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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication procedures

## Gateway control protocol: QoS support packages

Recommendation ITU-T H.248.52

ITU-T

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# Recommendation ITU-T H.248.52

## Gateway control protocol: QoS support packages


### Summary

Recommendation ITU-T H.248.52 provides H.248 packages for different quality of service (QoS) support mechanisms. The QoS class package may be used in various areas with relations to QoS, e.g., media gateway level admission control functions. The Differentiated Services package is specifically designed to support QoS marking for IPv4- or IPv6-based H.248 streams/terminations, but limited to the 6-bit DiffServ field within the IP header. The General IP Header QoS Octet package allows QoS marking and modification of the entire 8-bit field, related to QoS protocol control information elements in IPv4 and IPv6 packet headers.

Amendment 1 (03/2009), which is integrated in this edition, defines a new version of the *Differentiated Services* package, which clarifies the procedures for copying DSCP values from ingress packets to egress ones.



### Source

Recommendation ITU-T H.248.52 was approved on 13 June 2008 by ITU-T Study Group 16 (2005-2008) under the Recommendation ITU-T A.8 procedure. This edition includes the Amendment approved on 16 March 2009 by ITU-T Study Group 16 (2009-2012) under the Recommendation ITU-T A-8 procedure.

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# Recommendation ITU-T H.248.52

## Gateway control protocol: QoS support packages

### 1 Scope

This Recommendation provides H.248 packages for different quality of service (QoS) support mechanisms.

The QoS class package (clause 6) defines a single property for signalling a QoS class codepoint. Such a codepoint may be correlated with a set of network performance parameters. Such parameters may be used in the area of transport resource management or admission control.

The Differentiated Services package (clause 7) defines a property to control the 6-bit differentiated services (DS) field of the IP header, as defined in [IETF RFC 2474]. The media gateway controller (MGC) can set the quality of service (QoS) for egress media flows without having to provision the media gateway (MG) with a default differentiated service code point (DSCP) value.

Thus both packages have a slightly different scope as described in the clauses below (see also Appendix II).

The General IP Header QoS Octet package (clause 8) provides an extended capability, in comparison to the Differentiated Services package, in order to address the entire 8-bit field, and enable modification of individual bits.

### 1.1 Typical application of the QoS class package

This package is only relevant for ephemeral terminations, i.e., packet-switched bearer technologies. Any packet-based bearer connection traverses a set of packet nodes in the network. Even within an MG, a bearer may traverse a number of queuing points. To set up a bearer, generally resources must be reserved at each transport path/interface and/or MG-internally (see Note 1). The availability check, selection and allocation of resources are related to admission control (AC) functions (see Note 2), e.g., there could be admission control functions in an MG on the level of contexts (CoAC), terminations (TeAC) or even streams (StAC).

NOTE 1 – This may depend on how the network capacity and/or MG capacity is engineered, e.g., the MG external network interfaces may be "over-provisioned", operated in a "best effort" manner, or strict deterministic resource allocation schemes, etc. Similar resource management models may be applied internally to the MG.

NOTE 2 – The concept is very similar to the connection admission control (CAC) concept defined for B-ISDN/ATM [b-ITU-T I.371].

Any admission control function is motivated by QoS support and determines the admissibility of a new bearer (i.e., H.248 context, termination and/or stream; see Note 3) by checking the availability of various resources. Network performance parameters may be part of such an AC function and thus could be described by this package.

NOTE 3 – This may depend in particular on the H.248 connection model (e.g., IP-to-IP context), or single/multiple H.248 streams per termination, etc.

It has to be noted that the area of admission control is just one possible application of the QoS class package. The diversity of potential applications (see Note 4) is much broader due to the definition of the *qos* package property. The particular application should be defined in a profile specification.

NOTE 4 – Further applications are, e.g., support of path-coupled QoS signalling, or support of pushing/pulling QoS-specific policies, or even support of QoS marking.

## 1.2 Typical application of the Differentiated Services and General IP Header QoS Octet packages

"Packet marking" (also known as "QoS marking") is a QoS building block for support of quality of service in packet networks (see clause 8.4 of [ITU-T Y.1291]). This function involves assigning a value to a designated IP header field in IP networks. QoS marking in IP domains is the primary scope of the *ds* and *gih* packages and includes marking of:

– IPv4 Type-of-Service (ToS) field ([b-IETF RFC 1349]);

– IPv4 Explicit Congestion Notification (ECN) field ([b-IETF RFC 3168]);

– IPv4 ToS together with ECN;

– IPv4 Differentiated Services (DS) field ([IETF RFC 2474]);

– IPv6 Traffic Class field ([b-IETF RFC 2460]); or

– IPv6 Differentiated Services (DS) field ([IETF RFC 2474]).

The *ds* package is predestined for DS codepoint (DSCP) marking, but is also applicable for non-DS IP domains.

The function of QoS marking is illustrated by examples in Appendix IV. The *ds* package is furthermore applicable for controlling DS conditioning functions and per-hop behaviour (PHB).

## 1.3 Avoidance of interaction between the Differentiated Services and General IP Header QoS Octet packages

The two properties *ds/dscp* and *gih/iqo* overlap at a common 6-bit field in the IP header. Any parallel application of both properties to the same H.248 stream may thus lead to contradictory semantics. It is therefore recommended to use only one property per stream, and not both. Where both will result in a conflict, error code #473 ("*Conflicting property values*") is returned.

Likewise, parallel application of the *ds/tb* and *the gih/tm* properties to the same H.248 stream may lead to contradictory semantics. It is also recommended to use only one of these two properties per stream, and not both. Where both will result in a conflict, error code #473 "*Conflicting property values*" is returned.

# 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.248.1] Recommendation ITU-T H.248.1 (2005), *Gateway control protocol: Version 3*.

[ITU-T H.248.15] Recommendation ITU-T H.248.15 (2002), *Gateway control protocol: SDP H.248 package attribute*.

[ITU-T Y.1291] Recommendation ITU-T Y.1291 (2004), *An architectural framework for support of Quality of Service in packet networks*.

[IETF RFC 2474] IETF RFC 2474 (1998), *Definition of the Differentiated Services Field (DS field) in the IPv4 and IPv6 Headers*.
<http://www.ietf.org/rfc/rfc2474.txt>

## 3 Terms and definitions

### 3.1 Terms defined elsewhere

None.

### 3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

**3.2.1 QoS class**: QoS refers to a set of (network) performance parameters. Such a set could, for instance, constitute the traffic contract between the subscriber equipment and the network. Examples of such performance parameters include: packet loss ratio, packet transfer delay, and packet delay variation tolerance. The parameters are used to define distinct QoS classes.

## 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

| | |
|---|---|
| AC | Admission Control |
| ATM | Asynchronous Transfer Mode |
| BCAC | Bearer Connection Admission Control |
| BCP | Bearer Control Protocol |
| B-ISDN | Broadband Integrated Services Digital Network |
| CAC | Connection Admission Control |
| CES | Circuit Emulation Service |
| CoAC | Context Admission Control |
| CoS | Class of Service |
| CU | Currently Unused (DiffServ) |
| DiffServ | Differentiated Services |
| DS | Differentiated Services |
| DSCP | Differentiated Services Code Point |
| ECN | Explicit Congestion Notification |
| ER | Edge Router |
| IP | Internet Protocol |
| IPDV | Internet Protocol packet Delay Variation |
| IPER | Internet Protocol packet Error Ratio |
| IPLR | Internet Protocol packet Loss Ratio |
| IPRR | Internet Protocol packet Reordering Ratio |
| IPTD | Internet Protocol packet Transfer Delay |
| MG | Media Gateway |
| MGC | Media Gateway Controller |
| MLPP | Multi-Level Precedence and Preemption |
| NGN | Next Generation Network |

| | |
|---|---|
| PHB | Per-Hop Behaviour |
| QoS | Quality of Service |
| RACF | Resource and Admission Control Functions |
| SDO | Standards Development Organization |
| SDP | Session Description Protocol |
| StAC | Stream Admission Control |
| TeAC | Termination Admission Control |
| TC | Traffic Class (IPv6) |
| ToS | Type of Service |
| VPN | Virtual Private Network |

## 5 Conventions

None.

## 6 QoS class package

**Package name**: QoS class package

**Package ID**: qos (0x00c7)

**Description**: This package defines a property for signalling QoS class codepoints.

**Version**: 1

**Extends**: None

### 6.1 Properties

#### 6.1.1 Class of Service

**Property name**: Class of Service

**Property ID**: class (0x0001)

**Description**: There is a database of QoS classes provisioned in the MG. A specific QoS class comprises a set of parameter/value pairs. This property corresponds to an index for such a database.

**Type**: Integer

**Possible values**: 0 to 63

NOTE – [b-ITU-T Y.1541] recommends planning for at least eight classes. The code space for Y.1541 classes is sufficient to accommodate sixty-four class designations.

**Default**: 0

**Defined in**: Local, Remote

NOTE – Local and remote descriptor level support implies the usage of the SDP H.248 package attribute in text encoding mode, according to [ITU-T H.248.15].

**Characteristics**: Read/write

### 6.2 Events

None.

## 6.3 Signals

None.

## 6.4 Statistics

None.

## 6.5 Error Codes

None.

In a case where the MGC requests a QoS class that is not supported by the MG, it is recommended that the MG replies with error code #449 "*Unsupported or unknown parameter or property value*".

This error may occur either due to a) an invalid property value; or b) a valid property value, but the property value is outside of the range of supported QoS classes; or c) a valid QoS class, but associated network performance parameters are not yet provisioned in the MG.

## 6.6 Procedures

### 6.6.1 Resource and admission control procedures in NGN architectures

High-level procedures are defined by some NGN architectures, for instance as part of resource and admission control functions (e.g., the RACF defined by [b-ITU-T Y.2012]). For example, [b-ITU-T Y.2111] defines procedures for reference point *Rw*.

NOTE – This Recommendation could be applied for a H.248-based *Rw* signalling protocol according to [b-ITU-T Q.3303.2].

### 6.6.2 QoS class codepoint mapping on network performance parameters

The QoS class codepoint is a pointer to a set of network performance parameter/value pairs, which are stored in the MG. The definition of such parameter sets, as well as the configuration of parameter values, is out of scope of this Recommendation. Appendix I describes such a codepoint mapping for the example of QoS classes as defined by [b-ITU-T Y.1541].

The indicated network performance parameters may then be used by the MG for the functions as described in the subsequent clauses.

### 6.6.3 Application of network performance parameters in an MG

#### 6.6.3.1 Transport resource management

Network performance parameters may be used by MG resource management as additional information. The resource management could first use the QoS class codepoint for the selection of specific node mechanisms (see, e.g., Table 2 of [b-ITU-T Y.1541]).

#### 6.6.3.2 Admission control

The general application of network performance parameters is their usage in the perspective of admission control functions by the MG, such as context admission control (CoAC), termination admission control (TeAC) and/or stream admission control (StAC).

NOTE – There could be an additional bearer connection admission control (BCAC) in a case where the MG is terminating a bearer control protocol (BCP, e.g., [b-ITU-T Q.1970]).

The admission control function(s) determines the admissibility of a new context/termination/stream into the MG (and correspondent bearer connection in the network) by the availability of various MG resources.

The nodal (and network) efficiency thus depends on how well the CoAC/TeAC/StAC function models the traffic and queuing behaviour of the underlying congestion point(s). CoAC/TeAC/StAC functions could apply deterministic or statistical multiplexing models, depending on the specific MG resource component types behind a context and its terminations. An efficient admission control should try to achieve as much statistical gain as possible without risking a congestion condition that would impair QoS.

The (statistical) gain, or economy of scale effect, particularly in the case of ephemeral terminations (such as IP) is generally a function of:

– buffer size;
– traffic characteristics (e.g., explicit traffic parameters according to [b-ITU-T H.248.53] *tman* properties or SDP "b=" line, or implicit traffic parameters derived from SDP "m=" and "a=" lines); and
– QoS objectives (as indicated by H.248.52 QoS class codepoints).

Admission control functions, which take into account QoS objectives, should consider one or more network performance parameters.

Algorithms for admission control functions (such as CoAC, TeAC or StAC) are typically not specified by SDOs, and are thus out of scope of this Recommendation.

#### 6.6.3.3 Rejection of resource requests/modifications

Admission control (AC) functions may be triggered by ADD requests or MODIFY requests which signal the *qos/class* property. The result of the AC is either acceptance or rejection of the request. Acceptance relates to a positive reply command, whereas rejection would be expressed by an appropriated H.248 error code (e.g., #510 "*Insufficient resources*" or #526 "*Insufficient bandwidth*").

A request rejection need not be based solely on QoS objectives. Rejection may be based on the signalled traffic characteristics. For instance, a stream admission control (StAC) function could reject the addition of a further stream to a termination in case of an unsupported media parameter (e.g., codec type).

### 6.6.4 IP terminations using both the *ds* and *qos* packages

The properties of both packages could be applied together (see also Appendix II) for the same H.248 IP stream or termination.

For example, the *qos/class* property may be part of an admission control function (see clause 6.6.3) deciding whether a Context/Termination/Stream is accepted. The *ds/dscp* property is then used for the QoS marking of any IP packet flows that were admitted.

Particular use cases are out of scope of this Recommendation because such a particular network scenario is mainly related to the specific DS PHB, the specific role of the MG in the DS domain (see Appendix IV), and the specific semantic of the QoS class property.

## 7 Differentiated Services package

**Package name**: Differentiated Services package

**Package ID**: ds (0x008b)

**Description**: This package enables the setting of the differentiated services (DS) field in the header of IP packets.

**Version**: 2

**Extends**: None

## 7.1 Properties

### 7.1.1 Differentiated Services Code Point

**Property name**: Differentiated Services Code Point

**Property ID**: dscp (0x0001)

**Description**: This property corresponds to the 6-bit differentiated services code point field of the IP header, as defined in [IETF RFC 2474].

**Type**: Octet String

**Possible values**: The value represents any 8-bit value encoded as an octet string of two hexadecimal digits. Only the 6 most significant bits are significant (e.g., in the following binary representation the xx are neglected 0000 00xx), implying a range of 64 DSCP values. See clause 7.6.3 for encoding examples.

**Default**: Provisioned

**Defined in**: Local Control

**Characteristics**: Read/Write

### 7.1.2 Tagging Behaviour

**Property Name**: Tagging Behaviour

**Property ID**: tb (0x0002)

**Description**: This property controls whether the MG sets a specific DSCP value on egress packets, or copies the DSCP of the ingress packet to the egress one.

**Type**: Enumeration

**Optional**: Yes

**Possible values**: "MARK" (0x0000)

Mark the packet with the DSCP value given by the *ds/dscp* property

"COPY" (0x0001)

Copy the DSCP of the ingress packet to the egress one

NOTE – Applying a specific DSCP value (the "MARK" value), is beneficial for use cases (IV.2), (IV.3.1) and (IV.3.2), but may not be required by use cases (IV.3.3) and (IV.3.4). To generalize, setting a specific DSCP value is most applicable for IP-to-IP MGs in "Back-to-Back IP Host (B2BIH)" mode of operation, because this implies a full termination of the IP stack. Copying the DSCP of the ingress packet to the egress (the "COPY" value) can be applicable for IP-to-IP MGs in "transport protocol agnostic", "IP forwarding" or "IP router" modes of operation.

**Default**: "MARK"; unless provisioned otherwise

**Defined in**: Local Control

**Characteristics**: Read/Write

## 7.2 Events

None.

## 7.3 Signals

None.

## 7.4 Statistics

None.

## 7.5 Error Codes

None.

## 7.6 Procedures

### 7.6.1 General

#### 7.6.1.1 Setting a specific DSCP value

The MGC may apply different DSCP values to the IP packets of different media flows. This can be used, for example, to apply different service levels to different types of streams (audio, video and data) or to differentiate between the service levels given to different subscribers based on their pre-negotiated terms. Similarly, DSCP values may be set according to service-agreement between operators.

When the value of the *ds/tb* property is "MARK" (the default), the MG uses the *ds/dscp* property as the DSCP value of packets *leaving* the termination. The value of *ds/dscp* is also used to derive an internal PHB that the MF applies to the packets before they are sent. Note that the ingress media flow is not checked against the value of *ds/dscp* – the property affects the egress media flow only.

If the *ds/dscp* property is not set by the MGC, the MG shall use a provisioned default value. The default value may be unique for the whole MG or be dependent on pre-defined criteria such as the egress interface or the media type.

#### 7.6.1.2 Copying DSCP values from the ingress to the egress

In certain scenarios, every egress packet can be readily associated with a single, specific ingress packet. When operating under such a scenario, the MGC may wish to use the DSCP value of the incoming packet for that of the outgoing one.

To copy the DSCP values of the ingress packets to packets leaving an H.248 stream, the MGC sets the value of the *ds/tb* property to "COPY" (the value assigned to the *ds/dscp* property is then ignored). The MG should, as far as possible, apply the same PHB as if a DSCP value identical to that of the ingress packet had been set by explicit use of the *ds/dscp* property.

Figure 1 provides a graphical representation of this behaviour. Note that the figure presents the simplest case of a context containing only two terminations; however the behaviour can be applied to any number of terminations in a context:

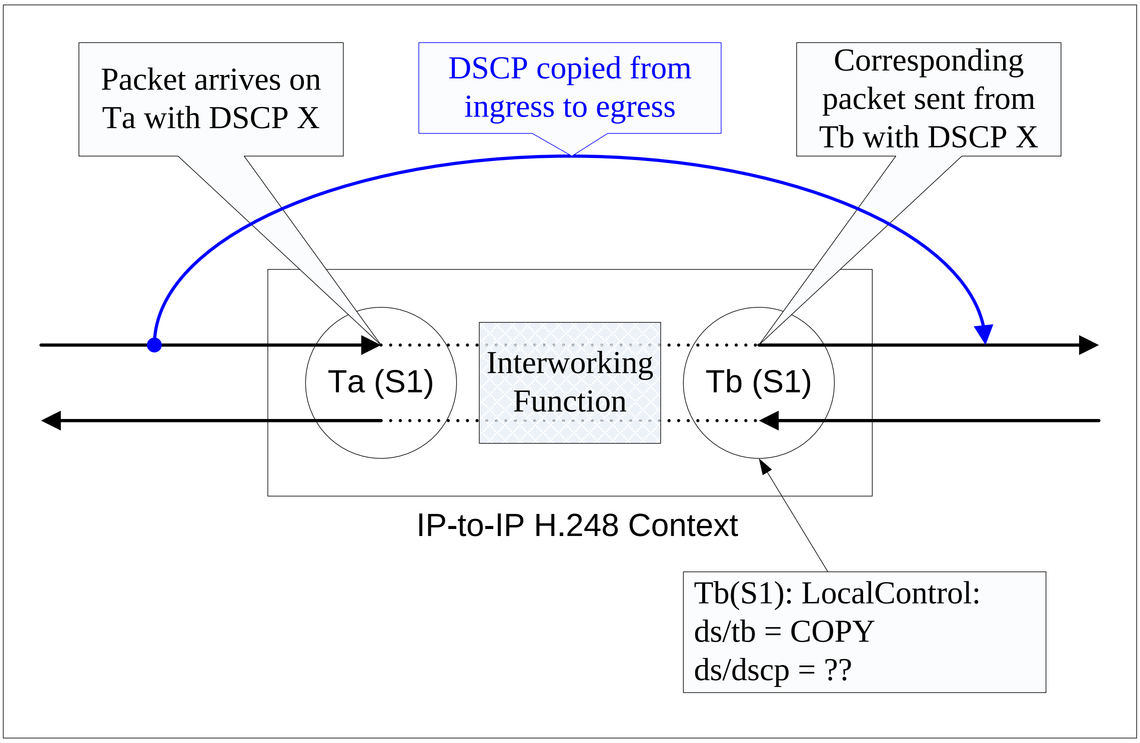



**Figure 1 – Copying DSCP values from ingress to egress side**

If the egress packet cannot be associated with an ingress packet (e.g., an internally generated announcement), the value of the *ds/tm* property is irrelevant. The DSCP value shall be derived from the *ds/dscp* property, as if *ds/tm* was set to "MARK".

#### 7.6.1.3 Backward compatibility with version 1

Version 1 of this package did not support the Tagging Behaviour property; however it did allow a similar default behaviour. That version used the following definition for the default value of the *ds/dscp* property:

***Default****: Provisioned, or copy the value received in the ingress packet*

This sub-clause deals with how a MG may provide a similar default behaviour while maintaining backward compatibility with a MGC that only supports version 1 of the package.

– Apply, by default, a specific DSCP value.

  This behaviour can be achieved by provisioning the default value of *ds/tb* to "MARK" and the default value of *ds/dscp* to the required value.

– Copy, by default, the value received in the ingress packet

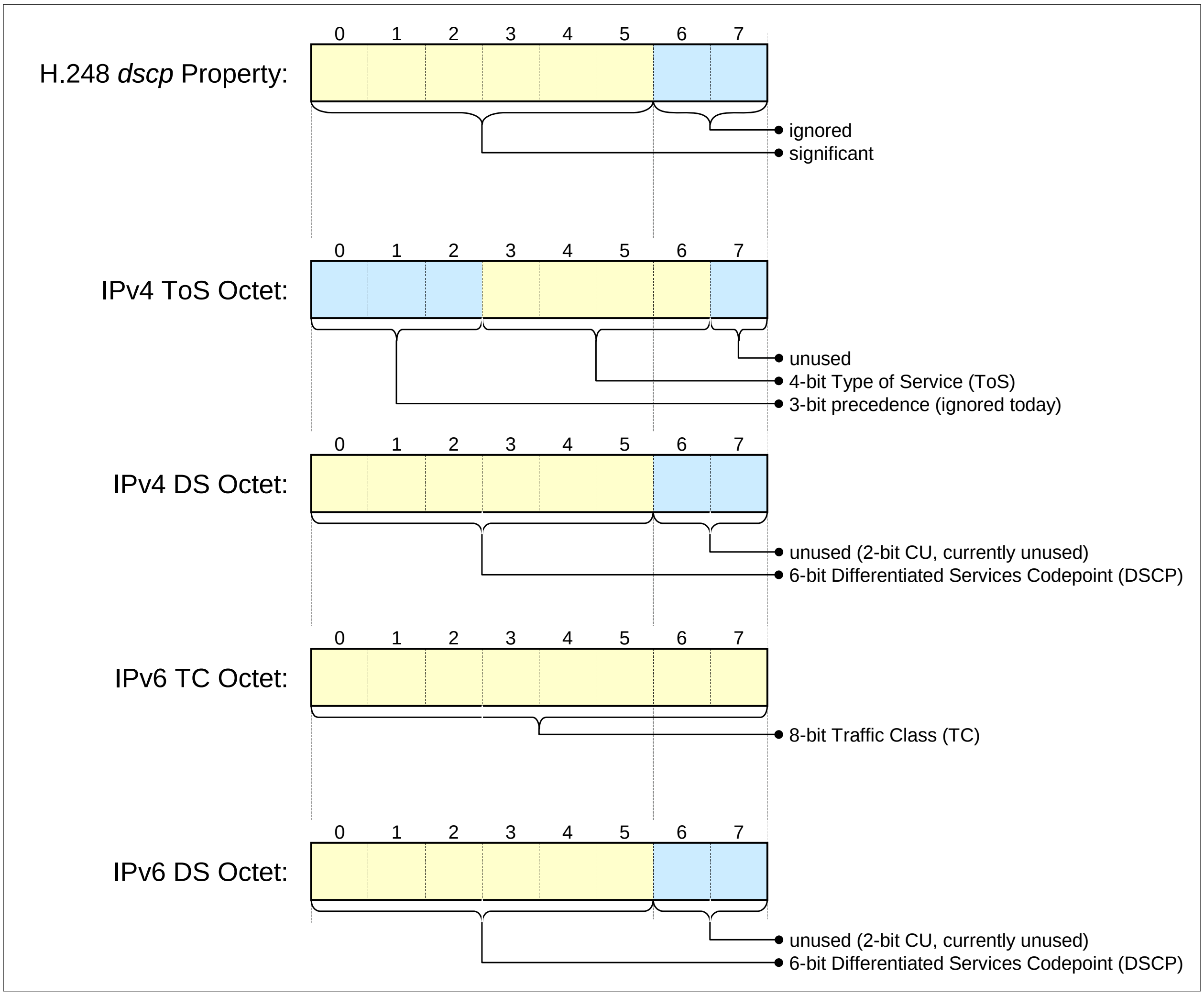
  Simply provisioning the default value of *ds/tb* to "COPY" will break interoperability with any version 1 MGC; as such a MGC will not be able to set any specific DSCP value. A more complicated default behaviour is necessary: The default value of *ds/tb* is set to "COPY" if the MGC does not specify a value for the *ds/dscp* property; and to "MARK" otherwise.

NOTE – Version 1 of the package did not provide any means to encode, in an AuditValue reply, a *ds/dscp* value that indicates that DSCP is copied from ingress packets to egress ones. MGs implementing that version of the package had to rely on some pre-agreement with the MGC about how such behaviour is reported in AuditValue replies. Interoperability with version 1 of the package may therefore be further complicated by the need to support such existing pre-agreements.

### 7.6.2 Specifics with regard to IP versions and ToS/DS octets

#### 7.6.2.1 Overview

The *ds/dscp* property is used to modify bits of an octet in the IP header. This operation of "packet marking" relates to either the IPv4 ToS octet, the IPv4 DS octet, the IPv6 TC octet or the IPv6 DS octet (see Figure 2).




NOTE – The decimal values 0 to 7 are used for numbering the bit positions. The number is not related to the weight of the bit below. The MSB/LSB order is defined by IETF RFCs for the IP header elements.

**Figure 2 – Specifics with regard to IP versions and ToS/DS octets**

It has to be noted that, for an H.248 IP termination, the H.248 MG is fundamentally:

– Aware of the IP version (due to the SDP "c=" line); but

– Respectively agnostic concerning ToS versus DS type octet (in case of IPv4) or TC versus DS type octet (in case of IPv6).

The MG must therefore map the significant *ds/dscp* property bits to the correct bit positions on the corresponding bits of the IP header. See clause 7.6.3 for encoding examples.

#### 7.6.2.2 IPv4 type of service octet

The first three bits of the six significant bits of the *ds/dscp* property are mapped on the 3-bit precedence field. The precedence field is generally unused, i.e., does not affect packet forwarding processes. The DiffServ header definition rules provide further background about the potential use of this field (see clause 4.2 of [IETF RFC 2474]).

The next three bits of the six significant bits of the *ds/dscp* property are mapped on the first three bits of the 4-bit ToS field. The corresponding limitation is rather small in practice due to the assigned ToS values (see www.iana.org/assignments/ip-parameters).

There are six assigned ToS values by IANA and the *dscp* property mapping would allow the support of five ToS classes (NOTE), which is typically enough in an IPv4 ToS aware environment.

NOTE – It is impossible to differentiate between the "Default" and "Minimize Monetary Cost" TOS classes using the properties of the *ds* package.

#### 7.6.2.3 IPv4 differentiated services octet

The six significant bits of the *ds/dscp* property are mapped on the 6-bit DSCP. The bits of the 2-bit CU field are not modified.

#### 7.6.2.4 IPv6 traffic class octet

The six significant bits of the *ds/dscp* property are mapped on the first six bits of the 8-bit traffic class. The remaining two bits of the 8-bit traffic class field are not modified.

#### 7.6.2.5 IPv6 differentiated services octet

The six significant bits of the *ds/dscp* property are mapped on the 6-bit DSCP. The bits of the 2-bit CU field are not modified.

#### 7.6.2.6 Others

The historical definitions for the IPv4 TOS octet are summarized in clause 22 of [b-IETF RFC 3168]. That RFC also introduces the ECN semantic. The ECN field cannot be controlled by this version of the *ds* package. See also clause 8.

### 7.6.3 Encoding of ds/dscp property – Examples

#### 7.6.3.1 Text encoding

The 8-bit binary value of the *ds/dscp* property represents a single octet, which must be encoded using two hexadecimal digits (see clause 12.1.2 of [ITU-T H.248.1]) according to clause B.3 of [ITU-T H.248.1].

Example:

1) The DSCP value to be encoded shall be the hexadecimal 2E (binary 101110).

2) IP header octet, bit representation: `1011 10xx`.

   NOTE – The MSB-to-LSB order in this example is from left to right (see [IETF RFC 2474]) according to bitfield definitions for IP header elements.

3) Hexadecimal encoding of this octet bit pattern: There are four possibilities due to the two "don't care" bits:

   a) **`1D`** (for binary **`1011 10`**`00`).

   b) **`9D`** (for binary **`1011 10`**`01`).

   c) **`5D`** (for binary **`1011 10`**`10`).

   d) **`DD`** (for binary **`1011 10`**`11`).

All four hexadecimal values are equivalent, and lead to the same DSCP value being applied to the packets (see also Figure 2).

#### 7.6.3.2 Binary encoding

No example.

### 7.6.4 Usage guidelines for DiffServ service classes

Values for the *ds/dscp* property may be derived by the MGC either directly from call/session/QoS control signalling protocols, or based on configuration guidelines. The DiffServ codepoint is defined in a hierarchical manner, divided in multiple codepoint spaces (see [IETF RFC 2474] and IANA concerning codepoint pools).

#### 7.6.4.1 Call/session/QoS-controlled DSCP codepoints

The MGC may directly forward the DSCP values to the MG, or may translate them based on a local policy.

#### 7.6.4.2 Configuration guidelines for DiffServ service classes

In some cases [b-IETF RFC 4594] may be used as a configuration framework, – e.g., MG as ToS pre-marker (see clause IV.2) or MG as DS pre-marker (see clause IV.3.1).

##### 7.6.4.2.1 General

Of particular interest may be the:

– telephony service class (see clause 4.1 of [b-IETF RFC 4594]);

– multimedia conferencing service class (see clause 4.3 of [b-IETF RFC 4594]);

– real-time interactive service class (see clause 4.4 of [b-IETF RFC 4594]); or

– multimedia streaming service class (see clause 4.5 of [b-IETF RFC 4594]).

##### 7.6.4.2.2 Voice-only environment

There may be network deployments with voice-only traffic. The MG then serves only the telephony service class, which from the IP network perspective according to [b-IETF RFC 4594] is usually comprised of:

– voice over IP (G.711, G.729 and other codecs);

– voiceband data over IP (fax/modem, data/modem, text/modem) in:
  - pass-through mode, i.e., V.152 VBD over IP; or
  - packet relay mode like T.38 fax over IP, V.150.1 modem over IP or V.151 text over IP;

– circuit emulation over IP (e.g., 1 x 64 kbit/s clearmode) see [b-IETF RFC 4040], virtual wire, etc.;

– IP virtual private network (VPN) service that specifies single-rate, mean network delay that is slightly longer than network propagation delay, very low jitter and very low packet loss.

DSCP marking could distinguish between circuit emulation services (CES) and non-CES services, and/or VPN and non-VPN services.

## 8 General IP Header QoS Octet package

**Package name**: General IP Header QoS Octet package

**Package ID**: gih (0x00e1)

**Description**: This package enables the setting and modification of the "QoS octet" field in the header of IP version 4 and version 6 packets. Major differences from the *ds* package are:

a) coverage of the entire 8-bit space instead of just 6 bits; and

b) modification of individual bits instead of a full setting (tagging or marking).

**Version**: 1

**Extends**: None

## 8.1 Properties

### 8.1.1 IP QoS Octet

**Property name**: IP QoS Octet

**Property ID**: iqo (0x0001)

**Description**: This property corresponds in general to an 8-bit field in the IP header (IPv4 ToS octet, IPv4 DS octet, IPv6 TC octet or the IPv6 DS octet), which may be related to, e.g., the 6-bit differentiated services field of the IP header, as defined in [IETF RFC 2474].

**Type**: Integer

**Possible values**: 0-255

**Default**: None.

**Defined in**: LocalControl, Remote

NOTE 1 – Remote descriptor level support implies the usage of the SDP H.248 package attribute in text encoding mode, according to [ITU-T H.248.15].

NOTE 2 – The property can be defined in the LocalControl Descriptor, as this maintains parity with (and eases migration from) the Differentiated-Services package. It can also be defined in the Remote Descriptor as it relates to packets leaving the MG. However these two placement options represent *one* instance of the property (i.e. the property cannot have different values in the different descriptors). Any command that assigns different values to the two placement options shall be rejected by the MG using error code #473 ("*Conflicting Property Values*").

**Characteristics:** Read/write

### 8.1.2 Tagging mask

**Property name**: Tagging mask

**Property ID**: tm (0x0002)

**Description**: This property defines an 8-bit mask, which is applied together with the *gih/iqo* property on the IP header. A bit in that IP header octet (IPv4 ToS octet, IPv4 DS octet, IPv6 TC octet or the IPv6 DS octet) is modified (according to the *iqo* value) when the corresponding *tm* bit is "1", and not modified when the corresponding *tm* bit is "0".

**Type**: Integer

**Possible values**: 0-255

NOTE 1 – Specifying both *ds/tb* and *gih/tm* on the same stream is not recommended and can cause conflicting semantics. The following table lists the possible combinations of *ds/tb* and *gih/tm* values that do *not* lead to a conflict:

| ds/tb | gih/tm |
|---|---|
| MARK | 0xFC, 0xFD, 0xFE, 0xFF |
| COPY | 0x00, 0x01, 0x02, 0x03 |

**Default**: None.

**Defined in**: LocalControl, Remote

NOTE 2 – See notes in clause 8.1.1 regarding the use of the different descriptors.

**Characteristics**: Read/write

## 8.2 Events

None.

## 8.3 Signals

None.

## 8.4 Statistics

None.

## 8.5 Error codes

None.

## 8.6 Procedures

### 8.6.1 General

See clause 7.6.1 in *ds* version 2 package.

### 8.6.2 Specifics with regard to IP versions and ToS/DS octets

See clause 7.6.2 in *ds* version 2 package. The mapping of the *ds/dscp* property to the IP header octet is now extended from six to eight bits.

Furthermore, there is an additional semantic defined.

#### 8.6.2.1 IP header with ECN usage

The historical definition for the IPv4 ToS octet is summarized in clause 22 of [b-IETF RFC 3168]. That RFC also introduces the ECN semantic. The ECN field can be controlled by this package.

### 8.6.3 Usage guidelines for DiffServ service classes

See clause 7.6.3 in *ds* version 2 package.

### 8.6.4 Modification of individual bits: Applications with the tagging mask

Tagging masks may be useful when the codepoint space is organized in a hierarchical manner, i.e., when only sub-fields are modified. Another application is the DiffServ re-marking function (see clause IV.3.3) for a particular codepoint pool.

# Appendix I

## QoS class codepoint mapping on Y.1541 QoS classes

(This appendix does not form an integral part of this Recommendation)

Below are the network QoS classes summarized as defined by [b-ITU-T Y.1541]. See clause 5.3 of [b-ITU-T Y.1541] for details.

**Table I.1 – IP network QoS class definitions and network performance objectives**

| **Network performance parameter** | **Nature of network performance objective** | **QoS classes** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Class 0** | **Class 1** | **Class 2** | **Class 3** | **Class 4** | **Class 5 unspecified** |
| IPTD | Upper bound on the mean IPTD | 100 ms | 400 ms | 100 ms | 400 ms | 1 s | U |
| IPDV | Upper bound on the $1 - 10^{-3}$ quantile of IPTD minus the minimum IPTD | 50 ms | 50 ms | U | U | U | U |
| IPLR | Upper bound on the packet loss probability | $1 \times 10^{-3}$ | $1 \times 10^{-3}$ | $1 \times 10^{-3}$ | $1 \times 10^{-3}$ | $1 \times 10^{-3}$ | U |
| IPER | Upper bound | $1 \times 10^{-4}$ | | | | | U |
| NOTE – See Tables 1 and 3 in [b-ITU-T Y.1541]. | | | | | | | |

**Table I.2 – Provisional IP network QoS class definitions and network performance objectives**

| **Network performance parameter** | **Nature of network performance objective** | **QoS classes** | |
|---|---|---|---|
| | | **Class 6** | **Class 7** |
| IPTD | Upper bound on the mean IPTD | 100 ms | 400 ms |
| IPDV | Upper bound on the $1 - 10^{-5}$ quantile of IPTD minus the minimum IPTD | 50 ms | |
| IPLR | Upper bound on the packet loss ratio | $1 \times 10^{-5}$ | |
| IPER | Upper bound | $1 \times 10^{-6}$ | |
| IPRR | Upper bound | $1 \times 10^{-6}$ | |
| NOTE – See Tables 1 and 3 in [b-ITU-T Y.1541]. | | | |

The *class* property relates to the Y.1541 QoS class, i.e., a property value equal to *i* corresponds to class *i* (e.g., value range 0 to 7 in case of this appendix).

# Appendix II

## Relation of QoS class package with differentiated services package

(This appendix does not form an integral part of this Recommendation)

The differentiated services package (see clause 7) is designed for H.248 terminations following the QoS architecture as defined by [IETF RFC 2474]. The *ds/dscp* property is related to the DiffServ field in the IPv4 and IPv6 headers, but is also applicable for the IPv4 service-marking model using the type of service (ToS; see [b-IETF RFC 1349]) attribute.

The *ds/dscp* property could be used for:

– QoS marking (e.g., "DiffServ marker" or "DiffServ pre-marker"; see also Appendix IV), i.e., setting or modifying the corresponding information field in the IP header. The H.248 MG could provide the role of a pre-marker (see [b-IETF RFC 2475]); or/and

– indication of conditioning functions and per-hop behaviours (PHBs). The H.248 MG could provide the role of a DiffServ router (e.g., first-hop, interior or egress router role).

The *ds/dscp* property is a codepoint for (DiffServ) "class of service" selection ("*dscp* is a class selector") in both cases, thus similar to the *class* property of the QoS class package. Although some may argue that both properties are synonymous, in practice, they have subtle distinctions:

– Operative concept:

  (DiffServ) CoS implies that services can be categorized into separate classes, which can, in turn, be handled individually. The function behind the *ds/dscp* property is therefore performed on each IP packet per H.248 termination ("active bearer connection"). Whereas the QoS class concept is more related to traffic contracts and transfer capabilities, which result typically in admission control and resource management functions, which are performed during bearer connection establishment phase ("ADD request for an ephemeral termination").

– Combined mode:

  There are use cases with DS codepoint indications together with QoS class codepoint signalling. For instance, the H.248 MG is a DS domain external node (e.g., peering a DiffServ edge router, (DS ER)), but provides the DiffServ pre-marker function, and the IP domain between the DS ER and MG supports QoS classes according to [b-ITU-T Y.1541].

  Another example is indicated in Table VI.1 of [b-ITU-T Y.1541] (association of Y.1541 QoS classes with Y.1221 transfer capabilities and differentiated services PHBs).

  Such applications require the support of the properties of both packages.

# Appendix III

## Relation of QoS class package with H.248 context attribute "priority"

(This appendix does not form an integral part of this Recommendation)

The H.248 context attribute *priority* (see clause 6.1.1 of [ITU-T H.248.1]) shall not be *re-used* as a codepoint for QoS class signalling, and it therefore does not replace the functionality of the QoS class package.

# Appendix IV

## Some examples for QoS marking with the H.248 differentiated services package

(This appendix does not form an integral part of this Recommendation)

### IV.1 Introduction

This appendix illustrates some examples for QoS marking in DS and non-DS networks. The H.248 MG acts in different roles in the various examples.

### IV.2 ToS marking

An IPv4 router should comply with [b-IETF RFC 1812], which implies a ToS-dependent IP forwarding process (see clause 5.3.2 of [b-IETF RFC 1812]). Figure IV.1 shows an IPv4 network with ToS-aware IP routers. The H.248 MG acts as a "ToS pre-marker" in the example. The IP next-hop is then typically a ToS-aware IP edge router.

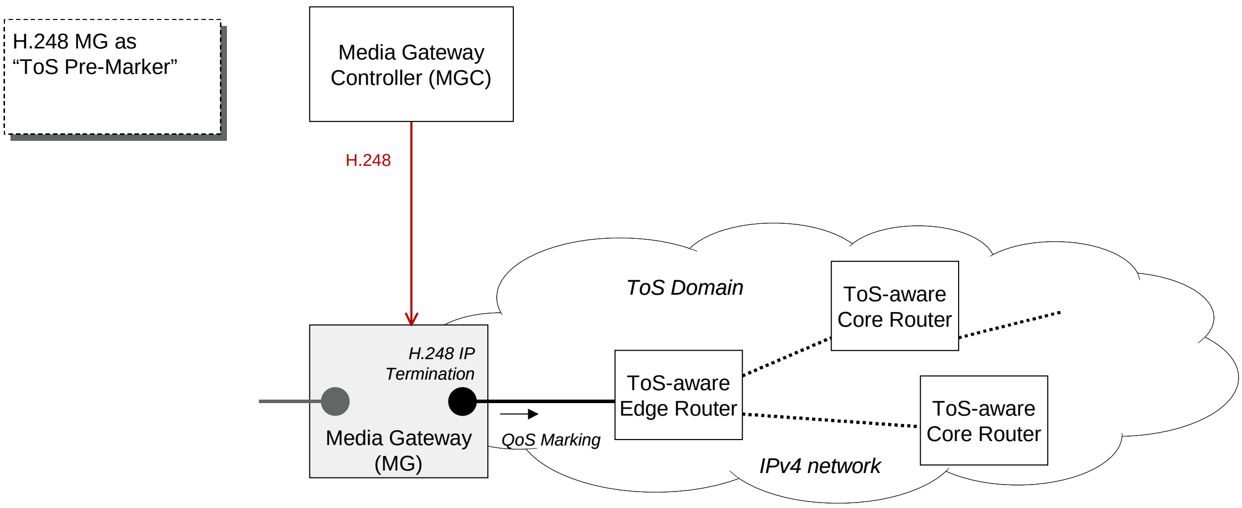



**Figure IV.1 – H.248 MG as "ToS pre-marker"**

Differentiated services are not used in this example.

### IV.3 DSCP Marking

An H.248 MG with IP terminations could participate in various roles in DiffServ networks. Some possible examples are illustrated. This list is not exhaustive.

#### IV.3.1 H.248 MG as "DS pre-marker"

The H.248 MG could act as "DS pre-marker" for a subsequent DS edge router (DS ER), see Figure IV.2. The DS ER bounds the DS domain, thus also called a DS boundary node (see [b-IETF RFC 2475]).

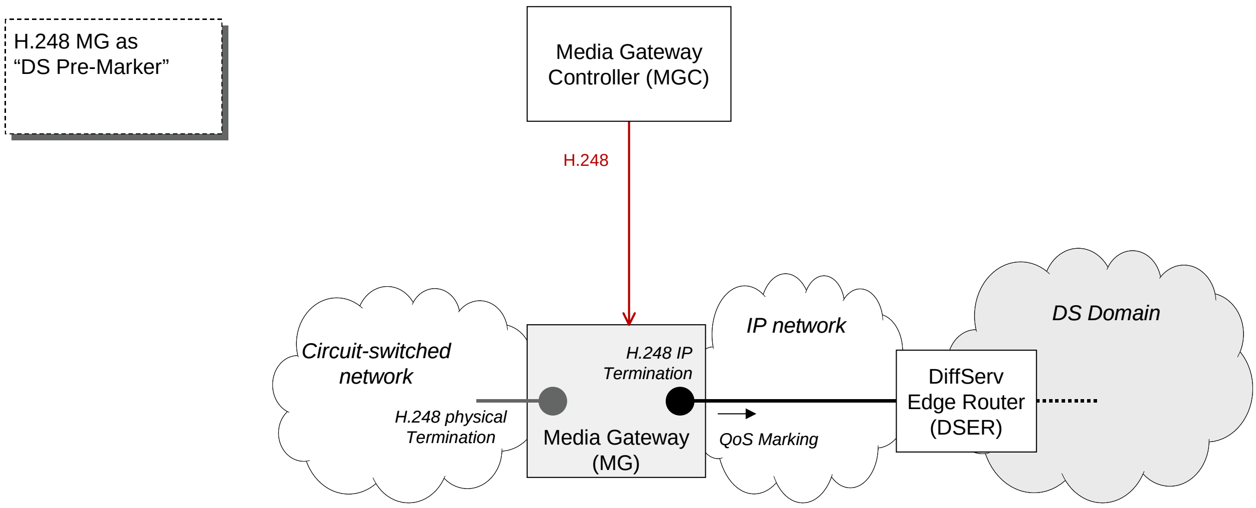



**Figure IV.2 – H.248 MG as "DS pre-marker"**

The function of packet "pre-mark" is defined as "to set the DS codepoint of a packet prior to entry into a downstream DS domain" ([b-IETF RFC 2475]). The H.248 MG is located prior to the DS domain.

### IV.3.2 H.248 MG as "DS boundary node"

An IP edge router function may be embedded in the same physical entity as the H.248 MG function. Figure IV.3 illustrates such an example with an embedded DS ER. The H.248 MG acts as a "DS boundary node".

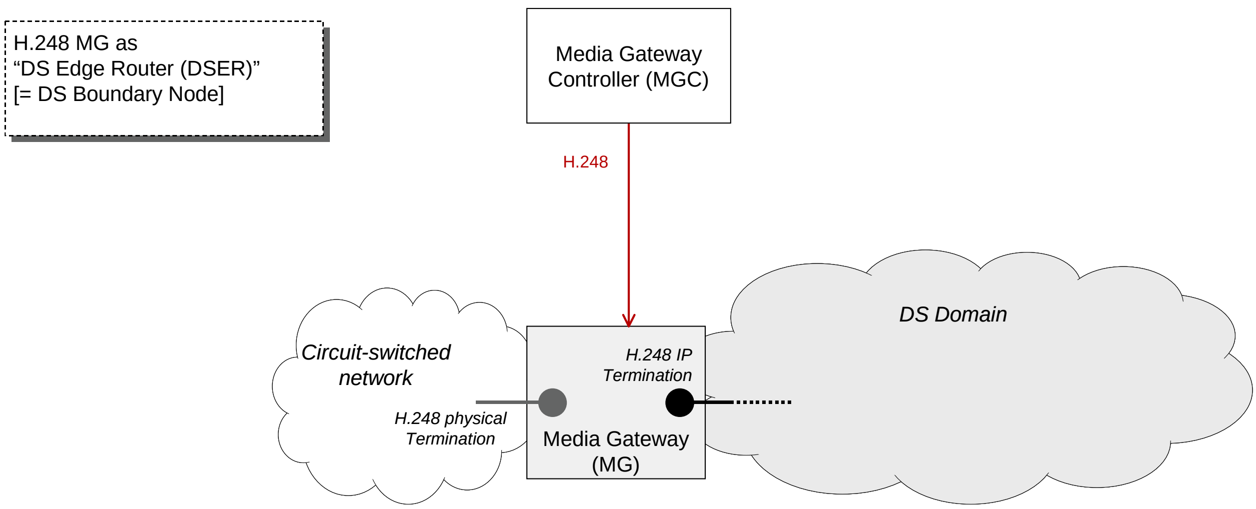



**Figure IV.3 – H.248 MG as "DS boundary node"**

The specific boundary node role in this example is the "DS ingress node" ([b-IETF RFC 2475]: "a DS boundary node in its role in handling traffic as it enters a DS domain").

### IV.3.3 H.248 MG between two DS domains

An H.248 IP-to-IP MG may be located between two DS domains. Figure IV.4 shows an example of a DS region (see [b-IETF RFC 2475]), which covers two DS domains "A" and "B". Both DS domains may use different DSCP value ranges. The MG could then for instance provide (MGC-controlled) DSCP value translation.

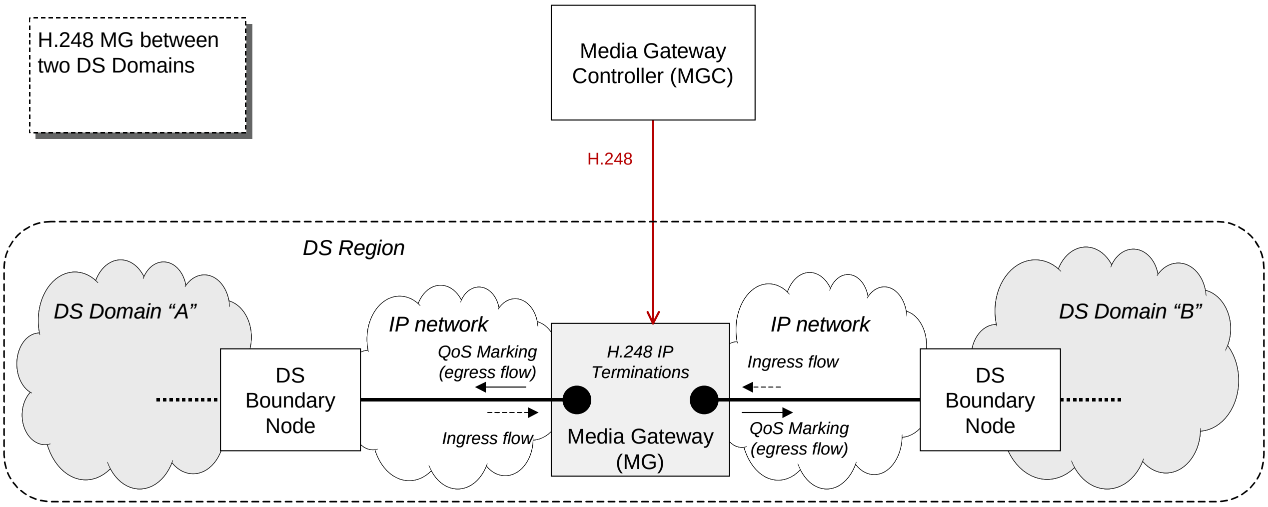



**Figure IV.4 – H.248 MG as "DSCP translator" between two DS domains with different DSCP usage**

Such a function is also known as packet "re-mark" ([b-IETF RFC 2475]: "to change the DS codepoint of a packet, usually performed by a marker in accordance with a [traffic conditioning agreement] TCA").

### IV.3.4 H.248 MG as "DS Interior Node"

A very common example is the location of an H.248 IP-to-IP MG within a single DS domain. The MG may then act as DS interior node, see Figure IV.5. The per-hop behaviour (PHB) of the DS interior node is then influenced by the MGC via *ds/dscp* property settings.

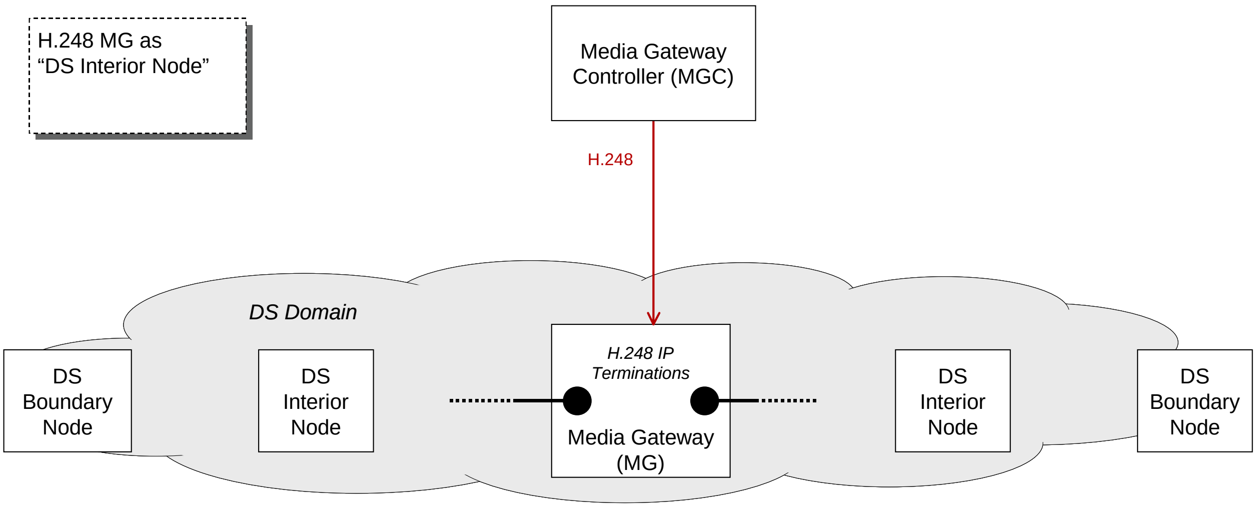



**Figure IV.5 – H.248 MG providing "DS PHB"**

## IV.4 Remarks

A comprehensive description of all relevant network details is beyond the scope of this Recommendation. Further information on network details should be sought from the corresponding standardization documents with regard to NGN architectures, IPv4/v6 network architectures and, in particular, DiffServ architectures.

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