

Extensions to the Path Computation Element protocol (PCEP) for residual path bandwidth support

draft-lazzeri-pce-residual-bw-01

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Background

- ▶ RFC5541 defines the objective function MBP (maximum residual bandwidth path)
 - ▶ It enables to compute the path maximizing the minimum value of the residual bandwidth (that is the physical bandwidth left free on the links along the path)
 - ▶ The path with the largest “bottleneck” is returned
- ▶ However:
 - ▶ The value of the bottleneck (which is the main objective of this proposal) **cannot be returned as MBP is an OF and not a metric**
 - ▶ **Only the physically available bandwidth is taken into account:** it’s also needed (and possibly more important) to consider the available bandwidth **per priority level**
 - ▶ **It’s not possible to put constraints on the bottleneck of the path**, that is finding a path which optimizes another metric and has a bandwidth bottleneck not narrower than a given value.

Proposal and rationale

- ▶ Proposal for the introduction of additional **metrics** in PCEP
 - ▶ **Path unreserved bandwidth at a given priority**: the minimum value of the unreserved bandwidth at that priority among all the links along the path
 - ▶ **Path residual bandwidth**: the minimum value of the free physical bandwidth among all the links along the path
- ▶ Rationale for the introduction of these metrics
 - ▶ When metrics are returned as a result of the path computation (using C bit as specified in RFC5440) they can be used to know how much traffic can still be routed through the path just computed
 - ▶ Optimizing a path against unreserved or residual bandwidth allows a better usage of the network resources, reducing network blockability
 - ▶ Putting constraints on the values of unreserved or residual bandwidth also helps preventing network bottlenecks

Changes between v01 and v00

- ▶ Focus moved away from Hierarchical Path computation in favor of definition of new metrics.
- ▶ Applicability to H-PCE and multi domain is no longer a requirement but moved to use case as example of applicability
- ▶ 4.1 mode of operations: Description of usage within METRIC object in PCReq and PCRep
- ▶ 5. Procedures:
 - ▶ No change to procedures defined in RFC5440 and RFC5441
 - ▶ Use case: applicability to ACTN

Changes to the protocol

- ▶ Two new metric types are added to the METRIC object of RFC5440
 - ▶ Path unreserved bandwidth

Given:

- ▶ A network with a set of N links $\{L_i, (i=1\dots N)\}$.
- ▶ A path of a point to point LSP including a list of K links $\{L_{pi}, (i=1\dots K)\}$.
- ▶ The maximum reservable bandwidth of each link L_i , named R_i .

The path unreserved bandwidth at a given priority k is defined as the minimum value of the unreserved bandwidth at priority k among all the links along the P2P path, that is

$$PU(p) = \min \{U_i(p), (i=1\dots K)\}$$

where:

- ▶ $U_i(p) = R_i - B_i(p)$ is the unreserved bandwidth at priority p of the link L_i
- ▶ $B_i(p)$ is the bandwidth allocated to the LSPs at priority p on the link L_i , that is the sum of the bandwidth of all the LSPs passing through the link L_i with priority $\geq p$

Changes to the protocol

▶ Path residual bandwidth

Given:

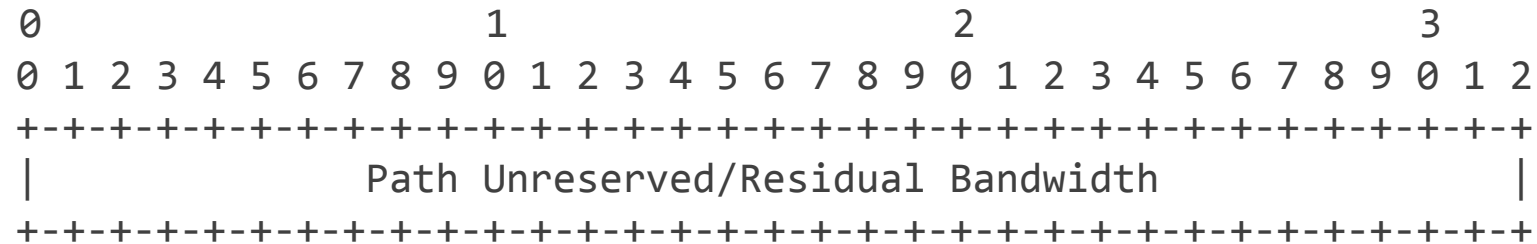
- ▶ A network with a set of N links $\{L_i, (i=1\dots N)\}$.
- ▶ A path of a point to point LSP including a list of K links $\{L_{pi}, (i=1\dots K)\}$.
- ▶ The maximum reservable bandwidth of each link L_i , named R_i .
- ▶ The allocated bandwidth of each link L_i , that is the sum of the bandwidth of all the LSPs passing through the link L_i , named A_i
- ▶ The residual bandwidth of the link L_i , $r(L_i) = R_i - A_i$

The path residual bandwidth is defined as the minimum value of the residual bandwidth among all the links along the P2P path, that is

$$PB = \min \{r(L_{pi}), (i=1\dots K)\}$$

Encoding

- ▶ Both path unreserved and path residual bandwidth have the same format:



- ▶ Two new metric types are added to the **METRIC** object of RFC5440
- ▶ The bandwidth is expressed in **bytes/sec** and encoded in 32 IEEE floating point format
- ▶ For **non PSC requests** the field could include (subject to further study) the count of available timeslots or lambdas (as included in the PCReq BANDWIDTH object), keeping the same format.
- ▶ The **priority** to be used for path unreserved bandwidth is the one mentioned on the LSPA object (if any, otherwise 0).

Summary and next steps

- ▶ Simple extensions with no dependencies
- ▶ Can be used to know how much traffic can still be routed through the path just computed
- ▶ Help preventing network bottlenecks
- ▶ Interest in the WG?