IGP Extensions for Intra-Domain SAV

draft-chen-savnet-lsr-intra-00

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IGP on every node builds its SAV Table based on its LSDB or RIB.
SAV table is used to validate source address of packet received.

<table>
<thead>
<tr>
<th>Source Prefix</th>
<th>Incoming Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-Prefix-1</td>
<td>Interface-a</td>
</tr>
<tr>
<td>S-Prefix-2</td>
<td>Interface-b</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>S-Prefix-n</td>
<td>Interface-x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Destination Prefix</th>
<th>Outgoing Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-Prefix-1</td>
<td>Out-Interface-a</td>
</tr>
<tr>
<td>D-Prefix-2</td>
<td>Out-Interface-b</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>D-Prefix-n</td>
<td>Out-Interface-x</td>
</tr>
</tbody>
</table>

Overview

Table 1. SAV Table

Table 2. FIB

If source address and incoming interface of the packet received is not in any row of SAV, then drop it; otherwise, continues to forward it.

IGP extensions for

1. Fast Convergence of SAV table on Routing Changes (0 to 1 SPF)
2. Accurate Validation (Illegal Packet dropped)
3. Backward Compatible (Work in Incremental/Partial Deployment)
Intra-Area SAV table (AS has 1 Area)

- When every link in AS/Area is symmetric,
  IGP on each node builds SAV table using RIB (0 SPF for SAV)
  by having a row in SAV table for each prefix with a NH interface in RIB

- When a link in AS/Area is not symmetric,
  IGP on each node X builds SAV table in 3 steps (1 SPF for SAV):
  1. **Builds reserve shortest path tree (RSPT).**
     builds a SPT from X to other nodes using cost of each link in reverse direction. (1 SPF)
  2. **Builds reserve routing table (RRT/RRIB) using RSPT.**
     For a shortest path from X to Y with a next hop interface in its RSPT, adds an entry for each prefix attached to Y into its RRT. The entry has the prefix as the destination and the next hop interface as the next hop.
  3. **Builds SAV table using RRT/RRIB.**
     has a row in SAV table for each prefix with a next hop interface in RRT/RRIB.

Options for scope of prefixes to be validated:
- Prefixes attached to every node (the above)
- Prefixes attached to each ASBR and ABR (consider only Y=ASBR, ABR in step 2)
- Prefixes indicated/configured on any node (consider only prefixes attached to node Y and indicated/configured by Y in step 2).
Inter-Area SAV table (AS has 1+ Areas)

IGP on each node X in area A builds SAV table in 4 steps (0-1 SPF for SAV):

1. **Gets area shortest path tree (ASPT)**
   - The ASPT is a tree from X as root to the other nodes in area A. If every link in A is symmetric, ASPT is SPT to the other nodes for RIB (reused); otherwise (i.e., asymmetric link in A), ASPT is RSPT from X to the other nodes in A.

2. **Extends ASPT**
   - Adds non-ABR’s prefixes to ASPT; If ASPT is SPT and every path in A’ between an ABR and a summary prefix is symmetric (no reverse cost to prefix Sub-TLV from A’), extended ASPT reuses portion of SPT with summary prefixes attached to ABR for RIB; otherwise, attaches summary prefixes to ABR using reverse cost to prefix.

3. **Builds reserve routing table (RRT/RRIB) using extended ASPT**
   - For a shortest path from X to Y with a next hop interface in its extended ASPT, adds an entry for each prefix attached to Y into its RRT/RRIB.

4. **Builds SAV table using RRT/RRIB**
   - has a row in SAV table for each prefix with a next hop interface in RRT/RRIB.

The last two steps here are similar to the last two steps for one area case.
Extensions to IGP

- New indication (e.g., S-Flag) indicating a prefix to be validated when option 3 is selected.

- A new Sub-TLV, called Reverse Cost to Prefix Sub-TLV, for ABR to advertise the cost of the shortest path from prefix to ABR when the path between ABR and prefix is not symmetric.
Next Step

• Comments
Comparisons with another

Differences:
1. Number of SPFs for SAV table
   0-1 SPF vs Multiple SPFs
2. Options for Scope of Prefixes to be Validated
   3 options vs 1 option (i.e., option 3)
3. IGP Extensions Depend on Options
   Yes vs No
4. Extensions
   S-flag in existing Sub-TLVs vs New Sub-TLVs
5. Reverse cost from ABR to summary prefix is distributed
   if asymmetric vs in any case (i.e., if symmetric or asymmetric)
Extensions to IGP: S-Flag

- New **S-Flag** (SAV Prefix Flag) indicating a prefix to be validated when option 3 is selected
  - **OSPFv2:**
    - 0x20 - S-Flag (SAV Prefix Flag) in existing OSPFv2 Extended Prefix TLV:
      Set when the prefix is configured for SAV (i.e., to be validated).
  - **IS-IS:**
    - Bit 5 - S-Flag (SAV Prefix Flag) in existing Prefix Attribute Flags Sub-TLV:
      Set when the prefix is configured for SAV (i.e., to be validated).
  - **OSPFv3:**
    - 0x01 - S-Flag (SAV Prefix Flag) in new OSPFv3 Prefix Attribute Flags Sub-TLV:
      Set when the prefix is configured for SAV (i.e., to be validated).
A new Sub-TLV, called Reverse Cost to Prefix Sub-TLV, for ABR to advertise the cost of the shortest path from prefix to ABR when the path between ABR and prefix is not symmetric.

- **OSPFv2:**
  New OSPFv2 Sub-TLV in Existing OSPFv2 Extended Prefix TLV

```plaintext
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type (TBD1) | Length (4) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Cost from Prefix to ABR |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
OSPFv2 Reverse Cost to Prefix Sub-TLV
```

- **OSPFv3:**
  New OSPFv3 Sub-TLV in Existing OSPFv3 Intra-Area-Prefix TLV

```plaintext
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type (TBD3) | Length (4) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Cost from Prefix to ABR |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
OSPFv3 Reverse Cost to Prefix Sub-TLV
```

- **IS-IS:**
  New IS-IS Sub-TLV in Existing TLV 135, 235, 236 and 237 for prefix

```plaintext
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type (TBD4) | Length (4) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Cost from Prefix to ABR |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
IS-IS Reverse Cost to Prefix Sub-TLV
```