Relay Path Management and Routing for 802.16j

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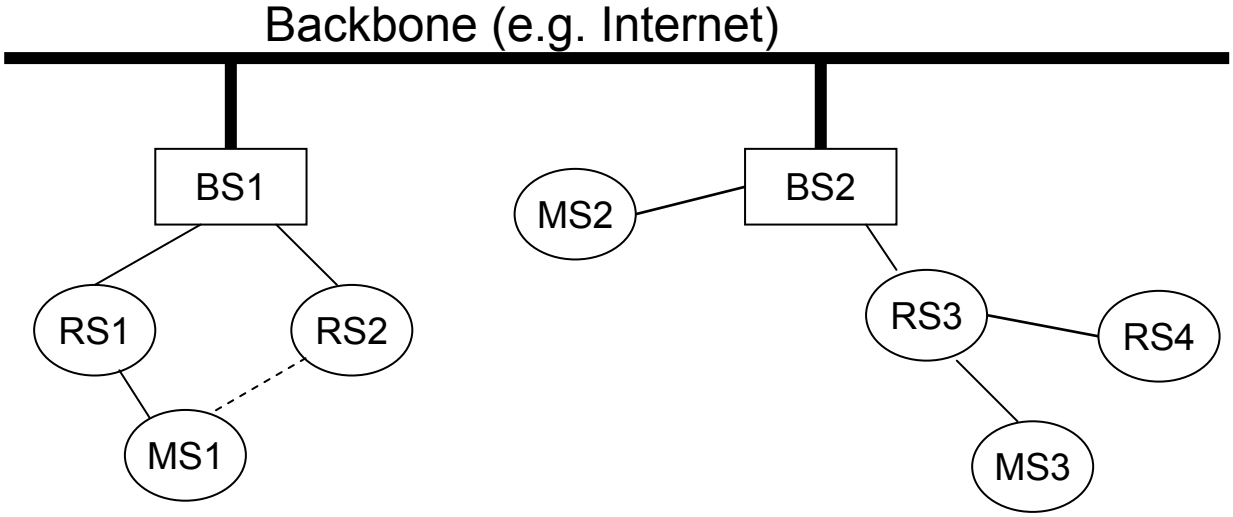
This is a response to a Call for Technical Proposal regarding IEEE Project P802.16j issued on 24th October 2006
http://ieee802.org/16/relay/docs/80216j-06_027.pdf

Purpose:

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

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



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: $T = \Sigma_i B_i \times H_i$
  - 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 Bavail < Breq (*Path is not chosen*)
  - Bavail = Bm – Bocu
    - Bm: Maximum bandwidth, not nominal channel capacity
    - Bocu: 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