Network Working Group
Request for Comments: 5455
Category: Standards Track

S. Sivabalan, Ed.
J. Parker
S. Boutros
Cisco Systems, Inc.
K. Kumaki
KDDI R&D Laboratories, Inc.

March 2009

Diffserv-Aware Class-Type Object for the Path Computation Element Communication Protocol

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Abstract

This document specifies a CLASSTYPE object to support Diffserv-Aware Traffic Engineering (DS-TE) where path computation is performed with the aid of a Path Computation Element (PCE).

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1. Introduction

[RFC5440] specifies the Path Computation Element Communication Protocol (PCEP) for communications between a Path Computation Client (PCC) and a Path Computation Element (PCE), or between two PCEs, in compliance with [RFC4657].

Diffserv-aware MPLS Traffic Engineering (DS-TE) addresses the fundamental requirement to be able to enforce different bandwidth constraints for different classes of traffic. It describes mechanisms to achieve per-class traffic engineering, rather than on an aggregate basis across all classes by enforcing Bandwidth Constraints (BCs) on different classes. Requirements for DS-TE and the associated protocol extensions are specified in [RFC3564] and [RFC4124], respectively.

As per [RFC4657], PCEP must support traffic Class-Type as an MPLS-TE-specific constraint. However, in the present form, PCEP [RFC5440] does not have the capability to specify the Class-Type in the path computation request.

In this document, we define a new PCEP object called CLASSTYPE, which carries the Class-Type of the TE LSP in the path computation request. During path computation, a PCE uses the Class-Type to identify the bandwidth constraint of the TE LSP.

1.1. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. Terminology

CT (Class-Type): A set of Traffic Trunks governed by a set of bandwidth constraints. Used for the purpose of link bandwidth allocation, constraint-based routing and admission control. A given Traffic Trunk belongs to the same CT on all links.

DS-TE: Diffserv-Aware Traffic Engineering.

LSR: Label Switching Router.

LSP: Label Switched Path.

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 Peer: an element involved in a PCEP session (i.e., a PCC or the PCE).

TE-Class: A pair consisting of a Class-Type and a preemption priority allowed for that Class-Type. An LSP transporting a Traffic Trunk from that Class-Type can use that preemption priority as the setup priority, the holding priority, or both.

TE LSP: Traffic Engineering Label Switched Path.

Traffic Trunk: An aggregation of traffic flows of the same class (i.e., treated equivalently from the DS-TE perspective), which is placed inside a TE LSP.

3. CLASSTYPE Object

The CLASSTYPE object is optional and is used to specify the Class-Type of a TE LSP. This object is meaningful only within the path computation request, and is ignored in the path reply message. If the TE LSP for which the path is to be computed belongs to Class 0, the

path computation request MUST NOT contain the CLASSTYPE object. This allows backward compatibility with a PCE that does not support the CLASSTYPE object.

3.1. Object Definition

The CLASSTYPE object contains a 32-bit word PCEP common object header defined in [RFC5440] followed by another 32-bit word object body as shown in Figure 1.

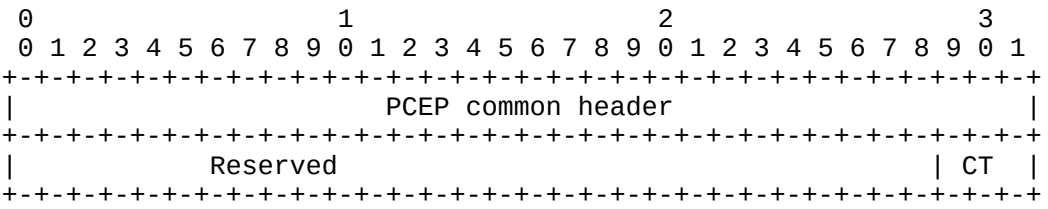

Figure 1: CLASSTYPE object format

The fields in the common object header are processed as specified in [RFC5440]. The values of object class and object type are 22 and 1, respectively. If included, the CLASSTYPE object must be taken into account by the PCE. As such, the P flag MUST be set. The I flag is ignored.

The CLASSTYPE object body contains the following fields:

CT: 3-bit field that indicates the Class-Type. Values allowed are 1, 2, ... , 7. The value of 0 is Reserved.

Reserved: 29-bit reserved field. It MUST be set to zero on transmission and MUST be ignored on receipt.

3.2. Path Computation Request Message with CLASSTYPE Object

[RFC5440] specifies the order in which objects must be inserted in the PCEP messages. This document specifies that the CLASSTYPE object be inserted after the END-POINT objects as shown below:

The format of a Path Computation Request (PCReq) message is as follows:

```
<PCReq Message>::= <Common Header>
                   [<SVEC-list>]
                   <request-list>
where:
   <svec-list>::=<SVEC>[<svec-list>]
   <request-list>::=<request>[<request-list>]
   <request>::= <RP>
                <END-POINTS>
                [<CLASSTYPE>]
                [<LSPA>]
                [<BANDWIDTH>]
                [<metric-list>]
                [<RRO>]
                [<IRO>]
                [<LOAD-BALANCING>]
where:
<metric-list>::=<METRIC>[<metric-list>]
```

Note that an implementation MUST form the PCEP messages using the object ordering rules specified using Backus-Naur Form. Please refer to [OBJ-ORD] for more details.

3.3. Processing CLASSTYPE Object

If the LSP is associated with Class-Type N (1 <= N <= 7), the PCC originating the PCReq MUST include the CLASSTYPE object in the PCReq message with the Class-Type (CT) field set to N.

If a path computation request contains multiple CLASSTYPE objects, only the first one is meaningful; subsequent CLASSTYPE object(s) MUST be ignored and MUST NOT be forwarded.

If the CLASSTYPE object is not present in the path computation request message, the LSR MUST associate the Class-Type 0 to the LSP.

A path computation reply message MUST NOT include a CLASSTYPE object. If a PCE needs to forward a path computation request containing the CLASSTYPE object to another PCE, it MUST store the Class-Type of the TE LSP in order to complete the path computation when the path computation reply arrives.

A PCE that does not recognize the CLASSTYPE object MUST reject the entire PCEP message and MUST send a PCE error message with Error-Type="Unknown Object" or "Not supported object", defined in [RFC5440].

A PCE that recognizes the CLASSTYPE object, but finds that the P flag is not set in the CLASSTYPE object, MUST send PCE error message towards the sender with the error type and error value specified in [RFC5440].

A PCE that recognizes the CLASSTYPE object, but does not support the particular Class-Type, MUST send a PCE error message towards the sender with the error type "Diffserv-aware TE error" and the error value of "Unsupported Class-Type" (Error-value 1).

A PCE that recognizes the CLASSTYPE object, but determines that the Class-Type value is not valid (i.e., Class-Type value 0), MUST send a PCE error towards the sender with the error type "Diffserv-aware TE error" and an error value of "Invalid Class-Type" (Error-value 2).

3.4. Determination of Traffic Engineering Class (TE-Class)

As specified in RFC 4124, a CT and a preemption priority map to a Traffic Engineering Class (TE-class), and there can be up to 8 TE-classes. The TE-class value is used to determine the unreserved bandwidth on the links during path computation. In the case of a PCE, the CT value carried in the CLASSTYPE object and the setup priority in the LSP Attribute (LSPA) object are used to determine the TE-class corresponding to the path computation request. If the LSPA object is absent, the setup priority is assumed to be 0.

3.5. Significance of Class-Type and TE-Class

To ensure coherent DS-TE operation, a PCE and a PCC should have a common understanding of a particular DS-TE Class-Type and TE-class. If a path computation request crosses an Autonomous System (AS) boundary, these should have global significance in all domains. Enforcement of this global significance is outside the scope of this document.

3.6. Error Codes for CLASSTYPE Object

This document defines the following error type and values:

Error-Type	Meaning
12	Diffserv-aware TE error Error-value=1: Unsupported Class-Type Error-value=2: Invalid Class-Type Error-value=3: Class-Type and setup priority do not form a configured TE-class

4. Security Considerations

This document does not introduce new security issues. The security considerations pertaining to PCEP [RFC5440] remain relevant.

5. IANA Considerations

IANA maintains a registry of parameters for PCEP. This contains a sub-registry for PCEP objects. IANA has made allocations from this registry as follows:

Object-Class	Name	Reference
22	CLASSTYPE	RFC 5455
	Object-Type	
	1: Class-Type	RFC 5455

IANA has allocated error types and values as follows:

Error-Type	Meaning	Reference
12	Diffserv-aware TE error	RFC 5455
	Error-value = 1:	RFC 5455
	Unsupported Class-Type	
	Error-value = 2:	RFC 5455
	Invalid Class-Type	
	Error-value = 3:	RFC 5455
	Class-Type and setup priority do not form a configured TE-class	

6. Acknowledgments

The authors would like to thank Jean Philippe Vasseur, Adrian Farrel, and Zafar Ali for their valuable comments.

7. References

7.1. Normative References

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7.2. Informative References

[RFC4657] Ash, J., Ed., and J. Le Roux, Ed., "Path Computation Element (PCE) Communication Protocol Generic Requirements", RFC 4657, September 2006.

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Authors' Addresses

Siva Sivabalan (editor)
Cisco Systems, Inc.
2000 Innovation Drive
Kanata, Ontario, K2K 3E8
Canada

EMail: msiva@cisco.com

Jon Parker
Cisco Systems, Inc.
2000 Innovation Drive
Kanata, Ontario, K2K 3E8
Canada

EMail: jdparker@cisco.com

Sami Boutros
Cisco Systems, Inc.
3750 Cisco Way
San Jose, California 95134
USA

EMail: sboutros@cisco.com

Kenji Kumaki
KDDI R&D Laboratories, Inc.
2-1-15 Ohara Fujimino
Saitama 356-8502, JAPAN

EMail: ke-kumaki@kddi.com