ENVELOPE

Evaluation and validation of connected mobility in real open systems beyond 5GS

PQOS API

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1 Introduction

Introduce the following aspects in this Section

- Scope: Describe the scope of the APIs, including the services involved and their context in *the ENVELOPE architecture.*
- Objectives: Outline what the APIs aim to achieve, e.g., interoperability, efficiency, security, or modularity.

2 API Overview

Table to be merged with the other ones to create a single table to be used for summary in the deliverable

API name	Description	Modules Involved	Use Cases
Name of the API	Short summary of the API	List of 5GS or other modules interacting with this API	List of Use Cases using the API
pqos_inf_sub_add	Subscribe for pQoS inference service	NWDAF	
pqos_inf_sub_edit	Edit an existing/subscribed pQoS inference service	NWDAF	
pqos_inf_sub_get	Get all existing subscriptions	NWDAF	
pqos_inf_sub_del	Remove an existing/subscribed pQoS inference service	NWDAF	
pqos_inf_req	Get pQoS inference analytics	NWDAF	
camara_application_profiles	Operations to define, read and manage an application's thresholds for network quality	NWDAF	

	(latency, jitter, loss, throughput)		
camara_connectivity_insights	Read the network's level of confidence that it can meet the quality thresholds for a given application profile and end user device	NWDAF	
camara_connectivity_insights_subscriptions	Create and manage a subscription to receive periodic connectivity insights	NWDAF	
pqos_train_sub_add	Subscribe for pQoS training service	NWDAF	
pqos_train_sub_del	Unsubscribe for pQoS training service	NWDAF	

3 Sequence Diagrams

Figure 1. pQoS Inference APIs pipelines

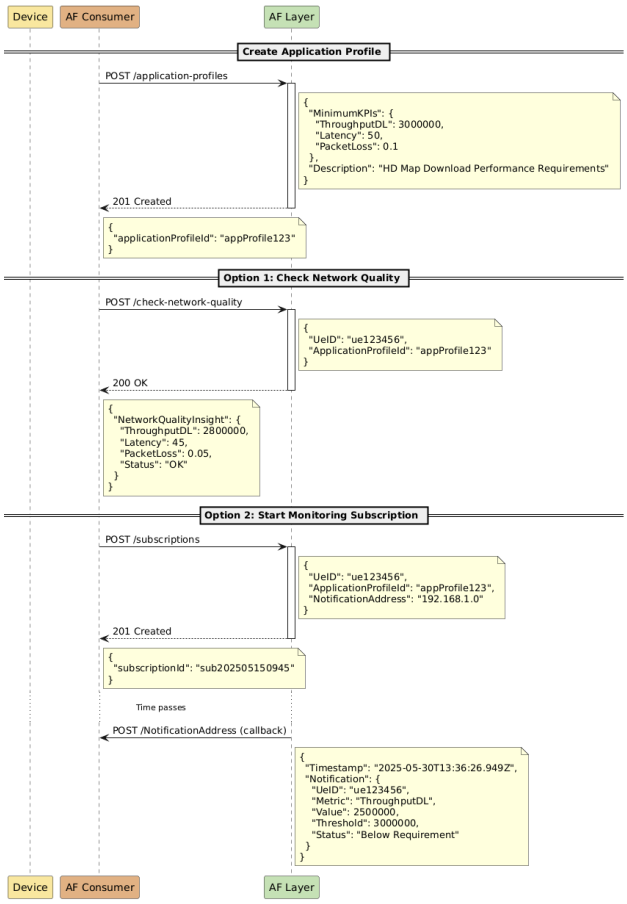

Figure 2. CAMARA pQoS pipelines

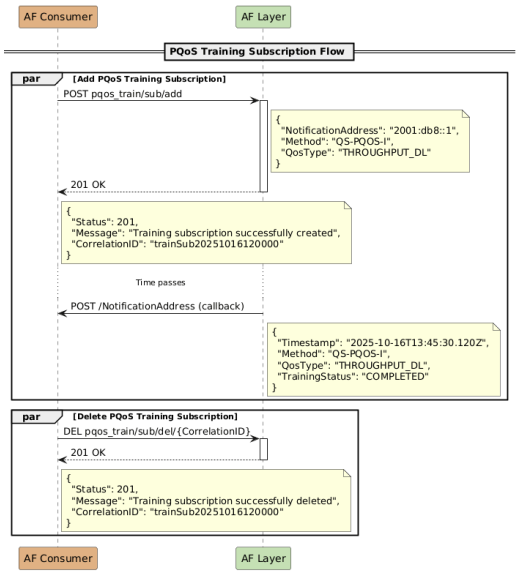

Figure 3. pQoS Training APIs pipelines

4 API definition

4.1 Resource structure

4.1.1 Resource URIs

The root of the resource URIs of this API shall be:{apiRoot}/{apiName}/ where apiName is set to pqos_inf

The resource URI structure of this API is introduced in Figure 1 and Figure 2.

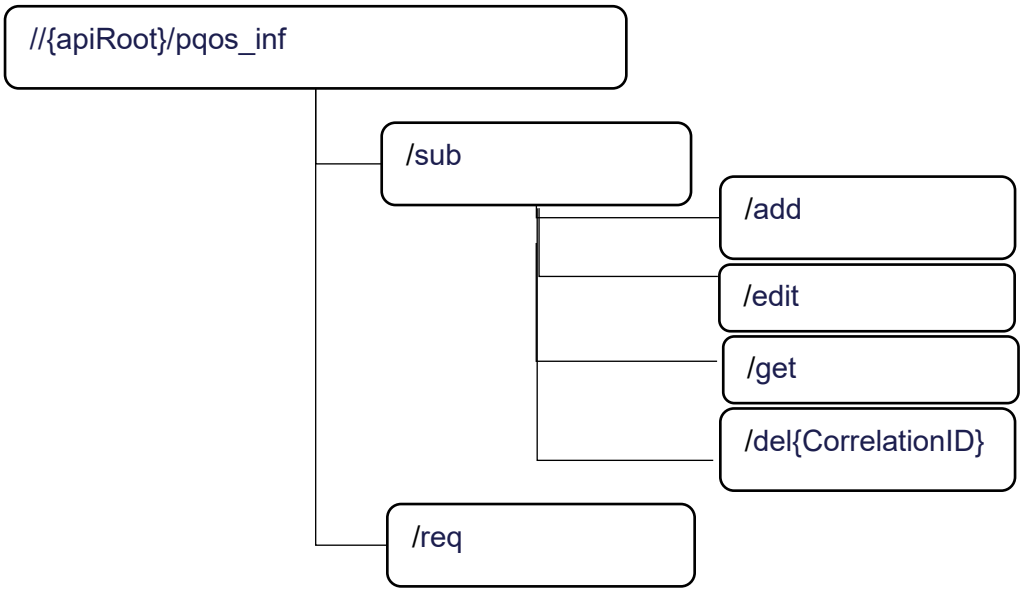

Figure 1 Resource URI structure for the pQoS-Inference

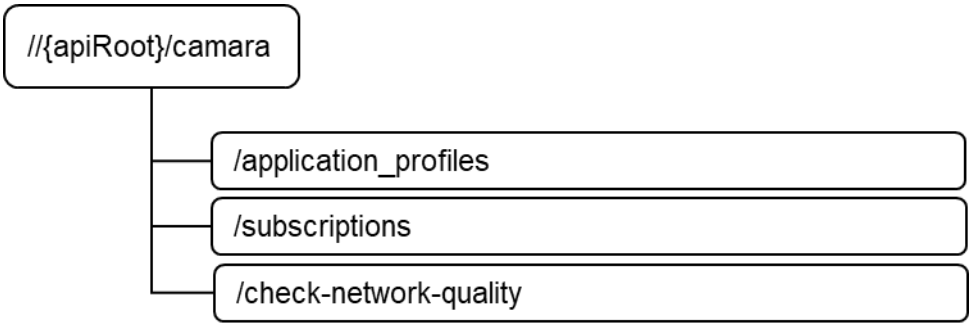

Figure 2 Resource URI structure for the CAMARA pQoS endpoints

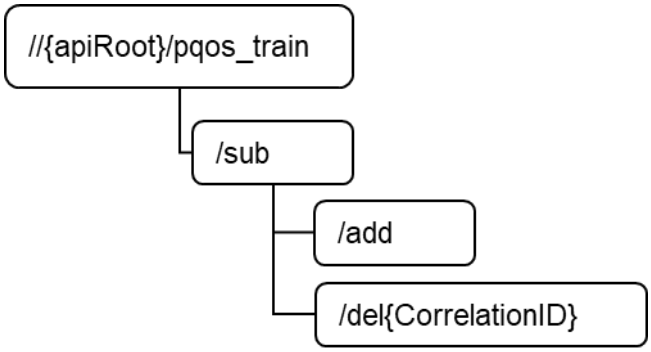

Figure 3 Resource URI structure for the pQoS-Training endpoints

Table 1 introduces an overview of the resources and of the methods.

Table 1. Resources and methods overview.

Resource name	Resource URI	HTTP method	Description
Pqos Inference Subscriptions Add	pqos_inf/sub/add	POST	Subscribe for pQoS inference service
Pqos Inference Subscriptions Edit	pqos_inf/sub/edit	POST	Edit an existing/subscribed pQoS inference service
Pqos Inference Subscriptions Get	pqos_inf/sub/get	GET	Get all existing subscriptions
Pqos Inference Subscriptions Delete	pqos_inf/sub/del{CorrelationID}	DELETE	Remove an existing/subscribed pQoS inference service
Pqos Inference Request	pqos_inf/req	POST	Get pQoS inference analytics
CAMARA pQoS Application Profile Create	camara/application_profiles	POST	Create an Application Profile
CAMARA pQoS Application Profile Update	camara/application_profiles/{applicationProfileId}	PATCH	Update an Application Profile
CAMARA pQoS	camara/application_profiles/{applicationProfileId}	GET	Get an Application Profile

Application Profile Get			
CAMARA pQoS Application Profile Delete	camara/application_profiles/{applicationProfileId}	DELETE	Delete an Application Profile
CAMARA pQoS Subscription Create	/subscriptions	POST	Create a Connectivity insights subscription for a device
CAMARA pQoS Subscription Get All	/subscriptions	GET	Retrieve a list of apiName event subscription
CAMARA pQoS Subscription Get Single	/subscriptions/{subscriptionId}	GET	Operation to retrieve a subscription based on the provided ID
CAMARA pQoS Subscription Delete	/subscriptions/{subscriptionId}	DELETE	Operation to delete a subscription
CAMARA pQoS Connectivity Insights	/check-network-quality	POST	Check network quality
Pqos Training Subscriptions Add	pqos_train/sub/add	POST	Subscribe for pQoS training service
Pqos Training Subscriptions Delete	pqos_train/sub/del{CorrelationID}	DELETE	Remove an existing/subscribed pQoS training service

4.2 Data model

4.2.1 PqosInfSubAdd data type

Table 2. PqosInfSubAdd data type

Field	Data Type	Cardinality	Description
NotificationAddress	ipv6	1	Server IP for pQoS notifications
Method	string	1	pQoS method, supported variants: {SIMPLE-QS-PQOS-I, SIMPLE-DN-PQOS-I, QS-PQOS-I, DN-PQOS-I, H-PQOS-I}

QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
QosThreshold	float	1	Threshold QoS value for notifications (in bps)
Matching	string	1	Matching value for threshold: {BELOW, ABOVE}
ApplicationServerAddress	ipv6	1	Application server endpoint
ApplicationFilterID	string	1	(Optional) Filter predictions to UEs with a specific application ID (only for DN-PQOS-I and H-PQOS-I).
Horizon	integer	1	Prediction horizon in [1,10] sec

4.2.2 PqosInfSubAddAck data type

Table 3. PqosInfSubAddAck data type

Field	Data Type	Cardinality	Description
Status	integer	1	HTTP status code returned
Message	string	1	HTTP response description
CorrelationID	string	1	Subscription ID if success, else None

4.2.3 PqosInfSubAddNotify data type

Table 4. PqosInfSubAddNotify data type

Field	Data Type	Cardinality	Description
Timestamp	string	1	The timestamp of the data on which this report is based
Report	object list	1..N	Groups QoS predictions that exceed thresholds
→ UeID	string	1	ID of the UE for which a prediction over a threshold is made
→ QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
→ QosThreshold	float	1	Threshold QoS value for notifications (in bps)
→ Matching	string	1	Matching value for threshold: {Below, Above}
→ Horizon	integer	1	Prediction horizon in [1,10]
→ Confidence	float	[0,1]	Prediction confidence

4.2.4 PqosInfSubEdit data type

Table 5. PqosInfSubEdit data type.

Field	Data Type	Cardinality	Description
CorrelationID	string	1	Subscription ID
NotificationAddress	ipv6	1	Server IP for pQoS notifications

Method	string	1	pQoS method, supported variants: {SIMPLE-QS-PQOS-I, SIMPLE-DN-PQOS-I, QS-PQOS-I, DN-PQOS-I, H-PQOS-I}
QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
QosThreshold	float	1	Threshold QoS value for notifications (in bps)
Matching	string	1	Matching value for threshold: {BELOW, ABOVE}
ApplicationServerAddress	ipv6	1	Application server endpoint
ApplicationFilterID	string	1	(Optional) Filter predictions to UEs with a specific application ID (only for DN-PQOS-I and H-PQOS-I).
Horizon	integer	1	Prediction horizon in [1,10] sec

4.2.5 PqosInfSubGet data type

Table 6. PqosInfSubEdit data type.

Field	Data Type	Cardinality	Description
Subscriptions	object list	1..N	Array of PqosInfSubEdit objects
→ PqosInfSubEdit	object	1	See 4.2.4

4.2.6 PqosInfReq data type

Table 7. PqosInfReq data type.

Field	Data Type	Cardinality	Description
Method	string	1	pQoS method, supported variants: {SIMPLE-QS-PQOS-I, SIMPLE-DN-PQOS-I, QS-PQOS-I, DN-PQOS-I, H-PQOS-I}
QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
ApplicationServerAddress	ipv6	1	Application server endpoint
Horizon	integer	1	Prediction horizon in [1,10] sec
ApplicationFilterID	string	1	(Optional) Filter predictions to UEs with a specific application ID (only for DN-PQOS-I and H-PQOS-I).

4.2.7 PqosInfReqResp data type

Table 8. PqosInfReqResp data type

Field	Data Type	Cardinality	Description
Timestamp	string	1	The timestamp of the data with on which this report is based
Report	object list	1..N	Groups QoS predictions

→ UeID	string	1	ID of the UE for which a prediction over a threshold is made
→ QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
→ QosValue	float	1	Predicted QoS value
→ Horizon	integer	1	Prediction horizon in [1,10]
→ Confidence	float	[0,1]	Prediction confidence

4.2.8 PqosTrainSubAdd data type

Table 9. PqosTrainSubAdd data type

Field	Data Type	Cardinality	Description
NotificationAddress	ipv6	1	Server IP for pQoS notifications
Method	string	1	pQoS method, supported variants: {QS-PQOS-I, DN-PQOS-I, H-PQOS-I}
QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}

4.2.9 PqosTrainSubAddAck data type

Table 10. PqosTrainSubAddAck data type

Field	Data Type	Cardinality	Description
Status	integer	1	HTTP status code returned
Message	string	1	HTTP response description
CorrelationID	string	1	Subscription ID if success, else None

4.2.10 PqosTrainSubAddNotify data type

Table 11. PqosTrainSubAddNotify data type

Field	Data Type	Cardinality	Description
Timestamp	string	1	The timestamp of the data on which this report is based
Method	string	1	pQoS method, supported variants: {QS-PQOS-I, DN-PQOS-I, H-PQOS-I}
QosType	string	1	QoS param for prediction, supported types: {THROUGHPUT_DL, THROUGHPUT_UL, E2E_LATENCY}
TrainingStatus	string	1	Update on the training status of the requested AI model. Types: {COMPLETED, FAILED, PENDING}

4.2.11 ApplicationProfile data type

Table 12. ApplicationProfile data type

Field	Data Type	Cardinality	Description
applicationProfileId	string (uuid)	1	Identifier for the Application Profile.
networkQualityThresholds	NetworkQualityThresholds	0..1	Thresholds for network quality parameters such as latency, jitter, loss, and throughput.
computeResources	ComputeResourcesThresholds	0..1	Thresholds for compute resource requirements (CPU, GPU, memory, storage).

4.2.12 ApplicationProfileRequest data type

Table 13. ApplicationProfileRequest data type

Field	Data Type	Cardinality	Description
networkQualityThresholds	NetworkQualityThresholds	0..1	User-defined network quality thresholds for an application.
computeResources	ComputeResourcesThresholds	0..1	User-defined compute resource thresholds for an application.

4.2.13 NetworkQualityThresholds data type

Table 14. NetworkQualityThresholds data type

Field	Data Type	Cardinality	Description
packetDelayBudget	PacketDelayBudget	0..1	Maximum allowable one-way latency between device and gateway.
targetMinDownstreamRate	TargetMinDownstreamRate	0..1	Target minimum downstream throughput.
targetMinUpstreamRate	TargetMinUpstreamRate	0..1	Target minimum upstream throughput.

packetLossErrorRate	PacketErrorLossRate	0..1	Acceptable packet error loss rate (expressed as exponent N of 10^(-N)).
jitter	Jitter	0..1	Maximum allowed variation in round-trip packet delay.

4.2.14 ComputeResourcesThresholds data type

Table 15. ComputeResourcesThresholds data type

Field	Data Type	Cardinality	Description
targetMinCPU	targetMinCPU	0..1	Minimum number of vCPUs required for the application instance.
targetMinMemory	targetMinMemory	0..1	Minimum memory required for the application.
gpuVendorType	gpuVendorType	0..1	GPU vendor name (e.g., NVIDIA, AMD).
gpuModelName	gpuModelName	0..1	GPU model name (e.g., “Tesla V100”).
targetMinGPU	targetMinGPU	0..1	Minimum number of GPUs required.
targetMinGPUMemory	targetMinMemory	0..1	Minimum GPU memory required.
targetMinEphemeralStorage	targetMinEphemeralStorage	0..1	Minimum ephemeral storage required.
targetMinPersistentStorage	targetMinPersistentStorage	0..1	Minimum persistent storage required.

4.2.15 Rate data type

Table 16. Rate data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric rate value.
unit	RateUnitEnum	1	Unit of rate measurement (e.g., Bps, Kbps, Mbps, Gbps, Tbps).

4.2.16 RateUnitEnum data type

Table 17. RateUnitEnum data type

Field	Data Type	Cardinality	Description
—	enum {Bps, Kbps, Mbps, Gbps, Tbps}	1	Enumerates supported rate units.

4.2.17 Compute data type

Table 18. Compute data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric compute capacity value.
unit	ComputeUnitEnum	1	Unit of compute measurement (Kb, Mb, Gb, Tb).

4.2.18 ComputeUnitEnum data type

Table 19. ComputeUnitEnum data type

Field	Data Type	Cardinality	Description
—	enum {Kb, Mb, Gb, Tb}	1	Enumerates supported compute resource units.

4.2.19 PacketDelayBudget data type

Table 20. PacketDelayBudget data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric value representing latency.
unit	TimeUnitEnum	1	Unit of time for delay measurement (Days, Hours, Minutes, Seconds, etc.).

4.2.20 PacketErrorLossRate data type

Table 21. PacketErrorLossRate data type

Field	Data Type	Cardinality	Description
—	integer	1	Exponential power of allowable error rate (10^-N). Range: 1–10. Example: 3 = 0.001.

4.2.21 Jitter data type

Table 22. Jitter data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric jitter duration.
unit	TimeUnitEnum	1	Unit of time for jitter measurement.

4.2.22 TargetMinDownstreamRate data type

Table 23. TargetMinDownstreamRate data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric target minimum downstream rate.
unit	RateUnitEnum	1	Unit of rate measurement.

4.2.23 TargetMinUpstreamRate data type

Table 24. TargetMinUpstreamRate data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric target minimum upstream rate.
unit	RateUnitEnum	1	Unit of rate measurement.

4.2.24 targetMinCPU data type

Table 25. targetMinCPU data type

Field	Data Type	Cardinality	Description
—	number	1	Number of vCPUs required for the application. Fractional values allowed. Example: 0.5 = half a vCPU.

4.2.25 targetMinGPU data type

Table 26. targetMinGPU data type

Field	Data Type	Cardinality	Description
—	integer	1	Minimum number of GPUs required for the application.

4.2.26 gpuVendorType data type

Table 27. gpuVendorType data type

Field	Data Type	Cardinality	Description
—	enum {Nvidia, AMD}	1	GPU vendor name.

4.2.27 gpuModelName data type

Table 28. gpuModelName data type

Field	Data Type	Cardinality	Description
—	string	1	GPU model name corresponding to vendor type (e.g., “Tesla V100”).

4.2.28 targetMinMemory data type

Table 29. targetMinMemory data type

Field	Data Type	Cardinality	Description
value	integer	1	Numeric minimum memory requirement.
unit	ComputeUnitEnum	1	Unit of measurement for memory (Kb, Mb, Gb, Tb).

4.2.29 targetMinEphemeralStorage data type

Table 30. targetMinEphemeralStorage data type

Field	Data Type	Cardinality	Description
value	integer	1	Minimum ephemeral storage required.
unit	ComputeUnitEnum	1	Unit of storage measurement.

4.2.30 targetMinPersistentStorage data type

Table 31. targetMinPersistentStorage data type

Field	Data Type	Cardinality	Description
value	integer	1	Minimum persistent storage required.
unit	ComputeUnitEnum	1	Unit of storage measurement.

4.2.31 Duration data type

Table 32. Duration data type

Field	Data Type	Cardinality	Description
value	integer	1	Duration numeric value (minimum 1).
unit	TimeUnitEnum	1	Time unit for duration.

4.2.32 TimeUnitEnum data type

Table 33. TimeUnitEnum data type

Field	Data Type	Cardinality	Description
—	enum {Days, Hours, Minutes, Seconds, Milliseconds,	1	Supported time units.

	Microseconds, Nanoseconds}		

4.2.33 ErrorInfo data type

Table 34. ErrorInfo data type

Field	Data Type	Cardinality	Description
status	integer	1	HTTP response status code.
code	string	1	Human-readable error code.
message	string	1	Description of the error.

4.2.34 AdditionalKpis data type

Table 35. AdditionalKpis data type

Field	Data Type	Cardinality	Description
signalStrength	enum {excellent, good, fair, poor, no signal}	0..1	Rough indication of the end-user device radio signal conditions.
connectivityType	enum {5G-SA, 5G-NSA, 4G, 3G}	0..1	Access technology connecting the user device to the operator network.

4.2.35 Subscription data type

Table 36. Subscription data type

Field	Data Type	Cardinality	Description
protocol	Protocol	1	Delivery protocol identifier (e.g., HTTP, MQTT3, etc.).
sink	string (uri)	1	The address to which events shall be delivered using the selected protocol. Must begin with **Error! Hyperlink reference not valid.**.

types	array of SubscriptionEventType	1..1	List of event types eligible to be delivered by this subscription.
config	Config	1	Configuration parameters used by the subscription manager.
subscriptionId	string	0··1	Identifier of this subscription.
startsAt	string (date-time)	1	Date when the event subscription will begin/began.
expiresAt	string (date-time)	0··1	Date when the subscription will expire.
status	enum {ACTIVATION_REQUESTED, ACTIVE, EXPIRED, DEACTIVE, DELETED}	0··1	Current status of the subscription lifecycle.

4.2.36 SubscriptionAsync data type

Table 37. SubscriptionAsync data type

Field	Data Type	Cardinality	Description
subscriptionId	SubscriptionId	0··1	Identifier for the asynchronously created or deleted subscription.

4.2.37 SubscriptionId data type

Table 38. SubscriptionId data type

Field	Data Type	Cardinality	Description
—	string	1	Identifier of the subscription, also referred to as `subscriptionId` in event notifications. Example: `qs15-h556-rt89-1298`.

4.2.38 Device data type

Table 39. Device data type

Field	Data Type	Cardinality	Description

phoneNumber	PhoneNumber	0..1	The telephone number (MSISDN) identifying the device.
networkAccessIdentifier	NetworkAccessIdentifier	0..1	Identifier addressing a subscription in a mobile network.
ipv4Address	DeviceIpv4Addr	0..1	IPv4 address details identifying the device.
ipv6Address	DeviceIpv6Address	0..1	IPv6 address identifying the device.

4.2.39 NetworkAccessIdentifier data type

Table 40. NetworkAccessIdentifier data type

Field	Data Type	Cardinality	Description
—	string	1	Public identifier for a mobile network subscription (e.g., 123456789@domain.com).

4.2.40 PhoneNumber data type

Table 41. PhoneNumber data type

Field	Data Type	Cardinality	Description
—	string (pattern '^\+[1-9][0-9]{4,14}$')	1	Telephone number formatted per E.164, prefixed with +.

4.2.41 DeviceIpv4Addr data type

Table 42. DeviceIpv4Addr data type

Field	Data Type	Cardinality	Description
publicAddress	SingleIpv4Addr	1	The public (observed) IPv4 address of the device.
privateAddress	SingleIpv4Addr	0··1	The private (local) IPv4 address of the device.
publicPort	Port	0··1	Public TCP/UDP port used by the device.

4.2.42 SingleIpv4Addr data type

Table 43. SingleIpv4Addr data type

Field	Data Type	Cardinality	Description
—	string (ipv4)	1	A single IPv4 address (no subnet mask). Example: `84.125.93.10`.

4.2.43 DeviceIpv6Address data type

Table 44. DeviceIpv6Address data type

Field	Data Type	Cardinality	Description
—	string (ipv6)	1	IPv6 address used to identify the device. Example: `2001:db8:85a3:8d3:1319:8a2e:370:7344`.

4.2.44 Port data type

Table 45. Port data type

Field	Data Type	Cardinality	Description
—	integer (0–65535)	1	TCP or UDP port number.

4.2.45 PortsSpec data type

Table 46. PortsSpec data type

Field	Data Type	Cardinality	Description
ranges	array of Range	0..1	List of TCP/UDP port ranges. Each range has `from` and `to` fields.
ports	array of Port	0..1	List of single TCP/UDP ports.

4.2.46 Protocol data type

Table 47. Protocol data type

Field	Data Type	Cardinality	Description
Field	**Data Type**	**Cardinality**	**Description**
—	enum {HTTP, MQTT3, MQTT5, AMQP, NATS, KAFKA}	1	Identifier of the delivery protocol. Currently only `HTTP` is supported.

4.2.47 ApplicationServer data type

Table 48. ApplicationServer data type

Field	Data Type	Cardinality	Description
ipv4Address	ApplicationServerIpv4Address	0..1	IPv4 address or subnet of the application server.
ipv6Address	ApplicationServerIpv6Address	0..1	IPv6 address or subnet of the application server.

4.2.48 ApplicationServerIpv4Address data type

Table 49. ApplicationServerIpv4Address data type

Field	Data Type	Cardinality	Description
—	string	1	IPv4 address in form `<address>` or `<address/mask>`. Example: `192.168.0.1/24`.

4.2.49 ApplicationServerIpv6Address data type

Table 50. ApplicationServerIpv6Address data type

Field	Data Type	Cardinality	Description
—	string	1	IPv6 address or subnet (e.g., `2001:db8:85a3:8d3::/64`).

4.2.50 Config data type

Table 51. Config data type

Field	Data Type	Cardinality	Description
subscriptionDetail	CreateSubscriptionDetail	1	Detailed configuration of the requested subscription.
subscriptionExpireTime	string (date-time)	0..1	Requested subscription expiration time.
subscriptionMaxEvents	integer (≥1)	0..1	Maximum number of event reports to generate.
initialEvent	boolean	0..1	Indicates whether to trigger an initial event upon subscription creation.

4.2.51 SinkCredential data type

Table 52. SinkCredential data type

Field	Data Type	Cardinality	Description
credentialType	enum {PLAIN, ACCESSTOKEN, REFRESHTOKEN}	1	Type of credential. Must be ACCESSTOKEN for now.

4.2.52 CreateSubscriptionDetail data type

Table 53. CreateSubscriptionDetail data type

Field	Data Type	Cardinality	Description
Field	**Data Type**	**Cardinality**	**Description**
device	Device	1	Device to which the subscription applies.
applicationServer	ApplicationServer	0..1	Application server used to evaluate network performance.
applicationServerPorts	PortsSpec	0..1	Single or range of ports on the application server.
applicationProfileId	ApplicationProfileId	1	Identifier for the Application Profile.

4.2.53 SubscriptionRequest data type

Table 54. SubscriptionRequest data type

Field	Data Type	Cardinality	Description
protocol	Protocol	1	Event delivery protocol.
sink	string (uri)	1	Destination address for event delivery.
sinkCredential	SinkCredential	0..1	Credentials for authentication/authorization of sink.
types	array of SubscriptionEventType	1..1	List of event types.
config	Config	1	Configuration parameters for subscription management.

4.2.54 NetworkQualityInsight data type

Table 55. NetworkQualityInsight data type

Field	Data Type	Cardinality	Description
applicationProfileId	ApplicationProfileId	0..1	Identifier of the related Application Profile.
packetDelayBudget	NetworkQualityThresholdsConfidence	0..1	Confidence in meeting packet delay budget requirements.
targetMinDownstreamRate	NetworkQualityThresholdsConfidence	0..1	Confidence in meeting downstream throughput requirements.
targetMinUpstreamRate	NetworkQualityThresholdsConfidence	0..1	Confidence in meeting upstream throughput requirements.
packetlossErrorRate	NetworkQualityThresholdsConfidence	0..1	Confidence in meeting packet loss/error rate

			requirements.
jitter	NetworkQualityThresholdsConfidence	0..1	Confidence in meeting jitter requirements.
additionalKpis	AdditionalKpis	0..1	Additional key performance indicators such as signal strength and access type.

4.2.55 NetworkQualityThresholdsConfidence data type

Table 56. NetworkQualityThresholdsConfidence data type

Field	Data Type	Cardinality	Description
—	enum {"meets the application requirements", "unable to meet the application requirements"}	1	Confidence level indicator.

4.2.56 Source data type

Table 57. Source data type

Field	Data Type	Cardinality	Description
—	string (uri-reference)	1	Identifies the context in which the event occurred (e.g., a URI, UUID, or app-specific identifier).

4.2.57 CloudEvent data type

Table 58. CloudEvent data type

Field	Data Type	Cardinality	Description

id	string	1	Unique identifier of this event.
source	Source	1	Context in which the event occurred.
type	EventTypeNotification	1	Type of event notification.
specversion	string (enum: "1.0")	1	CloudEvents specification version.
datacontenttype	string (enum: "application/json")	0..1	MIME type describing the event payload encoding.
data	NetworkQualityInsight	0..1	Data payload describing the network quality insights.
time	DateTime	1	Timestamp when the event occurred.

4.2.58 EventNetworkQuality data type

Table 59. EventNetworkQuality data type

Field	Data Type	Cardinality	Description
data	NetworkQualityInsight	0..1	Event data describing network quality information.

4.2.59 EventSubscriptionEnded data type

Table 60. EventSubscriptionEnded data type

Field	Data Type	Cardinality	Description
data	SubscriptionEnded	0..1	Event data describing why and how the subscription ended.

4.2.60 SubscriptionEnded data type

Table 61. SubscriptionEnded data type

Field	Data Type	Cardinality	Description
terminationReason	TerminationReason	1	Reason why the subscription ended.
subscriptionId	SubscriptionId	1	Identifier of the subscription that ended.

terminationDescription	string	0..1	Optional description explaining the termination cause.

4.2.61 TerminationReason data type

Table 62. TerminationReason data type

Field	Data Type	Cardinality	Description
—	enum {MAX_EVENTS_REACHED, NETWORK_TERMINATED, SUBSCRIPTION_EXPIRED, ACCESS_TOKEN_EXPIRED, SUBSCRIPTION_DELETED}	1	Reason why a subscription ended.

4.2.62 DateTime data type

Table 63. DateTime data type

Field	Data Type	Cardinality	Description
—	string (date-time, RFC 3339)	1	Timestamp of when the event occurred.

4.2.63 EventTypeNotification data type

Table 64. EventTypeNotification data type

Field	Data Type	Cardinality	Description
—	enum {org.camaraproject.connectivity-insights-subscriptions.v0.network-quality, org.camaraproject.connectivity-insights-	1	Event type identifiers for different notifications.

	subscriptions.v0.subscription-ended}		

4.2.64 SubscriptionEventType data type

Table 65. SubscriptionEventType data type

Field	Data Type	Cardinality	Description
—	enum {org.camaraproject.connectivity-insights-subscriptions.v0.network-quality}	1	Event type representing network quality notification trigger.

4.2.65 NetworkQualityInsightRequest data type

Table 66. NetworkQualityInsightRequest data type

Field	Data Type	Cardinality	Description
applicationProfileId	ApplicationProfileId	1	ID of the application profile.
device	Device	0..1	Device identifiers (optional when using 3-legged token).
applicationServer	ApplicationServer	1	Server hosting the backend application.
applicationServerPorts	PortsSpec	0..1	List of single ports or port ranges on the application server.
monitoringTimeStamp	string (date-time)	0..1	Optional future timestamp for predictive network data.

4.2.66 NetworkQualityInsightResponse data type

Table 67. NetworkQualityInsightResponse data type

Field	Data Type	Cardinality	Description

packetDelayBudget	NetworkQualityThresholdsConfidence	0..1	Confidence of meeting packet delay budget.
targetMinDownstreamRate	NetworkQualityThresholdsConfidence	0..1	Confidence of meeting minimum downstream rate.
targetMinUpstreamRate	NetworkQualityThresholdsConfidence	0..1	Confidence of meeting minimum upstream rate.
packetlossErrorRate	NetworkQualityThresholdsConfidence	0..1	Confidence of meeting packet loss/error rate threshold.
jitter	NetworkQualityThresholdsConfidence	0..1	Confidence of meeting jitter threshold.
additionalKPIs	AdditionalKpis	0..1	Additional network performance indicators.

4.2.67 NetworkQualityThresholdsConfidence data type

Table 68. NetworkQualityThresholdsConfidence data type

Field	Data Type	Cardinality	Description
—	string	1	Plain-language confidence of meeting network demand.

4.2.68 AdditionalKpis data type

Table 69. AdditionalKpis data type

Field	Data Type	Cardinality	Description
signalStrength	string	0··1	Rough indication of device radio signal quality.
connectivityType	string	0··1	Access technology of the device on the network.

4.2.69 DeviceResponseBody data type

Table 70. XXX data type

Field	Data Type	Cardinality	Description
device	DeviceResponse	0··1	The device identifier used to fulfill the request.

4.2.70 ApplicationProfileId data type

Table 71. ApplicationProfileId data type

Field	Data Type	Cardinality	Description
—	string (uuid)	1	Identifier for the application profile.

4.3 API operations

4.3.1 Resource: PQoS-Inference-Subscribe-Add

The resource URI is: {apiRoot}/pqos_inf/sub/add

Headers: Content type "application/json", AuthToken

4.3.1.1 Resource methods

4.3.1.1.1 POST

Creates a new subscription for QoS predictions for a specific metric, pQoS method and threshold. Upon a QoS degradation event, the pQoS server will send notifications to the client denoted by the API consumer. Upon successful subscription creation, a unique CorrelationID is generated, which can be used by the API consumer to edit or remove the subscription, thereafter.

Parameters: no parameters

Table 72. Data structures supported by the POST request on this resource

	Data type	Cardinality	Notes
Request body	PqosInfSubAdd	1	

.

Table 73. Data structures supported by the POST response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosInfSubAdd Ack	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.1.1.1.1 Callback

Important: this endpoint is to be implemented by the API consumer. The pQoS server will call this endpoint upon a QoS degradation event (notification)

Parameters: no parameters

Table 74. Data structures supported by the callback of this resource

Request body	Data type	Cardinality	Notes
	PqosInfSubAddNotify	1	

Table 75. Data structures supported by the callback response on this resource

Response body	Data type	Cardinality	Response Codes	Notes
	String	1	201	Notification received OK
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	503	Service unavailable

4.3.2 Resource: PQoS-Inference-Subscribe-Edit

The resource URI is: {apiRoot}/pqos_inf/sub/edit

Headers: Content type "application/json", AuthToken

4.3.2.1 Resource methods

4.3.2.1.1 POST

Edit an existing pQoS subscription, using the CorrelationID (as obtained from the Response of the PQoS-Inference-Subscribe-Add resource, see also PqosInfSubAddAck data type.

Parameters: no parameters.

Table 76. Data structures supported by the POST request on this resource

Request body	Data type	Cardinality	Notes
	PqosInfSubEdit	1	

Table 77. Data structures supported by the POST response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosInfSubAddAck	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.3 Resource: PQoS-Inference-Subscribe-Get

The resource URI is: {apiRoot}/pqos_inf/sub/get

Headers: AuthToken

4.3.3.1 Resource methods

4.3.3.1.1 GET

Gets all existing subscriptions

Parameters: None

Table 78 Data structures supported by the DELETE response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosInfSubGet	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.4 Resource: PQoS-Inference-Subscribe-Delete

The resource URI is: {apiRoot}/pqos_inf/sub/del{CorrelationID}

Headers: AuthToken

4.3.4.1 Resource methods

4.3.4.1.1 DELETE

Deletes an existing pQoS subscription, using the CorrelationID.

Parameters: Listed in Table 79.

Table 79 URI query parameters supported by the DELETE method on this resource

Name	Data type	Cardinality	Notes
CorrelationID	string	1	

Table 80 Data structures supported by the DELETE response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosInfSubAddAck	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.5 Resource: PQoS-Inference-Request

The resource URI is: {apiRoot}/pqos_inf/req

Headers: Content type "application/json", AuthToken

4.3.5.1 Resource methods

4.3.5.1.1 POST

Make a direct request for QoS predictions for a specific metric and pQoS method. Response is return directly.

Parameters: no parameters.

Table 81. Data structures supported by the POST request on this resource

Request body	Data type	Cardinality	Notes
	PqosInfReq	1	

Table 82. Data structures supported by the POST response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosInfResp	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.6 Resource: CAMARA-Application-Profiles

The resource URI is: {apiRoot}/camara/application-profiles

Headers: Content-Type: application/json, x-correlator, Authorization

4.3.6.1 Resource methods

4.3.6.1.1 POST

Create an Application Profile. Defines network monitoring intents and compute requirements for optimal end-user experience.

Parameters: None

Table 83. Data structures supported by the POST request on this resource

	Data type	Cardinality	Notes
Request body	ApplicationProfileRequest	1	Network and compute thresholds for the application profile.

.

Table 84. Data structures supported by the POST response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	ApplicationProfile	1	201	Application profile created successfully.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	429	Too many requests.

4.3.6.1.2 GET /application-profiles/{applicationProfileId}

Retrieve an Application Profile by ID.

Parameters: applicationProfileId (string).

Table 85. Data structures supported by the GET response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	ApplicationProfile	1	200	Application profile retrieved successfully.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	404	Not found.
	ErrorInfo	0..1	429	Too many requests.

4.3.6.1.3 PATCH /application-profiles/{applicationProfileId}

Update an existing Application Profile. Replaces the complete set of network and compute thresholds.

Parameters: applicationProfileId (string)

Table 86. Data structures supported by the PATCH request on this resource

	Data type	Cardinality	Notes
Request body	ApplicationProfile	1	New network and compute thresholds.

.

Table 87. Data structures supported by the PATCH response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	ApplicationProfile	1	201	Application profile created successfully.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	429	Too many requests.

4.3.6.1.4 DELETE /application-profiles/{applicationProfileId}

Delete an Application Profile.

Parameters: applicationProfileId (string)

Table 88. Data structures supported by the DEL response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	—	—	204	Application profile deleted successfully.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	404	Not found.
	ErrorInfo	0..1	429	Too many requests.

4.3.7 Resource: CAMARA-Subscriptions

The resource URI is: {apiRoot}/camara/subscriptions

Headers: Content-Type: application/json, x-correlator, Authorization

4.3.7.1 Resource methods

4.3.7.1.1 POST

Create a Connectivity Insights subscription for a device. This operation allows the client to subscribe to connectivity insights events for a given device.

Parameters: None

Table 89. Data structures supported by the POST request on this resource

	Data type	Cardinality	Notes
Request body	SubscriptionRequest	1	Contains the protocol, sink, subscription types and configuration.

.

Table 90. Data structures supported by the POST response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	Subscription	1	201	Subscription created successfully.
	SubscriptionAsync	1	202	Request accepted for asynchronous processing.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.

	ErrorInfo	0..1	409	Conflict.
	ErrorInfo	0..1	422	Unprocessable entity.
	ErrorInfo	0..1	429	Too many requests.

4.3.7.1.1.1 Callback

Upon connectivity events, the server calls the client-provided endpoint (sink) with a CloudEvent notification.

Parameters: no parameters

Table 91. Data structures supported by the callback of this resource

	Data type	Cardinality	Notes
Request body	CloudEvent	1	Contains NetworkQualityInsight data for the device.

Table 92. Data structures supported by the callback response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	String	1	201	Notification received OK
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	503	Service unavailable

4.3.7.1.2 GET

Retrieve a list of subscriptions. Returns all subscriptions accessible by the provided access token.

Parameters: None

Table 93. Data structures supported by the GET response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	Subscription[]	0..*	200	List of subscriptions.
	ErrorInfo	0..1	400	Invalid input
	ErrorInfo	0..1	401	Unauthorized
	ErrorInfo	0..1	403	Forbidden

4.3.7.1.3 GET /subscriptions/{subscriptionId}

Retrieve a subscription by ID.

Parameters: subscriptionId (string)

Table 94. Data structures supported by the GET response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	Subscription	1	200	Subscription details
	ErrorInfo	0..1	400	Invalid input
	ErrorInfo	0..1	401	Unauthorized
	ErrorInfo	0..1	403	Forbidden
	ErrorInfo	0..1	404	Not found

4.3.7.1.4 DELETE /subscriptions/{subscriptionId}

Delete a subscription by ID.

Parameters: subscriptionId (string)

Table 95. Data structures supported by the DEL response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	—	—	204	Subscription deleted successfully.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	404	Not found.
	ErrorInfo	0..1	429	Too many requests.

4.3.8 Resource: CAMARA-Check-Network-Quality

The resource URI is: {apiRoot}/camara/check-network-quality

Headers: Content-Type: application/json, x-correlator, Authorization

4.3.8.1 Resource methods

4.3.8.1.1 POST

Check the network quality for a given device and application profile. This operation allows the client to request the network's confidence in meeting the quality thresholds defined in an application profile for a specific device.

Parameters: None

Table 96. Data structures supported by the POST request on this resource

	Data type	Cardinality	Notes
Request body	NetworkQualityInsightRequest	1	Contains applicationProfileId, optional device identifiers, applicationServer, applicationServerPorts and monitoringTimeStamp for predictive data.

.

Table 97. Data structures supported by the POST response on this resource

	Data Type	Cardinality	Response Codes	Notes
Response body	NetworkQualityInsightResponse	1	200	Network confidence that the application's requirements can be met.
	DeviceResponseBody	0..1	200	Optional device identifier used to fulfil the request.
	ErrorInfo	0..1	400	Invalid input.
	ErrorInfo	0..1	401	Unauthorized.
	ErrorInfo	0..1	403	Forbidden.
	ErrorInfo	0..1	404	Not found
	ErrorInfo	0..1	422	Unprocessable entity.
	ErrorInfo	0..1	429	Too many requests.

4.3.9 Resource: PQoS-Training-Subscribe-Add

The resource URI is: {apiRoot}/pqos_train/sub/add

Headers: Content type "application/json", AuthToken

4.3.9.1 Resource methods

4.3.9.1.1 POST

Creates a new subscription for QoS predictive AI model training for a specified metric and pQoS method. This functionality is applicable only to the full-featured models — QS, DN and HYBRID — and not to their “SIMPLE” variants. When a QoS training event occurs (e.g., completion of model training), the pQoS server automatically sends notifications to the client identified by the API consumer. Upon successful subscription creation, the system generates a unique CorrelationID, which the API consumer can later use to cancel or remove the subscription.

Parameters: no parameters

Table 98. Data structures supported by the POST request on this resource

	Data type	Cardinality	Notes
Request body	PqosTrainSubAdd	1	

.

Table 99. Data structures supported by the POST response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosTrainSubAddAck	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable

4.3.9.1.1.1 Callback

Important: this endpoint is to be implemented by the API consumer. The pQoS server will call this endpoint upon a QoS training event (notification)

Parameters: no parameters

Table 100. Data structures supported by the callback of this resource

	Data type	Cardinality	Notes
Request body	PqosTrainSubAddNotify	1	

Table 101. Data structures supported by the callback response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	String	1	201	Notification received OK
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	503	Service unavailable

4.3.10 Resource: PQoS-Training-Subscribe-Delete

The resource URI is: {apiRoot}/pqos_train/sub/del{CorrelationID}

Headers: AuthToken

4.3.10.1 Resource methods

4.3.10.1.1 DELETE

Deletes an existing pQoS training subscription, using the CorrelationID.

Parameters: Listed in Table 79.

Table 102 URI query parameters supported by the DELETE method on this resource

Name	Data type	Cardinality	Notes
CorrelationID	string	1	

Table 103 Data structures supported by the DELETE response on this resource

	Data type	Cardinality	Response Codes	Notes
Response body	PqosTrainSubAddAck	1	201	Request ok
	ErrorResponse	0..1	400	Invalid input
	ErrorResponse	0..1	401	Unauthorized
	ErrorResponse	0..1	403	Forbidden
	ErrorResponse	0..1	500	Internal server error
	ErrorResponse	0..1	501	Not Implemented
	ErrorResponse	0..1	503	Service unavailable