IGMP and MLD Optimization in Wireless and Mobile Networks

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Aims

- Optimize IGMP and MLD to meet wireless or mobile multicast network requirements:
  - Adaptive to link conditions
  - Minimal group Join/Leave latency
  - Robust to packet loss
  - Reducing packet exchange
  - Avoiding packet burst
- Limit the changes within the protocol framework without introducing interoperability issues
- Possibly used in wired network where efficiency and robustness are required

Option List

- Switching between unicast and multicast Queries
- General Query supplemented with unicast Query
- Retransmission of General Query
- General Query suppression with no receiver
- Tuning Response Delay according to link type
- Triggering Report and Query quickly during handover

Switching Between Unicast and Multicast General Queries

- Add the capability of a router to query just 1 receiver by setting the destination as unicast address
- Enable the router to switch between unicast and multicast Queries according to actual network conditions
  - Use unicast Query to each receiver when number of valid receivers is small, while using multicast Query as normal when receiver number is large
  - A threshold is predefined to enable the switching
  - Explicit tracking is required to know the link state
- Benefits
  - Take advantages of both unicast and multicast Query
  - Unicast Query has less effect on non-members and helps improve batter-saving

General Query Supplemented with Unicast General Query

- Send unicast Query to non-respondent valid receivers after a run of normal General Query, presumably the scale of non-respondent receiver is small
- Reasons of non-responding valid receivers
  - Receiver silently leaves the network without notification
  - Reports are lost due to unstable link condition and etc.
- Trigger unicast Query at the end of the [Maximum Response Delay], and retransmit for [Last Member Query Count] times
- Require explicit tracking to be enabled
- Benefit
  - Improve Robustness without influencing other normal receivers

General Query Suppression with no Receiver

- Suppress General Query if there is no valid multicast receiver on an interface
- Example Scenarios
  - When last member reports its leave, by an explicit tracking router checking its membership database, or by a non-explicit-tracking router getting no response after sending Group-(and-Source-) Specific Queries
  - When the (only) member on a PTP link reports its leave
  - When a router after retransmitting General Queries on startup fails to get any response
  - When a router previously has valid members but fails to get any response after several rounds of General Queries.
- Benefit
  - Eliminate unnecessary continuous General Query have benefits for all terminal on the link for battery saving

Retransmission of General Query

- If after a General Query no response can be collected from all valid receivers, for one of the reasons of:
  - All valid receivers leave the group silently or moved out of range
  - All the responses of the receivers happen to be lost
  - Query does not arrive at the other side of the link to the receivers.
- Retransmit General Queries for [Last Member Query Count] times before deciding to stop General Query finally
- Require explicit tracking to be enabled
- Benefit
  - Improve robustness of General Query if there are valid members
  - Realize fast leave if all the receivers quit.

Tuning Response Delay according to link type and status

- Tuning maximum response delay according to link type and status to reduce message burst and leave latency, according to the expected number of responders, and link type and status:
  - If the expected number of reporters is large and/or link condition is bad, select larger [Maximum Response Delay]
  - If the expected number of reporters is small and/or the link condition is good, select smaller Delay
  - If link mode is PTP, choose smaller Delay; if link mode is PTMP or broadcast, configure larger Delay .

Triggering Reports and Queries during handover

- Access router triggers a Query (General Query or unicast General Query) as it detects a new terminal on its link.
- Terminal triggers a Report as soon as it detects connection to new network, if it is just in multicast reception state
- Benefits
  - During handover, new access network acquire terminal's membership and deliver the content to the receiver quickly to help reducing disruption or performance deterioration. .