BT's Contributions to CAMARA QoD API

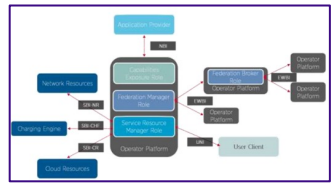
For OPAG and CAMARA internal use only

Milan Lalovic
CNS Team, BT Applied Research
Draft 5
Date: 15/7/2022
Shared with CAMARA QoD Group

Agenda

- Camara purpose and values – Review of current proposal for QoD API
- **Transformation Functions** (mapping with 5QI)
- **APIs "Chaining"** for Service Fulfilment
- **Example Proposal** – "Priority Queue with GBR" (for Private 5G)

OP Reference Architecture for QoS related APIs



Telco A – Network Resources

OP-A Domain

Transformation Function

API in SBI-NR SYSTEM APIs

API in NBI Service APIs CAMARA

Telco-A 5G CORE VNFs

NEF

OP Charging Engine

OP-A

Capabilities Exposure Role (CAMARA APIs)

Federation Manager Role

Service Resources Manager Role (3GPP APIs)

NBI

EWBI

Internet

OP customer

Application Developer

UE SDK:
Client 1 – OP Platform Client
Client 2 – Application Client

UNI

Access Networks

Transport Networks

UPF

UPF

HAG

UNI-UP

UNI-UP

QoS / 5QI

USER

SBI-NR

SBI-CHF

UNI

SBI-CR

Federation Broker Role (with or without)

EWBI

Telco/OP-B

Cloud Resources

Telco A – Cloud Resources

CHF-CR

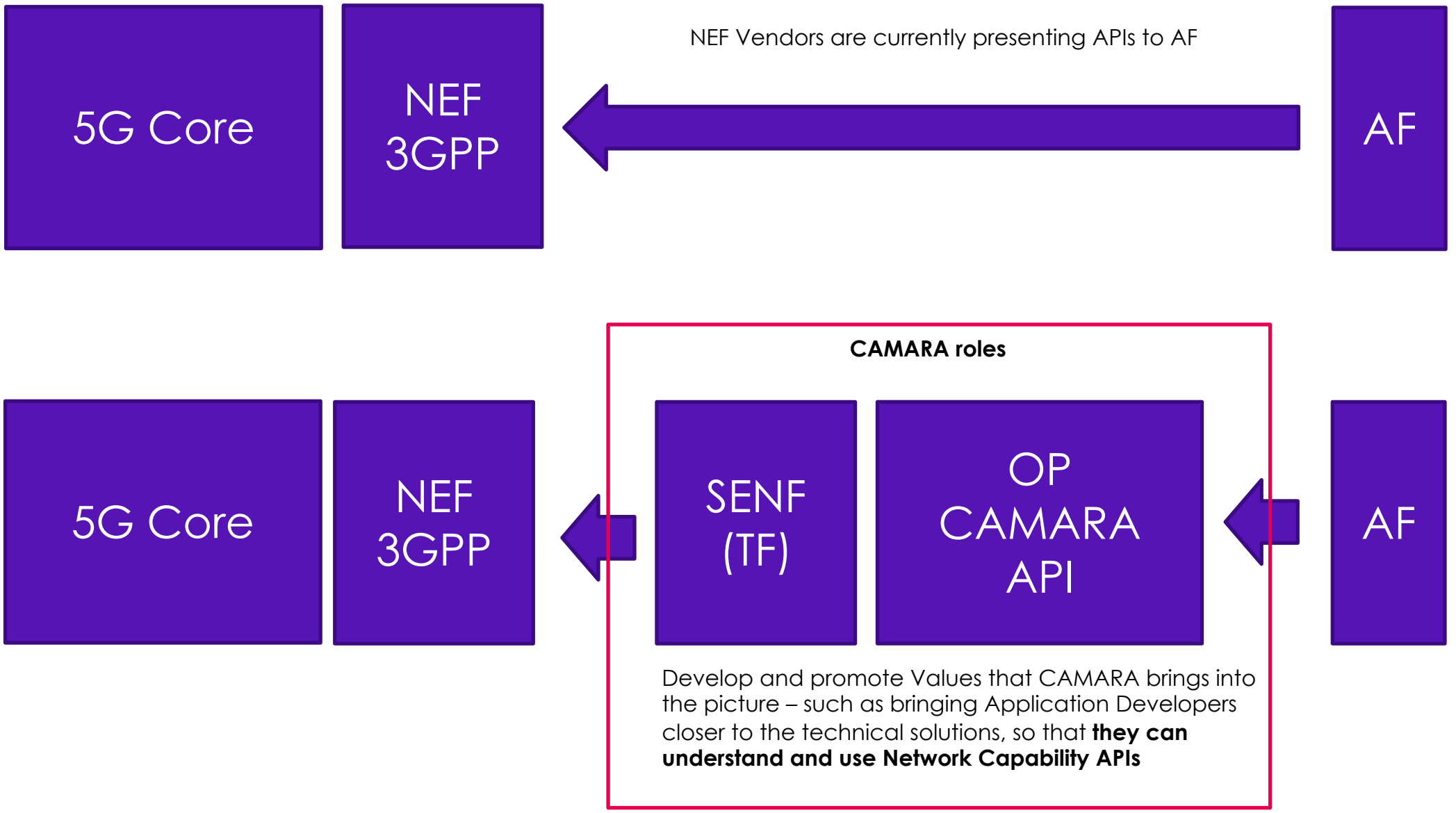
Cloud Resources

SBI-CR

API in SBI-CR SYSTEM APIs

SBI-EIN (in considerations)

CAMARA APIs – Purpose and Values



Analysis of the Initial CAMARA proposal for QoD API

QoS Profiles Mapping Table (REFERENCE DRAFT)

Profiles	User Info	5Qi mapping
LOW_LATENCY	Latency stays stable under congestion (throughput upto 2Mbps)	7
THROUGHPUT_L	DL upto 100Mbps (unlimited?)	6
THROUGHPUT_M	DL upto 30Mbps	6
THROUGHPUT_S	DL upto 10Mbps	6

Note: This table is only an example that can be used within Camara for validating the QoD APIs

5G QoS Identifier | 5QI Table

Following table mentions 5QI values and their corresponding QoS characteristics mapping.

5QI Value	Resource Type	Default Priority Level	Packet Delay Budget	Packet Error Rate	Default Maximum Data Burst Volume	Default Averaging Window	Example Services
6	Non-GBR	60	300 ms	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g. www, e-mail, chat, FTP, p2p file sharing, progressive video etc.)
7	Non-GBR	70	100 ms	10^{-3}	N/A	N/A	Voice, Video (Live Streaming), Interactive Gaming

Application Developer

CAMARA QoD API

1. **Throughput using RATE-LIMITING function (may not exist in MNO)**
2. **UNDEFINED Latency (what "stable under congestion" mean?)**

4 Objections
(highlighted in red)

4. UE ID can not be IP Address because the UE IP Address is typically in Private IP range (behind the NAT), hence other options needs to be considered

CAMARA
Transformation Function
and
Actions required to maintain QoS SLA
3. NOT DEFINED (Considered)

OPAG SBI-NR APIs

OP / Telco 5G Network

BT

CAMARA SENF – Transformation Function

Camara
Session Enabling Network Function (SENF)
Transformation Function

API Chaining
required for the
FULFILMENT

AF

Application Developer wants Assurance of QoE by paying "Priority" for their IP Packets traffic

Customer INPUTS
Network **Requirements:**

1. DL data speed
2. UL data speed
3. RTT Latency
4. Jitter
5. Packet Loss Rate
6. LOCATION

Technical INPUTs to CAMARA QoD API

Current Camara QoD

```
POST /qos-latency-senf/v1/sessions
{
 "ueAddr": "152.190.161.1",
 "asAddr": "192.176.1.84",
 "uePorts": "45342",
 "asPorts": "8082",
 "protocolIn": "TCP",
 "protocolOut": "TCP",
 "qos": "LOW_LATENCY",
 "notificationUri": "http://as.com/notifications"
}
```

SENF (TF)

Camara QoD API

AF

5G Core NEF

5QI (QoS levels) set automatically using AI and Network Automation

Service Differentiation Selected 5QI mapping with DSCP (commercial decisions)

CHF Function

Other APIs required for Fulfilment

Fulfilment

API "Chaining" for Service Fulfilment

In Confidence, OPAG and CAMARA

QoS Profiles Mapping Table (REFERENCE DRAFT)

Profiles	User Info	5Qi mapping
LOW_LATENCY	Latency stays stable under congestion (throughput upto 2Mbps)	7
THROUGHPUT_L	DL upto 100Mbps (unlimited?)	6
THROUGHPUT_M	DL upto 30Mbps	6
THROUGHPUT_S	DL upto 10Mbps	6

Note: This table is only an example that can be used within Camara for validating the QoD APIs

5G QoS Identifier | 5QI Table

Following table mentions 5QI values and their corresponding QoS characteristics mapping.

5QI Value	Resource Type	Default Priority Level	Packet Delay Budget	Packet Error Rate	Default Maximum Data Burst Volume	Default Averaging Window	Example Services
6	Non-GBR	60	300 ms	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g. www, e-mail, chat, FTP, p2p file sharing, progressive video etc.)
7	Non-GBR	70	100 ms	10^{-3}	N/A	N/A	Voice, Video (Live Streaming), Interactive Gaming

Application Developer paying for QoD API

CAMARA QoD API TF to OPAG APIs

OPAG = SBI-NR QoS Management API

API fulfilment status

Info Set → NEF → PCF → SMF → UPF → SDN Controller → **PHY Link configuration**

OPAG = SBI-NR Collecting Network Status API

What if UE changes location ?!

OPAG = SBI-NR Confirm User Location

OPAG = SBI-NR Network Events

OPAG = SBI-NR Traffic Influence

OPAG = SBI-NR Mobility Triggers

OPAG = SBI-NR Mobility Control

OPAG = SBI-NR Application Relocation

Actions required to maintain QoS SLA

No	OPAG APIs in SBI-NR Interface in Block B	OP Interface
1	Collecting Network Status	SBI-NR
2	QoS Management	SBI-NR
3	Traffic Influence	SNI-NR
4	Managing Service Availability in LADN	SBI-NR
5	Application Relocation	SBI-NR
6	Confirm User Location	SBI-NR
7	User Location Privacy Indicator	SBI-NR
8	Mobility Triggers	SBI-NR
9	Mobility Control	SBI-NR
10	User Authentication and Authorisation (contribution from Block D)	SBI-NR

Table 1. List of APIs in SBI-NR Interface

Transformation Function (TF) to OPAG APIs

- NBI = CAMARA QoD API
- EWBI = not developed
- SBI-NR = QoS Management API
- SBI-CR = not used
- SBI-CHF = not developed
- UNI = not used

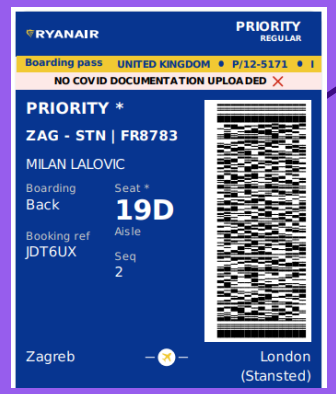
Example = “Priority Queue with GBR”

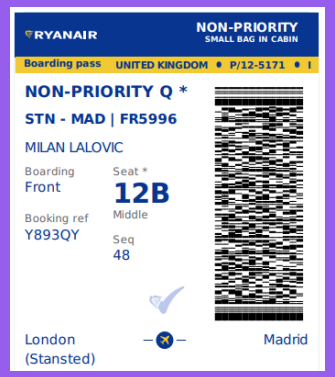
BT Proposal to Camara QoD API

- GBR
- Non-GBR
- Latency critical GBR

Priority

Best Effort





New proposal for Camara API for QoD

- **Input from Customer examples:**

1. **Min Downlink Throughput > Mbps**
2. **Min Uplink Throughput > Mbps**
3. **Latency RTT < milliseconds**
4. **Jitter (Latency stability) < milliseconds**
5. **Packet Loss (Contention) < %**
6. **Coverage (availability) = Locations**

→ 5QI Mapping

QoS Profiles Mapping Table (REFERENCE DRAFT)

Profiles	User Info	5Qi mapping
LOW_LATENCY	Latency stays stable under congestion (throughput upto 2Mbps)	7
THROUGHPUT_L	DL upto 100Mbps (unlimited?)	6
THROUGHPUT_M	DL upto 30Mbps	6
THROUGHPUT_S	DL upto 10Mbps	6

Note: This table is only an example that can be used within Camara for validating the QoD APIs

Initial Camara API for QoD

5QI and QCI Tables

5QI Value	Resource Type	Default Priority Level	Packet Delay Budget (NOTE 3)	Packet Error Rate	Default Maximum Data Burst Volume (NOTE 2)	Default Averaging Window	Example Services
1	GBR (NOTE 1)	20	100 ms (NOTE 11, NOTE 13)	10^{-2}	N/A	2000 ms	Conversational Voice
2		40	150 ms (NOTE 11, NOTE 13)	10^{-3}	N/A	2000 ms	Conversational Video (Live Streaming)
3		30	50 ms (NOTE 11, NOTE 13)	10^{-3}	N/A	2000 ms	Real Time Gaming, V2X messages (see TS 23.287 [121]). Electricity distribution – medium voltage, Process automation monitoring
***		***	***	***	***	***	***
5	Non-GBR (NOTE 1)	10	100 ms NOTE 10, NOTE 13)	10^{-6}	N/A	N/A	IMS Signalling
6		60	300 ms (NOTE 10, NOTE 13)	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7		70	100 ms (NOTE 10, NOTE 13)	10^{-3}	N/A	N/A	Voice, Video (Live Streaming) Interactive Gaming
***		***	***	***	***	***	***
82	Delay-critical GBR	19	10 ms (NOTE 4)	10^{-4}	255 bytes	2000 ms	Discrete Automation (see TS 22.261 [2])
83		22	10 ms (NOTE 4)	10^{-4}	1354 bytes (NOTE 3)	2000 ms	Discrete Automation (see TS 22.261 [2]); V2X messages (UE - RSU Platooning, Advanced Driving: Cooperative Lane Change with low LoA. See TS 22.186 [111], TS 23.287 [121])
84		24	30 ms (NOTE 6)	10^{-5}	1354 bytes (NOTE 3)	2000 ms	Intelligent transport systems (see TS 22.261 [2])
***		***	***	***	***	***	***

An extract of some 5QI values and their QoS characteristics. Source: Adapted from ETSI 2021a, table 5.7.4-1.

Based upon the above principles, [TS 23.203] has defined several QCIs. [TS 23.203] Release 16 6.1.7-A defines 26 QCIs:

QCI	Resource Type	Priority Level	Packet Delay Budget	Packet Error Loss	Example Services
1	GBR	2	100 ms	10.E-2	Conversational Voice
2	GBR	4	150 ms	10.E-3	Conversational Video (Live Streaming)
3	GBR	3	50 ms	10.E-3	Real Time Gaming, V2X messages, Electricity distribution (medium voltage) Process automation (monitoring)
4	GBR	5	300 ms	10.E-6	Non-Conversational Video (Buffered Streaming)
65	GBR	0.7	75 ms	10.E-2	Mission Critical user plane Push To Talk voice (e.g., MCPTT)
66	GBR	2	100 ms	10.E-2	Non-Mission-Critical user plane Push To Talk voice
67	GBR	1.5	100 ms	10.E-3	Mission Critical Video user plane
75	GBR	2.5	50 ms	10.E-2	V2X messages
71	GBR	5.6	150 ms	10.E-6	"Live" Uplink Streaming
72	GBR	5.6	300 ms	10.E-4	"Live" Uplink Streaming
73	GBR	5.6	300 ms	10.E-8	"Live" Uplink Streaming
74	GBR	5.6	500 ms	10.E-8	"Live" Uplink Streaming
76	GBR	5.6	500 ms	10.E-4	"Live" Uplink Streaming
5	Non-GBR	1	100 ms	10.E-6	IMS Signalling
6	Non-GBR	6	300 ms	10.E-6	Video (Buffered Streaming) TCP-based (e.g. www, email, chat, ftp, p2p file sharing, progressive video)
7	Non-GBR	7	100 ms	10.E-3	Voice, Video (live streaming), interactive gaming
8	Non-GBR	8	300 ms	10.E-6	Video (buffered streaming) TCP-based (e.g. www, email, chat, ftp, p2p file sharing, progressive video)
9	Non-GBR	9	300 ms	10.E-6	Same as 8
69	Non-GBR	0.5	60 ms	10.E-6	Mission Critical delay sensitive signalling (e.g., MC-PTT signalling, MC Video signalling)
70	Non-GBR	5.5	200 ms	10.E-6	Mission Critical Data (e.g. example services are the same as QCI 6/8/9)
79	Non-GBR	6.5	50 ms	10.E-2	V2X messages
80	Non-GBR	6.8	10 ms	10.E-2	Low latency eMMB applications (TCP/UDP-based); augmented reality
82	GBR	1.9	10 ms	10.E-6	Discrete automation (small packets)
83	GBR	2.2	10 ms	10.E-4	Discrete automation (large packets)
84	GBR	2.4	30 ms	10.E-5	Intelligent Transport Systems
85	GBR	2.1	5 ms	10.E-5	Electricity Distribution - High Voltage

CAMARA Transformation Function for 5QI Mapping (in more details)

Application Developers UNDERSTAND this language

Telco 5G Network UNDERSTAND this language

CAMARA QoD API INPUTS for ***Network Requirements***

1. **Min Downlink Throughput > Mbps**
2. **Min Uplink Throughput > Mbps**
3. **Latency RTT < milliseconds**
4. **Jitter (Latency stability) < milliseconds**
5. **Packet Loss (Contention) < %**
6. **Coverage (availability) = Locations**

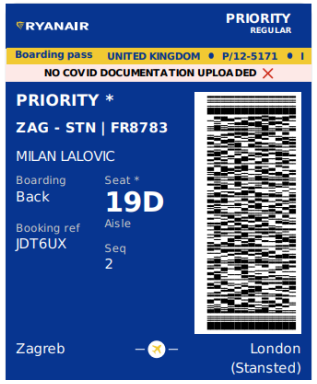
CAMARA QoD Transformation Function

- 5QI Mapping
- GBR in DL
- GBR in UL
- Packet Delay Budget
- Delay critical GBR
- Priority / PER Budget
- Coverage (Availability Zones)

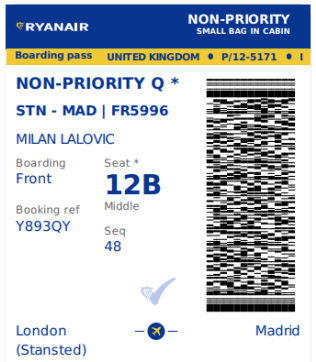
OPAG SBI-NR APIs

BT proposal to CAMARA QoD (based on GBR - Priority Queue example)

In Confidence, OPAG and CAMARA



CAMARA QoD API



Charging Function

OPAG APIs "chain"

Priority Queue GBR

API INPUTS:

1. Min Downlink Throughput > Mbps
2. Min Uplink Throughput > Mbps
3. Latency RTT < milliseconds
4. Jitter (Latency stability) < milliseconds
5. Packet Loss (Contention) < %
6. Coverage (availability) = Locations

Best Effort Queue Non-GBR

API INPUTS:

1. Min Downlink Throughput = Best Effort
2. Min Uplink Throughput = Best Effort
3. Latency RTT = Best Effort
4. Jitter (Latency stability) = Best Effort
5. Packet Loss (Contention) = Best Effort
6. Coverage (availability) = Locations

Charging Function

OPAG APIs "chain"

Backup Slides

Documenting Proposal on CAMRA Project Github

QoS Profiles Mapping Table (REFERENCE DRAFT)

Profiles	User Info	5Qi mapping

Note: This table is only an example that can be used within Camara for validating the QoD APIs

Priority Queue

Customer Inputs for Network Requirements (6 inputs)

GBR Mapping (Automatically)

Best Effort Queue

Customer Inputs for Network Requirements (6 inputs)

Non-GBR Mapping (Automatically)

5G QoS Identifier | 5QI Table

Following table mentions 5QI values and their corresponding QoS characteristics mapping.

5QI Value	Resource Type	Default Priority Level	Packet Delay Budget (NOTE 3)	Packet Error Rate	Default Maximum Data Burst Volume (NOTE 2)	Default Averaging Window	Example Services
1	GBR (NOTE 1)	20	100 ms (NOTE 11, NOTE 13)	10^{-2}	N/A	2000 ms	Conversational Voice
2		40	150 ms (NOTE 11, NOTE 13)	10^{-3}	N/A	2000 ms	Conversational Video (Live Streaming)
3		30	50 ms (NOTE 11, NOTE 13)	10^{-3}	N/A	2000 ms	Real Time Gaming, V2X messages (see TS 23.287 [121]). Electricity distribution – medium voltage, Process automation monitoring
...		...	...	...	...	...	...
5	Non-GBR (NOTE 1)	10	100 ms NOTE 10, NOTE 13)	10^{-6}	N/A	N/A	IMS Signalling
6		60	300 ms (NOTE 10, NOTE 13)	10^{-6}	N/A	N/A	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7		70	100 ms (NOTE 10, NOTE 13)	10^{-3}	N/A	N/A	Voice, Video (Live Streaming) Interactive Gaming
...		...	...	...	...	...	...
82	Delay-critical GBR	19	10 ms (NOTE 4)	10^{-4}	255 bytes	2000 ms	Discrete Automation (see TS 22.261 [2])
83		22	10 ms (NOTE 4)	10^{-4}	1354 bytes (NOTE 3)	2000 ms	Discrete Automation (see TS 22.261 [2]); V2X messages (UE - RSU Platooning, Advanced Driving: Cooperative Lane Change with low LoA. See TS 22.186 [111], TS 23.287 [121])
84		24	30 ms (NOTE 6)	10^{-6}	1354 bytes (NOTE 3)	2000 ms	Intelligent transport systems (see TS 22.261 [2])
...		...	...	...	...	...	...

An extract of some 5QI values and their QoS characteristics. Source: Adapted from ETSI 2021a, table 5.7.4-1.