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DetNet QoS Policy
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Abstract

   This document proposes a Quality of Service (QoS) policy to apply
   Differentiated Services (DiffServ) model for Deterministic Networking
   (DetNet) and defines a DetNet DiffServ mechanism including DetNet IP
   and MPLS encapsulation.

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1. Introduction

   As defined in [RFC8655], Deterministic Networking (DetNet) provides a
   capability to carry specified unicast or multicast data flows for
   real-time applications with extremely low data loss rates and bounded
   latency. DetNet and non-DetNet packets may be allowed to transmitted
   in the same network and more than one DetNet flows which has
   different priorities may be forwarded through the DetNet domain. The
   DetNet Class of Service (CoS) should be taken into consideration to
   provide Quality of Service (QoS) for DetNet services.

   As discussed in [I-D.ietf-detnet-mpls] and [I-D.ietf-detnet-ip],
   Differentiated Services (DiffServ) can provide traffic forwarding
   treatment for DetNet networks. The DiffServ architecture as
   specified in [RFC2475] defined a model that traffic entering a
   DiffServ domain is classified and conditioned at the boundaries and
   marked with a DiffServ Code Point (DSCP) defined in [RFC2474]. The
   DSCP is used at transit nodes to select the Per Hop Behavior (PHB)
   that determines the scheduling treatment. And [RFC3270] provide a
   solution to support DiffServ for traffic marked with Traffic Class
   (TC) [RFC5462] transported over an MPLS network.

This document proposes a QoS policy to apply DiffServ model for
DetNet networks and defines a DetNet DiffServ mechanism including
DetNet IP and MPLS encapsulation.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in [RFC2119].

1.2. Terminology

The terminology is defined as [RFC8655], [RFC3270], [RFC2475] and
[RFC2474].

2. DetNet DiffServ Overview

The DetNet network needs to be capable of supporting differentiated
services dividing to one or more contiguous DiffServ domains. The
key components within a DiffServ domain including traffic
classification and conditioning functions, and PHB-based forwarding.
The customers may specify packet classification policy, traffic
profiles and actions to DetNet flows which are in-profile or out-of-
profile at the boundary. The DiffServ domains may support different
PHB groups internally and different codepoint->PHB mappings at the
transit nodes. The DetNet DiffServ process for packets is as
Figure 1 shown.

```
                  +---------+
                  |  Meter  |-----------------------------------+
            +----->| (DetNet |------------------+               |
            |     | Profile)|--+               |               |
            |     +---------+  |               |               |
            |                  V               V               V
DetNet+-----------+    +---------+    +-----------+    +---------+
Flow  | Classifier |    |  Marker  |    |Shaper/Order|    | Queuing |
=====>| (DetNet    |===>| (DetNet  |===>|  Dropper/  |===>| (DetNet |
      |   BA/MF)   |    |  DSCP)   |    | Scheduler/ |    |  PHB)   |
      +-----------+    +---------+    +-----------+    +---------+
```
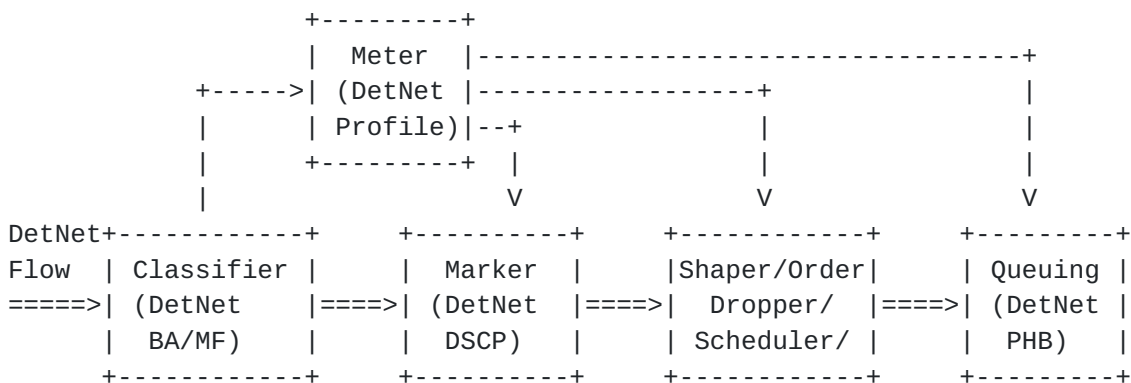
Figure 1: Overview of a DetNet DiffServ mechanism

2.1. DetNet Classifiers

   As defined in [RFC2475], packet classifiers select packets in a
   traffic stream based on the information of packet header including
   two types of classifiers, the BA (Behavior Aggregate) and MF (Multi-
   Field) Classifier. The difference is that the BA classifies packets
   based on the CoS field and the latter one based on more other header
   fields.

   In DetNet DiffServ model, BA and MF can be applied for packets
   classification. After classification, the flows can be seperated
   from DetNet and non-DetNet. As specified in [I-D.ietf-detnet-ip], no
   DetNet specific encapsulation is defined to support DetNet IP flow
   identification and DetNet service delivery. So the DetNet IP
   classifiers is the same as defined in [RFC2474] and [RFC2475]. As
   defined in [I-D.ietf-detnet-mpls], DetNet service Label (S-Label) is
   used to identify a DetNet flow and forwarding labels (F-Labels) are
   used to provide LSP-based connectivity in DetNet MPLS header. The
   S-Label and F-Labels can be used in combination with MPLS TC filed in
   MF classifier. And DetNet MPLS BA classifier select packets based on
   the MPLS TC field only as defined in [RFC5462].

2.2. DetNet Traffic Conditioners

   As mentioned in [RFC8655], DetNet flows can be shaped or scheduled.
   The rate limiting of DetNet traffic and the starvation avoiding of
   non-DetNet traffic, e.g., at the ingress of the DetNet domain must be
   applied by traffic policing and shaping functions. As [RFC2475]
   defined, the traffic conditioner may contain four elements: meter,
   marker, shaper and dropper. Traffic conditioning performs metering,
   shaping, policing and/or re-marking to ensure the traffic which
   entering the DiffServ domain conforms to the service provisioning
   policy.

   In DetNet, the traffic policing and conditioning SHOULD include
   meter, marker, shaper, dropper, scheduler and order. A meter with a
   DetNet Profile is used to measure the DetNet flows selected by a
   DetNet classifier and the result of the meter with respect to a
   packet may be used to trigger a DetNet action including a marking,
   shaping, dropping, scheduling or ordering. A marker is used to set
   the Cos field of a DetNet packet to a DetNet DSCP (section 2.3),
   mapping the marked packet to a DetNet PHB. A Shaper may apply
   specific shaping algorithms implemented by DetNet network, e.g.,
   credit-based shaper [IEEE802.1Qav]. A dropper is used to discard
   some of the non-DetNet packets to provide the QoS of the DetNet flows
   when congestion occurs.

2.2.1. Scheduler

As decribed in [RFC8655], the DetNet flows can be scheduled to
achieve time-based synchronization for scheduled traffic. This
document proposes a new type of action for DetNet traffic
conditioning named Scheduler action. A scheduler may apply specific
scheduling and related Queuing algorithms implemented by DetNet
network, e.g., Time-gated queues [IEEE802.1Qbv] and Cyclic Queuing
and Forwarding [IEEE802.1Qch].

2.2.2. Order

As defined in [I-D.ietf-detnet-mpls], DetNet control word (d-CW)
containing sequencing information for packet replication and
duplicate elimination purposes. Sequence Number is different packet-
by-packet. Based on Detnet MPLS date plane encapsulation, this
document proposes a new type of action for DetNet traffic
conditioning named order action which used to reorder the packets
within a DetNet flow that are received out of order.

2.3. DetNet DSCP

The DetNet DSCP carried in CoS field in IP header and TC field in
MPLS header may be uesd to mark packets at ingress nodes and select a
DetNet PHB (section 2.4) at transit nodes. DetNet DSCP MUST be
defined to one or more particular values, which MUST be unique for
codepoints in the standard space.

[Ed.note: We need to define one or more DetNet DSCP values and
related DetNet PHB for DetNet-specific treatment.]

2.4. DetNet PHB

As specified in [RFC2475], per-hop behaviors are defined to permit a
reasonably granular means of allocating buffer and bandwidth
resources at each node among competing traffic streams. PHB groups
will usually share a common constraint such as a packet scheduling or
buffer management policy. According to [RFC4594], Default Forwarding
(DF) PHB, Assured Forwarding (AF) PHBs, Expedited Forwarding (EF) PHB
and Class Selector (CS) PHBs have been defined to provide forwarding
treatment. These PHBs can be used to forward DetNet flows based on
the requirement.

This document defines a new type of Deterministic Networking (DN) PHB
which is intended for traffic requiring extremely low data loss rates
and bounded latency for DetNet. The DN PHB may include a set of PHB
classes, e.g., DN1,DN2,etc. And the number of the class is the same
with the DetNet DSCP values. The DSCP in IP header and TC in MPLS

header should be mapped to DN PHB with the relevant PHB specification
which may be completed in future discussion.

2.5. DetNet Queuing

As discussed in [RFC8655],the nodes in DetNet network shall queue
each received packets to one of the potential transmission ports and
provide storage for queued packets, awaiting to submit these for
transmission. A port provides one or more queues corresponding to
the number of traffic classes. The queuing mechanism should be
configured and implemented to DetNet nodes.

As defined in [RFC4594], Priority Queuing (PQ) was defined to queue
the packets in priority sequence and Rate Queuing (RQ)selects packets
according to the specified rate including Weighted Fair Queuing (WFQ)
and Weighted Round Robin (WRR). Active Queue Management (AQM) also
be defined to use packet dropping or marking to manage the depth of a
queue.

As per IEEE 802.1 WG, queuing and transmission selection algorithms
also can be used for queue scheduling in DetNet network.

3. DetNet IP DiffServ Consideration

As specified in [I-D.ietf-detnet-ip], no DetNet specific
encapsulation is defined to support DetNet IP flow identification and
DetNet service delivery. So the DetNet IP classification is the same
as defined in [RFC2474] and [RFC2475]. But the recommended DetNet
DSCP may be uesd to mark packets to select a DetNet PHB and the
transit nodes should implement mechanisms performing the PHB. The
mapping of DSCP to PHBs MUST be configurable. Implementations should
support the recommended codepoint-to-PHB mappings in their default
configuration.

4. DetNet MPLS DiffServ Consideration

As defined in [I-D.ietf-detnet-mpls], DetNet S-Label and F-Labels can
be used in combination with MPLS TC filed in MF classifier. The BA
classifier is the same with the [RFC3270].

Two types of LSPs including Explicitly TC-encoded-PSC LSP (E-LSP) and
Label-Only-Inferred-PSC LSP (L-LSP) follows the definition of
[RFC3270] and can be used to support DetNet explicit routes in MPLS-
TE LSP. A E-LSP can be used to support one or more DetNet flows and
a L-LSP can be established for one flow. E-LSP and L-LSP can use a
signaled TC->PHB mapping to forward packets whose corresponding PHBs
are defined in this document.

In DetNet MPLS network, DetNet Layer Two Service is supported in TSN over MPLS. The LSP egressing over egde nodes can use the preconfigured PHB->802.1 mapping as defined in [RFC3270].

As specified in [RFC3270], there may be more than one LSP carrying the same flow. Two or more LSPs can be merged into one LSP at one egressing LSR. It can be used to perform the packet replication (PRF) at ingress nodes and the packet elimination (PEF) at the egress nodes in DetNet DiffServ model. The order action which defined in this document can be used for packet ordering functionality (POF).

5. Security Considerations

TBD.

6. IANA Considerations

TBD.

7. Acknowledgements

TBD.

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