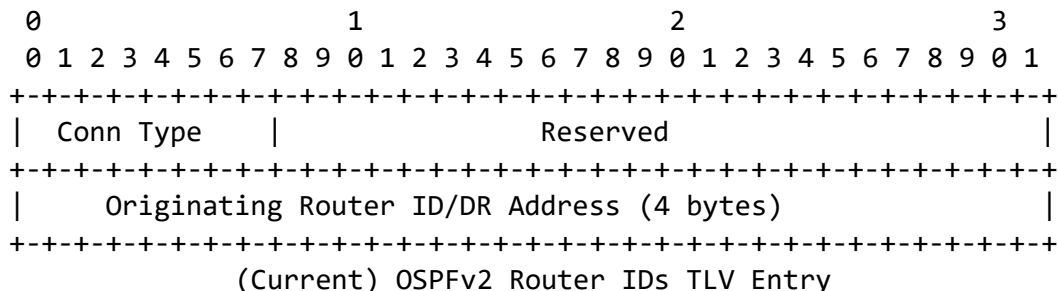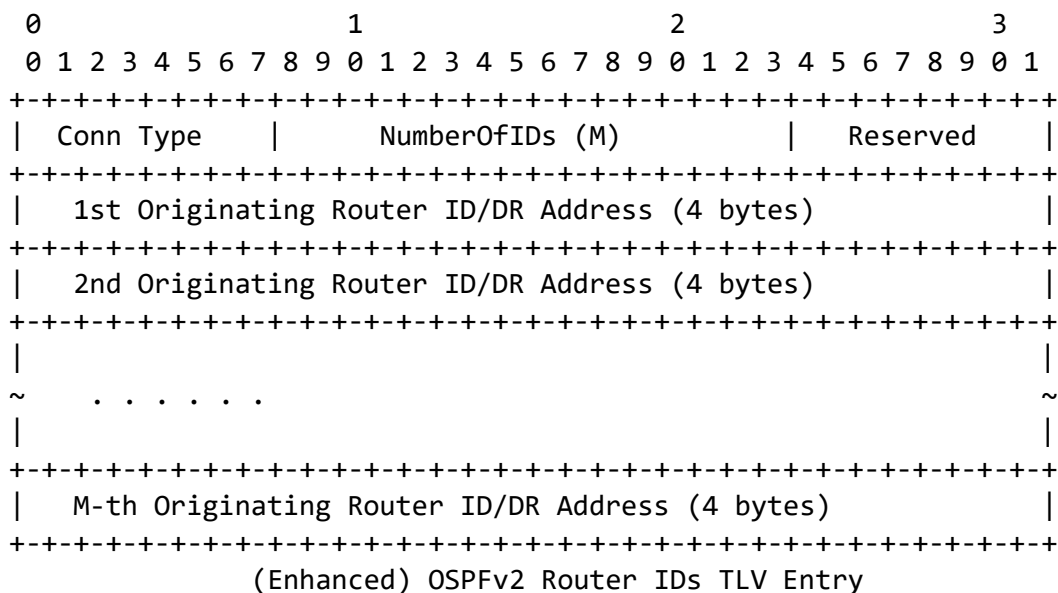**Enhancements on encoding of router IDs and DR IDs**

Currently for OSPFv2, OSPFv2 Area Router IDs TLVs are used to represent a sequence of router IDs or DR IDs (addresses). Each of IDs is encoded as an OSPFv2 Router IDs TLV Entry of 8 bytes.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Conn Type    |                   Reserved                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Originating Router ID/DR Address (4 bytes)               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
            (Current) OSPFv2 Router IDs TLV Entry
```

To represent N router IDs or DR addresses, we need N entries, which occupies 8*N bytes in the OSPFv2 Area Router IDs TLVs. Each entry represents just only one router ID or DR address.
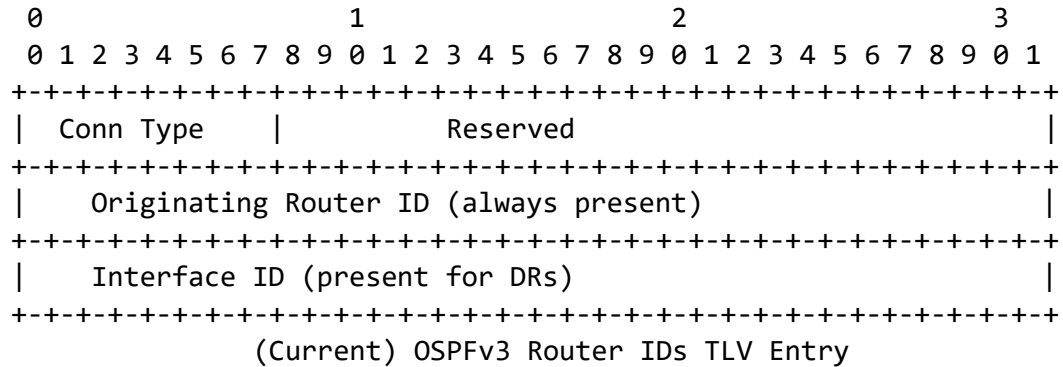
An enhancement below is to allow one entry to represent a number of router IDs or a number of DR addresses. This can be achieved by using two bytes of the Reserved field to indicate the number M of router IDs or a number of DR addresses contained in the entry. The value of the two bytes can be the number of IDs/Addresses (i.e., M) or the number of octets used (i.e., 4*M). The former is preferred.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Conn Type    |     NumberOfIDs (M)       |     Reserved     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   1st Originating Router ID/DR Address (4 bytes)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   2nd Originating Router ID/DR Address (4 bytes)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                              |
~        . . . . . .                                           ~
|                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   M-th Originating Router ID/DR Address (4 bytes)           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
            (Enhanced) OSPFv2 Router IDs TLV Entry
```

To represent N router IDs or N DR addresses using the enhanced entry, we need just one or a few entries. Using X entries occupies 4*(N + X) bytes in the OSPFv2 Area Router IDs TLVs.

Consider the case where there are 1000 routers in an area. To represent 1000 router IDs,
Using the current OSPFv2 Router IDs TLV Entries occupies 8*1000 = 8000 bytes;
Using the enhanced OSPFv2 Router IDs TLV Entries occupies 4*(1000 + 1) = 4004 bytes.
8000/4004 = 1.998. The saving on space is about 50% in this case.

Similarly for OSPFv3, OSPFv3 Area Router IDs TLVs are used to represent a sequence of router IDs or DR IDs. Each of router IDs is encoded as an OSPFv3 Router IDs TLV Entry of 8 bytes. Each of DR IDs is encoded as an OSPFv3 Router IDs TLV Entry of 12 bytes.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Conn Type     |            Reserved                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Originating Router ID (always present)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Interface ID (present for DRs)                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
            (Current) OSPFv3 Router IDs TLV Entry
```

An enhancement below is to allow one entry to represent a number of router IDs or a number of DR IDs. This can be achieved by using two bytes of the Reserved field to indicate the number M of router IDs or a number of DR IDs contained in the entry. The value of the two bytes can be the number of IDs (i.e., M) or the number of octets used (i.e., 4*M for M router IDs or 8*M for M DR IDs). The former is preferred.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Conn Type     |      NumberOfIDs (M)          |    Reserved   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 1st  Originating Router ID (always present)                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 1st  Interface ID (present for DRs)                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 2nd  Originating Router ID (always present)                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 2nd  Interface ID (present for DRs)                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~    . . . . . .                                                ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| M-th  Originating Router ID (always present)                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| M-th  Interface ID (present for DRs)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
            (Enhanced) OSPFv3 Router IDs TLV Entry
```