5G Quality Of Services (QoS)

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By **Sushobhit Goyal (http://5gblogs.com/author/sushobhit/)** in **(http://5gblogs.com/5g-quality-of-serv**
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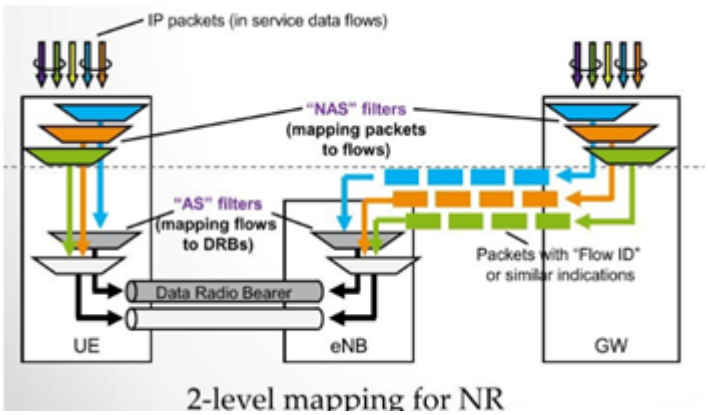

2-level mapping for NR

The concept of QoS in 5G is **flow based**. Packets are classified and marked using QFI (QoS Flow Identi
5G QoS flows are mapped in the AN (Access Network) to DRBs (Data Radio Bearers) unlike 4G LTE whe
mapping is one to one between EPC and radio bearers. It supports following QoS flow types.

- GBR QoS flow, requires guaranteed flow bit rate.
- Non-GBR QoS flow, does not require guaranteed flow bit rate.
- Delay Critical QoS flow, For Mission Critical guaranteed flow bit rate.

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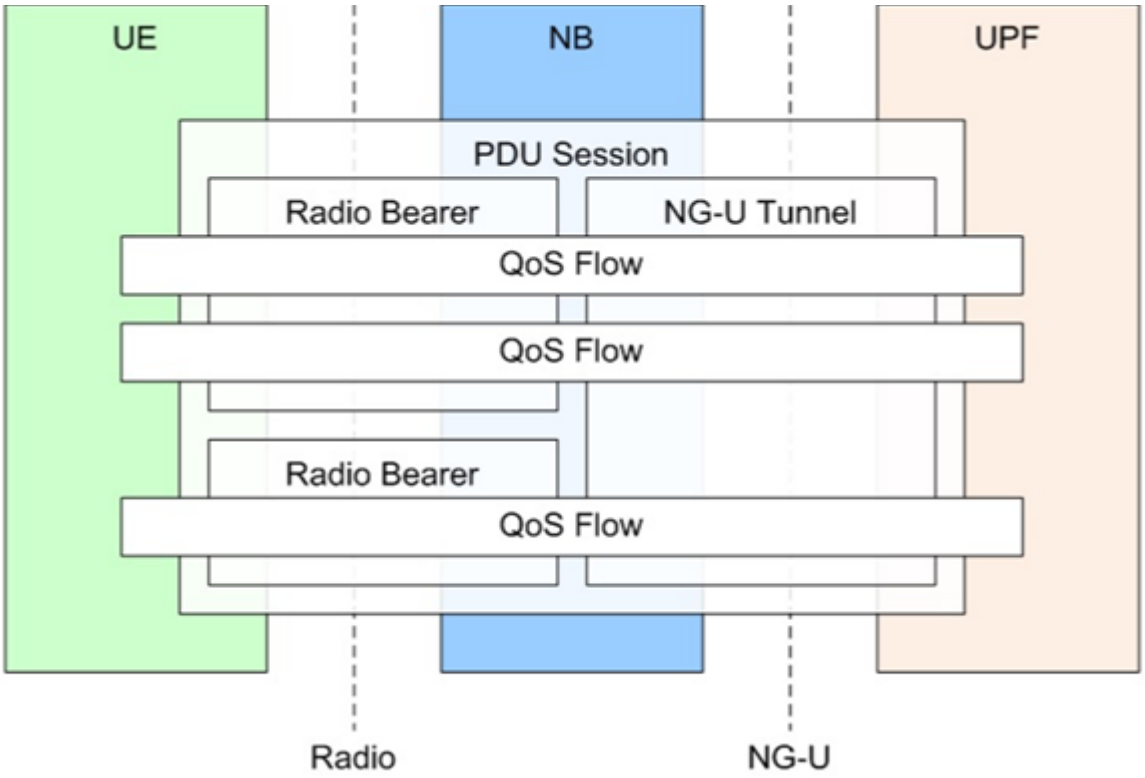
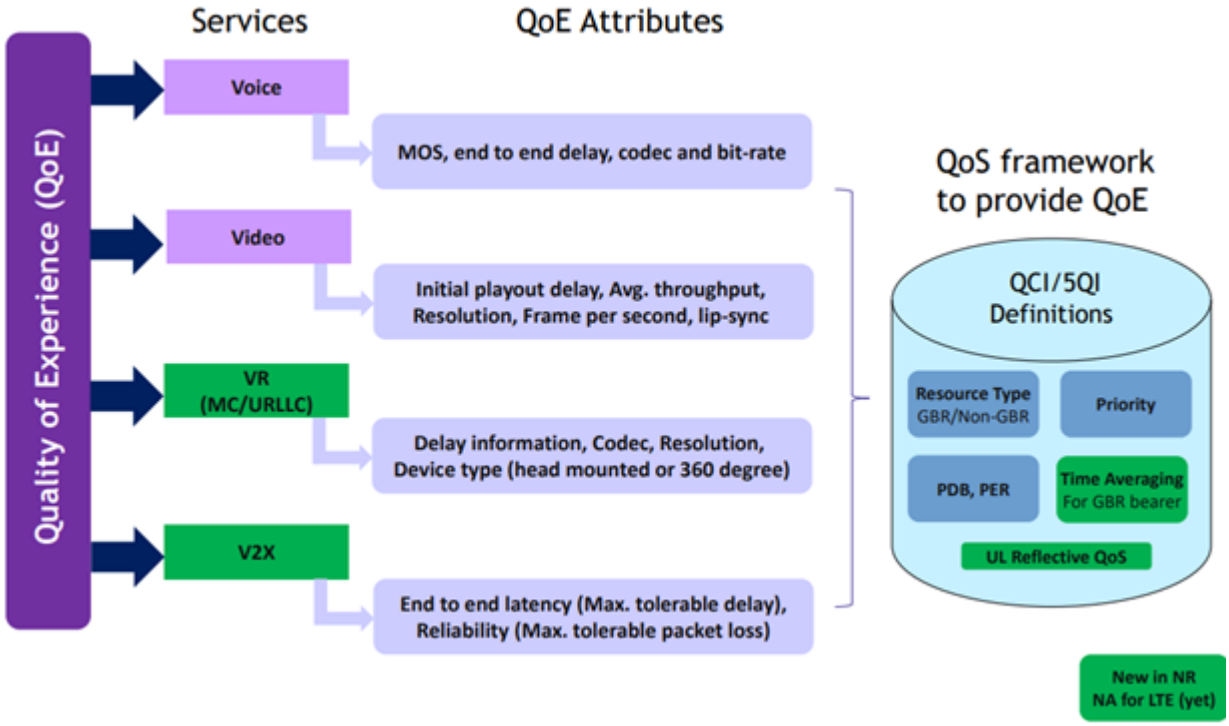
5G NR QoS Architecture



New Quality Of Experience (QoE) in 5G



How 5G QoS is differ from 4G

General

The concept of QoS in 4G LTE is based on Bearers. The Concept of QoS in 5G is based on Flow Based.

In 4G, EPS Bearer ID (EBI) is used to distinguish between different Quality Of Services (QoS).

5G uses QoS Flows, each identified by a QoS Flow ID (QFI). As with 4G LTE both non-GBR flows and GB supported in 5G, along with a new delay-critical GBR. 5G also introduces a new concept – Reflective Q

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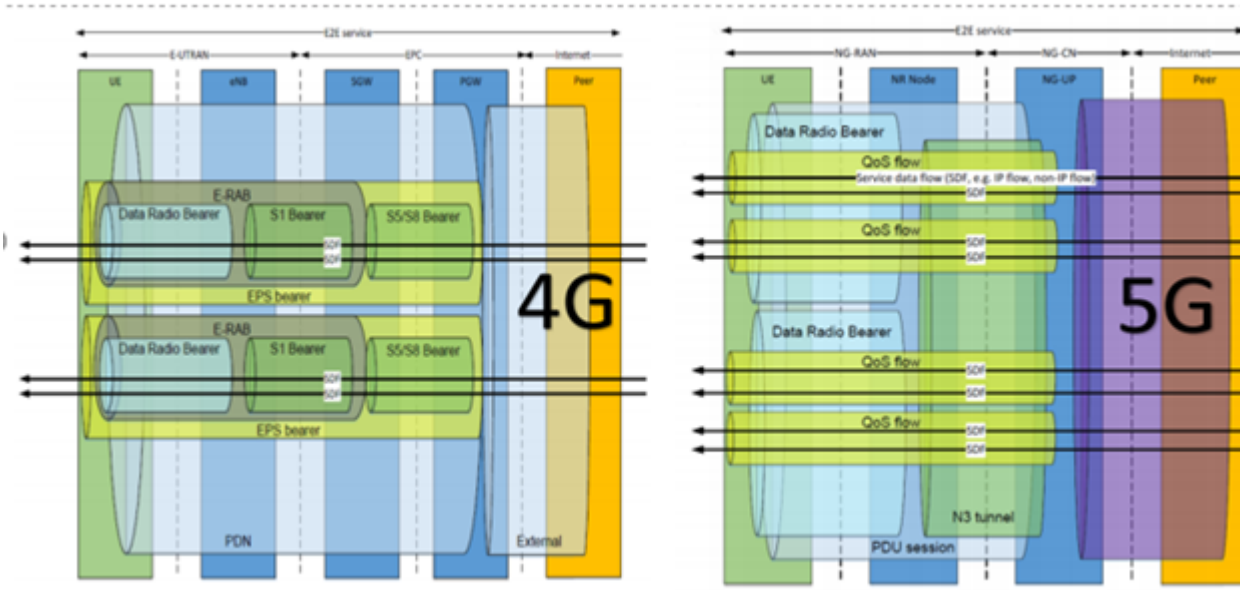
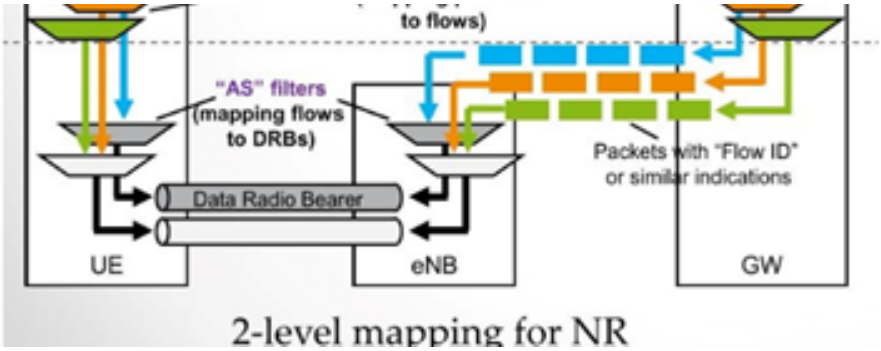
4G vs 5G QoS flow parameters

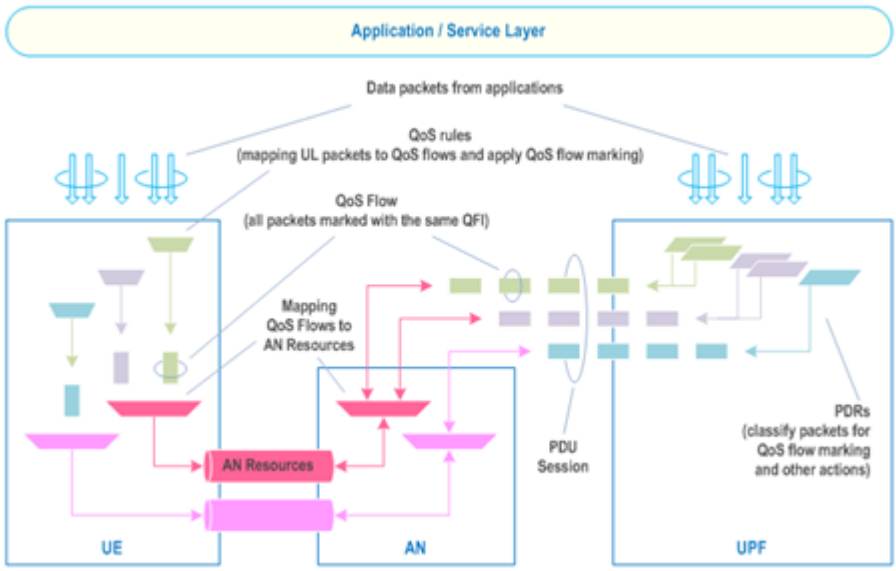


Parameter	5G	4G LTE
QoS Identifier	5G QoS Identifier - 5QI	Quality Class Indicator - QCI
IP Flow: UE to UPF/P-GW flow	QoS Flow	EPS Bearer
Flow/Bearer identifier	QoS Flow Identifier - QFI	EPS Bearer ID- EBI
Reflective QoS	Reflective QoS Indicator - RQI	N/A

5G – 5GC QoS Packet Filtering

In 5G, QoS Flow mapping happen two times. In the 5GC, there is only a single user plane network func UPF – for transport of data between the gNB and the core. In 5G, there is a one-to-many relationship l the GTP-U tunnel on N3 and the DRBs on the air interface. Each QoS flow on N3 is mapped to a single tunnel. The gNB may map individual QoS flows to one more DRBs. Therefore, a PDU session may cont multiple QoS flows and several DRBs but only a single N3 GTP-U tunnel. A DRB may transport one or r flows.





5G QoS Parameters / Attributes

QoS flow is identified by QFI within PDU session. This QFI is carried in an encapsulation header over N
• For each UE, 5GC establishes one or more PDU sessions and NG-RAN establishes at least one DRB tc
with PDU session. Additional DRBs are configured for QoS flows of that PDU session consecutively.
• NG-RAN maps packets which belong to the different PDU sessions to different DRBs.

NAS level packet filters in UE and in 5GC associate UL/DL packets with QoS flows. At NAS level, QoS fl
characterised by QoS profile provided by 5GC to NG-RAN and QoS rules provided by 5GC to UE.

AS-level mapping rules in UE and in NG-RAN associate UL/DL QoS flows with DRBs. At AS (Access Stra
DRB defines packet treatment on radio interface (Uu).

5G QoS Flow Descriptions

The network can also provide the UE with one or more QoS flow descriptions associated with a PDU s
the PDU session establishment or at the PDU session modification.

Each QoS flow description contains:

a) a QoS flow identifier (QFI);

b) if the flow is a GBR QoS flow:

1) Guaranteed flow bit rate (GFBR) for UL;

2) Guaranteed flow bit rate (GFBR) for DL;

3) Maximum flow bit rate (MFBR) for UL;

4) Maximum flow bit rate (MFBR) for DL; and

5) optionally averaging window, applicable for both UL and DL;

OR

If the flow is aNon-GBR QoS flow:

1. Reflective QoS Attribute (RQA) in DL
2. Additional QoS Flow Information

c) 5QI, if the QFI is not the same as the 5QI of the QoS flow identified by the QFI; and

d) ARP

e) optionally, an EPS bearer identity (EBI) if the QoS flow can be mapped to an EPS bearer .

5G QoS Rules

5G Signaled QoS Rule

The NAS protocol enables the network to provide the UE with signalled QoS rules associated with a PI session.The network can provide the UE with one or more signalled QoS rules associated with a PDU s the PDU session establishment or at the PDU session modification.

Each signalled QoS rule contains:

a) an indication of whether the QoS rule is the default QoS rule;

b) a QoS rule identifier (QRI);

c) a QoS flow identifier (QFI);

d) optionally, a set of packet filters; and

e) a precedence value.

5G Derived QoS Rule

The reflective QoS in the UE creates derived QoS rules associated with a PDU session based on DL use packets received via the PDU session.

Each derived QoS rule contains:

a) a QoS flow identifier (QFI);

b) a packet filter for UL direction; and

c) a precedence value of 80 (decimal)

5G QoS Flow Characteristics

- Resource Type (GBR, Delay critical GBR or Non-GBR);
- Priority Level;
- Packet Delay Budget (including Core Network Packet Delay Budget);
- Packet Error Rate;
- Averaging window (for GBR and Delay-critical GBR resource type only);
- Maximum Data Burst Volume (for Delay-critical GBR resource type only).

5G QoS Flow Table

5QI Value	Resource Type	Default Priority Level	Packet Delay Budget	Packet Error Rate	Default Maximum Data Burst Volume	Default Averaging Window	Example Services
1	GBR	20	100 ms	10^{-2}	N/A	2000 ms	Conversational Voice
2		40	150 ms	10^{-3}	N/A	2000 ms	Conversational Video (Live Streaming)
3		30	50 ms	10^{-3}	N/A	2000 ms	Real Time Gaming, V2X messages, Electricity distrib - medium voltage, Process automation - monitoring
4		50	300 ms	10^{-6}	N/A	2000 ms	Non-Conversational Video (Buffered Streaming)
65		7	75 ms	10^{-2}	N/A	2000 ms	Mission Critical user plane Push To Talk voice (e.g., MCPTT)
66		20	100 ms	10^{-2}	N/A	2000 ms	Non-Mission-Critical user plane Push To Talk voice
67		15	100 ms	10^{-3}	N/A	2000 ms	Mission Critical Video user plane
75							
71		56	150 ms	10^{-6}	N/A	2000 ms	"Live" Uplink Streaming
72		56	300 ms	10^{-4}			
73		56	300 ms	10^{-8}			
74		56	500 ms	10^{-8}			
76		56	500 ms	10^{-4}			
5		10	100 ms	10^{-6}	N/A	N/A	IMS Signalling
6		60	300 ms	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g., www, e-chat, ftp, p2p file sharing, progressive video, etc.)
7		70	100 ms	10^{-3}	N/A	N/A	Voice, Video (Live Streaming) Interactive Gaming

8	Non-GBR	80	300 ms	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g., www, e-chat, ftp, p2p file sharing, progressive video, etc.)
9		90					
69		5	60 ms	10^{-6}	N/A	N/A	Mission Critical delay sensitive signalling (e.g., MC-P signalling)
70		55	200 ms	10^{-6}	N/A	N/A	Mission Critical Data (e.g. example services are the s as 5QI 6/8/9)
79		65	50 ms	10^{-2}	N/A	N/A	V2X messages
80		68	10 ms	10^{-6}	N/A	N/A	Low Latency eMBB applications Augmented Reality
82	Delay Critical GBR	19	10 ms	10^{-4}	255 bytes	2000 ms	Discrete Automation
83		22	10 ms	10^{-4}	1354 bytes	2000 ms	Discrete Automation
84		24	30 ms	10^{-5}	1354 bytes	2000 ms	Intelligent transport systems
85		21	5 ms	10^{-5}	255 bytes	2000 ms	Electricity Distribution - high voltage

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