

# Flow Aggregation for Enhanced DetNet

draft-xiong-detnet-flow-aggregation-02

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# Updates from the pervious version

- Presented at IETF#120 (in Vancouver, July 2024); comments from the meeting and the WG email alias are highly appreciated:
  - Toerless, Janos and Lou
- Updates from the last version are following:
  - Split the (original) section#2 by adding a standalone section#4 to highlight the proposed enhancements when compared to the current DetNet spec.
  - Add a new (sub)section 4.3 "Flow Coordination" to reflect the potential optimized processing across flows
    - Also address one comment from the IETF-120
  - Editorial revision

# Ver#01

vs.

# Ver#02

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# Recap : 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.)

# Enhancement Consideration for Flow Aggregation

## ○ Flow Classification

- the DetNet flows MAY be classified to pre-defined levels based on the SLAs requirements of applications in scaling networks, such as tight/loose latency, jitter guarantee, low delay and jitter guarantee and so on.
- the service should be provisioned on an aggregated-class level, while the resources should be controlled and scheduled on a per-class basis, with the associated routes established based on the allocated resources.

## ○ Flow Identification

- dynamically and simplistically identify the aggregated flow to indicate the required treatments and forwarding behaviors on the level of class aggregation, which can be differentiated by an aggregation class identifier (e.g., A-Class) .
- the encoding of the A-Class may reuse the DSCP/TC or A-Label or other extensions.

## ○ Flow Coordination *(newly added in the latest draft revision)*

- flow aggregations become more prevalent, with flows frequently joining and leaving, which may potentially lead to accumulated bursts of flows across multiple hops.
- could be mitigated by coordinating packets within aggregated flows such as proportional scheduling and interleaving.



# 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 & coordination : 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

- Comments and suggestions are very welcome!
- A useful work for WG adoption?
- Thank you!

# Backup Slides from IETF-120



# 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

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- 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.

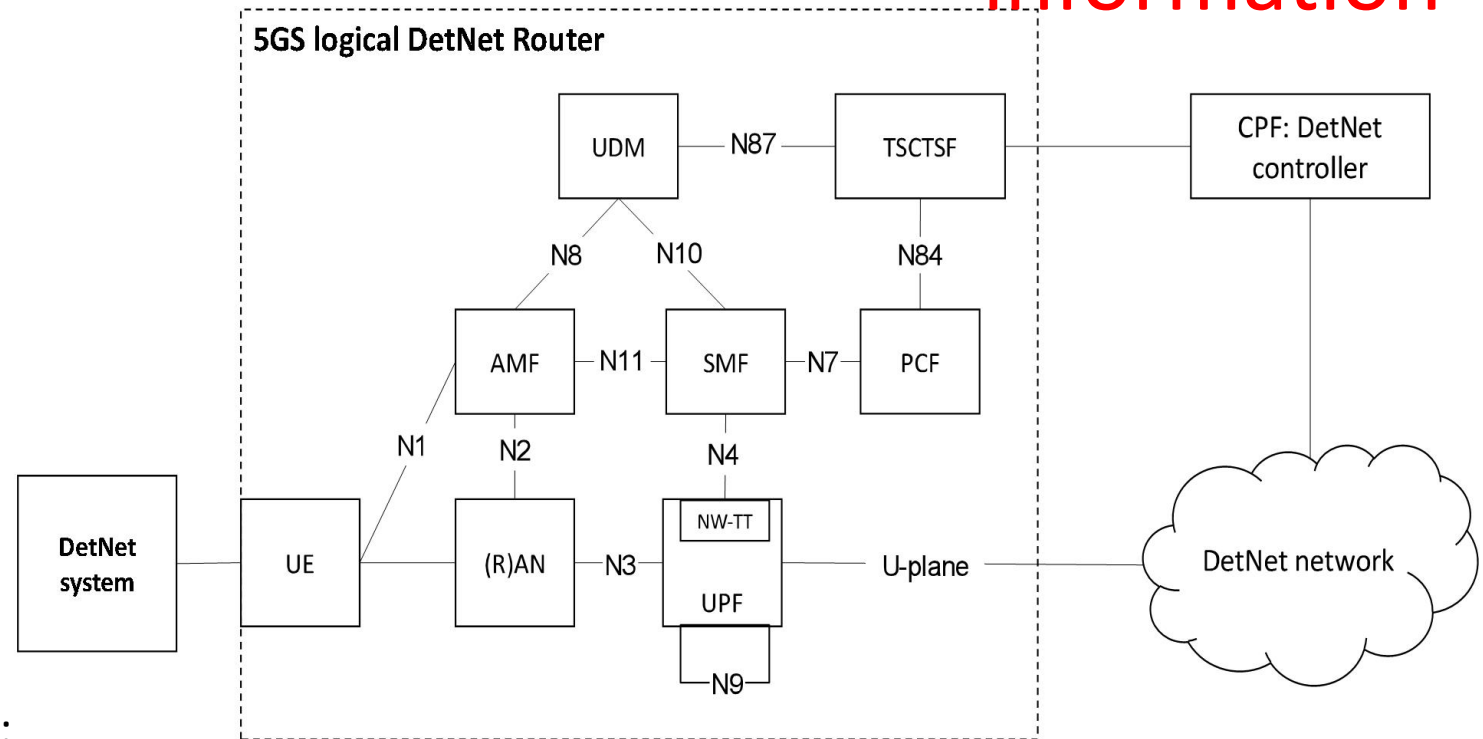
So, the similar path could be applied to DetNet Flow Aggregation!



# 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 TSCTSF 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

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