

Recommended transport network layer DSCP markings in line with IETF DiffServ Service Classes (RFC 4594)

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Outline

- > The policy for DiffServ Code Point (DSCP) markings of the tunnel header (outer IP header) is an operator's choice and may depend on various factors
 - e.g. it may be determined solely by the QCI of the SDF aggregate, but in some transport networks it may also be determined by the presence of any non-EPS traffic sharing the same transport links
- > In case the DSCP marking of the tunnel header is based only on the SDF aggregate's QCI, it is recommended to use DSCP markings in line with the IETF DiffServ Service Classes (RFC 4594)
- > The rationale for the proposed recommendation is presented as follows:
 - First the agreed QCIs are recalled, as well as how they map into R99 UMTS QoS parameters
 - Then two options (Option 1 and Option 2) are considered for mapping between QCIs and DiffServ Service Classes
 - It is proposed to take Option 2 for further consideration
 - The recommended transport network layer DSCP markings are obtained indirectly, given that every DiffServ Service Class is associated to one DSCP marking
 - The recommended mapping is checked against RFC 5127 in a transport network that can handle only three "Treatment Aggregates"
- > The recommended DSCP markings are provided in a CR (S2-082649)

Standardised QCI

Name of QCI Characteristic	Resource Type	Priority	Packet Delay Budget	Packet Loss Rate	Example Services
QCI #1	GBR	2	100 ms	10^{-2}	Conversational voice
QCI #2	GBR	4	150 ms	10^{-3}	Conversational video (live streaming)
QCI #3	GBR	5	300 ms	10^{-6}	Non-conversational video (buffered streaming)
QCI #4	GBR	3	50 ms	10^{-3}	Real Time Gaming
QCI #5	non-GBR	1	100 ms	10^{-6}	IMS signalling
QCI #6	non-GBR	7	100 ms	10^{-3}	Voice, Video (live streaming), Interactive Gaming
QCI #7	non-GBR	6	300 ms	10^{-6}	Video (buffered streaming), TCP-based (www, email, chat, ftp, p2p file sharing, progressive video, etc)
QCI #8	non-GBR	8	300 ms	10^{-6}	Same as QCI #7
QCI #9	non-GBR	9	300 ms	10^{-6}	Same as QCI #7

- > Flows with QCIs of GBR type are associated with a Guaranteed Bit Rate parameter that is signalled separately and are subject to admission control
- > *Priority* defines relative traffic importance in presence of congestion i.e. the likelihood for traffic shedding is the highest for flows with Priority=9 and the lowest for flows with Priority=1
- > In absence of congestion, packets are primarily scheduled based on the Packet Delay Budget (PDB)
- > Packet Loss Rate refers to non-congestion related losses and is primarily used to set up radio interface parameters (e.g. acknowledged or unacknowledged mode RLC, Forward Error Correction parameters, etc)
- > QCIs #7, #8 and #9 are used for differentiation on service basis or subscriber basis (operator configuration)
- > Example for differentiation on per-service basis:
 - QCI #7 and QCI#8 are used for two-level prioritisation of “premium” services
 - QCI #9 is used for all other non-differentiated services
- > Example for differentiation on per-subscriber basis:
 - QCI #8 is for the “Default bearer” for “premium” subscribers
 - QCI #9 is for the “Default bearer” for non-privileged subscribers

QCI mapping to R99 UMTS QoS parameters

Name of QCI Characteristic	Resource Type	Priority	Packet Delay Budget	Packet Loss Rate	Mapping to R99 QoS
QCI #1	GBR	2	100 ms	10^{-2}	Conversational, speech
QCI #2	GBR	4	150 ms	10^{-3}	Conversational, unknown
QCI #3	GBR	5	300 ms	10^{-6}	Streaming, unknown
QCI #4	GBR	3	50 ms	10^{-3}	FFS
QCI #5	non-GBR	1	100 ms	10^{-6}	Interactive, THP=1, Sig flag = YES
QCI #6	non-GBR	7	100 ms	10^{-3}	Interactive, THP=2
QCI #7	non-GBR	6	300 ms	10^{-6}	Interactive, THP=1
QCI #8	non-GBR	8	300 ms	10^{-6}	Interactive, THP=3
QCI #9	non-GBR	9	300 ms	10^{-6}	Background

- > Note the inverted order: QCI #6 and QCI #7 correspond to THP=2 and THP=1, respectively
- > QCI #4 has no counterpart in R99 QoS

Proposed QCI mapping to DiffServ Service Classes (RFC 4594): OPTION 1

Name of QCI Characteristic	Resource Type	Priority	Packet Delay Budget	Packet Loss Rate	DiffServ Service Class
QCI #1	GBR	2	100 ms	10^{-2}	Telephony media (EF)
QCI #2	GBR	4	150 ms	10^{-3}	Multimedia conferencing (AF4)
QCI #3	GBR	5	300 ms	10^{-6}	Broadcast video (CS3)
QCI #4	GBR	3	50 ms	10^{-3}	Real Time interactive (CS4)
QCI #5	non-GBR	1	100 ms	10^{-6}	Application (e.g. Telephony) signalling (CS5)
QCI #6	non-GBR	7	100 ms	10^{-3}	Low latency data (AF2)
QCI #7	non-GBR	6	300 ms	10^{-6}	Multimedia streaming (AF3)
QCI #8	non-GBR	8	300 ms	10^{-6}	High throughput data (AF1)
QCI #9	non-GBR	9	300 ms	10^{-6}	Standard (DF/CS0)

- > Similar to R99 mapping in the previous slide, note the inverted order: QCI #6 and QCI #7 correspond to AF=2 and AF=3, respectively
- > For the corresponding DSCP markings refer to the backup charts

OPTION 1: Proposed QCI mapping to DiffServ Service Classes (focus on QCI example services)

Name of QCI Characteristic	Example Services	DiffServ Service Class
QCI #1	Conversational voice	Telephony media (EF)
QCI #2	Conversational video (live streaming)	Multimedia conferencing (AF4)
QCI #3	Non-conversational video (buffered streaming)	Broadcast video (CS3)
QCI #4	Real Time Gaming	Real Time interactive (CS4)
QCI #5	IMS signalling	Application (e.g. Telephony) signalling (CS5)
QCI #6	Voice, Video (live streaming), Interactive Gaming	Low latency data (AF2)
QCI #7	Video (buffered streaming), TCP-based (www, email, chat, ftp, p2p file sharing, progressive video, etc)	Multimedia streaming (AF3)
QCI #8	Same as QCI #7	High throughput data (AF1)
QCI #9	Same as QCI #7	Standard (DF/CS0)

> Possible issues:

- AF4 is intended for adaptive codecs; may not be compatible with the GBR bearer type; suggestion to replace it with CS4
- AF2 is for transactional bursty data; does not seem to fit Voice and Video well; suggestion to replace it with AF4

Proposed QCI mapping to DiffServ Service Classes (RFC 4594) OPTION 2

Name of QCI Characteristic	Resource Type	Priority	Packet Delay Budget	Packet Loss Rate	DiffServ Service Class
QCI #1	GBR	2	100 ms	10 ⁻²	Telephony media (EF)
QCI #2	GBR	4	150 ms	10 ⁻³	Real Time interactive (CS4)
QCI #3	GBR	5	300 ms	10 ⁻⁶	Broadcast video (CS3)
QCI #4	GBR	3	50 ms	10 ⁻³	Real Time interactive (CS4)
QCI #5	non-GBR	1	100 ms	10 ⁻⁶	Application (e.g. Telephony) signalling (CS5)
QCI #6	non-GBR	7	100 ms	10 ⁻³	Multimedia conferencing (AF4)
QCI #7	non-GBR	6	300 ms	10 ⁻⁶	Multimedia streaming (AF3)
QCI #8	non-GBR	8	300 ms	10 ⁻⁶	High throughput data (AF1)
QCI #9	non-GBR	9	300 ms	10 ⁻⁶	Standard (DF/CS0)

> For the corresponding DSCP markings refer to the backup charts

OPTION 2: Proposed QCI mapping to DiffServ Service Classes (focus on QCI example services)

Name of QCI Characteristic	Example Services	DiffServ Service Class
QCI #1	Conversational voice	Telephony media (EF)
QCI #2	Conversational video (live streaming)	Real Time interactive (CS4)
QCI #3	Non-conversational video (buffered streaming)	Broadcast video (CS3)
QCI #4	Real Time Gaming	Real Time interactive (CS4)
QCI #5	IMS signalling	Application (e.g. Telephony) signalling (CS5)
QCI #6	Voice, Video (live streaming), Interactive Gaming	Multimedia conferencing (AF4)
QCI #7	Video (buffered streaming), TCP-based (www, email, chat, ftp, p2p file sharing, progressive video, etc)	Multimedia streaming (AF3)
QCI #8	Same as QCI #7	High throughput data (AF1)
QCI #9	Same as QCI #7	Standard (DF/CS0)

> Comments:

- CS4 (Real Time interactive) is better suited to the GBR bearer type of QCI #2; the only concern may be that the PDBs for QCI#2 and QCI#4 are different (150 ms vs 50 ms)
- AF2 (Low latency data) is not used

Proposed QCI mapping in case of aggregation of DiffServ Service Classes in three “Treatment Aggregates” (RFC 5127)

Name of “Treatment Aggregate”	Example Services	DiffServ Service Class
Real Time	QCI #1 (Conversational voice); QCI #2 (Conversational video); QCI #3 (Non-conversational video); QCI #4 (Real Time Gaming); QCI #5 (IMS signalling)	EF (Telephony media); CS4 (Real Time Interactive); CS3 (Broadcast video); CS4 (Real Time interactive); CS5 (Application signalling)
Assured Elastic	QCI #6 (various low latency); QCI #7 (Non-conversational video, TCP-based); QCI #8 (Non-conversational video, TCP-based)	AF4 (Multimedia conferencing); AF3 (Multimedia streaming); AF1 (High throughput data)
Elastic	QCI #9 (Non-conversational video, TCP-based)	DF/CS0 (Standard)

- > Note that all GBR QCIs plus the IMS signalling QCI end up in the Real Time category
- > Similarly, all non-GBR QCIs (except IMS signalling and default bearer traffic) end up in the Assured Elastic (AFxy) category

Backup slides

DiffServ Service Classes (RFC 4594) - Overview

Service Class Name	Application Examples	DSCP Name	DSCP Value
Network Control	Network routing	CS6	110000
Telephony	IP Telephony bearer (VoIP)	EF	101110
Signalling	IP Telephony signalling	CS5	101000
Multimedia Conferencing	H.323 / V2 video	AF41, AF42	100010, 100100
	Conferencing (adaptive)	AF43	100110
Real-time Interactive	Video conferencing & interactive gaming	CS4	100000
Multimedia Streaming	Streaming video & audio on demand	AF31, AF32, AF33	011010, 011100, 011110
Broadcast Video	Broadcast TV & live events	CS3	011000
Low Latency Data	Client / server transactions	AF21, AF22	010010, 010100
	Web-based ordering	AF23	010110
OAM	OAM&P	CS2	010000
High Throughput Data	Store & forward applications	AF11, AF12, AF13	001010, 001100, 001110
Standard	Undifferentiated applications	DF, (CS0)	000000
Low Priority Data	Any low that has no BW assurance	CS1	001000

> The two greyed-out DSSCs are not intended for user traffic

DiffServ Service Classes - Characteristics

Service Class Name	Tolerance to Traffic Characteristics	Loss	Delay	Jitter
Network Control	<i>Variable size packets, mostly inelastic short messages, but traffic can also burst (BGP)</i>	<i>Low</i>	<i>Low</i>	<i>Yes</i>
Telephony	Fixed size small packets, constant emission rate, inelastic and low rate flows	Very Low	Very Low	Very Low
Signalling	Variable size packets, some what bursty short lived flows	Low	Low	Yes
Multimedia Conferencing	Variable size packets, constant transmit interval, rate adaptive, reacts to loss	Low to Medium	Very Low	Low
Real-time Interactive	RTP/UDP streams, inelastic, mostly variable rate	Low	Very Low	Low
Multimedia Streaming	Variable size packets elastic with variable rate	Low to Medium	Yes	Medium
Broadcast Video	Constant and variable rate, inelastic, non bursty flows	Very Low	Medium	Low
Low Latency Data	Variable rate, bursty short lived elastic flows	Low	Low to Medium	Yes
OAM	<i>Variable size packets, elastic & inelastic flows</i>	<i>Low</i>	<i>Medium</i>	<i>Yes</i>
High Throughput Data	Variable rate, bursty long lived elastic flows	Low to High	Medium	Yes
Standard	A bit of everything	Not Specified		
Low Priority Data	Non real-time and elastic	High	High	Yes

> The two greyed-out DSSCs are not intended for user traffic

IP QoS Support Mechanisms

Service Class Name	DSCP Name	Per Hop Behaviour	Conditioning at the Edge		Scheduler/Shaper	
<i>Network Control</i>	CS6	RFC 2474	none		rate based	e.g. RFC 2963
Telephony	EF	RFC 3246	sr+bs	(RFC 2697)	priority	e.g. RFC 2963
Signalling	CS5	RFC 2474	sr+bs	(RFC 2697)	rate based	e.g. RFC 2963
Multimedia Conferencing	AF4n	RFC 2597	trtcm	RFC 2698	rate based	e.g. RFC 2963
Real-time Interactive	CS4	RFC 2474	sr+bs	(RFC 2697)	rate based	e.g. RFC 2963
Multimedia Streaming	AF3n	RFC 2597	trtcm	RFC 2698	rate based	e.g. RFC 2963
Broadcast Video	CS3	RFC 2474	sr+bs	(RFC 2697)	rate based	e.g. RFC 2963
Low Latency Data	AF2n	RFC 2597	srtcm	RFC 2697	rate based	e.g. RFC 2963
<i>OAM</i>	CS2	RFC 2474	sr+bs	(RFC 2697)	rate based	e.g. RFC 2963
High Throughput Data	AF1n	RFC 2597	trtcm	RFC 2698	rate based	e.g. RFC 2963
Standard	DF, (CS0)	RFC 2474	not specified		rate based	e.g. RFC 2963
Low Priority Data	CS1	RFC 3662	not specified		rate based	e.g. RFC 2963

sr + bs -> single rate + burst size;

srtcm -> single rate three colour marking;

trtcm -> two rate three colour marking;

> The two greyed-out DSSCs are not intended for user traffic