Extensions to Path Computation Element Communication Protocol (PCEP) for handling Link Bandwidth Utilization

draft-wu-pce-pcep-link-bw-utilization-00

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PCEP extension for handling Link Bandwidth Utilization

- Objective
  - Extensions to PCEP [RFC5440] to consider 'Link Bandwidth Utilization' as new constraints during path computation
- Motivation
  - Traffic Engineering Database (TED) as populated by IGP contains Maximum bandwidth, Maximum reservable bandwidth and Unreserved bandwidth ([RFC3630] and [RFC3784]),Residual bandwidth and Available bandwidth ([OSPF-TE-EXPRESS] and [ISIS-TE-EXPRESS]),Utilized Bandwidth ([ISIS-TE-EXPRESS]).
  - Real time link bandwidth utilization is becoming critical in the path computation in some networks
    - RSVP and non-RSVP traffic
  - It is important that link bandwidth utilization is factored in during path computation.
    - PCC can request a PCE to provide a path such that it selects under-utilized links.
    - The links in the path MAY be monitored for changes in the link bandwidth utilization
      - re-optimization of such path MAY be further requested

Terms Introduction

Term	Explanation
Link Bandwidth Utilization (LBU)	The bandwidth utilization on a link, forwarding adjacency, or bundled link. For a link or forwarding adjacency, bandwidth utilization represent the actual utilization of the link for forwarding any traffic irrespective of RSVP or Non-RSVP It is calculated in % by LBU / Maximum bandwidth * 100
Link Reserved Bandwidth Utilization (LRBU)	The reserved bandwidth utilization on a link, forwarding adjacency, or bundled link for forwarding traffic. This only include traffic for RSVP-TE LSP. It is calculated in % by LRBU /(Maximum bandwidth-Residual bandwidth) * 100 LRBU can be calculated by LRBU = LBU- (Residual bandwidth – Available bandwidth)

Extension to PCEP

- **BU (Bandwidth Utilization)Object**

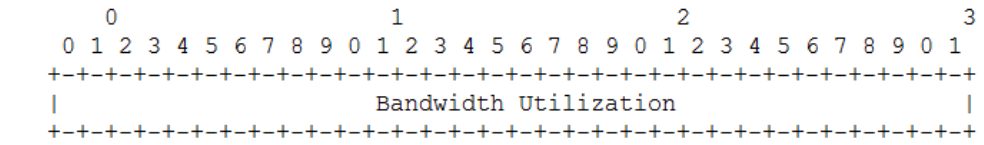
BU Object-Class is TBD.

Two Object-Type values are defined for the BU object:

o Link Bandwidth Utilization (LBU): BU Object-Type is 1.

o Link Reserved Bandwidth Utilization (LRBU): BU Object-Type is 2.

The format of the BU object body is as follows:



BU Object Body Format

- **New Objective Functions**

Objective functions are formulated using the following terminology:

o A network comprises a set of N links {Li, (i=1...N)}.
o A path P is a list of K links {Lpi,(i=1...K)}.
o Bandwidth Utilization on link L is denoted u(L).
o Reserved Bandwidth Utilization on link L is denoted ru(L).
o Maximum bandwidth on link L is denoted M(L).
o Current Reserved bandwidth on link L is denoted c(L).

Objective Function Code: TBD

Name: Maximum Under-Utilized Path (MUP)

Description: Find a path P such that (Min {(M(Lpi)- u(Lpi)) / M(Lpi), i=1...K }) is maximized.

Objective Function Code: TBD

Name: Maximum Reserved Under-Utilized Path (MRUP)

Description: Find a path P such that (Min {(c(Lpi)- ru(Lpi)) / c(Lpi), i=1...K }) is maximized.

The PCReq/PCRep Message

- PCReq Message Format:

```
<PCReq Message> ::= <Common Header>
                    [<svec-list>]
                    <request-list>
where:
     <svec-list> ::= <SVEC>
                     [<OF>]
                     [<metric-list>]
                     [<svec-list>]
     <request-list> ::= <request> [<request-list>]

     <request> ::= <RP>
                   <END-POINTS>
                   [<LSPA>]
                   [<BANDWIDTH>]
                   [<bu-list>]
                   [<metric-list>]
                   [<OF>]
                   [<RRO>[<BANDWIDTH>]]
                   [<IRO>]
                   [<LOAD-BALANCING>]
and where:
     <bu-list>::=<BU>[<bu-list>]
     <metric-list> ::= <METRIC>[<metric-list>]
```

- PCRep Message Format:

```
<PCRep Message> ::= <Common Header>
                    [<svec-list>]
                    <response-list>
where:

      <svec-list> ::= <SVEC>
                      [<OF>]
                      [<metric-list>]
                      [<svec-list>]
     <response-list> ::= <response> [<response-list>]
     <response> ::= <RP>
                    [<NO-PATH>]
                    [<attribute-list>]
                    [<path-list>]
     <path-list> ::= <path> [<path-list>]
     <path> ::= <ERO>
                <attribute-list>
and where:
     <attribute-list> ::= [<OF>]
                          [<LSPA>]
                          [<BANDWIDTH>]
                          [<bu-list>]
                          [<metric-list>]
                          [<IRO>]
        <bu-list>::=<BU>[<bu-list>]
     <metric-list> ::= <METRIC> [<metric-list>]
```

Next Step

- Request for adoption as a new work item.