Applicability of LDP Multi-Topology for Unicast Fast-reroute Using Maximally Redundant Trees
draft-li-rtgwg-ldp-mt-mrt-frr-01

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Introduction

• [I-D.ietf-rtgwg-mrt-frr-architecture] describes the architecture based on Maximally Redundant Trees (MRT) to provide 100% coverage for fast-reroute of unicast traffic.

• [I-D.ietf-mpls-ldp-multi-topology] has been proposed to provide unicast forwarding in the MRT FRR architecture.

• This informational draft is to provide the analysis of the applicability of LDP MT for MRT FRR
  - Procedures of LDP MT using for unicast MRT FRR
  - All possible scenarios are analyzed and typical examples are provided.
  - Applicability guidance is provided.
Procedures

- **Routing Calculation:** Consistency of all nodes in the network is the most important.

- **Label Distribution:** LDP will advertise label mapping message with corresponding MT-ID for the specific FEC. There are at least three label bindings for each FEC that are associated with default topology, red topology and blue topology.

- **Forwarding Entry Creation:** The route calculated based on MRT determines which label binding should be chosen for each FEC in a specific topology. There is not any MT information which should be processed in the forwarding plane.

- **Switchover and Re-Convergence:** The traffic switches when failure happens. The micro-loop may be produced during the course of re-convergence.

- **Switchback:** IGP-LDP synchronization can also be used for the default topology to prevent traffic loss.
Considerations

• MRT MT-ID and LDP-MT ID Consistency:
  • The MRT MT-ID used in IGP is not for routing but just for forwarding and the application to use MRT results, so the application’s (LDP-MT) MRT MT-ID should be same with IGP.

• Multiple IGP: Multiple IGPs deploy in one network.
  • It is highly desirable that in one network only one IGP protocol is deployed.

• Policy Control: Policy can be used to reducing labels’ usage for MRT FRR.
  • For multi-service network based on VPN, policy can be applied to permit only host addresses to setup LSPs in the default topology.
  • Policy is not recommended to control on LSP in the blue topology and the red topology
Scenarios (1)

• 2-Connected Network: Detailed example shows how LDP MT works for MRT FRR and how tie-breaking policy works.
• Non-2-Connected Network: Highlights how label forwarding entry installs for cut-vertex.
• Proxy Node: Difference between two scenarios are identified.
  ➢ Inter-Area and Inter-AS: End-to-end LSPs
  ➢ Partial Deployment: Proxy egress LSPs
• IP-Only Network: It is recommended that LDP MT should be deployed incrementally for the fast-reroute usage
Scenarios (2)

- LDP over TE

(a) Default Topology

(b) Graph I for MRT Computation

(c) Graph II for MRT Computation
2-Connected Network Example

(a) Topology

(b) Blue Topology

(c) Red Topology

Figure 1: 2-Connected Network

According to the MRT calculation, for a specific destination H, there are following paths in different topologies for other nodes,

Default Topology
R ->A->B->F->G->H
A ->B->F->G->H
B ->F->G->H
C ->B->F->G->H
D ->C->B->F->G->H
E ->D->C->B->F->G->H
F ->G->H
G ->H
I ->G->H
J ->H

Blue Topology
R->A->B->F->G->H
A->B->F->G->H
B->F->G->H
C->B->F->G->H
D->E->R->A->B->F
E->R->A->B->F->G->H
F->G->H
G->H
I->J->H
J->H

Red Topology
R->E->D->H
A->R->E->D->H
B->A->E->D->H
C->D->H
D->H
E->D->H
F->B->A->R->E->D->H
G->F->B->A->R->E->D->H
I->G->F->B->A->R->E->D->H
J->I->G->F->B->A->R->E->D->H

Figure 2: Paths in Different Topologies for H
2-Connected Network Example (cont)
2-Connected Network Example (cont)
## 2-Connected Network Example (cont)

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<thead>
<tr>
<th>Default Topology</th>
<th>Blue Topology</th>
<th>Red Topology</th>
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<tbody>
<tr>
<td>R Ingress</td>
<td>--/L A</td>
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<td>/Lr E</td>
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<tr>
<td>Transit</td>
<td>L/L A</td>
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<td></td>
<td>/Lr E</td>
<td>Lr/Lr E</td>
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<td>A Ingress</td>
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2-Connected Network Example (cont)

1. For an ingress label forwarding entry as follows, when forward, L will be pushed and sent to the next hop A. If failure happens, Lr will be pushed and sent to the next hop E.

   Ingress -->/L A
   /Lr E

2. For a "2-connected" network, the incoming packet will be sent to the next hop through the next hop route L/Lr.
2-Connected Network Example (cont)

1. For an ingress, the label will be pushed. Ingress

2. For a transit label forwarding entry as follows, when packet with the incoming label L arrives, L will be swapped to \( L_r \) and sent to the next hop A. If failure happens, L will be swapped to \( L_b \) and sent to the next hop E.

Transit L/Lr A

/Lr E
Summary

• LDP MT can work well in different scenarios for MRT FRR.
• When LDP MT is combined with MRT FRR, follow advantages can be proposed:
  - Simplify operation and management with few additional configurations and states introduced.
  - Inherit procedures of LDP to achieve high scalability
  - Propose no additional change on label forwarding behavior in the forwarding plane to facilitate incremental deployment
Next Steps

• Get comments on mailing list
• More scenarios will be taken into account.