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**Information technology – UPnP device architecture –
Part 17-11: Quality of Service Device Control Protocol – Level 3 – Quality of
Service Manager Service**

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ISO/IEC 29341-17-11

Edition 1.0 2011-08

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE



ICS 35.200

ISBN 978-2-88912-654-5

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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 17-11: Quality of Service Device Control Protocol – Level 3 – Quality of Service Manager Service

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The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Information technology – UPnP device architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

¹ UPnP Forum Steering committee, UPnP Forum, 3855 SW 153rd Drive, Beaverton, Oregon 97006 USA. See also "Introduction".

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1 Overview and Scope

This service definition is compliant with the UPnP Device Architecture version 1.0.

This service-type enables modeling of 'Quality of Service Manager' function capabilities. QoSManager functionality is the combination of QoSManager service and control point functionality that discovers and controls QoSDevice and QoSPolicyHolder services running on the network. The QoSManager function is responsible for requesting, updating, releasing and in general controlling the Quality of Service assigned by networking devices to various traffic streams. The QoSManager service is invoked from an UPnP Control Point to perform the functions related to setting up QoS² for that traffic stream. Once the network is configured with respect to the QoS for the upcoming traffic stream, the QoSManager service will hand back control to the Control Point. This service provides a mechanism for a Control Point to:

- Be agnostic of the QoS capabilities and associated details about the various QoS Devices on the network at the expense of potential network inefficiency.
- Abstract the tasks of setting up, modifying and revoking the QoS associated with every traffic stream
- QoSManager:3 defines new capabilities to set up Parameterized QoS. Control Points may now request reservations for specific resources for the exclusive use of individual streams. Successful resource reservation ensures that streams will always have the bandwidth and other resources to transport time critical data.
- QoSManager:3 defines a method for Control Points to request preemption of existing reservations on the UPnP-QoS network if necessary to admit a new stream.
- QoSManager:3 supports a mechanism for providing a list of blocking streams to a Control Point so that it can handle preemption on its own, if desired.

A QoSManager is a dual-role entity that exposes a QoSManager Service to the Control Point while acting as a Control Point for the QoSPolicyHolder Service and QoSDevice Services running on the network. This document describes the components of the UPnP QoSManager Service and the QoS Manager. The QoS Manager provides the Control Point functionality that discovers and controls QoSDevice Services and the QoSPolicyHolder Services running on the network. Additional information concerning the QoS Manager may be found in:

- UPnP QoS Architecture document [QoS Architecture]
- UPnP QoSDevice Service Definition Document [QOS DEVICE]
- UPnP QoSPolicyHolder Service Definition Document [POLICY HOLDER]

1.1 References & Terms

1.1.1 References

Unless explicitly stated otherwise herein, implementation of the mandatory provisions of any standard referenced by this specification shall be mandatory for compliance with this specification. This clause lists the normative references used in this document and includes the tag inside square brackets that is used for each sub reference:

1.1.1.1 Normative References

[XML] – *Extensible Markup Language (XML) 1.0 (Second Edition)*, T. Bray, J.Paoli, C. M. Sperberg McQueen, E Maler, eds. W3C Recommendations, 6 October 2000.

[DEVICE] - UPnP Device Architecture, version 1.0, UPnP Forum, July 20, 2006. Available at: <http://upnp.org/specs/arch/UPnP-arch-DeviceArchitecture-v1.0-20060720.pdf>

² Quality of Service

Latest version available at: <http://upnp.org/specs/arch/UPnP-arch-DeviceArchitecture-v1.0.pdf>

[POLICY HOLDER] – UPnP QosPolicyHolder:3 Service Document.
Available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosPolicyHolder-v3-Service-20081130.pdf>

Latest version available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosPolicyHolder-v3-Service.pdf>

[QOS DEVICE] – UPnP QosDevice:3 Service Document.
Available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosDevice-v3-Service-20081130.pdf>

Latest version available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosDevice-v3-Service.pdf>

[QDA:3] – UPnP QosDevice:3 Underlying Technology Interface Addendum
Available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosDevice-v3-Addendum-20081130.pdf>

Latest version available at: <http://www.upnp.org/specs/qos/UPnP-qos-QosDevice-v3-Addendum.pdf>

[IANA Portnumbers] – *Port Numbers*, IANA, Available at:
<http://www.iana.org/assignments/port-numbers>

[IANA Protocols] – *Assigned Internet Protocol Numbers*, IANA,
Available at: <http://www.iana.org/assignments/protocol-numbers>

[RFC 2141] – *URN Syntax*, R. Moats, May 1997, Available at:
<http://www.ietf.org/rfc/rfc2141.txt>

[RFC 2211] – *Specification of the Controlled-Load Network Element Service*, J. Wroclawski, September 1997. Available at: <http://www.ietf.org/rfc/rfc2211.txt>

[RFC 2212] – *Specification of Guaranteed Quality of Service*, S. Shenker et al., September 1997. Available at: <http://www.ietf.org/rfc/rfc2212.txt>

[RFC 3339] – *Date and Time on the Internet: Timestamps*, G. Klyne, July 2002.
Available at: <http://www.ietf.org/rfc/rfc3339.txt>

[RFC 3927] – *Dynamic Configuration of IPv4 Link-Local Addresses*, Internet Engineering Task Force, S. Cheshire et al., March 2005. Available at: <http://www.ietf.org/rfc/rfc3927.txt>

[RFC 3986] – *Uniform Resource Identifiers (URI): Generic Syntax*, T. Berners-Lee et al., January 2005. Available at: <ftp://ftp.rfc-editor.org/in-notes/rfc3986.txt>

1.1.1.2 Informative References

This clause lists the informative references used in this document and includes the tag inside square brackets that is used for each sub reference:

[CDS:2] – UPnP AV ContentDirectory Service Definition document version 2.0.
Available at: <http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v2-Service.pdf>
Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v2-Service-20060531.pdf>

[IEEE 802.3-2002] – IEEE Std 802.3, 2000 Edition, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications, LAN MAN Standards Committee of the IEEE Computer Society, 2000.

[IEEE 802.1D] – IEEE Std 802.1D – 2004, Media Access Control (MAC) Bridges, IEEE Computer Society, 2004.

[QoS Architecture] – *UPnP QoS Architecture V3.0* Available at: <http://www.upnp.org/specs/qos/UPnP-qos-Architecture-v3-20081130.pdf>
Latest version available at: <http://www.upnp.org/specs/qos/UPnP-qos-Architecture-v3.pdf>

[HPAV] – HomePlug AV Specification v1.1, HomePlug Power Alliance, 2007.

[PACKETC] – PacketCable Specification Multimedia Specification, Available at: <http://www.packetcable.com/downloads/specs/PKT-SP-MM-I03-051221.pdf>

[RFC 1363] – A Proposed Flow Specification, C. Partridge, September 1992, Available at: <http://www.ietf.org/rfc/rfc1363.txt>

1.1.2 Terms and Abbreviations

1.1.2.1 Abbreviations

Table 1-1 — Abbreviations

Abbreviation	Description
AV	Audio/Video
CP	Control Point
DCP	Device Control Protocol
DSCP	Differentiated Services Code Point
IANA	Internet Assigned Numbers Authority
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IETF	Internet Engineering Task Force
IGD	Internet Gateway Device
IP	Internet Protocol
LAN	Local Area Network
MAC	Medium Access Control
PVR	Personal Video Recorder
QD	<u>QoSDevice</u> Service
QM	<u>QoSManager</u> Service
QoS	Quality of Service
QPH	<u>QoSPolicyHolder</u> Service
SRP	Stream Reservation Protocol
STA	<u>Station</u>
STB	Settop Box
TSPEC	Traffic Specification
WMM	Wireless Multi Media
WMM-SA	Wireless Multi Media Scheduled Access
XML	eXtensible Markup Language

1.1.2.2 Terms

1.1.2.2.1 Admission Control

Admission control is the overall procedure that consists of

- Breaking down (by a [QoS Manager](#)) of the end-to-end requirements into per QoS *segment* requirements;
- Requesting the reservation of resources (at the [QoSDevice](#) Service) and the process that is carried out by a [QoSDevice](#) Service to reserve those resources;
- Applying the results from the [QoSPolicyHolder](#) Service to determine the priority and/or importance of the stream and whether it should be admitted at the possible expense of other streams.

The overall result is a yes/no decision of whether the traffic stream can be supported.

1.1.2.2.2 Admission Mechanism

Admission mechanism is the implementation of the resource management scheme of a [QoSDevice](#) Service. The [QoSDevice](#) Service abstracts the properties of a particular technology and the UPnP-QoS interface provides access to the *Admission Mechanism* via the defined actions. The resource management scheme may operate at any layer of the ISO stack, although it frequently uses L2 signaling.

1.1.2.2.3 Admission Policy

Admission policy is the set of rules that is applied in an *admission control* procedure. The rules are applied on the parameters from the [TrafficPolicy](#) as supplied by the [QoSPolicyHolder](#) Service and the Traffic Specification.

1.1.2.2.4 AV Control Point

A UPnP *Control Point* that is used in an AV scenario and utilizes UPnP AV services is called an *AV Control Point*.

1.1.2.2.5 Best Effort

Best effort is a service of the Internet Protocol; i.e. it makes almost no guarantees about a packet other than attempting to transmit it. At the destination, the packet may arrive damaged, it may be out of order (compared to other packets sent between the same hosts), it may be duplicated, or it may be dropped entirely. If reliability is needed, it is provided by upper level protocols transported using IP.

With the introduction of IEEE 802.1D *priority tagging* [IEEE 802.1D] the priority associated with untagged packets is also called "Best Effort".

1.1.2.2.6 Blocked Segments

A *segment* is called *blocked* for the setup of a new traffic stream, if the *admission* on the segment failed due to insufficient *resources* somewhere in the segment.

1.1.2.2.7 Blocking Traffic Stream

An *admitted traffic stream* is called *blocking* with respect to a new traffic stream S, if it uses network resources where the admission of S fails.

1.1.2.2.7.1 Bridge

A *device* that interconnects two or more LANs that use the same Data Link layer protocols above the MAC sublayer, but can use different MAC protocols.

1.1.2.2.8 Complex Type

A *complex type* is defined in the XML Schema Definition Language [XML] .

1.1.2.2.9 Container

A *container* is a UPnP-QoS construct that contains *containers* and/or *fields*. In XML it is expressed through elements of *complex type*.

1.1.2.2.10 Device

A *device* is a functional unit for a particular purpose. A device is not necessarily a *UPnP Device*.

1.1.2.2.11 Element

An *element* is defined in the XML Schema Definition Language [XML] .

1.1.2.2.12 End-to-End Delay

The End-to-End delay of an application payload is defined as the time difference between the delivery of the payload for sending by the application on the source device, and the delivery of the payload to the destination device's application. The time reference used at the source and destination is the same and is known at the application layer. The End-to-End delay experienced by the packets of a stream is not constant and the delay will have a maximum and a minimum, for a period of observation. An application may, for example, require that the maximum End-to-End delay be less than or equal to an actual value it desires. See [QOS DEVICE] for more details.

1.1.2.2.13 End-to-End Jitter

End-to-End Jitter is defined as the difference between the maximum of End-to-End Delay and the minimum of End-to-End Delay.

1.1.2.2.14 Existing User

When pre-empting an existing traffic stream, the user(s) enjoying this stream is/are affected. In a pre-emption discussion, this user is called the "*Existing User*".

1.1.2.2.15 Field

A *field* is a UPnP-QoS construct that provides information on properties, capabilities, etc. In XML it is expressed through an element of simple type.

1.1.2.2.16 Hub

A device, with two or more physical ports, that forwards all traffic received on any individual port to all other ports. This device is also referred to as a "repeater". In a home network, a hub connects networks segments of the same physical medium.

1.1.2.2.17 Interface

The point of interconnection between a device and a network.

1.1.2.2.18 Intermediate Device

An *intermediate device* is physically connected between the Source and Sink device traffic stream. There may be zero or more intermediate device between the Source to Sink.

1.1.2.2.19 Internet Gateway Device (IGD)

Internet Gateway Device is a border device that physically connects the Home Network with a Wide Area Network. This device performs routing. QoS mechanisms associated with routing are not addressed by this architecture; the IGD may present a [QoSDevice](#) Service on the Home Network.

1.1.2.2.20 L2 Technology

The term *L2 Technology* is short hand to refer to MAC / PHYs of various LAN technologies. Examples include: IEEE 802.3, MOCA, HomePlug.

1.1.2.2.21 Layer 2 Stream Id

A Layer 2 construct to uniquely identify a traffic stream within a *QoS segment*.

1.1.2.2.22 Lease Time

The *lease time* is the finite duration for which the resources are reserved for a traffic stream.

1.1.2.2.23 Link

A *link* is an (optionally bidirectional) direct connection between two devices for data exchange. This is called a link segment in the terminology of [IEEE 802.3-2002] .

1.1.2.2.24 Path

A *path* is the physical course that traffic stream will follow from source to sink. For UPnP-QoS, a path must reside within a single IP subnet, but a path may comprise multiple segments. This is called a link in the terminology of [IEEE 802.3-2002] .

1.1.2.2.25 Path Determination

Path determination is the process of determining the ordered set of [QoSDevice](#) Service(s) on the path of a given traffic stream.

1.1.2.2.26 Packet Priority

The *Packet Priority* is a Layer 2 parameter that indicates the priority handling requested by the source. Typically this parameter is part of a packet header and indicates the relative importance of the packet compared to other packets. It is used to differentiate packets to determine which are given preferential access to the communication medium. This parameter is typically mapped to an Access Priority value supported by the network device.

1.1.2.2.27 Parameterized QoS

Parameterized QoS refers to a general methodology for obtaining QoS. A contract is made with the network using a set of parameters that define the application's traffic requirements. The parameters typically include bandwidth and delay.

1.1.2.2.28 Policing

Policing is the process of ensuring that no more than the reserved resources are used.

1.1.2.2.29 Policy

Policy is a set of rules that is applied for the allocation of resources.

1.1.2.2.30 Policy Management

Policy Management is a function that applies policies to traffic streams.

1.1.2.2.31 Preempted Traffic Stream

A *preempted traffic stream* is a blocking traffic stream that has its reservation modified or deleted by the [QoS Manager](#).

1.1.2.2.32 Preemption

When an admission request fails due to the lack of resources, the [QoS Manager](#) may attempt to free resources necessary to allow the new traffic stream to reserve them. The process of taking resources from existing admitted traffic streams is called *preemption*.

1.1.2.2.33 Preemption Candidate

A *preemption candidate* is a blocking traffic stream that has been selected for possible preemption by the [QoS Manager](#).

1.1.2.2.34 Preemption Style

A *preemption style* is a UPnP-QoS defined method of how the [QoS Manager](#) selects preemption candidates.

1.1.2.2.35 Prioritized QoS

Prioritized QoS refer to a general methodology for providing QoS by differentiating traffic. Messages types are grouped by order of importance and assigned a priority. Message types assigned a higher priority are given preferential access to the communications medium.

1.1.2.2.36 Quality of Service (QoS)

The term *Quality of Service* (abbreviated QoS) refers to a broad collection of networking capabilities and techniques. The goal of QoS is to improve the user experience of a network's ability to deliver predictable results for sensitive applications such as audio, video, and voice applications. Elements of network performance within the scope of QoS often include bandwidth (throughput), latency (delay), and error rate. There are two broad classes of QoS: data reliability and temporal reliability. Each makes different demands on network technologies. This architecture is primarily concerned with delivering temporal reliability.

1.1.2.2.37 QoS segment

A *QoS segment* is defined as a collection of *interfaces* of [QoSDevice](#) services reporting the same [QoSSegmentId](#) (as defined in [QOS DEVICE]), and the network resources (e.g., wires) through which these interfaces are connected.

1.1.2.2.38 QoS Segment Delay

[QoS Segment Delay](#) represents one of the following: 1. The delay at the [QoSDevice](#) including the interfaces; or 2. The delay introduced by all or part of the QoS Segment between the [QoSDevices](#) including the interfaces. The sum of the [QoS Segment Delay](#) values for [QoSDevices](#) in the path on a QoS segment must be the total delay introduced on that QoS segment. The [QoS Segment Delay](#) for a [QoSDevice](#) service is technology and implementation specific. Details on calculating the QoS Segment Delay can be found in the [QoSDevice](#) Service document and the technology specific addendum [QDA:3].

1.1.2.2.39 QoS Segment Jitter

The QoS Segment Jitter is defined as the the difference between the maximum of QoS Segment Delay and the minimum of QoS Segment Delay of the same QoS Segment.

1.1.2.2.40 Resource

In the context of QoS, a *resource* is anything managed in order to support a QoS function. A distinction can be made between device resources and network resources.

1.1.2.2.41 Simple Type

A *simple type* is defined in the XML Schema Definition Language.

1.1.2.2.42 Sink Device

A *sink device* is the receiving end of a traffic stream regardless of other functions on the device.

1.1.2.2.43 Source Device

A *source device* is the originating end of a traffic stream regardless of other functions on the device.

1.1.2.2.44 Subnet

Subnet as defined in [RFC 3927] .

1.1.2.2.45 Switch

A *switch* is a device, with two or more similar or dissimilar physical ports, that sends traffic received on any individual port to the appropriate other port(s) based on layer 2 information.

1.1.2.2.46 Traffic Class

The *Traffic Class* indicates the kind of traffic in the traffic stream. The Traffic Class is used to distinguish, for example, audio from video. The distinction is at the application layer and the Traffic Class is mapped into the applicable layer 2 representations for the L2 Technology bearing the stream. An example is the mapping in IEEE 802.1D, Annex G [IEEE 802.1D].

1.1.2.2.47 Traffic Descriptor

The *TrafficDescriptor* is the representation of a traffic stream for purposes of providing QoS. It is composed of a TrafficId and other pertinent information that must be provided by the Control Point.

1.1.2.2.48 Traffic Identifier

A *Traffic Identifier* (*TrafficId*) is a set of information that uniquely identifies a data packet as belonging to a traffic stream. This information is typically used by a packet classifier function to associate a Traffic Specification's QoS contract to the service provided to the Traffic stream. Other technologies may refer to this as a Filter Spec (RFC2205) or Traffic Classifier (IEEE 802.11e).

1.1.2.2.49 Traffic Specification (TSPEC)

A *Traffic Specification* (*TSPEC*) contains a set of parameters that define the characteristics of the traffic stream. The TSPEC defines the resource requirements for carrying the traffic stream.

1.1.2.2.50 Traffic Stream

A *Traffic Stream* is a unidirectional flow of data. It originates at a source device and terminates at a sink device.

1.1.2.2.51 UPnP Device

A *UPnP Device* is defined in the UPnP Device Architecture[DEVICE] .

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2 Service Modeling Definitions

2.1 ServiceType

The following service type identifies a service that is compliant with this template:

urn:schemas-upnp-org:service:QosManager:3

2.2 State Variables

Reader Note: For first-time reader, it may be more insightful to read the theory of operations first and then the action definitions before reading the state variable definitions.

2.2.1 XML Fragments as UPnP Arguments

UPnP-QoS often uses XML Fragments as arguments in UPnP actions. The containing UPnP data type is a string. This places restrictions on a string's content; it has to represent a well-formed XML fragment (this includes a complete XML document).

An XML fragment, in adherence to the UPnP V1.0 architecture [DEVICE], MUST be escaped by using the normal XML rules, [XML] Clause 2.4 Character Data and Markup, before embedding it in a SOAP request / response message or an event notification message. The XML escaping rules are summarized:

- The (<) character is encoded as (<)
- The (>) character is encoded as (>)
- The (&) character is encoded as (&)
- The (") character is encoded as (")
- The (') character is encoded as (')

In their XML fragments, implementations MAY use an explicit reference to appropriate namespaces.

Table 2-1 — State Variables

Variable Name	Req. or Opt. ^a	Data Type	Allowed Value ^b	Default Value ^b	Eng. Units
A_ARG_TYPE_TrafficDescriptor	R	String (XML fragment)	See 2.2.2	n/a	n/a
A_ARG_TYPE_TrafficHandle	R	String (XML fragment)	See 2.2.3	n/a	n/a
A_ARG_TYPE_NumTrafficDescriptors	R	ui4	See 2.2.4	n/a	n/a
A_ARG_TYPE_NumPolicyHolders	R	ui4	See 2.2.5	n/a	n/a
A_ARG_TYPE_ListOfTrafficDescriptors	R	String (XML fragment)	See 2.2.6	n/a	n/a
A_ARG_TYPE_QmCapabilities	R	String (XML fragment)	See 2.2.7	n/a	n/a
A_ARG_TYPE_ExtendedTrafficQosInfo	O	String (XML fragment)	See 2.2.8	n/a	n/a
A_ARG_TYPE_ResultedQosType	R	ui4	See 2.2.9	n/a	n/a
<p>^a R = Required, O = Optional, X = Non-standard</p> <p>^b Values listed in this column are required. To specify standard optional values or to delegate assignment of values to the vendor, you MUST reference a specific instance of an appropriate table below.</p>					

2.2.2 A_ARG_TYPE_TrafficDescriptor

The A_ARG_TYPE_TrafficDescriptor state variable contains information about a particular traffic stream.

2.2.2.1 XML Schema Definition

This is a **string** containing an XML fragment. It contains information describing a traffic descriptor. The XML fragment in this argument MUST validate against the XML schema for TrafficDescriptor in the XML namespace "http://www.upnp.org/schemas/TrafficDescriptorv1.xsd" which is located at "http://www.upnp.org/schemas/qos/TrafficDescriptor-v3.xsd".

2.2.2.2 Description of fields in the TrafficDescriptor structure

2.2.2.2.1 TrafficHandle

This is an OPTIONAL field in the TrafficDescriptor and is not related to A_ARG_TYPE_TrafficHandle. TrafficHandle is a unique identifier associated with a particular instance of TrafficDescriptor; i.e. a particular traffic stream. It is a unique string generated by the QoSManager Service and provided to the Control Point in response to the QM:RequestTrafficQos() or QM:RequestExtendedTrafficQos() action. The QoS Manager must ensure that the generated Traffic Handle string is unique for all Traffic Descriptors on the network. In all subsequent communication between the Control Point and the QoSManager Service, TrafficHandle is used to uniquely reference a particular traffic stream.

2.2.2.2.2 TrafficId

This is a MANDATORY structure. TrafficId contains information about identifying/classifying packets that belong to that particular traffic stream. It consists of an XML structure consisting of: SourceAddress, DestinationAddress, SourcePort, DestinationPort, and IpProtocol. The embedded v3TrafficId further contains SourceUuid and DestinationUuid.

2.2.2.2.1 SourceAddress

This is an OPTIONAL or MANDATORY field depending on the action. The SourceAddress identifies the source of the traffic stream. A value of 0.0.0.0 represents a 'Don't Care' i.e., the

condition where a Control Point wants to set up QoS for all traffic streams irrespective of the SourceAddress.

2.2.2.2.2.2 DestinationAddress

This is an OPTIONAL or MANDATORY field depending on the action. The DestinationAddress identifies the destination of the traffic stream. A value of 0.0.0.0 represents a 'Don't Care' i.e., the condition where a Control Point wants to set up QoS for all traffic streams irrespective of the DestinationAddress.

2.2.2.2.2.3 SourcePort

This is an OPTIONAL or MANDATORY field depending on the action. The SourcePort identifies the port of the source of the traffic stream. A value of 0 represents a 'Don't Care' i.e., the condition where a Control Point wants to set up QoS for all traffic streams irrespective of the SourcePort.

2.2.2.2.2.4 DestinationPort

This is an OPTIONAL or MANDATORY field depending on the action. The SourcePort identifies the port of the destination of the traffic stream. A value of 0 represents a 'Don't Care' i.e., the condition where a Control Point wants to set up QoS for all traffic streams irrespective of the DestinationPort.

2.2.2.2.2.5 IpProtocol

This is an OPTIONAL or MANDATORY field depending on the action. The value of IpProtocol is an IANA assigned IP protocol number from 0-255 (for more information: [IANA Protocols]). A value of 0 represents a 'Don't Care' i.e., the condition where a Control Point wants to set up QoS for all traffic streams irrespective of the IpProtocol.

2.2.2.2.2.6 v2TrafficId

This is an OPTIONAL structure. It MAY contain a v3TrafficId structure.

2.2.2.2.2.6.1 v3TrafficId

This is an OPTIONAL structure under the TrafficId structure. The v3TrafficId structure contains two fields: SourceUuid and DestinationUuid.

2.2.2.2.2.6.1.1 SourceUuid

This is an OPTIONAL field. The SourceUuid field contains the UDN of the UPnP Device at the source.

```
UUID ::= (* The UDN of the device including the prefix 'uuid:'.
Refer to Clause 2.1 of [DEVICE] *)
```

Example:

```
uuid:2fac1234-31f8-11b4-a222-08002b34c003
```

2.2.2.2.2.6.1.2 DestinationUuid

This is an OPTIONAL field. The DestinationUuid field contains the UDN of the UPnP Device at the destination.

```
UUID ::= (* The UDN of the device including the prefix 'uuid:'.
Refer to Clause 2.1 of [DEVICE] *)
```

Example:

uuid:1fac1234-31f8-11b4-a222-08002b34c002

2.2.2.2.3 **AvailableOrderedTspecList**

This is a MANDATORY structure. **AvailableOrderedTspecList** contains one or more **Tspec** components. Their value of **TspecIndex** reflects the order of preference. The values of **TspecIndex** MUST be unique within an **AvailableOrderedTspecList**. TSPECs with smaller **TspecIndex** values are more preferred. **TspecIndex** values need not be consecutive numbers. The order of **Tspec** structures in the **AvailableOrderedTspecList** is not relevant.

2.2.2.2.3.1 **Tspec**

This is a MANDATORY structure. **Tspec** contains a TSPEC (TrafficSpecification) which is a description of the QoS Requirements.

In a UPnP-AV scenario, this information is extracted from the **ContentDirectory** Service of the **MediaServer** Device. In the **ContentDirectory** Service, **Tspec** is represented either as a string, containing an escaped XML structure, or as an URI pointing to the escaped XML structure. The UPnP-AV Control Point uses **CDS:Browse()** and/or **CDS:Search()** action³ calls to acquire the **Tspec** structure(s) associated with the content.

The XML structure contains the following elements:

- **TspecIndex**: This is a MANDATORY field. It is a unique numerical index associated with a particular **Tspec**. The value of **TspecIndex** indicates preference (as defined by the application or the end user). A **Tspec** with a smaller index is more preferred compared to a **Tspec** with a larger index.
- **AvTransportUri**: This is an OPTIONAL field. It is a string that contains the URI associated with the UPnP-AV content item for which QoS is being requested.
- **AvTransportInstanceID**: This is an OPTIONAL field. It is an integer representing the unique **InstanceID** associated with the UPnP **AVTransport** Service associated with the content item for which QoS is being requested.
- **TrafficClass**: This is an OPTIONAL field. It contains the traffic class associated with the traffic stream. This is an enumerated variable that can be assigned to one of the following list of values:
 - NetworkControl
 - StreamingControl
 - Voice
 - AV
 - Data
 - Audio
 - Image
 - Gaming
 - Other
 - Background
- **v2TrafficSpecification**: This is an OPTIONAL structure. It MAY contain a **v3TrafficSpecification** structure. The **v3TrafficSpecification** structure contains the parameters as specified in Clause 2.2.2.3.

³ CDS = **ContentDirectory** Service

2.2.2.2.4 ActiveTspecIndex

This is an OPTIONAL field when provided to the QosManager Service or QosPolicyHolder Service and a MANDATORY field when provided to the QosDevice Service. ActiveTspecIndex contains an integer which indicates the index of the current active Tspec from the AvailableOrderedTspecList. Tspec and AvailableOrderedTspecList are defined above.

2.2.2.2.5 TrafficImportanceNumber

This is an OPTIONAL field when provided to the QosManager Service or QosPolicyHolder Service and a MANDATORY field when provided to the QosDevice Service for Prioritized and Hybrid QoS requests. A TrafficImportanceNumber is an integer with values in the range of 0 through 7. This value follows the numbering scheme for traffic classes as described in IEEE 802.1D Annex G [IEEE 802.1D] and with additional traffic classes described in clause 2.4.1.4.2. This value is used by QosDevice service(s) in the traffic's path to indicate what priority level to utilize when priority tagging the traffic's network packets.

2.2.2.2.6 QosBoundarySourceAddress

This is an OPTIONAL field. If a traffic stream originates outside the UPnP-QoS network's subnet (e.g. on the Internet), the QosBoundarySourceAddress will be treated as the QoS termination point for UPnP-QoS. This parameter is OPTIONAL, because it is applicable only to traffic streams originating outside the home network. It should be noted that this address is not part of the traffic identifier, because the IP packets will carry the IP address of the actual source address. QosBoundarySourceAddress is used by the QoS Manager for decisions related to path determination and device selection.

The "Don't care" situation that may apply for SourceAddress and DestinationAddress IP address does not apply here.

2.2.2.2.7 QosBoundaryDestinationAddress

This is an OPTIONAL field. If a traffic stream terminates outside the UPnP-QoS network's subnet (e.g. on the Internet), the QosBoundaryDestinationAddress will be treated as the QoS termination point for UPnP-QoS. This parameter is OPTIONAL, because it is applicable only to traffic streams terminating outside the home network. It should be noted that this address is not part of the traffic identifier, because the IP packets will carry the IP address of the actual destination address. QosBoundaryDestinationAddress is used by QoS Manager for decisions related to path determination and device selection.

The "Don't care" situation that may apply for SourceAddress and DestinationAddress IP address does not apply here.

2.2.2.2.8 MediaServerConnectionId

This is an OPTIONAL field. This field may be useful in case of UPnP-AV based streaming with multiple Tspec structures. The MediaServerConnectionId may be used by the QosManager Service to identify the traffic stream that is being setup by the UPnP-AV Control Point which is requesting QoS. Please refer to UPnP-QoS Architecture document for more details [QoS Architecture]. The MediaServerConnectionId is obtained from the MediaServer Device via the CM:PrepareForConnection() action⁴.

2.2.2.2.9 MediaRendererConnectionId

This is an OPTIONAL field. This field may be useful in case of UPnP-AV based streaming with multiple Tspec structures. MediaRendererConnectionId may be used by the QosManager Service to identify the traffic stream that is being setup by the UPnP-AV Control Point which

⁴ CM = UPnP-AV ConnectionManager Service

is requesting QoS. Please refer to UPnP-QoS Architecture document for more details [QoS Architecture]. The [MediaRendererConnectionId](#) is obtained from the [MediaRenderer](#) Device via the [CM:PrepareForConnection\(\)](#) action.

2.2.2.2.10 [TrafficLeaseTime](#)

This is an OPTIONAL field. This field contains the lease time associated with a particular traffic stream. The lease time is expressed in seconds. When not specified (which MUST only occur for prioritized streams), it indicates an indefinite lease, that is the [TrafficDescriptor](#) will remain active until it is explicitly removed or the [QosDevice](#) is rebooted. When the [QosDevice](#) Service or [QosManager](#) Service reports the lease time to a Control Point, this is the remaining lease time.

2.2.2.2.11 [v2](#)

This is an OPTIONAL structure. It contains elements that are defined in UPnP-QoS v2 as specified below.

2.2.2.2.11.1 [PolicyHolderId](#)

This is an OPTIONAL field. A [PolicyHolderId](#) is a value that uniquely identifies [QosPolicyHolder](#) Service on the home network. This value informs the [QosManager](#) Service which [QosPolicyHolder](#) Service to query for a [TrafficPolicy](#). The value must be of the following form as described using EBNF:

```
PolicyHolderId ::= UUID ':' serviceId
UUID ::= (* The UDN of the QosPolicyHolder service including the
prefix 'uuid:'. Refer to Clause 2.1 of [DEVICE] *)
serviceId ::= (* The serviceId of the QosPolicyHolder service
including the prefix 'urn:upnp-org:serviceId:'. Refer
to Clause 2.1 of [DEVICE] *)
```

For example:

```
uuid:2fac1234-31f8-11b4-a222-08002b34c003:urn:upnp-org:serviceId:QosPolicyHolder-3a
```

2.2.2.2.11.2 [PolicyLastModified](#)

This is an OPTIONAL field. [PolicyLastModified](#) is an RFC3339 compliant string [RFC 3339] that identifies the wall clock date/time when the policy on a device containing the [QosPolicyHolder](#) Service was last modified. It is recognized that device clocks may not be synchronized. This field is valuable for implementations to provide diagnostic information to the end user.

2.2.2.2.11.3 [PolicyModifyingUserName](#)

This is an OPTIONAL field. [PolicyModifyingUserName](#) is a string that identifies the user who last changed the policy. This field MUST be <= 64 UTF-8 characters. At present this specification does not define the semantics for this field. Examples include, "Dad", "Jimmy", etc. This field is valuable for implementations to provide diagnostic information to the end user.

2.2.2.2.11.4 [PolicyHolderConfigUrl](#)

This is an OPTIONAL field. [PolicyHolderConfigUrl](#) is a string containing a URL on the device that provides the [QosPolicyHolder](#) Service. If the device provides the URL, containing "HTTP" or "HTTPS" as the <protocol>, for its configuration, then the control point may retrieve a page using the provided URL to allow a user to configure the [QosPolicyHolder](#) Service (the configuration method is out-of-scope). The host portion of the URL must be in dotted-decimal IP address form, e.g. "http://10.0.0.131/config_policy.html".

```
PolicyHolderConfigURL ::=
    Protocol '://' Host [':' Port] [Path ['?' Query]]
```

2.2.2.2.11.5 v3

This is an OPTIONAL structure. It contains elements that are defined in UPnP-QoS v3 as specified below.

2.2.2.2.11.5.1 QosBoundarySourceUuid

This is an OPTIONAL field. It contains the UDN of the UPnP Device at the QoS Boundary Source.

2.2.2.2.11.5.2 QosBoundaryDestinationUuid

This is an OPTIONAL field. It contains the UDN of the UPnP Device at the QoS Boundary Destination.

2.2.2.2.11.5.3 Critical

This is an OPTIONAL field. The Critical field contains a Boolean that expresses the control point's belief on whether this traffic stream is critical. Streams for entertainment are not critical traffic streams. Examples of critical traffic streams are emergency alerts, emergency calls, etc.

2.2.2.2.11.5.4 PolicyHolderConsultedId

This is an OPTIONAL field. The PolicyHolderConsultedId is a string that contains a value that uniquely identifies the QosPolicyHolder Service that was consulted in setting up QoS for the stream. The format is the same as the format of the PolicyHolderId field.

2.2.2.2.11.5.5 PolicyHolderConsultedType

This is an OPTIONAL field. The value of this integer expresses which version of the behavior to determine which QosPolicyHolder Service to be used was used for this traffic stream. There is no default value.

Table 2-2 — Meaning of PolicyHolderConsultedType parameter

Value	Meaning
0	Default policy
1	There was exactly one <u>QosPolicyHolder</u> Service on the network and that one was used. This is the original UPnP-QoS v1 behavior.
2	The <u>QosPolicyHolder</u> Service that was used is the one indicated by the Control Point. This is the normal UPnP-QoS v2 behavior.
3	The <u>QosPolicyHolder</u> Service that was used is the one preferred by the user.

2.2.2.2.11.5.6 UpdateTrafficLeaseTime

This is an optional boolean field. When a Control Point sets this to “1” in a QoS update request, it indicates that the Control Point is requesting that only the TrafficLeaseTime is updated for the traffic stream.

2.2.2.2.12 OptionalPolicyParameters

This is an OPTIONAL structure. It consists of the fields described in subsequent subclauses below.

2.2.2.2.12.1 UserName

This is an OPTIONAL field. UserName contains a string associated with the user who requested a particular traffic stream. This field identifies the name of the user initiating the UPnP-QoS Action. The field MUST be <= 64 UTF-8 characters. At present this specification does not define the semantics for this field. This field represents the name of the user initiating the QoS action. Examples include, “Dad”, “Jimmy”, “CN#1234567”. The latter is an example of a name provided by a service provider to uniquely identify its individual customers.

2.2.2.2.12.2 CpName

This is an OPTIONAL field. CpName contains a string associated with the Control Point requesting QoS for the traffic stream. This field identifies the name of the Control Point initiating the UPnP-QoS Action. The field MUST be <= 64 UTF-8 characters. At present this specification does not define the semantics for this field. The CpName may specify the brand name of the Control Point or it may indicate the location of the Control Point such as “living room”.

2.2.2.2.12.3 VendorApplicationName

This is an OPTIONAL field. VendorApplicationName contains a single URI string associated with an application. This field identifies the name of the application initiating the UPnP-QoS Action. For applications specified by vendors, the value of this field MUST begin with “urn:”, followed by an ICANN domain name owned by the vendor, followed by “:application:”, followed by an application name, i.e. the value of this field MUST be constructed as follows:

```
VendorApplicationName ::=
    'urn:' DomainName* ':' Application

DomainName ::= (* Application vendor domain name. This MUST follow the
    syntax specified for Namespace Identifier (NID) in [RFC
    2141]. The domain-name field MUST be <= 64 UTF-8
    characters. If the control point is not aware of this
    field, then it MAY be left blank *)

Application ::= 'application:' AppName

AppName ::= (* Name of the application provided by a vendor. This
    must follow the syntax specified for Name Specific
    String (NSS) in [RFC 2141]. The AppName field MUST be
    <= 64 UTF-8 characters. The AppName MUST NOT contain a
    colon character. *)
```

For example:

```
urn:example-org:application:MyApp
urn:example-org:application:ScheduledRecording
```

When requesting QoS it may be useful to know the manufacturer and name of the application software client or server that will process the traffic stream.

2.2.2.2.12.4 PortName

This is an OPTIONAL field. PortName contains a single URI **string** associated with the fixed port used by an application for its protocol set-up. This field, if present, shall identify the port number used by the application. The value of this field MUST begin with “urn:”, followed by an ICANN domain name owned by the vendor, followed by “:port:”, followed by the port name. i.e. the value of this field MUST be constructed as follows:

```
PortName ::= 'urn:' DomainName* ':' Port
```

```

DomainName      ::= (* Application vendor domain name. This MUST follow the
                    syntax specified for Namespace Identifier (NID) in [RFC
                    2141]. The domain-name field MUST be <= 64 UTF-8
                    characters. If the control point is not aware of this
                    field, then it MAY be left blank *)

Port            ::= 'port:' PortNumber

PortName       ::= (* An integer value. *)

```

For example:

```
urn:example-org:port:80
```

PortNumber is a fixed port number used by the application for protocol set-up. If the application uses a range of port numbers then the starting port number of that range MUST be specified. This value is either a vendor specific port used for the application or an IANA assigned port number for the application. The list of all the IANA assigned port numbers is maintained by IANA (see [IANA Portnumbers]).

This field indicate the port that is used by an application for its connection set-up. The use of IANA assigned port numbers is RECOMMENDED, but if not available for a particular application, a vendor assigned port number MAY be used.

2.2.2.2.12.5 ServiceProviderServiceName

This is an OPTIONAL field. ServiceProviderServiceName field contains a single URI string associated with a service offered by a service provider. This field identifies the name of the service offered by a service provider. For services provided by service providers, the value of this field MUST begin with “urn:”, followed by an ICANN domain name owned by a service provider, followed by “:service:”, followed by a service name, i.e. the value of this field MUST be constructed as follows:

```

ServiceProviderServiceName
    ::= 'urn:' DomainName* ':' Service

DomainName      ::= (* Application vendor domain name. This MUST follow the
                    syntax specified for Namespace Identifier (NID) in [RFC
                    2141]. The domain-name field MUST be <= 64 UTF-8
                    characters. If the control point is not aware of this
                    field, then it MAY be left blank *)

Service         ::= 'service:' ServName

ServName       ::= (* Name of the service provided by a service vendor.
                    This must follow the syntax specified for Name Specific
                    String (NSS) in [RFC 2141]. The ServName field MUST be
                    <= 64 UTF-8 characters. The ServName MUST NOT contain a
                    colon character. *)

```

For example:

```
urn:example-org:service:VoD
```

2.2.2.3 Description of fields in v3TrafficSpecification structure

This clause defines the parameters of the v3TrafficSpecification structure which is used to characterize the requirements of a specific traffic stream. The traffic specification describes the stream as it flows from Layer 3 to Layer 2. Therefore it includes headers such as the IP header, TCP header, or UDP header but excludes the MAC header, the LLC header, the IEEE 802.1q header, lower-layer FEC bits, or physical layer overhead.

The fields of the v3TrafficSpecification structure are listed in Table 2-3 — Traffic Specification Parameters together with a reference to their normative definition.

Table 2-3 — Traffic Specification Parameters

Name	M/O ^a	Definition	Default
<u>RequestedQosType</u>	O	Clause 2.2.2.3.1	0 (zero)
<u>DataRate</u>	M (if <u>RequestedQosType</u> non-zero)	[RFC 2212] where it is called bucket rate <i>r</i> .	N/A
<u>MinServiceRate</u>	O	Clause 2.2.2.3.7	None
<u>MaxBurstSize</u>	O	[RFC 2212] where it is called bucket depth <i>b</i> .	None
<u>PeakDataRate</u>	O	[RFC 2212] where it is called peak rate <i>p</i> .	Same as <u>DataRate</u> .
<u>ReservedServiceRate</u>	O	[RFC 2212] where it is called Rspec rate term <i>R</i> .	None
<u>TimeUnit</u>	O	Clause 2.2.2.3.4	1000 µsec
<u>MaxPacketSize</u>	O	[RFC 2212] where it is called maximum datagram size <i>M</i> .	1500 octets
<u>E2EMaxDelayHigh</u>	O	Clause 2.2.2.3.11	None
<u>E2EMaxDelayLow</u>	O	Clause 2.2.2.3.13	None
<u>E2EMaxJitter</u>	O	Clause 2.2.2.3.12	None
<u>QosSegmentMaxDelayHigh</u>	O	Clause 2.2.2.3.14	None
<u>QosSegmentMaxDelayLow</u>	O	Clause 2.2.2.3.14.5	None
<u>QosSegmentMaxJitter</u>	O	Clause 2.2.2.3.14.4	None
<u>MaxServiceInterval</u>	O	Clause 2.2.2.3.15	None
<u>MinServiceInterval</u>	O	Clause 2.2.2.3.16	None
<u>LossSensitivity</u>	O	[RFC 1363]	0
<u>ServiceType</u>	O	Clause 2.2.2.3.18	1

^a M = MANDATORY, O = OPTIONAL, X=Non-Standard

We will introduce the parameters with examples after which the definition follows.

2.2.2.3.1 RequestedQosType

The optional RequestedQosType parameter, if supplied, MUST contain a non-negative integer value. It is used to indicate the type of Quality of Service that is requested with this TrafficDescriptor. The default value is 0.

Table 2-4 — Meaning of *RequestedQoSType* parameter

Value	Meaning
0	Prioritized QoS If the QoS (update) request succeeds, this traffic stream MUST be successfully set up using prioritized QoS for every QoS segment it traverses. This includes, in particular, prioritized QoS setup for QoS segments that support parameterized QoS.
1	Hybrid QoS If the QoS (update) request succeeds, this traffic stream MUST be successfully admitted using parameterized QoS on every parameterized QoS segment it traverses and MUST be set up using prioritized QoS on every prioritized QoS segments it traverses.
2	Parameterized QoS If the QoS (update) request succeeds, this traffic stream MUST be successfully admitted using parameterized QoS on every parameterized QoS segments it traverses and the traffic stream MUST NOT traverse any non-parameterized QoS segment.
3 and higher	Reserved

2.2.2.3.2 Data rate related parameters

The following subclauses introduce the parameters related to data rate. These clauses are for information only and an attempt to explain the RFCs that contain the normative definitions.

For example, consider a traffic stream that emits $x(t)$ octets at time instant t . For simplicity we ignore propagation delay and therefore when a single packet is available at $t=1$, we have $x(1)$ equal the packet size. The time ranges over the real numbers but the traffic stream is sent in packets and therefore $x(t)=0$ almost everywhere. For ease of notation a stream starts at $t=0$.

2.2.2.3.2.1 Example

A simple example of the traffic generated by a traffic stream is shown in Figure 1. In this case, the amount of data and the frequency it is sent with is constant. Formally, there is a $C > 0$ and a time interval $s > 0$, such that for every positive integer k we have $x(ks) = C$ and for every $t > 0$ that is not an integer multiple of s , we have $x(t) = 0$.

This traffic stream will be modeled by setting the *DataRate* parameter, that we will describe below, to C .

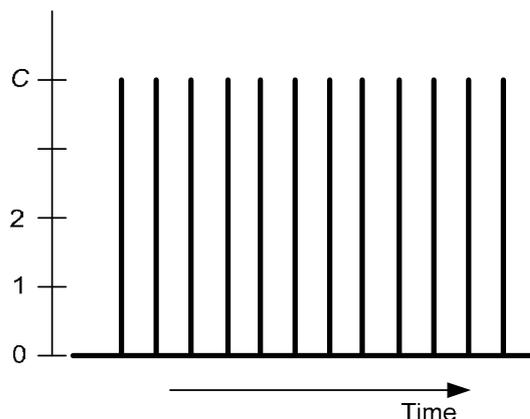


Figure 1 — An example traffic stream

If this traffic stream is served with a rate below C , packets will accumulate in queues. The queues can be emptied after the end of the traffic stream, when no new packets arrive.

If this traffic stream is served at a rate of at least C then packets are not delayed in queues and the total delay is the propagation delay. In Clause 2.2.2.3.11 we describe delay in more detail.

2.2.2.3.3 Data Rate

2.2.2.3.3.1 Definition and Requirements (Normative)

The parameter DataRate is defined in [RFC 2212] where it is called bucket rate r . The parameter DataRate MUST be provided if the value of the RequestedQosType parameter is non-zero. Its unit is octets per second.

2.2.2.3.3.2 Explanation of the Definition (Informative)

The parameter DataRate intends to characterize the long term data rate. To ones skilled in the art it is also called Mean Data Rate or Bucket Rate. For a traffic stream of a finite duration T , the DataRate is defined as

$$\frac{1}{T} \sum_{0 < t \leq T} x(t)$$

The unit of DataRate is therefore octets per second.

A crude approximation for a stored file, is obtained by dividing the file length by the duration of the play out of that file.

For traffic streams of infinite duration such as those output from a tuner, the DataRate is defined as

$$\lim_{T \rightarrow \infty} \frac{1}{T} \sum_{0 < t \leq T} x(t)$$

For practical purposes a sufficiently large value of T is used to determine the DataRate.

Since serving a traffic stream with a rate below the DataRate will lead to an unbounded accumulation of packets in queues, the traffic stream MUST be served with a rate of at least DataRate.

2.2.2.3.3.3 Example Constant Bit Rate Traffic

In this clause we present an example of using the DataRate for a traffic stream with a traffic corresponding to Figure 2. As can be seen from the figure, the amount of data and the frequency it is sent with is constant. Formally, there is a $C > 0$ and a time interval $s > 0$, such that for every positive integer k we have $x(ks) = C$ and for every $t > 0$ that is not an integer multiple of s , we have $x(t) = 0$.

In this example, the DataRate is C .

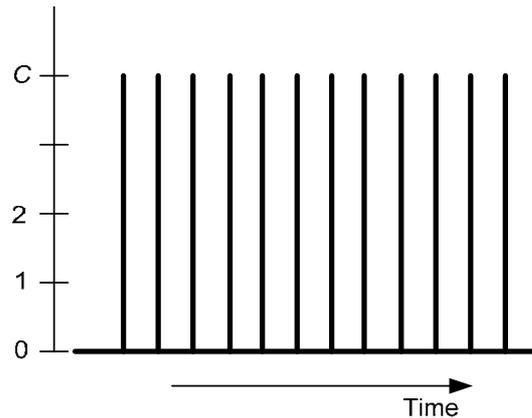


Figure 2 — A traffic stream with a constant bit rate

2.2.2.3.3.4 Example Variable Bit Rate Traffic

In this clause we present an example of using the DataRate for a traffic stream with a traffic corresponding to Figure 3 (left side). In contrast to the previous example, the amount of data is not constant. We can calculate DataRate as 3.08 or precisely

$$\frac{1}{12}(4+2+4+1+3+4+4+2+4+1+4+4).$$

If this traffic stream is served at a rate equal to DataRate, then queues will fill if $x(t) > \text{DataRate}$ and will empty if $x(t) < \text{DataRate}$. An efficient way of dealing with this traffic stream is by specifying additional parameters as defined in, e.g., Clause 2.2.2.3.5. However, it may be the case that not all details of the traffic are known.

If we do not know more about the stream, and if we are not worrying too much about efficiency, we can approximate our traffic stream with another traffic stream that has a constant bit rate D , see Figure 3 (right side). That is, formally there is a $D > 0$ and a time interval $s > 0$, such that for every positive integer k we have $x(ks) \leq D$ and for every $t > 0$ that is not an integer multiple of s , we have $x(t) = 0$.

In this case, we pick the larger value of D and specify the traffic stream as if it is a constant bit rate stream of DataRate D .

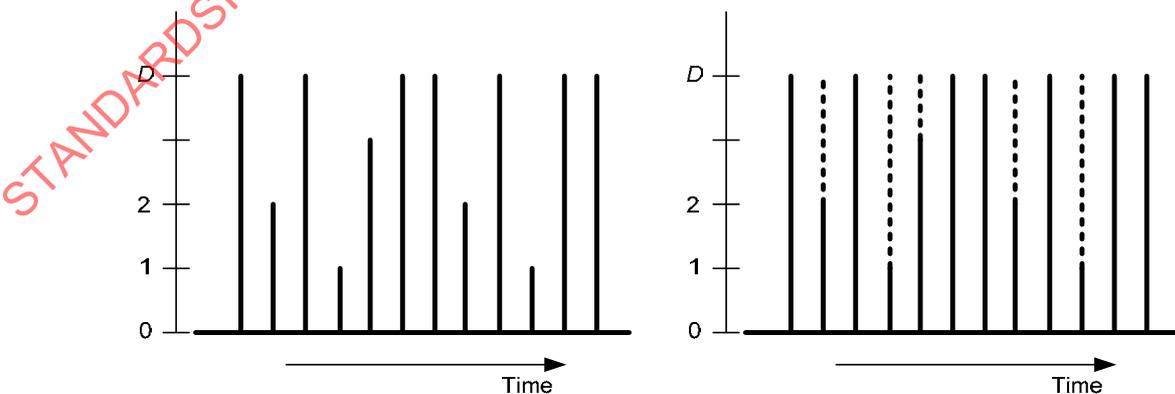


Figure 3 — The non-constant bit-rate traffic (left) can be viewed as a constant bit-rate traffic of a higher constant bit-rate D (right)

In certain contexts, this traffic is characterized by a Peak Data Rate. In Clause 2.2.2.3.5 below we define PeakDataRate and show how the combination of DataRate and PeakDataRate can be used to schedule this type of traffic in a more efficient way.

2.2.2.3.4 Time Unit (Normative)

This integer field specifies the smallest time interval, in units of microseconds, in which the behavior of the traffic source is characterized in this Traffic Specification. The value of the parameter TimeUnit will be used in the specification of the PeakDataRate and MaximumBurstSize below. Stated differently the TimeUnit parameter is a sampling interval.

2.2.2.3.4.1 More information on Time Unit (Informative)

An example TimeUnit is 1024 μs which is the one specified in IEEE 802.11. However, in many cases it is more convenient to choose a TimeUnit that is traffic specific rather than Layer-2 specific. A translation between Traffic Specifications from one TimeUnit to another can be performed by a QosManager Service and an example algorithm can be found in the [QoS Architecture]. For instance, the sampling rate or frame rate for audio/voice applications, and the 90kHz reference clock rate for broadcast quality A/V applications, are good choices for the TimeUnit as it makes it easy to derive the Traffic Specification parameters.

The smaller the TimeUnit finer the granularity in which the token bucket Traffic Specification characterizes the traffic source. However, Traffic Specification parameters with finer granularity are more difficult to obtain.

An example of different Traffic specifications with different values for the TimeUnit parameter follows the definition of PeakDataRate.

2.2.2.3.5 Peak Data Rate

2.2.2.3.5.1 Definition and Requirements (Normative)

The parameter PeakDataRate is defined in [RFC 2212] where it is called peak rate p . The parameter PeakDataRate is OPTIONAL. If not provided it defaults to the value of DataRate. The PeakDataRate SHOULD be specified to accommodate packet quantization.

2.2.2.3.5.2 Explanation of the Definition (Informative)

The parameter PeakDataRate contains the peak data rate and intends to characterize the largest data rate of the traffic stream. The physics of the network teaches us that every packet will be sent at the wire rate. It is therefore crucial to define PeakDataRate over a longer interval of time than the duration of sending a single packet. This interval should not be too long either, because the longer the interval, the closer PeakDataRate gets to MeanDataRate. The interval is TimeUnit.

Let p be the smallest value that for every interval $[t_1, t_2]$ of length at least TimeUnit satisfies

$$\frac{1}{t_2 - t_1} \sum_{t_1 \leq t \leq t_2} x(t) \leq p$$

Then p is called the PeakDataRate. The unit of PeakDataRate is octets per second, even though it is calculated per TimeUnit. If the PeakDataRate cannot be reliably calculated, a larger value of p will also do as it will not endanger the guaranteed level of QoS. It will, however, have a negative impact on the efficiency of the traffic stream's transportation.

It should be noted that p is not the same as the maximum of $x(t)$.

The principal purpose of PeakDataRate is that it defines an upper bound on the data rate at which this traffic stream needs to be served in order to serve the traffic stream within time. If the traffic stream is served at a rate above PeakDataRate, resources are unnecessarily reserved and possibly wasted.

2.2.2.3.6 Maximum Burst Size

2.2.2.3.6.1 Definition and Requirements (Normative)

The parameter MaxBurstSize is defined in [RFC 2212] where it is called bucket depth b . The parameter MaxBurstSize is OPTIONAL. If not provided it defaults to the value 0 (zero). The MaxBurstSize should be specified to accommodate packet quantization.

2.2.2.3.6.2 Explanation of the Definition (Informative)

The parameter MaxBurstSize contains the maximum burst size.

Let b be the smallest value that for every interval $[t_1, t_2]$ of length at least TimeUnit satisfies.

$$\sum_{t_1 \leq t \leq t_2} x(t) \leq r(t_2 - t_1) + b, \text{ where } r \text{ is Data Rate}$$

Then b is called the MaxBurstSize. The unit of MaxBurstSize is octets. If $b=0$, then the traffic stream is a constant bit rate stream and has no bursts.

In graphical terms, b is the surface between the graph of x and the horizontal line $y=r$ (restricted to the interval).

The principal purpose of MaxBurstSize is that it defines an upper bound on the buffer size if the traffic stream is served at a rate between mean and peak data rate. If the buffer is at least b , packets need not be dropped.

2.2.2.3.7 MinServiceRate

The parameter MinServiceRate is OPTIONAL. There is no default value. It specifies the lowest data rate, in octets per second, required for transport of the packets belonging to the TrafficStream. See Minimum data rate in [HPAV] for an example usage.

2.2.2.3.8 ReservedServiceRate

2.2.2.3.8.1 Definition and Requirements (Normative)

The parameter ReservedServiceRate is defined in [RFC 2212] where it is called Rspec rate term R . The parameter ReservedServiceRate is OPTIONAL. There is no default.

2.2.2.3.8.2 Explanation of the Definition (Informative)

This data rate typically lies between DataRate and PeakDataRate and provides a good indication to the L2 Technology. The larger ReservedServiceRate the smaller the delay will be. An example usage of ReservedServiceRate can be found in Clause 9.2 of the [PACKETC].

2.2.2.3.9 Packet Size Parameters

Packet-size parameters such as MaxPacketSize convey the information about packetization of traffic streams by an application. All the packet-size parameters include the application data and an approximation of the overhead of all protocol headers at and above the IP layer (IP, TCP, UDP, RTP, etc.). This approximation is of the overhead of all protocol headers is

performed by the application. They MUST not include the L2 header size, because these headers may change in size as the packet crosses different QoS Segments.

2.2.2.3.10 MaxPacketSize

2.2.2.3.10.1 Definition and Requirements (Normative)

The parameter MaxPacketSize is defined in [RFC 2212] where it is called maximum datagram size *M*. The parameter MaxPacketSize is OPTIONAL. If not provided it defaults to the value 1500 octets.

2.2.2.3.10.2 Explanation of the Definition (Informative)

This parameter specifies the maximum size, in units of octets, of the IP packets belonging to the traffic stream in this traffic specification. It is typically used to derive a queuing delay bound such as the Parekh-Gallager delay bound.

2.2.2.3.11 E2EMaxDelayHigh

2.2.2.3.11.1 Definition and Requirements (Normative)

The E2EMaxDelayHigh parameter defines the desired upper bound of the End-to-End Delay (as defined in clause 1.1.2.2.12) of individual packets belonging to the traffic stream. The parameter E2EMaxDelayHigh is OPTIONAL. The unit in which the E2EMaxDelayHigh parameter is expressed is microseconds.

2.2.2.3.11.2 Explanation of the Definition (Informative)

The Control Point supplies this parameter to request a specific upper bound to End-To-End Delay.

If this parameter is supplied by the Control Point, then the QoS Manager ensures that the sum of the maximum QoS Segment Delay values committed by various QoSDevice services on the path is less than E2EMaxDelayHigh for a successful admission or update request.

If this parameter is not provided by the Control Point then it indicates that any End-to-End delay is acceptable and the QoSManager Service does not include QoSSegmentMaxDelayHigh and QoSSegmentMaxDelayLow parameters in the QoS setup/update request to a QoSDevice service.

2.2.2.3.12 E2EMaxJitter

2.2.2.3.12.1 Definition and Requirements (Normative)

The E2EMaxJitter parameter defines an UPPER bound to the End-to-End Jitter as defined in clause 1.1.2.2.13. The E2EMaxJitter parameter is OPTIONAL. The unit in which the E2EMaxJitter parameter is expressed is microseconds.

2.2.2.3.12.2 Explanation of the Definition (Informative)

The Control Point supplies this parameter to request bounded End-to-End Jitter .

If this parameter is supplied by the Control Point, then the QoS Manager ensures that the sum of the maximum QoS Segment Jitter values committed by various QoSDevice services on the path is less than E2EMaxJitter for a successful admission or update request.

If E2EMaxJitter parameter is not provided, any finite End-to-End Jitter, up to and including the E2EMaxDelayHigh, is acceptable and the QoSManager Service does not include QoSSegmentMaxJitter parameter in the QoS setup/update request to a QoSDevice service.

2.2.2.3.13 E2EMaxDelayLow

2.2.2.3.13.1 Definition and Requirements (Normative)

The E2EMaxDelayLow parameter is a LOWER bound for the maximum End-to-End Delay. The parameter E2EMaxDelayLow is OPTIONAL. The purpose of the the E2EMaxDelayLow parameter is to express that packet delays smaller than E2EMaxDelayLow are not necessary.

The unit in which the E2EMaxDelayLow parameter is expressed is microseconds.

2.2.2.3.13.2 Explanation of the Definition (Informative)

This parameter is used together with the E2EMaxDelayHigh parameter to provide guidance to the QoSManager Service on the desired delay. The E2EMaxDelayLow parameter is intended to avoid unnecessarily low delay requirements. For more information, see the definition of QoSSegmentMaxDelayLow parameter in clause 2.2.2.3.14.5

Note: E2EMaxDelayLow is NOT the same concept as minimum of End-to-End delay. In other words E2EMaxDelayLow does NOT state that every packet has an End-to-End Delay of at least E2EMaxDelayLow.

2.2.2.3.14 QoSSegmentSpecificParameters

This is an OPTIONAL structure. It contains TSPEC parameters that are specific to a QoS Segment.

2.2.2.3.14.1 InterfaceId

This is a MANDATORY field. The value is of type string and MUST uniquely identify an interface within a QoSDevice Service.

2.2.2.3.14.2 QoSSegmentId

This is a MANDATORY field that contains the QoSSegmentId of the QoS Segment for which the QoSSegmentSpecificParameters are provided.

2.2.2.3.14.3 QoSSegmentMaxDelayHigh

This parameter is related to QoS Segment specific parameters.

2.2.2.3.14.3.1 Definition and Requirements (Normative)

The QoSSegmentMaxDelayHigh parameter defines an upper bound of the maximum of QoS Segment Delay (as defined in (clause 1.1.2.2.38) of individual packets belonging to the traffic stream. The parameter QoSSegmentMaxDelayHigh is OPTIONAL. The unit in which the QoSSegmentMaxDelayHigh parameter is expressed is microseconds.

2.2.2.3.14.3.2 Explanation of the Definition (Informative)

This parameter is optionally supplied as one of the input TSPEC parameters to a QoSDevice service for admission or update of a traffic stream. If the QoS Manager does not provide this parameter in the TSPEC, any delay is acceptable. In this case, the QoSDevice Service may use the best upper bound for the delay within the QoS segment.

If the control point has specified an E2EMaxDelayHigh value the QoS Manager determines QoSSegmentMaxDelayHigh values to use as input for admission or update actions on the QoSDevice service. A simple example is to set QoSSegmentMaxDelayHigh = E2EMaxDelayHigh / (Number of QoS Segments on the Path). Alternatively, the QD:GetExtendedQoSState() action optionally provides QoSSegmentMaxDelayHigh parameter to the QoS Manager as one the ProtoTspec parameters [QOS DEVICE] . The QoSManager

Service examines if the sum of the [QoSSegmentMaxDelayHigh](#) values returned in the ProtoTspec for all QoS segments is smaller than the [E2EMaxDelayHigh](#) value to determine if the request for admission or update would be successful.

2.2.2.3.14.4 [QoSSegmentMaxJitter](#)

This parameter is related QoS Segment specific parameters.

2.2.2.3.14.4.1 Definition and Requirements (Normative)

The QoS Segment Jitter is defined as the absolute value of the difference between the MAXIMUM QoS Segment Delay and the MINIMUM QoS Segment Delay. The [QoSSegmentMaxJitter](#) parameter is the UPPER bound to the QoS Segment Jitter.

The [QoSSegmentMaxJitter](#) parameter is OPTIONAL. The unit in which the [QoSSegmentMaxJitter](#) parameter is expressed is microseconds.

2.2.2.3.14.4.2 Explanation of the Definition (Informative)

This parameter is optionally supplied as one of the input TSPEC parameters to a [QoSDevice](#) service for admission or update of a traffic stream. If the [QoSSegmentMaxJitter](#) parameter is specified, then QoS Segment Jitter will be bounded and this can be used to determine buffer space at the egress device, and it can also be used to bound the [E2EMaxJitter](#).

If the control point has specified an [E2EMaxJitter](#) value, the [QoS Manager](#) MAY (but is NOT REQUIRED to) determine [QoSSegmentMaxJitter](#) values to use as input for admission or update. A simple example is to set $\text{QoSSegmentMaxJitter} = \text{E2EMaxJitter} / (\text{Number of QoS Segments on the Path})$. Alternatively, the [QD:GetExtendedQoSState\(\)](#) action optionally provides the [QoSSegmentMaxJitter](#) parameter to the [QoS Manager](#) as one the ProtoTspec parameters [QOS DEVICE] . The [QoSManager](#) Service examines if the sum of the [QoSSegmentMaxJitter](#) values returned in the ProtoTspec for all QoS segments is smaller than the [E2EMaxJitter](#) value to determine if the request for admission or update would be successful.

If the [QoSSegmentMaxJitter](#) parameter is not specified, the [QoSDevice](#) Service MAY infer jitter requirements (for example, from the [TrafficClass](#) value).

2.2.2.3.14.5 [QoSSegmentMaxDelayLow](#)

This parameter is related to QoS Segment specific parameters.

2.2.2.3.14.5.1 Definition and Requirements (Normative)

The [QoSSegmentMaxDelayLow](#) parameter is an informative LOWER bound for the MAXIMUM of QoS Segment Delay. The main purpose of the the [QoSSegmentMaxDelayLow](#) parameter is to express that packet delays smaller than [QoSSegmentMaxDelayLow](#) are not necessary. The parameter [QoSSegmentMaxDelayLow](#) is OPTIONAL. The unit in which the [QoSSegmentMaxDelayLow](#) parameter is expressed is microseconds.

2.2.2.3.14.5.2 Explanation of the Definition (Informative)

This parameter is used together with the [QoSSegmentMaxDelayHigh](#) parameter to provide guidance to the [QoSDevice](#) Service of the expected delay. The [QoSSegmentMaxDelayLow](#) parameter is intended to avoid unnecessarily tight minimum delay requirements on the underlying QoS segments.

Note: [QoSSegmentMaxDelayLow](#) is NOT the same concept as minimum of QoS Segment Delay. In other words [QoSSegmentMaxDelayLow](#) does NOT state that every packet has a QoS Segment Delay of at least [QoSSegmentMaxDelayLow](#).

2.2.2.3.14.5.3 Example

A certain L2 Technology offers two main classes for parameterized QoS. One class offers delay guarantees in the order of microseconds (class A) and the other class offers delay guarantees in the order of milliseconds (class B). Class A is intended for gaming applications, interactive applications, etc. If the [QoSSegmentMaxDelayHigh](#) parameter is not specified the [QoSDevice](#) Service could always pick class A but this is wasteful. Alternatively, the [QoSDevice](#) Service could determine the appropriate class A or B from for instance the Traffic Class, but this may not work out End-to-End. With the [QoSSegmentMaxDelayLow](#) specified, the [QoS Manager](#) can take End-to-End conditions into account and help the [QoSDevice](#) Service in determining the appropriate class. The [QD:GetExtendedQoSState\(\)](#) action informs the [QoS Manager](#) on the options.

2.2.2.3.15 [MaxServiceInterval](#)

The parameter [MaxServiceInterval](#) is OPTIONAL. There is no default value. It specifies the maximum interval, in units of microseconds, between the start of two successive contiguous transmissions of one or more IP packets belonging to the TrafficStream. See Maximum Inter-TXOP time in [HPAV] for an example usage.

2.2.2.3.16 [MinServiceInterval](#)

The parameter [MinServiceInterval](#) is OPTIONAL. There is no default value. It specifies the minimum interval, in units of microseconds, between the start of two successive contiguous transmissions of one or more IP packets belonging to the TrafficStream. See Minimum Inter-TXOP time in [HPAV] for an example usage.

2.2.2.3.17 [LossSensitivity](#)

[LossSensitivity](#) is an OPTIONAL parameter that specifies whether the stream is sensitive to packet loss. If not provided it defaults to the value 0 (zero). The value 0 (zero) indicates that the traffic stream is insensitive to loss. The value 1 (one) indicates that the traffic stream is sensitive to loss. If the value is a number larger than one, it equals the number of losses of packets of size [MaxPacketSize](#) for the traffic stream in an interval of 1 second. For more information, see [RFC 1363].

2.2.2.3.18 [ServiceType](#)

2.2.2.3.18.1 Definition and Requirements (Normative)

The [ServiceType](#) parameter is an OPTIONAL Boolean. The default is "1". If the value is "1", "guaranteed Quality of Service" as defined in [RFC 2212] is requested. If the value is "0", "controlled-load service" as defined in [RFC 2211] is requested.

2.2.2.3.18.2 Explanation of the Definition (Informative)

The use of controlled-load service provides flexibility in the specification of QoS requirements in terms of service quality. When the controlled-load service type is specified, the request is to provide the service quality that approximates the network behavior achieved from "Best Effort" service under unloaded conditions.

The result of specifying the controlled-load service type is that network devices and elements in the path can be expected to deliver a very high percentage of packets (packet loss approximates basic packet error rates for the transmission medium) and have a transit delay that for a very high percentage of transmitted packets will not greatly exceed the minimum transit delay experienced by any successfully delivered packet at the speed of light.

If ServiceType is "0", i.e., when controlled-load service is requested [ReservedServiceRate](#) and the delay parameters are not applicable and MUST not be specified.

2.2.2.4 Relationship between the fields in the *TrafficDescriptor* structure

If *SourceAddress* is not provided, the *SourceUuid* MUST be valid.

If *DestinationAddress* is not provided, the *DestinationUuid* MUST be valid.

If the *TrafficDescriptor* contains at least one TSPEC for which *RequestedQosType* > 0 , then

- the *SourceAddress* MUST NOT equal 0.0.0.0, and
- the *DestinationAddress* MUST NOT equal 0.0.0.0, and
- the *TrafficLeaseTime* MUST be specified
- the *DataRate* parameter MUST be specified

2.2.2.5 Sample argument XML string

The following is an example *TrafficDescriptor* that a Control Point could create to request parameterized QoS at the *QosManager* Service.

```
<?xml version="1.0" encoding="UTF-8"?>
<TrafficDescriptor xmlns="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd
    http://www.upnp.org/schemas/qos/TrafficDescriptor-v3.xsd">
  <TrafficHandle></TrafficHandle>
  <TrafficId>
    <v2TrafficId>
      <v3TrafficId>
        <SourceUuid>uuid:1fac1234-31f8-11b4-a222-08002b34c003</SourceUuid>
        <DestinationUuid>uuid:2fac1234-31f8-11b4-a222-08002b34c003</DestinationUuid>
      </v3TrafficId>
    </v2TrafficId>
  </TrafficId>
  <AvailableOrderedTspecList>
    <Tspec>
      <TspecIndex>1</TspecIndex>
      <TrafficClass>AV</TrafficClass>
      <v2TrafficSpecification>
        <v3TrafficSpecification>
          <RequestedQosType>2</RequestedQosType>
          <DataRate>10000000</DataRate>
          <E2EMaxDelayHigh>10000</E2EMaxDelayHigh>
          <E2EMaxDelayLow>1000</E2EMaxDelayLow>
          <E2EMaxJitter>100</E2EMaxJitter>
        </v3TrafficSpecification>
      </v2TrafficSpecification>
    </Tspec>
  </AvailableOrderedTspecList>
  <TrafficLeaseTime>10000</TrafficLeaseTime>
  <OptionalPolicyParams>
    <CpName>Amy's CP</CpName>
  </OptionalPolicyParams>
</TrafficDescriptor>
```

The following is an example *TrafficDescriptor* that a Control Point could create to request prioritized QoS at the *QosManager* Service.

```
<?xml version="1.0" encoding="UTF-8"?>
<TrafficDescriptor
  xmlns="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:prv="http://myPrivate.com"
  xmlns:prv2="http://myPrivate2.com"
  xsi:schemaLocation="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd
    http://www.upnp.org/schemas/qos/TrafficDescriptor-2-20060624.xsd">
  <!-- prv and prv2 are for illustration purpose only to show how
    vendor specific namespaces could be added -->
  <TrafficHandle>kiwin1</TrafficHandle>
  <TrafficId>
    <SourceAddress>
      <Ipv4>192.168.1.50</Ipv4>
    </SourceAddress>
    <SourcePort>23</SourcePort>
```

```

<DestinationAddress>
  <Ipv4>192.168.1.53</Ipv4>
</DestinationAddress>
<DestinationPort>23</DestinationPort>
<IpProtocol>1</IpProtocol>
<v2TrafficId>
  <v3TrafficId>
    <Whatever>whatever</Whatever>
  </v3TrafficId>
  <prv2:MyPrivate2>whatever</prv2:MyPrivate2>
</v2TrafficId>
  <prv:MyPrivate1>whatever</prv:MyPrivate1>
</TrafficId>
<AvailableOrderedTspecList>
  <Tspec>
    <TspecIndex>300</TspecIndex>
    <TrafficClass>AV</TrafficClass>
  </Tspec>
  <Tspec>
    <TspecIndex>2</TspecIndex>
    <TrafficClass>Audio</TrafficClass>
    <v2TrafficSpecification>
      <v3TrafficSpecification>
        <Whatever>whatever</Whatever>
      </v3TrafficSpecification>
      <prv2:MyPrivate2>whatever</prv2:MyPrivate2>
    </v2TrafficSpecification>
    <prv:MyPrivate1>whatever</prv:MyPrivate1>
  </Tspec>
</AvailableOrderedTspecList>
<ActiveTspecIndex>300</ActiveTspecIndex>
<TrafficImportanceNumber>5</TrafficImportanceNumber>
<v2>
  <v3>
    <Whatever>whatever</Whatever>
  </v3>
  <prv2:MyPrivate2>whatever</prv2:MyPrivate2>
</v2>
<prv:MyPrivate1>whatever</prv:MyPrivate1>
<OptionalPolicyParams>
  <CpName>Amy's CP</CpName>
  <v2OptionalParams>
    <v3OptionalParams>
      <Whatever>whatever</Whatever>
    </v3OptionalParams>
    <prv2:MyPrivate2>whatever</prv2:MyPrivate2>
  </v2OptionalParams>
  <prv:MyPrivate1>whatever</prv:MyPrivate1>
</OptionalPolicyParams>
</TrafficDescriptor>

```

Different Tspec(s) for the same traffic could be differentiated using traffic class and other TSPEC parameters as shown below.

```

<?xml version="1.0" encoding="UTF-8"?>
<TrafficDescriptor
  xmlns="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd
  http://www.upnp.org/schemas/qos/TrafficDescriptor-2-20060624.xsd">
  <TrafficHandle>kiwin1</TrafficHandle>
  <TrafficId>
    <SourceAddress>
      <Ipv4>192.168.1.50</Ipv4>
    </SourceAddress>
    <SourcePort>23</SourcePort>
    <DestinationAddress>
      <Ipv4>192.168.1.53</Ipv4>
    </DestinationAddress>
    <DestinationPort>23</DestinationPort>
    <IpProtocol>1</IpProtocol>
  </TrafficId>
  <AvailableOrderedTspecList>
    <Tspec>
      <TspecIndex>300</TspecIndex>
      <TrafficClass>AV</TrafficClass>
    </Tspec>
  </Tspec>

```

```

    <TspecIndex>2</TspecIndex>
    <TrafficClass>Audio</TrafficClass>
  </Tspec>
</AvailableOrderedTspecList>
<ActiveTspecIndex>300</ActiveTspecIndex>
<TrafficImportanceNumber>5</TrafficImportanceNumber>
<v2>
  <PolicyHolderId>
    uuid:XYZ-Com-QosPolicyHolder-T001:serviceId:qphT2
  </PolicyHolderId>
  <PolicyLastModified>2004-11-26T15:03:23-08:00</PolicyLastModified>
  <PolicyModifyingUserName>Amy</PolicyModifyingUserName>
  <PolicyHolderConfigUrl>http://10.0.0.50/ConfigPolicy.html
</PolicyHolderConfigUrl>
</v2>
  <OptionalPolicyParams>
    <CpName>Amy's CP</CpName>
  </OptionalPolicyParams>
</TrafficDescriptor>

```

2.2.3 A_ARG_TYPE_TrafficHandle

This state variable contains a unique identifier associated with a particular instance of TrafficDescriptor, i.e. a particular traffic stream. It is a unique string generated by the [QosManager](#) and provided to the Control Point in response to the [RequestTrafficQos\(\)](#) and [RequestExtendedTrafficQos\(\)](#) action. In all subsequent communication between the Control Point and the [QosManager](#) service, [TrafficHandle](#) is used to reference a particular traffic stream. The [QosManager](#) MUST ensure that TrafficHandle is a unique string that identifies one and only one TrafficDescriptor on the network.

2.2.4 A_ARG_TYPE_NumTrafficDescriptors

This state variable contains the number of Traffic Descriptors registered/admitted on the network as reported by the [QosManager](#) service. This information is returned in response to the [BrowseAllTrafficDescriptors\(\)](#) action call from the Control Point.

2.2.5 A_ARG_TYPE_NumPolicyHolders

This state variable contains the number of instances of [QosPolicyHolder](#) service discovered by a given instance of the [QosManager](#) service. This variable is returned in response to [RequestTrafficQos\(\)](#) and [UpdateTrafficQos\(\)](#) actions (as an output argument) to convey to a Control Point the number of active [QosPolicyHolders](#) on the network.

If the value of this variable is not equal to 1, it means that the default policy was used by the [QosManager](#) to make admission control decisions.

A value of "1" indicates that the policy provided by the Control Point selected [QosPolicyHolder](#) Service has been used or that exactly one [QosPolicyHolder](#) was found on the network or the preferred [QosPolicyHolder](#) on the network has been used. The actual [QosPolicyHolder](#) Service and its type used by the [QosManager](#) are identified by the [PolicyHolderConsultedId](#) and [PolicyHolderConsultedType](#) parameters in the traffic descriptor.

2.2.6 A_ARG_TYPE_ListOfTrafficDescriptors

This is a **string** containing an XML fragment. It contains information describing the ListOfTrafficDescriptors structure. This structure contains a list of traffic descriptors each with the information for a traffic stream.

The XML fragment in this argument MUST validate against the XML schema for ListOfTrafficDescriptors in the XML namespace "http://www.upnp.org/schemas/ListOfTrafficDescriptors.xsd" which is located at "http://www.upnp.org/schemas/qos/ListOfTrafficDescriptors-v3.xsd".

2.2.6.1 Sample argument XML string

Example 1:

```

<?xml version="1.0" encoding="UTF-8"?>
<ListOfTrafficDescriptors
  xsi:schemaLocation="http://www.upnp.org/schemas/ListOfTrafficDescriptors.xsd
    ListOfTrafficDescriptors-v3.xsd"
  xmlns="http://www.upnp.org/schemas/ListOfTrafficDescriptors.xsd"
  xmlns:n2="http://www.altova.com/samplexml/other-namespace"
  xmlns:td2="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<TrafficDescriptor>
<td2:TrafficHandle>TH1b4-a222-08002b34c0037f921234-723c-11b4</td2:TrafficHandle>
<td2:TrafficId>
<SourceAddress>
  <Ipv4>192.168.1.1</Ipv4>
</SourceAddress>
<SourcePort>554</SourcePort>
<DestinationAddress>
  <Ipv4>192.168.1.3</Ipv4>
</DestinationAddress>
<DestinationPort>7572</DestinationPort>
<IpProtocol>17</IpProtocol>
<v2TrafficId>
  <v3TrafficId>
    <SourceUuid>2fac1234-31f8-11b4-a222-08002b34c003</SourceUuid>
    <DestinationUuid>7f921234-723c-11b4-a222-2fac2b34c003</DestinationUuid>
  </v3TrafficId>
</v2TrafficId>
</td2:TrafficId>
<td2:AvailableOrderedTspecList>
<td2:Tspec>
  <td2:TspecIndex>1</td2:TspecIndex>
  <AvTransportUri>rtsp://192.168.1.1/Movies/Sample1.mpeg</AvTransportUri>
  <AvTransportInstanceId>0</AvTransportInstanceId>
  <TrafficClass>AV</TrafficClass>
  <v2TrafficSpecification>
    <v3TrafficSpecification>
      <RequestedQosType>2</RequestedQosType>
      <DataRate>15000000</DataRate>
      <PeakDataRate>20000000</PeakDataRate>
      <E2EMaxDelayHigh>10000</E2EMaxDelayHigh>
      <E2EMaxDelayLow>1000</E2EMaxDelayLow>
      <E2EMaxJitter>100</E2EMaxJitter>
      <ServiceType>1</ServiceType>
    </v3TrafficSpecification>
  </v2TrafficSpecification>
</td2:Tspec>
</td2:AvailableOrderedTspecList>
<ActiveTspecIndex>1</ActiveTspecIndex>
<TrafficImportanceNumber>5</TrafficImportanceNumber>
<MediaServerConnectionId>8973247048732</MediaServerConnectionId>
<MediaRendererConnectionId>7492</MediaRendererConnectionId>
<TrafficLeaseTime>10000</TrafficLeaseTime>
<v2>
  <PolicyHolderId>
    2fac1234-31f8-11b4-a222-08002b34c003:urn:upnp-org:serviceId:QosPolicyHolder- 3a
  </PolicyHolderId>
  <PolicyLastModified>2006-12-19T16:39:57-08:00</PolicyLastModified>
  <PolicyModifyingUserName>jpaine</PolicyModifyingUserName>
  <PolicyHolderConfigUrl>http://192.168.1.2/QPH.html</PolicyHolderConfigUrl>
  <v3>
    <Critical>0</Critical>
    <PolicyHolderConsultedId>
      fac1234-31f8-11b4-a222-08002b34c003:urn:upnp-org:serviceId:QosPolicyHolder-3a
    </PolicyHolderConsultedId>
    <PolicyHolderConsultedType>1</PolicyHolderConsultedType>
  </v3>
</v2>
<OptionalPolicyParams>
  <UserName>jpaine</UserName>
  <CpName>HomeQosPolicyHolder</CpName>
</OptionalPolicyParams>
</TrafficDescriptor>
</ListOfTrafficDescriptors>

```

Example 2:

```

<?xml version="1.0" encoding="UTF-8"?>
<ListOfTrafficDescriptors
  xmlns="http://www.upnp.org/schemas/ListOfTrafficDescriptors.xsd"
  xmlns:td="http://www.upnp.org/schemas/TrafficDescriptorv1.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.upnp.org/schemas/ListOfTrafficDescriptors.xsd
http://www.upnp.org/schemas/qos/ListOfTrafficDescriptors-2-20060624.xsd">
  <TrafficDescriptor>
    <td:TrafficHandle>kiwin1</td:TrafficHandle>
    <td:TrafficId>
      <td:SourceAddress>
        <td:Ipv4>192.168.1.50</td:Ipv4>
      </td:SourceAddress>
      <td:SourcePort>23</td:SourcePort>
      <td:DestinationAddress>
        <td:Ipv4>192.168.1.50</td:Ipv4>
      </td:DestinationAddress>
      <DestinationPort>23</DestinationPort>
      <IpProtocol>1</IpProtocol>
    </td:TrafficId>
    <td:AvailableOrderedTspecList>
      <td:Tspec>
        <td:TspecIndex>300</td:TspecIndex>
        <td:TrafficClass>AV</td:TrafficClass>
      </td:Tspec>
      <td:Tspec>
        <td:TspecIndex>2</td:TspecIndex>
        <td:TrafficClass>Audio</td:TrafficClass>
      </td:Tspec>
    </td:AvailableOrderedTspecList>
    <ActiveTspecIndex>1</ActiveTspecIndex>
    <TrafficImportanceNumber>5</TrafficImportanceNumber>
    <OptionalPolicyParams>
      <CpName>Amy's CP</CpName>
    </OptionalPolicyParams>
  </TrafficDescriptor>
  <TrafficDescriptor>
    <td:TrafficHandle>kiwin2</td:TrafficHandle>
    <td:TrafficId>
      <td:SourceAddress>
        <td:Ipv4>192.168.1.53</td:Ipv4>
      </td:SourceAddress>
      <td:SourcePort>23</td:SourcePort>
      <td:DestinationAddress>
        <td:Ipv4>192.168.1.55</td:Ipv4>
      </td:DestinationAddress>
      <td:DestinationPort>23</td:DestinationPort>
      <td:IpProtocol>1</td:IpProtocol>
    </td:TrafficId>
    <td:AvailableOrderedTspecList>
      <td:Tspec>
        <td:TspecIndex>300</td:TspecIndex>
        <td:TrafficClass>AV</td:TrafficClass>
      </td:Tspec>
      <td:Tspec>
        <td:TspecIndex>2</td:TspecIndex>
        <td:TrafficClass>Audio</td:TrafficClass>
      </td:Tspec>
    </td:AvailableOrderedTspecList>
    <ActiveTspecIndex>1</ActiveTspecIndex>
    <TrafficImportanceNumber>5</TrafficImportanceNumber>
    <OptionalPolicyParams>
      <CpName>Amy's CP</CpName>
    </OptionalPolicyParams>
  </TrafficDescriptor>
</ListOfTrafficDescriptors>

```

2.2.7 A_ARG_TYPE_QmCapabilities

This is a **string** containing an XML fragment. It contains information describing [QosManager](#) Service capabilities. The XML fragment in this argument MUST validate against the XML

schema for [QmCapabilities](#) in the XML namespace "urn:schemas-upnp-org:qos:QmCapabilities" which is located at "http://www.upnp.org/schemas/qos/QmCapabilities-v3.xsd".

2.2.7.1 Description of fields in the A_ARG_TYPE_QmCapabilities structure

ReportBlockingStreams: This **boolean** field is a required field. The [ReportBlockingStreams](#) field indicates whether information about blocking streams will be reported to a Control Point or not.

Preemption: This **boolean** field is a required field. The [Preemption](#) field indicates whether this [QosManager](#) performs Preemption.

2.2.7.2 Sample argument XML string

2.2.7.3

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2007 rel. 3 sp1 (http://www.altova.com)-->
<QmCapabilities xsi:schemaLocation="urn:schemas-upnp-org:qos:QmCapabilities
QmCapabilities-v3-20070510.xsd" xmlns="urn:schemas-upnp-org:qos:QmCapabilities"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <PreemptionCapabilities>
    <ReportBlockingStreams>1</ReportBlockingStreams>
    <Preemption>1</Preemption>
  </PreemptionCapabilities>
</QmCapabilities>
```

2.2.8 A_ARG_TYPE_ExtendedTrafficQosInfo

This is a **string** containing an XML fragment. It contains information describing [ExtendedTrafficQosInfo](#) structure.

The XML fragment in this argument MUST validate against the XML schema for [ExtendedTrafficQosInfo](#) in the XML namespace "urn:schemas-upnp-org:qos:ExtendedTrafficQosInfo" which is located at "http://www.upnp.org/schemas/qos/ExtendedTrafficQosInfo-v3.xsd"

This structure provides information about a list of existing streams blocking the admission of a new traffic stream on a given QoS Segment. The information contained in this structure is obtained by the [QosManager](#) from [QosDevice](#) Services residing on the failed QoS Segments on the path of the requested stream.

The information for an individual blocking stream consists of layer-2 stream information such as QosSegmentId, Layer2StreamId, and UPnP-QoS specific information such as TrafficDescriptor and the UserImportanceNumber, if available.

2.2.8.1 Description of fields in the A_ARG_TYPE_ExtendedTrafficQosInfo structure

UINOfCurrentStream: This is a required field is of type **ui4**. It represents the [UserImportanceNumber](#) of a traffic stream that cannot be admitted due to Blocking Streams listed in this structure. It's value ranges from 0 to 255.

QosSegmentId: The value is of type **string** and uniquely identifies a failed QoS Segment for a blocking stream.

TrafficDescriptor: This is an optional field. It provides the TrafficDescriptor of a Blocking Stream on a given QoS Segment.

UserImportanceNumber: This is an optional field. It provides the [UserImportanceNumber](#) of a Blocking Stream.

Layer2StreamId: This is a required field. This indicates layer-2 identifier of a blocking stream. This is included in the return argument of [QD:AdmitTrafficQos](#) or [QD:UpdateTrafficQos](#) action upon failure.

2.2.8.2 Sample argument XML string

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2008 sp1 (http://www.altova.com)-->
<ExtendedTrafficQosInfo xsi:schemaLocation="urn:schemas-upnp-org:qos:ExtendedTrafficQosInfo ExtendedTrafficQosInfo-v3.xsd" xmlns="urn:schemas-upnp-org:qos:ExtendedTrafficQosInfo"
xmlns:n2="http://www.altova.com/samplexml/other-namespace"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<UINOfCurrentStream>200</UINOfCurrentStream>
<BlockingStreamsPerSegment>
  <QosSegmentId>174957c7aff8e2a0d</QosSegmentId>
  <BlockingStreamInfo>
    <TrafficDescriptor>
      <TrafficHandle>TH1b4-a222-08002b34c0037f921234-723c-11b4</TrafficHandle>
      <TrafficId>
        <SourceAddress>
          <Ipv4>192.168.1.1</Ipv4>
        </SourceAddress>
        <SourcePort>554</SourcePort>
        <DestinationAddress>
          <Ipv4>192.168.1.3</Ipv4>
        </DestinationAddress>
        <DestinationPort>7572</DestinationPort>
        <IpProtocol>17</IpProtocol>
        <v2TrafficId>
          <v3TrafficId>
            <SourceUid>2fac1234-31f8-11b4-a222-08002b34c003</SourceUid>
            <DestinationUid>7f921234-723c-11b4-a222-2fac2b34c003</DestinationUid>
          </v3TrafficId>
        </v2TrafficId>
      </TrafficId>
      <AvailableOrderedTspecList>
        <Tspec>
          <TspecIndex>1</TspecIndex>
          <AvTransportUri>rtsp://192.168.1.1/Movies/Sample1.mpeg</AvTransportUri>
          <AvTransportInstanceId>0</AvTransportInstanceId>
          <TrafficClass>AV</TrafficClass>
          <v2TrafficSpecification>
            <v3TrafficSpecification>
              <RequestedQosType>2</RequestedQosType>
              <DataRate>15000000</DataRate>
              <PeakDataRate>20000000</PeakDataRate>
              <E2EMaxDelayHigh>10000</E2EMaxDelayHigh>
              <E2EMaxDelayLow>1000</E2EMaxDelayLow>
              <E2EMaxJitter>100</E2EMaxJitter>
              <QosSegmentSpecificParameters>
                <InterfaceId>String</InterfaceId>
                <QosSegmentId>174957c7aff8e2a0d</QosSegmentId>
                <QosSegmentMaxDelayHigh>5000</QosSegmentMaxDelayHigh>
                <QosSegmentMaxDelayLow>500</QosSegmentMaxDelayLow>
                <QosSegmentMaxJitter>75</QosSegmentMaxJitter>
              </QosSegmentSpecificParameters>
              <ServiceType>true</ServiceType>
            </v3TrafficSpecification>
          </v2TrafficSpecification>
        </Tspec>
      </AvailableOrderedTspecList>
      <ActiveTspecIndex>1</ActiveTspecIndex>
      <TrafficImportanceNumber>5</TrafficImportanceNumber>
      <MediaServerConnectionId>8973247048732</MediaServerConnectionId>
      <MediaRendererConnectionId>7492</MediaRendererConnectionId>
      <TrafficLeaseTime>10000</TrafficLeaseTime>
    </v2>
    <PolicyHolderId>
      2fac1234-31f8-11b4-a222-08002b34c003:urn:upnp-org:serviceId:QosPolicyHolder-3a
    </PolicyHolderId>
    <PolicyLastModified>2006-12-19T16:39:57-08:00</PolicyLastModified>
    <PolicyModifyingUserName>jpaine</PolicyModifyingUserName>
  </BlockingStreamInfo>
</BlockingStreamsPerSegment>
</ExtendedTrafficQosInfo>
```

```

<PolicyHolderConfigUrl>http://192.168.1.2/QPH.html</PolicyHolderConfigUrl>
<v3>
  <Critical>0</Critical>
  <PolicyHolderConsultedId>
    2fac1234-31f8-11b4-a222-08002b34c003:urn:upnp-org:serviceId:QosPolicyHolder-3a
  </PolicyHolderConsultedId>
  <PolicyHolderConsultedType>3</PolicyHolderConsultedType>
</v3>
</v2>
<OptionalPolicyParams>
  <UserName>jpaine</UserName>
  <CpName>HomeQosPolicyHolder</CpName>
</OptionalPolicyParams>
</TrafficDescriptor>
<UserImportanceNumber>10</UserImportanceNumber>
<Layer2StreamId>
  0c14cd560c14cd560c14cd560c14cd560c14cd560c14cd560c14cd560c14cd56
</Layer2StreamId>
</BlockingStreamInfo>
</BlockingStreamsPerSegment>
</ExtendedTrafficQosInfo>

```

2.2.9 A_ARG_TYPE_ResultedQoSType

This is a non-negative integer field that indicates the type of Quality of Service established for a traffic stream by the QoS Manager as a result of RequestExtendedTrafficQos() or UpdateExtendedTrafficQos() actions.

Table 2-5 — Meaning of ResultedQoSType parameter

Value	Meaning
0	Prioritized QoS The traffic stream is successfully set up using prioritized QoS for every QoS segment it traverses. This includes, in particular, prioritized QoS setup for QoS segments that support parameterized QoS.
1	Hybrid QoS The traffic stream is successfully admitted on every parameterized QoS segment it traverses and is set up using prioritized QoS on every prioritized QoS segment it traverses.
2	Parameterized QoS This traffic stream is successfully admitted on every parameterized QoS segments it traverses and the traffic stream does not traverse any non-parameterized QoS segment.
3 and higher	Reserved

2.2.10 Relationships Between State Variables

None

2.3 Eventing and Moderation

Table 2-6 — Event Moderation

Variable Name	Evented	Moderated Event	Max Event Rate ^a	Logical Combination	Min Delta per Event ^b
A_ARG_TYPE_TrafficDescriptor	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_TrafficHandle	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_NumTrafficDescriptors	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_NumPolicyHolders	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_ListOfTrafficDescriptors	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_QmCapabilities	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_ExtendedTrafficQosInfo	NO	n/a	n/a	n/a	n/a
A_ARG_TYPE_ResultedQosType	NO	n/a	n/a	n/a	n/a

^a Determined by N, where Rate = (Event)/(N secs).

^b (N) * (allowedValueRange Step).

2.3.1 Event Model

This service does not expose any eventing state variables.

2.4 Actions

Immediately following this table is detailed information about these actions, including short descriptions of the actions, the effects of the actions on state variables, and error codes defined by the actions.

Table 2-7 — Actions

Name	Req. or Opt. ^a
RequestTrafficQos()	R
UpdateTrafficQos()	R
ReleaseTrafficQos()	R
BrowseAllTrafficDescriptors()	R
GetQmCapabilities()	R
RequestExtendedTrafficQos()	O
UpdateExtendedTrafficQos()	O

^a R = Required, O = Optional, X = Non-standard

2.4.1 RequestTrafficQos()

A Control Point invokes this action for setting up QoS for a particular traffic stream. This action does not support optional extended capabilities such as preemption, reporting of blocking streams, etc.

The Control Point uses the *RequestTrafficQos()* action exposed by the *QosManager* Service to establish prioritized, parameterized or hybrid QoS for a stream. The Control Point puts the *InitialTrafficDescriptor* as an input argument in the *RequestTrafficQos()* action. The type of QoS established for the stream is determined by the absence or presence and value of the *RequestedQosType* parameter in the *InitialTrafficDescriptor*.

If the Control Point does not include the *RequestedQosType* parameter in the *InitialTrafficDescriptor* (e.g., legacy 2.0/1.0 CP), by default, the *QoS Manager* attempts to

establish prioritized QoS on all the QoS Segments on the path of the stream. If the value of RequestedQosType parameter is set to “0” (i.e., prioritized-only), the QoS Manager attempts to establish prioritized QoS on all the QoS Segments on the path of the stream. If the value of the RequestedQosType parameter is set to “1” (i.e., Hybrid), the QoS Manager attempts to establish parameterized QoS on the QoS Segments that support parameterized QoS and attempts to establish prioritized QoS on the QoS Segments that only support prioritized QoS. If the value of the RequestedQosType parameter is set to “2” (i.e., parameterized-only), the QoS Manager attempts to establish parameterized QoS on all the QoS Segments on the path of the stream.

2.4.1.1 Arguments

Table 2-8 — Arguments for RequestTrafficQos()

Argument	Direction	relatedStateVariable
InitialTrafficDescriptor	In	A_ARG_TYPE_TrafficDescriptor
TrafficHandle	Out	A_ARG_TYPE_TrafficHandle
NumPolicyHolders	Out	A_ARG_TYPE_NumPolicyHolders
UpdatedTrafficDescriptor	Out	A_ARG_TYPE_TrafficDescriptor

2.4.1.2 Service requirements

2.4.1.2.1 Base Requirements

The following generic requirements apply irrespective of the absence or presence and the value of the RequestedQosType parameter in the InitialTrafficDescriptor input argument:

- If a Control Point supplies TrafficImportanceNumber in TrafficDescriptor to the QosManager Service when calling the RequestTrafficQos() action, the QosManager Service MUST return an error (Error Code 721).
- If a Control Point supplies ActiveTspecIndex in TrafficDescriptor to QosManager Service when calling the RequestTrafficQos() action, the QosManager Service MUST return an error (Error Code 722).
- The QosManager Service MUST include a valid ActiveTspecIndex value in the TrafficDescriptor when it returns a non error value in response to RequestTrafficQos().
- If a Control Point supplies a non-null TrafficHandle in the RequestTrafficQos() action of QosManager Service, the QosManager Service MUST return error code 701.
- If a Control Point supplies PolicyLastModified, PolicyModifyingUserName, or PolicyHolderConfigUrl when calling the RequestTrafficQos() action, the QosManager Service MUST return error code 715.
- If a Control Point does not supply a unique TspecIndex for every Tspec within an AvailableOrderedTspecList, then the QosManager Service MUST return the error 725.
- If the QosManager consults a QosPolicyHolder Service, the QosManager Service MUST include the TrafficPolicy parameters received from QPH:GetTrafficPolicy() or QPH:GetListOfTrafficPolicies() action in the TrafficDescriptor when successfully returning the UpdatedTrafficDescriptor. The QosManager Service MUST always include QosPolicyHolderId.
- If the QoS Manager is successful in establishing QoS for a traffic stream on the entire path (i.e. QD:SetupTrafficQos() and/or QD:AdmitTrafficQos() actions are successfully executed on all the QosDevice Service on the path), the QosManager Service MUST return the admitted traffic descriptor to the Control Point in the UpdatedTrafficDescriptor output argument of the RequestTrafficQos() action.
- The QosManager Service MUST populate all the fields of the TrafficId in the UpdatedTrafficDescriptor.

- If the QoS Manager obtains the MaxCommittedDelay for every QoS Segment on the path, then the QoSManager Service MUST populate E2EMaxDelayHigh in the UpdatedTrafficDescriptor.
- If the QoS Manager obtains the MaxCommittedDelayJitter for every QoS Segment on the path, then the QoSManager Service MUST populate the E2EMaxJitter in the UpdatedTrafficDescriptor.
- The QoSManager Service MUST NOT return QoSSegmentSpecificParameter in the UpdatedTrafficDescriptor.
- If the QoSManager consults a QoSPolicyHolder Service, the QoSManager Service MUST return the value of “1” for the NumPolicyHolders output argument if it uses the preferred QoSPolicyHolder Service OR the QoSPolicyHolder Service supplied by the Control Point OR a single available QoSPolicyHolder Service on the network. The actual QoSPolicyHolder Service and its type used by the QoSManager Service are identified by the PolicyHolderConsultedId and PolicyHolderConsultedType parameters in the UpdatedTrafficDescriptor output argument.
- If the QoSManager doesn't consult a QoSPolicyHolder Service (e.g. in case of RequestedQoSType = “2” or when the QoS Manager uses default policies for RequestedQoSType = “0” and “1”), the QoSManager Service MUST return the actual number of QoSPolicyHolder Services discovered on the network.

2.4.1.2.2 RequestedQoSType Specific Requirements

The following requirements apply when RequestedQoSType parameter is present in the InitialTrafficDescriptor input parameter:

- For the RequestedQoSType parameter with the value of “1” or “2”, if the QoS Manager is unable to successfully admit the traffic stream on all the 3.0 QoSDevice Services on the path (with or without retries), the QoSManager Service MUST return Error Code 765 to the Control Point.
- For the RequestedQoSType parameter with the value of “2”, if the QoS Manager identifies that some of the QoS Segments on the path do not support parameterized QoS and no less preferred TSPEC is supplied, the QoSManager Service MUST return error to the CP in response to RequestTrafficQos() action with error code of 782.
- If a Control Point supplies the RequestedQoSType parameter with the value greater than “2”, the QoSManager Service MUST return error with Error Code 718 to the Control Point.
- For the RequestedQoSType parameter with the value of “1” or “2”, if a Control Point does not supply a value for the TrafficLeaseTime field in the InitialTrafficDescriptor input argument, the QoSManager Service MUST return error with Error Code 791 to the Control Point.
- For the RequestedQoSType parameter with the value of “1” or “2”, if a Control Point supplies the value for the E2EMaxDelayLow parameter but does NOT supply the value for the E2EMaxDelayHigh in the input TSPEC parameters, the QoSManager Service MUST return error with Error Code 792 to the Control Point.

2.4.1.3 Control Point requirements when calling the action

2.4.1.3.1 Base Requirements

The following generic requirements apply irrespective of the absence or presence and value of RequestedQoSType parameter in the InitialTrafficDescriptor input parameter:

- A Control Point MUST supply a TrafficHandle element with a null value (i.e. empty string) to the RequestTrafficQos() action.
- A Control Point MUST supply a TrafficId structure which contains at least either SourceAddress or SourceUuid and either DestinationAddress or DestinationUuid.

- A UPnP AV Control Point, when invoking the QoSManager Service, MUST supply the AVTransportURI, AVTransportInstanceId, MediaServerConnectionId and MediaRendererConnectionId.
- A Control Point MUST NOT supply TrafficImportanceNumber & UserImportanceNumber in InitialTrafficDescriptor when calling the RequestTrafficQos() action.
- A Control Point MUST supply a unique TspecIndex for every Tspec within an AvailableOrderedTspecList.
- A Control Point MUST NOT supply an ActiveTspecIndex when invoking RequestTrafficQos().
- If a Control Point supplies a QosBoundarySourceAddress, it MUST be a valid IP Address. The 0.0.0.0 option for the “don’t care” address does not apply to QosBoundarySourceAddress.
- If a Control Point supplies a QosBoundaryDestinationAddress it MUST be a valid IP Address. The 0.0.0.0 option for the “don’t care” address does not apply to QosBoundaryDestinationAddress.
- Whenever a Control Point specifies a PolicyHolderId it MUST specify a valid Id for a PolicyHolder as defined in the QosPolicyHolder service definition. [POLICY HOLDER].
- A Control Point MUST NOT supply PolicyLastModified, PolicyModifyingUserName, PolicyHolderConfigUrl as a part of InitialTrafficDescriptor.

2.4.1.3.2 RequestedQosType Specific Requirements

The following requirements apply when RequestedQosType parameter is present in the InitialTrafficDescriptor input parameter:

- A Control Point MUST NOT supply a value greater than “2” for the RequestedQosType parameter.
- For the RequestedQosType parameter with the value of “1” or “2”, a Control Point MUST supply a value for the TrafficLeaseTime field in the InitialTrafficDescriptor input argument.
- For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point supplies a value for the E2EMaxDelayLow as one of the input TSPEC parameters, then the Control Point MUST also supply the value for the E2EMaxDelayHigh parameters in the TSPEC.

2.4.1.4 QoS Manager Requirements

2.4.1.4.1 Base Requirements

The following generic requirements apply irrespective of the absence or presence and value of RequestedQosType parameter in the InitialTrafficDescriptor input parameter:

The QoS Manager MUST NOT supply any of the TrafficPolicy elements in the TrafficDescriptor when calling the **QPH:GetTrafficPolicy** action.

When a Control Point calls the RequestTrafficQos() action and the QoS Manager subsequently invokes actions with a TrafficDescriptor as an argument, the QoS Manager MUST NOT modify those elements that MUST equal the original TrafficDescriptor according to Table 2-9.

Table 2-9 — Elements that MUST equal those of the original TrafficDescriptor

Parameter Name	Must equal original TrafficDescriptor?	Comments
TrafficHandle	No	
TrafficId	Not applicable	See sub-elements below
. SourceAddress	Yes, if supplied	If not supplied by the Control Point, QM

Parameter Name	Must equal original TrafficDescriptor?	Comments
		obtains it from the QD
. SourcePort	Yes, if supplied	If not supplied by the Control Point, QM obtains it from the QD
. DestinationAddress	Yes, if supplied	If not supplied by the Control Point, QM obtains it from the QD
. DestinationPort	Yes, if supplied	If not supplied by the Control Point, QM obtains it from the QD
. IpProtocol	Yes, if supplied	If not supplied by the Control Point, QM obtains it from the QD
. v2TrafficId	Not applicable	See sub-elements below
. . v3TrafficId	Not applicable	See sub-elements below
. . . SourceUuid	Yes, if supplied	
. . . DestinationUuid	Yes, if supplied	
AvailableOrderedTspecList	Not applicable	See sub-elements below
. Tspec	Yes	
. . TspecIndex	Yes	
. . AvTransportUri	Yes	
. . AvTransportInstanceId	Yes	
. . TrafficClass	Yes	
. . v2TrafficSpecification	Not applicable	See sub-elements below
. . . v3TrafficSpecification	Not applicable	See sub-elements below
. . . . RequestedQosType	Yes, if supplied	
. . . . DataRate	Yes	
. . . . MaxBurstSize	Yes	
. . . . MinServiceRate	Yes	
. . . . ReservedServiceRate	Yes	
. . . . TimeUnit	Yes	
. . . . MaxPacketSize	Yes	
. . . . E2EMaxDelayHigh	Yes	
. . . . E2EMaxDelayLow	Yes	
. . . . E2EMaxJitter	Yes	
. . . . QosSegmentSpecificParameters	Not applicable	See sub-elements below
. InterfaceId	Not applicable	
. QosSegmentId	Not applicable	
. QosSegmentMaxDelayHigh	Not applicable	
. QosSegmentMaxDelayLow	Not applicable	
. QosSegmentMaxJitter	Not applicable	
. . . . MaxServiceInterval	Yes	
. . . . MinServiceInterval	Yes	
. . . . LossSensitivity	Yes	
. . . . ServiceType	Yes	
ActiveTspecIndex	No	
TrafficImportanceNumber	No	
QosBoundarySourceAddress	Yes	
QosBoundaryDestinationAddress	Yes	

Parameter Name	Must equal original TrafficDescriptor?	Comments
MediaServerConnectionId	Yes	
MediaRendererConnectionId	Yes	
TrafficLeaseTime	Yes	
PolicyHolderId	No	
PolicyLastModified	No	
PolicyModifyingUserName	No	
PolicyHolderConfigUrl	No	
QosBoundarySourceUuid	Yes	
QosBoundaryDestinationUuid	Yes	
Critical	Yes	
PolicyHolderConsultedId	No	
PolicyHolderConsultedType	No	
OptionalPolicyParams	Not applicable	See sub-elements below
. UserName	Yes	
. VendorApplicationName	Yes	
. PortName	Yes	
. ServiceProviderServiceName	Yes	
. CpName	Yes	

2.4.1.4.2 QoS Policy Retrieval Requirements for establishing Prioritized QoS

If the QoS Manager fails to discover any QosPolicyHolder service, the QoS Manager MUST perform the following steps:

- The QoS Manager MUST use the default policy of first-come-first serve admission control
- The QoS Manager MUST use the default priorities based on IEEE 802.1D Annex G as described below in Table 2-5.
- The QoS Manager MUST use default value of “Enabled” for the AdmissionPolicy.

The following table describes how the QoS Manager derives default priorities to be used in the TrafficImportanceNumber field. The QoS Manager takes the value of Traffic Class from the TSPEC found inside the Traffic Descriptor structure, and looks up the corresponding default priority from the following table:

Table 2-10 — Default Priorities used by the QoS Manager based on 802.1D (Annex G)

Traffic Class	802.1D (Annex G) Traffic Type	Default Priority (Traffic Importance Number)
Network Control	NC	7
Streaming Control	NC	7
Voice	VO	6
Gaming	VO	6
AV	VI	5
Audio	VI	5
Image	EE	3
Data	BE	0
Background	BK	1
Other	BE	0

When a Control Point calls the *RequestTrafficQos()* action, if a *QoS Manager* discovers one or more *QoSPolicyHolder* Services on the network the *QoS Manager* MUST follow the following steps:

- If the *QoSPolicyHolder* Service identified in the *PolicyHolderId* parameter of the input traffic descriptor is available, the *QoS Manager* MUST use the *QPH:GetTrafficPolicy()* action to retrieve the TrafficPolicy from that *QoSPolicyHolder* service. The *QoS Manager* MUST perform admission control, as defined in UPnP-QoS v2, if the *AdmissionPolicy* output parameter of the *QPH:GetTrafficPolicy()* is *Enabled*. If the *QoSPolicyHolder* Service identified in the *PolicyHolderId* is not available, the *QoSManager* responds to *RequestTrafficQos()* or *UpdateTrafficQos()* with error 780.
- If a *PolicyHolderId* is not provided in the *PolicyHolderId* parameter of the input traffic descriptor, the *QoS Manager* MUST identify if there is a preferred *QoSPolicyHolder* Service on the network as described in clause 2.4.1.4.3.
- If the *QoS Manager* determines that there is a preferred *QoSPolicyHolder* Service selected and available on the network, the *QoS Manager* MUST invoke *QPH:GetTrafficPolicy()* on the preferred *QoSPolicyHolder* Service. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “3” (Preferred) and MUST populate the UDN+ServiceId of the preferred *QoSPolicyHolder* in the *PolicyHolderConsultedId* parameter. If the preferred *QoSPolicyHolder* isn’t available, the *QoS Manager* MUST use default policy of first-come-first serve admission control with default priorities based on IEEE 802.1D Annex G. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “0” (Default) and MUST set *PolicyHolderConsultedId* parameter to NULL.
- If the *QoS Manager* determines that no preferred *QoSPolicyHolder* Service is selected on the network and there is a single *QoSPolicyHolder* on the network, the *QoS Manager* MUST invoke *QPH:GetTrafficPolicy()* on that *QoSPolicyHolder* Service. The *QoS Manager* MUST perform admission control, as defined in UPnP-QoS v2, if the *AdmissionPolicy* output parameter of the *QPH:GetTrafficPolicy()* is *Enabled*. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “1” (Single-Available) and MUST set *PolicyHolderConsultedId* parameter to the the UDN+ServiceId of the single *QoSPolicyHolder* Service available on the network.
- If the *QoS Manager* determines that no preferred *QoSPolicyHolder* Service is selected on the network and there are multiple *QoSPolicyHolder* Services on the network, the *QoS Manager* MUST use default policy of first-come-first serve admission control with default priorities based on IEEE 802.1D Annex G as specified above in Clause 2.4.1.4.2 The *QoS Manager* MUST use the default value of “Enabled” for the AdmissionPolicy. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “0” (Default) and MUST set *PolicyHolderConsultedId* parameter to NULL.

2.4.1.4.3 QoS Policy Retrieval Requirements for Parameterized and Hybrid QoS

When the QoS Manager needs to access QoS policies for a Hybrid or Parameterized stream, it MUST perform the following steps:

The *QoS Manager* invokes the *QD:SetPreferredQph()* action on all the *QoSDevice* Services that implement this action to retrieve the currently stored values of *PreferredQphId* and the *QphPreferenceCount* in those devices. The *QoS Manager* determines which *QphPreferenceCount* is the highest of all those retrieved from *QoSDevice* Services and uses that *QphPreferenceCount* to identify the preferred *QoSPolicyHolder* Service. The *QoSManager* MUST use the *QoSPolicyHolder* Service with the highest *QphPreferenceCount* as the preferred *QoSPolicyHolder* service.

If the *PreferredQphId* value is NULL, then the *QoS Manager* determines that the user did not prefer any *QoSPolicyHolder* Service on the network.

If the *QoS Manager* determines that there is a preferred *QoSPolicyHolder* Service selected and available on the network, for RequestedQosType = “1”, the *QoS Manager* MUST invoke *QPH:GetTrafficPolicy()* action on that preferred *QoSPolicyHolder* Service. When performing “ReportBlockingStreams” or “Preemption” operations for *RequestedQosType* = “1” or “2”, the *QoS Manager* MUST invoke *QPH:GetListOfTrafficPolicies()* on the preferred *QoSPolicyHolder* Service. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “3” (Preferred) and MUST populate the UDN+ServiceId of the preferred *QoSPolicyHolder* in the *PolicyHolderConsultedId* parameter. If the preferred *QoSPolicyHolder* isn’t available, the *QoS Manager* MUST use default policy of first-come-first serve admission control with default priorities based on IEEE 802.1D Annex G. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “0” (Default) and MUST set *PolicyHolderConsultedId* parameter to NULL.

If the *QoS Manager* determines that no preferred *QoSPolicyHolder* Service is selected on the network and there is a single *QoSPolicyHolder* on the network, the *QoS Manager* MUST invoke on that *QoSPolicyHolder* Service *QPH:GetTrafficPolicy()* action for *RequestedQosType* = “1”. When performing “ReportBlockingStreams” or “Preemption” operations for *RequestedQosType* = “1” or “2”, the *QoS Manager* MUST invoke *QPH:GetListOfTrafficPolicies()* on the single available *QoSPolicyHolder* Service. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “1” (Single-Available) and MUST set *PolicyHolderConsultedId* parameter to the the UDN+ServiceId of the single *QoSPolicyHolder* Service available on the network.

If the *QoS Manager* determines that no preferred *QoSPolicyHolder* Service is selected on the network and there are multiple *QoSPolicyHolder* Services on the network, the *QoS Manager* identifies if the *QoSPolicyHolder* supplied by the Control Point (in the *PolicyHolderId* parameter of the traffic descriptor) is available on the network. If the Control Point specified *QoSPolicyHolder* is available, the *QoS Manager* MUST invoke on that *QoSPolicyHolder* service *QPH:GetTrafficPolicy()* action for RequestedQosType = “1”. When performing “ReportBlockingStreams” or “Preemption” operations for *RequestedQosType* = “1” or “2”, the *QoS Manager* MUST invoke *QPH:GetListOfTrafficPolicies()* on the CP supplied *QoSPolicyHolder* Service. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “2” (CP Supplied) and MUST set *PolicyHolderConsultedId* parameter to the UDN+ServiceId of the *QoSPolicyHolder* supplied by the Control Point. If the *QoSPolicyHolder* identified by the *PolicyHolderId* is not available OR the *PolicyHolderId* parameter is not provided, the *QoS Manager* MUST use default policy of first-come-first serve admission control with default priorities based on IEEE 802.1D Annex G as specified above in Clause 2.4.1.4.2 The *QoS Manager* MUST use the default value of “Enabled” for the *AdmissionPolicy*. The *QoS Manager* MUST set the *PolicyHolderConsultedType* in the TrafficDescriptor to “0” (Default) and MUST set *PolicyHolderConsultedId* parameter to NULL.

2.4.1.4.4 Prioritized QoS Establishment Requirements

Upon receiving *RequestTrafficQos()* action with the *RequestedQosType* parameter in the *InitialTrafficDescriptor* either absent or of value “0”, the *QoS Manager* MUST perform the following steps to establish Prioritized QoS for the stream:

The *QoS Manager* MUST obtain QoS traffic policies as specified in Clause 2.4.1.4.2

The *QoS Manager* MAY invoke *QD:GetPathInformation()* action on *QoSDevice* service instances on the network to determine which intermediate devices are on the path from the source to the sink. Some UPnP *QoSDevice* service instances may also expose the *QD:GetQoSDeviceInfo()* action. The *QoS Manager* MAY invoke this action on the source and/or sink device to find out the IP addresses, port number and protocol information associated with that particular Traffic Descriptor, if they are not supplied by the CP. It is possible that some *QoSDevice* services on the path are v3 compliant and some are v2 or older. Depending on their version, the *QoS Manager* MUST invoke the *QD:GetQoSState()* action on v2 *QoSDevice* Services and/or *QD:GetExtendedQoSState()* action on v3 *QoSDevice* Services on the path of the traffic stream to obtain dynamic status about devices. The *QoS Manager* MAY also invoke *QD:GetQoSDeviceCapabilities()* action on v2 *QoSDevice* Services.

QoSStateId is a state variable defined in the QoSDevice that identifies the state of the device when it was queried by a QoS Manager with QD:GetQoSState() action. QoSDevice returns QoSStateId in response to QD:GetQoSState(). Subsequently, the QoS Manager repeats this string as input argument to QD:SetupTrafficQoS(). Please see QoSDevice Service [QOS DEVICE] for more details.

The QoS Manager MUST establish QoS for the most preferred of the TSPECs that are admissible on all the QoSDevice Services on the path from those supplied by the CP in the InitialTrafficDescriptor. The QoS Manager MUST NOT leave any unused allocated resources on the QoSDevice Services.

For v2 QoSDevice Services on the path, the QoSManager MUST invoke QD:SetupTrafficQoS() action. For v3 QoSDevice Services on the path, the QoS Manager MUST invoke either QD:AdmitTrafficQoS() or QD:SetupTrafficQoS() action. Invocation of QD:AdmitTrafficQoS() action is recommended.

If QD:SetupTrafficQoS() and/or QD:AdmitTrafficQoS() actions are successfully executed on all the QoSDevice Services involved, then the UpdatedTrafficDescriptor created by the QoS Manager is returned to the Control Point as an output argument to the RequestTrafficQoS() action. The QoS Manager MUST set the value of ActiveTspeclIndex in the UpdatedTrafficDescriptor to the index of the TSPEC for which the QoS is established.

If QD:SetupTrafficQoS() and/or QD:AdmitTrafficQoS() action fails on any one of the QoSDevice Services, even after retries (if performed), the QoS Manager MUST return Error Code 765 in response to the RequestTrafficQoS() action.

PathInformation state variable of QoSDevice Service is mandatory and it is evented with moderation. Any time there is a change in path information the QoSDevice issues an event and sends the updated PathInformation variable in the body of the event. See [QOS DEVICE] for more details. The QoSManager Service MAY subscribe to these events. Upon receiving an event, the QoSManager Service MAY take an action that it deems necessary e.g. recomputing the topology.

2.4.1.4.5 Parameterized and Hybrid QoS Establishment Requirements

Upon receiving RequestTrafficQoS() action with the RequestedQoSType parameter in the InitialTrafficDescriptor of either "1" or "2", the QoS Manager MUST perform the following steps to establish QoS for the stream:

If the RequestedQoSType parameter is set to "1", the QoS Manager MUST obtain QoS traffic policies as specified in Clause 2.4.1.4.3.

If the RequestedQoSType parameter is set to "2", the QoS Manager MAY obtain QoS traffic policies as specified in Clause 2.4.1.4.3.

The QoS Manager MUST determine which intermediate QoSDevice Services are on the path from the source to the sink.. The QoS Manager MAY invoke QD:GetPathInformation() action on QoSDevice service instances on the network to determine this or may have this information a priori. It is possible that some of the QoSDevice services on the path may not be able to support parameterized-based QoS (e.g. v2 or v1 QoSDevice Services).

The QoS Manager MUST invoke QD:GetQoSState() action on 2.0 or older QoSDevice Services on the path and MUST invoke QD:GetExtendedQoSState() on 3.0 QoSDevice services on the path to obtain the dynamic status of devices. The QoS Manager MAY also invoke QD:GetQoSDeviceCapabilities() action on v2 QoSDevice Services. The ProtoTspecl parameter in the QoSDeviceExtendedState state variable, that is returned as an output argument of QD:GetExtendedQoSState() action of the 3.0 QoSDevice Service, contains information about TSPECs that the QoSDevice Service can support on a QoS Segment (e.g.

QoSSegmentMaxDelayHigh, QoSSegmentMaxJitter, QoSSegmentMaxDelayLow) [QoS DEVICE] .

The QoSManager may use this information to decompose the end-to-end TSPEC parameters (e.g. E2EMaxDelayHigh, E2EMaxJitter, E2EMaxDelayLow) supplied by the Control Point into per-QoS Segment TSPEC parameters before invoking actions on individual QoSDevice Services on the path to admit the stream. The QoSManager examines if the sum of the QoS Segment specific parameters for all the QoS segments is less than the end-to-end parameters to determine if the request for admission or update would be successful. Please refer to the [QoS Architecture] for more details on this.

For the RequestedQoSType equal to “1” and “2”, if E2EMaxDelayHigh, E2EMaxDelayLow, and, E2EMaxJitter parameters are supplied by the Control Point, the QoS Manager MAY provide the corresponding QoS segment specific parameters: QoSSegmentMaxDelayHigh, QoSSegmentMaxDelayLow, and, QoSSegmentMaxJitter, respectively, in the TSPEC when invoking QD:AdmitTrafficQos() actions on QoSDevice services on the path.

Some v2 or older UPnP QoSDevice service instances may also expose the QD:GetQoSDeviceInfo() action. The QoS Manager MAY invoke this action on the source and/or sink device to find out the port number and protocol information associated with that particular Traffic Descriptor. The QD:GetExtendedQoSState() action on 3.0 QoSDevice Services provide IP address, port number and protocol information associated with that particular Traffic Descriptor.

If the QoS Manager determines, based on the network capabilities that even the least preferred TSPEC of the InitialTrafficDescriptor cannot be admitted, the QoS Manager MUST return error to the Control Point with the Error Code 765.

If the AdmitCtrlNet parameter for an interface on a QoSDevice Service is set to “1” in the QoSDeviceExtendedState state variable, then the QoSManager determines that the QoS Segment corresponding to that interface supports parameterized QoS.

If the RequestedQoSType is set to “1” and the QoS Manager identifies that some of the QoS Segments on the path are not able to support parameterized QoS, the QoS Manager MUST establish prioritized QoS for the stream on prioritized QoS Segments by invoking either QD:SetupTrafficQos() or QD:AdmitTrafficQos() action for those QoS Segments and MUST establish parameterized QoS on parameterized QoS Segments by invoking QD:AdmitTrafficQos() action for those QoS Segments.

Note: If the RequestedQoSType parameter is set to “1” and if the QoS Manager identifies that none of the QoS Segments on the path are able to support parameterized QoS, then the QoS Manager at the least establishes prioritized QoS for the stream on all the segments that support prioritized QoS.

If the RequestedQoSType parameter is set to “2” and if the QoS Manager identifies that some of the QoS Segments on the path are not able to support parameterized QoS and no less preferred TSPEC is supplied, the QoS Manager MUST stop establishing QoS for the stream. The QoSManager Service returns Error Code 782 to the Control Point in response to RequestTrafficQos() action as specified in clause 2.4.1.2.2.

If the QoS Manager identifies that all of the QoSDevice Services on the path are capable of Parameterized QoS, the QoS Manager MUST establish parameterized QoS on all of the QoS Segments by invoking QD:AdmitTrafficQos() action.

The QoS Manager MUST set the value of ActiveTspeclIndex in the TrafficDescriptor to the index of the TSPEC for which it intends to establish QoS before invoking QD:AdmitTrafficQos() and QD:SetupTrafficQos() actions.

The QoS Manager MUST establish QoS for the most preferred of the TSPECs that are admissible on all the QoSDevice Services on the path from those supplied by the CP in the InitialTrafficDescriptor. The QoS Manager MUST NOT leave any unused allocated resources on the QoSDevice Services.

If retries are performed for the same TSPEC, the QoS Manager MUST use random backoff.

If E2EMaxDelayHigh and E2EMaxJitter parameters are NOT supplied by the Control Point OR if the RequestedQoSType equal to "1":

- If QD:AdmitTrafficQos() and/or QD:SetupTrafficQos() actions are successfully executed on all the QoSDevice Services on the path, then the UpdatedTrafficDescriptor created by the QoSManager MUST be returned to the Control Point as an output argument to the RequestTrafficQos() action. The QoS Manager MUST set the value of ActiveTspeclIndex in the UpdatedTrafficDescriptor to the index of the TSPEC for which the QoS is established.

If E2EMaxDelayHigh and E2EMaxJitter parameters are supplied by the Control Point for the RequestedQoSType equal to "2", and if QD:AdmitTrafficQos() actions are successfully executed on all the QoSDevice Services on the path, then:

- If the sum of all MaxCommittedDelay values and the sum of all MaxCommittedJitter values returned by QoSDevice Services on the path is less than the E2EMaxDelayHigh and E2EMaxJitter values, respectively, then the QoSManager MUST return the UpdatedTrafficDescriptor to the Control Point as an output argument to the RequestTrafficQos() action. The QoS Manager MUST set the value of ActiveTspeclIndex in the UpdatedTrafficDescriptor to the index of the TSPEC for which the QoS is established.
- Otherwise, the QoS Manager MUST return error to the Control Point with Error Code 765.

If QD:AdmitTrafficQos() and/or QD:SetupTrafficQos() actions are unsuccessful on any of the QoSDevice Services on the path, even after retries (if performed), then the QoS Manager MUST return error to the Control Point with Error Code 765.

As an output argument of QD:AdmitTrafficQos() action and the QD:UpdateAdmittedTrafficQos() action, a QoSDevice Service may return a value in the A_ARG_TYPE_Layer2Mapping state variable [QOS DEVICE] This state variable is set by the QoSDevice Service, when the Layer2Mapping information is available, to report the Layer2StreamId associated with the admitted stream on the QoS Segment. It is expected that at least one QoSDevice Service on a QoS Segment knows about this mapping. If a QoSDevice Service does not return a Layer2StreamId as output argument of QD:AdmitTrafficQos() action and the QD:UpdateAdmittedTrafficQos() action, then the QoS Manager MUST invoke QD:SetL2Map() action on that QoSDevice Service if the action QD:SetL2Map() is implemented, and the Layer2StreamId mapping for that QoS Segment is known to the QoS Manager. This invocation of QD:SetL2Map(), when possible, serves to communicate the Layer2StreamId for this QoS Segment to the QoSDevice Service.

2.4.1.4.5.1 QoS Admission Retry Mechanism (Informative)

If there is a failure on one of the QD:AdmitTrafficQos() actions (i.e. there is admission failure in any one of the QoS Segments), the QoS Manager may attempt to admit the stream by following the retry mechanism as outlined below.

- Before retrying to admit the stream with the same TSPEC or a less preferred TSPEC, the QoS Manager releases the network resources on QoS Segments where the stream was successfully admitted.
- The QoS Manager attempts to admit the stream with the supplied TSPECs in the preference order specified by the CP.

- The QoS Manager attempts to admit the stream with the same TSPEC that it tried earlier one more time. If the QoS Manager retries to admit the stream with the TSPEC that it used in its earlier attempt, the QoS Manager waits for a period of time determined by a random backoff algorithm after the clean up before retrying the subsequent admission.
- If the QoS Manager retries to admit the stream with a less preferred TSPEC than what it used in its earlier attempt, the QoS Manager waits for a period of time determined by a random backoff algorithm after the clean up on the entire path before retrying the subsequent admission.
- Once the QoS Manager successfully admits the stream with one of the supplied Tspecs, the QoS Manager stops retrying.
- If the QoS Manager identifies that the stream cannot be admitted within 30 secs, the QoS Manager needs to release the resources on QoS Segments where the stream was successfully admitted by calling QD:ReleaseAdmittedTrafficQos() or QD:ReleaseTrafficQos() action on 3.0 QosDevice Services & QD:ReleaseTrafficQos() on 2.0 or older QosDevice Services.

Suggested random backoff algorithm is as follows:

The duration of each backoff interval is a random number in the interval $[50, 100 \cdot 2^n]$ milliseconds, where $n =$ retry attempt and take values of $\{1, 2\}$. Thus, there will be 2 retry attempts after initial failure. Thus, the maximum backoff time will be $200+400= 600$ milliseconds, after which the QoS Manager gives up setting up of QoS. These numbers should be configurable in an out-of-band manner.

When the QoS Manager is performing preemption, which is explained later in Clause 2.4.6.4.3.1 below, n takes values of $\{1, 2, 3\}$. Thus there will be 3 preemption attempts before the QoS Manager reports an error to the Control Point.

2.4.1.5 Dependency on State (if any)

Since UPnP QosManager is defined as a stateless entity, there is no dependency of this action on state.

2.4.1.6 Effect on State (if any)

Since UPnP QosManager is defined as a stateless entity, there is no effect of this action on state

2.4.1.7 Errors

Table 2-11 — Error Codes for RequestTrafficQos()

errorCode	errorDescription	Description
701	TrafficHandle must not be specified by the Control Point	TrafficHandle must not be specified by the Control Point
710	Incomplete TrafficId	At least one of the required parameters in the TrafficId is absent.
711	TrafficId could not be completed	The QosManager could not complete the TrafficId
713	Malformed Name-string	One or more of the String fields in the traffic descriptor do not conform to the specification.
715	Policy parameters MUST NOT be specified by the Control Point	PolicyLastModified, PolicyModifyingUserName, or PolicyHolderConfigUrl MUST NOT be specified by the Control Point
716	An input parameter (e.g. TrafficDescriptor) does not validate against the XML schema	One of the XML-based input arguments does not follow the schema

errorCode	errorDescription	Description
718	Invalid Requested QoS Type	Value supplied for RequestedQoSType parameter is invalid
721	TrafficImportanceNumber MUST not be specified by the Control Point	TrafficImportanceNumber must not be specified by the Control Point
722	The ActiveTspecIndex MUST NOT be specified by the Control Point	The ActiveTspecIndex must not be specified by the Control Point
725	Duplicate TspecIndex	All Tspec indices must be unique
740	No QosDevice at Source IP address	Source QosDevice does not exist.
741	No QosDevice at Destination IP address	Destination QosDevice does not exist.
742	No QosDevice at QosBoundarySourceAddress	Source Boundary QosDevice does not exist.
743	No QosDevice at QosBoundaryDestinationAddress	Destination Boundary QosDevice does not exist.
744	No QosDevices available	No QosDevice instances found on the network.
746	QosPolicyHolder failure	QosManager gets incorrect information from the QosPolicyHolder (could be malformed XML)
752	QosBoundarySourceAddress or QosBoundaryDestinationAddress not on the same subnet.	The source and/or destination is not on the subnet which is under the management of this QosManager
765	Admission Failure	A stream cannot be admitted due to lack of resources on the network.
772	Network not capable	Request exceeds network capabilities
773	Cannot retrieve XML namespace	An XML namespace was included in one of the arguments, but the QosManager service was unable to retrieve the namespace from the location provided.
780	QosPolicyHolder not found	The QosPolicyHolder specified by the PolicyHolderId was not found.
781	Preferred QosPolicyHolder not found	The Preferred QosPolicyHolder not found on the network.
782	Parameterized QoS not possible	End to end parameterized QoS cannot be established for a stream due to presence of at least on prioritized QoS segment.
785	Different Preferred QosPolicyHolder ServiceId values	QosDevice Services report different ServiceId values for the Preferred QosPolicyHolder with the same highest preference count.
791	TrafficLeaseTime is missing	TrafficLeaseTime in the traffic descriptor is missing
792	Incorrect TSPEC	Input parameters supplied in the TSPEC are incorrect.

2.4.2 UpdateTrafficQos()

When a Control Point needs to change the QoS associated with a particular traffic, it uses the [UpdateTrafficQos\(\)](#) action.

Upon receiving [UpdateTrafficQos\(\)](#) action, the [QosManager](#) repeats the admission control process described above for the revised TrafficDescriptor.

Note: It is possible that Control Points can invoke [UpdateTrafficQos\(\)](#) action on a [QosManager:2](#) Service to update traffic descriptors with [RequestedQoSType](#) greater than "0". However, the behavior of the [QosManager:2](#) Service upon invocation of such action is

unspecified. Hence, invocation of [UpdateTrafficQos\(\)](#) action by Control Points on [QosManager:2](#) Service for traffic descriptors with [RequestedQosType](#) greater than “0” is discouraged.

Table 2-12 shows which elements may be updated by the Control Point when calling the [UpdateTrafficQos\(\)](#) action.

Table 2-12 — Elements that are allowed to be updated when calling [UpdateTrafficQos\(\)](#)

Parameter Name	May be Updated?	Comments
TrafficHandle	No	
TrafficId	No	Not applicable / See sub-elements below
. SourceAddress	No	Must be the same one as from the returned Traffic Descriptor
. SourcePort	No	Must be the same one as from the returned Traffic Descriptor
. DestinationAddress	No	Must be the same one as from the returned Traffic Descriptor
. DestinationPort	No	Must be the same one as from the returned Traffic Descriptor
. IpProtocol	No	Must be the same one as from the returned Traffic Descriptor
AvailableOrderedTspecList	Yes	See sub-elements below
. Tspec	Yes	See sub-elements below
. . TspecIndex	Yes	
. . AvTransportUri	No	
. . AvTransportInstanceId	No	
. . TrafficClass	No	
. . v2TrafficSpecification	No	Not applicable/ See sub-elements below
. . . v3TrafficSpecification	No	Not applicable/ See sub-elements below
. . . . RequestedQosType	Yes	
. . . . DataRate	Yes	
. . . . MaxBurstSize	Yes	
. . . . MinServiceRate	Yes	
. . . . ReservedServiceRate	Yes	
. . . . TimeUnit	Yes	
. . . . MaxPacketSize	Yes	
. . . . E2EMaxDelayHigh	Yes	
. . . . E2EMaxDelayLow	Yes	
. . . . E2EMaxJitter	Yes	
. . . . QosSegmentSpecificParameters	N/A	Not applicable
. InterfaceId	N/A	Must not be supplied by Control Point
. QosSegmentId	N/A	Must not be supplied by Control Point
. QosSegmentMaxDelayHigh	N/A	Must not be supplied by Control Point
. QosSegmentMaxDelayLow	N/A	Must not be supplied by Control Point
. QosSegmentMaxJitter	N/A	Must not be supplied by Control Point
. . . . MaxServiceInterval	Yes	
. . . . MinServiceInterval	Yes	
. . . . LossSensitivity	Yes	

Parameter Name	May be Updated?	Comments
. . . . ServiceType	Yes	
ActiveTspecIndex	No	QosManager may update this in its response
TrafficImportanceNumber	No	QosManager may update this in its response
QosBoundarySourceAddress	No	
QosBoundaryDestinationAddress	No	
MediaServerConnectionId	No	
MediaRendererConnectionId	No	
TrafficLeaseTime	Yes	
PolicyHolderId	Yes	
PolicyLastModified	N/A	Must not be supplied by Control Point
PolicyModifyingUserName	N/A	Must not be supplied by Control Point
PolicyHolderConfigUrl	N/A	Must not be supplied by Control Point
QosBoundarySourceUuid	No	
QosBoundaryDestinationUuid	No	
Critical	Yes	
PolicyHolderConsultedId	No	QosManager may update this in its response
PolicyHolderConsultedType	No	QosManager may update this in its response
OptionalPolicyParams	Not applicable	See sub-elements below
. UserName	Yes	
. VendorApplicationName	No	
. PortName	No	
. ServiceProviderServiceName	No	
. CpName	Yes	This MUST be the CpName of the Control Point invoking the update

2.4.2.1 Arguments

Table 2-13 — Arguments for UpdateTrafficQos()

Argument	Direction	relatedStateVariable
TrafficHandle	In	A_ARG_TYPE_TrafficHandle
RequestedTrafficDescriptor	In	A_ARG_TYPE_TrafficDescriptor
ImplementedTrafficDescriptor	Out	A_ARG_TYPE_TrafficDescriptor
NumPolicyHolders	Out	A_ARG_TYPE_NumPolicyHolders

2.4.2.2 Service Requirements

2.4.2.2.1 Base Requirements

The following generic requirements apply irrespective of the absence or presence and value of *RequestedQosType* parameter in the *RequestedTrafficDescriptor* input argument:

- If Control Point supplies *TrafficImportanceNumber* in TrafficDescriptor to the *QosManager* Service when calling the *UpdateTrafficQos()* action, *QosManager* returns error 721.
- If Control Point supplies *ActiveTspecIndex* in TrafficDescriptor to *QosManager* when calling the *UpdateTrafficQos()* actions, the *QosManager* Service MUST return error code 722.

- The QoSManager Service MUST include a valid ActiveTspecIndex value in the TrafficDescriptor when it returns a non error value in response to UpdateTrafficQos() action.
- If a Control Point attempts to update elements in the TrafficDescriptor that are not specified by Table 2-12, the QoSManager Service MUST return error code 714.
- In response to the Control Point calling the UpdateTrafficQos() action, the QoSManager may update ActiveTspecIndex, and/or TrafficImportanceNumber in the TrafficDescriptor structure. All other non-<any> XML elements MUST NOT be updated by the QoSManager.
- If a Control Point supplies a non-existent TrafficHandle as first argument of UpdateTrafficQos(), the QoSManager MUST return an error (Error Code 703).
- If a Control Point supplies PolicyLastModified, PolicyModifyingUserName, or PolicyHolderConfigUrl when calling the UpdateTrafficQos() action, the QoSManager MUST return error code 715.
- If a Control Point does not supply a unique TspecIndex for every TSPEC within an AvailableOrderedTspecList, then the QoSManager will return the error 725.
- The QoSManager MUST include the TrafficPolicy parameters received from the QPH:GetTrafficPolicy() in the TrafficDescriptor when successfully returning the UpdatedTrafficDescriptor. The QoSManager MUST always include QosPolicyHolderId.
- If the QoS Manager is successful in updating the traffic stream on all the 3.0 QosDevice Services on the path, the QoSManager Service MUST return the updated TrafficDescriptor to the Control Point as ImplementedTrafficDescriptor output argument of QM:UpdateTrafficQos() action.
- The QoSManager Service MUST populate all the fields of the TrafficId in the ImplementedTrafficDescriptor.
- If the QoS Manager obtains the MaxCommittedDelay for every QoS Segment on the path, then the QoSManager Service MUST populate E2EMaxDelayHigh in the ImplementedTrafficDescriptor.
- If the QoS Manager obtains the MaxCommittedJitter for every QoS Segment on the path, then the QoSManager Service MUST populate the E2EMaxJitter in the ImplementedTrafficDescriptor.
- The QoSManager Service MUST NOT return QosSegmentSpecificParameter in the ImplementedTrafficDescriptor.
- The QoSManager Service MUST return the value of “1” for the NumPolicyHolders output argument if it uses the preferred QosPolicyHolder Service OR the QosPolicyHolder Service supplied by the Control Point OR a single available QosPolicyHolder Service on the network. Otherwise, (i.e, if the QoS Manager uses default policies) the QoSManager Service MUST return the actual number of QosPolicyHolder Services discovered on the network. The actual QosPolicyHolder Service and its type used by the QoSManager Service are identified by the PolicyHolderConsultedId and PolicyHolderConsultedType parameters in the UpdatedTrafficDescriptor output argument.
- If UpdateTrafficLeaseTime in the TrafficDescriptor is set to “1”, then the QoS Manager MUST invoke QD:UpdateTrafficLeaseTime() on each QosDevice Service on the path and MUST NOT invoke QD:UpdateAdmittedQos()

2.4.2.2.2 RequestedQosType Specific Requirements

The following requirements apply when RequestedQosType parameter is present in the RequestedTrafficDescriptor input parameter:

- For the RequestedQosType parameter with the value of “1” or “2” in the RequestedTrafficDescriptor, if the QoS Manager is unable to successfully update the traffic stream on all the 3.0 QosDevice Services on the path, even after retries (if performed), the QoSManager Service MUST return Error Code 763 to the Control Point.
- For the RequestedQosType parameter with the value of “2” in the RequestedTrafficDescriptor, if the QoS Manager identifies that some of the QoS

Segments on the path are not able to support Parameterized QoS, if no less preferred TSPEC is supplied, the QosManager Service MUST return error to the CP in response to UpdateTrafficQos() action with Error Code 782.

- If a Control Point supplies the RequestedQosType parameter with the value greater than “2” in the RequestedTrafficDescriptor, the QosManager Service MUST return error with Error Code 718 to the Control Point.
- For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point does not supply a value for the TrafficLeaseTime field in the RequestedTrafficDescriptor input argument, the QosManager Service MUST return error with Error Code 791 to the Control Point.
- For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point supplies the value for the E2EMaxDelayLow parameter but does NOT supply the value for the E2EMaxDelayHigh in the input TSPEC parameters, the QosManager Service MUST return error with Error Code 792 to the Control Point.

2.4.2.3 Control Point requirements when calling the action

2.4.2.3.1 Base Requirements

The following generic requirements apply irrespective of the absence or presence and value of RequestedQosType parameter in the RequestedTrafficDescriptor input parameter:

- A Control Point’s updated TrafficDescriptor MUST be conformant to Table 2-12. The fields that cannot be updated MUST have the same values as contained in the traffic descriptor stored on the QosDevice Service that is identified by the TrafficHandle.
- A Control Point MUST supply a valid TrafficHandle as the first argument when calling the UpdateTrafficQos() action.
- A Control Point MUST NOT supply TrafficImportanceNumber in the TrafficDescriptor to QosManager when calling the UpdateTrafficQos() action.
- A Control Point MUST supply a unique TspecIndex for every TSPEC within an AvailableOrderedTspecList.
- A Control Point MUST NOT supply ActiveTspecIndex in TrafficDescriptor to QosManager when calling the UpdateTrafficQos() actions.
- Whenever a Control Point specifies a PolicyHolderId it MUST specify a valid Id for a PolicyHolder as defined in the QosPolicyHolder service definition.[POLICY HOLDER]
- A Control Point MUST NOT supply PolicyLastModified, PolicyModifyingUserName, PolicyHolderConfigUrl.
- If a Control Point wants to update the TrafficLeaseTime of the QoS reservation for a stream indicated by the TrafficDescriptor without making any other updates to the QoS reservation, the UpdateTrafficLeaseTime field in the TrafficDescriptor MUST be set to “1”.

2.4.2.3.2 RequestedQosType Specific Requirements

The following requirements apply when RequestedQosType parameter is present in the RequestedTrafficDescriptor input parameter:

- A Control Point MUST NOT supply a value greater than “2” for the RequestedQosType parameter.
- For the RequestedQosType parameter with the value of “1” or “2”, a Control Point MUST supply a value for the TrafficLeaseTime field in the RequestedTrafficDescriptor input argument.
- For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point supplies a value for the E2EMaxDelayLow as one of the input TSPEC parameters, then the Control Point MUST also supply the value for the E2EMaxDelayHigh parameters in the TSPEC.

2.4.2.4 QoS Manager Requirements

2.4.2.4.1 Base requirements

The following generic requirements apply irrespective of the absence or presence and value of RequestedQoSType parameter in the RequestedTrafficDescriptor input parameter:

- When a Control Point calls the UpdateTrafficQos() action and the QoS Manager subsequently invokes actions with a TrafficDescriptor as an argument, the QoS Manager MUST NOT modify those elements that MUST equal the original TrafficDescriptor according to Table 2-9.
- In addition, the QoSManager MUST use the original TrafficHandle and MUST NOT generate a new TrafficHandle.

2.4.2.4.2 Prioritized QoS Update Requirements

Upon receiving UpdateTrafficQos() action with the RequestedQoSType parameter in the RequestedTrafficDescriptor either absent or with a value of 0, the QoS Manager MUST perform the following steps:

- The QoS Manager MUST obtain QoS traffic policies as specified in Clause 2.4.1.4.2.
- The QoS Manager then MUST invoke QD:ReleaseTrafficQos() and QD:SetupTrafficQos() actions, subsequently, on all v2 QosDevice Services on the path. The QoS Manager MUST invoke QD:UpdateAdmittedQos() OR QD:ReleaseTrafficQos() followed by QD:SetupTrafficQos(), action on all v3 QosDevice Services on the path. It is recommended that the QoS Manager invokes QD:UpdateAdmittedQos() action on v3 QosDevice Services.
- If QD:UpdateAdmittedQos() and QD:SetupTrafficQos() actions are successfully executed on all the QosDevice Services on the path, then the updated TrafficDescriptor created by the QoSManager is returned to the Control Point as ImplementedTrafficDescriptor output argument of QM:UpdateTrafficQos() action. The QoS Manager MUST set the value of ActiveTspeclndex in the ImplementedTrafficDescriptor to the index of the TSPEC for which the QoS is established.

2.4.2.4.3 Parameterized & Hybrid QoS Update Requirements

Upon receiving UpdateTrafficQos action with the RequestedQoSType parameter in the RequestedTrafficDescriptor of either "1" or "2", the QoS Manager MUST perform the following steps:

- If the RequestedQoSType parameter is "1", the QoS Manager MUST obtain QoS traffic policies as specified in Clause 2.4.1.4.3.
- If the RequestedQoSType parameter is "2", the QoS Manager MAY obtain QoS traffic policies as specified in Clause 2.4.1.4.3.
- If the RequestedQoSType parameter is "1", the QoS Manager MUST invoke QD:ReleaseTrafficQos() and QD:SetupTrafficQos() subsequently on all v2 QosDevice Services on the path and the QoS Manager MUST invoke QD:UpdateAdmittedQos() action on all v3 QosDevice Services on the path.
- If the RequestedQoSType parameter is "2", the QoS Manager MUST invoke QD:UpdateAdmittedQos() action on all v3 QosDevice Services on the path.
- For the RequestedQoSType equal to "1" and "2", if E2EMaxDelayHigh, E2EMaxDelayLow, and, E2EMaxJitter parameters are supplied by the Control Point, the QoS Manager MUST provide the corresponding QoS segment specific parameters: QosSegmentMaxDelayHigh, QosSegmentMaxDelayLow, and, QosSegmentMaxJitter, respectively, in the TSPEC when invoking QD:UpdateAdmittedQos() actions on QosDevice services on the path.
- The QoS Manager MUST establish QoS for the most preferred of the TSPECs that are admissible on all the QosDevice Services on the path from those supplied by the Control

Point in the RequestedTrafficDescriptor. The QoS Manager MUST NOT leave any unused allocated resources on the QoSDevice Services.

- If E2EMaxDelayHigh and E2EMaxJitter parameters are NOT supplied by the Control Point OR if the RequestedQoSType equal to “0” or “1”:
 - If QD:UpdateAdmittedQos() and QD:SetupTrafficQos() actions are successfully executed on all the QoSDevice services on the path, then the updated TrafficDescriptor created by the QoSManager is returned to the Control Point as ImplementedTrafficDescriptor output argument of QM:UpdateTrafficQos() action. The QoS Manager MUST set the value of ActiveTspeclIndex in the ImplementedTrafficDescriptor to the index of the TSPEC for which the QoS is established.
- If E2EMaxDelayHigh and E2EMaxJitter parameters are supplied by the Control Point for the RequestedQoSType equal to “2”, and if the QD:AdmitTrafficQos() and/or QD:SetupTrafficQos() actions are successfully executed on all the QoSDevice Services on the path, then:
 - If the sum of all MaxCommittedDelay values and the sum of all MaxCommittedJitter values returned by QoSDevice Services on the path is less than the E2EMaxDelayHigh and E2EMaxJitter values, respectively, then the QoSManager MUST return the ImplementedTrafficDescriptor to the Control Point as an output argument of the UpdateTrafficQos() action. The QoS Manager MUST set the value of ActiveTspeclIndex in the UpdatedTrafficDescriptor to the index of the TSPEC for which the QoS is established.
 - Otherwise, the QoS Manager MUST return Error code 763 to the Control Point in response to the UpdatedTrafficQos() action, even after retries (if performed), and the QoS Manager MUST restore the QoS established for the stream prior to attempting the update on all QoSDevice Services on the path.
- As an output argument of the QD:UpdateAdmittedTrafficQos() action, a QoSDevice Service may return a value in the A_ARG_TYPE_Layer2Mapping state variable [QOS DEVICE] . This state variable is set by the QoSDevice Service, when the Layer2Mapping information is available, to report the Layer2StreamId associated with the admitted stream on the QoS Segment. It is expected that at least one QoSDevice Service on a QoS Segment knows about this mapping. If a QoSDevice Service does not return a Layer2StreamId as output argument of the QD:UpdateAdmittedTrafficQos() action, then the QoS Manager MUST invoke QD:SetL2Map() action on that QoSDevice Service if the action QD:SetL2Map() is implemented, and the Layer2StreamId mapping for that QoS Segment is known to the QoSManager. This invocation of QD:SetL2Map(), when possible, serves to communicate the Layer2StreamId for this QoS Segment to the QoSDevice Services on this QoS Segment.
- If there is a failure on one of the QD:UpdateAdmittedQos() actions (i.e. there is admission failure in any one of the QoS Segments), the QoS Manager MAY follow the steps as identified in Clause 2.4.1.4.5.1 to retry admitting the updated traffic descriptor.
- If retries are performed for the same TSPEC, the QoS Manager MUST use random backoff.
- If the QoS Manager determines that the stream cannot be successfully updated even with the least preferred TSPEC, the QoSManager MUST return Error code 763 to the Control Point in response to the UpdatedTrafficQos() action and the QoS Manager MUST restore the QoS established for the stream prior to attempting the update on all QoSDevice Services on the path.

2.4.2.5 Dependency on State (if any)

Since UPnP QoSManager is defined as a stateless entity, there is no dependency for this action on the state.

2.4.2.6 Effect on State (if any)

Since QoSManager is defined as a stateless entity, there is no effect of this action on state.

2.4.2.7 Errors

Table 2-14 — Error Codes for UpdateTrafficQos

errorCode	errorDescription	Description
703	Traffic Handle unknown to this device	Traffic Handle unknown to this device
713	Malformed Name-string	One or more of the String fields in the traffic descriptor do not conform to the specification.
714	Tried to update unmodifiable Traffic Descriptor elements	QosManager cannot be requested to update some of the TrafficDescriptor parameters e.g. TrafficId, TrafficHandle
715	Policy parameters must not be specified by the Control Point	PolicyLastModified, PolicyModifyingUserName, or PolicyHolderConfigUrl MUST NOT be specified by the Control Point
716	An input parameter (e.g. TrafficDescriptor) does not validate against the XML schema	One of the XML-based input arguments does not follow the schema
718	Invalid Requested QoS Type	Value supplied for RequestedQoSType parameter is invalid
721	TrafficImportanceNumber must not be specified by the Control Point	TrafficImportanceNumber must not be specified by the Control Point
722	The ActiveTspecIndex must not be specified by the Control Point	The ActiveTspecIndex must not be specified by the Control Point
725	Duplicate TspecIndex	All Tspec indices must be unique
740	No QosDevice at Source IP address	Source QosDevice does not exist.
741	No QosDevice at Destination IP address	Destination QosDevice does not exist.
742	No QosDevice at QosBoundarySourceAddress	Source Boundary QosDevice does not exist.
743	No QosDevice at QosBoundaryDestinationAddress	Destination Boundary QosDevice does not exist.
744	No QosDevices available	No QosDevice instances found on the network.
746	QosPolicyHolder failure	QosManager gets incorrect information from the QosPolicyHolder (could be malformed XML)
752	QosBoundarySourceAddress or QosBoundaryDestinationAddress not on the same subnet	The source and/or destination is not on the subnet which is under the management of this QosManager
763	Update Failed	Failure in updating the traffic stream on one or more QosDevice Service(s) on the path.
773	Cannot retrieve XML namespace	An XML namespace was included in one of the arguments, but the service was unable to retrieve the namespace from the location provided.
780	QosPolicyHolder not found	The QosPolicyHolder specified by the PolicyHolderId was not found.
781	Preferred QosPolicyHolder not found	The Preferred QosPolicyHolder was not found on the network.
782	Parameterized QoS not possible	End to end parameterized QoS cannot be established for a stream due to presence of at least on prioritized QoS segment.
785	Different Preferred QosPolicyHolder ServiceId values	QosDevice Services report different ServiceId values for the Preferred QosPolicyHolder with the same highest preference count.
791	TrafficLeaseTime is missing	TrafficLeaseTime in the traffic descriptor is missing
792	Incorrect TSPEC	Input parameters supplied in the TSPEC are incorrect.

2.4.3 ReleaseTrafficQos()

Control Point can invoke this action for releasing the Quality of Service for a particular traffic stream.

2.4.3.1 Arguments

Table 2-15 — Arguments for ReleaseTrafficQos

Argument	Direction	relatedStateVariable
RevokeTrafficHandle	In	A_ARG_TYPE_TrafficHandle

2.4.3.2 Service requirements

If a Control Point supplies an unknown TrafficHandle, the [QosManager](#) returns an error (Error Code 703)

2.4.3.3 Control Point requirements when calling the action

A Control Point MUST supply a valid Traffic Handle when calling [ReleaseTrafficQos\(\)](#)

2.4.3.4 QoS Manager requirements

Upon receiving [ReleaseTrafficQos\(\)](#) for a traffic stream identified by the [RevokeTrafficHandle](#) argument, the [QoS Manager](#) MUST invoke the [QD:ReleaseTrafficQos\(\)](#) action on all v2 [QoSDevice](#) services and [QD:ReleaseAdmittedQos\(\)](#) or [QD:ReleaseTrafficQos\(\)](#) action on all v3 [QoSDevice](#) services on the path of the traffic stream. It is recommended that the [QoS Manager](#) invokes [QD:ReleaseAdmittedQos\(\)](#) on v3 [QoSDevice](#) services.

2.4.3.5 Dependency on State (if any)

Since [QosManager](#) is defined as a stateless entity, there is no dependency for this action on the state.

2.4.3.6 Effect on State (if any)

Since [QosManager](#) is defined as a stateless entity, there is no effect of this action on state.

2.4.3.7 Errors

Table 2-16 — Error Codes for ReleaseTrafficQos

errorCode	errorDescription	Description
703	Traffic Handle unknown to this device	
744	No QoSDevice services available	
773	Cannot retrieve XML namespace	An XML namespace was included in one of the arguments, but the service was unable to retrieve the namespace from the location provided.

2.4.4 BrowseAllTrafficDescriptors()

A Control Point can invoke this action to browse all the 'TrafficDescriptors' configured on the network. Each TrafficDescriptor represents QoS for a particular traffic stream.

2.4.4.1 Arguments

Table 2-17 — Arguments for BrowseAllTrafficDescriptors

Argument	Direction	relatedStateVariable
NumberOfTrafficDescriptors	Out	A_ARG_TYPE_NumTrafficDescriptors
TrafficDescriptorList	Out	A_ARG_TYPE_ListOfTrafficDescriptors

2.4.4.2 QoS Manager requirements

When a Control Point calls the [BrowseAllTrafficDescriptors](#) action, the [QoS Manager](#) MUST report back the details on various traffic streams admitted on the [QoSDevice](#) services on the network by querying known [QoSDevice](#) services (for example by calling the action [QD:GetQosState\(\)](#) or [QD:GetExtendedQosState\(\)](#)).

2.4.4.3 Dependency on State (if any)

This action does not have any dependency on state.

2.4.4.4 Effect on State (if any)

This action does not have any effect on state.

2.4.4.5 Errors

Table 2-18 — Error Codes for BrowseAllTrafficDescriptors

errorCode	errorDescription	Description
704	Network contains Different TrafficDescriptors for same TrafficHandle	Network contains Different TrafficDescriptors for same TrafficHandle. Note: This Error Code is maintained forward for backwards compatibility.
773	Cannot retrieve XML namespace	An XML namespace was included in one of the arguments, but the service was unable to retrieve the namespace from the location provided.

2.4.5 GetQmCapabilities()

A Control Point can invoke this action to determine various optional capabilities supported by the [QoSManager](#) Service (e.g. preemption).

2.4.5.1 Arguments

Table 2-19 — Arguments for GetQmCapabilities

Argument	Direction	relatedStateVariable
QmCapabilities	Out	A_ARG_TYPE_QmCapabilities

2.4.5.2 QoSManager Service requirements

If the [QoSManager](#) Service is capable of reporting information about Blocking Streams while attempting to admit a traffic stream as specified in Clause 2.4.6.4.3.1 below, the [QoSManager](#) Service MUST return the value of [ReportBlockingStreams](#) field as “1” in the [QmCapabilities](#) state variable that is returned as an output argument of [GetQmCapabilities\(\)](#) action. Otherwise the [QoSManager](#) Service MUST return the value of [ReportBlockingStreams](#) field as “0”.

If the [QoSManager](#) Service is capable of performing Preemption of Blocking Streams while attempting to admit a traffic stream as specified in Clause 2.4.6.4.3.1 below, the [QoSManager](#) Service MUST return the value of [Preemption](#) field as “1” in the [QmCapabilities](#) state variable

that is returned as an output argument of [GetQmCapabilities\(\)](#) action. Otherwise the [QosManager](#) Service MUST return the value of [Preemption](#) field as “0”.

2.4.5.3 Dependency on State (if any)

This action does not have any dependency on state.

2.4.5.4 Effect on State (if any)

This action does not have any effect on state.

2.4.5.5 Errors

Table 2-20 — Error Codes for GetQmCapabilities

errorCode	errorDescription	Description

2.4.6 RequestExtendedTrafficQos()

A Control Point invokes this optional action for setting up QoS for a specified traffic stream with optional additional capabilities, such as preemption and reporting of blocking streams that are not supported by [RequestTrafficQos\(\)](#) action.

2.4.6.1 Arguments

Table 2-21 — Arguments for RequestExtendedTrafficQos

Argument	Direction	relatedStateVariable
InitialTrafficDescriptor	In	A_ARG_TYPE_TrafficDescriptor
SelectedQmCapabilities	In	A_ARG_TYPE_QmCapabilities
TrafficHandle	Out	A_ARG_TYPE_TrafficHandle
UpdatedTrafficDescriptor	Out	A_ARG_TYPE_TrafficDescriptor
ExtendedTrafficQosInfo	Out	A_ARG_TYPE_ExtendedTrafficQosInfo
ResultedQosType	Out	A_ARG_TYPE_ResultedQosType

2.4.6.2 Service requirements

2.4.6.2.1 Base Requirements

Refer to Clause 2.4.1.2.1 above for base requirements when a Control Point invokes [RequestExtendedTrafficQos\(\)](#) action.

Note: The [QosManager](#) Service does not return [NumPolicyHolders](#) parameter as an output argument of [RequestExtendedTrafficQos\(\)](#) action.

2.4.6.2.2 Additional Requirements

If a Control Point requests non-supported [QosManager](#) Service capability in the SelectedQmCapabilities input argument, the [QosManager](#) Service MUST return Error Code 790.

For [RequestedQosType](#) parameter with the value of “1”, if the [QoS Manager](#) identifies that one of the QoS Segments on the path is not capable of supporting Parameterized QoS, the [QosManager](#) Service MUST set [ResultedQosType](#) output argument to “1”.

Note: The QoS Manager determines whether a QoS Segment is capable of supporting parameterized QoS based on the AdmitCtrlNet parameter retrieved via the QD: GetExtendedQosState() action.

For RequestedQosType parameter with the value of “1”, if the QoS Manager identifies that all of QoS Segments on the path are capable of supporting Parameterized QoS, the QoSManager Service MUST set ResultedQosType output argument to “2”.

For the RequestedQosType parameter with the value of “2”, if the QoS Manager identifies that some of the QoS Segments on the path are not able to support Parameterized QoS, and no less preferred TSPEC is supplied, the QoSManager Service MUST return error to the Control Point in response to RequestExtendedTrafficQos() with error code of 782.

If a Control Point supplies the RequestedQosType parameter with the value greater than “2” in the RequestedTrafficDescriptor, the QoSManager Service MUST return error with Error Code 718 to the Control Point.

For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point does not supply a value for the TrafficLeaseTime field in the InitialTrafficDescriptor input argument, the QoSManager Service MUST return error with Error Code 791 to the Control Point.

2.4.6.3 Control Point requirements when calling the action

2.4.6.3.1 Base Requirements

Refer to Clause 2.4.1.3.1 above when invoking RequestExtendedTrafficQos() action.

2.4.6.3.2 Additional Requirements

For the RequestedQosType parameter with the value of “1” or “2”, a Control Point MUST supply a value for the TrafficLeaseTime field in the InitialTrafficDescriptor input argument.

For the RequestedQosType parameter with the value of “1” or “2”, if a Control Point supplies a value for the E2EMaxDelayLow as one of the input TSPEC parameters, then the Control Point MUST also supply the value for the E2EMaxDelayHigh parameters in the TSPEC.

2.4.6.4 QoS Manager requirements

2.4.6.4.1 Base requirements

When a Control Point calls the RequestExtendedTrafficQos() action, the QoS Manager MUST follow all the requirements identified in Clause 2.4.1.4.1 above, irrespective of the value of RequestedQosType parameter in the InitialTrafficDescriptor input parameter.

2.4.6.4.2 Prioritized QoS Establishment Requirements with Extended Functionality

Upon receiving the RequestExtendedTrafficQos() action with the RequestedQosType parameter in the InitialTrafficDescriptor of value “0”, the QoS Manager MUST follow the requirements identified in Clause 2.4.1.4.4 above to establish prioritized QoS for the stream identified by InitialTrafficDescriptor input parameter.

2.4.6.4.3 Parameterized and Hybrid QoS Establishment Requirements with Extended Functionality

Upon receiving the RequestExtendedTrafficQos() action with the RequestedQosType parameter in the InitialTrafficDescriptor of value either “1” or “2”, the QoS Manager MUST follow the requirements identified in Clause 2.4.1.4.5 to admit the stream identified by the InitialTrafficDescriptor.

However, if the *QoS Manager* determines that the traffic stream cannot be admitted even with the least preferred TSPEC and if the CP requested extended *QoS Manager* capabilities (i.e. either Preemption =1 or ReportBlockingStreams =1 in the SelectedQmCapabilities input argument), the *QoS Manager* MUST perform the extended functions as specified in Clause 2.4.6.4.3.1 to admit the stream with the least preferred TSPEC. If the CP didn't request extended *QoS Manager* capabilities (i.e. CP set Preemption = "0" and ReportBlockingStreams = "0"), the *QoS Manager* MUST NOT perform the extended functions.

2.4.6.4.3.1 Additional QoS Manager Capabilities Functions

2.4.6.4.3.1.1 Implementation Guidelines (Informative):

- Upon failure of *QD:AdmitTrafficQos()* or *QD:UpdateAdmittedQos()* action, the *QosDevice* Service provides Layer2StreamIds of Blocking Traffic Streams, if available, in the ListOfLayer2StreamIds field of *A_ARG_TYPE_AdmitTrafficQosExtendedResult* output argument to the *QoS Manager*. See [QOS DEVICE] for more details.
- The *QoS Manager* invokes *QD:GetExtendedQosState()* on *QosDevice* Services on the Blocked QoS Segment(s) to obtain UPnP-QoS TrafficDescriptors corresponding to the blocking Layer2StreamIds.
- The *QoS Manager* invokes *QPH:GetListOfTrafficPolicies()* action to obtain the *UserImportanceNumber* for each of the blocking TrafficDescriptors and the *InitialTrafficDescriptor*; only if the version of the *QosPolicyHolder* Service consulted in clause 2.4.1.4.3 is 3.0 or higher.

2.4.6.4.3.1.2 Requirements for Reporting Blocking Streams:

If a Control Point sets the ReportBlockingStream field to a value of "1" in the *SelectedQmCapabilities* input parameter, then the *QoS Manager* MUST provide the following information in the *ExtendedTrafficQosInfo* output argument to the CP:

- a) UPnP-QoS traffic descriptor for all Blocking Streams along with their layer-2 stream information, if available, (QosSegmentId, Layer2StreamId);
- b) Layer-2 stream information (QosSegmentId, Layer2StreamId) for all non-UPnP Blocking Streams, if available;
- c) *UserImportanceNumber* for the TSPEC identified by *ActiveTspeclIndex* of all the Blocking Streams and for the InitialTrafficDescriptor by invoking *GetListOfTrafficPolicies()* on the *QosPolicyHolder* Service identified in clause 2.4.1.4.3 only if its version is 3.0.

If the *ExtendedTrafficQosInfo* output parameter is populated by the *QosManager*, then the admission is failed.

2.4.6.4.3.1.3 Requirements for Preemption:

If a Control Point sets the Preemption field to a value of "1" in the *SelectedQmCapabilities* input parameter and the version of the *QosPolicyHolder* Service identified in clause 2.4.1.4.3 is 3.0 or higher, then the *QoS Manager* MUST perform the following steps :

- a) If a Control Point sets the ReportBlockingStream field to a value of "0" in the *SelectedQmCapabilities* input parameter, and if all the Blocking Traffic Streams have higher or equal UINs for their TSPEC identified by ActiveTspeclIndex, then the stream to be admitted or updated, then the *QoS Manager* MUST return Error Code 766 to the Control Point to indicate that preemption is not possible.
- b) If a Control Point sets the ReportBlockingStream field to a value of "1" in the *SelectedQmCapabilities* input parameter, and if all the Blocking Traffic Streams have higher or equal UINs for their TSPEC identified by ActiveTspeclIndex than the stream to be admitted or updated, then the *QosManager* Service MUST follow all the requirements identified in Clause 2.4.6.4.3.1.2.
- c) If some of the Blocking Traffic Streams have lower UINs for their TSPEC identified by ActiveTspeclIndex than the stream to be admitted or updated, the *QoS Manager* takes into consideration characteristics of those Blocking Traffic Streams with lower UINs (such as

resources utilization) to determine the list of candidate traffic streams that need to be preempted. The actual method used by the QoS Manager to determine such a list of candidate traffic streams to be preempted is vendor-specific. Annex B outlines some example methods. However, the QoS Manager MUST NOT preempt any Blocking Streams that have higher or equal UIN than the stream to be admitted or updated.

- d) If the QoS Manager identifies that preemption of candidate traffic streams will not result in availability of sufficient resources for the stream to be admitted or updated on a QoS Segment, then the QoS Manager SHOULD NOT preempt any candidate traffic streams, and
- 1) If the Control Point set the ReportBlockingStream field to a value of “0” in the SelectedQmCapabilities input parameter, the QoSManager MUST return error to the Control Point with Error Code 766.
 - 2) If the Control Point set the ReportBlockingStream field to a value of “1” in the SelectedQmCapabilities input parameter, then the QoS Manager MUST follow all the requirements identified in clause 2.4.6.4.3.1.2.
- e) If the QoS Manager identifies that preemption of candidate traffic streams may result in the availability of sufficient resources for the stream to be admitted or updated, the QoS Manager MUST preempt each identified stream on all the QoSDevice Services on the path of each stream by invoking QD:ReleaseAdmittedQos() (to revoke the resources allocated to that stream). The QoS Manager MUST provide the PreemptingTrafficInfo parameter as input argument of QD:ReleaseAdmittedQos().
- f) After the QoS Manager completes preemption, it attempts to admit the new stream by invoking QD:AdmitTrafficQos() action on all the QoSDevice Services in each of the Blocked QoS Segments.
- g) If QD:AdmitTrafficQos() action is successful on all QoSDevice Services in each of the Blocked Segments, the QoSManager Service MUST return the UpdatedTrafficDescriptor to the Control Point with various traffic descriptor parameters set appropriately as per the requirements identified in Clause 2.4.1.4.5. In this case, the QoSManager Service MUST NOT populate the ExtendedTrafficQosInfo output parameter.
- h) If QD:AdmitTrafficQos() fails on any one of the QoSDevice Services on the path, the QoS Manager may retry preemption to admit the traffic stream. If retries are performed, the QoS Manager MUST use random backoff. If the QoS Manager determines that the traffic stream cannot be admitted after attempting preemption, then:
- 1) If the Control Point set the ReportBlockingStream field to a value of “0” in the SelectedQmCapabilities input parameter, the QoSManager MUST return error to the Control Point with Error Code 766.
 - 2) If the Control Point set the ReportBlockingStream field to a value of “1” in the SelectedQmCapabilities input parameter, then the QoS Manager MUST follow all the requirements identified in clause 2.4.6.4.3.1.2.

While performing these additional capabilities of Preemption or ReportBlockingStream, in case of failure, the QoS Manager MUST release any resources that it might have reserved on any other QoS Segments for the traffic stream.

2.4.6.5 Dependency on State (if any)

Since UPnP QoSManager is defined as a stateless entity, there is no effect of this action on state.

2.4.6.6 Effect on State (if any)

Since UPnP QoSManager is defined as a stateless entity, there is no effect of this action on state.

2.4.6.7 Errors

Table 2-22 — Error Codes for RequestExtendedTrafficQos

errorCode	errorDescription	Description
701	TrafficHandle must not be specified by the Control Point	TrafficHandle must not be specified by the Control Point
710	Incomplete TrafficId	At least one of the required parameters in the TrafficId is absent.
711	TrafficId could not be completed	The QosManager could not complete the TrafficId
713	Malformed Name-string	One or more of the String fields in the traffic descriptor do not conform to the specification.
715	Policy parameters must not be specified by the Control Point	PolicyLastModified, PolicyModifyingUserName, or PolicyHolderConfigUrl must not be specified by the Control Point
716	An input parameter (e.g. TrafficDescriptor) does not validate against the XML schema	One of the XML-based input arguments does not follow the schema
718	Invalid Requested QoS Type	Value supplied for RequestedQosType parameter is invalid
721	TrafficImportanceNumber must not be specified by the Control Point	TrafficImportanceNumber must not be specified by the Control Point
722	The ActiveTspecIndex must not be specified by the Control Point	The ActiveTspecIndex must not be specified by the Control Point
725	Duplicate TspecIndex	All Tspec indices must be unique
740	No QosDevice at Source IP address	Source QosDevice does not exist.
741	No QosDevice at Destination IP address	Destination QosDevice does not exist.
742	No QosDevice at QosBoundarySourceAddress	Source Boundary QosDevice does not exist.
743	No QosDevice at QosBoundaryDestinationAddress	Destination Boundary QosDevice does not exist.
744	No QosDevices available	No QosDevice instances found on the network.
746	QosPolicyHolder failure	QosManager gets incorrect information from the QosPolicyHolder (could be malformed XML)
752	QosBoundarySourceAddress or QosBoundaryDestinationAddress not on the same subnet	The source and/or destination is not on the subnet which is under the management of this QosManager
765	Admission Failure	A stream cannot be admitted due to lack of resources on the network.
766	Failure to admit even after preemption	Stream cannot be admitted even after preemption due to lack of resource
773	Cannot retrieve XML namespace	An XML namespace was included in one of the arguments, but the QosManager service was unable to retrieve the namespace from the location provided.
780	QosPolicyHolder not found	The QosPolicyHolder specified by the PolicyHolderId was not found.
781	Preferred QosPolicyHolder not found	The Preferred QosPolicyHolder not found on the network.

errorCode	errorDescription	Description
782	Parameterized QoS not possible	End to end parameterized QoS cannot be established for a stream due to presence of at least on prioritized QoS segment.
785	Different Preferred QoSPolicyHolder ServiceId values	QoSDevice Services report different ServiceId values for the Preferred QoSPolicyHolder with the same highest preference count.
790	Capability not supported	The QoSManager Service does not support the requested capability.
791	TrafficLeaseTime is missing	TrafficLeaseTime in the traffic descriptor is missing
792	Incorrect TSPEC	Input parameters supplied in the TSPEC are incorrect.

2.4.7 UpdateExtendedTrafficQos()

The Control Point invokes this optional action for updating QoS for a specified admitted traffic stream with optional additional capabilities, such as preemption and reporting of blocking streams that are not supported by [UpdateTrafficQos\(\)](#).

2.4.7.1 Arguments

Table 2-23 — Arguments for UpdateExtendedTrafficQos

Argument	Direction	relatedStateVariable
TrafficHandle	In	A_ARG_TYPE_TrafficHandle
RequestedTrafficDescriptor	In	A_ARG_TYPE_TrafficDescriptor
SelectedQmCapabilities	In	A_ARG_TYPE_QmCapabilities
ImplementedTrafficDescriptor	Out	A_ARG_TYPE_TrafficDescriptor
ReturnTrafficQosInfo	Out	A_ARG_TYPE_ExtendedTrafficQosInfo
ResultedQosType	Out	A_ARG_TYPE_ResultedQosType

2.4.7.2 Service Requirements

2.4.7.2.1 Base Requirements

Refer to Clause 2.4.2.2.1. for base requirements when a Control Point invokes [UpdateExtendedTrafficQos\(\)](#) action.

Note: The [QoSManager](#) Service does not return NumPolicyHolders parameter as an output argument of [UpdateExtendedTrafficQos\(\)](#) action.

2.4.7.2.2 RequestedQosType Specific Requirements

If a Control Point requests non-supported [QoSManager](#) Service capability in the SelectedQmCapabilities input argument, the [QoSManager](#) Service MUST return Error Code 790.

For [RequestedQosType](#) parameter with the value of “1” in the [RequestedTrafficDescriptor](#), if the [QoS Manager](#) identifies that one of the QoS Segments on path is not capable of supporting Parameterized QoS, the [QoSManager](#) Service MUST set [ResultedQosType](#) parameter to “1” which is returned as an output argument of [UpdateExtendedTrafficQos\(\)](#) action. The [QoS Manager](#) determines whether a QoS Segment is capable of supporting parameterized QoS based on the [AdmitCntrlNet](#) parameter retrieved via the QD: [GetExtendedQosState\(\)](#) action.

For [RequestedQosType](#) parameter with the value of “1” in the [RequestedTrafficDescriptor](#), if the [QoS Manager](#) identifies that all of QoS Segments on path are capable of supporting Parameterized QoS, the [QoSManager](#) Service MUST set [ResultedQosType](#) parameter to “2” which is returned as an output argument of [UpdateExtendedTrafficQos\(\)](#) action.

For the RequestedQoSType parameter with the value of “2” in the RequestedTrafficDescriptor, if the QoS Manager identifies that some of the QoS Segments on the path are not able to support Parameterized QoS, and no less preferred TSPEC is supplied, the QoSManager Service MUST return error to the CP in response to UpdateExtendedTrafficQos() with Error Code of 782.

For the RequestedQoSType parameter with the value of “1” or “2”, if a Control Point does not supply a value for the TrafficLeaseTime field in the RequestedTrafficDescriptor input argument, the QoSManager Service MUST return error with Error Code 791 to the Control Point.

2.4.7.3 Control Point requirements when calling the action

2.4.7.3.1 Base Requirements

Refer to Clause 2.4.2.3.1 above when invoking UpdatedExtendedTrafficQos() action.

2.4.7.3.2 RequestedQoSType Specific Requirements

A Control Point MUST provide RequestedQoSType parameter in the RequestedTrafficDescriptor input argument.

A Control Point MUST NOT supply a value greater than “2” for the RequestedQoSType parameter.

A Control Point MUST NOT request QoS Manager capabilities that are not supported by the QoSManager Service.

For the RequestedQoSType parameter with the value of “1” or “2”, a Control Point MUST supply a value for the TrafficLeaseTime field in the RequestedTrafficDescriptor input argument.

2.4.7.4 QoS Manager Requirements

2.4.7.4.1 Base requirements

When a Control Point calls the UpdatedExtendedTrafficQos() action, the QoS Manager MUST follow all the requirements identified in Clause 2.4.2.4.1, irrespective of the value of RequestedQoSType parameter in the InitialTrafficDescriptor input parameter.

2.4.7.4.2 Prioritized QoS Update Requirements with Extended Functionality

Upon receiving UpdateExtendedTrafficQos() action with the RequestedQoSType parameter in the RequestedTrafficDescriptor of “0”, the QoS Manager MUST follow all the requirements identified in Clause 2.4.2.4.2.

2.4.7.4.3 Parameterized and Hybrid QoS Update Requirements with Extended Functionality

Upon receiving UpdateExtendedTrafficQos() action with the RequestedQoSType parameter in the RequestedTrafficDescriptor of either “1” or “2”, the QoS Manager MUST follow all the requirements identified in Clause 2.4.2.4.3 to update the stream identified by the RequestedTrafficDescriptor.

However, if the QoS Manager identifies that the stream cannot be updated even with the least preferred TSPEC supplied in the RequestedTrafficDescriptor, and if the Control Point requested extended QoS Manager capabilities (i.e. either Preemption = “1” or ReportBlockingStreams = “1” in the SelectedQmCapabilities input argument), the QoS Manager MUST perform the extended functions, as outlined in clause 2.4.6.4.3.1 above, to

update the stream with the least preferred TSPEC. If the CP did not request extended QoS Manager capabilities (i.e. CP set Preemption = “0” and ReportBlockingStreams = “0”), the QoS Manager MUST NOT perform the extended functions.

2.4.7.5 Dependency on State (if any)

Since QoSManager is defined as a stateless entity, there is no dependency for this action on the state.

2.4.7.6 Effect on State (if any)

Since QoSManager is defined as a stateless entity, there is no effect of this action on state.

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