deployed in a deployment where the multi-carrier feature is used individual ARSs can support multiple RF carriers or only a single RF carrier. ARSs are used only to relay fully configured carriers.

When ARSs operate in a multi-carrier system, data is transmitted on a given carrier for the entire path between the ABS and AMS. For example, an MPDU transmitted from the ABS to the ARS on RF carrier 1 is transmitted to the AMS on the same RF carrier 1.

When a multihop topology is used (distance between ABS and AMSs is 3 hops or more) all of the ARSs in a path handle the same RF carriers. That is, if the first hop ARS is a multi-carrier ARS configured to operate on RF carriers 1 and 2, the second hop ARSs attached to it are also multi-carrier ARSs configured to operate on RF carriers 1 and 2. Similarly if the first hop ARS is a single carrier ARS configured to operate on RF carrier 1, the subordinate ARSs attached to this ARS are also single-carrier ARSs configured to operate on RF carrier 1.

As described in section 19, in multi-carrier mode one of the fully configured carriers is designated as primary carrier for an MS. The MS uses the control channels and signaling on primary carrier for networks entry and bandwidth requests. However when ARS's are involved in multi-carrier operation for an MS all downlink and uplink control channels for traffic allocation, including A-MAP signaling, Fast Feedback, HARQ Feedback, UL Ranging (both initial ranging and periodic ranging), UL Sounding, and Power Control are sent on the carrier on which data is exchanged. Control information pertaining to a secondary carrier is not sent on the primary carrier when ARSs are involved in multi-carrier operation..

When ARSs are used in multi-carrier operation, AMSs may not omit UL ranging on secondary carriers and may not make any assumptions about the timing offset on the secondary carrier. If ARQ if not performed end-to-end, then the packets from a flow must all be sent on one carrier and cannot be multiplexed across carriers.

When ARSs are used in multi-carrier operation for an AMS , the AMS's sleep mode is managed by the BS.

To ensure integrity of HARQ and PHY processing at the ABS and ARS level, for all connections through an ARS involving multi-carrier, MAC PDU segmentation is used to multiplex data across multiple carriers.