More Resilient GMP
draft-anggawijaya-pim-resilient-gmp-00

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GMP – Quick Recap

- Unsolicited membership reports sent from listeners wanting to receive multicast data
- GMP router forwards multicast data, based on group membership
- GMP router (querier) – sends periodic query to see if listeners still want the multicast data
- Solicited reports are sent by all listeners in response to the query

Lost GMP Packets

- Less reliable link layer
  - WiFi, issues identified in:
    - [draft-mcbride-mboned-wifi-mcast-problem-statement]
    - [draft-vyncke-6man-mcast-not-efficient]
  - Other wireless link technologies
- More likely on large L2 broadcast domains spanning multiple devices:
  - Temporary congestions on certain links
  - Transient states on devices – device restarting, temporary CPU congestions (during L2 topology change)

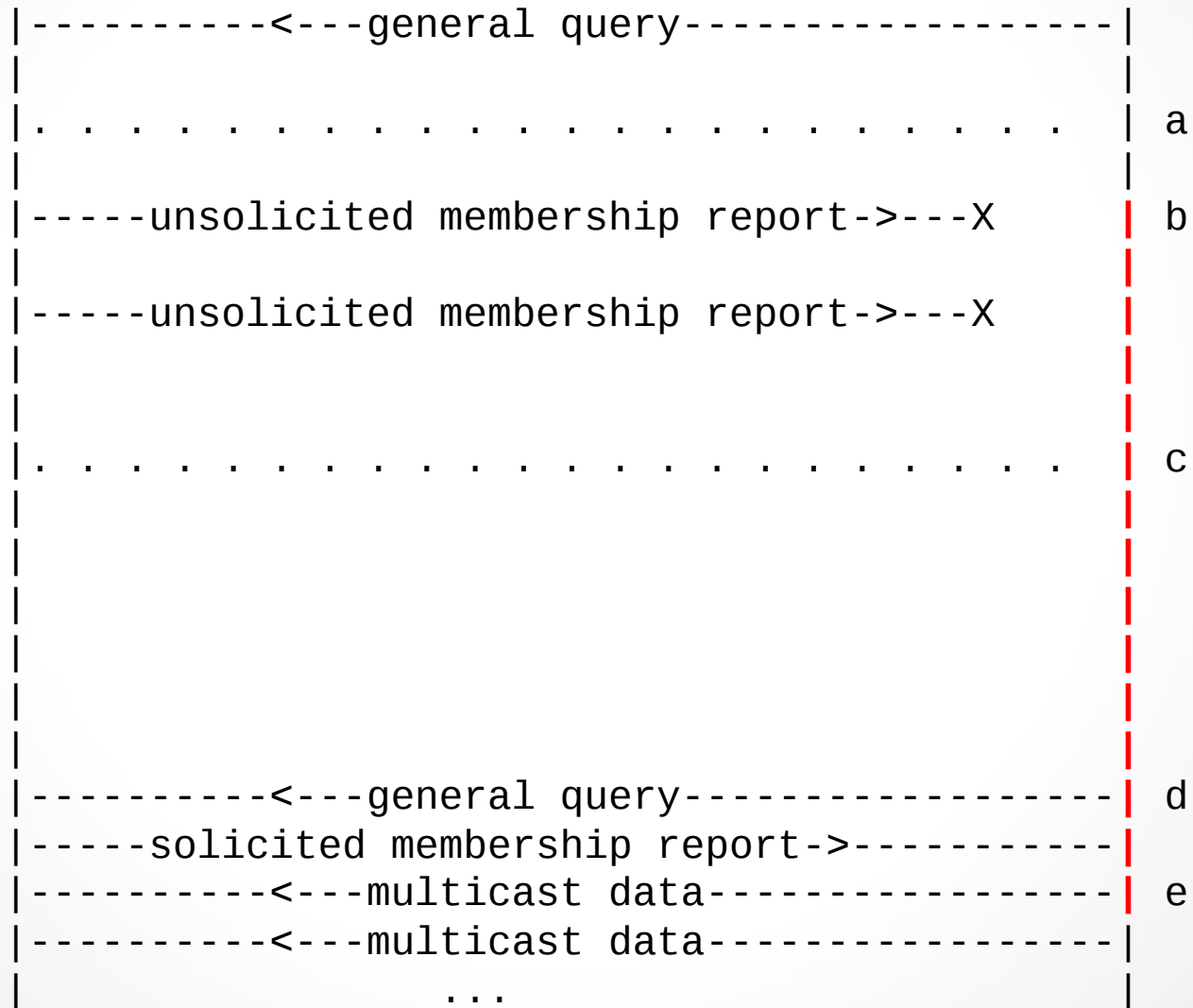# Problem Statement

- GMPs membership reports rely on retransmissions of packets
  - (Un)solicited membership reports are retransmitted:
    - robustness variable (RV) – default 2
    - random interval (0, [Unsolicited Report Interval]) – default (0, 1)
  - All listeners do retransmission
- **If the 'RV' number of reports are lost, 'dead period' may result**
- Consider the following scenario….

'Dead Period' in GMP

```
 Multicast listener                              GMP Querier
           |----------<---general query----------------|
           |                                           |
           |. . . . . . . . . . . . . . . . . .   . .  | a
           |                                           |
           |-----unsolicited membership report->---X   | b
           |                                           |
           |-----unsolicited membership report->---X   |    T
           |                                           |    i
           |                                           |    m
           |. . . . . . . . . . . . . . . . . . . .  . | c  e
           |                                           |    |
           |                                           |    |
           |                                           |    V
           |                                           |
           |                                           |
           |                                           |
           |                                           |
           |----------<---general query----------------| d
           |-----solicited membership report->---------|
           |----------<---multicast data---------------| e
           |----------<---multicast data---------------|
           |                    ...                     |
```
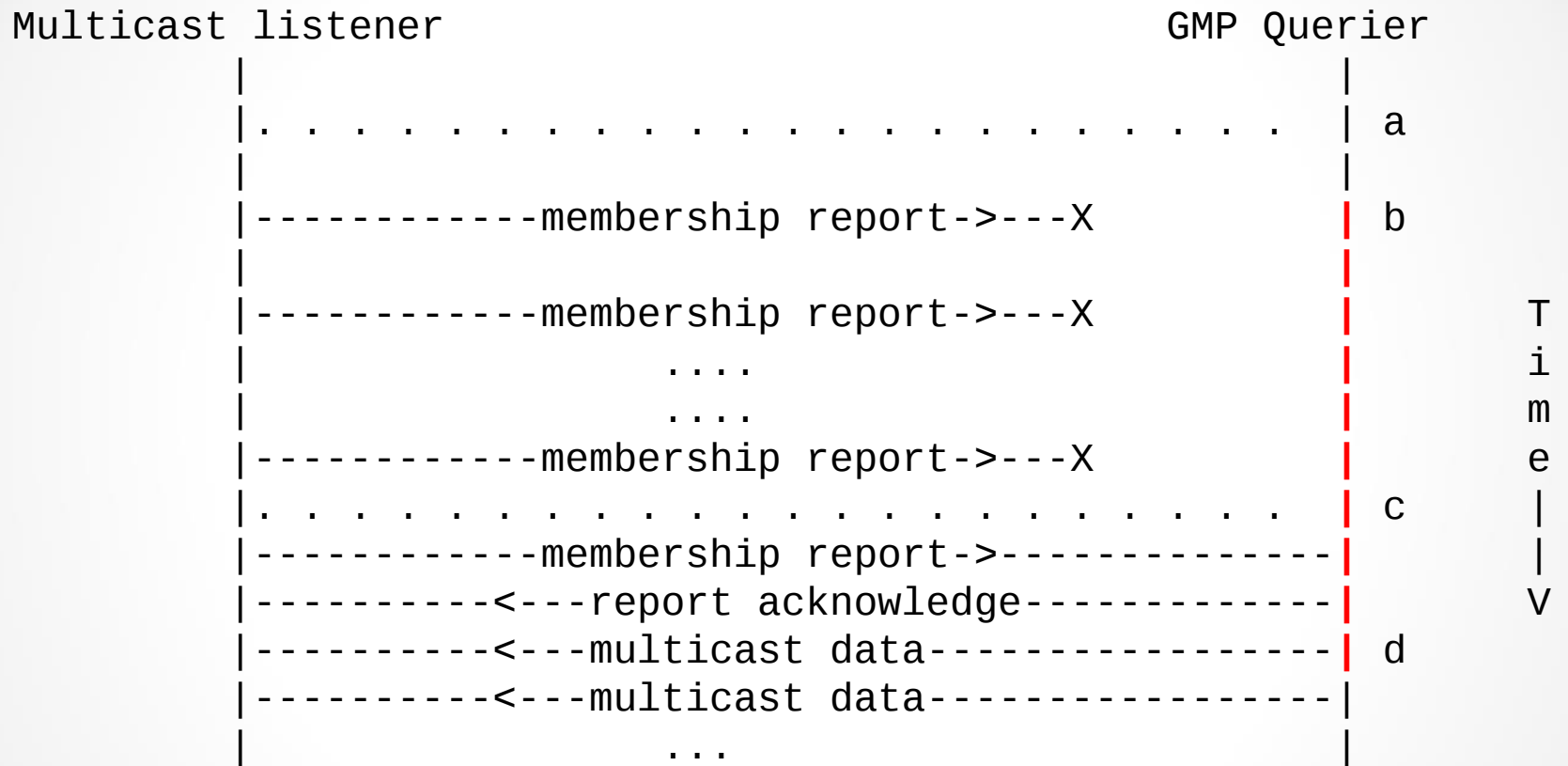
5

Mitigation Strategies

- Leave the responsibility to app layer to reset the socket, but better to do it in network layer

- Increase the robustness variable – increase chattiness for all listeners

- Decrease the query interval – also increase chattiness for all listeners

- Longer group membership timeout – applicable only to existing/known listeners only. This requires incrementing rv or query interval or QRI
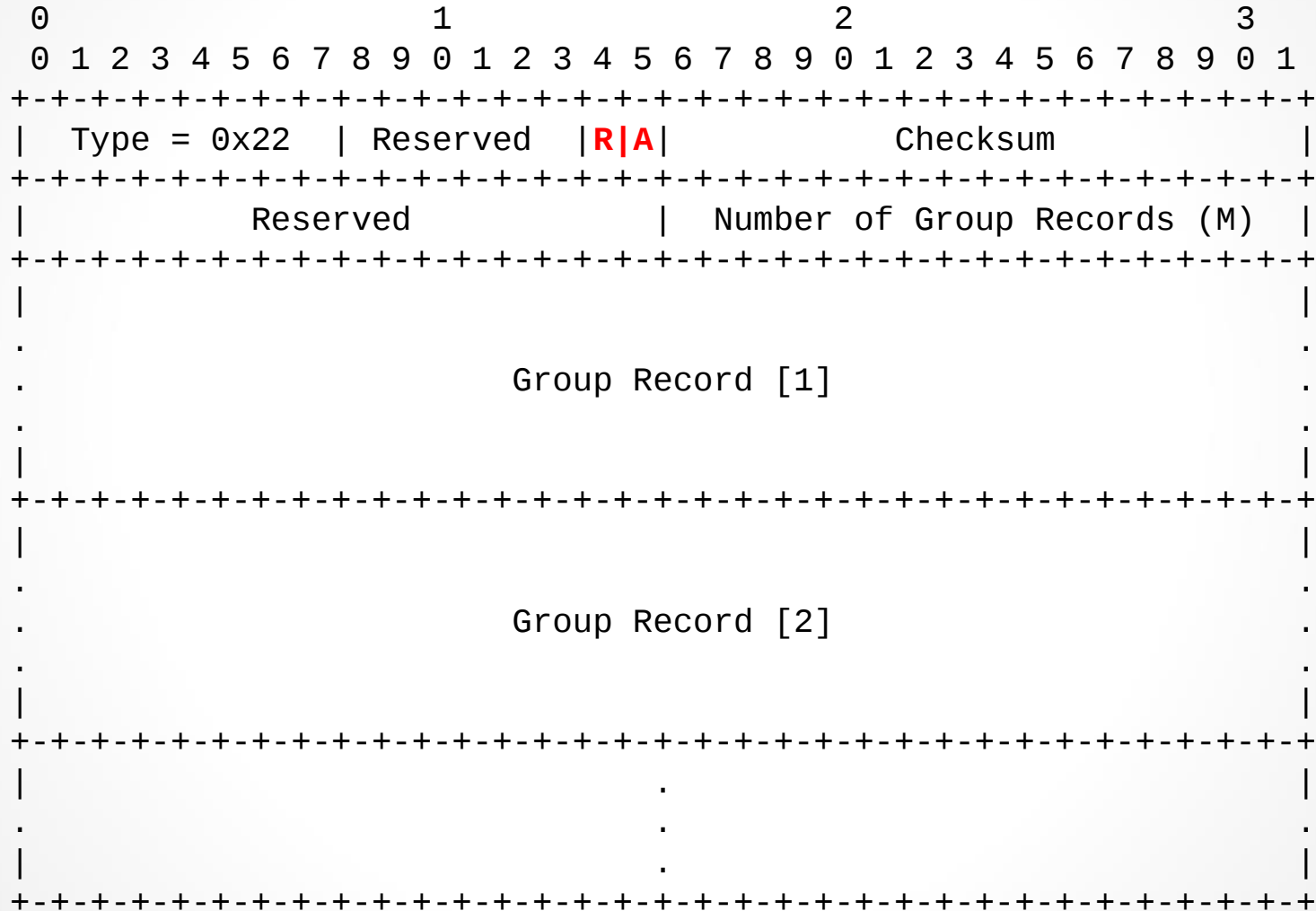
Proposed Solution

- Listeners retransmit membership reports beyond the robustness variable – *maybe disabled administratively*

- Only stops when router acknowledge the reports or when no router is detected (2.5 x Query Interval)

- Acknowledgement is sent unicast to listener - reflected membership report message

- Router announce capability to acknowledge reports in query packets

Proposed Solution – cont.

```
Multicast listener                                    GMP Querier
               |                                           |
               |. . . . . . . . . . . . . . . . . . . | a
               |                                           |
               |-------------membership report->---X   | b
               |                                           |
               |-------------membership report->---X   |
               |             ....                          |        T
               |             ....                          |        i
               |-------------membership report->---X   |        m
               |. . . . . . . . . . . . . . . . . . | c     |        e
               |-------------membership report->-------------|        |
               |----------<---report acknowledge------------|        V
               |----------<---multicast data----------------| d
               |----------<---multicast data---------------|
               |             ...                           |
```

8

Resilient IGMP - Report

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type = 0x22  | Reserved     |R|A|           Checksum          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Reserved          | Number of Group Records (M)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
.                                                               .
.                      Group Record [1]                         .
.                                                               .
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
.                                                               .
.                      Group Record [2]                         .
.                                                               .
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                               .                               |
.                               .                               .
|                               .                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
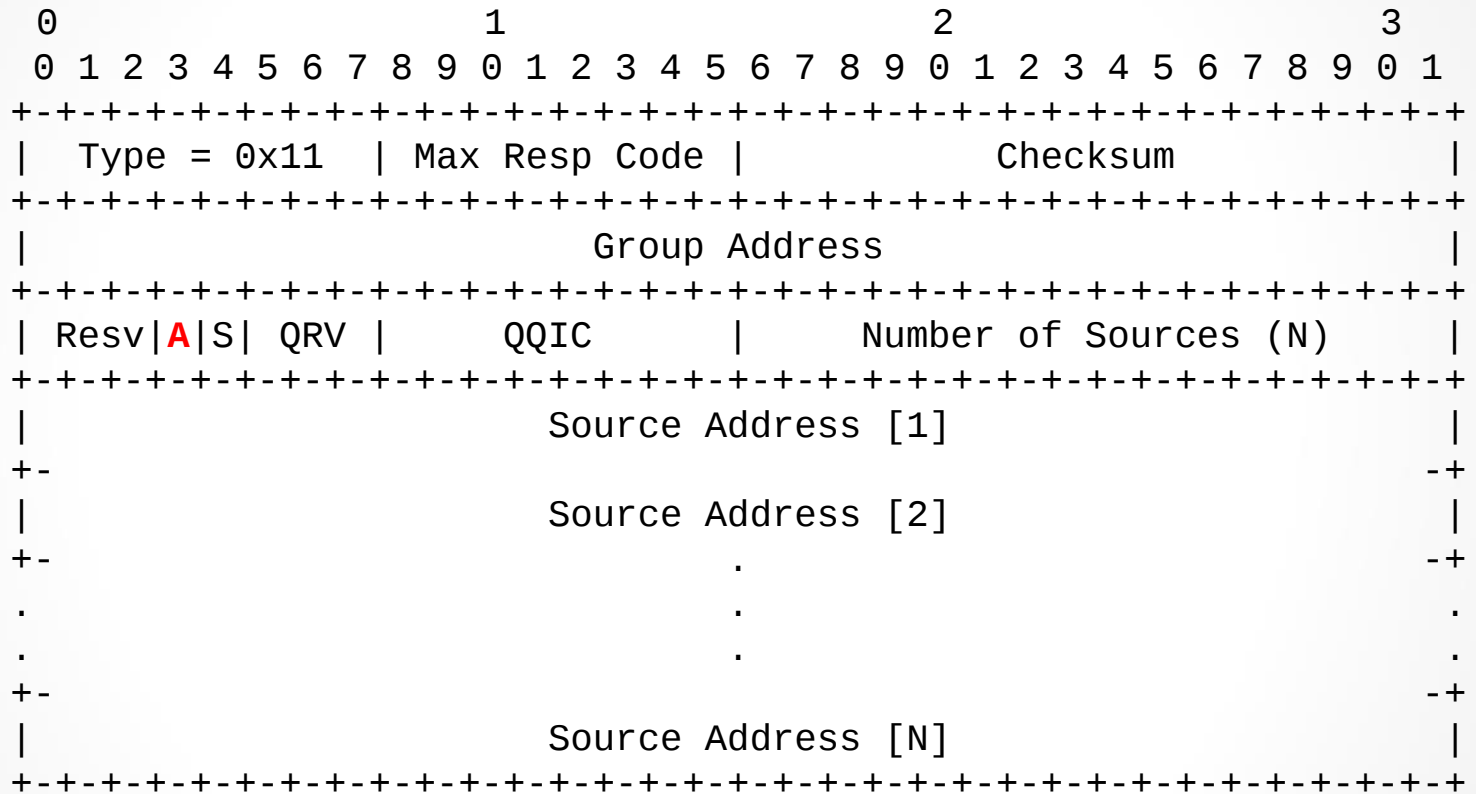
Resilient IGMP Report

- R: 'Request for Acknowledgement' flag – requires an acknowledgement in response
  - Only set if querier indicate it can ack reports
- A: 'Membership report acknowledgement' flag – set on reflected report by router as acknowledgement to the original report

Resilient IGMP Query

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type = 0x11  | Max Resp Code |           Checksum            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Group Address                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Resv|A|S| QRV |     QQIC      |      Number of Sources (N)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address [1]                     |
+-                                                            -+
|                       Source Address [2]                     |
+-                              .                             -+
.                               .                              .
.                               .                              .
+-                                                            -+
|                       Source Address [N]                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Resilient IGMP Query

- A : 'Acknowledgement Capable Querier' flag - indicates that the querier is capable of sending acknowledgements to multicast listeners.

- Querier only sends query with A-flag set *If enabled administratively*

- Listeners may ignore the A-flag from querier

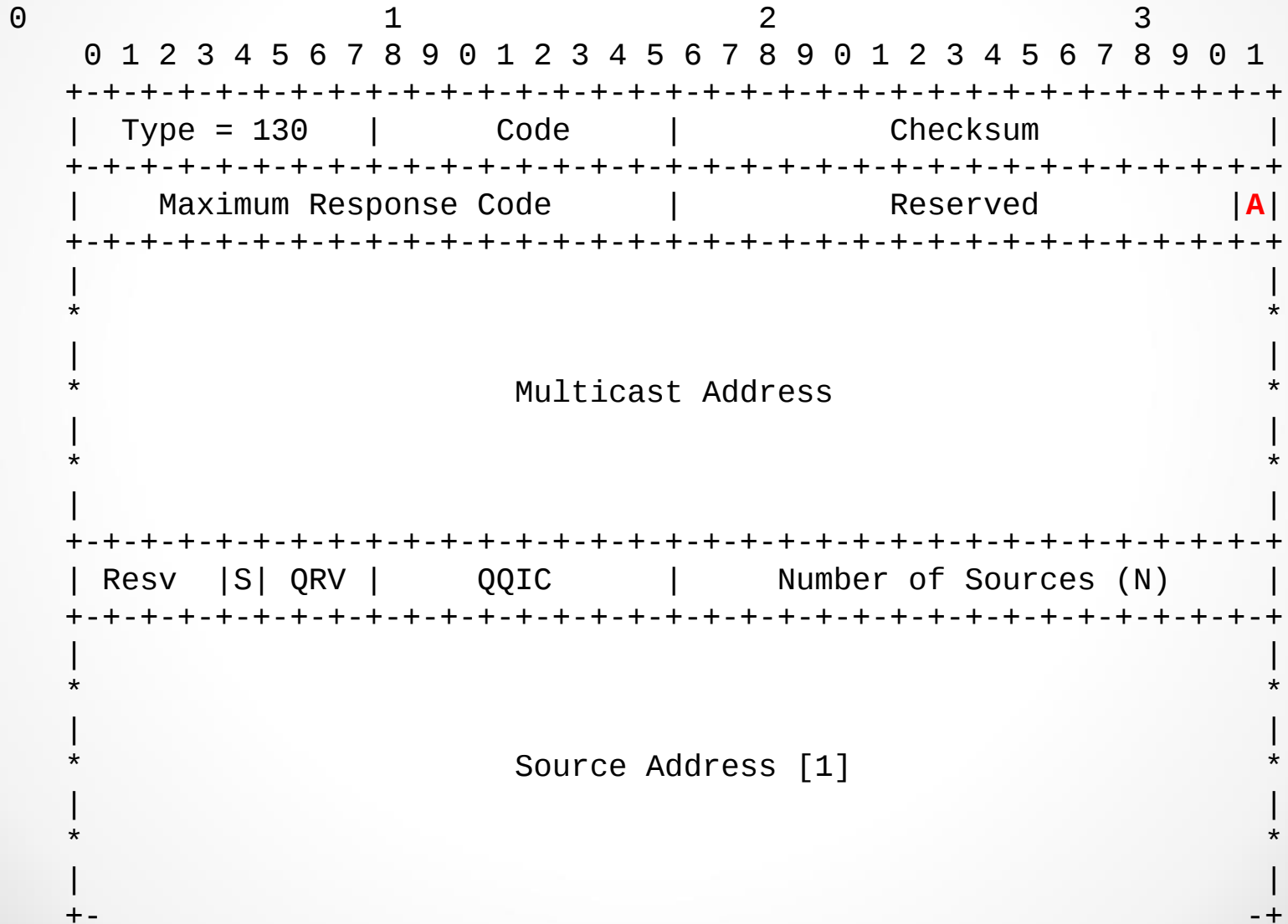# Resilient MLD Report

```
MLDv2 Membership Report
   0                   1                   2                   3
   0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |  Type = 143   |R|A|  Reserved |          Checksum             |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |           Reserved            |Nr of Mcast Address Records (M)|
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |                                                               |
  .                                                               .
  .                 Multicast Address Record [1]                  .
  .                                                               .
  |                                                               |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |                                                               |
  .                                                               .
  .                 Multicast Address Record [2]                  .
  .                                                               .
  |                                                               |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |                               .                               |
  .                               .                               .
  |                               .                               |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Resilient MLD Report

- R: 'Request for Acknowledgement' flag – requires an acknowledgement in response

- A: 'Membership report acknowledgement' flag – set on reflected report packet by router as acknowledgement to the original report

Resilient MLD Query

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Type = 130   |      Code     |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Maximum Response Code       |          Reserved         |A|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
*                                                               *
|                                                               |
*                   Multicast Address                           *
|                                                               |
*                                                               *
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Resv  |S| QRV |     QQIC      |     Number of Sources (N)     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
*                                                               *
|                                                               |
*                   Source Address [1]                          *
|                                                               |
*                                                               *
|                                                               |
+-                                                            -+
```

Resilient MLD Query

- A : 'Acknowledgement Capable Querier' flag - indicates that the querier is capable of sending acknowledgements to multicast listeners

- Querier only sends query with A-flag set *If enabled administratively*

- Listeners may ignore the A-flag from querier

Backwards Compatibility

- Listeners fallback to current behaviour when receiving query w/o A-flag set

- Router fallback to current behaviour when receiving query w/o A-flag set from other querier

- Also imply that when IGMPv2, or IGMPv1 are present, all fallback to current behaviour

- Similar behaviour for MLDv2

Observations

- Shorter 'dead period' – until router receives the next report (vs. solicited report received after the next general query)

- Not chatty unnecessarily – retransmissions only done by yet to be acknowledged listeners (vs. all listeners)

- *Some implementations processes unicast MLDv2 and IGMPv3 report – may need to change type for acknowledgement message?*

Operational Considerations

- The proposed mechanism is more effective when the querier is also the DR

  - Most of simple deployments have the querier on the same device as DR

- Does not work w/ addressless snooper

- Suitable for sparse L2 network, or more capable router needed for dense L2 network

- Security

  - Fake reports w/ R-flag set

  - Fake queries w/ A-flag set

Next Steps

- Questions
- Suggestions and Comments

Thank You

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