BIER Loop Avoidance using Segment Routing

draft-liu-bier-uloop-03

Presenter: Yuanxiang Qiu

Co-authors: Yisong Liu(China Mobile)

Changwang Lin (New H3C Technologies)

Zheng Zhang(ZTE Corporation)

Yuanxiang Qiu(New H3C Technologies)

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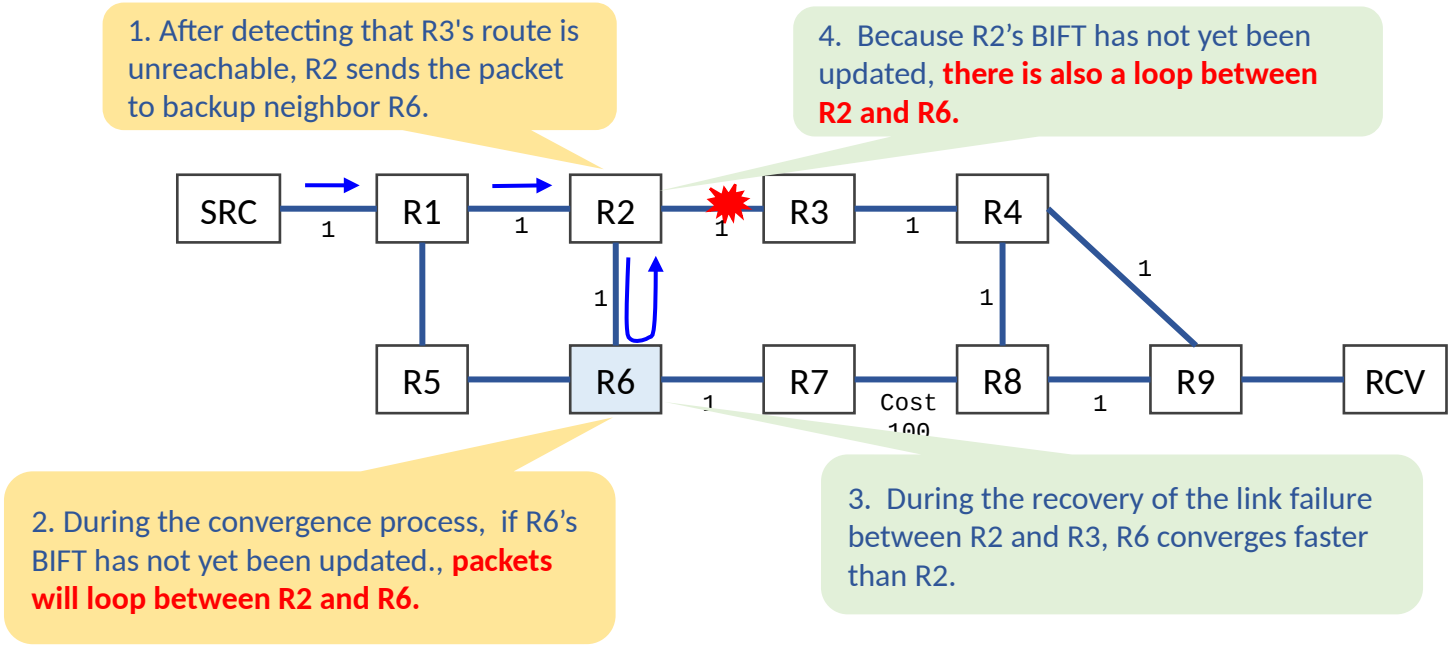
Background

Currently there is a loop issue in BIER forwarding.

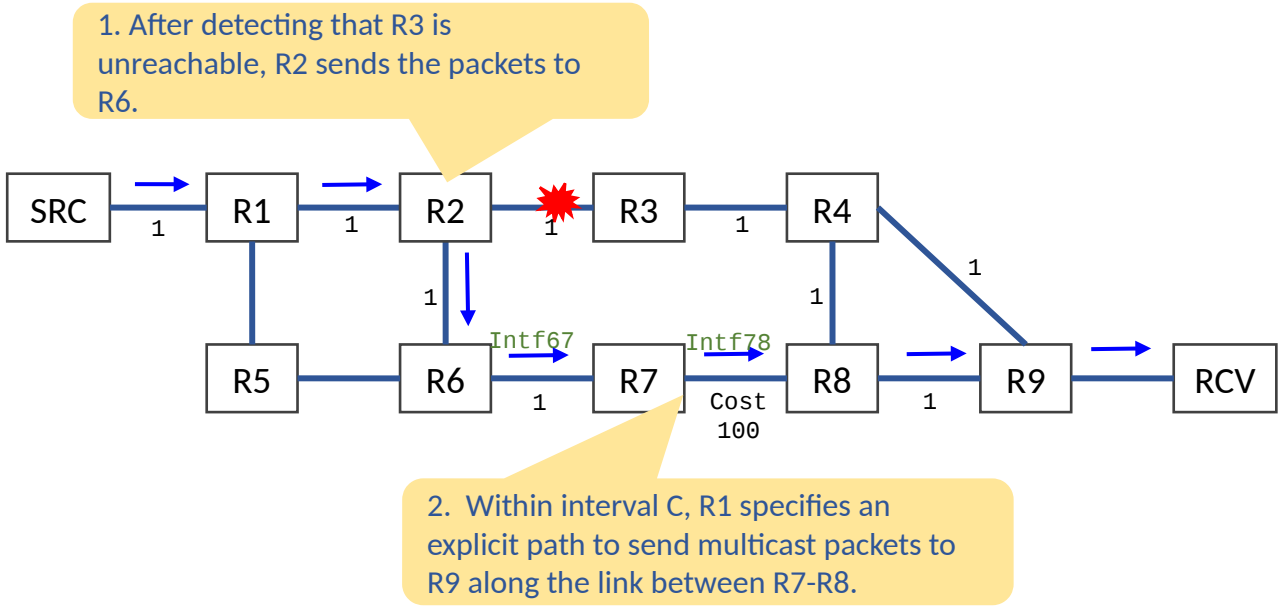
- The multicast packet sent from R1 to R9 is initially forwarded along the path R1->R2->R3->R4->R9.
- When the link between R2 and R3 fails, R2 will detect the route to R3 is unreachable and send the packet to backup BFR neighbor R6 according to BIER FRR.
- If the convergence of R6 is slower than that of R2, during the routing convergence process, when R6 receives a message, R6 will send the message back to R2.
- If R6 converges faster than R2, during the fault recovery, there is also a loop between R2 and R6.



Proposal

We propose a method leveraging SR-MPLS and/or SRv6 to ensure that BIER messages can be forwarded loop-freeness during the IGP convergence process.
Upon a topology change, BFR performs convergence processing as follows:

1. After calculating a new path to BFER, in an interval (C), BFR installs a BIFT for BFR neighbor that steers packets to BFER via a loop-freeness explicit path.
2. Within the interval C, multicast packets are forwarded along the path.
3. When C elapses, BFR installs the normal post-convergence forwarding entry.



Computing Method of Loop-avoiding Path

- Method 1: BFIR uses the concept of PQ spaces for TI-LFA to generate SR/SRv6 based explicit paths from P node to Q node.

1. When the link fails, unicast routing converges, and BFIR calculates a new SPF tree.
2. BFIR calculates Q node and P node for each BFER.
3. BFIR generates the repair segment list for BFERs.
   - For SR-MPLS, the repair list is {Node_SID(P), AdjSID(P->Q)}.
   - For SRv6, the repair list is {END_SID(P), END.X (P->Q)}.
4. BFIR installs the repair path indicated by the repair list.

During the IGP convergence process, BFIR sends BIER messages to endpoint along the repair path. After the endpoint receives the messages, remove the explicit path encapsulation, and then continue forwarding according to the BIER header.

- Method 2: BFIR directly generates a explicit path from BFIR to Q node.
  - For SR-MPLS, the repair list is {AdjSID(S->Q)}.
  - For SRv6, the repair list is {END.X(S->Q)}.

Q node: On the SPF tree, traverse the parent node from BFER until finding the node farthest from BFER. This node is not affected by link failures and can reach BFER.
P node: Starting from the Q node, traverse the parent node to find the node that BFIR can reach through the shortest path, which is not affected by link failure.

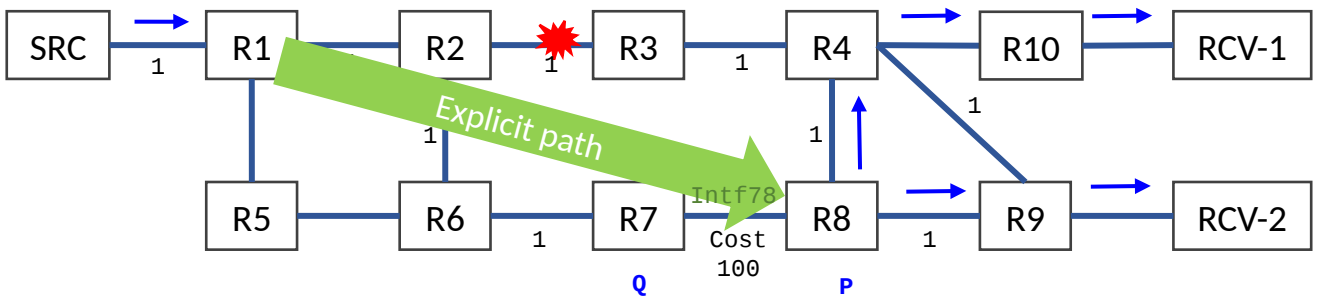
Example

The multicast data packet sent from R1 to R9 and R10 is initially forwarded along the path R1->R2->R3->R4->R9/R10.

When the link between R2 and R3 fails, BFIR R1 calculates the repair path for each BFER.

1. Calculate the P and Q nodes for R9, and the results are R8 and R7, respectively.
2. Calculate the P and Q nodes for R10. The P and Q nodes are also R8 and R7.
3. Because R9 and R10 have the same P and Q nodes, R9 and R10 will use the same repair path.
   - For SR-MPLS, the repair list for R9 and R10 is: <NodeSID(R7), AdjSID_R7R8>.
   - For SRv6, the repair list for R9 and R10 is: <End.X_R7R8>.

During the IGP convergence process, R1 will forward the multicast message to R8. After receiving the message, R8 copies it to R9 and R10.



Next Steps

- Any questions or comments are Welcomed
- Seeking for feedback