

Mapping QCI to DiffServ

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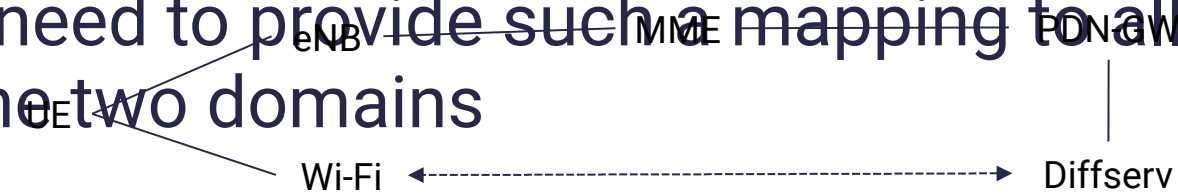
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Context

- Traffic flows from cellular realms to enterprise realms and back
- IR 34 defines an ISP to ISP QoS mapping mechanism. However:
 - This mechanism violates RFC 4594
 - There is no mechanism to map cellular QoS to enterprise QoS (following RFC 4594 and others)

- There is a need to provide such a mapping to allow translation of intent between the two domains



DiffServ Model

Application Class	Per-Hop Behavior	Queuing & Dropping	Application Examples
VoIP Telephony	EF	Priority Queue (PQ)	Cisco IP Phones (G.711, G.729)
Broadcast Video	CS5	(Optional) PQ	Cisco IP Video Surveillance / Cisco Enterprise TV
Real-Time Interactive	CS4	(Optional) PQ	Cisco TelePresence
Multimedia Conferencing	AF4	BW Queue + DSCP WRED	Cisco Jabber, Cisco WebEx
Multimedia Streaming	AF3	BW Queue + DSCP WRED	Cisco Digital Media System (VoDs)
Network Control	CS6	BW Queue	EIGRP, OSPF, BGP, HSRP, IKE
Signaling	CS3	BW Queue	SCCP, SIP, H.323
Ops / Admin / Mgmt (OAM)	CS2	BW Queue	SNMP, SSH, Syslog
Transactional Data	AF2	BW Queue + DSCP WRED	ERP Apps, CRM Apps, Database Apps
Bulk Data	AF1	BW Queue + DSCP WRED	E-mail, FTP, Backup Apps, Content Distribution
Default Forwarding	DF	Default Queue + RED	Default Class
Scavenger	CS1	Min BW Queue (Deferential)	YouTube, Netflix, iTunes, BitTorrent, Xbox Live

RFC 45

DiffServ Space

Binary	Decimal	PHB
0		0DF
1		1(LEPHB)
10		2
11		3
100		4
101		5
110		6
111		7
1000		8CS1
1001		9
1010		10AF11
1011		11
1100		12Af12
1101		13
1110		14AF13
1111		15
10000		16CS2
10001		17
10010		18AF21
10011		19
10100		20AF22
10101		21
10110		22AF23
10111		23

Binary	Decimal	PHB
11000		24CS3
11001		25
11010		26AF31
11011		27
11100		28AF32
11101		29
11110		30AF33
11111		31
100000		32CS4
100001		33
100010		34AF41
100011		35
100100		36AF42
100101		37
100110		38AF43
100111		39
101000		40CS5
101001		41
101010		42
101011		43
101100		44VA
101101		45
101110		46EF
101111		47

Binary	Decimal	PHB
110000		48CS6
110001		49
110010		50
110011		51
110100		52
110101		53
110110		54
110111		55
111000		56CS7
111001		57
111010		58
111011		59
111100		60
111101		61
111110		62
111111		63

QCI list (from 23203-f15)

Table 6.1.7-A: Standardized QCI characteristics

QCI	Resource Type	Priority Level	Packet Delay Budget (NOTE 13)	Packet Error Loss Rate (NOTE 2)	Example Services
1 (NOTE 3)	GBR	2	100 ms (NOTE 1, NOTE 11)	10^{-2}	Conversational Voice
2 (NOTE 3)		4	150 ms (NOTE 1, NOTE 11)	10^{-3}	Conversational Video (Live Streaming)
3 (NOTE 3, NOTE 14)		3	50 ms (NOTE 1, NOTE 11)	10^{-3}	Real Time Gaming, V2X messages Electricity distribution - medium voltage (e.g. TS 22.261 [51] clause 7.2.2) Process automation - monitoring (e.g. TS 22.261 [51] clause 7.2.2)
4 (NOTE 3)		5	300 ms (NOTE 1, NOTE 11)	10^{-6}	Non-Conversational Video (Buffered Streaming)
65 (NOTE 3, NOTE 9, NOTE 12)		0.7	75 ms (NOTE 7, NOTE 8)	10^{-2}	Mission Critical user plane Push To Talk voice (e.g., MCPTT)
66 (NOTE 3, NOTE 12)		2	100 ms (NOTE 1, NOTE 10)	10^{-2}	Non-Mission-Critical user plane Push To Talk voice
67 (NOTE 3, NOTE 12)		1.5	100 ms (NOTE 1, NOTE 10)	10^{-3}	Mission Critical Video user plane
75 (NOTE 14)		2.5	50 ms (NOTE 1)	10^{-2}	V2X messages

5 (NOTE 3)	Non-GBR	1	100 ms (NOTE 1, NOTE 10)	10^{-6}	IMS Signalling
6 (NOTE 4)		6	300 ms (NOTE 1, NOTE 10)	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7 (NOTE 3)		7	100 ms (NOTE 1, NOTE 10)	10^{-3}	Voice, Video (Live Streaming) Interactive Gaming
8 (NOTE 5)		8	300 ms (NOTE 1)	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
9 (NOTE 6)					
69 (NOTE 3, NOTE 9, NOTE 12)		0.5	60 ms (NOTE 7, NOTE 8)	10^{-6}	Mission Critical delay sensitive signalling (e.g., MC-PTT signalling, MC Video signalling)
70 (NOTE 4, NOTE 12)		5.5	200 ms (NOTE 7, NOTE 10)	10^{-6}	Mission Critical Data (e.g. example services are the same as QCI 6/8/9)
79 (NOTE 14)		6.5	50 ms (NOTE 1, NOTE 10)	10^{-2}	V2X messages
80 (NOTE 3)		6.8	10 ms (NOTE 10, NOTE 15)	10^{-6}	Low latency eMBB applications (TCP/UDP-based); Augmented Reality

QCI	Resource Type	Priority Level	Packet Delay Budget (NOTE B1)	Packet Error Loss Rate (NOTE B2)	Maximum Burst Size (NOTE B1)	Data Rate Averaging Window	Example Services
82 (NOTE B6)	GBR	1.9	10 ms (NOTE B4)	10^{-4} (NOTE B3)	255 bytes	2 s	Discrete Automation (TS 22.278 [38], clause 8 bullet g, and TS 22.261 [51], table 7.2.2-1, "small packets")
83 (NOTE B6)		2.2	10 ms (NOTE B4)	10^{-4} (NOTE B3)	1358 bytes (NOTE B5)	2 s	Discrete Automation (TS 22.278 [38], clause 8 bullet g, and TS 22.261 [51], table 7.2.2-1, "big packets")
84 (NOTE B6)		2.4	30 ms (NOTE B7)	10^{-5} (NOTE B3)	1358 bytes (NOTE B5)	2 s	Intelligent Transport Systems (TS 22.278 [38], clause 8, bullet h, and TS 22.261 [51], table 7.2.2).
85 (NOTE B6)		2.1	5 ms (NOTE B8)	10^{-5} (NOTE B3)	255 bytes	2 s	Electricity Distribution- high voltage (TS 22.278 [38], clause 8, bullet i, and TS 22.261 [51], table 7.2.2 and Annex D, clause D.4.2).

Mapping Challenges, Need for New Values

- QCI are classified based on 5 criteria: GBR/Non-GBR, priority (lower -> higher priority), delay budget, loss tolerance, designation (intent)
- QCI traffic intent does not match the QoS models defined by Diffserv.
 - For example, IMS signaling (QCI 5) has very high priority (1), low loss tolerance (10^{-6}), is non-GBR and belongs to the signaling category.
 - Conversational voice (QCI 1) has lower priority (2) and higher loss tolerance (10^{-2}), yet is GBR – fitting both QCIs 5 and 1 in the same model is challenging
 - QCIs 6, 8 and 9 all include voice traffic, video traffic, but also email or FTP, Diffserv does not see these types as belonging to the same class
- There needs to be mapping to existing classes wherever possible, but new values are needed to include these new use cases

QCI Groups and Traffic Types

- 23203-f10 distinguishes 17 QCIs, two bearer types (GBR, non-GBR), 16 priority values, 8 delay budget values, and 3 loss tolerance values.
- Providing classification by any single criterion is not reflective of the intent; combining multiple parameters results in deconstructed values
- However, traffic descriptions provides way to describe the intent, and also provides the ability to group QCIs of similar types
- Adding priority, delay budget and loss tolerance allows further relative classification within each family

QCI Groups and Traffic Types

- QCIs can be grouped in 8 different types / groups:
 1. Voice QCI [1] (dialer / conversational voice) is its own group
 2. Voice signaling [5] (IMS) is its own group
 3. Voice related (other voice applications, including PTT) [65,66,69]
 4. Video (conversational or not, mission critical or not) [67,2,4]
 5. Live streaming/ interactive gaming is its own group [7]
 6. Low latency eMBB, AR/VR is its own group [80]
 7. V2X messaging [75,3,9]
 8. Non-mission-critical data [6,8,9]
 9. Mission-critical data is its own group [70]

Translating QCI Based on Intents

- Group 1: Voice QCI 1
 - 1 is GBR, Conversational Voice, priority 2
- QCI 1 is admitted and allocated a GBR
- QCI 1 is conversational voice (dialer)
- As such, it maps in intent and function to RFC 5865, Admitted Voice, and is recommended for mapping to DSCP 44

Translating QCI Based on Intents

Binary	Decimal	PHB	QCI	Designation	Priority
101000	40	CS5		Voice signaling	
101001	41				
101010	42				
101011	43				
101100	44	VA	1	Voice admit Conversational voice	2
101101	45				
101110	46	EF		Voice	
101111	47				

- Group 1: **Conversational voice**, QCI 1 recommended marking:

Translating QCI Based on Intents

- Group 2: Signaling QCI 5
 - 5 is non-GBR, IMS signaling, priority 1
- 5 has a good budget delay (100 ms), and its intent maps correctly with CS5 (voice or rich media signaling, leveraging where possible IETF signaling protocols, e.g. SIP)
- As such, QCI 5 maps in intent with RFC 4594 Signaling, CS5, which is the recommended mapping

Translating QCI Based on Intents

Binary	Decimal	PHB	QCI	Designation	Priority
101000	40	CS5	5	Voice signaling / IMS signaling	1
101001	41				
101010	42				
101011	43				
101100	44	VA	1	Voice admit / Conversational voice	2
101101	45				
101110	46	EF		Voice	
101111	47				

- Group 2: Signaling QCI's recommended marking.

Group 3: Voice-related QCI, 65, 66, 69

Translating QCI Based on Intents

- 65 is GBR, mission critical PTT voice, priority 0.7
- 66 is GBR, non-mission critical PTT voice, priority 2
- 69 is non-GBR, mission-critical PTT signaling, priority 0.5
- These QCI are Voice in nature, and naturally fit into a proximity marking model with DSCP 46 and 44
 - Additionally, lower priority marks higher precedence intent in QCI
- However, there is no model in RFC 4594 that distinguishes 3 classes of voice traffic – new markings are unavoidable
- As such, grouping markings in the Voice category (101 xxx), and in the order 69, 65 and 66 respects all these requirements

Translating QCI Based on Intents

- Group 3: Voice-related QCI, 65, 66, 69
 - 69 is non-GBR, mission-critical PTT signaling, priority 0.5
- 69 is signaling, and latency sensitive (low 60 ms delay budget, low 10^{-6} loss tolerance)
- As such, 69 has proximity of intent with CS5 (Voice signaling, 40), already used by QCI 5, thus a new marking is needed, suggested marking of 41

Translating QCI Based on Intents

- Group 3: Voice-related QCI, 65, 66, 69
 - 66 is GBR, non-mission critical PTT voice, priority 2
- 66 is Voice in nature, and GBR. However, 66 is non-mission-critical, and has a lower priority than mission-critical Voice, a higher tolerance for delay (100 ms vs 75) – it cannot fit within RFC 4594 model (EF / DSCP46), a new marking is needed
- As such, this QCI fits in intent and proximity closest to Admitted Voice (but is non-GBR, and therefore non-admitted), guiding a suggested marking of 43

Translating QCI's Based on Intents

- Group 3: Voice-related QCI's, 65, 66, 69
 - 65 is GBR, mission critical PTT voice, priority 0.7
- 65 is GBR, and mission critical. Its priority is higher (0.7 vs 2) than 66, yet lower (0.7 vs 0.5) than 69.
- Additionally, it cannot be represented by DSCP 44 (used by QCI 1), or DSCP 46 (use by non-GBR voice)
- As such, 65 fits between 69 and 66, with a suggested marking of 42.

Translating QCI Based on Intents

Binary	Decimal	PHB	QCI	Designation	Priority
101000	40	CS5	5	Voice signaling / IMS signaling	1
101001	41		69	non-GBR mission critical voice signaling	0.5
101010	42		65	GBR mission critical PTT voice	0.7
101011	43		66	GBR non-mission critical PTT voice	2
101100	44	VA	1	Voice admit Conversational voice	2
101101	45				
101110	46	EF		Voice	
101111	47				

- Group 3: Voice-related QCI, 05, 06, 09 suggested marking :

Translating QCI Based on Intents

- Group 4: Video-related QCI, 67, 2, 4
 - 67 is GBR, mission-critical video user plane, priority 1.5
 - 2 is GBR, conversational video (live streaming), priority 4
 - 4 is GBR, non-conversational video (buffered streaming), priority 5
- All 3 QCI are video in nature and fit naturally in the AF4x category
- However, these QCI do not match RFC 4594 intent for multimedia conferencing (they are admitted / GBR)

Translating QCI Based on Intents

- Group 4: Video-related QCI, 67, 2, 4
 - 67 is GBR, mission-critical video user plane, priority 1.5
- QCI 67 is video in nature, and matches traffic that is rate-adaptive, and real time.
- QCI 67 priority is high (1.5), with a tolerant delay budget (100ms). QCI 67 is GBR.
- As such, its recommended to map it against the DSCP value closest to AF4x video with lowest discard eligibility (AF41), therefore with suggested mapping 33

Translating QCI Based on Intents

- Group 4: Video-related QCI, 67, 2, 4
 - 2 is GBR, conversational video (live streaming), priority 4
- QCI 2 is GBR and video in nature, however its priority is lower than QCI 67 (4 vs 1.5)
- Additionally, its delay budget is also larger (150 ms vs 100 ms)
- As such, QCI 2 fits well within a video queue, with a larger drop probability than QCI 67, and therefore receives a marking recommendation of 35

Translating QCIs Based on Intent

- Group 4: Video-related QCIs, 67, 2, 4
 - 4 is GBR, non-conversational video (buffered streaming), priority 5
- QCI 4 is video in nature. Although it is buffered, it is also GBR. QCI 4 as a lower priority than QCI 67 or 2, and a larger delay budget (300 ms vs 150/100).
- However, its loss tolerance is low (10^{-6}). This combination makes it eligible for a video category, but with a higher discard eligibility than QCI 67 and 2, resulting in a recommended mapping to 37.

Translating QCI Based on Intents

Binary	Decimal	PHB	QCI	Designation	Priority
100000	32	CS4			
100001	33		67	GBR, Mission Critical video User Plane	1.5
100010	34	AF41			
100011	35		2	GBR, Conversational Video	4
100100	36	AF42			
100101	37		4	GBR, non-conversational video	5
100110	38	AF43			
100111	39				

▪ Group 4:

ing:

Group 5: QCI 7

Translating QCIs Based on Intent

- 7 is non-GBR, voice/video (live streaming), interactive gaming, priority 7
- In Diffserv model, voice and video are different categories, also different from interactive gaming (real time interactive)
 - However, video and mission-critical video are defined in other queues, QCI priority is relatively low (7), with 100 ms budget delay and rather high loss tolerance (10^{-3}).
- As such, QCI 7 first well with bursty (e.g. video) and possibly rate adaptive flows, with possible discard eligibility. It is also non admitted (non-GBR), and as such, fits close to RFC 4594 intent for multimedia conferencing, with high discard eligibility. The recommended mapping is AF 43.

Translating QCI Based on Intents

- Group 5: (

Binary	Decimal	PHB	QCI	Designation	Priority
100000	32	CS4			
100001	33		67	GBR, Mission Critical User Plane	1.5
100010	34	AF41			
100011	35		2	GBR, Conversational Video	4
100100	36	AF42			
100101	37		4	GBR, non-conversational video	5
100110	38	AF43	7	non-GBR, voice / video /real time inter.	7
100111	39				

Translating QCI Based on Intents

- Group 6: QCI 80
 - 80 is non-GBR, low latency eMBB [enhanced Mobile Broadband] applications (AR/VR), priority 6.8
- QCI 80 is non-GBR, yet intended for real time. Traffic in this class does not react dynamically to losses, requires bandwidth and predictable delay.
- As such, QCI 80 matches closely the specifications for CS4, and receives CS4 as the recommended mapping.

Translating QCI Based on Intents

- Group 6: (

Binary	Decimal	PHB	QCI	Designation	Priority
100000	32	CS4	80	Low latency eMBB / AR	6.8
100001	33		67	GBR, Mission Critical User Plane	1.5
100010	34	AF41			
100011	35		2	GBR, Conversational Video	4
100100	36	AF42			
100101	37		4	GBR, non-conversational video	5
100110	38	AF43	7	non-GBR, voice / video /real time inter.	7
100111	39				

Translating QCI Based on Intents

- Group 7: V2X-related QCI, 75, 3, 79
 - 75 is GBR, V2X messages, priority 2.5
 - 3 is GBR, Real time gaming, V2X messages, utilities, priority 3
 - 79 is non-GBR, V2X messages, priority 6.5
- All 3 QCI are data in nature, and fit naturally into the AF2x category
- QCI 75 and 3 are admitted (GBR), and therefore do not fit in the current Diffserv model
- QCI 79 is non admitted, but matches none of the AF2X categories in RFC 4594

Translating QCI Based on Intents

- Group 7: V2X-related QCI, 75, 3, 79
 - 75 is GBR, V2X messages, priority 2.5
- QCI 75 is GBR, rather high priority (2.5), low delay budget (50 ms), but tolerance to losses (10^{-2}).
- Being low latency data in nature, QCI 75 fits well in the AF2X category; being admitted, it fits none of the existing markings
- Being the highest traffic (in priority) in this low latency data family, QCI 75 is recommended to be mapped to DSCP 17.

Translating QCI Based on Intents

- Group 7: V2X-related QCI, 75, 3, 79
 - 3 is GBR, Real time gaming, V2X messages, utilities, priority 3
- QCI 3 is data, but GBR. Delay budget is low (50 ms), but with tolerance to loss (10-3) and mild to high priority (3).
- QCI 3 is of the same type as QCI 75, but with lower priority. As such, it is recommended to a mapping similar to QCI 75, with a higher discard eligibility, 19.

- Group 7: V2X-related QCI, 75, 3, 79
- ## Translating QCI Based on Intent

- 79 is non-GBR, V2X messages, priority 6.5
- QCI 79 similar in nature to QCI 75 and 3, but is non-critical (non-GBR). It is defined in 3GPP 23.285.
 - Budget delay and tolerance to loss are similar to that of QCI 75 and 3, but priority is much lower (6.8 vs 2.5 and 3)
- QCI 79 partially matches AF2X, but is not elastic (and is also UDP based), and therefore cannot fit exactly in RFC 4594 model.
 - As such, it is recommended to a mapping similar to QCI 75 and 3, with a higher discard eligibility, 21.

Translating QCI Based on Intents

- Group 7: (

Binary	Decimal PHB	QCI	Designation	Priority
10000	16CS2			
10001	17	75	GBR, V2X messages	2.5
10010	18AF21			
10011	19	3	GBR, V2X, utility, real time gaming	3
10100	20AF22			
10101	21	79	non-GBR, V2X messages	6.5
10110	22AF23			
10111	23			

Translating QCI's Based on Intents

- 6 is non-GBR, Video or TCP data traffic, priority 6
- 8 is non-GBR, Video or TCP data traffic, priority 8
- 9 is non-GBR, Video or TCP data traffic, priority 9
- All 3 QCIs are data in nature, non-mission critical, relative low priority and therefore fit naturally into the AF1x category
 - buffered video is an imperfect match for AF1X, but the intent is buffered and non mission critical -> low priority flow
- Traffic descriptions for all are the same for all 3 QCIs, difference is in priority / criticality
 - As such using discard eligibility to differentiate them is logical, leading to a recommended marking of AF11, AF12 and AF13

Translating QCI Based on Intents

- Group 8: (

Binary	Decimal PHB	QCI	Designation	Priority
1000	8CS1			
1001	9			
1010	10AF11	6	non-GBR, video or TCP data	6
1011	11			
1100	12Af12	8	non-GBR, video or TCP data	8
1101	13			
1110	14AF13	9	non-GBR, video or TCP data	9
1111	15			

Translating QCI Based on Intents

- Group 9: Control and automation QCI, 82, 83, 84, 85
 - 82 is GBR, Discrete automation, priority 1.9
 - 83 is GBR, Discrete automation, priority 2.2
 - 84 is GBR, Intelligent Transport Systems, priority 2.4
 - 85 is GBR, Electricity distribution (high voltage), priority 2.1
- All 4 QCIs are data in nature, high priority, and should receive higher treatment than regular V2X and medium voltage distribution traffic categories (AF2X) and
- Being GBR, they do not fit into an existing Diffserv category

Translating QCI Based on Intents

- Group 9: Control and automation QCI, 82, 83, 84, 85
 - 84 is GBR, Intelligent Transport Systems, priority 2.4
- QCI 84 similar in nature to the other V2X categories (QCI 3, 75, 79), 75 being the closest in priority.
 - However, QCI 84 priority is higher, loss tolerance lower and delay budget lower -> requires a higher category
- QCI 84 is admitted, and therefore cannot fit exactly in RFC 4594 model.
 - As such, it is recommended to a mapping higher than QCI 75, mapping to 31.

Translating QCI Based on Intents

- Group 9: Control and automation QCI, 82, 83, 84, 85
 - 85 is GBR, Electricity distribution (high voltage), priority 2.1
- QCI 85 similar in nature to QCI 3 (also intended for electricity distribution, but medium voltage).
 - However, QCI 85 priority is higher, loss tolerance lower and delay budget lower -> requires a higher category
- QCI 85 is admitted, and therefore cannot fit exactly in RFC 4594 model.
 - As such, it is recommended to a mapping higher than QCI 3, mapping to 25.

- 82 is GBR, Discrete automation, priority 1.9
 - 83 is GBR, Discrete automation, priority 2.2
- ## Translating QCIs Based on Intent
- QCI 82 and 83 are similar in nature, but QCI 82 has higher priority, lower tolerance to loss and lower packet delay budget.
 - They should map to categories with close proximity
 - They also display the same priority level as the other control and automation traffic types -> should map to the same priority level
 - They are both admitted, and therefore cannot fit exactly in RFC 4594 model.
 - As such, it is recommended to map QCI 82 to 27 and QCI 83 to 29..

Translating QCIs Based on Intent

- Group 9: (

Binary	Decimal	PHB	QCI	Designation	Priority
11000	24	CS3			
11001	25		85	Electricity distribution (high voltage)	2.1
11010	26	AF31			
11011	27		82	Discrete automation	1.9
11100	28	AF32			
11101	29		83	Discrete automation	2.2
11110	30	AF33			
11111	31		84	Intelligent Transport System	2.4

Translating QCIs Based on Intent

- Group 10: QCIs, 70
 - 70 is non-GBR, mission critical data, priority 5.5
- Traffic examples are the same as QCIs 6,8,9 categories (group 8), but QCI 70 is specifically mission critical, of higher priority than 6,8,9, and therefore fits well in the AF2x family (while 6,8,9 are in AF1x).
- As it displays intermediate differentiated treatment, it fits well with an intermediate discard eligibility.
- Its recommended mapping is therefore to 20 (AF22)

Translating QCI Based on Intents

- Group 10:

Binary	Decimal PHB	QCI	Designation	Priority
10000	16CS2			
10001	17	75	GBR, V2X messages	2.5
10010	18AF21			
10011	19	3	GBR, V2X, utility, real time gaming	3
10100	20AF22	70	non-GBR, mission critical data	5.5
10101	21	79	non-GBR, V2X messages	6.5
10110	22AF23			
10111	23			

Mapping Recommendations Summary

Binary	Decimal	PHB	QCI	Designation	Priority	Binary	Decimal	PHB	QCI	Designation	Priority
0		ODF				11000	24	CS3			
1		1(LEPHB)				11001	25		85	Electricity distribution (high voltage)	2.1
10		2				11010	26	AF31			
11		3				11011	27		82	Discrete automation	1.9
100		4				11100	28	AF32			
101		5				11101	29		83	Discrete automation	2.2
110		6				11110	30	AF33			
111		7				11111	31		84	Intelligent Transport System	2.4
1000		8CS1				100000	32	CS4	80	Low latency eMBB / AR	6.8
1001		9				100001	33		67	GBR, Mission Critical User Plane	1.5
1010		10AF11	6	non-GBR, video or TCP data	6	100010	34	AF41			
1011		11				100011	35		2	GBR, Conversational Video	4
1100		12Af12	8	non-GBR, video or TCP data	8	100100	36	AF42			
1101		13				100101	37		4	GBR, non-conversational video	5
1110		14AF13	9	non-GBR, video or TCP data	9	100110	38	AF43	7	non-GBR, voice / video /real time inter.	7
1111		15				100111	39				
10000		16CS2				101000	40	CS5	5	Voice signaling / IMS signaling	1
10001		17	75	GBR, V2X messages	2.5	101001	41		69	non-GBR mission critical voice signaling	0.5
10010		18AF21				101010	42		65	GBR mission critical PTT voice	0.7
10011		19	3	GBR, V2X, utility, real time gaming	3	101011	43		66	GBR non-mission critical PTT voice	2
10100		20AF22	70	non-GBR, mission critical data	5.5	101100	44	VA	1	Voice admit Conversational voice	2
10101		21	79	non-GBR, V2X messages	6.5	101101	45				
10110		22AF23				101110	46	EF		Voice	
10111		23				101111	47				

Binary	Decimal	PHB	QCI
110000	48	CS6	
110001	49		
110010	50		
110011	51		
110100	52		
110101	53		
110110	54		
110111	55		
111000	56	CS7	
111001	57		
111010	58		
111011	59		
111100	60		
111101	61		
111110	62		
111111	63		

Diffserv to QCI

Control Traffic

- Network control protocol (CS6, CS7)
 - The Network Control service class is used for transmitting packets between network devices (e.g., routers) that require control (routing) information to be exchanged between
 - Not directly called by any specific QCI description, because 3GPP network control does not operate over UE data channels
 - However, when such network control traffic is forwarded, it is expected to receive a high priority and level of service. As such, packets marked to CS7 DSCP are RECOMMENDED to be mapped to QCI 82, thus benefiting from a dedicated bearer with low packet error loss rate ($10.E-4$) and low budget delay (10 ms). Similarly, it is RECOMMENDED to map Network Control Traffic marked CS6 to QCI 82, thereby admitting it to the Discrete Automation (GBR) category with a relative priority level of 1.9.

User Traffic

- Telephony (EF)
 - For applications that require real-time, very low delay, very low jitter, and very low packet loss for relatively constant-rate traffic sources (inelastic traffic sources).
 - 3GPP 23203 describes QCI 1 (GBR) and QCI 7 (non-GBR) for Voice traffic.
 - Telephony traffic as intended in [RFC4594] supposes resource allocation control. QCI 7 does not match these conditions. As such, packets marked to EF are RECOMMENDED to be mapped to QCI 1, thus admitting it to the GBR Conversational Voice category, with a relative priority of 2.

User Traffic

- Signaling (CS5)
 - For delay-sensitive client-server (e.g., traditional telephony) and peer-to-peer application signaling.
 - Needs higher than BE / QCI 7, but no need for high priority.
 - It is RECOMMENDED to map Signaling traffic marked CS5 DSCP to QCI 4, thereby admitting it to the GBR Non-conversational video category, with a relative priority level of 5.

User Traffic

- Multimedia Conferencing (AF4x)
 - 3 categories, for 3 levels of priority.
 - AF41 is video intended as real-time exchange; RECOMMENDED to map AF41 into the Conversational Video (Live Streaming) category, QCI 2, thereby into the GBR Conversational Video, with a relative priority of 4.
 - AF42 is video intended to be a component of real-time exchange, but which criticality is less than traffic carried with a marking of AF41. RECOMMENDED to map AF42 into the Conversational Video (Live Streaming) category, QCI 4, thereby into the GBR Conversational Video, with a relative priority of 5.
 - AF43 is real-time video exchange of lower criticality. RECOMMENDED to map QCI 7, thereby admitting AF47 into the non-GBR Voice, Video and Interactive gaming, with a relative priority of 7.

User Traffic

- Real-Time Interactive (CS4)
 - applications that require low loss and jitter and very low delay for variable-rate inelastic traffic sources: inelastic video-conferencing, but also gaming.
 - Primary media type is video; RECOMMENDED to map this class into a low latency Category. RECOMMENDED to map CS4 to QCI 80, thereby into the non-GBR category Low Latency eMBB (enhanced Mobile Broadband) applications with a relative priority of 6.8.
 - In cases where GBR is required, for example because a single bearer is allocated for all non-GBR traffic, RECOMMENDED to map CS4 to QCI 3, thereby admitting Real-Time Interactive traffic into the GBR category Real-time gaming, with a relative priority of 3.

User Traffic

- Multimedia Streaming (AF3x)
 - 3 categories, for 3 levels of priority. near-real-time packet forwarding of variable-rate elastic traffic sources. Typically, unidirectional.
 - RECOMMENDED to map AF31 to QCI 4, thereby into the GBR Non Conversational Video category, with a relative priority of 5.
 - AF32 expected to be of the same nature as AF32, but with a lower criticality. RECOMMENDED to map AF32 to QCI 6, thereby into the non-GBR category Video (Buffered Streaming) with a relative priority of 6.
 - AF33 expected to be of the same nature as AF31 and AF32, but with the lowest criticality. RECOMMENDED to map AF33 to QCI 8, thereby into the non-GBR category Video (Buffered Streaming) with a relative priority of 8.

User Traffic

- Broadcast Video (CS3)
 - applications that require near-real-time packet forwarding with very low packet loss of constant rate and variable-rate inelastic traffic sources. Typically, unidirectional.
 - Typically video; RECOMMENDED to map into a Video Category. RECOMMENDED to map CS3 to QCI 4, into the GBR Non Conversational Video category, with a relative priority of 5. In cases where GBR availability is constrained, using a non-GBR equivalent is also acceptable (QCI).

▪ Low Latency Data (AF2x)

User Traffic

- For elastic and time-sensitive data applications, often of a transactional nature, where a user is waiting for a response via the network in order to continue with a task at hand.
- The primary media type is data; RECOMMENDED to map this class into a data Category. RECOMMENDED to map AF21 to QCI 70, thereby into the non-GBR Mission Critical Data category, with a relative priority of 5.5.
- AF22 expected to be of the same nature as flows marked with AF21, but with a lower criticality. RECOMMENDED to map AF22 to QCI 6, thereby into the non-GBR category Video and TCP-based traffic, with a relative priority of 6.
- AF23 expected to be of the same nature as flows marked with AF21 and AF22, but with the lowest criticality. RECOMMENDED to map AF23 to QCI 8, thereby admitting AF23 traffic into the non-GBR category Video and TCP-based traffic, with a relative priority of 8.

Control Traffic

- OAM (CS2)
 - SNMP, Secure Shell (SSH), TFTP, Syslog, etc., as well as network services, such as NTP, DNS, DHCP, etc.
 - Applications using this service class require a low packet loss but are relatively not sensitive to delay. This service class is configured to provide good packet delivery for intermittent flows. As such, packets marked to CS2 are RECOMMENDED to be mapped to QCI 9, thus admitting it to the non-GBR Buffered video traffic, with a relative priority of 9.

High Throughput Data (AF IX)

User Traffic

- For elastic applications that require timely packet forwarding of variable-rate traffic sources. Typically not user interactive.
- Primary media type is data; RECOMMENDED to map this class into a data Category. RECOMMENDED to map AF11 to QCI 6, thereby into the non-GBR Video and TCP-based traffic category, with a relative priority of 6.
- AF12 expected to be of the same nature as flows marked with AF11, but with a lower criticality. RECOMMENDED to map AF12 to QCI 8, thereby into the non-GBR category Video and TCP-based traffic, with a relative priority of 8.
- AF13 expected to be of the same nature as flows marked with AF11 and AF12, but with the lowest criticality. RECOMMENDED to map AF13 to QCI 9, thereby into the non-GBR category Video and TCP-based traffic, with a relative priority of 9.

User Traffic

- Standard (CS0)
 - For traffic not classified into one of the other supported forwarding service classes in the Diffserv network domain. Provides the Internet's "best-effort" forwarding behavior.
 - Loosely corresponds to the default non-GBR bearer practice in 3GPP. RECOMMENDED to map to QCI 9, thereby to the low priority Video and TCP-based traffic category, with a relative priority of 9.

User Traffic

- Low Priority Data (CS1)
 - For applications that the user is willing to accept without service assurances.
 - No equivalent in the 3GPP domain, where all service is controlled and allocated differentially. As such, no clear QCI.
 - RECOMMENDED to map Low-Priority Data traffic marked CS1 DSCP to QCI 9, thereby to the low priority Video and TCP-based traffic category, with a relative priority of 9.