Multipath Extensions for MPLS Traffic Engineering

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Two internet-drafts:

1. Use of Multipath with MPLS-TP and MPLS
   draft-villamizar-mpls-tp-multipath-01

   - Lists requirements and potential solutions
     preferred solution requires some protocol extensions

2. Multipath Extensions for MPLS Traffic Engineering
   draft-villamizar-mpls-tp-multipath-te-extn-00

   - Specifies protocol extensions for preferred solution

Multipath Extensions History

1. Jun 2010: draft-villamizar-mpls-tp-multipath-00
   some verbal comments at IETF-80, some private email

2. Mar 2011: draft-villamizar-mpls-tp-multipath-01

3. Apr 2011: MPLS WG presentation in IETF-80
   interest expressed at WG meeting, verbal comments during and after meeting, no WG email activity

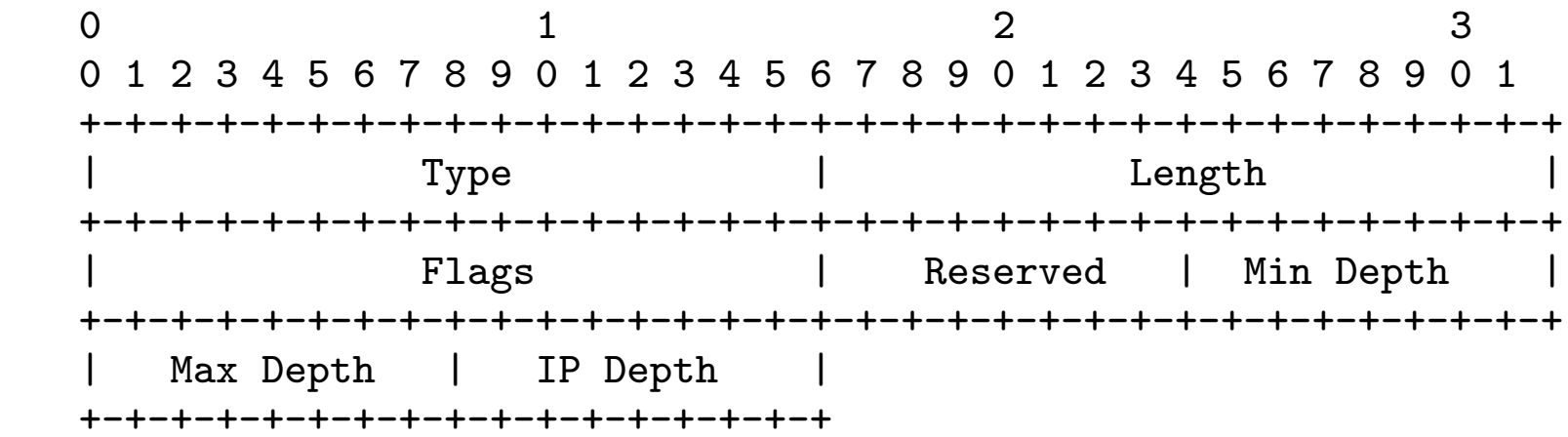
4. Jul 2011: draft-villamizar-mpls-tp-multipath-te-extn-00
   repeat request for comments on MPLS WG mailing list

5. Jul 2011: MPLS WG presentation in IETF-81
   this presentations

Multipath Extensions - IGP-TE

1. The Multipath Node Capability sub-TLV is added to the Node Attribute TLV [RFC5786]
2. The Multipath Link Capability sub-TLV is added to the Link Identification TLV [RFC3471]
3. The Node Attribute TLV [RFC5786] and Link Identification TLV [RFC3471] are defined for both OSPF-TE and ISIS-TE
4. The format of the Multipath Node Capability sub-TLV and the Multipath Link Capability sub-TLV is identical. See next slide.

Multipath Node/Link Capability sub-TLV



A few key field definitions (paraphrased for brevity)

Min Depth
The Min Depth field if non-zero is the stack depth at which the label stack will be inspected. This is set in FA advertisements.

Max Depth
IP Depth
These exist to accomodate harware limitations. No hardware can look infinitely deep into the label stack.

Multipath Node/Link Capability sub-TLV - Flags

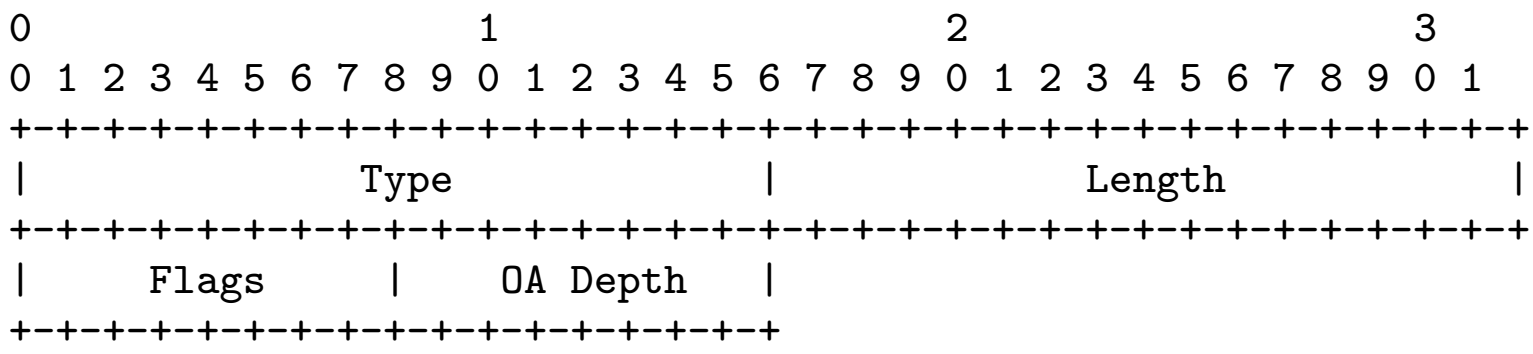
These Flags field contains the following bit definitions. These define the multipath capabilities and the default behavior of the node of link.

```
0x8000  Ordered Aggregate Enabled
0x4000  Multipath Enabled
0x2000  IPv4 Enabled Multipath
0x1000  IPv6 Enabled Multipath
0x0800  UDPIPv4 Multipath
0x0400  UDP/IPv6 Multipath
0x0200  TDPIPv4 Multipath
0x0100  TCP/IPv6 Multipath
0x0080  Default to Multipath
0x0040  Default to IP/MPLS Multipath
0x0020  Variable Depth Multipath
0x0010  IP Optioal Multipath
```

Multipath Extensions - RSVP-TE

1. The Contained Ordered Aggregate Attributes TLV is added to the LSP_ATTRIBUTES object [RFC5420]
2. The LSP Multipath Attributes TLV is added to the LSP_ATTRIBUTES object [RFC5420]
3. Each LSP_ATTRIBUTES object should have one Contained Ordered Aggregate Attributes TLV and should have one or more LSP Multipath Attributes TLV if it is not a OA LSP.
4. These TLV are described in following slides.

Contained Ordered Aggregate Attributes TLV



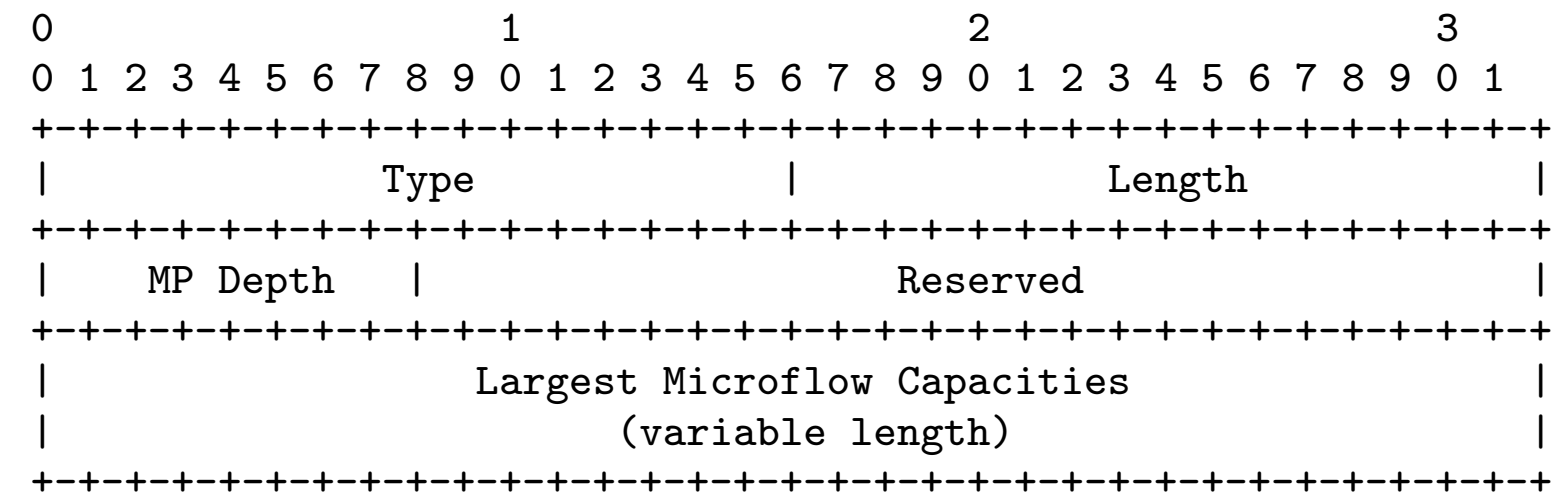
Flags are:

- 0x80 IP Multipath Allowed
- 0x40 May Contain IPv4
- 0x40 May Contain IPv6

OA Depth means:

- 0 no ordered aggregates of traffic are carried
- 1 the LSP itself must be treated as an ordered aggregate
- >1 one or more ordered aggregates is carried at the given depth

LSP Multipath Attributes TLV



MP Depth

The depth at which the Largest Microflow Capacities apply

Largest Microflow Capacities

Up to three IEEE 32 bit floating point values.

- Largest LSE Microflow
- Largest IP Microflow
- Largest L4 Microflow

Multipath Extension Protocol Mechanisms

1. OSPF-TE and ISIS-TE Advertisement
   describes use of Multipath Node/Link Capability sub-TLV in advertising the node, ordinary links, and H-LSP FA advertisements
2. RSVP-TE LSP Attributes
   describes how to set new LSP_ATTRIBUTES TLVs for LSP based on the LSP contained within them
3. Path Computation Constraints
   describes path computation constraints for ordered aggregate (OA) LSP, for LSP containing OA LSP

Backwards Compatibility

1. Legacy Multipath Behavior
   describes signaling the behavior of legacy interfaces such as Ethernet LAG, legacy link bundling
2. Networks without Multipath Extensions
   The easy cases to deal with have all LAG like multipath or all legacy link bundling. Network with a mix are no worse off than before but improvement can be made even without upgrading a subset of nodes
3. Transition to Multipath Extension Support
   describes transition strategies

Summary

1. At IETF-80 interest was expressed.
2. At IETF-80 and in draft-villamizar-mpls-tp-multipath-01 extensions are described as simple.
3. Some verbal comments indicated that the solutions would be more clear when protocol extensions were proposed.
4. Protocol extensions are now proposed. Hopefully the mechanisms are now sufficiently clear and discussion can begin on the MPLS WG mailing list.