

<i>BLUETOOTH</i> DOC	Date / Year-Month-Day 2005-11-25	Approved Adopted	Revision V10r00	Document No HFP1.5_SPEC
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HANDS-FREE PROFILE 1.5

Abstract

The Hands-Free Profile (HFP) 1.5 specification defines the minimum set of functions such that a Mobile Phone can be used in conjunction with a Hands-Free device (e.g. installed in the car or represented by a wearable device such as a headset), with a *Bluetooth*[®] Link providing a wireless means for both remote control of the Mobile Phone by the Hands-Free device and voice connections between the Mobile Phone and the Hands-Free device.

Compliance with this specification assures interoperability between a Bluetooth enabled Hands-Free device and any Bluetooth equipped Mobile Phone supporting this profile.

Revision History

Revision Number	Date	Comments
RC10.50	01-01-2912-11-2003	Hands-Free Profile 0.50 published 1 st draft for SubWG12 Review
RC21.00m VD	22-11-200403-14-03	CR document derived from FIPD07r04 Additional comments from BTI/BQRB reviews
D10r08	16-02-2005	Editing for Prototyping Specification standards
D12r00	19-03-2005	Incorporated Prototyping Specifications
D12r01	22-04-2005	Errata and corrections from IOP.
D12r02	28-04-2005	HFP 1.0 Errata- 13, 261, 317, 549, 550, 575, 586, 635, 706, 731, 746
D15r03	13-05-2005	Correct formatting problems and comments from review.
D15r04	27-05-2005	Errata 819, 820, 821, 822
D15r05	07-06-2005	Edits from BARB Review. Errata 823.
D15r06	07-18-2005	Changes from BARB review. Editorial changes for language and readability.
D15r07	08-01-2005	Comments from BTI/BARB review.
D15r08	09/02/2005	Comments from BTI review.
D15r09	09/22/2005	Comments from BTI review
D15r09	09/26/2005	Add 3GPP 27.07 version and remove reference to Call Waiting for AT+CHUP
D15r10-11	10/04/2005	BTI Comments
D15r12	10/05/2005	Editorial changes
D15r13	10/07/2005	Prepare for publication
V10r00	11/25/2005	Adopted by the <i>Bluetooth</i> Board of Directors

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Contents

1	Introduction	7
1.1	Scope.....	7
1.2	Profile Dependencies	8
1.3	Symbols and Conventions.....	8
1.3.1	Requirement Status Symbols	8
1.3.2	Naming Conventions.....	9
1.3.3	Signaling Diagram Conventions.....	10
2	Profile Overview	11
2.1	Protocol Stack.....	11
2.2	Configuration and Roles	11
2.3	User Requirements and Scenarios	12
2.4	Profile Fundamentals.....	12
2.5	Conformance	13
3	Application layer	14
4	Hands-Free Control Interoperability Requirements	17
4.1	Introduction	17
4.2	Service Level Connection Establishment	17
4.2.1	Service Level Connection Initialization	17
4.2.2	Link Loss Recovery.....	20
4.3	Service Level Connection Release	20
4.4	Transfer of Registration Status.....	21
4.5	Transfer of Signal Strength Indication	21
4.6	Transfer of Roaming Status Indication	22
4.7	Transfer of Battery Level Indication of AG	23
4.8	Query Operator Selection.....	23
4.9	Report Extended Audio Gateway Error Results Code	24
4.10	Transfer of Call, Call Setup and Held Call Status	25
4.11	Audio Connection Setup.....	25
4.12	Audio Connection Release	26
4.13	Answer an Incoming Call.....	27
4.13.1	Answer Incoming Call from the HF – In-Band Ringing	27
4.13.2	Answer Incoming Call from the HF – No In-Band Ringing.....	28
4.13.3	Answer Incoming Call from the AG	29
4.13.4	Change the In-Band Ring Tone Setting	30
4.14	Reject an Incoming Call.....	31
4.14.1	Reject an Incoming Call from the HF.....	31
4.14.2	Rejection/Interruption of an Incoming Call in the AG	32
4.15	Terminate a Call Process	33
4.15.1	Terminate a Call Process from the HF.....	33
4.15.2	Terminate a Call Process from the AG	33
4.16	Audio Connection Transfer Towards the HF	34
4.17	Audio Connection Transfer Towards the AG.....	35
4.18	Place a Call With the Phone Number Supplied by the HF	36
4.19	Memory Dialing from the HF.....	37
4.20	Last Number Re-Dial from the HF	38
4.21	Call Waiting Notification Activation	40
4.22	Three Way Call Handling.....	41
4.22.1	Three Way Calling—Call Waiting Notification.....	43
4.22.2	Three Way Calls – Third Party Call Placed from the HF	44
4.23	Calling Line Identification (CLI) Notification.....	45
4.24	The HF Requests Turning Off the AG’s EC and NR	45
4.25	Voice Recognition Activation	46
4.25.1	Voice Recognition Activation – HF Initiated.....	47
4.25.2	Voice Recognition Activation – AG Initiated	48

4.25.3	Voice Recognition Deactivation	48
4.26	Attach a Phone Number to a Voice Tag.....	49
4.27	Transmit DTMF Codes	50
4.28	Remote Audio Volume Control	50
4.28.1	Audio Volume Control	50
4.28.2	Volume Level Synchronization.....	51
4.29	Response and Hold	53
4.29.1	Query Response and Hold Status	53
4.29.2	Put an Incoming Call on Hold from HF	54
4.29.3	Put an Incoming Call on Hold from AG	55
4.29.4	Accept a Held Incoming Call from HF	56
4.29.5	Accept a Held Incoming Call from AG	57
4.29.6	Reject a Held Incoming Call from HF.....	57
4.29.7	Reject a Held Incoming Call from AG	58
4.29.8	Held Incoming Call Terminated by Caller	60
4.30	Subscriber Number Information.....	61
4.31	Enhanced Call Status Indications.....	62
4.31.1	Query List of Current Calls in AG.....	62
4.31.2	Indication of Status for Held Calls.....	62
4.32	Enhanced Call Control Mechanisms	65
4.32.1	Release Specified Call Index	65
4.32.2	Private Consultation Mode.....	66
4.33	AT Command and Results Codes.....	66
4.33.1	General	66
4.33.2	AT Capabilities Re-Used from GSM 07.07 and 3GPP 27.007	67
4.33.3	Bluetooth Defined AT Capabilities	75
5	Serial Port Profile	81
5.1	RFCOMM Interoperability Requirements	81
5.2	L2CAP Interoperability Requirements	81
5.3	SDP Interoperability Requirements	81
5.3.1	Interaction with Hands-Free Profile Rev 0.96 Implementations	84
5.4	Link Manager (LM) Interoperability Requirements	84
5.5	Link Control (LC) Interoperability Requirements	85
5.5.1	Class of Device	85
5.6	Synchronous Connection Interoperability Requirements.....	86
6	Generic Access Profile.....	88
6.1	Modes	88
6.2	Security Aspects.....	88
6.3	Idle Mode Procedures	88
7	References.....	89
8	List of Acronyms and Abbreviations.....	90
9	List of Figures.....	91
10	List of Tables.....	93

1 Introduction

1.1 Scope

This document defines the protocols and procedures that shall be used by devices implementing the Hands-Free Profile. The most common examples of such devices are in-car Hands-Free units used together with cellular phones, or wearable wireless headsets.

The profile defines how two devices supporting the Hands-Free Profile shall interact with each other on a point-to-point basis.

An implementation of the Hands-Free Profile typically enables a headset, or an embedded Hands-Free unit to connect, wirelessly, to a cellular phone for the purposes of acting as the cellular phone's audio input and output mechanism and allowing typical telephony functions to be performed without access to the actual phone.

1.2 Profile Dependencies

In Figure 1.1, the Bluetooth profile structure and the dependencies of the profiles are depicted. A profile is dependent upon another profile if it re-uses parts of that profile, by explicitly referencing it. Dependency is illustrated in the figure below.

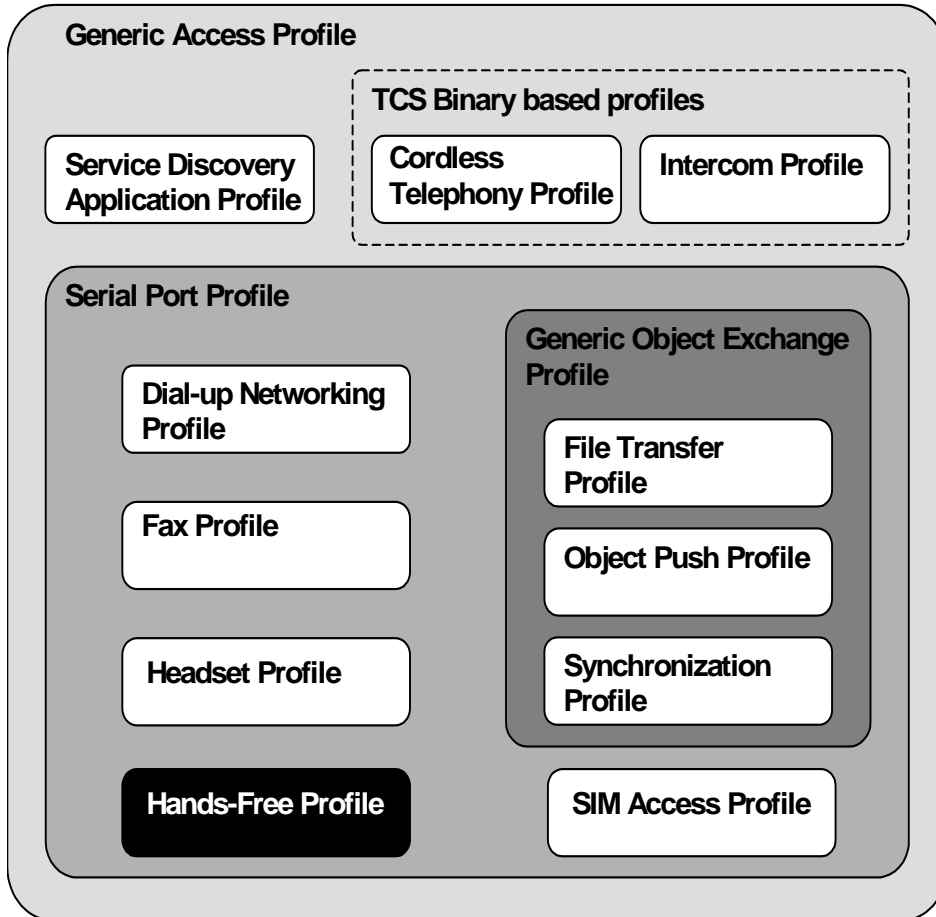


Figure 1.1: Bluetooth Profiles

As indicated in the figure, the Hands-Free Profile is dependent upon both the Serial Port Profile [5] and the Generic Access Profile [4]. Details are provided in Sections 5 (Serial Port Profile) and 6 (Generic Access Profile).

1.3 Symbols and Conventions

1.3.1 Requirement Status Symbols

In this document, the following symbols are used:

- "M" for mandatory to support
- "O" for optional to support
- "X" for excluded (used for capabilities that may be supported by the device, but the Hands-Free Profile shall not use these capabilities)

- "C" for conditional to support
- "N/A" for not applicable (in the given context this capability is not defined)

Some capabilities or features (identified as "X"), mandated according to the relevant Bluetooth specifications, are excluded with respect to this profile because they may degrade the operation of devices in the particular use case. Therefore, features or capabilities labeled "X" shall never be activated while operating in a use case where they are labeled as such.

1.3.2 Naming Conventions

In this document, the following naming conventions are used:

- Where "Core Specification" is said it refers to the Bluetooth Core Specification 1.1 or later adopted by the Bluetooth® SIG.
- Where "LMP link" is said, it means a Link Manager (LM) level link over which only Link Manager Protocol (LMP) commands are conveyed.
- Where "RFCOMM connection" is said, it means the presence of a virtual serial port as specified in [5].
- Where "Service Level Connection" is said, it means a synchronized high-level protocol connection involving a portion of the protocol stack. In this specific case, it refers to the presence of a RFCOMM connection, and assumes that the HF has synchronized itself to the state of the AG using the specified Service Level Connection initialization procedure.
- Where "Service Level Connection initialization" is said, it means the execution of the set of AT commands and responses specified by the profile necessary to synchronize the state of the HF with that of the AG.
- Where "Service Level Connection establishment" is said, it means the combined process of establishing the RFCOMM connection, as well as the necessary device synchronization using Service Level Connection initialization.
- Where "Synchronous Connection" is said, it means a SCO or eSCO logical link intended for supporting a full duplex Audio Connection.
- Where "Audio Connection" is said, it means a Synchronous Connection including the means to provide a complete audio path between two devices assuming roles within this profile.
- Where "incoming call" is said, it means a call connection in the direction "Phone Network=>AG", such that it is initiated by the Network to which the AG is attached.
- Where 'outgoing call' is said, it means a call connection in the direction "AG=>Phone Network", such that it is initiated by the AG towards the Network to which it is attached.

1.3.3 Signaling Diagram Conventions

The signaling diagrams in this specification are informative only. Within the diagrams, the following conventions are used to describe procedures:

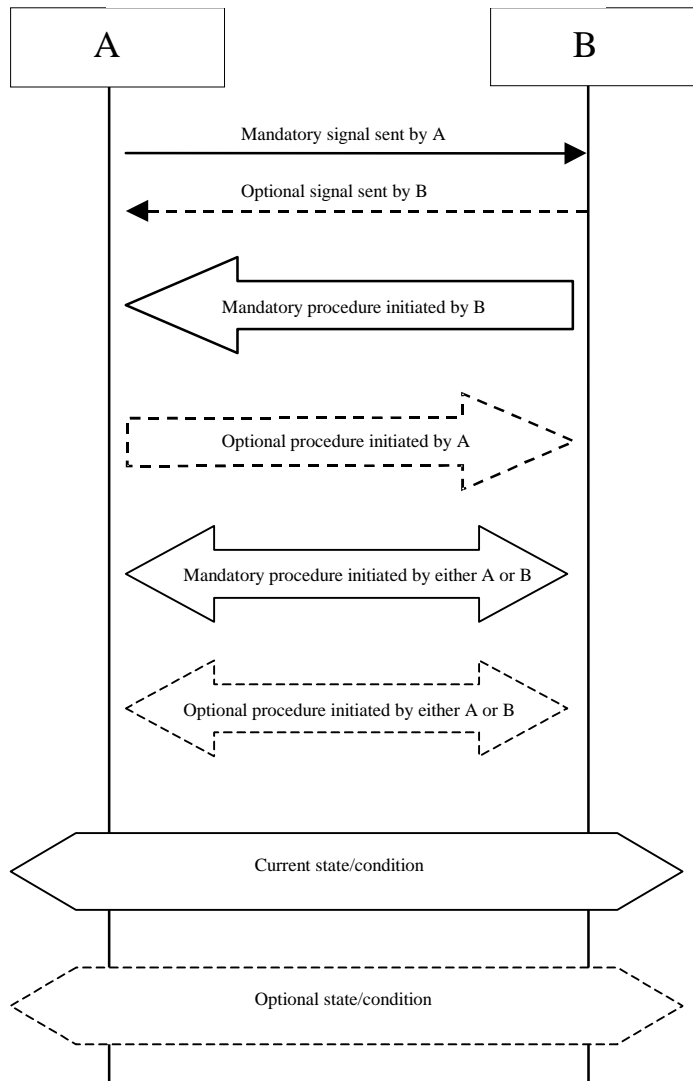


Figure 1.2: Conventions used in signaling diagrams

2 Profile Overview

2.1 Protocol Stack

The figure below shows the protocols and entities used in this profile.

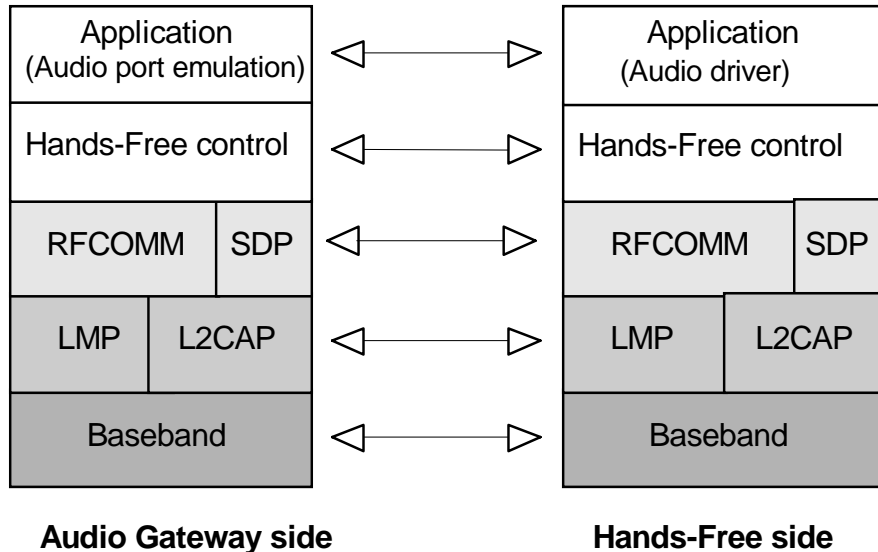


Figure 2.1: Protocol stack

The Baseband, LMP and L2CAP are the OSI layer 1 and 2 Bluetooth protocols. RFCOMM is the Bluetooth serial port emulation entity. SDP is the Bluetooth Service Discovery Protocol. See [1] for more details on these topics.

Compatibility to v1.1 or later Core Specification is required.

Hands-Free control is the entity responsible for Hands-Free unit specific control signaling; this signaling is AT command based.

Although not shown in the model above, it is assumed by this profile that Hands-Free Control has access to some lower layer procedures (for example, Synchronous Connection establishment).

The audio port emulation layer shown in Figure 2.1 is the entity emulating the audio port on the Audio Gateway, and the audio driver is the driver software in the Hands-Free unit.

For the shaded protocols/entities in Figure 2.1, the Serial Port Profile [5] is used as the base standard. For these protocols, all mandatory requirements stated in the Serial Port Profile apply except in those cases where this specification explicitly states deviations.

2.2 Configuration and Roles

Figure 2.2 below shows typical configurations of devices for which the Hands-Free Profile is applicable:

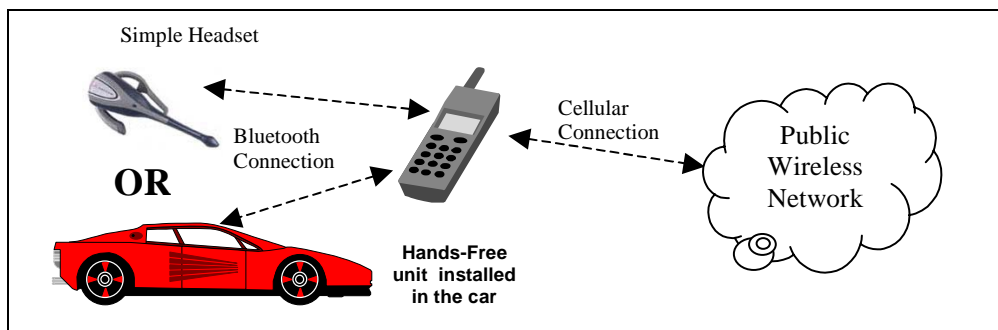


Figure 2.2: Typical Hands-Free Use

The following roles are defined for this profile:

Audio Gateway (AG) – This is the device that is the gateway of the audio, both for input and output. Typical devices acting as Audio Gateways are cellular phones.

Hands-Free unit (HF) – This is the device acting as the Audio Gateway's remote audio input and output mechanism. It also provides some remote control means.

These terms are used in the rest of this document to designate these roles.

2.3 User Requirements and Scenarios

The following rules apply to this profile:

- a) The profile states the mandatory and optional features when the “Hands-Free Profile” is active in the Audio Gateway and the Hands-Free unit.
- b) The profile mandates the usage of CVSD for transmission of audio (over the Bluetooth link). The resulting audio is monophonic, with a quality that, under normal circumstances, does not have perceived audio degradation.
- c) Between the Hands-Free unit and the Audio Gateway, only one Audio Connection per Service Level Connection at a time is supported.
- d) Both the Audio Gateway and the Hands-Free unit may initiate Audio Connection establishment and release. Valid speech data shall exist on the Synchronous Connection in both directions after the Audio Connection is established.
- e) Whenever an “Audio Connection” exists, a related “Service Level Connection” shall also exist.
- f) The presence of a “Service Level Connection” shall not imply that an “Audio Connection” exists. Releasing a “Service Level Connection” shall also release any existing “Audio Connection” related to it.

2.4 Profile Fundamentals

Baseband authentication and encryption is optional for both the Hands-Free unit and the Audio Gateway. If both devices support authentication and encryption, the application on either device may require its use.

A Hands-Free unit may be able to use the services of the Audio Gateway without the creation of a secure connection. It is implementation specific whether the Hands-Free unit provides or supports security enforcement for the user.

Whenever baseband authentication and/or encryption is used, the two devices shall create a secure connection using the GAP authentication procedure as described in Section 5.1 of the Generic Access Profile [4]. This procedure may include entering a Bluetooth PIN code and creation of proper link keys. In cases when the UI of the Hands-Free unit is limited, a fixed Bluetooth PIN code may be used during the GAP authentication procedure.

If a LMP link is not already established between the Hands-Free unit and the Audio Gateway, the LMP link shall be set up before any other procedure is performed.

There are no fixed master of slave roles in the profile.

The Audio Gateway and Hand-Free unit provide serial port emulation. For the serial port emulation, RFCOMM (see [1]) is used. The serial port emulation is used to transport the user data including modem control signals and AT command from the Hands-Free unit to the Audio Gateway. The AT commands are parsed by the Audio Gateway and responses are sent to the Hands-Free unit via the Bluetooth serial port connection.

2.5 Conformance

If conformance to this profile is claimed, all capabilities indicated as mandatory for this profile shall be supported in the specified manner (process mandatory). This also applies for all optional and conditional capabilities for which support is indicated. All mandatory, optional and conditional capabilities, for which support is indicated, are subject to verification as part of the Bluetooth Qualification Program.

3 Application layer

This section describes the feature requirements for units complying with Hands-Free Profile.

Table 3.1 below shows the feature requirements for this profile.

	Feature	Support in HF	Support in AG
1.	Connection management	M	M
2.	Phone status information	M ^(note 1)	M
3.	Audio Connection handling	M	M
4.	Accept an incoming voice call	M	M
5.	Reject an incoming voice call	M	O
6.	Terminate a call	M	M
7.	Audio Connection transfer during an ongoing call	M	M
8.	Place a call with a phone number supplied by the HF	O	M
9.	Place a call using memory dialing	O	M
10.	Place a call to the last number dialed	O	M
11.	Call waiting notification	O	M
12.	Three way calling	O ^(note 2)	O ^(note 3)
13.	Calling Line Identification (CLI)	O	M
14.	Echo canceling (EC) and noise reduction (NR)	O	O
15.	Voice recognition activation	O	O
16.	Attach a Phone number to a voice tag	O	O
17.	Ability to transmit DTMF codes	O	M
18.	Remote audio volume control	O	O
19.	Respond and Hold	O	O
20.	Subscriber Number Information	O	M
21a.	Enhanced Call Status	O	M
21b.	Enhanced Call Controls	O	O

Note 1: The HF shall support at least the two indicators "service" and "call".

Note 2: If "Three way calling" is supported by the HF, it shall support AT+CHLD values 1 and 2. The HF may additionally support AT+CHLD values 0,3 and 4.

Note 3: If "Three way calling" is supported by the AG, it shall support AT+CHLD values 1 and 2. The AG may additionally support AT+CHLD values 0,3 and 4.

Table 3.1: Application layer procedures

Table 3.2 below maps each feature to the procedures used for that feature. All procedures are mandatory if the feature is supported.

	Feature	Procedure	Ref.
1.	Connection management	Service Level Connection establishment	4.2
		Service Level Connection release	4.3
2.	Phone status information	Transfer of Registration Status	4.4
		Transfer of Signal Strength Indication	4.5
		Transfer of Roaming Status Indication	4.6
		Transfer of Battery Level Indication	4.7
		Query of Operator Selection	4.8
		Extended Audio Gateway Error Codes	4.9
		Transfer of Call, Call Setup and Call Held Status	4.10
3.	Audio Connection handling	Audio Connection set up	4.11
		Audio Connection release	4.12
4.	Accept an incoming voice call	Answer an incoming call	4.13
5.	Reject an incoming voice call	Reject an incoming call	4.14
6.	Terminate a call	Terminate a call process	4.15
7.	Audio Connection transfer during an ongoing call	Audio Connection transfer towards the HF	4.16
		Audio Connection transfer towards the AG	4.17
8.	Place a call with the phone number supplied by the HF	Place a call with the phone number supplied by the HF	4.18
9.	Place a call using memory dialing	Memory dialing from the HF	4.19
10.	Place a call to the last number dialed	Last number re-dial from the HF	4.20
11.	Call waiting notification	Call waiting notification activation	4.21
12.	Three way calling	Three way call handling	4.22
13.	Calling Line Identification (CLI)	Calling Line Identification (CLI) notification	4.23
14.	Echo canceling (EC) and noise reduction (NR)	HF unit requests turning off the AG's EC and NR	4.24
15.	Voice recognition activation	Voice recognition activation	4.25
16.	Attach a phone number to a voice tag	Attach a voice tag to a phone number	4.26
17.	Ability to transmit DTMF codes	Transmit DTMF code	4.27

	Feature	Procedure	Ref.
18.	Remote audio volume control	Remote audio volume control Volume level synchronization	4.28
19.	Response and Hold	Query response and hold status Put an incoming call on hold from HF Put an incoming call on hold from AG Accept a held incoming call from HF Accept a held incoming call from AG Reject a held incoming call from HF Reject a held incoming call from AG Held incoming call terminated by caller	4.29 4.29 4.29 4.29 4.29 4.29 4.29 4.29
20.	Subscriber Number Information	Subscriber Number Information	4.30
21a.	Enhanced Call Status	Query Call List Indication of Held Call Status	4.31 4.31
21b.	Enhanced Call Control	Release Specified Call Private Consult Mode	4.32 4.32

Table 3.2: Application layer feature to procedure mapping

4 Hands-Free Control Interoperability Requirements

4.1 Introduction

The interoperability requirements for the Hands-Free Control entity are completely contained in this section. Sections 4.2 through 4.28 specify the requirements for the procedures directly related to the application layer features.

The procedures listed in this section are primarily based on the use of a minimum set of AT commands as the control protocol. Section 4.33 specifies these AT commands and their result codes.

Section 4.2 specifies how Service Level Connections are handled in general and specifically states how the layers beneath the Hands-Free Control entity are used to establish and release a Service Level Connection.

4.2 Service Level Connection Establishment

Upon a user action or an internal event, either the HF or the AG may initiate a Service Level Connection establishment procedure.

A Service Level Connection establishment requires the existence of a RFCOMM connection, that is, a RFCOMM data link channel between the HF and the AG.

Both the HF and the AG may initiate the RFCOMM connection establishment. If there is no RFCOMM session between the AG and the HF, the initiating device shall first initialize RFCOMM.

The RFCOMM connection establishment shall be performed as described in Section 7.3 of Generic Access Profile [4] and Section 3 of Serial Port Profile [5].

4.2.1 Service Level Connection Initialization

When an RFCOMM connection has been established the Service Level Connection Initialization procedure shall be executed.

First in the initialization procedure the HF shall send the AT+BRSF=<HF supported features> command to the AG to both notify the AG of the supported features in the HF, as well as to retrieve the supported features in the AG using the +BRSF result code.¹

After having retrieved the supported features in the AG, the HF shall determine which indicators are supported by the AG, as well as the ordering of the supported indicators. This is because, according to the 3GPP 27.007 specification [2], the AG may support additional indicators not provided for by the Hands-Free Profile, and because the ordering of the indicators is implementation specific. The HF uses the AT+CIND=? Test command to retrieve information about the supported indicators and their ordering.

¹ Audio Gateways supporting the 0.96 version of Hands-Free Profile will return ERROR as a response to AT+BRSF

Once the HF has the necessary supported indicator and ordering information, it shall retrieve the current status of the indicators in the AG using the AT+CIND? Read command.

After having retrieved the status of the indicators in the AG, the HF shall then enable the "Indicators status update" function in the AG by issuing the AT+CMER command, to which the AG shall respond with OK. As a result, the AG shall send the +CIEV unsolicited result code with the corresponding indicator value whenever a change in service, call, or call setup status occurs. When an update is required for both the call and call setup indicators, the AG shall send the +CIEV unsolicited result code for the call indicator before sending the +CIEV unsolicited result code for the call setup indicator. The HF shall use the information provided by the +CIEV code to update its own internal and/or external indications.

Once the "Indicators status update" function has been enabled, the AG shall keep the function enabled until either the AT+CMER command is issued to disable it, or the current Service Level Connection between the AG and the HF is dropped for any reason.

After the HF has enabled the "Indicators status update" function in the AG, and if the "Call waiting and 3-way calling" bit was set in the supported features bitmap by both the HF and the AG, the HF shall issue the AT+CHLD=? test command to retrieve the information about how the call hold and multiparty services are supported in the AG. The HF shall not issue the AT+CHLD=? test command in case either the HF or the AG does not support the "Three way calling" feature.

The HF shall consider the Service Level Connection fully initialized, and thereby established, in either of the following cases:

- After the HF has successfully retrieved information about how call hold and multiparty services are supported in the AG using the AT+CHLD command, if and only if the "Call waiting and 3-way calling" bit was set in the SupportedFeatures attribute of the SDP records for both HF and AG.
- After the HF has successfully enabled the "Indicator status update" using the AT+CMER command, if and only if the "Call waiting and 3-way calling" bit was not set in the SupportedFeatures attribute of the SDP records for either the HF or the AG.

If the HF receives an indication from the AG that a call is currently active, the HF may determine if an unanswered call is currently on hold by querying the Response and Hold state of the AG (see section 4.29.1).

The AG shall consider the Service Level Connection to be fully initialized, and thereby established, in either of the following cases:

- After that the AG has successfully responded with information about how call hold and multiparty services are supported in the AG using +CHLD as well as responded OK, if and only if the "Call waiting and 3-way calling" bit was set in the supported features bitmap for both HF and AG.

- After the AG has successfully responded with OK to the AT+CMER command (to enable the “Indicator status update” function), if and only if the “Call waiting and 3-way calling” bit was not set in the supported features bitmap for either the HF or the AG.

Refer to Section 4.33 for more information on the AT+CIND, AT+CMER, AT+CHLD and AT+BRSF commands and the +CIEV unsolicited result code.

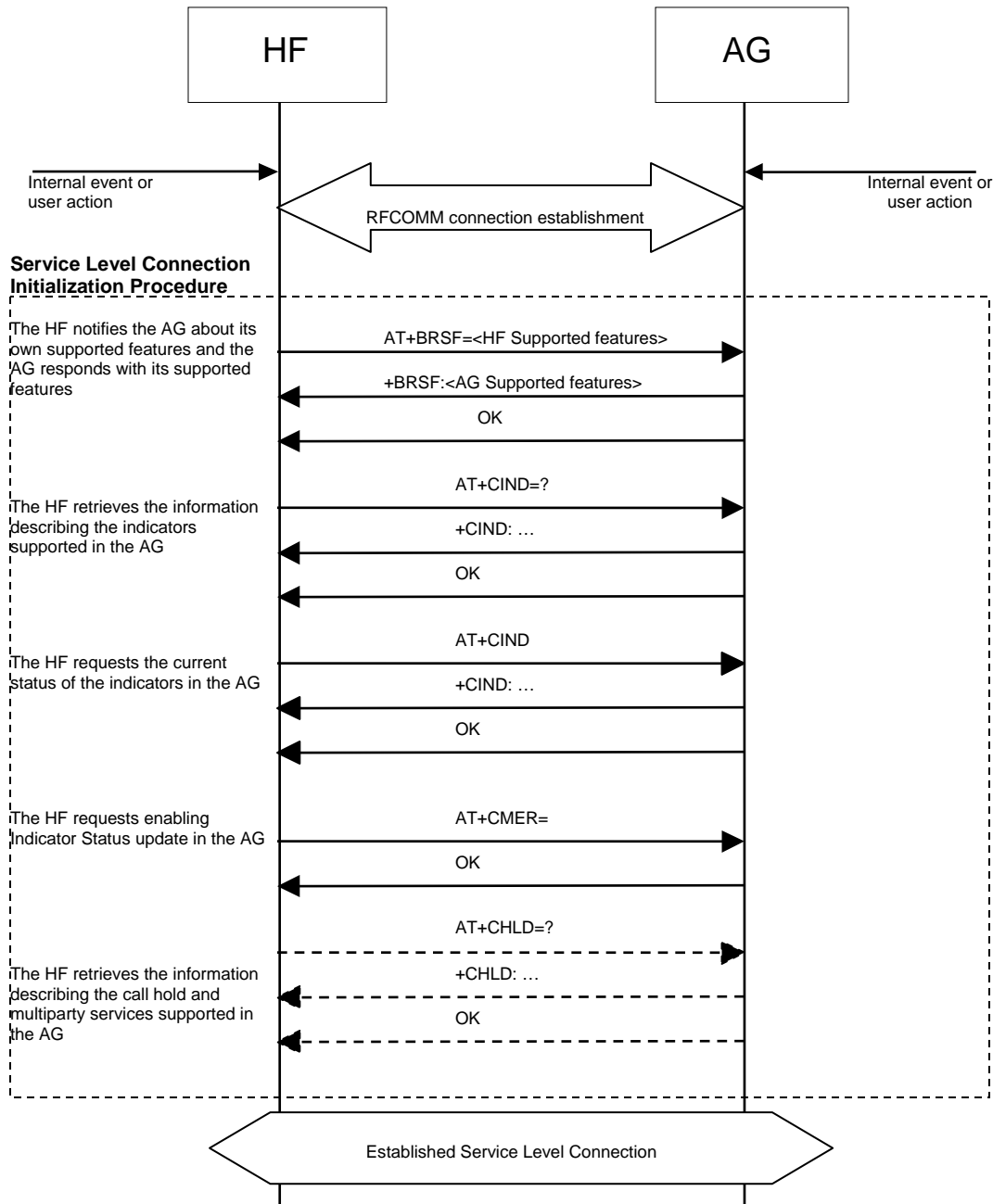


Figure 4.1: Service Level Connection establishment

4.2.2 Link Loss Recovery

This section addresses the link loss recovery from a HF unit. The HF unit may reconnect with the AG whenever there is loss of Bluetooth link.

When a Service Level Connection is disconnected due to explicit termination at one end (using the "Service connection release" as described in Section 4.3), then both devices (AG and HF unit) shall wait for an explicit user action before an attempt is made to re-establish the Service Level Connection.

If the HF unit determines that the Service Level Connection was disconnected due to a link supervision timeout, then the HF unit may execute the "Service Level Connection establishment" procedure as described in Section 4.2 to establish a new Service Level Connection to the AG. Following a link loss due to link supervision timeout, the HF unit shall not assume that the service level connection state from the previous connection is valid (such as Call Status, Service Status).

4.3 Service Level Connection Release

This section describes the procedure for releasing a Service Level Connection.

The disconnection of a Service Level Connection shall result in the immediate removal of the corresponding RFCOMM data link channel between the HF and the AG. Also, an existing audio connection has to be removed as consequence of the removal of the Service Level Connection. The removal of the L2CAP and link layers is optional.

An established Service Level Connection shall be released using a "Service Level Connection removal" procedure.

- Either the HF or AG shall initiate the "Service Level Connection release" procedure due to an explicit user request.
- The "Service Level Connection release" procedure shall be initiated if the Bluetooth functionality is disabled in either the HF or AG.
- The "Service Level Connection release" procedure may be initiated if an "Audio Connection transfer towards the AG", as stated in section 4.12, is performed during an ongoing call in the AG. In the case that the Service Level Connection is removed, the AG shall attempt to re-establish the Service Level Connection once the call is dropped.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist.

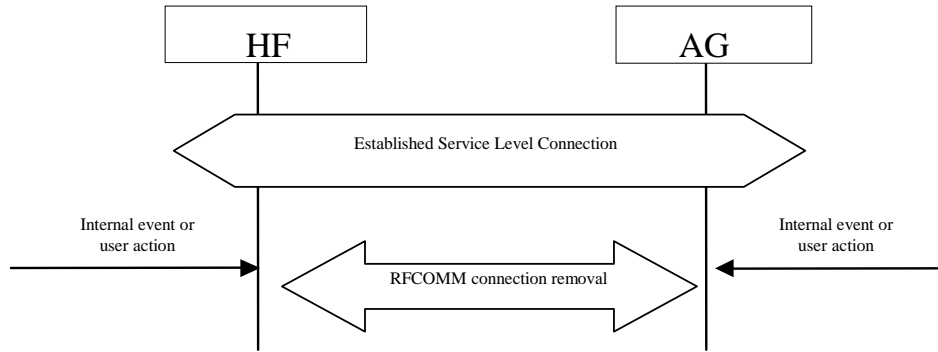


Figure 4.2: Service Level Connection removal

4.4 Transfer of Registration Status

The AT+CMER command, as described in Section 4.2, enables the “Registration status update” function in the AG. When this function is enabled, the AG shall send the +CIEV unsolicited result code with the corresponding service indicator and value whenever the AG's registration status changes. The HF unit shall be capable of interpreting the information provided by the +CIEV result code to determine the service availability status as listed in Section 4.33.2.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

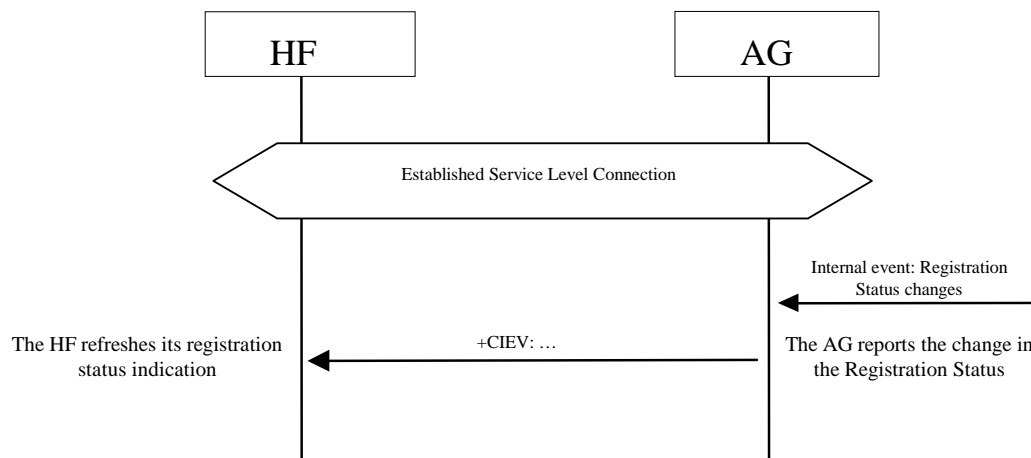


Figure 4.3: Typical Registration Status update

4.5 Transfer of Signal Strength Indication

This procedure enables the AG to send to HF unsolicited result codes with the signal strength values.

The following pre-condition applies for this procedure:

- An ongoing connection between the AG and the HF shall exist. If this connection does not exist, the AG shall establish a connection using “Service Level Connection set up” procedure described in section 4.2.

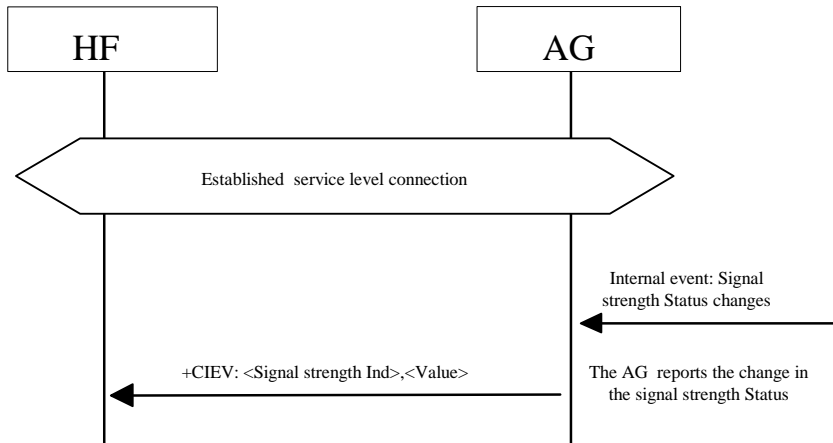


Figure 4.4: Transfer of Signal strength indication

- As a result, the AG shall send the +CIEV unsolicited result code with the corresponding signal strength value whenever its signal strength changes.

4.6 Transfer of Roaming Status Indication

This procedure enables the HF to know the “Roaming Status” of the AG.

The AT+CMER command, as described in Section 4.24.2, enables the “Roaming status Indication” in the AG. As a result, the AG shall send the +CIEV unsolicited result code with the corresponding indicator values whenever its roaming status changes.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall establish the Service Level Connection using the proper procedure as described in Section 4.2.

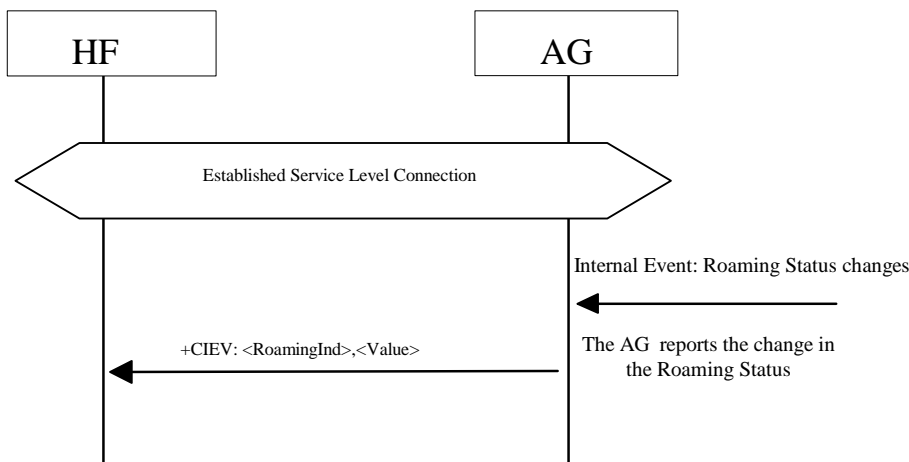


Figure 4.5: Transfer of Roaming Status Indication

4.7 Transfer of Battery Level Indication of AG

This procedure allows the HF to know the battery level of the AG.

The AT+CMER command, as described in Section 4.24.2, enables the “Battery level update” in the AG. As a result, the AG shall send the +CIEV unsolicited result code with the corresponding battery level values whenever its level changes.

The following pre-condition applies for this procedure:

- An ongoing connection between the AG and the HF shall exist. If this connection does not exist, the AG shall establish a connection using “Service Level Connection set up” procedure described in Section 4.2.

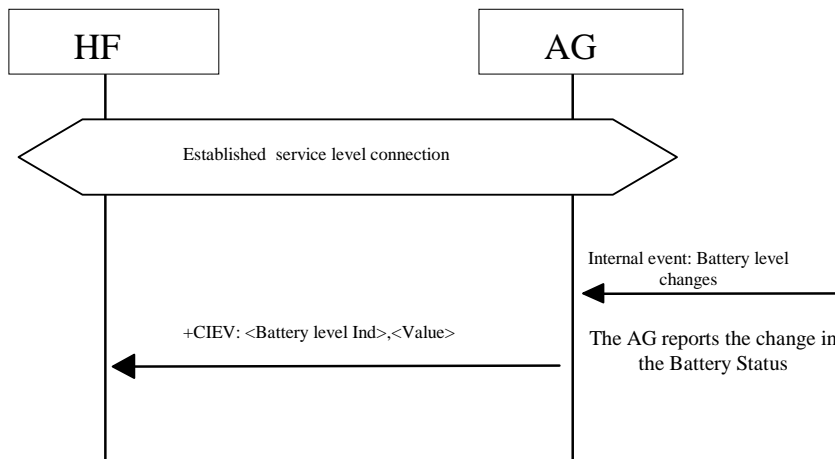


Figure 4.6: Transfer of Battery level indication

4.8 Query Operator Selection

The HF shall execute this procedure to find out the name of the currently selected Network operator by AG.

The following pre-condition applies for this procedure:

- An ongoing connection between the AG and the HF shall exist. If this connection did not exist, the AG shall establish a connection using “Service Level Connection set up” procedure described in Section 4.2.

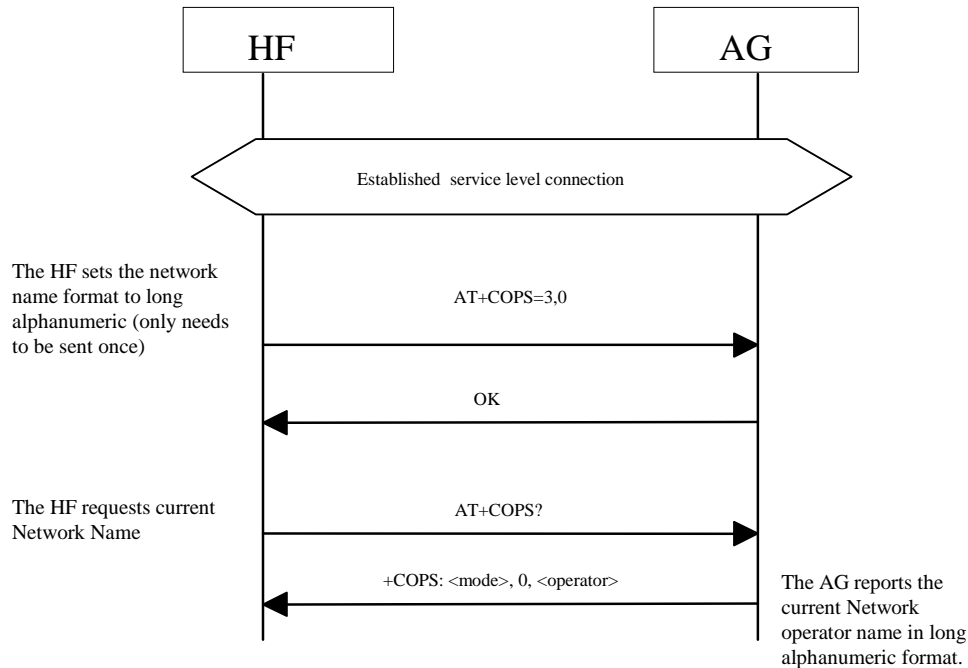


Figure 4.7: Query currently selected Network operator

- HF shall send AT+COPS=3,0 command to set name format to long alphanumeric. Long alphanumeric is defined as a maximum of 16 characters. The value of 3 as the first parameter indicates that this command is only affecting the format parameter (the second parameter). The second parameter, 0, is the value required to set the format to “long alphanumeric.”
- Upon an internal event or user-initiated action, HF shall send the AT+COPS? (Read) command to find the currently selected operator.
- AG shall respond with +COPS response indicating the currently selected operator. If no operator is selected, <format> and <operator> are omitted.

4.9 Report Extended Audio Gateway Error Results Code

The HF shall execute this procedure to enable/disable Extended Audio Gateway Error result codes in the AG.

The following pre-condition applies for this procedure:

- An ongoing connection between the AG and the HF shall exist. If this connection did not exist, the AG shall establish a connection using “Service Level Connection set up” procedure described in section 4.2.

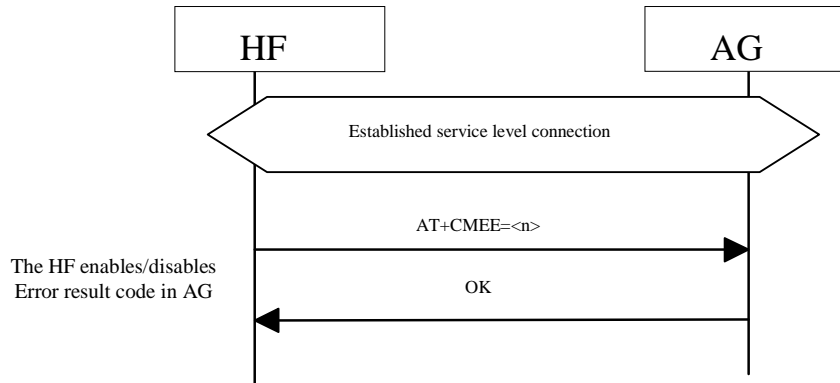


Figure 4.8: Enable/Disable AG Error result code

- The HF shall issue the AT+CMEE command to enable/disable the “Extended Audio Gateway Error Result Code” in the AG. The parameter <n> controls the activation/deactivation of the “Extended Error result code” notification.
- Whenever there is an error relating to the functionality of the AG as a result of AT command, the AG shall send +CME ERROR: <err> response to the HF.

4.10 Transfer of Call, Call Setup and Held Call Status

The AT+CMER command, as described in Section 4.2, enables the “Call Status indicators update” function in the AG. When this function is enabled, the AG shall issue a +CIEV unsolicited result code with the corresponding call indicator and value whenever the AG's current call status changes. Likewise, the AG shall issue a +CIEV unsolicited result code with the corresponding callsetup indicator and value whenever the AG's current call setup status changes. The AG shall also issue a +CIEV unsolicited result code with corresponding callheld indicator and value whenever the AG's current held call status changes.

The HF unit shall be capable of interpreting the information provided by the +CIEV result code to determine the call status as listed in Section 4.33.2.

Furthermore, the HF unit may also be capable of interpreting the optional callsetup state information provided by the +CIEV result code as listed in Section 4.33.2.

The HF unit shall be able to accept unknown indicators provided by the +CIEV result code. The HF unit may ignore unknown indicators provided by the +CIEV result code.

Note: Although the HF unit is required to parse the +CIEV result codes, the HF unit is not required to provide User Interface indicators for the +CIEV result codes.

4.11 Audio Connection Setup

Upon a user action or an internal event, either the HF or the AG shall initiate the establishment of an Audio Connection whenever necessary. Further internal actions may be needed by the HF or the AG to internally route the audio paths.

An Audio Connection set up procedure always means the establishment of a Synchronous Connection and it is always associated with an existing Service Level Connection.

In principle, setting up an Audio Connection by using the procedure described in this section is not necessarily related to any call process.

Once an Audio Connection between the HF and the AG exists, the AG shall utilize the HF as its primary audio port. The AG shall keep the audio paths, call related or not, routed towards HF for all the operations (e.g. voice, alert, key press tones) involving presence of audio.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the initiator of the procedure shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

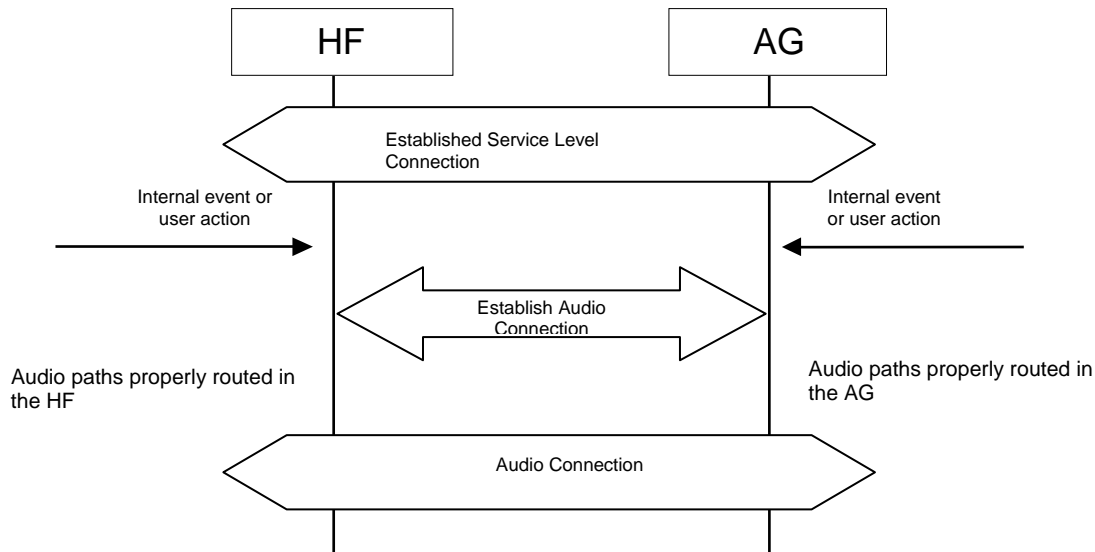


Figure 4.9: Audio Connection set up

Both the initiator and the acceptor shall notify the presence of the new Audio Connection.

4.12 Audio Connection Release

Upon a user action or an internal event, either the HF or the AG shall release an existing Audio Connection whenever necessary.

As pre-condition for this procedure, an ongoing Audio Connection between the AG and the HF shall exist.

An Audio Connection removal always means the disconnection of its corresponding Synchronous Connection.

When the audio connection is released, the audio path shall be routed to the AG.²

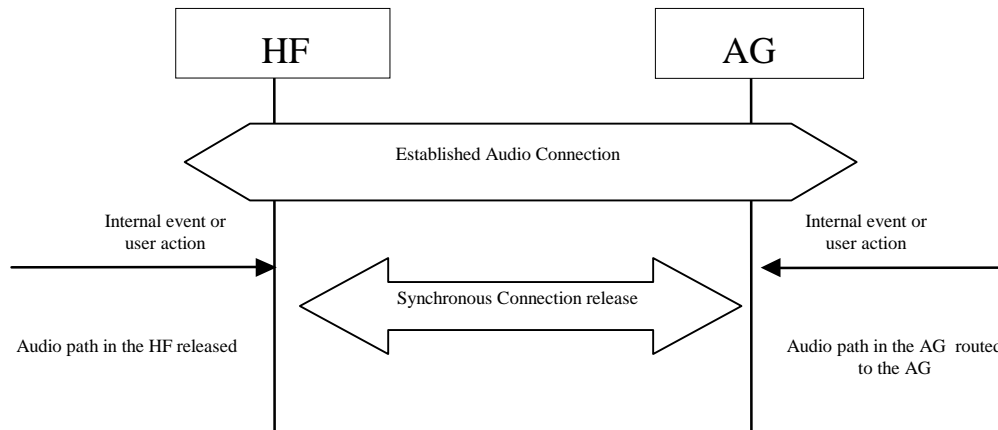


Figure 4.10: Audio Connection release

4.13 Answer an Incoming Call

Upon an incoming call, the AG shall send a sequence of unsolicited RING alerts to the HF. The RING alert shall be repeated for as long as the call acceptance is pending, or until the incoming call is interrupted for any reason.

The HF shall produce a local alerting in reaction to the RING.

If the AG's SDP record (or +BRSF message) indicates "In-band ring tone" is supported, the AG shall send in-band ring tones unless subsequently changed using procedures defined in Section 4.13.4.

The AG may abort the incoming call when necessary. It shall then stop sending the RING alert to the HF.

4.13.1 Answer Incoming Call from the HF – In-Band Ringing

Optionally, the AG may provide an in-band ring tone.

This case is described in Figure 4.11 below and implies, as pre-condition, that an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

As the figure below shows, if an in-band ring tone is used, the AG shall send the ring tone to the HF via the established Audio Connection.

² In principle, removing an Audio Connection by using the procedure described in this section is not necessarily related to any call process.

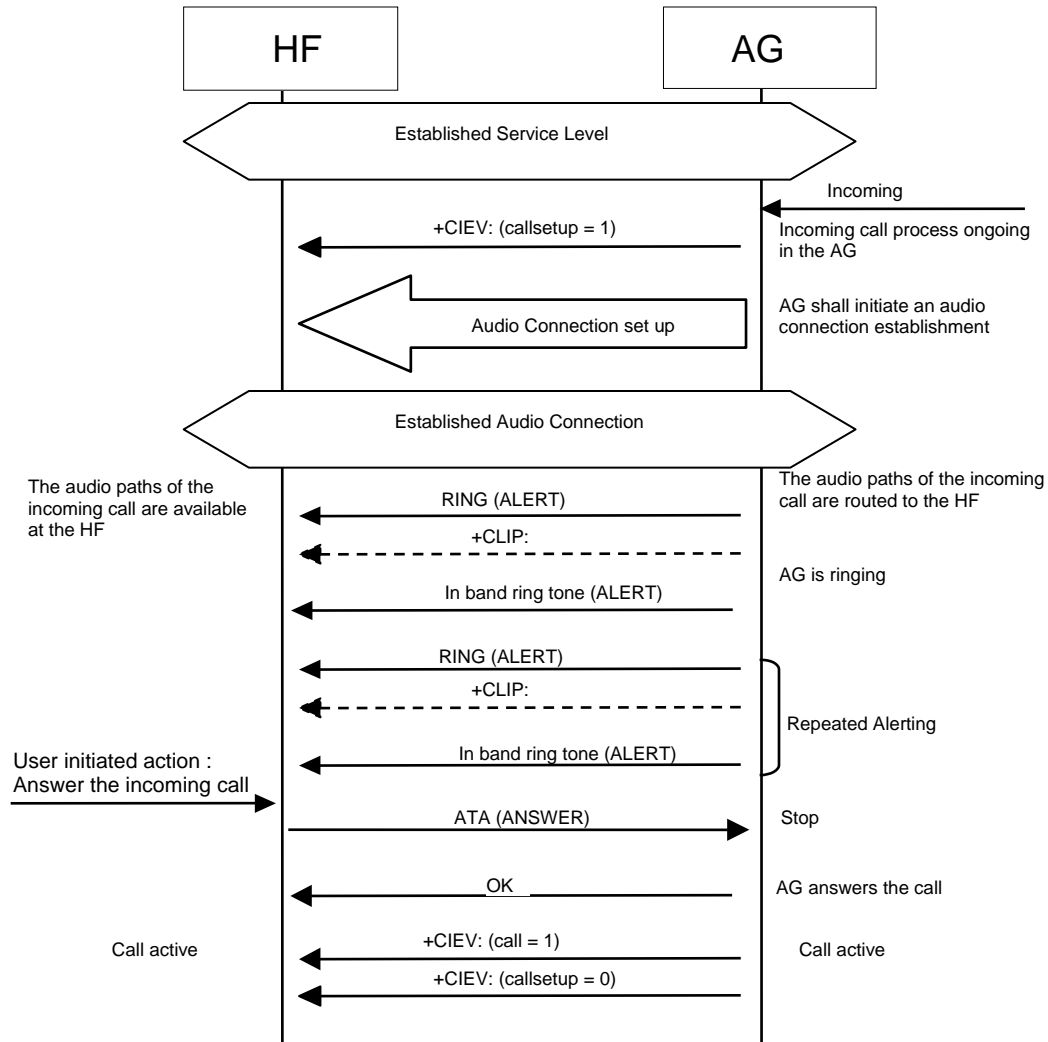


Figure 4.11: Answer an incoming call from the HF – in-band ring tone

The user accepts the incoming voice call by using the proper means provided by the HF. The HF shall then send the ATA command (see Section 4.33) to the AG. The AG shall then begin the procedure for accepting the incoming call.

If the normal incoming call procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0) to notify the HF of this condition (see also Section 4.14.2).

4.13.2 Answer Incoming Call from the HF – No In-Band Ringing

As pre-condition, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

As the figure below shows, if no in-band ring tone is used and an Audio Connection does not exist, the AG shall set up the Audio Connection and route the audio paths to the HF upon answering the call.

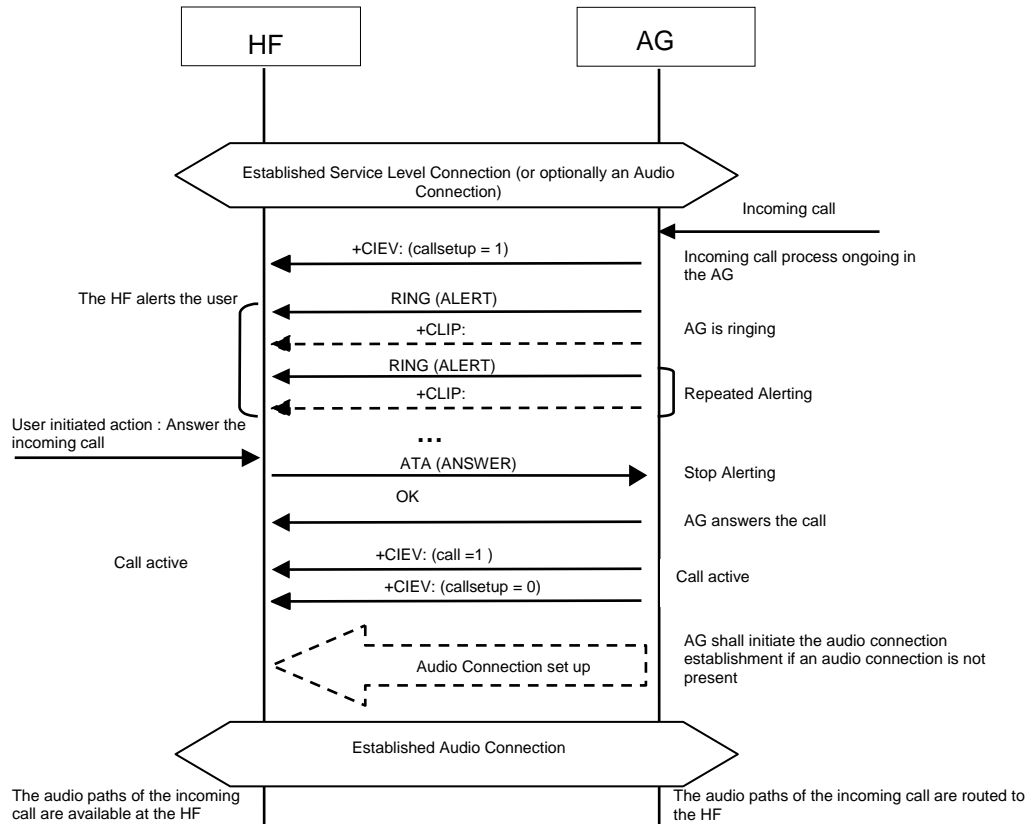


Figure 4.12: Answer an incoming call from the HF – no in-band ring tone

The user accepts the incoming voice call by using the proper means provided by the HF. The HF shall then send the ATA command (see Section 4.33) to the AG, and the AG shall start the procedure for accepting the incoming call and establishing the Audio Connection if an Audio Connection does not exist (refer to Section 4.11).

If the normal incoming call procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0) to notify the HF of this condition (see also Section 4.14.2).

4.13.3 Answer Incoming Call from the AG

The following pre-conditions apply for this procedure:

- As a pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist.
- The AG shall alert the HF using either of the two procedures described in Sections 4.13.1 and 4.13.2.
- The HF shall alert the user.

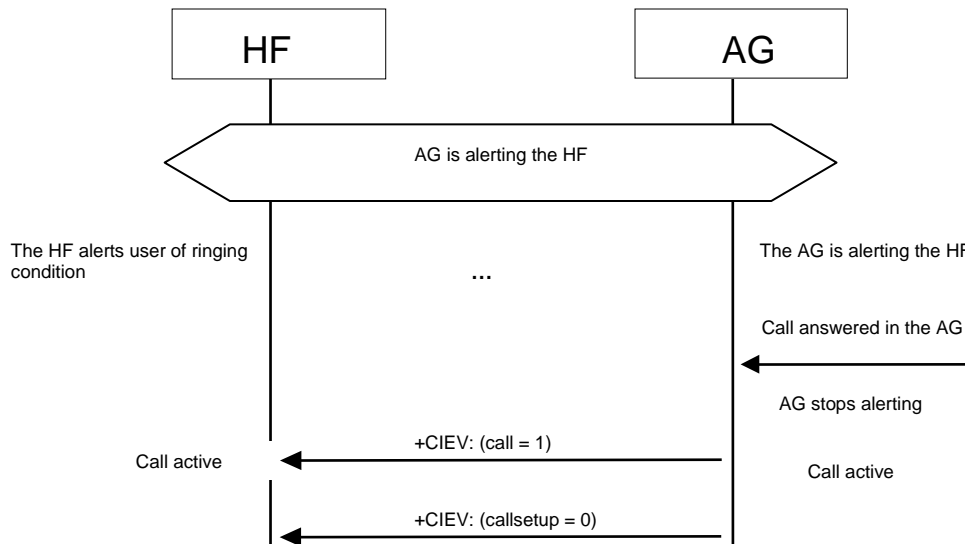


Figure 4.13: Answer an incoming call from the AG

The user accepts the incoming call by using the proper means provided by the AG.

If the normal incoming call procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0) to notify the HF of this condition (see also Section 4.14.2).

4.13.4 Change the In-Band Ring Tone Setting

The SDP record entry “In-band ring tone” of the “Supported features” record (see table 5.4) informs the HF if the AG is capable of sending an in-band ring tone or not. If the AG is capable of sending an in-band ring tone, it shall send the in-band ring tone by default. The AG may subsequently change this setting.

In case the AG wants to change the in-band ring tone setting during an ongoing service level connection, it shall use the unsolicited result code +BSIR (Bluetooth Set In-band Ring tone) to notify the HF about the change. See Figure 4.14 for details.

Refer to Section 4.33 for more information on the +BSIR unsolicited result code.

The in-band ring tone setting may be changed several times during a Service Level Connection.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

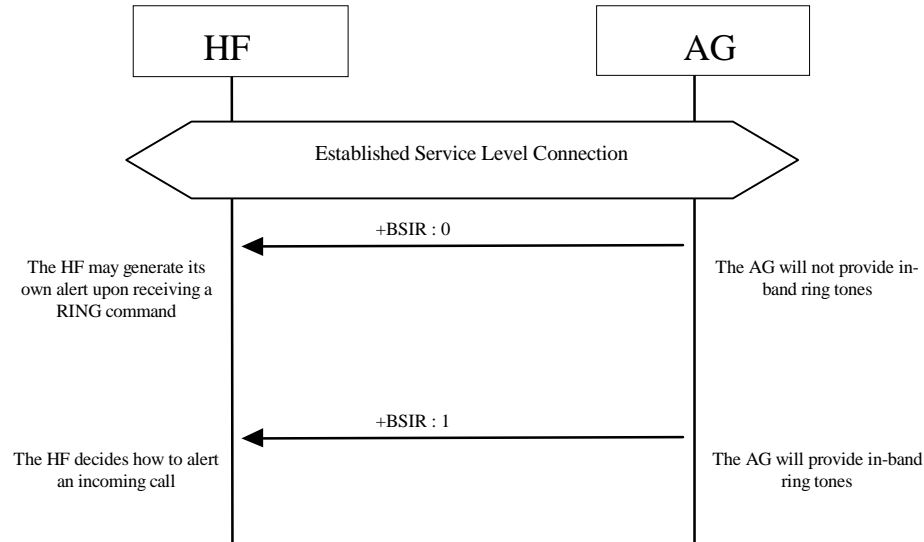


Figure 4.14: Change of the in-band ring tone setting initiated by the AG

In case the HF does not want to use the AG's in-band ring tone, it may mute the Audio Connection after it has received +CIEV:(callsetup=1). The HF shall un-mute the Audio Connection upon receiving the +CIEV:(callsetup=0) indication.

4.14 Reject an Incoming Call

In case of an incoming call, the AG shall alert the HF by either one of the two procedures described in Sections 4.13.1 and 4.13.2.

Instead of answering the call, the user may reject the incoming call process by user action at the HF or the AG. These two procedures are described in the following sections.

4.14.1 Reject an Incoming Call from the HF

As a precondition to this procedure, the AG shall alert the HF using either of the two procedures described in Sections 4.13.1 and 4.13.2.

The user rejects the incoming call by using the User Interface on the Hands-Free unit. The HF shall then send the AT+CHUP command (see Section 4.33) to the AG. This may happen at any time during the procedures described in Sections 4.13.1 and 4.13.2.

The AG shall then cease alerting the HF of the incoming call and send the OK indication followed by the +CIEV result code, with the value indicating (callsetup=0).

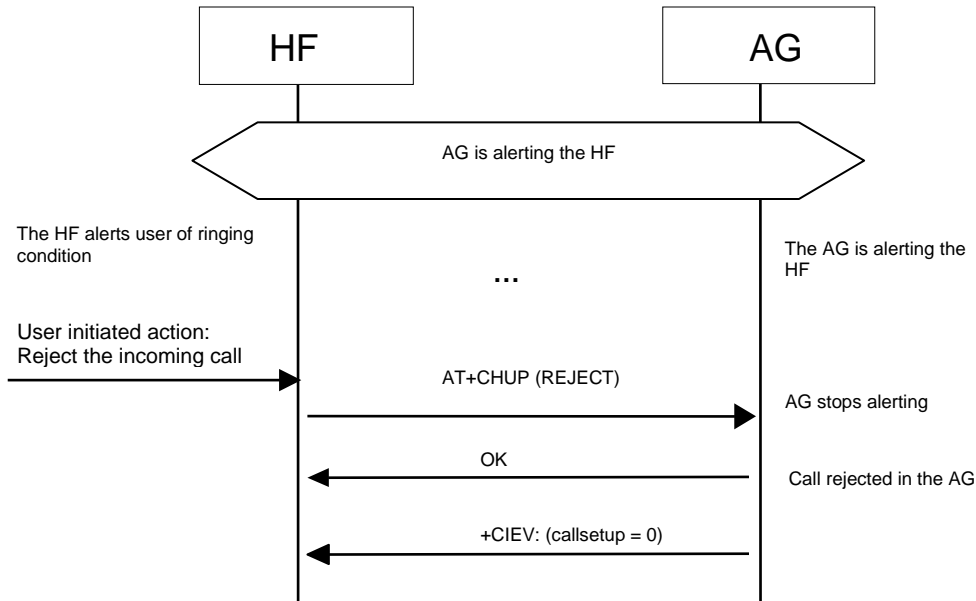


Figure 4.15: Reject an incoming call from the HF

4.14.2 Rejection/Interruption of an Incoming Call in the AG

As a precondition to this procedure, the AG shall alert the HF using either of the two procedures described in Sections 4.13.1 and 4.13.2.

The user rejects the incoming call by using the User Interface on the AG. Alternatively the incoming call process may be interrupted in the AG for any other reason.

As consequence of this, the AG shall send the +CIEV result code, with the value indicating (callsetup=0). The HF shall then stop alerting the user.

This may happen at any time during the procedures described in Sections 4.13.1 and 4.13.2.

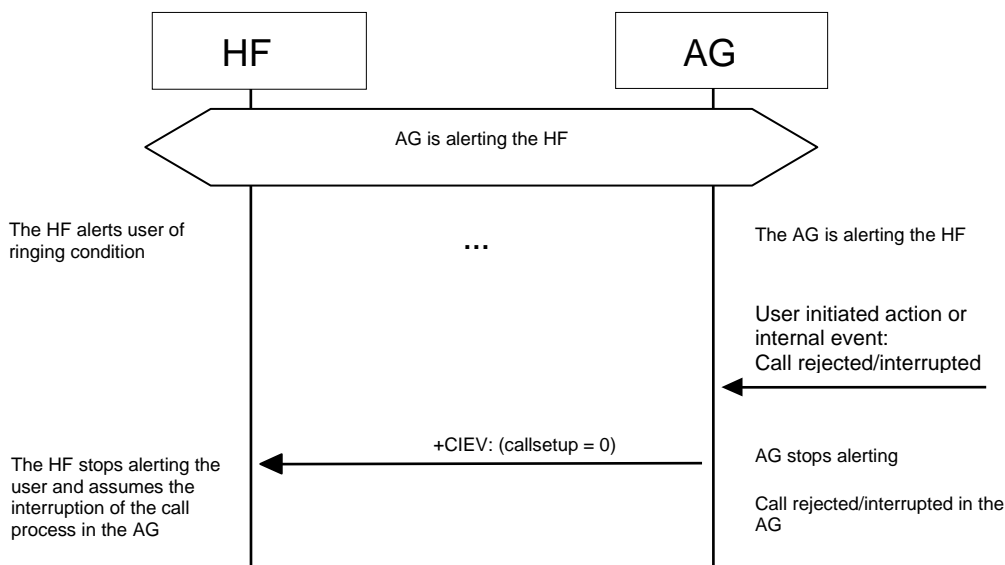


Figure 4.16: Rejection/interruption of an incoming call in the AG

4.15 Terminate a Call Process

An ongoing call process may be terminated by either the HF or the AG by means of a user action or any other event.

4.15.1 Terminate a Call Process from the HF

The following pre-conditions apply for this procedure:

- An ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.
- A call related process is ongoing in the AG.

Although not required for the call termination process, an Audio Connection is typically present between the HF and AG.

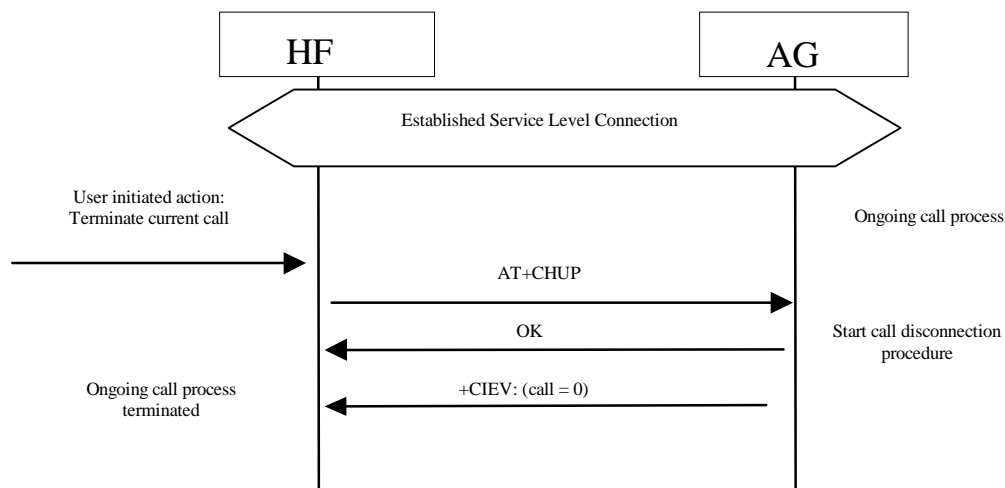


Figure 4.17: Terminate ongoing call - HF initiated

The user may abort the ongoing call process using whatever means provided by the Hands-Free unit. The HF shall send AT+CHUP command (see Section 4.33) to the AG, and the AG shall then start the procedure to terminate or interrupt the current call procedure. The AG shall then send the OK indication followed by the +CIEV result code, with the value indicating (call=0).

Performing a similar procedure, the AT+CHUP command described above may also be used for interrupting a normal outgoing call set-up process.

4.15.2 Terminate a Call Process from the AG

The following pre-conditions apply for this procedure:

- An ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.
- A call related process is ongoing in the AG.

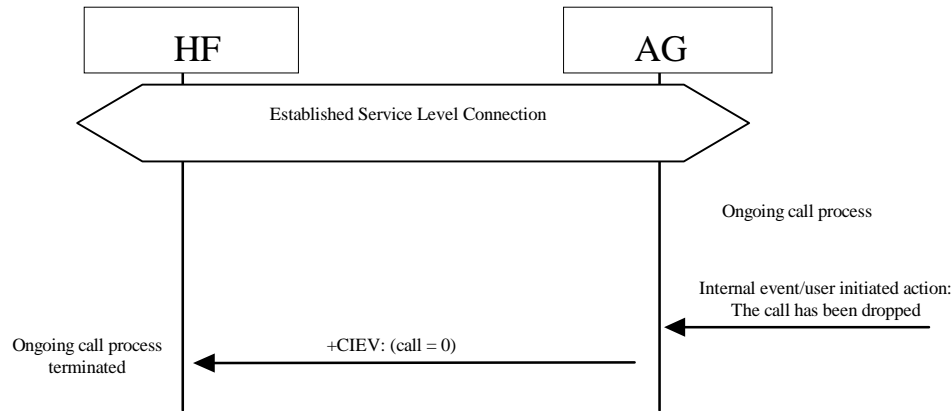


Figure 4.18: Terminate ongoing call - AG initiated

This procedure is fully applicable for cases in which an ongoing call process is interrupted in the AG for any reason.

In this case the AG shall send the +CIEV result code, with the value indicating (call=0).

4.16 Audio Connection Transfer Towards the HF

The audio paths of an ongoing call may be transferred from the AG to the HF. This procedure represents a particular case of an “Audio Connection set up” procedure, as described in Section 4.11.

The call connection transfer from the AG to the HF is initiated by a user action either on the HF or on the AG side. This shall result in either the HF or the AG, respectively, initiating an “Audio Connection set up” procedure with the audio paths of the current call being routed to the HF.

This procedure is only applicable if there is no current Audio Connection established between the HF and the AG. In fact, if the Audio Connection already exists, this procedure is not necessary because the audio path of the AG is assumed to be already routed towards the HF.

The following pre-conditions apply for this procedure:

- An ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the initiator of the “Audio Connection transfer towards the HF” procedure shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.
- An ongoing call exists in the AG, with the audio paths routed to the AG means.

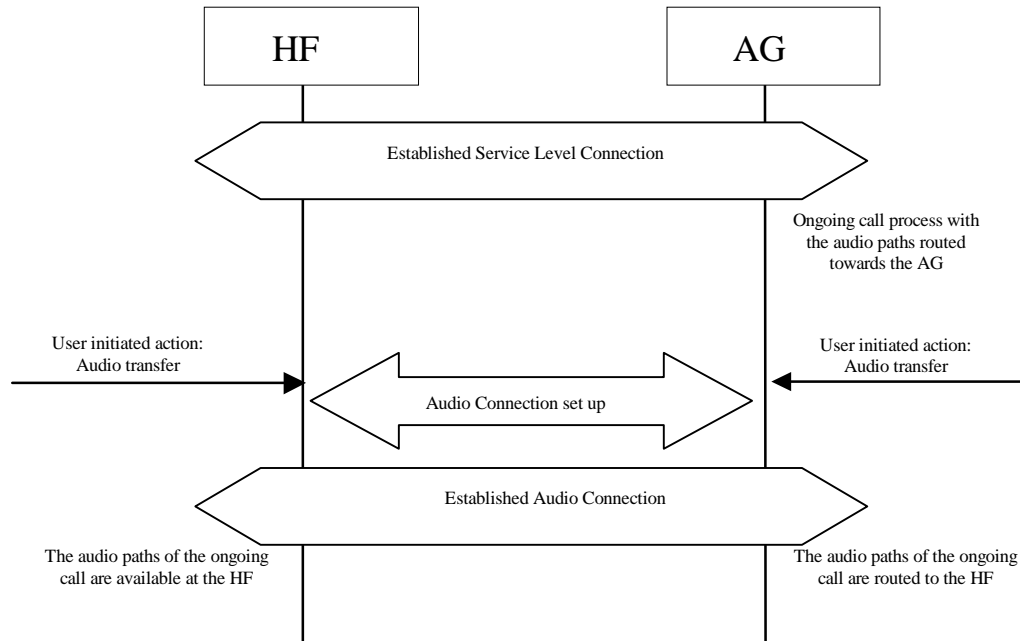


Figure 4.19: Audio Connection transfer to the HF

4.17 Audio Connection Transfer Towards the AG

The audio paths of an ongoing call may be transferred from the HF to the AG. This procedure represents a particular case of an “Audio Connection release” procedure, as described in Section 4.12.

The call connection transfer from the HF to the AG is initiated by a user action in the HF or due to an internal event or user action on the AG side. This results in an “Audio Connection release” procedure being initiated either by the HF or the AG respectively, with the current call kept and its audio paths routed to the AG.

If as a consequence of an HF initiated “Audio Connection transfer towards the AG” procedure, the existing Service Level Connection is autonomously removed by the AG, the AG shall attempt to re-establish the Service Level Connection once the current call ends.

As pre-condition for this procedure, an ongoing call process shall exist in the AG. The audio paths of the ongoing call shall be available in the HF via an Audio Connection established between the AG and the HF.

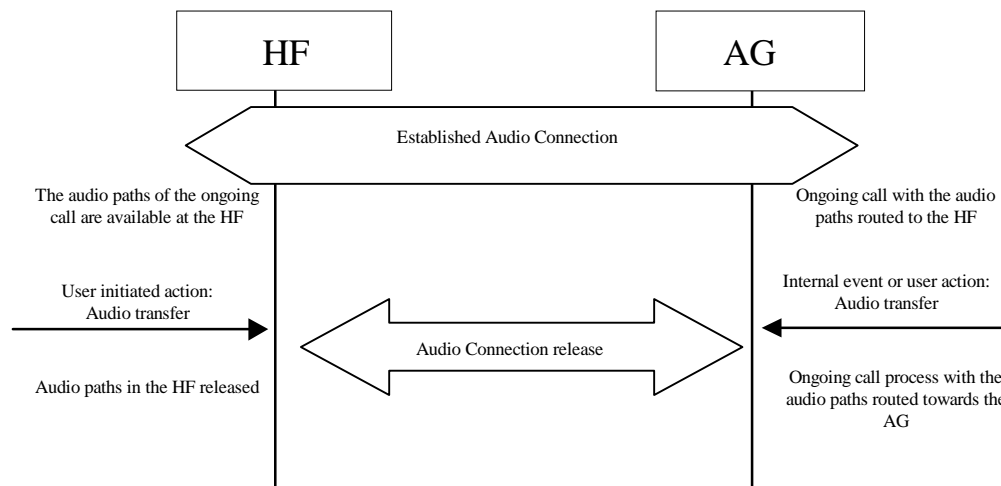


Figure 4.20: Audio Connection transfer to the AG

4.18 Place a Call With the Phone Number Supplied by the HF

The HF may initiate outgoing voice calls by providing the destination phone number to the AG. To start the call set-up, the HF shall initiate the Service Level Connection establishment (if necessary) and send a proper ATDdd...dd; command to the AG. The AG shall then start the call establishment procedure using the phone number received from the HF and issues the +CIEV result code, with the value (callsetup=2) to notify the HF that the call set-up has been successfully initiated.

Refer to Section 4.33 for more information on the ATDdd...dd; command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

If an Audio Connection is not established the AG shall establish the proper Audio Connection and route the audio paths of the outgoing call to the HF immediately following the commencement of the ongoing call set up procedure.

Once the AG is informed that the alerting of the remote party has begun, the AG shall issue the +CIEV result code, with the value indicating (callsetup=3). If the wireless network does not provide the AG of an indication of alerting the remote party, the AG may not send this indication.

Upon call connection the AG shall send issue the +CIEV result code, with the value indicating (call=1).

If the normal outgoing call establishment procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0), to notify the HF of this condition (see Section 4.15.2).

If the AG supports the “Three-way calling” feature and if a call is already ongoing in the AG, performing this procedure shall result in a new call being placed to a third party with

the current ongoing call put on hold. For details on how to handle multiparty calls refer to Section 4.22.2.

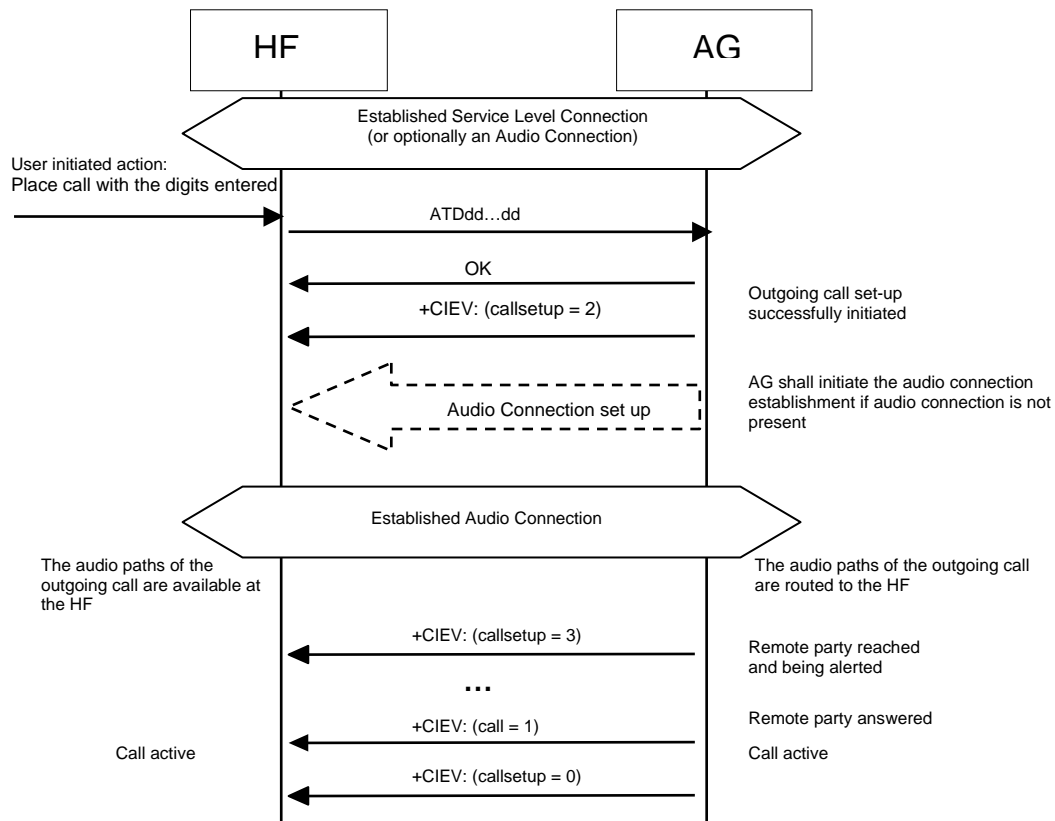


Figure 4.21: Place an outgoing voice call with the digits entered in the HF

4.19 Memory Dialing from the HF

The HF may initiate outgoing voice calls using the memory dialing feature of the AG. To start the call set-up, the HF shall initiate the Service Level Connection establishment (if necessary) and send an ATD>nnn...; command to the AG. The AG shall then start the call establishment procedure using the phone number stored in the AG memory location given by nnn...; and issue the +CIEV result code, with the value (callsetup=2) to notify the HF that the call set-up has been successfully initiated.

Refer to Section 4.33 for more information on the ATD>nnn... command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

If an Audio Connection is not established, the AG shall establish the proper Audio Connection and route the audio paths of the outgoing call to the HF immediately following the commencement of the ongoing call set up procedure.

Once alerting of the remote party begins, the AG shall issue the +CIEV result code, with the value indicating (callsetup=3).

Upon call connection the AG shall send issue the +CIEV result code, with the value indicating (call=1).

If the normal outgoing call establishment procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0), to notify the HF of this condition (see Section 4.15.2).

If the AG supports the “Three-way calling” feature and if a call is already ongoing in the AG, performing this procedure shall result in a new call being placed to a third party with the current ongoing call put on hold. For details on how to handle multiparty calls refer to Section 4.22.2.

If there is no number stored for the memory location given by the HF, the AG shall respond with ERROR.

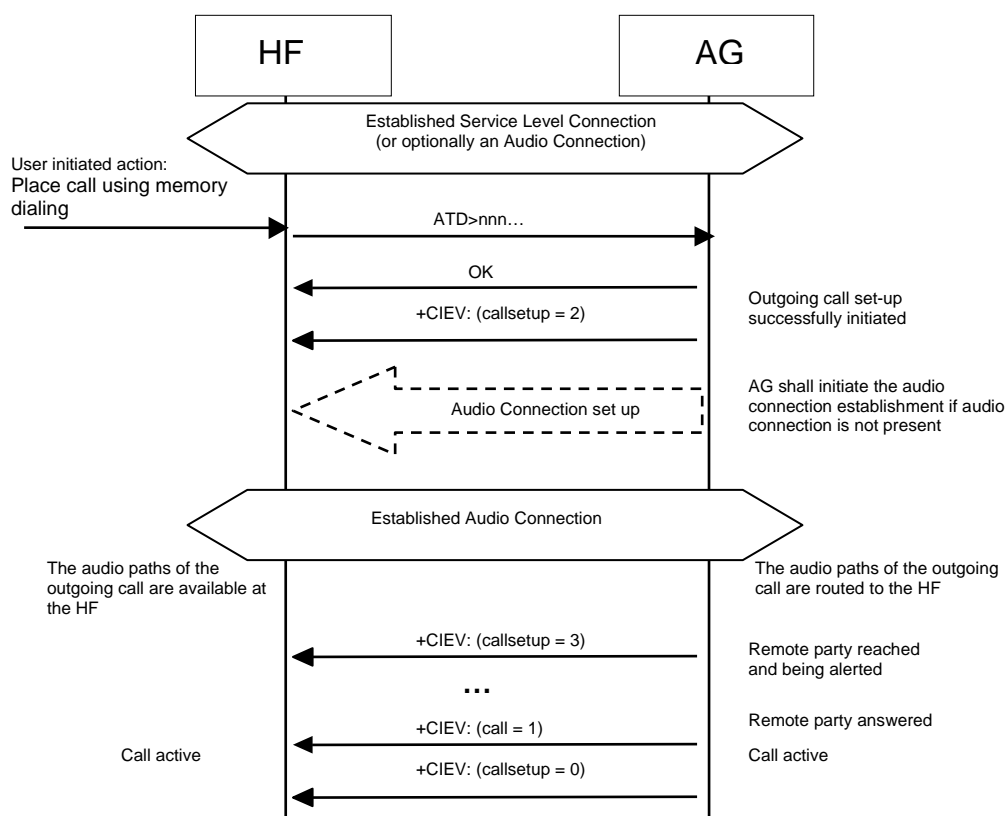


Figure 4.22: Place an outgoing voice call using memory dialing

4.20 Last Number Re-Dial from the HF

The HF may initiate outgoing voice calls by recalling the last number dialed by the AG. To start the call set-up, the HF shall initiate the Service Level Connection establishment (if necessary) and send an AT+BLDN command to the AG. The AG shall then start the call establishment procedure using the last phone number dialed by the AG, and issues the +CIEV result code, with the value (callsetup=2), to notify the HF that the call set-up has been successfully initiated.

Refer to Section 4.33 for more information on the AT+BLDN command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

If an Audio Connection is not established, the AG shall establish the proper Audio Connection and route the audio paths of the outgoing call to the HF immediately following the commencement of the ongoing call set up procedure.

Once alerting of the remote party begins, the AG shall issue the +CIEV result code, with the value indicating (callsetup=3).

Upon call connection the AG shall send issue the +CIEV result code, with the value indicating (call=1).

If the normal outgoing call establishment procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0), to notify the HF of this condition (see Section 4.15.2).

If the AG supports the “Three-way calling” feature and if a call is already ongoing in the AG, performing this procedure shall result in a new call being placed to a third party with the current ongoing call put on hold. For details on how to handle multiparty calls refer to Section 4.22.2.

If there is no number stored for the memory location given by the HF, the AG shall respond with ERROR.

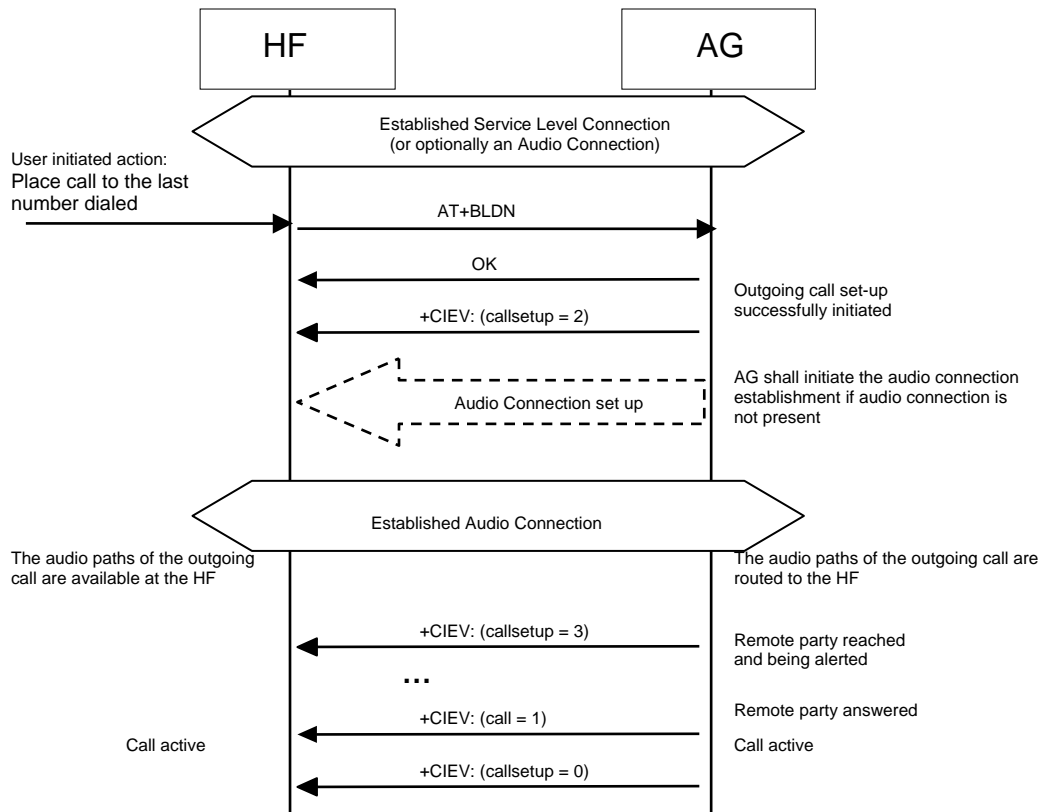


Figure 4.23: Place an outgoing voice call with the last number dialed

4.21 Call Waiting Notification Activation

The HF may issue the AT+CCWA command to enable the “Call Waiting notification” function in the AG. Once the “Call Waiting notification” is enabled, the AG shall send the corresponding +CCWA unsolicited result code to the HF whenever an incoming call is waiting during an ongoing call. It is always assumed that the “call waiting” service is already active in the network.

Once the HF issues the AT+CCWA command, the AG shall respond with OK. It shall then keep the “Call Waiting notification” enabled until either the AT+CCWA command is issued to disable “Call Waiting notification,” or the current Service Level Connection between the AG and the HF is dropped for any reason.

Refer to Section 4.33 for more information on the AT+CCWA command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

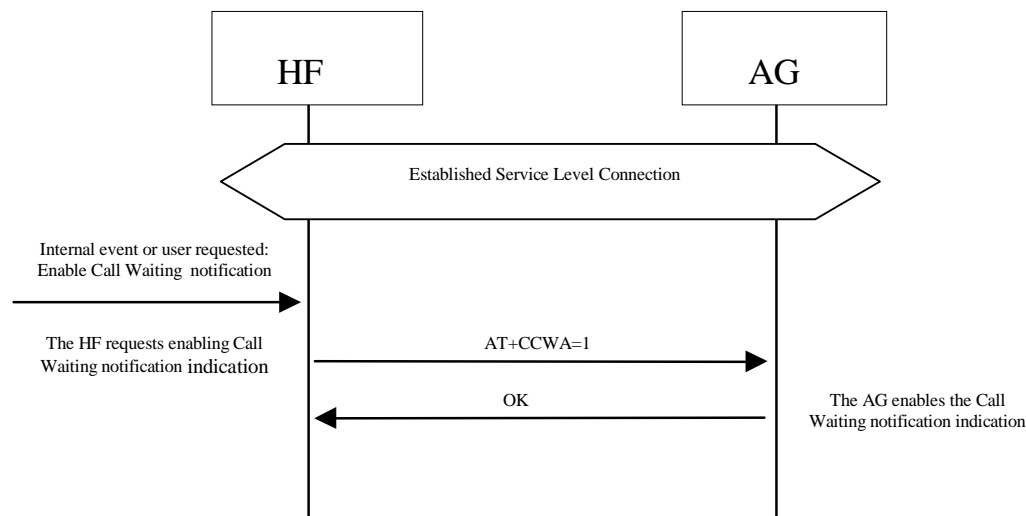


Figure 4.24: Activation of Call waiting notification

4.22 Three Way Call Handling

Proper management of several concurrent calls shall be accomplished by performing the procedures described in [2] but with some limitations stated in this specification. For more details, refer to Section 4.33.

The HF device cannot always assume that the "call hold and/or multiparty" services are available in the network. If the AG determines that a requested action by the HF device cannot be performed due to the inability of the network to support that feature or lack of subscriber subscription, the AG shall return a +CME error.

There are two +CME ERROR codes that are used to indicate network related failure reasons to the HF :

30 - No Network Service. Indicates that an AT+CHLD command cannot be implemented due to network limitations.

31 - Network Timeout. Indicates that an AT+CHLD command cannot be implemented due to network problems.

In general, when the user deals with multiple concurrent calls, the HF shall issue the corresponding AT+CHLD command as a result of user actions. This command allows the control of multiple concurrent calls and provides means for holding calls, releasing calls, switching between two calls, and adding a call to a multiparty conference.

When this feature is supported, the HF and AG are only mandated to implement the "basic Three Way calling" commands AT+CHLD = 1 and 2.

This section covers two cases. In one case the third party call is received in the AG, and notification is sent to the HF via a Call Waiting notification. In the second case, the third party call is placed from the HF.

Refer to Section 4.33 for more information on the AT+CHLD command.

The following pre-conditions apply for these procedures:

- As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the initiator of the procedure shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.
- An ongoing call in the AG shall exist.

4.22.1 Three Way Calling—Call Waiting Notification

In addition to the two previously stated preconditions, the Call Waiting notification to the HF shall already be enabled in the AG (that is, the procedure stated in Section 4.21 has been performed).

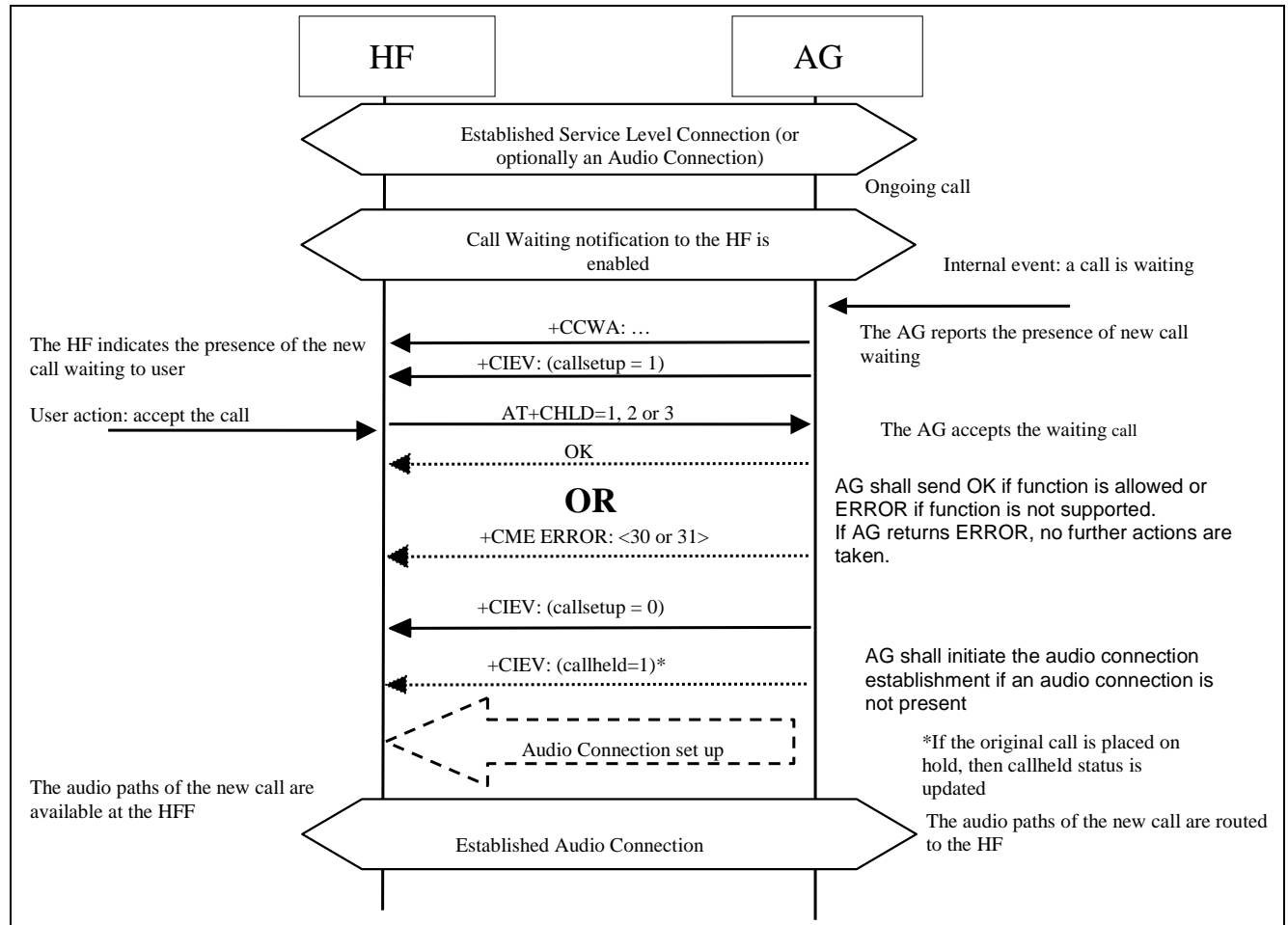


Figure 4.25: Typical Call Waiting indication followed by a three way call set up process

If the AG receives a third party call, it shall send the call waiting notification +CCWA and +CIEV result code, with the value indicating (callsetup=1), to the HF. If the user accepts the call at the HF, it shall send the AT+CHLD with parameter 1, 2 or 3 to the AG. The AG shall then accept the waiting call and respond with OK, and issue the +CIEV result code with the value indicating (callsetup=0). If the HF elects to send AT+CHLD=2 (placing the original call on hold), then the AG shall send the +CIEV result code with the value indicating a held call (callheld=1).

Optionally, the HF may then use the AT+CHLD command, in order to change the status of the held and active calls.

If the normal incoming call procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0), to notify the HF of this condition (see Section 4.14.2).

4.22.2 Three Way Calls – Third Party Call Placed from the HF

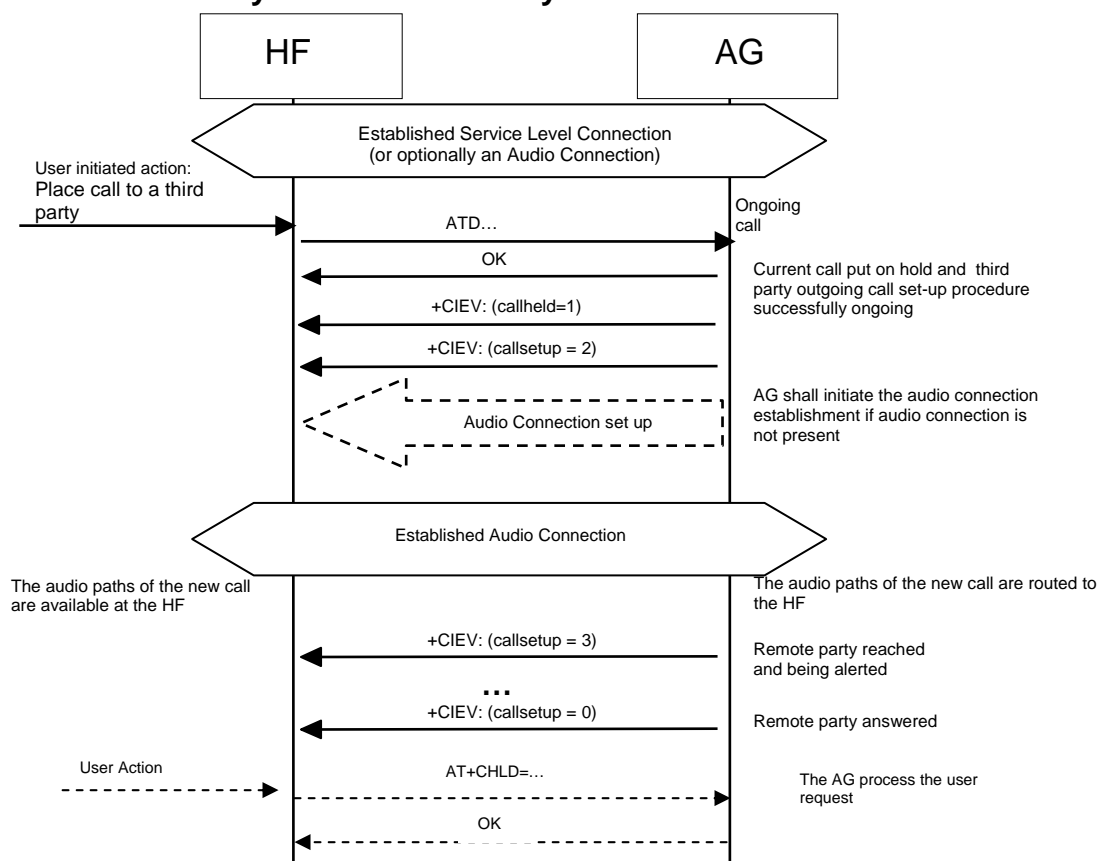


Figure 4.26: Three way call handling when the third party call is placed from the HF

If a third party call is placed from the HF using the ATD command, the AG shall send the OK indication and +CIEV result code, with the value indicating (callsetup=2), to the HF. The AG shall then place the active call in hold status in order to establish the new call.

Once the AG is informed that the alerting of the remote party has begun, the AG shall issue the +CIEV result code, with the value indicating (callsetup=3). If the wireless network does not provide the AG of an indication of alerting the remote party, the AG may not send this indication.

If the remote party answers the call, the AG shall issue the +CIEV result code with the value indicating (callsetup=0).

Optionally, the HF may then use the AT+CHLD command in order to change the status of the held and active calls. If the AT+CHLD command results in the change in a held call status the AG shall provide the status indication using the +CIEV result code with the value indicating the call held status (callheld=<0,1,2>).

If the normal outgoing call procedure is interrupted for any reason, the AG shall issue the +CIEV result code, with the value indicating (callsetup=0), to notify the HF of this condition (see Section 4.15.2).

4.23 Calling Line Identification (CLI) Notification

The HF may issue the AT+CLIP command to enable the “Calling Line Identification notification” function in the AG.

If the calling subscriber number information is available from the network, the AG shall issue the +CLIP unsolicited result code just after every RING indication when the HF is alerted in an incoming call. See Section 4.13 for more details.

Once the HF issues the AT+CLIP command, the AG shall respond with OK. The AG shall then keep the “Calling Line Identification notification” enabled until either the AT+CLIP command is issued by the HF to disable it, or the current Service Level Connection between the AG and the HF is dropped for any reason.

Refer to Section 4.33 for more information on the AT+CLIP command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

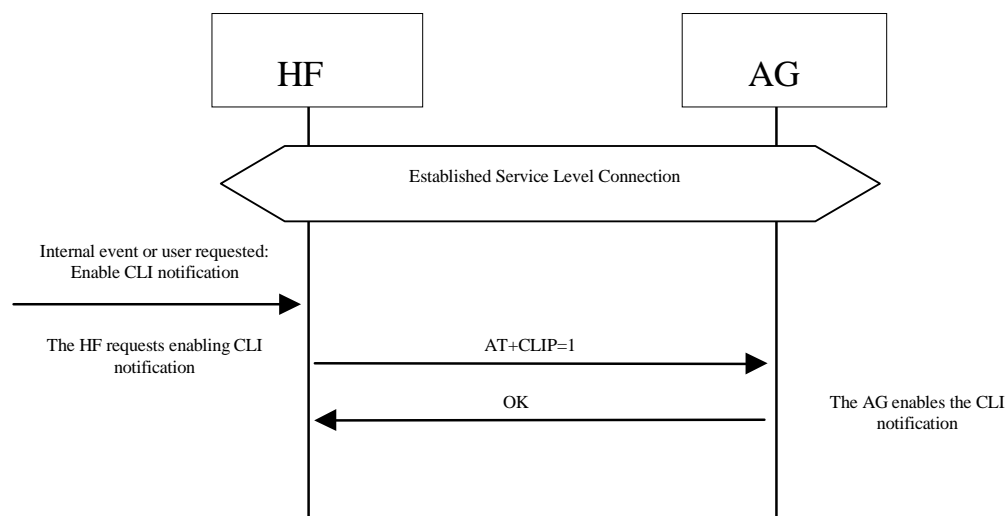


Figure 4.27: Activation of CLI notification

4.24 The HF Requests Turning Off the AG’s EC and NR

The HF may disable the echo canceling and noise reduction functions resident in the AG via the AT+NREC command.

If the HF supports embedded EC and/or NR functions it shall support the AT+NREC command as described in the procedures in this section. Moreover, if the HF has these functions enabled, it shall perform this procedure before any Audio Connection between the HF and the AG is established.

By default, if the AG supports its own embedded echo canceling and/or noise reduction functions, it shall have them activated until the AT+NREC command is received. From then on, and until the current Service Level Connection between the AG and HF is

dropped for any reason, the AG shall disable these functions every time an Audio Connection between the HF and the AG is used for audio routing.

If the AG does not support any echo canceling and noise reduction functions, it shall respond with the ERROR indicator on reception of the AT+NREC command.

Refer to Section 4.33 for more information on the AT+NREC command.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

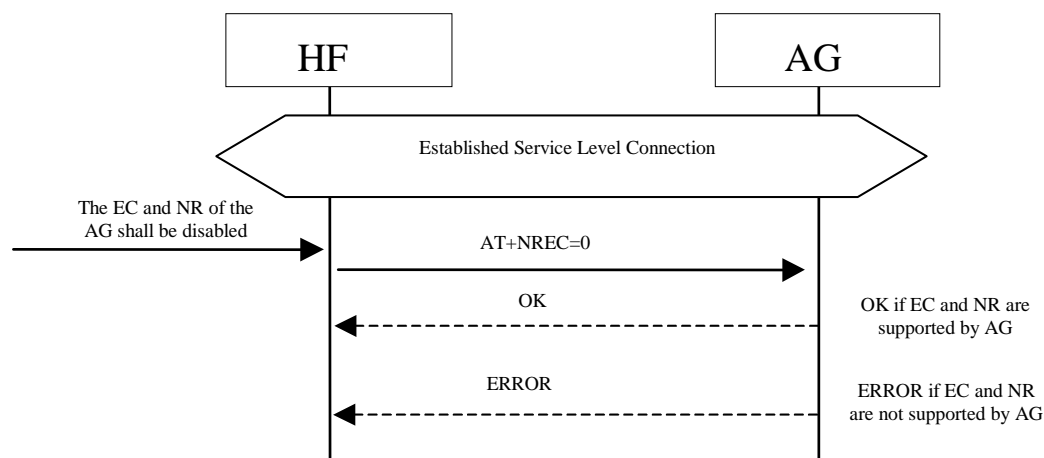


Figure 4.28: NR and EC functions available in the AG

The HF sends the AT+NREC command and AG confirms with either OK or ERROR indication.

4.25 Voice Recognition Activation

The HF, via the AT+BVRA command, or the AG autonomously, may activate/deactivate the voice recognition function resident in the AG. Beyond the audio routing and voice recognition activation capabilities, the rest of the voice recognition functionality is implementation dependent.

Whenever the AG supports a voice recognition function it shall support the AT+BVRA command as described in the procedures in this section.

If the HF issues the AT+BVRA command, the AG shall respond with the OK result code if it supports voice recognition, then initiate an Audio Connection to the HF (if the Audio Connection does not already exist) and begin the voice input sequence.

If the AG does not support voice recognition, the AG shall respond with the ERROR indication.

When the voice recognition function is activated from the AG, it shall inform the HF via the +BVRA: 1 unsolicited result code and the AG shall initiate an Audio Connection to the HF (if the Audio Connection does not already exist) and begin the voice input sequence.

Once activated, depending upon the voice recognition implementation, the AG shall then keep the voice recognition function enabled:

- For the duration of time supported by the implementation (“momentary on” voice recognition implementation). In this case, the AG shall notify the HF by sending a +BVRA: 0 unsolicited result code.
- Or until the AT+BVRA command is issued to disable voice recognition from the HF.
- Or until the current Service Level Connection between the AG and the HF is dropped for any reason.

Refer to Section 4.33 for more information on the AT+BVRA command and the +BVRA result code.

As pre-condition for these procedures, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the initiator of the procedure shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

4.25.1 Voice Recognition Activation – HF Initiated

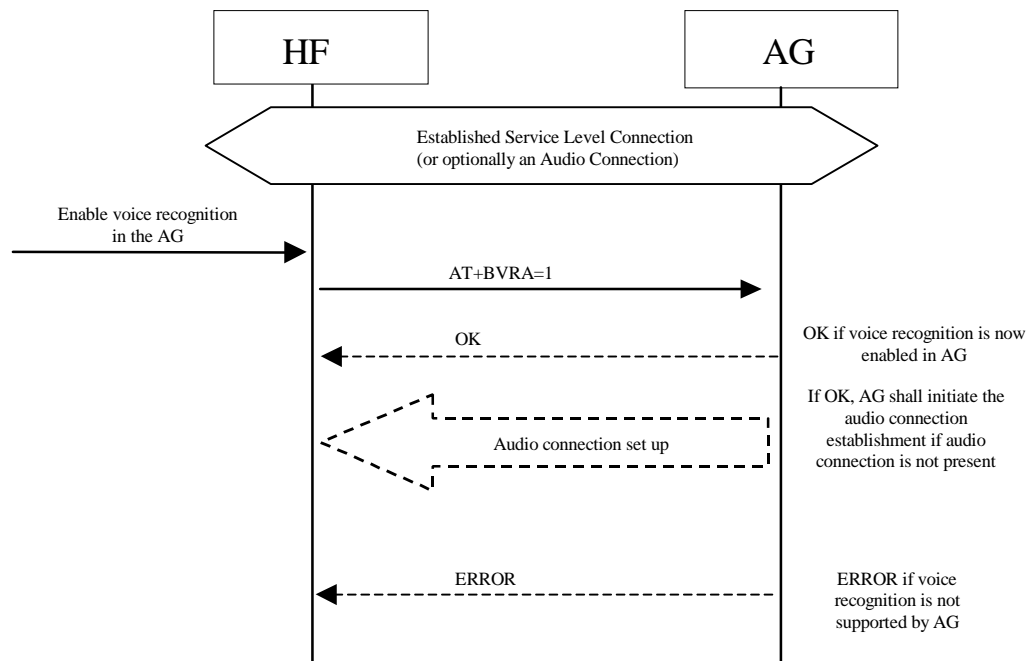


Figure 4.29: Voice recognition activation – HF initiated

4.25.2 Voice Recognition Activation – AG Initiated

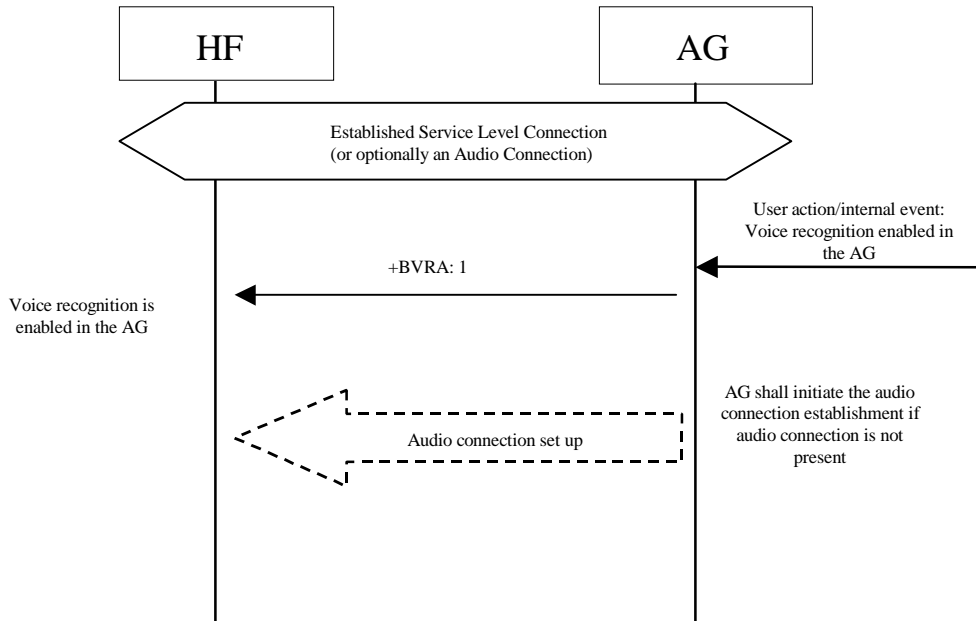


Figure 4.30: Voice recognition activation – AG initiated

4.25.3 Voice Recognition Deactivation

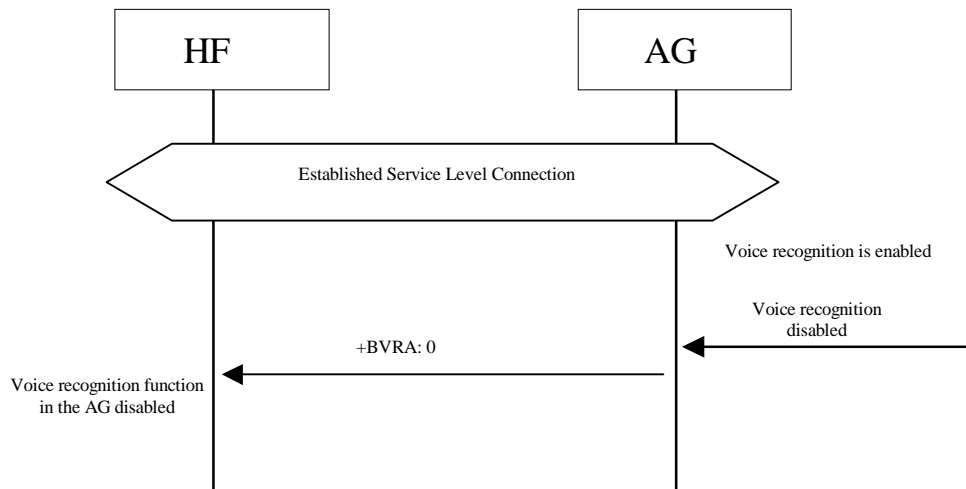


Figure 4.31: Voice recognition deactivation – “momentary on” approach

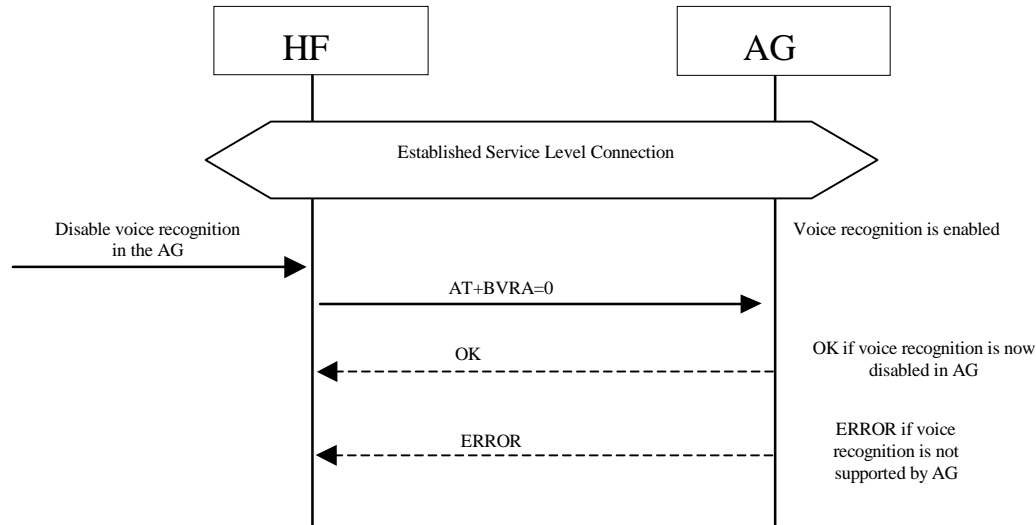


Figure 4.32: Voice recognition deactivation from the HF

4.26 Attach a Phone Number to a Voice Tag

This procedure is applicable to HF units supporting internal voice recognition functionality. It provides a means to read numbers from the AG for the purpose of creating a unique voice tag and storing the number and its linked voice tag in the HF unit's memory. The HF unit may then use its internal Voice Recognition to dial the linked phone numbers when a voice tag is recognized by using the procedure "Place a call with the phone number supplied by the HF" described in Section 4.18.

Upon an internal event or user action, the HF may request a phone number from the AG by issuing the AT+BINP=1 command. Depending on the current status of the AG, it may either accept or reject this request.

If the AG accepts the request, it shall obtain a phone number and send the phone number back to the HF by issuing the +BINP response.

If the AG rejects the request from the HF, it shall issue the ERROR result code to indicate this circumstance to the HF.

When this procedure is executed multiple times (to retrieve multiple AG phone numbers to be linked to voice tags), it is the responsibility of the AG to provide the next phone number to be passed to the HF each time the procedure is executed.

Refer to Section 4.33 for more information on the AT+BINP command and the +BINP response.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

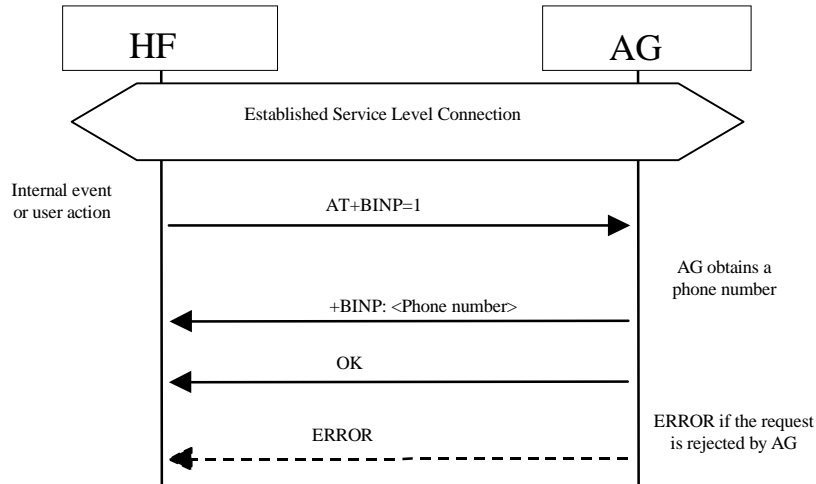


Figure 4.33: Request phone number to the AG

4.27 Transmit DTMF Codes

During an ongoing call, the HF transmits the AT+VTS command to instruct the AG to transmit a specific DTMF code to its network connection.

Refer to Section 4.33 for more information on the AT+VTS command.

The following pre-conditions apply for this procedure:

- An ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.
- An ongoing call in the AG exists.

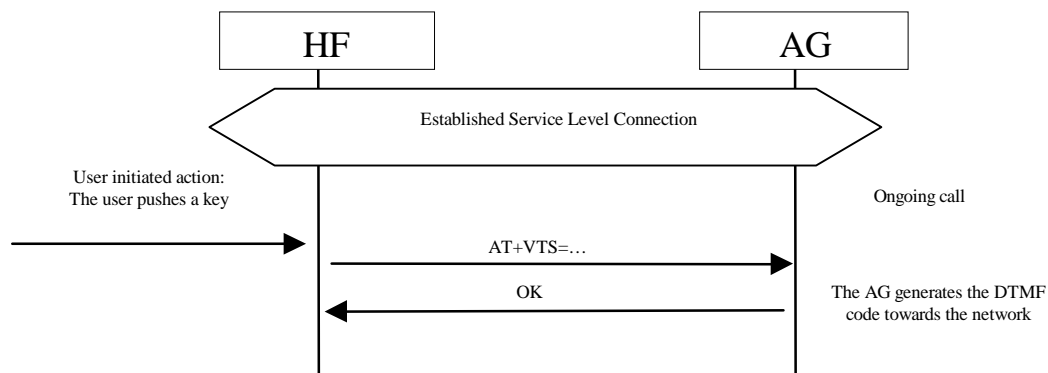


Figure 4.34: Transmit DTMF code

4.28 Remote Audio Volume Control

4.28.1 Audio Volume Control

This procedure enables the user to modify the speaker volume and microphone gain of the HF from the AG.

The AG may control the gain of the microphone and speaker of the HF by sending the unsolicited result codes +VGM and +VGS respectively. There is no limit in the amount and order of result codes.

If the remote audio volume control feature is supported in the HF device, it shall support at least remote control of the speaker volume.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the AG shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

An audio connection is not a necessary pre-condition for this feature.

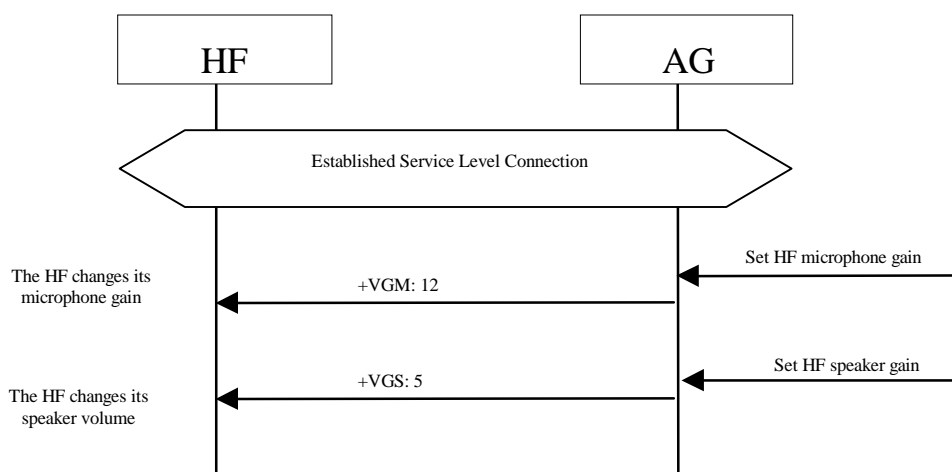


Figure 4.35: Typical example of audio volume control

Both the speaker and microphone gains are represented as parameter to the +VGS and +VGM, on a scale from 0 to 15. The values are absolute values, and relate to a particular (implementation dependent) volume level controlled by the HF.

Refer to Section 4.33 for more information on these commands and unsolicited result codes.

4.28.2 Volume Level Synchronization

This procedure allows the HF to inform the AG of the current gain settings corresponding to the HF's speaker volume and microphone gain.

On Service Level Connection establishment, the HF shall always inform the AG of its current gain settings by using the AT commands AT+VGS and AT+VGM.

If local means are implemented on the HF to control the gain settings, the HF shall also use the AT commands AT+VGS and AT+VGM to permanently update the AG of changes in these gain settings.

In all cases, the gain settings shall be kept stored, at both sides, for the duration of the current Service Level Connection. Moreover, if the Service Level Connection is released

as a consequence of an HF initiated “Audio Connection transfer towards the AG”, as stated in Section 4.17, the HF shall also keep the gain settings and re-store them when the Service Level Connection is re-established again.

The HF is only mandated to support microphone gain synchronization when it supports remote microphone gain control.

As pre-condition for this procedure, an ongoing Service Level Connection between the AG and the HF shall exist. If this connection does not exist, the HF shall autonomously establish the Service Level Connection using the proper procedure as described in Section 4.2.

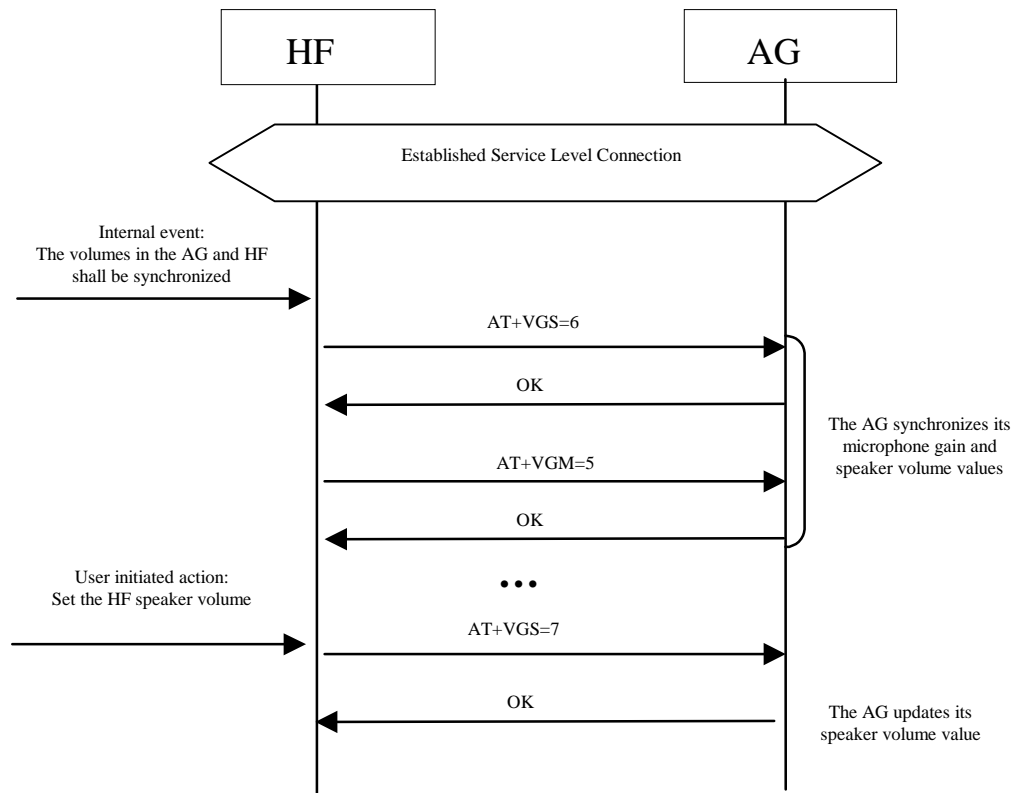


Figure 4.36: Typical example of volume level synchronization

Refer to Section 4.33 for more information on these commands and unsolicited result codes.

4.29 Response and Hold

This procedure allows the user to put an incoming call on hold and then accept or reject the call from the HF or AG. This feature is specific to the limited markets where PDC and CDMA networks support this function.

4.29.1 Query Response and Hold Status

The HF shall execute this procedure to query the status of the “Response and Hold” state of the AG.

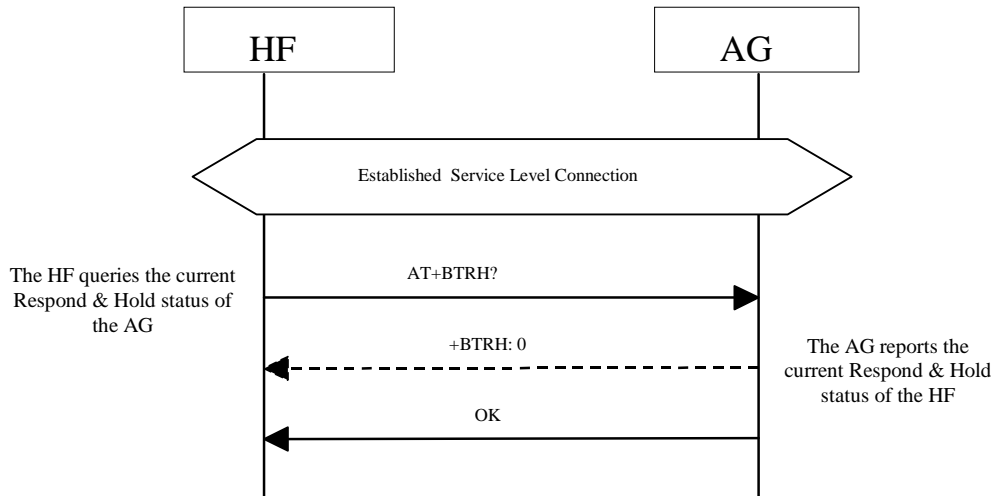


Figure 4.37: Query Response and Hold State of AG

- The HF shall issue AT+BTRH? command to query the current “Response and Hold” state of the AG.
- If the AG is currently in any of the Response and Hold states, then the AG shall send a +BTRH: Response with the parameter set to 0. If the AG is not in the Response and Hold states, then no response shall be sent.
- The AG shall send OK response to signal completion of the AT+BTRH? command.

4.29.2 Put an Incoming Call on Hold from HF

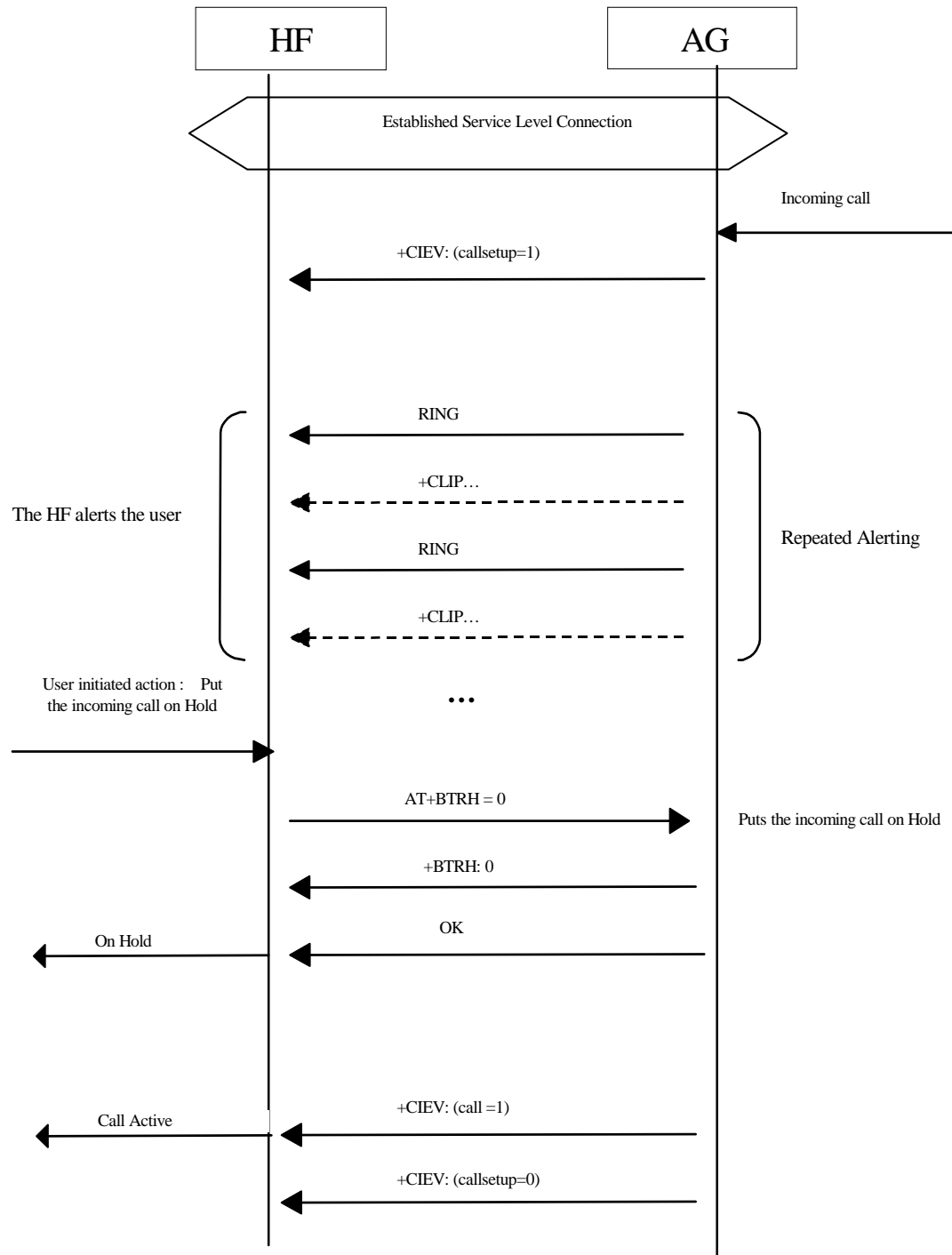


Figure 4.38: Put an incoming call on Hold from HF

- As a pre-condition to this procedure, the AG shall not have an active call or a call on hold.
- The AG shall send a sequence of unsolicited RING alerts to the HF. The RING alert shall be repeated until the HF accepts the incoming call or until the incoming call is interrupted for any reason.

- If the HF has enabled the Calling Line Identification [CLI], the AG shall send a +CLIP Response to HF.
- The user may put the incoming voice call on hold by using the proper means provided by the HF unit. The HF shall then send the AT+BTRH command with the parameter <n> set to 0. The AG shall then begin the procedure for putting the incoming call on hold.
- The AG shall send +BTRH Response with the parameter set to 0 as soon as the incoming call is put on hold.
- The AG shall send the +CIEV Response with the call status set to 1.
- The AG shall send the +CIEV Response with the callsetup status set to 0.

4.29.3 Put an Incoming Call on Hold from AG

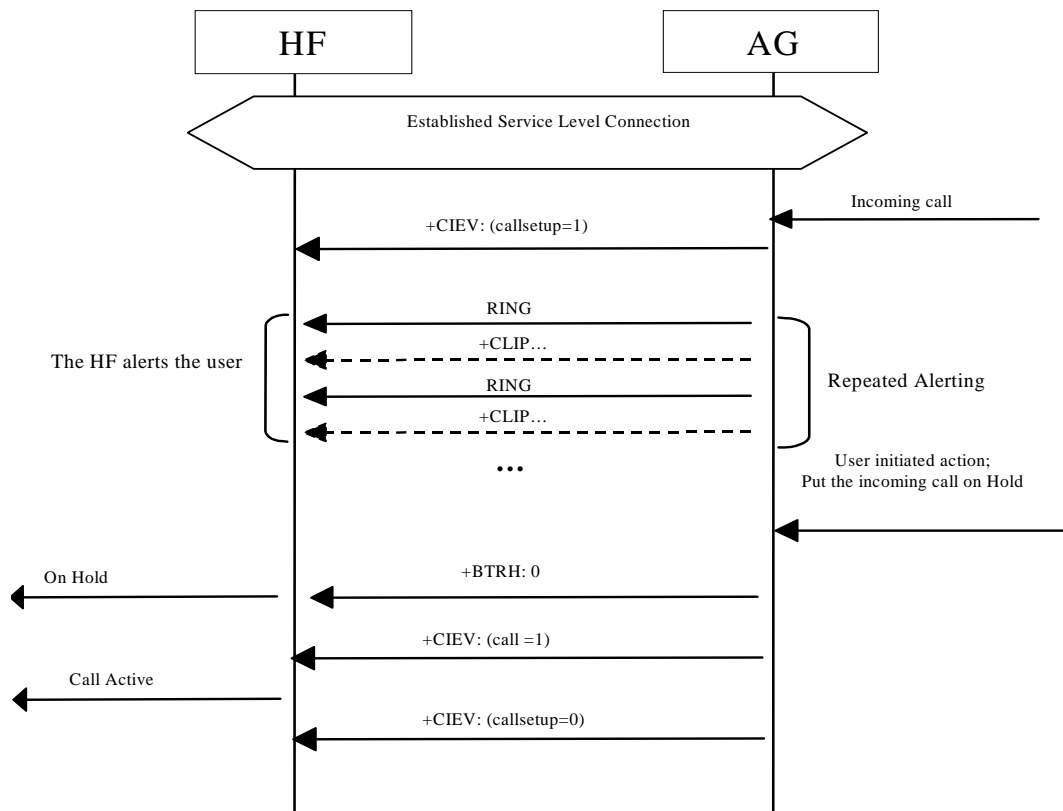


Figure 4.39: Put an incoming call on Hold from AG

As a pre-condition to this procedure, the AG shall not have an active call or a call on hold.

- The AG shall send a sequence of unsolicited RING alerts to the HF. The RING alert shall be repeated until the HF accepts the incoming call or until the incoming call is interrupted for any reason.
- If the HF has enabled the Calling Line Identification [CLI], the AG shall send a +CLIP Response to the HF.
- The user may put the incoming voice call on hold by using the proper means provided by the AG unit. The AG shall then send +BTRH Response with the parameter <n> set to 0 to indicate that the incoming call is on hold.
- Depending on whether in band ringing is enabled or disabled, there may or may not be a synchronous connection established between the HF and AG. The synchronous connection state (enabled or disabled) shall not be changed when an incoming call is placed on hold.
- The AG shall send the +CIEV Response with the call status set to 1.
- The AG shall send the +CIEV Response with the callsetup status set to 0.

4.29.4 Accept a Held Incoming Call from HF

The following additional pre-condition applies to this procedure:

- An incoming call was put on hold.

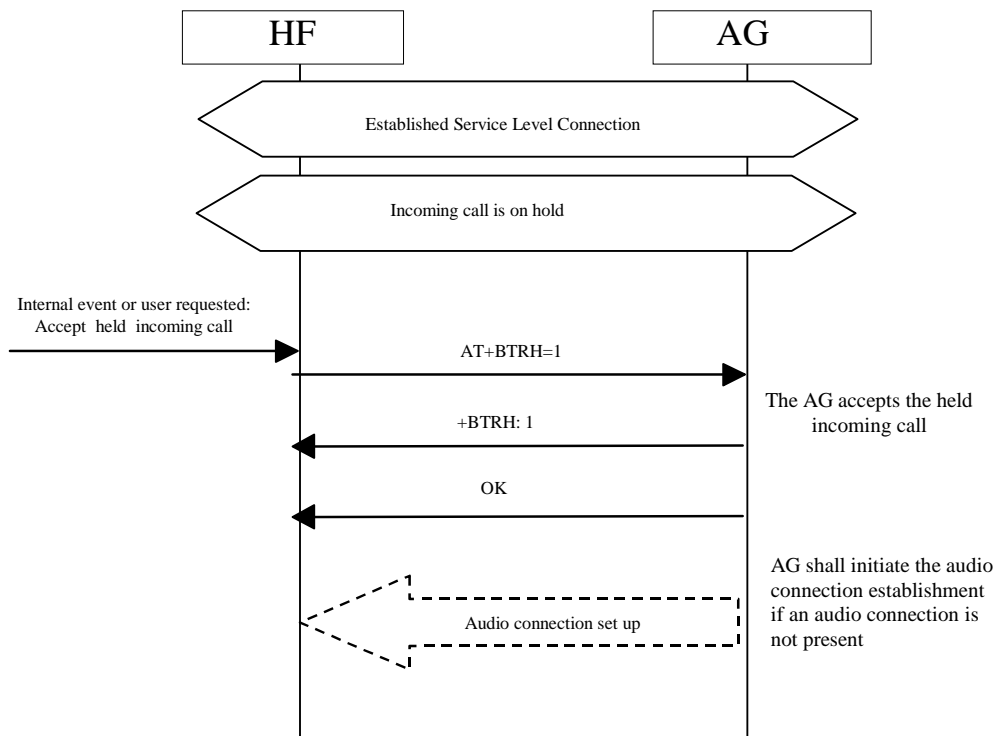


Figure 4.40: Accept a held incoming call from HF

- The user may accept the incoming voice call on hold by using the proper means provided by the HF unit. The HF shall then send the AT+BTRH command with the

parameter <n> set to 1. The AG shall then begin the procedure for accepting the incoming call that was put on hold.

- The AG shall then send +BTRH Response with the parameter <n> set to 1 to notify HF that the held incoming call was accepted.
- The AG shall start the procedure for establishing the audio connection and route the audio paths to the HF only if the audio connection was not established.

4.29.5 Accept a Held Incoming Call from AG

The following additional pre-condition applies to this procedure:

- An incoming call was put on hold.

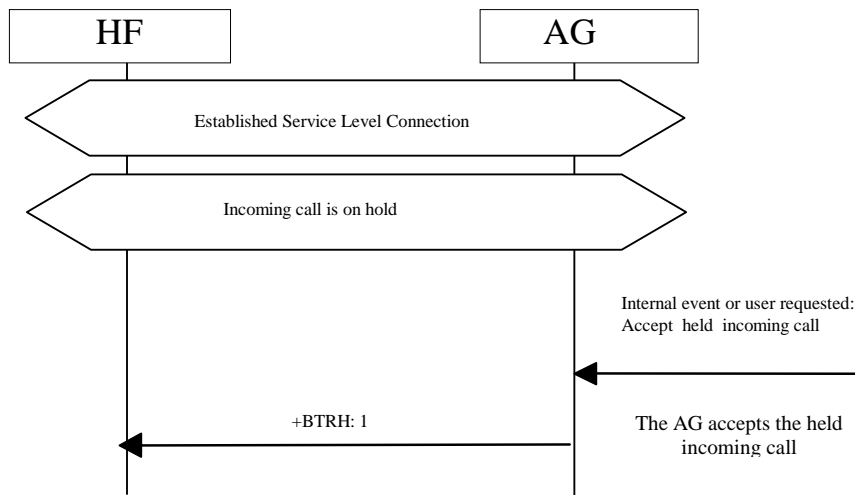


Figure 4.41: Accept a held incoming call from AG

- The user may accept the incoming voice call on hold by using the proper means provided by the AG unit. The AG shall then send +BTRH Response with the parameter <n> set to 1 to notify the HF that the held incoming call was accepted.

4.29.6 Reject a Held Incoming Call from HF

The following additional pre-condition applies to this procedure:

- An incoming call was put on hold.

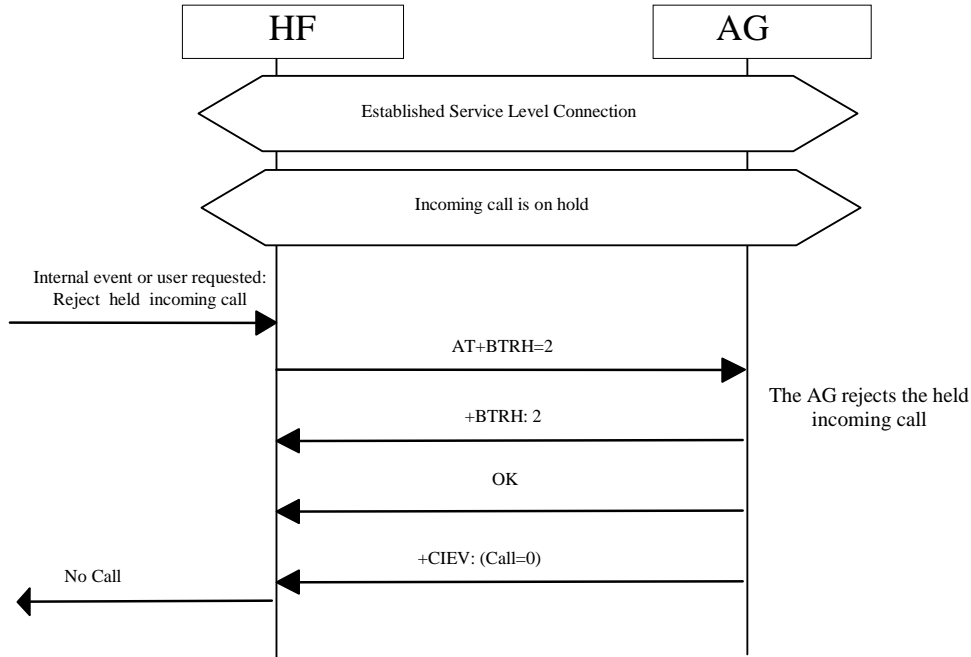


Figure 4.42: Reject a held incoming call from HF

- The user may reject the incoming voice call on hold by using the proper means provided by the HF unit. Either of the following two sequences shall be permissible by the HF and AG:
 - The HF may send the AT+BTRH command with the parameter <n> set to 2. The AG shall then begin the procedure for rejecting the incoming call that was put on hold. The AG shall send +BTRH Response with the parameter <n> set to 2 to notify the HF that the held incoming call was rejected.
 - The HF may send the AT+CHUP command to reject the held incoming call. The AG shall reject the held call and send the OK indication to the HF.
- The AG shall send the +CIEV Response with the call status set to 0.

4.29.7 Reject a Held Incoming Call from AG

The following additional pre-condition applies to this procedure:

- An incoming call was put on hold.

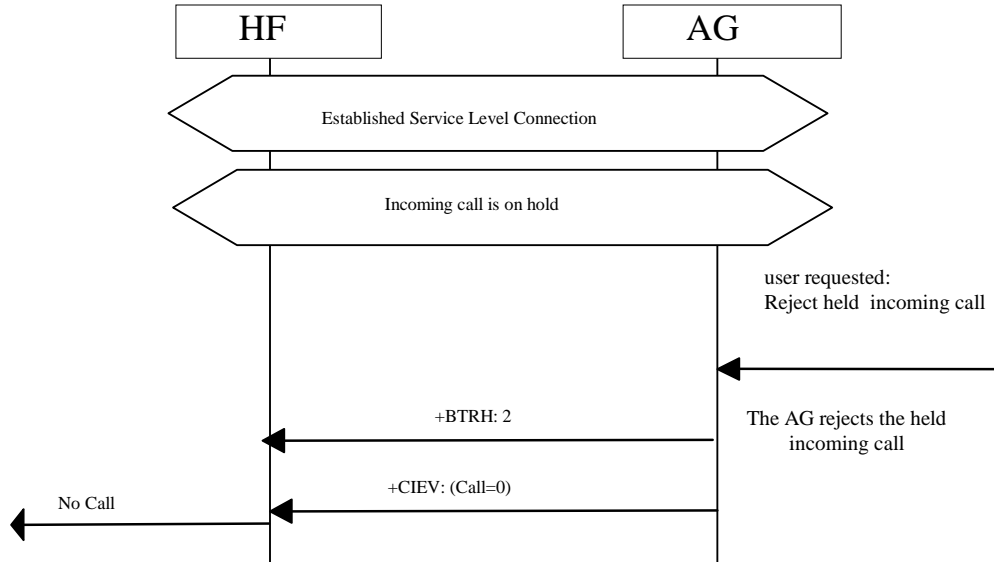


Figure 4.43: Reject a held incoming call from AG

- The user may reject the incoming voice call on hold by using the proper means provided by the AG unit. The AG shall then send +BTRH Response with the parameter <n> set to 2 to notify HF that the held incoming call was rejected.
- The AG shall also send the +CIEV Response with the call status parameter set to 0 to indicate that the AG is currently not in a call.

4.29.8 Held Incoming Call Terminated by Caller

The following additional pre-condition applies to this procedure:

- An incoming call was put on hold.

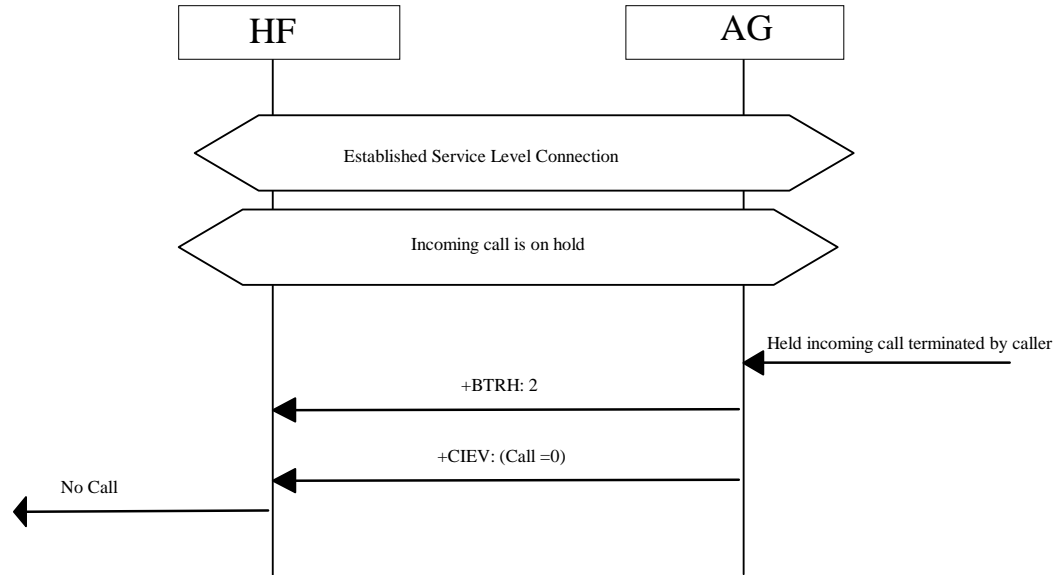


Figure 4.44: Held incoming call terminated by caller

- The caller may terminate the held incoming call. The AG shall then send +BTRH Response with the parameter <n> set to 2 to notify the HF that the held incoming call was terminated.
- The AG shall send the +CIEV Response with the Call status parameter set to 0 to indicate that the AG is currently not in a call.

4.30 Subscriber Number Information

This procedure allows HF to query the AG subscriber number.

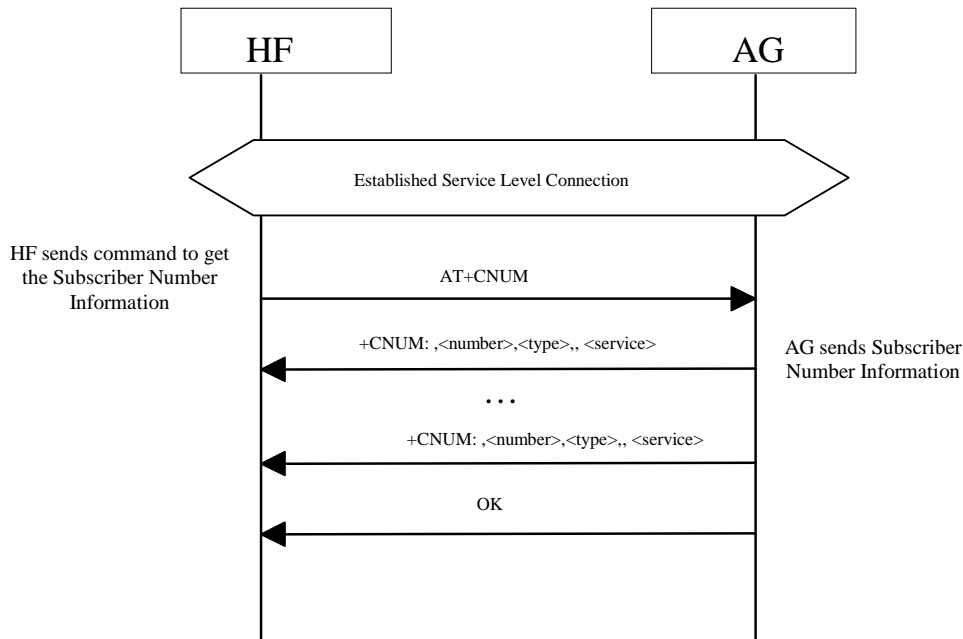


Figure 4.45: Query Subscriber Number Information of AG

This procedure illustrates AG response to the query of an empty subscriber number.

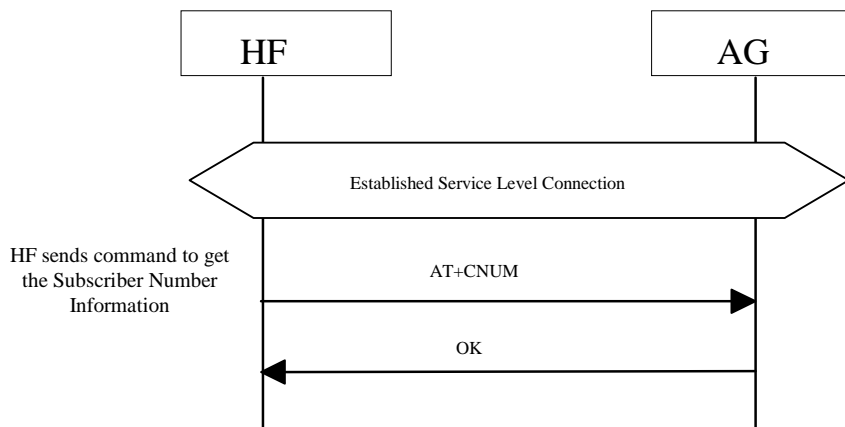


Figure 4.46: Empty Subscriber Number Information from AG

The following pre-condition applies for this procedure:

- An ongoing Service Level Connection between the HF and AG shall exist. If this connection does not exist, the HF shall establish a connection using the “Service Level Connection set up” procedure described in Section 4.2.
- The HF shall send the AT+CNUM command to query the AG subscriber number information.

- If the subscriber number information is available, the AG shall respond with the +CNUM response. If multiple numbers are available, the AG shall send a separate +CNUM response for each available number.
- The AG shall signal the completion of the AT+CNUM action command with an OK response. The OK will follow zero or more occurrences of the +CNUM response. (See figures 4.45 and 4.46).

4.31 Enhanced Call Status Indications

4.31.1 Query List of Current Calls in AG

The HF shall execute this procedure to query the list of current calls in AG.

The following pre-condition applies for this procedure:

- A SLC must exist between the AG and HF devices. If no current SLC exists, the HF shall first initiate a SLC.

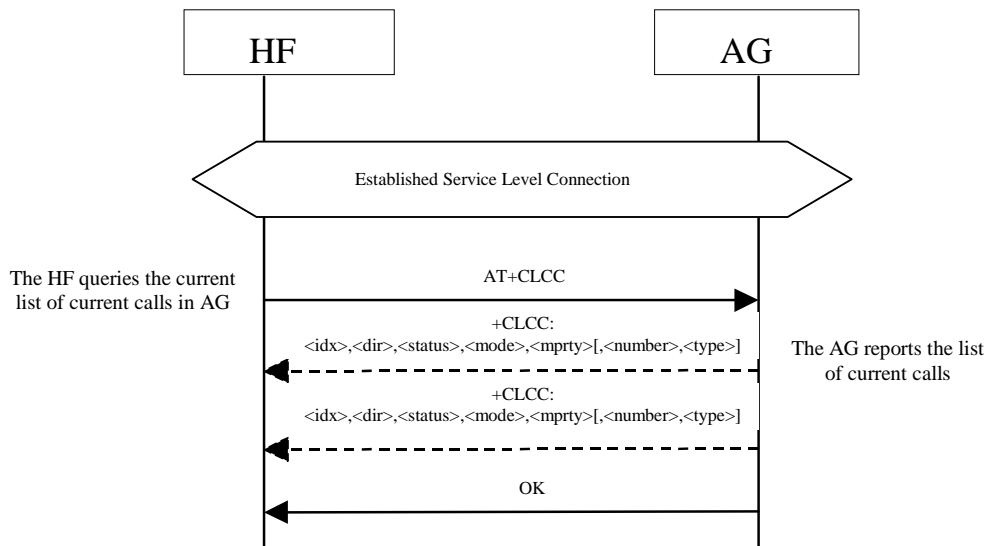


Figure 4.47: Query List of Current Calls

- HF shall find out the list of current calls in AG by sending the AT+CLCC command.
- If the command succeeds and if there is an outgoing (Mobile Originated) or an incoming (Mobile Terminated) call in AG, AG shall send a +CLCC response with appropriate parameters filled in to HF.
- If there are no calls available, no +CLCC response is sent to HF.
- The AG shall always send OK response to HF.

4.31.2 Indication of Status for Held Calls

Upon the change in status of any call on hold in the AG, the AG shall execute this procedure to advise the HF of the held call status. The values for the callheld indicator are:

0= No calls held

- 1= Call is placed on hold or active/held calls swapped
(The AG has both an active AND a held call)
- 2= Call on hold, no active call

The following pre-condition applies for this procedure:

- The HF shall have enabled the Call Status Indicators function in the AG.
- A SLC shall exist between the AG and HF devices.

Whenever an active call is placed on hold such that the AG now has both an active and held call or the active/held call positions swapped by a request from the HF or by action on the AG the AG shall issue a +CIEV unsolicited result code with the callheld indicator value of "1".

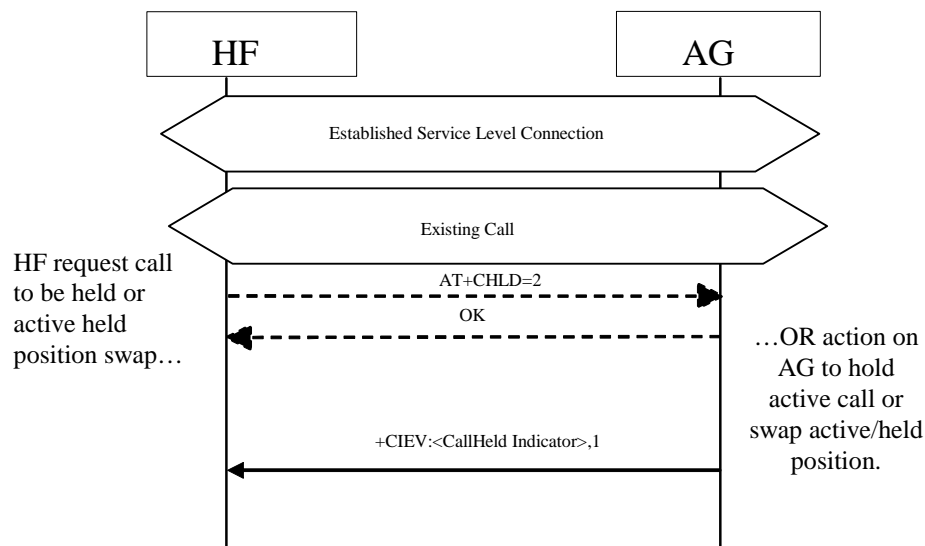


Figure 4.48: Call Held or Active/Held Position Swap

Consequently, upon the release of any call on hold by the HF, the AG or by network event, or actions by the HF or AG to retrieve a held call, the AG shall issue a +CIEV unsolicited result code with the callheld indicator value of "0".

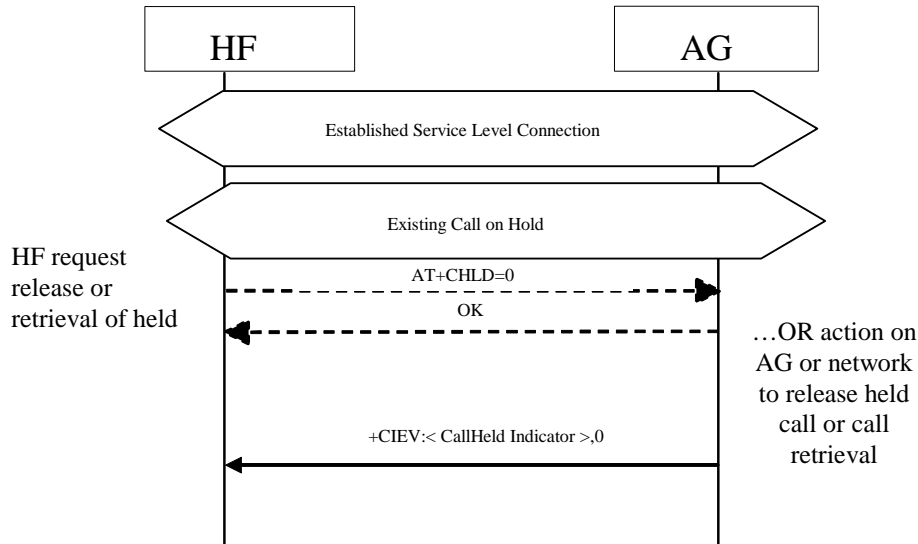


Figure 4.49: Held Call Release

If a call is still on hold when an active call is terminated or a single active call is put on hold, the AG shall issue a +CIEV unsolicited result code with the callheld indicator value of “2”.

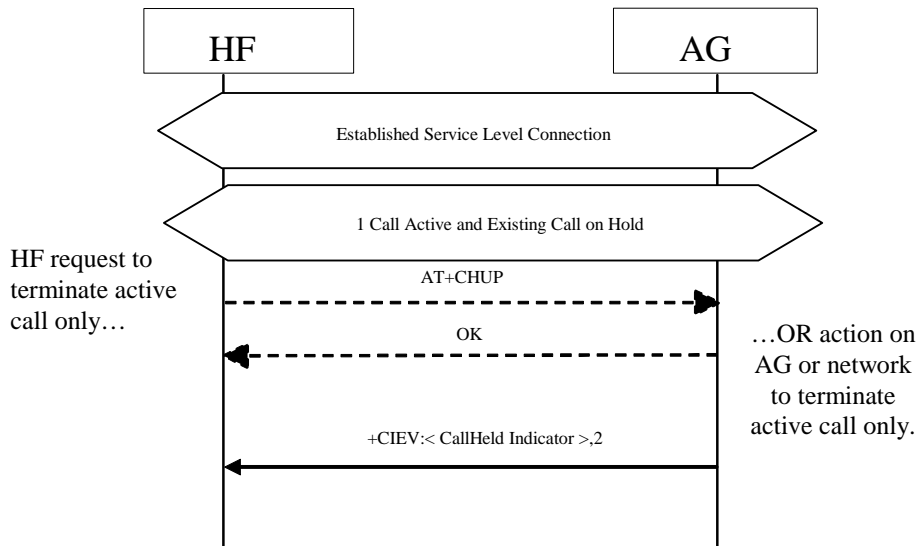


Figure 4.50: Active Call Terminated/Call Remains Held

4.32 Enhanced Call Control Mechanisms

As stated earlier, the Enhanced Call Control mechanism is simply an extension of the current AT+CHLD command. These extensions are defined as additional arguments to the AT+CHLD command. The new arguments for this command include an index of a specific call as indicated in the +CLCC response.

4.32.1 Release Specified Call Index

The HF shall execute this procedure to release a specific call in the AG.

The following pre-condition applies for this procedure:

- A SLC must exist between the AG and HF devices. If no current SLC exists, the HF shall first initiate a SLC.

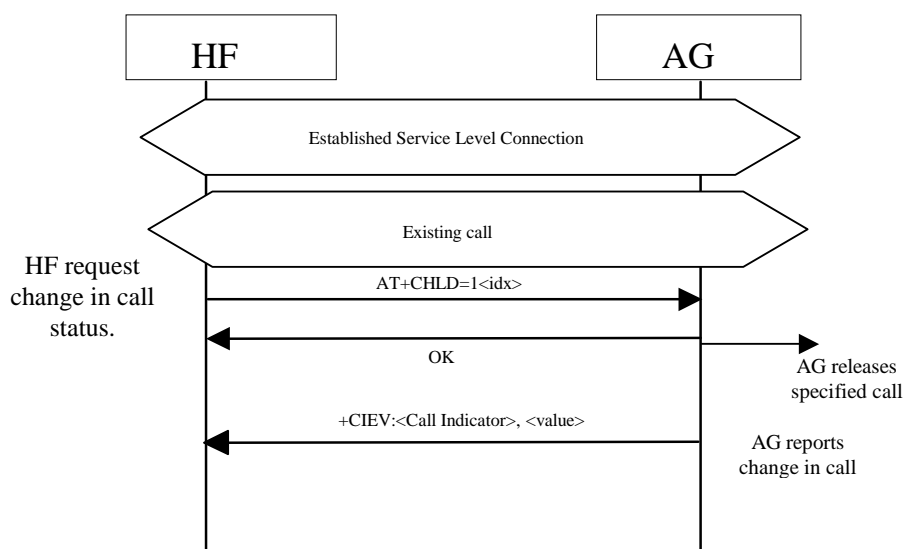


Figure 4.51: Release Specified Active Call

- The HF shall send the AT+CHLD=1<idx> command to release a specific active call.
- The AG shall release the specified call.
- If the released call was an active call and a call is currently held, the AG shall retrieve the held call.
- In the event that there are multiple held calls the AG shall retrieve the call associated with the lowest call index.
- The AG shall report the change in call status.

If the index (<idx>) is not valid, the AG shall report the proper error code.

4.32.2 Private Consultation Mode

The HF shall execute this procedure to place all parties of a multiparty call on hold with the exception of the specified call.

The following pre-condition applies for this procedure:

- A SLC must exist between the AG and HF devices. If no current SLC exists, the HF shall first initiate a SLC.
- Existing multiparty call is active in AG.

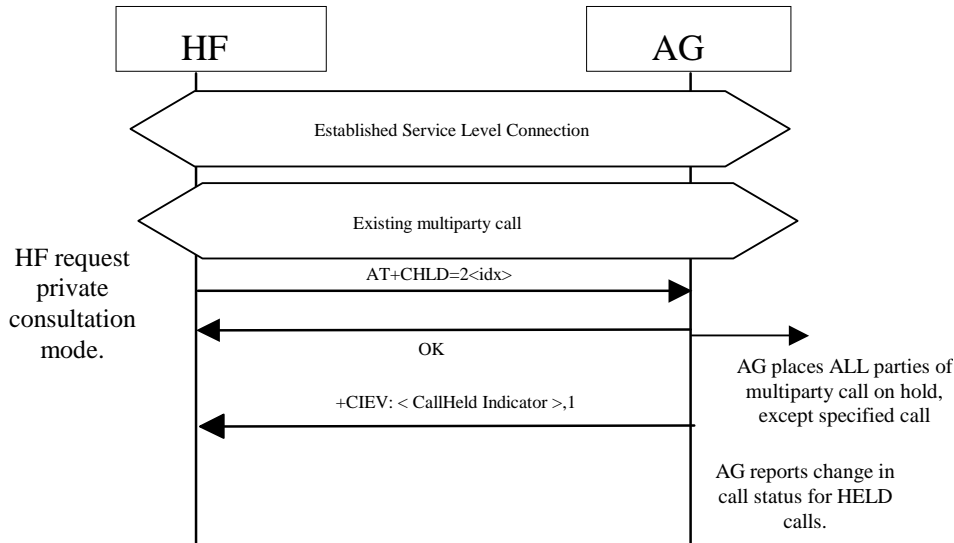


Figure 4.52: Request Private Consultation Mode

- HF shall send the AT+CHLD=2<idx> command to request private consultation mode.
- AG shall place all other parties of call on hold.
- AG shall report the change in status of the held parties.
- If the index (<idx>) is not valid, the AG shall respond with the proper error code.

4.33 AT Command and Results Codes

4.33.1 General

For the exchange of the commands and unsolicited results codes, the format, syntax and procedures of 3GPP 27.007 [2] shall be taken as reference. The following rules specifically apply for the HFP specification:

- Only one command (or unsolicited result code) per command line needs to be expected.
- The AG, by default, shall not echo the command characters.
- The AG shall always transmit result codes using verbose format.

- The characters below shall be used for AT commands and result codes formatting:
 <cr> corresponds to the *carriage return (0/13)* as stated in [6]
 <lf> corresponds to the *line feed (0/10)* as stated in [6]
- The format of an AT command from the HF to the AG shall be:
 <AT command><cr>
- The format of the OK code from the AG to the HF shall be:
 <cr><lf>OK<cr><lf>
- The format of the generic ERROR code from the AG to the HF shall be:
 <cr><lf>ERROR<cr><lf>
- The format of an unsolicited result code from the AG to the HF shall be:
 <cr><lf><result code><cr><lf>

The Hands-Free Profile uses a subset of AT commands and result codes from existing standards; these are listed in Section 4.33.2. Section 4.33.3 lists the new Bluetooth defined AT commands and result codes not re-used from any existing standard.

In general, the AG shall use the OK code, as described in Section 4.33.2, for acknowledgement of the proper execution of a command and respond with the proper error indication to any unknown command received from the HF.

It is mandatory for the AG to properly respond to any error condition and for the HF to properly process the corresponding error indication code received from the AG. The code ERROR, as described in Section 4.33.2, shall be used as error indication for this purpose.

The HF shall always ignore any unknown or unexpected indication code received from the AG. The only exception is the case in which the AG issues a “Mobile Equipment Error” indication using the +CME ERROR: result code (see [2]). In this case, the HF shall interpret this result code in the same way as if it was a generic ERROR code.

As a general rule, when an AT command or result code of this specification is implemented, support for the associated parameters “covered” in this specification, and all their corresponding possible values, shall be considered mandatory unless otherwise explicitly stated in each particular case.

4.33.2 AT Capabilities Re-Used from GSM 07.07 and 3GPP 27.007

The re-used AT commands and unsolicited result codes for implementing the functionality described in this specification are listed below:

As a convention, if a parameter of an AT command or result code is not “covered” in this specification, it shall not be present in the corresponding AT command, and the HF shall ignore the parameter whenever it is received in a result code.

- **ATA**

Standard call answer AT command. Refer to Annex G in [2].

- **ATDdd...dd;**

Standard AT command intended for placing a call to a phone number. Only voice calls are covered in this specification. Refer to Section 6.2 in [2].

- **ATD>nnn...;**

Extension of the standard ATD command, intended for memory dialing. Only voice calls are covered in this specification. Refer to Section 6.3 in [2].

- **ERROR**

Standard error indication code. It shall be issued on detection of any syntax, format or procedure error condition. The “Mobile Equipment Error” report code “+CME ERROR:” is covered below. Refer to Annex B in [2].

- **OK**

Standard acknowledgement to the execution of a command. Refer to Annex B in [2].

- **NO CARRIER, BUSY, NO ANSWER, DELAYED, BLACKLISTED**

Extended response indication codes for AT commands. These codes shall be issued from the AG to the HF as responses to AT commands from the HF to the AG or from the AG as unsolicited result codes. These are in addition to the +CME ERROR: responses.

- **RING**

Standard “incoming call” indication. Refer to Annex B in [2].

- **AT+CCWA**

Standard “Call Waiting notification” AT command. Within the AT+CCWA=[<n>[,<mode>[,<class>]]]command, only enabling/disabling of the Call Waiting notification unsolicited result code +CCWA , using the <n> parameter, is covered in this specification. Refer to Section 7.12 in [2].

- **+CCWA**

Standard “Call Waiting notification” unsolicited result code.

In the +CCWA result code only <number> and <type> parameters are covered in this specification. Other parameters are not considered relevant in this specification and shall be ignored by the HF.

The <number> parameter shall be a text string and shall always be contained within double-quotes.

The <type> field specifies the format of the phone number provided, and can be one of the following values:

- values 128-143: The phone number format may be a national or international format, and may contain prefix and/or escape digits. No changes on the number presentation are required.

- values 144-159: The phone number format is an international number, including the country code prefix. If the plus sign ("+") is not included as part of the number and shall be added by the AG as needed.
- values 160-175: National number. No prefix nor escape digits included.
- Refer to Section 7.12 in [2].

- **AT+CHLD**

Standard call hold and multiparty handling AT command. In the AT+CHLD=<n> command, this specification only covers values for <n> of 0, 1, 1<idx>, 2, 2<idx>, 3 and 4, where:

- 0 = Releases all held calls or sets User Determined User Busy (UDUB) for a waiting call.
- 1 = Releases all active calls (if any exist) and accepts the other (held or waiting) call.
- 1<idx> = Releases specified active call only (<idx>).
- 2 = Places all active calls (if any exist) on hold and accepts the other (held or waiting) call.
- 2<idx> = Request private consultation mode with specified call (<idx>).
(Place all calls on hold EXCEPT the call indicated by <idx>.)
- 3 = Adds a held call to the conversation.
- 4 = Connects the two calls and disconnects the subscriber from both calls (Explicit Call Transfer). Support for this value and its associated functionality is optional for the HF.

The test command AT+CHLD=? may be used for retrieving information about the call hold and multiparty services available in the AG (refer to Section 4.2.1).

Refer to Section 7.13 in [2] and Section 4.5.5.1 in [8] for details.

- **AT+CHUP**

Standard hang-up AT command. Execution command causes the AG to terminate the currently active call. This command shall have no impact on the state of any held call. Refer to Section 6.5 in [2].

AT+CHUP is also used as the command to reject any incoming call prior to answer.

- **AT+CIND**

Standard indicator update AT command. Only read command AT+CIND? and test command AT+CIND=? are required in this specification.

The AT+CIND? read command is used to get current status of the AG indicators.

The AT+CIND=? test command is used to retrieve the mapping between each indicator supported by the AG and its corresponding range and order index. It shall be issued at least once before any other command related to these indicators (AT+CIND? or AT+CMER) is used.

The following indicators are covered in this specification:

- service: Service availability indication, where:
 - <value>=0 implies no service. No Home/Roam network available.
 - <value>=1 implies presence of service. Home/Roam network available.
- call: Standard call status indicator, where:
 - <value>=0 means no call active.
 - <value>=1 means a call is active.
- callsetup: Bluetooth proprietary call set up status indicator³. Support for this indicator is optional for the HF. When supported, this indicator shall be used in conjunction with, and as an extension of the standard call indicator. Possible values are as follows:
 - <value>=0 means not currently in call set up.
 - <value>=1 means an incoming call process ongoing.
 - <value>=2 means an outgoing call set up is ongoing.
 - <value>=3 means remote party being alerted in an outgoing call.

Refer to Section 8.9 in [2].

- callheld: Bluetooth proprietary call hold status indicator. Support for this indicator is mandatory for the AG, optional for the HF. Possible values are as follows:
 - 0= No calls held
 - 1= Call is placed on hold or active/held calls swapped
(The AG has both an active AND a held call)
 - 2= Call on hold, no active call
- signal: Signal Strength indicator, where:
 - <value>= ranges from 0 to 5
- roam: Roaming status indicator, where:
 - <value>=0 means roaming is not active
 - <value>=1 means a roaming is active
- battchg: Battery Charge indicator of AG, where:
 - <value>=ranges from 0 to 5
- **+CIND**
 - Standard list of current phone indicators. Refer to section 8.9 in [2].
- **AT+CLCC**
 - Standard list current calls command. Refer to section 7.18 in [2].
- **+CLCC**
 - Standard list current calls result code. Refer to section 7.18 in [2].

³ This status indicator is not defined in the GSM 07.07 specification

Supported parameters are as follows:

- ❖ idx= The numbering (starting with 1) of the call given by the sequence of setting up or receiving the calls (active, held or waiting) as seen by the served subscriber. Calls hold their number until they are released. New calls take the lowest available number.
- ❖ dir= 0 (outgoing), 1 (incoming)
- ❖ status= 0 = Active
1 = Held
2 = Dialing (outgoing calls only)
3 = Alerting (outgoing calls only)
4 = Incoming (incoming calls only)
5 = Waiting (incoming calls only)
- ❖ mode= 0 (Voice), 1 (Data), 2 (FAX)
- ❖ mpty= 0 (Not Multiparty), 1 (Multiparty)
- ❖ number (optional)
- ❖ type (optional)

- **AT+COPS**

The AT+COPS=3,0 shall be sent by the HF to the AG prior to sending the AT+COPS? command. AT+COPS=3,0 sets the format of the network operator string to the long format alphanumeric.

The AT+COPS? command is used for reading network operator. This profile shall only support the "reading" of the name of the network operator. The response to this command from the AG shall return a +COPS:<mode>,<format>,<operator> where:

<mode> contains the current mode and provides no information with regard to the name of the operator.

<format> specifies the format of the <operator> parameter string, and shall always be 0 for this specification.

<operator> specifies a quoted string in alphanumeric format representing the name of the network operator. This string shall not exceed 16 characters. Refer to Section 7.3 in [2].

- **AT+CMEE**

Standard AT command used to enable the use of result code +CME ERROR: <err> as an indication of an error relating to the functionality of the AG.

The set command AT+CMEE=1 is covered in this specification.

- **+CME ERROR**

This is the Extended Audio Gateway Error Result Code response. Format of the response is: +CME ERROR: <err>. The format of <err> shall be numeric in this specification. The possible values for <err> covered in this specification are described below. These error codes may be provided instead of the standard ERROR response code to provide additional information to the HF. The ERROR

response code is still allowed while using the Extended Audio Gateway Error Result Codes.

- +CME ERROR: 0 – AG failure
- +CME ERROR: 1 – no connection to phone
- +CME ERROR: 3 – operation not allowed
- +CME ERROR: 4 – operation not supported
- +CME ERROR: 5 – PH-SIM PIN required
- +CME ERROR: 10 – SIM not inserted
- +CME ERROR: 11 – SIM PIN required
- +CME ERROR: 12 – SIM PUK required
- +CME ERROR: 13 – SIM failure
- +CME ERROR: 14 – SIM busy
- +CME ERROR: 16 – incorrect password
- +CME ERROR: 17 – SIM PIN2 required
- +CME ERROR: 18 – SIM PUK2 required
- +CME ERROR: 20 – memory full
- +CME ERROR: 21 – invalid index
- +CME ERROR: 23 – memory failure
- +CME ERROR: 24 – text string too long
- +CME ERROR: 25 – invalid characters in text string
- +CME ERROR: 26 – dial string too long
- +CME ERROR: 27 – invalid characters in dial string
- +CME ERROR: 30 – no network service
- +CME ERROR: 32 – Network not allowed – Emergency calls only

- **AT+CLIP**

Standard “Calling Line Identification notification” activation AT command. It enables/disables the Calling Line Identification notification unsolicited result code +CLIP. Refer to Section 7.6 in [2].

- **+CLIP**

Standard “Calling Line Identification notification” unsolicited result code.

In the +CLIP: <number>, <type> [,<subaddr>,<satype> [, [<alpha>] [, <CLI validity>]]] result code. Only <number> and <type> parameters are covered in this specification. Other parameters are not considered relevant in this specification and shall be ignored by the HF.

The <number> parameter shall be a text string and shall always be contained within double-quotes.

The <type> field specifies the format of the phone number provided, and can be one of the following values:

- values 128-143: The phone number format may be a national or international format, and may contain prefix and/or escape digits. No changes on the number presentation are required.

- values 144-159: The phone number format is an international number, including the country code prefix. If the plus sign ("+") is not included as part of the number and shall be added by the AG as needed.
- values 160-175: National number. No prefix nor escape digits included.

Refer to Section 7.11 in [2].

- **AT+CMER**

AT+CMER

Standard event reporting activation/deactivation AT command.

In the AT+CMER=[<mode>[,<keyp>[,<disp>[,<ind> [,<bfr>]]]]] command, only the <mode>, and <ind> parameters are relevant for this specification. Only their values <mode>=(0,3) and <ind>=(0,1) are covered in this specification. Refer to Section 8.10 in [2].

The following examples show how the AT+CMER command may be used for activating or deactivating the “indicator events reporting” result code:

AT+CMER=3,0,0,1 activates “indicator events reporting”.

AT+CMER=3,0,0,0 deactivates “indicator events reporting”.

- **+CIEV**

Standard “indicator events reporting” unsolicited result code.

In the +CIEV: <ind>,<value> result code, only the indicators stated in the AT+CIND command above are relevant for this specification where:

- <ind>: Order index of the indicator within the list retrieved from the AG with the AT+CIND=? command. The first element of the list shall have <ind>=1.
- <value>: current status of the indicator.

If the HF receives any unknown indicator or value, it shall ignore it.

Refer to Section 8.10 in [2].

- **AT+VTS**

Standard DTMF generation AT command. Only the AT+VTS=<DTMF> command format is covered in this specification.

Refer to Annex C.2.11 in [2].

- **AT+CNUM**

Syntax: AT+CNUM (Retrieve Subscriber Number Information)
AT+CNUM=? (Test Subscriber Number Information – Not Implemented)

Description:

Command issued by HF for the “Subscriber Number Information” feature in the AG.

Only the action command AT+CNUM format is used.

- **+CNUM**

Syntax: +CNUM: [<alpha>],<number>, <type>,[<speed>] ,<service> (Response for AT+CNUM)

Description:

Standard Response used for sending the "Subscriber Number Information" from AG to HF.

The AG shall send the +CNUM: response for the AT+CNUM from the HF.

Values:

-<alpha>: This optional field is not supported, and shall be left blank.

-<number>: Quoted string containing the phone number in the format specified by <type>.

-<type> field specifies the format of the phone number provided, and can be one of the following values:

- values 128-143: The phone number format may be a national or international format, and may contain prefix and/or escape digits. No changes on the number presentation are required.

- values 144-159: The phone number format is an international number, including the country code prefix. If the plus sign ("+") is not included as part of the number and shall be added by the AG as needed.

- values 160-175: National number. No prefix nor escape digits included.

-<speed>: This optional field is not supported, and shall be left blank.

-<service>: Indicates which service this phone number relates to. Shall be either 4 (voice) or 5 (fax).

Example:

+CNUM: ,"5551212",129,,4

Refer to section 7.1 in [2].

4.33.3 Bluetooth Defined AT Capabilities

The GSM 07.07 [2] format and syntax rules shall be taken as the reference for these commands.

The new Bluetooth specific AT capabilities are listed below:

- **AT+BINP** (*Bluetooth INPut*)

Syntax: AT+BINP=<datarequest>

Expected response: +BINP: <dataresp₁>...<dataresp_n>

Description:

Command used for requesting some specific data input from the AG⁴. On reception of this command the AG shall perform the proper actions such that the requested information is sent back to the HF using the +BINP response.

The type of data the HF shall expect in the <dataresp> parameter returned by the AG depends on the information requested in each case.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

Values:

<datarequest>: 1, where

1 = Phone number corresponding to the last voice tag recorded in the HF.

<dataresp_{1..n}>: Data parameters returned by the AG. Their contents depends on the value of the <datarequest> parameter as follows:

<u><datarequest> value</u>	<u><dataresp> parameters</u>
1	<Phone number>: Phone number string (max. 32 digits). The format (type of address) of the phone number string shall conform with the rules stated in [7], sub-clause 10.5.4.7, for a value (in integer format) of the <i>type of address octet</i> of 145, if dialing string includes international access code character "+", and for a value of 129 otherwise.

- **AT+BLDN** (*Bluetooth Last Dialed Number*)

Syntax: AT+BLDN

Description:

⁴ AT+BINP was created with future extensibility in mind. While the Hands-Free Profile only specifies a <datarequest> value of 1 (i.e. phone number), future profiles may choose to add values for <datarequest> to support the retrieval of additional data from the AG.

Command used for calling the last phone number dialed. On reception of this command, the AG shall set up a voice call to the last phone number dialed.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

- **AT+BVRA** (*Bluetooth Voice Recognition Activation*)

Syntax: AT+BVRA=<vrec>

Description:

Enables/disables the voice recognition function in the AG.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

Values:

<vrec>: 0, 1, entered as integer values, where
0 = Disable Voice recognition in the AG
1 = Enable Voice recognition in the AG

- **+BVRA** (*Bluetooth Voice Recognition Activation*)

Syntax: +BVRA: <vrect>

Description:

Unsolicited result code used to notify the HF when the voice recognition function in the AG is activated/deactivated autonomously from the AG.

The unsolicited +BVRA:1 result code shall not be sent by the AG to the HF if the corresponding voice recognition activation has been initiated by the HF. Likewise, the unsolicited +BVRA:0 result code shall not be sent by the AG to the HF if the corresponding voice recognition deactivation has been initiated by the HF, regardless of which side initiated the voice recognition activation.

Values:

<vrect>: 0, entered as integer value, where
0 = Voice recognition is disabled in the AG
1 = Voice recognition is enabled in the AG

- **AT+BRSF** (*Bluetooth Retrieve Supported Features*)

Syntax: AT+BRSF=<HF supported features bitmap>

Description:

Notifies the AG of the supported features available in the HF, and requests information about the supported features in the AG. The supported features shall be represented as a decimal value.

Values:

<HF supported features bitmap>: a decimal numeric string, which represents the value of a 32 bit unsigned integer. The 32 bit unsigned integer represents a bitmap of the supported features in the HF as follows:

<u>Bit</u>	<u>Feature</u>
0	EC and/or NR function
1	Call waiting and 3-way calling
2	CLI presentation capability
3	Voice recognition activation
4	Remote volume control
5	Enhanced call status
6	Enhanced call control
7-31	Reserved for future definition

The reserved bits [7-31] shall be initialized to Zero.

- **+BRSF** (*Bluetooth Retrieve Supported Features*)

Syntax: +BRSF: <AG supported features bitmap>

Description:

Result code sent by the AG in response to the AT+BRSF command, used to notify the HF what features are supported in the AG. The supported features shall be represented as a decimal value.

Values:

<AG supported features bitmap>: a decimal numeric string, which represents the value of a 32 bit unsigned integer. The 32 bit unsigned integer represents a bitmap of the supported features in the AG as follows:

<u>Bit</u>	<u>Feature</u>
0	Three-way calling
1	EC and/or NR function
2	Voice recognition function
3	In-band ring tone capability
4	Attach a number to a voice tag
5	Ability to reject a call
6	Enhanced call status
7	Enhanced call control
8	Extended Error Result Codes
9-31	Reserved for future definition

The reserved bits (9-31) shall be initialized to Zero.

- **AT+NREC** (*Noise Reduction and Echo Canceling*)

Syntax: AT+NREC=<nrec>

Description:

Command issued to disable any Echo Canceling and Noise Reduction functions embedded in the AG.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

Values:

<nrec>: 0, entered as integer value, where
0 = Disable EC/NR in the AG

- **AT+VGM** (*Gain of Microphone*)

Syntax: AT+VGM=<gain>

Description:

Command issued by the HF to report its current microphone gain level setting to the AG. <gain> is a decimal numeric constant, relating to a particular (implementation dependent) volume level controlled by the HF. This command does not change the microphone gain of the AG; it simply indicates the current value of the microphone gain in the HF.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

Values:

<gain>: 0 -15, entered as integer values, where
0 = Minimum gain
15 = Maximum gain

- **AT+VGS** (*Gain of Speaker*)

Syntax: AT+VGS=<gain>

Description:

Command issued by the HF to report its current speaker gain level setting to the AG. <gain> is a decimal numeric constant, relating to a particular (implementation dependent) volume level controlled by the HF. This command does not change the speaker gain of the AG; it simply indicates the current value of the speaker volume in the HF.

Only support for execution command is mandated. Neither the read nor test commands are mandatory.

Values:

<gain>: 0 -15, entered as integer values, where
0 = Minimum gain
15 = Maximum gain

- **+VGM** (*Gain of Microphone*)

Syntax: +VGM:<gain>

Description:

Unsolicited result code issued by the AG to set the microphone gain of the HF. <gain> is a decimal numeric constant, relating to a particular (implementation dependent) volume level controlled by the HF.

Due to the small inconsistency between the GSM standard ([2]) and the current Headset specification ([3]), the HF shall also accept the “=” symbol, in place of “:”, as a valid separator for this unsolicited result code.

Values:

<gain>: 0 -15, integer values, where
0 = Minimum gain
15 = Maximum gain

- **+VGS** (*Gain of Speaker*)

Syntax: +VGS:<gain>

Description:

Unsolicited result code issued by the AG to set the speaker gain of the HF. <gain> is a decimal numeric constant, relating to a particular (implementation dependent) volume level controlled by the HF.

Due to the small inconsistency between the GSM 07.07 standard ([2]) and the current Headset specification ([3]), the HF shall also accept the “=” symbol, in place of “:”, as valid separator for this unsolicited result code.

Values:

<gain>: 0 -15, integer values, where
0 = Minimum gain
15 = Maximum gain

- **++BSIR** (*Bluetooth Setting of In-band Ring tone*)

Syntax: ++BSIR: <bsir>

Description:

Unsolicited result code issued by the AG to indicate to the HF that the in-band ring tone setting has been locally changed. The HF may react accordingly by changing its own alert method.

Values:

<bsir>: 0 = the AG provides no in-band ring tone
1 = the AG provides an in-band ring tone

- **AT+BTRH** (**Bluetooth Response and Hold Feature**)

Syntax: AT+BTRH=<n> (Set command)
AT+BTRH? (Read Current Status)

Description:

Command issued by the HF for the “Response and Hold” feature in the AG.

This specification defines the use of the set and read command. The AT+BTRH? command shall be used by the HF to query the current “Response and Hold” state of the AG.

Values:

<n>: 0, 1, 2 entered as integer values, where
0 = Put Incoming call on hold
1 = Accept a held incoming call
2 = Reject a held incoming call

- **+BTRH (Bluetooth Response and Hold Feature)**

Syntax: +BTRH: <n> (Response for AT+BTRH)

Description:

Result code used to notify the HF when-ever the incoming call is either put on hold or accepted or rejected. The AG shall also respond back with this response for the AT+BTRH? command from the HF.

Values:

<n>: 0,1,2 entered as integer value, where
0 = Incoming call is put on hold in the AG
1 = Held incoming call is accepted in the AG
2 = Held incoming call is rejected in the AG

5 Serial Port Profile

This profile requires compliance to the Serial Port Profile [5]. The following text together with the associated sub-clauses defines the requirements with regard to this profile in addition to the requirements as defined in the Serial Port Profile.

For the Hands-Free Profile, both the AG and the HF may initiate connection establishment. Therefore, for the purposes of reading the Serial Port Profile [5], both the AG and the HF may assume the role of Device A or B.

5.1 RFCOMM Interoperability Requirements

For the RFCOMM layer, no additions to the requirements as stated in the Serial Port Profile [5] Section 4 apply.

5.2 L2CAP Interoperability Requirements

For the L2CAP layer, no additions to the requirements as stated in the Serial Port Profile [5] Section 5 apply.

5.3 SDP Interoperability Requirements

The following service records are defined for the Hands-Free Profile. There is one service record applicable to the Hands-Free unit and another for the Audio Gateway.

The attribute “SupportedFeatures” states the features supported in each device. This attribute is not encoded as a data element sequence; it is simply a 16-bit unsigned integer. The set of features supported in each case is bit-wise defined in this attribute on a yes/no basis. The mapping between the features and their corresponding bits within the attribute is listed below in Table 5.2 for the HF and in Table 5.4 for the AG. If a device indicates support for a feature, then it shall support that feature in the manner specified by this Profile, and be subject to verification as part of the Bluetooth Qualification Program.

The codes assigned to the mnemonics used in the Value column, as well as the codes assigned to the attribute identifiers (if not specifically mentioned in the AttrID column), are listed in the Bluetooth Assigned Numbers (see URL [9]).

The values of the “SupportedFeatures” bitmap given in Table 5.2 shall be the same as the values of the Bits 0 to 4 of the AT-command AT+BRSF (see Section 4.33.3).

Item	Definition	Type	Value	Status	Default
ServiceClassIDList				M	
ServiceClass0		UUID	Hands-Free	M	
ServiceClass1		UUID	Generic Audio	M	
ProtocolDescriptorList				M	
Protocol0		UUID	L2CAP	M	

Item	Definition	Type	Value	Status	Default
Protocol1		UUID	RFCOMM	M	
ProtocolSpecificParameter0	Server Channel	Uint8	N=server channel #	M	
BluetoothProfileDescriptorList				M	
Profile0	Supported Profiles	UUID	Hands-Free	M	Hands-Free
Param0	Profile Version	Uint16	0x0105 ⁵	M	
ServiceName	Display-able Text name	String	<i>Service-provider defined</i>	O	"Hands-Free unit"
SupportedFeatures	Features supported	Uint16	<i>Device dependent</i>	M	0x0000

Table 5.1: Service Record for the HF

Bit position (0=LSB)	Feature	Default in HF
0	EC and/or NR function (yes/no, 1 = yes, 0 = no)	0
1	Call waiting and three way calling(yes/no, 1 = yes, 0 = no)	0
2	CLI presentation capability (yes/no, 1 = yes, 0 = no)	0
3	Voice recognition activation (yes/no, 1= yes, 0 = no)	0
4	Remote volume control (yes/no, 1 = yes, 0 = no)	0

Table 5.2: "SupportedFeatures" attribute bit mapping for the HF

The "Network" attribute states, if the AG has the capability to reject incoming calls⁶. This attribute is not encoded as a data element sequence; it is simply an 8-bit unsigned integer. The information given in the "Network" attribute shall be the same as the information given in Bit 5 of the unsolicited result code +BRSF (see Section 4.33.3). An attribute value of 0x00 is translated to a bit value of 0; an attribute value of 0x01 is translated to a bit value of 1.

The values of the "SupportedFeatures" bitmap given in Table 5.4 shall be the same as the values of the Bits 0 to 4 of the unsolicited result code +BRSF (see Section 4.33.3).

⁵ Indicating version HFP 1.5.

⁶ In previous versions of the Hands-Free Profile, the attribute values were called "GSM like" and "others".

Item	Definition	Type	Value	Status	Default
ServiceClassIDList				M	
ServiceClass0		UUID	AG Hands-Free	M	
ServiceClass1		UUID	Generic Audio	M	
ProtocolDescriptorList				M	
Protocol0		UUID	L2CAP	M	
Protocol1		UUID	RFCOMM	M	
ProtocolSpecificParameter0	Server Channel	Uint8	N=server channel #	M	
BluetoothProfileDescriptorList				M	
Profile0	Supported Profiles	UUID	Hands-Free	M	Hands-Free
Param0	Profile Version	Uint16	0x0105 ⁷	M	
ServiceName	Display-able Text name	String	<i>Service-provider defined</i>	O	"Voice gateway"
Network		Uint8	0x01 – Ability to reject a call 0x00 – No ability to reject a call	M	
SupportedFeatures	Features supported	Uint16	<i>Device dependent</i>	M	0x0009

Table 5.3: Service Record for the AG

Bit position (0=LSB)	Feature	Default in AG
0	Three-way calling (yes/no, 1 = yes, 0 = no)	1
1	EC and/or NR function (yes/no, 1 = yes, 0 = no)	0
2	Voice recognition function (yes/no, 1 = yes, 0 = no)	0
3	In-band ring tone capability (yes/no, 1 = yes, 0 = no)	1
4	Attach a phone number to a voice tag (yes/no, 1 = yes, 0 = no)	0

Table 5.4: "SupportedFeatures" attribute bit mapping for the AG

⁷ Indicating version HFP 1.5

5.3.1 Interaction with Hands-Free Profile Rev 0.96 Implementations

HF implementations, which are according to the Hands-Free Profile specification Rev. 0.96, will not send the AT+BRSF command. Likewise, AG implementations, which are according to the Hands-Free Profile specification Rev. 0.96, will not be able to respond to AT+BRSF with the +BRSF unsolicited result code. Instead they will respond with ERROR.

In order to retrieve the “SupportedFeatures” information from an HF, which does not send AT+BRSF, Service Discovery should be used by the AG implementation. Whenever the “SupportedFeatures” attribute is not present in the HF service record, or if the AG does not perform the Service Discovery procedure, default values as stated in Table 5.2 shall be assumed.

In order to retrieve the “SupportedFeatures” and “Network” information from an AG, which does not send +BRSF, Service Discovery should be used by the HF implementation. Whenever the “SupportedFeatures” attribute is not present in the AG service record, or if the HF does not perform the Service Discovery procedure, default values as stated in Table 5.4 shall be assumed.

5.4 Link Manager (LM) Interoperability Requirements

The profile adopts the requirements for the Link Manager as stated in the “Serial Port Profile” [5].

Additionally this profile mandates that both the AG and HF devices shall support synchronous logical transports, subject to the requirements in Section 5.6.

5.5 Link Control (LC) Interoperability Requirements

Table 5.5 shows the changes from Link Controller requirements in the Serial Port Profile [5].

Table 5.5: Link Controller requirements

	Capability	Support in AG	Support in HF
1.	Inquiry		O
2.	Inquiry scan	O	
7	Voice CODEC		
C	CVSD	M	M

5.5.1 Class of Device

A device implementing the HF role of HFP shall set the "Audio" bit in the Service Class field. Optionally, if the HF intends to be discovered as a "Hands-Free", it may use the following values in the Class of Device field:

1. Indicate "Audio" as Major Device class.
2. Indicate "Hands-Free" as the Minor Device class.

An inquiring AG may use this information to filter the inquiry responses.

5.6 Synchronous Connection Interoperability Requirements

Synchronous connections may be realized by a SCO or by an eSCO logical transport. Only the support for SCO logical transports is mandated.

The remainder of this section relates to devices supporting eSCO logical transports. Here, “initiating” and “responding” refers to the initiating and responding (i.e. accept or reject) role in setting up the synchronous connection.

Table 5.6 defines eSCO configuration parameter sets S1, S2 and S3. HCI level parameters are given as a reference. On systems not incorporating HCI, values for LMP level eSCO parameters T_{eSCO} , W_{eSCO} and packet length shall be associated that correspond to these HCI parameters and fall into the mandatory parameter ranges for these packet types as given in the LMP specification, and the Voice Setting parameter translates into the air mode parameter of LMP.

eSCO parameter set	S1 “Safe Settings”	S2	S3
Packet type	EV3	2-EV3	2-EV3
Transmit/Receive Bandwidth	8000	8000	8000
Voice_Setting (air coding)	CVSD	CVSD	CVSD
Max_Latency	0x0007 (7 ms)	0x0007 (7 ms)	0x000A (10ms)
Retransmission_Effort	0x01	0x01	0x01

Table 5.6: eSCO synchronous connections (HCI Reference parameters)

The following requirements apply to the support and use of eSCO logical transports and are based on parameter sets S1, S2 and S3:

- The device starting the request for a Synchronous Connection is known as the Initiator, the device receiving the request from the Initiator is known as the Responder. The Responder is able to accept or reject a request for eSCO transport. The Responder shall always accept a request for SCO transport.
- If support for eSCO logical transports is indicated at the Controller level, the Initiator may request the setup of an eSCO logical transport instead of SCO.
- The Initiators request for an eSCO transport may involve any configuration parameters matching the bidirectional throughput requirements of the voice codec (see section 5.5). If an HCI is supported on this device, the request for setting up a synchronous connection may include single or multiple packet types masked within the same request.
- The Responder may choose to accept or reject the request from the Initiator. It may reject the request for an eSCO transport, or may accept it with parameters that do not match the requested parameters. In this case the Initiator may retry the Synchronous Connection setup with different configuration parameters.

- If one or subsequent requests for an eSCO logical transport fails, the Initiator shall not abandon the setup of an eSCO transport without having requested eSCO using the “safe settings” S1.
- Only for HCI-based devices: if the Responder does not reject the request for an eSCO transport, the response shall include the parameters corresponding to the “safe settings” S1 when accepting a request. The Responder shall not request eSCO parameters that would inhibit the ability of the Initiator to negotiate the S1 settings.
- If the Initiator fails to establish an eSCO transport with the S1 settings, the Initiator shall request the setup of a SCO transport.
- Only for HCI-based devices: the Responder shall include the parameters for a SCO transport when accepting a request for a Synchronous Connection.

The following requirements apply if a device supports both eSCO logical transports and Enhanced Data Rate (as of Bluetooth core specification v2.0 + EDR or later).

- The Controller shall support the packet type 2-EV3, hence mandatory eSCO parameters ranges as given in the LMP specification and contained in settings S2 and S3.
- On an HCI-Responder, at least the settings S2 shall be included in the list of acceptable parameters.

6 Generic Access Profile

This section defines the support requirements for the capabilities as defined in the “Generic Access Profile” of the Core Specification.

6.1 Modes

The table shows the support status for GAP Modes in this profile.

Procedure	Support in HF
General discoverable mode	M
Procedure	Support in AG
Pairable mode	M

Table 6.1: Modes

6.2 Security Aspects

There are no changes to the security requirements as stated in the Generic Access Profile.

6.3 Idle Mode Procedures

Table 6.2 shows the support status for Idle mode procedures within this profile.

Procedure	Support in AG
Initiation of general inquiry	M
Initiation of general bonding	O
Initiation of dedicated bonding	O

Table 6.2: Idle mode procedures

7 References

- [1] "Specification of the Bluetooth System; Core, v1.1 or later"
- [2] 3GPP 27.007 v6.8.0 now supersedes and replaces ETS 300 916, "Digital cellular telecommunications system (Phase 2+); AT command set for GSM Mobile Equipment (ME) (GSM 07.07 version 7.5.0)"
<http://www.3gpp.org/ftp/Specs/html-info/27007.htm>
- [3] "Specification of the Bluetooth System; Profiles, v1.1 or later, Headset Profile"
- [4] "Specification of the Bluetooth System; Core, v1.1 or later, Generic Access Profile"
- [5] "Specification of the Bluetooth System; Profiles, v1.1 or later, Serial Port Profile"
- [6] "ITU-T50, Terminal Equipment and Protocols for telematic services: International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 IA5). Information technology – 7-Bit coded character set for information interchange"
- [7] "Digital cellular telecommunication system (Phase 2+); Mobile radio interface layer 3 specification", (GSM 04.08 version 6.11.0)
- [8] "GSM 02.30 (version 7.1.0): Digital cellular telecommunications system (Phase 2+); Man-Machine Interface (MMI) of the Mobile Station (MS)"
- [9] Bluetooth Assigned Number URL is
https://www.bluetooth.org/foundry/assignnumb/document/assigned_numbers

8 List of Acronyms and Abbreviations

Abbreviation or Acronym	Meaning
AG	Audio Gateway
AT	Attention
CLI	Calling Line Identification
CODEC	COder DECoder
CVSD	Continuous Variable Slope Delta modulation
DTMF	Dual Tone Multi-Frequency
EC	Echo Cancellation
EDR	Enhanced Data Rate
eSCO	Extended Synchronous Connection Oriented
GAP	Generic Access Profile
GSM	Global System for Mobile communication
HF	Hands-Free unit
L2CAP	Logical Link Control and Adaptation Protocol
LMP	Link Manager Protocol
NR	Noise Reduction
OSI	Open System Interconnection
PIN	Personal Identification Number
RFCOMM	Serial port transport protocol over L2CAP
SCO	Synchronous Connection Oriented
SDP	Service Discovery Protocol
UI	User Interface
UUID	Universally Unique Identifier

9 List of Figures

Figure 1.1: Bluetooth Profiles.....	8
Figure 1.2: Conventions used in signaling diagrams.....	10
Figure 2.1: Protocol stack.....	11
Figure 2.2: Typical Hands-Free Use.....	12
Figure 4.1: Service Level Connection establishment.....	19
Figure 4.2: Service Level Connection removal.....	21
Figure 4.3: Typical Registration Status update.....	21
Figure 4.4: Transfer of Signal strength indication.....	22
Figure 4.5: Transfer of Roaming Status Indication.....	23
Figure 4.6: Transfer of Battery level indication.....	23
Figure 4.7: Query currently selected Network operator.....	24
Figure 4.8: Enable/Disable AG Error result code.....	25
Figure 4.9: Audio Connection set up.....	26
Figure 4.10: Audio Connection release.....	27
Figure 4.11: Answer an incoming call from the HF – in-band ring tone.....	28
Figure 4.12: Answer an incoming call from the HF – no in-band ring tone.....	29
Figure 4.13: Answer an incoming call from the AG.....	30
Figure 4.14: Change of the in-band ring tone setting initiated by the AG.....	31
Figure 4.15: Reject an incoming call from the HF.....	32
Figure 4.16: Rejection/interruption of an incoming call in the AG.....	32
Figure 4.17: Terminate ongoing call - HF initiated.....	33
Figure 4.18: Terminate ongoing call - AG initiated.....	34
Figure 4.19: Audio Connection transfer to the HF.....	35
Figure 4.20: Audio Connection transfer to the AG.....	36
Figure 4.21: Place an outgoing voice call with the digits entered in the HF.....	37
Figure 4.22: Place an outgoing voice call using memory dialing.....	38
Figure 4.23: Place an outgoing voice call with the last number dialed.....	40
Figure 4.24: Activation of Call waiting notification.....	41
Figure 4.25: Typical Call Waiting indication followed by a three way call set up process.....	43
Figure 4.26: Three way call handling when the third party call is placed from the HF.....	44
Figure 4.27: Activation of CLI notification.....	45
Figure 4.28: NR and EC functions available in the AG.....	46
Figure 4.29: Voice recognition activation – HF initiated.....	47
Figure 4.30: Voice recognition activation – AG initiated.....	48
Figure 4.31: Voice recognition deactivation – “momentary on” approach.....	48
Figure 4.32: Voice recognition deactivation from the HF.....	49
Figure 4.33: Request phone number to the AG.....	50
Figure 4.34: Transmit DTMF code.....	50
Figure 4.35: Typical example of audio volume control.....	51
Figure 4.36: Typical example of volume level synchronization.....	52
Figure 4.37: Query Response and Hold State of AG.....	53
Figure 4.38: Put an incoming call on Hold from HF.....	54
Figure 4.39: Put an incoming call on Hold from AG.....	55
Figure 4.40: Accept a held incoming call from HF.....	56
Figure 4.41: Accept a held incoming call from AG.....	57
Figure 4.42: Reject a held incoming call from HF.....	58
Figure 4.43: Reject a held incoming call from AG.....	59
Figure 4.44: Held incoming call terminated by caller.....	60
Figure 4.45: Query Subscriber Number Information of AG.....	61
Figure 4.46: Empty Subscriber Number Information from AG.....	61
Figure 4.47: Query List of Current Calls.....	62

Figure 4.48: Call Held or Active/Held Position Swap 63
Figure 4.49: Held Call Release 64
Figure 4.50: Active Call Terminated/Call Remains Held..... 64
Figure 4.51: Release Specified Active Call..... 65
Figure 4.52: Request Private Consultation Mode 66

10 List of Tables

Table 3.1: Application layer procedures.....	14
Table 3.2: Application layer feature to procedure mapping	16
Table 5.1: Service Record for the HF	82
Table 5.2: “SupportedFeatures” attribute bit mapping for the HF	82
Table 5.3: Service Record for the AG	83
Table 5.4: “SupportedFeatures” attribute bit mapping for the AG.....	83
Table 5.5: Link Controller requirements.....	85
Table 6.1: Modes	88
Table 6.2: Idle mode procedures	88