DetNet Data Plane

draft-dt-detnet-dp-sol-01

DetNet Data Plane design team update
IETF 99, Prague, 2017
Outline

• Design team
• Solution
• Open issues
• Next steps
Design team

• Members
  • Jouni Korhonen (lead)
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  • Norm Finn
  • Balazs Varga
  • Janos Farkas
  • Tal Mizrahi
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Design team update cont’d

• Weekly calls held...
• Other stuff found at the mailing list:
  • https://mailarchive.ietf.org/arch/search/?email_list=detnet-dp-dt
Use case – IEEE 802.1 TSN over DetNet

End Systems initiates / terminates IEEE802.1 TSN traffic..

With MPLS PSN this is an MS-PW T-PE with DetNet extensions i.e., DA-T-PE..

With MPLS PSN this is an MS-PW S-PE with DetNet extensions i.e., DA-S-PE..

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Use case – PW-based DetNet

End Systems initiates / terminates PWs over MPLS.

With MPLS PSN this is an MS-PW S-PE with DetNet extensions i.e., DA-S-PE.

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Use case – Native IPv6-based DetNet

End Systems initiates / terminates IPv6 packets with DetNet “support”
Mixing use cases..

• Combining “IEEE 802.1TSN over DetNet” and “PW-based native DetNet” use cases is rather straightforward:
  • The PW encapsulation/de-capsulation either takes place in an end station or an edge node.
  • However, interworking function still required at the edge node between 802.1TSN and PW e.g., when it comes to sequence numbers etc.

• Combining PW-based and “native IPv6” use cases:
  • Interworking needs some more tinkering. Probably trying to cover all possible combinations makes no sense (e.g., non-DetNet aware end station talks IPv6 to native IPv6 DetNet-aware end station over 802.1TSN interconnect..)
Solution basics

• Uses PseudoWires (with MPLS PSN) and IPv6 as the data plane encapsulation solutions.

• Designed to work with existing control planes
  • E.g. LDP, RSVP-TE, SR (for MPLS PWs) and centralized controller.
  • Small updates are inevitable, though.
  • Control plane for native IPv6 has not been discussed too much yet.

• Maximize the reuse of existing solutions and implementations:
  • Extend only where needed & mandatory for solution to work.
  • No new functionality unless really necessary.
Hard issues to get agreement

• Unified encapsulation for all types of traffic..
  • End result was – two encapsulations.
  • Native IPv6 and MPLS PWs.

• DetNet flow identification:
  • A PW Label for MPLS PWs. There is no “dedicated” DetNet label per se.
  • A flow label for Native IPv6.

• Service protection:
  • Packet Replication and Elimination for Redundancy (PREF).
  • Also need to differentiate between DetNet compound and member flows.
Packet formats with MPLS PWs encapsulation

- **DetNet flow:**
  - Flow-ID -> PW label.
  - SeqNum -> CW.

- **S-Label:**
  - A DetNet node to DetNet node "service" label that is used between DA-*-PE devices (see slide 5).

- **T-Label:**
  - Used to identify the LSP used to transport a DetNet flow across an MPLS PSN, e.g., a hop-by-hop label used between LSRs.

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Packet formats with Native IPv6 encapsulation

- DetNet flow:
  - Flow-ID -> Flow Label.

- For explicit routes DstOpt works well for unicast flows e.g., with Segment Routing.

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Packet formats cont’d

• PW Control Word is the same as for Ethernet over MPLS (RFC4448).

• Required for packet Replication and Elimination Function (PREF).

\[
\begin{array}{cccccccccccccccc}
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 \\
\end{array}
\]

| 0 0 0 0 | reserved - set to 0 | 16 bit Sequence Number |
|----------------|----------------------|

• IPv6 makes use of Destination Options – new option needed.

• Required for packet Replication and Elimination Function (PREF).

\[
\begin{array}{cccccccccccccccc}
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 0 & 1 \\
\end{array}
\]

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<th>4</th>
<th>Reserved</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>16 bit Sequence Number</th>
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Flow identification..

• Integral part of DetNet flow processing. Flow identification has two key aspects (MPLS PSN example):
  • At the **forwarding and queuing level**:
    • Flow identification implicitly part of FEC and encoded into label(s) and TC bits.
    • May identify an aggregate of DetNet flows or individual flows (e.g., a FEC per flow).
  • As **part of the Packet Replication and Elimination Function**:
    • Flow lookup based on the PW Label and accompanied with the CW SeqNum to detect whether a packet has already be seen.
    • Done within the PseudoWire (extended forwarder) function.
    • Note: replication is basically a reuse of 1+1 protection mechanism.
Other data plane considerations

• Class of Service:
  • CoS for DetNet flows with PWs (and MPLS PSN) encapsulation rely on RFC3270 described DiffServ architecture.
  • CoS for DetNet flows with IPv6 encapsulation rely on DiffServ DSCP code points and related mechanisms.
  • Plus some other considerations.

• Quality of Service:
  • A baseline set of QoS capabilities for DetNet flows carried in PWs and MPLS can provided by MPLS with Traffic Engineering (MPLS-TE) and the related control planes.
  • IPv6 should leverage the underlying network layer such as 802.1TSN.

• Cross-DetNet flow resource aggregation:
  • The data plane implications of aggregation are independent for MPLS/PW and IP encapsulated DetNet flows, and should leverage existing work e.g., hierarchical LSPs.
Other data plane considerations cont’d

• Bidirectional traffic:
  • How bidirectional traffic between two end stations are handled (e.g., associated & co-routed bidirectional flows in a case of LSP), fate sharing, ensuring the same path, etc.

• Layer 2 addressing and QoS Considerations:
  • Background: how baseline TSN standards identify TSN streams (e.g. DetNet flows), use VLAN tags, multicast destination addresses, etc..

• Interworking between PW- and IPv6-based encapsulations
  • Currently TBD. See slides 8 and 17.
Time Synchronization

• A full section added with time-synchronization related considerations within DetNet deployments..
Open issues

• Few topics are still under work:
  • Interworking between MPLS and IPv6 DetNet flows/transports.

• Control plane is another topic... out of scope for this I-D. However...
  • The design team did consider it as well to some extent.
  • Controlling PREF function, resource reservations, etc...

• Multicast destined DetNet flows:
  • The data plane assumes p2p transport connectivity within the DetNet domain.

• Relay and Edge node processing clarifications for native IPv6.
  • E.g. whether PREF can be done in anywhere else than in end hosts and edge nodes.

• Management and control considerations..
Next steps..

• Call for adoption as a WG Item!!
  • We acknowledge there is plenty of work to do.. but the current draft should work as a good basis for the final solution.