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**Information technology – UPnP device architecture –
Part 17-13: Quality of Service Device Control Protocol – Level 3 – Quality of
Service Device Service – Underlying Technology Interfaces**

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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 17-13: Quality of Service Device Control Protocol – Level 3 – Quality of Service Device Service – Underlying Technology Interfaces

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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 addendum contains recommendations for implementing interfaces between the UPnP QoSDevice Service and various lower transport layers. Its purpose is to ensure that implementers of these interfaces use consistent mapping of methods and parameters from UPnP to the lower layers.

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1.1 Referenced Specifications

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.

1.1.1 Normative References

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

[QD 3] *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>

[DEVICE] - *UPnP Device Architecture, version 1.0*.

[IANA] - IANA Interface Type (IANAifType)-MIB <http://www.iana.org/assignments/ianaiftype-mib>

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:

[Qos Architecture] – *UPnP Qos Architecture:3 Document* 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>

[Annex_G] – IEEE 802.1Q-2005, Annex G, IEEE Standard for Information technology - Telecommunications and information exchange between systems – IEEE Standard for Local and metropolitan area networks - Virtual Bridged Local Area Networks, 2005.

2 (Normative) Requirements on the QoSDevice Service and interactions that are specific for the Underlying Network Technologies

This addendum provides requirements for the QoSDevice Service that are specific to particular Underlying Network Technologies. It is expected that these UPnP QoSDevice Services will run directly on top of Layer 2 MAC/PHYs. QoSDevice Services MAY also run on top of higher layer mechanisms. Both of these Layer 2 and higher layer mechanisms will be referred to as L2 technologies and QoSDevice Service interactions with the L2 technologies. The described technologies were among those considered during development of UPnP-QoS v3.

Given the map in the Mapping Table defined in the appropriate L2 technology subclause below, if an optional parameter is omitted in the active TSPEC and there is a UPnP-QoS default value, the QoSDevice Service MUST use the UPnP-QoS default value (in preference to the L2 default value).

If UPnP-QoS v3 is implemented on an L2 technology that is not defined in this addendum, a clause based on the template provide in Annex B of QoSDevice Service [QD 3] MUST be completed. The purpose of this requirement is to ensure interoperability between products from different manufacturers.

The clauses below assume that the referenced specifications are available to the reader for terminology and functional definition.

2.1 DSCP

2.1.1 References

[RFC2475] – An Architecture for Differentiated Services, Klyne, et. al., July 2002.
<http://www.ietf.org/rfc/rfc2475.txt>

2.1.2 Priority Mapping

A QosDevice that supports DSCP [RFC2475] tagging must use the following mapping table.

Table 2.1-1 — Priority Mapping

UPnP-QoS Traffic Importance Number	DSCP tag (values are in hexadecimal)
0	0
1	8
2	10
3	18
4	20
5	28
6	30
7	38

2.2 HomePlug AV

2.2.1 References

[HPAV] HomePlug AV Specification Version 1.1.00. This specification is available from the HomePlug Powerline Alliance (<http://www.homeplug.org>).

2.2.2 Priority Mapping

HomePlug defines four priority levels at layer 2. These levels, from highest to lowest priority, are: CA3, CA2, CA1 and CA0. The mapping of the QoS Traffic Importance number to a HomePlug priority MUST follow the mappings in Table 2.1-1.

Table 2.2-1 — Priority Mapping

UPnP-QoS Traffic Importance Number	HomePlug Priority
0	CA1
1	CA0
2	CA0
3	CA1
4	CA2
5	CA2
6	CA3
7	CA3

2.2.3 QosSegmentId formation

The *QosSegmentId* MUST be formed by concatenating the IANAInterfaceType “174”, the hex digit “A” and “00000000” with the 54 bit Network ID (NID) of the AVLN as defined in [HPAV]. The NID is defined as being 6 octets (bits 0-7) and a 7th octet (bits 0-5). It is represented in the Beacon payload of 7 octets and must be represented as 14 hex digits in the

2.2.6 Blocking traffic stream identification

If an [AdmitTrafficQos \(\)](#) or [UpdateAdmittedQos \(\)](#) action fails to admit a stream because of inadequate resources on a HomePlug AV QoS Segment, the [QosDevice](#) Service MUST return a list containing the [Layer2StreamId](#) values of all currently active L2 streams on the HPAV QoS Segment.

2.2.7 Responsibility for Stream Setup.

In HomePlug AV the source or the destination within the QoS Segment is responsible for the setup of QoS and for UPnP-QoS setup the arbitrary choice was made to set up QoS from the destination side. Thus, if a [QosDevice](#) Service receives an [AdmitTrafficQos \(\)](#) action or an [UpdateAdmittedQos \(\)](#) action in which the [Resource](#) argument indicates that there is a [QosDevice](#) Service downstream from this [QosDevice](#) Service, this [QosDevice](#) Service MUST NOT take any action to reserve resources on the HPAV network, and MUST acknowledge the request by returning a [ReasonCode](#) = "001" to the QoS Manager.

2.2.8 Mapping of HomePlug AV Returned Parameters to [ProtoTspec](#) Parameters

Table 2.2-3 shows how UPnP-QoS ProtoTspec parameters are determined from returned [HomePlug AV](#) parameters. (See QosManager Service for definition of [ProtoTspec](#)).

Table 2.2-3 — [ProtoTspec](#) Parameters

UPnP-QoS Parameter	HPAV Parameter	Comment
DataRate	Average Data Rate	
MinServiceRate	Minimum Data Rate	
MaxBurstSize	Maximum Burst Size	
PeakDataRate	Maximum Data Rate	
MaxPacketSize	Maximum MSDU Size	
QosSegmentMaxDelayHigh	Delay Bound	
QosSegmentMaxJitter	Jitter Bound	
MaxServiceInterval	Maximum Inter-TXOP time	
MinServiceInterval	Minimum Inter-TXOP time	
LossSensitivity	MSDU Error Rate	
TrafficLeaseTime	Inactivity Interval	

Note: Unit conversion may be necessary.

2.2.9 Mapping of HomePlug AV Returned Parameters to [AdmitTrafficQosExtendedResult](#) and [AllocatedResources](#) Parameters

[HomePlug AV](#) does not provide additional information regarding QoS resource commitments.

2.3 HPNA

2.3.1 References

[HPNA] HomePNA Specification 3.1, December 2006;
http://www.homepna.org/en/spec_download/download_request.asp

2.3.2 Priority Mapping

HPNA defines eight priority levels. These are from highest to lowest, 7-0. The mapping of the QoS Traffic Importance number to a HPNA priority MUST follow the mappings in Table 2.3-1.

Table 2.3-1 — Priority Mapping

UPnP-QoS Traffic Importance Number	HPNA Priority
0	2
1	1
2	0
3	3
4	4
5	5
6	6
7	7

2.4 IEEE 802.1Q, Annex G

2.4.1 References

[Annex_G] – IEEE 802.1Q-2005, Annex G, IEEE Standard for Information technology - Telecommunications and information exchange between systems – IEEE Standard for Local and metropolitan area networks - Virtual Bridged Local Area Networks, 2005.

2.4.2 Priority Mapping

Devices that support IEEE 802.1Q, Annex G priority scheme must convert the UPnP Traffic Importance Number to the appropriate VLAN tag. The following mapping table must be used. Note that this table is used for tagging; for the queuing and buffer management when dealing with less than 8 queues, the behavior is specified by IEEE 802.1Q.

Table 2.4-1 — Priority Mapping

UPnP-QoS Traffic Importance Number	VLAN / IEEE 802.1Q priority
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7

Processing of received frames should be done in accordance with the IEEE 802.1q specification.

2.5 MoCA

2.5.1 References

[MoCA1.0] MoCA MAC/PHY SPECIFICATION v1.0, 2006.

Table 2.5-2 — Traffic Specification Parameters

MoCA Parameter	R / O	UPnP-QoS parameter	Comment
<u>T_PEAK_DATA_RATE</u>	<u>R</u>	<u>PeakDataRate</u> if provided otherwise <u>DataRate</u>	The maximum number of kilobits of payload that a MoCA PQoS Flow transfers over a one second period in the MoCA Network
<u>T_PACKET_SIZE</u>	<u>O</u>	<u>MaxPacketSize</u>	The packet length in octets of a flow. The bandwidth cost of the flow is calculated using this value.

Note: Unit conversion may be necessary.

For each flow admitted by the MoCA layer 2, every involved node is required by the MoCA 1.1 specification to be able to sustain the PQoS Flow as long as the following requirements are satisfied:

- The Injection Bit Rate is always less than or equal to the PQoS Flow's T_PEAK_DATA_RATE.
- The Injection PDU Rate is always less than or equal to the PQoS Flow's T_PEAK_DATA_RATE/T_PACKET_SIZE.
- The length of all injected PDUs is less than or equal to T_PACKET_SIZE.

2.5.6 Blocking traffic stream identification

If an AdmitTrafficQos() or UpdateAdmittedQos() action fails to admit a traffic stream because of inadequate resources on a QoS Segment, the QosDevice Service on a MoCA interface MUST return a list containing the MoCA Layer2StreamId values of all currently active L2 streams on the MoCA QoS Segment.

2.5.7 Responsibility for QoS Setup

In MoCA the source or the destination within the QoS Segment is responsible for the setup of QoS and for UPnP-QoS setup the arbitrary choice was made to set up QoS from the source side. Thus, if a QosDevice Service receives an AdmitTrafficQos () action or an UpdateAdmittedQos () action in which the Resource argument indicates that there is a QosDevice Service upstream from this QosDevice Service, it need not take any action but MUST acknowledge the request by returning a ReasonCode = "001" to the QoS Manager.

2.5.8 Mapping of MoCA Returned Parameters to ProtoTspec Parameters

Table 2.5-3 shows how UPnP-QoS ProtoTspec parameters are determined from returned MoCA parameters. (See QosManager Service for definition of ProtoTspec)

Table 2.5-3 — ProtoTspec Parameters

UPnP-QoS parameter	MoCA Parameter	Comment
<u>DataRate</u>	<u>T_PEAK_DATA_RATE</u>	For a ProtoTspec the DataRate should reflect the throughput currently available for reservation on the requested path.

Note: Unit conversion may be necessary.

2.5.9 Mapping of *MoCA* Returned Parameters to *AdmitTrafficQosExtendedResult* and *AllocatedResources* Parameters

Table 2.5-4 shows how UPnP-QoS *AdmitTrafficQosExtendedResult* and *AllocatedResources* parameters are determined from returned *MoCA* parameters.

A *QosDevice* Service with a *MoCA* interface that is the source of the traffic stream in the *MoCA* QoS segment MUST return the sum of *MaxCommittedDelay* values for all the QosDevices on the QoS Segment. If a *MoCA* device cannot return all of the *MaxCommittedDelay* for the QoS Segment it MUST return 0. All other QosDevices on the QoS Segment MUST return zero.

A *QosDevice* Service with a *MoCA* interface that is the source of the traffic stream in the *MoCA* QoS segment MUST return the sum of *MaxCommittedJitter* values for all the QosDevices on the segment. If a *MoCA* device cannot return all of the *MaxCommittedJitter* for the QoS Segment it MUST return zero. All other QosDevices on the QoS Segment MUST return zero.

Table 2.5-4 — *AllocatedResource* Parameters

UPnP-QoS parameter	As calculated from MoCA Parameter(s)	Comment
<i>MaxCommittedDelay</i>	<i>Latency</i>	MUST be the maximum latency defined for the <i>MoCA</i> version at 80% of bandwidth capacity.
<i>MaxCommittedJitter</i>		This is implementation dependent. Default should be the same value as Latency.

Note: Unit conversion may be necessary.

2.6 Wi-Fi WMM-AC

The requirements provided in this clause are applicable to all 802.11 wireless stations (STA) that are operating in infrastructure mode. It includes requirements for STAs that implement QoS enhancements

2.6.1 References

[WMM] WMM Specification, Wi-Fi WMM (Wireless Multimedia) Specification v1.1, Wi-Fi Alliance, December 2005. <http://www.wi-fi.org>.

2.6.2 Priority Mapping

Wi-Fi Alliance's Wi-Fi Multi Media (WMM) defines four priority levels at layer 2. These levels, from highest to lowest priority, are: AC_VO, AC_VI, AC_BE and AC_BK. The mapping of the QoS Traffic Importance number to a WMM priority MUST follow the mappings in Table 2.6-1.

2.6.7 Responsibility for QoS Setup

In WMM, the STA within the QoS Segment is responsible for the setup of QoS. For UPnP-QoS this implies that the ingress and egress of the QoS Segment are jointly responsible for the setup of QoS.

If a QosDevice Service with a WMM interface receives an AdmitTrafficQos () action or an UpdateAdmittedQos () and it is a STA, then this QosDevice Service uses an WMM ADDTS request frame to setup a Traffic Stream (TS) between it and an AP..

If a QosDevice Service with a WMM interface receives an AdmitTrafficQos () action or an UpdateAdmittedQos () action, and it is an AP, then this QosDevice Service behavior depends on the value of the Network Resource argument in the action.

- If QDUpstream=1 and QDDownstream=1 in the NetworkResource structure for this QosDevice Service, then the flow is STA(QD) → AP(QD) → STA(QD); this AP is in the middle and the QosDevice Service on the AP MUST NOT take any action to reserve resources but MUST acknowledge the request by returning a ReasonCode = "001" to the QoS Manager.
- If QDUpstream=0 in the NetworkResource structure for this QosDevice Service and the MAC address corresponding to the SourceAddress in the TrafficDescriptor is not in the list of ReachableMacs for the wireless interface in the PathInformation structure then the AP is at the ingress of the QoS Segment AP(QD)→STA(QD); and the QosDevice Service on the AP MUST NOT take any action to reserve resources but MUST acknowledge the request by returning a ReasonCode = "001" to the QoS Manager.
- If QDUpstream=0 in the NetworkResource structure for this QosDevice Service and the MAC address corresponding to the SourceAddress in the TrafficDescriptor is in the list of ReachableMacs for the wireless interface in the PathInformation structure then the AP is not at the ingress of the QoS Segment STA(non-QD) → AP(QD) → STA(QD). The AP accounts for layer 2 network resources of the STA → AP connection (since there is no QosDevice Service on the STA that will be able to perform a UPnP request for QoS). The returned ReasonCode depends on the success or failure of the layer 2 accounting.
- If QDDownstream=0 in the NetworkResource structure for this QosDevice Service and the MAC address corresponding to the DestinationAddress in the TrafficDescriptor is not in the list of ReachableMacs for the wireless interface in the PathInformation structure then the AP is at the egress of the QoS Segment STA(QD) → AP(QD); and the QosDevice Service on the AP MUST NOT take any action to reserve resources but MUST acknowledge the request by returning a ReasonCode = "001" to the QoS Manager.
- If QDDownstream=0 in the NetworkResource structure for this QosDevice Service and the MAC address corresponding to the DestinationAddress in the TrafficDescriptor is in the list of ReachableMacs for the wireless interface in the PathInformation structure then the AP is not at the egress of the QoS Segment STA(QD) → AP(QD) → STA(non-QD). The AP accounts for layer 2 network resources of the AP → STA connection (since there is no QosDevice Service on the STA that will be able to perform a UPnP request for QoS). The returned ReasonCode depends on the success or failure of the layer 2 accounting.

2.6.8 Mapping of WMM Returned Parameters to ProtoTspec Parameters

Table 2.6-3 shows how UPnP-QoS ProtoTspec parameters are determined from returned WMM parameters. (See QosManager Service for definition of ProtoTspec)

The values for all returned parameters for the ProtoTspec are implementation specific in WMM.

Table 2.6-3 — ProtoTspec Parameters

UPnP-QoS parameter	WMM Parameter	Comment
<u>DataRate</u>	Mean Data Rate	For a <u>ProtoTspec</u> the DataRate should reflect the throughput currently available for admission on the requested path.

Note: Unit conversion may be necessary.

2.6.9 Mapping of WMM Returned Parameters to AdmitTrafficQosExtendedResult and AllocatedResources Parameters

Table 2.6-4 shows how UPnP-QoS AdmitTrafficQosExtendedResult and AllocatedResources parameters are determined from returned WMM parameters.

A QosDevice Service with a WMM interface that is the source of the traffic stream in the WMM QoS segment MUST return the sum of MaxCommittedDelay values for all the QosDevices on the QoS Segment. If a WMM device cannot return all of the MaxCommittedDelay for the QoS Segment it MUST return 0. All other QosDevices on the QoS Segment MUST return zero.

A QosDevice Service with a WMM interface that is the source of the traffic stream in the WMM QoS segment MUST return the sum of MaxCommittedJitter values for all the QosDevices on the segment. If a WMM device cannot return all of the MaxCommittedJitter for the QoS Segment it MUST return 0. All other QosDevices on the QoS Segment MUST return zero.

Table 2.6-4 — AllocatedResource Parameters

UPnP-QoS parameter	As calculated from WMM Parameter(s)	Comment
<u>MaxCommittedDelay</u>		See above text
<u>MaxCommittedJitter</u>		See above text
<u>ListOfLayer2StreamIds</u>		

Note: Unit conversion may be necessary.

2.7 UPA

2.7.1 References

[UPA] Digital Home Specifications. Universal Powerline Association UPA (<http://www.upapl.org>)

2.7.2 Priority Mapping

UPA defines eight priority levels. These are from highest to lowest, 7-0. The mapping of the QoS Traffic Importance number to a UPA priority MUST follow the mappings in Table 2.7-1..