DetNet
Data Plane Solutions

draft-ietf-detnet-dp-sol-ip-01

draft-ietf-detnet-dp-sol-mpls-01

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DetNet Data Plane
Updates

- IP Data Plane solution: draft-ietf-detnet-dp-sol-ip-01
  - Changes in v01
  - Further work …
- MPLS Data Plane solution: draft-ietf-detnet-dp-sol-mpls-01
  - Changes in v01
  - Further work …

- Next steps
  - Discussions, Updates, RFC2119 language
  - Contributions are welcome …

IPv{4|6} DetNet

IP data plane – Updates
draft-ietf-detnet-dp-sol-ip-01

- Some structure clean up
  - Chapter 3: Overview and scenarios
  - Chapter 4: DetNet IP Data Plane considerations
- New content
  - Chapter 6: DN IP DP procedures (with rfc2119 language)
    - Flow identification
      - 6-tuple + some variants (IPSec, IPv6 flow label)
    - Forwarding procedures
    - Traffic treatment procedures
    - Aggregation considerations
  - Chapter 7: Mapping IP DN Flows to IEEE 802.1 TSN
    - TSN stream ID mapping
    - TSN usage of FRER
    - Procedures
    - Management and Control Implications

IP data plane – Scenarios
Chapter 3

- Simple DetNet (DN) Enabled IP Network
  - DetNet enabled end systems originate IP encapsulated traffic
- DetNet (DN) IP Over MPLS Network
  - IP flow is mapped to one or more PWs and MPLS (TE) LSPs
- Non-DetNet aware IP end systems with IP DetNet Domain
  - End systems are not DetNet aware, service proxies at Edge nodes

- Out-of-scope
  - Operation of IEEE802.1 TSN end systems over DetNet enabled IP networks is not described in this document. While TSN flows could be encapsulated in IP packets by an IP End System or DetNet Edge Node in order to produce DetNet IP flows, the details of such are out of scope of this document.

IP data plane – DP considerations
Chapter 4

- Text updated to reflect latest discussion results
  - Considerations, End systems (L3 only), DetNet routers, Sub-networks (MPLS, TSN)
- New text planned
  - OAM section to be filled in
- Editorial changes
  - Class of Service, Quality of Service
    - CoS: mechanisms that provide traffic forwarding treatment based on aggregate group basis (DSCP, TC, PCP)
    - QoS: mechanisms that provide traffic forwarding treatment based on a specific DetNet flow basis (discrete resource allocation, admission control, flow identification and isolation, and sometimes path control, traffic protection, shaping, policing and remarking)
  - Aggregation:
    - Traffic identification related aspects. Limited aggregation options, due to the available traffic flow identification fields of the IP solution.
    - Resource control and Management aspects are out-of-scope.
  - Time synchronization
    - Practically out-of-scope. Just references.

IP data plane – Procedures
Chapter 6 on 6-tuple

- Formally describes
  - How flows are identified
    - In *DetNet IP Flow Identification Procedures*
    - Covers: IPv4, IPv6; Transport Protocols
  - That standard IP forwarding next hop selection is impacted by DetNet
    - In *Forwarding Procedures*
  - That DetNet nodes must provide DetNet QoS
    - In *Traffic Treatment Procedures*
- Also provides
  - Aggregation Considerations

IP data plane – Procedures
DetNet IP Flow Identification

- DetNet flow identification is based on *Flow Identification Management and Control Information*
- MUST: Flow information matching is based on a first-match ordered list

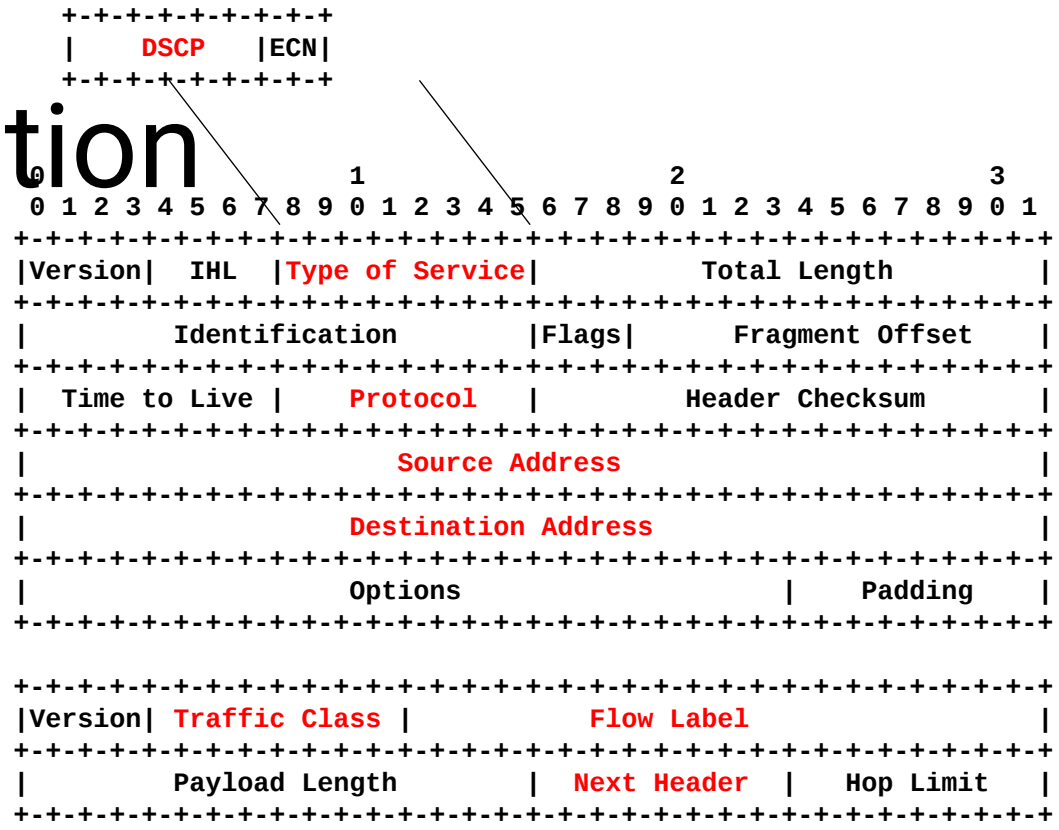
- Masks, lists, wildcards are used to support flow aggregation
  - Within a node: node maintains state about both the aggregated and component flows
  - Between nodes: one node maintains state about only flow aggregates while the other node maintains state on all or a portion of the component flows

DetNet IP Flow Identification

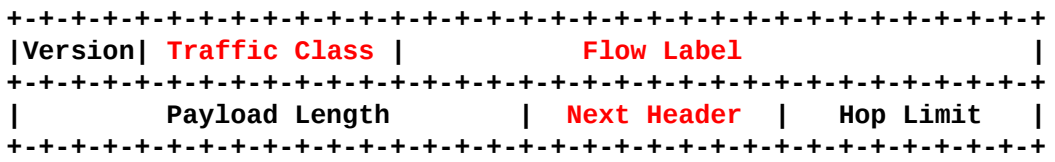
- Identification based on IP header fields
  - IPv4 (shown) and IPv6

Flows are identified based on:

- MUST: Source and Destination Addresses
  - SHOULD: support longest prefix matching
- IPv4 Protocol Field, IPv6 Next Header Field
  - MUST: Values in document (see next slide)
  - SHOULD: Other, non-zero, values or allow ignore
- IPv4 Type of Service and IPv6 Traffic Class Fields (revised)
  - MUST: DSCP, or ignored
  - Sources SHOULD NOT mix DetNet DSCPs and non-DetNet DSCPs on same 5-tuple flow



DetNet IP Flow Identification (cont)



- IPv6 Flow Label
  - SHOULD: support identification of DetNet flows based on the IPv6 Flow Label field
  - Use is optional
  - When used, flow identified by {Source, Destination address, Flow label}
  - When not used, flow identification via 6-tuple based identification

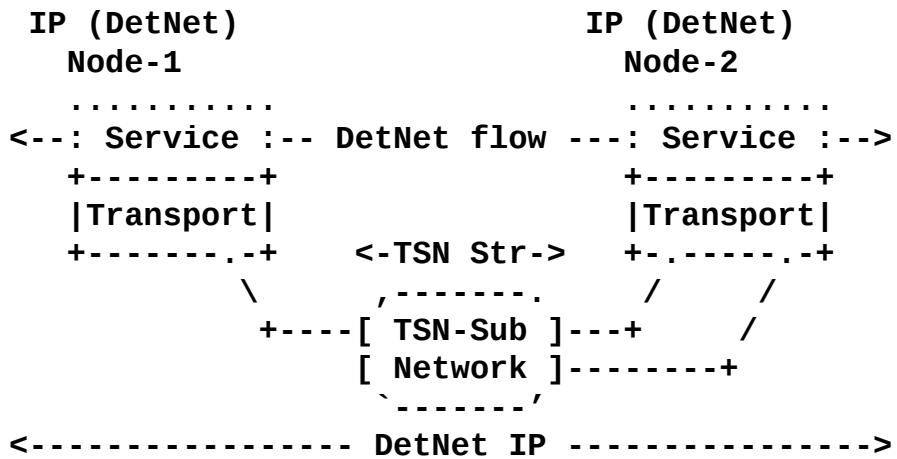
- Flow label usage has not been discussed previously
- Are there any comments or objections on this usage of Flow Label?

IP data plane – Procedures
DetNet IP Flow Identification fields (cont.)

- Specific Protocols/Next Header values MUST be supported
  - Support for TCP, UDP and IPsec required
  - Should others be required, e.g.:
    - E.g., IP in IP, GRE
- For TCP and UDP:
  - MUST: Source and Destination Ports, or ignored
  - SHOULD: range-based port matching
- For IPsec:
  - MUST: AH and ESP SPI field
  - SHOULD: ignore field

IP data plane – Mapping to TSN
Chapter 7

- Scenario:
  - two IP (DetNet) nodes are interconnected by a TSN sub-network.
  - IP nodes can be
    - (1) IP DetNet End System,
    - (2) IP DetNet Edge or Relay node or
    - (3) IP End System.
- Concept:
  - IP DetNet Flow and TSN Stream mapping is based on the active Stream Identification function, that operates at the frame level.
- Options
  - IP DetNet nodes without any TSN functions (out-of-scope)
  - IP DetNet nodes being TSN-aware



IP data plane – Mapping to TSN
IP DetNet nodes with TSN functions

- Mapping:
  - IP (DetNet) nodes being TSN-aware can be treated as a combination of a TSN-unaware Talker/Listener and a TSN-Relay.
  - IP (DetNet) node MUST provide the TSN sub-network specific Ethernet encapsulation over the link(s) towards the subnetwork.
- IP (DetNet) node MUST support the following TSN components:
  - For recognizing flows:
    - Stream Identification
  - For FRER used inside the TSN domain, additionally:
    - Sequencing function
    - Sequence encode/decode function
  - For FRER when the node is a replication or elimination point, additionally:
    - Stream splitting function
    - Individual recovery function

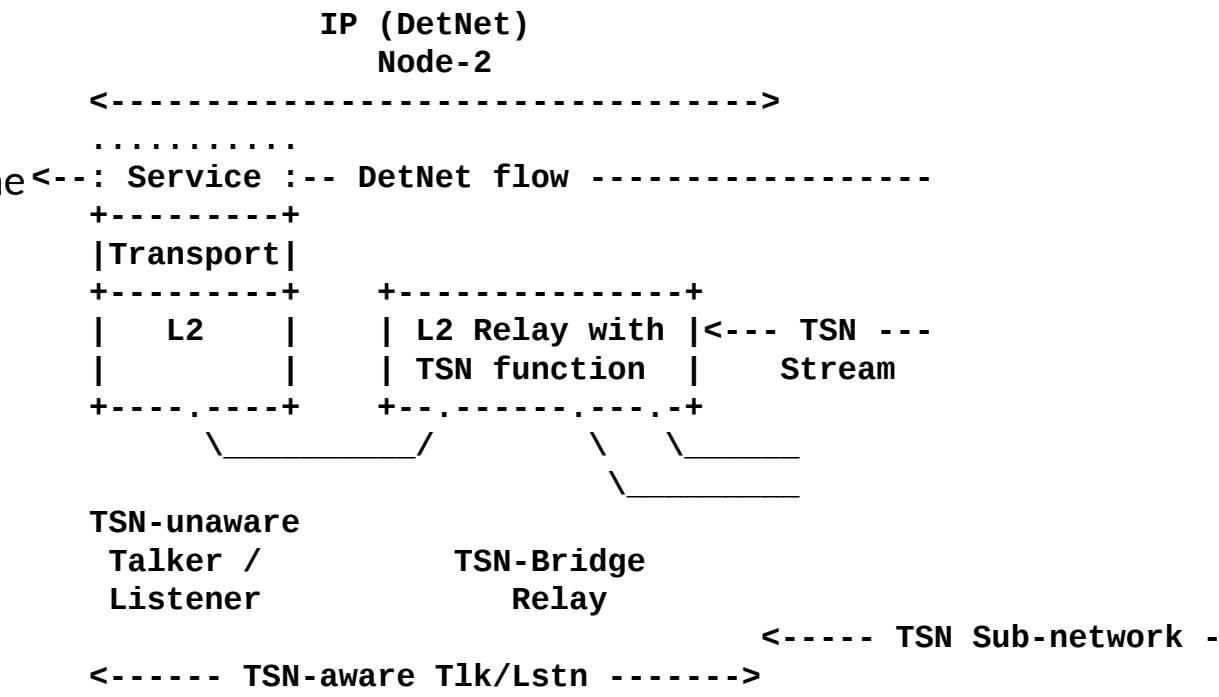


Figure 10: IP (DetNet) node with TSN functions

IP data plane – Further work
Need discussions

- Further work needed
  - OAM (chapter 4.4)
  - Management and control plane considerations (chapter 5.)
  - Data plane (chapter 6.)
    - IPv6 flow label
    - Other Protocol Header Information
  - Mapping to TSN (chapter 7.)
    - Procedures (conformance language)
    - Management and Control implications
  - General editorial clean up
- Do we need to support SRv6?
  - SRv6 not mentioned, maybe in a future document …

MPLS DetNet

MPLS data plane – Updates
draft-ietf-detnet-dp-sol-mpls-01

- New content
  - Chapter 10: DetNet MPLS over IEEE 802.1 TSN Sub-networks
    - Mapping of TSN Stream ID and Sequence Number
    - TSN usage of FRER
    - Management and Control Implications

MPLS data plane – Mapping to TSN
Chapter 10

- Scenario:
  - two MPLS (DetNet) nodes are interconnected by a TSN sub-network.
  - MPLS nodes can be
    - (1) MPLS DetNet End System,
    - (2) MPLS DetNet Edge or Relay node or
    - (3) MPLS Transit node
- Concept:
  - As protocol interworking function defined in IEEE 802.1CB does not work for MPLS labeled flows, the MPLS DetNet nodes MUST ensure proper TSN sub-network specific Ethernet encapsulation of the MPLS DetNet packets.
  - For a given TSN Stream (i.e., DetNet flow) an MPLS (DetNet) node MUST behave as a TSN-aware Talker or a Listener inside the TSN sub-network.

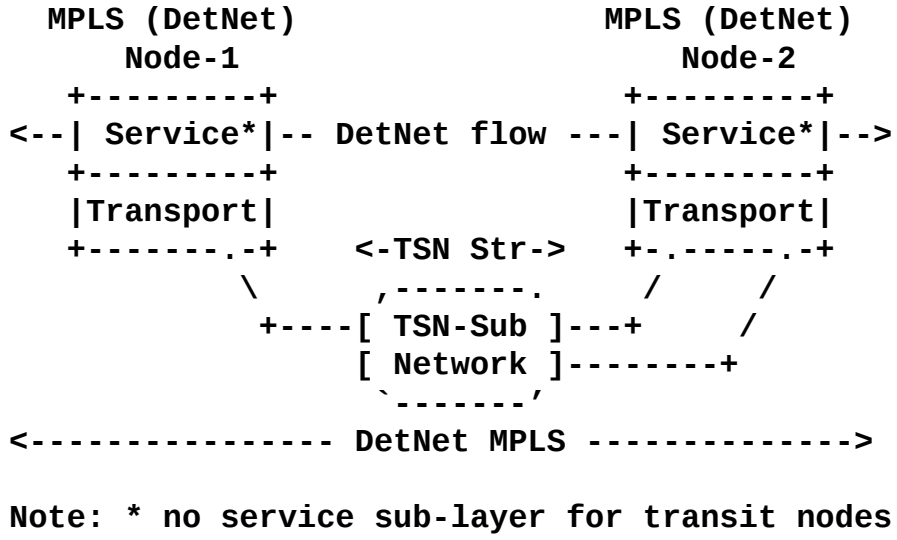


Figure 17: DetNet Enabled MPLS Network over a TSN sub-network

MPLS data plane – Mapping to TSN
MPLS DetNet nodes with TSN functions

- Mapping:
  - TSN capable MPLS (DetNet) nodes are TSN end stations
  - Maps DetNet flows to/from TSN Streams
- TSN end station required capabilities includes the following TSN components:
  - For recognizing flows:
    - Stream Identification (MPLS-flow-aware)
  - For FRER used inside the TSN domain, additionally:
    - Sequencing function (MPLS-flow-aware)
    - Sequence encode/decode function
  - For FRER when the node is a replication or elimination point, additionally:
    - Stream splitting function
    - Individual recovery function

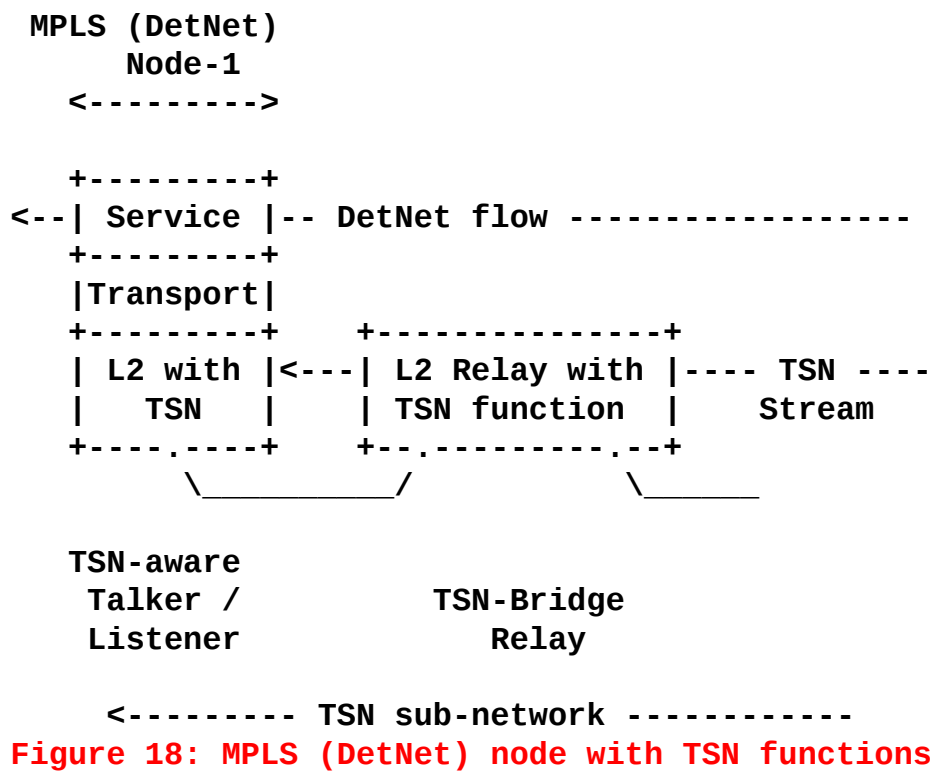


Figure 18: MPLS (DetNet) node with TSN functions

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
  - Procedures (conformance language) for MPLS data plane operations
  - DetNet IP Operation over DetNet MPLS Service
  - IEEE 802.1 TSN Interconnection over DetNet MPLS Service
    - Candidate for separate document
  - General editorial clean up

Next steps

Summary

- Next steps
  - Discussions, Updates, RFC2119 language
  - Contributions are welcome …

Thanks …

IP data plane – Mapping to TSN
Concept

- Concept:
  - IP DetNet Flow and TSN Stream mapping is based on the active Stream Identification function, that operates at the frame level.
  - E.g.,
    - Function 1 could be the Active Destination MAC and VLAN Stream identification
    - Function 2 could be the IP Stream identification

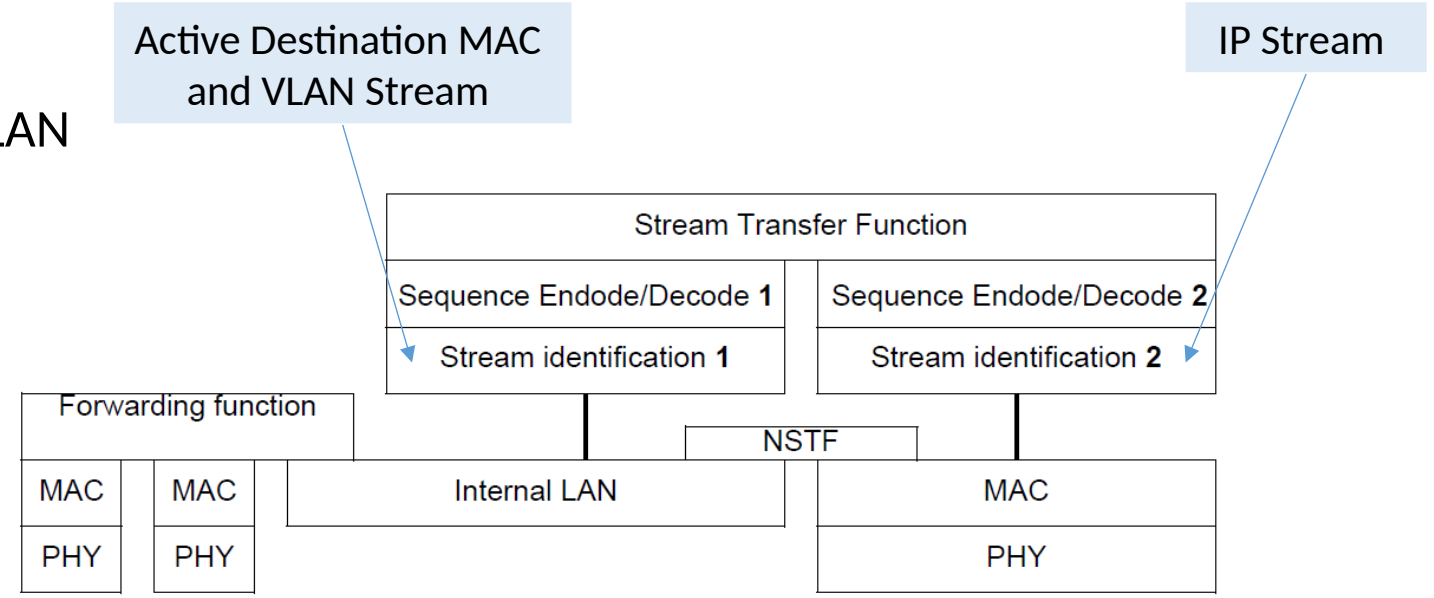


Figure C-10—Protocol interworking

IP data plane – Mapping to TSN
IP DetNet nodes without any TSN functions

- Mapping:
  - IP DetNet nodes without any TSN functions can be treated as TSN-unaware Talker or Listener.
  - Relay nodes in the TSN sub-network MUST modify the Ethernet encapsulation of the IP DetNet flow (e.g., MAC translation, VLAN-ID setting, Sequence number addition, etc.) to allow proper TSN specific handling of the flow inside the sub-network.

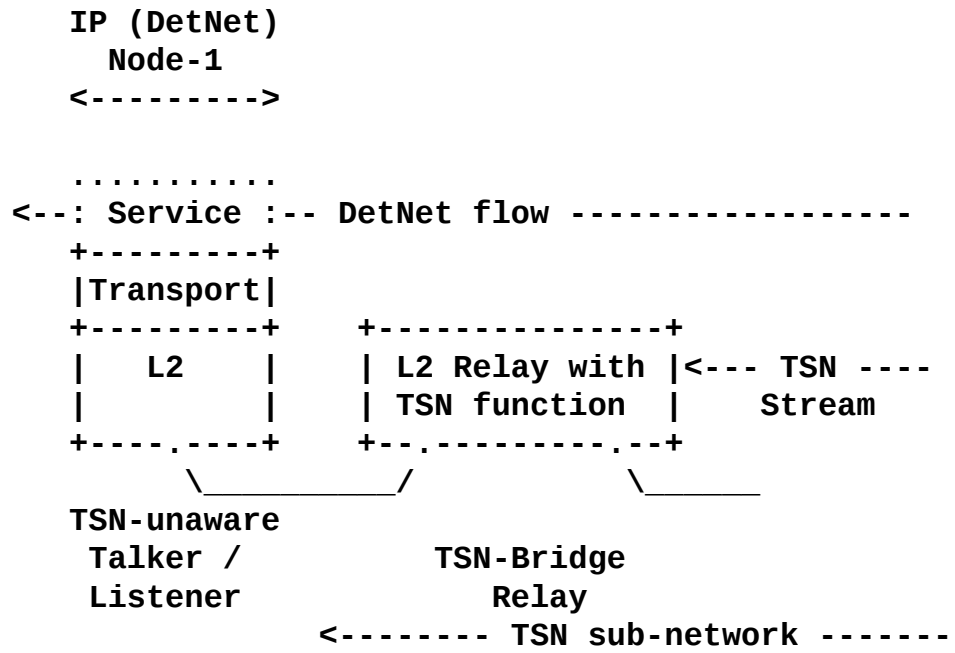


Figure 9: IP (DetNet) node without TSN functions

Note: out-of-scope for the document, will be removed in next version