International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

H.248.98

(02/2016)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication procedures

Gateway control protocol: Support of remote media pause and resume

Recommendation ITU-T H.248.98

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Recommendation ITU-T H.248.98

Gateway control protocol: Support of remote media pause and resume

Summary

Recommendation ITU-T H.248.98 allows the real-time transport protocol (RTP) stream pause and resume functionality as defined by IETF RFC 7728 to be supported on ITU-T H.248 controlled gateways.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.248.98	2016-02-29	16	11.1002/1000/12640

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Gateway control protocol: Support of remote media pause and resume

1 Scope

This Recommendation describes the support of real-time transport protocol (RTP) stream pause and resume functionality as defined by [IETF RFC 7728] on ITU-T H.248 controlled gateways. It describes the mapping of call control session description protocol (SDP) related to pause/resume to ITU-T H.248 SDP and vice versa. It also contains a package that allows several different implementation types to be supported. This allows the media gateway (MG) to operate in an autonomous manner by receiving, making pause/resume decisions and sending real-time control protocol (RTCP) level pause/resume messages with minimal media gateway controller (MGC) involvement. An MGC controlled configuration is also supported whereby the reception of pause/request requests/responses is indicated to the MGC for it to make decisions and determine a response. It also allows the MGC to initiate pause/resume requests.

The use of pause codec control messages (CCMs) as defined by [IETF RFC 7728] and temporary maximum media stream bit rate requests (TMMBR) as defined by [IETF RFC 5104] to pause and resume RTP media streams are both supported.

It also contains considerations related to the support of RTP stream pause and resume in ITU-T H.248 controlled gateways.

This Recommendation also details the relationship to other existing ITU-T H.248.x sub-series Recommendations where pause/resume functions are supported.

2 References

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

[ITU-T H.248.1] Recommendation ITU-T H.248.1 (2013), *Gateway control protocol: Version 3*.

[ITU-T H.248.9] Recommendation ITU-T H.248.1 (2009), *Gateway control protocol: Advanced media server packages*.

[ITU-T H.248.71] Recommendation ITU-T H.248.71 (2010), *Gateway control protocol: RTCP support packages*.

[ITU-T H.248.88] Recommendation ITU-T H.248.88 (2014), *Gateway control protocol: RTP topology dependent RTCP handling by ITU-T H.248 media gateways with IP terminations*.

[IETF RFC 3550] IETF RFC 3550 (2003), *RTP: A Transport Protocol for Real-Time Applications*.

[IETF RFC 5104] IETF RFC 5104 (2008), *Codec Control Messages in the RTP Audio-Visual Profile with Feedback (AVPF)*.

[IETF RFC 5576] IETF RFC 5576 (2009), *Source-Specific Media Attributes in the Session Description Protocol (SDP)*.

[IETF RFC 7728] IETF RFC 7728 (2015), *RTP Stream Pause and Resume*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 RTP stream [b-IETF RFC 7656]: A *stream* of RTP packets containing *media data*, *source* or *redundant*. The *RTP stream* is identified by an SSRC belonging to a particular *RTP session*.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 P/R-signalling: The "RTP pause and resume" signalling as defined by [IETF RFC 7728].

NOTE – The signalling protocol syntax is based on dedicated RTCP "feedback" packet types, the signalling protocol procedures use the associated bidirectional RTCP control flow and the signalling protocol semantics are that defined in sections 6 to 9 in [IETF RFC 7728].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AVPF Audio-Visual Profile with Feedback

B2BRE Back-to-Back RTP End System

CCM Codec Control Message

CNAME Canonical NAME

DTMF Dual Tone Multi Frequency

FB Feedback

IWF Interworking Function

MG Media Gateway

MGC Media Gateway Controller

P/R Pause and Resume

RTCP Real-Time Control Protocol

RTCP FB RTCP Feedback

RTP Real-time Transport Protocol

SDES Source Description

SDP Session Description Protocol

SSRC Synchronization Source Identifier

TMMBN Temporary Maximum Media stream Bit rate Notification

TMMBR Temporary Maximum Media stream Bit rate Request

5 Conventions

Elements of the ITU-T H.248 protocol model, e.g., Context, Termination, Stream, Event are represented using the first letter capitalized. Property, Event, Signal and Parameter identities are given in *italics*.

The suffix ".req" added to an ITU-T H.248 command name stands for a command request, while the suffix ".rep" stands for a command reply. For example, "Notify.req" represents a Notify Request.

Capitalized names PAUSE, RESUME, REFUSED, PAUSED refer abstractly to Codec Control Messages (CCM) defined in [IETF RFC 7728] or to the CCMs temporary maximum media stream bit rate request (TMMBR) and temporary maximum media stream bit rate notification (TMMBN) [IETF RFC 5104] when these are used to emulate specific pause/resume behaviour.

6 Relationship to other Recommendations in the ITU-T H.248 sub-series

Gateways utilising ITU-T H.248 currently have several methods to pause the transmission of media.

[ITU-T H.248.1]: Contains the Local Control Descriptor 'StreamMode' property that allows the MGC to effectively stop sending an RTP media flow (i.e., change from send/receive to receive only) while still maintaining an RTCP control flow. To resume the flow of media the MGC can change the StreamMode back to send/receive. However, this is a local MG action rather than a request to a remote endpoint. The action is also triggered from a call control level stimulus.

[ITU-T H.248.1]: The ITU-T H.248 connection model (including the TopologyDescriptor) allows Terminations/Streams to be isolated from other Terminations/Streams in the Context. This allows an MGC to isolate an ITU-T H.248 media stream from other input streams effectively stopping the flow of RTP media. The MGC may then move the Termination/Stream back into a Context to resume RTP media flow.

[ITU-T H.248.9]: Contains the "Play collect" package that enables a user to request (via a dual tone multi frequency (DTMF) digit) that the playout of media associated with a signal be paused. It also enables the user to resume the RTP media flow via a DTMF digit.

[b-ITU-T H.248.66]: Contains the "Signal pause" package which is a generic package that allows the MGC to request a pause in the playout of media and to later resume the RTP media flow. It is suited to scenarios where media playout has been initiated through the use of ITU-T H.248 Signals rather than real-time media flows. It again is a local MG action rather than a request to a remote endpoint and the action is also triggered from a call control level stimulus.

[ITU-T H.248.71]: Contains the "RTCP source description" package which allows the MGC to request the MG to monitor, extract and report synchronization source identifier (SSRC) values from RTP streams. Clause 8 describes how the package may be used together with RTP stream pause and resume services.

[ITU-T H.248.88]: Describes RTCP handling by an ITU-T H.248 MG in association with a particular enforced local RTP topology. Clause 8 provides more detailed information on the subject. None of the above methods match the functionality supported by [IETF RFC 7728]. [ITU-T H.248.1] and [b-ITU-T H.248.66] do not support user-originated requests being terminated at the MG and [ITU-T H.248.9] and [b-ITU-T H.248.66] do not allow the pause of ITU-T H.248 media streams not related to the playout of signals.

Pause/resume relates to real-time media flows (as subject of conversational communication services). Therefore, the resumption of an RTP media flow is based on the media at the time of the resume request rather than at the pause point. [b-ITU-T H.248.66] (typically applied in the context of streaming communication services) assumes that the playout occurs from the pause point unless another point is indicated in the resumption request.

7 Design considerations

Section 3 of [IETF RFC 7728] describes the main use cases for RTP stream pause and resume. It lists a number of RTP topologies. An ITU-T H.248 media gateway may act as a media sender, media receiver, mixer and/or other RTP topologies with involvement in pause and resume (P/R) signalling.

Appendix I provides a list of example use cases from the perspective of ITU-T H.248 gateways. As such the design criteria listed in section 4 of [IETF RFC 7728] should be considered when implementing RTP stream pause and resume on gateways.

Section 5 of [IETF RFC 7728] describes the remote pause and resume procedures through the use of pause and resume CCMs. In general, these procedures also apply to TMMBR/TMMBN messages. Section 5.6 of [IETF RFC 7728] contains considerations which also apply to this Recommendation. Procedures specific to TMMBR/TMMBN messaging will be specified.

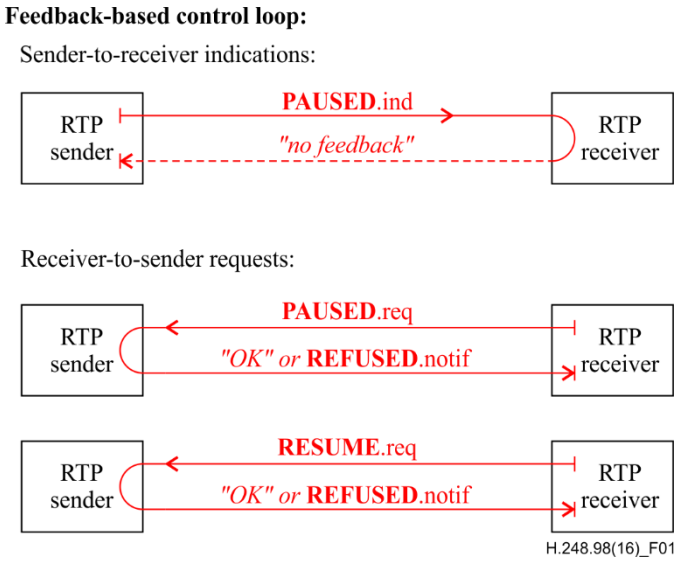
7.1 Real-time nature

Given the real-time aspects described in section 4.1 of [IETF RFC 7728] a gateway should ensure prompt handling of resume requests, i.e., an MG and optionally MGC should process and act upon any requests to resume an RTP stream in an expedited manner.

Pause requests are time-dependent; however, handling is not as stringent as resume requests.

7.2 Message direction

A gateway may: initiate a local pause or resume of an RTP stream, request a remote RTP sender to pause or resume an RTP stream, and respond to a request from a remote RTP receiver to pause or resume an RTP stream (see Figure 1).



NOTE – The "P/R-signalling" path is highlighted in red.

Figure 1 – RTP stream pause and resume as feedback-based control loop

Clause 9 provides functionality for an MG to act autonomously or for it to coordinate with the MGC to implement RTP stream pause and resume. Furthermore, it allows the specification of which pause CCM messages are used.

NOTE – There are configuration options in order to support partial implementations, see clause 9.6.1.1.

7.3 Apply to individual sources

Section 4.3 of [IETF RFC 7728] indicates that the pause CCM messages relate to a single RTP stream, i.e., relates to a single SSRC. This usually relates to a single ITU-T H.248 Stream. An RTP session may have multiple RTP streams. A single SDP m=line typically describes an RTP session. However, where media multiplexing is used (e.g., as described by [b-IETF BUNDLE]) multiple SDP m=lines can describe an RTP session. Thus an ITU-T H.248 Stream using a SDP "m=" line may describe one or more RTP streams. [IETF RFC 5576] provides attributes for source specific parameters.

This has implications for signals and events related to pause and resume on ITU-T H.248 Streams. In order for any signals and events to be correctly scoped where a single SDP m=line describes multiple sources the signal or event must be able to reference the source. Clause 9 allows the SSRC to be associated with pause and resume related signals and events. The MGC shall include the *ssrc* parameter in *rempr* package signals when there are multiple SSRCs in an ITU-T H.248 Stream to uniquely identify the RTP stream instance.

Alternatively, the MGC may consider alternate means (such as through ITU-T H.248 Stream grouping [b-ITU-T H.248.96]) to ensure that there is a single RTP stream per ITU-T H.248 Stream.

7.4 Consensus

Section 4.4 of [IETF RFC 7728] indicates that there must be consensus between RTP receivers before an RTP sender can pause an RTP stream. This requires that all RTP receivers be aware of the current RTP stream state (i.e., paused or playing, see section 6 of [IETF RFC 7728]) and that all receivers be aware of the pause request. Relevant example network use cases with ITU-T H.248 MGs are indicated in clause I.4. As described in section 5.3 of [IETF RFC 7728], the RTP sender should delay the pausing of a stream for a wait period. As the gateway acts as an RTP sender it should ensure that pausing meets these requirements. If MG autonomous response is indicated, the MG shall be responsible for maintaining the wait period. If MGC controlled mode is indicated, the MGC shall be responsible for maintaining the wait period.

If a new RTP receiver that supports pause messages is added while an RTP stream is in the paused state, the gateway shall send it a PAUSED indication as per section 5.4 of [IETF RFC 7728]. The MG is responsible for sending the PAUSED indication. In the case of MGC controlled mode the MG shall only send a PAUSED indication if the MGC had previously sent a "Local Pause" (*rempr/lpause*) Signal for the particular RTP stream.

7.5 Message acknowledgements

As described in section 4.5 of [IETF RFC 7728] the RTP and RTCP do not guarantee reliable data transmission, meaning that the PAUSE, RESUME, PAUSED and REFUSED messages may be lost. ITU-T H.248 MGCs and MGs should ensure that they follow the procedures in [IETF RFC 7728] with respect to sending PAUSED and REFUSED messages and detecting paused and resumed states. Clause 9 provides events for detecting when an RTP media stream has been paused or resumed to allow coordination between the MGC and MG.

7.6 Retransmitting requests

As per section 4.6 of [IETF RFC 7728], PAUSE and RESUME requests sent from an ITU-T H.248 gateway (as RTP receiver) to an RTP stream sender may result in no response (either the receipt of a PAUSED or REFUSED, or media action (pause/resume)) being detected from the sender. The gateway may assume that the PAUSE or RESUME message was lost and thus may need to retransmit the message. Depending on the configuration, the MGC or MG is responsible for the retransmission once the timeout period is met. If MG autonomous response is indicated, the MG shall be responsible for retransmitting the messages. If MGC controlled mode is indicated, the MGC shall be responsible for retransmitting the message (i.e., by sending a new signal to the MG indicating pause or resume).

7.7 Sequence numbering

Section 4.7 of [IETF RFC 7728] indicates that PAUSE request messages have a sequence number associated with them. This sequence number is then referenced by the other pause CCM messages. As the pause identity is updated for each PAUSE request, the gateway needs to manage the pause identities (i.e., parameter pauseID in the Feedback Control Information field). If MG autonomous mode is indicated, then the MG shall be responsible for assigning the identities. If MGC controlled mode is indicated, then the MGC shall be responsible for assigning the identities.

8 RTP topology dependent RTCP handling

8.1 Introduction

The ITU-T H.248 Stream endpoint(s) or/and Context involved in RTP stream pause and resume services may be requested to support additional RTP/RTCP related services, leading to potential interactions which should be considered by ITU-T H.248 profile designers. A brief summary of the problem statement may be found in clause 6 of [ITU-T H.248.88]. There are three basic aspects:

1. correct handling of RTCP feedback (FB) "pause/resume" messages, dependent on the end-to-end use case of RTP stream pause and resume (see Appendix I) and dependent on the MG-internally enforced RTP topology (see clause 8.2);

2. correct handling of compound RTCP packets (see clause 8.3); and

3. correct handling of SSRC values due to their usage as P/R-signalling endpoint identifiers as well as their occurrence at "multiple places" in SDP and ITU-T H.248 signalling elements (see clause 8.4).

[IETF RFC 7728] indicates that the use of TMMBR/TMMBN only applies to a point-to-point topology. Therefore, the use of other topologies requires the use of pause CCM messages for remote pause and resume.

8.2 Interactions with ITU-T H.248.88

[IETF RFC 7728] defines a service, with RTCP-based signalling along the IP media path, which belongs to the following [ITU-T H.248.88] category:

– *RTP profile dependent RTCP service* (clause 8.3.2 of [ITU-T H.248.88]) because it is required to use RTP profiles *RTP/AVPF* or *RTP/SAVPF*;

– handling of RTCP FB "pause/resume" messages is dependent on the network use case:

  o local P/R-signalling endpoint: requires the local *origination* and *termination* of such RTCP FB messages (i.e., support of function F-6 in clause 7.6 of [ITU-T H.248.88]);

  o transparent forwarding of P/R-signalling (e.g., use case #4 in Appendix I): requires the *unmodified forwarding* of such RTCP FB messages (i.e., support of function F-4 in clause 7.6 of [ITU-T H.248.88]); and

– such required RTCP handling behaviour should be consistent when RTP topologies "point-to-point" (i.e., back-to-back RTP end system (B2BRE)), "transport translator" or "mixer" is be enabled (i.e., a property setting of *rtpt/rtptopo* equal to 'PP', 'TR' or 'MX').

How does the MG know how RTCP FB "pause/resume" messages need to be processed, i.e., *transparent forwarding* or *origination/termination* mode? Typically, the solution would be:

– the ITU-T H.248 *rempr* package would be part of the operated ITU-T H.248 profile;

– the usage of *rempr* package elements (in an ITU-T H.248 command request) implies the *origination/termination* mode; and

– the omission of *rempr* package elements implies the *transparent forwarding* mode (i.e., the MG is not allowed to block such RTCP FB messages).

8.3 Interactions with compound and reduced-size RTCP packets

P/R-signalling could use *reduced-size* RTCP packets, which facilitates their processing by MGs because there are no interactions.

However, *compound* RTCP packets may require enhanced processing because the compound RTCP packet might contain multiple RTCP packet types with different destination RTP endpoints. For

instance, an RTCP extended report (XR) packet or RTCP FB explicit congestion notification (ECN) packet might be destined for a next RTP node in the forwarding path, whereas the RTCP FB "pause/resume" packet needs to be terminated locally. Hence, the MG might be required to *rewrite* a (compound) RTCP packet (i.e., support of function F-5 in clause 7.6 of [ITU-T H.248.88]).

8.4 Gathering SSRC values, relevant for P/R-signalling, from the IP media path

8.4.1 Active call interactions with ITU-T H.248.71

The *RTCP source description* package according to clause 6 of [ITU-T H.248.71] allows the observation and extraction of SSRC values from remote and local RTP endpoints. The ITU-T H.248.71 *rtcpsdes* package is typically applied for network-wide performance monitoring services for RTP traffic, which use RTCP XR packets for transporting measurement data (see [b-ITU-T H.248.48] and [b-ITU-T H.248.87]). There are two basic ITU-T H.248 profile types:

1. ITU-T H.248 profile with RTP stream pause and resume service support, but without any additional RTCP XR-based services; or

2. ITU-T H.248 profile with support of both RTCP-based services.

The ITU-T H.248.71 *rtcpsdes* package could be applied together with the *rempr* package in case 1, but it is not required for the P/R-signalling service. SSRC information would be extracted directly via ITU-T H.248 Events (of the *rempr* package) from RTCP FB pause/resume messages.

With respect to case 2, where both packages are in use, the procedure to follow is that of case 1 during the active call phase.

8.4.2 Pre-call usage of ITU-T H.248.71

The MGC might already need to know the local SSRC value (e.g., for call control signalling purposes) of the RTP endpoint in the MG, participating in RTP stream pause and resume service, *before* any RTP and RTCP packets are transmitted. Hence, the ITU-T H.248 Events (of the *rempr* package) would not work. The solution to such a requirement could be addressed by the ITU-T H.248.71 *rtcpsdes* package (see clause 6.6.1 of [ITU-T H.248.71]).

8.4.3 RTP topology "RTP source translator" (ITU-T H.248.88)

An ITU-T H.248 Context enabled both for 1) transparent forwarding of P/R-signalling and 2) an RTP source translator topology (see clause 11.1 of [ITU-T H.248.88] needs careful consideration because the RTP source translator may modify the SSRC field which is used for *RTP sender*/*RTP receiver* identification in P/R-signalling. Typically, such an interaction is conditionally dependent on the used RTCP packet structure (see clause 8.3).

9 Remote pause and resume package

Package name: Remote Pause and Resume

Package ID: rempr (0x0123)

Description: This package allows an MGC to request that the MG issue a request to a remote endpoint to pause (and subsequently resume) the transmission of an RTP media stream. These pause and resume requests typically apply to conversional media services.

The ITU-T H.248 media stream and RTP media flow are supposed to be used in a bidirectional manner. Hence there are two RTP streams, one in an incoming and one in an outgoing direction. This package makes the assumption that the MG may provide P/R-signalling for both unidirectional RTP streams. P/R-signalling procedures in both directions are disjoint. The package description makes the assumption

that the MG could provide the *RTP receiver* and/or the *RTP sender* function in parallel on a particular ITU-T H.248 stream endpoint (SEP) enabled for support of this package.

This package supports both pause CCM and TMMBR/TMMBN CCM messages although only one method may be used on a particular stream. There are two slightly different *RTP stream pause state models* at *RTP sender* and *RTP receiver* side, see also Appendix II.

Version: 1

Extends: None

9.1 Properties

9.1.1 Autonomous response

Property name: Autonomous Response

Property ID: ar (0x0001)

Description: This property indicates whether the MG shall provide an autonomous response to PAUSE and RESUME requests or whether it should notify the MGC and await confirmation from the MGC on what action to take.

Type: Boolean

Possible values: On MG autonomous: The MG responds autonomously

Off MGC controlled: The MG notifies the MGC and awaits a response

Default: On (unless provisioned otherwise)

Defined in: LocalControl or TerminationState

Characteristics: Read/Write

9.1.2 Autonomous request

Property name: Autonomous Request

Property ID: aq (0x0002)

Description: This property indicates whether the MG is allowed to autonomously send remote pause and resume requests. The MGC is allowed to request the MG to send remote pause and resume requests at any time.

Type: Boolean

Possible values: On MG autonomous: The MG is allowed to autonomously send

Off MGC controlled: The MG is only allowed to messages requested by the MGC.

Default: On (unless provisioned otherwise)

Defined in: LocalControl or TerminationState

Characteristics: Read/Write

9.2 Events

9.2.1 RTP Pause State

Event name: RTP Pause State

Event ID: rtpps (0x0001)

Description: This event allows the MG to indicate when the state associated with an RTP stream pause and resume changes. It is applicable to an ITU-T H.248 Stream endpoint that realizes the *RTP sender* function.

9.2.1.1 EventsDescriptor parameters

9.2.1.1.1 State

Parameter name: State

Parameter ID: state (0x0001)

Description: This parameter indicates which pause state the MGC wishes to be notified about. Based on the *RTP pause state model* according to section 6 of [IETF RFC 7728] (see also clause II.2).

Type: Sub-list of Enumeration

Optional: Yes

Possible values:

paused	The MG has paused RTP media flow as a result of the receipt of a PAUSE request from a remote RTP endpoint.
resumed	The MG has resumed RTP media flow as a result of the receipt of a RESUME request from a remote RTP endpoint.
localPause	The MG has paused RTP media flow based on a local decision.
localResume	The MG has resumed RTP media flow based on a local decision.

Default: All (paused, resumed, localPause, localResume)

9.2.1.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates on which SSRCs of the ITU-T H.248 Stream the event is detected.

Type: Sub-list of Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: The event is detected against all SSRCs that support pause/resume on the ITU-T H.248 Stream.

9.2.1.2 ObservedEventsDescriptor parameters

9.2.1.2.1 Observed state

Parameter name: Observed State

Parameter ID: obstate (0x0001)

Description: This parameter indicates the detected pause state. It is reported whenever there is a transition between the states.

Type: Enumeration

Optional: No

Possible values: As per "states" clause 9.2.1.1.1

Default: None

9.2.1.2.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates on which SSRC of the ITU-T H.248 Stream the event has been detected.

Type: Integer (32 bit)

Optional: No

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.2.2 Detect Pause/Resume Request

Event name: Detect Pause/Resume Request

Event ID: dprreq (0x0002)

Description: This event allows the MG to indicate when a PAUSE or RESUME request has been detected. Thus, the ITU-T H.248 Stream endpoint realizes the *RTP sender* function.

9.2.2.1 EventsDescriptor parameters

9.2.2.1.1 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0001)

Description: This parameter indicates on which SSRCs of the ITU-T H.248 Stream the event is detected.

Type: Sub-list of Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: The event is detected against all SSRCs that support pause/resume on the ITU-T H.248 Stream.

9.2.2.2 ObservedEventsDescriptor parameters

9.2.2.2.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID contained in the detected request.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.2.2.2.2 Request Type

Parameter name: Request Type

Parameter ID: reqt (0x0002)

Description: This parameter indicates whether a PAUSE or a RESUME is requested for the RTP stream.

Type: Enumeration

Optional: No

Possible values: "PAUSE" A PAUSE has been requested.

"RESUME" A RESUME has been requested.

Default: None

9.2.2.2.3 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0003)

Description: This parameter indicates on which SSRC of the ITU-T H.248 Stream the event has been detected.

Type: Integer (32 bit)

Optional: No

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.2.3 Detect pause and resume result

Event name: Detect Pause and Resume Result

Event ID: dprres (0x0003)

Description: This event allows the MG to detect and indicate whether the remote RTP sender has: sent a PAUSED indication, a REFUSE indication or resumed RTP transmission in response to a request initiated by the

MGC. It also detects a failure of the RTP sender to take action on a PAUSE or RESUME request.

Thus, the ITU-T H.248 Stream endpoint realizes the *RTP receiver* function.

9.2.3.1 EventsDescriptor parameters

9.2.3.1.1 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0001)

Description: This parameter indicates on which SSRCs of the ITU-T H.248 Stream the event is detected.

Type: Sub-list of Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: The event is detected against all SSRCs that support pause/resume on the ITU-T H.248 Stream.

9.2.3.2 ObservedEventsDescriptor parameters

9.2.3.2.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID contained in the detected PAUSED or REFUSED indication. It may also contain the pauseID related to a failed PAUSE or RESUME request.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.2.3.2.2 Response type

Parameter name: Response Type

Parameter ID: rest (0x0002)

Description: This parameter indicates whether a PAUSED or a REFUSED indication has been received. It also indicates whether a RESUME request as resulted in the flow of RTP packets from the RTP sender.

Type: Enumeration

Optional: No

Possible values: "paused" A PAUSED indication has been received.

"refused" A REFUSED indication has been received.

"resumed" The MG has detected a resumed RTP flow.

"failed" No response from the RTP sender has been detected

Default: None

9.2.2.2.3 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0003)

Description: This parameter indicates on which SSRC of the ITU-T H.248 Stream the event has been detected.

Type: Integer (32 bit)

Optional: No

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.3 Signals

9.3.1 Local Pause

Signal name: Local Pause

Signal ID: lpause (0x0001)

Description: This signal indicates that the MG shall pause the RTP stream and send a PAUSED indication to the remote RTP receiver(s). Thus, the ITU-T H.248 Stream endpoint realizes the *RTP sender* function.

Signal Type: Brief

Duration: None

9.3.1.1 Additional parameters

9.3.1.1.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID of the PAUSE to which the PAUSED indication relates.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.3.1.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates to which SSRC the PAUSE relates.

Type: Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.3.2 Local Resume

Signal name: Local Resume

Signal ID: lresume (0x0002)

Description: This signal indicates that the MG shall resume transmission of the RTP stream. Thus, the ITU-T H.248 Stream endpoint realizes the *RTP sender* function.

Signal Type: Brief

Duration: None

9.3.2.1 Additional parameters

9.3.2.1.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID indicating the PAUSE to which the RESUME relates.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.3.2.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates to which SSRC the RESUME relates.

Type: Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.3.3 Refuse

Signal name: Refuse

Signal ID: refuse (0x0003)

Description: This signal indicates that the MG shall not change the state of the RTP stream. If the MG had received a remote request to change the state, it should send a REFUSED indication to the remote end. Thus, the ITU-T H.248 Stream endpoint realizes the *RTP sender* function.

Signal Type: Brief

Duration: None

9.3.3.1 Additional parameters

9.3.3.1.1 Pause Identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID indicating the PAUSE to which the REFUSED relates.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.3.3.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates to which SSRC the REFUSED relates.

Type: Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.3.4 Remote Pause

Signal name: Remote Pause

Signal ID: rpause (0x0004)

Description: This signal indicates that the MG shall send a PAUSE request to the remote RTP sender. Thus, the ITU-T H.248 Stream endpoint realizes the *RTP receiver* function.

Signal Type: Brief

Duration: None

9.3.4.1 Additional parameters

9.3.4.1.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID contained in the PAUSE request.

Type: Integer

Optional: Yes

Possible values: 0 – 65535

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Default: None

9.3.4.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates to which SSRC the PAUSE relates.

Type: Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.3.5 Remote Resume

Signal name: Remote Resume

Signal ID: rresume (0x0005)

Description: This signal indicates that the MG shall send a RESUME request to the remote RTP sender. Thus, the ITU-T H.248 Stream endpoint realizes the *RTP receiver* function.

Signal Type: Brief

Duration: None

9.3.5.1 Additional parameters

9.3.5.1.1 Pause identity

Parameter name: Pause Identity

Parameter ID: pauseID (0x0001)

Description: This parameter indicates the pauseID contained in the RESUME request.

Type: Integer

Optional: Yes

NOTE – The pauseID shall be present if pause/resume CCM messages are used. If TMMBR/TMMBN messages are used it shall not be present.

Possible values: 0 – 65535

Default: None

9.3.5.1.2 RTP SSRC

Parameter name: ssrc

Parameter ID: ssrc (0x0002)

Description: This parameter indicates to which SSRC the RESUME relates.

Type: Integer (32 bit)

Optional: Yes

Possible values: As per section 3 of [IETF RFC 3550].

Default: None

9.4 Statistics

9.4.1 Local pause duration

Statistic Name: Local Pause duration

Statistic ID: lpdur (0x0001)

Description: This statistic indicates the total time that the stream has remained in local paused state (see Figure II.1.), i.e., not sending RTP media to a remote RTP receiver. This correlates to the period between sending a PAUSED indication to the sending of RTP media. The statistic is the sum of all such periods for the life of the stream.

Type: Unsigned Integer

Possible Values: Any in milliseconds.

Level: Stream

9.4.2 Remote pause duration

Statistic Name: Remote Local Pause duration

Statistic ID: rpdur (0x0002)

Description: This statistic indicates the total time that the stream has remained in remote paused state (see Figure II.2.), i.e., not receiving RTP media from a remote RTP sender. This correlates to the period between receiving a PAUSED indication to the detection of RTP media reception. The statistic is the sum of all such periods for the life of the stream.

Type: Unsigned Integer

Possible Values: Any in milliseconds.

Level: Stream

9.5 Error codes

None.

9.6 Procedures

This package allows the gateway to act in the following main modes:

1. MG autonomous handling of pause and resume requests from a remote *RTP receiver* where the MGC is notified of RTP stream state change. The MG acts in the *RTP sender* role.

2. MGC controlled handling of pause and resume requests from a remote *RTP receiver* where the MGC is notified of pause and resume messages from a remote RTP receiver and provides a response to the MG regarding the action to take. The MG acts in the *RTP sender* role.

3. MGC initiated pause/resume requests towards a remote RTP sender where the MGC receives the pause and resume request results from MG. The MG acts in the *RTP receiver* role.

4. MGC initiated local pause/resume where the MGC receives the local pause and local resume request results from MG. The MG acts in the *RTP sender* role.

5. MG initiated autonomous sending of pause and resume requests towards a remote RTP sender where the MGC is notified of the result. The MG acts in the *RTP receiver* role.

In addition, an MG acting as an RTP sender can autonomously pause and resume a stream. This package allows an MG to notify the MGC when such autonomous pause or resume actions take place.

The procedures for these modes are described in clauses 9.6.3 to 9.6.8. Clauses 9.6.1 and 9.6.2 provide general procedures for these modes.

9.6.1 General – SDP parameter setting

On ITU-T H.248 Streams where RTP stream pause and resume is supported, for these modes of operation the MGC shall set SDP media descriptions in the Local and/or Remote Descriptors indicating the support of "pause" CCM [IETF RFC 5104] as per section 9 of [IETF RFC 7728] or the support of "TMMBR/TMMBN" CCMs. This allows the MGC to indicate to the MG the support of MG initiated local pause and resume (as *RTP sender* and *RTP receiver*) without the need for ITU-T H.248 Signals and Events.

The inclusion of "**a=rtcp-fb:* ccm tmmbr**" and the absence of "**a=rtcp-fb:* ccm pause**" would indicate that TMMBR/TMMBN CCM signalling is used. The inclusion of "**a=rtcp-fb:* ccm pause**" irrespective of whether "**a=rtcp-fb:* ccm tmmbr**" is included would result in pause/resume CCMs being used.

9.6.1.1 Pause CCM

The SDP for "pause" allows a "config" parameter to be set against an m-line which indicates which pause/resume CCM messages it supports. This description is based on the m-line describing a bidirectional bearer, however the Local and Remote Descriptor describes a unidirectional bearer. Rather than mapping the "config" value to a separate value for the Local and Remote Descriptor the same value shall be set on both these Descriptors.

9.6.1.2 TMMBR CCM

See section 5.6 of [IETF RFC 7728] for TMMBR/TMMBN considerations and the mapping between TMMBR/TMMBN CMMs to Pause CMMs. The remainder of clause 9 discusses the procedures in terms of pause CMMs.

The TMMBR SDP does not support the sending of configurations indicating which messages are supported. The inclusion of TMMBR in an SDP Offer and SDP Answer implies that the offerer and answerer can receive TMMBR/TMMBN messages and act upon them, however it does not mean that they can send messages. Therefore, for the purposes of this package it is assumed that when using TMMBR/TMMBN configuration "1" applies except that the sending of a REFUSED in response to a PAUSE is not supported (see section 5.3 of [IETF RFC 7728). As per clause 9.6.1.1 identical TMMBR SDP shall be set on the both the Local and Remote Descriptors.

9.6.2 General – event and signal scope

Given that pause and resume relate to a single RTP stream, signals and vvents should be set in such a way that the affected RTP streams are unambiguously identified. Where an ITU-T H.248 Stream contains a single RTP stream (i.e., a single SSRC) the MGC may omit the *ssrc* parameter when setting any signals and events in this package. Where an ITU-T H.248 Stream contains multiple RTP streams the MGC shall include the *ssrc* parameter indicating the SSRC of the applicable RTP stream.

There are several ways that an MGC may determine which SSRC to use:

1. as detected and reported by the MG via ObservedEvent parameters *rtpps/ssrc* or *dpreq/ssrc*;
2. via **SDP attributes** in SIP signalling [IETF RFC 5576]; or/and

3. via [ITU-T H.248.71] "statistic" *rtcpdes/rssrc*.

Typically method 1) is used by this package where the MG detects and reports the SSRC from incoming pause/resume signalling. If available, method 2) is used where the MGC needs to initiate P/R signalling to a remote endpoint without prior knowledge of the SSRCs from the MG. An audit of the statistic in method 3) may be initiated by the MGC to discover the remote SSRC.

The ITU-T H.248 *ssrc* parameter shall be mapped by the MG to the correspondent SSRC field in a RTCP pause/resume CCM message, dependent on the applied in *RTP sender* or *RTP receiver* role (see also Appendix III).

Where there are multiple ITU-T H.248 Streams on a Termination the MGC shall set the StreamID related to the RTP stream in the events and signals in this package.

NOTE – The pauseID parameter shall be omitted when TMMBR/TMMBN signalling is used.

9.6.3 MG autonomous handling of remote requests

The MGC controller may confer handling of RTP pause/resume requests to the MG by setting the "Autonomous Response" (*rempr/ar*) property to "on" indicating that the MG shall autonomously process and respond to any RTP pause/resume messages as defined by [IETF RFC 7728]. If the MGC requires to be notified of any changes in RTP transmission state, then the MGC shall set the "RTP Pause State" (*rempr/rtppps*) Event with the states that it requires to be informed about. The MGC shall also set the 'pause' parameter in the Local and Remote Descriptor as appropriate according to clause 9.6.1.

On receipt of a PAUSE request message the MG shall as RTP sender act according to sections 5.2 and 5.4 of [IETF RFC 7728]. This may result in the MG pausing the RTP stream and the sending of a PAUSED indication or sending a REFUSE message and continuing the transmission of the RTP stream. If requested when entering the PAUSED state the MG will generate a Notify.req with a "RTP Pause State" (*rempr/rtpps*) ObservedEvent indicating that the RTP stream has entered the "paused" state (*obstate*="paused").

On receipt of a RESUME request message the MG shall as RTP sender act according to section 5.5 of [IETF RFC 7728]. This may result in the MG resuming the RTP stream or the sending of a REFUSE message and the continuation of the paused state. If requested when resuming media flow the MG will generate a Notify.req with a "RTP Pause State" (*rempr/rtpps*) ObservedEvent indicating that the RTP stream has been resumed (*obstate*="resumed").

9.6.4 MGC of pause and resume requests

The MGC may reception require that it be responsible for the decision of whether or not to pause or resume an RTP stream. In this case it shall set the "Autonomous Response" (*rempr/ar*) property to "off" indicating to the MG that it shall defer the decision to pause/resume an RTP stream to the MGC. The MGC shall also set the "Detect Pause/Resume Request" (*rempr/dprreq*) to request notification of pause or resume requests.

On receipt of a PAUSE request the MG shall send a Notify.req with the "Detect Pause/Resume Request" (*rempr/dprreq*) ObservedEvent indicating a request type indicating a pause (*reqt*="PAUSE"). The MGC shall take into account any topology (end-to-end RTP session topology, see clause 8 and MG-local internal RTP topology, see Appendix I), service or other local considerations to determine whether to grant the pause request. In order to grant the request, the MGC shall send the "pause" (*rempr/lpause*) Signal to the MG. On receipt of the signal the MG shall pause the RTP stream and send a PAUSED indication as per section 5.4 of [IETF RFC 7728]. To deny the request, the MGC shall send the "refuse" (*rempr/refuse*) Signal to the MG. On receipt of the signal the MG shall send a REFUSED indication as per sections 5.3 and 5.4 of [IETF RFC 7728].

On receipt of a RESUME request, the MG shall send a Notify.req with the "Detect Pause/Resume Request" (*rempr/dprreq*) ObservedEvent indicating a request type indicating a resume

(*reqt*="RESUME"). The MGC shall take into account any topology (see clause 8), service or other local considerations to determine whether to grant the resume request. In order to grant the request, the MGC shall send the "resume" (*rempr/lresume*) Signal to the MG. On receipt of the signal the MG shall resume the RTP stream as per section 5.5 of [IETF RFC 7728]. Media is resumed at a time-shifted point rather than from the pause point. To deny the request, the MGC shall send the "refuse" (*rempr/refuse*) Signal to the MG. On receipt of the signal the MG shall send a REFUSED indication as per section 5.5 of [IETF RFC 7728].

The MG shall not send a Notify.req with "Detect Pause/Resume Request" (*rempr/dprreq*) ObservedEvent with a request type for a pause state that the RTP stream is already in, i.e., the MG shall not send a request type equal to pause if the RTP stream is already paused.

9.6.5 MGC initiation of remote pause and resume requests

The MGC may require that for a particular RTP stream that the remote RTP sender pauses RTP transmission. In order to request the MG to send a PAUSE request to the remote RTP sender, the MGC shall send the "Remote Pause" (*rempr/rpause*) Signal to the MG. On reception of the signal the MG shall initiate a PAUSE request on the applicable RTP stream. The MGC may provide or wildcard CHOOSE a Pause Identity (*pauseid*). If the *pauseid* is wildcarded, the MG shall return the chosen value in a command reply. The MG will send the pause identity in the PAUSE request. The use of the pause identity allows the MGC and MG to correlate pause/resume requests and replies.

The MGC may require that for a particular RTP stream that the remote RTP sender resumes RTP transmission. In order to request the MG to send a RESUME request to the remote RTP sender, the MGC shall send the "Remote Resume" (*rempr/rresume)* Signal to the MG. On reception of the Signal the MG shall initiate a RESUME request on the applicable RTP stream. The MGC shall provide a fully specified a Pause Identity (*pauseid*).

In order that the MGC may be notified of the response from the remote RTP sender regarding MGC initiated PAUSE and RESUME requests it shall set the "Detect Pause and Resume Result" (*rempr/dprres*) Event. On reception of a *rempr/rpause* Signal with a pause identity, the MG arms the event and sends a Notify.req to the MGC when it detects a PAUSED or REFUSED indication for the applicable pause identity. On reception of a *rempr/rresume* Signal with a pause identity, the MG arms the events and sends a Notify.req to the MGC when it detects a REFUSED indication or when it detects a resumed RTP flow for the applicable RTP stream. The Notify.req contains the *dprres* ObservedEvent containing the Response Type (*rest*). If after a suitable timeout period (see section 4.6 of [IETF RFC 7728] the MG does not detect any response from the RTP sender (either by signalling pause CCM messages or via a modification in the sending of the RTP stream) the MG shall send a Notify.req containing the *dprres* ObservedEvent containing the Response Type indicating a failure.

9.6.6 Local pause and resume

According to sections 5.4 and 5.5 of [IETF RFC 7728] an RTP sender can choose to pause and resume a stream at any time. In a decomposed RTP sender, the decision to perform a local pause or resume may be taken by the MGC or autonomously by the MG.

9.6.6.1 MGC initiation of local pause and resume

The MGC may require that for a particular RTP stream that the MG as RTP sender pauses RTP transmission. In order to request the MG to pause RTP sending, the MGC shall send the "Local Pause" (*rempr/lpause*) Signal to the MG. On reception of the signal the MG shall initiate a PAUSE on the applicable RTP stream. The MG shall send a PAUSED indication to the RTP receivers. The MGC may provide or wildcard CHOOSE a Pause Identity (*pauseid*). If the *pauseid* is wildcarded, the MG shall return the chosen value in a command reply. The MG will send the pause identity in the PAUSED indication.

The MGC may require that for a particular RTP stream that the MG as RTP sender resumes RTP transmission. In order to request the MG to resume RTP sending, the MGC shall send the "Local Resume" (*rempr/lresume)* Signal to the MG. On reception of the signal the MG shall initiate a RESUME request on the applicable RTP stream. The MGC shall provide a fully specified Pause Identity (*pauseid*).

In order that the MGC may be notified of the result of the MG to MGC initiated local PAUSE and RESUME requests it shall set the "RTP Pause State" (*rempr/rtpps*) Event. On reception of a *rempr/lpause* Signal with a pause identity, the MG sends a Notify.req to the MGC when it enters the local paused state. On reception of a *rempr/lresume* Signal with a pause identity, the MG sends a Notify.req to the MGC when it resumes RTP flow for the applicable RTP stream. The Notify.req contains the *rtpps* ObservedEvent containing the Observed State (*obstate*) set to "localPause" or "localResume".

9.6.6.2 MG initiation of local pause and resume

An MG acting as RTP sender may pause an RTP stream at any time. If the MG initiates a local pause and it has been requested to report this state, it shall generate a Notify.req with a "RTP Pause State" (*rempr/rtpps*) ObservedEvent indicating that the RTP stream has been paused (*obstate*="localPause") due to a local decision.

The MG shall send a PAUSED indication to the RTP receivers containing a PAUSE ID generated according to the rules specified in section 5.4 of [IETF RFC 7728].

An MG may resume an RTP stream at any time. If the MG initiates a local resume and it has been requested to report this state, it shall generate a Notify.req with a "RTP Pause State" (*rempr/rtpps*) ObservedEvent indicating that the RTP stream has been resumed (*obstate*="localResume") due to a local decision.

9.6.7 MG initiation of remote pause and resume

The MGC controller may allow the MG to autonomously send remote pause and resume requests by setting the "Autonomous Request" (*rempr/aq*) property to "on". An MG shall only initiate pause and resume requests as allowed by the SDP "config" CCM parameters set for the stream. The trigger for sending the requests may be the reception of pause and resumes requests on other Terminations with the same stream. See clause I.3 for further information regarding coupled pause and resume signalling. To avoid this behaviour the MGC shall set the *rempr/aq* property to "off".

In order to determine the results of the MG initiated remote pause and resume requests the MGC should set the "Detect Pause and Resume Result" (*rempr/dprres*) Event. The ObservedEvent shall be notified to the MGC according to clause 9.6.5.

9.6.8 Error handling

The MGC shall not send signals or set events that are incompatible with the SDP "config" CCM parameters. For example, the MGC shall not request the "rpause" Signal on a stream if it has not set the "*config*" parameter equal to 1, 2 or 4. Table 1 indicates the allowed settings.

Table 1 – Allowed setting of "rempr" package signals and events

Package "rempr" signals	Valid "configs"	Comments
Local Pause (*lpause*)	1,2,3,5,6,8	
Local Resume (*lresume*)	1,2,4,5	
Refuse (*refuse*)	1,2,5	
Remote Pause (*rpause*)	1,2,4	
Remote Resume (*rresume*)	1,2,4	

Table 1 – Allowed setting of "rempr" package signals and events

Package "rempr" signals	Valid "configs"	Comments
RTP Pause State (*rtpps*)	1,2,3,4,5,6,7,8	As the event may detect any state it may be set against any configuration.
Detect Pause/Resume Request (*dprreq*)	1,2,3,4,6,7	
Detect Pause and Resume Result (*dprres*)	1,3,5	

If the MGC sends a Signal or Event without having also set the 'pause' or 'paused' SDP parameter in a Local or Remote Descriptor then the MG shall respond with error 472 "Required Information Missing". If the MGC sends a Signal or Event on a Stream where the 'pause' or 'paused' SDP parameter is set contravening Table 1, then the MG shall respond with error 473 "Conflicting Property Values".

9.6.9 Statistics

The MGC may determine the amount of time a stream has been locally paused and/or remotely paused through an audit of the *rempr/lpdur* and *rempr/rpdur* statistics respectively.

10 Examples

The clauses below show examples for initiating pause and resume on a stream.

Section 10 of [IETF RFC 7728] contains examples for pause and resume CCM flows.

10.1 Initiation – pause CCM config=1

This example shows a scenario where the MGC requests the MG to use pause and resume CCM signalling according to "config=1" and allows it to autonomously respond to requests. Autonomous requests are not supported. The SDP "nowait" parameter is included indicating that it will be the sole receiver. The MGC sends an SDP Offer with the following media description (see Table 2).

Table 2 – Example command encoding – (SIP) SDP offer

(SIP) SDP encoding	Comments
v=0 o=alice 3203093520 3203093520 IN IP4 alice.example.com s=Pausing Media t=0 0 c=IN IP4 alice.example.com m=audio 49170 RTP/AVPF 98 99 a=rtpmap:98 G719/48000 a=rtpmap:99 PCMA/8000 a=rtcp-fb:* ccm pause nowait	The SDP Offer is as per section 10.1 of [IETF RFC 7728].

The MGC maps this description into the Media Description in Table 3.

Table 3 – Example command encoding – MGC request

ITU-T H.248 encoding (shortened command)	Comments

Media {
  Stream = 1 {
  LocalControl {
  rempr/aq = Off, ; No autonomous sending
  ; No rempr/ar deaults to "on"
  ReservedValue = On, ; Reserve both audio formats
  },
  Remote {
c=IN IP4 alice.example.com
m=audio 49170 RTP/AVPF 98 99
a=rtpmap:98 G719/48000
a=rtpmap:99 PCMA/8000
a=rtcp-fb:* ccm pause nowait} ; Indicates pause ccms
; No config defaults to 1
  },
  Events=1234{ ; 3 Events are set as they are
  rempr/rtpps, ; all application to config=1
  rempr/dprreq, ; no ssrc parameters are used.
  rempr/dprres},
  }
  }
}
	A similar mapping would apply to the Local Descriptor. The Local Descriptor is not shown but it is also part of the Media Descriptor and will be sent to the MG.

10.2 Initiation – pause CCM config=5

This example shows a scenario where the MGC requests the MG to only respond to remote pause and resume requests using pause CCM signalling. This corresponds to "config=5". Autonomous response is allowed. Autonomous requests are not allowed due to the configuration. The MGC sends an SDP Offer with the following media description (see Table 4).

Table 4 – Example command encoding – (SIP) SDP offer

(SIP) SDP encoding	Comments
v=0 o=alice 3203093520 3203093520 IN IP4 alice.example.com s=Pausing Media t=0 0 c=IN IP4 alice.example.com m=audio 49170 RTP/AVPF 98 99 a=rtpmap:98 G719/48000 a=rtpmap:99 PCMA/8000 a=rtcp-fb:* ccm pause config=5	The SDP Offer is as per section 10.1 of [IETF RFC 7728] except that the use of config=5 is signalled.

The MGC maps this description into the Media Description in Table 5.

Table 5 – Example command encoding – MGC request

ITU-T H.248 encoding (shortened command)	Comments

Media {
  Stream = 1 {
  LocalControl {
  rempr/aq = Off, ; No autonomous sending
  ; No rempr/ar deaults to "on"
  ReservedValue = On, ; Reserve both audio formats
  },
  Remote {
c=IN IP4 alice.example.com
m=audio 49170 RTP/AVPF 98 99
a=rtpmap:98 G719/48000
a=rtpmap:99 PCMA/8000
a=rtcp-fb:* ccm pause config=3} ; Indicates pause ccms
 	
  },
  Events=1234{ ; 2 Events are set as they are
  rempr/rtpps, ; applicable to config=1
  rempr/dprreq ; dprres is not required
  }, ; no ssrc parameters are used.
  }
  }
}
	A similar mapping would apply to the Local Descriptor. The Local Descriptor is not shown but it is also part of the Media Descriptor and will be sent to the MG.

Appendix I

Network use cases with ITU-T H.248 media gateways in the end-to-end RTP path with pause/resume signalling

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

I.1 Introduction

Section 3 of [IETF RFC 7728] describes the main use cases for RTP sessions utilising RTP stream pause and resume. The example use cases consider the *unidirectional* RTP traffic flow between two or more RTP endpoints, with or without additional RTP nodes in between. Such interim RTP nodes realize a specific RTP topology function, which impact the variation of RTP pause/resume scenarios. This Appendix provides a mapping of the section 3 of [IETF RFC 7728] use cases on ITU-T H.248 gateways, i.e., when an ITU-T H.248 MG provides an RTP endpoint and an associated RTP topology function. The result of this analysis is a list of example reference network configurations with RTP stream pause and resume usage for a particular ITU-T H.248 gateway (profile).

The ITU-T H.248 use cases might be classified in ITU-T H.248 Context models with a *single* (clause I.2), *two* (clause I.3) or *more than two* (clause I.4) ITU-T H.248 RTP-enabled Terminations.

All use cases illustrate *only one traffic direction* (of a uni- or bidirectional RTP session) due to the asymmetric nature of RTP stream pause and resume between *RTP sender(s)* and *RTP receiver(s)*.

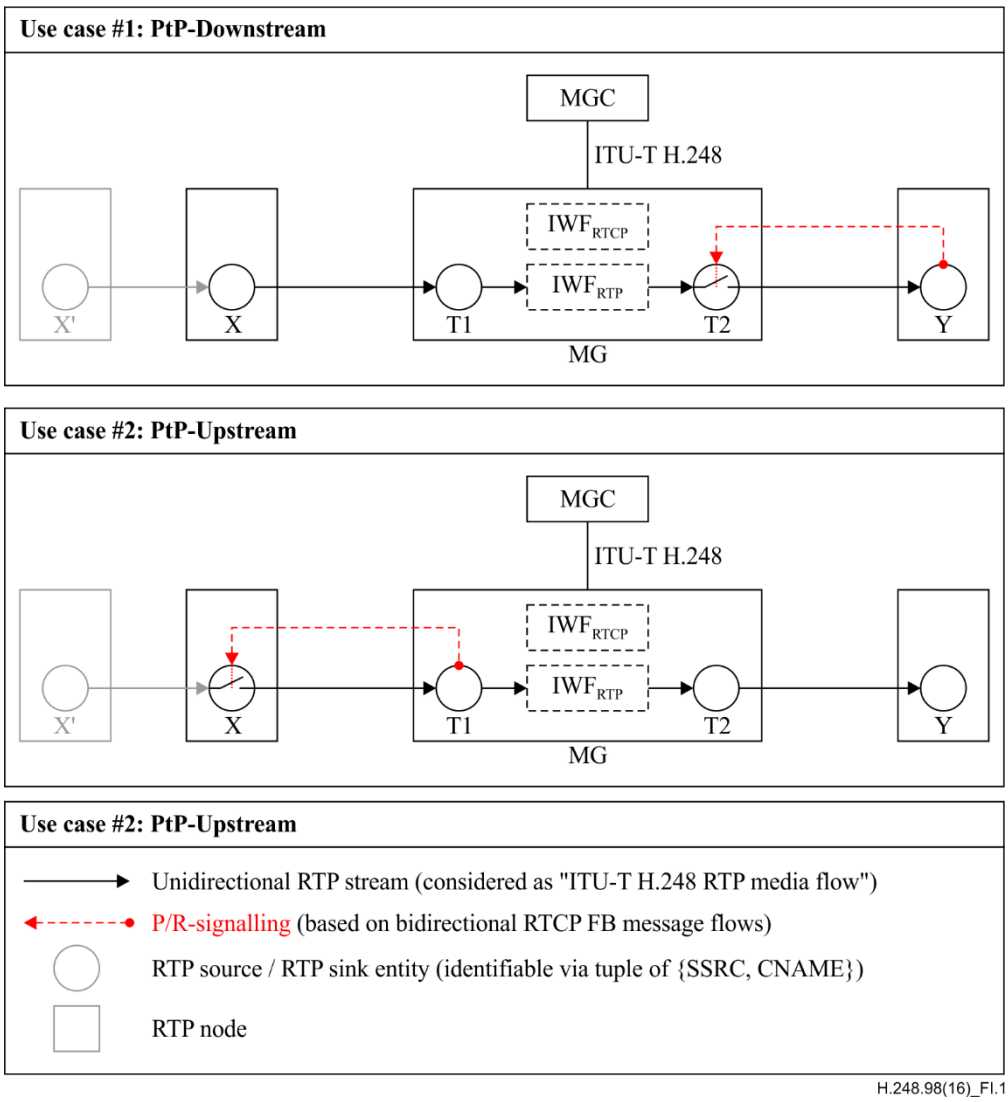
I.2 Single RTP Termination

This use case relates to ITU-T H.248 connection models with a single RTP-enabled Termination per ITU-T H.248 Context. For instance, this use case includes all variants of ITU-T H.248 physical-to-RTP MG types within public switched telephone network (PSTN) emulation subsystems. The ITU-T H.248 RTP Termination represents an RTP endpoint, i.e., all RTCP packet types are terminated (inclusive of RTCP FB) and there are not any context-internal P/R-signalling aspects as opposed to subsequent use case discussions of the following clauses I.3 and I4.

I.3 Dual RTP Terminations

The notion of "dual RTP Terminations" relates to an ITU-T H.248 Context with two ITU-T H.248 RTP-enabled Terminations (which are labelled as T1 and T2) in the diagrams below. Section 3.1 of [IETF RFC 7728] provides use cases for a "*Point-to-Point*" RTP topology, from an end-to-end communication perspective. Such an end-to-end (RTP)-connection might be routed via an interim ITU-T H.248 IP-to-IP MG, which could have multiple different "RTP topology" modes, such as an *RTP media translator*, *RTP transport translator* or *Back-to-Back RTP end system* topology (see [ITU-T H.248.88]). This clause lists some use cases for such an ITU-T H.248 connection model, but without discussion of the applied RTP topology by the (T1, T2) Context configuration.

Figure I.1 illustrates two use cases, termed "*point-to-point downstream*" and "*point-to-point upstream*".



NOTE – The legend applies to all Figures in this appendix.

Figure I.1 – Use-cases #1 "Point-to-Point Downstream" & #2 "Point-to-Point Upstream"

Description of the remote RTP nodes (from an ITU-T H.248 MG perspective): Node Y is a pure *RTP sink*. Node X represents an optional, *virtual RTP source* (from MG perspective) because the real RTP source X' might not be visible from the MG perspective. There are RTCP-based services where the real RTP source X' might become visible, such as in the case of RTCP XR-based performance monitoring (see [b-ITU-T H.248.48] and [b-ITU-T H.248.87].

The ITU-T H.248 MG provides support of RTP stream pause and resume only in an outgoing (#1) or in an incoming (#2) RTP traffic direction. The P/R-signalling related RTCP packet types need to be terminated by the correspondent ITU-T H.248 Terminations (and not context-internally forwarded).

Use cases #1 and #2 may be supported in parallel, leading to the configurations as outlined by Figure I.2.

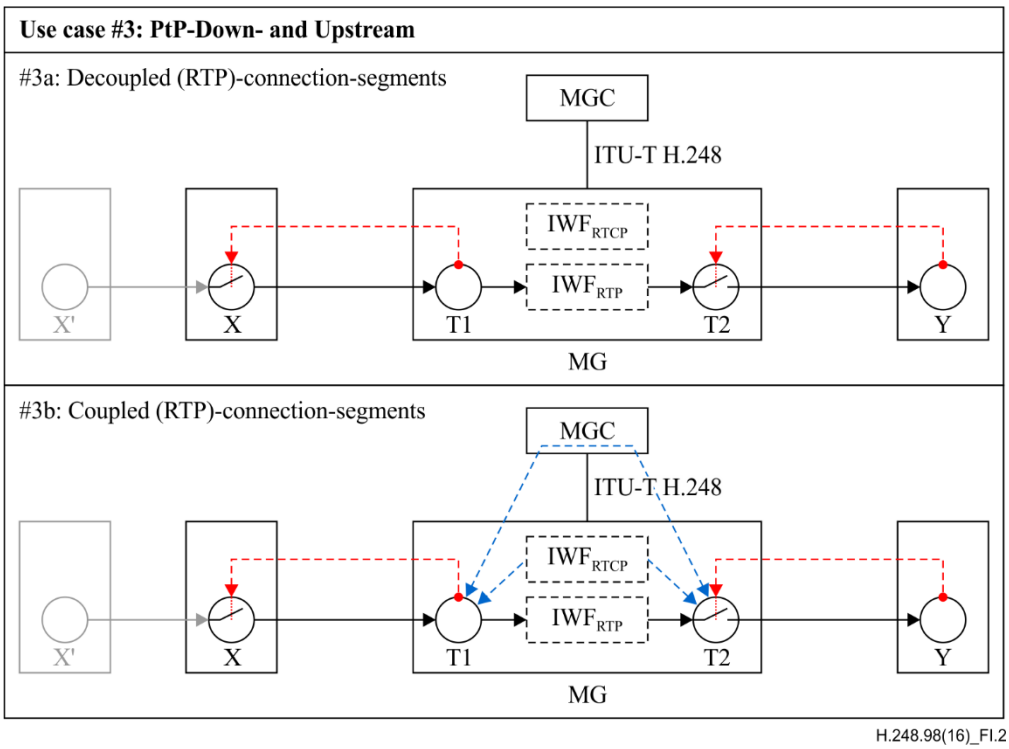


Figure I.2 – Use-cases #3 "Point-to-Point Downstream and Upstream"

There are multiple options: first, the P/R-signalling loops might be fully decoupled (#3a) or coupled (#3b). It has to be emphasized that the P/R-signalling loops were intentionally established with a local scope (i.e., X-to-T1 and T2-to-Y) and not as a signal loop with a global scope (i.e., end-to-end loop between X and Y). Use case #3a looks similar as use case #1, with the difference that the MG is aware of P/R-signalling towards X. The decoupled mode (#3a) could lead to situations of a paused *RTP source* T2 but a still-playing *RTP source* X, which leads to the question of whether the MG should buffer or discard RTP packets received at T1? Due to the fact that P/R-signalling, defined by [IETF RFC 7728], is typically used for conversational services, the RTP packets are silently discarded.

Use case #3b reflects the "coupled RTP stream pause and resume segments" case where the "RTP sink" requests to stop the RTP send process, meaning that the actual RTP source should be switched to pause mode (i.e., X or even X' and not T2). Hence, the two P/R-signalling loops need to be coupled. There are two coupling options: indirectly via the MGC or directly MG-internally.

Finally, there might be a single, end-to-end P/R-signalling loop across the ITU-T H.248 MG, see Figure I.3.

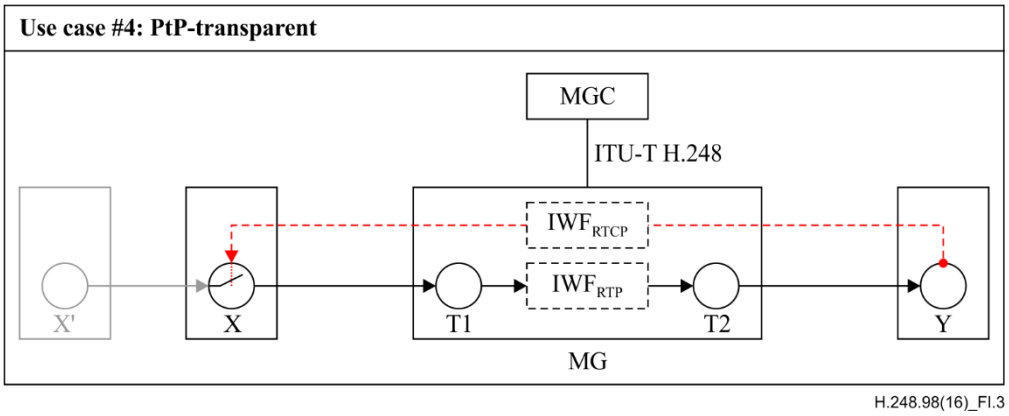


Figure I.3 – Use-cases #4 "Point-to-Point transparent"

The "end-to-end" RTP stream pause and resume scope implies that neither termination T1 nor T2 provides an "RTP sender" or "RTP receiver" role. P/R-signalling information needs to be transparently forwarded by the MG. Such a forwarding requirement for dedicated RTCP packet types needs to be taking into account by a suitable RTP topology (see [b-ITU-T H.248.88]).

I.4 Multiple RTP Terminations

This use case would be the result when an ITU-T H.248 MG realizes the "RTP mixer" function in all examples of sections 3.2 to 3.5 in [IETF RFC 7728].

NOTE – Another multipoint configuration is the (RTP) *relay* topology in [IETF RFC 7728], which represents a "*RTP translator with only unicast paths*" according to [b-IETF RFC 7667].

Figure I.4 illustrates a general multipoint configuration with enabled P/R-signalling between all RTP endpoints.

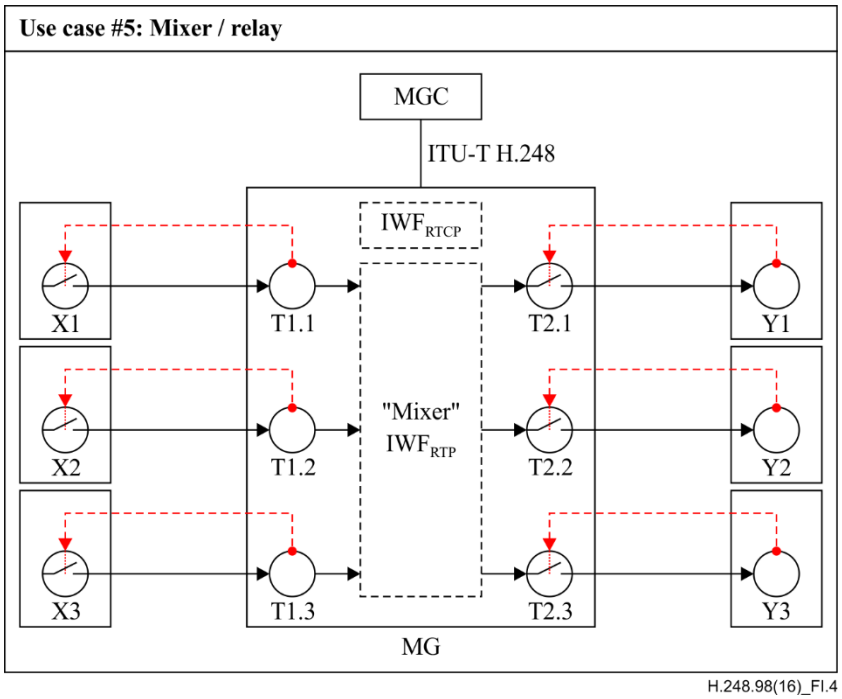


Figure I.4 – Use-case #5 "Multipoint-to-Multipoint" (with six RTP participants)

The MG behaviour (in use case #5) with respect to P/R-signalling handling is similar to that of use case #3, apart from the additional complexity that the MG-internal P/R-signalling interworking effort correlates with the applied mixer function for a multiparty, multimedia communication service. Three specific multipoint use case examples are discussed in more detail below.

Figure I.5 illustrates a configuration for three RTP participants where the downstream RTP sink Y1 gets the RTP traffic forwarded from one-out-of-two upstream RTP sources X1 or X2.

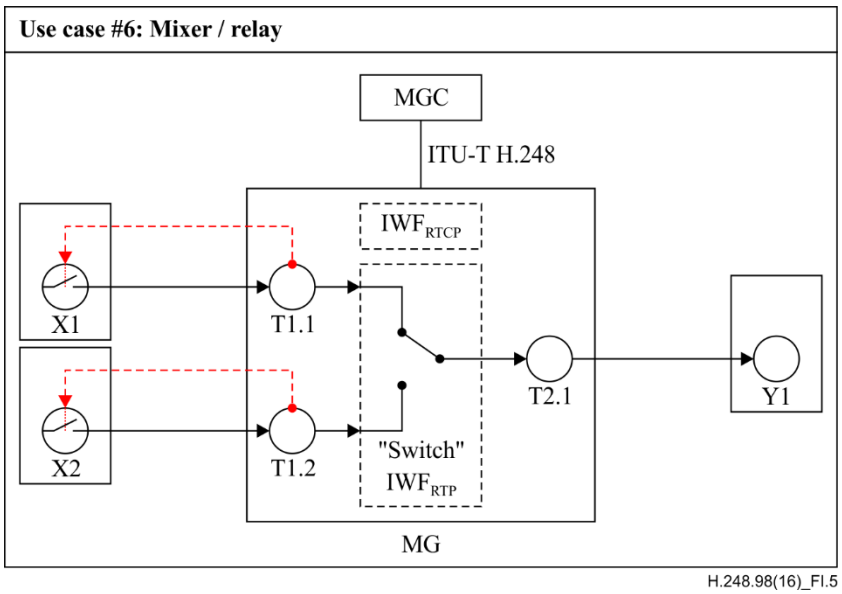


Figure I.5 – Use-case #6 "Dual point-to-Point switching" (with three RTP participants)

Such a use case is, for example, discussed in section 10.3 of [IETF RFC 7728] ("voice activated mixer"). The two self-contained P/R-signalling loops X1-to-T1,1 and X2-to-T1,2 need to be coupled by the ITU-T H.248 gateway due to the applied service configuration.

Figure I.6 illustrates a configuration between a sender X1 and two receivers Y1 and Y2 and an interim ITU-T H.248 MG in RTP transport relay topology (see also Figure 18 of [IETF RFC 7728]).

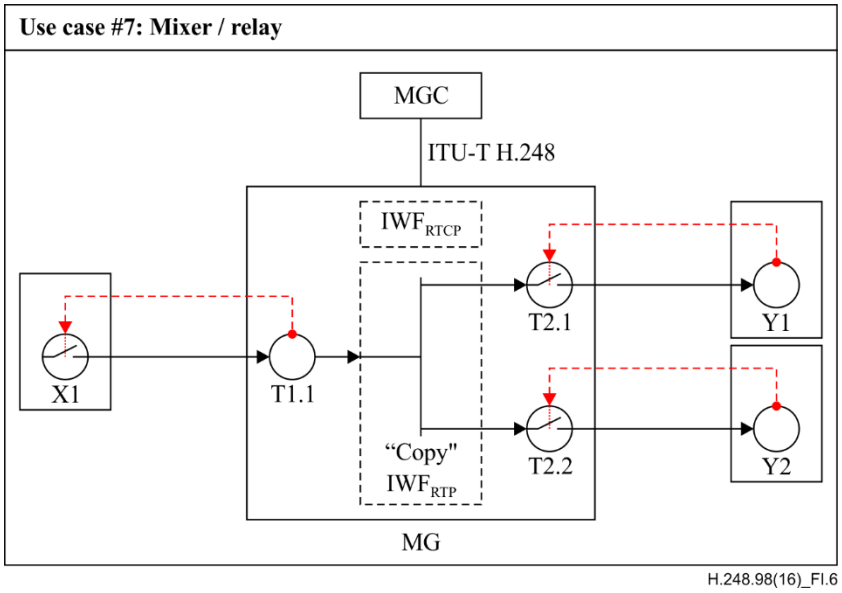


Figure I.6 – Use-case #7 "Point-to-Dual point copying" (with three RTP participants) and a "P/R-signalling active MG"

Both receivers Y1 and Y2 may request the single sender X1 to pause the RTP playout process, hence there are inherent interactions between the concurrent P/R-signalling loops. Use case #7 represents a network configuration where the ITU-T H.248 gateway resolves such interactions. Use case #8 (Figure I.7) shows the same end-to-end scenario, but with a "dumb ITU-T H.248 gateway" because the MG transparently forwards all RTCP FB "P/R-signalling messages".

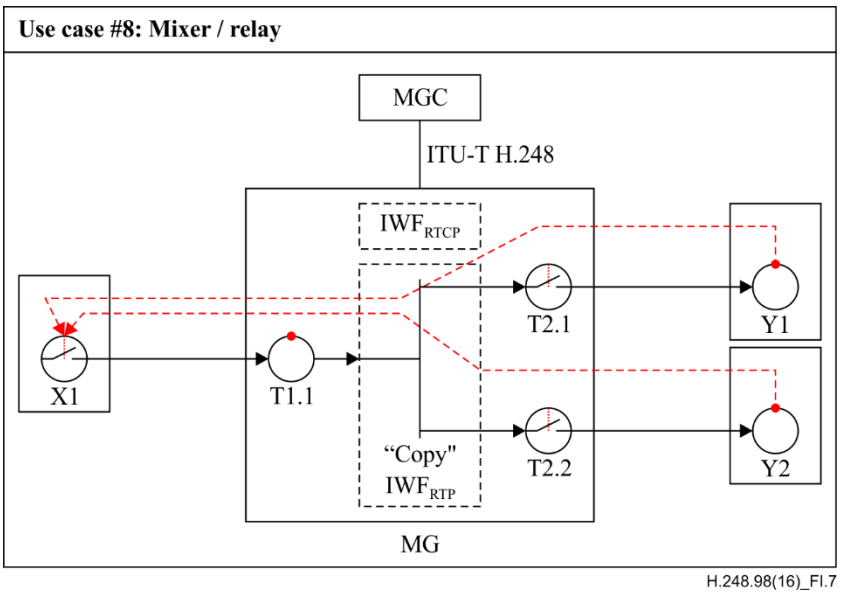


Figure I.7 – Use-case #8 "Point-to-Dual point copying" (with three RTP participants) and a "P/R-signalling passive MG"

In summary, the ITU-T H.248 MG provides the same RTP topology in use cases #7 and #8, but each results in an ITU-T H.248 profile with and without ITU-T H.248 *rempr* package usage.

Appendix II

State models for pause/resume signalling endpoints

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

II.1 Introduction

Section 6 of [IETF RFC 7728] defines the *RTP pause state model* at *RTP sender* side. This model is the normative framework for the ITU-T H.248 Events and Signals as defined by the *rempr* package in clause 9.

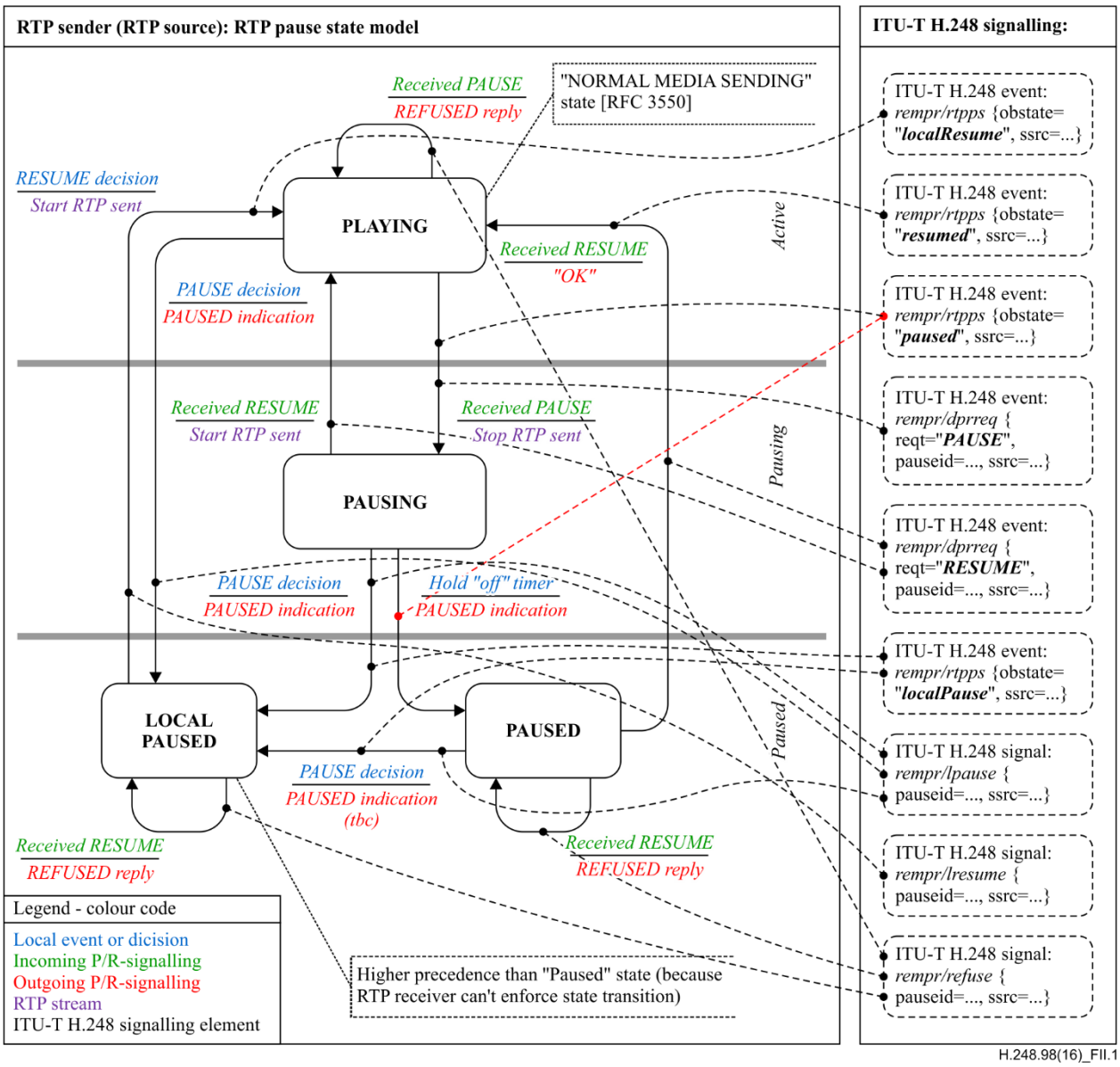
The purpose of this Appendix is to illustrate and indicate the state transitions which are correlated with the ITU-T H.248 signalling elements. In case of any discrepancies between this Appendix and clause 8, the package specification in clause 9 takes precedence.

II.2 RTP pause state model at the RTP sender side

Figure II.1 illustrates the *RTP sender* side state model.

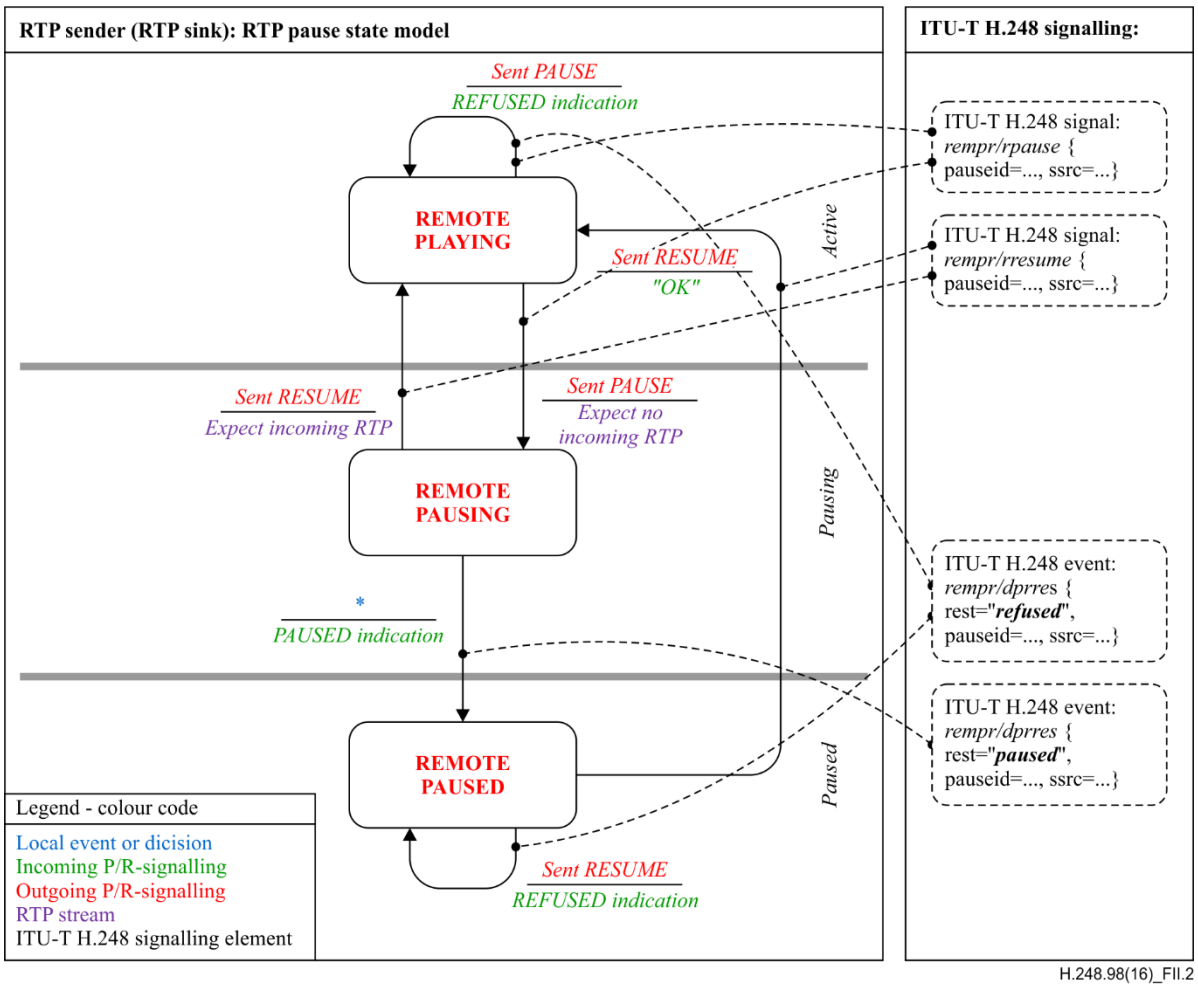
II.3 RTP pause state model at the RTP receiver side

Figure II.2 illustrates the *RTP receiver* side state model.



NOTE – The state model indicates the main state transitions, but without any claim of complete- and correctness.

Figure II.1 – *RTP sender* (RTP source): RTP pause state model, extended with additional indication of ITU-T H.248 signalling elements



NOTE – The state model indicates the main state transitions, but without any claim of complete- and corrections.

Figure II.2 – *RTP receiver* (RTP sink): RTP pause state model, extended with additional indication of ITU-T H.248 signalling elements

Appendix III

SSRC identifiers for pause/resume signalling endpoints

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

III.1 SSRC information in RTCP FB "pause/resume" messages

Figure III.1 outlines the structure of such a RTCP FB message type.

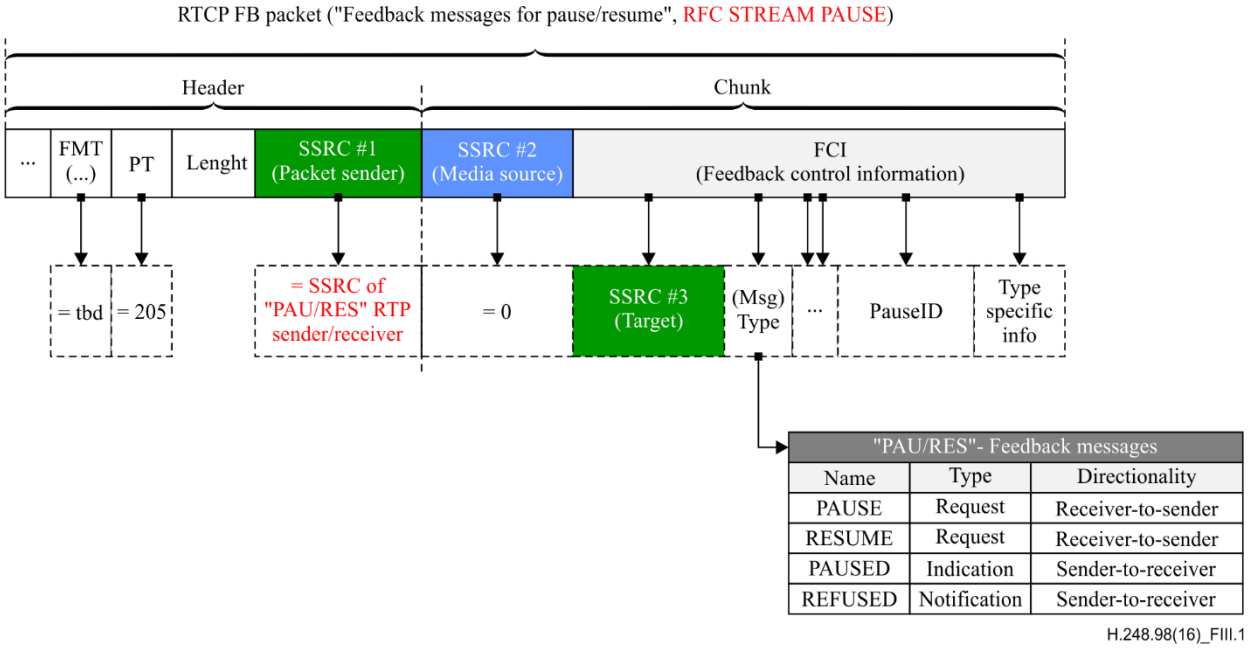


Figure III.1 – RTCP FB packets for pause/resume-signalling – SSRC related fields

There are (at least) three SSRC identifiers in such a RTCP FB packet:

1. **SSRC packet sender**: the SSRC of the RTP endpoint issuing a P/R-signalling message in an *RTP sender* or *RTP receiver* role;
2. **SSRC media source**: original semantic see [IETF RFC 5104], not used in P/R-signalling messages, set to value '0'; and
3. **SSRC target**: the SSRC of the remote RTP endpoint acting as the target of P/R-signalling (i.e., the associated *RTP sender* or *RTP receiver*).

It could be concluded that the ITU-T H.248 signalled *ssrc* parameter (as part of event configuration, event notification and signal configuration) is either mapped on SSRC #1 (packet sender) or SSRC #3 (target), dependent whether the ITU-T H.248 unidirectional media stream endpoint is acting in *RTP sender* or *RTP receiver* role.

III.2 Example use case

Figure III.2 provides an example, based on use case #3b from Appendix I, extended to bidirectional support of P/R-signalling. The ITU-T H.248 *rempr* package supports this case, which facilitates understanding the scope of the *ssrc* information in ITU-T H.248 Signals and Events of this package. Note that the MG provides an [ITU-T H.248.88] B2BRE RTP topology. Other RTP topologies might lead to different SSRC assignments. Figure III.2 outlines the SSRC values which appear in the SSRC fields #1 and #3 of the RTCP FB packets.

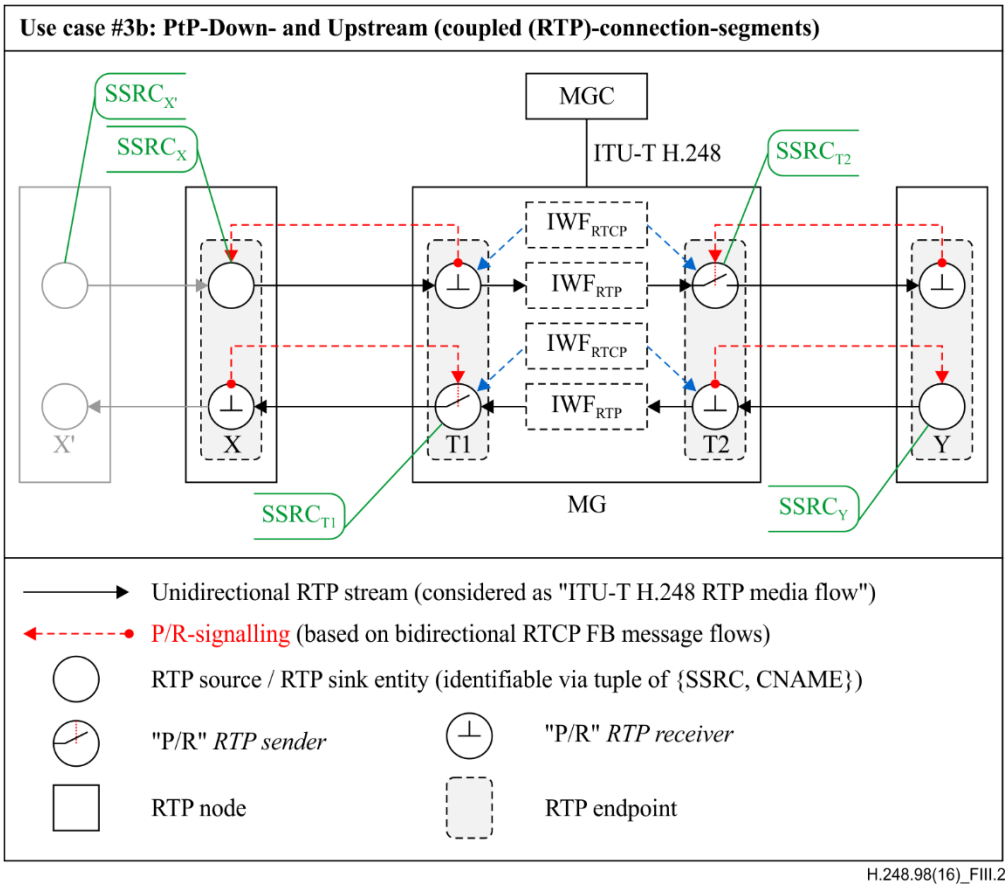


Figure III.2 – Example use case #3b (from Appendix I) – Extended for bidirectional P/R-signalling and indication of SSRCs

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Printed in Switzerland
Geneva, 2016