DetTrans: A DetNet Transport

draft-thubert-tsvwg-detnet-transport

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New draft-thubert-tsvwg-detnet-transport

This document specifies the behavior of a Transport Layer operating over a Deterministic Network and implementing a DetNet Service Layer and a Northbound side of the DetNet User-to-Network Interface.

- Provides adaptation layer for applications
- Enable separation between Host and Switch / Router
- Flow control between non-DetNet and DetNet worlds
- DetNet in DetNet for load sharing and interdomain

Architecture refinements

- Focusses on end systems and relays for higher-Layer functions
- Provides adaptation layer for applications
- Details on UNI between end system and DetNet network
- Function placement in the end systems and in the relays
- More information on what’s detnet service layer and what’s detnet transport layer

Interface specification

- UNI operations including flow control
  - Network pull, More Message
  - Rate Based, Time Correction Message

- DetNet Socket

Architecture Diffs

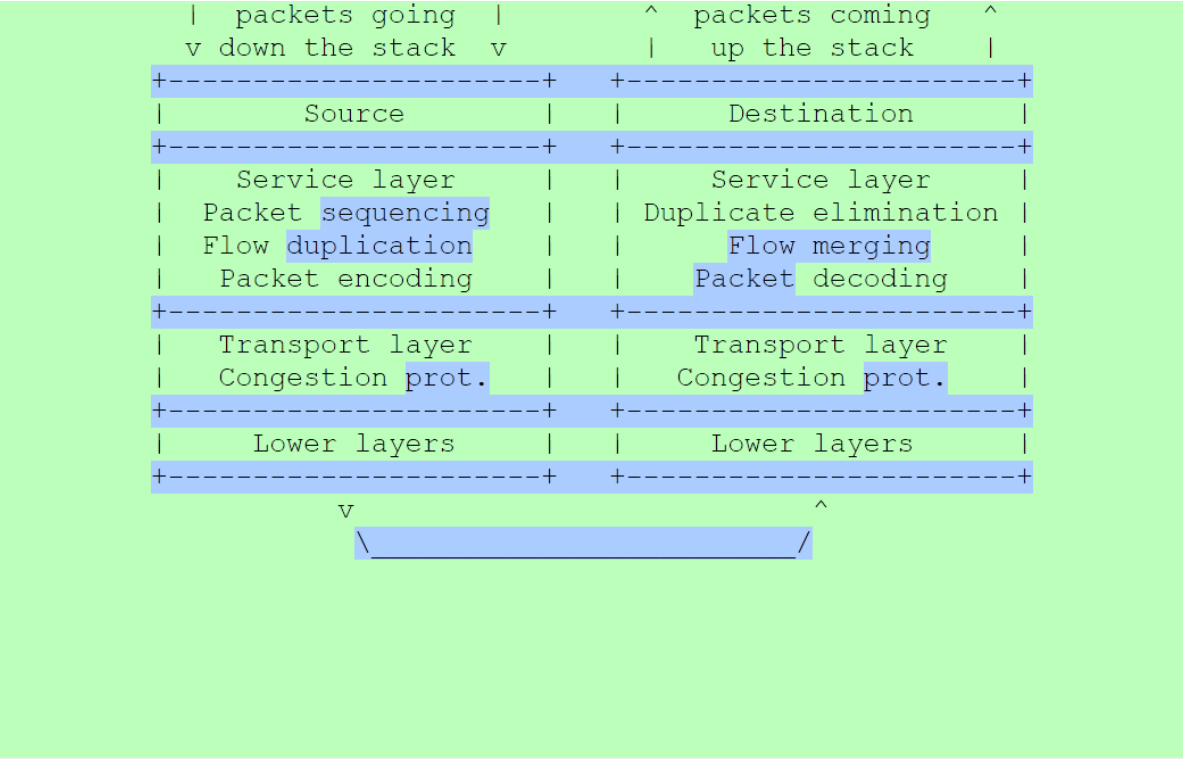
Packet replication and elimination, also known as seamless redundancy [HSR-PRP], or 1+1 hitless protection, is a function of the DetNet service layer. It involves three capabilities:

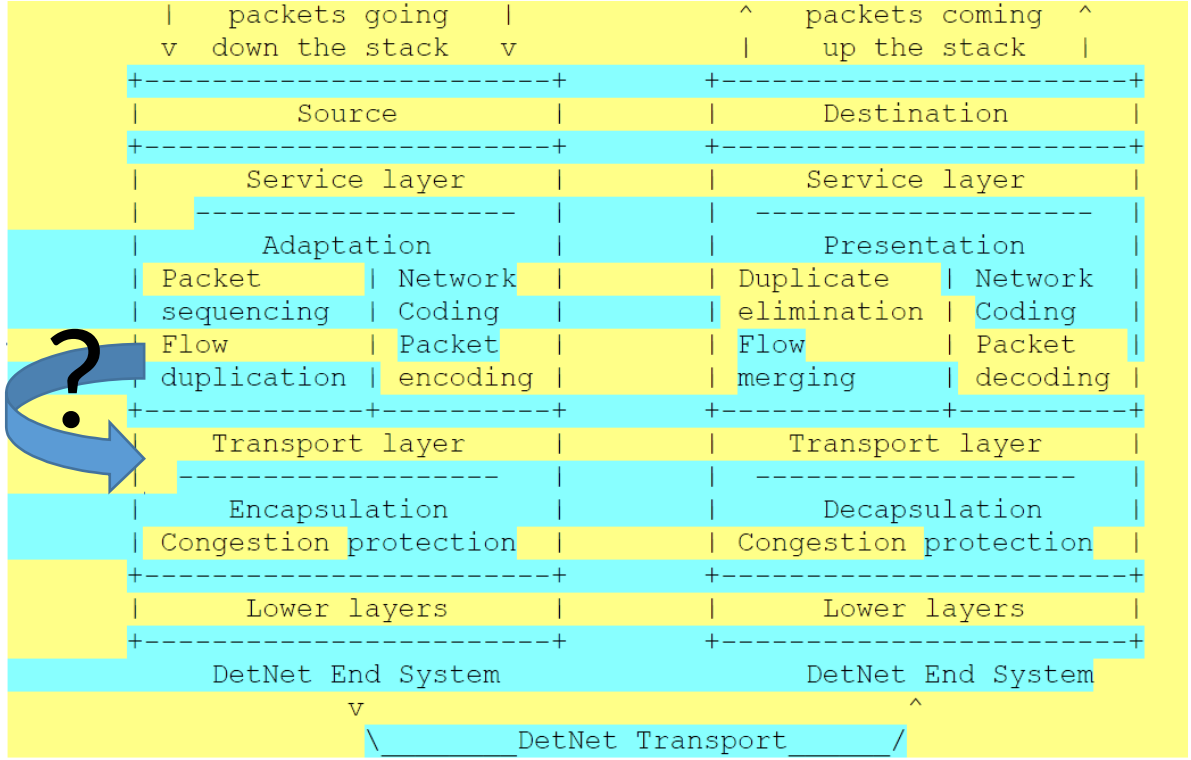
1+1 redundancy, also known as seamless redundancy [HSR-PRP], Live-Live protection, or 1+1 hitless protection, refers to injecting identical copies of a packet at the ingress of two non-congruent paths, and eliminating the excess copy when both are received at the egress of the paths. Packet Replication and Elimination extends the concept by enabling more than 2 paths, and allowing non-end-to-end redundant paths with intermediate Replication and Elimination points.

PRE operates at the DetNet service layer and involves three capabilities:

Load sharing refers to the use of multiple DetNet Service Flows in parallel to carry a single Determistic End-to-End Service Flow. Network Coding provides a Forward Error Correction between multiple packets or multiple fragments of one packet. It may be used at the DetNet Service layer to enable an efficient combination of seamless redundancy and load sharing.

Architecture Diffs





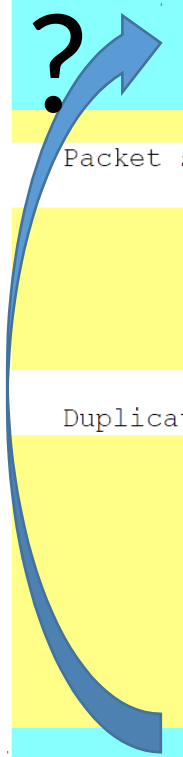
Architecture Diffs

Packet Adaptation

Optimizes the packetization and the delivery of application datastreams in order to match the DetNet Service Level Agreements. Peers with Presentation.

Packet Presentation

Presents the packets to the application in due form and time. Avoids the need for functions such as loss recovery and jitter elimination buffers from real time application. Peers with Adaptation.



Packet sequencing

As part of DetNet service protection, supplies the sequence number for packet replication and elimination (Section 3.2.4). Peers with Duplicate elimination. This layer is not needed if a higher-layer transport protocol is expected to perform any packet sequencing and duplicate elimination required by the DetNet flow duplication.

Packet sequencing

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Duplicate elimination

As part of the DetNet service layer, based on the sequenced number supplied by its peer, packet sequencing, Duplicate elimination discards any duplicate packets generated by DetNet flow duplication. It can operate on member flows, compound flows, or both. The duplication may also be inferred from other information such as the precise time of reception in a scheduled network. The duplicate elimination layer may also perform resequencing of packets to restore packet order in a flow that was disrupted by the loss of packets on one or another of the multiple paths taken.

Duplicate elimination

As part of the DetNet service protection, based on the sequence information supplied by its peer, packet sequencing, Duplicate elimination discards any duplicate packets generated by DetNet flow duplication. It can operate on member flows, compound flows, or both. The duplication may also be inferred from other information such as the precise time of reception in a scheduled network. The duplicate elimination layer may also perform resequencing of packets to restore packet order, for instance in case of load sharing or if a flow was disrupted by the loss of packets on one or another of the multiple paths taken.

Architecture Diffs

Packet encoding

As part of DetNet service protection, as an alternative to packet sequencing and flow duplication, packet encoding combines the information in multiple DetNet packets, perhaps from different DetNet compound flows, and transmits that information in packets on different DetNet member Flows.

Peers with Packet decoding.

Packet decoding

As part of DetNet service protection, as an alternative to flow merging and duplicate elimination, packet decoding takes packets from different DetNet member flows, and computes from those packets the original DetNet packets from the compound flows input to packet encoding. Peers with Packet encoding.

Packet encoding

Network Coding provides an efficient alternative to packet sequencing and flow duplication that can combine load sharing with redundancy. As part of DetNet service protection, packet encoding combines the information in multiple DetNet packets, perhaps from different DetNet compound flows, or from multiple fragments of a single packet, and transmits that information in packets on different DetNet member Flows. Peers with Packet decoding.

Packet decoding

As part of DetNet service protection, packet decoding takes Network Coded packets and reforms the original DetNet packets from the compound flows input to packet encoding. Peers with Packet encoding.

Encapsulation/Decapsulation

Flow aggregation requires that one flow or more DetNet flows get encapsulated in one or more other flows. The multiplexing / demultiplexing operation belongs to the DetNet Transport Layer. Direct one-in-one flow stitching also belongs to the DetNet Transport Layer. This happens when one flow is directly bridged into another, without adaptation such as service protection from the Service Layer.

Highlights

4.3.2.3. Flow Aggregation

Flow Aggregation refers to the encapsulation of more than one DetNet flows in one DetNet Flow, for instance using one large and long-lived DetNet Service Flow from a third party provider to carry multiple more dynamic Deterministic End-to-End Service Flows across domains. Packets are sequenced at the DetTrans Layer and distributed over the DetNet Transports paths in accordance to their relative capacities. In case of inconsistent jitter and Latency characteristics, packets may need to be reordered at the receiving DetTrans Layer based on the DSF Sequence.

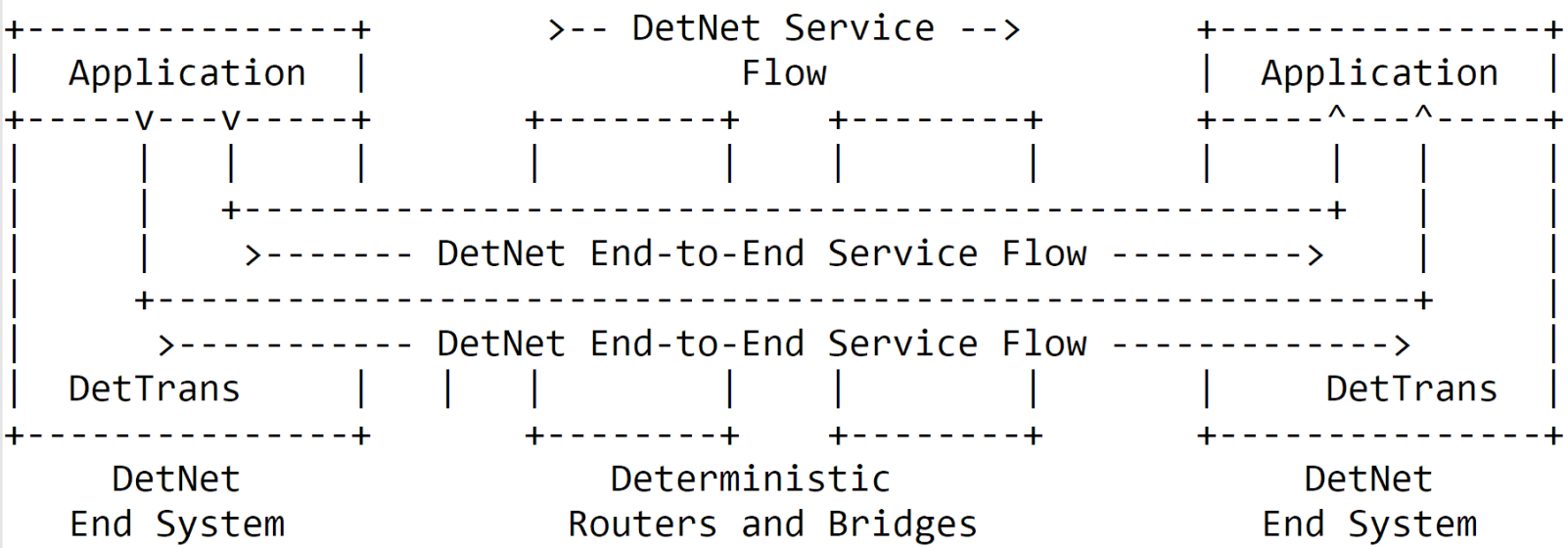

Figure 5: Flow Aggregation

Highlights

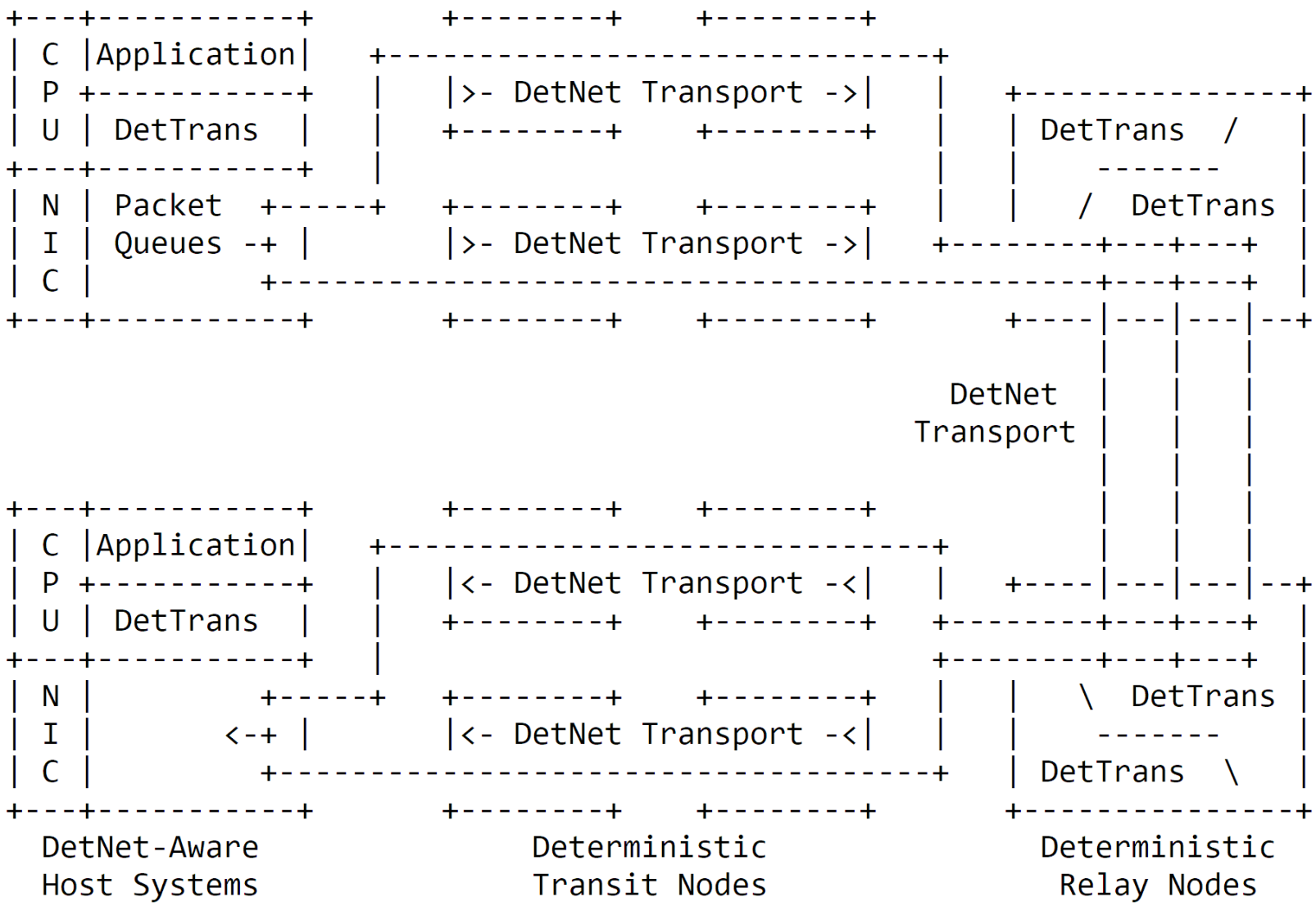

Figure 6: Intermediate Systems

Highlights

5.1.1. Dichotomy of a DetNet End System

The logical DetNet End System depicted in Figure 2 comprises several elements which may implemented in one or separate physical Systems. The example dichotomy in Figure 3 segregates ingress shaping and DetNet Relay functions, which are performed by IEEE Std. 802.1 TSN Bridges, from a DetNet-Aware Host.

Hosts and Edge Bridges are connected over Ethernet and together they form a DetNet End System. As it goes, this example introduces a further dichotomy within the Host, between the CPU and the NIC, across a local bus such as PCI, as illustrated in Figure 8.

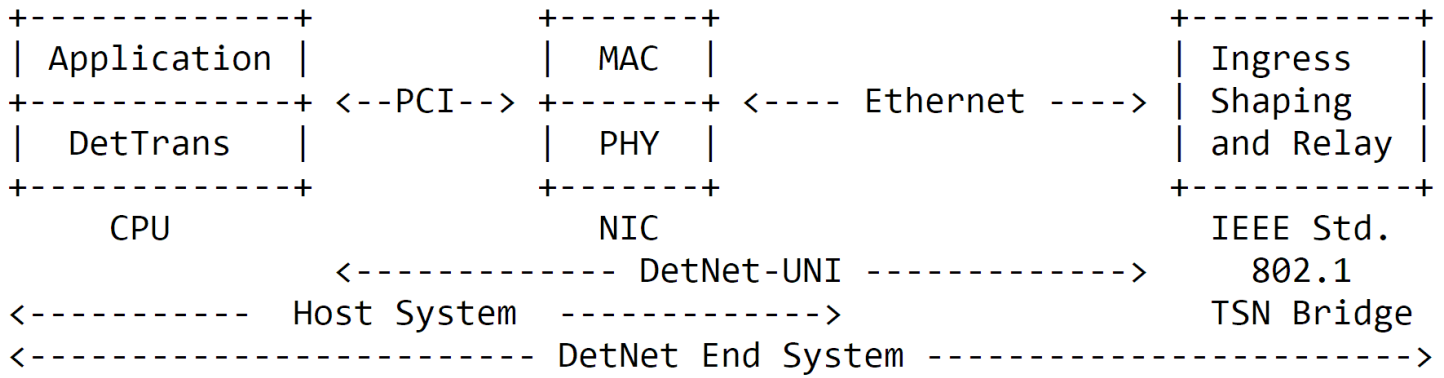

Figure 8: Chained Functions