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Title: Requirements and analysis of ring protection for MPLS-TP networks

LIAISON STATEMENT

For action to: IETF MPLS WG

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During the ITU-T SG15 Plenary meeting in September 2012, Geneva, Q9/15 have discussed on the MPLS-TP ring protection, and agreed to work on requirements and to prepare work for the candidate solutions for ITU-T G.8132 "MPLS-TP Shared Protection Ring" recommendation.

The on-going work has produced the following preliminary set of requirements and analyses we would like to have your feedback on.

We would also like to know status of the individual/working group drafts containing MPLS-TP ring protection solutions.

Requirements for ITU-T G.8132

Requirements and optimization criteria for ring protection specified in RFC5654 "MPLS-TP requirements" have to be taken into account.

Further requirements for ITU-T G.8132

Since Requirement 96 in RFC5654 for switching time is based on applying the MPLS-TP 1+1/1:1 linear protection on ring topology, and there is no requirement for shared ring protection switching time in RFC5654, the following new requirement shall be taken into:

[R1] *MPLS-TP protection in a ring MUST support switching time within 50 ms from the moment of fault detection in a network with a 16-node ring with less than 1200 km of fiber.*

It is also proposed to add requirements for supporting network upgrade from the linear protection to ring protection without service interruption, and supporting in-service insertion and removal of a node on the ring. Both of these aspects are considered to be important in MPLS-TP network operations.

[R2] *MPLS-TP ring protection should support network upgrade from the linear protection to ring protection without service interruption.*

[R3] *MPLS-TP ring protection shall accommodate the capability to upgrade the ring (node insertion/removal) without service interruption.*

Technical analysis on some candidate ring protection mechanisms

[T1] The ability of ring protecting against multiple failures is very important to the metro network scenarios of multi-ring interconnected topology (see the figure in Annex 1). According to R106 B in RFC5654, MPLS-TP recovery mechanisms in a ring SHOULD protect against multiple failures. The multiple failure cases such as Scenario 3 and Scenario 4 in Annex 1, the linear protection applied in ring topology (as an example, draft-ietf-mpls-tp-ring-protection-02) could not protect the services, while the shared ring protection could guarantee the survivability of the services.

[T2] According to the optimization criteria for ring protection specified in Section 2.5.6.1 in RFC5654, the MPLS-TP ring protection should be optimized for simplification of the ring operation and the resources consumption around the ring. The analysis of three potential mechanisms (ITU-T G.8132 Draft, IETF solution defined in draft-ietf-mpls-tp-ring-protection-02 and the MSRP solution proposed by China mobile) was given in Annex 2. The proposed solution for ITU-T G.8132 should be evaluated to meet such kind of requirements listed below:

a) Configure less OAM sessions and APS sessions in the ring protection (refer to optimization criteria a in Section 2.5.6.1 in RFC5654);

b) Configure less number of protection LSPs in the ring protection (refer to optimization criteria b in Section 2.5.6.1 in RFC5654);

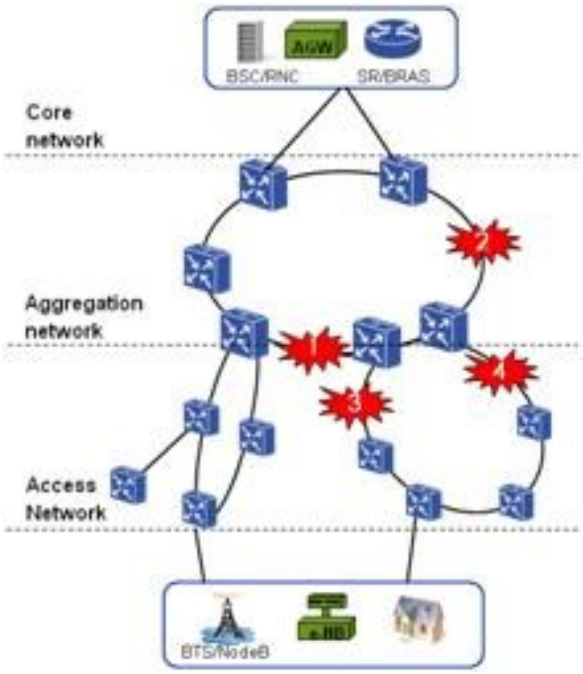
c) Consume less labels in the ring protection (refer to optimization criteria c in Section 2.5.6.1 in RFC5654 2.5.6.1);

d) Reduce the complexity in the configuration and protection switching actions in the ring protection (refer to 1 in Section 4.8 in RFC6372).

We hope the analysis of three potential solutions addressed in Annex 2 could be a starting point for experts in ITU-T and IETF to evaluate whether the proposed solutions comply with all the requirements for ring protection specified in Section 2.5.6.1 in RFC5654. Further efforts on collaborations are appreciated and invited to develop or improve the ring protection solution to fully satisfy the requirements for MPLS-TP ring protection.

Annex 1

The networks usually are constructed with multiple-ring topology as following figure. The access rings and the aggregation rings share the same cable with different fibber cores. The shared cable broken may cause following 4 kinds of multiple failures scenarios in different rings:



Scenario 1 : Failures at point 1 and point 3

Scenario 2 : Failures at point 2 and point 4

Scenario 3 : Failures at point 1 and point 4

Scenario 4 : Failures at point 2 and point 3

The broken points in Scenario 1 and 2 are in the same LSP, so it can be recovered through linear protection. However, in scenario 3 and 4, linear protection is not able to recover the service, while shared ring protection can.

Annex 2

1. Introduction

MPLS-TP based Packet Transport Network (PTN) usually is constructed with multiple-ring topology. Three different MPLS-TP Ring protection solutions are discussed in the contribution. They are ITU-T G.8132 Draft [1], IETF solution defined in draft-ietf-mpls-tp-ring-protection-02 [2] and the MSRP solution proposed by China mobile [3].

The analysis and comparison in the document focus on the point to point path and "wrapping" recovery mechanism which are using in China Mobile PTN network.

2. Discussions

In this contribution we assume that PTN ring has N PTN nodes, and the working LSP goes through M (on average) nodes of N. The ring carries W LSPs totally.

2.1 Analysis on wrapping solution of ITU-T G.8132

- LSP number in the Ring

ITU-T G.8132 wrapping solution is based on LSP. For each working LSP, one closed-loop protection LSP in the opposite direction should be configured. When W LSPs enter the ring, 2W Bidirectional LSP should be configured.

- label number in the Ring

For the nodes working path go through, 4 labels (2 for working LSP, 2 for protection) need to be assigned. For the nodes only protection path go through, 2 labels are assigned. For one LSP, the total labels number is 4M+2(N-M) =2N+2M. When W LSPs enter the Ring, the number will be W*(2N+2M)

- . OAM session number in the Ring

ITU-T G.8132 is using section layer OAM which are running in spans between two adjacent nodes, so that N section OAM sessions are needed.

- Protection switching time

Section layer OAM is using to detect fault. It only requires the two neighbouring nodes to detect the failure event, and then the protection switching can be triggered.

Switching time= Failure detection time (section OAM) + 1 node/prop. delay +Wrap time

- Complexity (Configuration, Protection Switching)

ITU-T G.8132 wrapping solution requires the same amounts of the protection LSPs to the original LSPs. When new LSP added, the new protection LSP should be configured. When the failure is detected, all those protection LSPs should be switched at the same time. It makes the protection switch more complex.

2.2 Analysis on wrapping solution of IETF ring protection mechanism

- LSP number in the Ring

IETF p2p wrapping solution is based on SPME. For link protection, each span need one primary SPME and one secondary SPME; for node protection, each node also needs one primary SPME and one secondary SPME. Totally 4N SPME are needed. The SPME is bidirectional LSP, so 4N Bidirectional LSP needed.

- label number in the Ring

For link protection, the each node on the primary SPME needs 2 labels; each node on the secondary SPME needs 2N labels. Totally (2N+2*2)*N labels are needed. Same with link protection, nodes protection also needs (2N+2*2)*N labels. Totally 2*(2N+2*2)*N are needed.

- OAM session in the Ring

IETF p2p wrapping solution is using LSP layer's OAM, for each LSP one OAM session is running. So totally 4N OAM sessions are needed.

- Protection switching time

When failure occurs, LSP layer OAM need pass n nodes between failure point and MEP to detect the failure. It requires all nodes to be informed of the failure event to trigger protection switching.

Switching time= Failure detection time (LSP layer OAM) + n* node/prop. Delays+ Wrap time

- Complexity (Configuration, Protection Switching)

The method can use the one protection LSP to protect many original LSPs. However, the solution creates the protection SPMEs for link failure and node failure respectively. When failure happens, the nodes which switch the primary SPME to secondary SPME should distinguish whether it is protecting for link or node failure. It is complex.

2.3 Analysis on wrapping solution of MSRP

- LSP number in the Ring

CMCC solution is based on Ring-LSP. For each node, 4 unidirectional Ring LSP (clockwise working LSP, anticlockwise protection LSP, anticlockwise working LSP and clockwise protection LSP) should be created. For N nodes ring, 4N unidirectional LSP needed.

- label number in the Ring

For each unidirectional Ring LSP, N labels are needed, so that totally 4N*N labels are needed.

- OAM session in the Ring

CMCC solution is using section layer OAM. The same with ITU-T G.8132, N section OAM sessions are needed.

- Protection switching time

Section layer OAM is using to detect fault. It only requires the two neighbouring nodes to detect the failure event, and then the protection switching can be triggered.

Switching time= Failure detection time (section OAM) + 1 node/prop. Delay +Wrap time

- Complexity (Configuration, Protection Switching)

The method can use the one protection LSP to protect the entire original LSPs exit from the same node. And when the failure occurs, the shared protecting LSPs are switched. It is simple.

2.4 Comparison

Based on the analysis above, following table shows the capability analysis of the different solutions.

Items	ITU-T G.8132	IETF solution	MSRP
LSP number	**Much more** 2* Protected LSP (Dependent on protected LSP number)	**More** 4*N Bidirectional LSP	**Less** 4*N Unidirectional LSP
Labels number	**Much more** (Dependent on protected LSP number)	**More** (Protected LSP Independent)	**Less** (Protected LSP Independent)
OAM/APS	**Section layer**	**LSP layer**	**Section layer**
OAM sessions	**Less**	**More**	**Less**
Protection time	**Short**	**Long**	**Short**
Complexity (Configuration, Protection Switching)	**More complex**	**Complex**	**Simple**
Upgrade from linear protection	**Easy**	**Hard**	**Easy**

References

[1] “Draft ITU-T Rec. ITU-T G.8132/Y.1382 (T-MPLS shared protection ring) for consent”, ITU-T SG15 meeting, Feb. 2008

[2] Y. Weingarten, S. Bryant, N. Sprecher, D. Ceccarelli, D. Caviglia, F. Fondelli, M. Corsi, B. Wu and X. Dai "Applicability of MPLS-TP Linear Protection for Ring Topologies", draft-ietf-mpls-tp-ring-protection-02, April 2012.

[3] C-2098 “MPLS-TP Shared-Ring protection (MSRP) mechanism for ring topology", ITU-T SG15 meeting, Sep. 2012