IETF 113 Path Computation Element (PCE) WG

Monday, March 21, 2022 (12:00-13:00 UTC)
Tuesday, March 22, 2022 (12:00-13:00 UTC)

Chairs
Julien Meuric (julien.meuric@orange.com)
Dhruv Dhody (dd@dhruvdhody.com)
Secretary
Hariharan Ananthakrishnan (hari@netflix.com)

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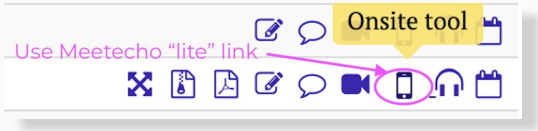

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- See BCP 54!

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    - Longer discussion on mailing list (or jabber)
- Collaborative minutes
  - https://notes.ietf.org/notes-ietf-113-pce

Agenda

PCE Working Group Meeting – Session I

12:00-13:00 UTC Monday March 21 Afternoon session

Introduction

1.1. Administrivia, Agenda Bashing (Chairs, 5 min) [5/60]

1.2. WG Status (Chairs, 10 min) [15/60]

1.3. State of WG I-Ds and next steps (Chairs, 10 min) [25/60]

Stateful

2.1 Local Protection Enforcement (Andrew Stone, 10 mins) [35/60]

draft-ietf-pce-local-protection-enforcement-04

2.2 SR-MPLS Entropy Label Position (Quan Xiong, 10 mins) [45/60]

draft-peng-pce-entropy-label-position-07

2.3 IFIT (Giuseppe Fioccola, 10 mins) [55/60]

draft-chen-pce-pcep-ifit-06

PCE Working Group Meeting – Session II

12:00-13:00 UTC Tuesday March 22 Afternoon session

Segment Routing

3.1 Circuit Style Segment Routing Policies (Christian Schmutzer, 10 mins) [10/60]

draft-schmutzer-pce-cs-sr-policy-01

3.2 Circuit Style Policies Extensions (Samuel Sidor, 10 mins) [20/60]

draft-sidor-pce-circuit-style-pcep-extensions-00

Others

4.1 VLAN-based Traffic Forwarding (, 10 mins) [30/60]

draft-wang-pce-vlan-based-traffic-forwarding-05

4.2 Multicast Tree Setup (Huanan Li, 10 mins) [40/60]

draft-li-pce-multicast-00

4.3 PCECC for BIER (Ran Chen, 10 mins) [50/60]

draft-chen-pce-pcep-extension-pce-controller-bier-03

Thanks!

Circuit-style Segment Routing Policies

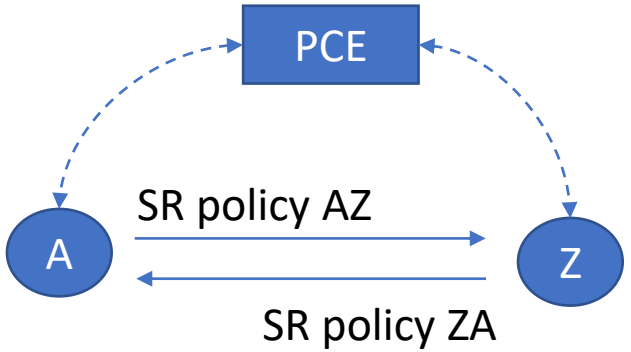
https://datatracker.ietf.org/doc/html/draft-schmutzer-pce-cs-sr-policy

C. Schmutzer – Cisco Systems (cschmutz@cisco.com) – Presenter
C. Filsfils (cfilsfil@cisco.com)
F. Clad (fclad@cisco.com)
Z. Ali – Cisco Systems (zali@cisco.com)
P. Maheshwari – Airtel India (praveen.maheshwari@airtel.com)

Motivation

- Allow a single network to carry both
  - L2/IP/VPN connection-less services
  - Connection-oriented p2p transport services (aka private lines)
- Address the following requirements
  - Persistent traffic engineered paths
  - Strict bandwidth commitment
  - End2end path protection (incl. <50msec) and restoration
  - Path OAM

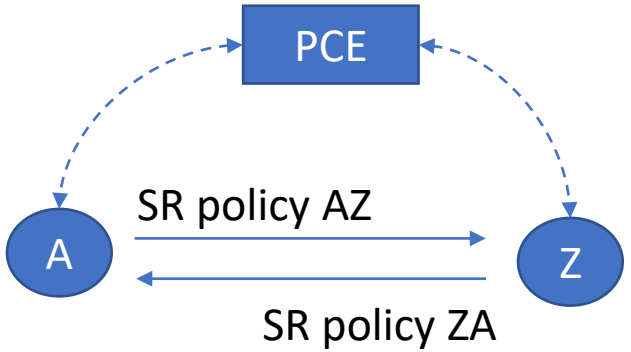
Circuit-style SR Policy Characteristics



- Bandwidth requested and reserved
- Bi-directional, co-routed paths by associating the SR policy from A to Z and Z to A
- Segment lists have strict hops of unprotected adj-SIDs
- No path reoptimization unless manually requested
- Multiple candidate paths for path protection and restoration
- STAMP loopback mode liveness and performance measurement

Circuit-style SR Policy Creation

- Network Topology
  - Unprotected adj-SIDs allocated persistently
    - IGP and BGP-LS extensions for topology info distribution
  - Bandwidth available for CS-SR per link



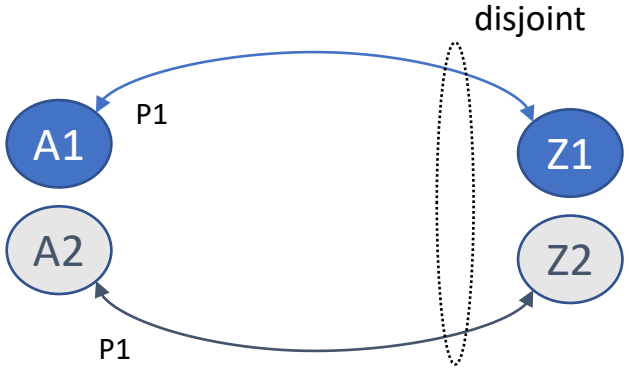
- PCC delegates SR policy candidate path computation to PCE
  - BANDWIDTH object (operational & requested bandwidth)
  - LSPA object (enforce no local protection via L=0 E=1)
  - Bidirectional association (co-routing via C=1) [1)]
  - SR policy association in case of multiple candidate paths [2)]
  - Disjointness association for 1:1 protection [3)]
  - Request strict hops and no-reoptimization [4)]

1) draft-ietf-pce-sr-bidir-path
2) draft-pce-segment-routing-policy-cp
3) RFC8800
4) draft-sidor-pce-circuit-style-pcep-extensions

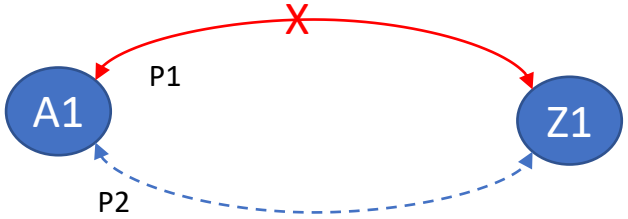
Recovery Schemes

Candidate-path preferences:
P1 > P2 > P3

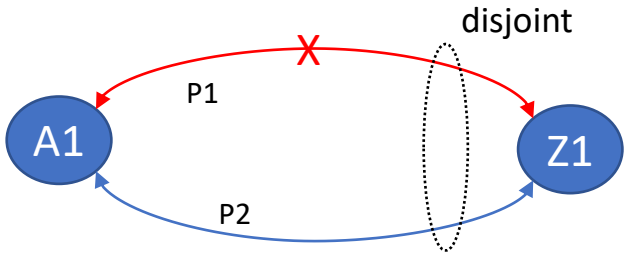
established
established, failed
on-demand



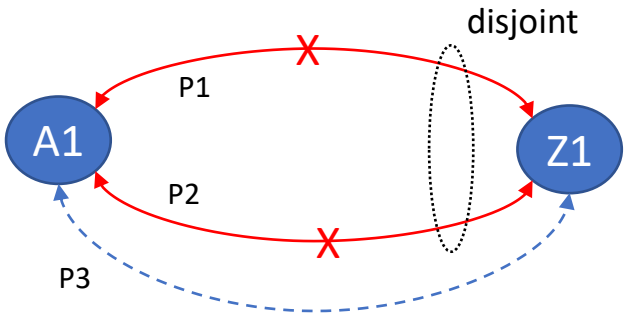
unprotected



1+R restoration



1:1 protection



1:1+R protection

Candidate-path state indication via O flag in LSP object
O=2 active, O=1 up, O=0 down

Next Steps

- Appreciate your comments and discussion

IETF 113 – Online
PCE Working Group

PCEP extensions for Circuit Style Policies

draft-sidor-pce-circuit-style-pcep-extensions

S. Sidor – Cisco Systems (ssidor@cisco.com) – Presenter
Z. Ali – Cisco Systems (zali@cisco.com)
P. Maheshwari – Airtel India (praveen.maheshwari@airtel.com)

Motivation

- Circuit Style Segment-Routing Policy
  - Designed to satisfy requirements for connection-oriented transport services
    - Often delivered using SONET/SDH or OTN networks
  - Details described in draft-schmutzer-pce-cs-sr-policy

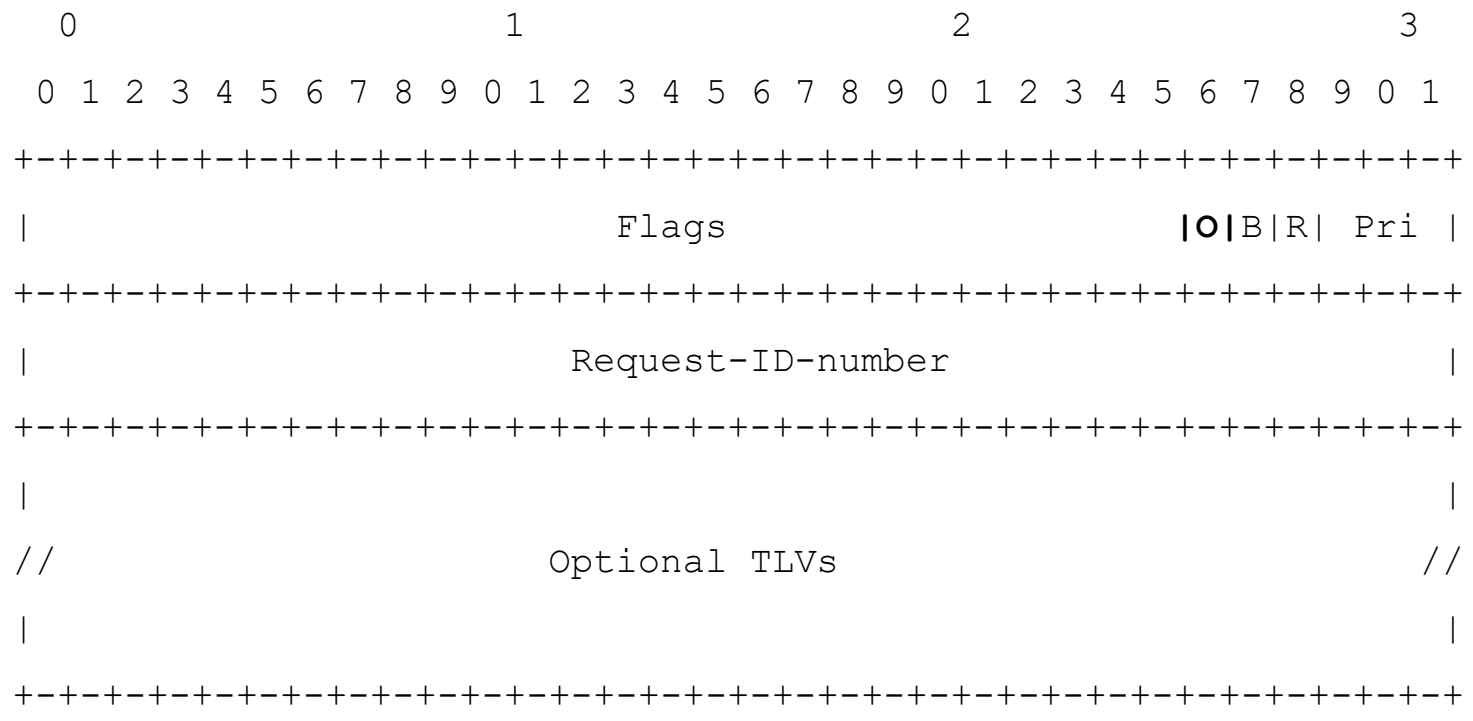
  Requirements covered by new PCEP extensions
  - path persistency
  - hop-by-hop behavior

Draft content summary

- Ability to request path from PCE consisting exclusively of strict hops
  - New flag for Stateful PCEP messages
  - Existing flag for PCReq and PCRep clarified for Segment-routing
    - Strict hop means adjacency SID
- Block re-computation based on specific triggers
  - Topology update
  - Periodic timer

Strict path – Stateless messages

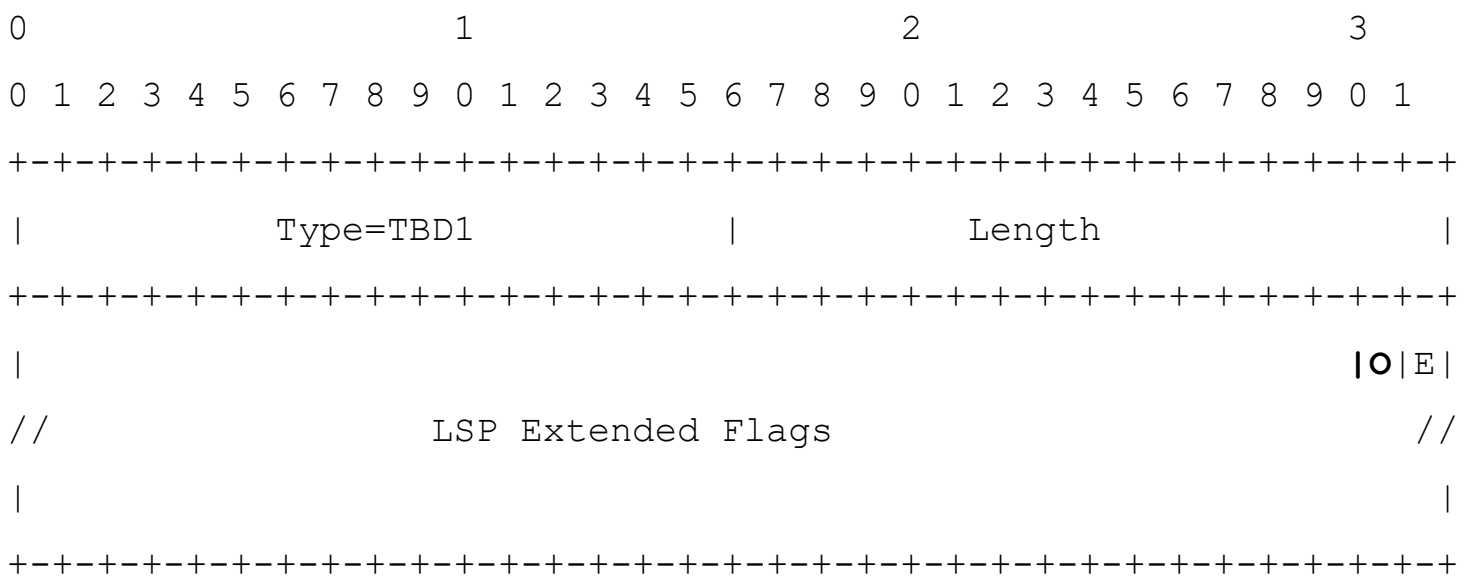
- Existing O flag in RP object clarified for Segment-routing



O (strict/loose - 1 bit) – If strict SR path is requested, then only Adjacency SIDs MUST be used

Strict path – Stateful messages

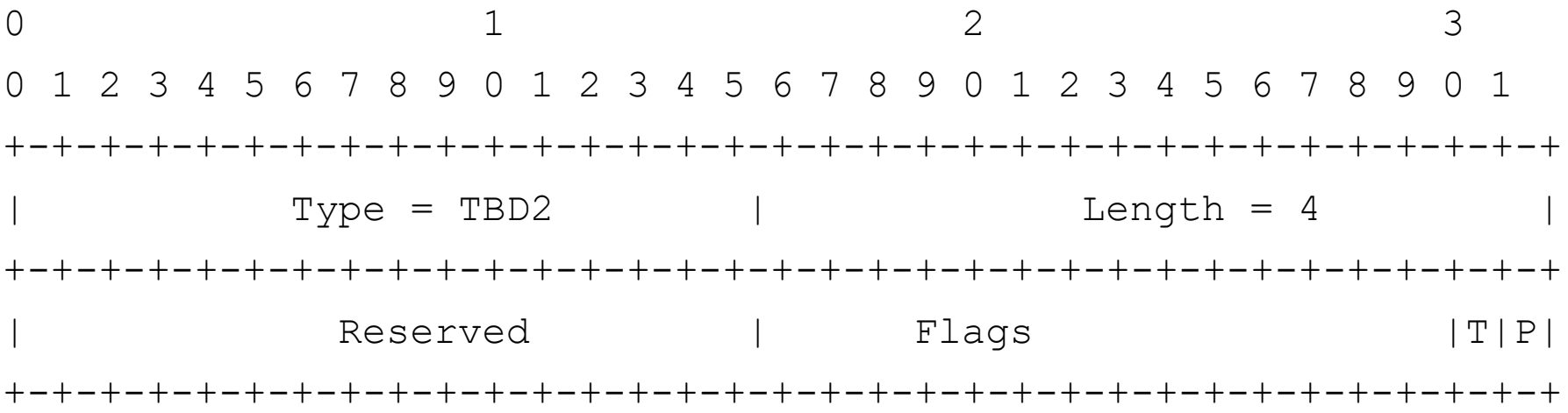
- New flag in LSP-EXTENDED-FLAG TLV in LSP object



- O flag
  - If set, path exclusively made of strict hops is required
  - If cleared, loose path is acceptable

Blocking path computation triggers

- New TLV RECOMPUTATION-TRIGGERS TLV in LSP object



T flag

- If set to 1, the PCE MUST NOT trigger path computation as a result of updated topology information

P flag

- If set to 1, the PCE MUST NOT trigger path computation based on any periodic timer

Next steps

- Comments and discussion are welcome

PCEP Procedures and Extension for VLAN-based Traffic Forwarding

[draft-wang-pce-vlan-based-traffic-forwarding]

Yue Wang (China Telecom)
Aijun Wang (China Telecom)
Fengwei Qin(China Mobile)
Huaimo Chen(Futurewei)
Chun Zhu(ZTE)
IETF 113, Mar. 2022

Motivation

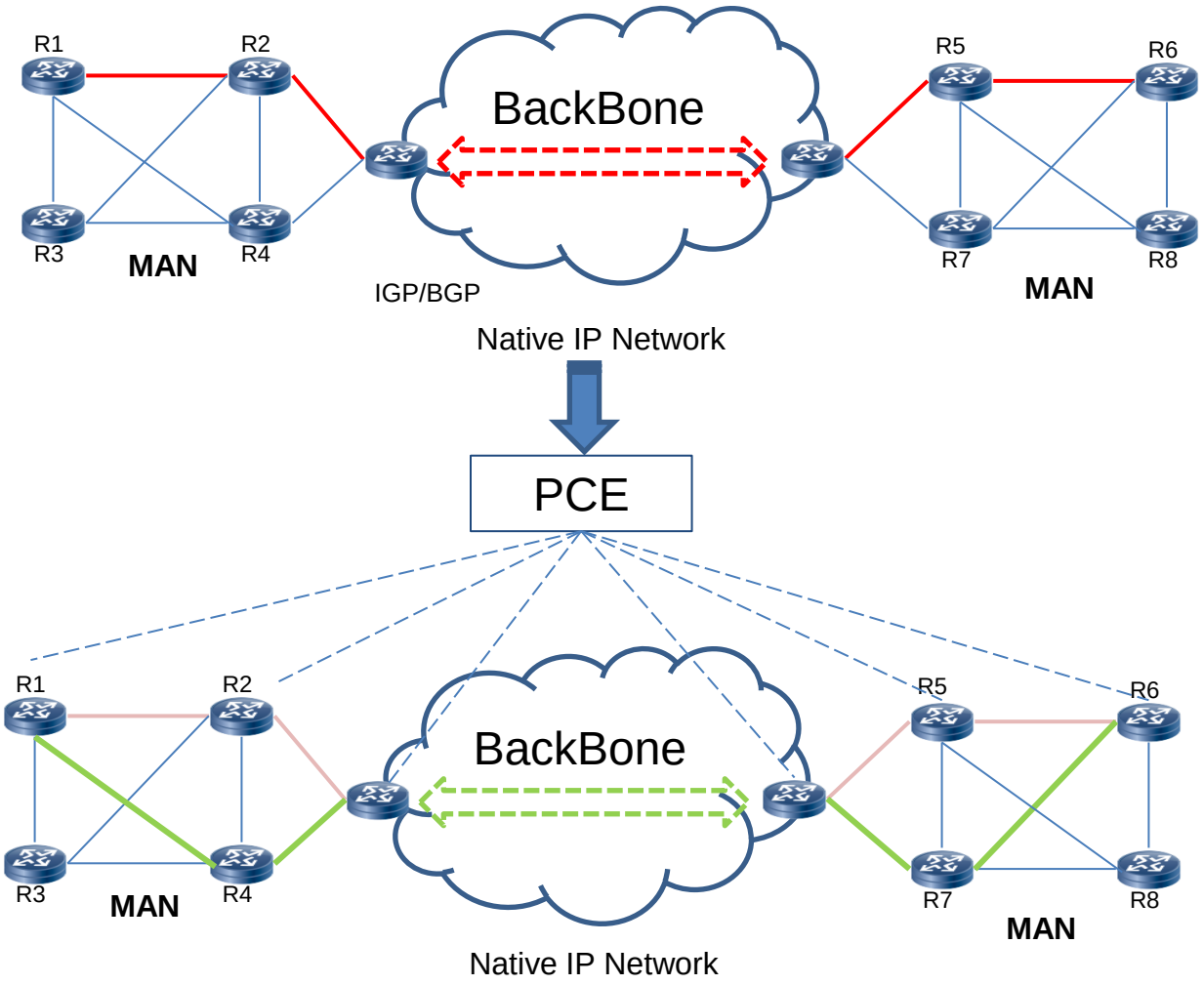
- RFC8821 describes an architecture for providing traffic engineering in a native IP network by using multiple BGP sessions and a PCE-based central control mechanism.

- RFC9050 specifies the procedures and PCEP extensions for PCECC to derive MPLS Label Switched Paths.

- With the large scale deployment of Ethernet interface, it is possible to use the info contained in the Layer2 frame to simplify the E2E packet forwarding procedure.

- Based on the mechanism mentioned in RFC9050 and RFC8821, this document defines PCEP extension for VLAN-based traffic forwarding in native IP network and describes the processes of the data packet forwarding system based on VLAN info.

Intra&inter-domain Scenario

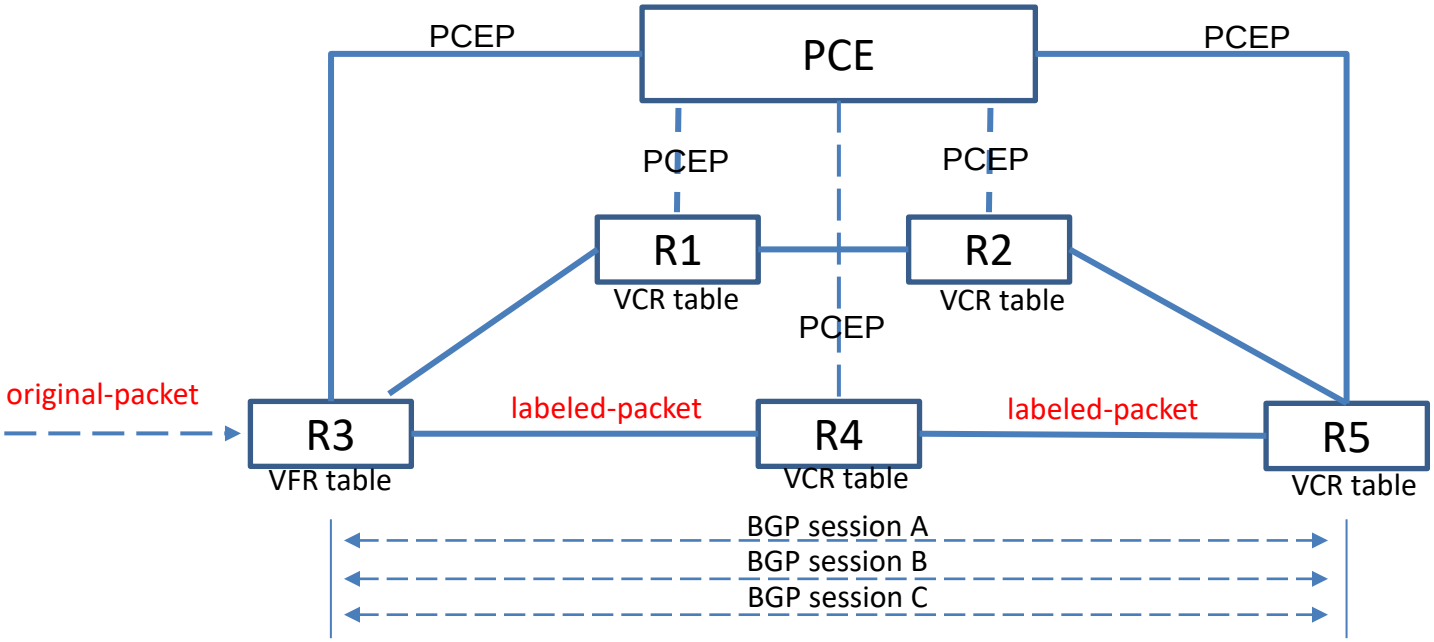


a. Intra-domain or inter-domain traffic guarantee.
b. The controller senses the network status and dynamically adapts to the network status.

Architecture requirements

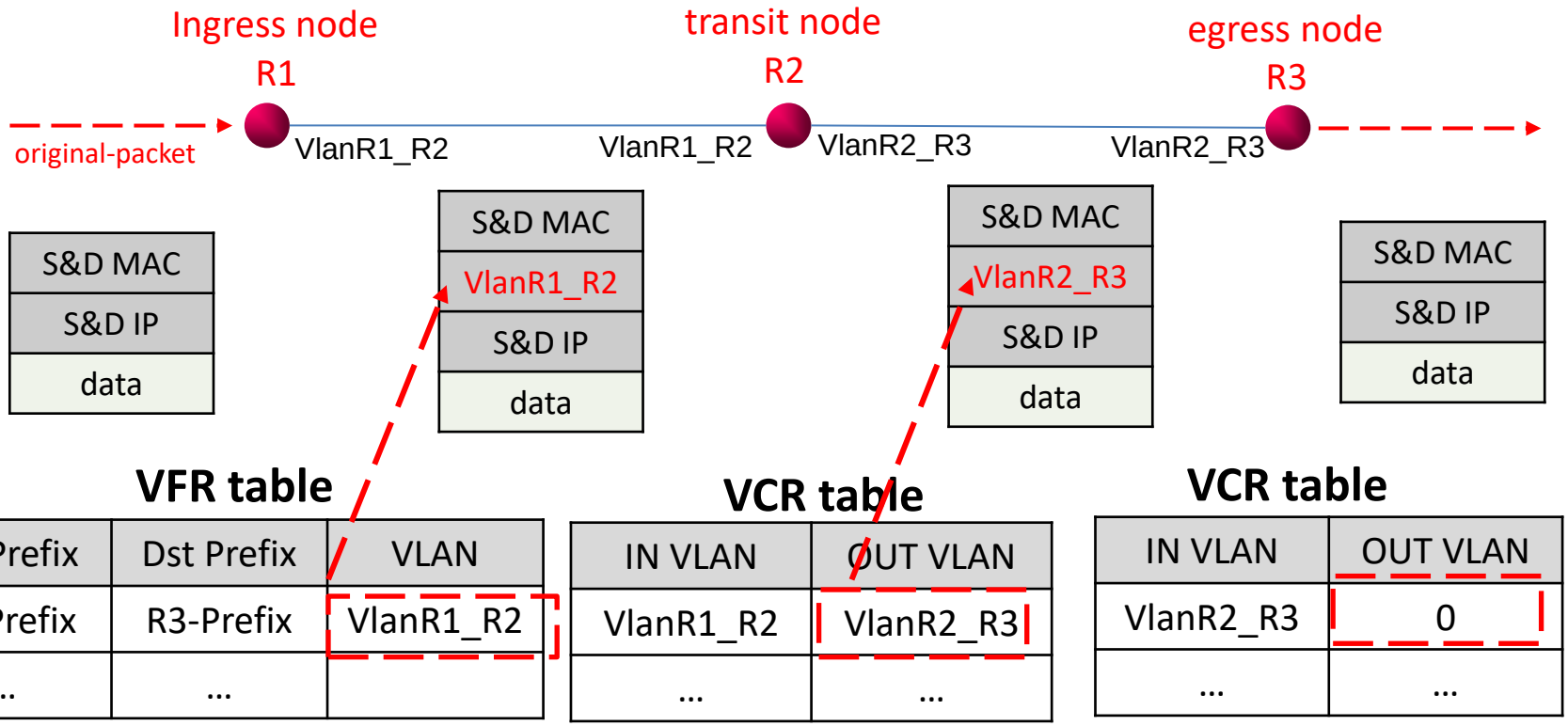
- Same solution for native IPv4 and IPv6 traffic.
- Support for intra-domain and inter-domain scenarios.
- Achieve E2E traffic assurance, with determined QoS behavior, for traffic requiring a service assurance (prioritized traffic).
- Based on centralized control through a distributed network control plane.
- Ability to adjust the optimal path dynamically upon the changes of network status. No need for reserving resources for physical links in advance.

Procedures for VLAN-based Traffic Forwarding



1. The PCE calculates the explict route and sends the route information to the PCCs through PCInitiate messages.
2. The ingress PCC forms a VLAN-Forwarding routing(VFR) table, the transit PCC and the egress PCC forms a VLAN-Crossing routing(VCR) table.
3. The packet to be guaranteed matches the table and then be labeled with corresponding VLAN tag.
4. The labeled packet will be further sent to the PCC's specific subinterface identified by the VLAN tag and then be forwarded.

Data Packet Encapsulation Process



- Use a completely new address space to bypass the already used MPLS label space, which will not conflict with other existing protocols and avoid considering the label overlap of the already used MPLS services in the MPLS-Native IP-Mixed environment.
- Is suitable for ipv4 and ipv6 networks and can leverage the existing PCE technologies as much as possible.
- Avoid SRH Overhead problem.

Updated Contents

Table 2: VLAN-Forwarding routing table

Dst IP Address	Interface	VLAN
Prefixes from R6 Session1	INF 1	VLAN_R1_R2
Prefixes from R6 SessionX	INF X	X
...		

VLAN-Forwarding routing (ingress PCC) is used to match the packet to be guaranteed based on the source and destination BGP prefix.

Table 4: VLAN-Crossing routing table

IN-Interface	IN-VLAN	OUT-Interface	OUT-VLAN
INF1	VLAN_R1_R2	INF2	VLAN_R2_R3
INF3	X	INF4	Y
INF5	Z	INF6	0
...			

Through the mapping of the in-VLAN and the out VLAN in the VLAN-Crossing routing table (transit PCC and egress PCC) , the data packet to be guaranteed will be transferred to the specific interface.

Updated Contents

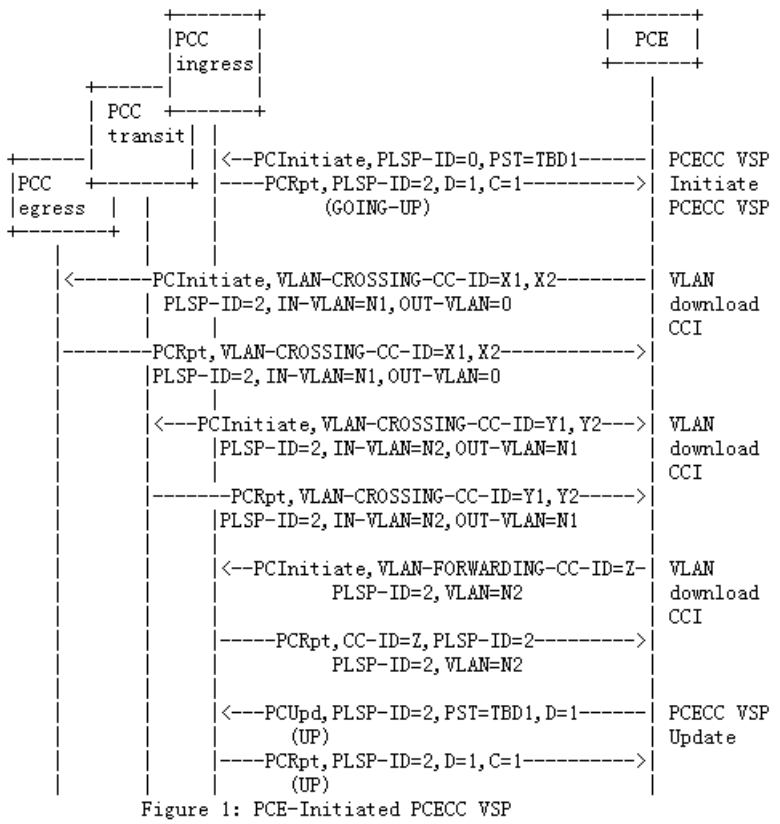


Figure 1: PCE-Initiated PCECC VSP

Adding VLAN Switching Path sequence diagram

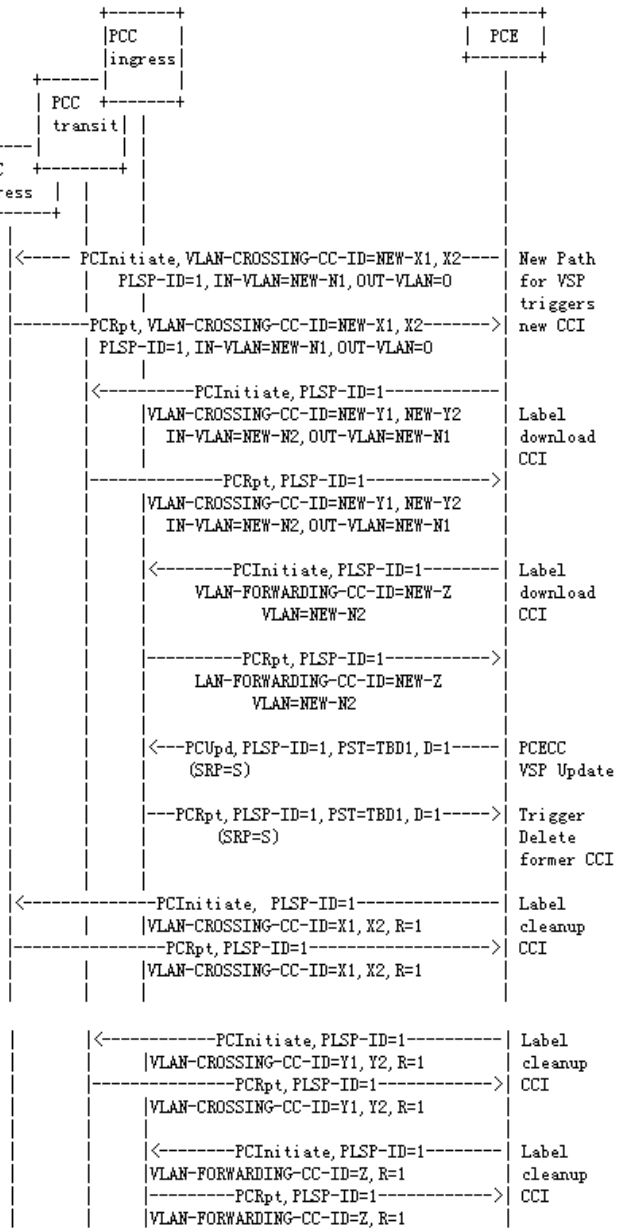


Figure 2: PCECC VSP Update

Next Step

- More solutions & comments are welcome.

wangy73@chinatelecom.cn
wangaj3@chinatelecom.cn
qinfengwei@chinamobile.com
Huaimo.chen@futurewei.com
zhu.chun1@zte.com.cn

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Multicast Tree Setup via PCEP

[draft-li-pce-multicast]

Huanan Li (China Telecom)

Aijun Wang (China Telecom)

Zhaohui Zhang (Juniper Networks)

Huaimo Chen (Futurewei)

Ran Chen (ZTE Corporation)

IETF 113, March. 2022

Motivation

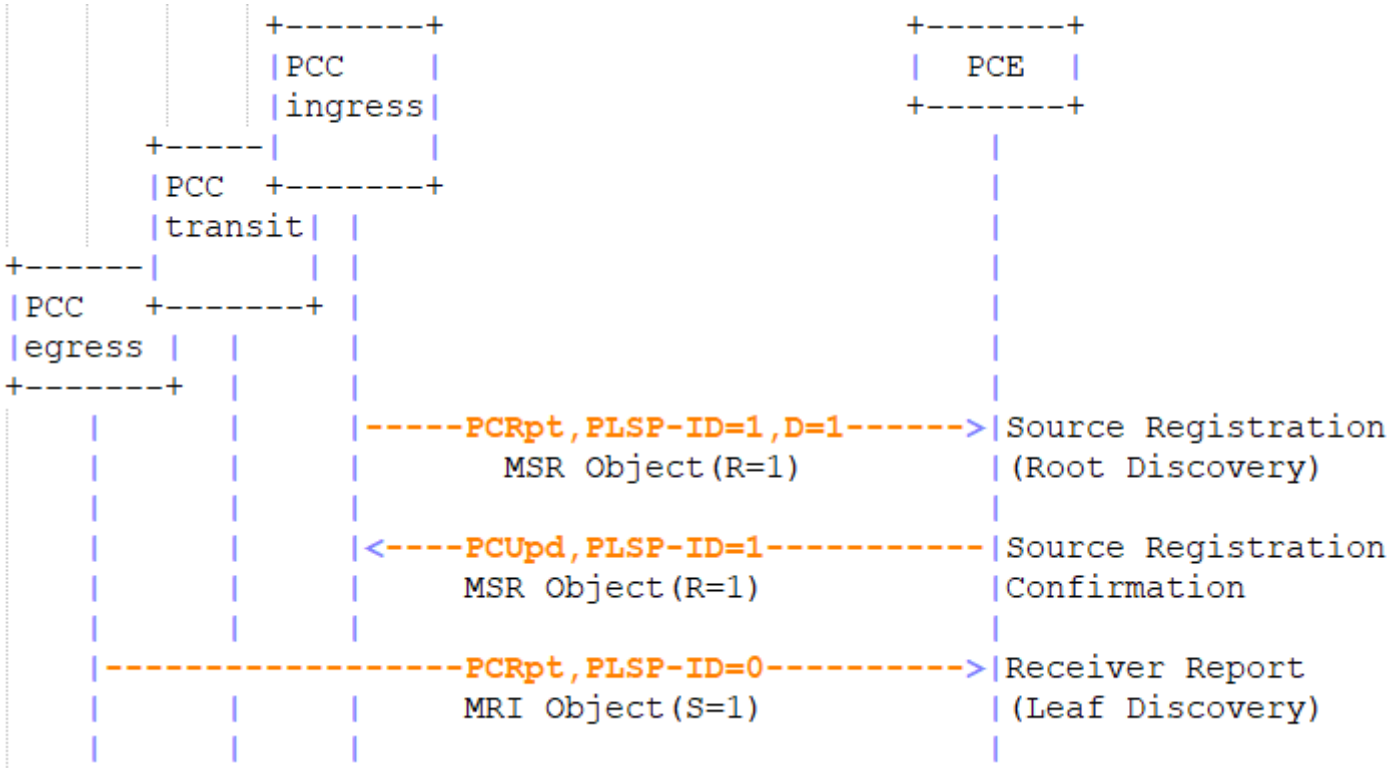
A draft of multicast tree management based on PCE:

- **Covering multiple multicast trees** (IP, mLDP, SR-P2MP)

Our consideration of the Procedures:

- **Multicast Tree Information Discovery**: collect relevant information of root and leaf nodes to calculate multicast tree.
- **Multicast Tree State Setup/Update**: association between multicast tree and P2MP path under different forwarding technologies (mLDP, SR-P2MP, BIER).
- **Multicast Statistics Synchronization**: Synchronize multicast statistics between egress and PCE and between PCE and ingress for multicast service analysis and business development.

Multicast Tree Information Discovery



- **Procedures**
  - **Root Discovery**：PCC report**.** Carrying **Tree Identifier** and **VPN information TLV**
  - **Leaf Discovery**：PCC report. Carrying **Tree Identifier** and **VPN information TLV**, and selectively carries **BFR information TLV** of egresses in BIER scenario
- **Tree Identifier**：
  - IP multicast: **Multicast Address TLV**, i.e. (s,g)/(*,g) tuple
  - mLDP multicast: **mLDP FEC TLV** for mLDP multicast
  - SR-P2MP multicast: (Root, Tree-ID) tuple, defined in I-D.ietf-pce-sr-p2mp-policy

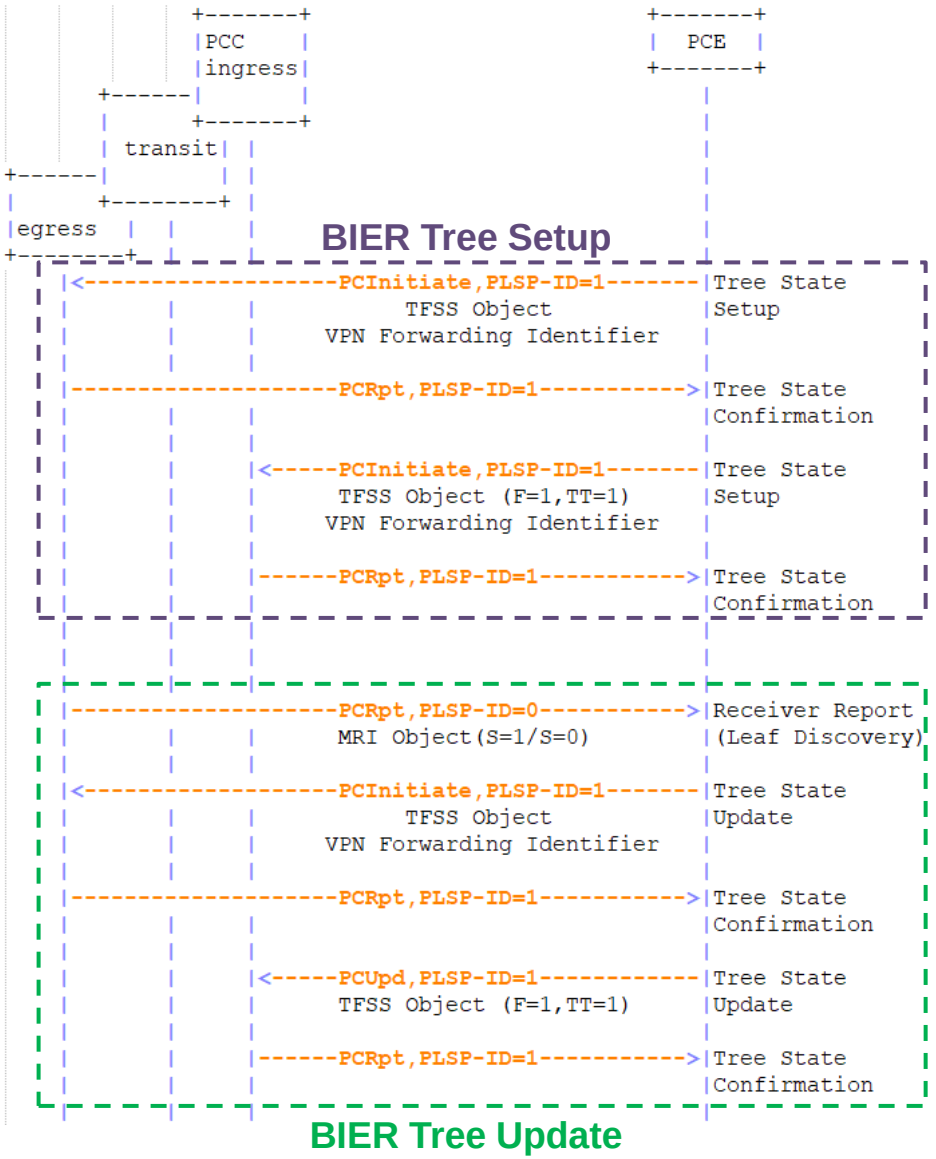
Multicast Tree State Setup/Update (Labeled Tree)

- Procedures are as per I-D.ietf-pce-sr-p2mp-policy. Follow the label download process

- **Newly defined TLVs:**
  - **Tree Label:** Identifying a multicast tree at the forwarding level
  - **VPN Forwarding Identifier:** determine which VRF to forward the packet to for egresses

- **Extension to Objects:**
  - **CCI Object**: Tree Label TLV, VPN Forwarding Identifier TLV
  - **LSP Object**: Multicast Address TLV or mLDP FEC TLV (associate multicast tree and p2mp path)

Multicast Tree State Setup/Update (BIER Tree)

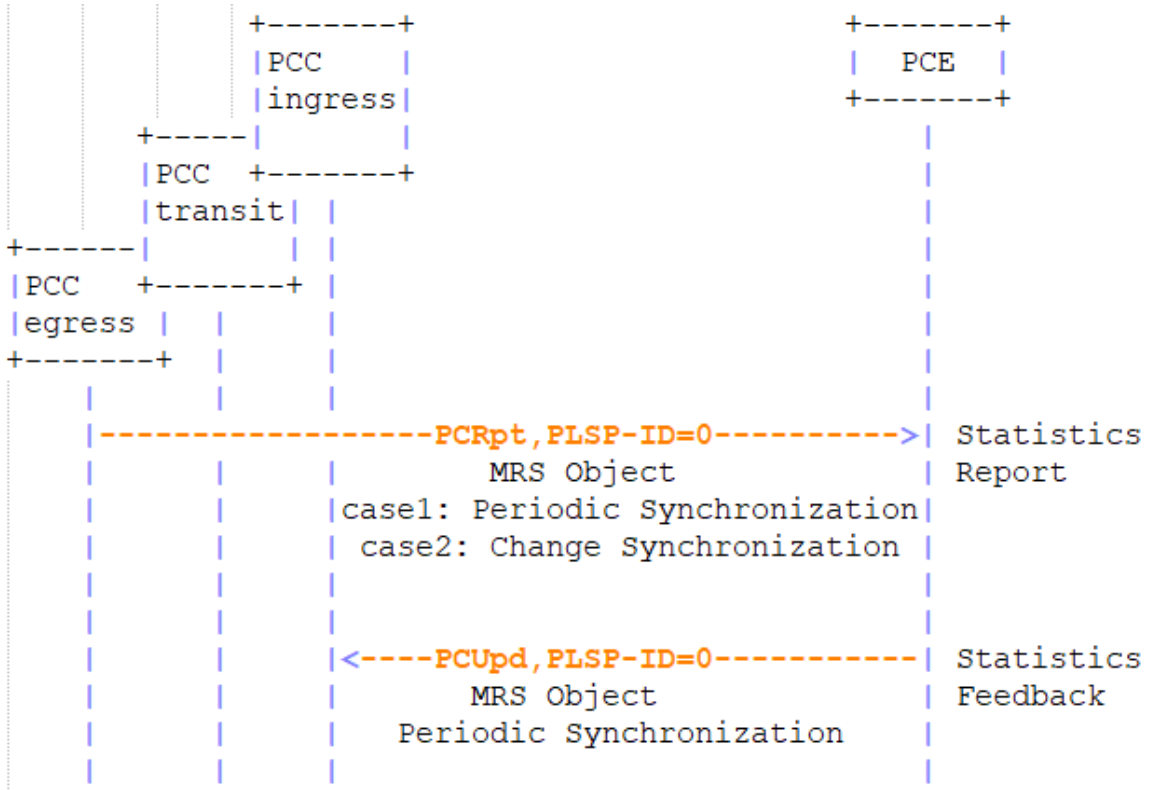


- **Procedures**:
  1. PCE combine BFR info of egresses
  2. PCE sends VPN Forwarding Identifier to egresses
  3. PCE sends BitString and VPN Forwarding Identifier to ingress

- **Newly defined Object and TLV:**
  - TFSS Object for Tree state management
  - BIER Attribute TLV (BitString)

- **Extension to Object:**
  - **LSP Object**: Multicast Address TLV (associate multicast tree and BitString)

Multicast Statistics Synchronization



- **Egresses syncs to PCE**: multicast statistics is the number of listeners or next-hop devices connected directly to egress.
- **PCE syncs to ingress** : overall of all egresses multicast statistics

Further Action

- comments are welcome.

lihn6@chinatelecom.cn
wangaj3@chinatelecom.cn
zzhang@juniper.net
Huaimo.chen@futurewei.com
chen.ran@zte.com.cn
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PCEP Procedures and Protocol Extensions for Using PCE as a PCECC of BIER

draft-chen-pce-pcep-extension-pce-controller-bier-03

Ran Chen, Chun Zhu, Bencong Xu(ZTE)

Huaimo Chen (futurewei)

Aijun Wang (China Telecom)

PCE WG IETF-113 Meeting, March 2022

Introduction

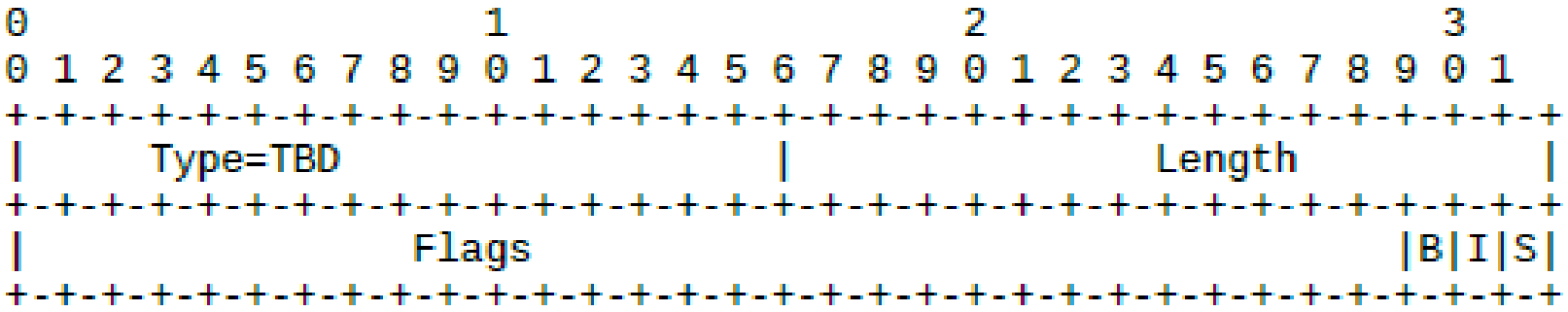
- This draft specify a new mechanism where PCE allocates the BIER information centrally and uses PCEP to distribute them to all nodes, then PCC generate a "Bit Index Forwarding Table"(BIFT).
- There are two ways to generate a "Bit Index Forwarding Table"(BIFT):
  - The PCECC allocate BIER parameters carried by CCI object, BIER Encapsulation TLV and FEC Object to the PCC. On receiving the BIER informations allocation, each node (PCC) uses IGP protocol to distribute BIER related information to other nodes. The node calculate the nexthop. In this case, Each node (PCC) only needs to be allocated its own BIER informations by the PCECC.
  - In scenarios where the IGP protocol is not used/available, Each node (PCC) is allocated its own and neighbor BIER informations by the PCECC, then PCC generates a BIFT based on the informations it receives.

Extensions

- BIER Capability Advertisement.
  - Defines a new Path Setup Type (PST) for BIER.
  - Adds B-bit in PCECC-CAPABILITY sub-TLV to exchange BIER capability.
- The SRP Object
  - Defines a new Path Setup Type (PST=TBD2) for BIER-TE.
- CCI Object
  - Defines a new CCI object-type for BIER
  - Defines/Reuses two optional TLV
    - Defines BIER Encapsulation Sub TLV to carry the BIER Encapsulation information.
    - Reuses ADDRESS TLV to carry the BFR outinterface and nexthop informations.
- FEC Object
  - Reuses FEC Object 1'IPv4 Node ID' and FEC Object-Type 2 'IPv6 Node ID‘ defined in [RFC8664] to carry the BFR prefix.

PCECC Capability sub-TLV

- [RFC9050] defined the PCECC-CAPABILITY TLV. A new B-bit is defined in PCECC-CAPABILITY sub-TLV for PCECC-BIER:



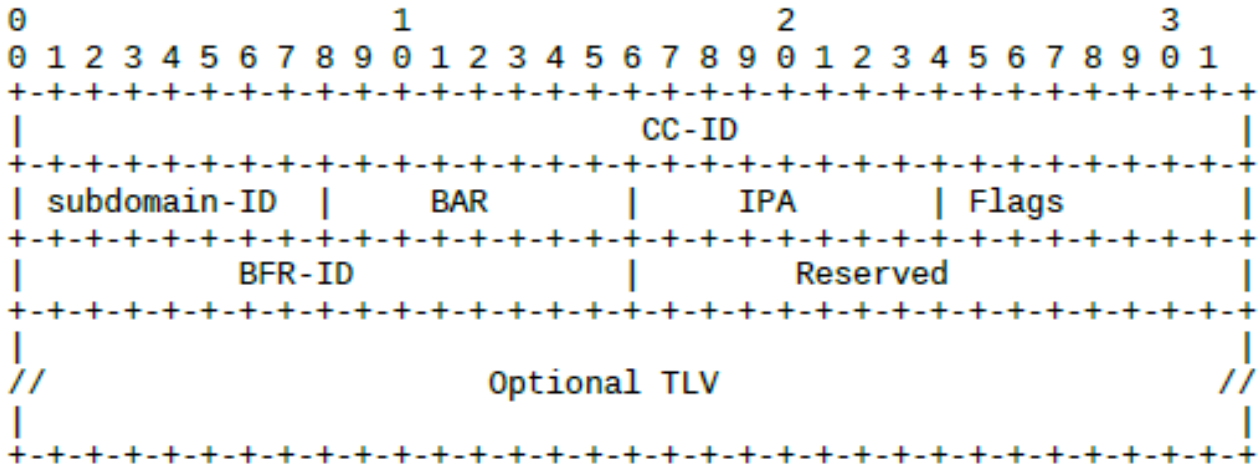
- B (PCECC-BIER-CAPABILITY - 1 bit): If set to 1 by a PCEP speaker, it indicates that the PCEP speaker is capable for PCECC-BIER capability and PCE would allocate BIER information on this session.

PATH-SETUP-TYPE TLV

- The PATH-SETUP-TYPE TLV is defined in [RFC8408]. PST = TBD is used when Path is setup via PCECC BIER mode. On a PCRpt/PCUpd/PCInitiate message, the PST=TBD indicates that this path was setup via a PCECCBIER based mechanism where either the BIER informations and BIER forwarding entries were allocated/instructed by PCE via PCECC mechanism.

CCI object

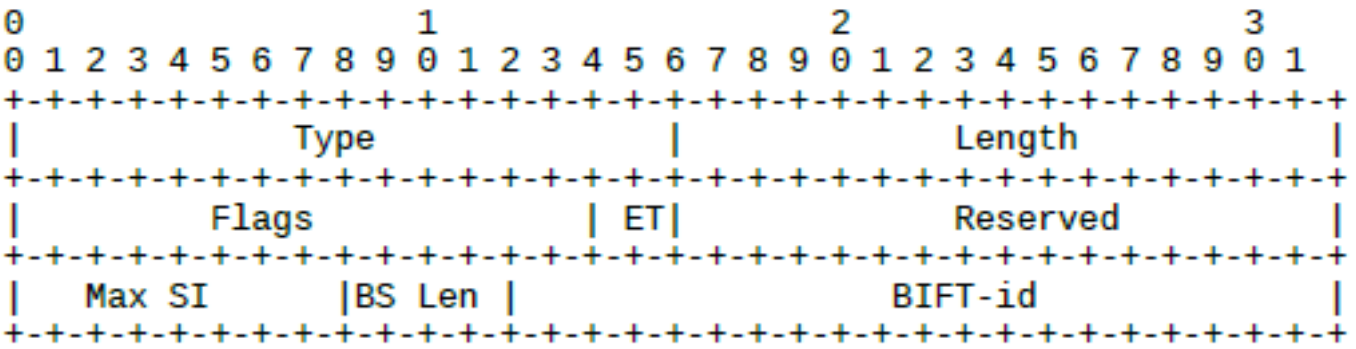
- Defines another object-type for BIER purpose.



- BIER subdomain-ID: Unique value identifying the BIER subdomain. (as defined in [RFC8401].
- BAR(BIER Algorithm) and IPA(IGP Algorithm), as documented in [RFC8401].
- BFR-ID: A 2-octet field encoding the BFR-id, as documented in [RFC8279].
- Optional TLV: There are two optional TLV are defined/reused in this draft.

Optional TLV

- BIER Encapsulation Sub TLV:



  - ET-Flag: Encapsulation type Flag, There are two Encapsulation Types:

    * 0b00-MPLS encapsulation.

    * 0b01-Non-MPLS encapsulation.
  - Max SI: A 1 octet field encoding the Maximum Set Identifier(Section 1 of [RFC8279]) used in the encapsulation for this BIER subdomain for this BitString length.
  - Local BitString Length (BS Len): Encoded BitString length as per [RFC8296].
  - BIFT-id: A 20 bit field encoding the first BIFT-id of the BIFT-id range.

Optional TLV (Cont.)

- Address TLVs
  - Address TLVs described in [RFC9050] are used to associate the nexthop information, so we Reuse ADDRESS TLV to carry the BFR outinterface and nexthop informations.

FEC Object

- BIER information is always associated with a host prefix, so we reuse FEC Object 1'IPv4 Node ID' and FEC Object-Type 2 'IPv6 Node ID‘ defined in [RFC8664] to carry the BFR prefix.

Next Steps

- Comments welcome.

Thanks!