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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication procedures

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Gateway control protocol: Explicit congestion notification support

Recommendation ITU-T H.248.82

ITU-T

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Recommendation ITU-T H.248.82

Gateway control protocol: Explicit congestion notification support

Summary

Recommendation ITU-T H.248.82 defines a package to allow ITU-T H.248 controlled media gateways to support explicit congestion notification (ECN). ECN is a mechanism to provide indications of incipient congestion affecting a Real-Time Protocol (RTP) stream to a receiver and, usually, to a sender. ECN when used with an RTP stream over UDP uses the RTP control protocol to provide feedback of ECN congestion markings to an RTP sender. The mechanism allows senders and/or receivers to react in order to reduce congestion in real-time communications. This Recommendation only describes the use of ECN in RTP over UDP streams.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.248.82	2013-03-16	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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had not 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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Gateway control protocol: Explicit congestion notification support

1 Scope

Explicit congestion notification is a mechanism to provide indications of incipient congestion affecting an RTP stream to a receiver and, usually, to a sender. ECN, when used with an RTP stream over UDP, uses the RTP control protocol to provide feedback of ECN congestion markings to an RTP sender. Depending on previous signalling the sender and/or receiver can take action to minimize congestion in reception of the ECN congestion markings.

The session description protocol (SDP) is utilized to indicate support of ECN and what parameters relate to its use. As a media gateway (MG) sends/receives RTP based media (and RTCP), these parameters must be agreed and coordinated between the media gateway controller (MGC) and the MG. In ITU-T H.248 controlled gateways, this information must be provided via ITU-T H.248.

This Recommendation defines the "ECN for RTP-over-UDP Support Package" in order to establish ECN support on media gateways.

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 E.107] Recommendation ITU-T E.107 (2007), *Emergency Telecommunications Service (ETS) and interconnection framework for national implementations of ETS*.

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

[ITU-T H.248.47] Recommendation ITU-T H.248.47 (2008), *Gateway Control Protocol: Statistic conditional reporting package*.

[ITU-T H.248.50] Recommendation ITU-T H.248.50 (2010), *Gateway Control Protocol: NAT traversal toolkit packages*.

[ITU-T H.248.64] Recommendation ITU-T H.248.64 (2013), *Gateway Control Protocol: IP router packages*.

[ITU-T H.248.81] Recommendation ITU-T H.248.81 (2011), *Gateway Control Protocol: Guidelines on the use of the international emergency preference scheme (IEPS) call indicator and priority indicator in ITU-T H.248 profiles*.

[IETF RFC 3168] IETF RFC 3168 (2001), *The Addition of Explicit Congestion Notification (ECN) to IP*.

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

[IETF RFC 3611] IETF RFC 3611 (2003), *RTP Control Protocol Extended Reports (RTCP XR)*.

[IETF RFC 4585] IETF RFC 4585 (2006), *Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)*.

[IETF RFC 5245] IETF RFC 5245 (2010), *Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols*.

[IETF RFC 5506] IETF RFC 5506 (2009), *Support for Reduced-Size Real-Time Transport Control Protocol (RTCP): Opportunities and Consequences*.

[IETF RFC 6679] IETF RFC 6679 (2012), *Explicit Congestion Notification (ECN) for RTP over UDP*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 sender [IETF RFC 6679]: A sender of RTP packets carrying an encoded media stream. The sender can change how the media transmission is performed by varying the media coding or packetization. It is one endpoint of the ECN control loop.

NOTE – The sender in this sense may or may not be the same as the RTP End System.

3.1.2 receiver [IETF RFC 6679]: A receiver of RTP packets with the intention to consume the media stream. It sends RTCP feedback on the received stream. It is the other end-point of the ECN control loop.

NOTE – The receiver in this sense may or may not be the same as the RTP End System.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 AuditValue.req: An ITU-T H.248.1 AuditValue command request.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ABNF Augmented Backus-Naur Form

B2BIH Back-to-Back Internet protocol Host

B2BRE Back-to-Back RTP End system

CE Congestion Experienced

DCCP Datagram Congestion Control Protocol

ECN Explicit Congestion Notification

ECT ECN Capable Transport

ETS Emergency Telecommunications Service

IP Internet Protocol

IPR Internet Protocol Router

LD Local Destination

LS Local Source

Lx Layer number

MCU	Media Control Unit
MG	Media Gateway
MGC	Media Gateway Controller
MSRP	Message Sending Relay Protocol
NAT	Network Address Translation
RD	Remote Destination
RS	Remote Source
RTP	Real Time Protocol
RTCP	Real-Time Transport Control Protocol
SCTP	Stream Control Transport Protocol
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SSRC	Synchronization Source
STUN	Session Traversal Utilities for NAT
UDP	User Datagram Protocol

5 Conventions

Elements of the ITU-T H.248 protocol model, e.g., Context, Termination, Stream, Event are represented using the first letter capitalized. ITU-T H.248 Property, Event, Signal and Parameter identities are given in *italics*. When used in the main text SDP syntax is highlighted in bold i.e., "**m=**".

6 Use of ECN with ITU-T H.248

ITU-T H.248 entities (MG and MGC) may be involved with ECN in multiple ways. Clause 6.1 introduces the basic control principle. Subsequent clauses illustrate example IP transport (and possibly application) protocol-specific use of ECN with ITU-T H.248.

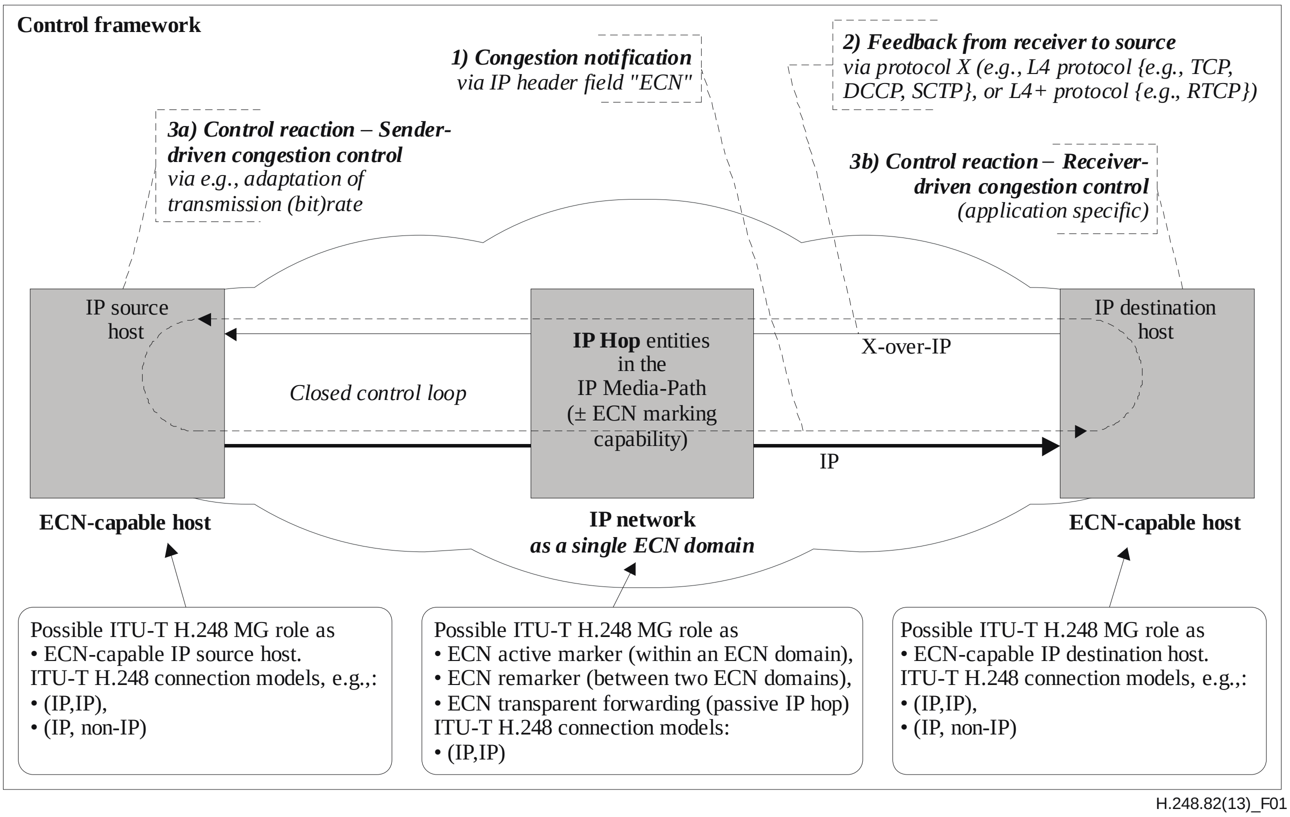
6.1 Basic ECN control loop

[IETF RFC 3168] defines an addition to IP for ECN support. This support relates to a unidirectional connection model, i.e., IP traffic in IP source host to IP destination host direction. Figure 1 illustrates the basic ECN control principle. The control loop may be abstracted by four components in the user plane:

1. the *congestion notification information* flow in source to destination host direction;
2. the *feedback information* flow in reverse direction, back to the traffic source;
3. the *actuating elements* in case of indicated congestion (typically located in the source host); and
4. the *sensor elements*, responsible for indicating congestion (at a network route, in an IP hop) by ECN marking in the IP path.

There might be a further component in the control plane for:

5. the indication and negotiation of a congestion control.



NOTE – The thick arrow shows the unidirectional IP packet path (where hop entities may provide ECN-CE marking). The thin arrow in reverse direction indicates protocol X packets in feedback direction.

Figure 1 – ECN supporting IP network (ITU-T H.248 bearer plane) – Basic model of the ECN control loop

In Figure 1, the control loop spans two ECN-capable IP host entities with information flows in both directions, requiring a bidirectional communication path. There are different protocols in use for ECN (Figure 1) in each direction:

– IPv4 or IPv6 in the source-to-destination host direction for carrying ECN indications;

– Higher layer protocols in the reverse direction. This is normally the applied IP transport protocol if extended (like TCP) or designed for ECN support (like DCCP, SCTP); or an L4+ protocol (like RTCP in case of UDP transport).

ITU-T H.248 MG entities may be involved in ECN control loops in various ways. There may be potential use cases for all four of the above indicated protocol groups to be involved in the control loop. Figure 1 outlines some possible MG roles.

6.2 Use of ECN with TCP traffic

TCP relates to a bidirectional transport connection, allowing the use of TCP control elements for the ECN feedback path. The use of ECN with TCP is defined in clause 6 of [IETF RFC 3168]. It is achieved primarily by the use of two additional TCP header flags. Figure 2 illustrates the control model of the use of ECN with TCP traffic.

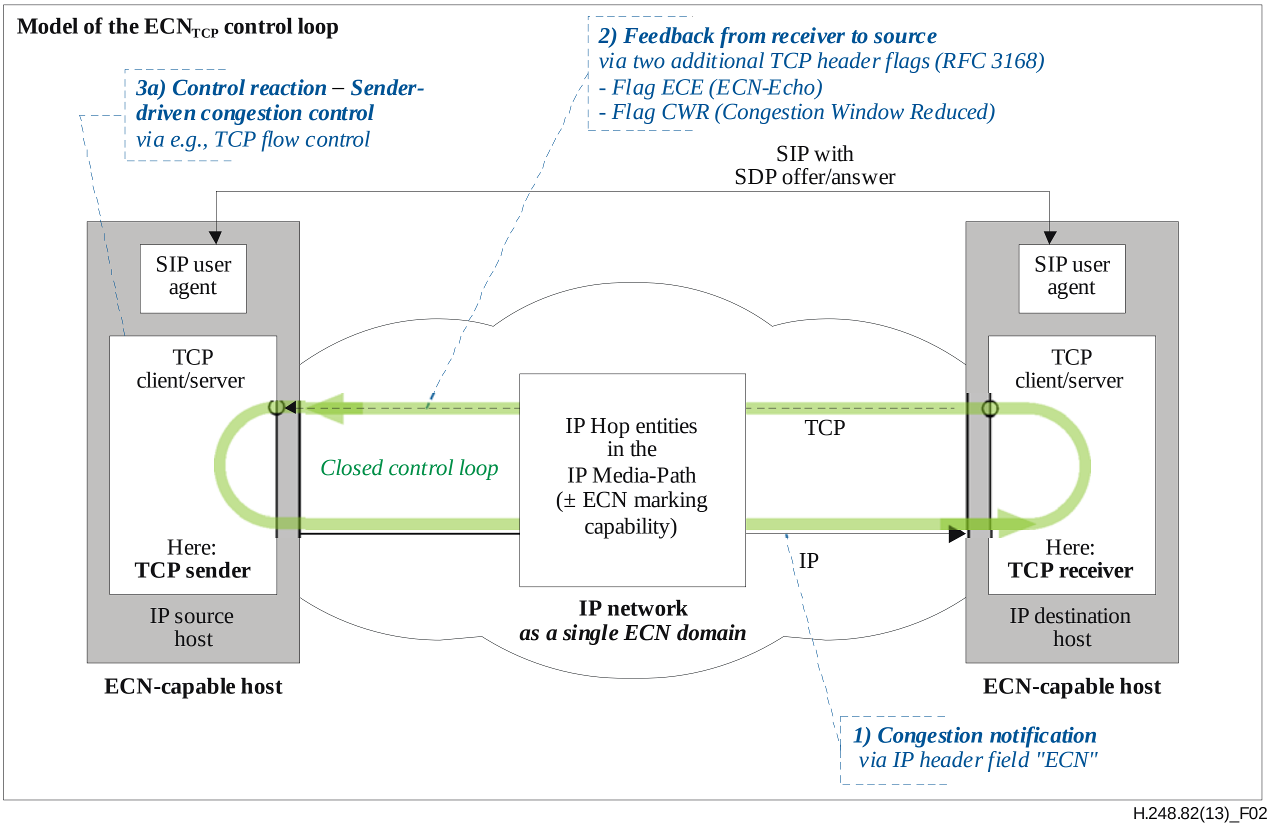


Figure 2 – Use of ECN with TCP traffic

Use of ECN with TCP is relevant for ITU-T H.248 MGs with TCP-based streams (e.g., used for MSRP-over-TCP based transport of instant messaging traffic).

6.3 Use of ECN with RTP-over-UDP traffic

UDP is a connectionless transport protocol, lacking control elements for carrying ECN feedback in the UDP header. The ECN feedback information path is thus delegated to higher layer protocols, e.g., RTCP in case of RTP-over-UDP sessions. Figure 3 summarizes the ECN solution framework as defined by [IETF RFC 6679].

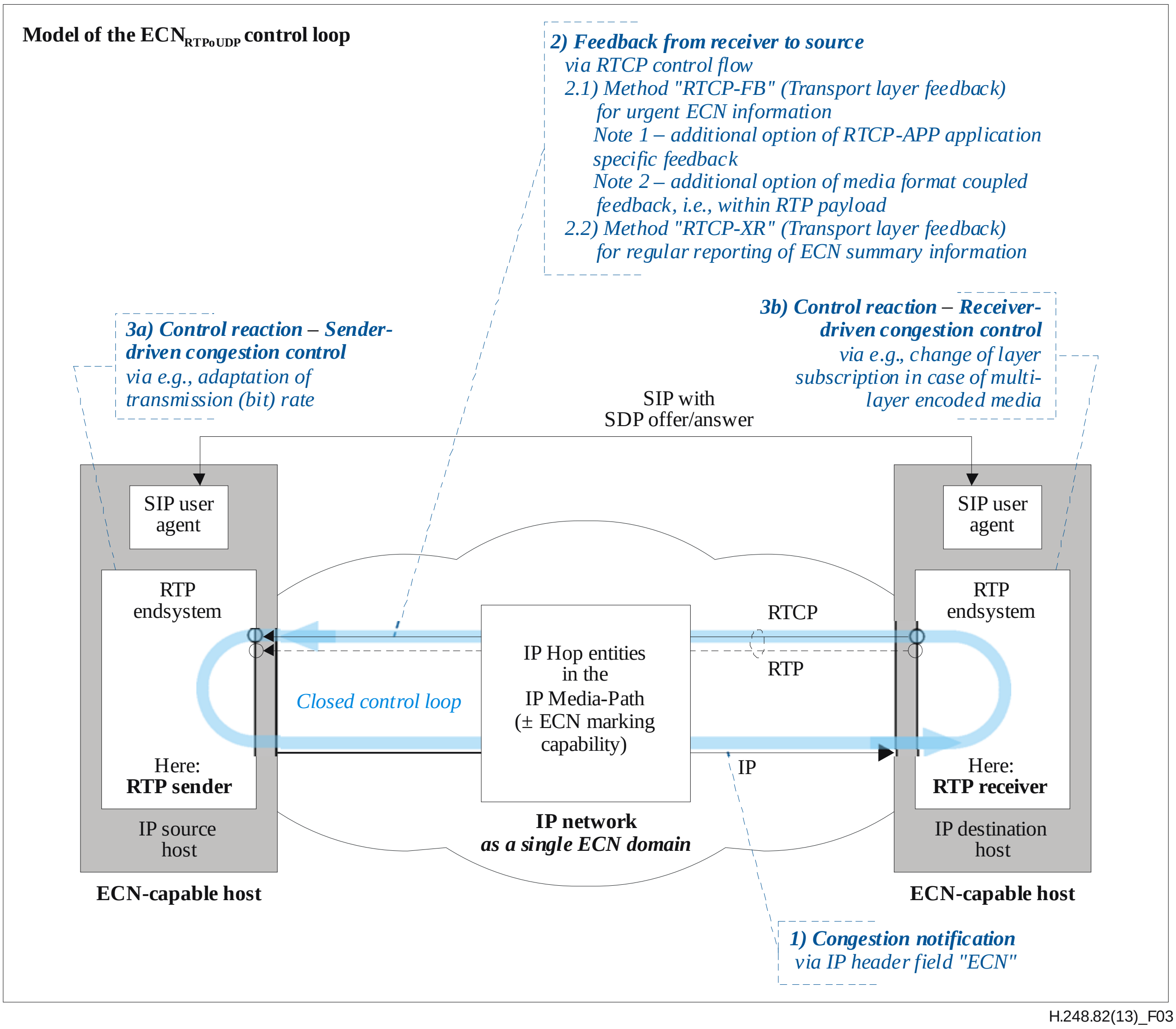


Figure 3 – Use of ECN with RTP-over-UDP traffic

There are multiple deployment scenarios, given interim NAT devices, NAT-traversal support functions or "middlebox" behaviour in the ECN IP path, as well as control plane options for RTP session control (see next clause). Figure 4 summarizes the procedures defined by [IETF RFC 6679].

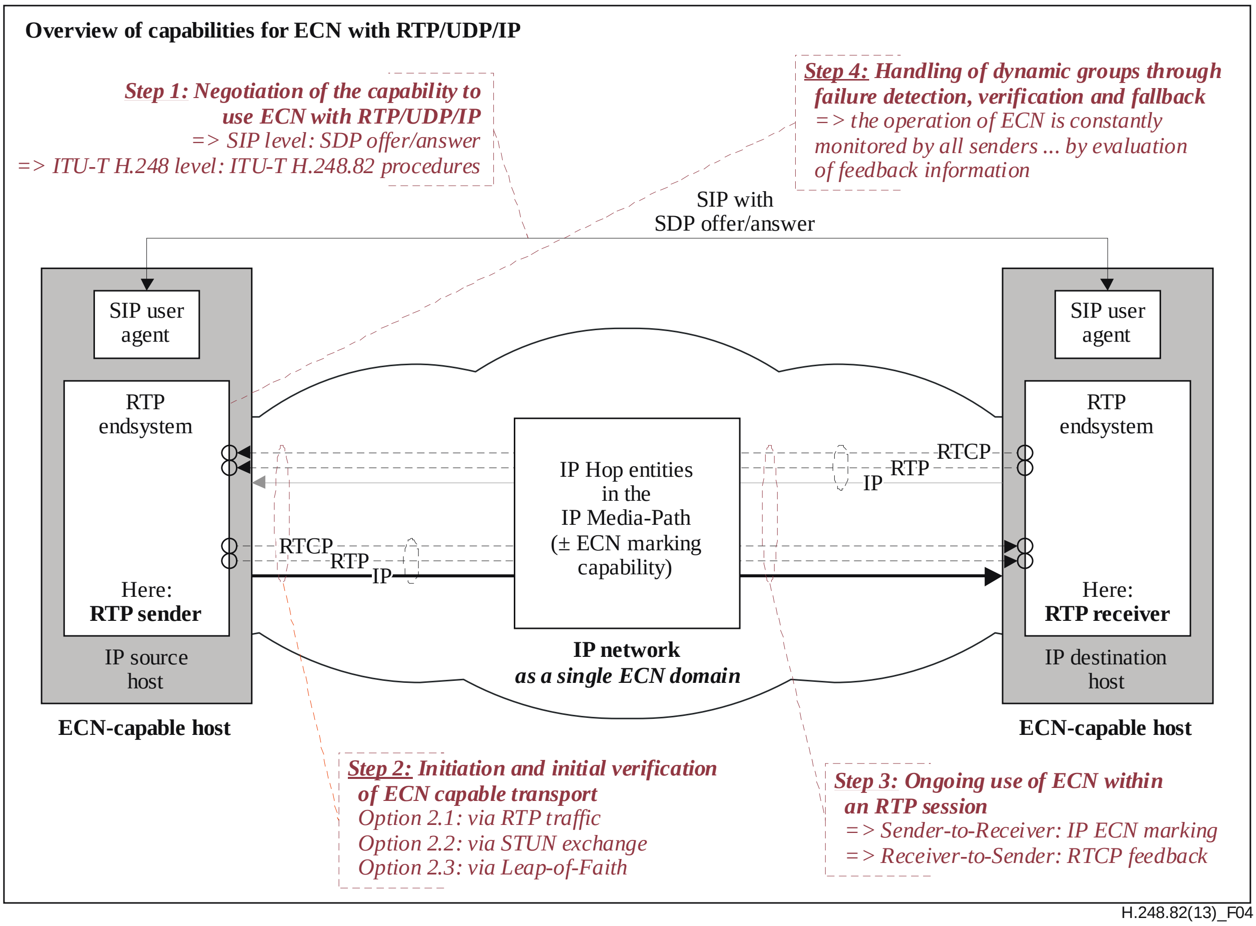


Figure 4 – Procedures for use of ECN with RTP-over-UDP traffic

6.4 Capability declaration and negotiation of ECN in the control plane

There are multiple control plane protocol options (e.g., ITU-T H.323, SIP, SIP-I) for the establishment and release of RTP sessions. Figures 3 and 4 indicate the example of SIP with its embedded SDP Offer/Answer protocol, used for end-to-end capability declaration and negotiation of ECN usage.

[IETF RFC 6679] assumes the use of a SIP based control plane with additional SDP information elements.

Figure 5 outlines an example scenario in scope of this Recommendation, e.g., SIP as session control signalling protocol at MGC level, and the mapping of SIP-level SDP information to ITU-T H.248 control elements, and an ITU-T H.248 MG, which may provide various ECN behaviours (as outlined in clauses 6.1 and 6.5).

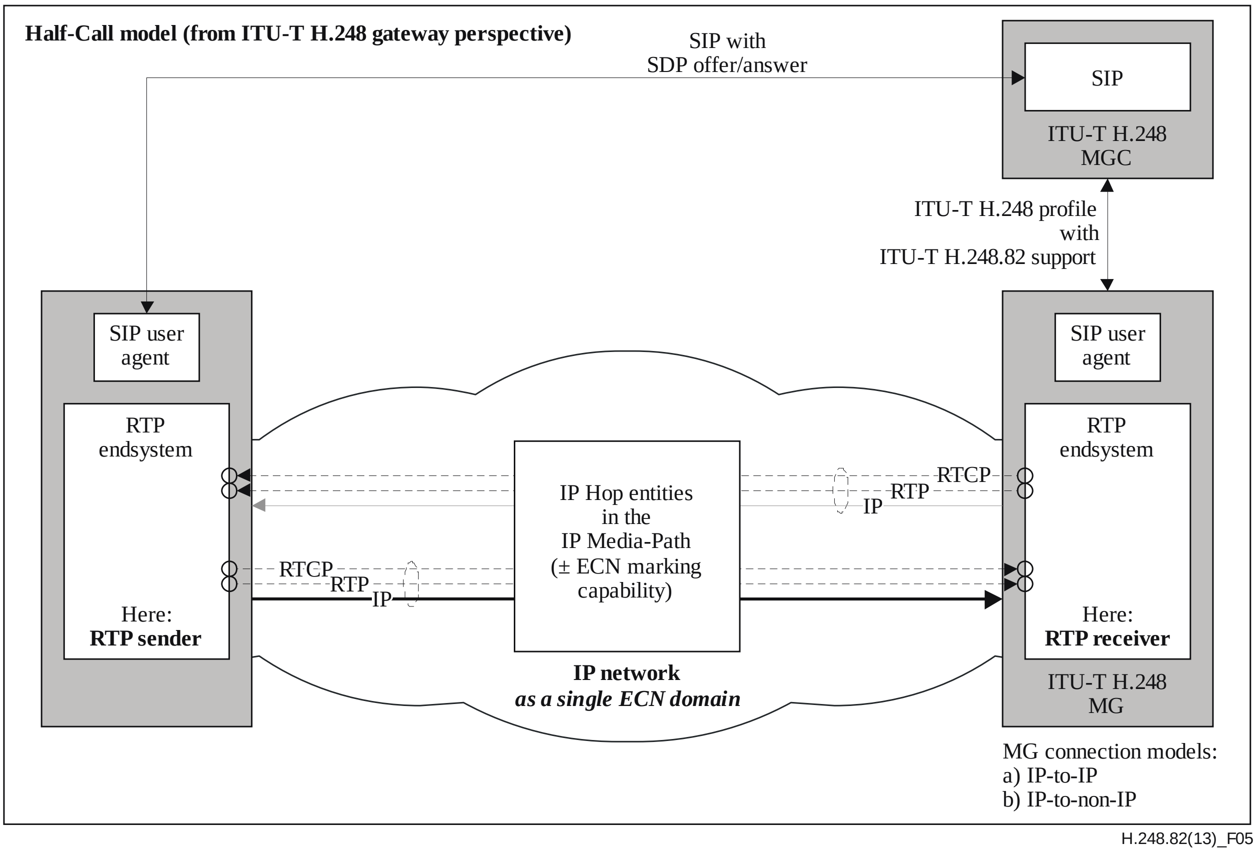


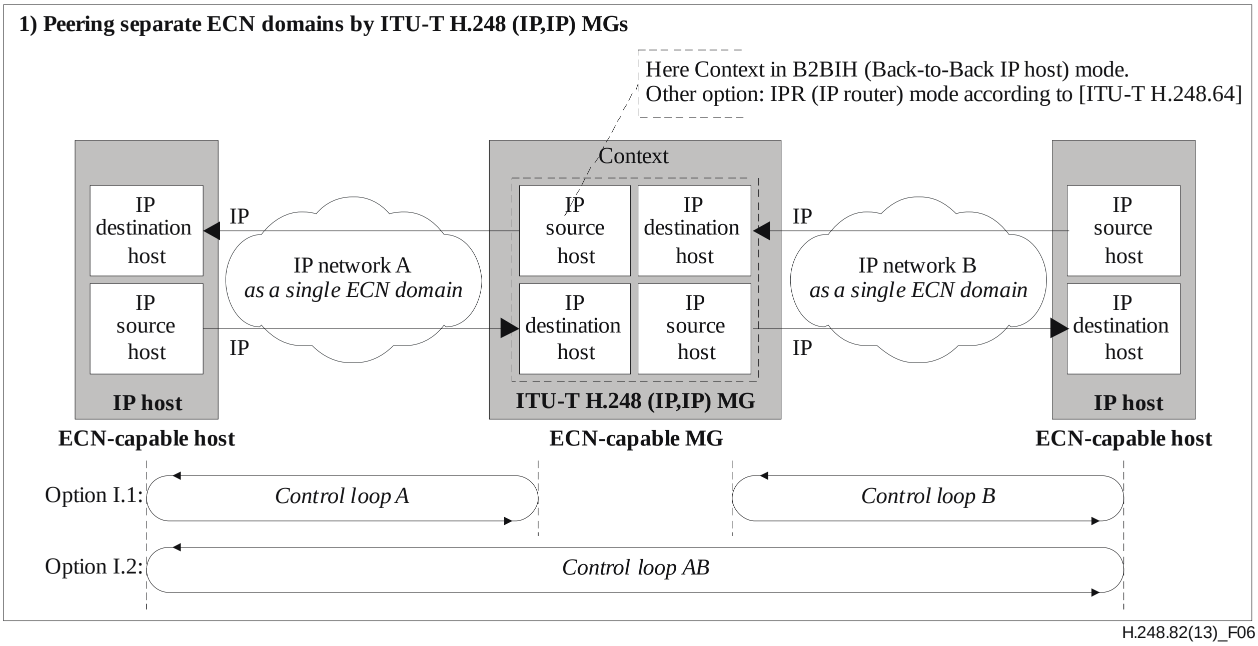
Figure 5 – Control plane example with ITU-T H.248 network elements at the edge of an ECN domain

6.5 ECN interworking scenarios

For traffic and network engineering of IP networks with regards to ECN domains, the ITU-T H.248 MG may play the role of an ECN-capable IP host endpoint or be located within the ECN IP path, as introduced in clause 6.1. ECN defines multiple code points for ECN marking in case of ECN capable transport (ECT), termed as ECT(0), ECT(1) and ECT(random) code points.

For traffic and network engineering of IP networks with regards to ECN domains, the ECT code point options and the various possible MG behaviours may lead to different ECN interworking scenarios. Some basic network configurations are illustrated below.

Figure 6 provides the example of a peering scenario. For instance, there may be different ECT code points in use in each ECN domain. The ITU-T H.248 MG may then be requested to remark ECN code points in case of the end-to-end ECN control loop approach (option I.2 below).



NOTE – The IP topologies are basically associated with the ITU-T H.248 Stream level. The figure above illustrates an example on Context level (referred to the IP topology models according to clause 3.2.1 (B2BIH) and clause 6.5.1 (IP router) of [ITU-T H.248.64]).

Figure 6 – Peering separate ECN domains by ITU-T H.248 (IP,IP) MGs

Each ECN domain may be also completely separated by limiting the control loops on each domain (option I.1).

Figure 7 illustrates another configuration, the example of an ITU-T H.248 (IP,IP) MG located within the IP path of a single ECN domain.

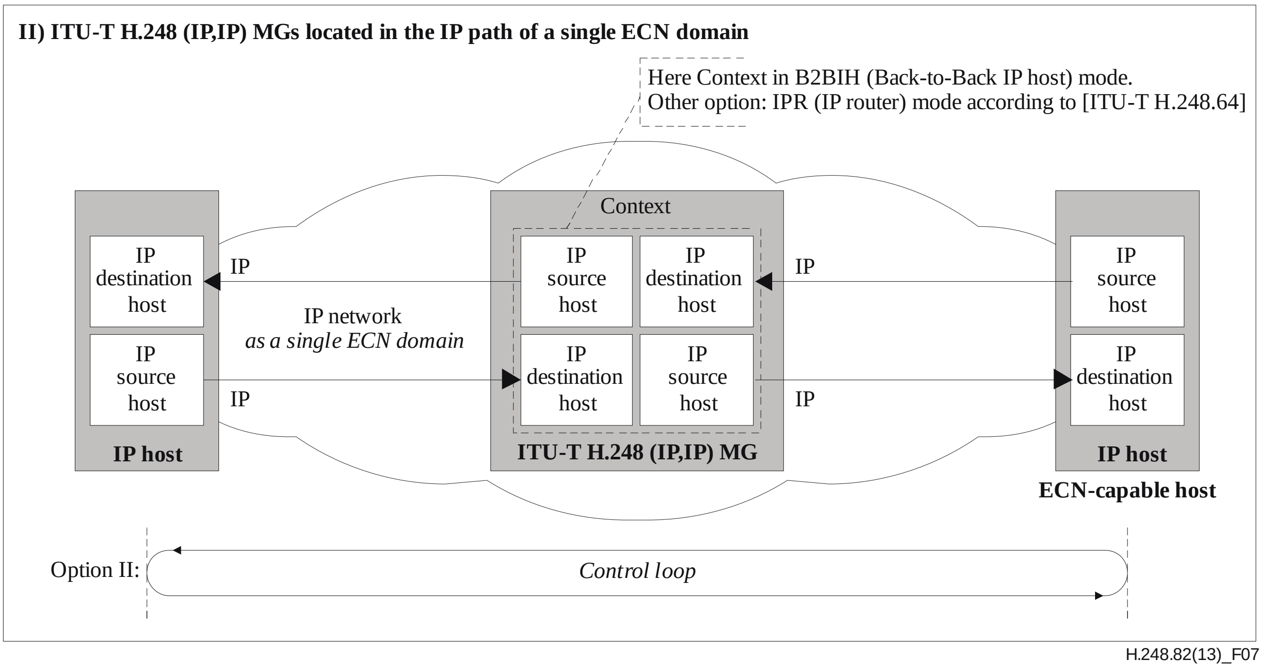


Figure 7 – ITU-T H.248 (IP,IP) MGs located in the IP path of a single ECN domain

The ITU-T H.248 MG may be required to enforce a different ECN support behaviour, like transparent forwarding of ECN information in IP headers, or the active marking of ECN bits due to "local congestion information", or the reading and collecting of ECN information for local ITU-T H.248 statistics, etc.

7 ECN for RTP-over-UDP Support package

Package name: ECN for RTP-over-UDP Support Package

Package ID: ecnrous (0x010b)

Description: This package allows an MGC to indicate to an MG that it shall support Explicit Congestion Notification (ECN) for RTP over UDP (as defined by [IETF RFC 6679]) on a particular Termination/Stream.

Version: 1

Extends: None

7.1 Properties

7.1.1 ECN Enabled

Property name: ECN Enabled

Property ID: ecnen (0x0001)

Description: This property allows the MGC to indicate whether or not ECN is enabled on a Stream.

Type: Boolean

Possible values: True ECN is enabled

False ECN is not enabled

Default: False

Defined in: Local/Remote

Characteristics: Read/Write

7.1.2 Congestion Response Method

Property name: Congestion Response Method

Property ID: crm (0x0002)

Description: When RTP packets are received with ECN-CE marks from the remote side or local congestion is experienced, the sender and/or receivers MUST react with congestion control as if those packets had been lost. However there are different control methods which an MG could use. This property allows the MGC to request different types of control. These types are defined in section 7.3.3 of [IETF RFC 6679].

Type: Enumeration

Possible values:	"SDCC" (0x0001)	Sender driven congestion control
	"RDCC" (0x0002)	Receiver driven congestion control
	"Hybrid" (0x0003)	A hybrid mechanism

The value "Hybrid" requires an additional MG behaviour description which is outside the scope of this Recommendation. This could be specified within an application profile.

Default: Provisioned

Defined in: Local/Remote

"SDCC" in Local Descriptor implies the MG, when receiving ECN-CE marked media, generates ECN feedback towards the sender of the media.

"RDCC" in Local Descriptor implies the MG reacts to the received ECN-CE marks without contacting the sender.

NOTE – As a result of the action taken by the MG, the sender is eventually notified, for example of a change of subscription to a less bandwidth consuming layer or through bit adaptation requests.

"SDCC" in Remote Descriptor implies ECN feedback may be received from the remote receiver and the MG shall react to this feedback for example with bit adaptation requests.

"RDCC" in Remote Descriptor requires no action from the MG.

Characteristics: Read/Write

7.1.3 Initiation method

Property name: Initiation Method

Property ID: initmethod (0x0003)

Description: This property indicates which ECN initiation method is to be used. This property is equivalent to the "init-value" defined by the ABNF grammar defined by section 6.1 of [IETF RFC 6679].

If the MGC requires that the MG choose any appropriate initiation value, it shall provide the list of possible value as an over specified list.

Type: String

Possible values: As per "init-value" in section 6.1 of [IETF RFC 6679].

"rtp", "ice" or "leap".

This package also defines an additional value "inactive" that may be used with this property or for the "init-value" parameter if SDP is used. "Inactive" indicates that no ECN initiation is performed (and thus the ECN procedures in clause 7.6.2.1 do not apply) for the particular RTP stream.

Default: Provisioned

Defined in: Local/Remote

Characteristics: Read/Write

7.1.4 ECN mode

Property name: ECN Mode

Property ID: mode (0x0004)

Description: The ECN Mode parameter as defined in [IETF RFC 6679] describes an endpoint's ability to set and read ECN marks in UDP packets. Thus it describes a bidirectional flow.

The ECN mode property in this package indicates whether the MG should set and/or read ECN marks. This property is equivalent to "mode" defined by the ABNF grammar defined by section 6.1 of [IETF RFC 6679]. However, the mode information is set in both the Local and Remote Descriptors and is thus unidirectional.

The property refers to the mode that the MG shall operate in order to determine the correct ECN procedures to apply. The MG specific semantic is detailed below.

Type: Enumeration

Possible values: As per "mode" section 6.1 of [IETF RFC 6679] with the exception that the value "setread" is not signalled by the MGC to the MG. Where an MGC requires "setread" behaviour it shall set "setonly" in the Remote Descriptor and "readonly" in the Local Descriptor.

"setonly" (0x0001)	This value is set in the Remote Descriptor and indicates that ECN marks may be set on this Stream.
"readonly" (0x0002)	This value is set in the Local Descriptor and indicates that ECN marks may be read from this Stream.

Default: In order to correspond to the [IETF RFC 6679] ECN Mode default ("setread"), the default setting of this property is "setonly" in the Remote Descriptor and "readonly" in the Local Descriptor.

Defined in: Local/Remote

Characteristics: Read/Write

7.1.5 ECT Marking

Property name: ECT Marking

Property ID: ectmark (0x0005)

Description: When set in the Remote Descriptor this property indicates how the MG should set ECN marks. When set in the Local Descriptor this property indicates which ECN mark is expected from the remote sender (Note). The expected value however does not usually influence the MG behaviour, even in the case where it does not correspond to the value actually received. This property is equivalent to the "ect" element defined by the ABNF grammar defined by section 6.1 of [IETF RFC 6679].

NOTE – There is also an ECN-CE marking function (besides ECT marking), which may be supported by ITU-T H.248 MGs and interim IP devices. Such marking due to experienced local congestion is out of scope of this property.

Type:	Enumeration
Possible values:	As per "ect" section 6.1 of [IETF RFC 6679]:
	"1" (0x0001)
	"0" (0x0002)
	"Random" (0x0003)
Default:	"0".
Defined in:	Local/Remote
Characteristics:	Read/Write

7.1.6 ECN Congestion Marking

Property name:	ECN Congestion Marking
Property ID:	congestmark (0x0006)
Description:	This property allows the MGC to indicate whether or not RTP packets may be ECN-CE marked by the MG (or not) if it the MG itself experiences congestion.
Type:	Enumeration
Possible values:	"mgdet" (0x0001): The MG determines if ECN Congestion Marking is enabled.
	"cemark" (0x0002): ECN Congestion marking is enabled.
	"nomark" (0x0003): ECN Congestion marking is not enabled.
Default:	Provisioned
Defined in:	Local/Remote NOTE – The property is irrelevant when included in the Local Descriptor.
Characteristics:	ReadOnly

7.1.7 ECN SDP Usage

Property name:	ECN SDP Usage	
Property ID:	ecnsdp (0x0007)	
Description:	This property allows the MGC to determine which method for signalling the ECN "initiation method", "mode" and "ect marking" the MG supports. The MGC may then use any method that the MG supports.	
Type:	Enumeration	
Possible values:	"P" (0x0001)	The properties in clauses 7.1.1, 7.1.3, 7.1.4 and 7.1.5.
	"S" (0x0002)	The SDP "**a=ecn-capable-rtp**" attribute.
	"B" (0x0003)	Either of the above two methods.
Default:	Provisioned	
Defined in:	Termination State (Root Termination only)	
Characteristics:	ReadOnly	

7.2 Events

7.2.1 ECN Failure

Event name: ECN Failure

Event ID: fail (0x0001)

Description: This event indicates that ECN has failed on the indicated StreamID. The event may be set at a Termination or Stream level. The ObservedEvent shall return the StreamID of where the ObservedEvent was detected. The MG shall return the failure type. The MG may optionally return the path that has failed.

7.2.1.1 EventsDescriptor parameters

None.

7.2.1.2 ObservedEventsDescriptor parameters

7.2.1.2.1 Failure Type

Parameter name: Failure Type

Parameter ID: type (0x0001)

Description: This parameter indicates at what stage ECN has failed. A failure may occur during the transport level initiation phase or during the ongoing use phase. A failure during the initiation phase indicates a problem with the signalling used for the initiation of ECN. A failure during the ongoing use phase indicates that whilst ECN was successfully negotiated, the continued use of ECN is causing problems. The detection of failures during ongoing use is described in section 7.4 of [IETF RFC 6679].

Type: Enumeration

Optional: No

Possible values: INIT (0x0001): Failure during initiation phase

USE (0x0002): Failure during ongoing use phase

Default: None

7.2.1.2.2 Media Sender SSRC

Parameter name: Media Sender SSRC

Parameter ID: ssrc (0x0002)

Description: This parameter contains the SSRC of the media sender with whom ECN has failed.

Type: Integer

Optional: Yes

Possible values: SSRC as per [IETF RFC 3550]

Default: None. If not sent it indicates all media senders associated with the StreamID have failed.

7.3 Signals

None.

7.4 Statistics

7.4.1 Source (SSRC)

Statistic name: Source

Statistic ID: ssrc (0x0001)

Description: This statistic provides a list of RTP sources associated with the Stream.

Type: Sub-list of integer

Possible values: SSRC as per [IETF RFC 3550]

Level: Stream

7.4.2 CE Counter

Statistic name: CE Counter

Statistic ID: cecount (0x0002)

Description: This statistic provides the number of RTP packets received so far in the session with an ECN field set to CE for a particular SSRC within the Stream. Each position of the sub-list is associated with a SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of double

Possible values: 0 and upwards

Level: Stream

7.4.3 ECT 0 Counter

Statistic name: ECT0 Counter

Statistic ID: ectzero (0x0003)

Description: This statistic provides the number of RTP packets received so far in the session with an ECN field set to ECT (0) for a particular SSRC within the Stream. Each position of the sub-list is associated with an SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of double

Possible values: 0 and upwards

Level: Stream

7.4.4 ECT 1 Counter

Statistic name: ECT1 Counter

Statistic ID: ectone (0x0004)

Description: This statistic provides the number of RTP packets received so far in the session with an ECN field set to ECT (1) for a particular SSRC within the Stream. Each position of the sub-list is associated with an SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of double

Possible values: 0 and upwards

Level: Stream

7.4.5 Not-ECT Counter

Statistic name: Not-ECT Counter

Statistic ID: notect (0x0005)

Description: This statistic provides the number of RTP packets received so far in the session with an ECN field set to not-ECT for a particular SSRC within the Stream. Each position of the sub-list is associated with an SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of double

Possible values: 0 and upwards

Level: Stream

7.4.6 Lost Packets Counter

Statistic name: Lost Packets Counter

Statistic ID: lost (0x0006)

Description: This statistic provides the number of RTP packets that are expected minus the number received for a particular SSRC within the Stream. Each position of the sub-list is associated with a SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of double

Possible values: 0 and upwards

Level: Stream

7.4.7 Extended Highest Sequence number

Statistic name: Extended Highest Sequence number

Statistic ID: ehsn (0x0007)

Description: This statistic provides the highest sequence number seen when sending this report, but with additional bits, to handle disambiguation when wrapping the RTP sequence number field for a particular SSRC within the Stream. Each position of the sub-list is associated with a SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.

Type: Sub-list of integer

Possible values: 0 and upwards

Level: Stream

7.4.8 Duplication Counter

Statistic name:	Duplication Counter
Statistic ID:	dup (0x0008)
Description:	This statistic provides the cumulative number of RTP packets received that are a duplicate of an already received packet from this SSRC since the receiver joined the RTP session. Each position of the sub-list is associated with a SSRC at related position in the *ssrc* statistic. See section 7.4.2 of [IETF RFC 6679] for more details.
Type:	Sub-list of integer
Possible values:	0 and upwards
Level:	Stream

7.5 Error codes

None.

7.6 Procedures

7.6.1 RTP topology

ECN functionality may be used with different RTP session topologies. The ECN behaviour in conjunction with certain RTP topologies is described in section 3.2 of [IETF RFC 6679]. Through the MGC setting the combination of Terminations/Streams in a Context, the properties in the "ECN for RTP-over-UDP Support" and other elements in the Local and Remote Descriptors, the MG is able to determine the correct ECN behaviour.

7.6.2 Negotiation of the capability to use ECN with RTP/UDP/IP

As per [IETF RFC 6679], an MG supporting ECN with RTP/UDP/IP requires different RTCP extensions:

– RTP/AVPF [IETF RFC 4585] transport layer feedback format for urgent ECN information;

– RTCP XR [IETF RFC 3611] ECN summary report block type for regular reporting of the ECN marking information.

Thus, in addition to the methods for indicating/negotiating ECN described below, the MGC may need to send other information (i.e., SDP "**m**=" and "**a**=" lines) indicating the support of RTP/AVPF [IETF RFC 4585] and RTCP XR [IETF RFC 3611] as well as the appropriate address information for the Stream.

NOTE – In some cases (i.e., where timely feedback is not required and usage of the leap of faith initialization method) transport layer feedback for urgent ECN information may not be required. See section 3.3 of [IETF RFC 6679] for further information on the need for transport layer feedback.

In order to be notified of failures, the MGC shall also set the "ECN failure" (*ecnrous/fail*) event.

If the MGC requires information regarding the use of ECN, the MGC should set the "Source" (*ecnrous/ssrc*), "CE Counter" (*ecnrous/cecount*), "ECT 0 Counter" (*ecnrous/ectzero*), "ECT 1 Counter" (*ecnrous/ectone*), "Not-ECT Counter" (*ecnrous/notect*), "Lost Packets Counter" (*ecnrous/lost*) and the "Extended Highest Sequence Number" (*ecnrous/ehsn*) statistics. Alternatively, for packet loss counters, the statistics defined in the RTP package [ITU-T H.248.1] can be used.

[ITU-T H.248.47] provides a means to dynamically discover the values of statistics. However [ITU-T H.248.47] is only applicable where a statistic has a single value. It does not support statistics with type "list of". Thus, if [ITU-T H.248.47] is used with the statistics in this Recommendation, it shall be used in the case that a statistic relates to a single SSRC.

7.6.2.1 Signalling ECN capability

In order to use ECN, the use of ECN needs to be enabled and information regarding the "initiation method", "ecn mode" and "ect marking" needs to be determined. These may be communicated to the MG either utilising the "ECN Enable" (*ecnrous/ecnen*), "Initiation Method" (*ecnrous/initmethod*), "ECN Mode" (*ecnrous/mode*) and "ECT Marking" (*ecnrous/ectmark*) properties or via the use of the "**a=ecn-capable-rtp**" SDP attribute as defined in section 6.1 of [IETF RFC 6679]. The MGC can determine which method is supported via an audit of the "ECN SDP Usage" (*ecnrous/ecnsdp*) property. Alternatively, the supported method may be provisioned. For the property based signalling method any property that has a provisioned value does not need to be sent for the relevant Stream. For the SDP based method, the MGC shall include a CHOOSE wildcard for the particular information element in question.

In order to utilize the RTCP ECN feedback and the RTCP XR block for ECN summary, the use of these should be indicated as per sections 6.2 and 6.3 of [IETF RFC 6679].

If the MGC requires that the MG apply a particular congestion control method as a result of the reception of ECN-CE marked RTP packets, it shall send the "Congestion Response Method" (*ecnrous/crm*) property to the MG with the required value.

Furthermore, the MGC may also control through the use of the "ECN Congestion Marking" (*ecnrous/congestmark*) property whether or not RTP packets may be ECN-CE marked by the MG (or not) if it the MG itself experiences congestion.

The above properties are defined for use in the Local and Remote Descriptors as these are related to stream resources that need to be reserved on a per-stream basis. ITU-T H.248 Streams are bidirectional in nature with one direction described by the Local Descriptor and the other via the Remote Descriptor. This allows an asymmetric usage of ECN. However, for a typical bidirectional use case, symmetric usage with the parameters placed in both the Local and Remote Descriptors may be assumed.

When ECN is used in both the sending and receiving direction the *ecnrous/mode* is set to "readonly" in the Local Descriptor and to "setonly" in the Remote Descriptor. The *ecnrous/ecnen* is set to TRUE in both Descriptors.

When ECN is only used in the receiving direction, the *ecnrous/mode* property is set to "readonly" in the Local Descriptor. The *ecnrous/ecnen* property is set to TRUE in the Local Descriptor and to FALSE in the Remote Descriptor.

When ECN is only used in the sending direction, the *ecnrous/mode* property is set to "setonly" in the Remote Descriptor. The *ecnrous/ecnen* property is set to TRUE in the Remote Descriptor and to FALSE in the Local Descriptor.

7.6.2.2 ICE parameter to signal ECN capability

As per section 6.4 of [IETF RFC 6679], an Internet connectivity exchange (ICE) [IETF RFC 5245] flag may be used to indicate ECN support for ICE. However, it is assumed that this attribute is used between MGCs when they have knowledge that the MG supports ECN functionality. This may be known through provisioning or an Audit of the Packages Descriptor indicating the support of the "ECN Package".

7.6.3 Initiation and initial verification of ECN capable transport

The use and initiation of ECN on a Termination/Stream is mainly determined via the setting of "ECN Enabled" equal to "True" on a Termination/Stream in combination with an "Initiation Method". [IETF RFC 6679] defines three initiation methods "rtp", "ice" and "leap". This package defines an additional method "inactive", which indicates that ECN initiation procedures should not be started. Other properties may be examined in the Local and Remote Descriptors to determine media handling that may have an impact on ECN procedures and error handling. This can be used, for example, to determine:

– If there is a change in packetization (segmentation/reassembly);

– If there is transcoding.

NOTE 1 – As per [IETF RFC 6679], a transcoding scenario requires the use of ECN properties to split the ECN connection in two parts, each with its own negotiation.

If "ECN Enabled" equal to "True" and "Initiation Method" equal to "inactive" (either by default or specification) is set on the same stream (and direction) on both Terminations of a Context with no other ECN related properties set then the MG shall not perform ECN initiation. It shall behave as an ECN aware MG and copy ECN bits (including CE information) from ingress packets to the egress one.

If "ECN Enabled" equal to "True" and "Initiation Method" equal to "inactive" (either by default or specification) is set on the same stream (and direction) on both Terminations of a Context with no other ECN related properties set, but the MG performs packet segmentation or reassembly, without media transcoding, the MG derives ECT and ECN-CE marks in the egress stream from the corresponding ones in the ingress stream, as specified in [IETF RFC 6679].

If "ECN Enabled" is equal to "True", "Initiation Method" is set to a value other than "inactive" and other ECN related properties are set then the MG shall perform ECN initiation and processing. The Termination at which these properties are set shall behave as an ECN endpoint, i.e., it shall not pass ECT markings transparently to its egress even if the corresponding termination has identical stream properties.

NOTE 2 – The MGC may determine that ECN processing is required as a result of the need for transcoding. [IETF RFC 6679] indicates that where transcoding occurs, a middlebox (i.e., the MG) shall process ECN as separate ECN Endpoints. ECN processing may also be required due to independent ECN negotiation at the call control layer, independent of transcoding.

ECN processing may also be triggered by setting "ECN Enabled" equal to "True" on a single Termination/Stream and "ECN Enable" equal to "False" on the opposite Termination/Stream. If behaviour other than the specified default behaviour is required, the properties in this package related to that behaviour shall be signalled.

NOTE 3 – The support of section 7.2.2 of [IETF RFC 6679] is for further study. [ITU-T H.248.50] supports STUN and ICE but does not support an ECN field.

As per section 7.2.1 of [IETF RFC 6679], the transport level negotiation of ECN may be unsuccessful and this should be logged. The ECN failure event (*ecnrous/fail*) with failure type "INIT" is used to indicate this to the MGC.

7.6.4 Ongoing use of ECN within an RTP session

7.6.4.1 ECN Initiated

Once the MG has initiated ECN it shall operate according to section 7.3 of [IETF RFC 6679]. If reduced size RTCP [IETF RFC 5506] is to be used this should be indicated (via "**a=rtcp-rsize**"), this should be signalled as part of section 5.1 of [IETF RFC 6679].

When RTP packets are received with ECN-CE marks, senders and/or receivers shall react with an appropriate congestion control. One of several different types of congestion control may be used (see section 7.3.3 of [IETF RFC 6679]). When the MG receives RTP packets with ECN-CE marks it should act according to the type specified in the "Congestion Response Method" (*ecnrous/crm*) property.

On receipt of the RTP packets with ECN-CE marks if the MGC has previously requested notification of this (via [ITU-T H.248.47], see clause 7.6.2 above) and the relevant criteria is met, then the MG shall notify the MGC of this ObservedEvent.

7.6.4.2 No ECN initiated

If no ECN initiation was performed, the MG shall continue to operate according to clause 7.6.2 as per cases where "Initiation Method" equals "inactive".

7.6.5 Handling of dynamic groups through failure detection, verification and fallback

When detecting failures, the MG should operate according to sections 7.4, 7.4.1 and 7.4.2 of [IETF RFC 6679]. This allows the MG to act autonomously to congestion, high packet loss rate and other failures without the need for interaction with an MGC. However, if the MG determines that the use of ECN should be disabled, it should notify this to the MGC via the ECN failure event (*ecnrous/fail*) with type set to "USE"; the criteria for the MG to determine this is outside the scope of this Recommendation.

Associated with ECN are summary reports that may be used to detect various types of ECN path issues. These reports are per source SSRC and contain the following information: CE counter, ECT (0/1) counters, not-ECT Counter, Lost Packets counter, Extended Highest Sequence number and Duplication Counter. For more information, see section 7.4.2 of [IETF RFC 6679]. The MG sends these reports to its peer using RTCP. The MGC may also request this information for its own purposes, which is outside the scope of this Recommendation. In order to make this information available to an MGC, this information is recorded in ITU-T H.248 statistics. Thus, if the MGC requires this information, it should set the statistics during the capability negotiation phase (see clause 6.4). The MGC may then perform an AuditValue.req on the statistics. In order to support multiple SSRCs per Stream, the values of the Statistics are in a sub-list form. The values in a certain sub-list position are relative to each other across all the statistics in the ECN package.

7.6.6 Interactions

There may be interactions between ECN with other congestion control mechanisms or priority handling schemes in use by endpoints/networks.

Clause 9 of [ITU-T H.248.81] provides some details on the interaction between ECN and the Emergency Telecommunications Service (ETS) [ITU-T E.107].

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