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Encoding of Attributes for Multiprotocol Label Switching (MPLS) Label Switched Path (LSP) Establishment Using RSVP-TE

[draft-ietf-mpls-rsvp-te-attributes-00.txt](#)

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Abstract

Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) may be established using the Resource Reservation Protocol Traffic Engineering extensions (RSVP-TE). This protocol includes an object (the SESSION_ATTRIBUTE object) which carries a flags field used to indicate options and attributes of the LSP. That flags field has eight bits allowing for eight options to be set.

Recent proposals in many documents that extend RSVP-TE for signaling additional features and function for MPLS LSPs have suggested uses

for each of the previously unused bits.

This document defines a new object for RSVP-TE messages that allows the signaling of further attribute bits and also the carriage of arbitrary attribute parameters. This makes RSVP-TE easily extensible to support new requirements.

1. Introduction and Problem Statement

Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) [[RFC3031](#)] may be established using the RSVP-TE signaling protocol [[RFC3209](#)]. This protocol uses the Path message to request that a LSP be set up. The Path message includes the SESSION_ATTRIBUTE object which carries a flags field used to indicate desired options and attributes of the LSP.

The flags field in the SESSION_ATTRIBUTE object has eight bits. Just three of those bits are assigned in [[RFC3209](#)]. A further two bits are assigned in [[FRR](#)] for fast re-reroute functionality leaving only three bits available. Several recent proposals and Internet Drafts have demonstrated that there is a high demand for the use of the other three bits. Some, if not all, of those proposals are likely to go forward as RFCs resulting in depletion or near depletion of the flags field and a consequent difficulty in signaling new options and attributes that may be developed in the future.

This document defines a new object for RSVP-TE messages that allows the signaling of further attributes bits. The new object is constructed from TLVs, and a new TLV is defined to carry up to thirty two new attributes bits. Because of the nature of the TLV construction the object is flexible and allows the future definition of:

- further sets of thirty two bits if more flags are needed to carry yet more attributes
- arbitrary options and attributes parameters carried as individual TLVs.

It is noted that that some options and attributes do not need to be acted on by all Label Switched Routers (LSRs) along the path of the LSP. In particular, these options and attributes may apply only to key LSRs on the path such as the ingress and egress. Special transit LSRs, such as AS Border Routers (ASBRs) may also fall into this category. This means that the new options and attributes should be signaled transparently, and only examined at those points that need to act on them.

On the other hand, other options and attributes may require action

at all transit LSRs along the path of the LSP. Inability to support the required attributes by one of those transit LSRs may require the LSR to refuse the establishment of the LSP.

These considerations are particularly important in the context backwards compatibility. In general, it should be possible to provide new MPLS services across a legacy network without upgrading those LSRs that do not need to participate actively in the new services.

RSVP includes a way for unrecognized objects to be forwarded by transit nodes without them refusing the protocol message and with the objects being stripped from the protocol message (see [\[RFC2205\]](#) [section 3.10](#)). This extends to RSVP-TE and provides a good way to ensure that only those LSRs that understand a particular object examine it.

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This document distinguishes between options and attributes that are only required at key LSRs along the path of the LSP, and those that must be acted on by every LSR along the LSP. Two LSP Attributes objects are defined in this document: the first may be passed transparently by LSRs that do not recognize it, the second must cause LSP setup failure with the generation of a PathErr message if an LSR does not recognize it.

Comments on this document should be made direct to the MPLS mailing list at mpls@uu.net.

[1.1](#) Applicability to Generalized MPLS

The RSVP-TE signaling protocol also forms the basis of a signaling protocol for Generalized MPLS (GMPLS) as described in [\[RFC3471\]](#) and [\[RFC3473\]](#). The extensions described in this document are intended to be equally applicable to MPLS and GMPLS.

[1.2](#) A Rejected Alternate Solution

A rejected alternate solution was to define a new C-Type for the existing SESSION_ATTRIBUTE object. This new C-Type could allow a larger Flags field and address the immediate problem.

This solution was rejected because:

- A C-Type is not backward compatible with deployed implementations that expect to see a C-Type of 1 or 7. It is important that any solution be capable of carrying new attributes transparently across legacy LSRs if those LSRs are not required to act on the

attributes.

- Support for arbitrary attributes parameters through TLVs would have meant a significant change of substance to the existing object.

1.3 Protocol Developments Without an Explicit Need

[This section to be removed if this draft proceeds towards an RFC.
References in this section are not intended to be normative.]

It is unusual and inadvised for the IETF to accept a speculative change to a protocol without an explicit need. That is, in this case, although there is an obvious problem identified, there is no existing Working Group proposal that requires further option bits. For today, the existing protocol objects are adequate.

There are, however, several Internet Drafts that propose additional attributes associated with LSP setup. These include [CRANKBACK], [REOPT] and [INTER-AS]. In view of the likelihood of one or more of these drafts advancing to RFC, and considering the probable requirement to be able to signal further options and attributes for other purposes in the very near future, it is proposed that this document be debated within the MPLS Working Group so that a solution will be available should the need arise.

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Further, the lack of a considered approach to handle the shortage of SESSION_ATTRIBUTE flags might give rise to a range of diverse solutions each developed within the context of a single protocol extension. Clearly a single coherent solution is better.

[This section to be removed if this draft proceeds towards an RFC.]

2. Terminology

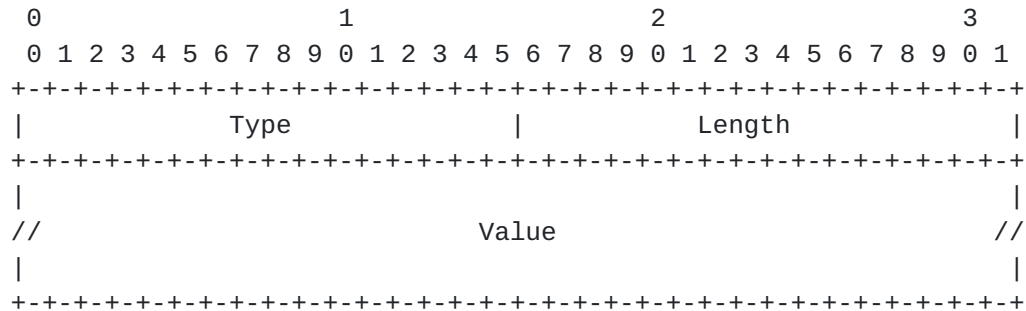
This document uses terminology from the MPLS architecture document [RFC3031] and from the RSVP-TE protocol specification [RFC3209] which inherits from the RSVP specification [RFC2205].

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 RFC2119 [6].

3. Attributes TLVs

Attributes carried by the new objects defined in this document are

Each TLV is encoded as follows.



The identifier of the TLV.

The length of the value field in bytes. Thus if no value field is present the length field contains the value zero. Each value field must be zero padded at the end to take it up to a four byte boundary - the padding is not included in the length so that a one byte value would be encoded in an eight byte TLV with length field set to one.

The data for the TLV padded as described above.

This document defines only one TLV type value. Type 1 indicates the Attributes Flags TLV. Other TLV types may be defined in future with type values assigned by IANA.

The Attributes Flags TLV value field is a 32 bit array of flags numbered from the MSB as bit zero. The length field for this TLV is set to 4.

Unassigned bits are considered as reserved and MUST be set to zero on transmission and ignored on receipt.

No bits are defined in this document. The assignment of bits is managed by IANA.

4. LSP_ATTRIBUTES Object

The LSP_ATTRIBUTES object is used to signal attributes required in support of an LSP, or to indicate the nature or use of an LSP where that information is not required to be acted on by all transit LSRs. Specifically, if an LSR does not support the object, it forwards it unexamined and unchanged. This facilitates the exchange of attributes across legacy networks that do not support this new object.

This object effectively extends the flags field in the SESSION_ATTRIBUTE object and allows for the future inclusion of more complex objects through TLVs.

The LSP_ATTRIBUTES object class is TBD of the form 11bbbbbb. This C-Num value (see [section 7](#)) ensures that LSRs that do not recognize the object pass it on transparently.

One C-Type is defined, C-Type = 1 for LSP Attributes.

This object is optional and may be placed on Path messages to convey additional information about the desired attributes of the LSP.

4.1 Format

LSP_ATTRIBUTES class = TBD, C-Type = 1

```

      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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                                     |
//                               Attributes TLVs                               //
|                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

The Attributes TLVs are encoded as described in [section 3](#).

4.2 Generic Processing Rules

An LSR that does not support this object will pass it on unaltered because of the C-Num.

An LSR that does support this object, but does not recognize a TLV type code carried in this object, or recognizes the TLV but does not support the attribute MUST act as specified in the document that defines the TLV.

An LSR that supports the Attributes Flags TLV, but does not recognize a bit set in the Attributes Flags TLV MUST forward the object unchanged.

An LSR that supports the Attributes Flags TLV and recognizes a bit that is set but does not support the indicated attribute MUST act as specified in the document that defines the bit.

5. LSP_REQUIRED_ATTRIBUTES Object

The LSP_REQUIRED_ATTRIBUTES object is used to signal attributes required in support of a LSP, or to indicate the nature or use of a LSP where that information MUST be inspected at each transit LSR. Specifically, each transit LSR MUST examine the attributes in the LSP_REQUIRED_ATTRIBUTES object and MUST NOT forward the object transparently.

This object effectively extends the flags field in the SESSION_ATTRIBUTE object and allows for the future inclusion of more complex objects through TLVs. It complements the LSP_ATTRIBUTES object.

The LSP_REQUIRED_ATTRIBUTES object class is TBD of the form 0bbbbbbb. This C-Num value (see [section 7](#)) ensures that LSRs that do not recognize the object reject the LSP setup effectively saying that they do not support the attributes requested. This means that this object should only be used for attributes that require support at some transit LSRs and so require examination at all transit LSRs. See [section 4](#) for how end-to-end and selective attributes are signaled.

One C-Type is defined, C-Type = 1 for LSP Required Attributes.

This object is optional and may be placed on Path messages to convey additional information about the desired attributes of the LSP.

5.1 Format

LSP_REQUIRED_ATTRIBUTES class = TBD, C-Type = 1

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																	
+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-																	

7.1 New RSVP C-Nums and C-Types

Two new RSVP C-Nums are defined in this document and should be assigned by IANA.

o LSP_ATTRIBUTES object

The C-Num should be of the form 11bbbbbb so that LSRs that do not recognize the object will ignore the object but forward it, unexamined and unmodified, in all messages resulting from this message.

One C-Type is defined for this object and should be assigned by IANA.

o LSP Attributes TLVs

Recommended C-Type value 1.

o LSP_REQUIRED_ATTRIBUTES object

The C-Num should be of the form 0bbbbbbb so that LSRs that do not recognize the object will reject the message that carries it with an "Unknown Object Class" error.

One C-Type is defined for this object and should be assigned by IANA.

o LSP Required Attributes TLVs

Recommended C-Type value 1.

7.2 New TLV Space

The two new objects referenced above are constructed from TLVs. Each TLV includes a 16-bit type identifier (the T-field). The same T-field values are applicable to both objects.

IANA is requested to manage the space of TLV type identifiers as follows:

- TLV Type
- TLV Name
- Whether allowed on LSP_ATTRIBUTES object
- Whether allowed on LSP_REQUIRED_ATTRIBUTES object.

This document defines one TLV type as follows:

- TLV Type = 1
- TLV Name = LSP Attributes Flags
- allowed on LSP_ATTRIBUTES object
- allowed on LSP_REQUIRED_ATTRIBUTES object.

7.3 Attributes Flags

This document provides 32 new attributes bit flags for use in other documents that specify new RSVP-TE attributes. These flags are present in the LSP Attributes Flags TLV referenced in the previous section.

IANA is requested to manage the space of attributes bit flags numbering them in the usual IETF notation starting at zero.

7.4 SESSION_ATTRIBUTE Flags Field

This document does not make any alterations to the definition of the existing SESSION_ATTRIBUTE object nor to the definition of meanings assigned to the flags in the Flags field of that object. These flags are assigned meanings in various other RFCs and Internet Drafts.

It is suggested that IANA manage the allocation of meaning to the bits in the Flags field of the SESSION_ATTRIBUTE object to prevent accidental double allocation of any one bit.

7.5 New Error Codes

This document defines the following new error codes and error values. Numeric values should be assigned by IANA.

Error Code	Error Value
"Unknown Attributes TLV"	Identifies the unknown TLV type code.
"Unknown Attributes Bit"	Identifies the unknown Attribute Bit.

8. Security Considerations

This document adds two new objects to the RSVP Path message as used in MPLS and GMPLS signaling. It does not introduce any new direct security issues and the reader is referred to the security considerations expressed in [[RFC2205](#)], [[RFC3209](#)] and [[RFC3473](#)].

It is of passing note that any signaling request that indicates the functional preferences or attributes of an MPLS LSP may provide anyone with unauthorized access to the contents of the message with

information about the LSP that an administrator may wish to keep secret. Although this document adds new objects for signaling desired LSP attributes, it does not contribute to this issue which can only be satisfactorily handled by encrypting the content of the signaling message.

9. Acknowledgements

Credit to the OSPF Working Group for inspiration from their solution to a similar problem.

Thanks to Rahul Aggarwal for his careful review and support of this work. Thanks also to Raymond Zhang for his input.

10. Intellectual Property Consideration

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11. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2205] Braden, R. (Ed.), Zhang, L., Berson, S., Herzog, S. and S. Jamin, "Resource ReserVation Protocol --

Version 1 Functional Specification", [RFC 2205](#),
September 1997.

- [RFC3209] Awduche, D., Berger, L., Gan, D., Li, T.,
Srinivasan, V. and G. Swallow, "RSVP-TE: Extensions
to RSVP for LSP Tunnels", [RFC 3209](#), December 2001.
- [RFC3471] Berger, L. (Editor), "Generalized Multi-Protocol Label
Switching (GMPLS) Signaling Functional Description",
[RFC 3471](#), January 2003.
- [RFC3473] Berger, L. (Editor), "Generalized MPLS Signaling -
RSVP-TE Extensions", [RFC 3473](#) January 2003.
- [FRR] Pan, P. (Ed.), "Fast Reroute Extensions to RSVP-TE for
LSP Tunnels", <[draft-ietf-mpls-rsvp-lsp-fastreroute-03](#)
.txt>, Internet Draft, work in progress.

12. Informative References

- [RFC2026] Bradner, S., "The Internet Standards Process
-- Revision 3", [RFC 2026](#), October 1996.
- [RFC3031] Rosen, E., Viswanathan, A., and Callon, R.,
"Multiprotocol Label Switching
Architecture", [RFC 3031](#), January 2001.
- [INTER-AS] Vasseur, JP., Zhang, R., "Inter-AS MPLS Traffic
Engineering", <[draft-vasseur-inter-as-te-01.txt](#)>,
Internet Draft, work in progress.
- [OSPF-CAPS] Lindem, A., Shen, N., Aggarwal, R., Shaffer, S.,
Vasseur, JP., "Extensions to OSPF for Advertising
Optional Router Capabilities", <[draft-ietf-ospf-cap-00.txt](#)>,
Internet Draft, work in progress.
- [REOPT] Vasseur, JP., Ikejiri, Y., "Reoptimization of MPLS
Traffic Engineering loosely routed explicit LSP path",
<[draft-vasseur-mpls-loose-path-reopt-02.txt](#)>, Internet
Draft, work in progress.

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