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STANDARDIZATION SECTOR
OF ITU

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Amendment 2
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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS
Infrastructure of audiovisual services – Communication
procedures

Gateway control protocol: Version 3
**Amendment 2: New Appendix IV, plus
corrections and clarifications**

Recommendation ITU-T H.248.1 (2005) –
Amendment 2



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For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T H.248.1

Gateway control protocol: Version 3

Amendment 2

New Appendix IV, plus corrections and clarifications

Summary

To achieve greater scalability, this Recommendation decomposes the ITU-T H.323 Gateway function defined in Recommendation ITU-T H.246 into functional subcomponents and specifies the protocols these components use to communicate. This allows implementations of H.323 gateways to be highly scalable and encourages leverage of widely deployed Switched Circuit Network (SCN) capabilities such as SS7 switches. This also enables H.323 gateways to be composed of components from multiple vendors distributed across multiple physical platforms. The purpose of this Recommendation is to add capabilities currently defined for H.323 systems and is intended to provide new ways of performing operations already supported in H.323.

This Recommendation includes several enhancements to Recommendation ITU-T H.248.1 Version 2:

- capability to define context properties via packages;
- an IEPS context property;
- a flag to indicate that the MG has OutOfService terminations to report at registration time;
- new message segmentation package and procedures for non-segmenting transports;
- refined package definition requirements and a new package template;
- refined profile definition requirements and a new profile template;
- addition of statistics on a stream level;
- addition of a signal request identifier to differentiate similar signals within a SignalList;
- addition of a base signal parameter to indicate in which direction to play the signal;
- addition of two new Topology types;
- addition of an intersignal delay timer for signals in a SignalList;
- addition of a new ContextIDList construct for command responses;
- addition of a TerminationIDList construct for commands and responses;
- refined ServiceChange procedures;
- addition of a capability for the MGC to regulate the rate at which it receives notifications;
- addition of the ability to add filter conditions to audit requests.

~~This Amendment 1 introduced in Recommendation ITU-T H.248.1 (2005/09) the corrections and clarifications identified in previous Implementor's Guides to H.248.1. It also introduces some formatting changes to enhance readability. It also introduced the DigitMap unsuccessful match reporting functionality.~~

This Amendment 2 to Recommendation ITU-T H.248.1 (2005/09) introduces the corrections and clarifications identified in previous Implementors' Guides to Recommendation ITU-T H.248.1. It provides updated H.248 Package registration procedures. A new statistic is added to the RTP Package. It also adds Appendix IV, "Practices on Statistics – Example use-cases".

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.248	2000-06-15	16
1.1	ITU-T H.248.1 v1.1	2002-03-29	16
2.0	ITU-T H.248.1 v2	2002-05-22	16
2.1	ITU-T H.248.1 v2 (2002) Cor. 1	2004-03-15	16
3.0	ITU-T H.248.1 v3	2005-09-13	16
3.1	ITU-T H.248.1 v3 (2005) Amend. 1	2008-05-02	16
3.2	ITU-T H.248.1 v3 (2005) Amend.2	2009-12-14	16

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

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Recommendation ITU-T H.248.1

Gateway control protocol: Version 3

Amendment 2

New Appendix IV, plus corrections and clarifications

Modifications introduced by this amendment are shown in revision marks. Unchanged text is replaced by ellipsis (...). Some parts of unchanged text (clause numbers, etc.) may be kept to indicate the correct insertion points.

Additionally, this amendment changed the presentation of clause 2 citations as follows:

Original text	Replacement text
ITU-T Rec. E.106	[ITU-T E.106]
ITU-T Rec. E.107	[ITU-T E.107]
ITU-T Rec. H.225.0	[ITU-T H.225.0]
ITU-T Rec. H.235.0	[ITU-T H.235.0]
ITU-T Rec. H.245	[ITU-T H.245]
ITU-T Rec. H.246	[ITU-T H.246]
ITU-T Rec. H.248.4	[ITU-T H.248.4]
ITU-T Rec. H.248.5	[ITU-T H.248.5]
ITU-T Rec. H.248.8	[ITU-T H.248.8]
ITU-T Rec. H.248.14	[ITU-T H.248.14]
ITU-T Rec. H.323	[ITU-T H.323]
ITU-T Rec. I.363.1	[ITU-T I.363.1]
ITU-T Rec. I.363.2	[ITU-T I.363.2]
ITU-T Rec. I.363.5	[ITU-T I.363.5]
ITU-T Rec. I.366.1	[ITU-T I.366.1]
ITU-T Rec. I.366.2	[ITU-T I.366.2]
ITU-T Rec. I.371	[ITU-T I.371]
ITU-T Rec. Q.763	[ITU-T Q.763]
ITU-T Rec. Q.765.5	[ITU-T Q.765.5]
ITU-T Rec. Q.931	[ITU-T Q.931]
ITU-T Rec. Q.2630.1	[ITU-T Q.2630.1]
ITU-T Rec. Q.2931	[ITU-T Q.2931]
ITU-T Rec. Q.2941.1	[ITU-T Q.2941.1]
ITU-T Rec. Q.2961.1	[ITU-T Q.2961.1]
ITU-T Rec. Q.2961.2	[ITU-T Q.2961.2]
ITU-T Rec. Q.2965.1	[ITU-T Q.2965.1]
ITU-T Rec. Q.2965.2	[ITU-T Q.2965.2]
ITU-T Rec. V.76	[ITU-T V.76]

Original text	Replacement text
ITU-T Rec. X.213	[ITU-T X.213]
ITU-T Rec. X.680	[ITU-T X.680]
ITU-T Rec. X.690	[ITU-T X.690]
ATM Forum UNI 4.0	[ATM Forum UNI 4.0]
RFC 791	[IETF RFC 791]
RFC 1006	[IETF RFC 1006]
RFC 2234	[IETF RFC 2234]
RFC 2327	[IETF RFC 2327]
RFC 2373	[IETF RFC 2373]
RFC 2401	[IETF RFC 2401]
RFC 2402	[IETF RFC 2402]
RFC 2406	[IETF RFC 2406]
RFC 2409	[IETF RFC 2409]
RFC 2460	[IETF RFC 2460]
RFC 3550	[IETF RFC 3550]
RFC 3551	[IETF RFC 3551]
RFC 3556	[IETF RFC 3556]
RFC 5226	[IETF RFC 5226]
RFC 5615	[IETF RFC 5615]

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4 **Abbreviations and acronyms**

This Recommendation uses the following abbreviations and acronyms:

AAD	Average Acknowledgement Delay
AAL	ATM Adaptation Layer
<u>ABNF</u>	<u>Augmented Backus-Naur Format</u>
ADEV	Average Deviation
<u>ALC</u>	<u>Automatic Level Control</u>

ALF	Application Level Framing
<u>AH</u>	<u>Authentication Header</u>
ATM	Asynchronous Transfer Mode
<u>BER</u>	<u>Basic Encoding Rules</u>
C	Context
CAS	Channel Associated Signalling
<u>DLSR</u>	<u>Delay since last SR</u>
DNS	Domain Name System
DTMF	Dual Tone Multi-Frequency
<u>ESP</u>	<u>Encapsulating Security Payload</u>
FAS	Facility Associated Signalling
GSM	Global System for Mobile communications
GW	Gateway
IANA	Internet Assigned Numbers Authority (superseded by ICANN)
ICANN	Internet Corporation for Assigned Names and Numbers
<u>ICV</u>	<u>Integrity Check Value</u>
IEPS	International Emergency Preference Scheme
<u>IKE</u>	<u>Internet Key Exchange</u>
IP	Internet Protocol
IS	In-Service
ISUP	ISDN User Part
IVR	Interactive Voice Response
<u>LD</u>	<u>Local Descriptor</u>
<u>LSR</u>	<u>Last SR timestamp</u>
MG	Media Gateway
MGC	Media Gateway Controller
<u>MID</u>	<u>Message Identifier</u>
<u>MTP3</u>	<u>Message Transfer Part 3</u>
<u>MTU</u>	<u>Maximum Transmission Unit</u>
MWD	Maximum Waiting Delay
<u>NDA</u>	<u>Non Disclosure Agreement</u>
NFAS	Non-Facility Associated Signalling
OoS	Out-of-Service
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
QoS	Quality of Service
<u>RD</u>	<u>Remote Descriptor</u>

<u>RR</u>	Receiver Report
<u>RSA</u>	Rivest, Shamir and Adleman algorithm
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol
RTPD	Round-Trip Propagation Delay
<u>Rx</u>	Receive
SC	ServiceChange
SCN	Switched Circuit Network
<u>SCTP</u>	Stream Control Transmission Protocol
<u>SDP</u>	Session Description Protocol
SG	Signalling Gateway
<u>SR</u>	Sender Report
SS7	Signalling System No. 7
T, Term	Termination
<u>TCP</u>	Transmission Control Protocol
<u>Tx</u>	Transmit
<u>UDP</u>	User Datagram Protocol
<u>VBD</u>	Voice Band Data
<u>VMG</u>	Virtual Media Gateway

5 Conventions

5.1 Key words to indicate requirement levels

In this Recommendation, "shall" refers to a mandatory requirement, while "should" refers to a suggested but optional feature or procedure. The term "may" refers to an optional course of action without expressing a preference.

5.2 Connection endpoint naming conventions

5.2.1 Generic concept

There are basically four connection endpoints (concerning sources and sinks of traffic) in case of a bidirectional connection. ITU-T H.248 uses a specific terminology for naming these endpoints from the perspective of an H.248 entity. Figure 1 provides a conceptual overview. The naming scheme is generic because it is technology-independent.

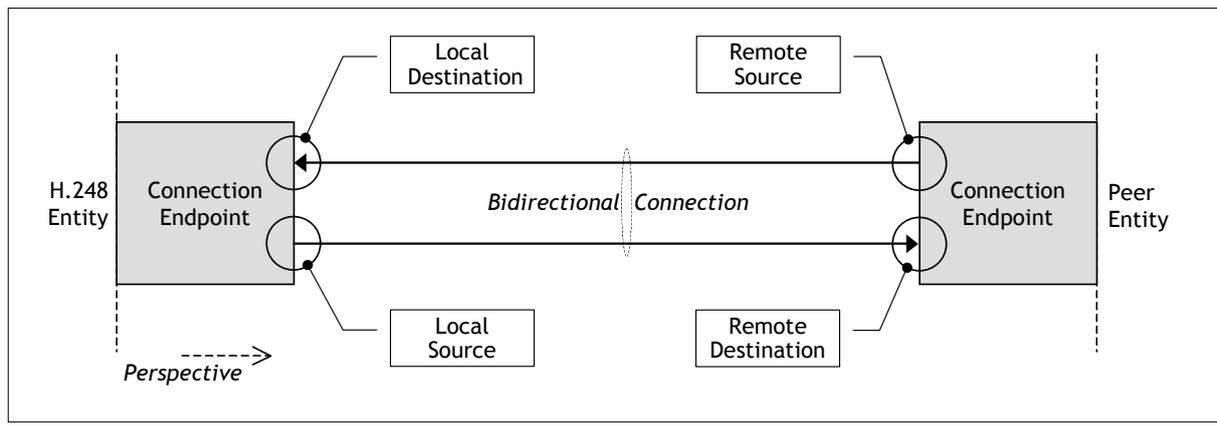


Figure 1 – Connection endpoint naming conventions – Generic concept

The geographical locations of the endpoints are termed as 'local' (also known as 'near-end') and as 'remote' (also known as 'far-end'). The traffic directions are termed as 'source' (also known as 'egress', 'outgoing', 'outbound', 'transmit', or 'Tx') and as 'destination' (also known as 'ingress', 'incoming', 'inbound', 'receive', or 'Rx').

5.2.2 Scope of Local and Remote Descriptors

The Local and Remote Descriptors are defined in clause 7.1.8. Both descriptors have different connection endpoints in scope (see Figure 2). The Local Descriptor (LD) is related to the "local destination" endpoint, the Remote Descriptor (RD) is related to the "remote destination" endpoint. The media gateway is primarily responsible for the resources and configuration of the "local source" endpoint (NOTE – There are a few protocol elements which allow the MGC to control certain endpoint aspects). The "remote source" endpoint is completely out of scope of H.248 entities.

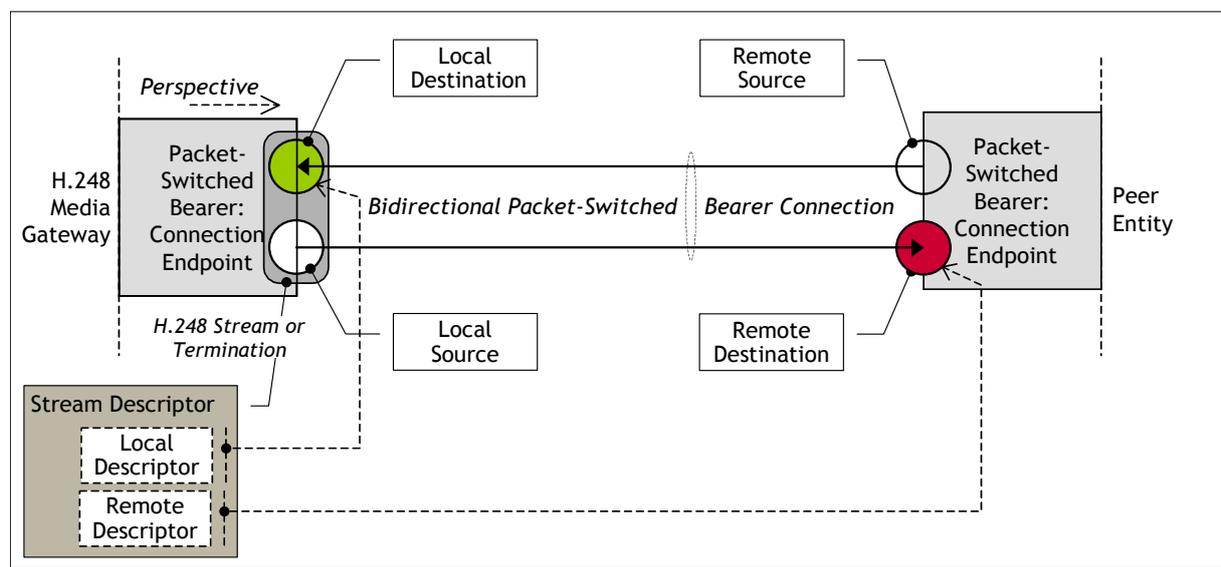


Figure 2 – Connection endpoint naming conventions – Scope of Local and Remote Descriptors

Figure 2 underlines that just the traffic sink endpoints of H.248 streams are controlled via the Local and Remote Descriptors.

5.2.3 Concrete "connection" types

An example shall illustrate the application of the naming conventions for a specific combination of a bearer technology and protocol layer.

5.2.3.1 Example "IP connection"

Figure 3 shows an IP connection, e.g., behind an H.248 IP stream or termination, or below an IP-based H.248 Control Association.

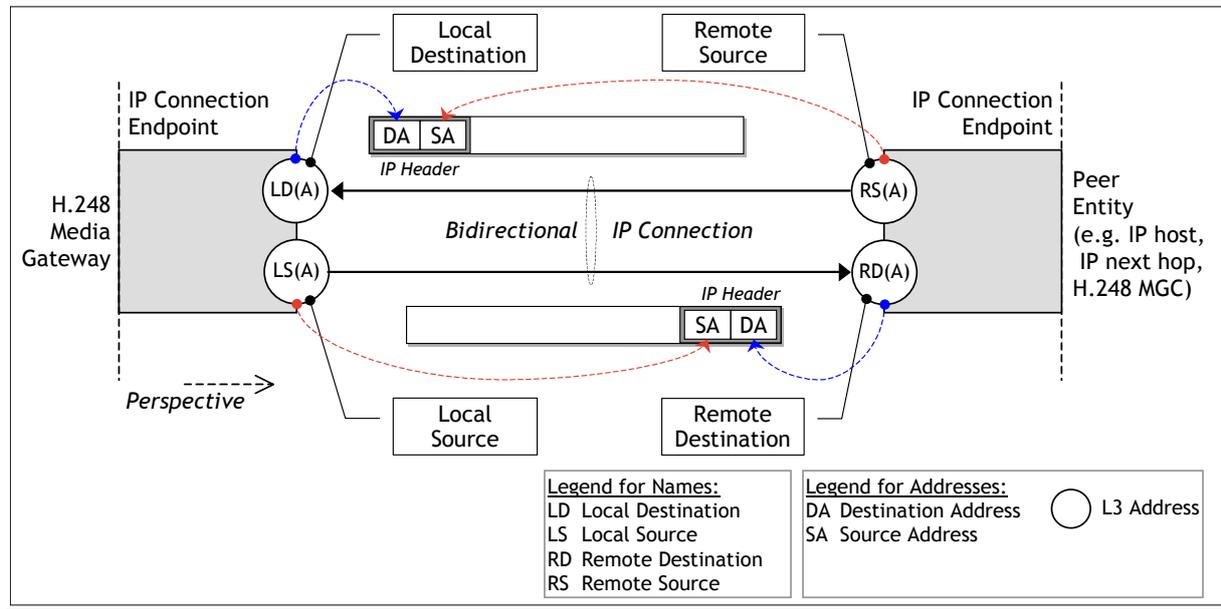


Figure 3 – Connection endpoint naming conventions – IP connection

The two local or remote connection endpoints may be assigned to the same or different IP interfaces. They are then so called symmetrical or asymmetrical (connection) addresses.

6 Connection model

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Following is a graphical depiction of these concepts. The diagram of Figure 44 gives several examples and is not meant to be an all-inclusive illustration. The asterisk box in each of the contexts represents the logical association of terminations implied by the context.

...

Figure 44 – Example of H.248.1 connection model

The example in Figure 52 shows an example of one way to accomplish a call-waiting scenario in a decomposed access gateway, illustrating the relocation of a termination between contexts. Terminations T1 and T2 belong to Context C1 in a two-way audio call. A second audio call is waiting for T1 from Termination T3. T3 is alone in Context C2. T1 accepts the call from T3, placing T2 on hold. This action results in T1 moving into Context C2, as shown in Figure 36.

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Figure 25 – Example call waiting scenario/alerting applied to T1

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Figure 3-6 – Example call waiting scenario/answer by T1

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6.1.1 Context attributes and descriptors

The attributes of contexts are:

- ContextID.
- The Topology Descriptor (who hears/sees whom).
The topology of a context describes the flow of media between the terminations within a context. In contrast, the Mode Property of a termination ("SendOnly"/"RecvOnly"/...) describes the flow of the media at the egress/ingress of the media gateway.
- The priority indicator is used for a context in order to provide the MG with information about a certain precedence handling for a context. The MGC can also use the priority indicator to control autonomously the traffic precedence in the MG in a smooth way in certain situations (e.g., restart), when a lot of contexts must be handled simultaneously. Priority 0 is the lowest priority and a priority of 15 is the highest priority.
- An indicator for an emergency call is also provided to allow a preference handling in the MG.
- An indicator for an IEPS call is provided to allow the features and techniques of e.g., [ITU-T E.106] and [ITU-T E.107] to be achieved. See [b-ITU-T H-Sup.9] for more information.

...

6.2 Terminations

...

Multimedia gateways may process multiplexed media streams. For example, [~~b-ITU-T Rec.~~ H.221] describes a frame structure for multiple media streams multiplexed on a number of digital 64 kbit/s channels. Such a case is handled in the connection model in the following way. For every bearer channel that carries part of the multiplexed streams, there is a physical or ephemeral "bearer termination". The bearer terminations that source/sink the digital channels are connected to a separate termination called the "multiplexing termination". The multiplexing termination is an ephemeral termination representing a frame-oriented session. The Multiplex Descriptor for this termination describes the multiplex used (e.g., [b-ITU-T H.221] for an [b-ITU-T H.320] session) and indicates the order in which the contained digital channels are assembled into a frame.

Multiplexing terminations may be cascades (e.g., [b-ITU-T H.226] multiplex of digital channels feeding into a [b-ITU-T H.223] multiplex supporting an [b-ITU-T H.324] session).

...

Figures 4-7, 5-8, and 6-9 illustrate typical applications of the multiplexing termination and Multiplex Descriptor.

...

Figure 4-7 – Multiplexed termination scenario – Circuit-to-packet

...

Figure 5-8 – Multiplexed termination scenario – Circuit-to-circuit

...

Figure 6-9 – Multiplexed termination scenario – Single-to-multiple terminations

...

6.2.3 Packages

...

For improved interoperability and backward compatibility, an MG may publish all packages supported by its terminations, including base packages from which extended packages are derived. An exception to this is in cases where the base packages are expressly defined as "Designed to be extended only".

In the case that the MG publishes the base PackageIDs in response to a Packages Descriptor Audit, it will also respond to a wildcarded PackageID Audit with the PackageID of the H.248 Package Element where the element was originally defined.

In the case that the MG publishes only the extended PackageID in response to a Packages Descriptor Audit, the MG will respond to a wildcarded PackageID Audit using the extended H.248 PackageIDs.

NOTE – Whilst a Subtract request does not explicitly request an AuditValue.req of Statistics with a wildcarded PackageID, it is implicit in the command. Similarly, an audit of a complete descriptor is equivalent to an audit with a wildcarded PackageID. Thus, the procedure described above will be used in both cases.

6.2.4 Termination properties and descriptors

...

Setting properties on different terminations in the same context implicitly instructs the MG to perform certain functions. For example: if a [b-ITU-T G.711] codec is set on Termination A and a [b-ITU-T G.729] codec is set on Termination B, then the MG will activate a transcoding function as soon as a media flow is enabled between the two terminations (i.e., by setting the Mode Property to a state other than "Inactive" at each termination).

...

Descriptor name	Description
Modem	Identifies modem type and properties when applicable. (Note)
Mux	Describes multiplex type for multimedia terminations (e.g., [b-ITU-T H.221], [b-ITU-T H.223], [ITU-T H.225.0]) and terminations forming the input mux.
Media	A list of media stream specifications (see 7.1.4).
...	

...

7.1 Descriptors

The parameters to a command are termed descriptors. A descriptor consists of a name and a list of items. Some items may have values. Many commands share common descriptors. This subclause enumerates these descriptors. Descriptors may be returned as output from a command. Descriptors shall be returned in the order that they were received. In any such return of descriptor contents, an empty descriptor is represented by its name unaccompanied by any list. Parameters and parameter usage specific to a given command type are described in the subclause that describes the command.

...

7.1.2 Modem Descriptor

The Modem Descriptor specifies the modem type and parameters, if any, required for use in, e.g., [b-ITU-T H.324] and text conversation. The descriptor includes the following modem types: V.18, V.22, V.22 *bis*, V.32, V.32 *bis*, V.34, V.90, V.91, Synchronous ISDN, and allows for extensions. By default, no Modem Descriptor is present in a termination.

...

7.1.7 LocalControl Descriptor

a) Overview

The LocalControl Descriptor contains the Mode Property, the ReserveGroup and ReserveValue Properties and properties of a termination (defined in packages) that are stream specific, and are of interest between the MG and the MGC. Values of properties may be specified as in 7.1.1.

b) Mode Property (for directionality control)

The allowed values for the Mode Property are "SendOnly", "RecvOnly", "SendRecv", "Inactive" and "LoopBack". "SendOnly", "RecvOnly" and "LoopBack" are with respect to the exterior of the context, so that, for example, a stream set to mode = "SendOnly" does not pass received media into the context. When a stream is set to "LoopBack" on a termination, media received (Local Descriptor) on the termination will be looped back to the sending side (Remote Descriptor) of the termination and no media is passed between that termination and other terminations in the context. The looped back media shall be sent according to the Remote Descriptor. The default value for the Mode Property is "Inactive". Signals and events are not affected by the Mode Property. The LocalControl Mode Property takes precedence over any mode specified in the Local and Remote Descriptors. However, duplication and use of mode information in the SDP should be avoided. Due to the default of LocalControl Mode Property being "Inactive", if mode information was added to the Local and Remote Descriptor SDP and the LocalControl Mode was not explicitly sent, the effective mode would still be inactive.

c) Reserve Properties (for resource handling control)

The boolean-valued Reserve Properties, ReserveValue and ReserveGroup, of a termination indicate what the MG is expected to do when it receives a Local and/or Remote Descriptor.

...

The default value of ReserveValue and ReserveGroup is "False". More information on the use of the two Reserve Properties is provided in 7.1.8.

d) Descriptor usage

A new setting of the LocalControl Descriptor completely replaces the previous setting of that descriptor in the MG. Thus, to retain information from the previous setting, the MGC must include that information in the new setting. If the MGC wishes to delete some information from the existing

descriptor, it merely resends the descriptor (in a Modify Command) with the unwanted information stripped out.

NOTE – The Mode Property is also known as "StreamMode" in the encoding definitions in Annexes A and B. These terms are interchangeable within H.248.

7.1.7.1 LocalControl Properties

7.1.7.1.1 StreamMode

Property Name: StreamMode

Description: The value of this property indicates the current service state of the termination.

Type: Enumeration

Possible values:

- Inactive: The termination does not pass any media for the stream.
- SendOnly: The termination passes media for the stream from the interior to the exterior of the context.
- RecvOnly: The termination passes media for the stream from the exterior to the interior of the context.
- SendRecv: The termination passes media for the stream both into and out of the context.
- LoopBack: The termination loops received media for the stream back to the sender.

NOTE – The term "media" underlines that the StreamMode settings only affect the "media flow" component(s) of the H.248 Stream, but not potential "control flow" component(s) (like, e.g., in case of an H.248 Stream, carrying a RTP session with an RTP media flow and RTCP control component). It may be noted that the separation of media and control components is consistent with the SDP understanding of "media streams", see [b-IETF RFC 4566].

Default: Inactive

...

7.1.7.1.3 ReserveValue

...

Possible values:

- True: The MG is to reserve resources to serve as many as possible of the sets of property values indicated in the selected media group (if ReserveGroup is False) or in each media group (if ReserveGroup is True) in the Local and Remote Descriptors.
- False: The MG is to reserve a single set of property values from those indicated in the selected media group (if ReserveGroup is False) or in each media group (if ReserveGroup is True) in the Local and Remote Descriptors.

NOTE – A single set of property values may consist of a single media type (e.g., audio or video) related media format complemented by a list of supplementary media formats. Supplementary media formats are for example:

- Comfort noise ([b-IETF RFC 3389]).
- RTP Payload for DTMF digits, telephony tones and telephony signals ([b-IETF RFC 4733]).

- Voiceband data (VBD) services (according to [b-ITU-T V.152]),
- or other auxiliary media (e.g., inband signalling) associated to the main media flow.

Default: False

...

7.1.8.1.1 Specific syntax for H.248 text encoding

7.1.8.1.1.1 Rules

...

A Stream Descriptor specifies a single bidirectional media stream, a session description consists of a session-level section followed by a media-level section and so a single session description must not include more than one media description ("m = " line). A session description should not contain duplicate SDP lines on session-level and media-level. If duplication occurs the media level line takes precedence.

A Stream Descriptor may contain additional session descriptions as alternatives. Each media stream for a termination must appear in distinct Stream Descriptors. When multiple session descriptions are provided in one descriptor, the "v = " lines are required as delimiters; otherwise they are optional in session descriptions sent to the MG. Implementations shall accept session descriptions that are fully conformant to [IETF RFC 2327] according to the above restrictions.

If a MG does not understand the SDP provided, rather than ignoring that piece of SDP, an appropriate error response shall be provided.

7.1.8.1.1.2 Summary – H.248 usage of SDP

Figure 10 provides an overview of the structure of the H.248 Media Descriptor. SDP is used, within the H.248 Stream Descriptor, in the Local Descriptor (LD) and in the Remote Descriptor (RD). There are thus separate SDP specifications for ingress traffic (provided by the H.248 LD) and egress traffic (provided by the H.248 RD). The (SDP) media description within that SDP block is reflected in the LD and RD and determines the H.248 media gateway behaviour.

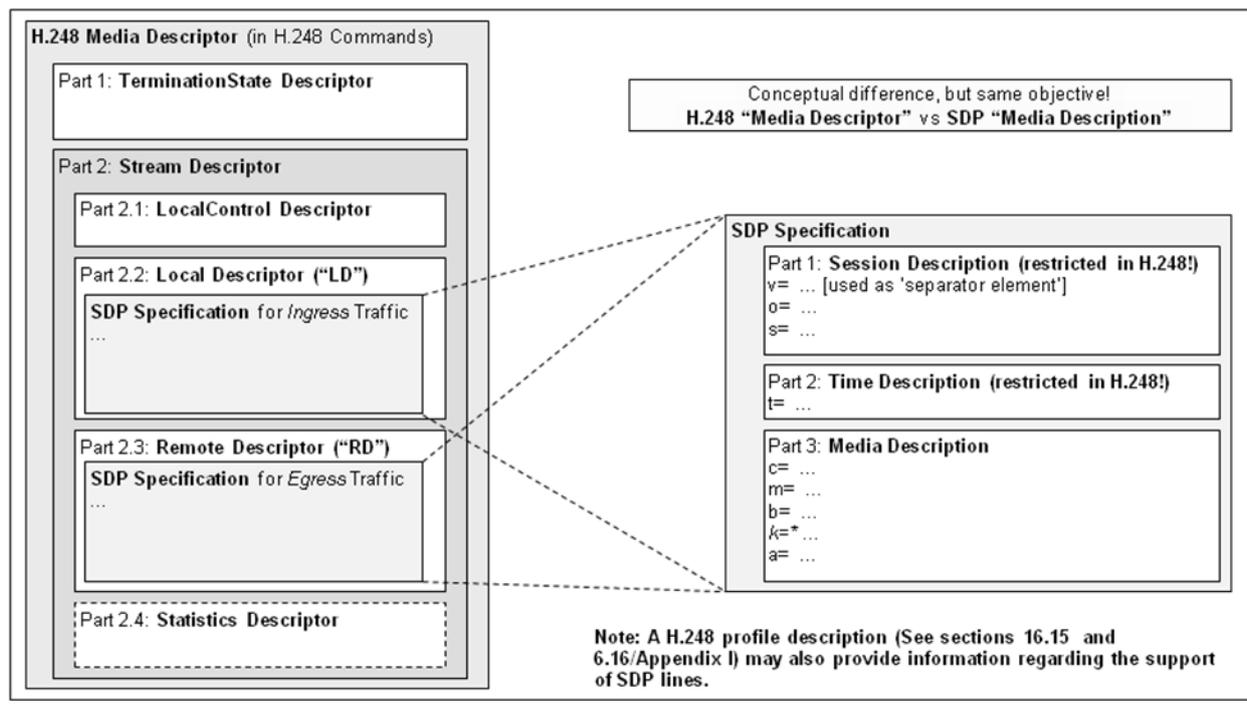


Figure 10 – Overview Structure of H.248 Media Descriptor (H.248 "Media Descriptor" vs SDP "Media Description")

...

7.1.11 Signals Descriptor

...

Signals are defined in packages. Signals shall be named with a PackageID (in which the signal is defined) and a SignalID. No wildcard shall be used in the SignalID. Signals that occur in a Signals Descriptor have an optional StreamID parameter (default is 0, to indicate that the signal is not related to a particular media stream), an optional signal type (see below), an optional duration and possibly parameters defined in the package that defines the signal. This allows a single signal to have some variation in meaning, obviating the need to create large numbers of individual signals.

In case the MGC does not specify the StreamID parameter (or sets the StreamID parameter value explicitly to 0) the Signals Descriptor shall be applied to all streams (including any existing Streams and any new Stream defined by the command containing the Signals Descriptor).

...

If the signal type is specified in a Signals Descriptor, it overrides the default signal type (see 12.1.4). It is not possible to change the semantics of a signal by overriding the signal type. If duration is specified for an on/off signal, it shall be ignored.

...

7.1.17 ObservedEvents Descriptor

ObservedEvents is supplied with the Notify Command to inform the MGC of which event(s) were detected. Used with the AuditValue Command, the ObservedEvents Descriptor returns events in the event buffer which have not been notified. ObservedEvents contains the RequestID of the Events Descriptor that triggered the notification, the event(s) detected, optionally the detection time(s) and

any parameters of the observed event. Detection times are reported with a precision of hundredths of a second.

The ObservedEvents Descriptor may contain the StreamID associated with the detected Event. If the MGC has set the Event on a termination level, the MG may or may not report the StreamID depending on the semantic of the event. If the MGC has set the Event on a particular stream then this StreamID shall be returned.

7.1.18 Topology Descriptor

7.1.18.1 General

A Topology Descriptor is used to specify flow directions between terminations in a context. Contrary to the descriptors in previous clauses, the Topology Descriptor applies to a context instead of a termination. The default topology of a context is that each termination's transmission is received by all other terminations. When a Termination is added to a Context, its default Topology is "bothway" to the other Terminations in the Context. If another Topology is required this shall be indicated in any updated Topology Descriptor. The Topology Descriptor is optional to implement. An MG that does not support Topology Descriptors, but receives a command containing one, returns Error Code 444 ("Unsupported or unknown descriptor"), and optionally includes a string containing the name of the unsupported descriptor ("Topology") in the error text in the Error Descriptor.

The Topology Descriptor occurs before the commands in an action. It is possible to have an action containing only a Topology Descriptor, provided that the context to which the action applies already exists.

7.1.18.2 Structure (syntax) of the Topology Descriptor

A Topology Descriptor consists of a sequence of associated terminations of the form (*T1*, *T2*, *association*[,*StreamID*]). *T1* and *T2* specify terminations within the context, possibly using the ALL or CHOOSE wildcard. If the optional StreamID field is used, the association applies only to the particular stream between *T1* and *T2* labeled by the StreamID. If the StreamID field is omitted, the topology applies to all streams in the termination.

7.1.18.3 Descriptor element "association"

The *association* specifies how media flows between these two terminations as follows:

...

7.1.18.4 Wildcarding of TerminationID elements

7.1.18.4.1 Wildcard CHOOSE

CHOOSE wildcards may be used in *T1* and *T2* as well, under the following restrictions:

- the action (see clause 8) of which the Topology Descriptor is part contains an Add Command in which a CHOOSE wildcard is used;
- if a CHOOSE wildcard occurs in *T1* or *T2*, then a partial name (underspecified Termination ID) shall not be specified.

The CHOOSE wildcard in a Topology Descriptor matches the TerminationID that the MG assigns in the first Add Command that uses a CHOOSE wildcard in the same action. An existing termination that matches *T1* or *T2* in the context to which a termination is added is connected to the newly added termination as specified by the Topology Descriptor. If a termination is not mentioned within a Topology Descriptor, any topology associated with it remains unchanged. If, however, a new termination is added into a context, its association with the other terminations within the context defaults to Bothway, unless a Topology Descriptor is given to change this (e.g., if *T3* is

added to a context with *T1* and *T2* with topology (*T3*, *T1*, Oneway) it will be connected bothway to *T2*).

7.1.18.4.2 Wildcard ALL

ALL wildcard may be used in *T1* or *T2* as well, under the following restrictions:

- "all" excludes the other termination in the Topology Descriptor (this semantic is in line with clause 6.2.2).

ALL wildcard may not be used for both *T1* and *T2* in a single descriptor with a one-way association.

7.1.18.4.3 Combination of Wildcard ALL and CHOOSE in a single Topology Descriptor

ALL wildcard may be used in *T1* and CHOOSE wildcard may be used in *T2*, or vice versa. The chosen termination is then excluded from the "all" set of the remaining terminations.

7.1.18.5 Topologies on Stream-level

If the topology is applied to one particular stream (*T1*, *T2*, association, StreamID), the topology of other streams between the terminations does not change.

A Topology Descriptor shall not include a combination of associations between two terminations (*T_i*, *T_j*) with and without the optional StreamID field, to avoid undefined behaviour. For example (*T1*, *T2*, Bothway) and (*T1*, *T2*, Isolate, S1) shall not appear in the same descriptor. Upon receipt of such a Topology Descriptor, a MG shall respond with an error response, including Error Code 421 ("Unknown action or illegal combination of actions").

7.1.18.6 Association types

7.1.18.6.1 "Oneway"

A oneway connection must be implemented in such a way that the other terminations in the context are not aware of the change in topology.

7.1.18.7 Example topologies

Figure 711, the table following it and Figure 812 following it show some examples of the effect of including Topology Descriptors in actions. In these examples it is assumed that the Topology Descriptors are applied in sequence. Figures 913 and 1014 are stand-alone examples showing the specific effects of the OnewayExternal and OnewayBoth topology settings.

...

Figure 711 – Example topologies

...

Figure 812 – Example topology at stream level

...

Figure 913 – OnewayExternal contrasted with Oneway topology

...

Figure 1014 – Operation of OnewayBoth topology

7.1.20 Error Descriptor

...

An Error Descriptor shall be specified at the "deepest level" that is semantically appropriate for the error being described and that is possible given any parsing problems with the original request. An Error Descriptor may refer to a syntactic construct other than where it appears. For example, Error Descriptor 422 ("Syntax Error in Action"), could appear within a command even though it refers to the larger construct, the action, and not the particular command within which it appears.

If the error being described can be determined to be at a descriptor level, the Error Descriptor may be returned at the descriptor level. If this is the case, the Error Descriptor should be returned where the descriptor that generated an error would have been inserted in the response.

...

7.2.5 AuditValue

...

The command:

```
Context=*{ContextAttr{ContextList={*}},AuditValue=Root{Audit{}}}
```

returns:

```
Context=*{ContextAttr{ContextList={1,2,3,4}},AuditValue=Root{}}
```

The following illustrates other information that can be obtained with the AuditValue Command:

...

7.2.8.1.3 ServiceChangeAddress and ServiceChangeMgcID

The optional ServiceChangeAddress parameter specifies the address (e.g., IP port number for IP networks) to be used for subsequent communications. It can be specified in the input parameter descriptor or the returned result descriptor.

The optional ServiceChangeMgcID parameter is of type Message Identifier (MID, see clause 8.3), the parameter format represents thus either an address (IP version 4 or 6 domain address, or broadband MTP3 address) or a name (IP domain name or a generic device name). In both cases, it is the parameter used for an unambiguous identification of an MGC entity (i.e., a primary or secondary MGC).

NOTE 1 – There is the following difference between the name and address formats: the network address is routable, thus may be directly inserted as destination address in the signalling transport protocol data unit, whereas names require first a resolution into a routable address. The name-to-address resolution by the MG requires a local or remote DNS query request in case of the domain format, or a local mapping table in case of the device format.

ServiceChangeAddress and ServiceChangeMgcID parameters must not both be present in the ServiceChange Descriptor or the ServiceChangeResult Descriptor. The ServiceChangeAddress provides an address to be used within the context of the association currently being negotiated, while the ServiceChangeMgcID provides an alternate address (see Note 2) where the MG should seek to establish another association. MGCs and MGs must be able to cope with the ServiceChangeAddress being either a full address or just a port number in the case of IP-based transports such as UDP, TCP or SCTP.

NOTE 2 – In case of a name format, a previous name-to-address resolution is implied (see Note 1 above).

...

7.2.8.1.8 ExtensionParameter

The optional Extension parameter may contain any value whose meaning is mutually understood by the MG and MGC. The value "X-SC" is reserved for the use of signalling ServiceChange parameters that have been added as a result of H.248.1 version 3 (and subsequent versions). It is only used in the initial H.248.1 version 1 coded ServiceChange Command from the MG to MGC when the ServiceChangeVersion is greater than or equal to 3. The structure of the value is defined by the following ABNF:

$$\text{X-SC} = 1^* (\text{NAME EQUAL paramValue [COMMA]})$$

The value is encoded using the String type (see clause 12.1.2).

NOTE – When multiple NAME EQUAL parmValue constructs are used, the COMMA shall be used to separate them.

When adding new ServiceChange parameters it is recommended that a name/value be assigned if the parameter is to be sent in an initial ServiceChange. For example:

Name: Strings of up to 64 characters, containing no spaces, starting with an alphabetic character and consisting of alphanumeric characters and/or digits, and possibly including the special character underscore ("_").

Type: As per 12.1.2 "Properties". When using the "String" type, the values shall be compliant to the SafeChar syntax (see Annex B.2).

...

8 Transactions

Commands between the Media Gateway Controller and the Media Gateway are grouped into transactions, each of which is identified by a TransactionID. Transactions consist of one or more actions. An action consists of a non-empty series of commands, context property modifications, or context property audits that are limited to operating within a single context. Consequently, each action typically specifies a ContextID. However, there are two circumstances where a specific ContextID is not provided with an action. One is the case of modification of a termination outside of a context. The other is where the controller requests the gateway to create a new context. Figure 44-15 is a graphic representation of the transaction, action and command relationships.

...

Figure 44-15 – Transactions, actions and commands

...

10.1 Protection of protocol connections

A security mechanism is clearly needed to prevent unauthorized entities from using the protocol defined in this Recommendation for setting up unauthorized calls or interfering with authorized calls. The security mechanism for the protocol when transported over IP networks is IPSec ([IETF RFC 2401] to [b-IETF RFC 2411]).

...

11.7.1 Compatibility rules – forward and backward compatibility

H.248 through its versioning and package extension capabilities allows forward compatibility. As per [b-ITU-T Q.1400] clause 12.3, forward compatibility mechanisms are defined as a scheme to enable a version of a protocol to communicate effectively with and interwork with future versions of the protocol. That is, a version of a protocol should not restrict future protocols from providing extra capabilities.

When extending the H.248 protocol backwards compatibility shall be maintained. As per [b-ITU-T Q.1400] clause 12.3 backward compatibility rules are defined as a scheme to ensure that nodes implementing future versions of the protocol will be able to send protocol messages of the previous version which will be understood and fully processed by the node supporting the previous version. That is, future versions of a protocol must allow earlier versions to operate with it and not reduce the earlier version's service level, i.e., a version 1 message with the version removed shall be able to be sent with a version 3 protocol with exactly the same meaning.

...

12.1.1 Package

Overall description of the package, specifying:

Package Name: only descriptive

Package_ID: is an identifier

Description: is a description of the package

...

12.1.2 Properties

Properties defined by the package, specifying:

Property Name: only descriptive

Property_ID: is an identifier.

Description: is a description of the function of the property

Type: One of:

Boolean

String: UTF-8 string

Octet String: A number of octets. See Annex A and B.3 for encoding

Integer: 4-byte signed integer

Unsigned Integer: 4-octet unsigned integer

Double: 8-byte signed integer

Character: Unicode UTF-8 encoding of a single letter; could be more than one octet.

Enumeration: one of a list (NOTE) of possible unique values. Packages **MUST** define the text and binary encodings for each value in the enumeration.

Sub-list: a list of several values from a list (NOTE). The type of sub-list shall also be specified. The type shall be chosen from the types specified in this section (with the exception of sub-list). For example, Type: sub-list of enumeration. The encoding of sub-lists is specified in Annexes A.2 and in B.2.

NOTE – A Sub-list may contain a single list item. See clauses A.2 and B.2 for the encoding options.

...

12.1.3 Events

Events defined by the package, specifying:

Event name: only descriptive

Event_ID: is an identifier

Description: a description of the function of the event

EventsDescriptor Parameters:

Parameters used by the MGC to configure the event, and found in the Events Descriptor. See 12.2. If there are no parameters for the Events Descriptor, then "none" shall be specified.

ObservedEventsDescriptor Parameters:

Parameters returned to the MGC in Notify requests and in replies to command requests from the MGC that audit ObservedEvents Descriptor, and found in the ObservedEvents Descriptor. See 12.2. If there are no parameters for the ObservedEvents Descriptor, then "none" shall be specified.

12.1.4 Signals

Signals defined by the package, specifying:

Signal Name: only descriptive

Signal_ID: is an identifier. SignalID is used in a Signals Descriptor

Description: a description of the function of the signal

...

12.1.5 Statistics

Statistics defined by the package, specifying:

Statistic name: only descriptive

Statistic_ID: is an identifier

StatisticID is used in a Statistics Descriptor

Description: a description of the statistic

Type: One of:

Boolean

String: UTF-8 string

Octet String: A number of octets. See Annex A and B.3 for encoding

Integer: 4-byte signed integer

Unsigned Integer: 4-octet unsigned integer

Double: 8-byte signed integer

Character: Unicode UTF-8 encoding of a single letter. Could be more than one octet.

Enumeration: One of a list (NOTE) of possible unique values. Packages MUST define the text and binary encodings for each value in the enumeration.

Sub-list: A list of several values from a list (NOTE). The type of sub-list shall also be specified. The type shall be chosen from the types specified in this section (with the exception of sub-list). For example, Type: sub-list of enumeration. The encoding of sub-lists is specified in Annexes A and in B.2.

NOTE – A Sub-list may contain a single list item. See clauses A.2 and B.2 for the encoding options.

...

12.1.5.1 Aspects of statistics transformation

H.248 statistics are generated by Media Gateways. Such statistics are either based on MG local measurements, that is, the MG is the measurement point, or the statistics are based on remote measurements from the MG perspective. The reported statistics by the MG could be transformed in some specific cases, e.g., by the served user of the statistics (see Figure 42-16).

...

Figure 42-16 – Potential location of statistics transformation

...

13 Profile definition

Profiles may be specified to further define how the H.248.1 protocol is used and what functionality is supported by a MG. It only describes the capabilities of the MGC/MG H.248 interface. The profile itself specifies what options associated with H.248.1 have been used. For example: transport and packages used for an application.

Any profile definition shall not extend the H.248.1 protocol by, e.g., adding new syntactical elements, revision of semantics, or additional procedures (like, e.g., cross-package level procedures) in a profile. Possible profile procedures are thus given only by possible core protocol level (1) and package level (2) procedures.

...

14 IANA H.248 registration considerations

Registrations for H.248 Packages, Error Codes, ServiceChangeReasons and Profile are requested from the IANA. [IETF RFC 5615] documents the procedures from an Expert reviewer and an IANA considerations perspective. This clause and its subclauses provide an outline to requesters of the information required and the procedures for public and private registrations.

14.1 Packages Package registration procedure

Package requesters are encouraged to review their work against clause 12, "Package definition", and are encouraged to use the package definition template provided in Appendix II.

The process for registering a public Package is deemed to be "specification required" as per [IETF RFC 5226]. As such, once the initial checks occur, Package requesters for public packages under development shall send the package text to IANA. They are also encouraged to send the package to the ITU-T Question/Study Group responsible for the H.248 sub-series of Recommendations (Question 3 of ITU-T Study Group 16 at the time of writing) for review. Updated contact information can be found in the latest version of the H.248 Sub-series Implementors' Guide. This should occur as soon as practicable after the rough draft of the definition

is completed and at least before the package is approved, in order to ensure the package is consistent with H.248 methodologies and package design principles.

In order to register private Packages, a specification is not required but is encouraged.

Package requesters are encouraged to request registration as early as practicable in the design process, to reserve a binary ID. Binary IDs shall be published in the document defining the package.

Once the initial or final request for a Package registration is received by IANA, it will be forwarded to the Internet Engineering Steering Group (IESG) appointed Expert for review. During the review the input package and details will be compared to the Package template for completeness, as well as being compared against protocol syntax and procedures. It will be compared against existing work to see that it does not duplicate existing functionalities. It will be reviewed to see that any potential security issues are addressed. The Expert reviewer will then work towards a resolution of any issues with the Package requester. The IESG appointed Expert may complete the review in consultation with other H.248 experts (i.e., Currently Question 3 of ITU-T Study Group 16 and via email to IETF Megaco email list). If the package is deemed suitable, the IESG appointed Expert shall issue a statement indicating approval, copied to IANA.

The IESG Expert reviewer will ensure the following considerations are met to register a package with IANA:

- 1) A unique string name, unique serial number and version number is registered for each package. The string name is used as the PackageID for text encoding. The serial number is used as the PackageID for binary encoding. Public packages MUST be given serial numbers in the range 0x0001 to 0x7fff. Private packages MUST be given serial numbers in the range 0x8000 to 0xffff. Serial number 0 is reserved. The unique string name and unique serial number MAY either be requested by the package requester or, if not requested, assigned by IANA.
- 2) The package requester shall provide a contact name, and an email and postal addresses for that contact. The contact information shall be updated by the defining organization, as necessary.
- 3) The public package requester shall provide a reference to a document that describes the package, which should be public:
 - a) The document shall specify the version of the package that it describes.
 - b) If the document is public, it should be located on a public web server and should have a stable URL. The site should provide a mechanism to provide comments, and appropriate responses should be returned.
 - c) If the document is not public, it must be made available for review by the IESG appointed Expert (without requiring a non disclosure agreement (NDA)) at the time of the application.

NOTE – The document does not have to be publicly available at the time of the registration request, however the document shall be provided and available for review by the IESG appointed Expert. Once approved by a standards body, the package should be publicly available; however, the package may remain not public.

For private packages a contact email address for the package registration shall be provided.

- 4) Packages registered by other than recognized standards bodies shall have a minimum package name length of 8 characters.
- 5) Package names are allocated on a first come-first served basis if all other conditions are met.

Status – "In Progress (IP)" indicates that the package has not been fully reviewed and approved; therefore, it may contain errors or may not be consistent with H.248 principles. "Final" indicates that the Package has been reviewed and approved and is stable. New

packages shall be registered with a status of "IP". Once the Package has been finalized (i.e., approved according to the procedures of the Package Requester's Organization) they should contact IANA in order to update the status to "Final".

Once the IESG appointed Expert has determined that the registration is appropriate they will advise IANA to register the Package.

IANA will assign a serial number to each package meeting the conditions of registration (except for an update of an existing package, which retains the serial number of the package it is updating), in consecutive order of registration.

The following considerations shall be met to register a package with IANA:

- 1) ~~A unique string name, unique serial number and version number is registered for each package. The string name is used with text encoding. The serial number shall be used with binary encoding. Serial Numbers 0x8000 to 0xFFFF are reserved for private use. Serial number 0 is reserved.~~
- 2) ~~A contact name, email and postal addresses for that contact shall be specified. The contact information shall be updated by the defining organization as necessary.~~
- 3) ~~A reference to a document that describes the package, which should be public:
— The document shall specify the version of the package that it describes.
— If the document is public, it should be located on a public web server and should have a stable URL. The site should provide a mechanism to provide comments and appropriate responses should be returned.~~
- 4) ~~Packages registered by other than recognized standards bodies shall have a minimum package name length of 8 characters.~~
- 5) ~~All other package names are first come first served if all other conditions are met.~~

14.2 Error codes code registration procedure

Error code requesters shall send a request to IANA to register the error code. Documentation addressing the considerations below shall be provided (i.e., Specification required as per [IETF RFC 5226]). IANA shall then forward the request to the IESG appointed Expert for review.

The following considerations shall be met to register an error code with IANA:

...

- 6) ~~An error number shall not be redefined nor modified except by~~Only the organization or individual that originally defined it; (or their successors or assigns); can modify an error number definition.

If the modification leads to a change in the error code number, error code name or error string, the error code modifier shall send a request to IANA to register the update. This request shall be treated as a new error code request which will involve an Expert review.

Once the IESG appointed Expert has determined that the registration is appropriate they will advise IANA to register the error code.

14.3 ServiceChange reasons registration procedures

ServiceChange reason requesters shall send a request to IANA to register the ServiceChange reason. Documentation addressing the considerations below shall be provided (i.e., Specification required as per [IETF RFC 5226]). IANA shall then forward the request to the IESG appointed Expert for review.

The following considerations shall be met to register ServiceChange reason with IANA:

- 1) A one-phrase, 80-character maximum, unique reason code is registered for each reason.

- 2) A complete description of the conditions under which the reason is used shall be included in a publicly available document. The description shall be sufficiently clear to differentiate the reason from all other existing reasons.
- 3) The document should be available on a public web server and should have a stable URL.

Once the IESG appointed Expert has determined that the registration is appropriate they will advise IANA to register the ServiceChange reason.

14.4 Profile registration proceduress

Profile name requesters shall send a request to IANA to register the profile name. Documentation addressing the considerations below shall be provided. IANA shall then forward the request to the IESG appointed Expert for review.

The following considerations shall be met to register a profile with IANA:

...

All other profile names are first come-first served if all other conditions are met.

Once the IESG appointed Expert has determined that the registration is appropriate they will advise IANA to register the profile.

...

A.2 ASN.1 syntax specification

...

```

Command ::= CHOICE
{
    addReq           AmmRequest,
    moveReq          AmmRequest,
    modReq           AmmRequest,
    -- Add, Move, Modify requests have the same parameters
    subtractReq      SubtractRequest,
    auditCapRequest  AuditRequest,
    auditValueRequest AuditRequest,
    notifyReq        NotifyRequest,
    serviceChangeReq ServiceChangeRequest,
    ...
}

CommandReply ::= CHOICE
{
    addReply          AmmsReply,
    moveReply         AmmsReply,
    modReply          AmmsReply,
    subtractReply     AmmsReply,
    -- Add, Move, Modify, Subtract replies have the same parameters
    auditCapReply    AuditReply,
    auditValueReply  AuditReply,
    notifyReply       NotifyReply,
    serviceChangeReply ServiceChangeReply,
    ...
}

TopologyRequest ::= SEQUENCE
{
    terminationFrom TerminationID,
    terminationTo   TerminationID,
    topologyDirection ENUMERATED
}

```

```

    {
        bothway(0),
        isolate(1),
        oneway(2)
    },
    ...,
    streamID                StreamID OPTIONAL,
    topologyDirectionExtension  ENUMERATED OPTIONAL
    {
        onewayexternal(0),
        onewayboth(1),
        ...
    } OPTIONAL
}
--- if present, topologyDirectionExtension takes precedence over
--- topologyDirection

...

-- In PropertyParm, value is a SEQUENCE OF octet string. When sent
-- by an MGC the interpretation is as follows:
-- empty sequence means CHOOSE
-- one element sequence specifies value
-- If the sublist field is not selected, a longer sequence means
-- "choose one of the values" (i.e., value1 OR or value2 OR ...) etc., from a
-- collection of values.
-- If the sublist field is selected,
-- a sequence with more than one element encodes the value of a
-- list-valued property (i.e., a collection of values, value1 and value2
-- and ...) value1 AND value2 AND ...).
-- Note that when encoding a sub-list of length one, the sublist field
-- may be left unselected.
-- The relation field may only be selected if the value sequence
-- has length 1. It indicates that the MG has to choose a value
-- for the property. E.g., x > 3 (using the greaterThan
-- value for relation) instructs the MG to choose any value larger
-- than 3 for property x.
-- The range field may only be selected if the value sequence
-- has length 2. It indicates that the MG has to choose a value
-- in the range between the first octet in the value sequence and
-- the trailing octet in the value sequence, including the
-- boundary values.
-- When sent by the MG, only responses to an AuditCapability request
-- may contain multiple values, a range, or a relation field.

...

DigitMapValue ::= SEQUENCE
{
    startTimer                INTEGER(0..99) OPTIONAL,
    shortTimer                INTEGER(0..99) OPTIONAL,
    longTimer                 INTEGER(0..99) OPTIONAL,
    digitMapBody              IA5String,
    -- Units are seconds for start, short and long timers, and hundreds
    -- of milliseconds for duration timer. Thus start, short, and long
    -- range from 1 to 99 seconds and duration from 100 ms to 9.9 s
    -- An exception is the start timer, which may equal 0.
    -- See A.3 for explanation of DigitMap syntax
    ...,
    durationTimer             INTEGER (0..99) OPTIONAL
}

```

...

```
ServiceChangeResParm ::= SEQUENCE
{
    serviceChangeMgcId      MiId OPTIONAL,
    serviceChangeAddress    ServiceChangeAddress OPTIONAL,
    serviceChangeVersion    INTEGER(0..99) OPTIONAL,
    serviceChangeProfile    ServiceChangeProfile OPTIONAL,
    timestamp               TimeNotation OPTIONAL,
    ...
}
```

...

B.2 ABNF specification

...

```
; Enumeration: An enumeration must use the SafeChar form of VALUE
; and can contain anything allowable in the SafeChar form.
;
; Boolean: Boolean values are encoded as "on" and "off" and are
; case insensitive. The SafeChar form of VALUE must be used.
;
; OctetString: Where a package specifies the data type "OctetString" the
; hexadecimal form defined in B.3 shall be used. NOTE - The OctetString BNF
; is only for the carriage of SDP in the Local and Remote Descriptors.
;
; Sub-list: Sub-lists are encoded using the "sublist" branch of
; alternativeValue. A sub-list with a length of one may also be encoded
; simply as a single VALUE of the appropriate type.
;
; Future types: Any defined types must fit within
; the ABNF specification of VALUE. Specifically, if a type's encoding
; allows characters other than SafeChars, the quotedString form must
; be used for all values of that type, even for specific values that
; consist only of SafeChars.
;
```

...

```
propertyParm          = pkgdName parmValue
```

```
; the (Safe)Char '$' means CHOOSE
```

```
; the (Safe)Char '*' means ALL
```

```
parmValue             = (EQUAL alternativeValue / INEQUAL VALUE)
```

```
alternativeValue      = (VALUE
```

```
    / LSBRKT VALUE *(COMMA VALUE) RSBRT
```

```
        ; sublist (i.e., A AND B AND ...)
```

```
    / LBRKT VALUE *(COMMA VALUE) RBRKT
```

```
        ; alternatives (i.e., A OR B OR ...)
```

```
    / LSBRKT VALUE COLON VALUE RSBRT)
```

```
        ; range
```

```
; If the alternative or range branches are used,
```

```
; a sequence means "choose one of the values" (i.e., value1 or value2, etc.
```

```
; from a collection of values).
```

```
; If the sublist branch is used,
```

; a sequence with more than one element encodes the value of a
; list-valued property (i.e., a collection of values, value1 and
; value2 and ...).

INEQUAL = LWSP (">" / "<" / "#") LWSP ; '#' means "not equal"

...

digitMapValue = ["T" COLON Timer COMMA] ["S" COLON Timer COMMA] ["L"
COLON Timer COMMA] ["Z" COLON Timer COMMA] digitMap

Timer = 1*2DIGIT
; Units are seconds for T, S, and L timers, and hundreds of
; milliseconds for Z timer. Thus T, S, and L range from 1 to 99
; seconds and Z from 100 ms to 9.9 s
; An exception is the start timer, which may equal 0.

digitMap = (digitString / LWSP "(" LWSP digitStringList LWSP
")" LWSP)

...

indAudterminationStateDescriptor
= TerminationStateToken LBRKT
indAudterminationStateParm RBRKT
; NOTE - There is an inconsistency between request and reply for individual
; audits. The request does not permit multiple parameters to be contained within
; a single TerminationState Token, whereas the reply permits multiple
; parameters.

indAudterminationStateParm
= pkgdName / propertyParm / ServiceStatesToken
[(EQUAL/INEQUAL) serviceStatesValue] / BufferToken

...

statisticsDescriptor = StatsToken [LBRKT statisticsParameter *(COMMA
statisticsParameter) RBRKT]

;at-most-once per item

statisticsParameter = pkgdName [EQUAL VALUE /
(LSBRKT VALUE *(COMMA VALUE) RSBKRT)]

...

B.3 Hexadecimal octet coding

Hexadecimal octet coding is a means for representing package elements of type Octet String as a string of hexadecimal digits, with two digits representing each octet. This octet encoding should be used when encoding values of type Octet String in the text version of the protocol.

For each octet, the 8-bit sequence is encoded as two hexadecimal digits. Bit 0 is the first transmitted or leftmost; bit 7 is the last or rightmost.

NOTE 1 – This means that Bit 0 is the MSB of the original octet and Bit 7 is the LSB of the original octet, according to the common convention used to specify octet values.

Bits 7-4 are encoded as the first hexadecimal digit, with Bit 7 as MSB of the first hexadecimal digit and Bit 4 as LSB of the first hexadecimal digit. Bits 3-0 are encoded as the second hexadecimal digit, with Bit 3 as MSB of the second hexadecimal digit and Bit 0 as LSB of the second hexadecimal digit.

NOTE 2 – The above encoding results in the reversal of bits from the original octet.

...

E.1.2.1 Cause

Event Name: Cause

EventID: cause (0x0001)

Description: Generic error event

EventsDescriptor Parameters: None

ObservedEvents Descriptor Parameters:

General Cause

Parameter Name: General Cause

ParameterID: Generalcause (0x0001)

Description: This parameter groups the failures into six groups, which the MGC may act upon.

Type: enumeration

Optional: No

Possible values:

"NR"_(0x0001);	Normal_—Release
"UR"_(0x0002);	Unavailable_—Resources
"FT"_(0x0003);	Failure,_—Temporary
"FP"_(0x0004);	Failure,_—Permanent
"IW"_(0x0005);	Interworking_—Error
"UN"_(0x0006);	Unsupported

Default: None

...

E.1.2.2 Signal Completion

...

Termination Method

Parameter Name: Termination Method

ParameterID: Meth (0x0002)

Description: Indicates the means by which the signal terminated.

Type: Enumeration

Optional: No

Possible values:

"TO" (0x0001); Signal timed out or otherwise completed on its own
"EV" (0x0002); Interrupted by event

"SD" (0x0003): Halted by new Signals Descriptor
"NC" (0x0004): Not completed, other cause
"PI" (0x0005): First to penultimate iteration. For last iteration, use TO.

Default: None

...

E.2.1.2 Maximum Terminations Per Context

Property Name: MaxTerminationsPerContext

PropertyID: maxTerminationsPerContext (0x0002)

Description: The maximum number of allowed terminations in a context, see clause 6.1. This is not related to the capacity of the NULL Context. This is related to non-Root termination types (physical, ephemeral), including multiplexing terminations.

Type: Integer

...

E.6 DTMF Detection Package

...

Version: 42

Extends: tonedet version 1

...

E.6.2.2 DigitMap Completion Event

Event Name: DigitMap Completion Event

EventID: ce (0x0004)

Description: Generated when a DigitMap completes as described in 7.1.14.

EventsDescriptor Parameters: None

Unsuccessful Match Reporting

Parameter Name: Unsuccessful Match Reporting

ParameterID: umr (0x0001)

Description: The MGC may use this parameter to control whether the DigitMap Completion Event is generated in the event of an unsuccessful DigitMap match (i.e., match with method "Partial match" or "Full Match").

Type: Boolean

Optional: Yes

Possible values:

On Generate DigitMap Completion Event on unsuccessful match.

Off Do not generate a DigitMap Completion Event on an unsuccessful match.

Default: On

...

E.6.5 Procedures

DigitMap processing is activated only if an Events Descriptor is activated that contains a DigitMap completion event as defined in E.6.2 and that DigitMap completion event contains an EventDM field in the requested actions as defined in 7.1.9. Other parameters such as KeepActive or embedded Events or Signals Descriptors may also be present in the Events Descriptor and do not affect the activation of DigitMap processing. By default DigitMaps are processed according to the procedures of 7.1.14 and when the DigitMap has completed (see clause 7.1.14.4) it is notified to the MGC, and any embedded signals and embedded events are triggered. However, if the Unsuccessful Match Reporting is set to "off" and the DigitMap completion was triggered as a result of an unsuccessful match, then the DigitMap completion event is not notified to the MGC nor are embedded signals and/or embedded events triggered. The DigitMap however will be de-activated.

...

E.7.5 Procedures

NOTE – The required set of tone IDs corresponds to those defined in ~~[b-ITU-T Rec. E.180/Q.35]~~. See ~~[b-ITU-T Rec. E.180/Q.35]~~ for definition of the meanings of these tones.

E.8 Call progress tones detection package

Package Name: Call Progress Tones Detection Package

PackageID: cd (0x0008)

Description: This package defines the basic call progress detection tones. This package extends the possible values of tone ID in the Start Tone Detected, End Tone Detected and Long Tone Detected Events.

Additional values

Tone ID values are defined for Start Tone Detected, End Tone Detected and Long Tone Detected with the same values as those in package cg (Call Progress Tones Generation Package).

The required set of tone IDs corresponds to ~~[b-ITU-T Rec. E.180/Q.35]~~. See ~~[b-ITU-T Rec. E.180/Q.35]~~ for definition of the meanings of these tones.

Version: 1

Extends: tonedet version 1

...

E.9 Analog Line Supervision Package

Package Name: Analog Line Supervision Package

PackageID: al₇ (0x0009)

Description: This package defines events and signals for an analog line.

Version: 1

Extends: None

...

E.10.5 Procedures

...

NOTE – Example tones and test procedure details are given in clauses 7 and 8/[b-ITU-T Q.724], 2.1.8/[b-ITU-T Q.764] and [b-ITU-T Rec-Q.1902.4].

...

E.12 RTP Package

Package Name: RTP Package

PackageID: rtp (0x000c)

Description: This package is used to support packet-based multimedia data transfer by means of the Real-time Transport Protocol (RTP) [IETF (RFC 3550)].

Version: 42

Extends: nt version 1

...

E.12.4.1 Packets Sent

Statistic Name: Packets Sent

StatisticID: ps (0x0004)

Description: Provides the number of RTP packets sent from the termination or stream since the termination has existed or been out of the NULL Context and the statistic has been enabled.

Type: Double

Possible values: any 64-bit integer 0 and up

Level: Either

E.12.4.2 Packets Received

Statistic Name: Packets Received

StatisticID: pr (0x0005)

Description: Provides the number of RTP packets received on the termination or stream since the termination has existed or been out of the NULL Context and the statistic has been enabled.

Type: Double

...

E.12.4.5 Delay

Statistic Name: Delay

StatisticID: delay (0x0008)

Description: Requests the current value (Note 1) of packet round-trip propagation delay (RTPD) expressed in timestamp units. ~~This is the same as average latency.~~ The computation of RTPD may be based upon RTCP sender reports and receiver reports (Note 2).

NOTE 1 – The term "current value" mentioned in the description is the latest (most recently measured) RTPD.

NOTE 2 – The arrival of a new RTCP SR/RR packet leads to the computation of a new latest (most recently measured) RTPD value. This is based on the RTCP protocol elements "delay since last SR (DLSR)" and "last SR timestamp (LSR)" as well as the report block arrival time, according to section 6.4.1 of [IETF RFC 3550].

Type: Double

Possible values: any 64-bit integer 0 and up

Level: Either

E.12.4.6 Cumulative Packet Loss

Statistic Name: Cumulative Packet Loss

Statistic ID: cpl (0x001c)

Description: Provides the total number of incoming packets that were lost since the statistic was enabled. This number is defined to be the number of packets expected less the number of packets actually received, where the number of packets received includes any which are late or duplicates. Thus, packets that arrive late are not counted as lost, and the loss may be negative if there are duplicates.

See [IETF RFC 3550] for further details.

Type: Double

Possible values: Any value

Level: Either

E.12.5 Procedures

E.12.5.1 Working with RTP

When RTCP is associated with an RTP stream, RTCP shall remain unaffected by the H.248.1 Mode Property in the LocalControl Descriptor.

When RTCP is associated with an RTP stream and the MG receives an Empty Remote Descriptor for that stream, the MG shall stop the RTCP stream along with the corresponding RTP stream.

Where the Payload Transition (*pltrans*) event is used, the codec currently used by the relevant Stream on the MG is the start codec. In the case where a MG has not selected a codec for use, it can be assumed that the initial codec is the first one listed in the Local Descriptor (e.g., SDP). Therefore, an MG receiving the *pltrans* event from the MGC should consider the first codec listed as the "start codec". If the MG chooses another codec, it should send a Notify.req with the *pltrans* observed event.

...

E.14.6 Procedures

...

Example 1:

```
Sender:      !/3 [12.34.56.78]:2944 P=1/1{C=1{AV=term1{...}, AV=term2{...}}}  
Receiver:    !/3 [12.34.56.79]:2944 SM=1/1  
Sender:      !/3 [12.34.56.78]:2944 P=1/2{C=1{AV=term3{...}}, C=2{AV=term4{...}}}  
Receiver:    !/3 [12.34.56.79]:2944 SM=1/2  
Sender:      !/3 [12.34.56.78]:2944 P=1/3/&{C=3{AV=term5{...}}}  
Receiver:    !/3 [12.34.56.79]:2944 SM=1/3/&  
Receiver:    !/3 [12.34.56.79]:2944 K={1}
```

Example 2:

...

E.15.5.2.1 Quadrant I and II Behaviour

No special NotifyBehaviour is required on the MG as the MGC is not in overload and can receive all messages (notifications) from the MG. However, once the MGC has determined the type of call, it may set a priority in the MG by using an appropriate Context Attribute (i.e., the priority indicator).

...

F.5.7 ServiceChangeMgcID

The use of the ServiceChangeMgcID parameter is described in clause 7.2.8, specifically clause 7.2.8.1.3. The MGC may send this parameter in a ServiceChange Command directed toward the Root Termination. Upon receipt during a registration attempt, the MG shall attempt registration with the MGC at the specified address (see Note). When received in a ServiceChange Handoff Command from the MG's primary MGC, the MG shall utilize the procedures outlined in 11.5.

NOTE – In case of a name format, a name-to-address resolution is implied, see clause 7.2.8.1.3.

The MGC should not use the ServiceChangeMgcID parameter in a ServiceChange Reply when responding to a ServiceChange Forced or Graceful Command with reason 908.

The MGC may use the ServiceChangeMgcID parameter in a ServiceChange Reply when responding to a ServiceChange Disconnected with reason 900 (see also clause 8.4 of [b-ITU-T H-Sup.7]).

...

Appendix I

Example call flows

All H.248.1 implementors must read the normative part of this Recommendation carefully before implementing from it. No one should use the examples in this appendix as stand-alone explanations of how to create protocol messages.

The examples in this appendix use SDP for encoding of the Local and Remote Descriptors. SDP is defined in [IETF RFC 2327]. If there is any discrepancy between the SDP in the examples and [IETF RFC 2327], the RFC should be consulted for verification. Audio profiles used are those defined in [IETF RFC 4890] and [IETF RFC 3551], and others registered with IANA. For example, G.711 A-law is called PCMA in SDP, and is assigned profile 08. G.723.1 is called G723 and is profile 4; H.263 is called H263 and is profile 34. See also <http://www.iana.org/assignments/rtp-parameters>.

...

I.1.1 Programming residential GW analog line terminations for idle behaviour

...

- 3) The MGC programs a termination in the NULL Context. The TerminationID is A4444, the streamID is 1, the requestID in the Events Descriptor is 2222. The MID is the identifier of the sender of this message; in this case, it is the IP address and port [123.123.123.4]:55555.

The Mode Property for this stream is set to ~~SendRecv~~Inactive. "al" is the analog line supervision package. The Local and Remote Descriptors are assumed to be provisioned.

```
MGC to MG1:
MEGACO/3 [123.123.123.4]:55555
Transaction = 9999 {
  Context = - {
    Modify = A4444 {
      Media { Stream = 1 {
        LocalControl {
          Mode = SendRecvInactive,
          tdmc/gain=2, ; in dB,
          tdmc/ec=on
        },
      },
    },
    Events = 2222 {al/of {strict=state}}
  }
}
}
```

...

I.1.2 Collecting originator digits and initiating termination

...

- 6) MG1 detects an off-hook event from User 1 and reports it to the Media Gateway Controller via the Notify Command.

```
MG1 to MGC:
MEGACO/3 [124.124.124.222]:55555
Transaction = 10000 {
  Context = - {
    Notify = A4444 {ObservedEvents =2222 {
      19990729T22000000:al/of{-(init=OFF)-}}
    }
  }
}
```

...

- 8) The MGC modifies the termination to play dial tone, to look for digits according to Dialplan0 and to look for the on-hook event now.

```
MGC to MG1:
MEGACO/3 [123.123.123.4]:55555
Transaction = 10001 {
  Context = - {
    Modify = A4444 {
      Events = 2223 {
        al/on{-(strict=state)-}, dd/ce {DigitMap=Dialplan0}
      },
      Signals {cg/dt},
      DigitMap= Dialplan0{
(0| 00| [1-7]xxx|8xxxxxxxx|Fxxxxxxxx|Exx|91xxxxxxxxxxxx|9011x.)}
      }
    }
  }
}
```

...

- 12) The controller then analyses the digits and determines that a connection needs to be made from MG1 to MG2. Both the ~~TDM-physical~~ termination A4444, and an ephemeralRTP

termination are added to a new context in MG1. Mode is RecvOnly since Remote Descriptor values are not yet specified. Preferred codecs are in the MGC's preferred order of choice.

```
MGC to MG1:
MEGACO/3 [123.123.123.4]:55555
Transaction = 10003 {
  Context = $ {
    Add = A4444 { LocalControl {
      Mode = SendRecv} },
    Add = $ {
      Media {
        Stream = 1 {
          LocalControl {
            Mode = RecvOnly,
            nt/jit=40 ; in ms
          },

```

...

- 13) MG1 acknowledges the new termination and fills in the Local IP address and UDP port. It also makes a choice for the codec based on the MGC preferences in Local. MG1 sets the RTP port to 2222.

```
MEGACO/3 [124.124.124.222]:55555
Reply = 10003 {
  Context = 2000 {
    Add = A4444,
    Add=A4445{
      Media {
        Stream = 1 {
          Local {
v=0
o=- 2890844526 2890842807 IN IP4 124.124.124.222
s=-
c=IN IP4 124.124.124.222
t= 0 0
m=audio 2222 RTP/AVP 4
a=ptime:30
a=recvonly
          } ; RTP profile for G.723.1 is 4
        }
      }
    }
  }
}

```

- 14) The MGC will now associate A5555 with a new context on MG2, and establish an RTP Stream (i.e., A5556 will be assigned), SendRecv connection through to the originating user, User 1. The MGC also sets ring on A5555.

```
MGC to MG2:
MEGACO/3 [123.123.123.4]:55555
Transaction = 50003 {
  Context = $ {
    Add = A5555 { Media {
      Stream = 1 {
        LocalControl {Mode = SendRecv} }},
    Events=1234{al/of{+(strict=state)}},
    Signals {al/ri}
  },
  Add = $ {Media {

```

```

Stream = 1 {
  LocalControl {
    Mode = SendRecv,
    nt/jit=40 ; in ms
  },
  Local {

```

...

- 17) The two gateways are now connected and User 1 hears the ringback. The MG2 now waits until User2 picks up the receiver and then the two-way call is established.

From MG2 to MGC:

```

MEGACO/3 [125.125.125.111]:55555
Transaction = 50005 {
  Context = 5000 {
    Notify = A5555 {ObservedEvents =1234 {
      19990729T22020002:al/of{-(init=off+)} }
  }
}

```

From MGC to MG2:

```

MEGACO/3 [123.123.123.4]:55555
Reply = 50005 {
  Context = - {Notify = A5555}
}

```

From MGC to MG2:

```

MEGACO/3 [123.123.123.4]:55555
Transaction = 50006 {
  Context = 5000 {
    Modify = A5555 {
      Events = 1235 {al/on{-(strict=state+)}},
      Signals ; to turn off ringing
    }
  }
}

```

...

- 20) The MG2 replies.

...

```

Remote {
v=0
o=- 2890844526 2890842807 IN IP4 124.124.124.222
s=-
c=IN IP4 124.124.124.222
t= 0 0
m=audio 2222 RTP/AVP 4
a=ptime:30
} } },
DigitMap,
Events,
Signals,
DigitMap,
Packages {nt-1, rtp-1},
Statistics { rtp/ps=1200, ; packets sent
nt/os=62300, ; octets sent

```

```

    rtp/pr=700, ; packets received
    nt/or=45100, ; octets received
    rtp/pl=0.2, ; % packet loss
    rtp/jit=20,
    rtp/delay=40 } ; avg latency
  }
}

```

- 21) When the MGC receives an on-hook signal from one of the MGs, it brings down the call. In this example, the user at MG2 hangs up first.

From MG2 to MGC:

```

MEGACO/3 [125.125.125.111]:55555
Transaction = 50008 {
  Context = 5000 {
    Notify = A5555 {ObservedEvents =1235 {
      19990729T24020002:al/on{+(init=off+)}
    }
  }
}

```

...

Appendix II

H.248 Package template

...

6 <Package Title>

Package Name: <name>
PackageID: <PackageID "text", binary <0x????>>
Description: <description>
Version: <version>
Extends: <extended PackageID and version>

Package Name: <name>
Package ID: <PackageID "text", binary <0x????> >
Description: <description>
Version: <version>
Extends: <extended PackageID and version>

6.1 Properties

6.1.1 <Property Title>

Property Name: <name>
PropertyID: <text ID, binary ID (0x????)>

Description: _____ <description>
Type: _____ <type>
Possible values: _____ <values>
Default: _____ <value>
Defined in: _____ <Local, Remote, LocalControl, TerminationState, ContextAttribute>
Characteristics: _____ <ReadOnly, Read/Write>
Property Name: <name>
Property ID: <text ID, binary ID (0x????)>
Description: <description>
Type: <type>
Possible values: <values>
Default: <value>
Defined in: <Local, Remote, LocalControl, TerminationState, ContextAttribute>
Characteristics: <ReadOnly, Read/Write>

6.2 Events

6.2.1 <Event Title>

Event Name: _____ <event name>
EventID: _____ <(text ID), (binary ID (0x????))>
Description: _____ <description>
Event Name: <event name>
Event ID: <(text ID), (binary ID (0x????))>
Description: <description>

6.2.1.1 EventsDescriptor parameters

6.2.1.1.1 <Parameter Title>

Parameter Name: _____ <name>
ParameterID: _____ <(text ID), (binary ID (0x????))>
Description: _____ <description>
Type: _____ <types>
Optional: _____ <yes/no>
Possible values: _____ <values>
Default: _____ <value>
Parameter Name: <name>
Parameter ID: <(text ID), (binary ID (0x????))>
Description: <description>
Type: <types>
Optional: <yes/no>

Possible values: <values>

Default: <value>

6.2.1.2 ObservedEventsDescriptor parameters

6.2.1.2.1 <Parameter Title>

~~Parameter Name:~~ <name>

~~ParameterID:~~ <(text ID), (binary ID (0x????))>

~~Description:~~ <description>

~~Type:~~ <types>

~~Optional:~~ <yes/no>

~~Possible values:~~ <values>

~~Default:~~ <value>

Parameter Name: <name>

ParameterID: <(text ID), (binary ID (0x????))>

Description: <description>

Type: <types>

Optional: <yes/no>

Possible values: <values>

Default: <value>

6.3 Signals

6.3.1 <Signal Title>

~~Signal Name:~~ <name>

~~SignalID:~~ <(text ID), (binary ID (0x????))>

~~Description:~~ <description>

~~Signal Type:~~ <type>

~~Duration:~~ <duration>

Signal Name: <name>

SignalID: <(text ID), (binary ID (0x????))>

Description: <description>

Signal Type: <type>

Duration: <duration>

6.3.1.1 Additional parameters

6.3.1.1.1 <Parameter Title>

~~Parameter Name:~~ <name>

~~ParameterID:~~ <(text ID), (binary ID (0x????))>

~~Description:~~ <description>

~~Type:~~ <types>

Optional: ~~_____~~ <yes/no>
Possible values: ~~_____~~ <values>
Default: ~~_____~~ <value>
Parameter Name: <name>
Parameter ID: <(text ID), (binary ID (0x????))>
Description: <description>
Type: <types>
Optional: <yes/no>
Possible values: <values>
Default: <value>

6.4 Statistics

6.4.1 <Statistic Title>

Statistic Name: ~~_____~~ <name>
Statistic ID: ~~_____~~ <(text ID), (binary ID (0x????))>
Description: ~~_____~~ <description>
Type: ~~_____~~ <type>
Possible values: ~~_____~~ <values>
Level: ~~_____~~ <Termination, Stream, Either>
Statistic Name: <name>
Statistic ID: <(text ID), (binary ID (0x????))>
Description: <description>
Type: <type>
Possible values: <values>
Level: <Termination, Stream, Either>

6.5 Error Codes

6.5.1 <Error Code Title>

~~_____~~ **Error Code #:** ~~_____~~ <number>
~~_____~~ **Name:** ~~_____~~ <name>
~~_____~~ **Definition:** ~~_____~~ <definition>
~~_____~~ **Error Text in the Error Descriptor:** <error text to return>
~~_____~~ **Comment:** ~~_____~~ <comment>
Error Code #: <number>
Name: <name>
Definition: <definition>
Error Text in the Error Descriptor: <error text to return>
Comment: <comment>

6.6 Procedures

<The procedures associated with the package>

Appendix III

H.248 Profile Definition template

New H.248 profiles should be defined using the following profile template. It is in an ITU Recommendation format. Editors from non-ITU organizations should, at a minimum, use the structures in clause 6 below. If this template format is not used, then editors of profiles should ensure that the headings and points in this appendix are covered by their profile.

Support of Profile Elements

The headings in the structure below represent items that may be considered as optional. For profile definitions, a certain H.248.1 item may be unused despite being mandatory in H.248.1. These items are also included in the structure below. Non-listed items are to be considered mandatory by the H.248.1 protocol. In the profile template below, elements can be defined as "optional" and "mandatory". "Optional" means that it is optional for either the sender or the receiver to include the element in a message.

The MGC may use the H.248 packages audit mechanism to determine which of the optional packages are supported by the MG.

Within each of the cited (mandatory and optional) packages, individual properties, signals, events or statistics are tagged as being optional or mandatory. The interpretation of this categorization in this profile is as follows:-

- Any property, signal, event or statistic that is tagged as mandatory in a mandatory package must be supported by the MG. Such properties, signals, events and statistics may optionally be used by the MGC.
- Any property, signal, event or statistic that is tagged as mandatory in an optional package must be supported by the MG if the MG supports that optional package. As the MGC is the master, it determines when properties/signals/events and statistics are set on the MG and as such, properties, signals and events may optionally be used by the MGC.
- Any property, signal, event or statistic that is tagged as optional in a mandatory or optional package may be supported by the MG if the MG supports that package. Such properties, signals and events may optionally be used by the MGC. Should the MGC attempt to use such an unsupported optional property/signal/event/statistic, the MG shall respond with error code 501 (Not Implemented). If the MGC receives statistics that are not understood, then they are ignored.

Where the cited properties, events, signals and statistics have associated parameters, such parameters are also tagged as being mandatory or optional. Where a parameter is designated in the Package description to be "Optional: No" the Profile definition shall not specify this parameter to be "Optional". The interpretation of this categorization in this profile is as follows:

- any parameter that is tagged as mandatory may be included by the sending entity and must be supported by the receiving entity;
- any parameter that is tagged as optional may be included by the sending entity and may be supported by the receiving entity. If the receiving entity receives an optional element that it has not implemented as per clause 6.2.3, it should send Error Code 501 ("Not Implemented").

If the receiving entity receives an optional element that it has not implemented as per 6.2.3 it should send Error Code 501 ("Not Implemented").

The editor should provide written description in each of the subclauses below if it furthers clarifies H.248.1 behaviour. For example, if the Move Command (see 6.8.4) is limited to certain termination types, this should be indicated.

Italics text is to be removed.

<text> in brackets is to be filled in.

Recommendation ITU-T <xxx>

<Profile Title>

1 Scope

...

6.5 Context attributes

Context attribute	Supported	Values supported
Topology	<Yes/No>	See 6.7.8
Priority Indicator	<Yes/No>	<1-15>
Emergency Indicator	<Yes/No>	NA
IEPS call indicator	<Yes/No>	NA
ContextAttribute Descriptor	<Yes/No>	If "Yes", see 6.8.9 for details of supported attributes.
ContextIDList Parameter	<Yes/No>	NA

...

6.8.7 Notify

Which descriptors can be used in a Notify ~~Command~~request?

Descriptors used by Notify request:	<ObservedEvents, Error>
--	-------------------------

What descriptors can be used in a Notify reply?

Descriptors used by Notify reply:	<Error>
--	---------

6.8.8 ServiceChange

...

ServiceChangeAddress used:	<Yes/No>
-----------------------------------	----------

Is ServiceChangeMgclid used?

ServiceChangeMgclid used:	<Yes/No>
----------------------------------	----------

Is ServiceChangeDelay used?

...

6.8.9 Manipulating and auditing context attributes

Which Context Attributes may be manipulated and/or audited?

Context Attributes manipulated:	<Topology, Emergency <u>Indicator</u> , Priority <u>indicator</u> , IEPS <u>call i</u> ndicator, ContextAttribute Descriptor (list attribute names), ALL>
Context Attributes audited:	<Topology, Emergency <u>Indicator</u> , Priority <u>indicator</u> , IEPS <u>call i</u> ndicator, ContextAttribute Descriptor (list attribute names), ALL>

...

6.14 Packages

Package usage information

This table specifies how the packages above will be used. For example:

- *it lists whether the properties/signals/events/statistics are optional or mandatory;*
- *if the value of the property/signal/event provisioned should be specified (e.g., names and number of cycles for an [b-ITU-T H.248.7] announcement);*

...

Appendix IV

Practices on Statistics – Example use-cases

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

All H.248.1 implementers must read the normative part of this Recommendation carefully before implementing from it. The examples of this appendix should not be used as stand-alone explanations of how to create protocol messages.

The examples in this appendix are in text-encoded H.248.

IV.1 Introduction

The Statistics Descriptor may contain, according to syntax specifications in Annexes A and B, either:

- an empty list ("empty Statistics Descriptor");
- a list of statistic names (each statistic name is given as PackageID/StatisticID);
- a list of statistic names, each accompanied by that statistic's value.

The above syntactical definition and existing H.248 semantics of the protocol allow a flexible use of the Statistics Descriptor. This appendix provides examples to illustrate some typical use cases.

IV.1.1 MGC operations

The MGC may perform the following operations on MG processes related to the generation of H.248 Statistics (see Figure IV.1):

- Statistic data:
 - 1) Read access on statistic objects (name/value combinations)
 - a) read all statistics of a termination;
 - b) read all statistics of a dedicated package associated to a termination;
 - c) read of individual statistics of a termination.
- Statistic control:
 - 2) Activate the collection of all statistics or a specific subset of statistics.
 - 3) Deactivate the collection of all statistics or a specific subset of statistics.
 - 4) Combine 3) and 2) in order to reset the value of all statistics or a specific subset of statistics.

Each operation type results in the application of a single H.248 descriptor type (here: either the Audit Descriptor or the Statistics Descriptor), and a specific setting of the descriptor itself.

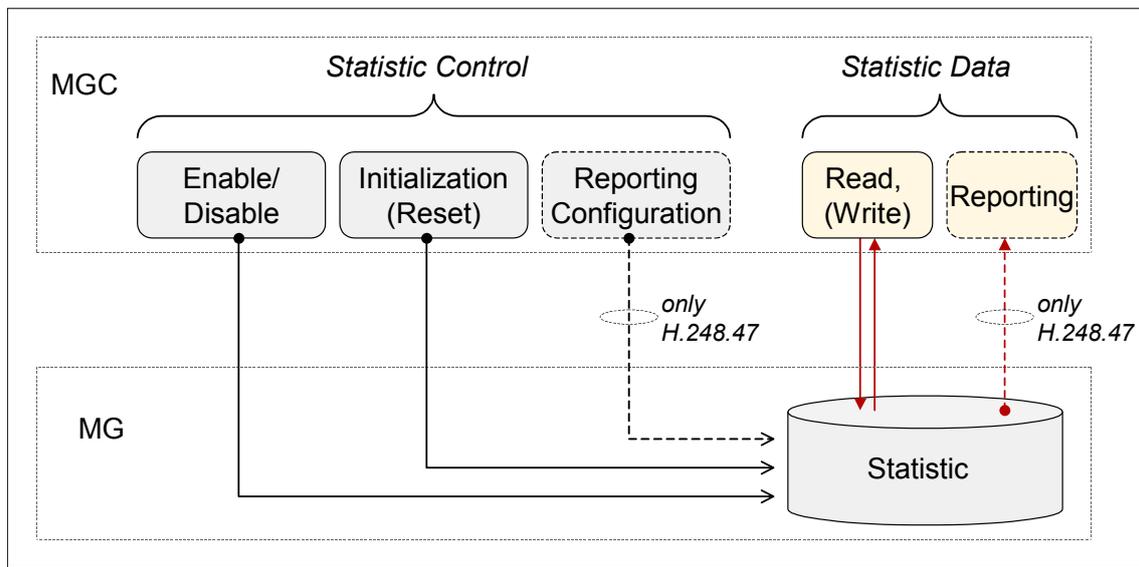


Figure IV.1 – Categories of MGC operations on statistics ('Reporting' requires support of [b-ITU-T H.248.47])

IV.1.1.1 Dependency on H.248.1 protocol version

The control operations on statistics appearing in this appendix are realized with the Add, Modify, Move, and/or Subtract commands. These commands may include an Audit Descriptor under all H.248.1 protocol versions. However, a Statistics Descriptor may only be used with an Add, Modify or Move command and only in H.248.1 Version 3.

IV.1.1.2 Relation to ITU-T H.248.47

The Statistic Conditional Reporting Package [b-ITU-T H.248.47] supports additional capabilities related to statistics (as indicated in Figure IV.1); namely a mechanism for real-time reporting of statistics. This mechanism is out of the scope of this appendix.

IV.1.2 Examples' background

This example scenario illustrates the use of the protocol elements in conjunction with an ephemeral termination. The packages chosen for the examples are the network package (nt; clause E.11) and

<pre> } } } } </pre>	
<p>The Statistics Descriptor is included in this Add request of an ephemeral termination. The initial set of active statistics contains the "rtp/pl", "rtp/delay" and "nt/dur" statistics.</p> <p>NOTE 1 – The rtp version 1 package extends the nt version 1 package. Therefore statistics defined by the nt package may also be referenced using the rtp PackageID; for example rtp/dur.</p> <p>NOTE 2 – The reply does not repeat the Statistics Descriptor. The general principle is to avoid redundancy in replies, i.e., information sent by the MGC should not be replied again by the MG.</p>	

IV.2.3 Use-case: activating all statistics on a new termination

Including the wildcard "ALL/ALL" in the Statistics Descriptor of the Add command will result in all statistics being active on the new termination. See Table IV.3.

NOTE – This use-case results in the same behaviour as omitting the Statistics Descriptor from the Add command. See clause IV.2.1.

Table IV.3 – Activating all statistics on a new termination

<u>H.248 text encoding example</u>	<u>Result</u>
<pre> H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31205 { Context = 2005 { Add = rtp/30/\$ { Media{ ... }, Statistics{ */* ;ALL stats of ALL pkgs } } } } </pre>	<pre> H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31205 { Context = 2005 { Add = rtp/30/23 { Media{ ... } } ; NOTE 1 } } </pre>
<p>The Statistics Descriptor is included in this Add request of an ephemeral termination. Collection of all statistics is activated by a Statistics Descriptor including a single element: "All/All".</p> <p>NOTE 1 – The reply does not repeat the Statistics Descriptor, even though a wildcard statistic name appeared in the request. The same principle described in Note 2 of Table IV.2 is applied.</p> <p>NOTE 2 – The effect of this command is identical to that of the command outlined in Table IV.1.</p>	

IV.2.4 Use-case: activating no statistics on a new termination

Including an empty Statistics Descriptor in an Add command will result in all statistics being inactive on the new termination. See Table IV.4.

Table IV.4 – Activating no statistics on a new termination

H.248 text encoding example	Result
<pre>H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31205 { Context = 2005 { Add = rtp/30/\$ { Media{ ... }, Statistics ; empty descriptor } } }</pre>	<pre>H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31205 { Context = 2005 { Add = rtp/30/23 { Media{ ... } } } }</pre>
<p>The Statistics Descriptor is empty. No statistics will be collected on the termination.</p>	

IV.3 Activating and deactivating Statistics

The set of statistics that an existing termination collects can be changed by including the Statistics Descriptor in a Modify command or a Move command. Table IV.5 provides an example use case. The example assumes that this Modify command follows the Add command appearing in Table IV.2.

Table IV.5 – Changing the active statistics

H.248 text encoding example	Result
<pre>H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31205 { Context = 2005 { Modify = rtp/30/23 { Statistics{ nt/*, ; ALL NT statistics rtp/ps, ; RTP packets sent rtp/delay ; RTP packet delay } } } }</pre>	<pre>H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31205 { Context = 2005 { Modify = = rtp/30/23 ; NOTE } }</pre>
<p>In this example the assumption is that statistics were previously activated according to Table IV.2; i.e., "rtp/pl", "rtp/delay" and "nt/dur" are active. The above Modify request results in:</p> <ol style="list-style-type: none"> 1) keeping active of "nt/dur" and "rtp/delay"; 2) activation of " nt/or" and " nt/os"; 3) deactivation of "rtp/pl". <p>NOTE – The reply does not include the Statistics Descriptor, even though a wildcard statistic name appeared in the request. The same principle described in Note 2 of Table IV.2 is applied.</p>	

IV.3.1 Keeping a statistic active

For a statistic already active to remain so, it must appear in the Statistics Descriptor of any Modify or Move command (see clause 7.1.15: "... to maintain already set statistics, these shall be included in the new Statistics Descriptor and the statistic values shall not be reset"). Table IV.5 illustrates this behaviour with the "nt/dur" and "rtp/delay" statistics.

IV.3.2 Activating a statistic

A statistic appearing in the Statistics Descriptor of a Modify or Move command will be activated (or reactivated) if it was not active before that command. Upon activation, the value of such a

statistic is reset to its initial value (see clause 7.1.15: "... if the particular statistic is reactivated by a subsequent Statistics Descriptor, the value shall be reset"). Table IV.5 illustrates this behaviour with the "nt/or" and "nt/os" statistics.

IV.3.3 Deactivating a statistic

A statistic missing from the Statistics Descriptor of a Modify or Move command is deactivated and should no longer be collected by the termination. However, the value of this statistic is maintained and not reset (see clause 7.1.15: "Statistics that have been removed from a Statistics Descriptor shall maintain their values until the termination is subtracted"). The MGC may later read this value according to the procedures of clause IV.6. Table IV.5 illustrates this behaviour with the "rtp/pl" statistic.

NOTE – Statistics are also automatically deactivated when a termination is destroyed or returned to the NULL context through a Subtract command. In this scenario however, the value of the statistics is reset and not maintained. See clause IV.4.

IV.3.4 Use-case: activating all statistics of an existing termination

Including the wildcard "ALL/ALL" in the Statistics Descriptor of a Modify or Move command will result in all statistics being active after the command completes (see clause 7.1.15: "A MGC may reactivate all statistics on a termination/stream by issuing a Statistics Descriptor with a single statistic with the PackageID and StatisticID wildcarded with "ALL". To reactivate all statistics in a given package on a termination/stream, a Statistics Descriptor with a single statistic with the PackageID specified and the StatisticID wildcarded with "ALL" is issued."). Each statistic will either be kept-active or activated; depending on its state before the command was executed.

Table IV.6 shows an example of this procedure. The example assumes that this MODIFY command follows the MODIFY command appearing in Table IV.5.

Table IV.6 – Activate/keep active all statistics of an existing termination

<u>H.248 text encoding example</u>	<u>Result</u>
<pre> H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31209 { Context = 2005 { Modify = rtp/30/23 { Statistics{ */* ;ALL stats of ALL pkgs } } } } </pre>	<pre> H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31209 { Context = 2005 { Modify = rtp/30/23 } } </pre>
<p><u>All statistics are either activated or kept-active by a Statistics Descriptor including a statistic of "ALL/ALL".</u></p> <p><u>In this example, the assumption is that statistics were previously activated according to Table IV.5; i.e., "nt/dur", "nt/os", "nt/or" and "rtp/pl" are active. The Modify request results in:</u></p> <ol style="list-style-type: none"> <u>1) keeping active of "nt/dur", "nt/os", "nt/or" and "rtp/pl";</u> <u>2) activation of "rtp/ps", "rtp/pr", "rtp/jit", and "rtp/delay".</u> 	

IV.3.5 Use-case: deactivating all statistics of an existing termination

Including an empty Statistics Descriptor in an Add, Modify or Move command will result in no statistics being active following the command. Table IV.7 shows an example of this procedure.

Table IV.7 – Deactivate all statistics of an existing termination

<u>H.248 text encoding example</u>	<u>Result</u>
<u>H.248 request:</u> MEGACO/3 [11.9.19.65]:12345 Transaction = 31209 { Context = 2005 { Modify = rtp/30/23 { Statistics ; empty descriptor } } } }	<u>H.248 reply:</u> MEGACO/3 [2.3.19.70]:6789 Reply = 31209 { Context = 2005 { Modify = rtp/30/23 } } }
<p>The Statistics Descriptor is empty. Following this command, no statistics will be collected on the termination. However, the value of all statistics will be retained.</p> <p>NOTE – A reply to a subsequent Subtract command missing a Statistics Descriptor will not contain the termination's statistics. See clause IV.5.</p>	

IV.4 Resetting statistics

The value of a statistic can be reset to its initial value by first deactivating it and then reactivating it. Two commands are therefore required to perform this operation. The two commands may be grouped into one transaction to ensure their ordering and minimize the time interval where the statistic is kept inactive. However, this does not guarantee that this interval will be of zero length: i.e., some statistical data may be lost during the time the statistic is inactive. Table IV.8 provides an example use-case for resetting statistics.

Statistics are also reset when the termination is destroyed or returned to the NULL context by a Subtract command (see clause 7.1.15: "Statistics are reset when a termination ceases to exist or is returned to the NULL Context due to a Subtract Command.").

Table IV.8 – Reset RTP statistics

<u>H.248 text encoding example:</u>	<u>Result:</u>
<u>H.248 request:</u> MEGACO/3 [11.9.19.65]:12345 Transaction = 41225 { Context = 2005 { Modify = rtp/30/23 { ; 1st Command Statistics { nt/* ; ALL NT statistics } } Modify = rtp/30/23 { ; 2nd Command Statistics { rtp/* ; ALL RTP statistics } } } } }	<u>H.248 reply:</u> MEGACO/3 [2.3.19.70]:6789 Reply = 41225 { Context = 2005 { Modify = rtp/30/23, Modify = rtp/30/23 } } }

Table IV.8 – Reset RTP statistics

In this example, the assumption is that all statistics of the nt package are active before the command. The transaction request contains two Modify requests, each containing a Statistics Descriptor. The first command deactivates all statistics other than those of the nt package. The statistics of the nt package are kept active. The second command activates all the statistics of the rtp package. Note that, as the rtp package extends the nt package, this includes all statistics of the nt package. Therefore, the second command will keep the nt statistics active. Following the execution of the two commands, the statistics of the rtp package will be active and their value reset. The statistics of the nt package are kept active through both commands.

IV.5 Reporting statistics

Statistics are reported by the MG in the reply to a Subtract command, unless all statistics on the termination were previously deactivated (see clause 7.1.15: "By default, unless an empty Statistics Descriptor had earlier been used to indicate that no statistics are to be collected, termination and stream level statistics are reported when the termination ceases to exist or is returned to the NULL Context due to a Subtract command.").

An example is given by Table IV.9.

Table IV.9 – Default reporting of statistics

<u>H.248 text encoding example</u>	<u>Result</u>
<u>H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 37258 { Context = 2005 { Subtract = rtp/30/23 } }</u>	<u>H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 37258 { Context = 2005 { Subtract = rtp/30/23 { Statistics { nt/os=62345, ; octets sent nt/or=45123, ; octets received nt/dur=38000, ; in millisec rtp/ps=1245, ; packets sent rtp/pr=780, ; packets received rtp/pl=10, ; % packets lost rtp/jit=27, ; jitter rtp/delay=48, ; average latency } } } }</u>
<u>By default, statistics are reported in the reply to a Subtract command.</u>	

IV.5.1 Report suppression

The reporting of statistics may be explicitly suppressed by the MGC by including an empty Audit Descriptor in the Subtract command. This behaviour is independent of whether any statistics are currently active on the termination (see clause 7.1.15: "By default, This default behaviour can also be overridden by including an empty Audit Descriptor in the Subtract Command." and clause 7.1.12: "The Audit Descriptor may be empty, in which case, no descriptors are returned. This is useful in the Subtract Command to inhibit return of statistics, especially when using wildcard.").

Table IV.10 shows an example use case.

Table IV.10 – Explicit suppression of statistics reporting

H.248 text encoding example	Result
<pre>H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31225 { Context = 2005 { Subtract = rtp/30/23 { Audit{} ; empty audit descriptor } } }</pre>	<pre>H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31225 { Context = 2005 { Subtract = rtp/30/23 } }</pre>
<p>An empty Audit Descriptor in the Subtract request suppresses reporting of statistics.</p>	

IV.6 Reading statistics

The MGC may read the value of the statistics at any time, by including an appropriate Audit Descriptor within an AuditValue, Add, Modify, Move or Subtract command (see clause 7.1.15: "Statistics may also be returned from the AuditValue Command, or any Add/Move/Modify Command using the Audit Descriptor."). Table IV.11 shows an example use case.

NOTE 1 – Unless the reading of the statistics coincides with a need to change some of the termination's states, the use of the AuditValue command is most appropriate.

NOTE 2 – Reading statistics in an Add command, while syntactically correct, has little practical value.

Table IV.11 – Explicit reading of statistics

H.248 text encoding example	Result
<pre>H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 31225 { Context = 2005 { AuditValue = rtp/30/23 { Audit{} ; Audit Descriptor with Statistics ; Statistics Token } } }</pre>	<pre>H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 31225 { Context = 2005 { AuditValue = rtp/30/23 { Statistics{ nt/os=62345, ; octets sent nt/or=45123, ; octets received nt/dur=38000, ; in millisec rtp/ps=1245, ; packets sent rtp/pr=780, ; packets received rtp/pl=10, ; % packets lost rtp/jit=27, ; jitter rtp/delay=48, ; average latency } } } }</pre>
<p>An Audit Descriptor containing the Statistics Token in a command request triggers the reporting of statistics.</p>	

IV.6.1 Read and activate/deactivate statistics

It is possible to use a single Add, Modify or Move command to both read the value of statistics and change the set of statistics that are collected. Such a command will include both an Audit Descriptor, as described under clause IV.6, and a Statistics Descriptor, as described under clause IV.3.

The MG should perform the two operations (i.e., the statistics' reading and activation/deactivation) according to the order in which the descriptors appear within the command (see clause 7.2:

"Descriptors may appear as parameters to commands in any order. The descriptors shall be processed in the order in which they appear"). Note that this ordering is meaningful only when a statistic is activated (as activating a statistic resets its value while deactivating it does not).

Table IV.12 provides an example use case with a Modify command.

NOTE – Unless the need to read and reset and change the statistics coincides with a need to move the termination between contexts, the use of a Modify command is most appropriate.

Table IV.12 – Read and deactivate statistics

H.248 text encoding example	Result
<pre> H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 47397 { Context = 2005 { Modify = rtp/30/23 { Audit{ ; 1) Audit Descript. Statistics ; with Statistics }, ; Token for 'read' Statistics; 2) empty Statist. ; Descriptor } } } </pre>	<pre> H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 47397 { Context = 2005 { Modify = rtp/30/23 { Statistics{ nt/os=62345, ; octets sent nt/or=45123, ; octets received nt/dur=38000, ; in millisec rtp/ps=1245, ; packets sent rtp/pr=780, ; packets received rtp/pl=10, ; % packets lost rtp/jit=27, ; jitter rtp/delay=48, ; average latency } } } } </pre>
<p>The Modify request contains an ordered list: first an Audit Descriptor containing a Statistics token; and second an empty Statistics Descriptor. The Audit Descriptor initiates the reading of all statistics, the subsequent Statistics Descriptor deactivates the collection of all statistics.</p> <p>NOTE – As detailed under clause IV.3.3, the statistics are not reset when deactivated. A subsequent reading of the statistics will return identical values to the ones given above.</p>	

IV.6.2 Use-case: reading and resetting all statistics of a termination

The MGC can combine the procedures of clauses IV.6.1 and IV.4 in order to:

- 1) Read all statistics collected on a termination.
- 2) Instruct the MG to reset all statistics to their default value.
- 3) Instruct the MG to keep collecting all statistics.

This is done by issuing a Move or Modify command that reads the values of all statistics and deactivates them, as described under clause IV.6.1; followed by a Modify command that activates all statistics, as described under clause IV.3.4. As explained under clause IV.4, the two commands should be grouped into a single transaction in order to ensure their ordering and to minimize the interval during which the statistics are kept inactive. However, no guarantee is given that this interval will be of zero length.

Table IV.13 provides an example of this procedure.

Table IV.13 – Read and reset statistics

H.248 text encoding example	Result
<pre> H.248 request: MEGACO/3 [11.9.19.65]:12345 Transaction = 58932 { Context = 2005 { Modify = rtp/30/23 { Audit{ ; 1) Audit Descriptor Statistics ; with Statistics }, ; Token Statistics ; 2) Empty Statistics ; Descriptor }, Modify = rtp/30/23 { Statistics { ** ;ALL stats of ALL pkgs } } } } </pre>	<pre> H.248 reply: MEGACO/3 [2.3.19.70]:6789 Reply = 58932 { Context = 2005 { Modify = rtp/30/23 { Statistics{ nt/os=62345, ; octets sent nt/or=45123, ; octets received nt/dur=38000, ; duration rtp/ps=1245, ; packets sent rtp/pr=780, ; packets received rtp/pl=10, ; % packets lost rtp/jit=27, ; jitter rtp/delay=48 ; average latency } }, Modify = rtp/30/23 } } } </pre>
<p>The first Modify request contains an ordered list: first an Audit Descriptor containing a Statistics token; and second an empty Statistics Descriptor. The Audit Descriptor initiates the reading of all statistics, the subsequent Statistics Descriptor deactivates the collection of all statistics.</p> <p>The second Modify request contains a Statistics descriptor with an "ALL/ALL" statistic. This command resets and reactivates all statistics.</p>	

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