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Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Specification of protocols required to support the NGN Overload Control Architecture; Part 3: Overload and Congestion Control for H.248 MG/MGC

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

The present document is part 3 of a multi-part deliverable covering the Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Specification of protocols required to support the NGN Overload Control Architecture, as identified below:

Part 1: "Overview";

Part 2: "Overload and Congestion control; GOCAP";

Part 3: "Overload and Congestion Control for H.248 MG/MGC";

Part 4: "Adaptative Control for the MGC".

1 Scope

The present document describes an extension to H.248.1 gateway protocol to enable a robust overload control mechanism to be implemented between Access media GateWays (AGWs) and their associated Media Gateway Controllers (MGCs). This proposal is intended to provide a resolution to a specific known NGN architectural issue that needs to be resolved within the NGN release 1 time frame. The proposal is targeted at reference 1 and is independent of the H.248 core protocol version.

1.1 Applicability

The Access media GateWay/MGC Overload Control Protocol is **applicable** for:

- analog line interfaces with Analog Line Signalling (ALS), corresponding AMG H.248 Terminations are of type analog line (ALN);
- interfaces with Channel Associated Signalling (CAS).

The Access media GateWay/MGC Overload Control Protocol is **not applicable** for:

- all interface types with Common Channel Signalling (CCS) for controlling the corresponding bearer connections at the AMG, e.g.:
  a) ISDN B-channels of ISDN BRIs;
  b) ISDN B-channels of ISDN PRIs;
  c) V5.1 B-channels of V5.1 interfaces;
  d) V5.2 B-channels of V5.2 interfaces; or
  e) any narrowband Access Node interface with CCS.

NOTE 1: CCS traffic is relayed in this kind of AGW by embedded SIGTRAN Signalling Gateways (SG). Such a SG type terminates layer 2 of the control plane protocol stack (e.g. Q.921 [3]) and passes the layer 3 signalling (e.g. Q.931 [4]) transparently to the associated MGC. The AGW therefore has no capability to detect start of call events nor provide address digit analysis.

NOTE 2: Extending the AGW type (of note 1) by an additional capability of "monitoring layer 3 call control signalling" may allow the application of the MGC Overload Control Protocol for CCS interfaces. However, such a concept is for further study.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

[1] ITU-T Recommendation H.248.1: "Gateway control protocol: Version 3".

[2] ITU-T Recommendation Q.543: "Digital exchange performance design objectives".

[3] ITU-T Recommendation Q.921: "ISDN user-network interface - Data link layer specification".

[4] ITU-T Recommendation Q.931: "ISDN user-network interface layer 3 specification for basic call control".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

call attempt: attempt to setup a path to carry user data between end users

callRejectRatio: percentage of call attempts that should be rejected by an AGW

load: total number of call attempts in a given interval of time

load state: percentage of call attempts that are currently being rejected by a MGC

Media Gateway Controller overload: point at which the number of call attempts presented to an MGC exceeds its engineered processing capacity for a significant period of time, excluding momentary peaks

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AGW	Access media GateWay
ALS	Analog Line Signalling
BRI	Basic Rate Interface
CAS	Channel Associated Signalling
CCS	Common Channel Signalling
IP	Internet Protocol
MGC	Media Gateway Controller
NGN	New Generation Networks
OL	OverLoad
PRI	Primary Rate Interface
RTP	Real-Time Transport Protocol
RTP/AVP	Real-Time Protocol Audio-Video Profile
SG	Signalling Gateways
SNMP	Simple Network Management Protocol

4 AGW - MGC OverLoad Control Mechanism

The purpose of the present specification is to define an overload control mechanism between Access media GateWays (AGWs) and their associated Media Gateway Controllers (MGCs) in an NGN. This mechanism is concerned solely with MGC overload due to excessive originating call attempts from dependent AGWs. Additional mechanisms (which are out of scope of the present document) must also be employed to provide an overall overload control solution/strategy in a NGN.

4.1 AGW-MGC Overload Scenarios

In an NGN there exists the possibility that there will be many thousands of AGWs connected to a single MGC. With such an architecture it is envisaged that it may only require a moderate increase in call attempt levels across all of the AGWs to cause a MGC to become overloaded. In the case of media-stimulated events (e.g. tele-voting) or in the event of a disaster, there is often a large step change in the level of call attempts. In the NGN architecture, such an event is likely to grossly overload the MGCs to a level where service may cease completely.

With such large numbers of AGWs connected to a single MGC it will be necessary to efficiently, and quickly, propagate information relating to the MGC overload back to its dependant AGWs, allowing the AGWs to immediately take preventative action, and thus quickly reduce the level of load that is being offered to the overloaded MGC.

4.2 AGW-MGC Overload Control Mechanism

The high level requirement is to enable the rate of new originating calls that are generated by an AGW to be reduced during conditions of MGC overload, whilst at the same time permitting priority calls to be admitted (e.g. calls to an emergency operator).

The basic premise of the load control mechanism is that the MGC is able to invoke a regulating capability on the AGW when the MGC is in overload. This is achieved by sending a H.248 MODIFY message against the ROOT termination with a new package (see clause 5.2) that is recognized by the AGW as being indicative of MGC overload, and contains an indication of the amount of load to be regulated by the AGW. Since the AGW is unaware of the concept of a "call", it is proposed that the AGW shall regulate the level of new Off-Hook notifications it offers to the overloaded MGC to the level that has been signalled by the MGC. A new Off-Hook is identified at the AGW via detection of an Off-Hook event at a termination that is in the NULL context. The proposed mechanism enables the MGC to quickly propagate information relating to its overload, and the proportion of Off-Hooks that its dependant AGWs should be regulating in order to reduce the offered load to the MGC. The purpose of the control mechanism is to maintain high effective throughput at an overloaded MGC subject to bounding MGC response times, i.e. keeping the response times short enough to prevent customer reattempts. The new package would be used by the MGC on the occurrence of either a new originating / terminating a call from/to a dependent AGW to enable regulation of new Off-Hook notifications.

Under this proposal, AGWs will, during a MGC overload, regulate any new Off Hook notifications based upon the current level signalled from the MGC. Off Hook notifications that are accepted by the regulation mechanism are passed onto the MGC and handled normally. For those calls that are regulated by the filtering mechanism, then the AGW must first determine if is the line is initiating a priority call. The AGW does this by autonomously responding to the Off Hook notification by applying standard dial tone and then, if necessary, collecting and comparing signalled digits with pre-defined simple digit strings. The signalled digits will be sufficient to enable the AGW to distinguish between priority digit strings and non-priority digit strings. If the digit string is determined to be a priority string then a notification is sent to the MGC to enable the "priority call" to be handled. If the digit string is determined to be a non-priority string then the AGW applies an autonomous line/port control functionality defined by a pre-configured script/data. In essence, this script defines a sequence of signals that are applied to the line so that the expected behaviour of the calling party is to hang up and re-attempt the o/g call at a later time. The sequence of signals covers the playing of appropriate indications (e.g. network busy tone) together with appropriate line feeds to eventually return the line to an idle state.

As the overload abates on the MGC, the regulation level on the AGWs shall be eventually reduced back to zero and normal operation shall resume.

5 H.248 Details

A new package is introduced to convey the degree of overload at the (overloaded) MGC to the dependent AGWs. This package is based upon the Notification Behaviour (nb) package that has been defined in ITU-T Recommendation H.248.1 [1]. The main difference is that this package may be applied to AGWs that support any version of H.248.

5.1 ETSI Notification Behaviour Package

Package Name: ETSI Notification Behaviour Package.

PackageID: etsi_nb (0x00a4).

Version: 1.

Description: This package enables the MGC to convey its degree of overload to the AGW.

Extends: None.

5.1.1 Properties

Property Name: Notification Regulation.

PropertyID: notreg (0x0001).

Description: This property duplicates the name of a corresponding property in ITU-T Recommendation H.248.1 [1]. However, in this package, it conveys the percentage of Off-Hook notifications from terminations in the NULL context that should be regulated by an AGW. The property applies to the ROOT termination.

Type: Integer.

Possible Values: 0 through to 100.

A value of 0 means that no regulation shall occur on the AGW (i.e. normal behaviour).

A value of 100 means that all Off-Hooks shall be regulated on the AGW.

Default Value: 0.

Defined In: Termination State.

Characteristics: read/write.

Property Name: Off -Hook Notification.

PropertyID: offHookNot (0x0002).

Description: This property determines whether the Off-Hook event is reported to the MGC for (priority) o/g calls that are regulated and permitted to proceed by the AGW during periods of MGC overload. The property applies to the ROOT termination.

Type: Enumeration.

Possible Values: "Required" (x0001).

"NotReq" (x0002.

"Required" means that the Off-Hook notification shall be reported to the MGC.

"NotReq" means that the Off-Hook notification shall not be reported to the MGC.

Default Value: Provisioned on the AGW.

Defined In: Termination State.

Characteristics: read/write.

Property Name: Overload Abatement Control.

PropertyID: olAbateCont (0x0003).

Description: This property determines whether the level of MGC overload may be abated via explicit MGC control or via a decay timer on the AGW. The property applies to the ROOT termination.

Type: Enumeration.

Possible Values: "agTimer" (x0001).

"mgc" (x0002).

"agTimer" means that the load shall be abated via a decay timer on the AGW.

"mgc" means that the load shall be abated via explicit command from the MGC.

Default Value: Provisioned on the AGW.

Defined In: Termination State.

Characteristics: read/write.

5.1.2 Events

None.

5.1.3 Signals

None.

5.1.4 Statistics

None.

5.1.5 Error Codes

None.

5.1.6 Procedures

The purpose of the mechanism is to enable a MGC, under conditions of overload, to convey this fact to the AGW via a Modify command. The AGW activates a filtering mechanism to limit the Off-Hook notifications sent through to the MGC. The MGC overload is conveyed in terms of the notreg property (i.e. the percentage of new Off-Hook notifications to be regulated by the AGW). The new property shall be sent/used against the ROOT termination as follows:

```
Transaction = XXX{
    Context=-{
        Modify=ROOT{
            Media{
                TerminationState{etsi_nb/notreg=ZZZ}
            }
        }
    }
}
```

where XXX = transaction number and ZZZ = the MGC restriction ratio.

The AGW will then invoke/activate a regulating mechanism for Off-Hooks detected against terminations in the NULL context. Off-Hooks that are not subject to regulating will be presented to the MGC in the normal manner. However, Off-Hooks that are subject to regulating will be given special treatment by the AGW. The special treatment results in the AGW applying appropriate signals to the line to enable sufficient digits to be collected to enable comparison with pre-loaded (priority) digit strings. If no such match occurs, the AGW will apply appropriate line signals to cause the end user to hang up and return the line to the idle state. If a match occurs, then the dialled digit string is reported to the MGC. The Off-Hook may also be reported in the same message, based on the *offHookNot* property.

The MGC may use an Audit of the Packages Descriptor to determine if an AGW supports the "etsi_nb" package.

Example message flows are provided in annex A to illustrate how the "etsi_nb" package operates.

5.1.6.1 Actions At An Overloaded MGC

A MGC shall be aware of its current load state, and hence the notreg that is being communicated to its dependant AGWs, at all times. A MGC shall be capable of recomputing the notreg whenever its Load State changes.

It is left to the implementor to decide precisely the way in which this is achieved as the MGCs Load State is dependant upon the overload control mechanisms used on the MGC, and different suppliers' MGCs are likely to have different overload control mechanisms. Ideally the MGCs load control mechanism should exhibit the properties outlined in ITU-T Recommendation Q.543 [2], as shown below.

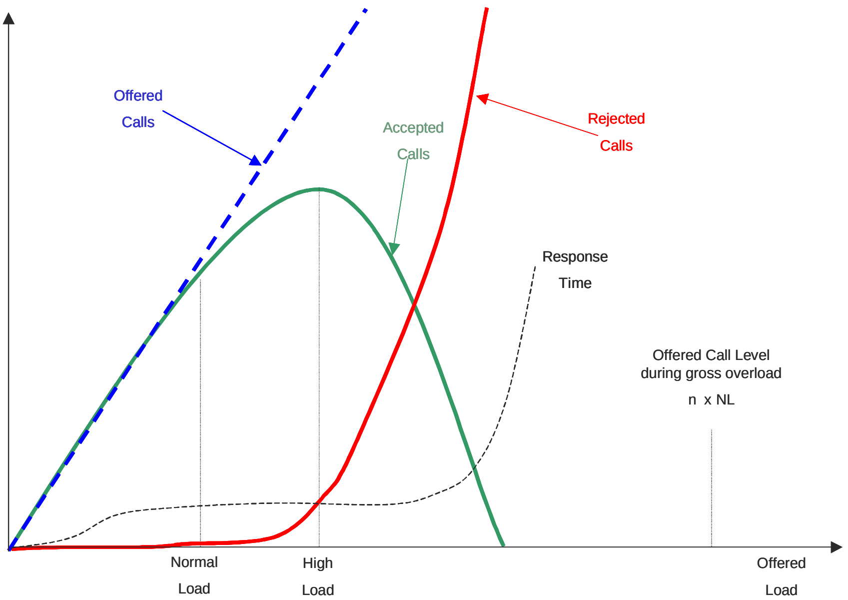

Figure 1: Nodal Load Behaviour

Under overload conditions a MGC shall, on receipt of a new originating call attempt from an AGW (e.g. Off-Hook notification), seek to off-load the processing of that call (and future calls) from the AGW by the sending a H.248 MODIFY message using the new package to convey its notreg. The MGC shall also use terminating call attempts as a trigger to update the notreg on a given AGW. In order avoid extra H.248 messages, the notification may be sent in the first available message to a given AGW.

The MGC shall be aware of the previously signalled notreg to each of its AGWs. On receipt of new originating / terminating call attempts from/to an AGW, the MGC shall update the notreg if it has increased from the value previously signalled. If *olAbateCon=mgc*, the MGC shall also update the notreg if it has decreased from the value previously signalled. In essence a MGC has three states in relation to each of its dependant AGWs:

- Not Overloaded.
- Waiting to send notreg to AGW.
- Sent notreg to AGW.

In the state "Not Overloaded":

- If the MGC detects it is overloaded, then change state to "Waiting to send notreg to AGW".

In the state "Waiting to send callRejectRatio to AGW":

- If a new outgoing call attempt is received, then the MGC shall proceed with the outgoing call and send the notreg using a Modify command against the ROOT termination. In order to minimize the number of H.248 transactions, the MGC may nest the Modify command within the same H.248 transaction as that used to progress the outgoing call. Change state to "Sent notreg to AGW".
- If a new terminating call is offered to the AGW, then send the notreg using a Modify command against the ROOT termination. In order to minimize the number of H.248 transactions, the MGC may nest the Modify command within the same H.248 transaction as that used to signal the incoming call to the AGW. change state to "Sent notreg to AGW".
- If the MGC detects it is not in overload and *olAbateCont=agTimer*, then change state to "Not Overloaded".
- If the MGC detects it is not in overload and *olAbateCont=mgc*, then change state to "Not Overloaded" if previously signalled notreg value to AGW is zero.

In the state "Sent notreg to AGW":

- If a new outgoing call attempt is received from AGW then the MGC shall proceed with the outgoing call.
- If the MGC detects it is not in overload and *olAbateCont=agTimer*, then change state to "Not Overloaded".
- If the notreg increases or the notreg decreases and *olAbateCont=mgc*, then change state to "Waiting to send notreg to AGW".

It should be noted that a new outgoing call attempt is signalled by the AGW via a Notify command containing either just an Off-Hook observed event or an Off-Hook and Digit Completion observed event or a Digit Completion event. The first situation occurs when an Off-Hook is not restricted. The second situation occurs when an Off-Hook is initially restricted but a priority digit string match occurs and the property *offHookNot=Required*. The third situation occurs when an Off-Hook is initially restricted but a priority digit string match occurs and the property *offHookNot=NotReq*.

Having sent a MODIFY to increase the notreg value to a given AGW, a MGC shall endeavour to handle any new received Off-Hooks as normal.

5.1.6.2 Actions At An AGW

5.1.6.2.1 Activation of AGW Regulating Mechanism

Regulating of new Off-Hook notifications at an AGW shall be activated when the notreg property is greater than 0. The notreg property is set by the MGC by issuing a Modify command against the ROOT termination.

If property *olAbateCont = agTimer*, then activation of the regulating mechanism shall also cause a DecayInterval timer to be computed and then activated. This DecayInterval shall be set to an operator-configurable value. The DecayInterval represents the mean of a random distribution so as to alleviate synchronization problems that may occur during periods of sudden gross overload. The means by which the AGW's notreg is decremented upon expiry of the DecayInterval timer is described in clause 5.1.6.2.3.

If property *olAbateCont = mgc*, then the AGW's notreg shall be decreased under explicit control of the MGC.

Activation of the regulating shall cause the AGW to start monitoring for new Off-Hook events, and when appropriate (i.e. in the case of a putative call rejection) invoke special treatment for such terminations.

NOTE: This "special treatment" is described in annex B.

5.1.6.2.2 AGW Behaviour During Regulating Mechanism

If property *olAbateCont = agTimer, t*he AGW shall increase its notreg if and only if a higher notreg value is signalled down from the MGC (in which case it sets its notreg equal to the signalled value). It should be noted that it is also possible for a lower value may be received from the MGC when *olAbateCont = agTimer* (e.g. due to spare-over of MGC). In this case, the AGW shall respond OK to the MGC but shall not reduce its in-hand notreg value.

If property *olAbateCont = mgc*, then a lower value will also be received from the MGC. Upon receipt of a new Off-Hook, if the notreg is non-zero, then the AGW shall apply the special treatment described below:

- If the new Off-Hook not subject to regulation, then a "Off-Hook" observed event is sent to the MGC, obeying the in hand events descriptor which was previously sent by the MGC. The H.248 Notification message shall contain the in-hand RequestID (as previously sent from the MGC).
- Otherwise, If the new outgoing call attempt is subject to regulation, then the AGW shall apply the special treatment described below:
  - The AGW connects dial tone and collects sufficient digits to determine whether the dialled string matches a pre-loaded priority digit string or not.
  - If a match occurs, then an observed event of Off-Hook and Digit Completion or Digit Completion (dependent on the *offHookNot* property) are reported to the MGC using a default request id of "FFFFFFFF"(Hex).
  - If no match occurs with the priority digit strings, then the AGW applies a provisioned sequence of signals to the termination (e.g. an end of call indication such as congestion tone together with any related analogue signals such as end of call/pulsed reduced battery) to encourage the end user to go On-Hook.
  - On receipt of an On-Hook event for such a regulated call, the AGW shall not notify the MGC of this event, and shall apply appropriate signals (e.g. idle line feed) to return the termination to an idle state.

The special treatment logic applied by an AGW may be pre-defined or controlled via a configurable script. This is an AGW implementation decision. Moreover, the script defines the special line treatment logic described above, including the packages/events used for reporting the observed events, the request id to be used for reporting the observed events and the end of call tone etc.

5.1.6.2.3 Reduction of Regulating Level at AGW

If *olAbateCont = agTimer,* then upon expiry of the DecayInterval timer, the regulation level of the AGW shall be decremented by an operator configurable value, the restrictionRatioDecayStep. If the resultant regulation level of the AGW is greater than zero, then the DecayInterval timer shall be restarted. The regulation level on the AGW may not fall below zero.

If *olAbateCont = mgc*, then the regulation level at the AGW shall be driven by explicit commands from the MGC.

5.1.6.2.4 Termination of Regulating Mechanism on the AGW

The regulation level on the AGW shall reduce as described in clause 5.1.6.2.3. If the resultant regulation level of the AGW is less than zero, then it is set to zero.

If the regulation level of the AGW is equal to zero then the overload control is terminated, and the AGW shall return to normal working, i.e. all Off-Hooks are passed to the MGC.

5.1.6.2.5 Receipt of H.248 Signalling on a termination during Regulating Mechanism

During periods of AGW regulating, it is possible for a new terminating call to be offered to the AGW whilst it is in the process of regulating an outgoing seizure on a termination (e.g. dial tone connected or partial digit match to priority digit string). Under these circumstances an incoming H.248 command from the MGC shall be rejected with error code 40 ("Unexpected Initial Hook State"). The MGC shall, on receipt of this error code, provide appropriate call handling (e.g. reject the incoming call attempt with reason "subscriber busy").

5.1.6.3 MGC Failure

In the event of a MGC failure, knowledge of previous notreg values signalled to dependent AGWs may be lost. Under these circumstances, a MGC may send a notreg value that is lower than that previously signalled (see clause 5.1.6.2.2).

Following a restart, the MGC shall assume an initial value of notreg. The initial value shall be implementation specific. It is recommended that the initial value be greater than zero to compensate for the extra work needed to be done by a MGC in the initial period following a restart. The MGC shall enter the "Waiting to send notreg to AGW" state (see clause 5.1.6.1).

If property *olAbateCont = mgc*, then the MGC must ensure that it refreshes the current AGW restriction level to prevent a stale restriction level persisting on the AGW.

5.1.6.4 AGW Failure

In the event of an AGW failure, the in-hand notreg value may be lost. Under these circumstances, an AGW shall assume an initial value of notreg of zero. On receipt of the Service Change from an AGW, it is recommended that the MGC use receipt of this message as a trigger to send the current notreg value to the AGW in order to re-synchronize the MGC load state information.

6 Management Requirements

6.1 Configuration of parameters relating to reduction of restriction rate

The DecayInterval timer shall be a mean of the time duration which is operator-configurable by means of a proprietary management interface, or the use of SNMP. The implementor shall ensure that the range and granularity of this parameter is configurable and sufficient so as to work over a wide range of scenarios.

The notregDecayStep shall be an integer value between 1 and 100 which is operator-configurable by means of a proprietary management interface, or the use of SNMP. The implementor shall ensure that the range and granularity of this parameter is configurable and sufficient so as to work over a wide range of scenarios.

6.2 AGW Statistics

When an MGC initiates this type overload control towards an AGW, then the following information shall be recorded by the AGW for subsequent retrieval via a proprietary interface, or the use of SNMP:

- Date.
- Time.
- AGW identity.
- MGC identity.

When an AGW terminates this type overload control towards an MGC, then the following information shall be recorded by the AGW for subsequent retrieval via a proprietary interface, or the use of SNMP:

- Date.
- Time.
- AGW identity.
- MGC identity.
- Total number of Off-Hooks offered to the regulation mechanism for the duration of the control activation.

- Total number of Off-Hooks offered to the regulation mechanism and subsequently sent to MGC (based on priority digit string match) for the duration of the control activation.
- Total number of Off-Hooks offered to the regulation mechanism and not subsequently sent to MGC (based on no priority digit string match) for the duration of the control activation.

Annex A (informative): Message Flows

This annex provides some example message flows to illustrate the MGC overload mechanism. In all flows, DEL (Direct Exchange Lines) ports are assumed on the AGW.

	AGW	MGC
Line is primed for Off-Hook.	**Transaction = 998 { Context = - { Modify = aln/1/1 { Events = 1111{ al/of{strict=state}} } } }**	The MGCMGC asks the AGW to notify an Off-Hook event. Note that the use of embedded events and signal descriptor are not illustrated - although they could be used.
	Reply = 998 { Context = - { Modify = aln/1/1 } }	Now ready for next call.
OFF HOOK Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed. Informs the MGC of the Off-Hook event		
Normal line feed.		
	Transaction = 100 { Context = - { Notify = aln/1/1 { ObservedEvents = 1111 { 20031215T22000000: al/of { init=false } } } } }	MGC notes that analogue port 1 on the AGW wants to initiate a call and performs the following actions: Acknowledges the receipt of the Off-Hook. Marks the port as busy for incoming calls. The init=false denotes that a transition is being reported - i.e. the line was not "already off hook".
AGW notes that MGC has received the Off-Hook.	**Reply = 100 { Context = - { Notify = aln/1/1 } }**	

	AGW	MGC
	← **Transaction = 999 {** **Context = $ {** **Add = aln/1/1 {** **Media {** **Stream = 1 {** **LocalControl {** **Mode = SendReceive** **}} } } }}**	**POINT-A** The MGC firstly places the analogue termination into a context.
The AGW creates a context and responds.	→ **Reply = 999 {** **Context = 1 {** **Add = aln/1/1 } }**	The context is noted.
AGW performs the following actions: Sends a positive ack to the MGC Applies dial tone. Connects DTMF receiver and collects digits according to the digit map. Monitors for an On-Hook event and Hook Flash.	← **Transaction = 1000 {** **Context = 1 {** **Modify = aln/1/1 {** **Events = 1112 {** **al/on {** **strict = state** **},** **al/fl ,** **xdd/xce{DigitMap=[0-9EF],bc=5}** **} },** **Signals {** **cg/dt }** **} } } }**	**POINT-B** MGC now: Requests dial tone to be applied, Request digits are collected according to MGC data (1 digit shown here), with a digit buffering control timer of 5 seconds and the shortest match digit procedures are specified. Activates the events descriptor to monitor for On-Hook and Hook Flash.
	→ **Reply = 1000 {** **Context = 1 { Modify = aln/1/1 } }**	
← - - - - - - - - - - Dial Tone returned. - - - - - - - - - - →		
	AGW autonomously disconnects dial tone and collects digits according to digit map	
First Digit Detected.		
	→ **Transaction = 101 {** **Context = 1 {** **Notify = aln/1/1 {** **ObservedEvents = 1112 {** **20031215T22000020: xdd/xce {** **ds = '0',** **meth=UM** **}** **} } } }**	The MGC receives the digit and accesses its database.

	AGW	MGC

```
Reply = 101 {
    Context = 1 { Notify = aln/1/1 }  }
```

MGC: The Notify specifying the digit string is acknowledged.

```
Transaction = 1002 {
    Context = 1 {
        Modify = aln/1/1 {
            Events = 1112 {
                al/on {
                    strict = state
                            },
                al/fl {},
                xdd/xce{DigitMap={[0-9EF][0-
                        9EF][0-9EF]},bc=5}
              } },
              Signals { }
} } } }
```

MGC: The MGC now requests the next block of digits - 3 are shown here.

The AGW responds.

```
Reply = 1002 {
   Context = 1 { Modify = aln/1/1 } }
```

Digits detected and collected until they match the digit map.

```
Transaction = 102 {
   Context = 1 {
       Notify = aln/1/1 {
          ObservedEvents =  1112 {
               20031215T22000020: xdd/xce {
                    ds =  '123',
                    meth=UM}
          }
 }  }   }
```

MGC: MGC accesses its database again and the call is routed or further digits requested from the AGW.

```
Reply = 102 {
    Context = 1 {Notify = aln/1/1 }  }
```

MGC: **O/G Call Proceeds.**

Figure A.1: Normal (not priority) Outgoing Call Attempt (MGC not in overload, no regulating)

	AGW	MGC
Line is primed for Off-Hook	← **Transaction = 998 { Context = - { Modify = aln/1/1 { Events = 1111{ al/of{strict=state}} } } }**	The MGC asks the AGW to notify an Off-Hook event. Note that embedded events are not used - although they could be and would give a more efficient flow.
	→ **Reply = 998 { Context = - { Modify = aln/1/1 } }**	Now ready for next call.
- - - - - - - - - - → OFF HOOK Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed. Informs the MGC of the Off-Hook event		
← - - - - - - - - - - Normal line feed		
	→ **Transaction = 100 { Context = - { Notify = aln/1/1 { ObservedEvents = 1111 { 20031215T22000000: al/of { init=false } } } } }**	MGC notes that analogue port 1 on the AGW wants to initiate a call and performs the following actions: Acknowledges the receipt of the Off-Hook Marks the port as busy for incoming calls. The init=false denotes that a transition is being reported - i.e. the line was not "already off hook".
AGW notes that MGC has received the Off-Hook.	← **Reply = 100 { Context = - {Notify = aln/1/1 } }**	
	← **Transaction = 999 { Context = $ { Add = aln/1/1 { Media { Stream = 1 { LocalControl { Mode = SendReceive }} } } }}**	The MGC firstly places the analogue termination into a context.
The AGW creates a context and responds.	→ **Reply = 999 { Context = 1 {Add = aln/1/1 } }**	The context is noted.
AGW performs the following actions: Sends a positive ack to the MGC Applies dial tone Connects DTMF receiver and collects digits according to the digit map. Monitors for an On-Hook event and Hook Flash.	← **Transaction = 1000 { Context = 1 { Modify = aln/1/1 { Events = 1112 { al/on { strict = state }, al/fl , xdd/xce{DigitMap=[0-9EF],bc=5} } }, Signals {cg/dt } } } } }**	MGC now: Requests dial tone to be applied, Request digits are collected according to MGC data (1 digit shown here), with a digit buffering control timer of 5 seconds and the shortest match digit procedures are specified. Activates the events descriptor to monitor for On-Hook and Hook Flash.
	→	

	AGW	MGC

```
Reply = 1000 {
   Context = 1 {Modify = aln/1/1 } }
```

Dial Tone returned

AGW autonomously disconnects dial tone and collects digits according to digit map.

First Digit Detected

```
Transaction = 101 {
   Context = 1 {
       Notify = aln/1/1 {
          ObservedEvents =  1112 {
               20031215T22000020: xdd/xce {
                    ds =  '9',
                    meth=UM
                                                     }
                                        } } }  }
```

The MGC receives the digit and accesses its database.

Note that the emergency code of 999 is assumed - i.e. as per UK.

```
Reply = 101 {
    Context = 1 {Notify = aln/1/1 }  }
```

The Notify specifying the digit string is acknowledged.

```
Transaction = 1002 {
    Context = 1 {
        Modify = aln/1/1 {
            Events = 1112 {
               al/on {
                  strict = state
                             },
               al/fl {},
               xdd/xce{DigitMap={[0-9EF][0-
                          9EF]},bc=5}
            } },
            Signals { }
} } } }
```

The MGC now requests the next block of digits - 2 are shown here.

The AGW responds.

```
Reply = 1002 {
   Context = 1 {Modify = aln/1/1 } }
```

Digits detected and collected until they match the digit map

```
Transaction = 102 {
   Context = 1 {
       Notify = aln/1/1 {
          ObservedEvents =  1112 {
               20031215T22000020: xdd/xce {
                    ds =  '99',
                    meth=UM}
} } }  }
```

MGC accesses its database again and the call is routed to the emergency operator.

```
Reply = 102 {
    Context = 1 {Notify = aln/1/1 }
}
```

O/G Call proceeds.

Figure A.2: Priority Outgoing Call Attempt (MGC not in overload, no regulating)

In the following case, the MGC has entered an overloaded state but has not yet informed the AGW.

	AGW	MGC
Line is primed for Off-Hook.	← **Transaction = 998 { Context = - { Modify = aln/1/1 { Events = 1111{ mskukal/of{strict=state}} } } }**	The MGC asks the AGW to notify an Off-Hook event. Note that embedded events are not used - although they could be and would give a more efficient flow.
	→ **Reply = 998 { Context = - { Modify = aln/1/1 } }**	Now ready for next call.
		In the meantime, the MGC has gone into overload but has not sent/received any calls from this particular gateway.
OFF HOOK → Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed. Informs the MGC of the Off-Hook event ← Normal line feed		
	→ **Transaction = 100 { Context = - { Notify = aln/1/1 { ObservedEvents = 1111 { 20031215T22000000: al/of {init=false} } } } }**	MGC receives the new o/g call attempt and determines that it is overload and that its current overload level is greater than that sent to the AGW previously.
AGW notes that MGC has received the Off-Hook.	← **Reply = 100 { Context = - { Notify = aln/1/1 } }**	This Off-Hook will be processed but will be used to trigger a MODIFY to inform the AGW of the increased overload level.
	← **Transaction = 999 { Context = $ { Add = aln/1/1 { Media { Stream = 1 { LocalControl { Mode = SendReceive} } } } }, Context=-{ Modify = ROOT {Media{ TerminationState{ etsi_nb/notreg=40, etsi_nb/olAbateCont=agTimer, etsi_nb/offHookNot=Required } }} } }**	The MGC firstly places the cct into a context. Additionally, a MODIFY is sent on ROOT.
The AGW creates a context, notes the MGC overload level and responds.	→ **Reply = 999 { Context = 1 { Add = aln/1/1}, Context = - { Modify = ROOT}**	The context is noted for the o/g call. The (triggering) o/g call continues as in figure A.1 (POINT-B).

	AGW	MGC
	}	
The AGW autonomous filtering is now invoked.		MGC has switched on the autonomous filtering/rejection in the AGW. MGC remembers the level sent to the AGW.

Figure A.3: Outgoing Call Attempt
(MGC in overload, MGC awaiting to send *notreg* to AGW and regulation is currently inactive)

	AGW	MGC
Assume that a callrejectratio has been previously sent to the AGW - as for example figure A.3. - ►		
OFF HOOK Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed. ◄ -		
Normal line feed AGW AGW regulating is active, but the AGW determines that this call is not subject to regulating. The Off-Hook is sent through to the MGC (as normal)		
	────────────────►	
	Transaction = 100 { Context = - { Notify = aln/1/1 { ObservedEvents = 1111 { 20031215T22000000: al/of { init=false } } } } }	MGC notes that analogue port 1 on the AGW wants to initiate a call and proceeds with the outgoing call by performing the following actions: Acknowledges the receipt of the Off-Hook Marks the port as busy for incoming calls. The init=false denotes that a transition is being reported - i.e. the line was not "already off hook".
AGW notes that MGC has received the Off-Hook.	◄────────────────	
	Reply = 100 { Context = - {Notify = aln/1/1 } }	
		The o/g call continues as in figure A.1 (POINT-A).

Figure A.4: Outgoing Call Attempt
(MGC in overload, Regulating Active in the AGW, Off-Hook is admitted to the MGC)

In figure A.5, the AGW is regulating new Off-Hooks to the MGC (based on *notreg*). The Off-Hook is regulated, digits collected and the notification subsequently sent to the MGC since the digits match a priority string.

	AGW	MGC
Assume that a notreg > 0 has been previously sent to the AGW - as for example figure A.3. AGW -► OFF HOOK Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed. Informs the MGC of the Off-Hook event ◄- Normal line feed AGW The AGW determines that the call is subject to regulating. At this point, Dial Tone is applied to collect digits to determine if it is a priority call. ◄- Dial Tone Digits are dialled -► AGW removes Dial Tone on first digit reception and compares dialled digits with the pre-configured emergency dial plan. In this case, assume that 999 dialled matches one of its candidate list of strings in the emergency dial plan.		
A notify is sent with the Off-Hook & digits using the default reply id of "FFFFFFFF (Hex)".	────────────► **Transaction = 100 { Context = - { Notify = aln/1/1 { ObservedEvents = 4294967295 { 20031215T22000000: al/of { init=false }, 20031215T22000003: xdd/xce { ds = '999', meth=UM } } } } }**	In this case, the MGC is in the "Sent restriction level" state and accepts the Off-Hook & digits together and proceeds with the outgoing call set up.-AGWMGC
AGW notes that MGC has received the notify.	◄──────────── **Reply = 100 { Context = - { Notify = aln/1/1 } }**	
	◄──────────── **Transaction = 999 { Context = $ { Add = aln/1/1 { Media { Stream = 1 { LocalControl { Mode = SendReceive }} } } }}**	The MGC firstly places the analogue termination into a context.
The AGW creates a context and	────────────►	The context is noted.

	AGW	MGC
responds.	**Reply = 999 { Context = 1 { Add = aln/1/1 } }**	MGC The MGC performs the following:
The AGW creates a context and notes that receive only path has been requested and fills in the IP address and RTP port number of the local descriptor.	← **Transaction = 1002 { Context = 1 { Add = $ {Media { Stream =1 { LocalControl { Mode = ReceiveOnly}, Local { v=0 c=IN IP4 $ m=audio $ RTP/AVP 8 a=ptime:10} } } } } }**	- Enables the backward path to enable ring tone to be returned from the far end by adding an ephemeral termination to the context. - Local descriptor specifies a G.711 A law and packetization time of 10 ms.
A positive acknowledgement is sent.	→ **Reply = 1002 { Context = 1 { Modify = aln/1/1, Add = rtp/1 { Media { Stream =1 { Local { v=0 c=IN IP4 10.0.0.1 m=audio 2222 RTP/AVP 8} } } } } }**	- The MGC now routes the call to the emergency call centre. **O/G Call proceeds.**

Figure A.5: Priority Outgoing Call Attempt (MGC in overload, Regulating Active in the AGW, Off-Hook is regulated in the AGW and then admitted to MGC)

	AGW	MGC
Assume that a notreg > 0 has been previously sent to the AGW - as for example figure A.3. AGW		
OFF HOOK		
Off-Hook is detected and the AGW performs the following: Autonomously applies Normal line feed.		
Normal line feed		
Assume that a load level passed back previously to the AGW - as figure A.3.		
The AGW apples its regulating criteria and in this case, the call is not allowed through.		
At this point, Dial Tone is applied to collect digits to determine if it is a priority call.		
Dial Tone		
Digits are dialled		
AGW removes Dial Tone on first digit reception and compares dialled digits with the pre-configured emergency dial plan.		
In this case, assume that 012 dialled which matches none of its candidate strings - so call will be rejected by AGW by applying its special call treatment script resulting in for example reduction of line feed to indicate the call has ended and the application of congestion tone and monitoring for On-Hook.		
End of call pulse (pulsed reduced battery)		
Congestion Tone		
On -Hook	On-Hook is detected and the AGW applies a "pulsed no battery" analogue signal to indicate that the On-Hook has been accepted and then finally puts idle line feed on.	
Disconnect Clear Pulse (pulsed no battery)		
Idle Line Feed		
Line is idle.		

Figure A.6: Non-Priority Outgoing Call Attempt (MGC in overload, Regulating Active in the AGW, Off-Hook is regulated in the AGW and then line returned to idle by the AGW)

	AGW	MGC
		Assume that the MGC has moved into an overloaded state but that: it has not yet conveyed the fact to the AGW, or the current load state is greater that that previously conveyed. An incoming call arrives at a line on the AGW.
	◄────────────	The MGC firstly places the cct into a context. As part of this transaction, the ROOT termination is also modified with the latest notreg.
The AGW creates a context and responds. The AGW also updates its in-hand notreg.	────────────►	The context is noted.
AGW is now regulating at the new notreg value.		**I/C Call Continues as normal.**

Transaction sent from MGC to AGW:

```
Transaction = 999 {
    Context = $ {
        Add = aln/1/1 {
            Media {
            Stream = 1 {
                LocalControl {
                    Mode = SendReceive}

                }}
        }
      },
      Context = - {
          Modify = ROOT {Media{
                        TerminationState{
                        etsi_nb/notreg=55,
etsi_nb/olAbateCont=agTimer,
etsi_nb/offHookNot=Required }
                    }}
        }
}
```

Reply sent from AGW to MGC:

```
Reply = 999 {
    Context = 1 {
          Add = aln/1/1
     },
     Context = - {
          Modify = ROOT
     }
}
```

Figure A.7: Incoming Call Attempt (MGC in Overload and awaiting to send *notreg* to AGW)

Annex B (informative): AGW Load State Behaviour

This annex provides an example state transition diagram to illustrate the AGW handling of the new package.

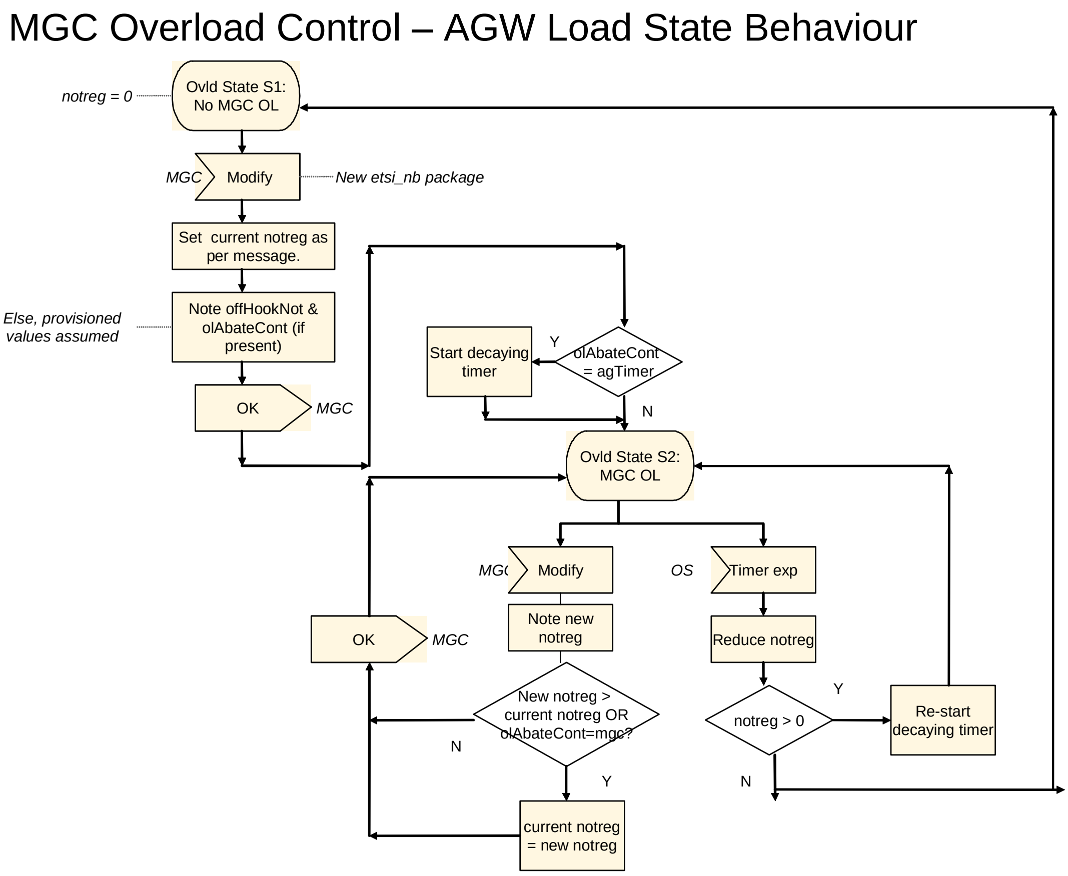

Figure B.1: AGW Load State Behaviour

Annex C (informative):
AGW Regulating Behaviour

This annex provides an example state transition diagram to illustrate the AGW behaviour during the regulating mechanism.

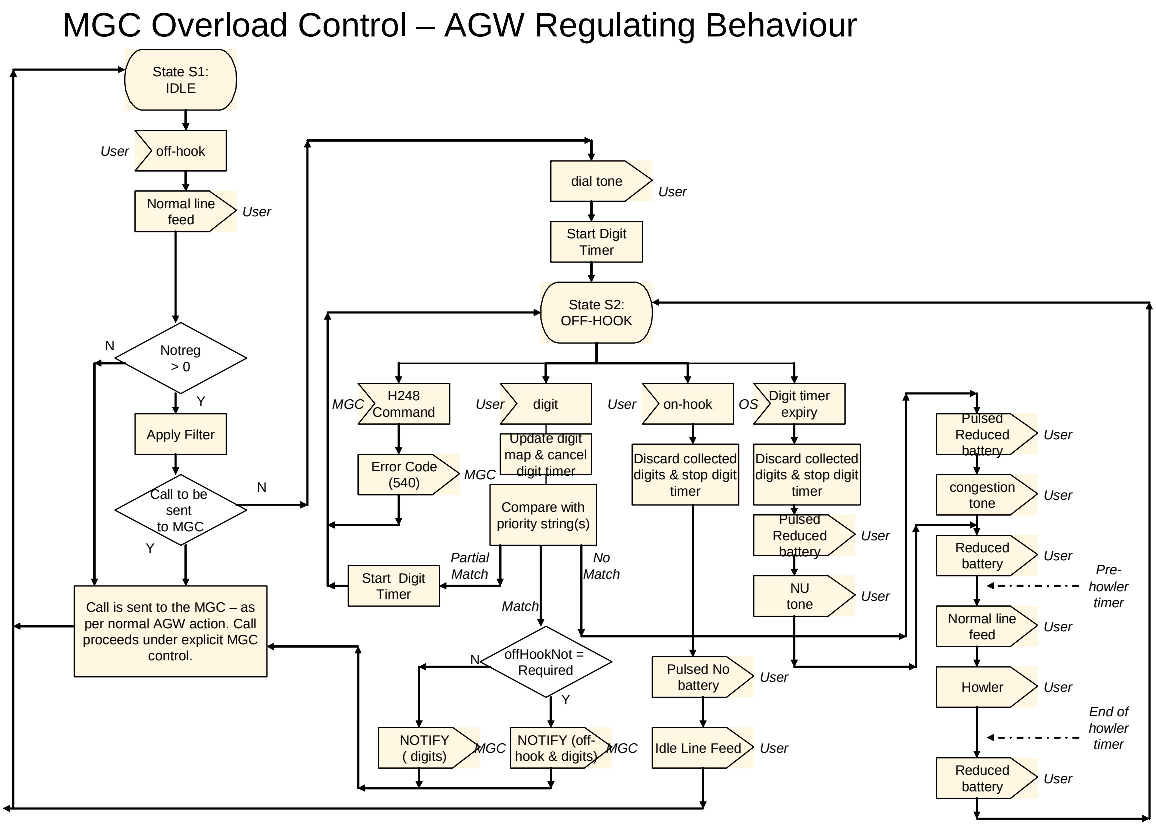

Figure C.1: AGW Regulating Behaviour

Annex D (informative): Bibliography

ETSI ES 283 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP) Stage 3".

History

Document history		
V1.1.1	June 2006	Publication
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