

Flow Aggregation for Enhanced DetNet

draft-xiong-detnet-flow-aggregation-01

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IETF 120 @ Vancouver, Canada

July, 2024

Agenda: Flow Aggregation for Enhanced DetNet

- Significant revisions for IETF-120
 - Objectives, requirements and general principles
 - Realization of flow aggregation for 5GS DetNet service
- **(Backup)** Recaptures of IETF-119:
 - Scenarios, Gaps and Requirements

IETF-120 Update: Thoughts & Revision Logics:

- Derived from the IETF-119 Comments & Feedback

- **Foundation of the I.D.:**

- To achieve flow aggregation is *a must in large-scale* enhanced DetNet [as per the IETF scaling draft]. So, the I.D. lays out the general objectives and requirements for flow aggregation of the enhanced DetNet.

- **Revised structure of the I.D.**

- Revolving around *objectives & requirements*, the I.D. proposes some principles (or schemes) for optimized flow aggregation, e.g., flow-aggregate, aggregation-class, aggregated QoS w/ PHB, accommodating fine-grained flow-level classification/identification/QoS provisioning, DetNet state maintenance, etc.

- **Realization of I.D.'s principles:**

- Use 5GS as an excellent realization scenario by applying the proposed principles. This application helps prove the merits and effectiveness of the proposals in the draft.

IETF-120 Update: Ver #00 -> #01

Ver #00 (IETF-119)

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Ver #01

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IETF-120 (ver#01): Objectives, Requirements & Principles

1. Aggregating DetNet flows across domains:

- Flow-aggregation in the multi-domain scenario to achieve the end-to-end QoS guarantees for aggregated flow(s) that span across multiple domains.

2. Aggregated vs. Fine-grained (flow-level) QoS Provisioning

- Coarse-grained aggregated-level vs. fine-grained flow-level

3. Scale Down States Maintenance at Transit Nodes

- Type of Class-level to categorize solutions (solutions into 'buckets')
- Flow-aggregation (based on class-level) for better scalability (reduced states#, more effective flow-identification, etc.)

4. Implications of flow aggregations (class-level) to transit nodes

- Transit nodes: flow-aggregation NOT impact per-flow service reqs. (in an aggregation)
- Flow-classification, flow-identification:
 - what to do, how to do, etc.
 - Dynamic vs. pre-defined classification, identification, etc.

An analogue on IETF Reference to 3GPP

- A 3GPP document (SP-240937 in SA/CT Plenary in June 2024):
 - *IETF Status Report to TSG CT/SA#104*
- Talk about an IETF TEAS WG draft and its reference to 3GPP:
 - A *Realization of Network Slices for 5G Networks Using Current IP/MPLS Technologies* (<https://datatracker.ietf.org/doc/draft-ietf-teas-5g-ns-ip-mpls/>)
- IETF Network Slicing -> Realization for (3GPP) 5GS

TEAS -> SA2, SA3, SA5, RAN3

SP-240937



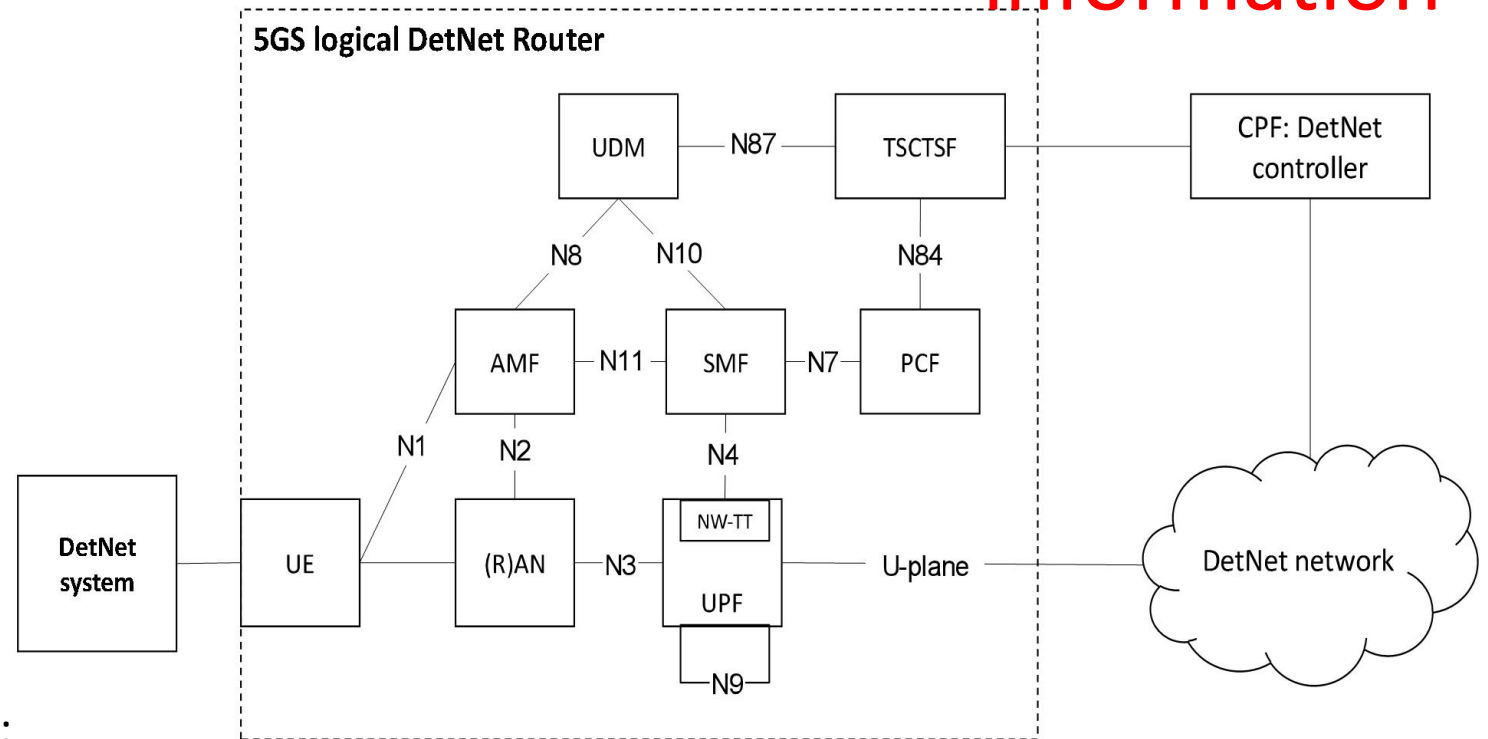
- LS on "A Realization of Network Slices for 5G Networks Using Current IP/MPLS Technologies"
- The TEAS WG would like to request 3GPP to review the document "[A Realization of IETF Network Slices for 5G Networks Using Current IP/MPLS Technologies](#)" and provide confirmation that the brief 5G overview included in the Appendix is accurate. The TEAS WG would like to request that feedback on this is provided in an LS by the deadline. The TEAS WG also encourages the use of the TEAS WG mailing list [6] for individuals to send comments, raise concerns and seek clarification on the document.

So, the similar path could be applied to DetNet Flow Aggregation!

5GS – A Logical DetNet Transit Node*

For everyone's
information

- Holistically as a transparent box to external networks integrated in the DetNet domain
- Only considering the DetNet forwarding sub-layer related functions
- 5G NF TSCTSFC performs mappings in the control plane between the 5GS internal NFs and the DetNet controller in the IP domain.
- 2-type Traffic parameters: per-(logical)-node vs. flow-level
- Two(2) types of external-facing interfaces:
 - **DS-TT** or the (UE) device-side ports (not tagged in the picture): connects with external DetNet entities (e.g., DetNet end systems or full-fledged IP DetNet nodes/routers); could be a typical deployment for small businesses to achieve deterministic network connectivity via 5G wireless services
 - **NW-TT** or the network-side ports or NW-TT: connected via the 5G data-plane to external DetNet domain (most likely, an IP deterministic network).
- Forwarding IP packets between 5GS N6 (off UPF, NW-TT toward DN) and UE (DS-TT)



*3GPP TS 23.501 5GS System Architecture (Rel-18)

*IETF I.D., draft-jlg-detnet-5gs-01, "DetNet YANG Model Extension for 5GS as a Logical DetNet Node"

IETF-120: Realization of Flow Aggregation for 5GS DetNet Service

1. Realization of 5GS DetNet Service across Domains:

- A 5GS (logical) DetNet node (like a sub-domain) integrated into the IP DetNet domain
- CPF:DetNet Controller: dividing holistic DetNet service Reqs. into (sub)domain Reqs.

2. 5GS QoS Provisioning: Aggregated vs. Fine-grained

- 2-type Traffic parameters: per-(logical)-node (aggregated) vs. flow-level
- Attributes & Specifications: coarse-grained (5GS-logical-node) vs. fine-grained (flow-level)

3. State Maintenance at a 5GS Transit Node

- 5GS QoS architecture: UE, PDU-session, QoS-flow, etc.; a 5GS logical DetNet node having 'composite' nature (i.e., comprised of multiple DetNet nodes)
- 5GS DetNet states *remains hidden* from external domains; having *no state exposure*.

4. Flow Classification & Identification at a 5GS Node

- Classification: IETF CPF:DetNet providing traffic parameters, specifications, class-mappings, etc.; relieve burden of 5GS nodes
- Identification: Leverage 5GS advantages: e.g.,
 - [3GPP TS 23.501] Hierarchy-based QoS (ABR: UE/Session/Flow), PDR, SDF filters;
 - [3GPP TS 23.502] Standardized procedures for flow dynamics, e.g., session establishment/update, etc. [23.502]

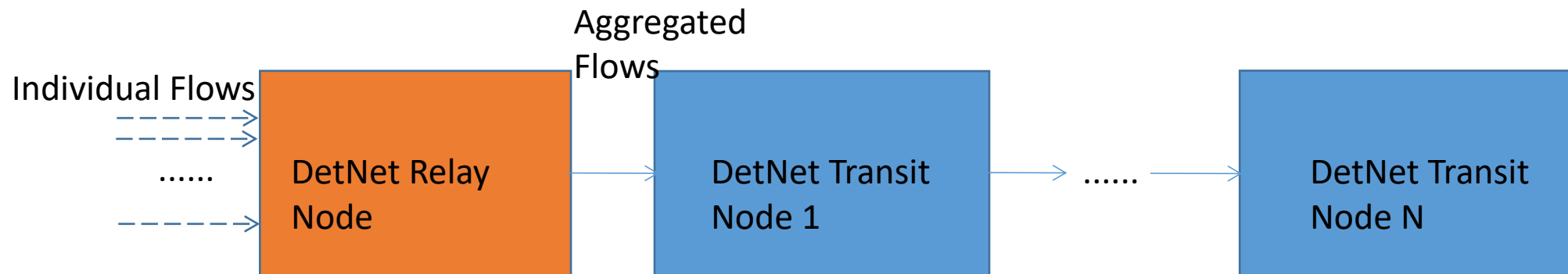
Next Step

- Further refine objectives, requirements and general principles; and the realization of flow aggregation for a 5GS logic DetNet node.
- Comments and suggestions are very welcome!
- A useful work for WG adoption?

Backup Slides from IETF-119

IETF-119 Recapture: Gaps and Requirements-1

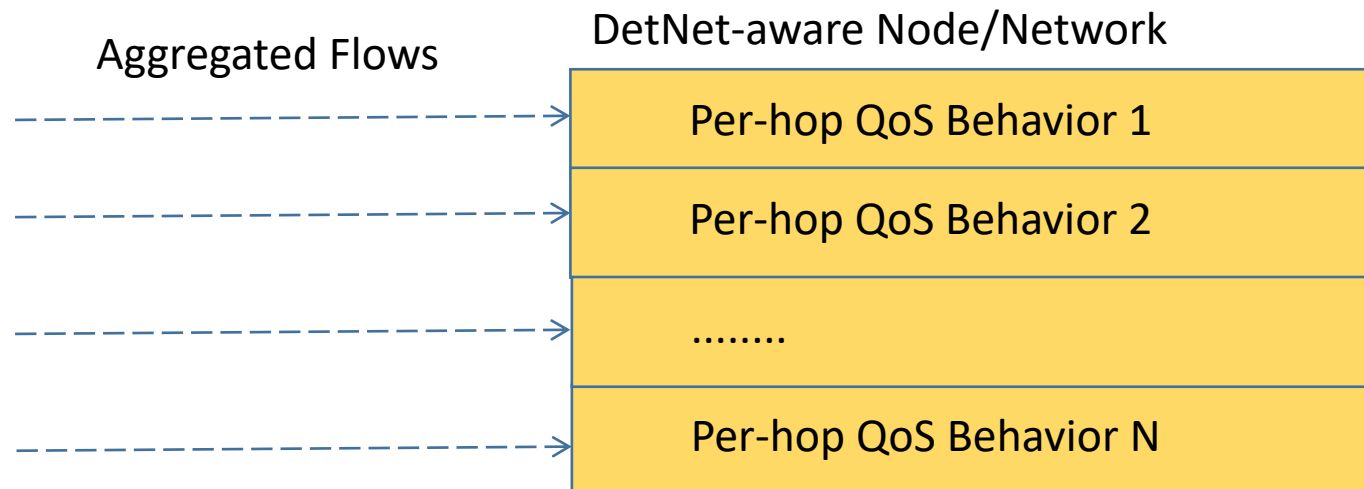
- **Aggregating DetNet flows to resolve the scalability issues at transit nodes**
 - ✓ As per [RFC9522], it might suffer from the scalability concerns and the existing aggregation of individual flows may be still challenging for network operations.
 - ✓ As per [I-D.joung-detnet-taxonomy-dataplane], the class level could be provided to simplify the control and accommodate traffic fluctuations by aggregating flows with the same level of service requirements.
 - ✓ The flow aggregation based on the class level or hierarchical aggregation could resolve the scalability issues. When DetNet flows are aggregated, transit nodes provide service for several limited aggregate levels.



Large number of Individual Flows  Limited number of aggregated classes

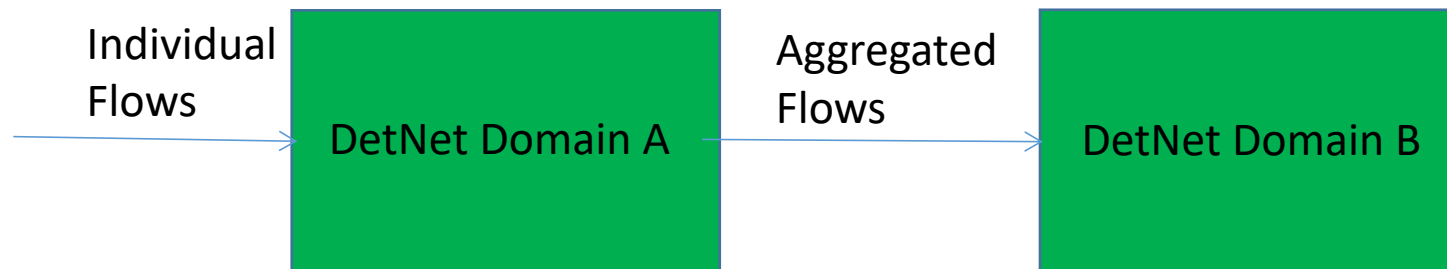
IETF-119 Recapture: Gaps and Requirements-2

- **Aggregating DetNet flows to provide fine-grained QoS behaviors**
 - ✓ As per [I-D.ietf-detnet-scaling-requirements], different levels of applications differ in the SLAs requirements such as tight jitter, strict latency, loose latency and so on.
 - ✓ As per [I-D.joung-detnet-taxonomy-dataplane], the treatment solutions in data plane can be categorized based on performance and functional characteristics. For example, delay bound guarantee such as C-SCOR/EDF , jitter bound guarantee such as CQF variations.
 - ✓ The DetNet node or domain needs to transmit the individual flows by aggregating the flows to a select a treatment solution with corresponding per-hop QoS behavior to provide fine-grained provisioning.



IETF-119 Recapture: Gaps and Requirements-3

- **Aggregating DetNet flows across different network domains**
 - ✓ As per [I-D.ietf-detnet-scaling-requirements], different network implementations may be intended for different application domains, where there is no additional requirements for the coordination.
 - ✓ As defined in [ITU-T Y.2122], the network operating parameters of a flow aggregate should be exchanged among different network domains.
 - ✓ The flow aggregation may be used to achieve the interworking of different domains in multi-domain scenario such as the mapping of the QoS requirements.



IETF-119 Recapture: Aggregating DetNet Flows on Aggregated-class Level

- **Flow Classification**
 - Individual flows may be aggregated for treatment based on shared DetNet flow-specific QoS characteristics on aggregated-class level .
 - Aggregated classes can be predefined to indicate the different levels of applications with SLAs requirements and each class demands differentiated QoS behaviors and treatment as well as different DetNet capabilities in scaling networks.
- **Flow Identification**
 - The aggregated flows are required to be dynamic and simplified to be identified by an aggregation class (A-Class).
 - The aggregation class information may be used alone or together with other metadata to indicate the required queuing and forwarding behaviors.
 - The encoding of the A-Class may reuse the DSCP/TC or existing field such as the TC field in A-Label.