

Extensions to PCEP for handling **Link Bandwidth Utilization**

draft-wu-pce-pcep-link-bw-utilization-03

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Link Bandwidth Utilization

Objective

- Specify extensions to PCEP to use link bandwidth utilization as constraint during path computation

Motivation

- [[OSPF-TE-EXPRESS](#)] and [[ISIS-TE-EXPRESS](#)] define mechanisms that distribute link bandwidth utilization information via OSPF and ISIS respectively.
- [[PCE-SERVICE-AWARE](#)] describes extensions to PCEP to consider link latency, latency variation and packet loss as constraints during path computation but how to use link bandwidth utilization information as constraint to compute path is not discussed.
- When we developed [[ISIS-TE-EXPRESS](#)], we had a lot of discussion about how to use other bandwidth related metric to calculate bandwidth utilization for all traffic or only for RSVP traffic
 - All traffic comprise of RSVP only traffic and Non-RSVP traffic(i.e., best effort traffic)
- Re-optimization of such path may be needed when link bandwidth utilization for all traffic or RSVP only traffic changes.

Relationship between I-Ds

IGP

draft-ietf-ospf-te-metric-extensions / draft-ietf-isis-te-metric-extensions

Delay Sub-TLV

Delay Variation
Sub-TLV

Link Loss Sub-TLV

Residual
Bandwidth Sub-TLV

Available
Bandwidth Sub-TLV

Utilized Bandwidth
Sub-TLV

Latency (Delay)
Metric

Latency Variation
(Jitter) Metric

Packet Loss
Metric

Link Bandwidth
Utilization (LBU)

Link Reserved
Bandwidth
Utilization (LRBU)

draft-ietf-pce-pcep-service-aware

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PCEP

Overview

Allows real-time traffic flow into consideration while computing new paths.

Bandwidth

- Maximum bandwidth, Maximum reservable bandwidth and Unreserved bandwidth. [RFC3630][RFC3784]
- Residual bandwidth, Available bandwidth and Utilized bandwidth. [OSPF-TE-EXT] and [ISIS-TE-EXT]

A new object “BU (Bandwidth Utilization) Object” has been defined to indicate the upper limit of the acceptable link bandwidth utilization percentage.

New objective functions, namely MUP (Maximum Under-Utilized Path) and MRUP (Maximum Reserved Under-Utilized Path) are defined.

Next Steps

- Call for WG adoption
 - Document is stable
 - Linked with other IGP and PCE WG drafts

BACKUP SLIDES...

Link Utilization

Link Bandwidth Utilization (LBU)

- It is 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. (i.e. as measured in the router) for forwarding all traffic (RSVP and Non-RSVP).
- LBU Percentage is described as: $(LBU / \text{Maximum bandwidth}) * 100$

Link Reserved Bandwidth Utilization (LRBU)

- It is the reserved bandwidth utilization on a link, forwarding adjacency, or bundled link.
- This includes traffic for only RSVP-TE LSPs.
- LRBU Percentage is described as: $(LRBU / (\text{Maximum Reservable bandwidth})) * 100$

Objective Functions

Maximum Under-Utilized Path (MUP)

- Find a path P such that $(\text{Min} \{ (M(L_{pi}) - u(L_{pi})) / M(L_{pi}), i=1...K \})$ is maximized.

Maximum Reserved Under-Utilized Path (MRUP)

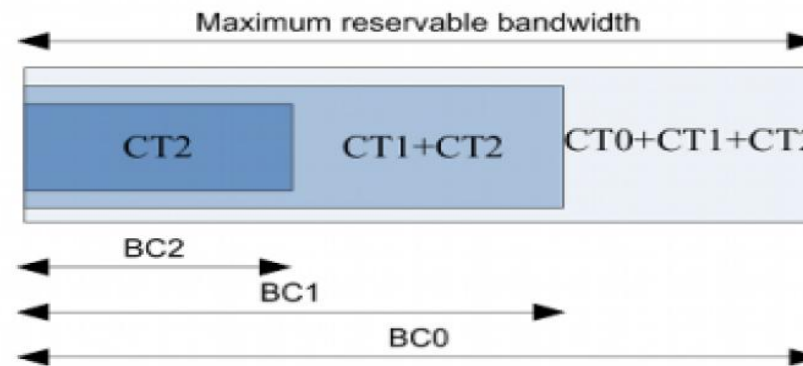
- Find a path P such that $(\text{Min} \{ (R(L_{pi}) - ru(L_{pi})) / R(L_{pi}), i=1...K \})$ is maximized.

Where...

- A network comprises a set of N links $\{L_i, (i=1...N)\}$.
- A path P is a list of K links $\{L_{pi}, (i=1...K)\}$.
- Bandwidth Utilization on link L is denoted $u(L)$.
- Reserved Bandwidth Utilization on link L is denoted $ru(L)$.
- Maximum bandwidth on link L is denoted $M(L)$.
- Maximum Reserved bandwidth on link L is denoted $R(L)$.

Applicability of Russian Doll model (RDM)

- Raised during the last IETF
- RDM uses Bandwidth Constraint model to determine bandwidth allocation per class type



- RDM is used when one needs to prevent QoS degradation of all Class Types and can impose pre-emption.
- Bandwidth utilization is not related to RDM
 - Russian doll model deals with reserved bandwidth per class types, while this draft is dealing with real time traffic (RSVP as well as non-RSVP) measured across class.
 - Also IGP extension provides bandwidth utilization across class