Relay Path Management and Routing for 802.16j

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Purpose:  
A partial technical proposal submitted IEEE 802.16j TG for considerations and further discussions.

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Scenario

- RS mainly assumed to be static
  - Nomadic and mobile RS also considered
- Links established between
  - MS → RS, MS → BS, RS → BS, RS → RS
  - No cross communication allowed (i.e. P2P)
- Traffic is from MS to backbone
  - Internet

Backbone (e.g. Internet)

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<th>MS2</th>
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Path management and routing

• Topology forms the underlying network for routing
  – Improved connectivity and coverage
  – Enhanced capacity and throughput

• Path management and routing in the context of 802.16j should be able to
  – Find the best path from MR-BS to the SS
  – Load conditions, link failures, mobility
Path selection and discovery

• Path discovery is initiated when MS powered on or enters the network

• Broadcast a RREQ (Route Request) message and wait for response
  – Different RS on different frequencies hence all channels are scanned in a round robin fashion

• RS/BS replies with a RREP (Route Reply)
  – Station ID, channel number, number of hops to the RS/BS, traffic load
  – Above information stored in a routing table
Load Balancing

• RS periodically measures the traffic
  – e.g. load metric: \( T = \sum_i B_i \times H_i \)
  – \( B \) is the measured traffic, \( H \) is the number of hops

• MS use \( T \) to choose route (RS)
  – Two routes have equal load then route with the minimum hop number is chosen

• RSs exchange and update load information
  – Accuracy depends on granularity of time window
  – Information is shared among RSs and MR-BS
Load-aware relay path management

• MS contending for a real-time traffic needs to have minimum bandwidth requirement
  – MS should include its required bandwidth in RREQ

• RSs use its admission control decision on available bandwidth estimation
  – if $B_{avail} < B_{req}$ (*Path is not chosen*)
  – $B_{avail} = B_{m} - B_{ocu}$
    • $B_{m}$: Maximum bandwidth, not nominal channel capacity
    • $B_{ocu}$: Each RS measures the traffic in its carrier sensing range periodically in a time window

• Better QoS and system utilisation
Route maintenance

• RSs update this information in the routing table accordingly
  – For example: HELLO or Piggyback

• In addition the HELLO/Piggyback messages allow the following
  – Detection of link breaks
  – Signalling for Route Error messages
  – Change route, re-initiate route discovery

• Possibility to dynamically allow MS to switch to different station
  – Achieving best route selection
RS configuration

• RS need to have knowledge of the topology and network
  – Station IDs, number of hops
  – Traffic load and available bandwidth, link quality, delay
• Allow fairness in the system
• Above metrics have to be maintained in a routing table at each RS
• Information in routing table should be continuously updated
  – Use of Hello messages
Path selection criteria

• Specifications of metrics involved in the routing
  – Shortest path (i.e. minimum hop)

• Extra QoS metrics
  – Bandwidth, delay

• Choose the most suitable path based on the above metrics
  – Trade-off between complexity and performance gain