

Way forward on NextGen QoS Framework

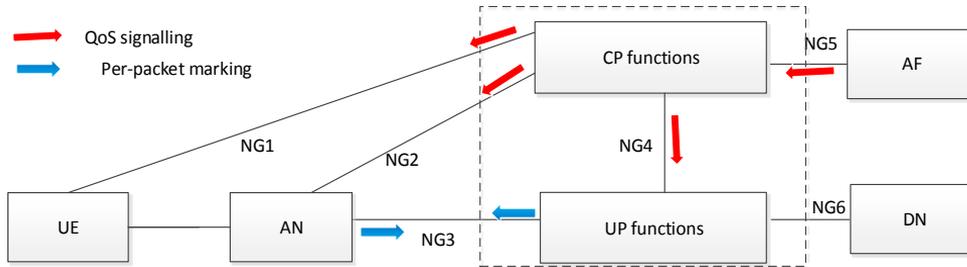
Intel

3GPP SA2#117 Kaohsiung, Taiwan, 17-21 Oct, 2016

Outline

- Walk-through the interim QoS agreements (TR 23.799 clause 8.2)
- Suggestion for closing open points
- NOTE: some of the topics are partly in scope of RAN groups. Those topics are tagged as “RAN-related” or “partly RAN-related”. It is suggested to liaise the relevant RAN groups on these topics

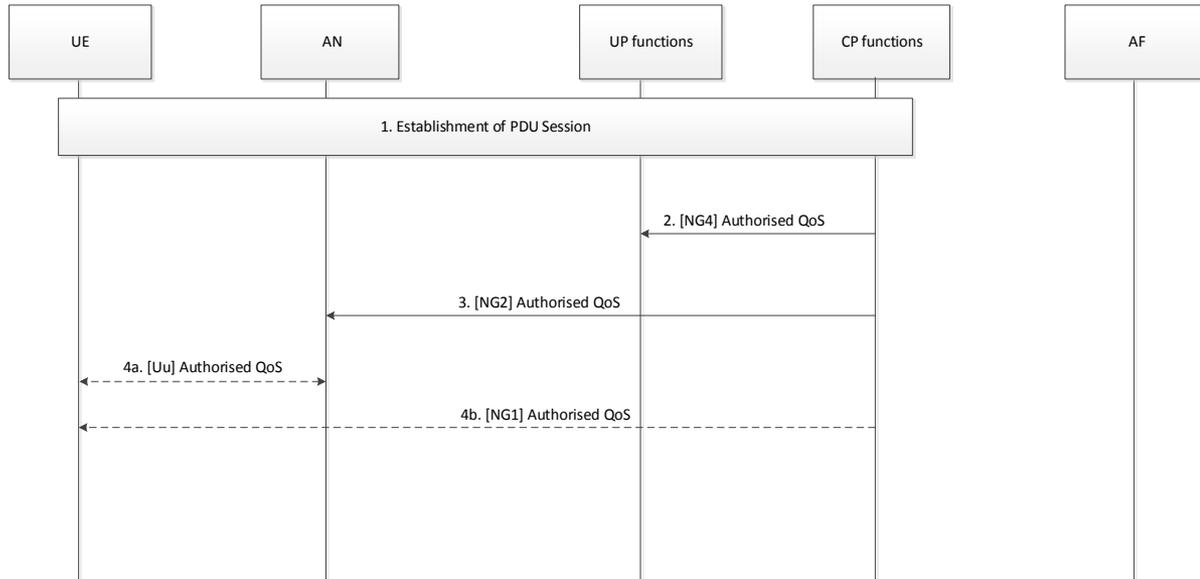
Flow-based QoS in a nutshell



- NG1: Reference point between the UE and the CP functions
- NG2: Reference point between the RAN and the CP functions
- NG3: Reference point between the RAN and the UP functions
- NG4: Reference point between the CP functions and the UP functions
- NG5: Reference point between the CP functions and an Application Function
- NG6: Reference point between the UP functions and a Data Network (DN)

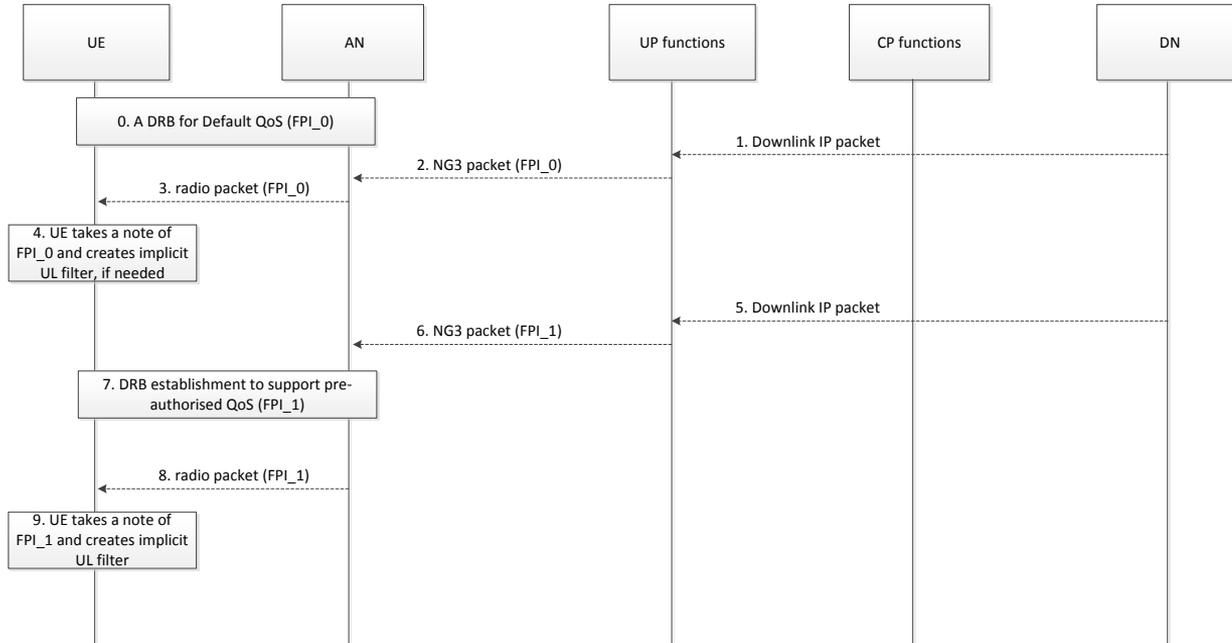
- “QoS Flow” is the finest granularity for QoS handling in the NextGen System (IA#9)
- The set of per-flow QoS characteristics includes: PDB, PER, Priority level, MBR, GBR, Admission (IA#13)
- Two types of NG3 markings
 - “FPIs”: indicators of standardized QoS characteristics (IA#11)
 - “FIIs” (a.k.a. “PFIs”, “QoS IDs”): pointers to dynamic QoS parameters signaled via NG2 (IA#12)
- Default QoS rule and Pre-authorized QoS rule(s) provided to RAN and UE upon PDU Session est. (IA#3)
 - Primarily needed for UL
- C-plane signaling is used at least for GBR flows (IA#4)
 - C-plane info contains QoS rule and associated FII
- Intent to avoid C-plane (NG1, NG2) signaling for non-GBR (IA#5; IA#6)
 - By relying on FPIs and Reflective QoS
- Main open points
 - AS vs NAS for QoS rules
 - UL binding
 - DRB-related (RAN-related)

At PDU Session establishment



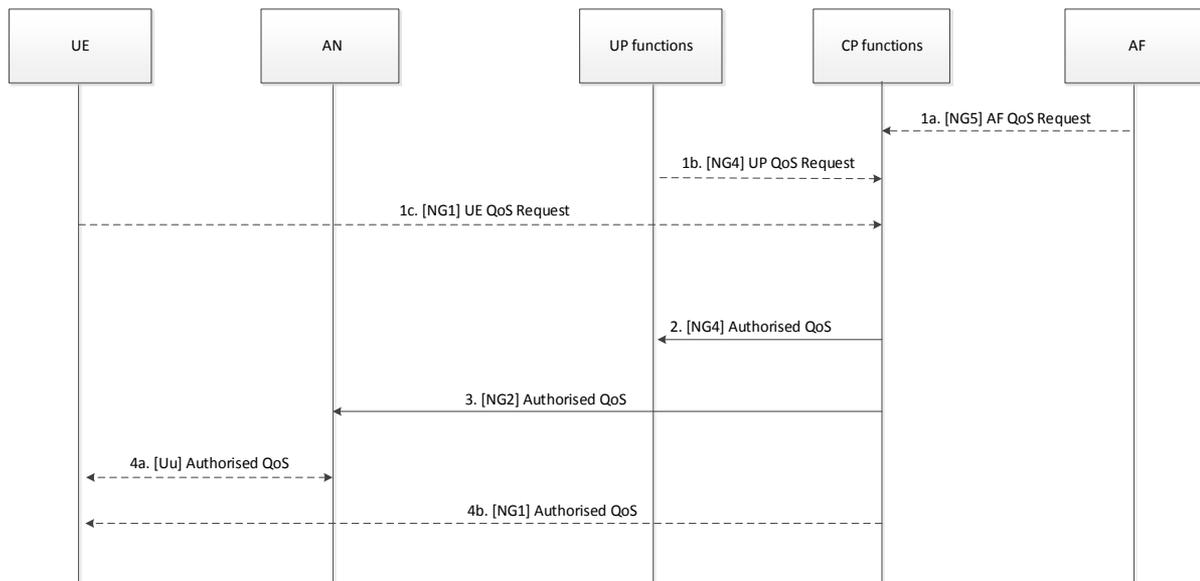
- Authorized QoS at PDU Session establishment refers to
 - A [Default QoS rule](#)
 - Zero or more [pre-authorized QoS rules](#)
- A QoS rule in UE consists of
 - QoS information (e.g. an FQI or a set of dynamic QoS parameters)
 - Packet filters (e.g. 5-tuple or 6-tuple)
 - Precedence order
- For discussion:
 - Is Authorized QoS provided to UE as AS (step 4a) or NAS (step 4b)
 - It is noted that at PDU Establishment there is both AS and NAS transaction
 - [RAN-related] Are all DRBs corresponding to Authorized QoS established at PDU Session est., or can they be established later as needed?

With NG3 marking of “FPI” type



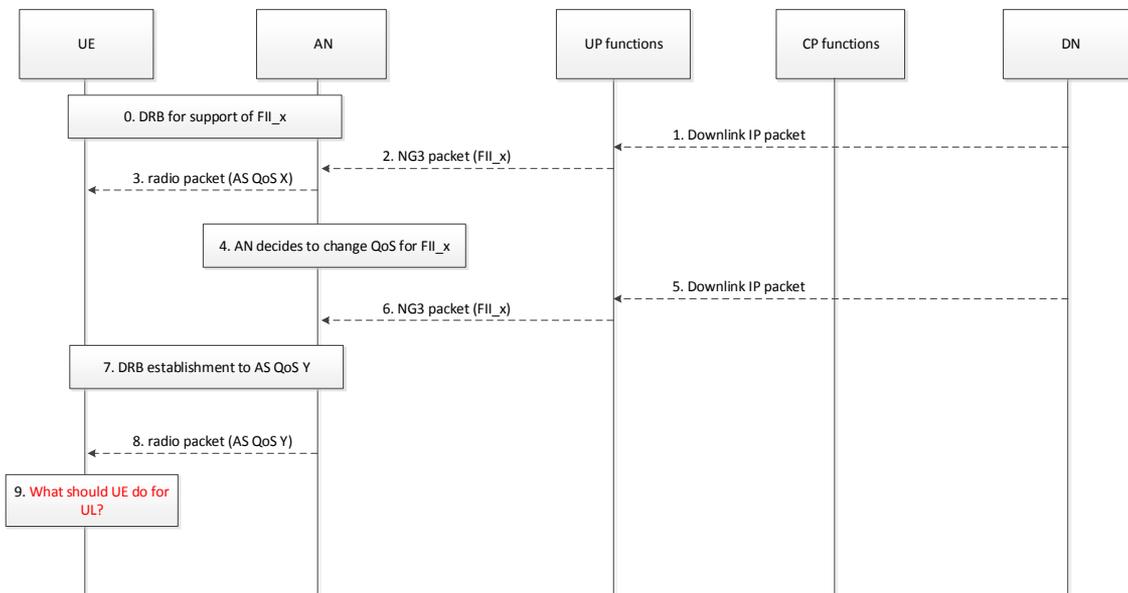
- The figure assumes that only one DRB was established at PDU Session est. e.g. to support the Default QoS rule
- For discussion (RAN-related):
 - Can a DRB be established on the fly e.g. triggered by so far non-used, but pre-authorized, FPI_1 (step 6 and 7)?
 - Or should all DRBs for pre-authorized QoS be established upon PDU Session est.?
 - **If the former, note that an AS-level QoS-related transaction occurs outside of a corresponding NAS transaction**
- The same questions apply for UL (RAN-related)
 - Can UE request a DRB for pre-authorized QoS on-the-fly (e.g. when an app effectively starts generating such traffic)

With NG3 marking of “FII” type



- NG3 marking of FII type is linked to C-plane signaling
- C-plane QoS transaction can be triggered by AF (step 1a), UP function (step 1b) or UE (step 1c)
- CP function determines Authorized QoS and signals it to UP function, AN and UE
- Authorized QoS here refers to
 - Dynamic QoS parameters
 - Associated FII
 - Packet filters
 - Precedence order
- This C-plane transaction may result in:
 - New DRB
 - Modification of existing DRB (e.g. increase or decrease of GBR)
 - Neither of the previous (e.g. when new UL filters are provided to UE)
- For discussion:
 - Is Authorized QoS provided to UE as AS (step 4a) or NAS (step 4b)
 - It is noted that the C-plane signaling for FII traffic consists of both AS and NAS transaction

RAN-initiated QoS change



- Some solutions suggest that RAN can autonomously decide to change (upgrade or downgrade) the QoS of a QoS Flow
 - E.g. traffic of FII_x is mapped to “AS QoS X” or “AS QoS Y” in the figure
- For discussion:
 - It is noted that in this case there is an AS-level QoS-related transaction outside of a corresponding NAS transaction
 - How is UE supposed to behave in UL? Should it apply the new (downgraded or upgraded) QoS in UL?
- Proposal:
 - Any QoS change decision in the RAN should not impact the UE handling of UL traffic at NAS level
 - It is up to RAN to decide whether corresponding UL traffic is mapped on the old or new DRB. However, the NG3 marking needs to correspond to the original (non-degraded) QoS marking

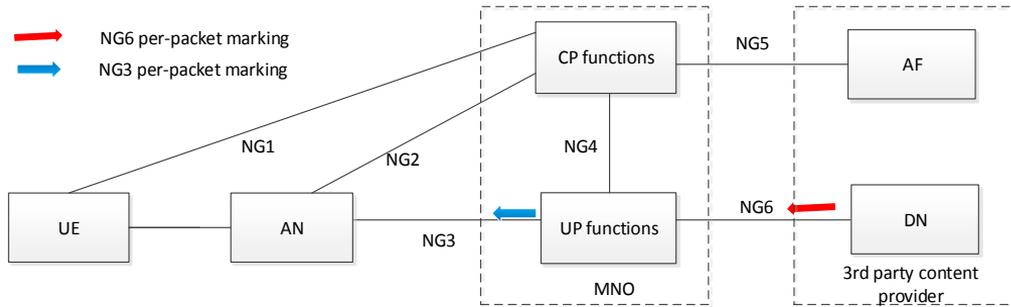
Proposed summary on the AS vs NAS signalling of QoS rules

- There are two cases where AS and NAS transactions are executed at the same time
 - 1) PDU Session establishment and 2) C-plane signalling for “FII” type of traffic
 - In these two cases **QoS rules** with “rich” information (incl. dynamic QoS parameters and UL packet filters) are provided to UE
- There are two cases where AS transaction is executed outside of a corresponding NAS transaction
 - 1) “FPI” type of traffic and 2) RAN-initiated QoS change
 - In these two cases there is **no need for signalling of QoS rules** either: a) because of the use of Reflective QoS (FPI type of flows), or b) because the RAN-initiated QoS change is transparent for the NAS-level QoS handling in the UE and does not impact NG3 markings for UL traffic
- Proposal
 - Agree that QoS rule is a NAS concept and is associated with NAS-level QoS (FPI or FII)
 - As such, explicit QoS rules are signaled using NG1 signalling
 - This does not preclude the definition of AS-level QoS (e.g. associated with DRB), however, so far there is no identified need for using packet filters in AS-level transactions

Binding of UL traffic to access resources (e.g. DRBs)

- Contrary to EPS where UL packets are bound to an EPS Bearer ID, and then the latter is mapped 1:1 to a corresponding DRB, in the NextGen QoS framework UL packets are bound directly to access specific resources (e.g. DRBs)
 - In case of 3GPP access, Interim agreement 10.2 can be re-written as: *UE binds uplink packets onto ~~[access-specific resources]~~**[DRBs]** based on ~~[information for binding uplink packets onto access-specific resources]~~**[DRB binding information]** provided explicitly by the access network and/or based on **QoS rules** (explicitly signaled or implicitly derived via reflective QoS).*
- During the discussion on the conference call it was commented that (from SA2 perspective) UL traffic is actually bound to the QoS of a specific QoS rule (in the form of FPI or FII)
 - It is then up to RAN to define how the QoS rule maps to specific RAN-resources (e.g. DRBs)
 - As a consequence, IA#10.2 needs to be changed by removing the “DRB binding information”, which seems to be in RAN scope
- On the conference call it was also commented that NAS needs to provide to AS a PDU Session identifier
 - The same comment applies on the network side: RAN may need to take into account both the NG3 QoS marking and the PDU Session identifier when performing DRB binding
- Regarding the ranking of implicit QoS rules, it is proposed that:
 - Implicit QoS rules are considered by UE with lower precedence order compared to explicit QoS rules (with the exception of the Default QoS rule, which is always the lowest precedence order)
- QoS-aware apps (e.g. MCPTT, Skype for Business, etc.) provide QoS on per-packet basis, typically via the DSCP marking of the e2e packet
 - The DSCP marking can be part of the packet filter (see TS 23.060) in the QoS rule. Specifically, it should be part of the pre-authorized QoS rules

Other: NG6 to NG3 mapping



- Forwarding behavior determined by FPI or FII
- Discard behavior determined by PDPI

- May be needed for the use case where support of QoS differentiation of encrypted traffic (e.g. HTTPS-based video streaming) is required
 - Could be used e.g. in cooperation with major content providers
- Requires an SLA for per-packet marking on NG6 between the MNO and the 3rd party
- UP functions maps the NG6 markings (which can be proprietary) to NG3 markings that define forwarding behavior within the NextGen system (i.e. “FPI”, “FII”)
- The main potential impact on NG3 is a new type of NG3 packet marking, in addition to FPI, FII e.g. per-packet discard priority indication (PDPI)
 - Could be used for educated dropping of video frames in case of radio congestion
 - E.g. all video frames of a video streaming flow are mapped to the same QoS Flow (i.e. same FPI), which means that in absence of congestion they are all delivered in FIFO order
 - However, in presence of congestion it is the packet tagged with PDPI that are dropped first, which minimizes the impact on user’s QoE
- **Proposal:** This is an add-on feature and may be considered at a later stage

Summary of proposals

- QoS rule is a NAS concept and is associated with NAS-level QoS (FPI or FII)
- QoS rule consists of NAS-level QoS (FPI or FII), dynamic QoS parameters (FII only), packet filter(s) and precedence order
- Explicit QoS rules are signaled using NG1
- Implicit QoS rules (derived using Reflective QoS) rank higher than Default QoS rule, but lower than any other explicitly signaled QoS rule
- UE binds UL traffic to the NAS-level QoS (FPI or FII). Note that this implies that UE is aware of the NAS-level QoS
- QoS-aware applications are taken into account by using a 6-tuple (i.e. the DSCP marking) in the QoS rules
- When passing an UL packet from NAS to AS in the UE, the NAS provides the NAS-level QoS (FPI or FII) and the PDU Session identifier
- Conversely, when passing a DL packet from AS to NAS in the UE, the AS provides the NAS-level QoS (FPI or FII) and the PDU Session identifier
- When passing a DL packet from CN to RAN, the RAN uses the NG3 QoS marking (FPI or FII) and the PDU Session identifier to select the access resources (e.g. DRB)
- Conversely, when passing an UL packet from RAN to CN, the RAN uses the NG3 QoS marking (FPI or FII) and selects the NG3 tunnel associated with the underlying PDU Session identifier
- It is up to RAN to decide the AS-level QoS of the DRB and how DL and UL packets (associated with the FPI/FII and PDU Session identifier) are mapped to DRBs
- Any RAN-initiated QoS change should have no impact on the FPI/FII marking on NG3 or on the NAS/AS interface in the UE
- It is proposed to send an LS to the RAN groups informing them of the agreements

BACKUP

Interim agreements (1/2)

- 1. Support **Reflective QoS** over RAN under control of the network. The network decides on the QoS to apply on the DL traffic and the UE reflects the DL QoS to the associated UL traffic. When the UE receives a DL packet for which reflective QoS should be applied, the UE creates a new implicit QoS rule. The packet filter in the implicit QoS rule is derived from the header of the DL packet.
- 2. **U-plane marking** for QoS is carried **in encapsulation header on NG3** i.e. without any changes to the e2e packet header.
- 3a. A **default QoS rule** shall and **pre-authorized QoS rules** may be provided at PDU Session establishment **to UE**.
- 3b. **QoS rules** can be (e.g. depending on access capabilities) provided at PDU Session establishment **to the RAN** using NG2 signalling.
- 4. QoS Flow-specific QoS signalling via the **C-plane is needed for GBR service data flows**.
- 5. **NG2 signalling** related to QoS, outside of PDU Session establishment, corresponding to a pre-authorized QoS rule **should be minimised** for initiation, modification or termination of SDFs with no GBR requirements.
- 6. **NG1 signalling** related to QoS, outside of PDU Session establishment, corresponding to a pre-authorized QoS rule **should be minimised** for initiation, modification or termination of SDFs with no GBR requirements.

Interim agreements (2/2)

- 7. For the purpose of subscription and service differentiation, **enforcement of UL rate** limit per Service Data Flow and per PDU Session shall be done **in a CN UP**, being a trusted point of enforcement in the network, handling all traffic of the PDU session.
- 8. The **AN shall enforce a rate limit in UL per UE**.
- 9. **QoS Flow** is the finest granularity for QoS treatment in the NG System.
- 10.1. **In the downlink the (R)AN binds QoS Flows** onto access-specific resources **based on the NG3 marking** and the corresponding QoS characteristics provided via NG2 signalling. Packet filters are not used for binding of QoS Flows onto access-specific resources in (R)AN.
- 10.2. **UE binds uplink packets** onto access-specific resources based on information for binding uplink packets onto access-specific resources provided explicitly by the access network and/or based on QoS rules (explicitly signaled or implicitly derived via reflective QoS).
- 11. **Some User plane markings** are scalar values that have **standardized** QoS characteristics.
- 12. **Some User plane markings** are scalar values that point to **dynamic** QoS parameters signalled over NG2.
- 13. **Dynamic QoS parameters may include** the following: a. Maximum Flow Bit Rate; b. Guaranteed Flow Bit Rate; c. Priority level; d. Packet Delay Budget; e. Packet Error Rate; f. Admission control.