Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**BS Centrally Controlled Peer-to-Peer Communication**
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Re:	Call for Contributions on Project 802.16m System Description Document (SDD) Contribution pertains to: IEEE 802.16m Frame Structure Design
Abstract	To allow BS controlled peer-to-peer communication
Purpose	For IEEE 802.16m discussion and eventual adoption
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BS Centrally Controlled Peer-to-Peer Communication

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1. Introduction

P2P (peer-to-peer) mode is required in the IMT-Advanced Network Topology. As for P2P mode, user terminals receive and forward traffic on behalf of others to form a dynamic multi-hop network among users. Possibly the P2P traffic does not pass through BS. P2P communication has many advantages such as high flexibility, reliability, load balance, etc. It also eliminates the high burden and possible traffic bottleneck in links to/from BS in the existing star-like topology. However, the key headache problem in P2P topology is how to control peer to peer service for scheduling, management, routing, etc

This contribution proposes a peer-to-peer data communication scheme under BS centralized control in IEEE 802.16m. In the proposed scheme, all the MSs and RSs are synchronized, and exchange control information with BS directly. They are directly controlled by BS for management, scheduling, routing, etc. The control signal and data is separated, following different paths. This scheme provides peer-to-peer data transmission between users with BS's centralized control. The multi-hop P2P mode defined in this proposal is distinguished from the prior IEEE 802.16 Mesh Mode by offering direct BS central control to involved MS and RS. For MS that is out of the BS coverage, RS may take the responsibility for MS synchronization and forwarding BS control signals. The solution is integrated to coexist with legacy point-to-multipoint (PMP) services.

2. Description

The peer-to-peer transmission could be traffic from one MS to another MS directly, or multi-hop communication through intermediate RS or MS, possibly not passing BS. All the MSs and RSs exchange control information with BS directly. They are directly controlled by BS for management, scheduling, routing, etc.

Fig.1 illustrates a peer-to-peer data transmission under BS centralized control where control signal and data traffic is physically separated in the transmission. Here physical separation means that control signal and data traffic follow different paths. Control signals, such as service request, authorization, channel resource reservation, priority indication, etc. are directly communicated between the BS and RS/MS, as shown in the figure by the dotted and directed lines. Base station is responsible for all the control and management functions. On the other hand, peer-to-peer data traffic can be relayed through several intermediate RSs or MSs as shown by the solid and directed lines. It is not necessary for data traffic to pass through BS with the benefit of load balance. The separation of control signal and data stream obviously benefits the centrally controlled peer-to-peer communications. BS is responsible for data traffic path selection while intermediate RSs or MSs only have functions of receiving and forwarding data according to the selected path notified by the BS. These intermediate RSs or MSs have no/less intelligence for path selection, or resource allocation. All the transmission configurations (for example the desired frequency bandwidth) are decided and allocated by the BS. Intermediate RS or MS only needs to report its status to BS or its upper level station for decision optimization. The radio link for data traffic could have short distance and line of sight or near line of sight propagation condition for high data rate. Control link, however, could be designed with low data rate, high reliability for large area coverage.

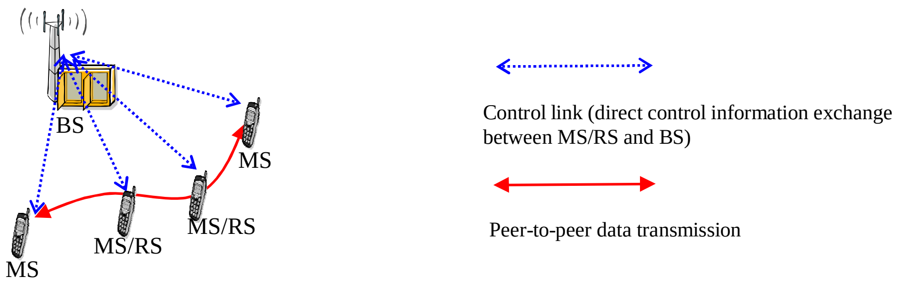

Fig. 1 Peer-to-peer data transmission under BS centralized control

Load balance can be easily realized with this scheme. In case that the requested/serving BS is heavy loaded, data traffic can be relayed to neighbor BS. Fig. 2 shows an example of cross-BS connection for load balance. MS requests a service to its “home” base station A. However, base station A has already been overloaded. Therefore base station A negotiates with its neighbor base stations to see if they have free capacity for the requested service. After checking on relevant issues regarding service requirement, network conditions, available resource, etc., base station A selects one neighbor base station (e.g. base station B) and negotiate with it to setup a multi-hop connection. BS A and BS B send commands to involved relay stations in their coverage respectively to tell them the selected route and allocated resource for the service. Thus a cross-BS connection is established and MS gets service from neighbor BS.

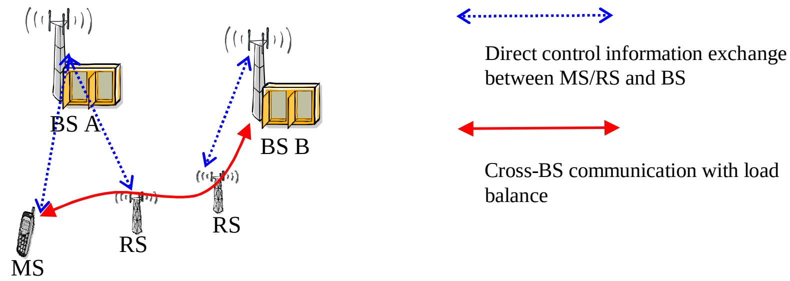

Fig.2 Cross-BS connection with load balance

3. Inclusion of an “Peer-to-Peer Zone” in the Frame Structure

As illustrated in Figure 3, the P2P zone is a TDM/FDM allocation in the sub-frame to enable MS and/or RS in configurations with peer-to-peer communications. This could be an optional feature in the frame structure definition. MS/RS is still synchronized with BS, and exchange control signal with BS. BS performs resource allocation, scheduling, etc. for MS. For example, MS may send bandwidth request directly to BS for P2P service, and BS allocates resource (i.e. P2P zone) to MS and other involved stations through MAP. After the establishment of P2P connection, MS can start the P2P communication under BS control. For MS nodes that are out of the BS coverage, RS may be assigned for MS synchronization and forwarding control signal exchanged between BS and MS. Spatial reuse for P2P communications within one cell is allowed to increase system capacity.

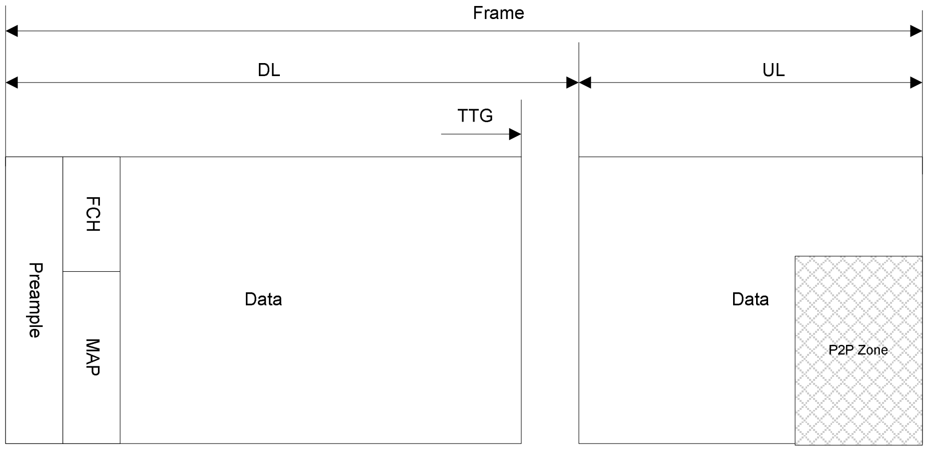

Fig.3 Example frame structure to support peer-to-peer communication

4. Summary

This contribution proposes a peer-to-peer data transmission under centralized control. In this architecture, data traffic is multi-hop relayed via RS or MS. It is not necessary for data traffic to pass through BS. This helps to eliminate the traffic bottleneck at the BS node. The network is more efficient and flexible due to the distributed data traffic routing. The inherent redundancy of the network architecture significantly improves reliability. Traffic load is balanced among nodes within the cell. Efficient and optimal path is selected for traffic transmission without the limitation of traffic aggregation. All the involved nodes (MS, RS) are directly controlled by BS, or RS may forward control information exchanged between MS and BS (if MS is out of BS coverage). Thus control signal experiences less hops and herewith less latency. This is still a centralized network, benefiting optimized scheduling, management, billing and etc.

Proposed Text for SDD

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11.x.x Frame structure to support peer-to-peer communication

A P2P zone is a TDM/FDM allocation in the sub-frame to enable MS and / or RS in configurations with peer-to-peer communications under BS control. This could be an optional feature in the frame structure definition. This peer-to-peer transmission can be traffic from one MS to another MS directly, or multi-hop communication through intermediate RS or MS, possibly not passing BS. MS / RS are still synchronized with BS, and exchange control signal with BS. BS performs resource allocation, scheduling, etc. for MS. MS conducts the P2P communication under BS central control.

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