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## **PCEP Extension for DetNet High Reliability**

### **Abstract**

Real-time network performance information, like latency, delay variation, packet loss and in order delivery, is becoming critical in the path computation in some networks.

This document propose metric extensions to PCEP messages, to better describe the path computation constraints and QoS requirements of Deterministic Networking (DetNet) flows, especially the high reliability requirements on packet loss and in order delivery.

PCEP Extensions defined in this document could be used not only for DetNet, but also for other PCEP scenarios.

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## Table of Contents

- [1. Introduction](#)
  - [1.1. Requirements Language](#)
  - [1.2. Terminology](#)
- [2. PCEP Extensions](#)
  - [2.1. Extensions to METRIC Object](#)
    - [2.1.1. End-to-End Loss Metric](#)
    - [2.1.2. Consecutive Loss Metric](#)
    - [2.1.3. Misordering Metric](#)
    - [2.1.4. Metric Flags](#)
- [3. IANA Considerations](#)
- [4. Security Considerations](#)
- [5. References](#)
  - [5.1. Normative References](#)
  - [5.2. Informative References](#)
- [Acknowledgements](#)
- [Authors' Addresses](#)

## 1. Introduction

[[RFC5440](#)] specifies the Path Computation Element Protocol (PCEP) for communications between a PCC and a PCE. [[RFC8231](#)] describes a set of extensions to PCEP to enable stateful control of MPLS-TE and GMPLS LSPs via PCEP.

[[RFC8655](#)] provides the overall architecture for Deterministic Networking (DetNet), and specifies the primary goals of DetNet QoS, which can be expressed in terms of minimum and maximum end-to-end latency from source to destination, timely delivery, bounded jitter, packet loss ratio of the nodes and links, and an upper bound on out-of-order packet delivery. It is important that the QoS requirements be met when computing path for DetNet flows.

[[I-D.ietf-detnet-controller-plane-framework](#)] provides a framework overview for the DetNet controller plane. The DetNet control plane model could be distributed, fully centralized or hybrid. In centralized control plane model, PCEP could be used as a communication protocol between the controller and DetNet nodes.

## 1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

## 1.2. Terminology

The abbreviations used in this document are:

PCC: Path Computation Client; any client application requesting a path computation to be performed by a Path Computation Element.

PCE: Path Computation Element; an entity (component, application, or network node) that is capable of computing a network path or route based on a network graph and applying computational constraints.

PCEP: Path Computation Element Protocol; a protocol for communications between a PCC and a PCE.

DetNet: Deterministic Networking

## 2. PCEP Extensions

### 2.1. Extensions to METRIC Object

[[RFC5440](#)] defines METRIC Object to indicate an optimization or bound constraint on the path cost when computing path for Label Switched LSPs (LSPs). [[RFC8233](#)] defines the extension to PCEP METRIC object to carry latency, delay variation, packet loss as constraints for path computation. This document propose three new metric type, and two bit flags.

#### 2.1.1. End-to-End Loss Metric

All though path loss metric type (T=14) was defined in [[RFC8233](#)], the corresponding metric value of METRIC Object is described as the sum of "Unidirectional Link Loss" along the path, which does not count in the packet loss arises in the nodes along the path.

This document propose a new metric type, end-to-end loss metric, which counts in both link and node loss along the path. It could describe the end-to-end packet loss metric more precisely. It expresses the maximum Packet Loss Rate (PLR) requirement for the DetNet flow between the Ingress and Egress(es).

Metric Type T=TBD1: End-to-End Loss metric

PCCs **MAY** use this METRIC object in PCReq/PCRpt messages to carry end-to-end packet loss metric constraint for path computation; PCEs **MAY** use this METRIC object in PCRep/PCInitiate/PCUpd messages to express the computed value of end-to-end packet loss metric of the computed path.

#### **2.1.2. Consecutive Loss Metric**

As per [[RFC9016](#)], consecutive packet loss tolerance in a certain period could be considered as constraint when computing path for DetNet flows. This document specifies a new metric type, Consecutive Loss, to describe the consecutive packet loss along the path.

Metric Type T=TBD2: Consecutive Loss metric

PCCs **MAY** use this METRIC object in PCReq/PCRpt messages to carry consecutive packet loss metric constraint for path computation; PCEs **MAY** use this METRIC object in PCRep/PCInitiate/PCUpd messages to express the computed value of consecutive packet loss metric of the computed path.

#### **2.1.3. Misordering Metric**

As per [[RFC8655](#)], packet misordering should be considered as constraint when computing path for DetNet flows. This document specifies a new metric type, Misordering tolerance, to describe the misordering packets counts along the path.

Metric Type T=TBD3: Misordering metric

PCCs **MAY** use this METRIC object in PCReq/PCRpt messages to carry packet misordering metric constraint for path computation; PCEs **MAY** use this METRIC object in PCRep/PCInitiate/PCUpd messages to express the computed value of packet misordering metric of the computed path.

#### **2.1.4. Metric Flags**

As per [[RFC5440](#)], a "Flags" field (8 bits) is defined in METRIC Object. The flags field is comprised of several bit flags, currently B (Bound) and C (Computed) bits have been defined.

##### **2.1.4.1. Low Bound**

As per [[RFC5440](#)], an abstract B bit flag was defined in METRIC Object, and in most case it describes the up bound value of the corresponding metric type.

As per [[RFC8655](#)], both minimum and maximum end-to-end latency could be used to express the QoS requirements of DetNet flows.

This document propose a new bit, Low Bound, which is defined in Flags field of METRIC Object, to specify that the metric value is a low bound constraint.

L bit: Low bound of a metric type

PCCs **MAY** use L bit flag of METRIC object in PCReq/PCRpt messages to request a path that the metric value of the path **MUST** be larger or equal to the value specified in related METRIC object.

#### 2.1.4.2. Margin

In some DetNet scenario, allowance methods could be used to mitigate the negative impact caused by rapid value variations of certain metric of DetNet nodes and links.

This document propose a new bit, Margin, which is defined in Flags field of METRIC Object, to describe that the metric value is a margin value.

M bit: Margin of a metric type

A METRIC object with M bit set **MAY** be used along with another METRIC object with the same metric type and B or L bit set. PCCs **MAY** use M bit flag of METRIC object in PCReq/PCRpt messages to express the requirement that a margin of the metric value specified in the METRIC object with M bit set could be tolerated when computing a path.

### 3. IANA Considerations

TBD.

### 4. Security Considerations

The security considerations described in [RFC5440] and [RFC8655] apply to the extensions defined in this document as well. This document does not raise new security issues.

### 5. References

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## Acknowledgements

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