IETF 111 Path Computation Element (PCE) WG

Monday, July 26, 2021 (21:30-22:30 UTC)

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Administrivia

- Minute taker(s), jabber scribe(s)
- Meetecho Etiquette
  - Join the queue if you would like to speak/present
    - Do not send audio directly
  - Please state your name before speaking
  - Be mindful of the agenda time
    - Longer discussion on mailing list (or jabber)
- Collaborative minutes
  - https://codimd.ietf.org/notes-ietf-111-pce?both

Usual Reminders

- Please use the mailing list actively!
- Please be more vocal during WG business (WGLC, adoption, etc)!
- Use the WG wiki to track progress - https://trac.ietf.org/trac/pce/wiki/WikiStart
- Request for early code point allocation when you are planning to interop!

Agenda Bashing

Monday, July 26, 2021 14:30-15:30 PST

Introduction
1.1 Administrivia, Agenda Bashing (chairs, 5 min)
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 Native IP (Aijun, 10 min) [35/60]
draft-ietf-pce-pcep-extension-native-ip-14
2.2 IFIT (Giuseppe, 5 min) [40/60]
draft-chen-pce-pcep-ifit-04
2.3 New TE Constraints (Quan, 5 min) [45/60]
draft-peng-pce-te-constraints-06

New I-Ds
3.1 RSVP Color (Balaji, 5 min) [50/60]
draft-rajagopalan-pcep-rsvp-color-01
3.2 VLAN-based Native IP (Yue Wang, 5 min) [55/60]
draft-wang-pce-vlan-based-traffic-forwarding-00

Thursday, July 29, 2021 12:00-13:00 PST (19:00-20:00 UTC)

Segment Routing (SR)
4.1 Algorithm in SID (Samuel, 10 min)
draft-tokar-pce-sid-algo-04
4.2 Entropy Label Position (Quan, 10 min) [20/60]
draft-peng-pce-entropy-label-position-06

Multicast
5.1 SR P2MP Policy (Hooman, 10 min) [30/60]
draft-hsd-pce-sr-p2mp-policy-03
5.2 BIER-TE (Ran, 5 min) [35/60]
draft-chen-pce-bier-09
5.3 PCE based BIER (Huanan, 10 min) [45/60]
draft-li-pce-based-bier-01
5.4 BIER-TE Ingress Protection (Huaimo, 10 min) [55/60]
draft-chen-pce-bier-te-ingress-protect-00

WG Status

Beyond the WG

- 3 new RFCs since IETF 110
  - RFC 9059 - Bi-Dir
  - RFC 9050 - PCECC
  - RFC 9005 - Policy Association
- RFC Editor Queue
  - draft-ietf-pce-pcep-flowspec
    - MISREF on IDR's L2VPN flowspec since Nov 2020
    - IDR WG moving L2VPN for Flowspec V2
    - Strip the L2VPN from this I-D?
- With the AD
  - draft-ietf-pce-binding-label-sid
    - Changes made during WGLC and Shepherd review

In the WG's Hands

- Errata
  - RFC 5088 - Editorial (Verified)
  - RFC 8231 - Technical (Reported)
    - Order of LSP and CLASSTYPE object in PCReq message
    - Hold for document update?
- Early IANA codepoint allocation
  - draft-ietf-pce-local-protection-enforcement
    - Expires 2022-01-28
  - draft-ietf-pce-segment-routing-policy-cp
    - Expires 2022-03-30
  - draft-ietf-pce-binding-label-sid
    - Expires 2022-03-29

Status of WG I-Ds & Next Steps

WG documents “nearing” WG LC

draft-ietf-pce-pcep-stateful-pce-gmpls

- -15 posted on 2021-06-24
- Reorganization done by authors after the merge of 2 I-Ds
- Ready for WG-LC

draft-ietf-pce-enhanced-errors

- -09 posted on 2021-02-17
- Is there still interest in this work?
  - Feedback requested on the mailing list
    - Only 1 author responded!
- Options: Progress this work as experimental or mark it as waiting for implementation

WG documents “nearing” WG LC

draft-ietf-pce-pcep-yang

- -16 posted on 2021-02-22
- Pending: Comments from Tom Petch, update coming SOON!
- Very early YANG Doctor review was done
  - ready for another one?
- WGLC next!

WG I-Ds

draft-ietf-pce-pcep-extension-native-ip

- -14 posted on 2021-06-07
- On Agenda
- Feedback requested from IDR

draft-ietf-pce-flexible-grid

- -05 posted on 2021-02-22
- No change since a long time!
- Is this ready?

WG I-Ds

draft-ietf-pce-segment-routing-ipv6

- -09 posted on 2021-05-28
- Added Manageability Consideration
- Added Implementation Status
- Is this ready?

draft-ietf-pce-vn-association

- -04 posted on 2021-04-16
- A refresh
- Is this ready?

WG I-Ds

draft-ietf-pce-sr-path-segment

- No update

draft-ietf-pce-sr-bidir-path

- -07 posted on 2021-07-12
- Sync with RFC 9059
- Nearing WG LC?

WG I-Ds

draft-ietf-pce-segment-routing-policy-cp

- -05 posted on 2021-05-23
- Early allocation done
- Pending - need to add the 2 flags from the earlier version of SR BSID related to SR policy in this document

draft-ietf-pce-local-protection-enforcement

- No update

WG I-Ds

draft-ietf-pce-pcep-extension-pce-controller-sr

- -02 posted on 2021-03-25
- Aligned to the published RFC 9050

draft-ietf-pce-stateful-interdomain

- -02 posted on 2021-07-12
- Reusing TE-PATH-BINDING TLV

draft-ietf-pce-lsp-extended-flags-00

- No update
- Comments receiving during adoption call are pending

Recent WG I-Ds

draft-ietf-pce-multipath

- Adopted on 2021-05-03

draft-ietf-pce-state-sync

- Adopted on 2021-06-28

WG Adoption Poll Queue

- draft-dhody-pce-stateful-pce-optional
- draft-li-pce-controlled-id-space
- …
- Refer to wiki: https://trac.ietf.org/trac/pce/wiki/WikiStart#WGAdoptionCallQueue

Thanks!

Updates for PCEP Extension for Native IP Network

draft-ietf-pce-pcep-extension-native-ip-14

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B. Khasanov (Yandex)
Sheng Fang (Huawei Technologies)
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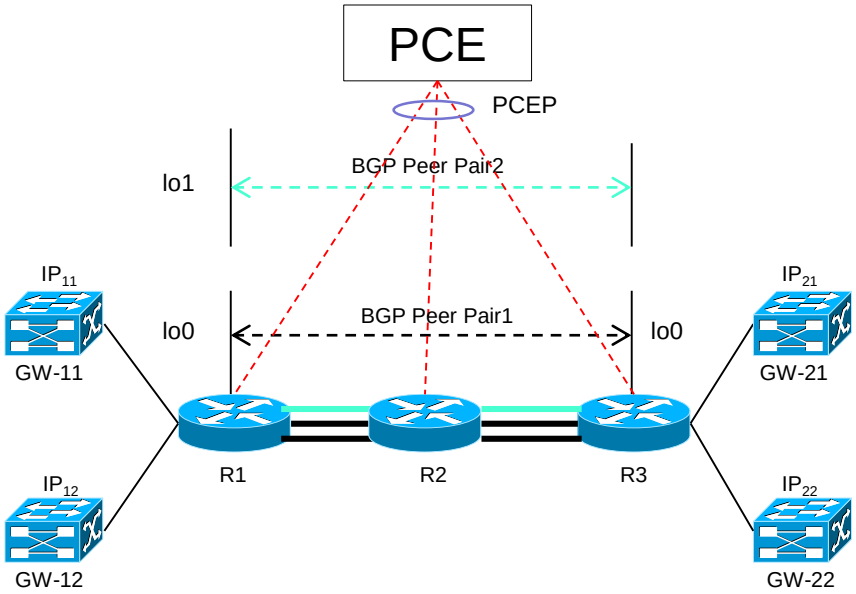
Chun Zhun(ZTE Corporation)

IETF-111, July 2021

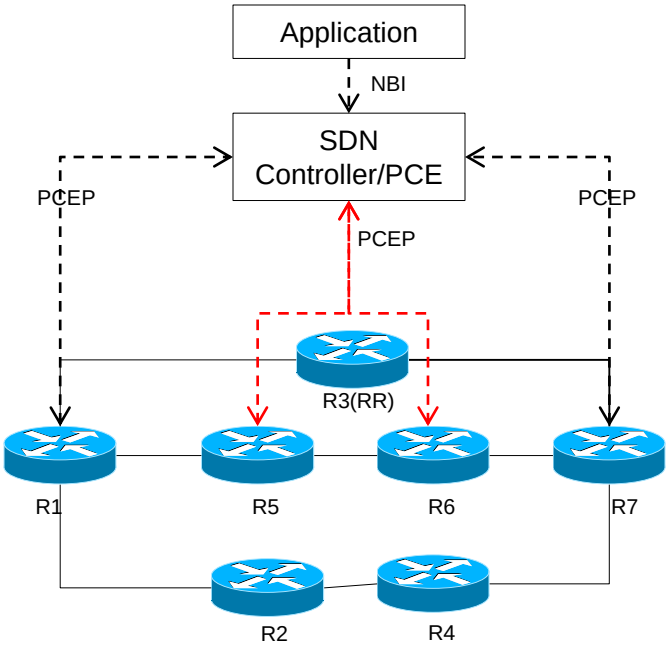
Motivation

- Introduce the updates for “PCEP extension for Native IP Network”
- Seek feedbacks for the overall updated solution
- Ready for WG Last Call

Overview of the Solution



Dual/Multi-BGP Solution

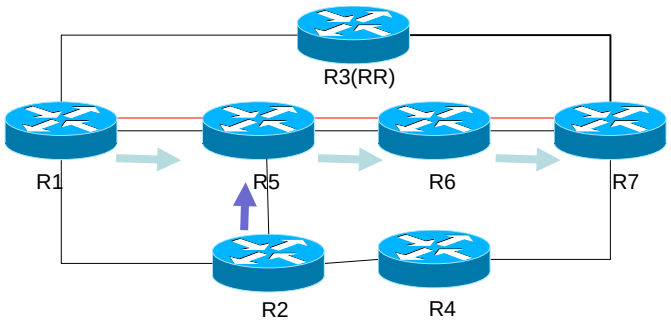


Simplified CCDR* Architecture in a Large Network

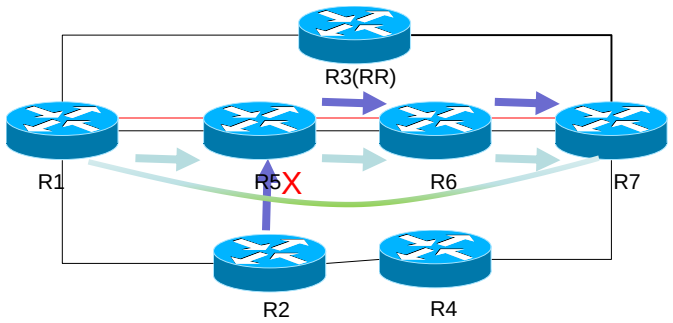
- Building Dual/Multi BGP sessions between edge routers upon request via PCEP
- Advertises different prefixes via different BGP sessions, w/PCEP-based setup
- Steer traffic towards particular routes via BGP next-hop w/PCEP-based setup
- Detail explanation can be referred at /meeting/110/materials/slides-110-pce-31-native-ip-01

CCDR* - Centralized Control Dynamic Routing, RFC 8735

Updates Considerations



Native Traffic Forwarding



Tunneled Traffic Forwarding

- ✓ Destination of user traffic based
- ✓ Traffic from different sources to the same destination may share the priority path
- ✓ Moderate traffic path control

- ✓ Destination of tunnel based
- ✓ Traffic for different (source, address) tuple are put into different tunnel
- ✓ Strict traffic path control

Updates Contents

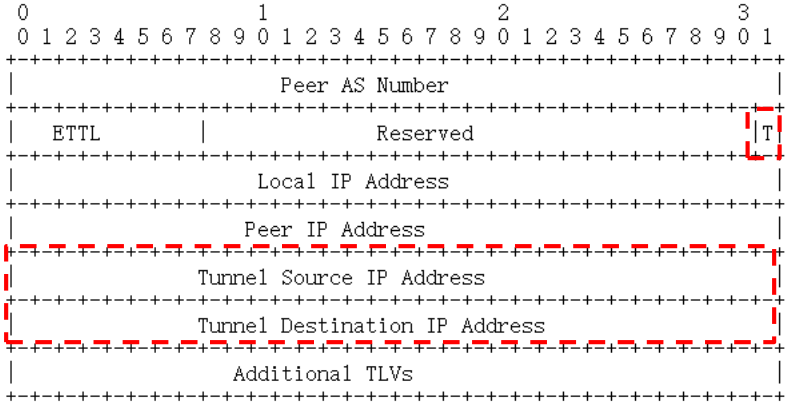


Figure 6: BGP Peer Info Object Body Format for IPv4

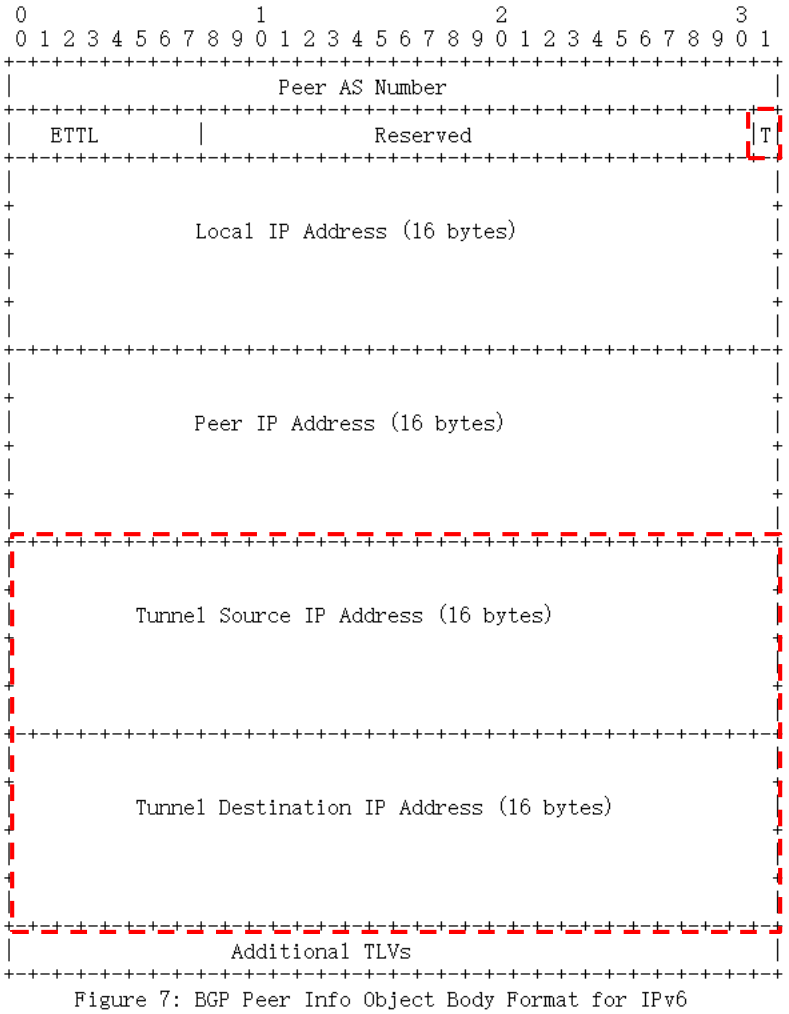


Figure 7: BGP Peer Info Object Body Format for IPv6

- ✓ Flag “T” bit indicates whether the field “Tunnel Address” are presence or not.
  - T=1, “Tunnel Address” field is presence
  - T=0, “Tunnel Address” field is not presence

Updates Contents

- ✓ Flag “T” bit in BPI(BGP Peer Info Object)indicates whether the field “Next Hop Address” in EPR(Explicit Peer Route Object) Object are for “Peer Address” or “Tunnel Destination Address”:
  - T=1, “Next Hop Address” field is for Tunnel Destination Address
  - T=0, “Next Hop Address” field is for Peer Address
- ✓ From the POV of PCC, there is no difference between these two addresses. The actions based on this Object are same.

The format of Explicit Peer Route object body for IPv4(Object-Type=1) is as follows:

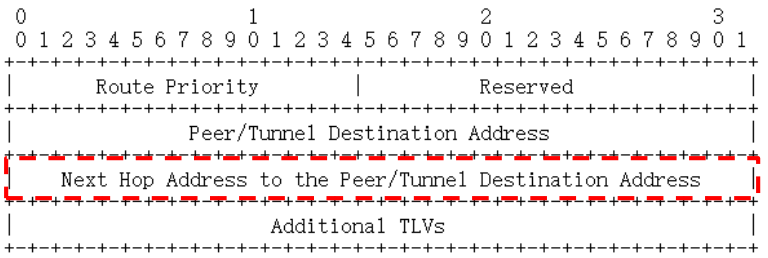


Figure 8: Explicit Peer Route Object Body Format for IPv4

The format of Explicit Peer Route object body for IPv6(Object-Type=2) is as follows:

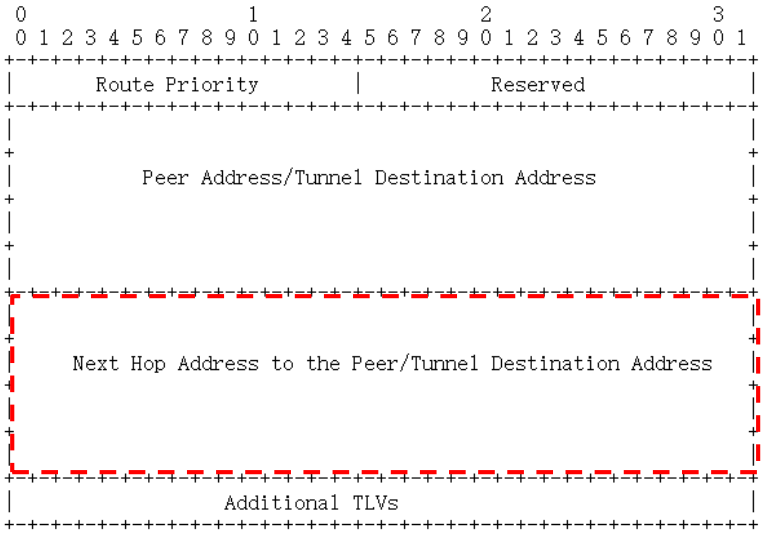


Figure 9: Explicit Peer Route Object Body Format for IPv6

Next Step

1. Comments/Q&A
2. WG Last Call?

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Path Computation Element Communication Protocol (PCEP) Extensions to Enable IFIT

draft-chen-pce-pcep-ifit-04

Online, Jul 2021, IETF 111

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Tianran Zhou (Huawei)
Weidong Li (Huawei)
Giuseppe Fioccola (Huawei)
Yali Wang (Huawei)

Background and Motivation

- In-situ Flow Information Telemetry (**IFIT**) refers to dataplane on-path telemetry techniques, including **IOAM** (draft-ietf-ippm-ioam-data) and **Alternate Marking** (RFC8321, RFC8889)

- The **PCEP extension** defined in this document allows to signal the IFIT capabilities. In this way IFIT methods are automatically activated and running.

The IFIT attributes can be generalized and included as **TLVs** carried inside the **LSPA** (**LSP Attributes**) **object** in order to be applied for all path types, as long as they support the relevant data plane telemetry method

Changes from -02

- Specified the usage scenario of IFIT

IFIT is a solution focusing on specific network domains according to RFC8799.

- For a number of reasons, such as policies, options supported, style of network management and security requirements, it is suggested to limit applications including the emerging IFIT techniques to a controlled domain.

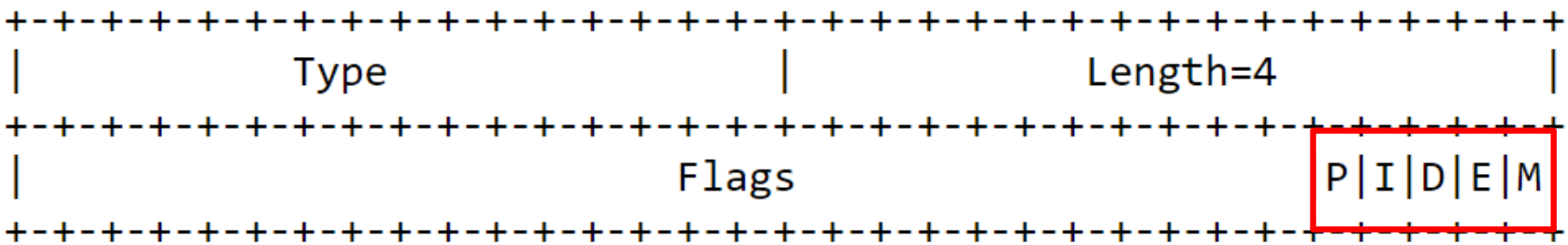
- Improved Security Considerations section

IFIT data MUST be propagated in a limited domain to avoid malicious attacks. Solutions to ensure this requirement are respectively discussed in draft-ietf-ippm-ioam-data and draft-ietf-6man-ipv6-alt-mark.

- A limited administrative domain provides the network administrator with the means to select, monitor and control the access to the network, making it a trusted domain also for the PCEP extensions defined in this document.

IFIT capability advertisement TLV

A new **IFIT-CAPABILITY TLV**, that is an optional TLV for use in the OPEN Object for IFIT attributes via PCEP capability advertisement



P: IOAM Pre-allocated Trace Option Type-enabled flag (draft-ietf-ippm-ioam-data)

I: IOAM Incremental Trace Option Type-enabled flag (draft-ietf-ippm-ioam-data)

D: IOAM DEX Option Type-enabled flag (draft-ietf-ippm-ioam-data)

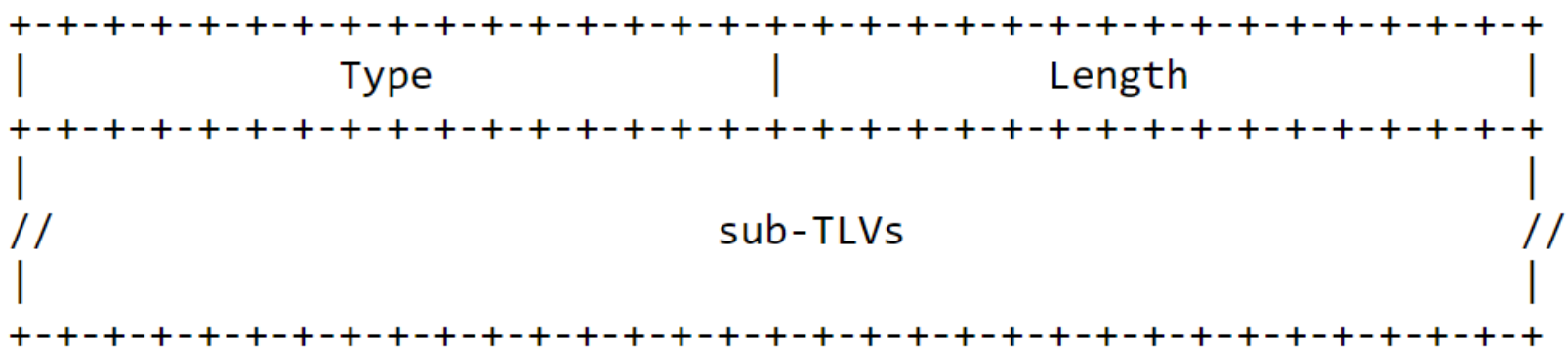
E: IOAM E2E Option Type-enabled flag (draft-ietf-ippm-ioam-data)

M: Alternate Marking enabled flag (RFC8321)

- If set to 1 by a PCC, the flag indicates that the PCC allows instantiation of the feature by a PCE
- If set to 1 by a PCE, the flag indicates that the PCE supports the feature instantiation
- The flag MUST be set by both PCC and PCE in order to support the instantiation

IFIT Attributes TLV

The **IFIT-ATTRIBUTES TLV** provides the configurable knobs of the IFIT feature, and it can be included as an optional TLV in the **LSPA object**

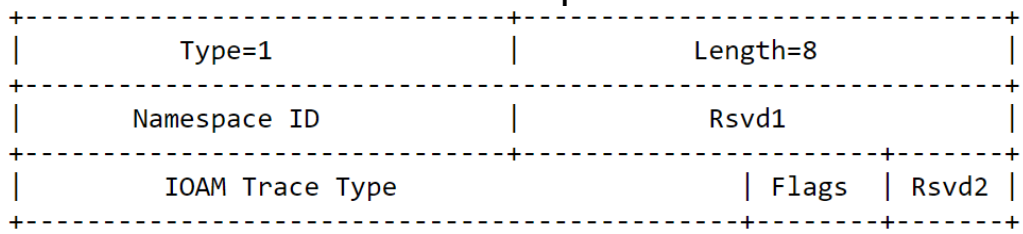


IFIT attribute TLVs, carried inside the LSPA object and applicable to all path types

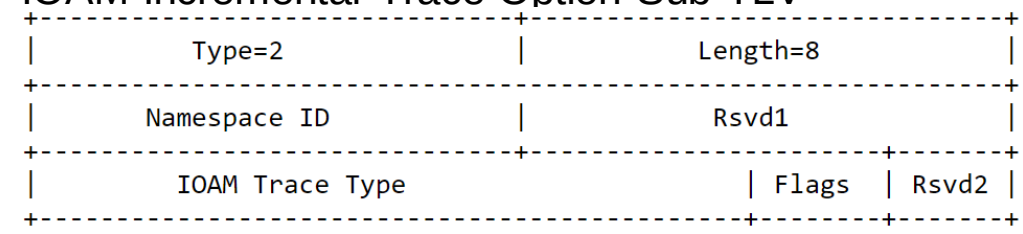
- IFIT TLVs are optional and can be taken into account by the PCE during path computation and by the PCC during path setup.
- In general, the LSPA object can be carried within a PCInitiate message, a PCUpd message, or a PCRpt message in the stateful PCE model.

IOAM Sub-TLVs

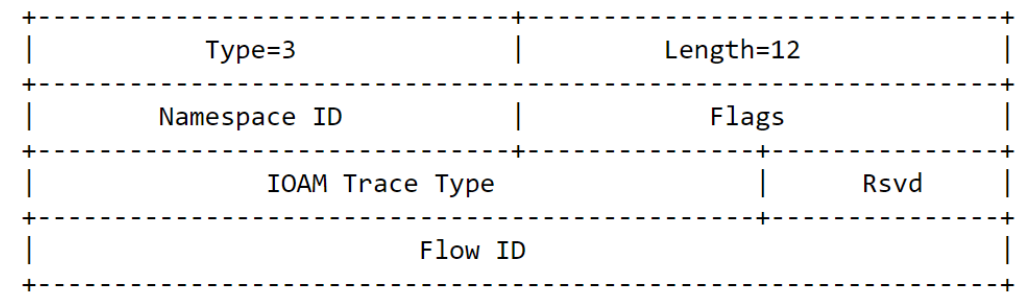
- IOAM Pre-allocated Trace Option Sub-TLV



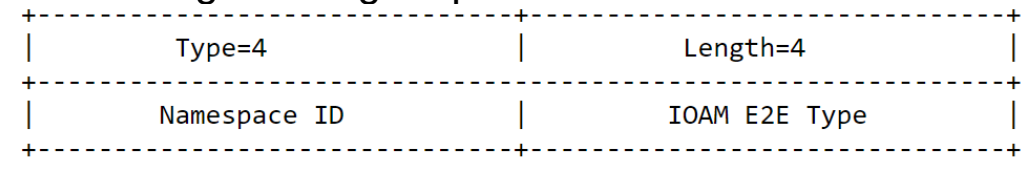
- IOAM Incremental Trace Option Sub-TLV



- IOAM Directly Export Option Sub-TLV

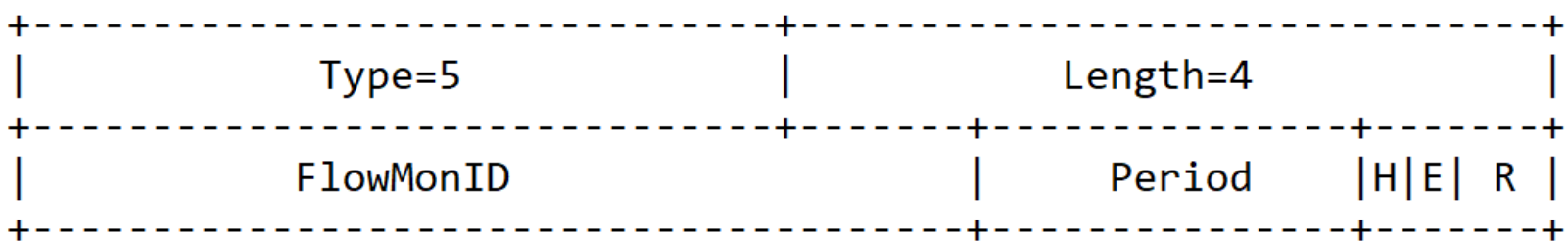


- IOAM Edge-to-Edge Option Sub-TLV



Enhanced Alternate Marking Sub-TLV

- Enhanced Alternate Marking Sub-TLV



H: A flag indicating that the measurement is Hop-By-Hop.

E: A flag indicating that the measurement is end to end.

Discussion & Next Steps

- Since IFIT methods are becoming mature for SR-MPLS and SRv6, IFIT attributes TLV also complements draft-ietf-pce-segment-routing-policy-cp to enable SR policy with native IFIT.

- Evaluate WG adoption

- Welcome questions, comments

Thank you

TE Constraints for PCEP

draft-peng-pce-te-constraints-06

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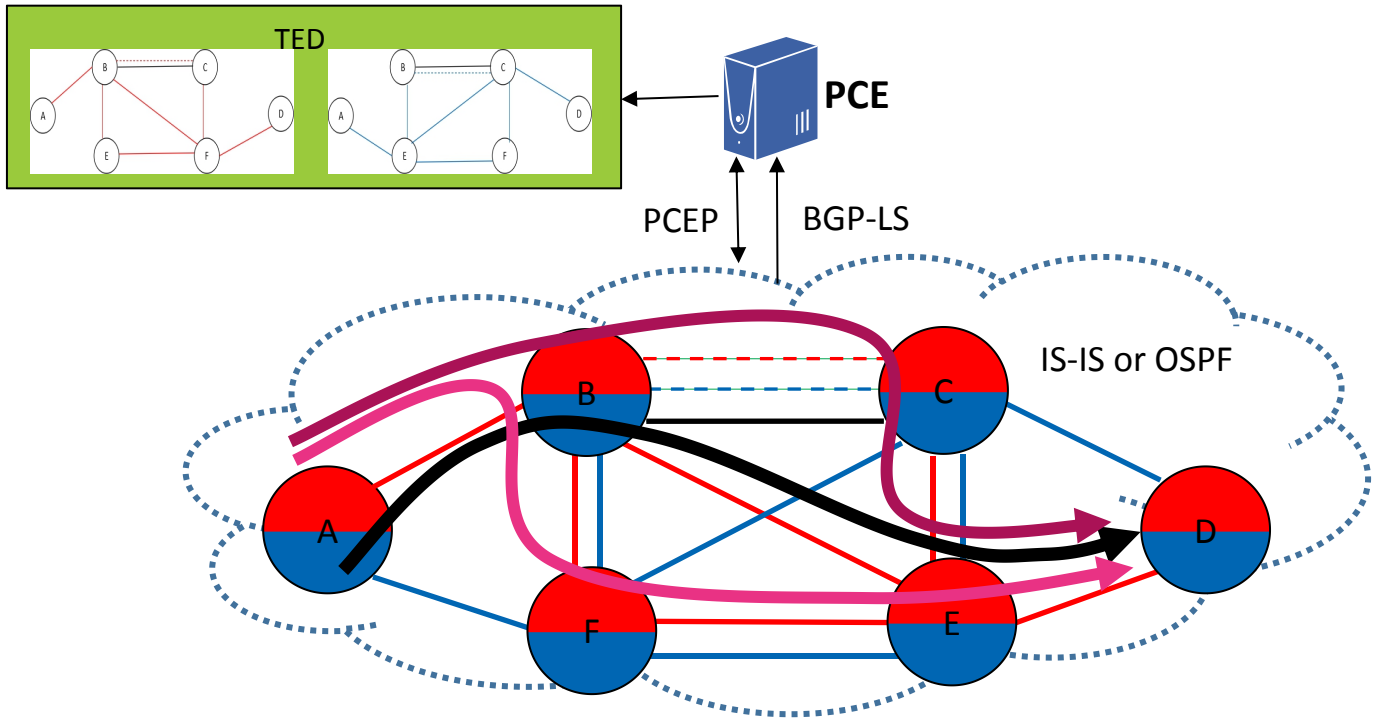
Siva Sivabalan(Ciena)

IETF111 PCE, 2021, Online

Overview

- As defined in RFC4655, the PCE MAY compute the path of a TE on the TED based on the considering the constraints such as metric, bandwidth, delay, affinity, etc.
- This document proposes a set of constraints for PCEP with the network topology information as following shown.
  - Source Protocol ID (IS-IS [RFC8202], OSPF [RFC6549], BGP-LS [RFC7752])
  - Muti-topology ID (IS-IS [RFC5120], OSPF [RFC4915], BGP-LS [RFC7752])
  - Application ID (IS-IS [RFC8919])
  - Slice ID (draft-ietf-teas-ietf-network-slice-definition)
  - Color (BGP [RFC9012])
  - FA ID (draft-ietf-lsr-flex-algo)



Constraint 1-Source Protocol ID

- Source Protocol TLV
  - Sub-topology identified by the specific source protocol ID.
  - The Source Protocol TLV is optional and is defined to carry the source protocol constraint.
  - Protocol-ID : 8 bits, as defined in RFC7752, indicates the Source Protocol identifier. IS-IS (RFC8202) and OSPF (RFC6549) MAY run multiple routing protocol instances over the same link.
  - Identifier : 64 bits, as defined in RFC7752, indicates the routing universe identifier.

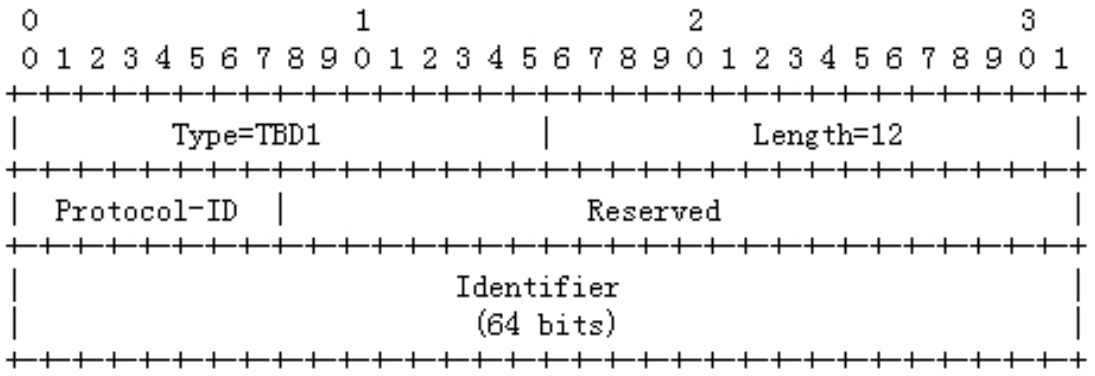


Figure 1: Source Protocol TLV

Protocol-ID	NLRI information source protocol
1	IS-IS Level 1
2	IS-IS Level 2
3	OSPFv2
4	Direct
5	Static configuration
6	OSPFv3

Constraint 2-Multi-topology ID

- Multi-topology TLV
  - Sub-topology identified by the specific Multi-Topology ID within a source protocol.
  - The Multi-topology TLV is optional and is defined to carry the multi-topology protocol constraint.
  - Multi-Topology ID :
    - as defined in RFC5120, 12bits, non-zero MT ID of the topology being announced Source Protocol identifier.
    - as defined in RFC4915, 8bits, represent Multi-Topology ID.
    - as defined in RFC7752, If the value is derived fromOSPF, then the upper 9 bits MUST be set to 0.
  - R bits: set to 0 when originated and ignored on receipt.

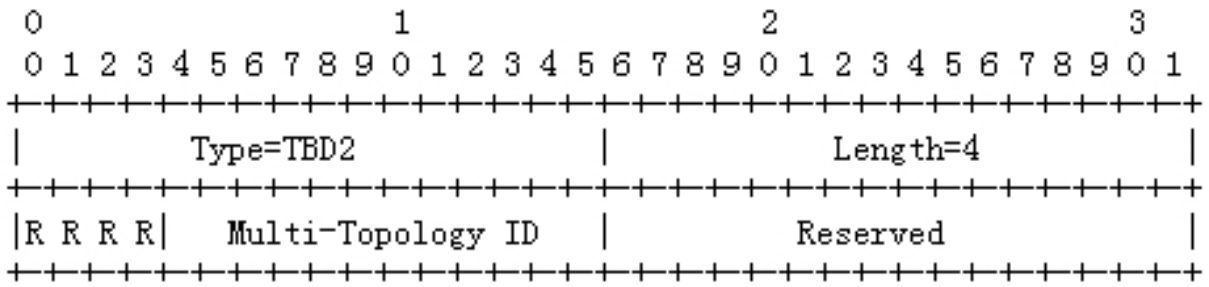


Figure 2: Multi-topology TLV

Constraint 3-Application ID

- Application Specific TLV
  - Sub-topology provides the Application Specific information.
  - The Application Specific TLV is optional and is defined to carry the application specific constraints.
  - Standard Application ID : 32bits, indicates a bit-position value for a single STANDARD application. IS-IS Link Attribute Application Identifiers is defined in RFC8919.
  - User Defined Application ID : 32 bits, indicates a single user defined application which is a specific implementation.

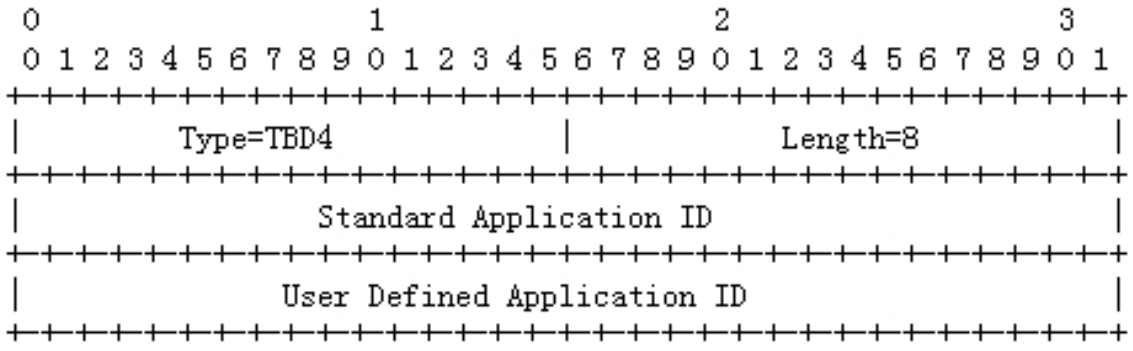


Figure 4: Application Specific TLV

Bit #	Name
0	RSVP-TE (R-bit)
1	Segment Routing Policy (S-bit)
2	Loop-Free Alternate (F-bit)
3-63	Unassigned

Constraint 4-Slice ID

- Slice-id TLV
  - Sub-topology identified by the specific Slice-id, which is independent of routing protocols such as IGP/BGP and can be applied to any of the virtual network.
  - The Slice-id TLV is optional and is defined to carry the slice specific constraint.
  - Slice-id : 32 bits, indicates the Slice identifier. The Network Slice is defined in draft-ietf-teas-ietf-network-slice-definition.

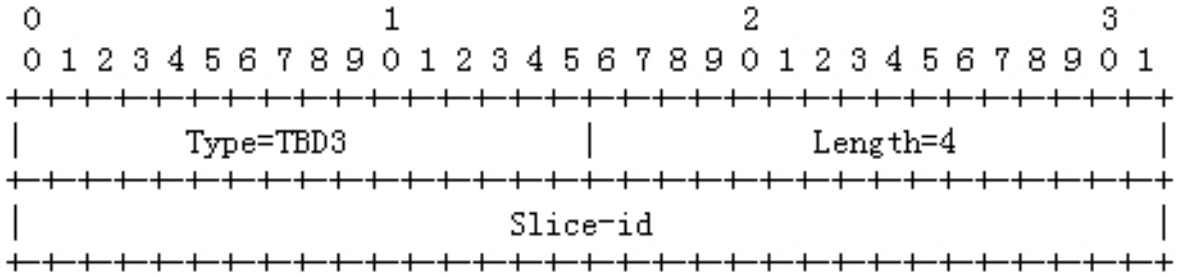


Figure 3: Slice-id TLV

Constraint 5-Color

- Color TLV
  - Sub-topology identified by the specific Color Template which carried specific color parameter and it is suitable for any TE instance such as RSVP-TE, SR-TE, SR-policy.
  - The Color TLV is optional and is defined to carry the color constraints.
  - Color: 32bits, indicates a TE template. It is consistent with the Color Extended Community defined in RFC9012.
  - The color of SR policy is defined in draft-ietf-spring-segment-routing-policy and the color of candidate path in the Composite Candidate Path is discussed in draft-ietf-pce-multipath.

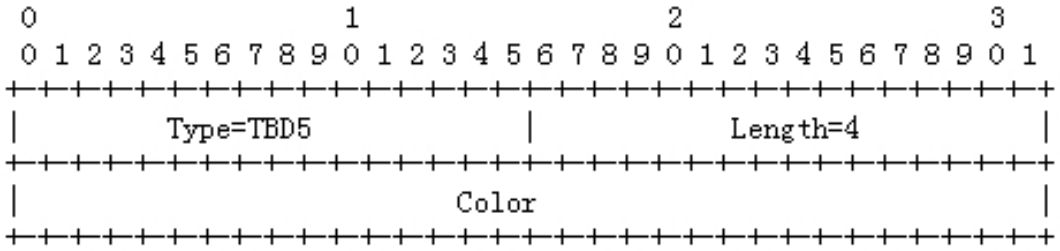


Figure 5: Color TLV

Constraint 6-FA ID

- FA-id TLV
  - Sub-topology identified by the specific FA-id to optimize segment stack depth for the IGP area partial of the entire SR policy.
  - The FA-id TLV is optional and is defined to carry the Flex-algo constraints.
  - FA-id : 8 bits, indicates an explicit FA-id mapping information defined in draft-ietf-lsr-flex-algo.
  - Flags : 8 bits, indicates the flags indicater.
  - Flag-M: Indicate mapping behavior when unset, and merging behavior when set.

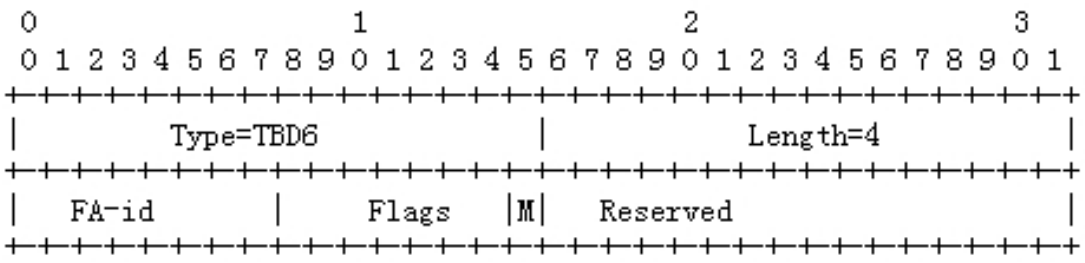


Figure 6: FA-id TLV

Next Step

- Comments and discussions are very welcome!
- Ready for Adoption?

Thank you!

RSVP Color in PCEP

22nd July 2021

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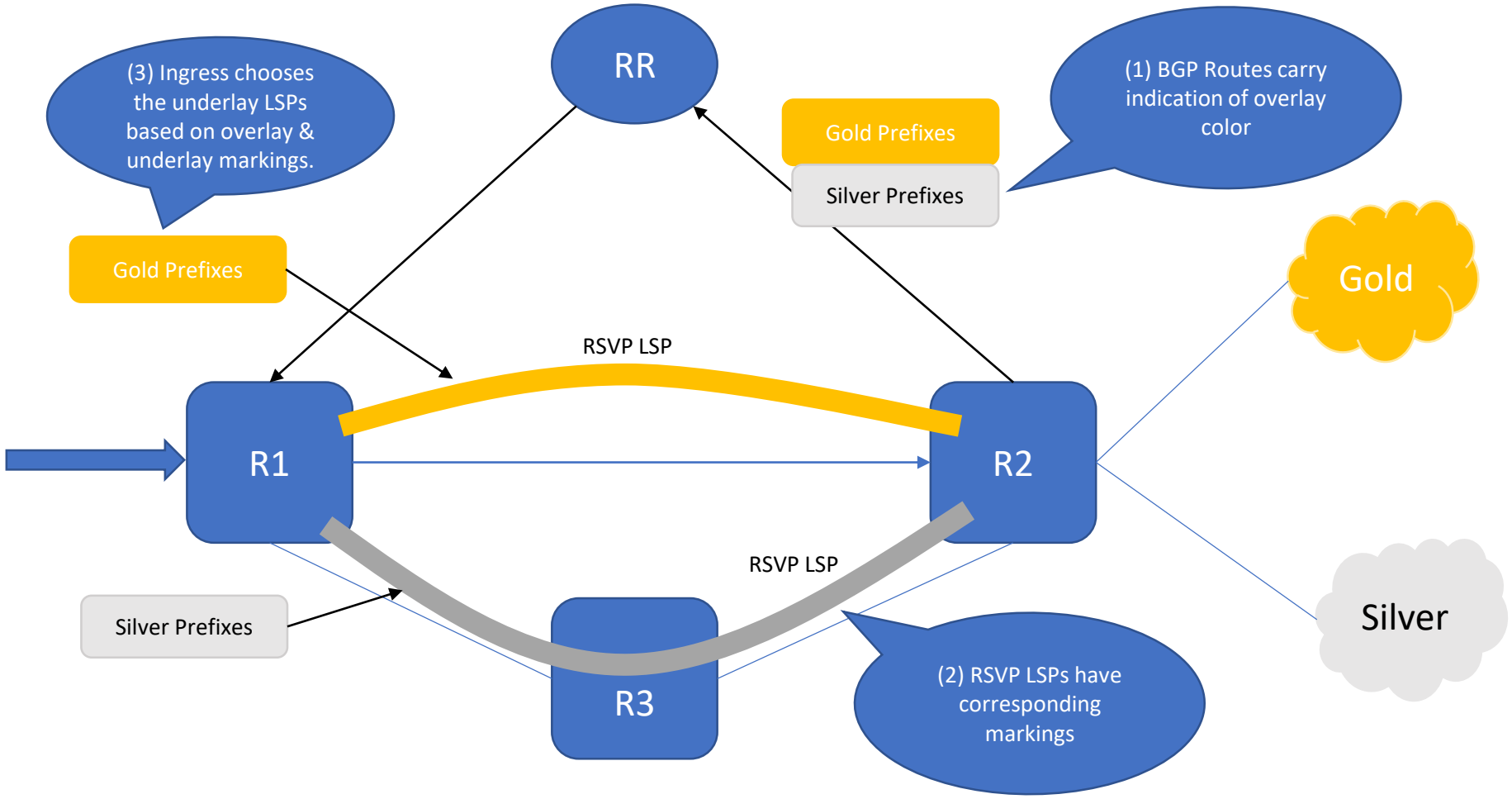
PROBLEM STATEMENT

- Provide a convenient way to associate service prefixes with RSVP underlay tunnels
- Need has existed for some time. Existing solutions using ‘color’ marking for SR-TE:
  - https://tools.ietf.org/html/draft-ietf-idr-segment-routing-te-policy-11 carries SR-TE color in BGP SR-TE NLRI
  - https://tools.ietf.org/html/draft-barth-pce-segment-routing-policy-cp-06 carries SR-TE color in PCEP
- Carrying color markings across domain boundaries in BGP:
  - https://tools.ietf.org/html/draft-kaliraj-idr-bgp-classful-transport-planes-06
- Existing RSVP deployments have a similar need.

ENVISIONED USAGE



SOLUTION OVERVIEW: PCEP PROTOCOL

- LSP Object carries color marking in a new TLV
  - Can be used by PCE to create an LSP with the appropriate color
  - Can be used by PCC to report color
- ‘Color’ is a property of a tunnel, rather than individual LSP’s of the tunnel.
  - Attach with “primary” LSP

Type (2 bytes)	Length(2 bytes)
Color (4 bytes)	

Note: Need to reconcile with https://tools.ietf.org/html/draft-peng-pce-te-constraints-04

MISMATCH HANDLING

PCE	PCC	Implication
Y	N	LSP can't honor color. Server needs to know.
N	Y	The values reported by the PCC are ignored by server, which is benign. But, client can as well not insert color.

STATEFUL-PCE-CAPABILITY TLV

Type (2 bytes)	Length (2 bytes)
Flags (4 bytes) A new C-bit to represent color	

Usage with BGP-CT

- While BGP-CT is not a pre-requisite for using the color specified in this draft, BGP-CT & RSVP PCEP color can inter-operate.
- In BGP-CT, overlay marking (mapping community) selects “resolution scheme”
  - Resolution scheme is associated with an ordered set of transport classes
  - The PCEP RSVP ‘color’ field can be used to associate LSP’s with transport classes

THANK YOU!

PCEP Procedures and Extension for VLAN-based Traffic Forwarding

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

Yue Wang (China Telecom)

Aijun Wang (China Telecom)

IETF 111, July. 2021

Motivation

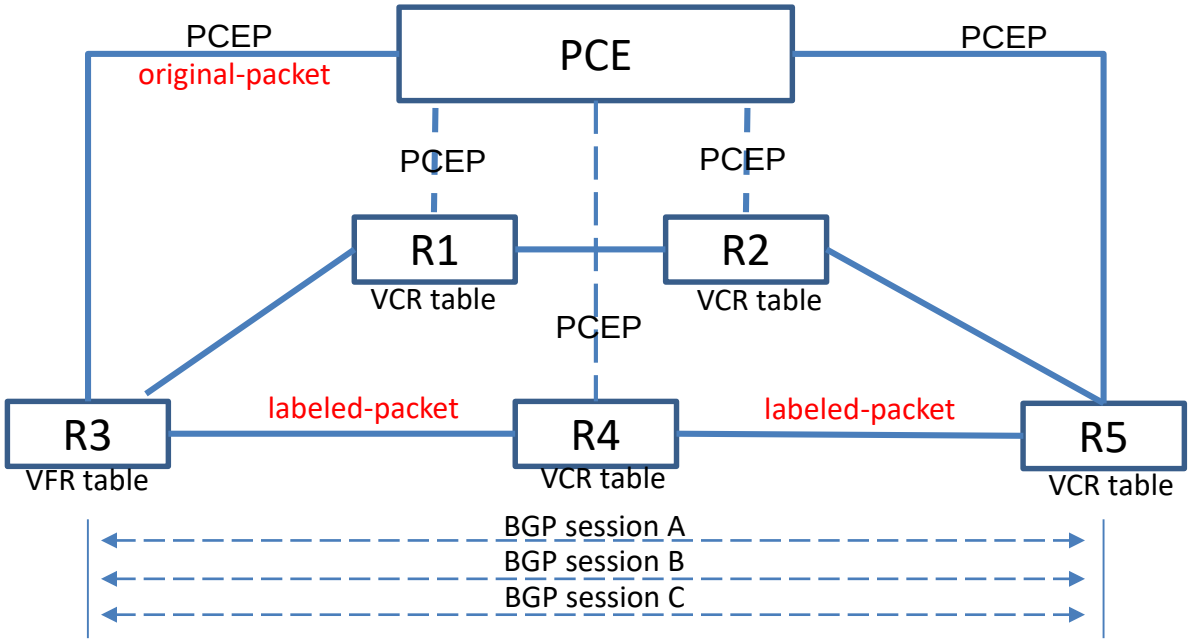
- Draft-ietf-pce-pcep-extension-native-ip describes the PCEP extensions and procedures to practically build a PCE-based central control mechanism.

- 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.

- 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.

- This mechanism uses a completely new address space and is suitable for ipv4 and ipv6 networks and can leverage the existing PCE technologies as much as possible.

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.

Capability Advertisement

- RFC8408 defines the Path Setup Type Capability TLV to indicate the path type supported by the PCE and PCC

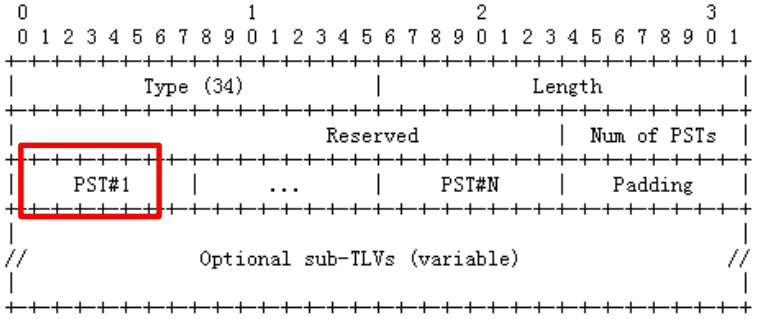


Figure 1: PATH-SETUP-TYPE-CAPABILITY TLV

- New PST(TBD) is defined for VLAN-based traffic forwarding

- Draft-ietf-pce-pcep-extension-native-ip describes the PCECC capability sub-TLV to indicate the capability for TE in Native IP network.

  - V (VLAN-based-forwarding-CAPABILITY - 1 bit - TBD2) is defined to indicate the PCEP speaker's capability of VLAN based traffic

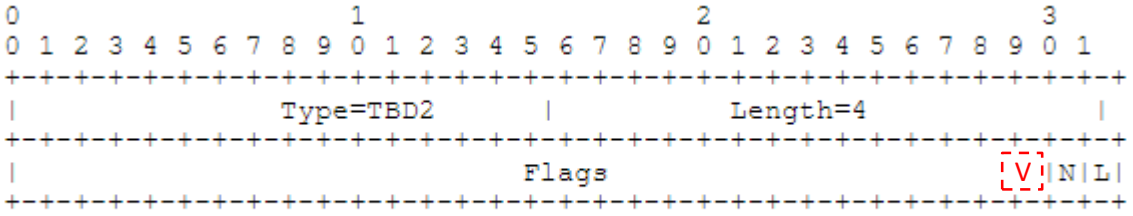


Figure 1: PCECC Capability sub-TLV

Updated PCEP Messages

```
<PCInitiate Message> ::= <Common Header>
                         <PCE-initiated-lsp-list>
   Where:
      <Common Header> is defined in [RFC5440]

      <PCE-initiated-lsp-list> ::= <PCE-initiated-lsp-request>
                                   [<PCE-initiated-lsp-list>]

      <PCE-initiated-lsp-request> ::=
                          (<PCE-initiated-lsp-instantiation>|
                           <PCE-initiated-lsp-deletion>|
                           <PCE-initiated-lsp-central-control>

      <PCE-initiated-lsp-central-control> ::= <SRP>
                                              <LSP>
                                              <cci-list>|
                                              ((<BPI>|<PPA>)
                                              <new-CCI>)

      <cci-list> ::=  <new-CCI>
                      [<cci-list>]

Where:
       <cci-list> is as per
       [I-D.ietf-pce-pcep-extension-for-pce-controller].
       <PCE-initiated-lsp-instantiation> and
       <PCE-initiated-lsp-deletion> are as per [RFC8281].
       <BPI> and <PPA> are as per
       [draft-ietf-pce-pcep-extension-native-ip-09]
```

```
<PCRpt Message> ::= <Common Header>
                    <state-report-list>
     Where:

        <state-report-list> ::= <state-report>[<state-report-list>]

        <state-report> ::= (<lsp-state-report>|
                            <central-control-report>)

        <lsp-state-report> ::= [<SRP>]
                               <LSP>
                               <path>

        <central-control-report> ::= [<SRP>]
                                     <LSP>
                                     <cci-list>|
                                     ((<BPI>|<PPA>)
                                     (<new-CCI>)

      Where:
        <path> is as per [RFC8231] and the LSP and SRP object are
        also defined in [RFC8231].
        <BPI> and <PPA> are as per
        [draft-ietf-pce-pcep-extension-native-ip-09]
```

- When PCInitiate message is used to create VLAN-based forwarding instructions, the SRP, LSP and CCI objects MUST be present.
- Only one of BPI, PPA or one type of CCI objects MUST be present.

New PCEP Objects(1/2)

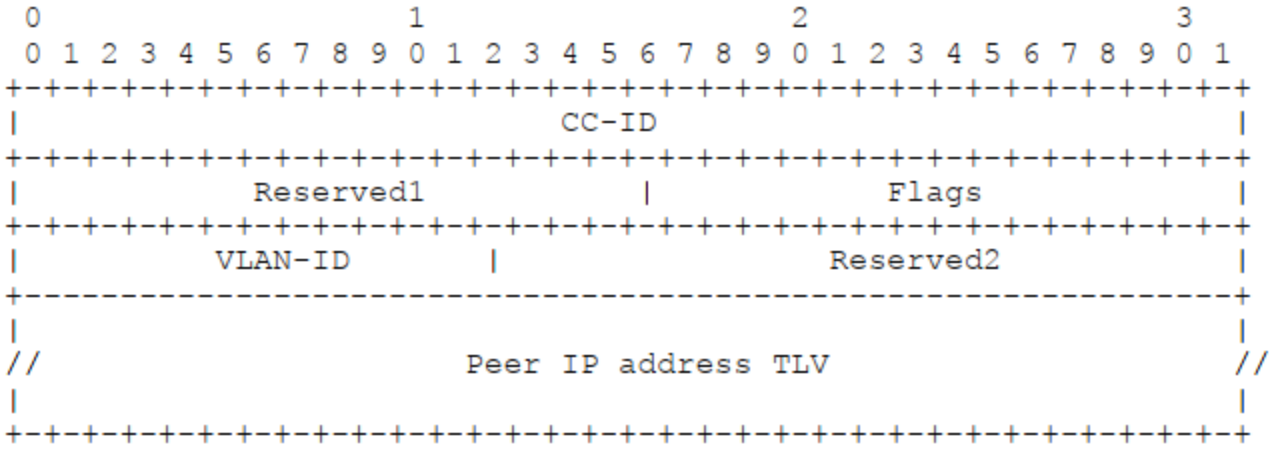


Figure 5: VLAN forwarding CCI Object

- VLAN ID(12 bits):the ID of the VLAN forwarding path that the PCC will set up on its logical subinterface in order to transfer the packet to the specific hop.

- [RFC8779] defines IPV4-ADDRESS, IPV6-ADDRESS, and UNNUMBERED-ENDPOINT TLVs for the use of Generalized Endpoint. The same TLVs can also be used in the CCI object to find the Peer address that matches egress PCC and further identify the packet to be guaranteed.

New PCEP Objects(2/2)

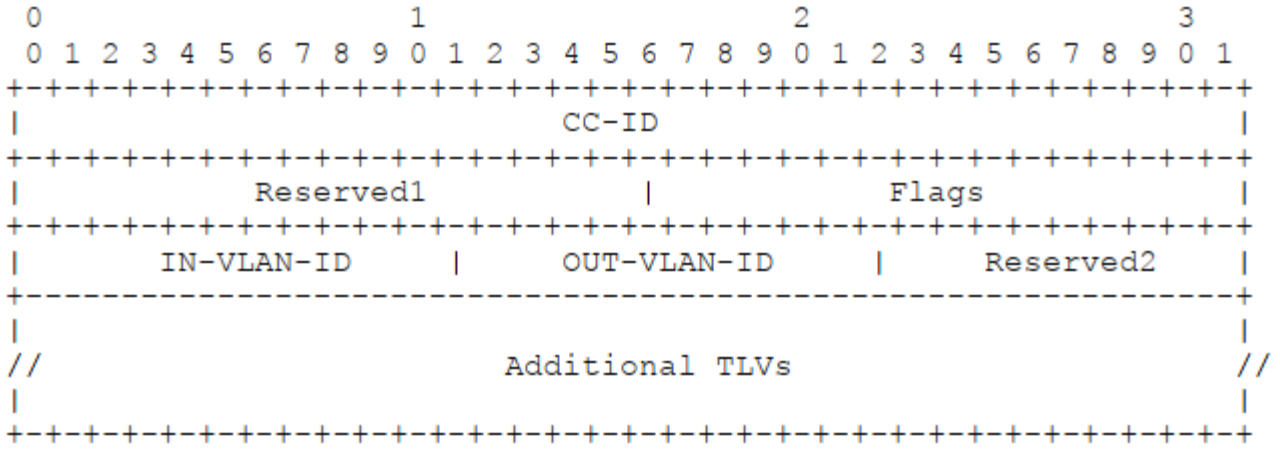


Figure 6: VLAN Crossing CCI Object

- IN-VLAN ID(12 bits): The ID of the VLAN forwarding path which is used to identify the traffic that needs to be protected.

- OUT-VLAN ID(12 bits):The ID of the VLAN forwarding path that the PCC will set up on its logical subinterface in order to transfer the packet labeld with this VLAN ID to the specific hop.
  transit PCC - the value must not be 0.
  egress PCC - the value must be 0.

VLAN-Based forwarding info Advertisement Procedures

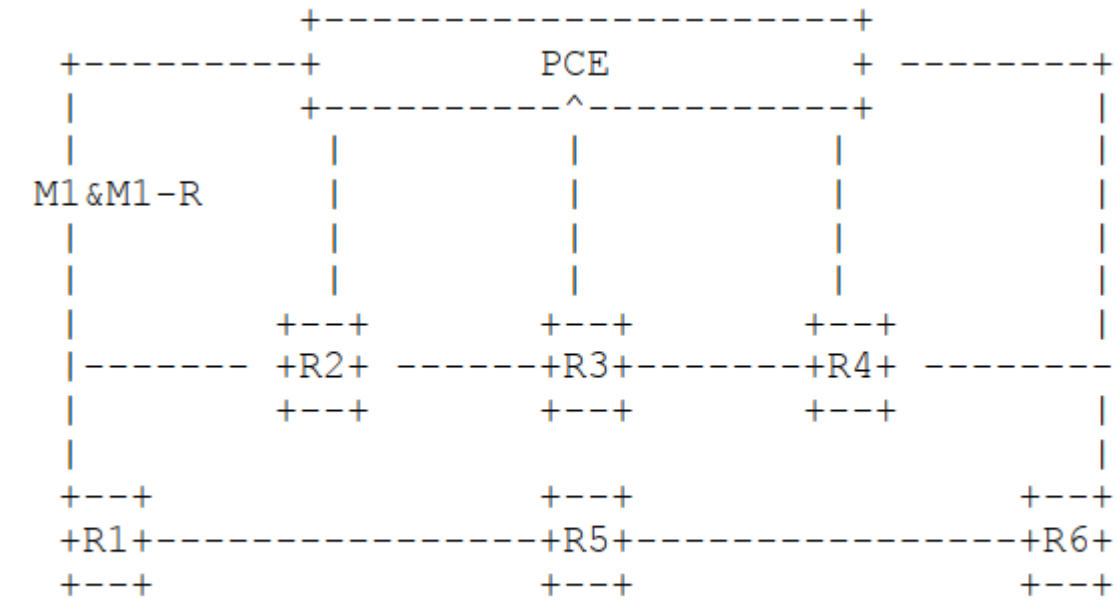


Figure 3: VLAN-Based forwarding info Advertisement Procedures for Ingress PCC

Table 1: Message Information

No.	Peers	Type	Message Key Parameters
M1 M1-R	PCE/R1	PCInitiate PCRpt	CC-ID=X1 VLAN Forwarding CCI Object (Peer_IP=R6_A,VLAN_ID=VLAN_R1_R2)

VLAN-Based crossing info Advertisement Procedures

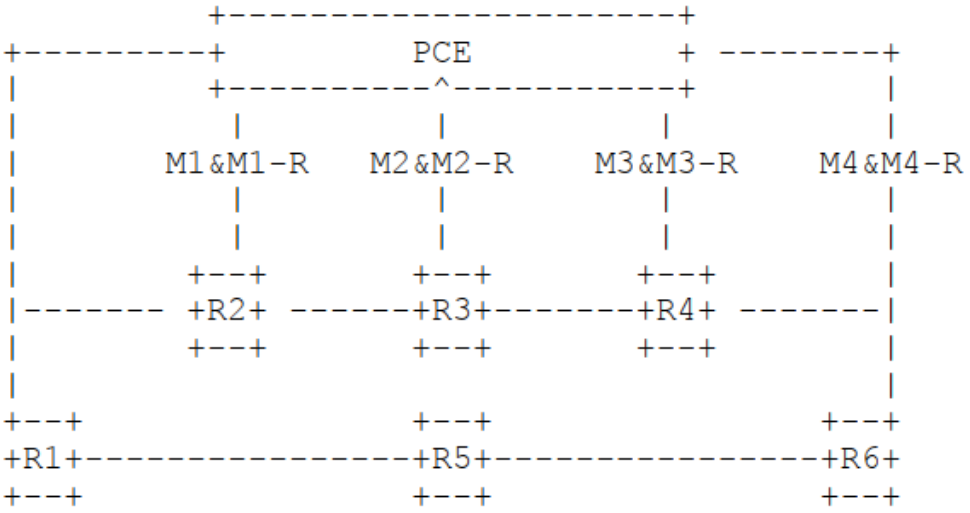


Figure 4: VLAN-Based crossing info Advertisement Procedures for transit PCC and egress PCC

Table 2: Message Information

No.	Peers	Type	Message Key Parameters
M1 M1-R	PCE/R2	PCInitiate PCRpt	CC-ID=X1 VLAN crossing CCI Object (IN_VLAN_ID=VLAN_R1_R2,OUT_VLAN_ID=VLAN_R2_R3)
M2 M2-R	PCE/R3	PCInitiate PCRpt	CC-ID=X1 VLAN crossing CCI Object (IN_VLAN_ID=VLAN_R2_R3,OUT_VLAN_ID=VLAN_R3_R4)
M3 M3-R	PCE/R4	PCInitiate PCRpt	CC-ID=X1 VLAN crossing CCI Object (IN_VLAN_ID=VLAN_R3_R4,OUT_VLAN_ID=VLAN_R4_R6)
M4 M4-R	PCE/R6	PCInitiate PCRpt	CC-ID=X1 VLAN crossing CCI Object (IN_VLAN_ID=VLAN_R4_R6,OUT_VLAN_ID=0)

Next Step

- Comments

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Thanks!