MPLS-TP Shared Ring Protection (MSRP) Mechanism

draft-cheng-mpls-tp-shared-ring-protection-01

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Why topology-specific protection solution?

- Ring topology is deployed worldwide, which can use minimized fiber resource to provide physical two tours.
- Traditional transport networks (such as SDH) are constructed with ring topology, so that network infrastructure such as fiber/power supply/machine rooms are deployed for ring topology.
- Maintenance engineers are familiar with ring topology based operation.
- Local mesh can also be treated as Ring topology, so Ring topology specific protection solutions can also be used in those application scenarios.
- MPLS-TP are often used for mission critical services such as trading, finance, mobile backhaul(especially for voice service) etc. which require sub-50ms protection. From our test results, Ring topology specific protection can meet those requirements with minimized hardware cost.

Requirements of the Ring protection

- **“Multiple failures” recovery**

  Multiple links or nodes failures are caused by single event, Such as:

  - ✓ Multiple links of rings are using fibers in one cable or pipeline, and which is cut off
  - ✓ network migration/network cutover in different rings at the same time

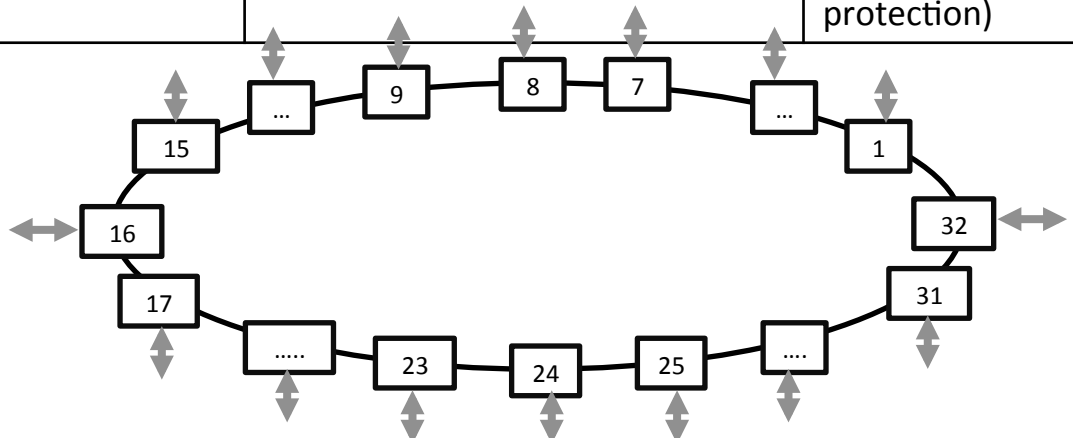
  Ring protection should cover following possible failures scenarios

  - ✓ Multiple failures in single ring
  - ✓ Multiple failures in connected rings
- **Simplify configuration and maintenance**
  - ✓ protection configurations should be independent of service number
  - ✓ Minimize the management elements
- **Simplify the hardware requirements**
  - ✓ Minimize the number of OAM entities
  - ✓ Minimize the number of elements of recovery
  - ✓ Minimize the number of labels required
- **Linear protection using in field, operators require smooth migration from linear protection to ring protection without service impacted.**
  - ✓ Simple Wrapping solution required

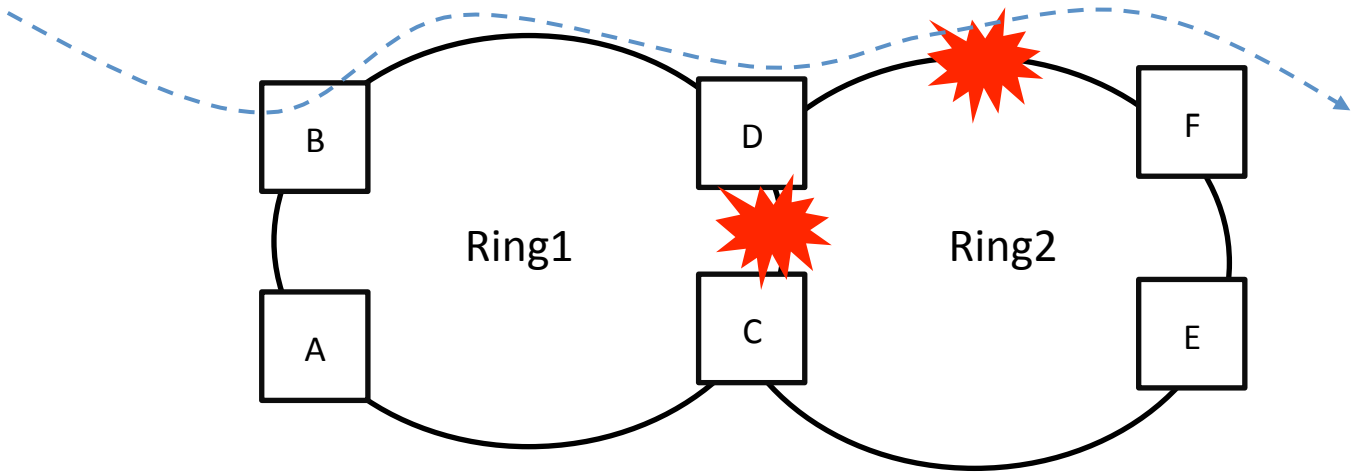
Why “shared ring protection”

- Because Wrapping Solution of RFC6378 can not cover multiple-failure issues, we will not analyze it here, we focus on the Steering Solution of RFC6378
- For a typical MPLS-TP ring topology which include 32 node. 10 bidirectional service LSP carried between each two nodes, total 4960 bidirectional service LSP. The table below is analysis of MPLS label and OAM session consumed for different protection solutions.

Resource consumed in each node	**Shared ring protection**	**Steering solution of RFC6378**
MPLS Labels in each node	**Total 434** ➢Ring tunnel label:124(4*31) ➢Service tunnel label:310	**Total 1302** ➢Ring tunnel label: 1922(2*31*31) ➢Service tunnel label: 310
OAM sessions in each node	**Total 2** ➢ 1 east direction and 1 west direction	**Total 124** ➢31(node)* 4(anticlockwise work/ protection and clockwise work/ protection)



Why need wrapping ring protection



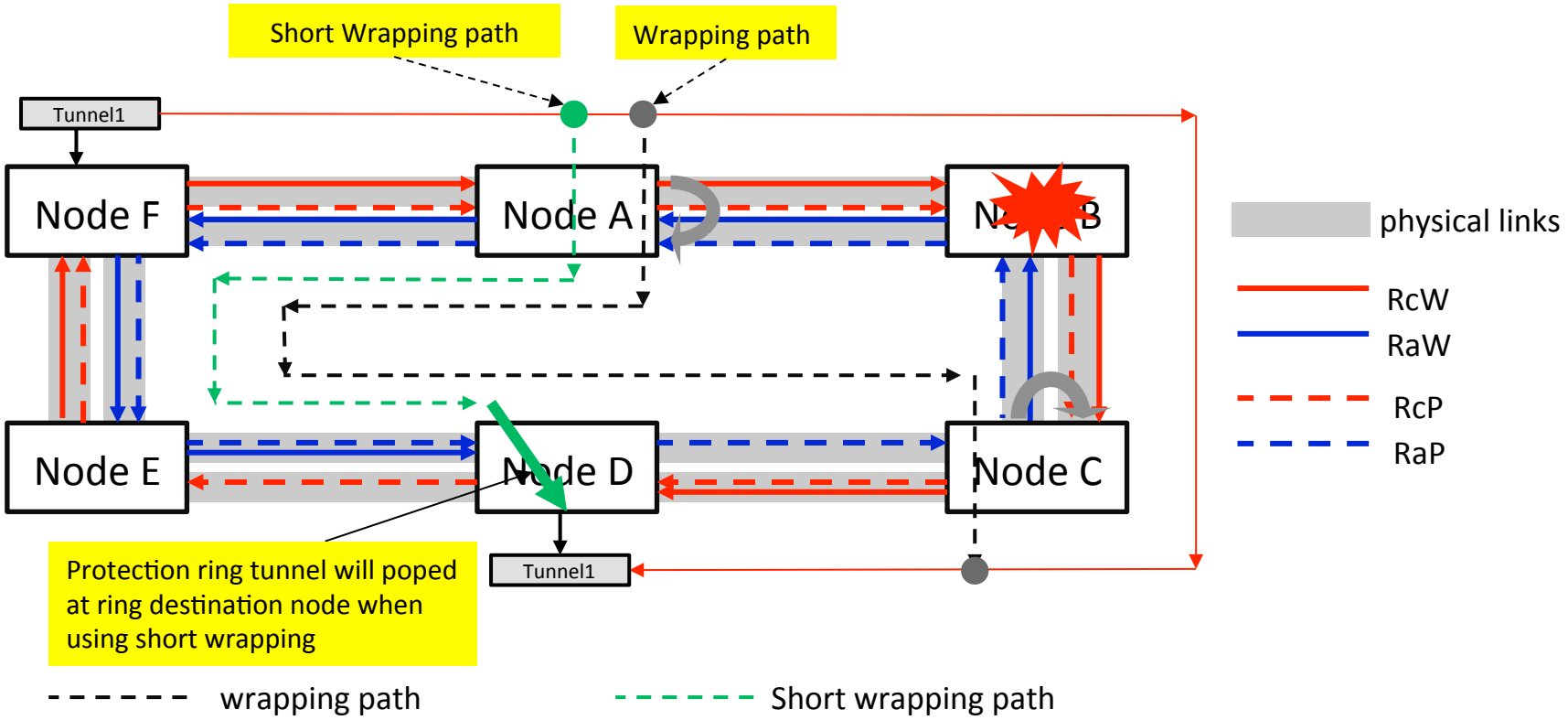
interconnected ring protection scenarios

- Steering ring protection is hard to meet interconnected ring topology recovery requirement. When failure occurred as the figure show above, Steering ring protection need to notify failure information and topology to source node(as Node B). It need to introduce complex protocols.
- When using wrapping ring protection, the switching action only execute in failure detected node(as Node D). It is simple to implement in the network devices then steering ring protection.

Scope

- Differences from version 00
  - short wrapping is added as an optimized wrapping solution
    - to improve latency and bandwidth efficiency in some cases (e.g. the destination/exit node is far from the defect)
  - an interconnected ring protection mechanism is added
    - MPLS-TP, as a packet transport technology, are typically constructed with interconnected ring topology, like other transport networks (e.g. SDH).
    - Current ring protection mechanism can't recover from interconnection node failure.

P2P short wrapping solution



Short Wrapping v.s Wrapping (Node D as an exit node)

- **Wrapping:** Protection switching happens at neighbouring nodes of the failure (Service is received from the working path at the exit node) . See the black line in the figure.
- **Short Wrapping**: Protection switching occurs at the up-stream neighboring node of the failure and the exit node (Service is received from the protection path at the exit node).

Interconnected ring protection mechanism

- ① Interconnected rings will be regarded as two independent rings. Each ring runs protection switching independently. Failure in one ring only triggers protection switching in itself and does not affect the other ring.

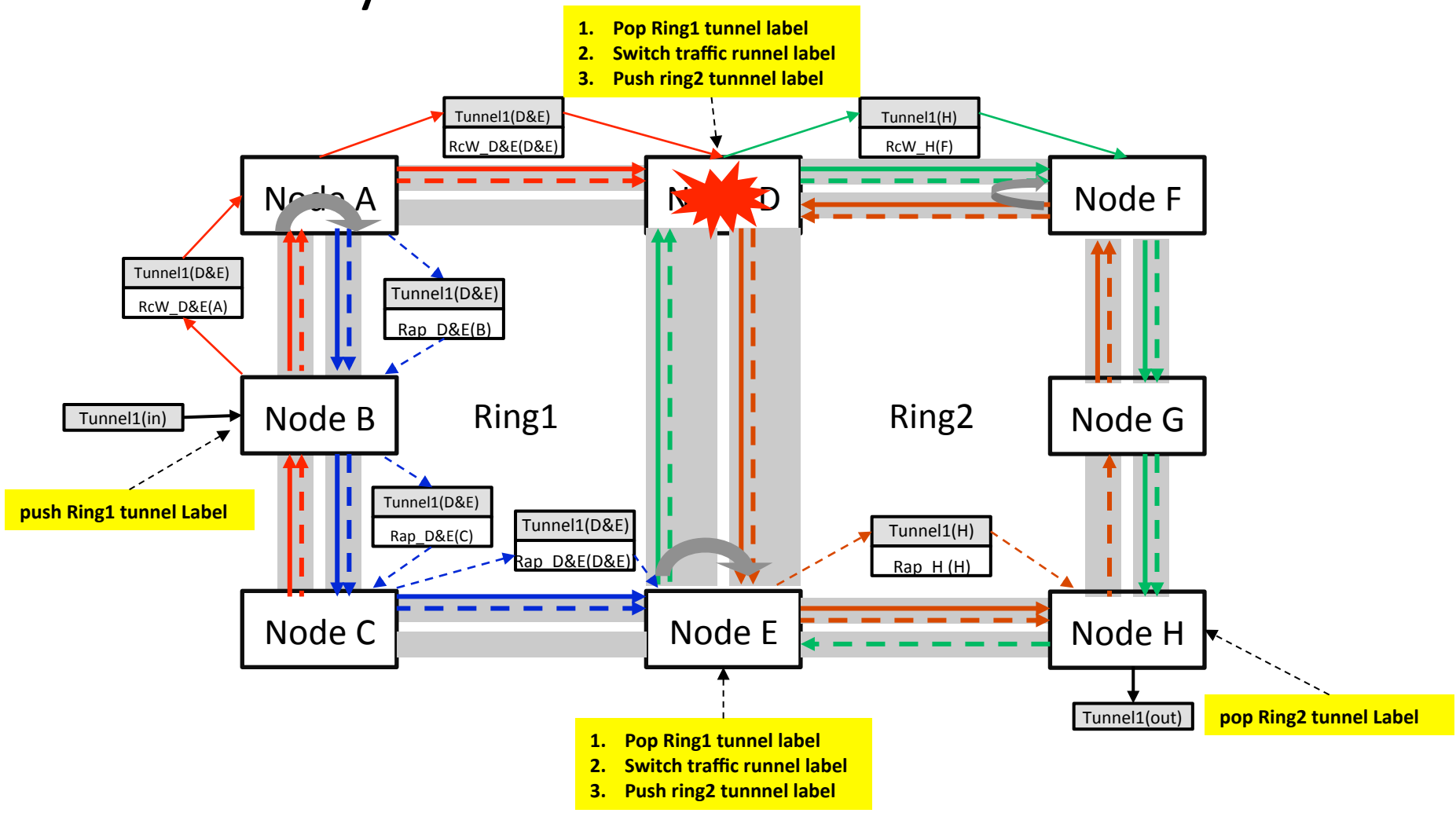
- ② The service LSPs that traverse the interconnected rings via the interconnection nodes must use different ring tunnels in different rings. The ring tunnel used in the source ring will be removed, and the ring tunnel of destination ring will be added at interconnection nodes.

- ③ For protected interconnection node in dual-node interconnected ring, the service LSPs in the interconnection nodes should use the same MPLS label. So either interconnection node can terminate the source ring runnel and push the destination ring tunnel according to service LSP label.

- ④ Two interconnection nodes can be managed as a virtual interconnection node group. Each ring assigns ring tunnels to the virtual interconnection node group. The interconnection nodes in the group should terminate the working ring tunnel in each ring. Protection ring tunnel is a closed ring to switch with the working ring tunnel at the nodes which detect the fault. Ring tunnels to the virtual interconnection node group will be established by each ring of the interconnected rings :
  - one clockwise working ring tunnel to the virtual interconnection node group;
  - one anticlockwise protection ring tunnel to the virtual interconnection node group,
  - one anticlockwise working ring tunnel to the virtual interconnection node group;
  - one clockwise protection ring tunnel to the virtual interconnection node group.

  These ring tunnel will terminated at all nodes in virtual interconnection node group.

Recovery from Interconnection node failure

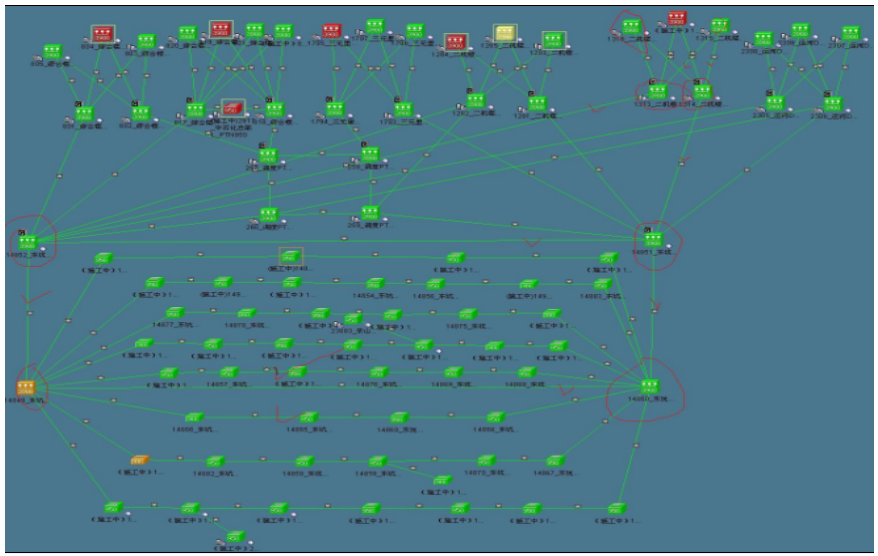


Recovery from Interconnetcion node failure (Node D failure)

① NodeD and NodeE should deal with the same traffic LSP label. Tunnel1 will process correctly in any node of NodeD and NodeE；

MSRP Field trial and deployment in CMCC

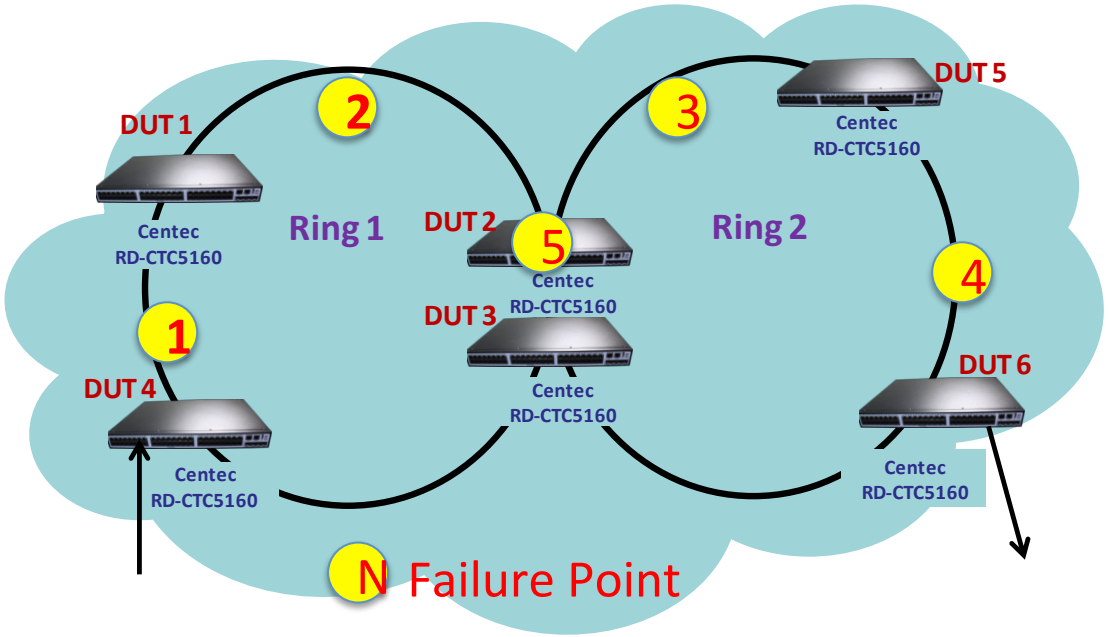
- CMCC have done field trial of more than 100 nodes(from Huawei) networks in Gangdong province, and the result shows:
  - **MSRP can improve the network survivability and provisioning.**
  - **Smooth migration from linear protection to ring protection.**
- Huawei,ZTE,Fiberhome and WH-NEC can support MSRP already



item	Test result（200 Tunnel configuration）
Interconnected Ring switching time	**23ms~37ms**
Migration from linear protection to ring protection	Step1: establish runnel for each node using NMS. Step 2: Move all work tunnel to the ring. Step 3： Delete linear protection tunnel. If using Interconnected ring mechanism. Operation time : **less then 10min**

PTN network topology in the field trail

Silicon support and latest Lab test results



- The test bed is based on Centec's switching chip CTC5160, which has Silicon-Level MSRP Support
- Line-rate test traffic as 352Mbps (500,000pps single tagged packet), 200 LSP instances

Failure Point	Description	Test Result	
		Protection Switch	Recovery
1	Link Failure between DUT1-DUT4	11.3ms	<0.1ms
2	Link Failure between DUT1-DUT2	19.56ms	<0.1ms
3	Link Failure between DUT2-DUT5	9.18ms	<0.1ms
4	Link Failure between DUT5-DUT6	19.28ms	<0.1ms
2&4	Link Failure between DUT1-DUT2 and DUT5-DUT6	20.42ms	<0.1ms
5	Node Failure of DUT2	20.76ms	<0.1ms

Next Step

- MSRP protocol to be added.
- Any enhancement based on the feedbacks from the group