IETF 94 ROLL

Routing over Low-Power And Lossy Networks

Chairs:
Michael Richardson
Ines Robles
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Source: https://www.ietf.org/about/note-well.html
Meeting Materials

- Remote Participation
  - Jabber Room: roll@jabber.ietf.org
  - Meetecho: http://www.meetecho.com/ietf94/roll
- Etherpad:
  - http://tools.ietf.org/wg/roll/minutes
- Audio Streaming:
- Minutes taker:
- Jabber Scribe:
- Please sign blue sheets :-(
Agenda

- State of: (10 minutes)
  - Work item
  - ROLL I-D
  - Related I-D
  - Open Issues
- draft-robles-roll-useofrplinfo-02 (30 min)
- draft-thubert-roll-dao-projection-02 (10 min)
- Open floor (10 minute)
## Milestones (cont.)

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<th>Milestone</th>
<th>Schedule</th>
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<tr>
<td>Submit draft about when to use RFC 6553, RFC 6554, and IPv6-in-IPv6 encapsulation to the IESG.</td>
<td>Aug 2015</td>
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<tr>
<td>Submit draft about how to compress RFC 6553, RFC 6554, and IP headers in the 6LoWPAN adaptation layer context to the IESG.</td>
<td>Nov 2015</td>
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<tr>
<td>Evaluate WG progress, recharter or close</td>
<td>Nov 2015</td>
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## State of Active Internet-Drafts

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<tr>
<td>draft-ietf-roll-admin-local-policy-03</td>
<td>RFC Editor Queue</td>
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<tr>
<td>draft-ietf-roll-applicability-ami-11</td>
<td>Ready to be submitted to IESG</td>
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<tr>
<td>draft-ietf-roll-mpl-parameter-configuration-08</td>
<td>New version should address comments of IESG</td>
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# Related Internet-Drafts

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<td>When to use RFC 6553, 6554 and IPv6-in-IPv6</td>
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<tr>
<td>draft-thubert-roll-dao-projection-02</td>
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<td>draft-tan-roll-clustering-00</td>
<td>RPL-based Clustering Routing Protocol</td>
<td>Future Discussion</td>
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<tr>
<td>draft-turner-roll-dio-ctx-00</td>
<td>RPL DIO Option for Specifying Compression Contexts</td>
<td>Future Discussion</td>
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<td>draft-wang-roll-adaptive-data-aggregation</td>
<td>Design of Adaptive Data Aggregation Schemes</td>
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<td>draft-zhong-roll-dis-modifications-00</td>
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# Open Tickets

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RPL RPI/RH3 uses

draft-robles-roll-useofrpi

Michael Richardson
Pascal Thubert
Ines Robles
structure of network - reference diagram

11 <-> 12 <-> 13

6LBR (00)

6lowpan only node (Q)

backbone

RPL-aware data collector

Internet

generic internet node

6lowpan only node (N)
RPL DOMAIN ARCHITECTURE

Border Router to the RPL domain
(may be a RPL virtual root)

Backbone

Backbone router

Backbone router

Backbone router

PCI-exp / \ USB

Ethernet

(6LBR == RPL DODAG root)

(6LR == RPL router)

(6LoWPAN Host)

------------------------ RPL Instance ------------------------
Rules for the Proposed Scenarios

- This document assumes a rule that a **Header cannot be inserted or removed on the fly inside an IPv6 packet that is being routed.**

- This means that an **intermediate router that needs to add a header must encapsulate the packet in an outer IP header where the new header can be placed.**

- This also means that a Header can only be removed by an intermediate router if
  - it is placed in an encapsulating IPv6 Header,
  - and that the IPv6 header is *addressed* to that intermediate router!

  The whole encapsulating header must be removed - a replacement may be added though.

- **RPI should be present in every single RPL data packet**
  - the **rank** is important, especially in storing-mode, even if there is only one RPLinstanceID
  - There is an exception in non-storing mode, when a packet is going down from the route: the entire route is written, so there are no loops of confusion about which table to use (purpose of instanceID).
Scenarios analyzed in draft-robles-roll-useofrpi
work done at virtual interim working meeting, September 29.

{Storing,Non-Storing} X {RPL-aware-leaf,non-RPL-aware,root, Internet} X {RPL-aware-leaf,non-RPL-aware,root,Internet}

(but Internet->Internet cases removed, so 24, not 32)

STORING

1. Flow from RPL-aware-leaf to root
2. Flow from root to RPL-aware-leaf
3. Flow from non-RPL-aware-leaf to root
4. Flow from root to non-RPL-aware-leaf
5. Flow from RPL-aware-leaf to Internet
6. Flow from Internet to RPL-aware-leaf
7. Flow from non-RPL-aware-leaf to Internet
8. Flow from Internet to non-RPL-aware-leaf
9. Flow from RPL-aware-leaf to RPL-aware-leaf
10. Flow from RPL-aware-leaf to non-RPL-aware-leaf
11. Flow from non-RPL-aware-leaf to RPL-aware-leaf
12. Flow from non-RPL-aware-leaf to non-RPL-aware-leaf

NON-STORING

13. Flow from RPL-aware-leaf to root
14. Flow from root to RPL-aware-leaf
15. Flow from non-RPL-aware-leaf to root
16. Flow from root to non-RPL-aware-leaf
17. Flow from RPL-aware-leaf to Internet
18. Flow from Internet to RPL-aware-leaf
19. Flow from non-RPL-aware-leaf to Internet
20. Flow from Internet to non-RPL-aware-leaf
21. Flow from RPL-aware-leaf to RPL-aware-leaf
22. Flow from RPL-aware-leaf to non-RPL-aware-leaf
23. Flow from non-RPL-aware-leaf to RPL-aware-leaf
24. Flow from non-RPL-aware-leaf to non-RPL-aware-leaf
no problems: storing-mode, Flow from RPL-aware-leaf to root

RPL-aware data collector

Internet

generic internet node

ulp - upper layer payload/protocol (e.g. UDP, TCP, etc.)
few problems: storing-mode, Flow from RPL-aware-leaf to Internet

node 22 needs to know that traffic is “off-RPL”. This needs to be signaled. Attribute of ::/0 route? Or implicit because dst not matching PIO? If in doubt, add IPIP? IPIP dst = 6LBR (00)
few problems: non-storing-mode Internet to non-RPL-aware-Leaf

In Non-Storing mode, root knows node N is attached to node 26, and builds RH3 \{12\} with IPIP dst=26. Node 26 removes IPIP header, and sends to node N.
In storing mode, root doesn’t know node N is attached to node 26, only that it’s behind node 13. It needs to add RPI, though, so it adds IPIP=dst=N.

Node N drops packet, because RPI has unknown header 0x63, and 0x63 has “01” = discard packet. If RPI had 0x23, it would “skip”
no problems: non-storing-mode from RPL-aware-leaf to RPL-aware-leaf

DODAG root can not remove RPI, adds IPIP+RH3, does require need RPI in non-storing.

packet arrives, IPIP removed, RH3, removed, IP processed, and RPI removed.
few problems: non-storing-mode from RPL-aware-leaf to RPL-aware-leaf

RPL-aware data collector

DODAG root can remove RPI, adds IPIP (dst=26)+RH3, RPI not required in non-storing.

6LBR (00)

IP,RPI,IP,ulp

IPIP,(RPI),RH3,IP,ulp

IP,RPI,IP,ulp

IPIP,(RPI),RH3,IP,ulp

IPIP,(RPI),RH3,IP,ulp

RPI added using IPIP so it can be removed

packet arrives, IPIP removed, RPI, and RH3, removed, packet forwarded to N.

6lowpan only

6lowpan only node (N)

Internet
generic internet node

backbone

only node (Q)
Case that Fails: Storing From RPL aware to Non-RPL aware

Somehow, the sender has to know that the receiver is not RPL aware, and needs to know 6LR, and not even the root knows where the 6LR is (in storing mode). This case **FAILS**.

6LN --> 6LR --> common parent (6LR) --> 6LR --> not-RPL-aware 6LN

**How to solve this?**
Future RPL work

There are cases from above that are not clear how to send the information. It requires further analysis on how to proceed to send the information from source to destination.

we have in storing mode:

- Flow from RPL-aware-leaf to non-RPL-aware-leaf: Somehow, the sender has to know that the receiver is not RPL aware, and needs to know 6LR, and not even the root knows where the 6LR is located.

- Flow from not-RPL-aware-leaf to not-RPL-aware-leaf: The problem to solve is how to indicate where to send the packet when get into LLN.
Root initiated routing state in RPL

draft-thubert-dao-projection

Pascal Thubert
IETF 94

Yokohama, November 2025
Highlights

• Allows for centralized routing computation with RPL
  E.g. Root coordinates with PCE

• Need topological information and / or device constraints
  e.g. how many routes can a given RPL router store?
  Can leverage TEAS / DETNET work
  Enough topology info in non-storing route optimization at the root

• New: Added support for transversal route
  Works for storing and non storing routes
New generic route optimization
Stretch in non-storing mode
Stretch in storing mode
New (projected) DAO with path segment unicast to target 53 via 41 (ingress), 42 and 43 (egress)
DAO projection

Storing mode DAO (forced) with lifetime along segment
DAO projection

Storing mode DAO (forced) with lifetime along segment
DAO projection

DAO-ACK unicast, self 41 as parent, final destination 53 as target
Optimized Path
Existing non storing optimization
New (projected) DAO with path segment unicast to target 56 via 35 (ingress) and 46 (egress)
mode DAO (forced) with lifetime along
DAO-ACK (alt: non storing DAO) unicast, self 35 as parent, final destination 56 as target
DAO from 46 installs a route to 56 in 35 (all nodes in projected route from ingress included to egress excluded)
=> egress should already have a route to target

Preexisting connected route to 56 via 46
DAG Root

Loose Source routed DATA Path
Packet to 13, RH 24, 35, 56

Non source routed DATA Path
Adding New (projected) DAO with path segment unicast to target 56 via 13 (ingress), 24, and 35 (egress)
Storing mode DAO (forced) with lifetime along segment.
DAO-ACK (alt: non storing DAO) unicast, self 13 as parent, final destination 56 as target
DAG Root

56 via 24

56 via 35

56 via 46

Preexisting connected route to 56
Alternate Programming By the root (Michael)

ALT: Adding New (projected) DAO with path segment unicast to target 35 via 13 (ingress) and 24 (egress)
Storing mode DAO (forced) with lifetime along segment
DAO-ACK (alt: non storing DAO) unicast, self 13 as parent, final destination 56 as target.
Loose Source routed DATA Path Packet to 35, RH 56

routed DATA Path

routed DATA Path
Questions on the list

- Terminology:
  Segment vs. projected route
  New msg for “projected DAO”

- Need for a new MOP?
  Suggestion to add a capability option in node’s original DAOs

- DAO direction, clarify flows
- Transversal routes
- DAO-ACK request bit setting
- -> or non storing DAO?
Arigatou!

A&Q