

# DetNet Topology YANG

Xuesong Geng, Huawei

Tianji Jiang, China Mobile

Mach(Guoyi) Chen, Huawei

Zhenqiang Li, China Mobile

Reshad Rahman, Cisco Systems

# DetNet YANG Model Background

DetNet YANG Model (draft-ietf-detnet-yang) covers:

- DetNet service: which describes the characteristics of services being provided for application flows over a network
- DetNet flow configuration: which is for DetNet flow path establishment, flow status reporting
- DetNet functions configuration: which is to achieve end-to-end bounded latency and zero congestion loss, are both included in this document.

DetNet Topology YANG covers:

- Topology based DetNet capability
- Topology based requirement allocation

DetNet YANG Model is mature and we think it is good timing to discuss DetNet Topology YANG, which is requested by DetNet deployment, for example in 5GS.

# DetNet Topology YANG Requirements

DetNet Topology YANG is an augmentation of RFC 8795 (YANG Data Model for Traffic Engineering (TE) Topologies)

The following attributes are requested for DetNet Topology YANG:

- Bandwidth related attributes (e.g., bandwidth reserved for DetNet);
- Buffer/queue management related attributes (e.g., queue management parameters, etc.);
- PREOF (Packet Replication, Elimination and Ordering Function) capabilities and parameters (e.g., maximum out-of-order packets, etc.);
- Delay related attributes (e.g., node processing delay, queuing delay, link delay, etc.);

The above attributes are categorized into three types: node attributes, link attributes and LTP (Link Termination Point) attributes.

# DetNet Node Attributes

- Maximum DetNet packet processing delay
- Minimum DetNet packet processing delay
- Maximum DetNet packet processing delay variation

```
augment /nw:networks/nw:network/nw:node/tet:te/tet:te-node-attributes:
  +-rw detnet-node-attributes
    +-rw minimum-packet-processing-delay?      uint32
    +-rw maximum-packet-processing-delay?      uint32
    +-rw maximum-packet-processing-delay-variation?  uint32
```

## RFC 9320

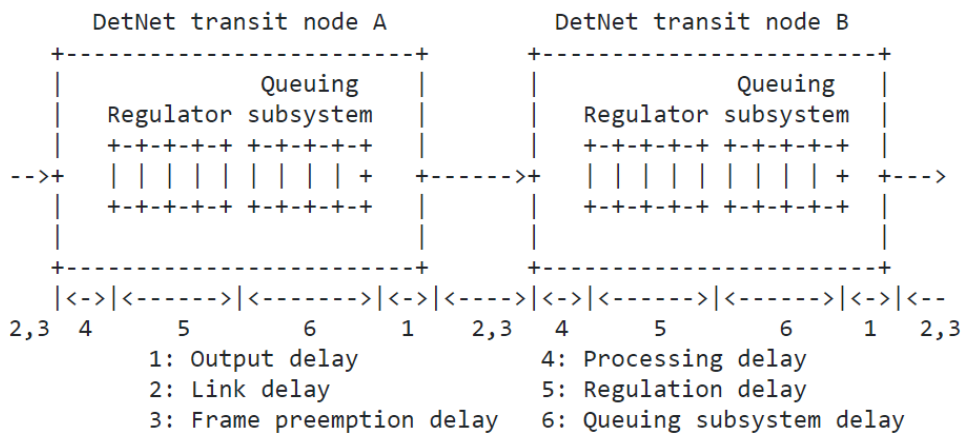


Figure 1: Timing Model for DetNet or TSN

Per-hop Delay Bound=

Non-queuing Delay Bound + Queuing Delay Bound

Non-queuing Delay Bound=

(1. output delay)+(2. link delay)+(3. frame preemption delay)+(4. processing delay)

Queuing Delay Bound=

(5. regulation delay) + (6. queuing sub-system delay)

# DetNet Link Attributes

- Link delay: link delay
  - a constant that only depends on the physical connection, which has been defined in ietf-te-topology
- Maximum DetNet reservable bandwidth:
  - the maximum reservable bandwidth that is allocated to DetNet. For a 10G link, if 50% of the bandwidth is allocated to DetNet, then the maximum DetNet reservable bandwidth is 5G. That means there are 5G bandwidth that can be used by DetNet flows.
- Reserved DetNet bandwidth:
  - the bandwidth that has been reserved for DetNet flows
- Available DetNet bandwidth:
  - the bandwidth that is available for new DetNet flows

```
augment /nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes:
  +--rw detnet-link-attributes
    +--rw maximum-reservable-bandwidth
      | +--rw te-bandwidth
      |   +--rw (technology)?
      |     +--:(generic)
      |       +--rw generic?   te-bandwidth
    +--rw reserved-detnet-bandwidth
      | +--rw te-bandwidth
      |   +--rw (technology)?
      |     +--:(generic)
      |       +--rw generic?   te-bandwidth
    +--rw available-detnet-bandwidth
      +--rw te-bandwidth
        +--rw (technology)?
          +--:(generic)
            +--rw generic?   te-bandwidth
```

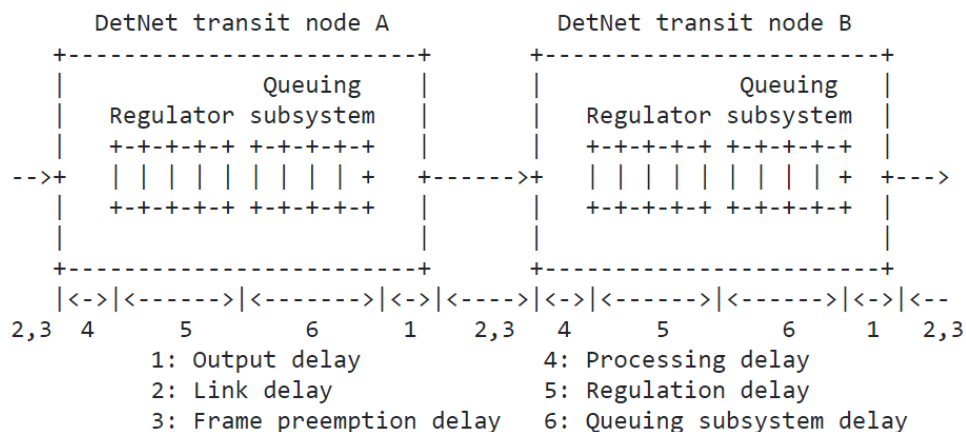


Figure 1: Timing Model for DetNet or TSN

## RFC 9320

Per-hop Delay Bound=  
 Non-queuing Delay Bound + Queuing Delay Bound

Non-queuing Delay Bound=  
 (1. output delay)+(2. link delay)+(3. frame preemption delay)+(4. processing delay)

Queuing Delay Bound=  
 (5. regulation delay) + (6. queuing sub-system delay)

# DetNet Link Terminate Point Attributes

PREOF (Packet Replication/Elimination/Ordering Function) is for DetNet service protection, which includes :

- in-order-capability: indicates whether a LTP has the in-order delivery capability
- maximum-number-of-out-of-order-packets: indicates the maximum number of out-of-order packets that an LTP can support, it depends on the reserved buffer size for packet reordering
- replication-capability: indicates whether a LTP has the packet replication capability.
- elimination-capability: indicates whether a LTP has the packet elimination capability.

```
augment /nw:networks/nw:network/nw:node/nt:termination-point/tet:te:
  +--rw detnet-terminate-point-attributes
    +--rw elimination-capability?          boolean
    +--rw replication-capability?         boolean
    +--rw in-ordering-capability
      | +--rw in-ordering-capability?     boolean
      | +--rw maximum-out-of-order-packets? uint32
```

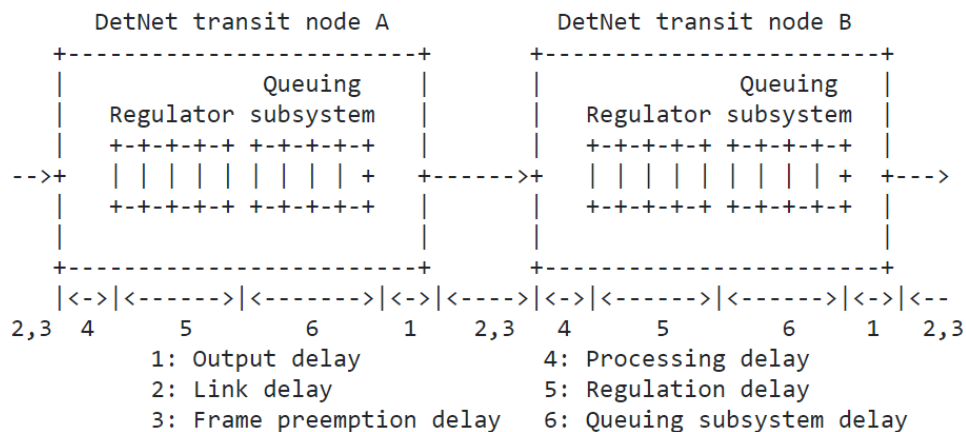
# DetNet Link Terminate Point Attributes

In addition, DetNet LTP also covers queuing management algorithms and queuing delay attribute, includes :

- queuing-algorithm-capabilities
- detnet-queues
- queue-identifier
- queue-buffer-size
- enabled-queuing-algorithm
- minimum-queuing-delay
- maximum-queuing-delay-variation

```

+--rw queuing-algorithm-capabilities
|   +--rw credit-based-shaping?          boolean
|   +--rw time-aware-shaping?           boolean
|   +--rw cyclic-queuing-and-forwarding?  boolean
|   +--rw asynchronous-traffic-shaping?  boolean
+--rw queues* [queue-identifier]
    +--rw queue-identifier                uint32
    +--rw queue-buffer-size?             uint32
    +--rw enabled-queuing-algorithm
    |   +--rw credit-based-shaping?      boolean
    |   +--rw time-aware-shaping?       boolean
    |   +--rw cyclic-queuing-and-forwarding?  boolean
    |   +--rw asynchronous-traffic-shaping?  boolean
    +--rw minimum-queuing-delay?         uint32
    +--rw maximum-queuing-delay?         uint32
    +--rw maximum-queuing-delay-variation? uint32
    
```



## RFC 9320

Per-hop Delay Bound=  
Non-queuing Delay Bound + Queuing Delay Bound

Non-queuing Delay Bound=  
(1. output delay)+(2. link delay)+(3. frame preemption delay)+(4. processing delay)

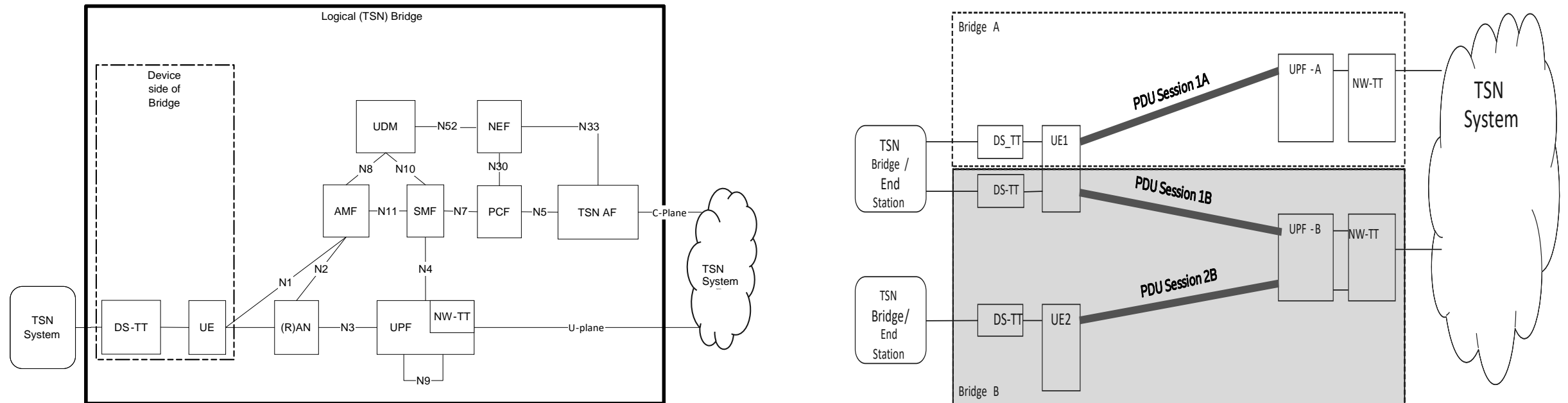
Queuing Delay Bound=  
(5. regulation delay) + (6. queuing sub-system delay)

Figure 1: Timing Model for DetNet or TSN

# Application Scenario: 5GS DetNet Interworking(1)\*

Architecture assumptions:

- 5GS acting as a logical DetNet node in the DetNet domain
- Only considering the DetNet forwarding sub-layer related functions
- Forwarding IP packets between 5GS N6 (off UPF toward DN) and UE
- Granularity of the 5GS DetNet node is per UPF for each network instance

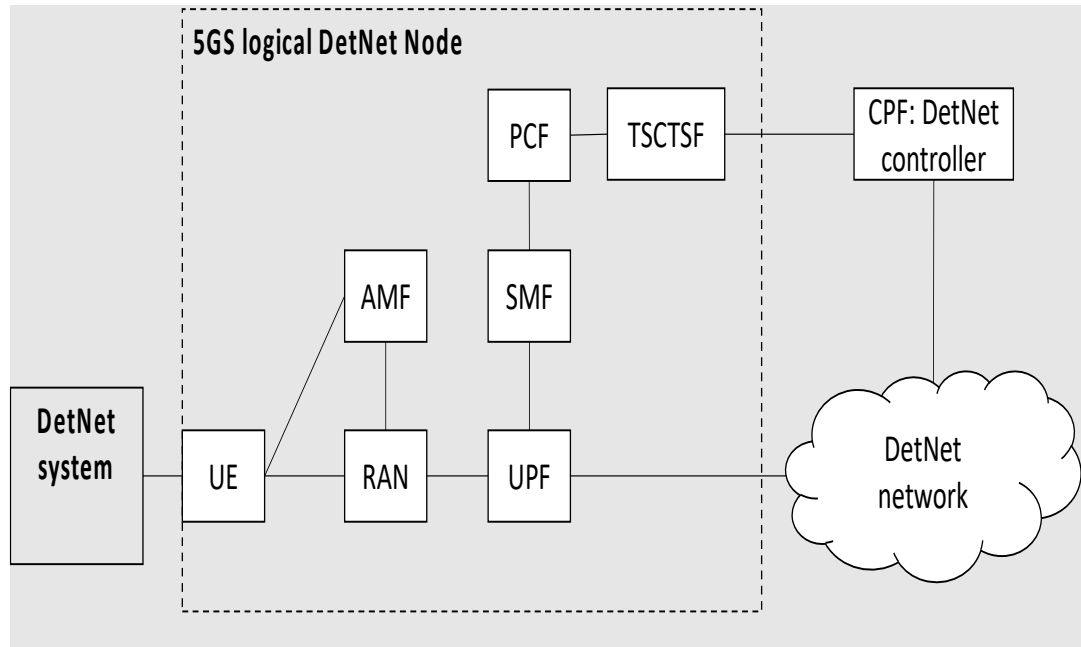




# Application Scenario: 5GS DetNet Interworking (2)

Key Issues to address (2):

- 5GS logical DetNet node reporting to CPF (DetNet controller): resources, capabilities, and adjacencies
- CPF (DetNet controller) provisioning the 5GS logical node: expecting **per-(logical)-node** DetNet configuration, e.g., flow attributes, DnTrafficSpec, DnFlowReqs, etc.
  - DnReqs to 5GS mapping (approximate but incorrect): MaxLatency => PDB, and MaxLoss => PER



**Applicable attributes as defined in the IETF draft:**

➤ **DetNet node** attributes:

- Max/Min DetNet packet processing delay
- Maximum DetNet packet processing delay variation

➤ **DetNet Link** Attributes:

- Maximum DetNet reservable bandwidth
- Reserved/Available DetNet bandwidth

... and more 5GS logical-node related configurations could be defined further in later IETF versions...

**So, let's re-activate the draft!**

# Next Step

- Activate draft-ietf-detnet-yang
- Prepare a new document to provide guidance about how to use draft-ietf-detnet-yang in 5GS

Thanks