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

**Gateway control protocol: International CAS
compelled register signalling packages**

Recommendation ITU-T H.248.29



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Recommendation ITU-T H.248.29

Gateway control protocol: International CAS compelled register signalling packages

Summary

The packages in Recommendation ITU-T H.248.29 provide ITU-T H.248 support for channel associated signalling (CAS) compelled register signalling. This can be used for R2, although the packages are generic so that they can also be used for other non-R2 compelled schemes. This Recommendation proposes methods to support:

- standard *en bloc* compelling;
- overlap compelling;
- the ability to enable end-to-end compelled signalling.

This Recommendation provides only the capabilities of compelled register signalling and it is expected that a system would need to implement the *bcas*, *icas* and *casblk* packages for the line signalling components of any CAS protocol.

Three packages are defined in Annex A:

- *icasc* which provides standard *en bloc* compelling;
- *icasco* which extends *icasc* and provides overlap compelling in addition to *en bloc*;
- *icasce* which extends *icasco* and provides the ability to enable end-to-end signalling in addition to *en bloc* and overlap.

Annex B defines an alternative package for support of these functions, called *icascgen*. This package defines a generic register signalling, which may be used for national variants of Signalling System R2. This kind of interregister signalling is a compelled multifrequency code system. The package is suitable for ITU-T Signalling System R2, although it is defined in a generic way. Thus it can also be used exclusively, or in addition to the packages defined in Annex A. The proposed package comprises following compelled address transfer modes:

- generic standard *en bloc* compelling; and
- overlap procedures.

NOTE – The ability to enable end-to-end compelled signalling utilizing Annex B is for further study.

Annex B introduces the concepts of Detection Events Map and Generation Signals Map, which are very similar to ITU-T H.248 Digit Map usage.

This revision incorporates a new parameter to indicate whether the Generic Digit information Event is generated in the event of an unsuccessful events map match.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.248.29	2005-01-08	16
1.1	ITU-T H.248.29 (2005) Cor. 1	2007-08-29	16
2.0	ITU-T H.248.29	2013-03-16	16

FOREWORD

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

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

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

NOTE

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

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As of the date of approval of this Recommendation, ITU had 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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Recommendation ITU-T H.248.29

Gateway control protocol: International CAS compelled register signalling packages

1 Scope

These packages are intended for use in analogue (one-way operation) or digital transmission systems (one-way or both-ways operations). The MGC should be unaware of the transmission details at the physical layer. The MG is therefore assumed to be provisioned with the actual signalling frequencies for interregister signalling (for example 2-out-of-n inband multifrequency code with forward and backward compelled signalling for R2) along with their properties such as amplitude, tone duration, cadence, etc. and also their logical significance. Any timers that dictate the interregister compelling actions are also assumed to be provisioned in the MG.

NOTE – Annex B specifies additional termination properties allowing the definition of some SSR2 timers.

Support for any of these packages is optional.

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.248.16] Recommendation ITU-T H.248.16 (2013), *Gateway control protocol: Enhanced digit collection packages and procedures*.

[ITU-T H.248.25] Recommendation ITU-T H.248.25 (2013), *Gateway control protocol: Basic CAS packages*.

[ITU-T H.248.28] Recommendation ITU-T H.248.28 (2007), *Gateway control protocol: International CAS packages*.

[ITU-T Q.400] Recommendation ITU-T Q.400-Q.490 (1988), *Specifications of Signalling System R2*.

[ITU-T Q-Sup.7] ITU-T Q-series Recommendations – Supplement 7 (1988), *Semi-compelled and non-compelled multifrequency interregister signalling for national satellite applications based on System R2 interregister signalling*.

3 Definitions

This Recommendation defines the following terms:

3.1 backward signal: A signal, used for the establishment, release or other control of a connection, sent in the opposite direction to call set-up.

3.2 compelled signalling: A signalling method in which the signal to be transmitted is applied continuously until acknowledged or until a timeout occurs. Upon recognition of the initial signal, the acknowledgement signal is applied continuously until the cessation of the initial signal or until a timeout occurs. The cessation of the acknowledgement signal may provoke the beginning of the

next subsequent compelled cycle. In addition to the acknowledgement, the acknowledgement signal may carry other signalling information (e.g., concerning the next cycle).

3.3 *en bloc* signalling: A signalling method in which the address digits are assembled into one block for onward transmission, the block containing all of the address information necessary to route the call to its destination.

3.4 *end-to-end* signalling: A signalling method in which signals are transmitted from one end of a multi-link connection to the other end where processing of these signals is required.

3.5 *forward* signal: A signal, used for the establishment, release or other control of a connection sent in the same direction as call set-up.

3.6 *interregister* signalling: Signalling System R2: Interregister signals are of the multifrequency type using a 2-out-of-6 in-band code in both directions. The multifrequency combinations are sent and received by multifrequency signalling equipment which is assumed to be associated with the registers used to control the switching equipment at both ends of the inter-exchange link.

3.7 *KP (start-of-pulsing)* signal (sent in the forward direction): This register signal is sent subsequent to the recognition of a start-dialling signal and is used to prepare the incoming multifrequency register for the receipt of subsequent interregister signals.

3.8 *line* signalling: A signalling method in which signals are transmitted between equipment which terminate and continuously monitor part or all of the traffic circuit.

3.9 *overlap address* signalling: A signalling method in which the onward transmission of address signals from a switching centre may commence before the reception of all the address signals over the preceding link has been completed.

3.10 *register*: The apparatus, in an automatic system, which receives the dialled impulses and controls the subsequent switching operations.

3.11 *register* function: The functions of receiving, storing, analysing and possibly translating and transmitting address information and other information for the purpose of controlling the setting-up of a call.

3.12 *register* signalling: Signalling System R1: Link-by-link multifrequency (MF) in-band pulse signalling is used for the transmission of address information. The signalling frequencies are 700 Hz to 1700 Hz, in 200 Hz steps, and combinations of two, and two only, determine the signal. The address information is preceded by a KP signal (start-of-pulsing) and terminated by an ST signal (end-of-pulsing). Either *en bloc*, *en bloc* overlap or overlap sending may apply. This register signalling arrangement is used extensively with other in-band and out-of-band line signalling systems.

3.13 *ST (end-of-pulsing)* signal (sent in the forward direction): This register signal is sent to indicate that there are no more address signals to follow. The signal is always sent in semi-automatic as well as automatic working.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CAS	Channel Associated Signalling
IC	Incoming
MC	Multifrequency Combination
MF	Multifrequency
MG	Media Gateway

MGC	Media Gateway Controller
NGN	Next Generation Network
OG	Outgoing
SSR2	Signalling System R2

5 ITU-T H.248 package approaches for compelled CAS

This Recommendation takes into account that there are various NGN evolution scenarios for legacy compelled CAS equipment. Thus, it supports different modes of operation.

5.1 System operation modes

This Recommendation defines two operation modes of the ITU-T H.248 interface for support of international compelled CAS register signalling systems (see Appendix II for a complete CAS system overview). The first design is more "MG centric" and covered in Annex A. The second approach in Annex B may be correspondingly called "MGC centric".

The background is a slightly different functional partitioning concept with respect to control and CAS signalling handling. "MGC centric" means that the full handling is more or less located in the ITU-T H.248 media gateway controller. In the "MG centric" approach, the ITU-T H.248 media gateway provides local handling, for instance in order to offload the MGC.

Annexes A and B are basically functionally equivalent. Of course, both halves of an associated MGC-MG pair must be operated in the same mode. It is further anticipated that an MGC is either operated in Annex A or Annex B mode, but not supporting both operation modes in parallel. This is due to the underlying functional partitioning approach.

The ITU-T H.248.29 operation mode on the media gateway side is determined by the corresponding MGC node.

5.2 Reasons and criteria

There are a number of different possible approaches for partitioning the functional responsibility between the media gateway controller and the media gateway. Partitioning criteria are dependent upon the system or network architecture and may consider the following: the number of interactions between the MGC and MG, timing considerations, the abstraction level of the ITU-T H.248 interface, signalling complexity, coverage of compelled CAS address transfer modes, coverage of existing CAS systems, reusability of control logic, recognition of existing CAS equipment, recognition of /market/region/country specific CAS variants or recognition of customized design extensions (CDE) in general.

It shall be noted that this list is unweighted and not exhaustive. Deciding upon an ITU-T H.248.29 operation mode according to Annex A or Annex B may be the natural result of an evaluation of a specific subset of these types of criteria.

5.3 Motivation for two package approaches

Channel associated signalling (CAS) has been successfully deployed in private and public telecommunication networks for more than a half-century, since the introduction of electro-mechanical and stored-program controlled circuit switching techniques. This historical situation and background is the prime reason why it is not easy to define a straightforward interconnection model between ITU-T H.248 media gateways for next generation networks (NGN) and the broad spectrum of CAS standards and variants in use.

The two operation modes of ITU-T H.248.29 originate in different partitioning principles of the control architecture in legacy synchronous transfer mode (STM) switches. The decomposition principles may be diverse, particularly for compelled CAS capable switching systems. ITU-T H.248.29 recognizes the fact of this installed legacy switching base and offers seamless evolution paths toward NGN by applying either Annex A or B.

Annex A

International CAS compelled register signalling packages

(This annex forms an integral part of this Recommendation.)

A.1 International CAS Compelled Package

Package name:	ICAS Compelled Package
Package ID:	icasc (0x007d)
Description:	This package defines ITU-T H.248 methods to support channel associated signalling (CAS) compelled standard <i>en bloc</i> register signalling.
Version:	1
Extends:	None

A.1.1 Properties

A.1.1.1 Source Number Length

Property name:	Source Number Length
Property ID:	snl (0x0001)
Description:	Indicates that the calling party digits are to be collected by the MG up to a maximum length as specified by this parameter value.
Type:	Integer
Possible values:	Non-negative number of digits; 0 indicates no defined maximum length.
Default:	Provisioned
Defined in:	TerminationState
Characteristics:	Read/Write

A.1.1.2 Compelling Sequence Keepalive Time

Property name:	Compelling Sequence Keepalive Time
Property ID:	cskt (0x0002)
Description:	Specifies the time duration for which the incoming MG may keep alive the compelling sequence waiting for the called party reachability status information (or alternative compelled sequence completion signal) from the MGC.
Type:	Integer
Possible values:	Non-negative number of milliseconds
Default:	Provisioned
Defined in:	TerminationState
Characteristics:	Read

A.1.2 Events

A.1.2.1 Address

Event name:	Address
Event ID:	addr (0x0001)
Description:	Reports the address parameters collected through compelled register signalling. The Event supports <i>en bloc</i> compelled register signalling. The MG will perform standard <i>en bloc</i> compelled register signalling, with all the relevant information (di, si, sc, etc.) being collected and then Notified at the end as a single ObservedEvent. After receiving the first incoming digit, the information collected and the order of collecting the information is determined by local MG provisioning.

A.1.2.1.1 EventsDescriptor parameters

A DigitMap (as defined in clause 7.1.14 of [ITU-T H.248.1]) parameter activated for collection of destination number, by specifying a digitmap by name (previously configured) or by value. Where such a digitmap is missing, destination number shall be collected until end-of-digit signal is detected.

A.1.2.1.2 ObservedEventsDescriptor parameters

A.1.2.1.2.1 Destination Number

Parameter name:	Destination Number
Parameter ID:	di (0x0001)
Description:	The called party number digit string collected through the compelled register signalling.
Type:	String
Optional:	No
Possible values:	A sequence of the characters '0' through '9'.
Default:	None

A.1.2.1.2.2 Destination Number Termination Method

Parameter name:	Destination Number Termination Method
Parameter ID:	dimeth (0x0002)
Description:	Indicates the reason for the generation of the Destination Number parameter. When a digitmap is present in the EventsDescriptor, this is a mandatory ObservedEventsDescriptor parameter. When a digitmap is absent from the EventsDescriptor, this parameter shall be absent from the ObservedEvents Descriptor.
Type:	Enumeration
Optional:	Yes
Possible values:	"UM" (0x0001) Unambiguous Match "PM" (0x0002) Partial Match
Default:	None

A.1.2.1.2.3 Source Number

Parameter name:	Source Number
Parameter ID:	si (0x0003)
Description:	The calling party number digit string, that is collected during compelled register signalling.
Type:	String
Optional:	Yes
Possible values:	A sequence of the characters '0' through '9'.
Default:	None

A.1.2.1.2.4 Source Number Termination Method

Parameter name:	Source Number Termination Method
Parameter ID:	simeth (0x0004)
Description:	If the Source Number parameter is reported, this parameter indicates the method of its termination.
Type:	Enumeration
Optional:	Yes
Possible values:	"EP" (0x0001) End of Pulsing "ML" (0x0002) Maximum Length "TO" (0x0003) Timeout
Default:	None

A.1.2.1.2.5 Calling Subscriber Category 1

Parameter name:	Calling Subscriber Category 1
Parameter ID:	sc1 (0x0005)
Description:	The Calling Party subscriber's category, as collected through compelled register signalling delivered in response to category request A-3.
Type:	Enumeration
Optional:	Yes
Possible values:	"NNPS" (0x0001) Non-priority subscriber (National Working) "NPRS" (0x0002) Priority subscriber (National Working) "NMNT" (0x0003) Maintenance equipment (National working) "NOPR" (0x0004) Operator call (National Working) "NDT" (0x0005) Data transmission (National working) "ISOPR" (0x0006) Subscriber or operator without forward transfer facility (International working) "IOPRF" (0x0007) Operator with forward transfer facility (International working) "IDT" (0x0008) Data transmission (International working) "IPRS" (0x0009) Priority subscriber (International working) "NSMTR" (0x000a) Subscriber with meter (National working) "SIDD" (0x000b) Subscriber with IDD "NATL1" (0x000c) Spare for National Use (equivalent to II-4)

"NATL2" (0x000d)	Spare for National Use (equivalent to II-11)
"NATL3" (0x000e)	Spare for National Use (equivalent to II-12)
"NATL4" (0x000f)	Spare for National Use (equivalent to II-13)
"NATL5" (0x0010)	Spare for National Use (equivalent to II-14)
"NATL6" (0x0011)	Spare for National Use (equivalent to II-15)

Default: None

A.1.2.1.2.6 Echo Suppression

Parameter name: Echo Suppression

Parameter ID: es (0x0006)

Description: Control information on echo suppressors.

Type: Enumeration

Optional: Yes

Possible values:

"OGRQ" (0x0001)	Call requires echo suppressors and outgoing half-echo suppressor has to be inserted
"NRQ" (0x0002)	Call may not require any echo suppressor
"OGINS" (0x0003)	Call requires echo suppressors and outgoing half-echo suppressor has already been inserted
"ICRQ" (0x0004)	Call requires incoming echo suppressors to be inserted

Default: None

A.1.2.1.2.7 Country Code

Parameter name: Country Code

Parameter ID: cc (0x0007)

Description: If present, conveys the country code (and possibly the area code) information digits collected as a part of the compelled register signalling in international working.

Type: String

Optional: Yes

Possible values: A sequence of the characters '0' through '9'.

Default: None

A.1.2.1.2.8 Discriminating Indicator

Parameter name: Discriminating Indicator

Parameter ID: disc (0x0008)

Description: For automatic working, this will specify that a discriminating digit is used. For semi-automatic working, this will specify the service language (Language digit) to be used by the operator. For international working this may serve as a test call indicator.

Type: Enumeration

Optional: Yes

Possible values:	"DISC" (0x0001)	Discriminating digit for automatic working
	"FR" (0x0002)	Language digit French
	"EN" (0x0003)	Language digit English
	"GR" (0x0004)	Language digit German
	"RU" (0x0005)	Language digit Russian
	"SP" (0x0006)	Language digit Spanish
	"OT1" (0x0007)	Language digit Other (as indicated by I-6 pulse)
	"OT2" (0x0008)	Language digit Other (as indicated by I-7 pulse)
	"OT3" (0x0009)	Language digit Other (as indicated by I-8 pulse)
	"OT4" (0x000a)	Language digit Other (as indicated by I-9 pulse)
	"TCI" (0x000b)	Call by automatic test equipment

Default: None

A.1.2.1.2.9 Nature of Circuit

Parameter name:	Nature of Circuit	
Parameter ID:	noc (0x0009)	
Description:	Reports if satellite links are included in circuits involved with the connection.	
Type:	Enumeration	
Optional:	Yes	
Possible values:	"SATINC" (0x0001)	Satellite link included
	"SATNOINC" (0x0002)	Satellite link not included
Default:	None	

A.1.2.1.2.10 Access Indicator

Parameter name:	Access Indicator	
Parameter ID:	ai (0x000a)	
Description:	If present, indicates that the call must be routed to the indicated position. In the case of "TST", test equipment address digits are conveyed in the destination number parameter.	
Type:	Enumeration	
Optional:	Yes	
Possible values:	"INC" (0x0001)	Incoming Operator
	"DEL" (0x0002)	Delay Operator
	"TST" (0x0003)	Test Equipment
Default:	None	

A.1.2.1.2.11 Calling Subscriber Category 2

Parameter name:	Calling Subscriber Category 2	
Parameter ID:	sc2 (0x000b)	
Description:	The Calling Party subscriber's category, as collected through compelled register signalling delivered in response to category request A-5. This category is occasionally known as the Billing category.	
Type:	Enumeration	

Optional:	Yes	
Possible values:	"NNPS" (0x0001)	Non-priority subscriber (National Working)
	"NPRS" (0x0002)	Priority subscriber (National Working)
	"NMNT" (0x0003)	Maintenance equipment (National working)
	"NOPR" (0x0004)	Operator call (National Working)
	"NDT" (0x0005)	Data transmission (National working)
	"ISOPR" (0x0006)	Subscriber or operator without forward transfer facility (International working)
	"IOPRF" (0x0007)	Operator with forward transfer facility (International working)
	"IDT" (0x0008)	Data transmission (International working)
	"IPRS" (0x0009)	Priority subscriber (International working)
	"NSMTR" (0x000a)	Subscriber with meter (National working)
	"SIDD" (0x000b)	Subscriber with IDD
	"NATL1" (0x000c)	Spare for National Use (equivalent to II-4)
	"NATL2" (0x000d)	Spare for National Use (equivalent to II-11)
	"NATL3" (0x000e)	Spare for National Use (equivalent to II-12)
	"NATL4" (0x000f)	Spare for National Use (equivalent to II-13)
	"NATL5" (0x0010)	Spare for National Use (equivalent to II-14)
	"NATL6" (0x0011)	Spare for National Use (equivalent to II-15)
Default:	None	

A.1.2.2 CAS Failure Event

Event name:	CAS Failure Event	
Event ID:	casf (0x0002)	
Description:	This event handles failure or abnormal register signalling conditions associated with this package.	

A.1.2.2.1 EventsDescriptor parameters

None.

A.1.2.2.2 ObservedEventsDescriptor parameters

A.1.2.2.2.1 Error Code

Parameter name:	Error Code	
Parameter ID:	ec (0x0001)	
Description:	Describes the failure reason.	
Type:	Enumeration	
Optional:	No	
Possible values:	"RTO" (0x0001)	Register Signalling Timeout
	"ADR" (0x0002)	Error during outpulsing
	"ERR" (0x0003)	Error in compelling sequence with peer signalling entity.
	"INC" (0x0004)	Information signalled by the MGC is incomplete, and the compelling sequence at the outgoing MG cannot continue.
	"CSKT" (0x0005)	The Compelling Sequence Keepalive Timer has expired.

"SME" (0x0006) CAS protocol state machine error

Default: None

A.1.2.3 Called Party Reachability Status

Event name: Called Party Reachability Status

Event ID: cprs (0x0003)

Description: Reports the line status of the called subscriber in order to terminate compelling.

A.1.2.3.1 EventsDescriptor parameters

None.

A.1.2.3.2 ObservedEventsDescriptor parameters

A.1.2.3.2.1 Subscriber Line Condition

Parameter name: Subscriber Line Condition

Parameter ID: lsts (0x0001)

Description: Conveys the line condition of the subscriber.

Type: Enumeration

Optional: No

Possible values:

"UN" (0x0001)	Unallocated number
"SLB" (0x0002)	Subscriber line busy
"SLFC" (0x0003)	Subscriber line free, charge
"SLFNOC" (0x0004)	Subscriber line free, no charge
"SOO" (0x0005)	Subscriber out of order
"SIT" (0x0006)	Send special information tone
"NK" (0x0007)	Subscriber status not known, set-up speech path
"NATL1" (0x0008)	Spare for National Use (equivalent to B-1)
"NATL2" (0x0009)	Spare for National Use (equivalent to B-9)
"NATL3" (0x000a)	Spare for National Use (equivalent to B-10)
"NATL4" (0x000b)	Spare for National Use (equivalent to B-11)
"NATL5" (0x000c)	Spare for National Use (equivalent to B-12)
"NATL6" (0x000d)	Spare for National Use (equivalent to B-13)
"NATL7" (0x000e)	Spare for National Use (equivalent to B-14)
"NATL8" (0x000f)	Spare for National Use (equivalent to B-15)

Default: None

A.1.2.4 Congestion

Event name: Congestion

Event ID: cng (0x0004)

Description: Reports the register signal indicating network congestion at the far end.

A.1.2.4.1 EventsDescriptor parameters

None.

A.1.2.4.2 ObservedEventsDescriptor parameters

A.1.2.4.2.1 Location

Parameter name:	Location
Parameter ID:	loc (0x0001)
Description:	Conveys the location of the congestion.
Type:	Enumeration
Optional:	Yes
Possible values:	"NATL" (0x0001) Congestion at national level "INTL" (0x0002) Congestion at international level
Default:	NATL

A.1.3 Signals

A.1.3.1 Address

Signal name:	Address
Signal ID:	addr (0x0001)
Description:	This is a composite signal that supplies all the necessary address parameters to start the compelling register signalling from the outgoing MG. The MG shall transmit only the information that is relevant to the compelling action configured at the MG and requested by the compelling peer.
Signal type:	TimeOut
Duration:	Depends on parameters supplied

A.1.3.1.1 Additional parameters

A.1.3.1.1.1 Destination Number

Parameter name:	Destination Number
Parameter ID:	di (0x0001)
Description:	The called party number digits.
Type:	String
Optional:	No
Possible values:	A sequence of the characters '0' through '9'.
Default:	None

A.1.3.1.1.2 Source Number

Parameter name:	Source Number
Parameter ID:	si (0x0002)
Description:	The calling party number digits.
Type:	String
Optional:	Yes
Possible values:	A sequence of the characters '0' through '9'.

Default: Empty ("")

A.1.3.1.1.3 Calling Subscriber Category 1

Parameter name: Calling Subscriber Category 1

Parameter ID: sc1 (0x0003)

Description: The Calling Party subscriber's category, as collected through compelled register signalling delivered in response to category request A-3.

Type: Enumeration

Optional: Yes

Possible values:

"NNPS" (0x0001)	Non-priority subscriber (National Working)
"NPRS" (0x0002)	Priority subscriber (National Working)
"NMNT" (0x0003)	Maintenance equipment (National working)
"NOPR" (0x0004)	Operator call (National Working)
"NDT" (0x0005)	Data transmission (National working)
"ISOPR" (0x0006)	Subscriber or operator without forward transfer facility (International working)
"IOPRF" (0x0007)	Operator with forward transfer facility (International working)
"IDT" (0x0008)	Data transmission (International working)
"IPRS" (0x0009)	Priority subscriber (International working)
"NSMTR" (0x000a)	Subscriber with meter (National working)
"SIDD" (0x000b)	Subscriber with IDD
"NATL1" (0x000c)	Spare for National Use (equivalent to II-4)
"NATL2" (0x000d)	Spare for National Use (equivalent to II-11)
"NATL3" (0x000e)	Spare for National Use (equivalent to II-12)
"NATL4" (0x000f)	Spare for National Use (equivalent to II-13)
"NATL5" (0x0010)	Spare for National Use (equivalent to II-14)
"NATL6" (0x0011)	Spare for National Use (equivalent to II-15)

Default: None

A.1.3.1.1.4 Echo Suppression

Parameter name: Echo Suppression

Parameter ID: es (0x0004)

Description: Control information on echo suppressors.

Type: Enumeration

Optional: Yes

Possible values:

"OGRQ" (0x0001)	Call requires echo suppressors and outgoing half-echo suppressor has to be inserted
"NRQ" (0x0002)	Call may not require any echo suppressor
"OGINS" (0x0003)	Call requires echo suppressors and outgoing half-echo suppressor has already been inserted
"ICRQ" (0x0004)	Call requires incoming echo suppressors to be inserted

Default: None

A.1.3.1.1.5 Country Code

Parameter name: Country Code
Parameter ID: cc (0x0005)
Description: If present, conveys the country code (and possibly the area code) information digits.
Type: String
Optional: Yes
Possible values: A sequence of the characters '0' through '9'.
Default: None

A.1.3.1.1.6 Discriminating Indicator

Parameter name: Discriminating Indicator
Parameter ID: disc (0x0006)
Description: For automatic working, this will specify that a discriminating digit is used. For semi-automatic working, this will specify the service language (Language digit) to be used by the operator. For international working this may serve as a test call indicator, as well.
Type: Enumeration
Optional: Yes
Possible values:
"DISC" (0x0001) Discriminating digit for automatic working
"FR" (0x0002) Language digit French
"EN" (0x0003) Language digit English
"GR" (0x0004) Language digit German
"RU" (0x0005) Language digit Russian
"SP" (0x0006) Language digit Spanish
"OT1" (0x0007) Language digit Other (as indicated by I-6 pulse)
"OT2" (0x0008) Language digit Other (as indicated by I-7 pulse)
"OT3" (0x0009) Language digit Other (as indicated by I-8 pulse)
"OT4" (0x000a) Language digit Other (as indicated by I-9 pulse)
"TCI" (0x000b) Call by automatic test equipment
Default: None

A.1.3.1.1.7 Nature of Circuit

Parameter name: Nature of Circuit
Parameter ID: noc (0x0007)
Description: Reports if satellite links are included in circuits involved with the connection.
Type: Enumeration
Optional: Yes
Possible values:
"SATINC" (0x0001) Satellite link included
"SATNOINC" (0x0002) Satellite link not included
Default: None

A.1.3.1.1.8 Access Indicator

Parameter name:	Access Indicator
Parameter ID:	ai (0x0008)
Description:	If present, indicates that call must be routed to the indicated position. In the case of "TST", test equipment address digits are conveyed in destination number parameter.
Type:	Enumeration
Optional:	Yes
Possible values:	"INC" (0x0001) Incoming Operator "DEL" (0x0002) Delay Operator "TST" (0x0003) Test Equipment
Default:	None

A.1.3.1.1.9 Calling Subscriber Category 2

Parameter name:	Calling Subscriber Category 2
Parameter ID:	sc2 (0x0009)
Description:	The Calling Party subscriber's category, as collected through compelled register signalling delivered in response to category request A-5. This category is occasionally known as the Billing category.
Type:	Enumeration
Optional:	Yes
Possible values:	"NNPS" (0x0001) Non-priority subscriber (National Working) "NPRS" (0x0002) Priority subscriber (National Working) "NMNT" (0x0003) Maintenance equipment (National working) "NOPR" (0x0004) Operator call (National Working) "NDT" (0x0005) Data transmission (National working) "ISOPR" (0x0006) Subscriber or operator without forward transfer facility (International working) "IOPRF" (0x0007) Operator with forward transfer facility (International working) "IDT" (0x0008) Data transmission (International working) "IPRS" (0x0009) Priority subscriber (International working) "NSMTR" (0x000a) Subscriber with meter (National working) "SIDD" (0x000b) Subscriber with IDD "NATL1" (0x000c) Spare for National Use (equivalent to II-4) "NATL2" (0x000d) Spare for National Use (equivalent to II-11) "NATL3" (0x000e) Spare for National Use (equivalent to II-12) "NATL4" (0x000f) Spare for National Use (equivalent to II-13) "NATL5" (0x0010) Spare for National Use (equivalent to II-14) "NATL6" (0x0011) Spare for National Use (equivalent to II-15)
Default:	None

A.1.3.2 Called Party Reachability Status

Signal name:	Called Party Reachability Status
Signal ID:	cprs (0x0002)

Description: Applies the called subscriber line status information signal to terminate compelling.
Signal type: TimeOut
Duration: Provisioned

A.1.3.2.1 Additional parameters

A.1.3.2.1.1 Subscriber Line Condition

Parameter name: Subscriber Line Condition
Parameter ID: lsts (0x0001)
Description: Conveys the line condition of the subscriber.
Type: Enumeration
Optional: No
Possible values:

"UN" (0x0001)	Unallocated number
"SLB" (0x0002)	Subscriber line busy
"SLFC" (0x0003)	Subscriber line free, charge
"SLFNOC" (0x0004)	Subscriber line free, no charge
"SOO" (0x0005)	Subscriber out of order
"SIT" (0x0006)	Send special information tone
"NK" (0x0007)	Subscriber status not known, set-up speech path
"NATL1" (0x0008)	Spare for National Use (equivalent to B-1)
"NATL2" (0x0009)	Spare for National Use (equivalent to B-9)
"NATL3" (0x000a)	Spare for National Use (equivalent to B-10)
"NATL4" (0x000b)	Spare for National Use (equivalent to B-11)
"NATL5" (0x000c)	Spare for National Use (equivalent to B-12)
"NATL6" (0x000d)	Spare for National Use (equivalent to B-13)
"NATL7" (0x000e)	Spare for National Use (equivalent to B-14)
"NATL8" (0x000f)	Spare for National Use (equivalent to B-15)

Default: None

A.1.3.3 Congestion

Signal name: Congestion
Signal ID: cng (0x0003)
Description: Applies the indication to alert the far-end that congestion has occurred at the near-end.
Signal type: Timeout
Duration: Provisioned

A.1.3.3.1 Additional parameters

A.1.3.3.1.1 Location

Parameter name: Location
Parameter ID: loc (0x0001)
Description: Conveys the location of the congestion.
Type: Enumeration

Optional:	Yes
Possible values:	"NATL" (0x0001) Congestion at national level "INTL" (0x0002) Congestion at international level
Default:	Provisioned

A.1.4 Statistics

None.

A.1.5 Procedures

A.1.5.1 Compelled signalling

Compelled register signalling is a two-way process – it is not possible to simultaneously support an address signal and an address event. Furthermore, as the sequence of outpulsed data is under the control of the remote signalling peer, it is meaningless to update the address signal (or event) while a current address signal (or event) is ongoing. Therefore, attempts to apply simultaneous address signals or simultaneous address events on a termination, or attempts to update an address signal or event shall be rejected with error code 512, "Media Gateway unequipped to detect requested event" or 513, "Media Gateway unequipped to generate requested signals" as appropriate.

Termination of the address signal or cancellation of the address event (e.g., by sending EventsDescriptor and/or SignalsDescriptor without icasc/addr, or through detection of another event when the KeepActive parameter is not present on that event) shall cause register signals to be immediately disasserted.

A.1.5.2 General procedures

The MG may be connected to a peer compelled CAS switch for compelled signalling, a peer MG for media transport and a MGC for exchanging signalling information using ITU-T H.248 with this package.

This package uses the following conventions for incoming/outgoing MG:

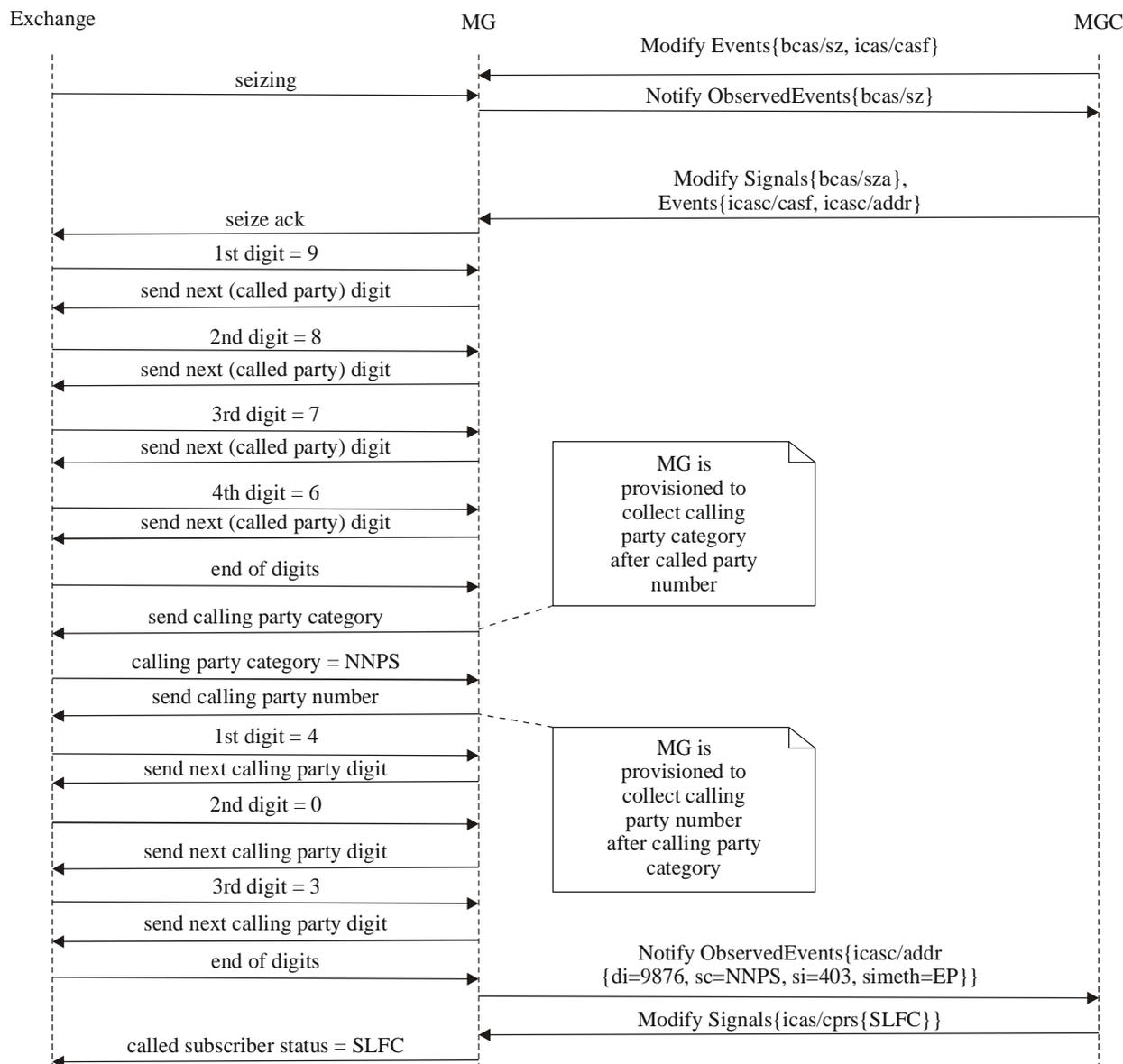
- Incoming MG: The peer R2 exchange initiates the call signalling towards the MG.
- Outgoing MG: The MG initiates the call signalling towards the peer R2 exchange.

An incoming MG might not be provisioned to recognize the "end of pulsing" compelled forward register signal. Therefore, the incoming MG shall detect the end of digit information in called party number based on a MGC supplied digitmap. This also takes care of situations where identification of the end of digit sequence is achieved through length determination or timeout mechanisms. The calling party number shall be compelled until the maximum length of the calling party number is achieved, the end of pulsing is encountered or a timeout occurs. The maximum length is provisioned in the MG, and may be altered by the MGC via the snl parameter.

The MG shall be provisioned with a list of possible country codes. The MG shall compel the country code digits based upon this provisioned information.

A.1.5.3 Incoming *en bloc* compelled register signalling

An example of incoming *en bloc* compelled register signalling is given in Figure A.1.



NOTE – Transaction replies are not shown for clarity.

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Figure A.1 – Incoming *en bloc* compelled register signalling example

En bloc compelled register signalling is triggered by the MGC by sending the *icasc/addr* event in an Events Descriptor. The MG autonomously takes control of the compelling sequence and collects all the information, sending a single Notify message when completed. The completion of the compelling sequence will depend on the configuration of the MG and consequent actions by the MGC (see below).

Compelling action starts by the peer signalling entity sending a forward signal. This may be the first digit of called party number or the Country Code Indicator.

The incoming MG shall collect called party number digits using the digit map specified by the MGC, in accordance with digit map completion event rules of [ITU-T H.248.1] and the "end of pulsing" register signal.

During called party number compelling when the MG determines that an unambiguous match has been found with an alternative in the digit map, the MG shall report the collected digits with the Destination Number Termination Method set to "Unambiguous Match". This matching criterion may coincide with the reception of the "end of pulsing" signal. In the absence of a digitmap this "end of pulsing" register signal shall determine the unambiguous termination condition of the accumulated digits.

Digit collection may terminate due to completion by timer expiry or the reception of "end of pulsing" signal when an alternative in the digit map has partially matched. In this instance, the MG shall report the collected digits with the Destination Number Termination Method set to "Partial Match".

The MG shall collect calling party number digit string until any of the following events occur:

- Reception of end-of-pulsing signal. The MG shall report all the collected calling party digits with the Source Number Termination Method set to "End of Pulsing".
- Collection of the maximum number of digits for the calling party number, as specified by the *snl* parameter. The MG shall report all the collected calling party digits with the Source Number Termination Method set to "Maximum Length".
- A digit timeout occurs, in accordance with a value provisioned at the MG. The timer is started the moment calling party number compelling starts. The MG shall report all the collected calling party digits with the Source Number Termination Method set to "Timeout".

If connected to an international trunk where exchange of country code may occur, then the MG shall be locally provisioned with the list of country codes. Based on this, the incoming MG may terminate the compelling of the country code digits.

Following detection of the end of each address parameter, the MG sends a backward compelled register signal to request the next group of information (e.g., calling party category) based on MG provisioned ordering.

Following completion of compelling of all necessary address parameters based on MG provisioning, the MG shall notify the MGC and shall wait for a signal to terminate the compelling sequence from the MGC, e.g., *icasc/cprs* or *icasc/cng* backwards signal response. The MG shall wait for a timeout equal to the value of the *cstk* property. If the timer expires without the receipt of a signal – immediately if *cstk* is set to 0 – the MG shall terminate compelling with a suitable backwards register signal.

The following conditions during impulse shall be deemed to be CAS failure conditions. The MG shall report the *icasc/casf* event with *ec* equal to "ERR" when any of the following occurs:

- an initial digit timeout (timeout based on local provisioning);
- failure of the signalling peer to disassert the transmitted signal in response to the response digit (timeout based on local provisioning);
- an inter-digit timeout (timeout based on local provisioning);
- an unexpected signal.

When the Compelling Sequence Keepalive Timer expires, the MG shall report the *icasc/casf* event with *ec* equal to "CSKT".

A.1.5.4 Outgoing *en bloc* compelled register signalling

After receiving the *icasc/addr* signal and if the Country Code parameter is present, the termination shall output the echo suppression parameter followed by the Country Code Indicator; otherwise, the termination shall output the first digit of the *di* string. Thereafter the termination shall respond to the signals requested by its signalling peer.

When a new parameter is requested for which a termination has no data, the signal shall be deemed to have failed. At this time g/sc event shall be sent, if requested as part of the signal request, with the Not Completed termination method. It will be the responsibility of the incoming signalling peer to recover the compelled signalling phase or close down the call. MGs may provide provisioned default values for parameters. Specified parameters of the address signal shall override the provisioned values.

Upon receipt of the backwards "Called Party Reachability Status" register signal (or an alternative signal indicating the end of compelling) from its signalling peer, the signal is deemed to be complete. At this time g/sc event shall be sent, if requested as part of the signal request, with the Timeout termination method.

If the signalling peer does not respond to a transmitted signal within the provisioned timeout, or the response is not disasserted after the transmitted signal is disasserted within the provisioned timeout, or the signalling peer sends an unexpected backwards signal, then the signal is deemed to have failed to complete. At this time g/sc event shall be sent, if requested as part of the signal request, with the Not Completed termination method.

A.2 International CAS Compelled with Overlap Package

Package name:	ICAS Compelled with Overlap Package
Package ID:	icasco (0x007e)
Description:	This package defines ITU-T H.248 methods to support channel associated signalling (CAS) compelled overlap register signalling.
Version:	1
Extends:	icasc version 1

A.2.1 Properties

None.

A.2.2 Events

A.2.2.1 Address

Event name:	Address
Event ID:	addr (0x0001)
Description:	Reports the address parameters collected through compelled register signalling. This event extends the icasc/addr event to support overlap compelled register signalling in addition to <i>en bloc</i> compelled signalling.

A.2.2.1.1 EventsDescriptor parameters

A.2.2.1.1.1 Compelling Sequence

Parameter name:	Compelling Sequence
Parameter ID:	seq (0x0001)
Description:	Defines the order in which compelled information is collected. See the procedures for usage.
Type:	String
Optional:	Yes

Possible values: See the procedures for the syntax of this parameter.

Default: Empty ("")

A.2.2.1.2 ObservedEventsDescriptor parameters

None.

A.2.2.2 Request Backwards

Event name: Request Backwards

Event ID: reqback (0x0005)

Description: Reports that the terminating signalling peer has requested a category that is not present as part of current addr signal via the backwards signalling channel.

A.2.2.2.1 EventsDescriptor parameters

None.

A.2.2.2.2 ObservedEventsDescriptor parameters

A.2.2.2.2.1 Category

Parameter name: Category

Parameter ID: cat (0x0001)

Type: Enumeration

Optional: No

Possible values:	"SI" (0x0001)	Collect source number
	"SC1" (0x0002)	Collect calling subscriber category
	"CC" (0x0003)	Collect country code
	"ES" (0x0004)	Collect echo suppression information
	"DISC" (0x0005)	Collect discriminating indicator
	"NOC" (0x0006)	Collect nature of circuit
	"AI" (0x0007)	Collect access indicator
	"SC2" (0x0008)	Collect billing category

Default: None

A.2.3 Signals

A.2.3.1 Address

Signal name: Address

Signal ID: addr (0x0001)

Description: This extends the icasc/addr signal with a parameter value extension to the di parameter.

Signal type: TimeOut

Duration: Depends on parameters supplied

A.2.3.1.1 Additional parameters

A.2.3.1.1.1 Destination Number

Parameter name: Destination Number

Parameter ID:	di (0x0001)
Description:	The called party number digits.
Type:	String
Optional:	No
Possible values:	A sequence of the characters '0' through '9' and 'F'. The end-of-digit character is explicit ('F') and will only be sent if the next digit is requested after the last 0-9 digit has been sent and the character is present in the string.
Default:	None

A.2.3.2 Delta Address

Signal name:	Delta Address
Signal ID:	delta (0x0004)
Description:	This signal provides a mechanism to add parameters to a current icasco/addr signal.
Signal type:	Brief
Duration:	Variable

A.2.3.2.1 Additional parameters

This signal may have all the same parameters as the icasco/addr signal.

A.2.4 Statistics

None.

A.2.5 Procedures

A.2.5.1 Compelling sequence syntax and usage

If the seq parameter is empty (i.e., seq=""), then the MG will perform standard *en bloc* compelled register signalling, with all the relevant information (di, si, sc, etc.) being collected and then notified at the end as a single ObservedEvent. The information collected and its order is determined by MG provisioning.

If the seq parameter is provided, then the MGC is able to specify in which order the information (di, si, sc, etc.) is collected. The MGC can also request that particular information elements be returned as they are collected. These behaviours are used to support overlap compelled register signalling.

The seq parameter is a text string consisting of information elements separated by the forward slash '/' character. The list of possible information elements are:

- di – collect destination number. The di token may be followed by a previously or concurrently defined digitmap name enclosed in normal parentheses "di(digitMapName)", or a digitmap enclosed first in brackets, and then in parentheses "di({digitMapValue})". This digitmap is used to collect the destination number. The digitMapName and digitMapValue shall comply with the ITU-T H.248.1 ABNF definition. If the di token does not include a DigitMap name or value, then the digit map defined within the EventsDescriptor is used. If a digit map is neither provided within the di portion of this parameter nor as an EventDM parameter, then digits are collected until the end of pulsing digit is received. Once the digitmap completes, or the end of pulsing digit is received, the di information shall be reported.
- si – collect source number

- sc1 – collect calling subscriber category
- cc – country code
- es – collect echo suppression information
- disc – collect discriminating indicator
- noc – collect nature of circuit
- ai – access indicator
- sc2 – collect billing category
- N – report all unreported collected information. This is not required after the last token because a Notify will be sent upon completion of information collection. This token is used for overlap compelled register signalling to allow intermediate results to be reported to the MGC.

The di information element and the N report request may appear multiple times. The other information elements may only appear once any given seq parameter.

An example Events descriptor (with related DigitMap descriptors) is:
 Events{icasco/addr{seq="di(dm1)/sc/si/N/di(dm2)" }},DigitMap=dm1 {xxx},DigitMap=dm2{x.F}.

A.2.5.2 Incoming overlap compelled register signalling

An example of overlap compelled register signalling is given in Figure A.2.

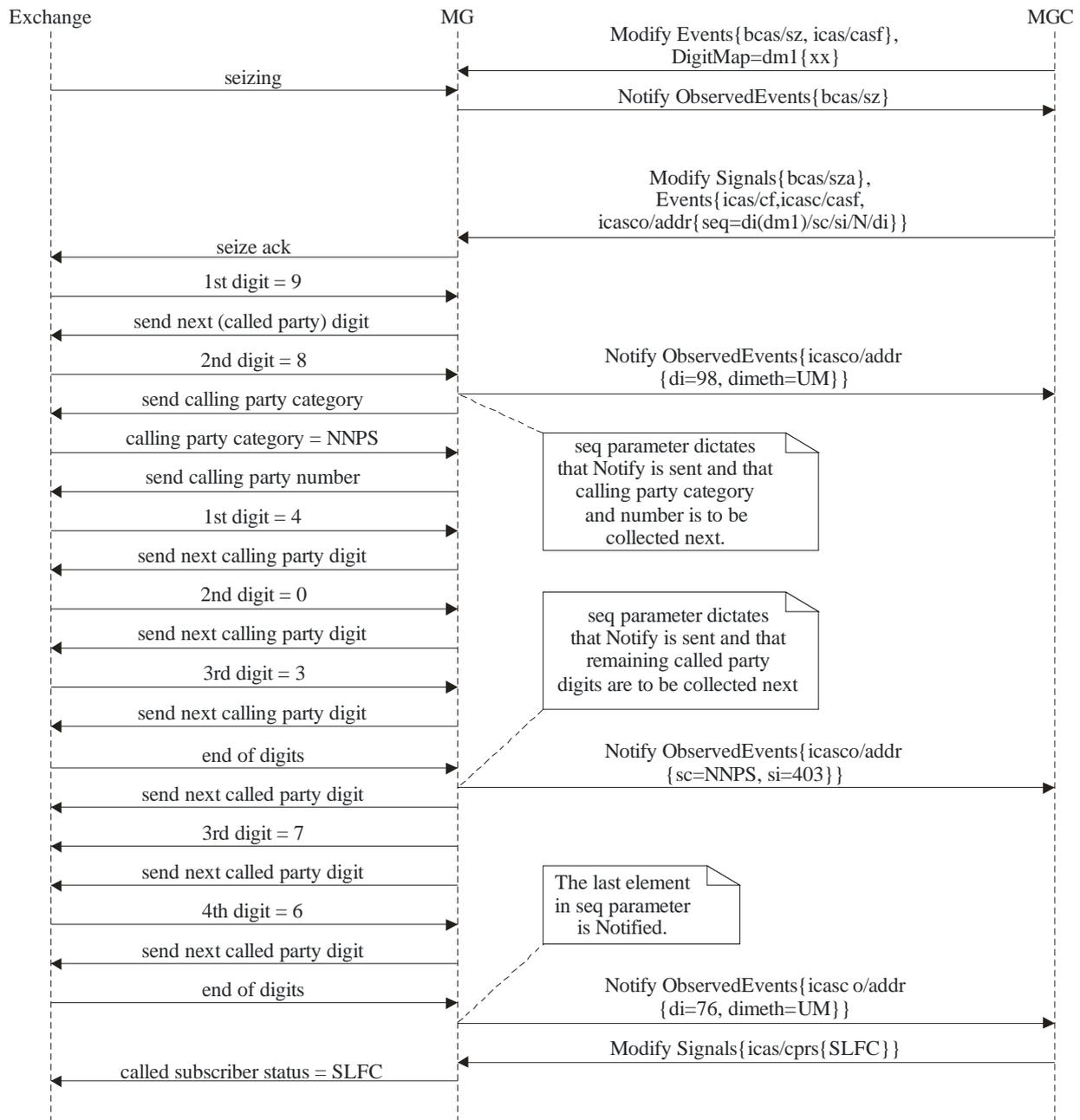


Figure A.2 – Incoming overlap compelled register signalling example

Overlap for a compelled sequence entails breaking the collected information into separate ObservedEvents reported to the MGC. The MG behaviour is similar to *en bloc* with two key differences:

- The MG requests compelled register information (e.g., called party, calling party category, calling party number, etc.) from the exchange in the order indicated by the MGC in the request message. Order is not driven by MG provisioning.
- The MG sends Notify commands during the compelling sequence as indicated by the MGC in the seq parameter.

The MGC performs overlap compelled register signalling by sending an *icasco/addr* event with the new *seq* parameter. The order of information elements (e.g., called party, calling party category, calling party number, etc.) in the *seq* parameter specifies the order in which compelled information is collected.

If an information element in the *seq* parameter is followed by "N", then a Notify command with all the collected information since the last Notify shall be sent to the MGC once the information element is collected. The *di* information elements and the last information element in the *seq* parameter are always notified, regardless of whether they are followed by "N" or not.

The collection of called party number (*di*) can be split into many parts, each part having its own digitmap. For example, a MGC may request to be notified of the first few called-party digits ("*di*({xxx})"), followed by other information (for example, calling party category and number), and then followed by the remaining called-party digits ("*di*({x.F})") and other information.

A.2.5.3 Outgoing overlap compelled register signalling

Overlap compelling differs from *en bloc* compelling in that the address parameters may be updated during the compelling exchange. Therefore, the MGC shall be permitted to add new parameters, using the *icasco/delta* signal while a previous *icasco/addr* signal is still being signalled, as long as that original *icasco/addr* signal is kept active using the "KA" parameter. Such address parameters may have been requested by the MG by notification of the *reqback* event. New address parameters (apart from the *di* parameter) may be provided in their entirety in the original signal, or in any subsequent Signals descriptor. The *di* parameter may be provided in instalments in any address signal, where subsequent values append to the existing value.

The "F" character terminating a *di* string when applied in *icasco/addr* signal is not implicit. If the current *di* string is being compelled and the last explicit digit (0-9) has been sent and the incoming peer requests "next digit", the outgoing termination will wait for further digits to be supplied as part of a subsequent *icasco/delta* signal. Any *di* parameters in such an *icasco/delta* signal will be appended to the value of the current *di* parameter. If the MG is waiting for further *di* digits as part of the compelling sequence, then the MG shall play out the first digit of the latest *di* parameter instalment immediately when it is received.

Other Address parameters (apart from *di*) may be provided in subsequent messages. As these parameters do not append to previously signalled parameters and there can be no guarantee as to where in the compelling sequence, such a message may arrive (such a parameter could arrive part way through the compelling of the previous value), such parameters are valid once per-parameter type within a compelled sequence. For example, if the "es" parameter is received in the first *icasco/addr* signal, instances of "es" in subsequent *icasco/delta* messages will be ignored.

As *icasco/delta* is a signal that amends the current *icasco/addr* signal, transmission of a SignalsDescriptor with a delta signal and without a concurrent *icasco/addr* {..., KA} signal is meaningless and shall be NACKed or ignored. Receipt of a delta signal concurrent with *icasco/addr* {..., KA} signals after completion of *addr* signal causes the delta signal to be discarded along with *icasco/addr* signal. Multiple delta signals may be sent (with appropriate KA parm) – where these contain instalments to the *di* parameter, these will be appended in the order they are inserted in the SignalsDescriptor.

An example is given in Figure A.3 below.

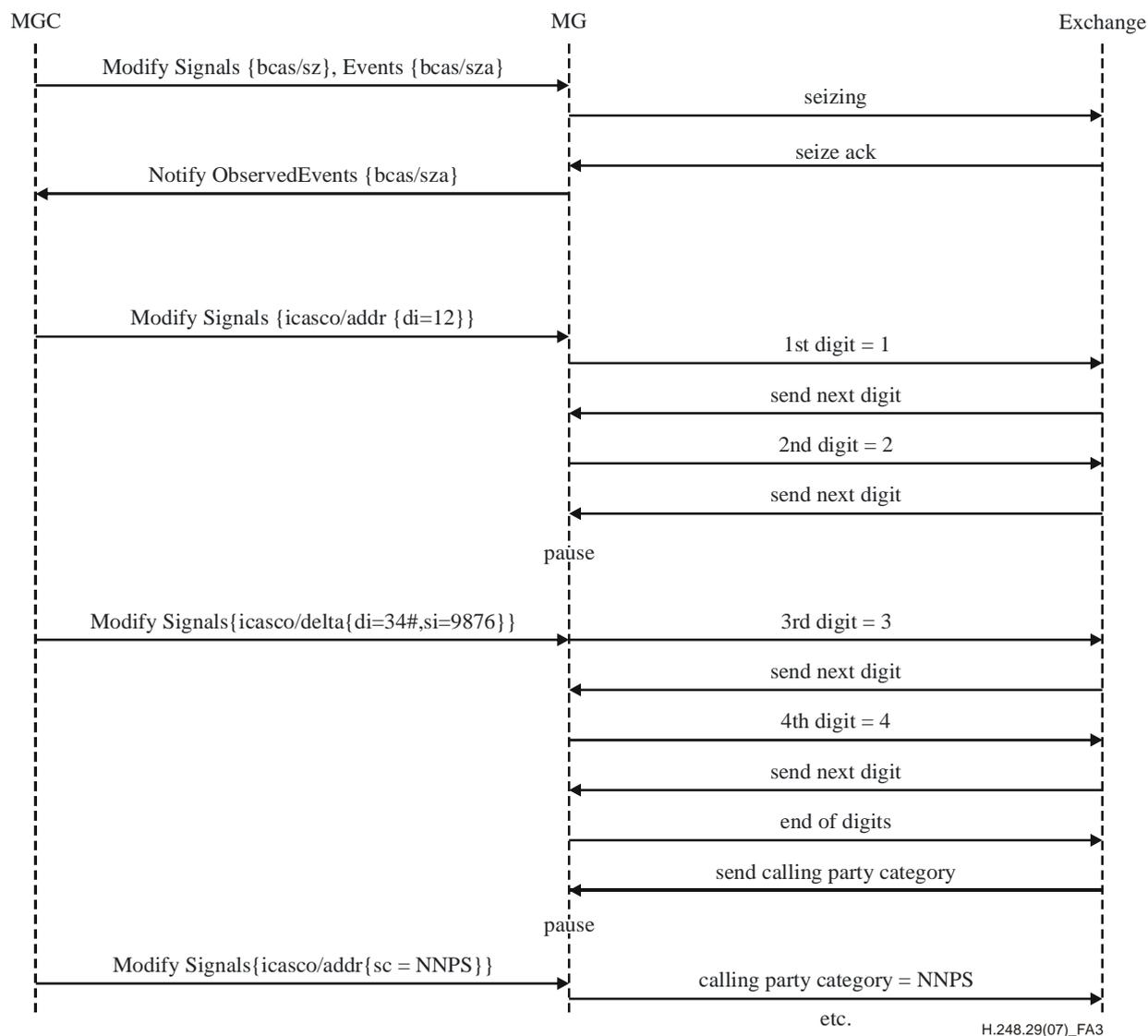


Figure A.3 – Outgoing overlap compelled register signalling example

A.3 International CAS Compelled with End-to-End Package

Package name: ICAS Compelled with End-to-End Package

Package ID: icasce (0x007f)

Description: This package defines ITU-T H.248 methods to support channel associated signalling (CAS) compelled end-end register signalling.

Version: 1

Extends: icasco version 1

A.3.1 Properties

None.

A.3.2 Events

None.

A.3.3 Signals

A.3.3.1 Compelled Backward Register Signalling

Signal name: Compelled Backward Register Signalling

Signal ID: back (0x0005)

Description: This signal provides a further choice of backwards signals to terminate a compelling sequence that allows the incoming MG to request the peer outgoing signalling entity to repeat part or all of the register signalling. See the procedures for usage information.

Signal type: TimeOut

Duration: Variable depending on compelling peer.

A.3.3.1.1 Additional parameters

A.3.3.1.1.1 Signal Type

Parameter name: Signal Type

Parameter ID: sig (0x0001)

Description: This parameter specifies the backward compelled signal that should be sent.

Type: Enumeration

Optional: No

Possible values:

"LB1" (0x0001)	Last but one
"LB2" (0x0002)	Last but two
"LB3" (0x0003)	Last but three
"NATL1" (0x0004)	Spare for National Use (equivalent to A-9)
"NATL2" (0x0005)	Spare for National Use (equivalent to A-10)

Default: None

A.3.4 Statistics

None.

A.3.5 Procedures

A.3.5.1 Usage of the back signal

The back signal is used when the end-to-end signalling phase is being entered. This may be sent when the incoming MG has collected all or part of the dialled number, has notified the MGC and is currently waiting with the Compelling Sequence Keepalive Timer (cskt) running. In this case, it is likely that the incoming MG, as part of a distributed switch, has established an end-to-end connection through to a peer MG which itself is connected to an incoming port on a CAS switch running compelled signalling.

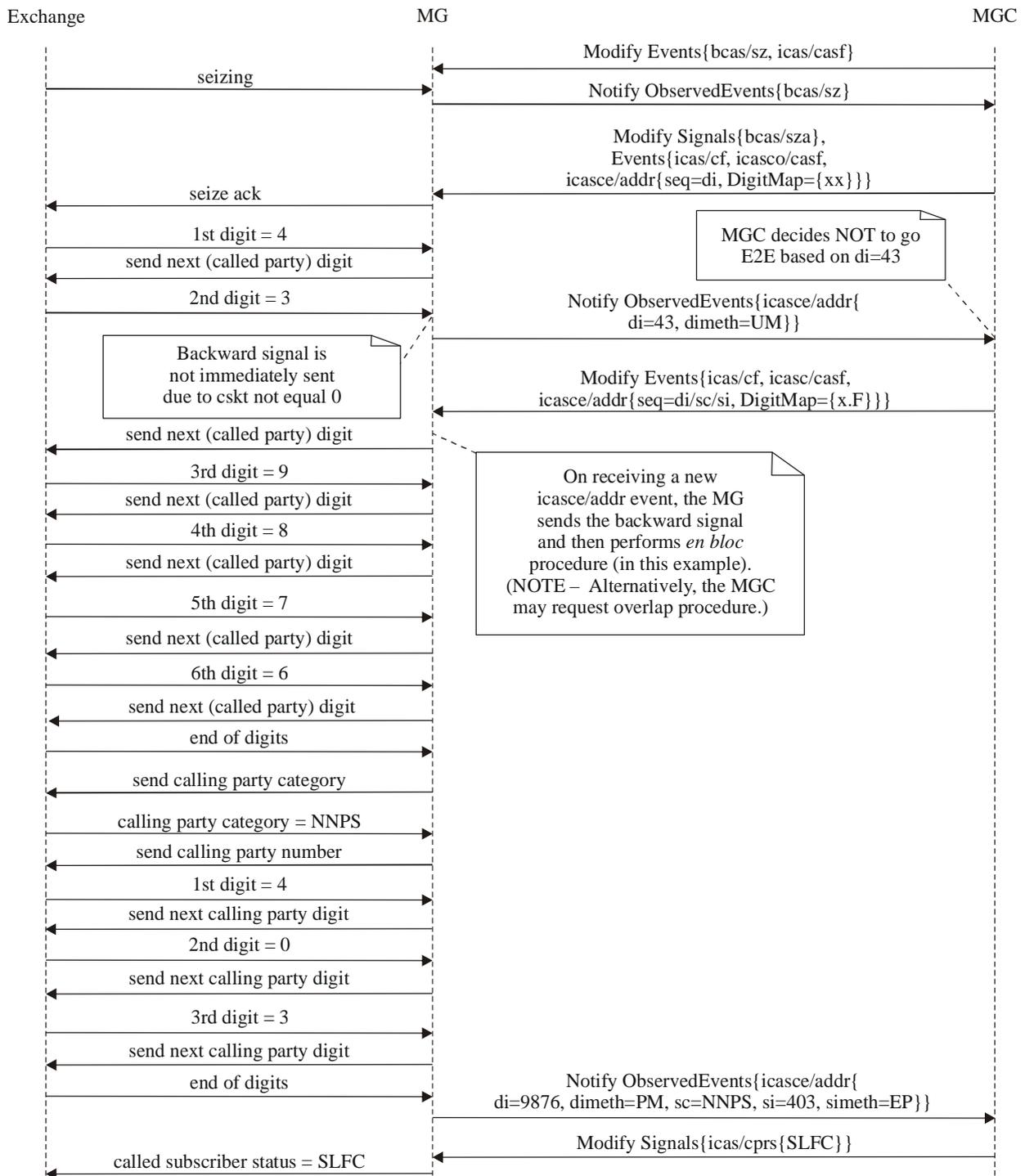
Receipt by the incoming MG of a message with a "back" signal and an empty Events Descriptor causes the active addr event to be terminated and the back signal to be applied.

The icasce/back signal is completed when the MG detects that the current forward signal (from the compelling peer) has been removed. The MGC may request NotifyCompletion TimeOut on the back signal and request the g/sc event so that it is notified when this happens. This is used as a way to let the MGC know when it is suitable to use end-to-end signalling.

If the *icasce/back* signal is received while the MG is not running the Compelling Sequence Keepalive Timer, then the MG will treat the signal as if it had instantaneously completed and will not modify the compelled register signalling.

A.3.5.2 End-to-end (E2E) compelled register signalling

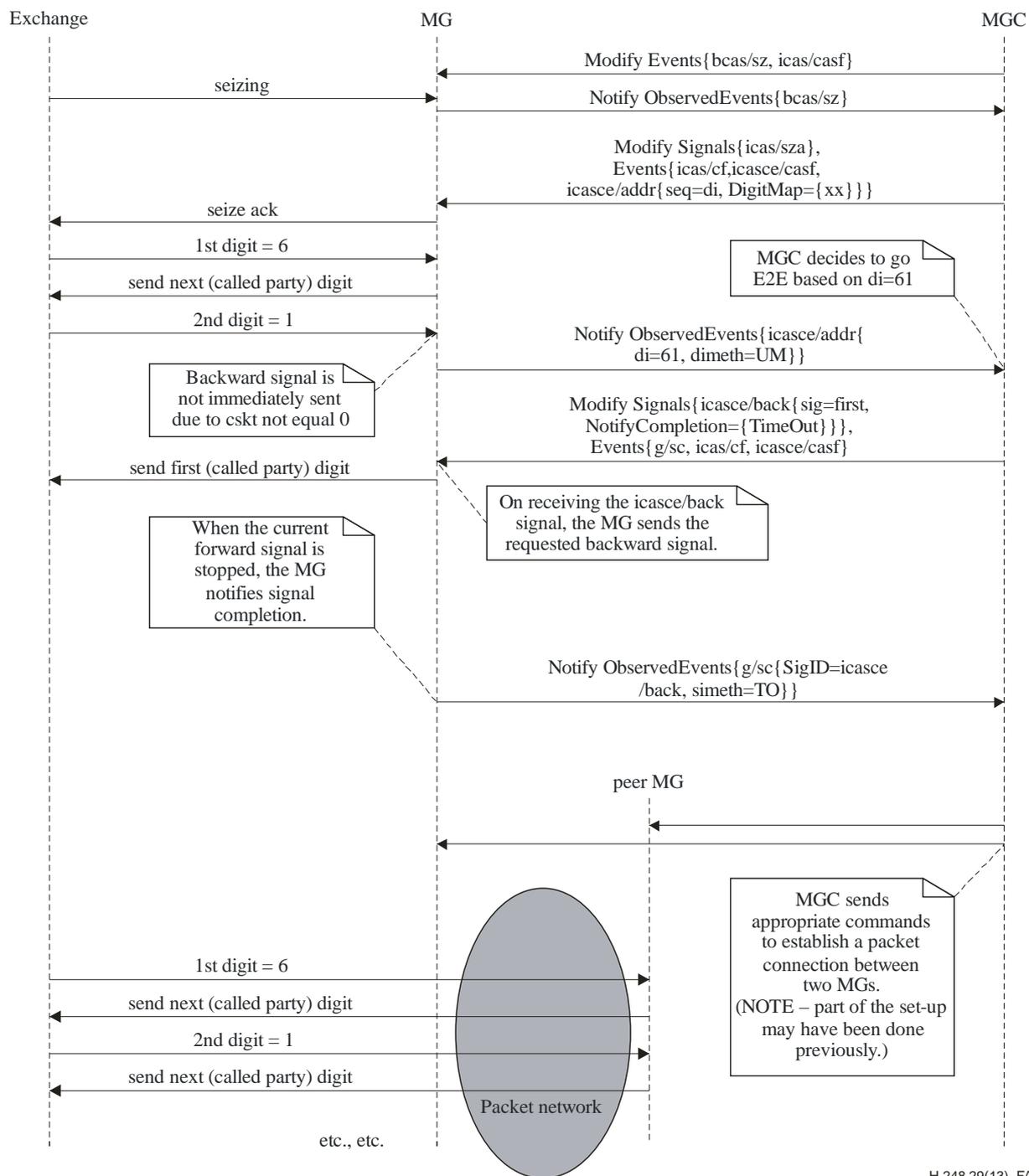
An example of end-to-end (E2E) compelled register signalling procedures where the MGC decides not to use E2E signalling is shown in Figure A.4.



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Figure A.4 – Example where MGC decides NOT to use end-to-end signalling

An example of end-to-end (E2E) compelled register signalling procedures where MGC decides to use E2E signalling is shown in Figure A.5.



NOTE – ITU-T H.248 responses are not shown for clarity.

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Figure A.5 – Example where MGC decides to use end-to-end signalling

If the TDM-termination is E2E capable, then the MGC sends an initial request for called party number with a preliminary digitmap to collect the first relevant part of the address. The initial request consists of an `icasce/addr` (or `icasco/addr`) command using `di` within the `seq` parameter. The `cskt` property is set to a suitable non-zero value. This forces the MG to wait in a pending state for the next MGC message with `cskt` active. An example Events descriptor is: `Events {icasce/addr {seq="di({xxx})"}}` OR `Events{icasce/addr{seq="di(dm1)"},DigitMap=dm1{xxx}}`.

If the MGC decides not to use E2E signalling, the MGC sends a new *icasce/addr* event (either *en bloc* or *overlap*) to reactivate the compelled register signalling. Note that unlike the *icasce/addr* or *icasco/addr* events, the *icasce/addr* event may be received when the previous *addr* event is active and *cskt* is active. Since *cskt* is active, the MG sends an appropriate backward compelled register response as the next listed *seq* parameter information element to continue the compelled cycle.

If the MGC decides to use E2E signalling, the MGC sends an *icasce/back* signal, with its parameter set to the appropriate backward register compelled signal (1st digit, last but 1, etc.). The MGC may also request signal completion (*TimeOut*) and the *g/sc* event. Upon receipt of the MGC request, the MG will exit the pending state and send the requested backward register compelled signal. When the current forward register compelled digit stops, the MG notifies that the *icasce/back* signal is complete. The MGC may then request a connection between the MG and a peer-MG so that the two MGs can pass-through compelled register signalling without MGC interaction.

NOTE – The actual connection may be established earlier to minimize delay; however, the termination Mode property would be set to inactive. Therefore, this step may simply set the Mode property to *SendReceive*.

Annex B

Generic CAS compelled register signalling package

(This annex forms an integral part of this Recommendation.)

The *icascgen* package covers register signalling only. Any termination supporting the *icascgen* package must also support the *icas* package [ITU-T H.248.28] or another package covering the corresponding line signalling part of the underlying CAS system (for instance, SSR2).

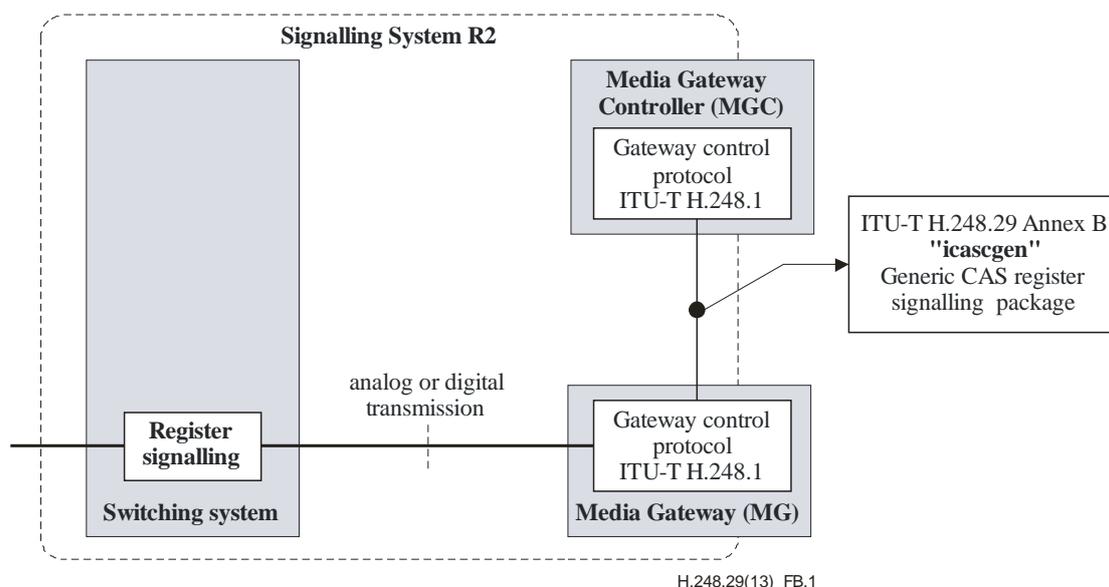


Figure B.1 – Scope of "icascgen"

Package *icascgen* comprises the two compelled address transfer modes of generic standard *en bloc* compelling and overlap procedures. Both modes are applied between two peer register nodes. This scope is outlined in Figure B.1. The ITU-T H.248.29 capable H.248 MG has an embedded "register" function and is peering a "register signalling" operated switching system.

The third compelled address transfer mode of end-to-end compelled signalling has a more extended view. This specific mode is out of scope of the *icascgen* package.

B.1 Generic CAS Compelled Register Signalling Package

Package name: Generic CAS Compelled Register Signalling Package

Package ID: *icascgen* (0x0094)

Description: This package defines ITU-T H.248 methods to support a generic channel associated signalling (CAS) compelled standard register signalling. The term "standard" refers to standardized CAS systems and means "address transfer modes" like *en bloc* transfer or overlap signalling.

Version 2 of the package introduces a new parameter to indicate whether the Generic Digit information Event is generated in the event of an unsuccessful events map match.

Version: 2

Extends: None

B.1.1 Properties

B.1.1.1 Detection Open Numbering Length

Property name:	Detection Open Numbering Length
Property ID:	donl (0x0001)
Description:	Indicates that the digits are to be collected by the MG up to a maximum length as specified by this parameter value. Value "0" indicates no defined maximum length. For concatenated SSR2 Events and SSR2 Signals Map, this applies to the open numbering parts only ("."). Exceeding this threshold causes an error reported via the failure event defined by icascgenf. It must be set high enough, so that this maximum is never reached in normal circumstances. NOTE – This property is used to protect the "x." parts of SSR2 Events Maps against endless number collection.
Type:	Integer
Possible values:	Non-negative number of digits
Default:	Provisioned
Defined In:	TerminationState
Characteristics:	Read/Write

B.1.1.2 Compelling Mode

Property name:	Compelling Mode
Property ID:	cmode (0x0002)
Description:	Specifies the register signalling mode used. The operation mode could be fully-compelled as specified in [ITU-T Q.441] and [ITU-T Q.442], or as semi- or non-compelled as specified in [ITU-T Q-Sup.7].
Type:	Enumeration
Possible values:	"CO" (0x0001) Fully-Compelled "SC" (0x0002) Semi-Compelled "NC" (0x0003) Non-Compelled
Default:	Provisioned
Defined In:	TerminationState
Characteristics:	Read

B.1.1.3 Register Signalling Direction

Property name:	Register Signalling Direction
Property ID:	rsdir (0x0003)
Description:	Specifies whether the termination is used as an incoming or outgoing register signalling interface in case the line signalling is configured as bothway. This can be changed on a call by call basis for this termination. It must not be changed during a register signalling session.
Type:	Enumeration

Possible values: "IC" (0x0001) Incoming
"OG" (0x0002) Outgoing

Default: Provisioned

Defined In: TerminationState

Characteristics: Read/Write

B.1.1.4 Incoming Non-Recognition Time

Property name: Incoming Non-Recognition Time

Property ID: inrt (0x0004)

Description: Determines the time during which the MG does not recognize SSR2 register signals in the pulsed backward signal case [ITU-T Q.442]. After timeout, a normal compelled cycle treatment is done.

Type: Integer

Possible values: Positive number of milliseconds

Default: 300

Defined In: TerminationState

Characteristics: Read/Write

B.1.1.5 Incoming Keep Alive Timer

Property name: Incoming Keep Alive Timer

Property ID: ikat (0x0005)

Description: Determines the timeout for compelled keep alive (see Figure B.2). It is used as the maximum timeout value for signals sent from the incoming SSR2 interface.

Type: Integer

Possible values: Positive number of milliseconds

Default: 300

Defined In: TerminationState

Characteristics: Read/Write

B.1.1.6 Outgoing Keep Alive Timer

Property name: Outgoing Keep Alive Timer

Property ID: okat (0x0006)

Description: Determines the timeout for compelled keep alive. It is used as the maximum timeout value while waiting for an acknowledge event (see Figure I.1).

Type: Integer

Possible values: Positive number of milliseconds

Default: 300

Defined In: TerminationState

Characteristics: Read/Write

B.1.1.7 Outgoing End of Compelled Cycle Timer

Property name:	Outgoing End of Compelled Cycle Timer
Property ID:	oect (0x0007)
Description:	Determines the timeout for outgoing register signalling awaiting the end of a backward SSR2 signal (see Figure B.2).
Type:	Integer
Possible values:	Positive number of milliseconds
Default:	80
Defined In:	TerminationState
Characteristics:	Read/Write

B.1.2 Events

B.1.2.1 Multifrequency Combination Event

Event name:	Multifrequency Combination Event
Event ID:	mc1 (0x0001)
Description:	Detects and reports the multifrequency combination (MC) signal codepoint 1. The characteristics of the MF signal code, including frequencies and durations, are provisioned on the MG.

B.1.2.1.1 EventsDescriptor parameters

None.

B.1.2.1.2 ObservedEventsDescriptor parameters

None.

B.1.2.1.3 Additional values

The events for the other MC code events are specified in exactly the same way. Table B.1 shows all event names, Event Ids and SSR2 Events Map symbols. The event identifiers are defined with the same names as the SSR2 signalling codepoints in [ITU-T Q.442].

Table B.1 – Event IDs (for SSR2)

Combination number as specified in [ITU-T Q.441]	Event ID	SSR2 events map string ID	Remark
1	mc1 (0x0001)	"1"	
2	mc2 (0x0002)	"2"	
3	mc3 (0x0003)	"3"	
4	mc4 (0x0004)	"4"	
5	mc5 (0x0005)	"5"	
6	mc6 (0x0006)	"6"	
7	mc7 (0x0007)	"7"	
8	mc8 (0x0008)	"8"	
9	mc9 (0x0009)	"9"	
10	mc10 (0x000a)	"0"	

Table B.1 – Event IDs (for SSR2)

Combination number as specified in [ITU-T Q.441]	Event ID	SSR2 events map string ID	Remark
		"A" or "a"	Reserved
11	mc11 (0x000b)	"B" or "b"	
12	mc12 (0x000c)	"C" or "c"	
13	mc13 (0x000d)	"D" or "d"	
14	mc14 (0x000e)	"E" or "e"	
15	mc15 (0x000f)	"F" or "f"	"End of Digit" symbol
		"G" or "g"	Reserved
	
		"K" or "k"	Reserved

B.1.2.2 Generic Digit Information

Event name: Generic Digit Information

Event ID: gdi (0x0010)

Description: Generic Digit Information reports the detected MF tones collected through compelled register signalling. The gdi event supports *en bloc* and overlap compelled register signalling.

B.1.2.2.1 EventsDescriptor parameters

B.1.2.2.1.1 Detection Events Map

Parameter name: Detection Events Map

Parameter ID: dem (0x0001)

Description: Detection Events Map parameter is activated for collection of register signals. When a Detection Events Map is missing, the received events are reported event by event.

Type: String

Optional: Yes

Possible values: A detected sequence of the characters '0' through '9' and 'B-F', 'x', '.' and the interdigit threshold timers 'T', 'S' and 'L'. In addition, it can also contain '<' and '>' indicating the used backward acknowledge signal. ABNF Syntax is specified in clause B.2.2.

NOTE 1 – The SSR2 Events Map is a specific Detection Events Map for Signalling System R2 codepoints.

NOTE 2 – "x" represents any character in the range of "0" through "9".

Default: None

B.1.2.2.1.2 Unsuccessful Match Reporting

Parameter name: Unsuccessful Match Reporting

Parameter ID: umr (0x0002)

Description: The MGC may use this parameter to control whether the Generic Digit Information Event is generated in the event of an unsuccessful events map match (i.e., match with method "Partial match, unmatched event" or "Partial Match, timer expired").

Type: Boolean

Optional: Yes

Possible values: *On*: Generate a Generic Digit Information Event on unsuccessful match.
Off: Do not generate a Generic Digit Information Event on an unsuccessful match.

Default: *On*

B.1.2.2.2 ObservedEventsDescriptor parameters

B.1.2.2.2.1 Detection Event String

Parameter name: Detection Event String

Parameter ID: des (0x0002)

Description: Detection Event String is the collected events string, which matches part or all of an alternative event sequence specified in the Detection Events map. The ABNF Syntax for an SSR2 Event String is specified in clause B.2.3.

Type: String

Optional: No

Possible values: A detected sequence of the characters '0' through '9' and 'B-F'. In addition, it may also contain '<' and '>' indicating the used backward acknowledge signal deviating from the default backward signal MC1.
NOTE – The SSR2 Event String is a specific Detection Event String for Signalling System R2 codepoints.

Default: None

B.1.2.2.2.2 Number Termination Method

Parameter name: Number Termination Method

Parameter ID: meth (0x0003)

Description: Indicates the reason for the generation of the Detection Event String parameter. When a Detection Events Map is present in the EventsDescriptor, this is a mandatory ObservedEventsDescriptor parameter. When a Detection Events Map is absent from the EventsDescriptor, this parameter is also absent.

Type: Enumeration

Optional: Yes

Possible values:

"UM"	(0x0001)	Unambiguous Match
"PM"	(0x0002)	Partial Match, unmatched event
"FM"	(0x0003)	Full Match, unmatched event
"PMT"	(0x0004)	Partial Match, timer expired
"FMT"	(0x0005)	Full Match, timer expired

Default: None

B.1.2.3 Signal Completion

Event name: Signal Completion

NOTE – The term "signal" in the context of this clause means for instance an "SSR2 Signal", which correlates here with "ITU-T H.248 Event".

Event ID: sc (0x0011)

Description: Indicates the termination of a signal for which the notifyCompletion parameter was set to enable reporting of a completion event. For further procedural description, see clauses 7.1.1, 7.1.17 and 7.2.7 of [ITU-T H.248.1].

B.1.2.3.1 EventsDescriptor parameters

B.1.2.3.1.1 Signalling Completion Reference

Parameter name: Signalling Completion Reference

Parameter ID: scref (0x0001)

Description: The Reference String generated by the MGC, which will be copied by the MG to the ObservedEvents Descriptor for reference.

Type: String

Optional: Yes

Possible values: Any string value

Default: None

B.1.2.3.2 ObservedEvents Descriptor parameters

B.1.2.3.2.1 Generated Signal String

Parameter name: Generated Signal String

Parameter ID: gss (0x0002)

Description: This parameter identifies the signal which has been sent. For a signal that is contained in a Generation Signals Map, the delivered signals are indicated in form of a list.

Type: String

Optional: No

Possible values: A signal which has terminated. A signal shall be identified using the pkgdName syntax without wildcarding. In case a Generation Signals Map is used, the gss parameter contains the Generation Signals Map from beginning until the last sent out signal. ABNF Syntax for an SSR2 Signals Map is specified in clause B.2.1 without using the alternatives.

Default: None

B.1.2.3.2.2 Termination Method

Parameter name: Termination Method

Parameter ID: Meth (0x0003)

Description: Indicates the means by which the signal terminated.

Type:	Enumeration
Optional:	No
Possible values:	"NT" (0x0001) Normal termination, completed on its own "EV" (0x0002) Interrupted by event (unexpected backward signal) "SD" (0x0003) Halted by new Signals Descriptor "NC" (0x0004) Not completed, other cause
Default:	None

B.1.2.3.2.3 Signalling Completion Reference

Parameter name:	Signalling Completion Reference
Parameter ID:	scref (0x0004)
Description:	The Reference String sent by the MGC in the Events Descriptor, which is copied by the MG to this parameter for reference.
Type:	String
Optional:	No
Possible values:	The string contained in the original request. In case scref is not specified in the Events Descriptor, the scref is generated from gsm as specified in the original request.
Syntax:	scref=" <i>gsm-value</i> "; e.g., gsm="123<6>7777" is referenced as scref="123<6>7777"
Default:	None

B.1.2.4 CAS Failure

Event name:	CAS Failure
Event ID:	icascgenf (0x0012)
Description:	This event handles failure or abnormal register signalling conditions associated with this package.

B.1.2.4.1 EventsDescriptor parameters

None.

B.1.2.4.2 ObservedEventsDescriptor parameters

B.1.2.4.2.1 Error Code

Parameter name:	Error Code
Parameter ID:	ec (0x0001)
Description:	Indicates the error that occurred.
Type:	Enumeration
Optional:	No
Possible values:	"ERR" (0x0001) Error in compelling sequence with peer signalling entity. "NOL" (0x0002) Number overlength (donl exceeded). "TO" (0x0003) Compelled time out condition due to expiry of one of the timers ikat, okat, or oect.

Default: None

B.1.3 Signals

B.1.3.1 Multifrequency Combination 1

Signal name: Multifrequency Combination 1

Signal ID: mc1 (0x0001)

Description: It generates multifrequency combination (MC) signal code 1. The characteristics of the MF signal code, including frequencies and durations, are provisioned on the MG. The duration time must be set much higher than the longest maximum timers (ikat, okat, oect) to guarantee compelled cycles.

The other MC signal codes are specified in exactly the same way. Table B.2 below indicates all signal IDs.

Signal type: Brief

Duration: Provisioned

Table B.2 – Signal IDs

	Combination number as specified in [ITU-T Q.441]	Signal ID/tone ID	SSR2 Signals Map string IDs
	1	mc1 (0x0001)	"1"
	2	mc2 (0x0002)	"2"
	3	mc3 (0x0003)	"3"
	4	mc4 (0x0004)	"4"
	5	mc5 (0x0005)	"5"
	6	mc6 (0x0006)	"6"
	7	mc7 (0x0007)	"7"
	8	mc8 (0x0008)	"8"
	9	mc9 (0x0009)	"9"
	10	mc10 (0x000a)	"0"
	11	mc11 (0x000b)	"B" or "b"
	12	mc12 (0x000c)	"C" or "c"
	13	mc13 (0x000d)	"D" or "d"
	14	mc14 (0x000e)	"E" or "e"
	15	mc15 (0x000f)	"F" or "f"

B.1.3.1.1 Additional parameters

B.1.3.1.1.1 Exceptional SSR2 treatment

Parameter name: Exceptional SSR2 Treatment

Parameter ID: er2t (0x0001)

Description: Used to alter the normal compelling mode behaviour for special compelling modes. Absence of this parameter indicates that normal compelling behaviour is used.

Type:	Enumeration
Optional:	Yes
Possible values:	"PwP" (0x0001) Pulsed backward signal with pause.
Default:	Empty (no special treatment)

B.1.3.2 Generic Digit Information

Signal name:	Generic Digit Information
Signal ID:	gdi (0x0010)
Description:	Generic Digit Information is a composite signal that supplies all the necessary signals to start the compelling register signalling at the outgoing MG.
Signal type:	Brief
Duration:	Depends on parameters supplied

B.1.3.2.1 Additional parameters

B.1.3.2.1.1 Generation Signals Map

Parameter name:	Generation Signals Map
Parameter ID:	gsm (0x0001)
Description:	The generic signal to be sent.
Type:	String
Optional:	No
Possible values:	A sequence of the characters "0" through "9", "B" through "F" as a quoted string. In addition it can also contain '<' and '>' indicating the expected backward signal. The ABNF syntax for an SSR2 Signals Map is specified in clause B.2.1. NOTE – The SSR2 Signals Map is a specific Generation Signals Map for Signalling System R2 codepoints.
Default:	None

B.1.4 Statistics

None.

B.1.5 Procedures

The following clauses are specific to Signalling System R2.

B.1.5.1 Relation with Signalling System R2

For an outgoing SSR2 link on a MG, the MGC provides the MG with the signal information to be sent to the peer SSR2 node. For an incoming SSR2 link, the MGC provides the MG with the information that the MGC requests from the previous remote SSR2 peer node.

Termination of the address signal or cancellation of the address event (e.g., by sending Events Descriptor and/or Signals Descriptor without icascgen/gdi, or through detection of another line signalling event) shall cause register signals to be immediately removed and may be notified to MGC.

B.1.5.2 General procedures

The MG can be connected to a peer compelled CAS switching system, a peer MG for media transport, and a MGC for exchanging signalling information using ITU-T H.248 with this package.

This package uses the following convention for incoming/outgoing MG:

- Incoming MG: the peer SSR2 exchange initiates the call signalling towards the MG.
- Outgoing MG: the MG initiates the call signalling towards the peer SSR2 exchange.

In general, the incoming/outgoing MG SSR2 interface can treat each event/signal separately by using a normal Events or Signals Descriptor. (For instance, refer to Figure B.2 for one cycle.)

B.1.5.2.1 Signal and Event Maps

The Generation Signals Map or Detection Events Map shall be applied whenever possible.

The incoming MG shall detect the end of generic register events based upon a MGC supplied Detection Events Map. This also takes care of situations where identification of the end of Detection Events Map is achieved through length determination or timeout mechanisms. The Detection Events Maps shall be processed until the maximum length of the generic number is achieved, the "end-of-digit" is encountered or a timeout occurs. The maximum length is provisioned in the MG, and may be altered by the MGC via parameter donl (Detection Open Numbering Length).

The outgoing MG is instructed with a MGC-supplied Generation Signals Map to start or continue with the next section of compelled cycles.

B.1.5.2.2 Relation with other CAS packages

The relation of icascgen to other CAS packages is illustrated in Appendix II.

B.1.5.3 Handling of events

For register signalling, events may be specified on an event by event basis. But this is not the recommended approach, since it will be difficult to meet timing and congestion restrictions (see [ITU-T Q.457] and [ITU-T Q.458]). Therefore, the use of a map-based approach is recommended. The register signalling interface is principally used in the following manner:

- event by event; or
- consecutive events by using Detection Events Maps (section by section); or
- consecutive events by using Detection Events Maps with alternatives (for a complete sequence).

B.1.5.3.1 SSR2 events map syntax

The Detection Events Map (dem) parameter contained in the EventsDescriptor uses the events IDs as specified in Table B.1. Timer symbols T, S and L may be used as well. Timer T is used to specify the maximum time the MG may wait for a first register signal after the bearer connection has been seized.

Additionally, for each SSR2 multifrequency combination (MC) in this map, the MGC may instruct the MG to use another SSR2 backward signal enclosed with "<>".

NOTE – Using "<>" should allow the use of existing H.248 protocol parsers without any modification.

Example: dem="123<3>"

MC1 is used as the default backward signal until specified otherwise within the SSR2 Events Map. In order to use an alternative SSR2 backward signal from the beginning of the Events Map, it is permitted to begin an SSR2 Events Map with an "<>" enclosed backward signal codepoint.

Symbols '<' and '>' are used in the ObservedEventsDescriptor to separate consecutive register information which is used by the MGC to recognize used alternatives.

Example 1: Detection Events Map usage

MGC request:

```
Events =<requestID> { icasgen/gdi{ dem="xx<6>[1-2]<1>x.F<3>[12568]" } }
```

After two digits, the MG sends a backward signal '6' requesting, e.g., a Calling Party Category (see [ITU-T Q.400]) followed by Calling Party Number, etc. The collected MCs are reported to the MGC by using the different backwards signals as separators.

MG response:

```
Observed Events =<requestID> { icasgen/gdi{ des="77<6>2<1>555555F<3>8" } }
```

 to the MGC.

Example 2:

MGC request:

```
Events =<requestID> { icasgen/gdi{ dem="xx<6>[1-2]<1>x.<3>[12568]" } }
```

MG response:

The Notify sends the following information to MGC:

```
Observed Events =<requestID> { icasgen/gdi{ des="77<6>2<1>77777<3>8" } }
```

 to the MGC.

B.1.5.3.2 General handling of incoming register signalling

The Detection Events Map of this package is used exclusively for the incoming register signalling case.

B.1.5.3.3 General handling of outgoing register signalling

The Signal Descriptor covers all events within a sequence of a Generation Signals Map. All remaining events described in Events Descriptor not covered by the Signal Descriptor are included in the Events Descriptor.

B.1.5.4 Handling of signals

Register signalling signals can be specified on a signal by signal basis. But this is not recommended, since it will be difficult to meet the timing and congestion restrictions (see [ITU-T Q.457] and [ITU-T Q.458]). Therefore the use of SSR2 Signals Maps is recommended. The register signalling interface is used in following manner:

- signal by signal; or
- concatenated signals by using SSR2 Signals Maps (section by section); or
- concatenated signals by using SSR2 Signals Maps with alternatives (for a complete sequence).

B.1.5.4.1 SSR2 signals map syntax

The gsm parameter contained in the Signals Descriptor uses the signal IDs specified in Table B.2 formatted as a String. If not otherwise specified, the MG sends the specified signals in the compelled sequence awaiting the default backward signal MC1.

The expected backward signal can be changed within an SSR2 Signals Map by specifying a new expected backward acknowledge signal enclosed with symbols "< >", which is valid for the remaining SSR2 Signals Map or next compelling sequence.

NOTE – Using "< >" should allow the use of existing ITU-T H.248 protocol parsers without any modification.

Example 1:

MGC request:

```
Signals{icasngen/gdi{gsm="77<6>2<1>555555F<3>8"}}
```

SSR2 Signals Maps alternatives can also be used, similar to SSR2 Events Maps.

Example 2:

MGC request:

```
Signals{icasngen/gdi{gsm="12(<1>34567 | <6>2<1>555555F<3>34567 )"}}
```

With the SSR2 Signals Map, it is possible to specify a complete outgoing signal sequence without any notification to the MGC. Alternative branches within the Generation Signals Map are selected based on the received backward signals (<1> or <6> in this example).

B.1.5.4.2 General handling of incoming register signalling

The signals for a compelled incoming register signalling sequence are processed by the Events Descriptor. The Signals Descriptor is used only:

- In the signal by signal case to send the next backward SSR2 signal.
- In other cases to send the next backwards SSR2 signal and continue further treatment of the next compelling sequence with information contained in Detection Events Map (dem).

Incoming compelled register signalling is triggered by the MGC by sending an Events Descriptor with the icasngen/gdi event. The MG autonomously takes control of the compelling sequence as long as the peer responses are covered by the specified SSR2 Events Map and collects all the information, sending a single Notify message when it has been completed.

The compelling action starts by the peer signalling entity by sending a forward signal. In this package, the MG does not know whether it is a Called Party Number or the Country Code Indicator. The meaning of the Detection Events Map is only known by the MGC.

The incoming MG shall collect generic events using the Detection Events Map specified by the MGC and the "End of Digit" register signal as specified by a SSR2 Events Map. In the absence of an SSR2 Detection Events Map, the events are notified on an event by event basis to the MGC.

During a generic number compelling sequence, when the MG determines that an unambiguous match has been found with an alternative in the SSR2 Events map, the MG shall report the collected events with the Generic Number Termination Method set to "Unambiguous Match". This matching criterion may coincide with the reception of the "End of Digit" signal.

Digit collection may terminate due to a timer expiry or the reception of "End of Digit" signal when an alternative in the SSR2 Events Map has partially matched. In this instance, the MG shall report the collected SSR2 events with the Destination Number Termination Method set to "Partial Match". Similarly, SSR2 events collection may terminate due to a timer expiry or the reception of "End of Digit" signal after one of the alternative in the SSR2 Events Map has fully matched, the MG shall report all the collected SSR2 events with the "Method" codepoint set to "Full Match".

The MG shall collect a string of MCs until any of the following events occur:

- The reception of the "End-of-Digit" signal, if specified in an SSR2 Events Map. The MG shall report the complete string with the "End of Digit" representation ("F") included. Other "End of Digit" symbols may also be possible in non-SSR2 signalling systems.

- The collection of more than the maximum number of digits (for instance for the called party number), as specified by the donl parameter. The MG shall report the "NOL" CAS Failure event.
- A digit timeout occurs, in accordance with a value provisioned at the MG. The timer is started the moment generic number compelling starts. The T, S and L timers will be used. The MG shall report all the Detection Events String with the method set to "PMT" or "FMT".

Normally, the last received digit is never answered by a backward signal unless the MG is instructed by the MGC via an embedded Signals Descriptor to do so.

The MGC is responsible to instruct the MG in an adequate manner, either via another Modify or via an embedded Signals or Events Descriptor, on how to proceed with the compelled cycle.

Some SSR2 interfaces require maximum time allowed between the seizure of a line and the first register signal. In this case especially, the "T" timer can be used on incoming side.

B.1.5.4.3 General handling of outgoing register signalling

SSR2 Signals Map of this package is used exclusively for the outgoing register signalling case.

An outgoing compelled register signalling sequence is started with sending the first MC to the remote peer system. The MG does not know the meaning of the sent Generic Digit Information, the interpretation is only known to the MGC.

Normally the compelling action starts after receiving a signal or a SSR2 Signals Map from MGC. In case a previous compelled cycle is not finished yet (i.e., timer oect is still running), the signals respectively the SSR2 Signals Map processing, shall be delayed.

When a single signal is sent, the backward signal is notified according to the Events Descriptor. "Completion" is notified towards the MGC immediately after the SSR2 signal is transmitted. This applies also to the last signal contained in a SSR2 Signals Map.

When a SSR2 Signals Map is used, the MG continues the next compelled cycle, as long as the received backward signal matches the specified backward signal. If the received backward signal does not match the expected backward signal within a SSR2 Signals Map, and the signal completion event was specified in the Events Descriptor, a signal completion notification is reported to the MGC with list of already sent out SSR2 signals and the received backward signal according to the Events Descriptor. This enables the MGC to resume the remaining SSR2 signals in a later phase. If signal completion is not used, a CAS failure with error code "ERR" is reported to MGC.

In general the following shall be applied:

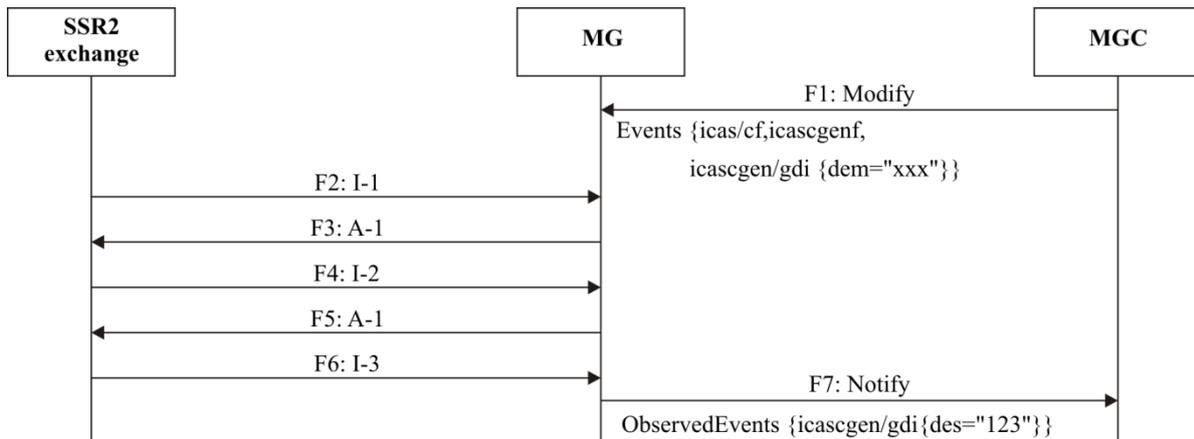
- If SSR2 Signals Map list is not fully sent out and a backward signal is received not matching the currently expected backward SSR2 signal, a signal completion event with Method equal to "EV" is notified to the MGC if signalling completion was specified in the Events Descriptor. Otherwise a CAS failure with error code "ERR" is reported to indicate that the compelled sequence cannot continue.
- When SSR2 Signals Map list is fully sent out, then the normal Events Descriptor handling applies.

The MGC instructs the MG with the generic MC information to be sent next.

In case of strong timing requirements between seizing of a line and the first register signal applies, the use of an embedded Signals Descriptor is recommended, when the seizure of the line is requested.

B.1.5.5 Incoming *en bloc* compelled register signalling

An example of incoming *en bloc* compelled register signalling is given in Figure B.2.



H.248.29(13)_FB.2

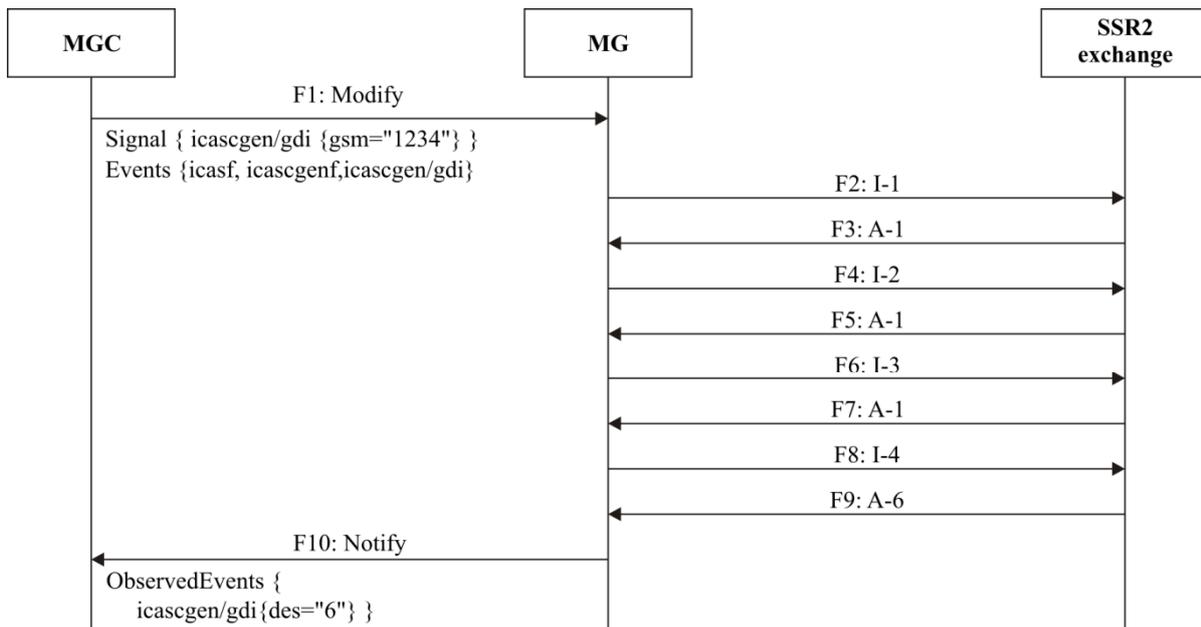
NOTE 1 – Transaction replies are not shown for clarity.

NOTE 2 – SSR2 interregister signalling codepoints shown are Group I Forward Signals defined in Table 6 of [ITU-T Q.441], and Group A Backward Signals defined in Table 8 of [ITU-T Q.441].

Figure B.2 – Incoming generic *en bloc* compelled register signalling example

B.1.5.6 Outgoing *en bloc* compelled register signalling

An example of outgoing *en bloc* compelled register signalling is given in Figure B.3.



H.248.29(13)_FB.3

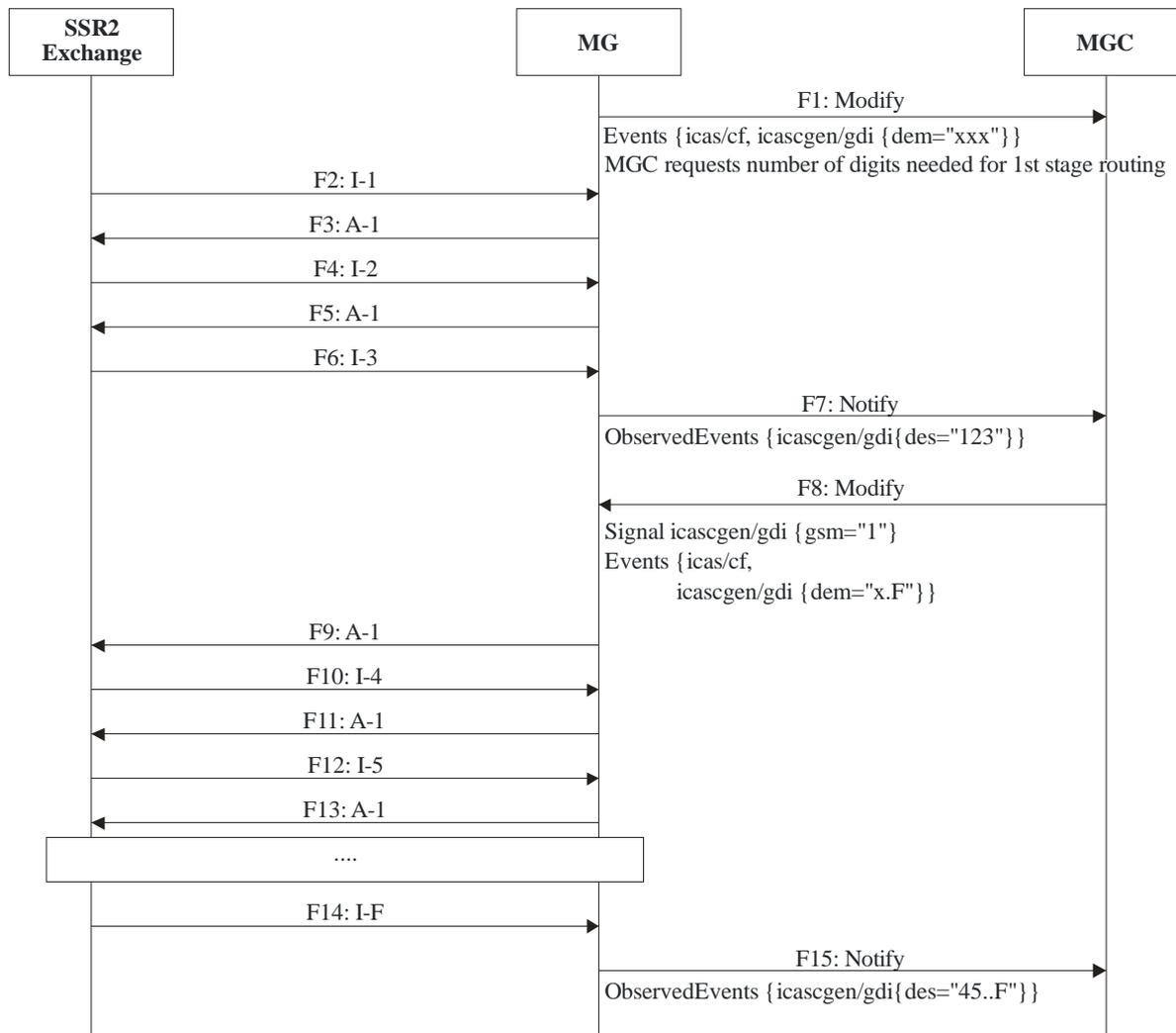
NOTE – SSR2 interregister signalling codepoints shown are Group I Forward Signals defined in Table 6 of [ITU-T Q.441], and Group A Backward Signals defined in Table 8 of [ITU-T Q.441].

Figure B.3 – Outgoing generic *en bloc* compelled register signalling (one section)

B.1.6 Support for overlap signalling

B.1.6.1 Incoming

Figure B.4 shows an example of an incoming overlap sequence.

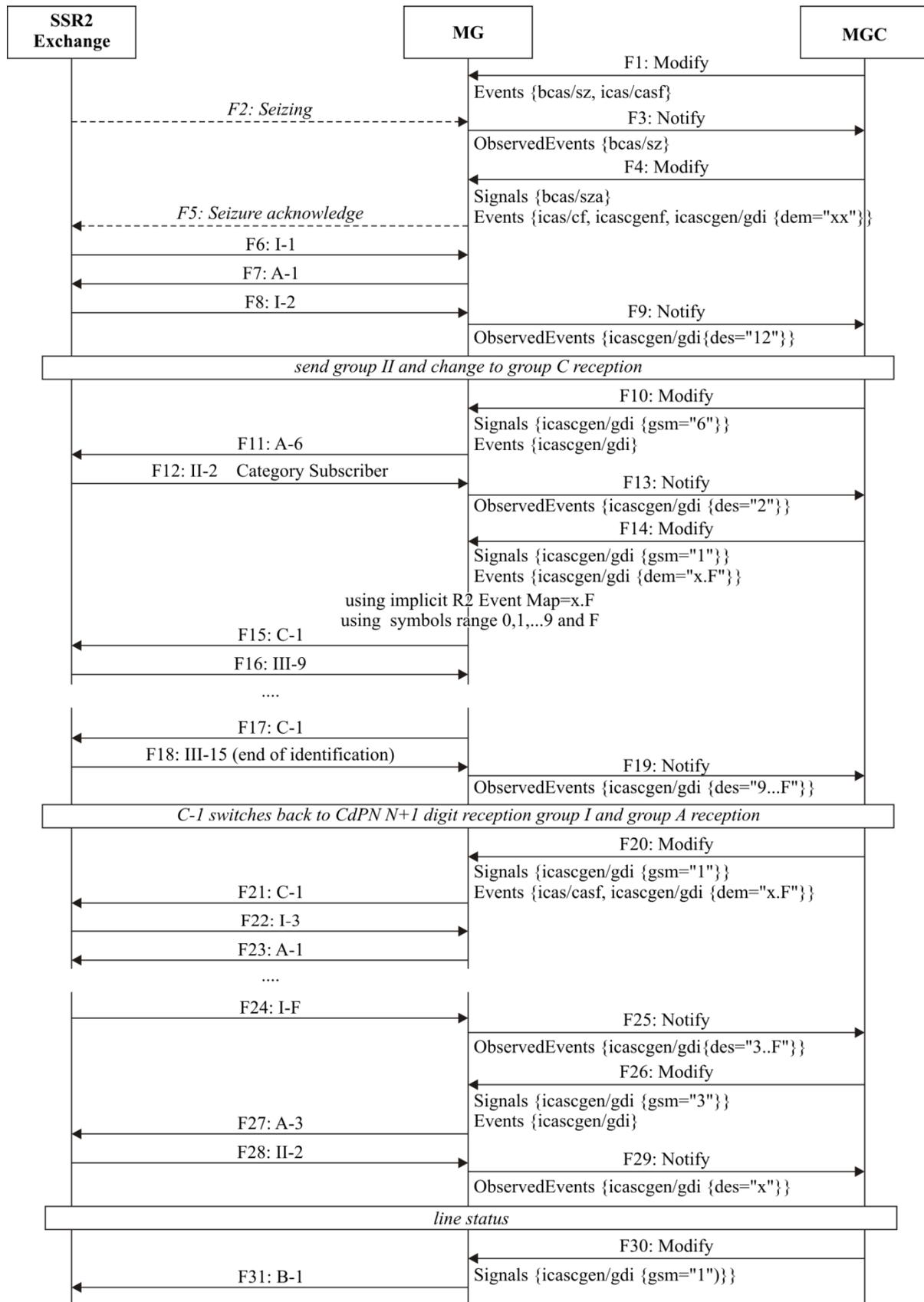


H.248.29(13)_FB.4

NOTE – SSR2 interregister signalling codepoints shown are Group I Forward Signals defined in Table 6 of [ITU-T Q.441], and Group A Backward Signals defined in Table 8 of [ITU-T Q.441].

Figure B.4 – Incoming section by section

An example of complex incoming overlap compelled register signalling is given in Figure B.5:



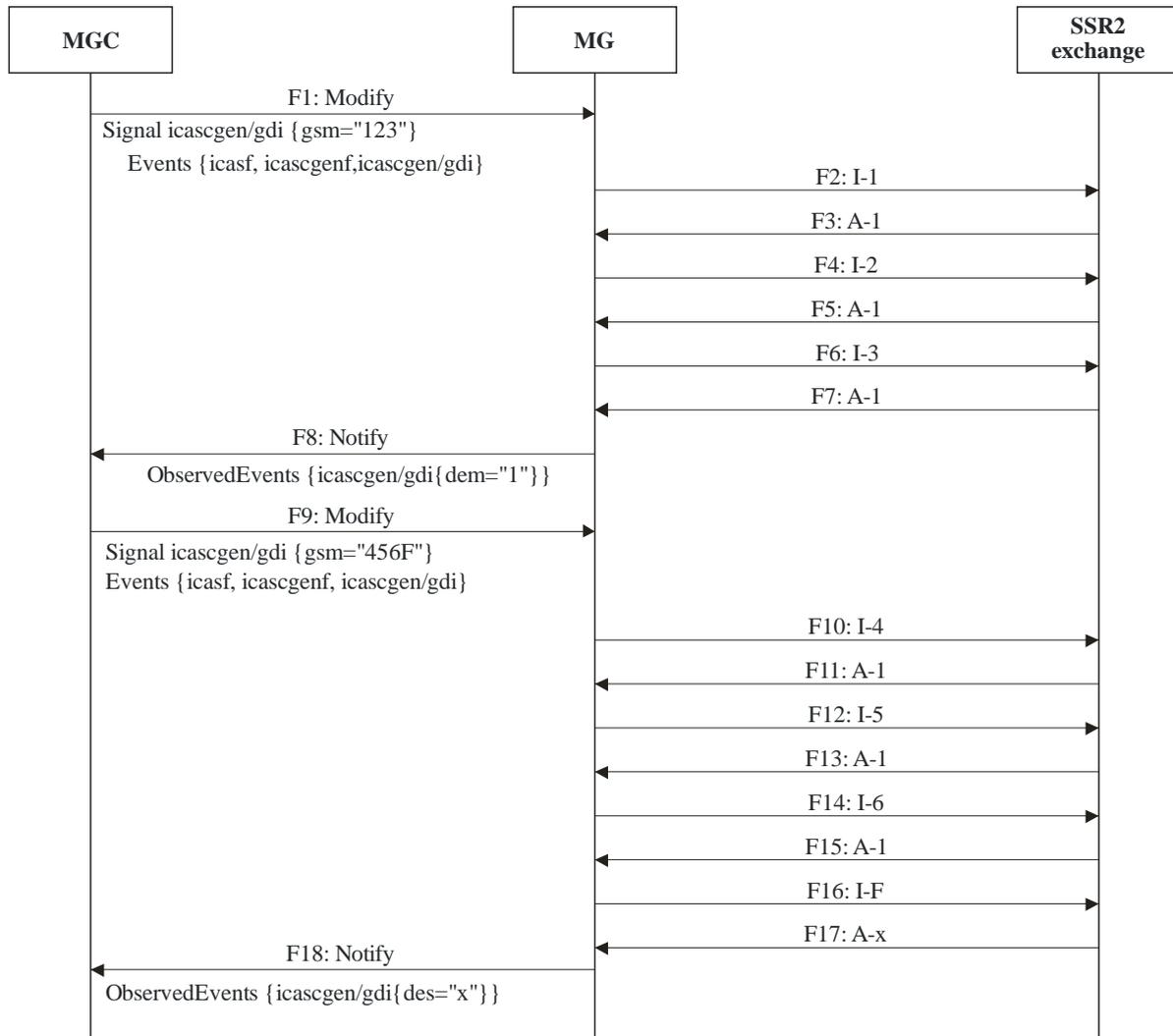
NOTE – SSR2 interregister signalling codepoints used here are Group II Forward Signals defined in Table 7 of [ITU-T Q.441], Group III Forward Signals and Group C Backward Signals to show an example of national extensions. The exact definitions of these codepoints are not relevant here.

H.248.29(13)_FB.5

Figure B.5 – Incoming overlap compelled register signalling

B.1.6.2 Outgoing

Figure B.6 shows an example of an outgoing overlap sequence.



H.248.29(13)_FB.6

NOTE – SSR2 interregister signalling codepoints shown are Group I Forward Signals defined in Table 6 of [ITU-T Q.441], and Group A Backward Signals defined in Table 8 of [ITU-T Q.441].

Figure B.6 – Outgoing section by section signalling

If the outgoing MGC cannot deliver the complete SSR2 Signals Map, it shall use the service completion event mechanism. By using this, the MGC receives a notification, which is used to start the next compelling sequence.

B.1.7 Pulsed backward SSR2 signal without receiving a forward SSR2 signal

If the previous SSR2 system cannot provide the next SSR2 signal, the incoming SSR2 system updates its last backward signal by sending a new pulsed backward signal. The MGC shall indicate this exceptional case with the "er2t" set to "PwP" in the Signals Descriptor. The MG is responsible for ensuring the minimum inactivity on the SSR2 interface before sending out the requested pulsed backward signal. The MG starts a non-recognition timer when activating the pulsed SSR2 backward signal. While this non-recognition timer is running, all incoming MC signals are ignored. After expiration of this timer, the normal compelled cycle treatment applies.

This scenario is illustrated in Appendix I.

B.1.8 End-to-end SSR2 register signalling

For further study.

NOTE – One question is whether the end-to-end case is needed in a NGN network as it is used only in national segments and these are evolving towards becoming NGN networks in the future.

B.2 ABNF encoding

The syntax for the new introduced map types is presented in ABNF according to [b-IETF RFC 2234].

B.2.1 SSR2 signals map syntax

```
r2sigMapValue      = r2signalMap
r2sigMap           = 1* (r2sigMapLetter) *(r2sigStrList)
r2sigStrList      = r2sigStr / ( "(" r2sigStr *( LWSP "|" LWSP r2sigStr ) ")" )
r2sigStr          = r2sigBackAckPos 1*(r2sigMapLetter) *(r2sigStrList)
r2sigBackAckPos   = LWSP "<" r2sigMapLetter ">" LWSP
r2sigMapLetter    = DIGIT ;Basic R2 signal symbols
                  / %x42-46 / %x62-66 ; b-f, B-F
```

B.2.2 SSR2 events map syntax

```
r2eventMapValue    = ["T" COLON Timer COMMA] ["S" COLON Timer COMMA]
                  ["L" COLON Timer COMMA] r2evtMap
r2evtMap           = (r2evtStr /
                    LWSP "(" LWSP r2evtStrList LWSP ")" LWSP)
r2evtStrList      = r2evtStr *( LWSP "|" LWSP r2evtStr )
r2evtStr          = 1*( r2eventStrElement)
r2eventStrElement = ((r2evtDigitPos [DOT]) / r2evtBackAckPos)
r2evtBackAckPos   = LWSP "<" r2digitMapLetter ">" LWSP
r2evtDigitPos     = r2digitMapLetter / r2digitMapRange
r2evtDigitMapRange = ("x" / (LWSP "[" LWSP r2digitLetter LWSP "]" LWSP))
r2evtDigitLetter  = *((DIGIT "-" DIGIT ) / r2digitMapLetter)
r2evtDigitMapLetter = DIGIT ;Basic event symbols
                  / %x42-46 / %x62-66 ; b-f, B-F
                  / "L" / "S" ;Inter-event timers (long, short)
```

B.2.3 SSR2 event string syntax

```
r2detEvtString     = *(r2detEventStringElement)
r2detEvtStringElement = r2detEvtLetter [r2evtBackAckPos]
r2detEvtLetter     = DIGIT
                  / %x42-46 ; b-f
                  / %x62-66 ; B-F
```

; r2evtBackAckPos already defined as part of r2eventMapValue

Appendix I

Timing aspects

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

Timing Specifications for Signalling System R2 are detailed in clause 4.5.2 of [ITU-T Q.457]. Figure I.1 shows the relation to the ITU-T H.248 MG timers.

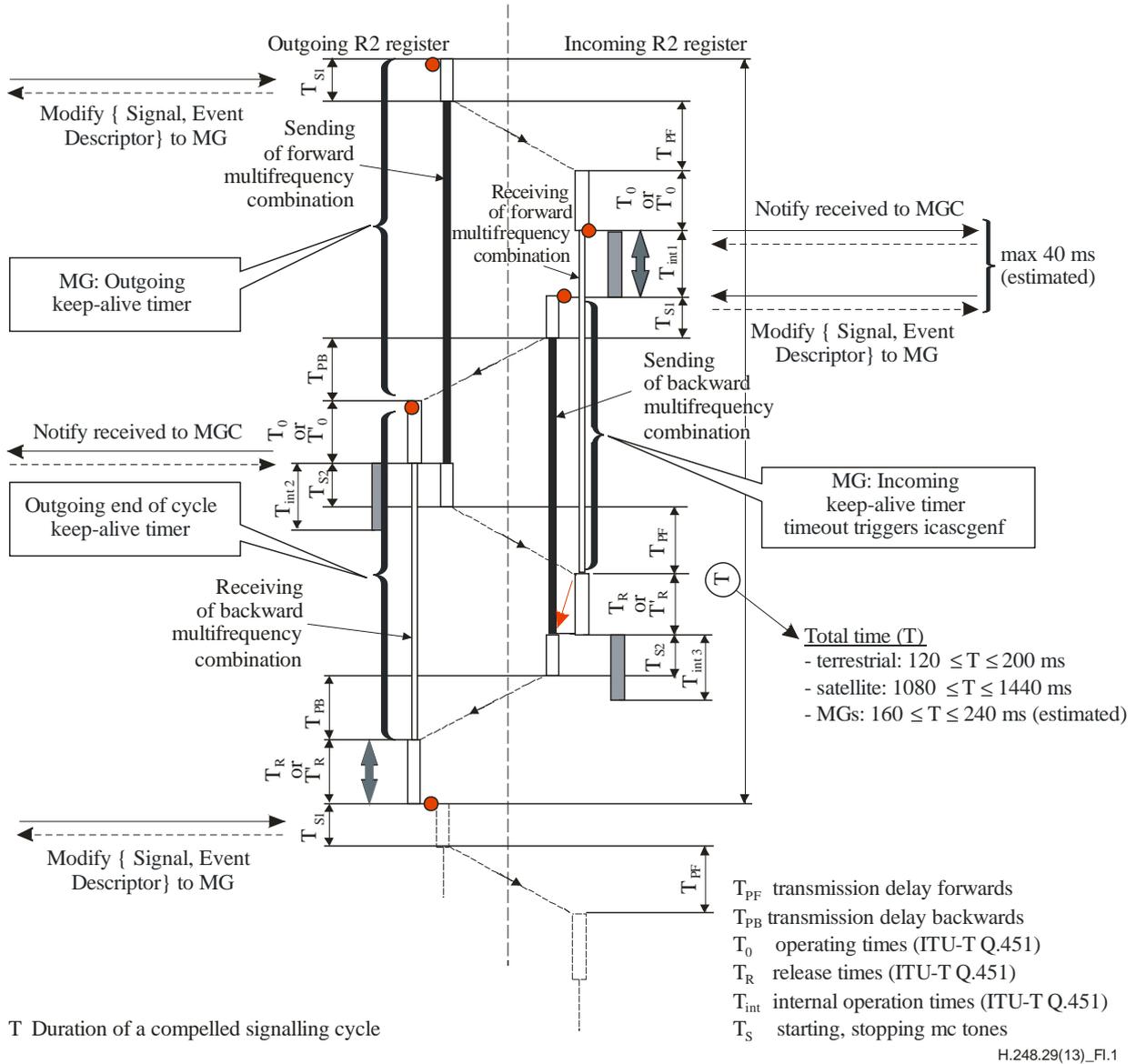
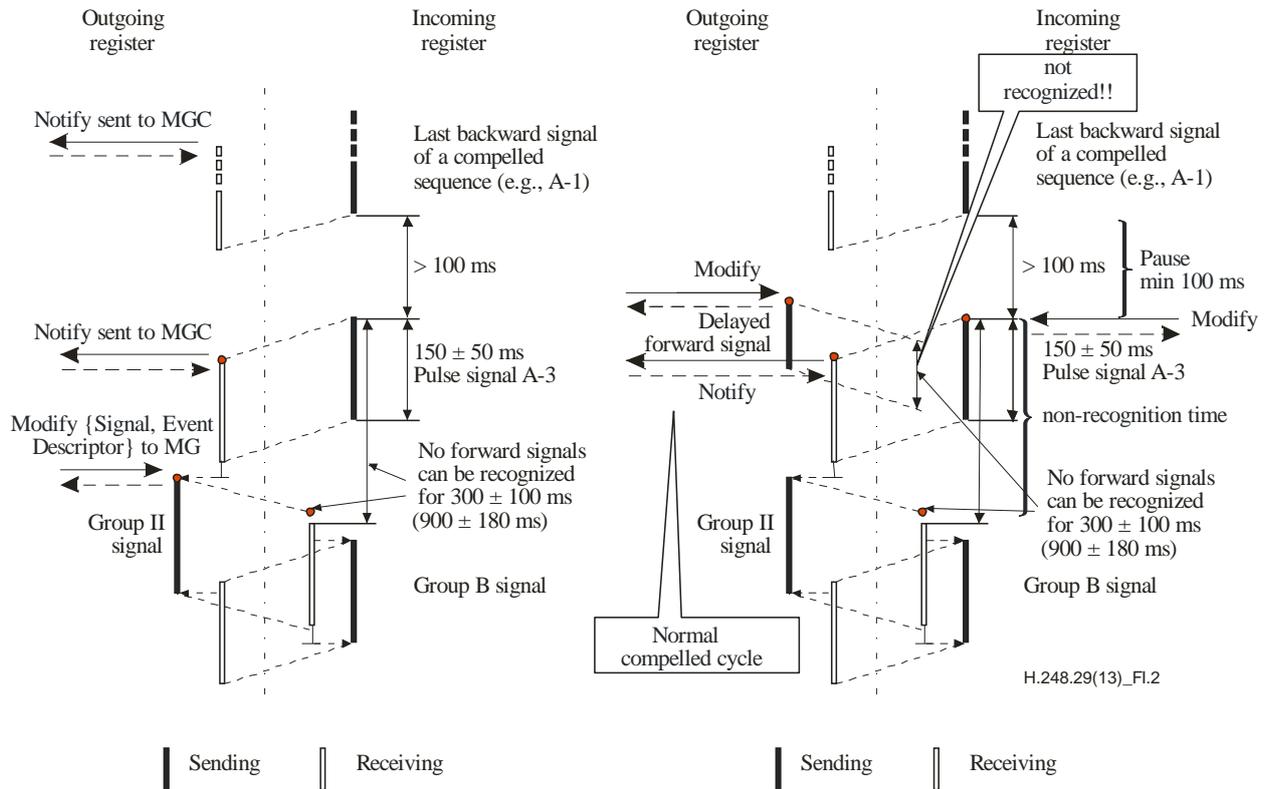


Figure I.1 – Time sequence of a complete compelled signalling cycle (based on [ITU-T Q.457])

H.248.29(13)_Fl.1

The following signalling performance recommendation is derived from [ITU-T Q.457]: "The signalling rates would be between approximately 8 and 5 signalling cycles per second for terrestrial circuits".



a) Pulse transmission of signal A-3
(from Figure 14 of ITU-T Q.442)

a) Pulse transmission of signal A-3
when delayed forward signal appears
(from Figure 15 of ITU-T Q.442)

Figure I.2 – Time sequence of a pulsed transmission signal based on [ITU-T Q-Sup.7]

Appendix II

Survey of ITU-T H.248 packages for CAS

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

Channel associated signalling (CAS) interface handling, in contrast to common channel signalling (CCS) interfaces, is under direct responsibility of ITU-T H.248 media gateways. This responsibility includes handling of analogue line signalling (ALS). Figure II.1 provides an overview and genealogy of ITU-T H.248 packages for CAS and ALS processing.

NOTE – The overview reflects the situation at time of publication.

ITU-T H.248 Packages for CAS are covered by [ITU-T H.248.25], [ITU-T H.248.28] and ITU-T H.248.29. Analogue or digital trunk CAS-based MG interfaces are instantiated via [ITU-T H.248.25] ("two-wire" interfaces) and [ITU-T H.248.28] ("four-wire" interfaces). ITU-T H.248.29 complements the CAS functionalities with packages for support of register-based CAS systems with compelled signalling capabilities.

Figure II.1 outlines the two operation modes of ITU-T H.248.29: Annex A with three sequenced packages *icasc*, *icasco*, and *icasce*; and alternatively Annex B with the package *icascgen*.

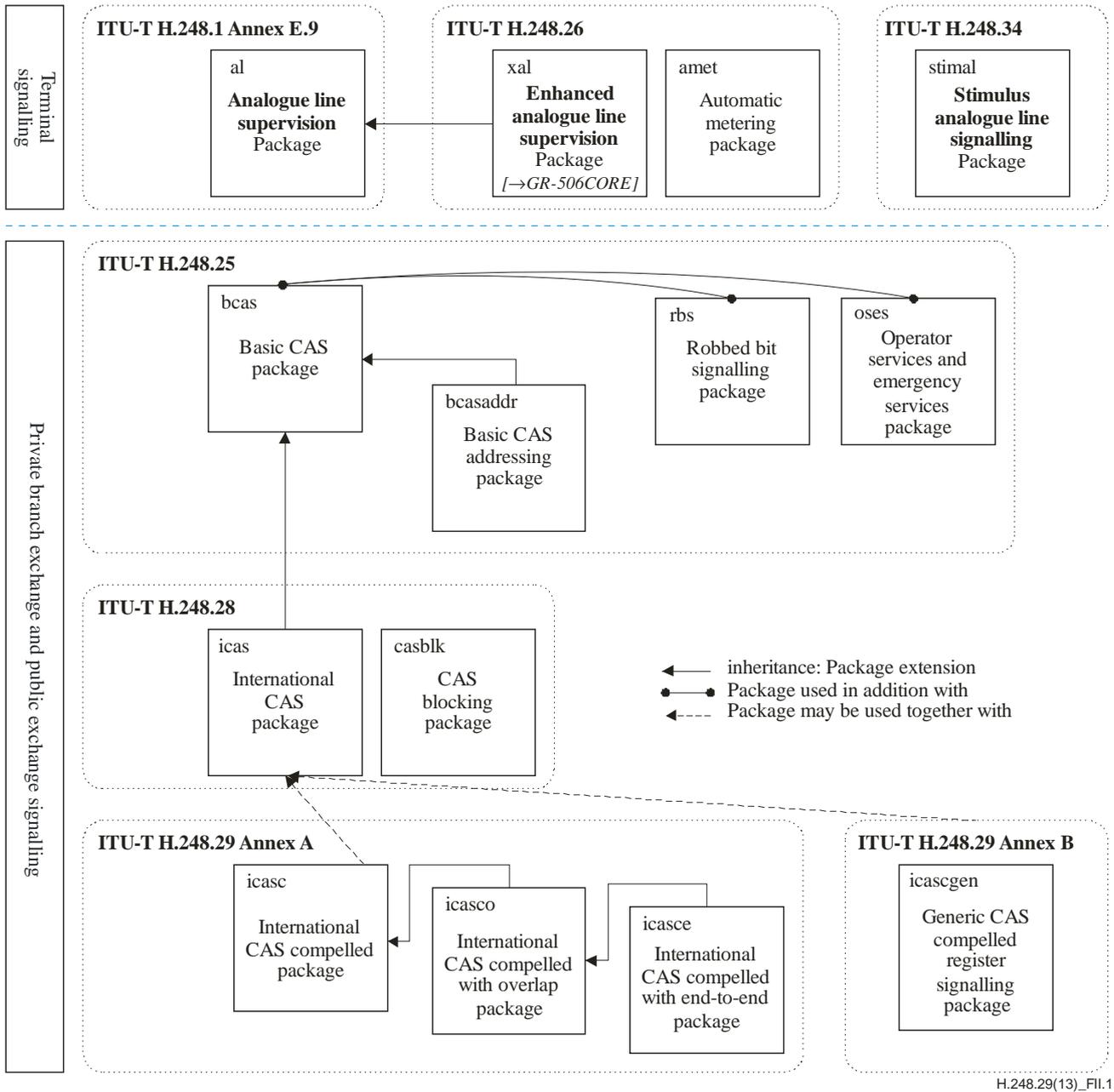


Figure II.1 – Survey of ITU-T H.248 packages for CAS (incl. ALS) interfaces

Bibliography

[b-IETF RFC 2234] IETF RFC 2234 (1997), *Augmented BNF for Syntax Specifications: ABNF*.

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