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

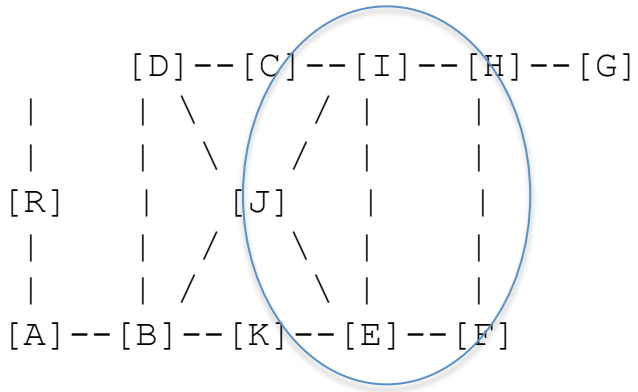
- MRT MT-ID and LDP-MT ID Consistency:
  - The MRT MT-ID used in IGP is not for routing but just for forwarding and the application to use MRT results, so the application's (LDP-MT) MRT MT-ID should be same with IGP.
- Multiple IGP: Multiple IGPs deploy in one network.
  - It is highly desirable that 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)

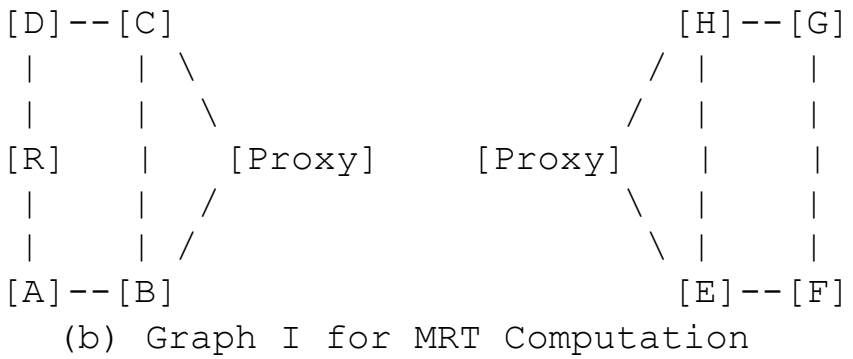
- 2-Connected Network: Detailed example shows how LDP MT works for MRT FRR and how tie-breaking policy works.
- Non-2-Connected Network: Highlights how label forwarding entry installs for cut-vertex.
- Proxy Node: Difference between two scenarios are identified.
  - Inter-Area and Inter-AS: End-to-end 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)

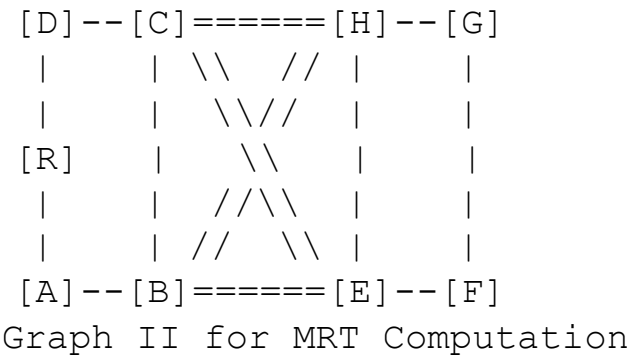
- LDP over TE



(a) Default Topology

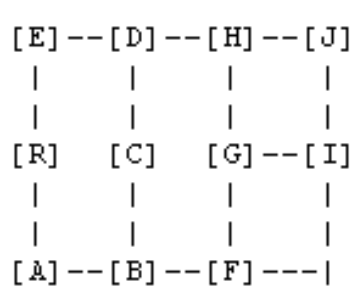


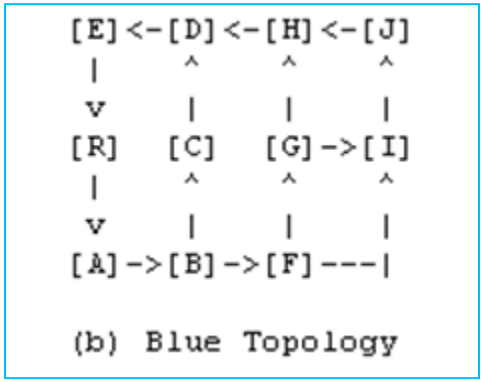
(b) Graph I for MRT Computation



(c) Graph II for MRT Computation

2-Connected Network Example





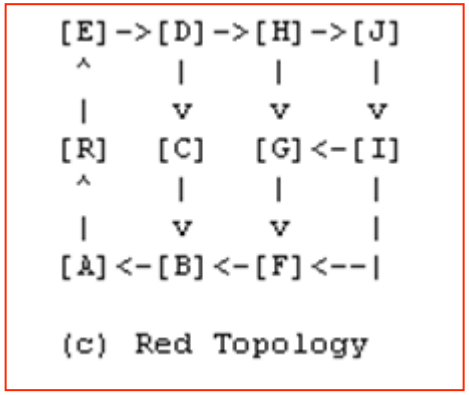


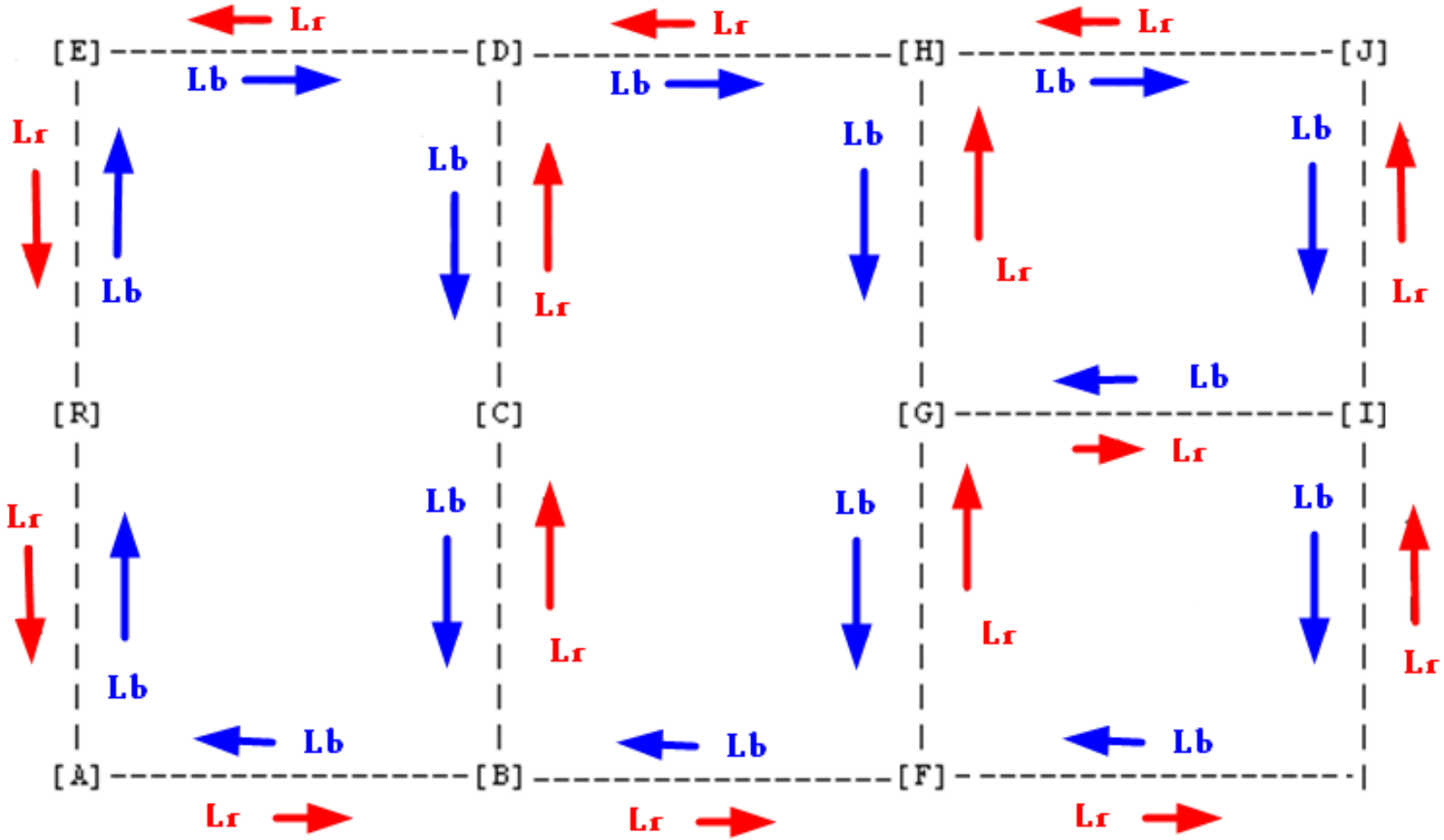
Figure 1: 2-Connected Network

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

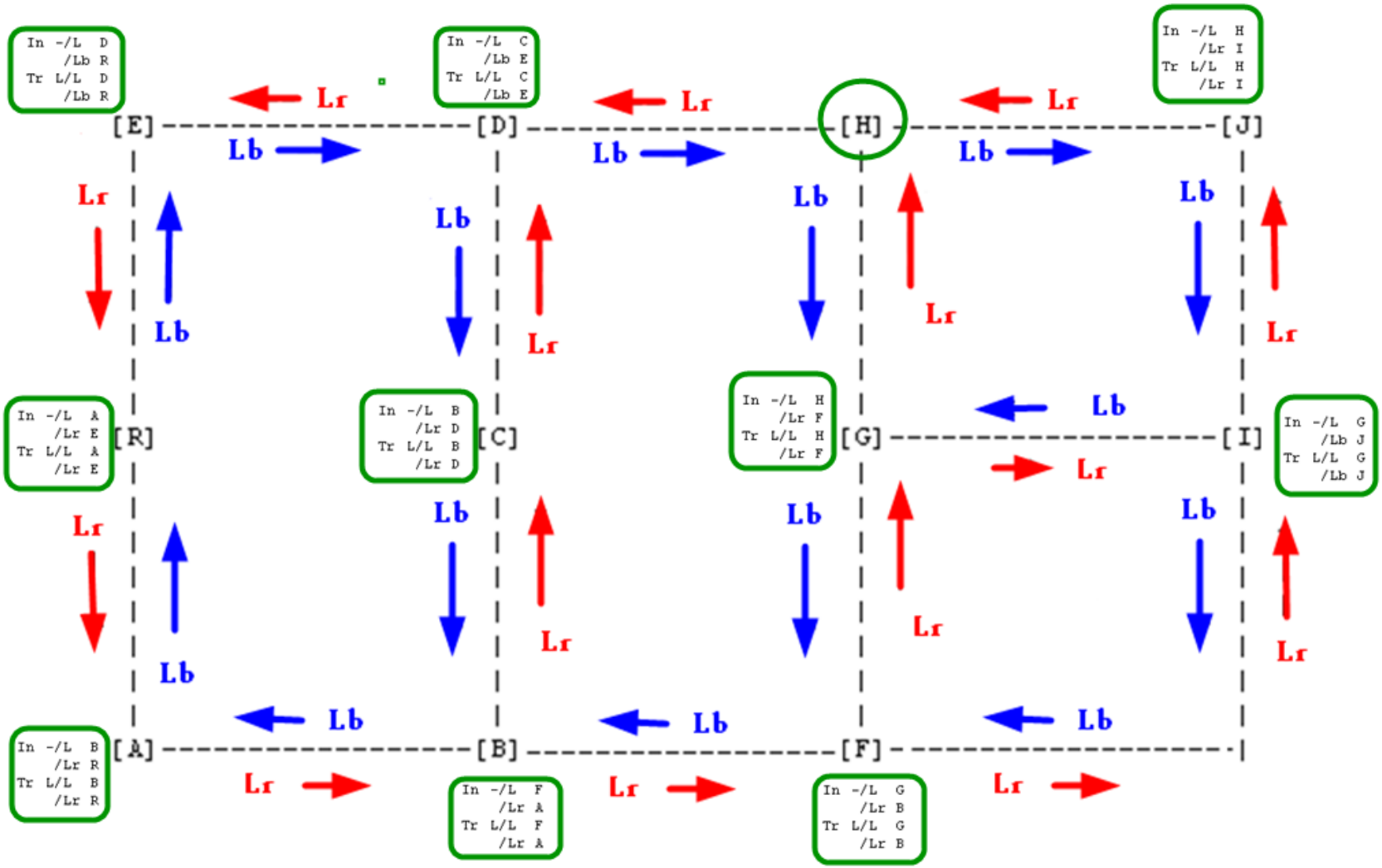
	Default Topology	Blue Topology	Red Topology
R	R->A->B->F->G->H	R->A->B->F->G->H	R->E->D->H
A	A->B->F->G->H	A->B->F->G->H	A->R->E->D->H
B	B->F->G->H	B->F->G->H	B->A->R->E->D->H
C	C->B->F->G->H	C->B->F->G->H	C->D->H
D	D->C->B->F->G->H	D->E->R->A->B->F	D->H
E	E->D->C->B->F->G->H	E->R->A->B->F->G->H	E->D->H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

		Default Topology	Blue Topology	Red Topology
R	Ingress	--/L A		
		/Lr E		
	Transit	L/L A	Lb/Lb A	Lr/Lr E
		/Lr E	/Lr E	
A	Ingress	--/L B		
		/Lr R		
	Transit	L/L B	Lb/Lb B	Lr/Lr R
		/Lr R	/Lr R	
B	Ingress	--/L F		
		/Lr A		
	Transit	L/L F	Lb/Lb F	Lr/Lr A
		/Lb R		
	Transit	L/L D	Lb/Lb R	Lr/Lr D
		/Lb R	/Lr D	
F	Ingress	--/L G		
		/Lr B		
	Transit	L/L G	Lb/Lb G	Lr/Lr B
		/Lr B	/Lr B	
G	Ingress	--/L H		
		/Lr F		
	Transit	L/L H	Lb/Lb H	Lr/Lr F
		/Lr F	/Lr F	
I	Ingress	--/L G		
		/Lb J		
	Transit	L/L G	Lb/Lb J	Lr/Lr G
		/Lb J	/Lr G	
J	Ingress	--/L H		
		/Lr I		
	Transit	L/L H	Lb/Lb H	Lr/Lr I
		/Lr I	/Lr I	

		Default Topology	Blue Topology	Red Topology
R	Ingress	--/L A		
		/Lr E		
	Transit	L/L A	Lb/Lb A	Lr/Lr E
		/Lr E	/Lr E	

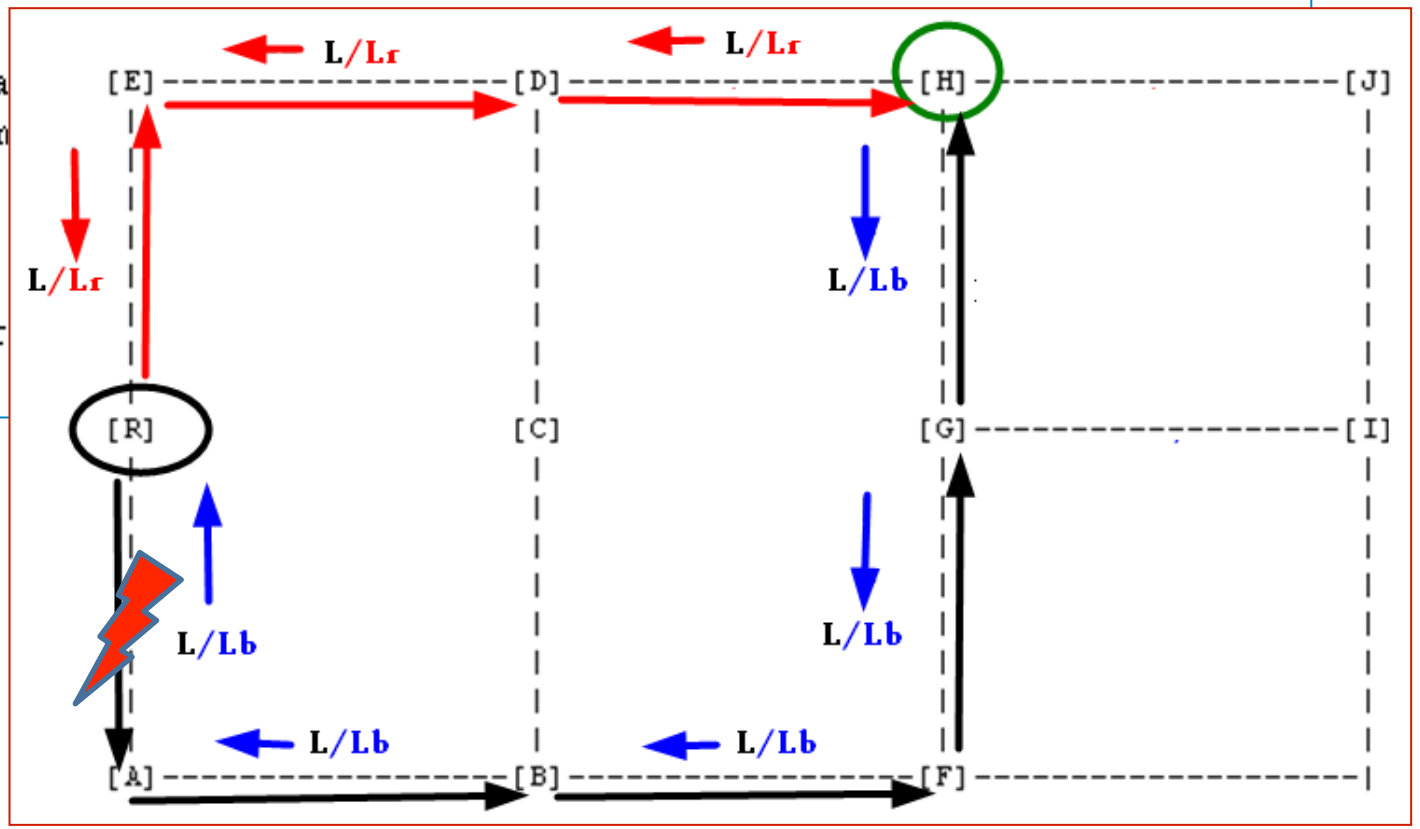
2-Connected Network Example (cont)

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.

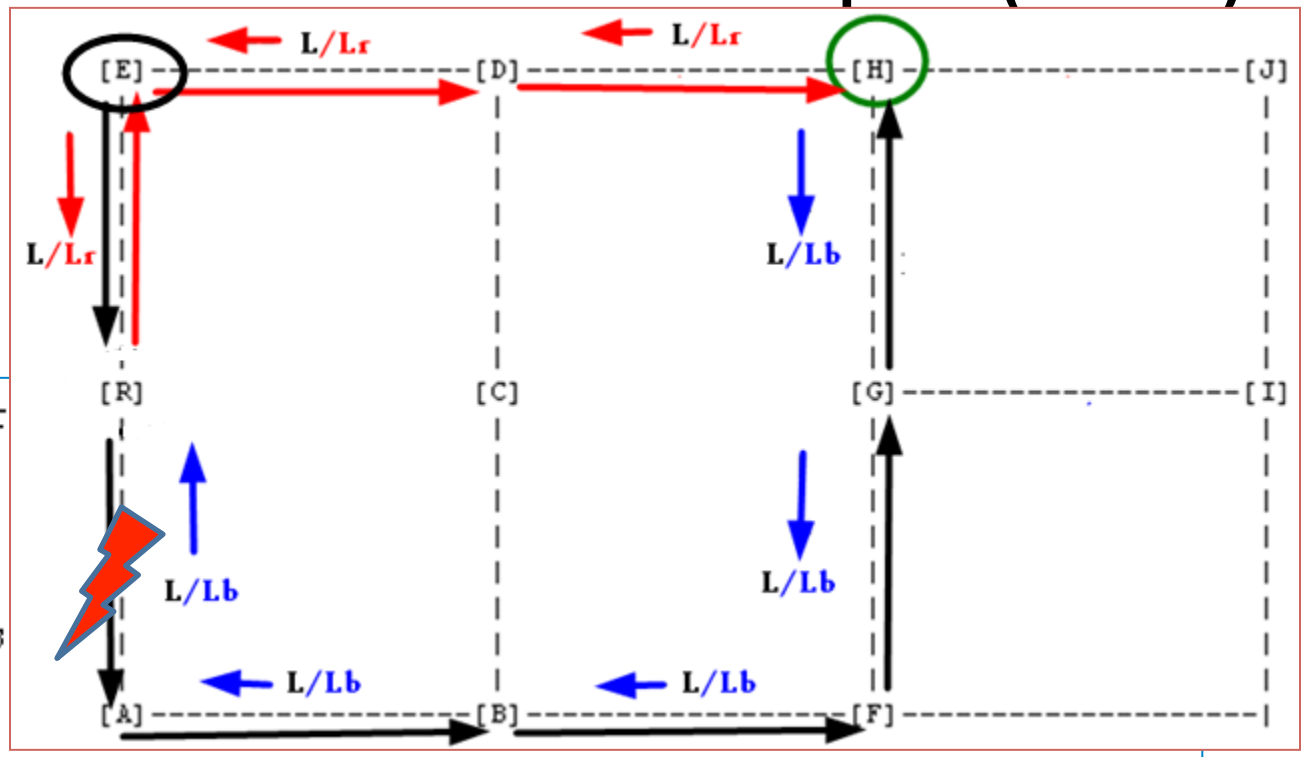
Ingress --/L A
/Lr E

2. For a
the incom
next hop
the next

Tr



2-Connected Network Example (cont)



1. For an ingr
will be pushed
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 and sent to the next hop A. If failure happens, L will be swapped to Lr and sent to the next hop E.

Transit	L/L	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.