Operational Guidance for Protection mechanisms in SRv6 Networks

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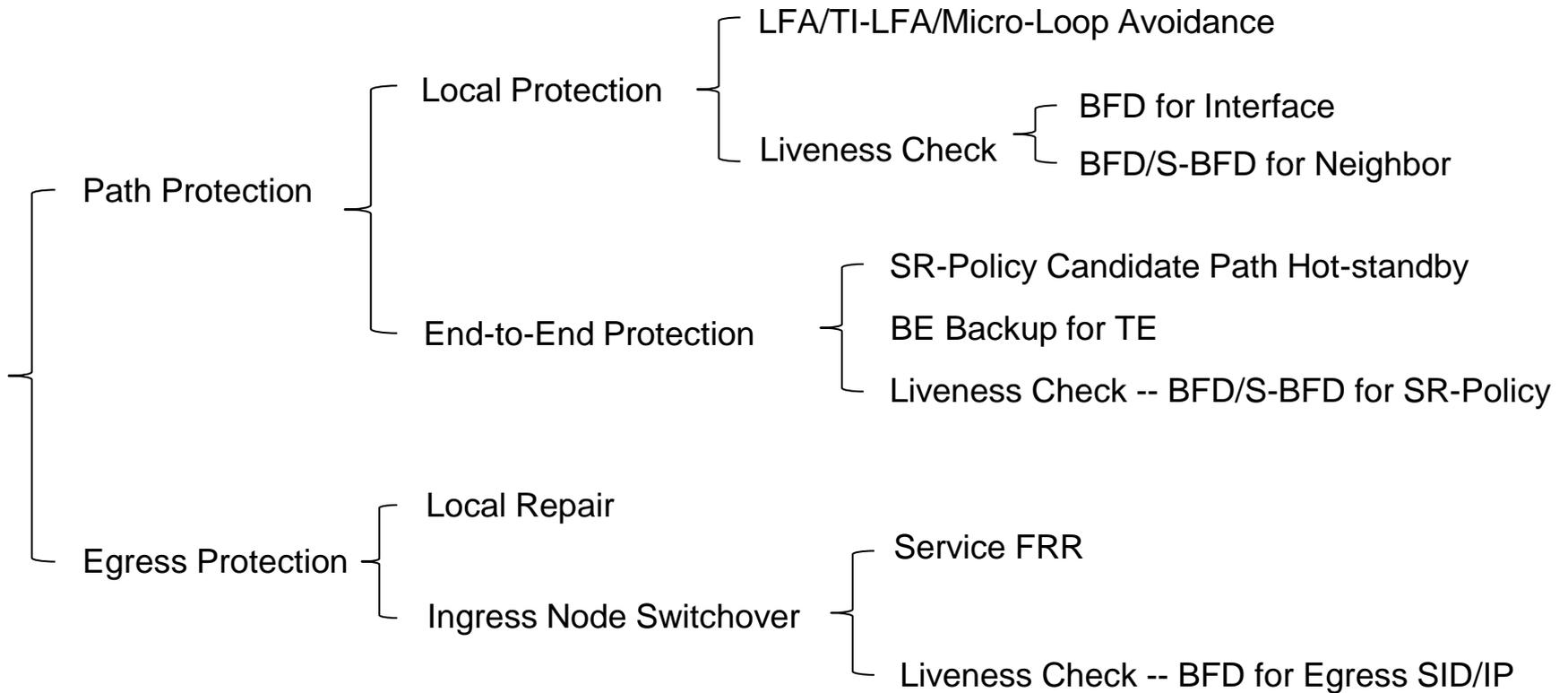
IETF 122

Changes of the draft

Version-02:

- Changed "Best Practice" to "Operational Guidance."
- Added considerations and deployment recommendations
   for various protection mechanisms.
- Included MSD (Maximum SID Depth) considerations for protection paths.
- Incorporated MTU (Maximum Transmission Unit) considerations for protection paths.

Version-01:

Rewrite Section 4 (Implementation Recommendations)
- Deployment for single-homed scenario & multi-homed scenario
- Recommendations for BFD
- Add Section 5 (Considerations for SRv6 Segment List Compression)
  - Discuss the impact of SRv6 Segment-List compression on protection
  - TI-LFA with C-SID & micro-Loop avoidance with C-SID

Operational Guidance for Protection in SRv6 networks

Path Protection
- Local Protection
  - LFA/TI-LFA/Micro-Loop Avoidance
  - Liveness Check
    - BFD for Interface
    - BFD/S-BFD for Neighbor
- End-to-End Protection
  - SR-Policy Candidate Path Hot-standby
  - BE Backup for TE
  - Liveness Check -- BFD/S-BFD for SR-Policy

Egress Protection
- Local Repair
- Ingress Node Switchover
  - Service FRR
 - Liveness Check -- BFD for Egress SID/IP

Operational Guidance for Local Protection

- LFA/TI-LFA
  - The scope of prefixes to be protected
  - LFA, TI-LFA configuration options
  - Control the interfaces to be protected
  - Backup paths exclude policy configuration
  - Delay calculation time during switchover: 5 to 30 seconds.
  - Risk group configuration for multipoint failures
- Micro-loop Prevention
  - Default Duration: 5 seconds as a default value.
  - Adjusting Duration for Larger Networks.
  - Local vs. Remote Micro-Loop Prevention
- Consideration for Liveness Check:
  - < 100ms, recommended to configure BFD
  - Local Interface State Detection.
  - BFD Session Optimization.
  - Alternative Detection Protocols

Operational Guidance for End-to-End Protection

- End-to-End Protection

  – Hot Standby for SRv6 Policy

  – End-to-End Detection

  – Switch Delay and Up Delay

  – Multiple Suboptimal Paths for Sequential Backup:

  – Escape to Best Effort Path

- Consideration for Liveness Check:

  – Detection Time for Inconsistent Paths

  – No-Bypass for Detection Packets

  – Encapsulation Mode for Detection Packets

Operational Guidance for Egress Protection
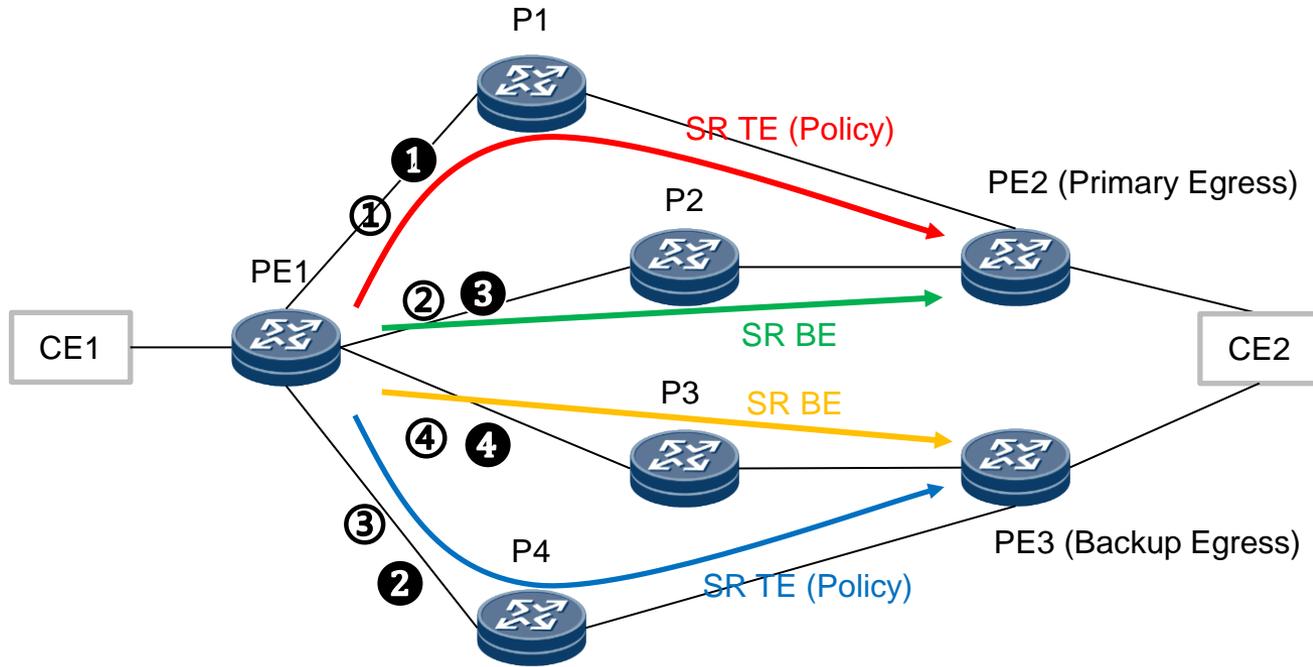
	Egress-node-first policy	TE-first policy
Primary Next-hop:	①	❶
Backup Next-hop of 1st Priority:	②	❷
Backup Next-hop of 2nd Priority:	③	❸
Backup Next-hop of 3rd Priority:	④	❹

Operational Guidance for Single-homed Scenario
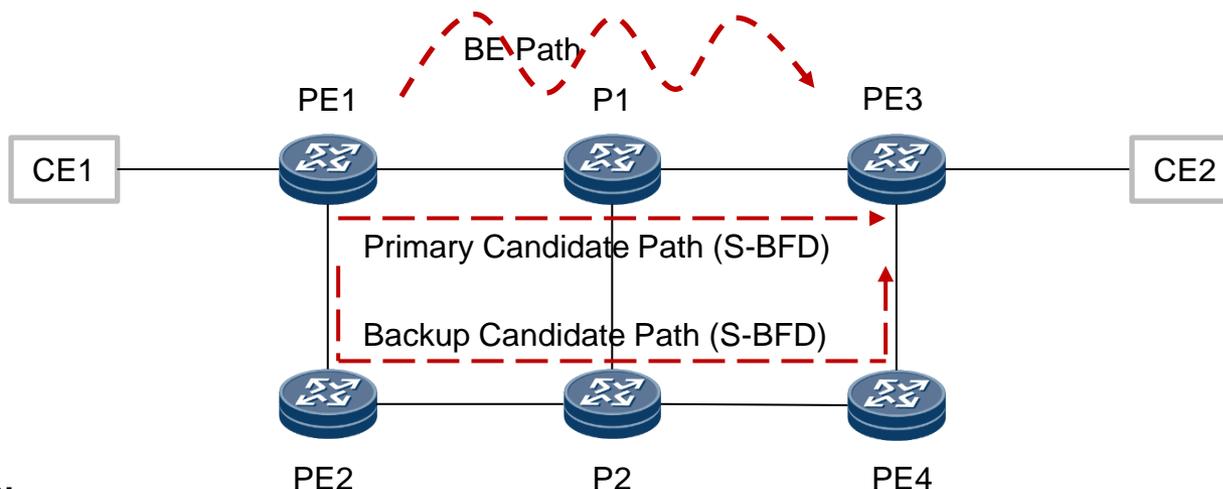
Deployments:

- TI-LFA as local protection
- Multiple candidate paths switchover as end-to-end protection
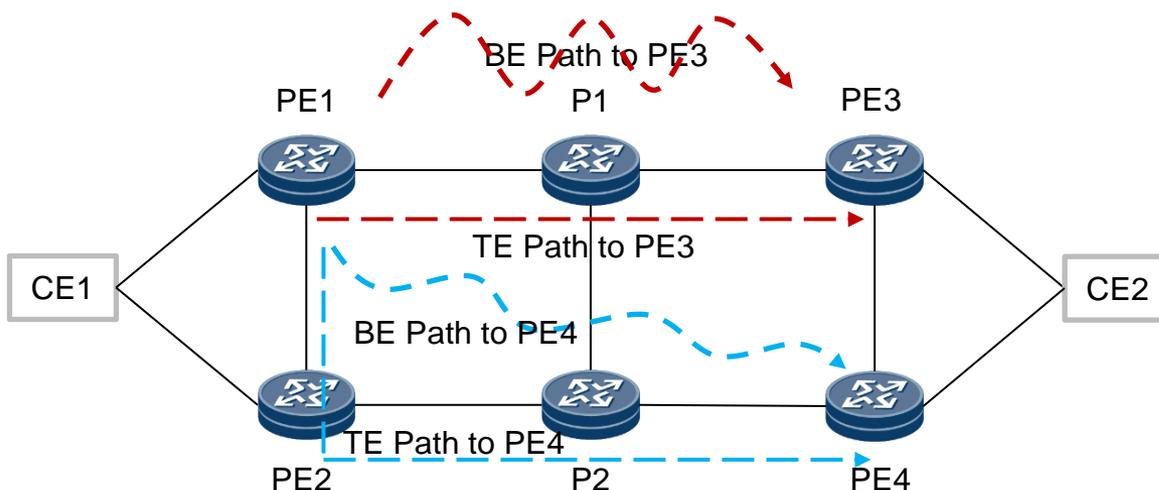- BE backup for TE

Protection of SR-BE traffics:

- TI-LFA, triggered by BFD for links and neighbors

Protection of SR-TE traffics:

- High SLA cases (end-to-end protection preferred):
    - Only candidate path switchover
- Fast traffic restoring cases (local protection preferred):
    - First, TI-LFA, triggered by BFD for links and neighbors
    - Then, Candidate path switchover, triggered by BFD/S-BFD for SR Policy
- BE backup for TE
    - Operate when multi-point faults (When link PE1-P1 & P2-PE4 both fail, SR BE path can still reach PE3)
    - Exceptions (dropping preferred): strong SLA requirements

Operational Guidance for Multi-homed Scenario

Deployments:

- For each egress PE, same with Single-homed Scenario
  - TI-LFA as local protection
  - Multiple candidate paths switchover as end-to-end protection
  - BE backup for TE
- Ingress Node Switchover
  - Monitor the liveness of egress nodes: BFD for egress nodes, or validating IGP routes of egress nodes
  - Switchover among different egress nodes (for example, when PE3 fails, PE1 switch from SR-Policy-to-PE3 to SR-Policy-to-PE4)

Recommended BFD Time Interval

Trigger of TI-LFA:

Local protection ≤ 50ms

- BFD for links and neighbors: 10ms * 3

Trigger of candidate paths switchover (primary candidate path down):

- BFD for primary candidate path of SR Policy: 50ms * 3

Trigger of BE backup for TE (all candidate paths down):

- BFD for backup candidate path of SR Policy: 100ms * 3

End-to-end protection ≤ 300ms

Trigger of egress protection:

- BFD for egress nodes: 50ms * 3

Considerations for MSD and SRv6 Path MTU

Considerations for MSD Check

- Enable MSD Strict Check：Configure MSD strict check to ensure the current node rigorously verifies the MSD supported by nodes along the path.

- Impact of MSD Strict Check：After enabling MSD strict check, if the supported MSD of any node along the path is less than the required label stack depth, the Local protection label stack cannot be formed.

Considerations for SRv6 Path MTU

- Reserve Additional SRH Length : TI-LFA FRR, micro-loop prevention, or Egress protection, which introduce extra SRH length.

- Active Path MTU Calculation: SRv6 Path MTU – Reserve Len

- Recommended Reserve Value: A reserve value of 72 bytes is recommended.

Running Code

Lab Interop-test Status

Hardware devices and software implementations which have passed SRv6 protection interoperability tests hosted by China Mobile in 2021 and 2022:

- China Unitechs Unified Controller

- Huawei NE40E and NE5000E

- H3C CR16010H-FA and CR19000-8

- ZTE M6000-8S Plus and M6000-3S

- Ruijie RG-N8010-R

Both single AS domain and Inter-AS domain scenarios have passed interoperability testing.

Deployment Status

Trials of SRv6 protection in five branch networks of China Mobile in 2021 and 2022

- Beijing

- Zhejiang

- Fujian

- Guangdong

- Henan

Next Step

- Any questions or comments?

- Ask for adoption call