                 Extended Administrative Groups in MPLS-TE
                  draft-ietf-mpls-extended-admin-group-05

Abstract

   MPLS-TE advertises 32 administrative groups (commonly referred to as
   "colors" or "link colors") using the Administrative Group sub-TLV of
   the Link TLV. This is defined for OSPFv2 (RFC3630), OSPFv3 (RFC5329)
   and ISIS (RFC5305).

   This document adds a sub-TLV to the IGP TE extensions, "Extended
   Administrative Group". This sub-TLV provides for additional
   administrative groups (link colors) beyond the current limit of 32.

Requirements Language

   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].

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1. Introduction

Do we need more than 32 bits?

The IGP extensions to support MPLS-TE (RFCs 3630 [RFC3630] and 5305
[RFC5305]) define a link TLV known as Administrative Group (AG) with
a limit of 32 AGs per link. The concept of Administrative Groups
comes from section 6.2 of RFC 2702 [RFC2702], which calls them
Resource Classes. RFCs 3630 [RFC3630] and 5305 [RFC5305] describe
the mechanics of the TLV and use the term Administrative Groups
(sometimes abbreviated herein as AGs), as does this document.

Networks have grown over time, and MPLS-TE has grown right along with
them. Administrative Groups are advertised as a fixed-length 32-bit
bitmask. This can be quite constraining, as it is possible to run
out of vaues rather quickly. One such use case is #5 in Section 6.2
of RFC 2702 [RFC2702], using AGs to constrain traffic within specific
topological regions of the network. A large network may well have
far more than 32 geographic regions. One particular operator builds
their network along the lines of this use case, using AGs to flag
network regions down to the metro scale, e.g. Seattle, San Francisco,

Dallas, Chicago, St. Louis, etc. MPLS-TE tunnels are then specified
with affinities to include or exclude specific metro regions in their
path calculation. Each metro region is given its own bit in the AG
bitmask. This means that 32 bits can only (cleanly) represent 32
metro areas. It should be obvious that 32 may not be enough even for
a US-based network, nevermind a worldwide network.

There may be some opportunity for color reuse; that is, bit 0x8 may
mean 'Seattle' or 'Prague' or 'Singapore' depending on the geography
in which it is used. In practice, coordinating this reuse is fraught
with peril and the reuse effectively becomes the limiting factor in
MPLS-TE deployment. With this example it is not possible to build an
LSP which avoids Seattle while including Prague, as it is the same AG
value.

This document provides Extended Administrative Groups (EAGs). The
number of EAGs has no fixed limit, it is constrained only by
protocol-specific restrictions such as LSA or MTU size. While an
operator may one day need to go beyond these protocol-specific
restrictions, allow for an arbitrary number of EAGs should easily
provide the operator with hundreds or thousands of bit values, thus
no longer making the number of AGs an impediment to network growth.

EAG's intended use case is within a single domain. As such, this
document provides no support for signaling EAG. It provides no
analog to either the SESSION_ATTRIBUTE of C-Type 1 defined in
[RFC3209], nor the LSPA object of the Path Computation Element
Communication Protocol (PCEP) defined in [RFC5440].

2. Extended Administrative Groups sub-TLV

This document defines a sub-TLV of the Link TLV for both OSPF
[RFC3630] and ISIS [RFC5305] called the Extended Administrative
Groups (EAG) sub-TLV. The EAG sub-TLV is used in addition to the
Administrative Groups when a node wishes to advertise more than 32
colors for a link. The EAG sub-TLV is optional. Coexistence of EAG
and AG TLVs is covered in Section 2.3.1 of this document.

This document uses the term 'colors' as a shorthand to refer to
particular bits with an AG or EAG. The examples in this document use
'red' to represent the least significant bit in the AG (red == 0x1),
'blue' to represent the second bit (blue == 0x2). To say that a link
has a given color or that the specified color is set on the link is
to say that the corresponding bit or bits in the link's AG are set to
1.

2.1. Packet Format

The format of the Extended Administrative Groups sub-TLV is the same
for both OSPF and ISIS:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Extended Admin Group                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         ..........                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Extended Admin Group                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Type of the sub-TLV for OSPF and ISIS is TBD. The Length is the
size of the Extended Admin Group (EAG) value in bytes. The EAG may
be of any non-zero length, but MUST be a multiple of 4 bytes. The
only limits on EAG size are those which are imposed by protocol-
specific or media-specific constraints (e.g. max packet length).

2.2. Admin group numbering

By convention, the existing Administrative Group TLVs are numbered 0
(LSB) to 31 (MSB). The EAG values are a superset of AG. That is,
bits 0-31 in the EAG have the same meaning and MUST have the same
values as an AG flooded for the same link. If an EAG's length is
more than 4 bytes, numbering for these additional bytes picks up
where the previous byte left off. For example, the least significant
bit in the 5th byte of an 8-byte EAG is referred to as bit 32.

2.3. Backward compatability

There are two questions to consider for backward compatibility with
existing AG implementations - how do AG and EAG coexist, and what
happens if a node has matching criteria for unadvertised EAG bits?

2.3.1. AG and EAG coexistence

If a node advertises EAG it MAY also advertise AG.

If a node advertises both AG and EAG then the first 32 bits of the
EAG MUST be identical to the advertised AG.

If both an AG and EAG are present, a receiving node MUST use the AG
as the first 32 bits (0-31) of administrative color and use the EAG
for bits 32 and higher if present.

A receiving node that notices that the AG differs from the first 32
bits of the EAG, SHOULD report this mismatch to the operator.

This process allows nodes which do not support EAG to obtain some
link color information from the network, but also allow for an
eventual migration away from AG.

2.3.2. Desire for unadvertised EAG bits

The existing AG sub-TLV is optional; thus a node may be configured
with a preference to include red or exclude blue, and be faced with a
link that is not advertising a value for either blue or red. What
does an implementation do in this case? It shouldn't assume that red
is set, but it is also arguably incorrect to assume that red is NOT
set, as a bit must first exist before it can be set to 0.

Practically speaking this has not been an issue for deployments, as
many implementations always advertise the AG bits, often with a
default value of 0x00000000. However, this issue may be of more
concern once EAGs are added to the network. EAGs may exist on some
nodes but not others, and the EAG length may be longer for some links
than for others.

Each implementation is free to choose its own method for handling
this question. However, to allow for maximum interoperability an
implementation SHOULD treat desired but unadvertised EAG bits as if
they are set to 0. Consider the case where a node wants to only use
links where the 127th bit of an EAG is set to 1. If a link is only
advertising 64 EAG bits, clearly the 127th EAG bit is not defined -
that is, it is neither explicitly 0 nor 1. The node which wants the
127th EAG bit to be 1 MUST NOT use this link when implementing the
recommended behavior, as the assumption is than an unadvertised bit
is set to 0.

A node MAY provide other strategies for handling this case. A
strategy which deviates from the recommended behavior in this
document SHOULD be configurable, in order to provide maximum
interoperability.

3. Security Considerations

This extension adds no new security considerations.

4. IANA Considerations

This document requests a sub-TLV allocation in both OSPF and ISIS.

For OSPF, the name space is "Types for sub-TLVs of TE Link TLV (Value 2)" in the "Open Shortest Path First (OSPF) Traffic Engineering TLVs".

For ISIS, it is "Sub-TLVs for TLV 22, 141, and 222" in the "IS-IS TLV Codepoints" registry. For IS-IS the value should be marked 'y' for Sub-TLVs 22, 141 and 222; this is identical to the allocation for the Administrative Group sub-TLV (value 3).

In both registries the first free value should be assigned. As of this writing, that's 26 in the OSPF registry and 14 in the IS-IS registry. The Sub-TLV should be caled "Extended Administrative Group".

5. Acknowledgements

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6. References

6.1. Normative References

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6.2. Informative References

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