

DetNet

Data Plane Solutions

[draft-ietf-detnet-dp-sol-ip-00](#)

[draft-ietf-detnet-dp-sol-mpls-00](#)

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DetNet WG

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DetNet Data Plane History

- Data Plane solution: [draft-ietf-detnet-dp-sol-04](#)
 - Individual drafts: [draft-bryant-detnet-mpls-dp-00](#)
[draft-malis-detnet-ip-dp-00](#)
- Split of DP document and incorporate discussion results
 - IP data plane [draft-ietf-detnet-dp-sol-ip-00](#)
 - MPLS data plane [draft-ietf-detnet-dp-sol-mpls-00](#)
- Initial versions
 - capturing major concepts, there is work to be done (rfc2119 language, ...)
- Contributions are welcome ...

IPv{4|6} DetNet

IP data plane – Basics

draft-ietf-detnet-dp-sol-ip-00

- DetNet data plane operation
 - for IP hosts and routers that provide DetNet service to **IP encapsulated data**
 - No DetNet specific encapsulation is defined to support IP flows, rather existing IP header information is used to support flow identification and DetNet service delivery ("**6-tuple**" based flow identification)
- DetNet Architecture
 - **service layer: provides DetNet service protection and reordering**
 - **transport layer: provides congestion protection (low loss, bounded latency, and limited reordering, controller plane based service protection)**

Note: As no DetNet specific headers are added only transport layer functions are supported

Note2: Service protection can be provided on a per sub-net basis using technologies such as MPLS and IEEE802.1 TSN

IP data plane – Scenarios

Simple DetNet (DN) Enabled IP Network

- DetNet enabled end systems originate IP encapsulated traffic
- Relay nodes
 - understand the transport requirements of the DetNet flow and ensure that node, interface and sub-network resources are allocated to ensure DetNet service requirements
 - are DetNet service aware but do not perform any DetNet service layer function
- Service protection:
 - May be provided at sub-net / link layer (e.g., 802.1TSN), but not by DetNet IP

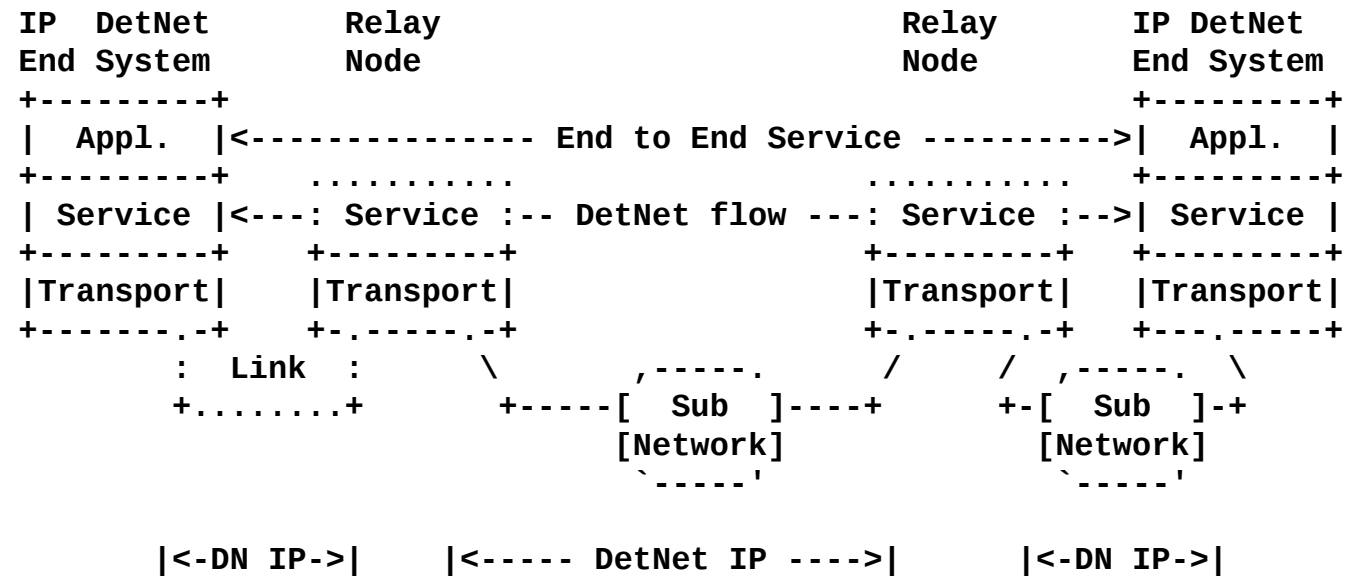


Figure 1: A Simple DetNet (DN) Enabled IP Network

IP data plane – Scenarios

DetNet (DN) IP Over MPLS Network

- IP flow is mapped to one or more PWs and MPLS (TE) LSPs
- Relay nodes
 - map each DetNet flow to MPLS LSPs.
 - can provide service layer functions such as PREOF over the MPLS transport layer
- Transit node
 - is MPLS (TE) LSP aware and performs switching based on MPLS labels, and need not have any specific knowledge of the DetNet service or the corresponding DetNet flow identification

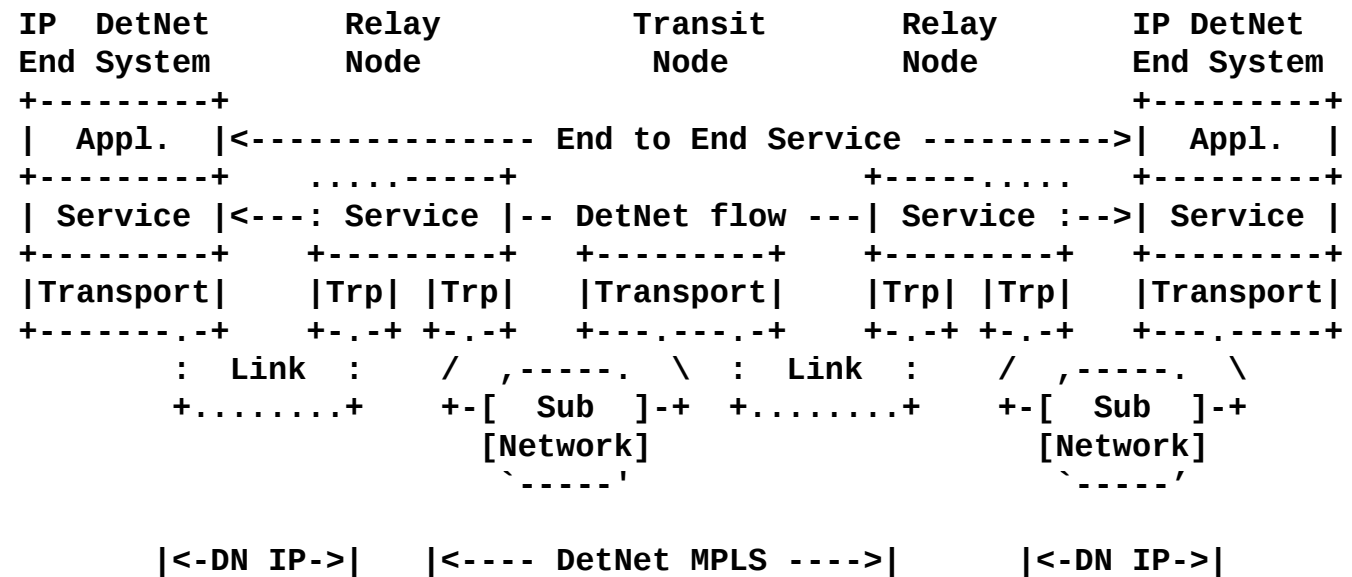


Figure 2: DetNet (DN) IP Over MPLS Network

IP data plane – Scenarios

Non-DetNet aware IP end systems with IP DetNet Domain

- End systems are not DetNet aware
- Edge nodes
 - edge nodes sit at the boundary of the DetNet domain and act as DetNet service proxies for the end applications by initiating and terminating DetNet service for the non-DetNet aware IP flows
- Flow identification
 - existing header information can be used

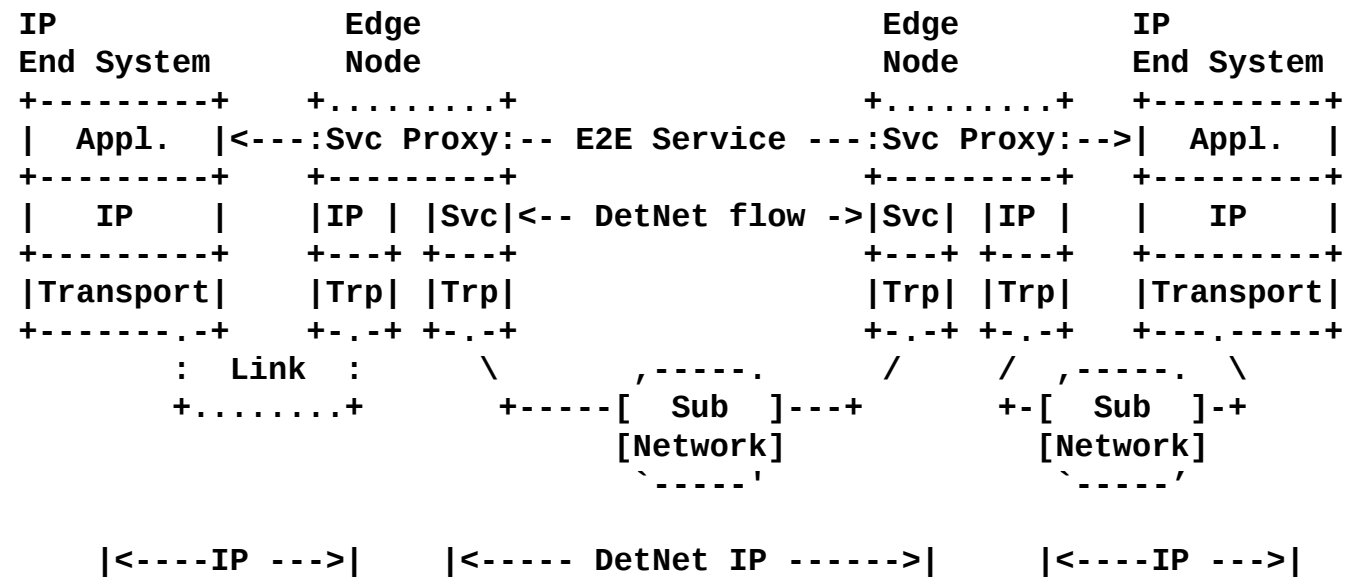


Figure 3: Non-DetNet aware IP end systems with IP DetNet Domain

IP data plane – Flow identification

6-tuple

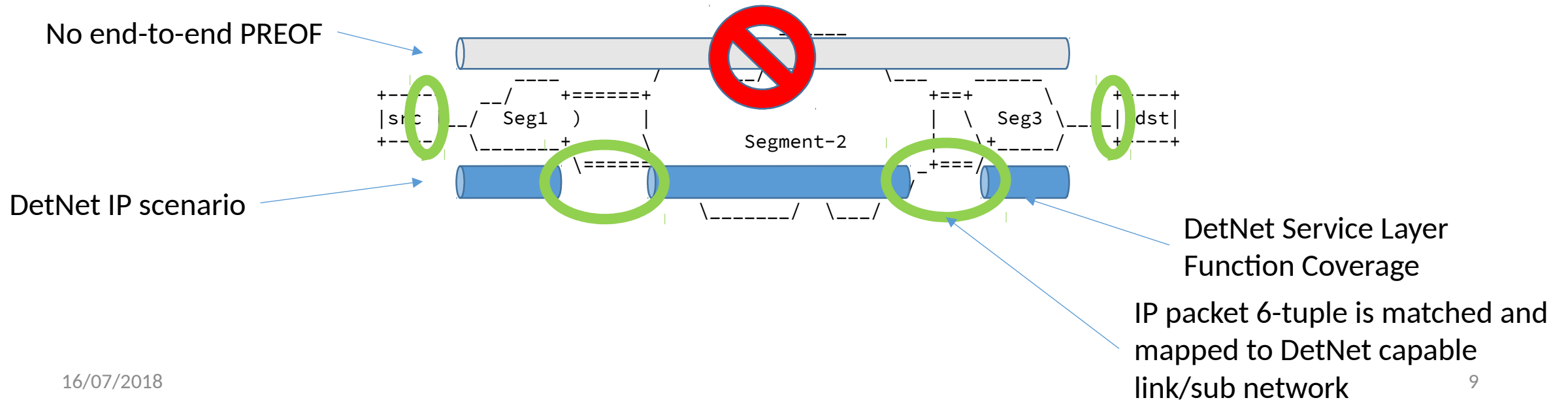
- Flow identification
 - based on IP, both IPv4 and IPv6, header information.
 - "6-tuple": the traditional 5-tuple + DSCP
 - IP **source** and **destination** address fields,
 - the next level **protocol** or header field,
 - the next level protocol (e.g. TCP or UDP) **source** and **destination ports**, and
 - the IPv4 Type of Service or IPv6 Traffic Class field (i.e., **DSCP**)
 - any of the fields can be ignored (wildcarded), and bit masks, prefix based longest match, and ranges can also be used

IP data plane – Service Protection

NOT end-to-end

- Service Protection

- is done within each link / subnetwork independently using the domain specific mechanisms (due the lack of a unified end to end sequencing information that would be available for intermediate nodes).



IP data plane – Further work

Need discussions

- Further work needed
 - Networks with multiple technology segments
 - OAM
 - Aggregation

- Class of Service / Quality of Service (candidate for dedicated document)
- Time synchronization (candidate for dedicated document)

- Management and control plane considerations
- DetNet IP Encapsulation Procedures
- Mapping IP DetNet Flows to IEEE 802.1 TSN

++ Adding rfc2119 conformance language

MPLS DetNet

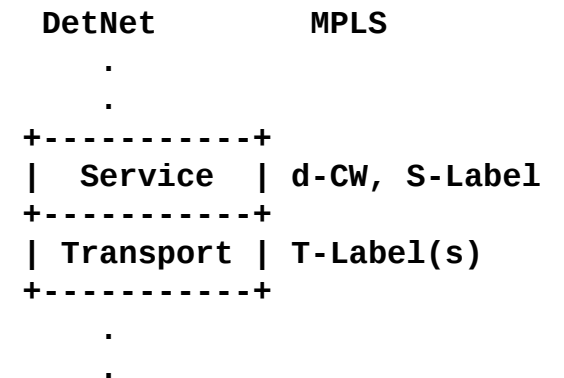
MPLS data plane – Basics

draft-ietf-detnet-dp-sol-mpls-00

- DetNet data plane operation
 - DetNet flows over an MPLS-based Packet Switched Network (PSN)
 - DetNet service for **IP** and **Ethernet hosts**
 - DetNet specific encapsulation is defined: **DetNet PW**

- DetNet Architecture

- service layer:
 - provides DetNet service protection and reordering
 - supported based on existing pseudowire (PW) encapsulations and mechanisms
- transport layer:
 - provides congestion protection (low loss, assured latency, and limited reordering)
 - supported based on existing MPLS Traffic Engineering encapsulations and mechanisms



MPLS data plane – End-system Encapsulation

- Two types of end-systems are distinguished:
 - L2 (Ethernet) end-system: application directly over L2.
 - L3 (IP) end-system: application over L3.
- Two types of services are distinguished:
 - DetNet Layer Two Service:
L2 headers MUST either be kept, or provision must be made for their reconstruction at egress from the DetNet domain
 - DetNet Routing Service (IP over MPLS):
IP headers are modified per standard router behavior, e.g., TTL handling.

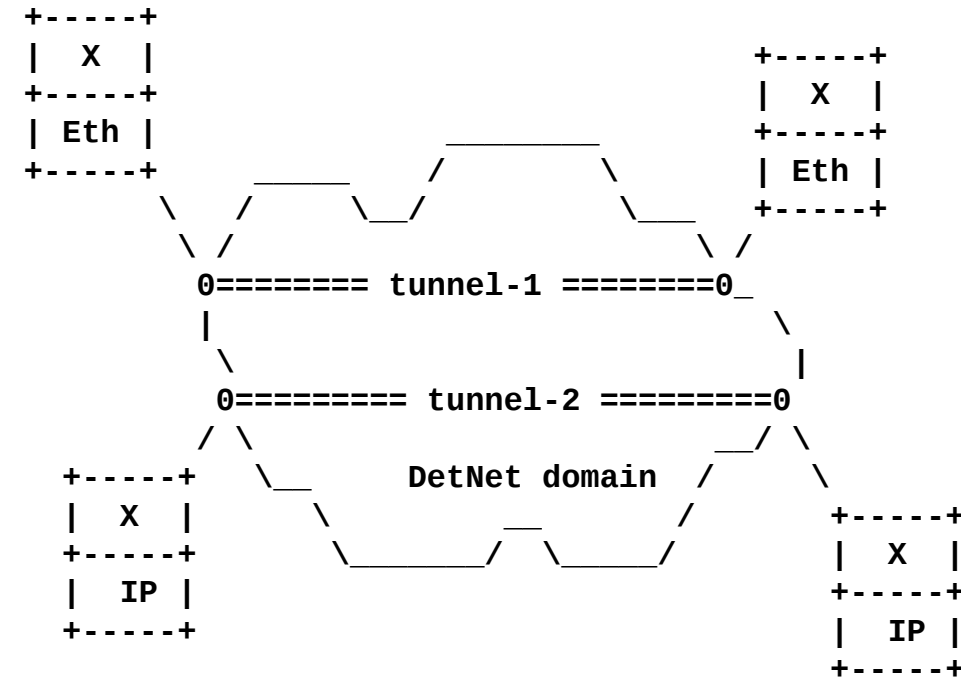


Figure 9: End-systems and the DetNet domain

MPLS data plane – Scenarios

TSN over DetNet MPLS Enabled Network

- TSN end systems originate Ethernet encapsulated traffic
- DetNet Edge Nodes
 - sit at the boundary of a DetNet domain
 - are responsible for mapping non-DetNet aware traffic to DetNet services
 - support the imposition and disposition of the required DetNet encapsulation.
 - functionally similar to pseudowire (PW) Terminating Provider Edge (T-PE) nodes which use MPLS-TE LSPs.
- Transit nodes
 - are normal MPLS LSRs
 - are generally unaware of the special requirements of DetNet flows

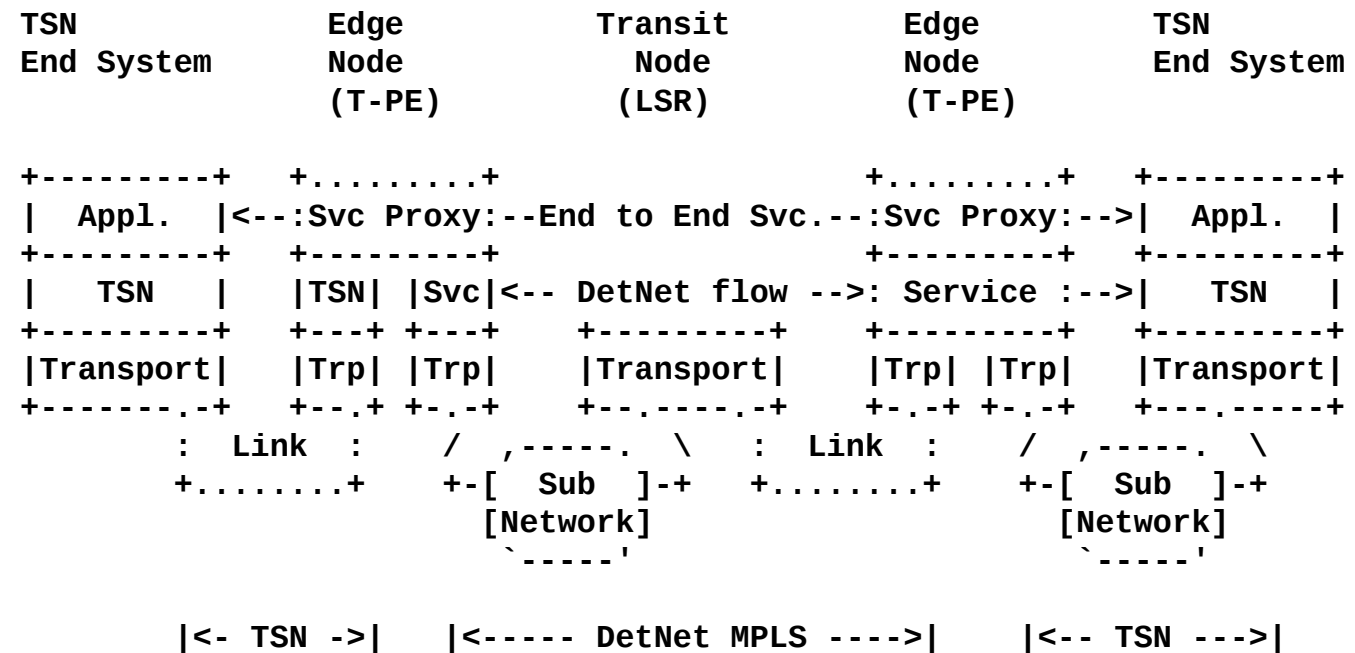


Figure 2: A TSN over DetNet MPLS Enabled Network

This conceptually parallels L2VPN services

MPLS data plane – Scenarios

DetNet (DN) IP Over MPLS Network

- IP flow is mapped to one or more PWs and MPLS (TE) LSPs
- Relay nodes
 - map each DetNet flow to MPLS PWs
 - are functionally similar to PW S-PEs or, when at the edge of an MPLS network, T-PEs
- Transit node
 - is MPLS (TE) LSP aware and performs switching based on MPLS labels, and need not have any specific knowledge of the DetNet service or the corresponding DetNet flow identification

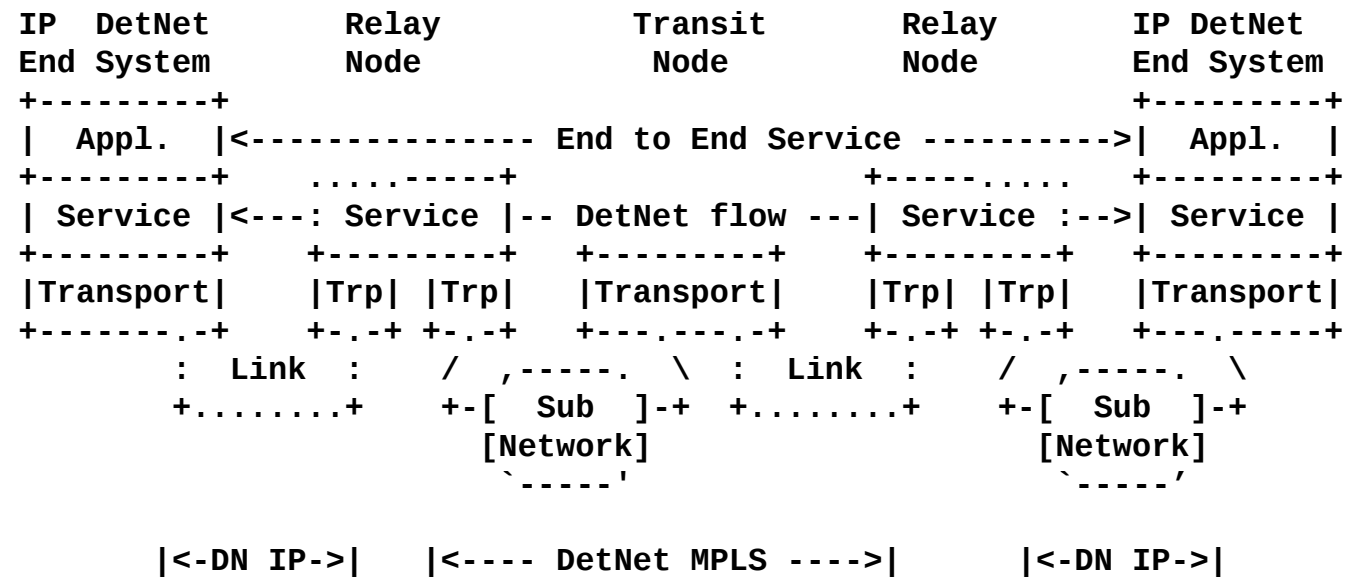


Figure 3: DetNet (DN) IP Over MPLS Network

MPLS data plane – Scenarios

MPLS-Based DetNet (non-MPLS End System)

- End systems are not DetNet aware
- Edge nodes
 - edge nodes sit at the boundary of the DetNet domain and act as DetNet service proxies for the end applications by initiating and terminating DetNet service for the non-DetNet aware IP flows
- Flow identification
 - at edge: existing header information can be used
 - at relay: S-label

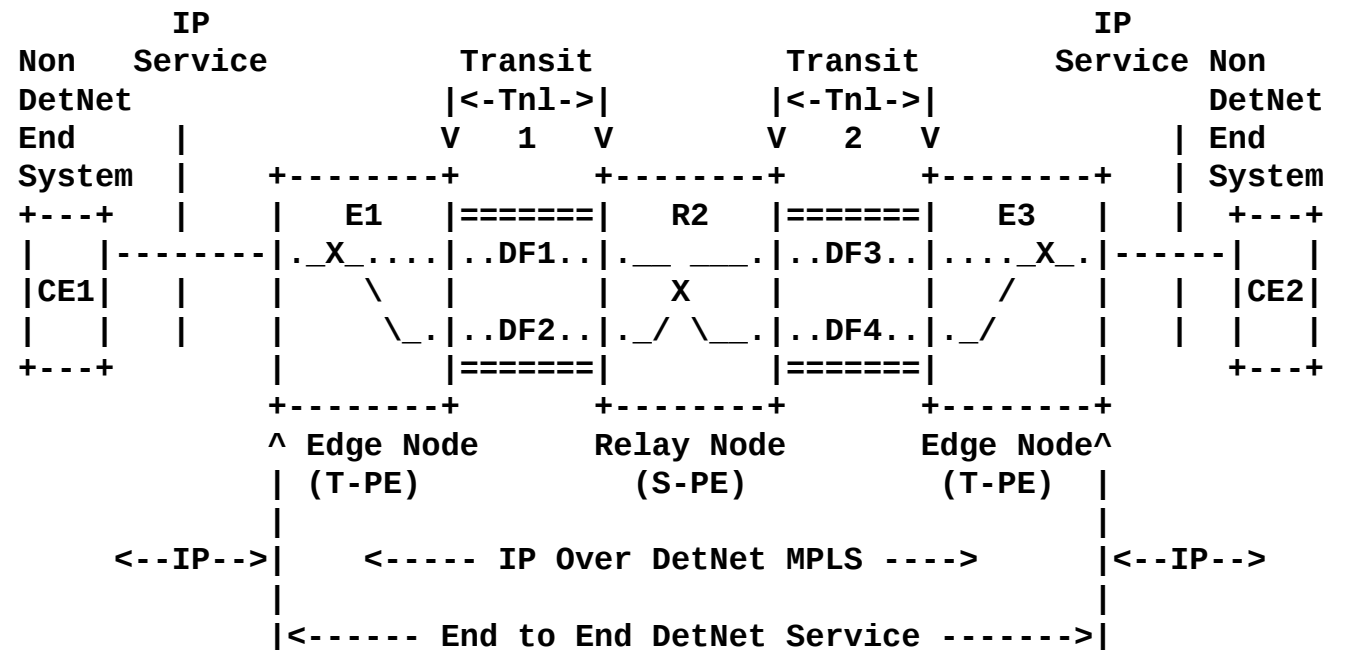


Figure 6: MPLS-Based DetNet (non-MPLS End System)

MPLS data plane – Encapsulation

DetNet PW

- MPLS-based DetNet data plane encapsulation:
 - DetNet control word (d-CW) containing sequencing information for packet replication and duplicate elimination purposes, and the OAM indicator.
 - DetNet service Label (S-label) that identifies a DetNet flow to the peer node that is to process it.
 - Zero or more MPLS transport LSP label(s) (T-label) used to direct the packet along the label switched path (LSP) to the next peer node along the path.
 - The necessary data-link encapsulation is then applied prior to transmission over the physical media.

DetNet MPLS-based encapsulation

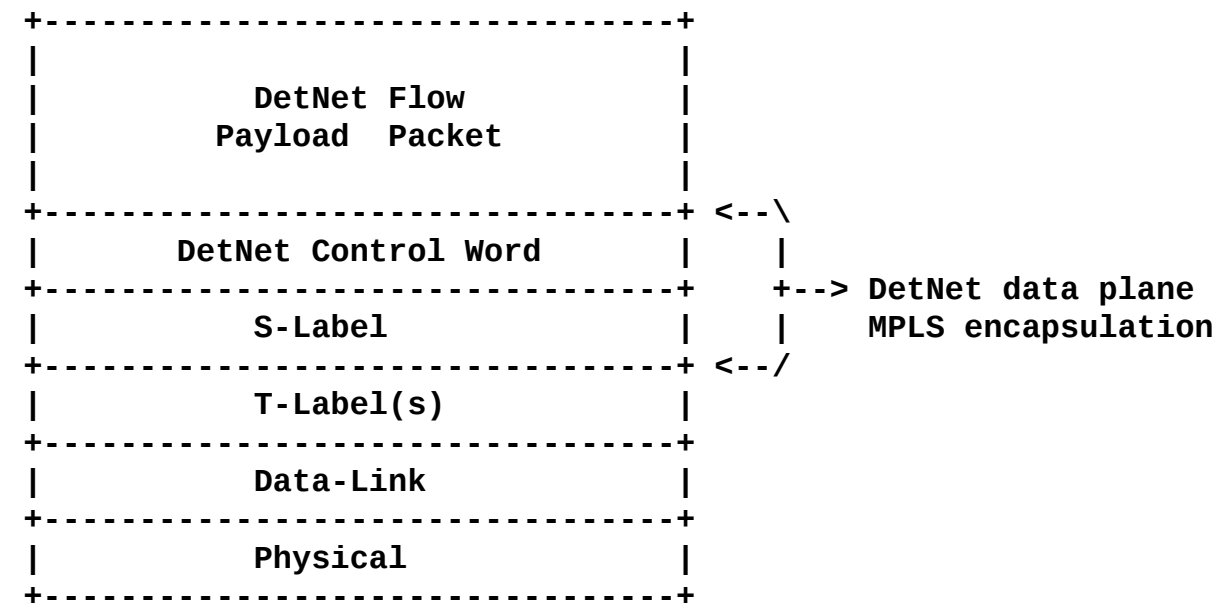


Figure 15: Encapsulation of a DetNet flow in an MPLS(-TP) PSN

MPLS data plane – Encapsulation

DetNet control word

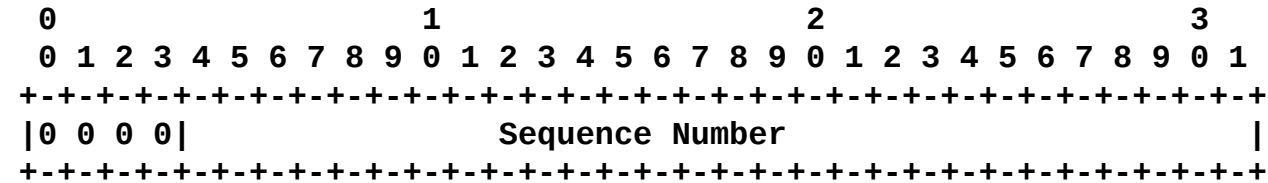


Figure 16: DetNet Control Word

- d-CW:
 - d-CW MUST always be present in a packet (even if it is not used)
 - A DetNet control word (d-CW) conforms to the Generic PW MPLS Control Word (PWMCW) defined in [RFC4385]
 - Two sequence number sizes are supported: 16 bits and 28 bits.
 - The sequence number size in use for the d-CW associated with a DetNet flow (S-Label) is configured either by a controller plane or manually for each DetNet flow.
 - Zero is an ordinary sequence number with no special meaning

MPLS data plane – Encapsulation

Flow and payload type

- DetNet flow identification
 - at a DetNet service layer is realized by an S-label
 - S-label is allocated from the platform label space (MUST/SHOULD?)
 - S-label MUST be at the bottom label of the label stack and MUST precede the d-CW
- Indication of the DetNet Payload Type
 - only nodes that needs to know the payload type of a flow are the DetNet ingress node and the DetNet egress nodes
 - packet type is indicated to the egress edge node through the value of the S-label

MPLS data plane – Flow aggregation

Work in progress ...

- The ability to aggregate individual flows, and their associated resource control, into a larger aggregate is an important technique for improving scaling of control in the data, management and control planes
- Methods covered:
 1. Aggregate at the LSP (Transport)
 2. Aggregating DetNet flows as a new DetNet flow
 3. Simple Aggregation at the DetNet layer

MPLS data plane – MPLS over IP DetNet PSN

DetNet PW over IP ...

- MPLS over UDP and IP:
 - IP encapsulation takes advantage of the MPLS encapsulation
 - T-Label(s) can be replaced by UDP and IP
 - S-Label is used to identify a DetNet flow (S-Label is allocated from the receiving node's platform label space)

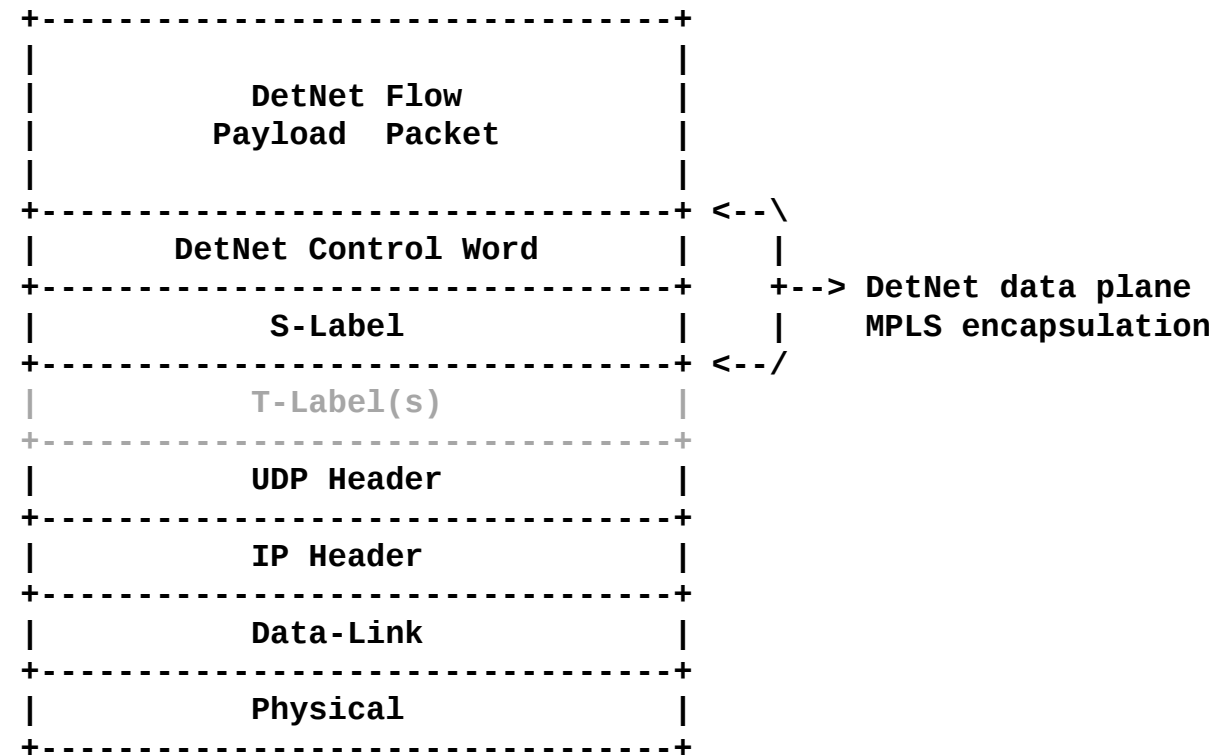


Figure 17/18: IP Encapsulation of DetNet

MPLS data plane – Further work

Work in progress ...

- Further work needed
 - Class of Service
 - Quality of Service
 - Cross-DetNet flow resource aggregation
 - Layer 2 addressing and QoS Considerations

- Time synchronization (candidate for dedicated document)

MPLS data plane – Further work

Work in progress ...

- Further work needed
 - Management and control plane considerations
 - S-Label assignment and distribution, Explicit routes, Packet replication and elimination, Congestion protection and latency control, Bidirectional traffic, Flow aggregation control
 - DetNet IP Operation over DetNet MPLS Service
 - IEEE 802.1 TSN Interconnection over DetNet MPLS Service
 - DetNet MPLS Transport Layer Operation over IEEE 802.1 TSN Sub-Networks

++ Adding 2119 conformance language

Thanks ...