End-to-End Throughput Metrics for QoS Management in 802.16j MR Systems

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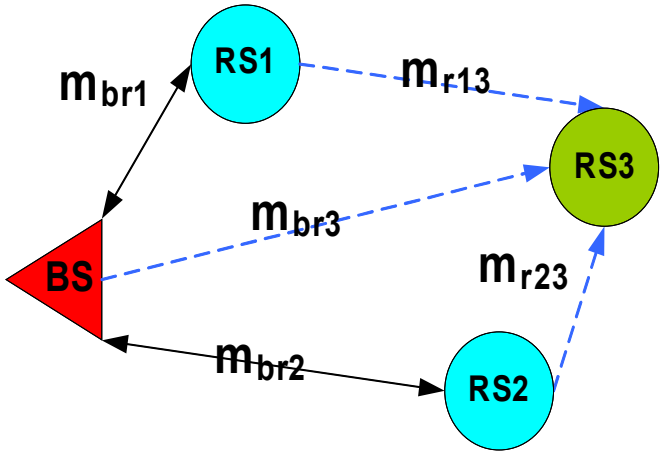
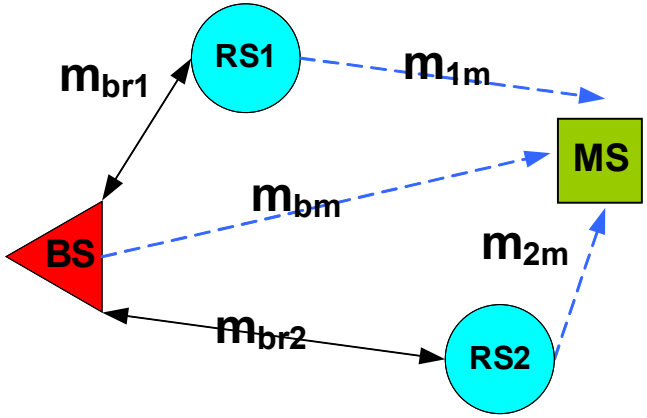
Purpose: Technical Contribution to propose throughput metrics for end-to-end QoS management, Routing and Path Management

Why end-to-end metrics?

- Performance over multiple wireless hops must be described by a single aggregate e2e metric
  - Applications: network entry, handoff, OFDMA resource allocation, etc
  - Knowledge of all intermediate hops is not necessary at source or destination !!!
- Example: RS network entry
  - New RS3 can choose best existing RS based on last-hop + e2e metric between BS and RS
  - Allows distributed operation
  - => Needs advertisement of e2e metric by RS, BS
- Example: MS network entry
  - As MS is constrained to be backward compatible, it cannot read the e2e metric advertised by RS
  - Needs centralized operation
  - => RS can measure last hop and update UL e2e metric





End-to-end metrics based on link adaptation

- Fixed modulation per hop

$$End\_to\_End\_Throughput \quad \frac{1}{N} \min_{n\ 1,\ldots N} R_n$$

- Adaptive modulation per hop

$$End\_to\_End\_Throughput \quad \sum_{n\ 1}^{N} \frac{1}{R_n}^{1}$$

  - Performs better than fixed modulation!
  - Easy to do: only needs channel knowledge between RSs separated by 1 hop

Example end-to-end metrics

- Capacity-based PHY abstraction

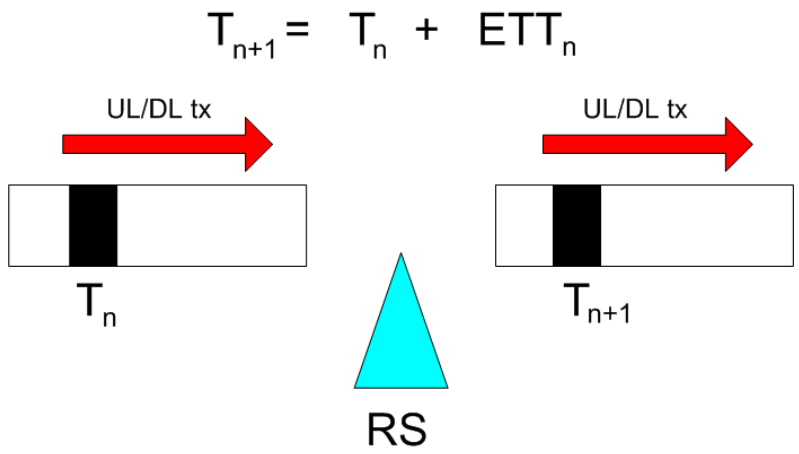
$$SINR_{eff} \quad 2^{C} \quad 1, \quad where \quad C \quad \frac{1}{\sum_{n\ 1}^{N} \frac{1}{C_n}} \quad \frac{1}{\sum_{n\ 1}^{N} \frac{1}{\log_2(1 \quad SINR_{eff,n})}}$$

- Practical throughput-based metric

$$Throughput \quad \frac{B}{T} \quad \frac{B}{\sum_{n\ 1}^{N} ETT_n} \qquad where \qquad ETT_n \quad T_{overhead} \quad \frac{B}{R_n} \ ETX_n$$

  - Expected Transmission Time (ETT) also used in 802.11s
- Additive metric is recommended

Fields required to support end-to-end metrics



- New field required in DL and UL to carry the accumulated end-to-end metric from hop to hop with updates on each hop

Proposed text change: Routing Advertisement IE

- Carried in the DL-MAP transmitted by the MR-BS and the RSs as an extended IE.
- Insert following table in Section 8.4.5.3.28

Syntax	Size	Notes
Routing_Advertisement _IE(){	-	-
Extended DIUC	4 bits	RANN = 0x0A
Length	4 bits	Length = 0x06 or 0x13
ETE Metric	16 bits	The metric of the path from the access station to its MR-BS
Metric Identifier	32 bits	Identifies the ETE metric being used. Most significant 3 octets represent the OUI. Least significant 1 octet represents specific metric. See table (below) for metric identifier encoding.
BSID	48 bits	The BSID of the MR-BS to which the access station is associated
Next Hop Node ID	48 bits	The ID of the node next hop towards the MR-BS.
Number of Hops	8 bits	Number of hops from the access station to its MR-BS
}	-	-

Harmonization

- This contribution is the result of harmonization of C202 and C158 from Dallas November 2006 meeting
- Further harmonization is planned this week