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Network Assigned Upstream-Label
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Abstract

   This document discusses a GMPLS RSVP-TE protocol mechanism that
   enables the network to assign an upstream-label for a given LSP.
   This is useful in scenarios where a given node does not have
   sufficient information to assign the correct upstream-label on its
   own and needs to rely on the network to pick an appropriate label.

Conventions used in this document

   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

   The GMPLS RSVP-TE extensions for setting up a Bidirectional LSP are
   discussed in [RFC3473]. The Bidirectional LSP setup is indicated by
   the presence of an UPSTREAM_LABEL Object in the PATH message. As per
   the existing setup procedure outlined for a Bidirectional LSP, each
   upstream-node must allocate a valid upstream-label on the outgoing
   interface before sending the initial PATH message downstream.
   However, there are certain scenarios where it is not desirable or
   possible for a given node to pick the upstream-label on its own.
   This document defines the protocol mechanism to be used in such

scenarios. This mechanism enables a given node to offload the task
of assigning the upstream-label for a given LSP onto the network.

2. Use-Case: Alien Wavelength Setup

Consider the network topology depicted in Figure 1. Nodes A and B
are client IP routers that are connected to an optical WDM transport
network. F, H and I represent WDM nodes. The transponder sits on the
router and is directly connected to the add-drop port on a WDM node.

The optical signal originating on "Router A" is tuned to a
particular wavelength. On "WDM-Node F", it gets multiplexed with
optical signals at other wavelengths. Depending on the
implementation of this multiplexing function, it may not be
acceptable to have the router send signal into the optical network
unless it is at the appropriate wavelength. In other words, having
the router send signal with a wrong wavelength may adversely impact
existing optical trails. If the clients do not have full visibility
into the optical network, they are not in a position to pick the
correct wavelength up-front.

```
                              |
                              | +---+               /-\
                              | |   | Router      (    ) WDM
                              | +---+ Node         \-/   node
                              |_____

   +---+           /-\              /-\              /-\           +---+
   | A |---------( F )---------( H )---------( I )---------| B |
   +---+           \-/              \-/              \-/           +---+
```

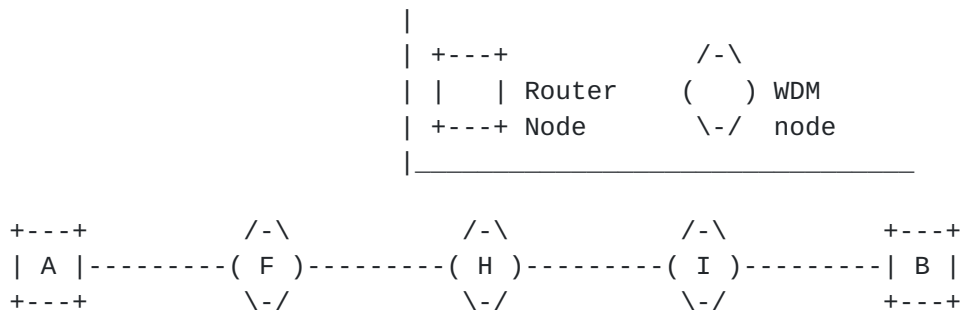   Figure 1: Sample topology

3. The "crank-back" approach

There are currently no GMPLS RSVP-TE protocol mechanisms that an
upstream-node can use for indicating that it does not know what
upstream-label to use and that it needs the downstream-node to pick
the label on its behalf.

The following setup sequence is an attempt to address the above use-
case using existing protocol mechanisms:

```
    +---+                 /-\             /-\                  +---+
    | A |----------------( F ) ~~~~~~~~~ ( I )----------------| B |
    +---+                 \-/             \-/                  +---+


        PATH
          Upstream Label (any available value)
        -------------------->
        PATH-ERROR
          Routing problem/Unacceptable Label Value
          Acceptable Label Set (L1, L2 .. Ln)
        <--------------------
        PATH
          Upstream Label (L2)
        -------------------->
                            -- ~~ -- ~~ -->
                                          PATH
                                          -------------------->
                                          RESV
                                          <-------------------
                            <-- ~~ -- ~~ --
        RESV
          Label (Assigned)
        <--------------------
```
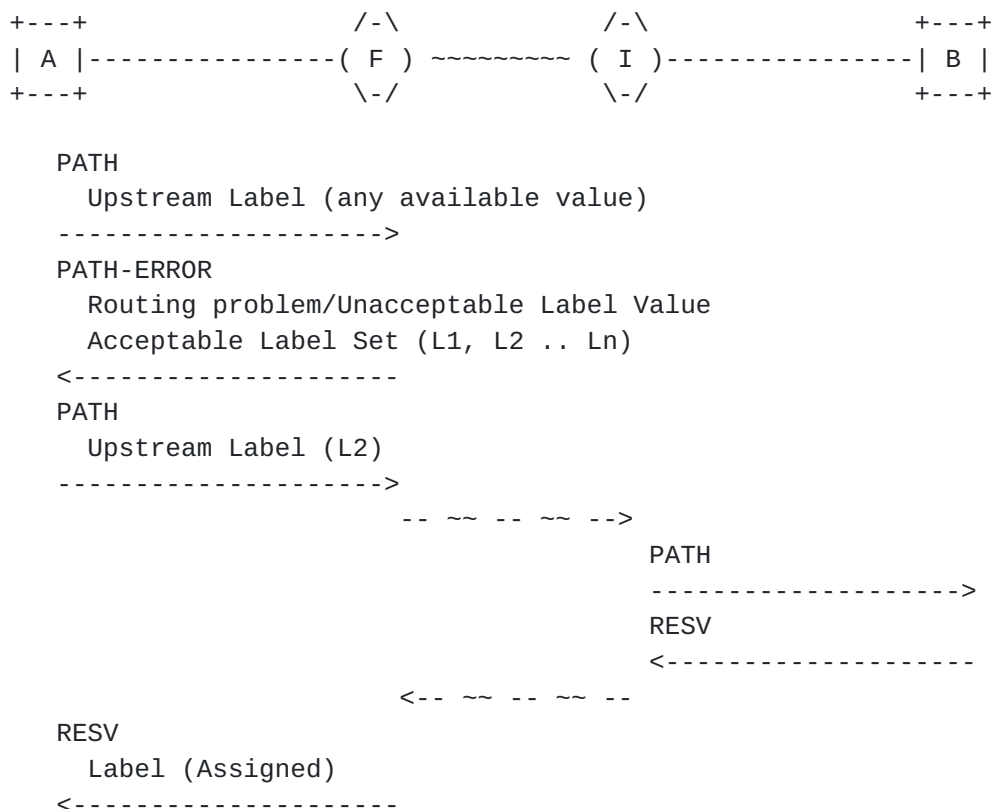
            Figure 2: Setup Sequence - Crank-back Approach

   The above approach does sort of work, but there are a few obvious
   concerns:

   - Since "Router-A" does not know which upstream-label to use, it
     picks some random label and signals it without programming its
     data-plane. As a result, the outgoing PATH message has no
     indication of whether the upstream-label has been installed along
     the data-path or not.
   - If "Router-A" somehow correctly guesses (by sheer luck) an
     acceptable upstream label upfront, the network may end up finding
     a path which is suboptimal (there could be a different acceptable
     upstream label which corresponds to a better path in the network)
   - The "Path-Error with Acceptable Label Set" retry approach is
     usually used for exception handling. The above solution uses it
     for almost every single setup request (except in the rare scenario
     where the appropriate upstream-label is guessed correctly).
   - There is an awkward window between the time the network sends out
     the Path-Error (with the ACCEPTABLE_LABEL_SET) and receives the
     corresponding Path (with the selected UPSTREAM_LABEL); this window

opens up the possibility of the selected UPSTREAM_LABEL to be
stale by the time the network receives the retry PATH.
- The above solution assumes the use of "symmetric labels" by
default.

The rest of the sections in this draft discuss a solution proposal
that is devoid of any of the above concerns.

4. Symmetric Labels

As per [RFC3471], the upstream-label and the downstream-label for an
LSP at a given hop need not be the same. The use-case discussed in
this document pertains to Lambda Switch Capable (LSC) LSPs and it is
an undocumented fact that in practice, LSC LSPs always have
symmetric labels at each hop along the path of the LSP.

The use of the protocol mechanism discussed in this document
mandates "Label Symmetry". This mechanism is meant to be used only
for Bidirectional LSPs that assign Symmetric Labels at each hop
along the path of the LSP.

5. Unassigned Upstream Label

This document proposes the use of a special label value -
"0xFFFFFFFF" - to indicate an Unassigned Label. The presence of this
value in the UPSTREAM_LABEL object of a PATH message indicates that
the upstream-node has not assigned an upstream label on its own and
has requested the downstream-node to provide a label that it can use
in both forward and reverse directions. The presence of this value
in the UPSTREAM LABEL object of a PATH message can also be
interpreted as a request to mandate "symmetric labels" for the LSP
at the given hop.

5.1. Processing Rules

The Unassigned Upstream Label is used by an upstream-node when it is
not in a position to pick the upstream label on its own. In such a
scenario, the upstream-node sends a PATH message downstream with an
Unassigned Upstream Label and requests the downstream-node to
provide a symmetric label. If the upstream-node desires to make the
downstream-node aware of its limitations with respect to label
selection, it has the option to specify a list of valid labels via
the LABEL_SET object.

In response, the downstream-node picks an appropriate symmetric
label and sends it via the LABEL object in the RESV message. The

upstream-node would then start using this symmetric label for both
directions of the LSP. If the downstream-node cannot pick the
symmetric label, it MUST issue a PATH-ERR message with a "Routing
Problem/Unacceptable Label Value" indication.

The upstream-node will continue to signal the Unassigned Upstream
Label in the PATH message even after it receives an appropriate
symmetric label in the RESV message. This is done to make sure that
the downstream-node would pick a symmetric label if and when it
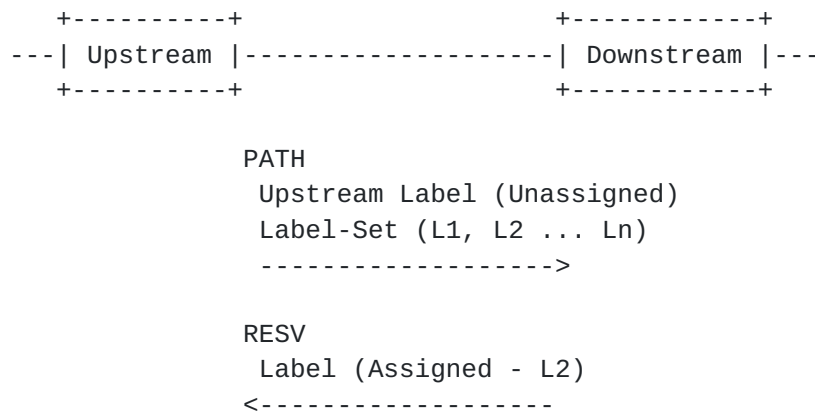needs to change the RESV label at a later point in time.

```
        +----------+                      +------------+
   ---| Upstream |-------------------| Downstream |---
        +----------+                      +------------+


                    PATH
                     Upstream Label (Unassigned)
                     Label-Set (L1, L2 ... Ln)
                    ------------------>

                    RESV
                     Label (Assigned - L2)
                    <------------------
```

                Figure 3: Unassigned UPSTREAM_LABEL

5.2. Backwards Compatibility

If the downstream-node is running an older implementation (which may
be using the "crank-back" approach discussed in Section 3) and
doesn't understand the semantics of an Unassigned UPSTREAM LABEL, it
will either (a) reject the special label value and generate an error
or (b) accept it and treat it as a valid label.

If the behavior that is exhibited is (a), then there are obviously
no backwards compatibility concerns. Ingress implementations may
even choose to adopt the "crank-back" approach in such cases. If
there is some existing implementation that exhibits the behavior in
(b), then there could be some potential issues. The use-case
discussed in this draft pertains to LSC LSPs and it is safe to
assume that the behavior in (b) will not be exhibited for such LSPs.

6. Applicability

Let us revisit the "alien wavelength" use-case discussed in Section
2 and examine how the mechanism proposed in this document allows the

optical network to select and communicate the correct wavelength to
its clients.

6.1. Initial Setup

```
+---+                   /-\               /-\                   +---+
| A |---------------( F ) ~~~~~~~~~ ( I )---------------| B |
+---+                   \-/               \-/                   +---+

    PATH
      Upstream Label (Unassigned)
    --------------------->
                          -- ~~ -- ~~ -->
                                            PATH
                                            -------------------->
                                            RESV
                                            <-------------------
                          <-- ~~ -- ~~ --
    RESV
      Label (Assigned)
    <---------------------
```
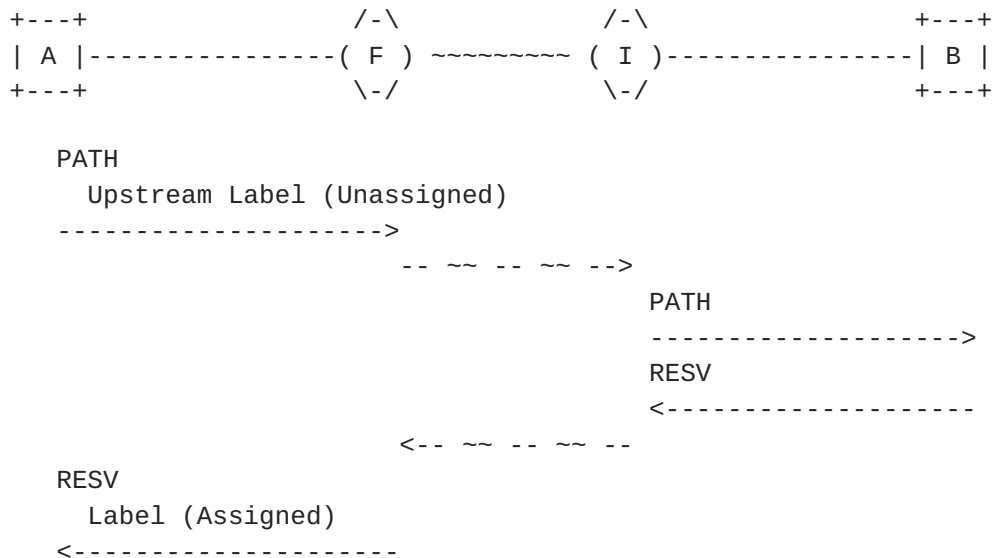
              Figure 4: Alien Wavelength - Initial Setup

Steps:
  - "Router A" does not have enough information to pick an
    appropriate client wavelength. It sends a PATH downstream
    requesting the network to assign an appropriate symmetric label
    for it to use. Since the client wavelength is unknown, the
    laser is off at the ingress client.
  - The network receives the PATH, chooses the appropriate
    wavelength values and forwards them in appropriate label fields
    to the egress client ("Router B")
  - "Router B" receives the PATH, turns the laser ON and tunes it
    to the appropriate wavelength (received in the
    UPSTREAM_LABEL/LABEL_SET of the PATH) and sends out a RESV
    upstream.
  - The RESV received by the ingress client carries a valid
    symmetric label in the LABEL object. "Router A" turns on the
    laser and tunes it to the wavelength specified in the network
    assigned symmetric LABEL.

For cases where the egress-node relies on RSVP signaling to
determine exactly when to start using the LSP, this draft recommends

integrating the above sequence with any of the existing graceful
setup procedures:
   - "RESV-CONF" setup procedure (or)
   - 2-step "ADMIN STATUS" based setup procedure ("A" bit set in the
     first step; "A" bit cleared when the LSP is ready for use).

6.2. Wavelength Change

After the LSP is set up, the network MAY decide to change the
wavelength for the given LSP. This could be for a variety of reasons
- policy reasons, restoration within the core, preemption etc.

In such a scenario, if the ingress client receives a changed label
via the LABEL object in a RESV modify, it MUST retune the laser at
the ingress to the new wavelength. Similarly if the egress client
receives a changed label via UPSTREAM_LABEL/LABEL_SET in a PATH
modify, it MUST retune the laser at the egress to the new
wavelength.

7. Security Considerations

TBD

8. IANA Considerations

TBD

9. Normative References

[RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3471]   Berger, L., "Generalized Multi-Protocol Label Switching
              Signaling Functional Description", RFC 3471, January
              2003

[RFC3473]   Berger, L., "Generalized Multi-Protocol Label Switching
              Signaling Resource Reservation Protocol-Traffic
              Engineering Extensions", RFC 3473, January 2003.

10. Acknowledgments

TBD

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