An MPLS-Based Forwarding Plane for Service Function Chaining

draft-farrel-mpls-sfc-04/05
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Agenda

• Overview and (Non-)Objectives of the Design
• Issues and Changes
  – Nits and Editorial
  – Removal of Discussion of Segment Routing
  – Purpose and Intent
  – Transport Independence
  – SFC-Awareness and SFC Proxies
  – Metadata
  – Control Planes
• Future Plans
Recall the SFC Architecture

- Packets flow from source to destination
- Packets are classified onto a Service Function Path (SFP)
- SFP traverses a series of Service Function Forwarders (SFFs)
- Each SFF delivers packets on the SFP to a specific Service Function Instance (SFI)
- SFC Proxy may be placed between SFF and SFI
Objectives / Non-objectives

1. Not trying to replace or obsolete NSH
2. Looking at a specific environment where deployed MPLS routers can serve as SFFs
   - No change to forwarding plane
   - Work using existing MPLS forwarding operations (push/pop/swap)
   - Able to forward SFC packets “at line speed”
3. Aim to get high level of SFC functionality
   - Possible that some features will be sacrificed in compromise with desire to achieve objectives
   - Must support SFC architecture (RFC 7665)
   - Should support metadata
   - Try to integrate with control plane solutions that work with NSH
   • draft-ietf-bess-nsh-bgp-control-plane
Overview of Solution

• Basic building block is a two-label unit

  • Labels included as Label Stack Entries
  • Neither of the labels can be in the range 0..15
    – I.e., must not overlap with Special Purpose Label values
  • An SFF uses top label to identify “path”
    – Local context
    – Select path to next SFF
  • An SFF uses second label to identify SF

<table>
<thead>
<tr>
<th>SFC Context Label</th>
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<tbody>
<tr>
<td>Service Function Label</td>
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Nits and Editorial

• Changes from -02 to -04
  – RFC 8300 published
  – RFC 8174 published
  – MPLS S-bit (not S-flag or S-field)
  – Abbreviation expansions
  – Add a section on Proxies (see later slide)
  – Clarify metadata usage is less functional than NSH
    • (see later slide)
  – Typos in examples
Discussion of Segment Routing

• Called out on mailing list
  – Resulted in Adrian’s mea culpa email

• -05 will
  – Remove all discussion of SR (specifically MPLS-SR)
  – Talk only about the MPLS forwarding plane as already defined
    • push, pop, and swap
  – Not discuss control plane mechanisms in any detail

• Continue to discuss
  – Use of labels to encode information included in NSH
  – How to handle metadata with labels

• Where to discuss this draft?
  – Seems to leave the document as an MPLS draft
  – With necessary SFC review
Purpose and Intent

• As stated in objectives
  – SFFs built from existing (MPLS) routers
    • Able to forward packets at line speed
  – Functionally of 7665 and 8300
  – Authors think this will provide migration assist
    • Experience with SFC
    • Gateway to use of control plane and other tools
    • Easy way to introduce SFC to today’s network

• Debate over whether such an SFF could exist
  – Should authors describe how to do that? Or is that secret-sauce?

• Non-objective
  – Obsolete or modify NSH

• -05 will
  – Add/clarify text on objectives and non-objectives
Transport Independence

• SFC transport means:
  – Between SFFs
    • NSH is transport independent
      – This draft shows MPLS as the transport
        » This is the most likely use case for this work
  – Between SFF and SF
    • NSH and this document are transport independent
    • See also discussion of proxies on next slide
    • SFs are usually Ethernet/VxLAN/PW attached?

• Nothing proposed for -05
  – Anything needed?
SFC-Awareness and SFC Proxies

• “SFC-Aware” means “able to handle the SFC encapsulation”

• SFFs
  • Usually SFC-aware, but...
  • Might be programmed with label forwarding/operations
    – E.g. “pop and forward”, “incoming port maps to label imposition”

• SFs
  • Legacy VNFs and PNFs are not SFC-aware by definition
  • Must use an SFC Proxy
    – Strip encapsulation
    – Pass to SF
    – Receive from SF (on logical port)
    – Impose encapsulation
  • NSH and MPLS encodings have identical requirements and issues

• -04 introduced Section 8 on proxies
  • -05 clarifies and provides early pointer to Section 8
Metadata

• Document acknowledges it cannot do everything that NSH can do
  – Not carry metadata in user data packet
    • Cannot do per-packet metadata
  – Use same technique as draft-farrel-sfc-convent
    • (On RFC Editor queue with SFC WG consensus)
    • Send metadata in dedicated packets following the SFP
    • Point to metadata from packet using label

• Technique is not seamless
  – SFF can forward metadata just as user data
  – SFC Proxy must map metadata as SF is not MPLS-aware
    • But this is exactly how SFC Proxy must behave for all metadata

• Draft already includes explanation
  – No changes planned for -05 but welcome input
Control Planes

• This document does not depend on any control plane
  – But a control plane will probably be needed
• Want a YANG model?
  – Write one, probably in SFC WG
• Like SR?
  – Probably in SPRING where Xiaohu Xu has a draft
• Want to use BGP?
  – See draft-ietf-bess-nsh-bgp-control-plane
• Legacy world?
  – See draft-ietf-bess-service-chaining
    • This is a BGP VPN approach
    • Popular way to introduce the technology
    • SFP is achieved by programming SFFs (i.e., not following SFC WG)
Next Steps

• There are always things to polish, but...
  – This is now relative stable
  – Support for swapping and stacking in a common way took some effort, but has good benefits

• Fits with BESS control plane work

• To the authors approach seems “obvious”
  – What do other people think?

• The authors think this is in charter for MPLS WG
  – Use of special purpose labels belongs in MPLS
  – But obviously it needs review by SFC WG

• Actions for chairs
  – Decide where this belongs
  – Resolve adoption issues

• Actions for participants
  – Objective discussion of the design.
Backup Slides
Where To Have This Discussion?

• SFC WG has developed problem statement and architecture for SFC
  – We re-use these

• SFC chartered to work on “generic encapsulation” that is “agnostic to the layer at which it is applied”
  – Has developed the NSH

• This work is specific to an MPLS forwarding plane and uses an MPLS encapsulation
  – Need review from experts
    • Want to be sure MPLS parts work
    • Want to be sure SFC parts work
  – Some functions need specific MPLS extensions and codepoints

• Let the chairs and ADs work out where the work belongs
MPLS Label Swapping

- Tunnels between SFFs “as normal”
  - Of course, we are interested in MPLS as the transport
- SPI and SI used “as normal” for NSH
  - Some limitation as SPI is constrained here to 20 bits

MPLS-SFC processing...
- Labels are looked up and acted on by SFF to determine next hop
  - Maybe forward to SFI or SFC proxy
  - Maybe forward to next SFF
- In some cases action can be achieved simply through SPI
- In other cases need the two label context
  - SI is updated before further forwarding (it’s a swap)
  - SPI and SI set during classification
  - Potentially also during re-classification

<table>
<thead>
<tr>
<th>Tunnel Labels</th>
<th>SFC Context Label = SPI</th>
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<tbody>
<tr>
<td>Service Function Label = SI</td>
<td></td>
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<tr>
<td>Payload</td>
<td></td>
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Metadata

- MPLS encapsulation not well suited for carrying “arbitrary” metadata
- We define an Extended Special Purpose Label
  - This three-label sequence can be included at the bottom of the label stack
  - Metadata label is an index into a store of metadata
    - Must also not use 0..15
    - Store may be populated through management plane, control plane, or in-band (next slide)
      - This approach is not good for “per-packet metadata” (e.g., hashes)
      - Works fine for per-SFP or per-flow metadata

<table>
<thead>
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<th>Metadata Label Indicator (MLI)</th>
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<td>15 = Extended Special Purpose Label Follows</td>
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In-Band Metadata Distribution

- Consider draft-farrel-sfc-convent
  - Defines use of NSH with Next Protocol == None
  - Can be used to send NSH packets along an SFP without carrying payload (but still carrying metadata)
  - This draft defines how to do this in MPLS

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<tbody>
<tr>
<td>Metadata Label</td>
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<tr>
<td>Length</td>
<td>Type</td>
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<tr>
<td>Metadata</td>
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- Use an Extended Special Purpose Label
  - Hence, a three label sequence
  - Placed at the bottom of the label stack
  - Rest of stack exactly as for SFP
  - Metadata carried as payload
    - Formatted as TLV
    - Type field defined by SFC WG for NSH
    - Metadata as defined by SFC WG