

# MRT-FRR: Architecture, Algorithms, Analysis, and Extensions

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# Outline:

## Discussing MRT-FRR Drafts

- [draft-ietf-rtgwg-mrt-frr-architecture-03](#)
- [draft-enyedi-rtgwg-mrt-frr-algorithm-03](#)
- Analysis of MRT-FRR on Network Topologies
- [draft-atlas-ospf-mrt-00](#)
- [draft-atlas-mpls-ldp-mrt-00](#)

# Architecture: Comparison

Method	Coverage	Alternate Looping?	Computation (in SPF's)
MRT-FRR	100% Link/Node	None	less than 3
LFA	Partial Link/Node	Possible	per neighbor
Remote LFA	Partial Link/Node	Possible	per neighbor (link) or neighbor's neighbor (node)
Not-Via	100% Link/Node	None	per link and node

# Architecture:

## Text Changes & Clarifications

- Partial Deployment
  - Form MRT Island and can protect against destinations outside MRT Island
- Importance of 100% coverage
  - Protection during maintenance changes or after a failure
  - Topology agnostic – freedom for IGP metric engineering and network architecture
  - Preventing micro-forwarding loops usually extends network convergence times, which is only harmless with 100% coverage.
  - Multicast node vs. link protection (via p2p tunnels) depends on assumption that link protection is 100% available.
- Clarified final architecture decisions.

# Architecture:

## Defined Default MRT Profile

- Defining MRT Profiles for flexibility
  - for different applications if desired (MRT-FRR, Multicast live-live)
  - to change to new algorithm or behavior
- MRT Profiles for simplicity
  - Just indicate profile and not all the details that means in signaling
- MRT Profile describes required behavior for other routers

# Architecture: Multi-homed Prefixes

- End-point Selection (for IP)
  - Local Decision for alternate selection
  - Pick another router advertising the prefix and tunnel to it.
  - Only needed if failure point is also an advertising router (or a cut-node on path to it)
- Named Proxy-Node
  - Needs to have an LDP FEC for it.
  - Advertise MRT-Red and MRT-Blue FECs also
  - Can attach or detach without causing MRT recomputation
  - Just like attaching prefixes to the SPT after it has been computed.

# Architecture Summary

- Very stable and clarified – please read if you've read an earlier version.
- Multiple prototypes in progress
  - Need comments soon

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# Algorithm Draft Changes

- Focused on Lowpoint Algorithm
  - Moved hybrid and SPF versions to Appendix
- Added section for a named proxy-node
- A bit of normative text
- Lowpoint algorithm very stable
- Added analysis

# Algorithm Draft Next Steps

- May add backwards-compatible improvement: shortcut for alternates
  - Idea clear and agreed correct
  - Needs coding and to see improvement vs. computation
- Please tell about implementations
  - Interested in verifying interoperable correctness
- Comments?

Interested now in WG Adoption

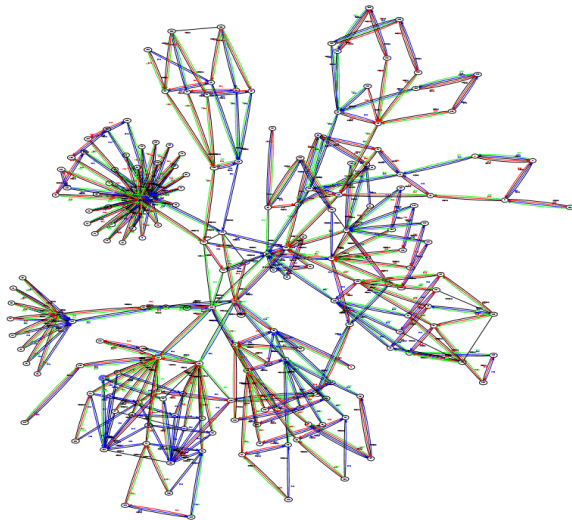
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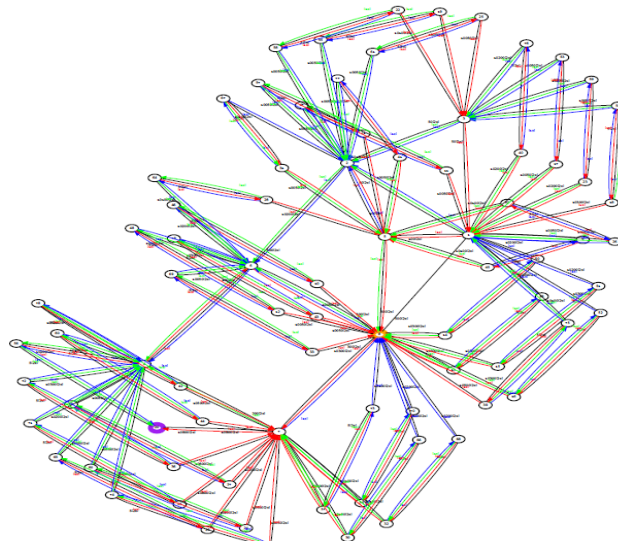
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# Evaluating IPFRR technologies on service provider network topologies

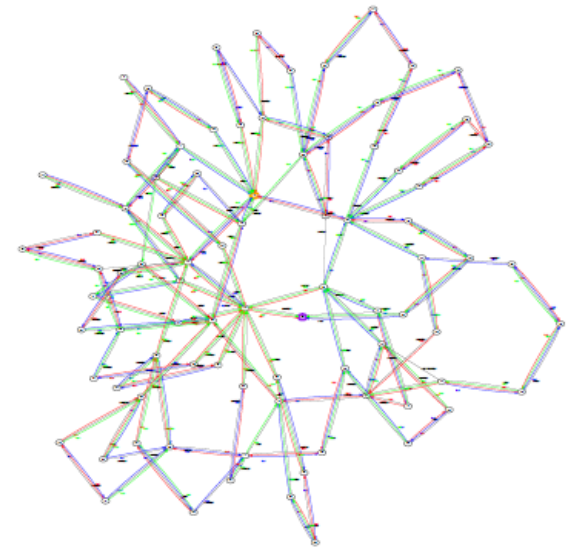
- Failure coverage
  - MRT vs. optimal (100%)
  - RLFA vs. optimal
    - Link and node-protection
    - Link-protection only
    - Link-protection with potential to loop when node fails
- Alternate path length



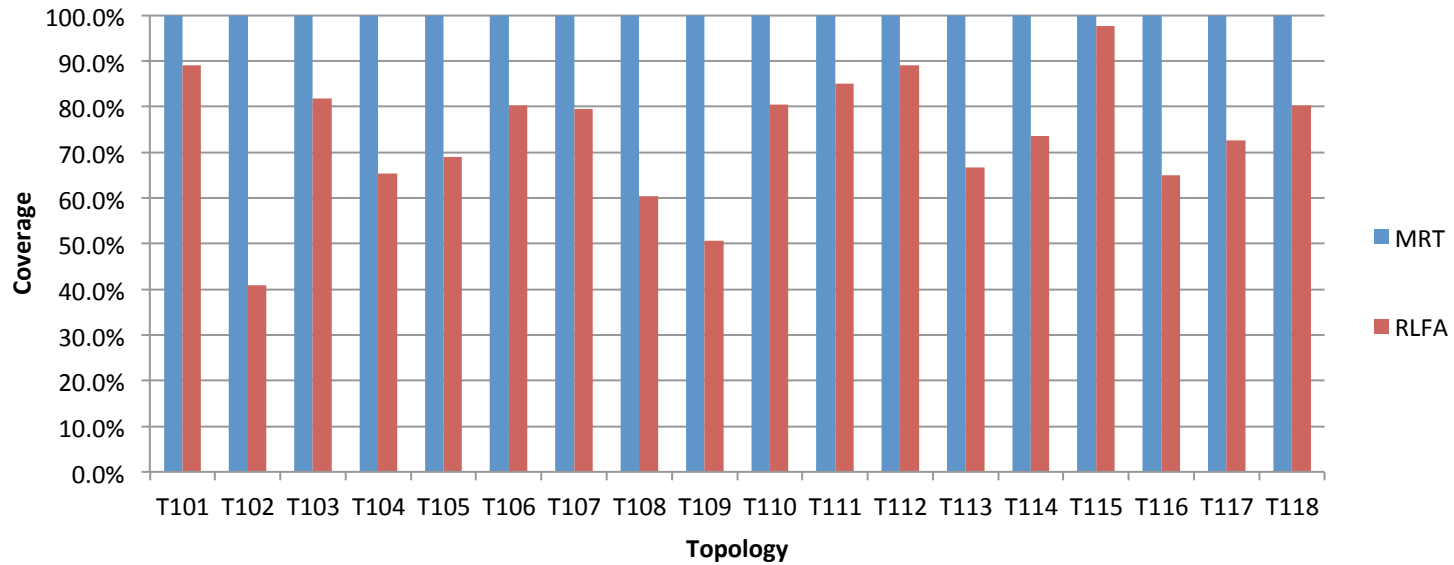
IETF 87 MPLS: 2 August 2013



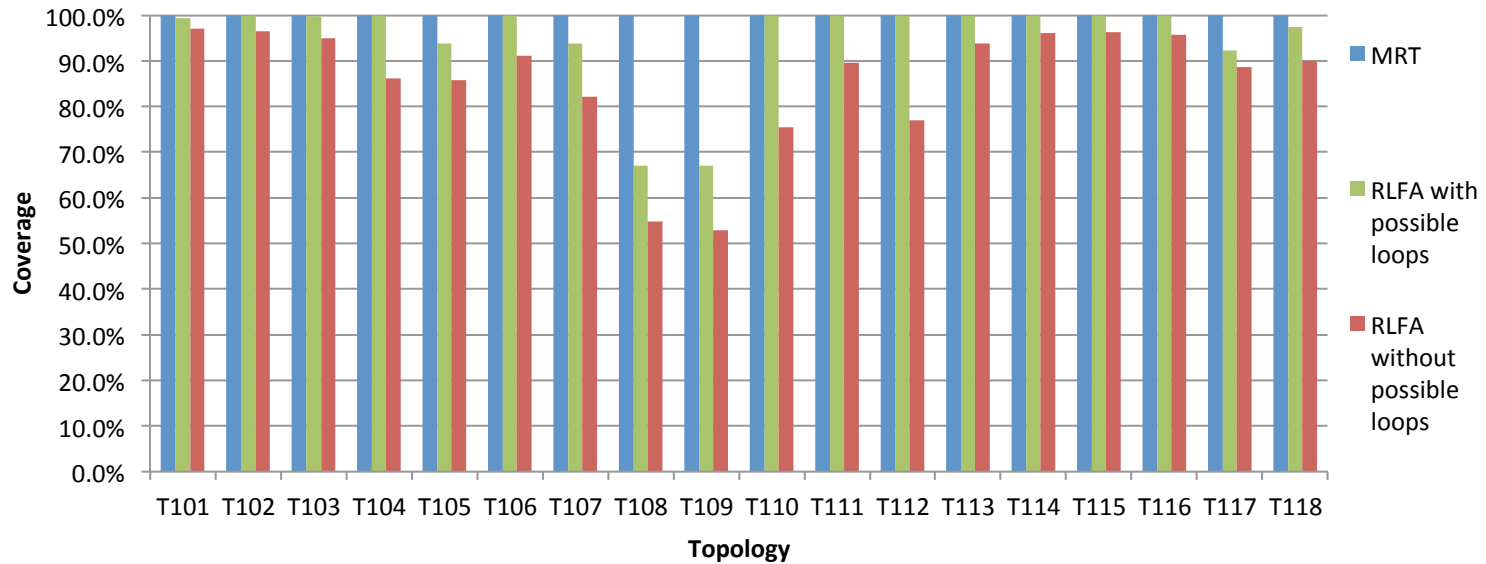
draft-ietf-rtgwg-mrt-frr-architecture-03, etc.



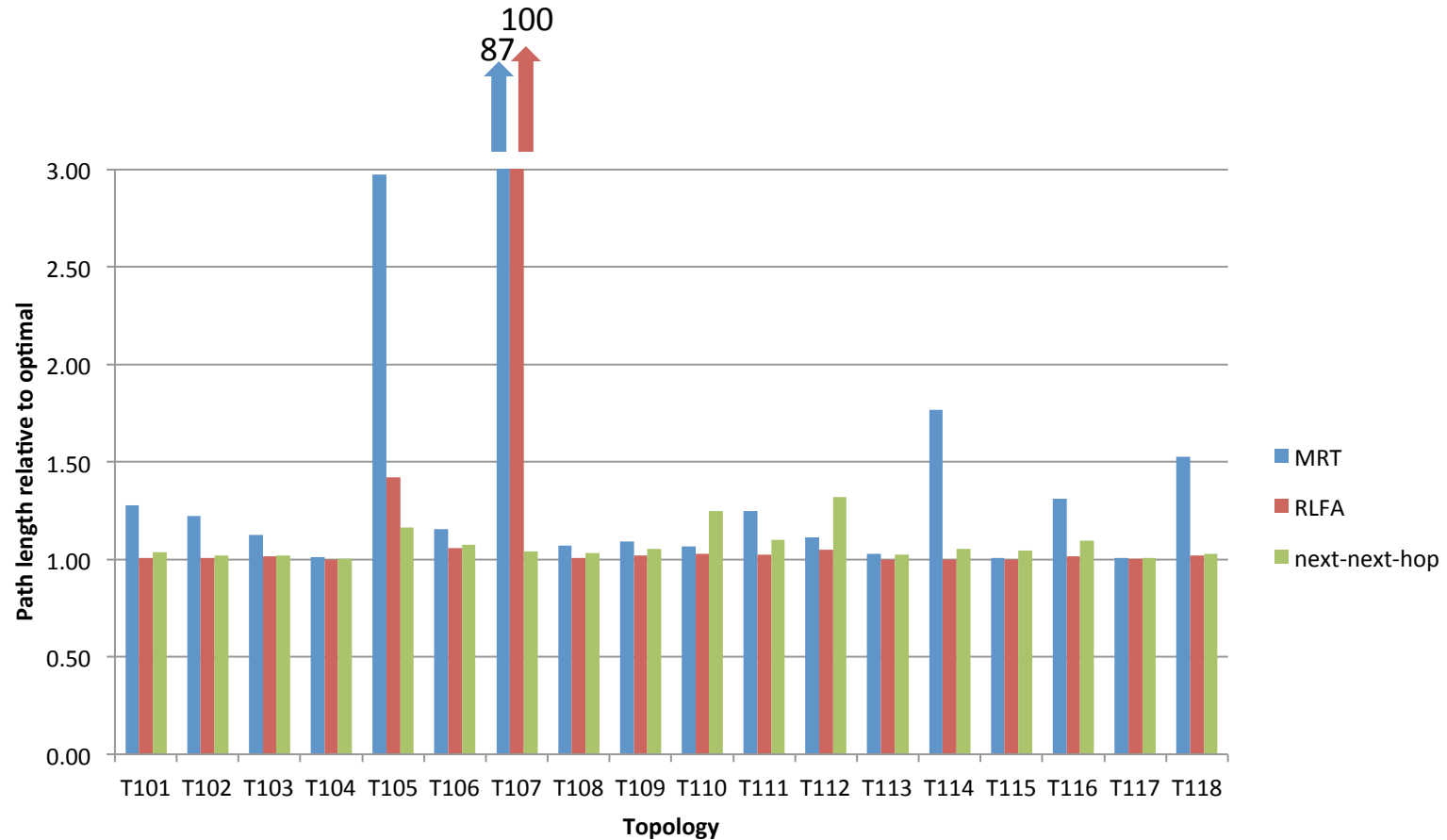
### link and node failure coverage



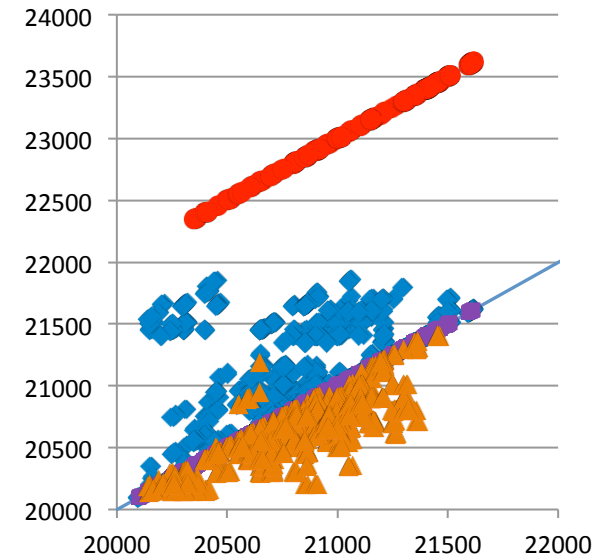
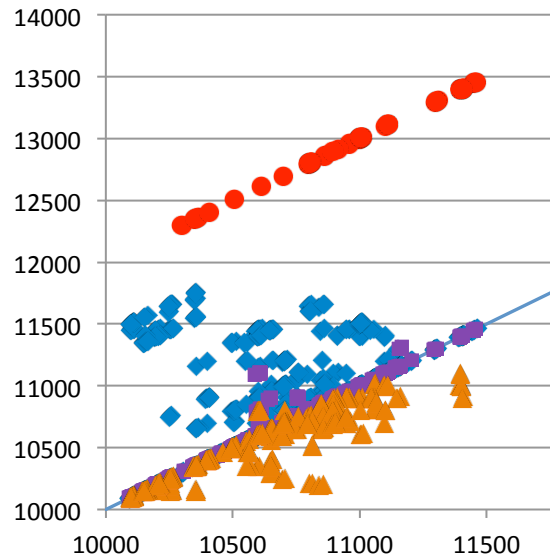
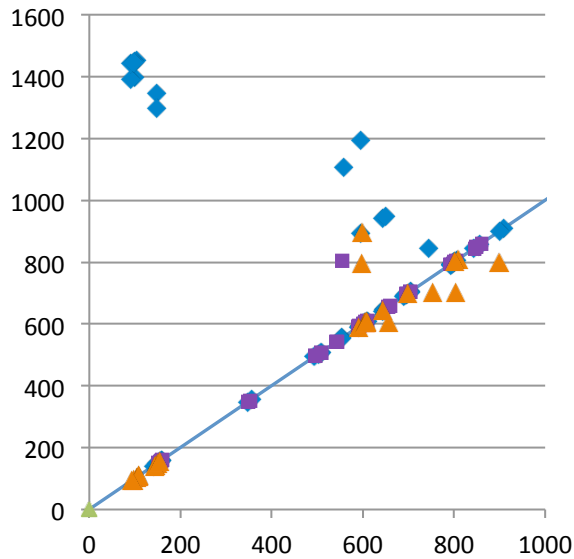
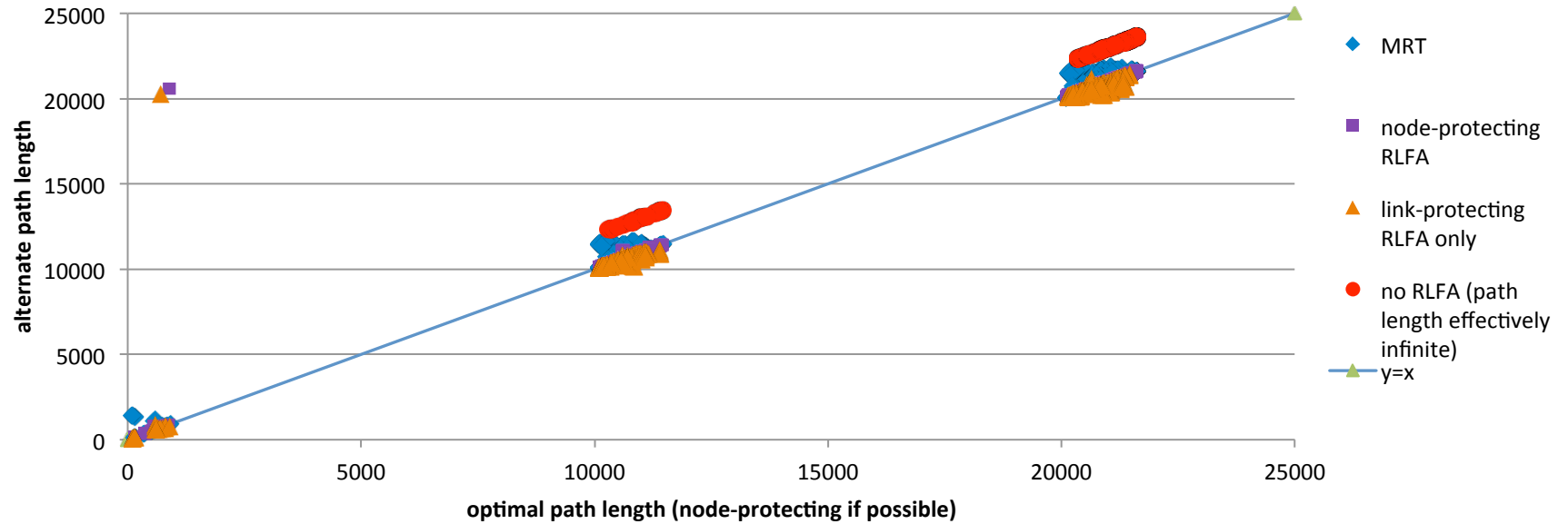
### link-only failure coverage



# Average relative alternate path for all topologies modeled



# Path length distribution for one topology



## Alternate selection priorities for this MRT analysis

1. node-protecting downstream local LFA
2. node-protecting MRT alternate
3. link-protecting downstream local LFA
4. MRT alternate

## Alternate selection priorities for this RLFA analysis

1. node-protecting local LFA
2. link-protecting remote LFA providing node-protection
3. link-protecting downstream local LFA
4. link-protecting downstream remote LFA
5. link-protecting local LFA



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# Overview of OSPFv2 and OSPFv3 Extensions

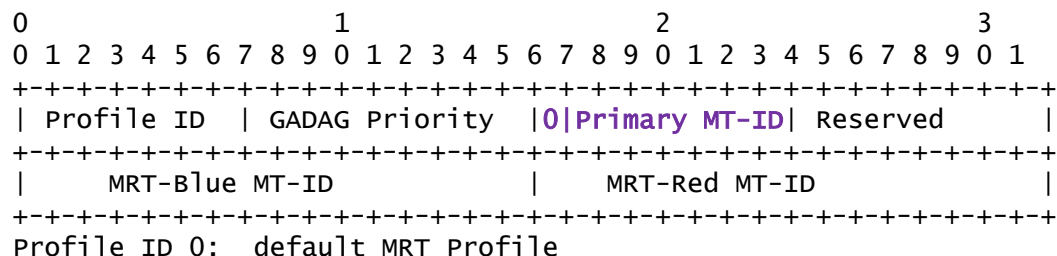
- MRT Capability:
  - Uses a bit from the Router-LSA
- MRT Profile supported and associated GADAG Root Selection Priority
  - In TLV for Router Information LSA
- Flood local MRT-ineligible links for consistent topology
- Flood local worst-case convergence time to derive network worst-case convergence time
  - Old idea from draft-atlas-bryant-shand-lf-timers

Merging with draft-li-rtgwg-igp-ext-mrt-frr-01

# Planned Changes: for MT Routing

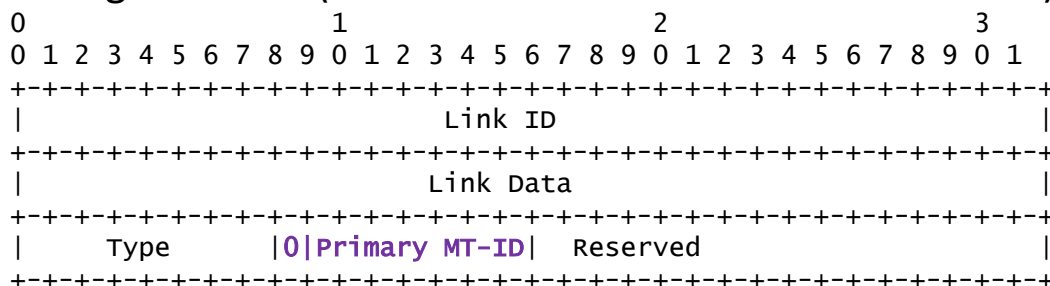
Adding support for multi-topology routing so primary can have an MT-ID.

- MRT Profile TLV in Router Information LSA



If the MRT-Blue MT-ID is 0, then the value specified in the associated MRT Profile is assumed.  
 If the MRT-Red MT-ID is 0, then the value specified in the associated MRT profile is assumed.

- MRT-Ineligible Links (shown for OSPFv2 – similar for OSPFv3)



# GADAG Root Selection Priority

- Picking a good GADAG Root improves the length of the alternates significantly.
- Off-line analysis can identify good candidates (e.g. closeness centrality)
- Default value, if unspecified, is 100 – which allows specifying priorities above or below.
- Only routers that are good (or bad) GADAG Root candidates need to advertise the MRT Profile TLV in the Router Information LSA.

# Goals of Extensions

- Confirm MRT capability and support
- Provide for supporting multiple MRT Profiles
  - Matches into the MRT island for Primary MT-ID, if MRT Profile and MRT-Blue MT-ID and MRT-Red MT-ID match
- Ability to remove links from the topology used by MRT algorithm
  - Sec 3.2.1 of draft-ietf-rtgwg-lfa-manageability-00 requires the ability to mark a link as a non-candidate.
- Worst-Case Convergence Time
  - Used to decide when to start computing (or installing) MRTs and alternates.
  - Will also be useful for micro-loop prevention techniques.

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# What is needed from LDP

- New Capability
  - need to know that peer supports MRT and its use of MT-FECs.
- For inter-area/inter-level case, need to signal different label for same (MT-ID, IP Prefix)
  - Define “Rainbow MT-ID” – indicates supplied label applies to
    - All (Blue MT-ID, IP Prefix),
    - All (Red MT-ID, IP Prefix), and
    - (MT-ID = 0, IP Prefix)
  - Can also use Rainbow MT-ID as egress
  - Means same label always advertised for same MT-FEC, but different MT-FECs may be sent to different neighbors.

# Overall Summary

- MRT-FRR architecture is mature
- Algorithm draft is stable and ready
- Signaling extensions defined
  - OSPF, LDP this time
  - ISIS soon
  - Needed for interoperable implementations
- Prototypes underway
- Interested in feedback