Proposal for 802.16 Connection Oriented Mesh

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Purpose:

Presentation regarding need for connection oriented mesh in 802.16.

Proposal for 802.16 Connection Oriented Mesh
March 2003

Service Provider Feedback

- Surveyed leading service providers in US, China, India, Latin America, and Mexico
- Reported Benefits of Mesh Solutions
  - Pay as you grow investment
  - Cost effective coverage
  - Fast payback
- Mesh requirements
  - Licensed band operation
  - Scalable, high density solution
  - Multi service support

Limitations of current 802.16 Mesh

- Limited scalability
  - 802.16 MAN intended to serve 100s - 1000s of subscribers per sector
  - 802.16 Mesh deployment limited to <100 subscribers due to centralized scheduling message structures
- Quality of Service (Connection management)
  - 802.16 MAN intended to serve data as well as real time voice and video services
  - 802.16 Mesh MAC is connectionless and can't be used to support guaranteed QoS over multiple hops
  - Current method of UDP tunneling of MAC control messages puts L2 messages on L4 and adds large latencies
- Interference
  - 802.16 Mesh Coordinated Distributed Scheduling – nodes coordinate transmissions in extended 2-hop neighborhood
    - Assumes no interference more than 2 hops away

Scalability

- 802.16 Mesh MAC limits network to <100 subscribers due to centralized scheduling messages
  - MSH-CSCF (Table 56x – pg 44)
    - For n nodes in Mesh network and average of 4 child nodes per sponsor, message length = 5n + 11 bytes
    - Typical control message has 3 overhead symbols + 4 message symbols @ 25 bytes/symbol = 100 bytes – only supports 19 nodes
    - 64 nodes → 331 bytes – MSH-CSCF message of ~16 symbols
    - Large message rebroadcast by every sponsor node in network
      - 16 times in example – 8 frames @ 32 symbols/control sub-frame
  - MSH-CSCH structure (Table 56w – pg 43)
    - MSH-CSCH message length (for n nodes) = n + 12 bytes
    - Typical control message (100 bytes) can support up to 84 nodes
    - Needs to be rebroadcast grant message 21 times for 84 nodes – 6 frames @ 4 messages per control sub-frame
    - Requests take 21 frames for 84 nodes – 4 requests per frame
    - Implies MSH-CSCH schedule validity = 27 frames
    - At 8ms per frame takes 216ms
  - Each node needs to know the burst profiles of all other nodes via MSH-CSCF

Quality of Service (Connection Management)

- 802.16 Mesh MAC is connectionless and can't be used to support guaranteed service provider QoS needs for voice
  - Requires traversing IP stack up to L3 at each node
    - Segmentation and Reassembly
    - IP Routing – limited to Diffserv QoS capabilities
  - Connections are only on a link basis, no concept of end to end connections
- L2 MAC messages unnecessarily tunneled over UDP at L4 (Section 6.2.15)

Connection Oriented Mesh Proposal

- Add Optional Connection Oriented Mesh
- Utilize as much of existing connection based PMP structures as possible
- Utilize existing mesh specific structures where possible
  - Scalability
    - Use modified mesh centralized scheduling mechanism and tables to allow >1000 nodes per sector from current <100
    - Use sparse MSH-CSCH format for scalability, only changes in allocations sent in message
    - Use scaling to fit allocation in small multiple of frames and then repeat allocation until next MSH-CSCH message
    - Eliminate MSH-CSCF as link burst profiles don't need to be broadcast – grants are in # of mini-slots, not in bits/sec
  - Connection oriented QoS
    - Modify design to support end to end connections with 802.16 PMP QoS parameters and manageable latency
    - Replace UDP tunneling mechanism for management messages and utilize end to end control connections consistent with PMP