Francois Le Faucheur
Thomas D. Nadeau
Cisco Systems, Inc.

Angela Chiu
AT&T

William Townsend
Tenor Networks

Darek Skalecki
Nortel Networks

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Extensions to IS-IS, OSPF, RSVP and CR-LDP
for support of Diff-Serv-aware MPLS Traffic Engineering

Status of this Memo

Abstract

A companion document [DIFF-TE-REQTS] defines the requirements for support of Diff-Serv-aware MPLS Traffic Engineering on a per-Class-Type basis, as discussed in the Traffic Engineering Working Group Framework document [TEWG-FW].

This document proposes corresponding extensions to OSPF, ISIS, RSVP and CR-LDP for support of Traffic Engineering on a per-Class-Type basis.

1. Introduction

As Diffserv becomes prominent in providing scalable multi-class of services in IP networks, performing traffic engineering at a per-class level instead of an aggregated level is needed to further enhance networks in performance and efficiency. By mapping a traffic trunk in a given class on a separate LSP, it allows the traffic trunk to utilize resources available on both shortest path(s) and non-shortest paths and follow paths that meet constraints which are specific to the given class. It also allows each class to select the proper protection/restoration mechanism(s) that satisfy its survivability requirements in a cost effective manner.

Besides the set of parameters defined for the general aggregate TE [TE-REQ], a new set of per-class parameters needs to be provided at each LSR interface and propagated via extensions to the IGP (ISIS/OSPF) [TEWG-FW]. Furthermore, the per-class parameters can be aggregated into per-Class-Type parameters. The main motivation for grouping a set of classes into a Class-Type is to improve the scalability of the IGP link state advertisements by propagating information on a per-Class-Type basis instead of on a per-class basis. This approach also has the benefit of allowing better bandwidth sharing between classes in the same Class-Type.

A Class-Type [TEWG-FW] is defined as a set of classes that satisfy the following two conditions:

1) Classes in the same Class-Type possess common aggregate maximum and minimum bandwidth requirements to guarantee the required performance level.

2) There is no maximum or minimum bandwidth requirement to be enforced at the level of an individual class within the Class-Type. One can still implement some "priority" policies for classes within the same Class-Type in terms of accessing the Class-Type bandwidth (e.g. via the use of preemption priorities).

An example of Class-Type comprising multiple Diff-Serv classes is a low-loss Class-Type that includes both AF1-based and AF2-based Ordering Aggregates.

Note that with per Class-Type TE, Constraint-Based Routing is performed with bandwidth constraints on a per Class-Type basis but LSPs may carry a single Diff-Serv class (Ordered Aggregate) with Diff-Serv scheduling (i.e. PHB) performed separately for each class. Diff-Serv scheduling parameters for a given class within a Class-Type may be automatically adjusted by the LSRs based on the bandwidth of all LSPs currently established for each class within the Class-Type.

In this document, we will only discuss "per Class-Type TE" because "per Class TE" can be viewed as a special case of per Class-Type TE (where each Class-Type is degenerated into a single Diff-Serv class).

This document focuses on intra-domain operations. Inter-domain operations is for further study.

A companion document [DIFF-TE-REQTS] defines the requirements for support of MPLS Traffic Engineering on a per-Class-Type basis. The following sections propose detailed extensions to OSPF, ISIS, RSVP and CR-LDP that meet those requirements.

2. OSPF Extensions

In this section we propose extensions to OSPF for support of Diff-Serv Traffic Engineering on a per-Class-Type basis which meet the requirements defined in [DIFF-TE-REQTS]. These extensions are in addition to the extensions already defined for support of (aggregate) MPLS Traffic Engineering [OSPF-TE].

2.1. Existing TE Sub-TLVs

[OSPF-TE] defines a new LSA for support of (aggregate) Traffic Engineering, which is referred to as the Traffic Engineering LSA. This LSA contains a Link TLV (Type 2) comprising a number of sub-TLVs.

In this document we refer to the sub-TLV 7 (maximum reservable bandwidth) of the Link TLV (as defined in [OSPF-TE]) as the "Maximum Reservable Aggregate Bandwidth".

We also refer to the sub-TLV 8 (unreserved bandwidth) of the Link TLV (as defined in [OSPF-TE]) as the "Unreserved Bandwidth for Class-Type 0".

2.2. New Sub-TLVs

The following additional sub-TLVs are defined for the Link TLV of the Traffic Engineering LSA (sub-TLV numbers to be allocated)

```
TBD   - Unreserved Bandwidth for Class-Type 1 (32 octets)
TBD+1 - Unreserved Bandwidth for Class-Type 2 (32 octets)
TBD+2 - Unreserved Bandwidth for Class-Type 3 (32 octets)
```

Each sub-TLV may occur only once. Unrecognized types are ignored.

Unlike the sub-TLVs defined for the Link TLV in [OSPF-TE], the additional sub-TLVs defined above are optional.

The Link TLV may include the sub-TLVs for any subset of the three additional Class-Types. In other words, the Link TLV may contain none of the three sub-TLVs defined above, any one of those, any two of those, or the three sub-TLVs. Where a Class-Type is not effectively used in a network, it is recommended that the corresponding sub-TLV is not included in the Link TLV. For instance, a Network Administrator may elect to use Diff-Serv Traffic Engineering in order to compute separate routes for data traffic and voice traffic (and apply different bandwidth constraints to the route computation for those). In that case, the IGP would only advertise the sub-TLV for one additional Class-Type (i.e. the Link TLV would contain sub-TLV 7 for the Maximum Reservable Aggregate Bandwidth, sub-TLV 8 for the Unreserved Bandwidth for Class-Type 0 and sub-TLV TBD for Unreserved Bandwidth for Class-Type 1).

An LSR which supports Class-Type N and receiving a Link TLV without the sub-TLV corresponding to Class-Type N, interprets this as meaning that the corresponding link does not support Class-Type N. For Constraint Based Routing purposes, the LSR may consider this equivalent to the case where the Link TLV contains an Unreserved Bandwidth for Class-Type N sub-TLV set to zero.

2.3. Sub-TLV Details

The Unreserved Bandwidth for Class-Type N (N= 1,2,3) sub-TLV specifies the amount of bandwidth not yet reserved at each of the eight preemption priority levels for Class-Type N, in IEEE floating point format. Each value will be less than or equal to the Maximum Reservable Bandwidth for Class-Type N. The units are bytes per second. The values correspond to the bandwidth that can be reserved with a holding priority of 0 through 7, arranged in increasing order with priority 0 occurring at the start of the sub-TLV, and priority 7 at the end of the sub-TLV.

The Unreserved Bandwidth for Class-Type N sub-TLV is TLV type (TBD-1+N) , and is 32 octets in length.

3. ISIS Extensions

In this section we describe extensions to IS-IS for support of Diff-Serv Traffic Engineering on a per-Class-Type basis which meet the requirements defined in [DIFF-TE-REQTS]. These extensions are in addition to the extensions required to support (aggregate) MPLS

Traffic Engineering [ISIS-TE].

3.1. Existing TE sub-TLVs

[ISIS-TE] defines new extended TLVs for support of (aggregate) Traffic Engineering. One of these extended TLV is referred to as the extended IS reachability TLV (TLV type 22). This TLV contains a number of new sub-TLVs.

In this document we refer to the sub-TLV 10 (maximum reservable bandwidth) of the extended IS reachability TLV (as defined in [ISIS-TE]) as the "Maximum Reservable Aggregate Bandwidth".

We also refer to the sub-TLV 11 (unreserved bandwidth) of the extended IS reachability TLV (as defined in [ISIS-TE]) as the "Unreserved Bandwidth for Class-Type 0".

3.2. New Sub-TLVs

The following additional sub-TLVs are defined for the extended IS reachability TLV (sub-TLV numbers to be allocated):

```
TBD   - Unreserved bandwidth for Class-Type 1 (32 octets)
TBD+1 - Unreserved bandwidth for Class-Type 2 (32 octets)
TBD+2 - Unreserved bandwidth for Class-Type 3 (32 octets)
```

Each sub-TLV may occur only once. Unrecognized types are ignored.

The additional sub-TLVs defined above are optional so that they may or may not be included in the extended IS reachability TLV.

The extended IS reachability TLV may include the sub-TLVs for any subset of the three additional Class-Types. In other words, the IS reachability TLV may contain none of the three sub-TLVs defined above, any one of those, any two of those, or the three sub-TLVs. Where a Class-Type is not effectively used in a network, it is recommended that the corresponding sub-TLV is not included in the IS reachability TLV. For instance, a Network Administrator may elect to use Diff-Serv Traffic Engineering in order to compute separate routes for data traffic and voice traffic (and apply different bandwidth constraints to the route computation for those). In that case, the IGP would only advertise the sub-TLV for one additional Class-Type (i.e. the extended IS reachability TLV would contain sub-TLV 10 for the Maximum Reservable Aggregate Bandwidth, sub-TLV 11 for the Unreserved Bandwidth for Class-Type 0 and sub-TLV TBD for Unreserved Bandwidth for Class-Type 1).

An LSR which supports Class-Type N and receiving an extended IS reachability TLV without the sub-TLV corresponding to Class-Type N, interprets this as meaning that the corresponding link does not support Class-Type N. For Constraint Based Routing purposes, the LSR may consider this equivalent to the case where the extended IS reachability TLV contains an Unreserved Bandwidth Class-Type N sub-TLV set to zero.

3.3. Sub-TLV Details

The Unreserved Bandwidth for Class-Type N (N= 1,2,3) sub-TLVs specifies the amount of bandwidth not yet reserved at each of the eight preemption priority levels for Class-Type N, in IEEE floating

point format. Each value will be less than or equal to the Maximum Reservable Bandwidth for Class-Type N. The units are bytes per second. The values correspond to the bandwidth that can be reserved with a holding priority of 0 through 7, arranged in increasing order with priority 0 occurring at the start of the sub-TLV, and priority 7 at the end of the sub-TLV.

The Unreserved Bandwidth for Class-Type N sub-TLV is TLV type (TBD-1+N), and is 32 octets in length.

4. RSVP Extensions

In this section we describe extensions to RSVP for support of Diff-Serv Traffic Engineering on a per-Class-Type basis which meet the requirements defined in [DIFF-TE-REQTS]. These extensions are in addition to the extensions to RSVP defined in [RSVP-TE] for support of (aggregate) MPLS Traffic Engineering and to the extensions to RSVP defined in [DIFF-MPLS] for support of Diff-Serv over MPLS.

4.1. Diff-Serv related RSVP Messages Format

One new RSVP Object is defined in this document: the CLASSTYPE Object. Detailed description of this Object is provided below. This new Object is applicable to Path messages. This specification only defines the use of the CLASSTYPE Object in Path messages used to establish LSP Tunnels in accordance with [RSVP-TE] and thus containing a Session Object with a C-Type equal to LSP_TUNNEL_IPv4 and containing a LABEL_REQUEST object.

Restrictions defined in [RSVP-TE] for support of establishment of LSP Tunnels via RSVP are also applicable to the establishment of LSP Tunnels supporting Diff-Serv Traffic Engineering. For instance, only unicast LSPs are supported and Multicast LSPs are for further study.

This new CLASSTYPE object is optional with respect to RSVP so that general RSVP implementations not concerned with MPLS LSP set up do not have to support this object.

An LSR supporting Diff-Serv Traffic Engineering on a per-Class-Type basis in compliance with this specification MUST support the CLASSTYPE Object. It MUST support Class-Type value 1, and MAY support other Class-Type values.

4.1.1. Path Message Format

The format of the Path message is as follows:

```
<Path Message> ::=      <Common Header> [ <INTEGRITY> ]
                        <SESSION> <RSVP_HOP>
                        <TIME_VALUES>
                        [ <EXPLICIT_ROUTE> ]
```



```
                        <LABEL_REQUEST>
                        [ <SESSION_ATTRIBUTE> ]
                        [ <DIFFSERV> ]
                        [ <CLASSTYPE> ]
                        [ <POLICY_DATA> ... ]
                        [ <sender descriptor> ]

<sender descriptor> ::=  <SENDER_TEMPLATE> [ <SENDER_TSPEC> ]
                        [ <ADSPEC> ]
                        [ <RECORD_ROUTE> ]
```

4.2. CLASSTYPE Object

The CLASSTYPE object format is shown below.

4.2.1. CLASSTYPE object

class = TBD, C_Type = 1 (need to get an official class num from the IANA with the form 0bbbbbbb)

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Reserved                                           |CT |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Reserved : 30 bits
    This field is reserved. It must be set to zero on transmission
    and must be ignored on receipt.

CT : 2 bits
    Indicates the Class-Type. Values currently allowed are 1, 2 and
    3.

4.3. Handling CLASSTYPE Object

To establish an LSP tunnel with RSVP, the sender LSR creates a Path message with a session type of LSP_Tunnel_IPv4 and with a LABEL_REQUEST object as per [RSVP-TE]. The sender LSR may also include the DIFFSERV object as per [DIFF-MPLS].

If the LSP is associated with Class-Type 0, the sender LSR must not include the CLASSTYPE object in the Path message.

If the LSP is associated with Class-Type N (N=1,2,3), the sender LSR must include the CLASSTYPE object in the Path message with the Class-Type (CT) field set to N.

[Editor's Note: additional options whereby the Class-Type could be determined by the LSR without explicit Class-Type signaling are

investigated. For example, the Class-Type could be determined from Diff-Serv information already signaled such as the PSC for an L-LSP and using a PSC<-->Class-Type mapping locally configured]

If a path message contains multiple CLASSTYPE objects, only the first one is meaningful; subsequent CLASSTYPE object(s) must be ignored and not forwarded.

Each LSR along the path records the CLASSTYPE object, when present, in its path state block.

If the CLASSTYPE object is not present in the Path message, the LSR must associate the Class-Type 0 to the LSP.

The destination LSR responds to the Path message by sending a Resv message without a CLASSTYPE object (whether the Path message contained a CLASSTYPE object or not).

During establishment of an LSP corresponding to the Class-Type N, the LSR performs admission control over the bandwidth available for that particular Class-Type, which is computed using the smallest of:

- the Class-Type N bandwidth currently unreserved (i.e. the difference between the Maximum Reservable Bandwidth for Class-Type N and the bandwidth reserved by existing Class-Type N LSPs).
- the aggregate bandwidth currently unreserved (i.e. the difference between the Maximum Reservable Aggregate Bandwidth and the bandwidth reserved by existing LSPs of all Class-Types).

In order to accurately apportion the resources associated with a Class-Type among the classes comprised in this Class-Type, the LSR may automatically adjust Diff-Serv scheduling parameters associated with a class within a Class-Type based on the bandwidth currently reserved by LSPs currently established in that class.

An LSR that recognizes the CLASSTYPE object and receives a path message which contains the CLASSTYPE object but which does not contain a LABEL_REQUEST object or which does not have a session type of LSP_Tunnel_IPv4, must send a PathErr towards the sender with the error code `Diff-Serv TE Error' and an error value of `Unexpected CLASSTYPE object'. Those are defined below in section 4.5.

An LSR receiving a Path message with the CLASSTYPE object, which recognizes the CLASSTYPE object but does not support the particular Class-Type, must send a PathErr towards the sender with the error code `Diff-Serv TE Error' and an error value of `Unsupported Class-Type'. Those are defined below in section 4.5.

An LSR receiving a Path message with the CLASSTYPE object, which recognizes the CLASSTYPE object but determines that the Class-Type value is not valid (i.e. Class-Type value 0), must send a PathErr towards the sender with the error code `Diff-Serv TE Error' and an

error value of `Invalid Class-Type value'. Those are defined below in section 4.5.

An LSR MUST handle the situations where the LSP can not be accepted for other reasons than those already discussed in this section, in accordance with [RSVP-TE] and [DIFF-MPLS] (e.g. a reservation is rejected by admission control, a label can not be associated).

4.4. Non-support of the CLASSTYPE Object

An LSR that does not recognize the CLASSTYPE object Class-Num must behave in accordance with the procedures specified in [RSVP] for an unknown Class-Num whose format is 0bbbbbbb (i.e. it must send a PathErr with the error code `Unknown object class' toward the sender).

An LSR that recognizes the CLASSTYPE object Class-Num but does not recognize the CLASSTYPE object C-Type, must behave in accordance with the procedures specified in [RSVP] for an unknown C-type (i.e. it must send a PathErr with the error code `Unknown object C-Type' toward the sender).

In both situations, this causes the path set-up to fail. The sender should notify management that a LSP cannot be established and possibly might take action to retry reservation establishment without the CLASSTYPE object.

4.5. Error Codes For Diff-Serv TE

In the procedures described above, certain errors must be reported as a `Diff-Serv TE Error'. The value of the `Diff-Serv TE Error' error code is (TBD).

The following defines error values for the Diff-Serv TE Error:

Value	Error
1	Unexpected CLASSTYPE object
2	Unsupported Class-Type
3	Invalid Class-Type value

5. CR-LDP Extensions

CR-LDP, defined in [CR-LDP], is an extension to LDP, defined in [LDP], for support of (aggregate) MPLS Traffic Engineering. In this section we describe extensions to CR-LDP for support of Diff-Serv Traffic Engineering on a per-Class-Type basis which meet the requirements defined in [DIFF-TE-REQTS]. These extensions are in addition to the extensions to LDP defined in [DIFF-MPLS] for support of Diff-Serv over MPLS. They closely resemble the extensions to RSVP defined in the previous section.

Note that extensions of this section for support of Diff-Serv Traffic Engineering are not applicable to LDP due to the fact that LDP does not support MPLS Traffic Engineering and bandwidth reservation in particular.

5.1. Diff-Serv related CR-LDP Messages Encoding

One new CR-LDP TLV is defined in this document: the Class Type TLV. Detailed description of this TLV is provided below. This new TLV is applicable to Label Request messages.

Restrictions defined in [CR-LDP] for support of establishment of LSPs via CR-LDP are also applicable to the establishment of LSPs supporting Diff-Serv Traffic Engineering: for instance, only unicast LSPs are supported and multicast LSPs are for further study.

This new Class Type TLV is optional with respect to CR-LDP so that general CR-LDP implementations not concerned with per-Class-Type Diff-Serv Traffic Engineering do not have to support this TLV.

An LSR supporting Diff-Serv Traffic Engineering on a per-Class-Type basis in compliance with this specification MUST support the Class Type TLV. It MUST support Class-Type value 1, and MAY support other Class-Type values.

5.1.1. Label Request Message Encoding

The encoding for the CR-LDP Label Request message is extended as follows, to optionally include the Class Type TLV:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|   Label Request (0x0401)   |      Message Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Message ID                                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     FEC TLV                                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Diff-Serv TLV        (LDP, optional)      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Class Type TLV       (CR-LDP optional)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Other CR-LDP TLVs                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The extension is based on a related LDP extension, defined in [DIFF-MPLS], for support of Diff-Serv TLV but further extended for CR-LDP with CR-LDP TLVs.

5.2. Class Type TLV

The Class Type TLV has the following form:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0|       Class Type TLV     |      Length                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Reserved                                           |CT |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Reserved : 30 bits
    This field is reserved. It must be set to zero on transmission and must be ignored on receipt.

CT : 2 bits
    Indicates the Class-Type. Values currently allowed are 1, 2 and 3.

5.3. Handling Class Type TLV

To establish an LSP using CR-LDP, an ingress LSR generates a Label Request message as per [CR-LDP]. This Label Request may optionally include the Diff-Serv TLV as defined in [DIFF-MPLS] for LDP but extended to CR-LDP.

If the LSP is associated with Class-Type 0, the ingress LSR must not include the Class Type TLV in the Label Request message.

If the LSP is associated with Class-Type N (N=1,2,3), the ingress LSR must include the Class Type TLV in the Label Request message with the Class-Type (CT) field set to N.

[Editor's Note: additional options whereby the Class-Type could be determined by the LSR without explicit Class-Type signaling are investigated. For example, the Class-Type could be determined from Diff-Serv information already signaled such as the PSC for an L-LSP and using a PSC<-->Class-Type mapping locally configured]

If a Label Request message contains multiple Class Type TLVs, only the first one is meaningful; subsequent Class Type TLV(s) must be ignored and not forwarded.

If the Class Type TLV is not present in the Label Request message, an LSR must associate the Class-Type 0 to the LSP.

A downstream LSR sending a Label Mapping message in response to a Label Request message must not include the Class-Type TLV (whether the Class-Type TLV was included in the Label Request message or not).

During establishment of an LSP corresponding to the Class-Type N, an LSR performs admission control over the bandwidth available for that particular Class-Type, which is computed using the smallest of:

- the Class-Type N bandwidth currently unreserved (i.e. the difference between the Maximum Reservable Bandwidth for Class-Type N and the bandwidth reserved by existing Class-Type N LSPs).
- the aggregate bandwidth currently unreserved (i.e. the difference between the Maximum Reservable Aggregate Bandwidth and the bandwidth reserved by existing LSPs of all Class-Types).

In order to accurately apportion the resources associated with a Class-Type among the classes comprised in this Class-Type, an LSR may automatically adjust Diff-Serv scheduling parameters associated with a class within a Class-Type based on the bandwidth currently reserved by LSPs currently established in that class.

An LSR that recognizes the Class Type TLV and receives a Label Request message which contains the Class Type TLV but which does not contain any of the CR-LDP TLVs, must reject the label request by sending upstream a Notification message which includes the Status TLV with a Status Code of 'Unexpected Class-Type TLV'. This is defined below in section 5.4. This error can only occur when an LDP LSP as opposed to CR-LDP LSP is being established. As was already mentioned, Class Type TLV extension for Diff-Serv Traffic Engineering is not applicable to LDP.

An LSR receiving a Label Request message with the Class Type TLV, which recognizes the Class Type TLV but does not support the particular Class-Type, must reject the label request by sending upstream a Notification message which includes the Status TLV with a Status Code of 'Unsupported Class-Type'. This is defined below in section 5.4.

An LSR receiving a Label Request message with the Class Type TLV, which recognizes the Class Type TLV but determines that the Class-Type value is not valid (i.e. Class-Type value 0), must reject the label request by sending upstream a Notification message which includes the Status TLV with a Status Code of 'Invalid Class-Type value'. This is defined below in section 5.4.

An LSR MUST handle the situations where the LSP can not be accepted for other reasons than those already discussed in this section, in accordance with [CR-LDP], [LDP] and [DIFF-MPLS] (e.g. reservation rejected by admission control, a label can not be associated).

5.4. Status Code Values for Diff-Serv TE

In the procedures described above, certain errors must be reported. The following values are defined for the Status Code field of the Status TLV:

Status Code	E	Status Data
Unexpected Class Type TLV	0	TBD
Unsupported Class-Type	0	TBD
Invalid Class-Type value	0	TBD

6. Security Considerations

This document raises no new security issues for IS-IS, OSPF, RSVP or CR-LDP. The security mechanisms already proposed for these technologies may be used.

7. Acknowledgments

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Authors' Address:

Francois Le Faucheur
Cisco Systems, Inc.
Petra B - Les Lucioles - 291, rue Albert Caquot - 06560 Valbonne - France
Phone: +33 4 92 96 75 64
Email: flefauch@cisco.com

Angela Chiu
AT&T Labs
Rm 4-204,100 Schulz Dr., Red Bank, NJ 07701
USA
Phone: +1 (732) 345-3441
Email: alchiu@att.com

William Townsend
Tenor Networks
100 Nagog Park
Acton, MA 01720
Phone: +1-978-264-4900
Email: btownsend@tenornetworks.com

Thomas D. Nadeau
Cisco Systems, Inc.
250 Apollo Drive
Chelmsford, MA 01824
Phone: +1-978-244-3051
Email: tnadeau@cisco.com

Darek Skalecki
Nortel Networks
3500 Carling Ave,
Nepean K2H 8E9
Phone: +1-613-765-2252
Email: dareks@nortelnetworks.com