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Updating the IANA MPLS LSP Ping Parameters
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Abstract

This document updates [RFC 8029](#) and [RFC 8611](#) that both define IANA registries for MPLS LSP Ping. It also updates the description of the procedures for the responses sent when an unknown or erroneous code point is found. The updates are to clarify and align this name space with recent developments.

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1. Introduction

There were a few reasons to start the work that have led to this document, e.g.:

- o When the LSP Ping registry was created it was incorrectly assumed that code points allocated by Experimental RFCs would be 'experimental' code points; a code point made available in a public IANA registry is not limited by the type of RFC that made the allocation but is available for any document.
- o The number of 'experimental' code points was also too large, as compared to what we normally allocated for "Experimental Use".
- o [RFC 8029](#) uses the words "mandatory" and "optional" differently from what others RFC does. [RFC 8029](#) for example talks about mandatory TLVs to indicate that it is mandatory to take a certain action if the TLV is found in a message but not recognized, other RFCs uses "mandatory TLV" to indicate a TLV that must be present in a message.

Over time there has been attempts administratively update some of the registries, but it was soon decided the an RFC was needed. We also found other, often minor, potential updates, e.g. reserving the value 0 (zero) in registries there that is possible.

When [RFC 8029](#) [[RFC8029](#)] was published it contained updates to the "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" IANA name space [[IANA-LSP-PING](#)].

[RFC 8611](#) [[RFC8611](#)] updated the LSP Ping IANA registries to match [RFC 8029](#). This document further clarifies the entries in those registries and makes the definitions more precise.

This document updates [RFC 8029](#) [[RFC8029](#)] and [RFC 8611](#) [[RFC8611](#)] by updating two groups of registries as follows:

First the registries for Message Types [[IANA-MT](#)], Reply Modes [[IANA-RM](#)] and Return Codes [[IANA-RC](#)] are updated. The changes to these registries are minor.

Second, this document updates the TLV and sub-TLV registries.

- o TLVs [[IANA-TLV-reg](#)].
- o Sub-TLVs for TLVs 1, 16 and 21 [[IANA-Sub-1-16-21](#)].
- o Sub-TLVs for TLV Type 6 [[IANA-Sub-6](#)].

- o Sub-TLVs for TLV 11 [[IANA-Sub-11](#)].
- o Sub-TLVs for TLV 20 [[IANA-Sub-20](#)].
- o Sub-TLVs for TLV 23 [[IANA-Sub-23](#)].
- o Sub-TLVs for TLV 27 [[IANA-Sub-27](#)].

The registry for sub-TLVs for TLV 9 [[IANA-Sub-9](#)] is not updated.

Third, some code points (TLVs and sub-TLVs) are "mandatory" or "optional". Contrary to how other RFCs use these words, indicating that it is mandatory or optional to include the code points in a message, [RFC 8029](#) uses these words to indicate that an action might or might not be necessary. This document updates [RFC 8029](#) to drop the words "mandatory" and "optional", and the text is changed to focus on what should be done.

[1.1.](#) Requirement 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 Used in this Document

This document uses some terms that relates to IANA registries in this way:

IANA Name Space,
a name space is a top level registry. An example could be "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" [[IANA-LSP-PING](#)]. A name space is most often a container for registries that hold code points that share some affinity.

IANA Registry,
an IANA registry holds code points, and lists the registration procedures and allocation of code points these code points. One example would be the "TLVs" registry [[IANA-TLV-reg](#)].

IANA Sub-registry,
a sub-registry is used when a code point, or a set of code points allocated in a single registry, needs "sub-code points" scoped by the code point or the set of code points. An example of a sub-

registry that holds code points for more than one TLV is "Sub-TLVs for TLV Types 1, 16, and 21" [[IANA-Sub-1-16-21](#)]

2. Updating the Message Types, Reply Mode and Return Codes Registries

The following changes are made to the Message Types, Reply Modes and Return Codes [[IANA-MT](#)] registries.

- o In the listing of assigned code points the term "Vendor Private Use" is changed to "Private Use".
- o The registration procedure "Specification Required" is changed to "RFC Required" and the note "Experimental RFC needed" is removed.
- o A small set of code points (4 code points) for Experimental Use is added by reducing the "RFC Required" range.
- o The registration procedures "Private Use" and "Experimental Use" are added to the table of registration procedures.
- o A note "Not to be assigned" is added for the registration procedures "Private Use" and "Experimental Use".
- o In the lists that capture the assignment status, the fields that are reserved, i.e., 0 (zero), Private Use and Experimental Use are clearly marked as such.
 - * Note that in the Return Codes registry [[IANA-RC](#)] the code point "0" has already been assigned. This assignment is not changed and in this registry the code point "0" continues to be assigned as "No Return Code".

The new Registration Procedures, the registry layouts and the new assignments for these registries are found in [Section 6.1](#).

3. Updating the TLV and Sub-TLV Registries

3.1. General Principles for the LSP Ping TLV and Sub-TLV registries

The following principles apply to the processing of any TLV from any of the LSP Ping TLV and sub-TLV IANA registries.

- o All TLVs and sub-TLVs with a type in the range 0-32767 require a response if they are not recognized.
- o All TLVs and sub-TLVs in the range 32768-65535 may be silently dropped, stepped over or an error message sent if they are not recognized.

Each of the blocks has code point spaces with the following registration procedures:

- o Standards Action.
- o RFC Required.
- o Experimental Use.
- o First Come First Served (FCFS).

The exact definitions of these procedures are found in [[RFC8126](#)].

3.1.1. Unrecognized Experimental Use TLVs and Sub-TLVs

Unrecognized TLVs and sub-TLVs in the Experimental Use, and FCFS ranges are handled as any other unrecognized TLV or sub-TLV.

- o If the unrecognized TLV or sub-TLV is from the Experimental Use range (37140-31743) or from the FCFS range (31744-32767) a Return Code of 2 ("One or more of the TLVs was not understood") will be sent in the echo response.
- o If the unrecognized TLV or sub-TLV is from the Experimental Use range (64508-64511) or from the FCFS range (64512-65535) the TLVs may be silently ignored, stepped over or an error message sent.

The IETF does not prescribe how recognized or unrecognized Experimental Use and Private Use TLVs and sub-TLVs are handled in experimental or private networks, that is up to the agency running the experiment or the private network. The statement above describes how standards compliant implementations will treat the unrecognized TLVs and sub-TLVs from these ranges.

3.2. Common Registration Procedures for TLVs and sub-TLVs

This section describes the new registration procedures for the TLV and sub-TLV registries.

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for TLVs and sub-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for TLVs and sub-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for TLVs and sub-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for TLVs and sub-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for TLVs and sub-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for TLVs and sub-TLVs that can be silently dropped if not recognized.

Table 1: TLV and sub-TLV Registration Procedures

3.3. Changes to the LSP Ping Registries

This section lists the changes to each MPLS LSP Ping TLV and sub-TLV Registry, see [section 6.2.1](#) to 6.2.7 describe how the new versions of the IANA registries should look, together with the registration procedures for each registry.

The new Registration Procedures description and the new assignments for these registries are used to model the changed MPLS LSP Ping registries, see [Section 6](#).

3.3.1. Common Changes to the TLV and Sub-TLV Registries

The following changes are made to the TLV and sub-TLV registries.

- o The registration procedures "First Come First Served (FCFS)" and "Experimental Use" are added to the table of registration procedures.
- o Two small sets of code points (4 code points each) for Experimental Use, are created. The first set is for the range that requires a response if the TLV or sub-TLV is not recognized; the second set is for the range there the TLV or sub-TLV that may be silently dropped if not recognized. The code points for experimental use are actually taken from the two ranges now called "RFC Required".
- o The registration procedure "Specification Required" is changed to "RFC Required" and the note "Experimental RFC needed" is removed.
- o In the listing of assignments the term "Vendor Private Use" is changed to "First Come First Served (FCFS)".
- o In the listing of assignments the range for "Experimental Use" is added.
- o A note saying "Not to be assigned" is added for the registration procedures "Experimental Use".
- o In the list that captures assignment status, the fields that are reserved, i.e., 0 (zero) and Experimental Use are clearly marked.

4. Updates to Related RFCs

Some referenced RFCs use the concept "mandatory TLVs" and "mandatory sub-TLVs" to indicate that, if a TLV or sub-TLV of the range 0-32767 in a message is not understood, an error message needs to be sent in response.

The same RFCs use "optional TLVs" and "optional sub-TLVs" to mean TLVs or sub-TLVs that can be silently ignored if not recognized.

Since other RFCs use "mandatory TLVs" and "mandatory sub-TLVs" to indicate TLVs and sub-TLVs that must be present in a message, we want to discontinue the use of "mandatory" to indicate TLVs and sub-TLVs that requires an error message in response if not understood. The changes to the RFCs below align with this practice.

4.1. Updates to [RFC 8029](#)

Mandatory and optional are used to indicate whether a response is needed if a TLV or sub-TLV is not understood on pages 14 and 15 in [Section 3 of RFC 8029](#).

The text in those two paragraphs is now updated to the following:

TLV and sub-TLV Types less than 32768 (i.e., with the high-order bit equal to 0) are TLVs and sub-TLVs that **MUST** either be supported by an implementation or result in the Return Code of 2 ("One or more of the TLVs was not understood") being sent in the echo response.

An implementation that does not understand or support a received TLV or sub-TLV with Type greater than or equal to 32768 (i.e., with the high-order bit equal to 1) **SHOULD** ignore and step over the TLV or sub-TLV, however an implementation **MAY** send an echo response with Return Code 2 ("One or more of the TLVs was not understood") as it would have done if the high order bit had been clear.

In [Section 3.8 of RFC 8029](#) "mandatory" is used in the same way. The first two paragraphs of this section are now updated to read as follows:

The following TLV is a TLV that **MAY** be included in an echo reply to inform the sender of an echo request that includes TLVs or sub-TLVs Types less than 32768 (i.e., with the high-order bit equal to 0) are either not supported by the implementation or parsed and found to be in error.

The Value field contains the TLVs, including sub-TLVs, that were not understood, encoded as sub-TLVs.

4.2. Updates to [RFC 8611](#)

[Section 13.4.1](#) of "Label Switched Path (LSP) Ping and Traceroute Multipath Support for Link Aggregation Group (LAG) Interfaces [[RFC8611](#)]" defines "Sub-TLVs for TLV Type 6" [[IANA-Sub-6](#)].

The "Sub-TLVs for TLV Type 6" registry is now updated to align with changes defined in this document.

[Section 13.4.1 of RFC 8611](#) is now updated as follows:

[Section 13.4.1](#) Sub-TLVs for TLV Type 6

IANA has created a new sub-registry "Sub-TLVs for TLV Type 6" [[IANA-Sub-6](#)] under the "TLVs" registry [[IANA-TLV-reg](#)] of the "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" name space [[lsp-ping-NameSpace](#)].

The "Sub-TLVs for TLV Type 6" sub-registry is now updated to align with changes defined in this document.

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sub-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sub-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved not to be assigned
31744-32767	FCFS	This range is for sub-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sub-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sub-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved not to be assigned
64512-65535	FCFS	This range is for sub-TLVs that can be silently dropped if not recognized.

Table 2: Sub-TLVs for TLV Type 6 Registration Procedures

5. Security Considerations

This document updates IANA registries. It also updates terminology used to define, and clarifies the terminology related to, the code points in the registries. The document does not change how the code-points in the registries are used. This should not create any new threats.

However, the updated terminology and the clarifications improve security because it makes it more likely that implementations will be consistent and harder to attack.

6. IANA Considerations

IANA is requested to update the "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" name space [[IANA-LSP-PING](#)] as described in this document.

See [Section 1.2](#) "Terminology Used in this Document" to see how "name space", "registry" and "sub-registry" are used in this document.

In other parts of this document the communality of the changes to the LSP Ping registries has been the focus. For the IANA considerations each changed registry has been described in its own right.

The following registries and sub-registries are changed:

"Message Types", [[IANA-MT](#)],
"Reply Modes", [[IANA-RM](#)]
"Return Codes" [[IANA-RC](#)]
"TLVs" [[IANA-TLV-reg](#)]
"Sub-TLVs for TLV Types 1, 16, and 21" [[IANA-Sub-1-16-21](#)]
"Sub-TLVs for TLV Type 6" [[IANA-Sub-6](#)]
"Sub-TLVs for TLV Type 11" [[IANA-Sub-11](#)]
"Sub-TLVs for TLV Type 20" [[IANA-Sub-20](#)]
"Sub-TLVs for TLV Type 23" [[IANA-Sub-23](#)]
"Sub-TLVs for TLV Type 27" [[IANA-Sub-27](#)]

6.1. Updates to the Message Type, Reply Mode and Return Codes Registries

This section details the updated registration procedures and allocations for "Message Type", "Reply Mode" and "Return Codes" registries.

6.1.1. Updates to the Message Type registry

This is the changes to the "Message Type" registry specified in this document:

- o Code Point 0 (zero) is marked Reserved.
- o The registration procedure "Specification Required" is changed to "RFC Required" and the comment "Experimental RFC needed" is removed.
- o Four code point have been taken from what was earlier "Specification Required" to form a set of code points for "Experimental Use."

The registration procedures after the changes for the "Message Type" registry are shown in the table below:

Range	Registration Procedures	Note
0-191	Standards Action	
192-247	RFC Required	
248-251	Experimental Use	Reserved, not to be assigned
252-255	Private Use	Reserved, not to be assigned

Table 3: Message Type registration procedures

The updated assignments for the "Message Types" registry will look like this:

Value	Meaning	Reference
0	Reserved	This document
1	MPLS Echo Request	[RFC8029]
2	MPLS Echo Reply	[RFC8029]
3	MPLS Proxy Ping Request	[RFC7555]
4	MPLS Proxy Ping Reply	[RFC7555]
5	MPLS Relayed Echo Reply	[RFC7743]
6-247	Unassigned	
248-251	Reserved for Experimental Use	This document
252-255	Reserved for Private Use	[RFC8029]

Table 4: Assignments for the Message Types registry

6.1.2. Updates to the Reply Modes registry

This is the changes to the "Reply Modes" registry specified in this document:

- o Code Point 0 (zero) is marked Reserved.
- o The registration procedure "Specification Required" is changed to "RFC Required" and the comment "Experimental RFC needed" is removed.
- o Four code point have been taken from what was earlier "Specification Required" to form a set of code points for "Experimental Use".

The registration procedures after the changes for the "Reply Modes" registry are show in the table below:

Range	Registration Procedures	Note
0-191	Standards Action	
192-247	RFC Required	
248-251	Experimental Use	Reserved, not to be assigned
252-255	Private Use	Reserved, not to be assigned

Table 5: Reply Modes registration procedures

The updated assignments for the "Reply Modes" registry will look like this:

Value	Meaning	Reference
0	Reserved	This document
1	Do not reply	[RFC8029]
2	Reply via an IPv4/IPv6 UDP packet	[RFC8029]
3	Reply via an IPv4/IPv6 UDP packet with Router Alert	[RFC8029]
4	Reply via application-level control channel	[RFC8029]
5	Reply via Specified Path	[RFC7110]
6-247	Unassigned	
248-251	Reserved for Experimental Use	This document
252-255	Reserved for Private Use	[RFC8029]

Table 6: Assignments for the Reply Modes registry

6.1.3. Updates to the Return Codes registry

This is the changes to the "Return Codes" registry specified in this document:

- o The registration procedure "Specification Required" is changed to "RFC Required" and the comment "Experimental RFC needed" is removed.

- o Four code point have been taken from what was earlier "Specification Required" to form a set of code points for "Experimental Use".

The registration procedures after the changes for the "Return Codes" registry are show in the table below:

Range	Registration Procedures	Note
0-191	Standards Action	
192-247	RFC Required	
248-251	Experimental Use	Reserved, not to be assigned
252-255	Private Use	Reserved, not to be assigned

Table 7: Return Codes registration procedures

The updated assignments for the "Return Codes" registry will look like this:

Value	Meaning	Reference
0	No Return Code	This document
1	Malformed echo request received	[RFC8029]
2	One or more of the TLVs was not understood	[RFC8029]
3	Replying router is an egress for the FEC at stack-depth (RSC)	[RFC8029]
4	Replying router has no mapping for the FEC at stack-depth (RSC)	[RFC8029]
5	Downstream Mapping Mismatch (See [1])	[RFC8029]
6	Upstream Interface Index Unknown (See [1])	[RFC8029]
7	Reserved	[RFC8029]
8	Label switched at stack-depth (RSC)	[RFC8029]
9	Label switched but no MPLS forwarding at stack-depth (RSC)	[RFC8029]
10	Mapping for this FEC is not the given label at stack-depth (RSC)	[RFC8029]
11	No label entry at stack-depth (RSC)	[RFC8029]
12	Protocol not associated with interface at FEC stack-depth	[RFC8029]

	(RSC)	
13	Premature termination of ping due to label stack shrinking to a single label	[RFC8029]
14	See DDMAP TLV for meaning of Return Code and Return Subcode (See [2])	[RFC8029]
15	Label switched with FEC change	[RFC8029]
16	Proxy Ping not authorized	[RFC7555]
17	Proxy Ping parameters need to be modified	[RFC7555]
18	MPLS Echo Request could not be sent	[RFC7555]
19	Replying router has FEC mapping for topmost FEC	[RFC7555]
20	One or more TLVs not returned due to MTU size	[RFC7743]
21	OAM Problem/Unsupported BFD Version	[RFC7759]
22	OAM Problem/Unsupported BFD Encapsulation format	[RFC7759]
23	OAM Problem/Unsupported BFD Authentication Type	[RFC7759]
24	OAM Problem/Mismatch of BFD Authentication Key ID	[RFC7759]
25	OAM Problem/Unsupported Timestamp Format	[RFC7759]
26	OAM Problem/Unsupported Delay Mode	[RFC7759]
27	OAM Problem/Unsupported Loss Mode	[RFC7759]
28	AM Problem/Delay variation unsupported	[RFC7759]
29	OAM Problem/Dyadic mode unsupported	[RFC7759]
30	OAM Problem/Loopback mode unsupported	[RFC7759]
31	OAM Problem/Combined mode unsupported	[RFC7759]
32	OAM Problem/Fault management signaling unsupported	[RFC7759]
33	OAM Problem/Unable to create fault management association	[RFC7759]
34	OAM Problem/PM Configuration Error	[RFC7759]
35	Mapping for this FEC is not associated with the incoming interface	[RFC8287] sec 7.4

36-247	Unassigned	[RFC7759]	
248-251	Reserved for Experimental Use	This document	
252-255	Reserved for Private Use	[RFC8029]	
+-----+-----+-----+-----+			

Table 8: Assignments for the Return Codes registry

Notes [1] and [2] for code point 5,6 and 14 points to footnotes in the "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" name space. The footnoes are not changed by this document.

6.2. Updates to the TLV and Sub-TLV registries

The updates to the TLV and the sub-TLV registries are mostly the same, however the Sub-TLVs for TLV Type 9 [[IANA-Sub-9](#)] has not been updated.

Note that when a field in an assignment table says "EQ", it means that the field should not be changed as compared to the corresponding field in the "Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" name space [[IANA-LSP-PING](#)]

6.2.1. Updates to the TLVs registry

This section describes the new registration procedures and the assignments for the "TLVs" registry [[IANA-TLV-reg](#)] based on the new registration procedures.

The registration procedures has been changed the following way for the "TLVs" registry.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.

- o The notes related to the registration procedures have been changed to reflect when a response is required or not if a TLV is not recognized.

The registration procedures for the "TLVs" registry [[IANA-TLV-reg](#)] will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for TLVs that can be silently dropped if not recognized.

Table 9: TLV Registration Procedures

The TLV Assignments will now look like this.

Note that when a field in this table does say "EQ", it means that it should be the same as the registry being updated.

Type	TLV Name	Reference	Sub-TLV Registry
0	Reserved	This document	
1-7	EQ	EQ	EQ
8	Unassigned		
9-16	EQ	EQ	EQ
17-19	unassigned		
20-27	EQ	EQ	EQ
28-31739	Unassigned		
31740-31743	Experimental Use	This Document	Reserved, not to be assigned
31744-32767	Unassigned		
32768-32770	EQ	EQ	EQ
32771-64507	EQ	EQ	EQ
64508-64511	Experimental Use	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 10: TLV Assignments

6.2.2. Updates to the registry for SubTLVs for TLVs 1, 16 and 21

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Types 1, 16, and 21" [[IANA-Sub-1-16-21](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Types 1, 16, and 21" [[IANA-Sub-1-16-21](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 11: Registration Procedures for Sub-TLVs for TLVs 1, 16 and 21

Type	TLV Name	Reference	Comment
0	Reserved	This document	
1-4	EQ	EQ	EQ
5	Unassigned		
6-8	EQ	EQ	EQ
9	EQ	EQ	DEPRECATED
10-20	EQ	EQ	EQ
21	unassigned		
22-37	EQ	EQ	EQ
38-31739	Unassigned		
31740-31743	Experimental	This Document	Reserved, not to be assigned
31744-64507	Unassigned		
64508-64511	Experimental	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 12: Sub-TLV for TLV 1, 16 and 21 Assignments

6.2.3. Updates to the registry for SubTLVs for TLV 6

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Type 6" [[IANA-Sub-6](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Type 6"
[[IANA-Sub-6](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 13: Registration Procedures for Sub-TLVs for TLVs 6

Type	TLV Name	Reference	Comment
0	Reserved	This document	
1-2	EQ	EQ	EQ
3-31739	Unassigned		
31740-31743	Experimental	This Document	Reserved, not to be assigned
	Use		
31744-64507	Unassigned		
64508-64511	Experimental	This document	Reserved, not to be assigned
	Use		
64512-65535	Unassigned		

Table 14: Sub-TLVs for TLV 6 Assignments

6.2.4. Updates to the registry for SubTLVs for TLV 11

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Type 11" [[IANA-Sub-11](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Type 11" [[IANA-Sub-11](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 15: Registration Procedures for Sub-TLVs for TLVs 11

Type	TLV Name	Reference	Comment
0	Reserved	This document	
1-4	EQ	EQ	EQ
5-31739	Unassigned		
31740-31743	Experimental Use	This Document	Reserved, not to be assigned
31744-64507	Unassigned		
64508-64511	Experimental Use	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 16: Sub-TLVs for TLV 11 Assignments

6.2.5. Updates to the registry for Sub-TLVs for TLV 20

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Type 20" [[IANA-Sub-20](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Type 20" [[IANA-Sub-20](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 17: Registration Procedures for Sub-TLVs for TLVs 20

Type	TLV Name	Reference	Comment
0	Reserved	This document	
1-5	EQ	EQ	EQ
6-31739	Unassigned		
31740-31743	Experimental Use	This Document	Reserved, not to be assigned
31744-64507	Unassigned		
64508-64511	Experimental Use	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 18: Sub-TLVs for TLV 20 Assignments

6.2.6. Updates to the registry for SubTLVs for TLV 23

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Type 23" [[IANA-Sub-23](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Type 23" [[IANA-Sub-23](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 19: Registration Procedures for Sub-TLVs for TLVs 23

Type	TLV Name	Reference	Comment
0	Reserved	[RFC7555]	
1	EQ	EQ	EQ
2-31739	Unassigned		
31740-31743	Experimental Use	This Document	Reserved, not to be assigned
31744-64507	Unassigned		
64508-64511	Experimental Use	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 20: Sub-TLVs for TLV 23 Assignments

6.2.7. Updates to the registry for SubTLVs for TLV 27

This section describes the new registration procedures and the assignments for the "Sub-TLVs for TLV Type 27" [[IANA-Sub-27](#)] sub-registry based on the new registration procedures.

- o The "Specification Required" registration procedure has been changed to "RFC Required", the comment "Experimental RFC Required" has been removed.
- o The code points registration procedure "Vendor Private Use" has been removed and replaced with "First Come, First Served" code points.
- o Two small sets, 4 code points each, have been created for Experimental Use.
- o Code points that are reserved are clearly marked as such.
- o The assignments have been updated to match the new registration procedures.
- o The notes related to the registration procedures have been changed to reflect when a response is required if a sub-TLV is not recognized or not.

The registration procedures for the "Sub-TLVs for TLV Type 27" [[IANA-Sub-27](#)] sub-registry will now look like this:

Range	Registration Procedures	Note
0-16383	Standards Action	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
16384-31739	RFC Required	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
31740-31743	Experimental Use	Reserved, not to be assigned
31744-32767	FCFS	This range is for sun-TLVs that require an error message if not recognized. [This document, section 3.1]
32768-49161	Standards Action	This range is for sun-TLVs that can be silently dropped if not recognized.
49162-64507	RFC Required	This range is for sun-TLVs that can be silently dropped if not recognized.
64508-64511	Experimental Use	Reserved, not to be assigned
64512-65535	FCFS	This range is for sun-TLVs that can be silently dropped if not recognized.

Table 21: Registration Procedures for Sub-TLVs for TLV 27

Type	TLV Name	Reference	Comment
0	Reserved	[RFC7555]	
1	EQ	EQ	EQ
2-31739	Unassigned		
31740-31743	Experimental Use	This Document	Reserved, not to be assigned
31744-64507	Unassigned		
64508-64511	Experimental Use	This document	Reserved, not to be assigned
64512-65535	Unassigned		

Table 22: Sub-TLVs for TLV 27 Assignments

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