Network Working Group
Request for Comments: 5462
Updates: 3032, 3270, 3272, 3443, 3469,
3564, 3985, 4182, 4364, 4379,
4448, 4761, 5129
Category: Standards Track

L. Andersson
Acreo AB
R. Asati
Cisco Systems

February 2009

# Multiprotocol Label Switching (MPLS) Label Stack Entry: "EXP" Field Renamed to "Traffic Class" Field

## Status of This Memo



## Copyright Notice



## Abstract

The early Multiprotocol Label Switching (MPLS) documents defined the form of the MPLS label stack entry. This includes a three-bit field called the "EXP field". The exact use of this field was not defined by these documents, except to state that it was to be "reserved for experimental use".

Although the intended use of the EXP field was as a "Class of Service" (CoS) field, it was not named a CoS field by these early documents because the use of such a CoS field was not considered to be sufficiently defined. Today a number of standards documents define its usage as a CoS field.

To avoid misunderstanding about how this field may be used, it has become increasingly necessary to rename this field. This document changes the name of the field to the "Traffic Class field" ("TC field"). In doing so, it also updates documents that define the current use of the EXP field.

Table of Contents



## 1. Introduction

The format of an MPLS label stack entry is defined by RFC 3032 [RFC3032] to include a three-bit field called the "EXP field". The exact use of this field is not defined by RFC 3032, except to state that it is to be "reserved for experimental use".

The EXP field, from the start, was intended to carry "Class of Service" (CoS) information. The field was actually called the "Class of Service field" in early versions of the working group document that was published as RFC 3032. However, at the time that RFC 3032 was published, the exact usage of this "Class of Service" field was not agreed upon and the field was designated as "experimental use"; hence, the name has since been the "EXP field".

The designation "for experimental use" has led other Standards Development Organizations (SDOs) and implementors to assume that it is possible to use the field for other purposes. This document changes the name of the field to clearly indicate its use as a traffic classification field.

At first, we discussed using the original "CoS field" as the name for the field, but it has been pointed out that this name does not cover the following changes that have occurred with respect to its usage since RFC 3032 was published.

1. The use of the EXP field was first defined in RFC 3270 [RFC3270], where a method to define a variant of Diffserv Label Switched Paths (LSP), called EXP-Inferred-PSC LSP (E-LSPs), was specified. PSC is a two-stage acronym that is expanded as PHB (Per Hop Behavior) Scheduling Class (PSC).

2. The use of the EXP field as defined in RFC 3270 has been further extended in RFC 5129 [RFC5129], where methods for explicit congestion marking in MPLS are defined.

This document, hence, uses the name "Traffic Class field (TC field)", which better covers the potential use. The MPLS TC field relates to an MPLS encapsulated packet the same way as the IPv6 TC field relates to an IPv6 encapsulated packet or the IPv4 Precedence field relates to an IPv4 encapsulated packet.

The definitions of how the EXP field is used are perfectly clear in RFC 3270 and RFC 5129. However, these RFCs do not explicitly state they update RFC 3032, and this fact was not captured in the RFC repository until after work on this document was started.

This document updates RFC 3032, RFC 3270, and RFC 5129 to clarify the intended usage of the TC field. The changes to these RFCs requires some changes to the actual text in those documents; Section 2 explains the changes.

This document also updates several other RFCs; see Section 2.4. For these documents, the change is limited to changing the name of the Label Stack entry field.

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. Details of Change

The three RFCs 3032, 3270, and 5129 are now updated according to the following.

### 2.1. RFC 3032

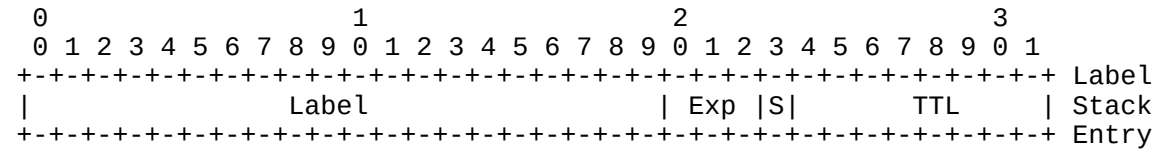
RFC 3032 states on page 4:

> 3. Experimental Use
>
> This three-bit field is reserved for experimental use.

This paragraph is now changed to:

> 3. Traffic Class (TC) field
>
> This three-bit field is used to carry traffic class information, and the change of the name is applicable to all places it occurs in IETF RFCs and other IETF documents.
>
> RFC 3270 and RFC 5129 update the definition of the TC field and describe how to use the field.

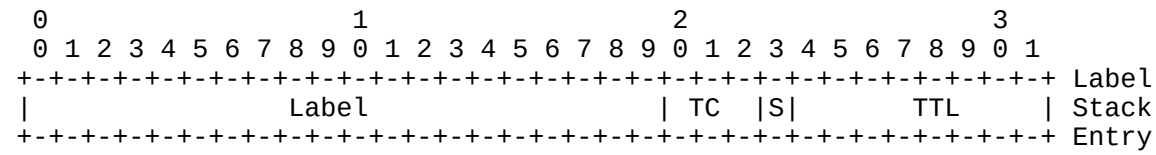
In Figure 1 on page 3 in RFC 3032, the format of a label stack entry is specified as:




Label: Label Value, 20 bits
Exp: Experimental Use, 3 bits
S: Bottom of Stack, 1 bit
TTL: Time to Live, 8 bits

Figure 1

Figure 1 in RFC 3032 is now changed to match the change of name to TC field:




Label: Label Value, 20 bits
TC: Traffic Class field, 3 bits
S: Bottom of Stack, 1 bit
TTL: Time to Live, 8 bits

Figure 1 (new)

Note: The designation of the picture above as "Figure 1 (new)" is introduced as a way to distinguish the figures in this document. It will still be "Figure 1" in RFC 3032.

## 2.2. RFC 3270

RFC 3270 says on page 6:

1.2 EXP-Inferred-PSC LSPs (E-LSP)

> A single LSP can be used to support one or more OAs. Such LSPs can support up to eight BAs of a given FEC, regardless of how many OAs these BAs span. With such LSPs, the EXP field of the MPLS Shim Header is used by the LSR to determine the PHB to be applied to the packet. This includes both the PSC and the drop preference.
>
> We refer to such LSPs as "EXP-inferred-PSC LSPs" (E-LSP), since the PSC of a packet transported on this LSP depends on the EXP field value for that packet.
>
> The mapping from the EXP field to the PHB (i.e., to PSC and drop precedence) for a given such LSP, is either explicitly signaled at label set-up or relies on a pre-configured mapping.
>
> Detailed operations of E-LSPs are specified in section 3 below.

RFC 3270 is now updated like this:

a. A new paragraph is added at the end of Section 1 "Introduction":

> The EXP field has been renamed the TC field, and thus all references in RFC 3270 to the EXP field now refer to the TC field.

b. A new term is added to Section 1.1 "Terminology":

> TC Traffic Class (replaces the term EXP)

c. In Section 1.1 "Terminology", the acronym E-LSP is now understood to mean:

> E-LSP Explicitly TC-encoded-PSC LSP

Section 1.2 on page 6 in RFC 3270 is now changed to:

1.2 Explicitly TC-encoded-PSC LSPs (E-LSP)

> The EXP field has been renamed to the TC field, and thus all references in RFC 3270 to EXP field now refer to the TC field. However, we retain the acronym E-LSP (Explicitly TC-encoded-PSC LSP) as the acronym is in widespread use.

A single LSP can be used to support one or more OAs. Such LSPs can support up to eight BAs of a given FEC, regardless of how many OAs these BAs span. With such LSPs, the TC field of the MPLS Shim Header is used by the LSR to determine the PHB to be applied to the packet. This includes both the PSC and the drop preference.

We refer to such LSPs as "Explicitly TC-encoded-PSC LSPs" (E-LSPs), since the PSC of a packet transported on this LSP depends on the TC field (previously called the EXP field) value for that packet.

The mapping from the TC field to the PHB (i.e., to PSC and drop precedence) for a given such LSP is either explicitly signaled at label set-up or relies on a pre-configured mapping.

This is an update to RFC 3032 [RFC3032], in line with the original intent of how this field in the MPLS Shim Header should be used (as a TC field). RFC 3270 has itself been updated by RFC 5129 [RFC5129].

Detailed operations of E-LSPs are specified in Section 3 of RFC 3270.

### 2.3. RFC 5129

RFC 5129 is now updated like this:

A new paragraph is added at the end of Section 1.1 "Background":

> The EXP field has been renamed to the TC field, and thus all references in RFC 5129 to the EXP field now refer to the TC field.

Section 2 (bullet 5) on page 7 of RFC 5129 says:

- A third possible approach was suggested by [Shayman]. In this scheme, interior LSRs assume that the endpoints are ECN-capable, but this assumption is checked when the final label is popped. If an interior LSR has marked ECN in the EXP field of the shim header, but the IP header says the endpoints are not ECN-capable, the edge router (or penultimate router, if using penultimate hop popping) drops the packet. We recommend this scheme, which we call ‘per-domain ECT checking’, and define it more precisely in the following section. Its chief drawback is that it can cause packets to be forwarded after encountering congestion only to be dropped at the egress of the MPLS domain. The rationale for this decision is given in Section 8.1.

Section 2 (bullet 5) of RFC 5129 is now updated to:

- o A third possible approach was suggested by [Shayman]. In this scheme, interior LSRs assume that the endpoints are ECN-capable, but this assumption is checked when the final label is popped. If an interior LSR has marked ECN in the TC field of the shim header, but the IP header says the endpoints are not TC-capable, the edge router (or penultimate router, if using penultimate hop popping) drops the packet. We recommend this scheme, which we call 'per-domain ECT checking', and define it more precisely in the following section. Its chief drawback is that it can cause packets to be forwarded after encountering congestion only to be dropped at the egress of the MPLS domain. The rationale for this decision is given in Section 8.1. This scheme is an update to RFC 3032 [RFC3032] and RFC 3270 [RFC3270].

## 2.4. The Scope of This Change

There are several places in the RFCs that are explicitly updated by this document that reference the "Exp field", sometimes they refer to the field as "Exp bits", "EXP bits", or "EXP". In all those instances, the references now reference the TC field.

There are also other RFCs (e.g., RFC 3272 [RFC3272], RFC 3443 [RFC3443], RFC 3469 [RFC3469], RFC 3564 [RFC3564], RFC 3985 [RFC3985], RFC 4182 [RFC4182], RFC 4364 [RFC4364], RFC 4379 [RFC4379], RFC 4448 [RFC4448], and RFC 4761 [RFC4761]) that reference the "Exp field"; sometimes they refer to the field as "Exp bits", "EXP bits", and "EXP". For all RFCs, including but not limited to those mentioned in this paragraph, such references now reference the TC field.

# 3. Use of the TC field

Due to the limited number of bits in the TC field, their use for QoS and ECN (Explicit Congestion Notification) functions is intended to be flexible. These functions may rewrite all or some of the bits in the TC field.

Current implementations look at the TC field with and without label context, and the TC field may be copied to the label stack entries that are pushed onto the label stack. This is done to avoid label stack entries that are pushed onto an existing label stack having different TC fields from the rest of the label stack entries.

## 4. Security Considerations

This document only changes the name of one field in the MPLS shim header, and thus does not introduce any new security considerations.

## 5. Acknowledgments

The authors would like to thank Stewart Bryant, Bruce Davie, George Swallow, and Francois Le Faucheur for their input to and review of the current document.

The authors would also like to thank George Swallow, Khatri Paresh, and Phil Bedard for their help with grammar and spelling; a special thanks to Adrian Farrel for his careful review and help trawling the RFC-sea for RFCs that reference the EXP field.

## 6. References

### 6.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3032] Rosen, E., Tappan, D., Fedorkow, G., Rekhter, Y., Farinacci, D., Li, T., and A. Conta, "MPLS Label Stack Encoding", RFC 3032, January 2001.

[RFC3270] Le Faucheur, F., Wu, L., Davie, B., Davari, S., Vaananen, P., Krishnan, R., Cheval, P., and J. Heinanen, "Multi-Protocol Label Switching (MPLS) Support of Differentiated Services", RFC 3270, May 2002.

[RFC3272] Awduche, D., Chiu, A., Elwalid, A., Widjaja, I., and X. Xiao, "Overview and Principles of Internet Traffic Engineering", RFC 3272, May 2002.

[RFC3443] Agarwal, P. and B. Akyol, "Time To Live (TTL) Processing in Multi-Protocol Label Switching (MPLS) Networks", RFC 3443, January 2003.

[RFC3469] Sharma, V. and F. Hellstrand, "Framework for Multi-Protocol Label Switching (MPLS)-based Recovery", RFC 3469, February 2003.

[RFC3564] Le Faucheur, F. and W. Lai, "Requirements for Support of Differentiated Services-aware MPLS Traffic Engineering", RFC 3564, July 2003.

[RFC3985] Bryant, S. and P. Pate, "Pseudo Wire Emulation Edge-to-Edge (PWE3) Architecture", RFC 3985, March 2005.

[RFC4182] Rosen, E., "Removing a Restriction on the use of MPLS Explicit NULL", RFC 4182, September 2005.

[RFC4364] Rosen, E. and Y. Rekhter, "BGP/MPLS IP Virtual Private Networks (VPNs)", RFC 4364, February 2006.

[RFC4379] Kompella, K. and G. Swallow, "Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures", RFC 4379, February 2006.

[RFC4448] Martini, L., Rosen, E., El-Aawar, N., and G. Heron, "Encapsulation Methods for Transport of Ethernet over MPLS Networks", RFC 4448, April 2006.

[RFC4761] Kompella, K. and Y. Rekhter, "Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signaling", RFC 4761, January 2007.

[RFC5129] Davie, B., Briscoe, B., and J. Tay, "Explicit Congestion Marking in MPLS", RFC 5129, January 2008.

## 6.2. Informative References

[Shayman] Shayman, M. and R. Jaeger, "Using ECN to Signal Congestion Within an MPLS Domain", Work in Progress, November 2000.

## Authors' Addresses

Loa Andersson
Acreo AB

EMail: loa@pi.nu

Rajiv Asati
Cisco Systems

EMail: rajiva@cisco.com