The Minimum Rank Objective Function with Hysteresis

draft-ietf-roll-minrank-hysteresis-of-01

Omprakash Gnawali and Philip Levis

IETF 80
Prague, Czech Republic

The Minimum Rank Objective Function with Hysteresis (MRHOF)

- Applicable metrics
  - Listed in `I-D.ietf-roll-routing-metrics`
  - Additive
  - Global
  - Metric minimization as routing objective

- Based on experiences with ETX
  - Might be applicable to latency and other metrics

Metric Minimization

- Compute the Path metric and parent
  - At the root
    - cur_min_path_metric = MIN_PATH_METRIC
  - On other nodes
    - candidate_min_path_metric(i) =
      Link metric to a candidate ***i*** + Path metric from ***i*** to the DAG root
    - cur_min_path_metric = Min{candidate_min_path_metric(1..n)}
    - Parent = candidate whose cost is equal to cur_min_path_metric

- Examples
  - ETX: Paths with the smallest expected transmit count
  - Latency: Least latency paths

Hysteresis

- Link metric can have jitter
  - Example: ETX jitter due to changing link quality
  - Can cause churn in the topology
- Hysteresis delays the effects
  - Short-term and small changes in link properties should not trigger path recomputation
- Change parent if the new path metric is better by at least PARENT_SWITCH_THRESHOLD

Computing Rank from Cost

Metric	Rank
Node Energy	255 – Cost
Hop Count	Cost
Latency	Cost/65536
Link Quality Level	Cost
ETX	Cost

- Node state and attributes
- Throughput
- Link color

Discussions

- Follows DIO processing rules in RPL

– Parent set size

- "Stretch" of rank from preferred parent rank?
- Configuration parameter?

Parent set size concern

- For a neighbor to be in the parent set, the node must maintain its Rank
  - Additional 2 bytes per parent per DAG
  - State/efficiency tradeoff
- Increasing Rank (and available parent set) can require obtaining Rank values

  DIS?
  - Link-local multicast DIS?

Implementation of RPL

Gnawali

IETF 80
Prague, Czech Republic

Goal

  - timers, optional mechanisms, buffer sizes, …
- Guidelines for efficient implementation
  - Collect the experiences from experiments and deployments

performance

- Minimum Interval
  - Small value encouraged
  - Maximum Interval
    - The larger the better
    - Experiences with max interval of several hours
- Experiences with max interval of several hours
  - Redundancy Constant

Route Poisoning

- Does not prevent loops
- Does not prevent loops

Lossy

links

- Tradeoff: complexity for incremental expedience in topology repair
  - It is possible to detect and repair loops in tens of

Flushing Neighbor Information

- Should avoid flushing neighbor information as much as possible
- Can take a lot of time (and energy) to rebuild

- Do not flush the table if the route is lost
  - Link qualities to the neighbors might still be valid

Data-path Slowdown During Repair

packet transmission during repair

- Yields the channel to control traffic
- Greatly improves inconsistency repair

- Can lead to higher latency and buffer overflow at the edges

Path Cost Minimization vs Stability

- Minimize/stabilize path cost (Rank) instead of maximizing path stability
  - But very rapid path changes to minimize cost can also be harmful (MRHOF) -- tradeoff