# 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

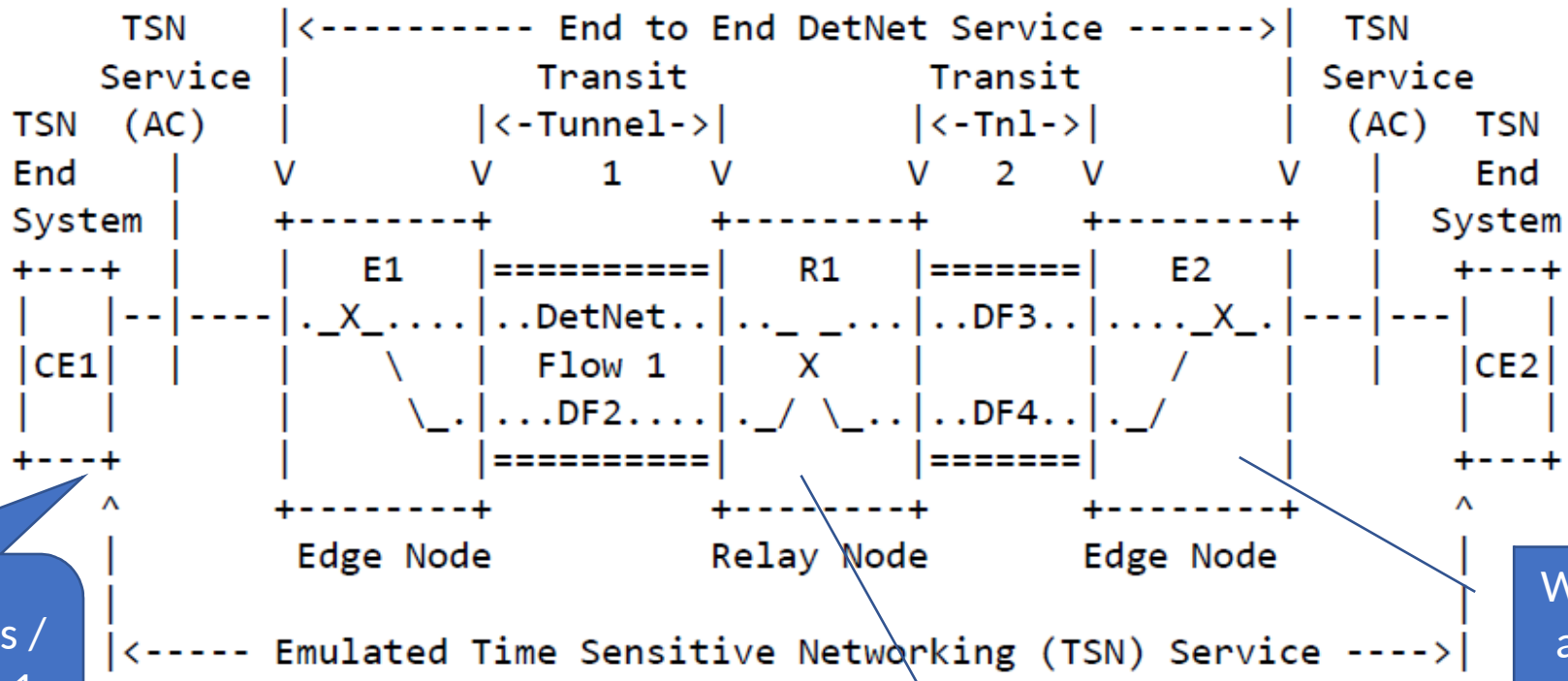
# Design team

- Members
  - Jouni Korhonen (lead)
  - Carlos Bernardos
  - Loa Andersson
  - Yuanlong Jiang
  - Norm Finn
  - Balazs Varga
  - Janos Farkas
  - Tal Mizrahi
  - David Mozes

# 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 802.1TSN over DetNet




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

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

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

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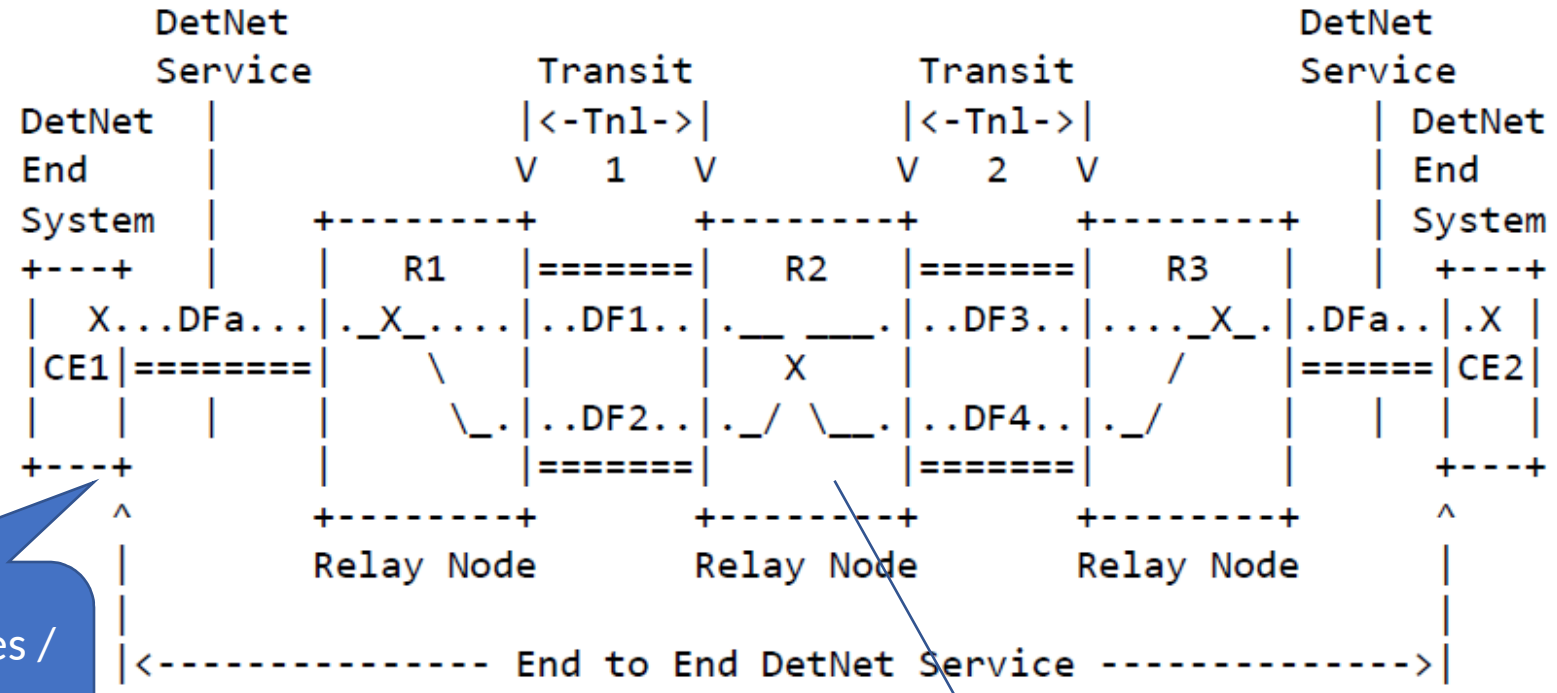
# Use case – PW-based DetNet

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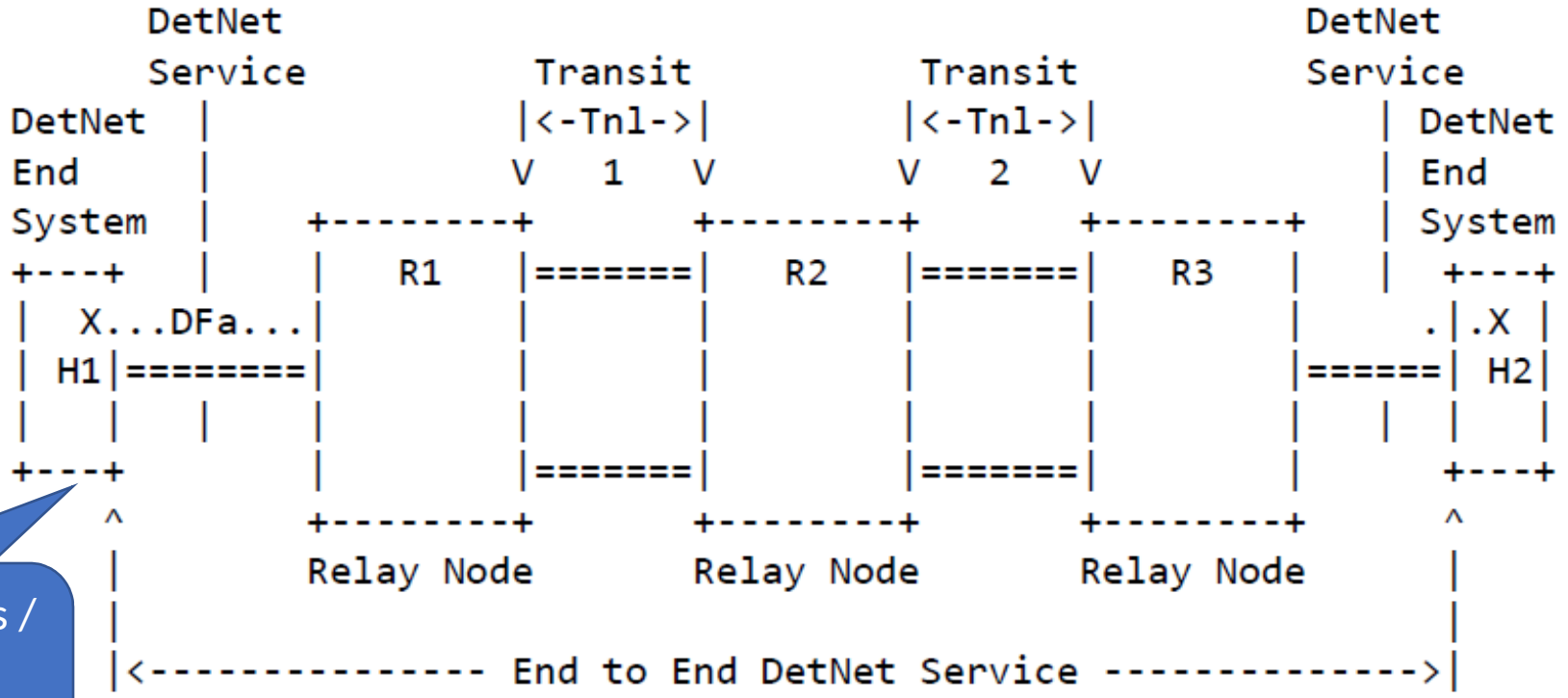
# Use case – Native IPv6-based DetNet




End Systems initiates / terminates IPv6 packets with DetNet "support"

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# Mixing use cases..

- Combining “IEEE 802.1TSN over DetNet” and “PW-based native DetNet” use cases is rather straight forward:
  - 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.

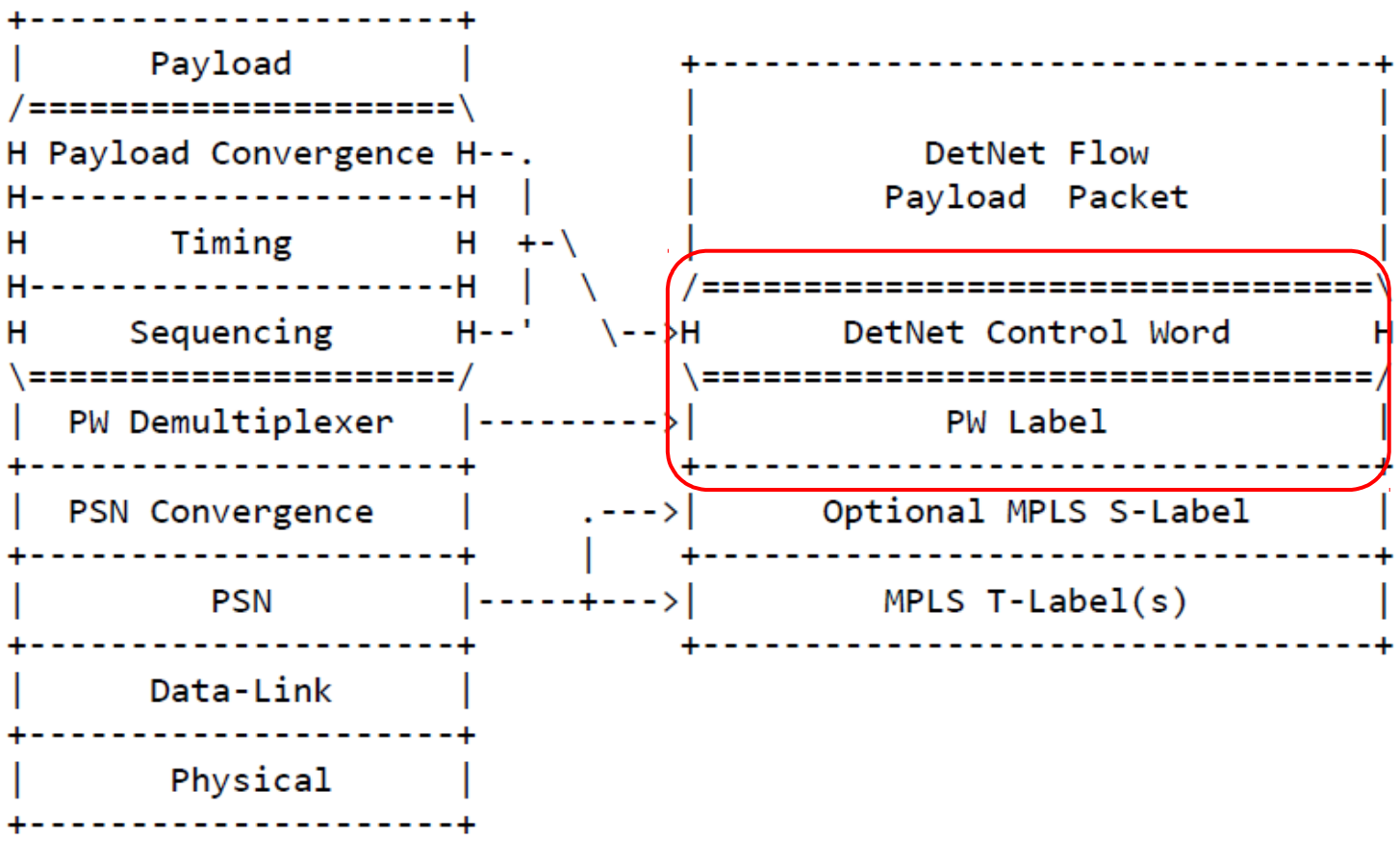
# Hard issues to get agreement

- 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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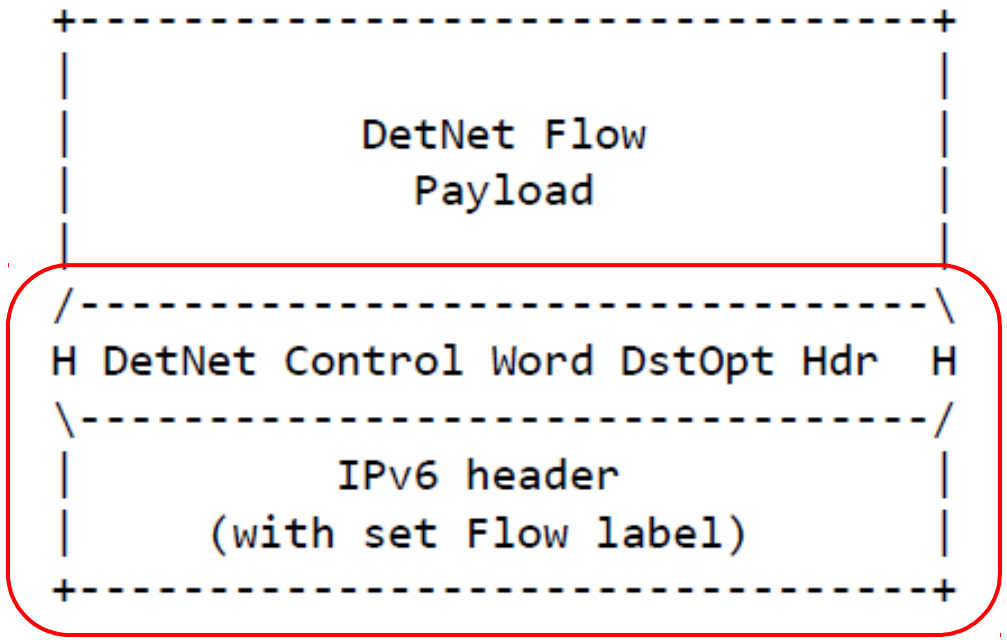
# Packet formats with Native IPv6 encapsulation




- DetNet flow:
  - Flow-ID -> Flow Label.
  - SeqNum -> DetNet DstOpt.
- For explicit routes DstOpt works well for unicast flows e.g., with Segment Routing.

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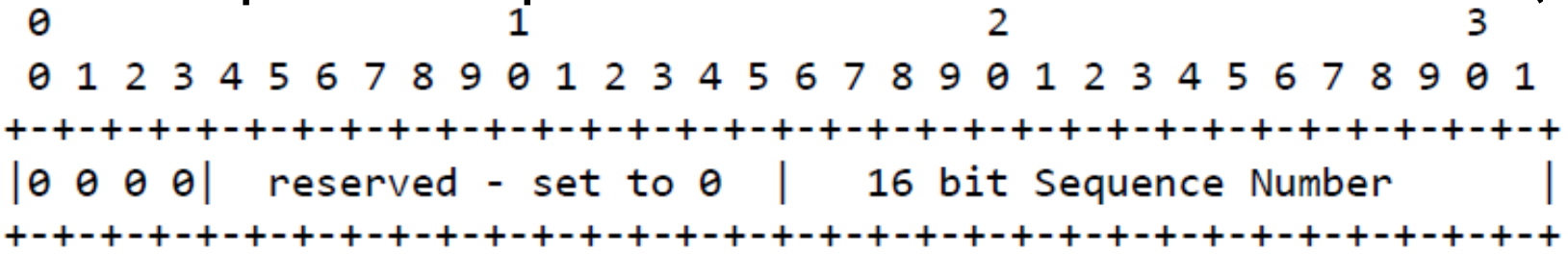
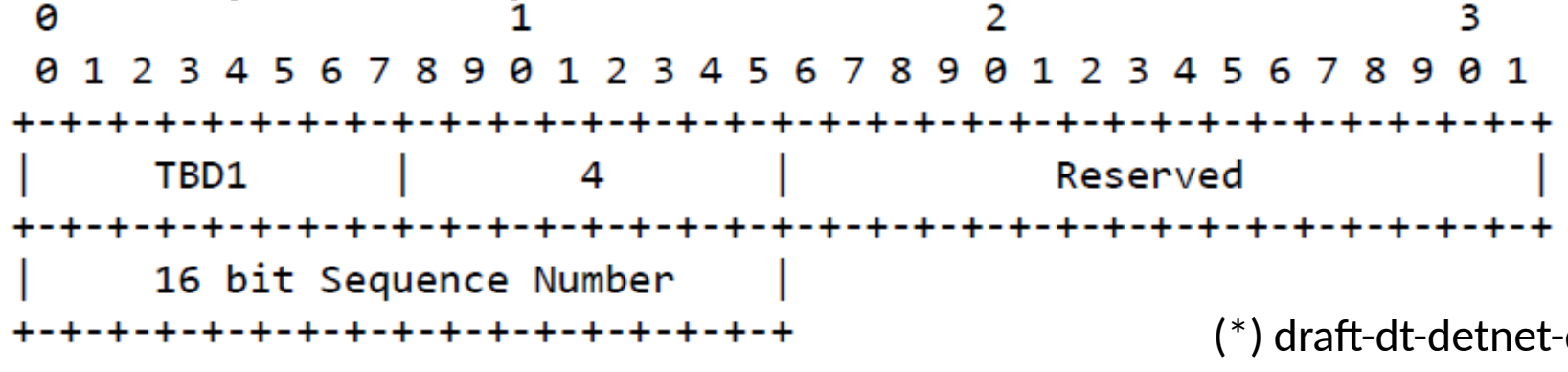
# Packet formats cont’d

- PW Control Word is the same as for Ethernet over MPLS (RFC4448).
- Required for packet Replication and Elimination Function (PREF).




- IPv6 makes use of Destination Options – new option needed.
- Required for packet Replication and Elimination Function (PREF).

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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.