Link State (LS) Flooding Reduction

draft-cc-ospf-flooding-reduction-04

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Overview

00 version: Distributed mode. Every node computes flooding topology using same algorithm. mentioned distributed, central, static modes

01 version: Allow operators to
- Select a mode: Distributed, Central, xor Static
- Chose Algorithm for computing flooding topology
- Enable Flooding Reduction and Roll Back smoothly

04 version:
- For central and distributed modes,
  - Backup Paths: backup flooding topology split
- For central mode,
  - Message for flooding topology, including a block encoding
  - Encoding for backup paths
- Protocol extensions: OSPFv2, OSPFv3 and IS-IS
Backup for Flooding Topology Split

Construct a flooding topology
- reduces the amount of LS flooding greatly (.slim) and
- is tolerant to multiple failures (fat)
This is hard
To get around this
- use backup paths for critical nodes and links on flooding topology
- Flooding topology can be slim and tolerant to failures

Critical node goes down \(\Rightarrow\) flooding topology is split into parts
- Backup paths for node connects split parts into one
- Through backup paths and remaining flooding topology, LS can be flooded to every live node

Multiple links and nodes failures
- Through backup paths for these links and nodes + remaining flooding topology, LS can be flooded to every live node
Message for Flooding Topology: Links Encoding

Flooding Topology:
• represented by links on it

Links (between a local node and its adjacent nodes) Encoding:

➤ Local node encoding:
  ❖ encoded node index size indication (ENSI) +
  ❖ compact node index (CNI)
➤ Adjacent nodes encoding:
  ❖ Number of Nodes (NN) +
  ❖ compact node indexes (CNIs)

Node index size = ENSI + 9

```
+-----------------+---------------------+-------------------+
|     0 1 2 3 4 5 6 7 8     | ENSI (3 bits) [9 bits CNI] |         |
+-----------------+---------------------+-------------------+
| 0 0 0 |         |                   | Encoding for       |
| 0 1 1 |         |                   | Local Node LN1    |
| 0 1 1 |         |                   | Encoding for       |
|       |         |                   | 3 adjacent nodes  |
|       |         |                   | RN1, RN2, RN3     |
|       |         |                   | of LN1             |
|       |         |                   |                   |
Node index size = ENSI + 9
```
Message for Flooding Topology: LSA

Flooding Topology Links TLV
• links encodings

Flooding Topology Opaque LSA
• Links TLV

OSPFv2: Flooding Topology Opaque LSA
Block Encoding

A single structure encoding a block (or part) of topology

Links encoding is extended to include links connected to adjacent nodes

- Extending Flags (E Flags for short) between NN and CNIs for the adjacent nodes
- E Flags is NN bits, each bit i is for a node. i=1: links to adjacent node RN_i included

```
<table>
<thead>
<tr>
<th>Link on flooding topology</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN1 --- RN1</td>
</tr>
<tr>
<td></td>
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<tr>
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<tr>
<td></td>
</tr>
</tbody>
</table>

0 1 2 3 4 5 6 7 8
+--------+
|0 0 0| ENSI (3 bits) [9 bits CNI] |
+--------+          } Encoding for Local Node LN1
| LN1 Index Value | CNI (9 bits) |
+--------+
|0 1 1| NN(3 bits)[3 adjacent nodes]|
+--------+                      } Encoding for 3 adjacent nodes (RN1, RN2, RN3) of LN1
| RN1's Index | CNI (9 bits) for RN1 |
+--------+
| RN2's Index | CNI (9 bits) for RN2 |
+--------+
| RN3's Index | CNI (9 bits) for RN3 |
+--------+
|0 0 1| NN (3 bits)[1 adjacent node]|
+--------+                          } Encoding for 1 adjacent node (RN11)
|0| E Flags [NN=1 bit] |
+--------+
| RN11's Index | CNI (9 bits) for RN11 |
+--------+
|0 1 0| NN(3 bits)[2 adjacent nodes]|
+--------+                          } Encoding for 2 adjacent nodes (RN31, RN32)
|0 0| E Flags [NN=2 bits] |
+--------+
| RN31's Index | CNI (9 bits) for RN31 |
+--------+
| RN32's Index | CNI (9 bits) for RN32 |
```
Encodings for Backup Paths: Node

Backup paths for a node:
- node index encoding +
- node backup paths encoding

| K | 1 bit (K=1: Key/Critical Node, K=0: Normal Node) |
|---------------|
| NNBP | 3 bits (number of node backup paths) |
| PLEN | 4 bits (backup path len) |
| ENSI | 3 bits (Ix Bits Indication) |

Backup paths encoding:
- | PN1 Index | #Bits indicated by ENSI |
- | PNn Index | #Bits indicated by ENSI |

K flag (Key/Critical node flag) of 1 bit
3 bits NNBP (number of node backup paths)
path length PLEN of 4 bits (number of nodes)
ENSI for all the nodes in the path

Node Backup Paths TLV:
- multiple nodes and their backup paths
Encodings for Backup Paths: Link

Backup paths for a link:
- link index encoding +
- link backup paths encoding

C flag (Key/Critical link flag) of 1 bit
2 bits NNBP (number of link backup paths)
path length PLEN of 3 bits (number of nodes)
ENSI for the nodes in the path

Link Backup Paths TLV:
- multiple links and their backup paths
## Encodings for Backup Paths: LSA

Backup paths Opaque LSA: node backup paths TLVs and link backup paths TLVs

```
0                   1                   2                   3
+-------------------------------------------------------------------+
|            LS age             |     Options   | LS Type = 10  |
+-------------------------------+----------------+--------------+
| BP-Type(TBD7) |                   Instance ID                 |
+-------------------------------+---------------------------------------------+
| Advertising Router          |                                             |
+-------------------------------+---------------------------------------------+
| LS Sequence Number           |                                             |
+-------------------------------+---------------------------------------------+
| LS checksum                  |           Length                            |
+-------------------------------+---------------------------------------------+
~                      Link Backup Paths TLVs  ~
~                      Node Backup Paths TLVs  ~
+-------------------------------------------------------------------+
```

### OSPFv2: Backup Paths Opaque LSA

```
0                   1                   2                   3
+-------------------------------------------------------------------+
|            LS age             |1|0|1|      BP-LSA (TBD8)      |
+-------------------------------+----------------+--------------+
|                        Link State ID                          |
+-------------------------------+---------------------------------------------+
| Advertising Router          |                                             |
+-------------------------------+---------------------------------------------+
| LS Sequence Number           |                                             |
+-------------------------------+---------------------------------------------+
| LS checksum                  |           Length                            |
+-------------------------------+---------------------------------------------+
~                      Link Backup Paths TLVs  ~
~                      Node Backup Paths TLVs  ~
+-------------------------------------------------------------------+
```

### OSPFv3: Backup Paths LSA
Next Step

Welcome comments
Request for adoption