

# 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

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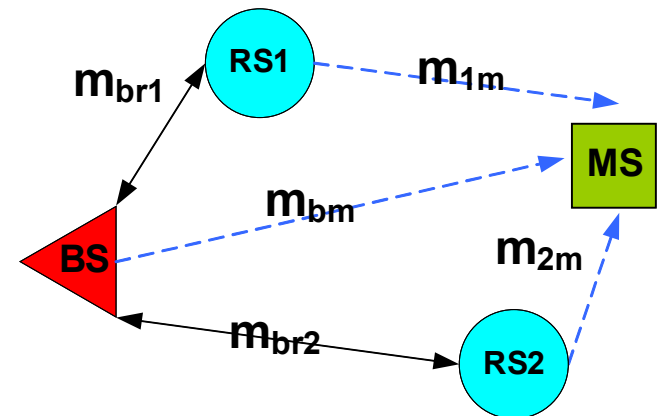
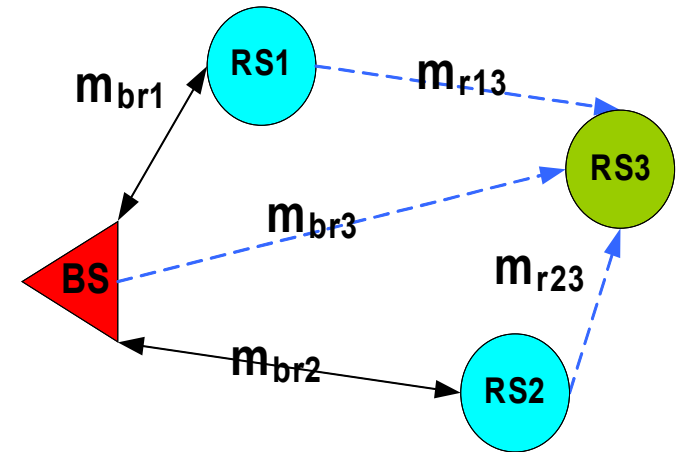
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# Why end-to-end metrics?

- 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

$$\text{End\_to\_End\_Throughput} = \frac{1}{N} \min_{n=1,\dots,N} R_n$$

- Adaptive modulation per hop

$$\text{End\_to\_End\_Throughput} = \frac{1}{N} \prod_{n=1}^N R_n$$

- 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

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

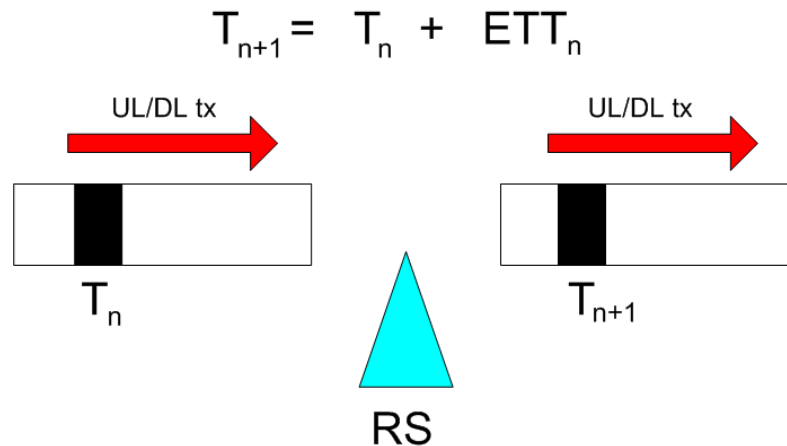
- Practical throughput-based metric

$$Throughput = \frac{B}{T} = \frac{B}{N} \frac{1}{\frac{1}{n-1} \sum_{n=1}^N ETT_n} \text{ where } ETT_n = T_{overhead} + \frac{B}{R_n} ETX_n$$

– 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