3GPP TSG-SA WG2#152E e-meeting S2-220xxxx

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**Title: KI#2: Update Solution #3**

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**Agenda Item: 9.6**

**Work Item / Release: FS\_DetNet / Rel-18**

*Abstract of the contribution: Resolve two Editor’s notes in Solution #3.*

# Proposal

We propose to resolve two Editor’s notes in Soluion #3. We Solution 3 in 23.700-46 as follows.

\*\*\*\*\* START CHANGE \*\*\*\*\*\*

## 6.3 Solution #3 for Key Issue #2: Mapping from DetNet YANG model to 3GPP configuration

### 6.3.1 Introduction

The assumed architecture is shown in the figure below. On the device side, we typically have an end host as a DetNet system that makes use of the DetNet functionality. Note that the end host does not have to be DetNet aware.



Figure 6.3.1-1: DetNet logical reference architecture distribution in 5GC

The main principles of the solution are as follows.

- In the DetNet YANG model (draft-ietf-detnet-yang [5]), the forwarding sub-layer configuration and the traffic profile are for the mapping.

- The forwarding sub-layer configuration identifies the flow and the incoming, outgoing interfaces. Based on this information, the PDU Session and the flow direction (uplink, downlink or whether it is UE to UE) can be determined.

- The DetNet traffic requirements in the traffic profile include the max-latency, min-bandwidth and the max-loss, which can be converted to the 3GPP delay, GFBR and PER requirements.

- The YANG model as currently defined in IETF only includes the end to end traffic requirements. There are two options: the TSCTSF may either derive the per 5GS requirements from the end to end requirements, or the DetNet YANG model is extended for the 5GS to include also the requirements specific to the 5GS.

- The DetNet traffic specification is used to determine the periodicity and the bandwidth requirement of the flow.

### 6.3.2 Functional Description

**Parameters to consider from the DetNet controller**

The YANG model in draft-ietf-detnet-yang [5] describes the parameters that are used by the DetNet nodes to set up the configuration for DetNet. As the 5GS realizes the forwarding sub-layer, it is the forwarding sub-layer configuration that needs to be considered in the YANG model. In addition, the YANG configuration can provide the Traffic Profile that includes the traffic requirements and the traffic specification that could be used by the 5GS system.

The DetNet YANG model contains the following parameters in the traffic requirements referenced in the forwarding sub-layer which can be mapped to 3GPP parameters.

- Max-latency, which relates to the required delay in the 5GS.

- Min-bandwidth, which relates to the guaranteed bitrate that is needed for the flow (GFBR).

- Max-loss, which relates to the PER that is being proposed to be added as a new parameter in the release 18 in the 5TRS\_URLLC study that can be provided to the 5GS.

The DetNet YANG model also contains other parameters in the traffic profile that is referenced in the forwarding sub-layer which do not easily map to 3GPP parameters: max-latency-variation, max-consecutive-loss-tolerance, max-mis-ordering. There is no straightforward 3GPP mapping for these parameters as their definition differs from the current 3GPP parameters. Hence it is proposed not to standardize any mapping for these parameters in the current release.

The traffic specification referenced in the forwarding sub-layer includes the following parameters that can be mapped.

- Interval: this corresponds to the periodicity in the 3GPP system.

- max-pkts-per-interval, max-payload-size: can be used to determine the maximum burst size; together with the interval parameter, the required bandwidth can be calculated, which corresponds to the MFBR.

The traffic specification can also contain min-pkts-per-interval, min-payload-size, which do not map to any 3GPP parameters hence these are not proposed to be supported in the standardized mapping.

The TSCTSF can use the Interval to generate the periodicity value in the TSCAI.

Regarding the traffic requirements, it must be noted that the current DetNet YANG model includes only the end to end traffic requirements (e.g. in terms of maximal latency), and not the per node requirements that need to be realized by a given node. Even though it is the per node requirements that matter for the configuration of a given node, that information is currently not included in the IETF model as of today.

Based on the current IETF YANG model as currently defined, two main options can be used by the 5GS acting as a DetNet node.

- The TSCTSF derives the per node traffic requirements from the end to end traffic requirements using a pre-configured mapping in the TSCTSF, based on the knowledge of the given deployment. E.g. take a given fraction of the end to end requirements and/or subtract a constant that corresponds to the rest of the network. This mapping can be configured by the operator based on the knowledge of the given deployment’s properties, in such a way that the derived delay ensures that the e2e delay does not exceed the traffic requirements. This approach may be especially suitable for smaller DetNet deployments.

- Extend the IETF YANG model with additional parameters that apply to the 5GS system on a per node basis. The YANG modelling language allows for extensibility. That can be achieved by a 3GPP defined YANG model that imports the IETF defined DetNet YANG model and adds the needed per node parameters. In that way, the model used by 5GS remains compatible with IETF DetNet, but allows for the DetNet controller to provide the traffic requirements on a per node basis when the DetNet controller is prepared for this and when it is aware that the DetNet node is a 5GS. (That knowledge can be available based on the exposure solution in Key Issue #1.) This type of extension of YANG models is a commonly used to tailor the configuration according to the needs of a given deployment. An example for the YANG extension was provided in S2-2204764. The extension can be described in a 3GPP specification, with the possibility to further tailor the YANG model according to the operator needs of the given deployments. In this way, the IETF defined DetNet YANG model does not need to be modified (even though a future enhancement of the IETF DetNet model may consider the 3GPP defined extension). This approach may be especially suitable for bigger DetNet deployments.

**Identification of the PDU Sessions**

The TSCTSF receives the DetNet YANG forwarding configuration, which refers to the incoming and outgoing interfaces in 5GS. These are based on the interface identification that is provided in the reporting from the 5GS to the DetNet controller as part of Key Issue #1 solution. The interface is identified by its name, which is derived from the if-Index, which in turn is based on the port number that is set by the UPF. The TSCTSF stores the mapping between the port number (if-Index and the corresponding interface name) and the PDU Session, hence the PDU Session can be identified. The incoming and outgoing interfaces also identify whether the flow is uplink or downlink, hence flow direction is known, and also whether it is a UE to UE flow.

The TSCTSF may also perform a verification whether the 3GPP system routes the given flow as defined in the DetNet forwarding sub-layer. Note that it is out of scope of the current study to update the 3GPP system's routing based on the DetNet configuration, but it can be possible to verify in the TSCTSF whether the incoming and outgoing interfaces in the DetNet configuration correspond to a valid routing in the 3GPP system. As an example, the TSCTSF may verify whether the destination IP address in a downlink flow towards a given interface corresponding to a PDU Session is the same IP address that is assigned for the same PDU Session. As another example, the TSCTSF may be preconfigured with the knowledge whether or not UE to UE routing is enabled or not. The TSCTSF may also verify other parameters of the configuration, and indicate that the configuration for the flow is not accepted if the configuration is outside of the supported range, based on TSCTSF preconfiguration. As a result of this optional verification, the TSCTSF may decide to accept or reject a given DetNet configuration.

In the case of a UE to UE flow, if the system allows for such traffic, the TSCTSF generates separate requests on PDU Session basis towards the PCF(s) for the uplink and the downlink legs of the flow.

**3GPP configuration for DetNet**

The PCF receives the relevant QoS requirements from the TSCTSF as well as the flow description as determined by the TSCTSF based on the DetNet configuration. The stage 3 definition of the flow description is extended according to the needs of DetNet, also including the DSCP value and optionally IPv6 flow label and IPsec SPI. The PCF determines the 3GPP QoS parameters based on the QoS requirements provided by the TSCTSF. The PCF may also consider the DSCP value in the flow description. The PCF may establish new QoS flows or modify existing QoS flows as needed.

**Deployment option: configuration of the implementation specific routing functionality on N6**

Below we clarify a possible deployment option that does not require additional 3GPP specification.

The UPF node may have routing functionality on the N6 interface side which is implementation specific. The 3GPP specifications are not responsible for setting the routing on the N6 interface side. In deployments where the implementation specific routing functionality on the N6 side also needs to be configured for DetNet, direct configuration can be used between the CPF and the routing functionality co-located with the UPF. This case can be modelled with a single interface between the UPF and the router; when the UPF and the router are co-located in the same physical node, then the interface between them can be modelled as a single virtual interface. This optional deployment is shown in the figure below. There is no need to use this option in deployments where there is no need for routing configuration by the CPF on the N6 side.



Figure 6.3.2-1: Optional deployment scenario with CPF control of N6 routing

**Other considerations**

The solution does not require an NEF between the DetNet controller and the TSCTSF, since the DetNet controller is assumed to be trusted by the operator and can influence the QoS of the traffic flows.

### 6.3.3 Procedures

The figure illustrates the procedure for the mapping of the DetNet configuration.



Figure 6.3.3-1: Signaling for setting up YANG configuration for DetNet

1. The DetNet controller provides YANG configuration to the TSCTSF. The TSCTSF uses the identity of the incoming and outgoing interfaces to determine the affected PDU Session(s) and whether the flow is uplink or downlink. (For this, the information collected in the solution to Key Issue #1 is used.) The TSCTSF also determines if the flow is UE to UE in which case two PDU Sessions will be affected for the flow and can also verify whether the specified routing is applicable. The TSCTSF maps the configuration as described above and calculates the delay and PER requirements and the TSC Assistance Container for each flow description.

2. The TSCTSF provides the mapped parameters and the flow description to the PCF(s) on PDU Session basis.

3. The PCF(s) determines, based on the parameters received from the TSCTSF, whether the existing QoS flows need to be modified or a new QoS flow needs to be created. Additionally, the TSC Assistance Container is provided to the SMF.

4. The PCF responds to the TSCTSF, which includes information about the success of the configuration.

5. The TSCTSF provides a response to the CPF regarding the success of the configuration setup. Optionally, it can be possible to provide 3GPP specific status codes to provide additional information if the requested configuration could not be set up.

If the status of the flow changes later on for any reason, the TSCTSF notifies the CPF. Upon release of a PDU Session that is part of the existing DetNet configuration, the PCF notifies the TSCTSF for the PDU Session release, and TSCTSF notifies the CPF on status of the flow.

### 6.3.4 Impacts on existing entities and interfaces

TSCTSF: Maintains mapping between the port number in a UPF and the PDU Session and the associated interface in the DetNet configuration. Mapping of DetNet parameters and providing information to the DetNet controller whether the configuration is accepted.

PCF:

- Stage 3 definition of flow description parameter is extended.

\*\*\*\*\* END CHANGE \*\*\*\*\*\*