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HEADSET PROFILE

Abstract:

This profile defines the requirements for Bluetooth® devices necessary to support the Headset use case. The requirements are expressed in terms of end-user services, and by defining the features and procedures that are required for interoperability between Bluetooth devices in the Headset use case.

*Headset Profile (HSP)***Revision History**

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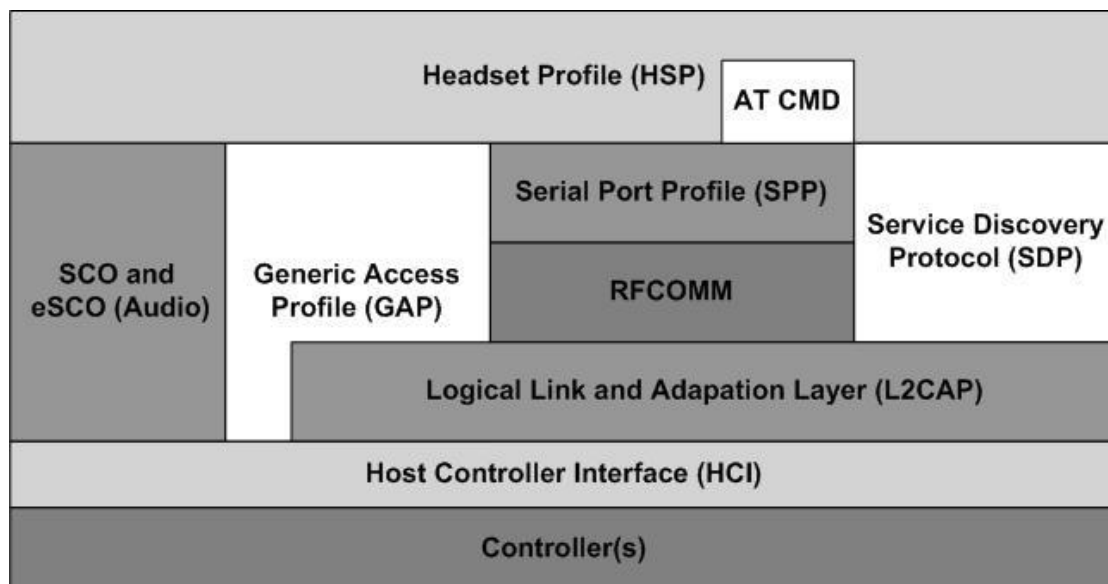
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1 Introduction

1.1 Scope

This Headset profile defines the protocols and procedures that shall be used by devices requiring a full-duplex audio connection combined with minimal device control commands. The most common examples of such devices are headsets, personal computers, PDAs, and cellular phones, though most cellular phones will prefer to use a more advanced profile such as Hands-Free Profile.

The headset can be wirelessly connected for the purposes of acting as the device's audio input and output mechanism, providing full duplex audio. The headset increases the user's mobility while maintaining call privacy.

1.2 Profile Dependencies

The Headset profile is dependent upon both the Serial Port Profile and the Generic access profile – details are provided in [Serial Port Profile](#) and 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 unit but shall never be used in this use case)
- 'C' for conditional to support
- 'N/A' for not applicable (in the given context it is impossible to use this capability)

Some excluded capabilities are capabilities that, according to the relevant Bluetooth specification, are mandatory. These are features that may degrade operation of devices in this use case. Therefore, these features shall never be activated while a unit is operating as a unit within this use case.

1.4 Signaling Diagram Conventions

The following arrows are used in diagrams describing procedures:

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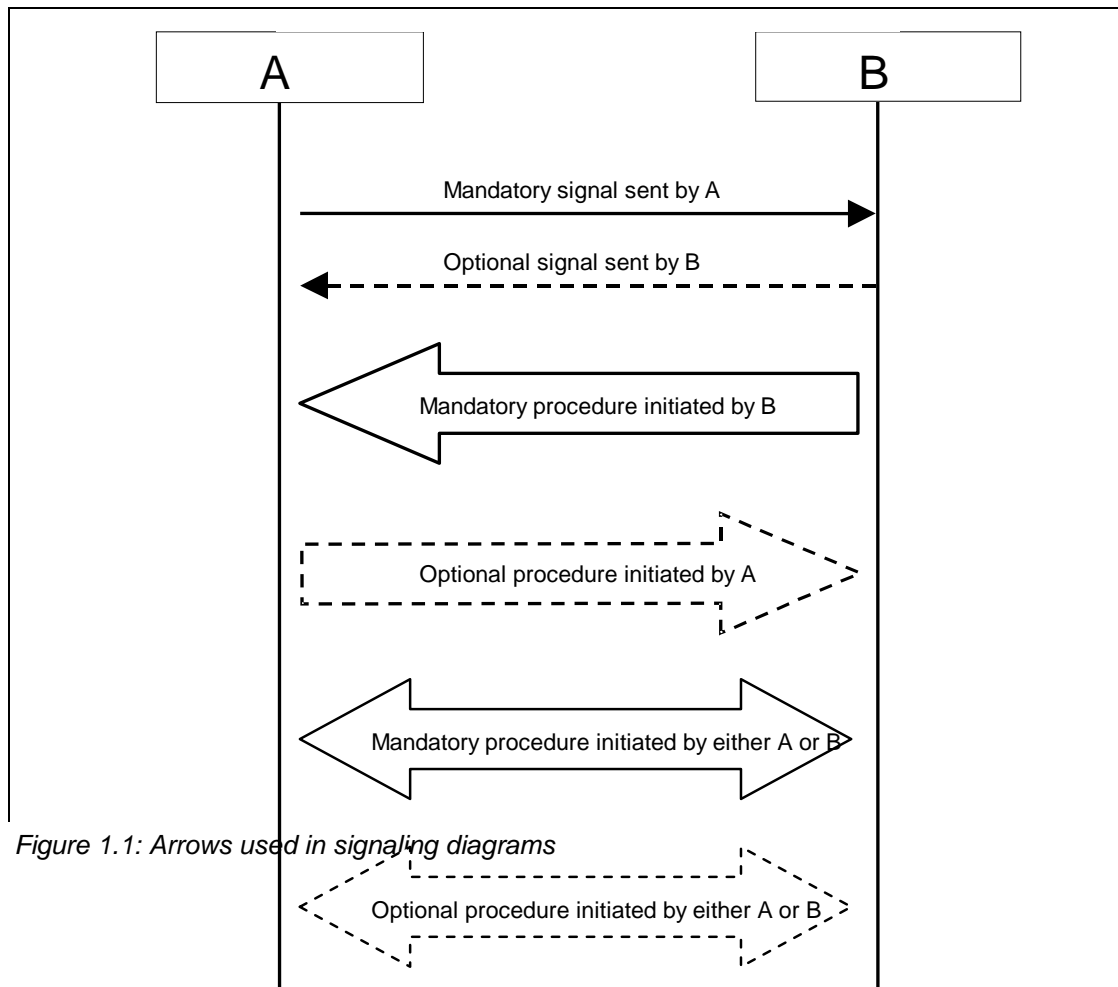
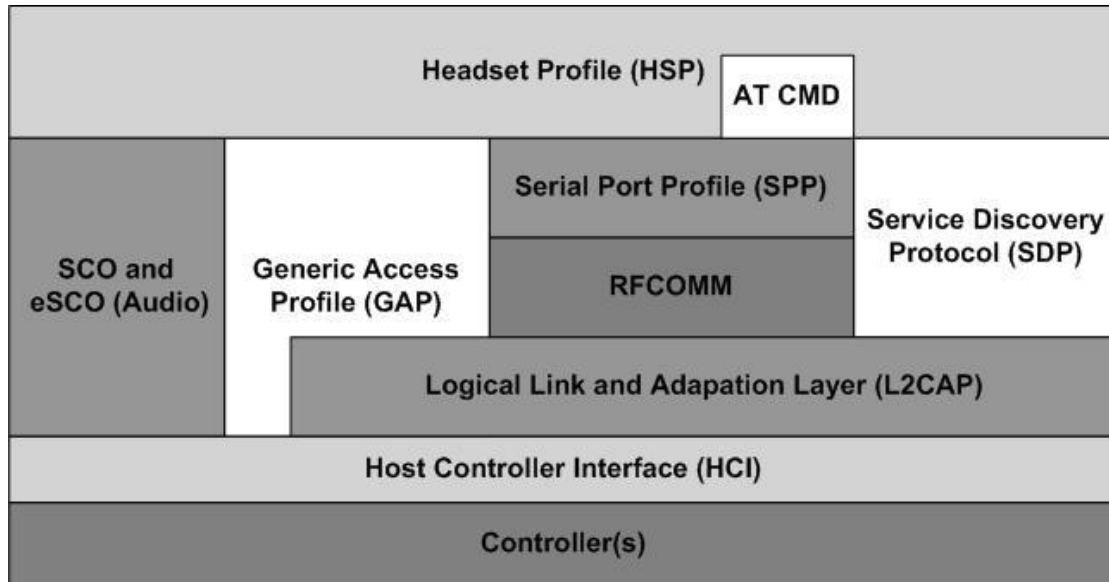


Figure 1.1: Arrows used in signaling diagrams

2 Profile Overview

2.1 Profile stack

Figure 2.1 shows the protocols and entities used in this profile.



2.2

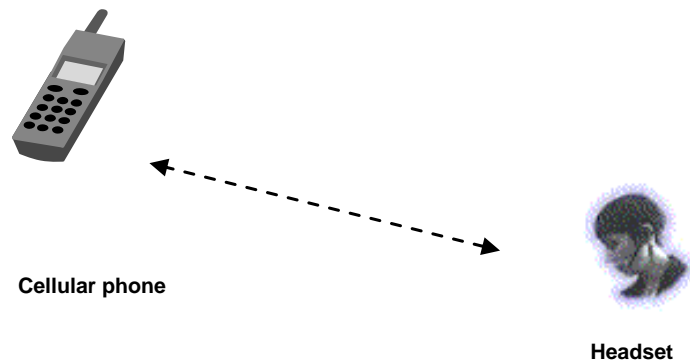
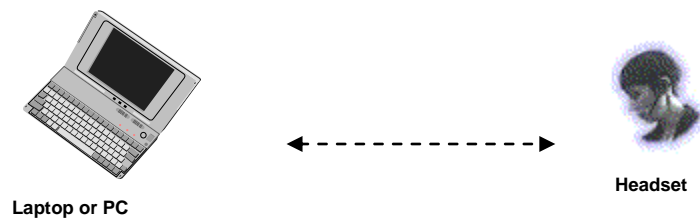
Figure 2.1: Protocol model

The Controller, HCI, and L2CAP are the OSI layer 1 and 2 Bluetooth protocols. RFCOMM is the Bluetooth adaptation of GSM TS 07.10 [5]. SDP is the Bluetooth Service Discovery Protocol. Headset Profile and AT CMD are the entities responsible for headset specific control signaling, which is AT command based.

.For the HSP layer in Figure 2.2 the [Serial Port Profile](#) is used as a base standard. For this protocol, all requirements stated in the [Serial Port Profile](#) apply except in those cases where this profile explicitly states deviations.

2.3 Configuration and roles

The figures below show two typical configurations of devices for which the Headset profile is applicable:

Headset Profile (HSP)*Figure 2.2: Headset profile, example with cellular phone**Figure 2.3: Headset profile, example with personal computer*

The following roles are defined for this profile:

Audio Gateway (AG) – This device acts as either the end point, or a relay, for telephony quality audio, which is typically two-way. Exemplary devices acting as Audio Gateways are cellular phones and personal computers.

Headset (HS) – This device provides the Audio Gateway's remote audio input and output mechanism.

The abbreviations AG and HS are used in the rest of this document to designate these roles.

2.4 User requirements and Scenarios

The Headset profile defines the protocols and procedures that shall be used by devices implementing this use case.

The following restrictions apply to this profile:

- The profile mandates CVSD encoding for audio transmitted over the Bluetooth SCO link. The resulting audio is monophonic, with a quality that – under normal circumstances – will be comparable to standard cellular phone audio quality.
- Only one audio connection at a time is supported by a single instance of this profile.

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- The AG controls the SCO link establishment and release. The headset directly connects (disconnects) the internal audio streams upon SCO link establishment (release). All SCO links are, by definition, full duplex.
- The use of eSCO [3] by co-operating devices is not prohibited, but will not be further specified in this profile.¹
- The profile offers only basic interoperability – multi-party call handling at the AG, for example, is not specified.
- The only required HS user interface is a button-press event. The HS can signal the AG that the button has been pressed, but the ability to send button-press and button-release as two distinct signals is not defined.

2.5 Profile Fundamentals

Depending on the underlying core specification version², an HS may be able to use the services of the AG without the creation of a secure connection. It is the implementer's responsibility to enforce security on devices that support authentication and/or encryption in the execution of this profile. If baseband authentication and/or encryption is desired, the two devices shall create a secure connection, using the authentication procedure as described in the Generic Access profile.

A link must be established before establishing an audio connection. Normally, this requires paging of the other device.

There are no fixed master/slave roles.

The AG and HS provide serial port emulation by using the serial port profile, which in turn uses the RFCOMM protocol. The serial port emulation is used to exchange the user data including modem control signals and AT commands and responses. AT commands are parsed by the AG and responses are sent to the HS.

2.6 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 capabilities, and optional and conditional capabilities for which support is indicated, are subject to verification as part of the Bluetooth qualification program.

¹ Interested parties should refer to the Hands-Free Profile, version 1.5 for a relevant discussion of eSCO.

² Core specifications 2.1 and later require secure connections.

3 Application Layer

This section describes the feature requirements for units complying with the Headset Profile.

Table 3.1 shows the feature requirements made by this profile.

	Feature	Support in HS	Support in AG
1.	Incoming audio connection	M	M
2.	Outgoing audio connection	M	O
3.	Audio connection transfer	M	M
4.	Remote audio volume control	O	O

Table 3.1: Application layer procedures

In the table above, incoming and outgoing shall be interpreted from the headset (HS) point of view.

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

	Feature	Procedure	Ref.
1.	Incoming audio connection	Incoming audio connection establishment	4.2
		Audio connection release	4.4
2.	Outgoing audio connection	Outgoing audio connection establishment	4.3
		Audio connection release	4.4
3.	Audio connection transfer	Audio connection transfer	4.6
4.	Remote audio volume control	Remote audio volume control	4.7

Table 3.2: Application layer feature to procedure mapping

4 Headset Control Interoperability Requirements

4.1 Introduction

The interoperability requirements for the Headset Control entity are completely contained in this chapter. Sections 4.2 through Section 4.7 specify the requirements for the procedures directly relating to the application layer features.

Section 4.8 specifies the AT commands and results codes used for signaling purposes.

Section 4.9 specifies how the layers beneath the Headset Control entity are used to establish and release a connection.

4.2 Audio Gateway Initiated ACL Connection Establishment

Upon an internal or user generated event, the AG will initiate connection establishment (see Section 4.8.1), once the connection is established, there are then two options as described in the Sections 4.2.1 and Sections 4.2.2. The SCO link establishment can take place anytime after the ACL connection establishment.

4.2.1 Using In-Band Ringing

An in-band ring tone is an audible alert, such as a tone, melody, short music clip, that is transmitted by the AG, to the HS, to alert the user of an event; typically an incoming call. As shown in Figure 4.1, the AG may generate an in-band ring tone using the SCO connection to the HS. The AG decides how to use this SCO connection. When using an in-band ring tone, the AG shall **not** send the RING unsolicited result code to the HS³.

³ Please note this behavior differs from the Hands-Free Profile versions 1.0 and 1.5, which do send RING when using in-band ring tone notification.

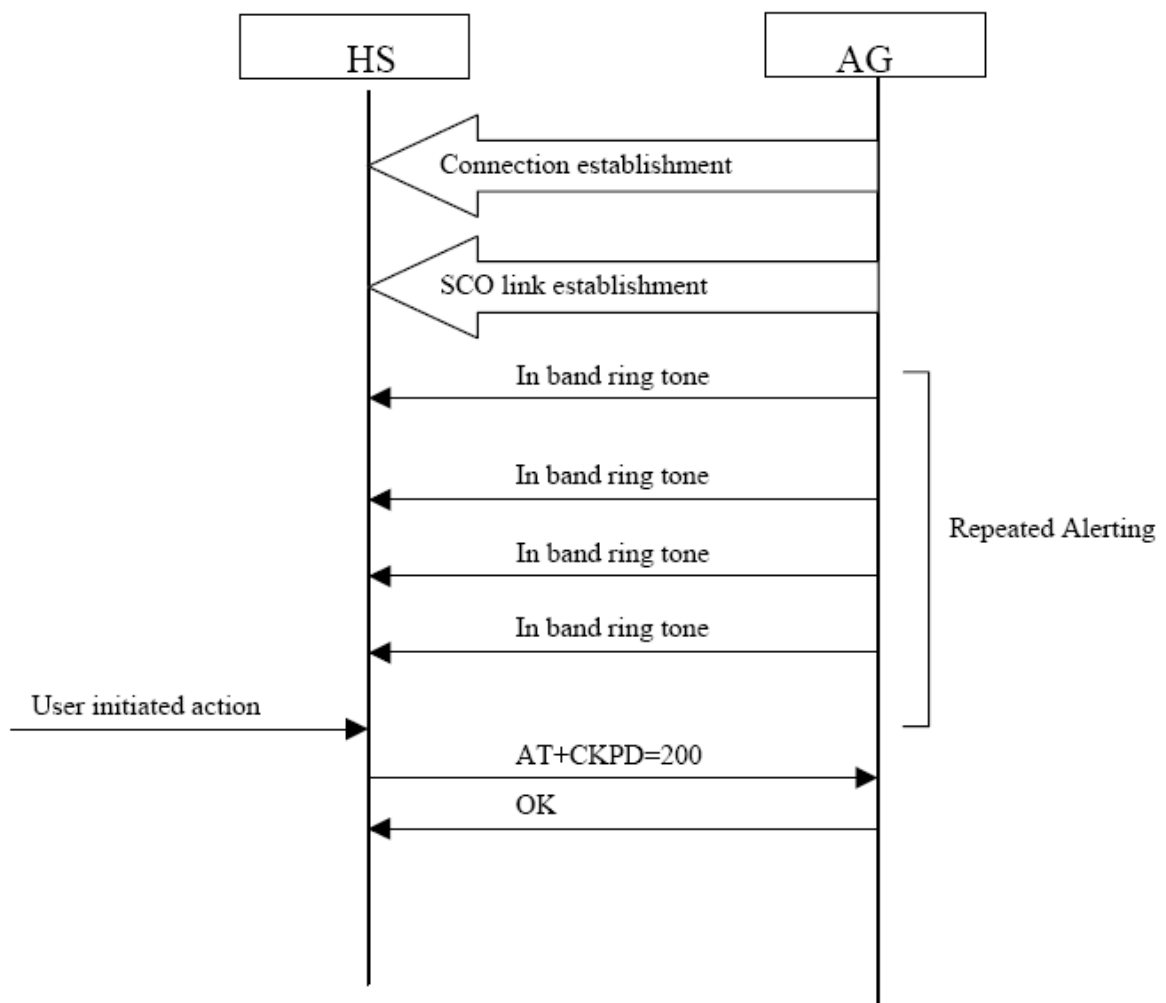
Headset Profile (HSP)

Figure 4.1: Incoming audio connection establishment using in-band ring tone

4.2.2 Using the RING message

As shown in [Figure 4.2](#), the AG will repeatedly send the RING unsolicited result code to the HS for a time period decided by the AG. The RING may be repeated for as long as the connection establishment is pending.

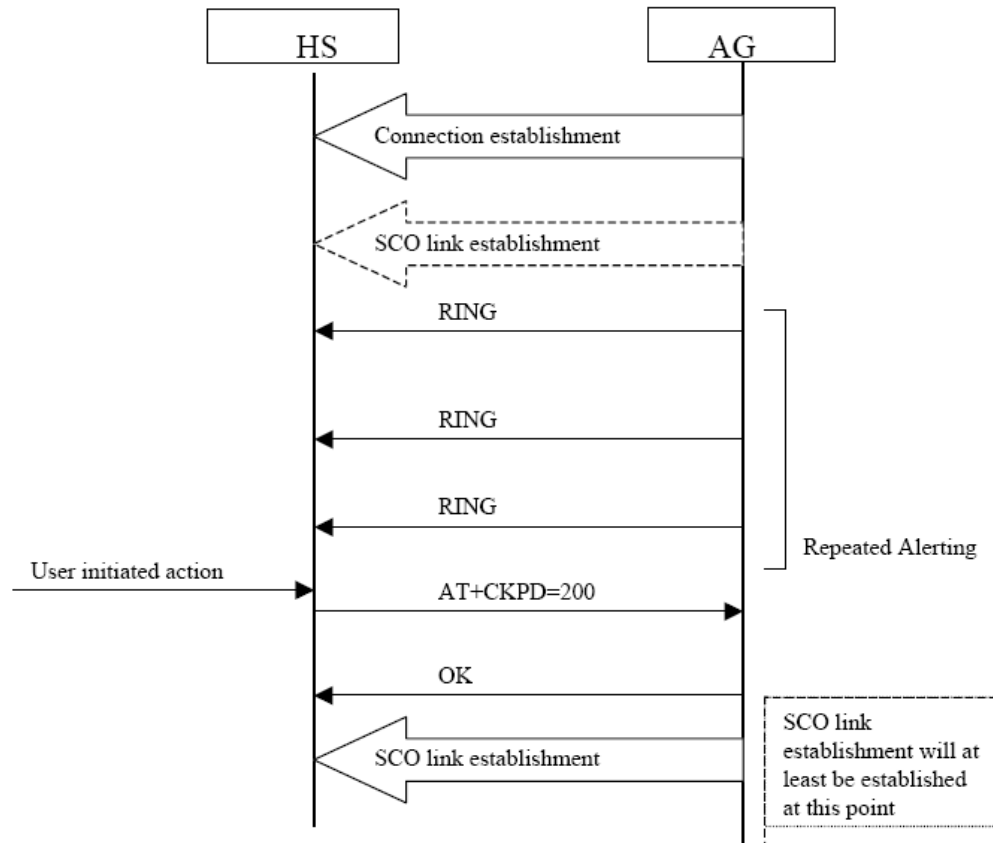
Headset Profile (HSP)

Figure 4.2 Incoming connection establishment (using RING message)

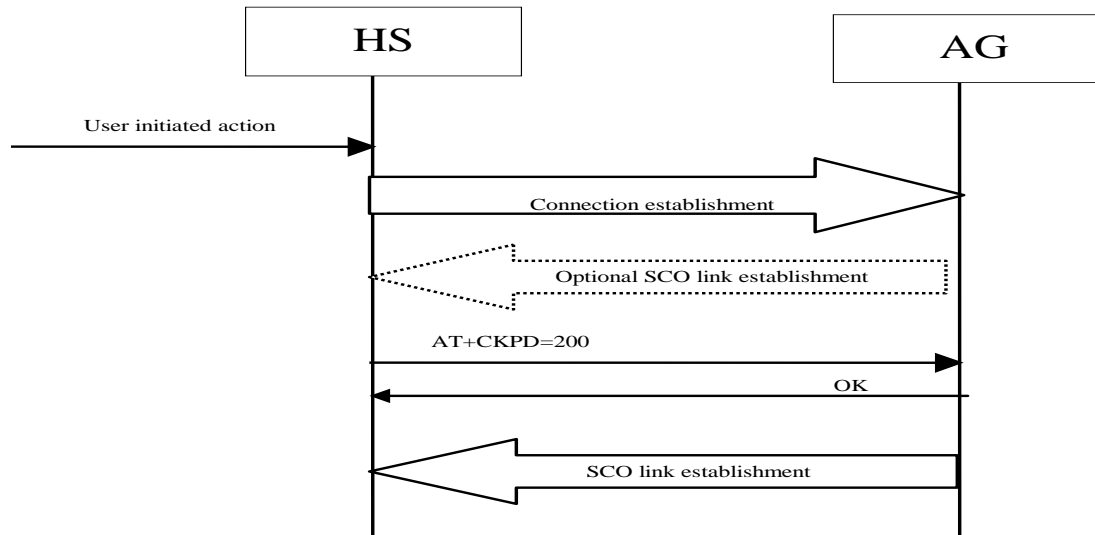
4.3 Headset Initiated ACL Connection Establishment

A headset (HS) originated ACL connection is initiated (see Section 4.9) by a user action (e.g. pressing a button on the headset). Upon completion of a connection establishment that was initiated by pressing the “headset button”, the HS shall send the AT+CKPD=200 command to the AG. If the HS connection is initiated by an event other than a headset button press, the HS shall not send AT+CKPD=200.

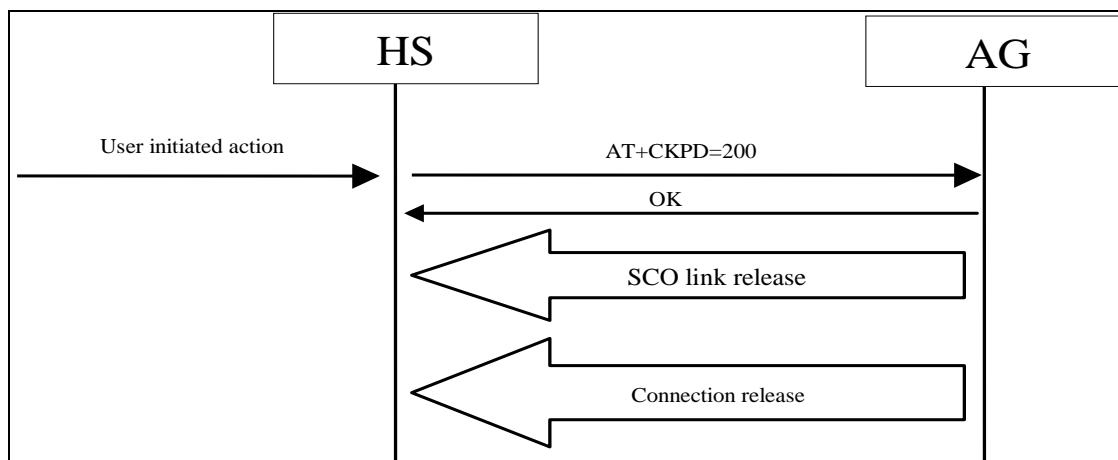
The AG may initiate a SCO connection after the completion of the ACL connection establishment, but before receiving the AT+CKPD=200 command from the HS. This may be desirable when the AG is a mobile phone. In all cases, the AG is responsible for establishing the SCO link if needed. Further internal actions may be needed on the AG to internally establish and/or route the audio stream to the HS⁴.

As shown in Figure 4.3, the SCO link connection may be set up prior to receiving the AT+CKPD=200 command. If this is not the case, then the SCO link connection shall be set up after receiving the AT+CKPD=200 command.

4 For a cellular phone a cellular call may need to be established, e.g. using last dialled number or a pre-programmed number. For a personal computer this may relate to VoIP calls or voice command/prompt interaction with the computer.

Headset Profile (HSP)*Figure 4.3: Audio connection establishment***4.4 Headset Control Following Connection Establishment**

While a headset profile connection exists between AG and HS, and upon the receipt of a user initiated action (for example, button press) on the HS, the HS shall send the AT+CKPD=200 command to the AG. The action performed by the AG on receipt of the AT+CKPD=200 command is implementation dependent. The actions performed by the AG may be dictated by the state the AG is in at the time it received the command.

4.5 Audio Connection Release*Figure 4.4: Audio connection release – HS initiated*

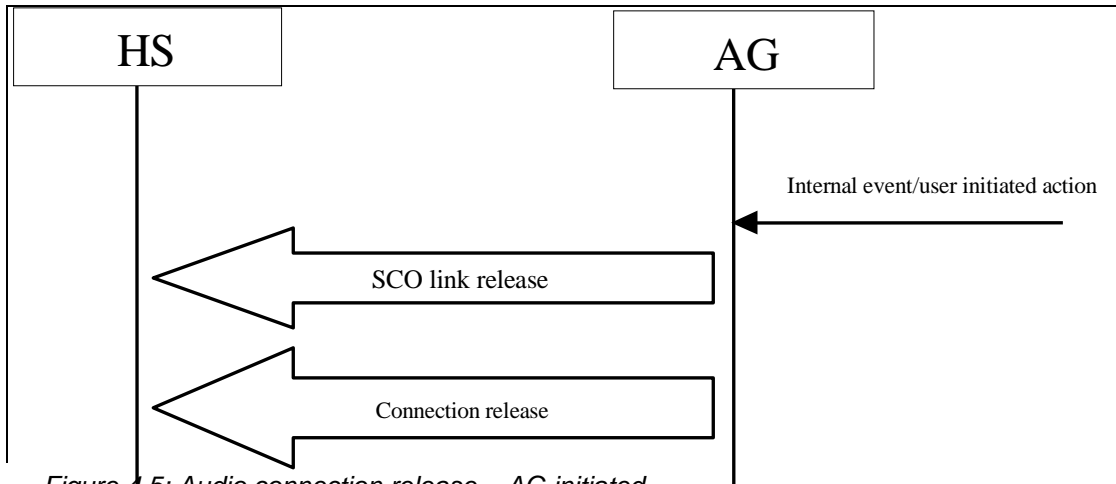
Headset Profile (HSP)

Figure 4.5: Audio connection release – AG initiated

The AG may release the Audio connection (SCO) upon an internal event in the AG or after the AG receives an indication of a user initiated action (e.g. button press) from the AG or HS.

The HS may initiate an Audio connection (SCO) release in circumstances such as power-down event while an Audio connection (SCO) is established.

Irrespective of the initiating side, the AG is responsible for releasing the profile's serial port (RFCOMM) connection (see Section [4.9.1.2](#)).

4.6 Audio Connection Transfer

An audio connection can be transferred from AG to HS or from HS to AG. The connection is transferred to the device initiating the transfer.

4.6.1 Audio Connection Transfer from AG to HS

The audio connection transfer from AG to HS is initiated by a user action on the HS side. To effect this transfer, the HS shall send the AT+CKPD=200 command to the AG.

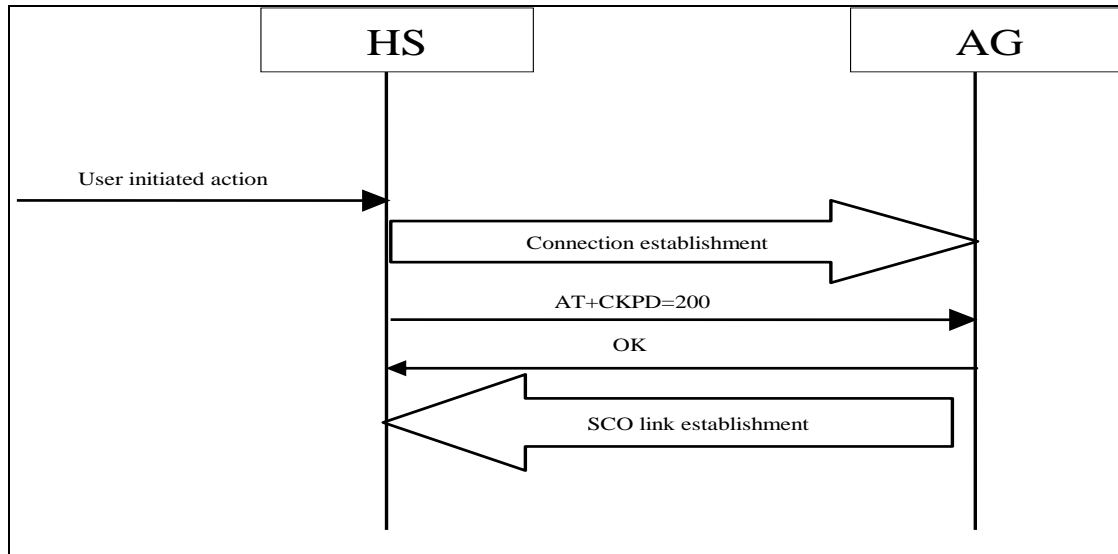


Figure 4.2: Audio connection transfer from AG to HS

4.6.2 Audio Connection Transfer from HS to AG

The audio connection transfer from HS to AG is initiated by a user action on the AG. This user action shall result in the AG releasing the SCO connection.

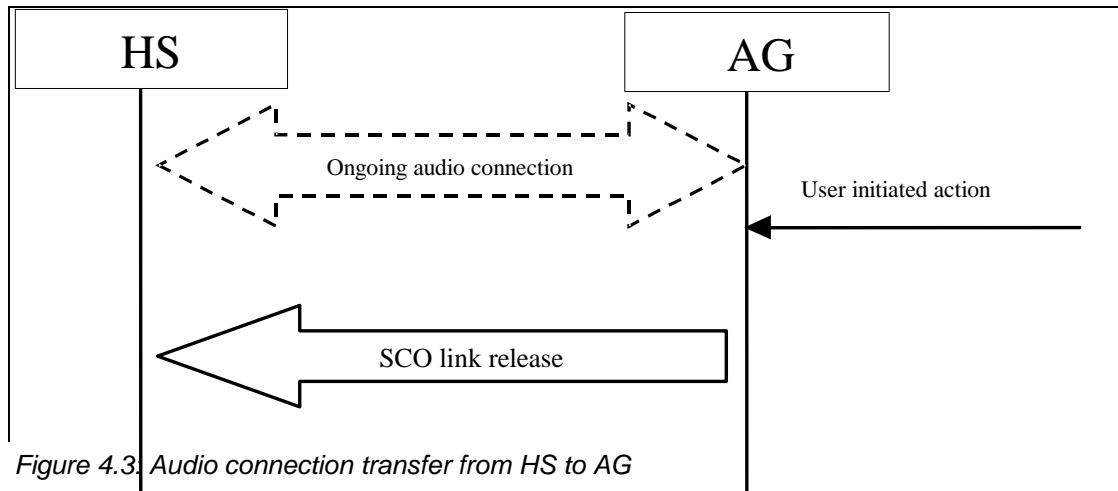


Figure 4.3: Audio connection transfer from HS to AG

4.7 Remote Audio Volume Control

The AG can control the gain of the microphone or speaker of the HS by sending unsolicited result codes +VGM or +VGS respectively. There is no restriction on the number or order of these result codes. Support for remote audio volume control is

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optional, so an implementation may support none, either, or both of the controls for microphone volume and speaker volume.

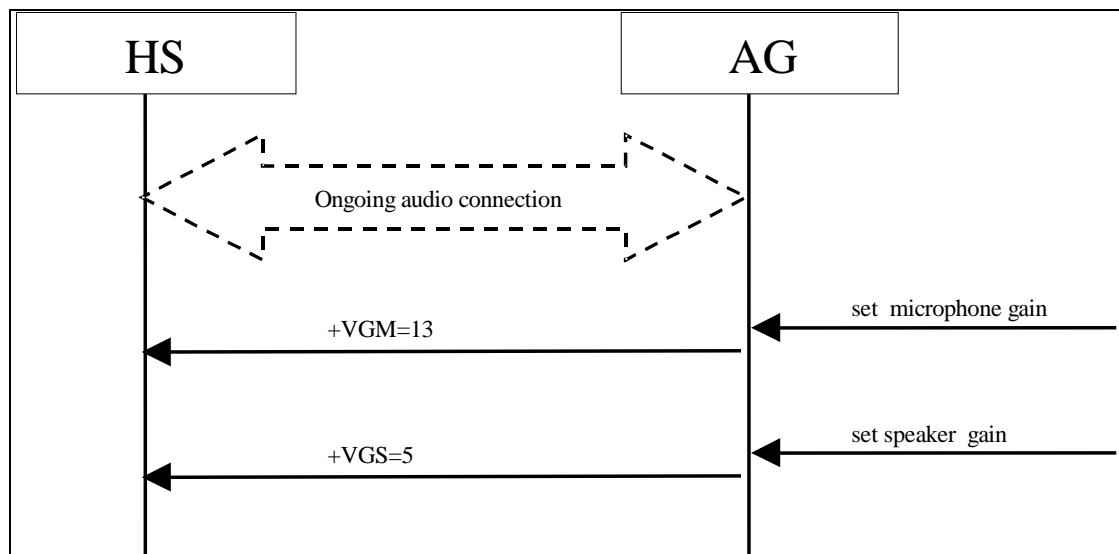
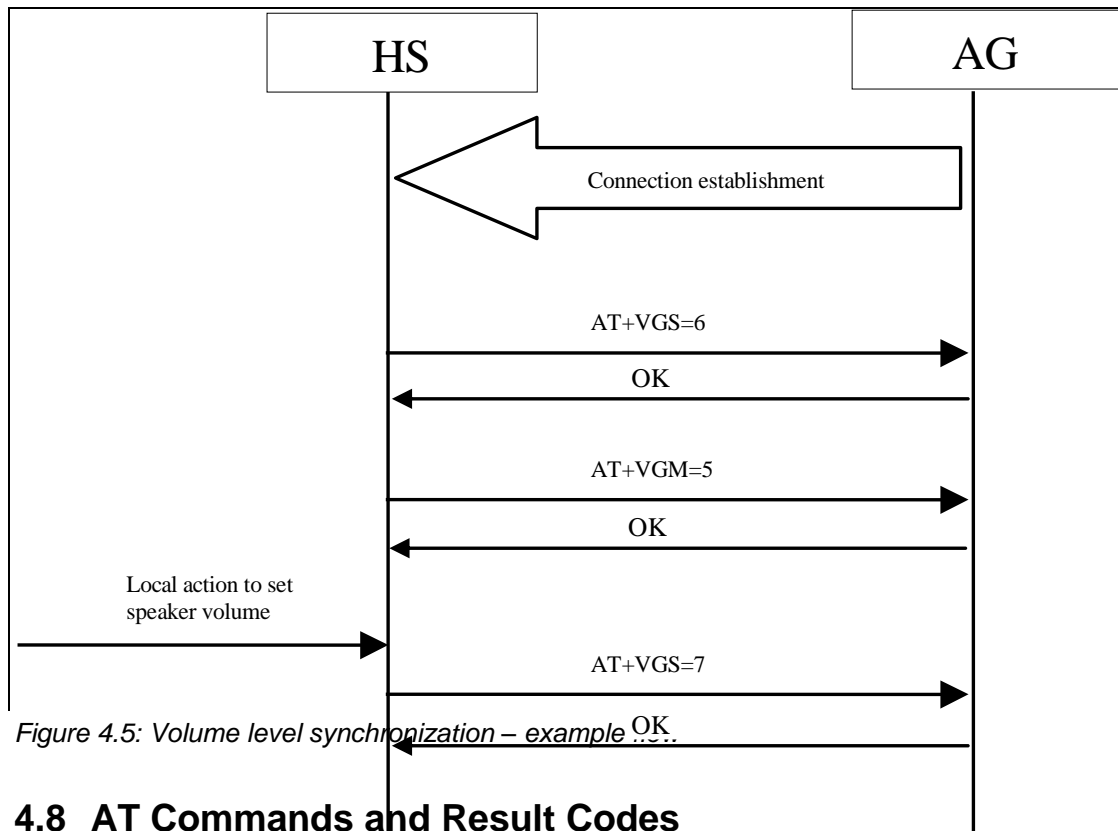


Figure 4.4: Audio volume control – example flow

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

The HS may store the VGS and VGM settings at connection release. At connection establishment, the HS may restore the previous settings using the AT commands AT+VGS and AT+VGM. In case physical mechanisms (buttons, dials etc.) means are implemented on the HS to control the volume levels, the HS shall also use the AT commands AT+VGS and AT+VGM to inform the AG of any changes in the volume levels.

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4.8 AT Commands and Result Codes

4.8.1 General

The command line termination character shall be carriage return (IA5 0/13). The response formatting character shall be line feed (IA5 0/10). The AG shall not echo command characters⁵. The AG shall transmit result codes, using the verbose (rather than numeric) format.

The format for a command from the HS to the AG is thus:

AT<cmd>=<value><cr>

If the command is processed successfully, the resulting response from the AG to the HS is:

<cr><lf>OK<cr><lf>

If the command is not processed successfully, or is not recognized, the resulting response from the AG to the HS is:

<cr><lf>ERROR<cr><lf>

The format for an unsolicited result code (such as RING) from the AG to the HS is:

<cr><lf><result code><cr><lf>

⁵ 1This is the opposite of the default recommended by V.250

*Headset Profile (HSP)***4.8.2 AT Capabilities Re-used from V.250**

The mandatory set of AT commands and unsolicited result codes are indicated in [Table 4.1](#).

AT capability	Syntax	Description
RING – See note 1	RING	The Incoming call indication of V.250 [1], Section 6.3.4.
Headset button press	+CKPD=200	Command issued by HS to indicate that the button has been pressed

Table 4.1: Mandatory AT capabilities

Note 1: Mandatory for HS to support RING, optional for AG

4.8.3 Bluetooth-defined AT capabilities

Optionally, the AT capabilities as indicated in [Table 4.2](#) may be supported.

AT capability	Syntax	Description	Values
Microphone gain	+VGM=<gain >	Unsolicited result code issued by the AG to set the microphone gain of the HS. <gain> is a decimal numeric constant, relating to a particular (implementation- dependent) volume level controlled by the HS.	<gain>: 0-15
Speaker gain	+VGS=<gain>	Unsolicited result code issued by the AG to set the speaker gain of the HS. <gain> is a decimal numeric constant, relating to a particular (implementation-dependent) volume level controlled by the HS.	<gain>: 0-15
Microphone gain level report	+VGM=<gain >	Command issued by the HS to report the 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 HS.	<gain>: 0-15
Speaker gain level indication report	+VGS=<gain>	Command issued by the HS to report the 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 HS.	<gain>: 0-15

Table 4.2: Optional AT capabilities

4.9 Lower Layer Handling

This section describes how the layers below the Headset Control entity are used to establish and release a connection.

*Headset Profile (HSP)***4.9.1 Connection Handling****4.9.1.1 Connection establishment**

Either the HS or the AG may initiate connection establishment. If there is no RFCOMM session between the AG and the HS, the initiating device shall first initialize RFCOMM. Connection establishment shall be performed as described in Section 7.3 of GAP and Section 3 of SPP.

4.9.1.2 Connection release

When the audio connection is released, the profile's serial port (RFCOMM) connection may be released as well.

Since it is possible that multiple profiles are active between the two devices, the Headset Profile should not initiate an ACL level disconnection, that action should be left to a lower layer that can determine when it is appropriate to disconnect the physical link.

4.9.1.3 Sniff mode

The use of sniff mode is recommended⁶ for devices that need to reduce power consumption while maintaining an active connection. This can be used for ACL connection when a call is in progress or when a call is not in progress. Note; it is not necessary to exit sniff mode when exchanging AT commands and responses.

⁶ Support for sniff mode may be mandatory depending on the underlying core stack version.

5 Serial Port Profile

This profile requires compliance with the Serial Port Profile. 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.

As with the Headset Profile, both the AG and the HS can initiate connection establishment. For the purposes of reading the Serial Port Profile, both the AG and the HS can assume the role of Device A and B.

5.1 RFCOMM Interoperability Requirements

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

5.2 L2CAP Interoperability Requirements

For the L2CAP layer, no additions to the requirements as stated in the Serial Port Profile Section 5 shall apply [3].

5.3 SDP Interoperability Requirements

This profile [3] defines following service records for the headset and the audio gateway respectively.

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) can be found on the Bluetooth Assigned Numbers web page.

Item	Definition	Type	Value	AttrID	Status	Default
ServiceClassIDList					M	
ServiceClass0		UUID	Headset		M	
ServiceClass1		UUID	Generic Audio		M	
ProtocolDescriptorList					M	
Protocol0		UUID	L2CAP		M	
Protocol1		UUID	RFCOMM		M	
Protocol Specific Parameter0	Server Channel	UInt8	N=server channel #		M	
BluetoothProfile DescriptorList					M	
Profile0	Supported Profiles	UUID	Headset Profile		M	Headset
Param0	Profile Version	UInt16	0x0102 ⁷		M	0x0102
ServiceName	Display able Text name	String	Service- provider defined		O	'Headset'

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Item	Definition	Type	Value	AttrID	Status	Default
Remote audio volume control		Boolean	True/False		O	False

Table 5.1: Service Record for Headset

Item	Definition	Type	Value	AttrID	Status	Default
ServiceClassIDList					M	
ServiceClass0		UUID	Headset Audio Gateway		M	
ServiceClass1		UUID	Generic Audio		M	
ProtocolDescriptorList					M	
Protocol0		UUID	L2CAP		M	
Protocol1		UUID	RFCOMM		M	
Protocol Specific Parameter0	Server Channel	Uint8	N=server channel #		M	
BluetoothProfile DescriptorList						
Profile0	Supported Profile	UUID	Headset Profile		M	Headset
Param0	Profile Version	Uint16	0x0102 ⁷		M	0x0102
ServiceName	Display able Text name	String	Service-provider defined		O	'Voice gateway'

Table 5.2: Service Record for the Audio Gateway

5.4 Link Manager (LM) Interoperability Requirements

In addition to the requirements for the Link Manager as stated in the Serial Port Profile, this profile mandates support for SCO links, in both the HS and AG.

5.5 Link Control (LC) Interoperability Requirements

CVSD audio shall be supported in both the AG and HS.

5.5.1 Class of Device

A device that is active in the HS role shall, in the Class of Device field:

⁷ Indicating version 1.2

Headset Profile (HSP)

1. Set the bit 'Audio' in the Service Class field

Further, a device may optionally:

1. Indicate 'Audio' as Major Device class
2. Indicate "Headset" as the Minor Device class

An inquiring AG may use the Service Class field to filter the inquiry responses. The Device Class fields should not be used as filters since many devices support multiple profiles.

6 Generic Access Profile

This section defines the support requirements for the capabilities as defined in Generic Access Profile [3].

6.1 Modes

The table shows the support status for Modes within this profile.

	Procedure	Support in HS	Support in AG
1	Discoverability modes		
	Non-discoverable mode	M	O
	Limited discoverable mode	O	O
	General discoverable mode	M	O
2	Connectability modes		
	Non-connectable mode	O	O
	Connectable mode	M	M
3	Pairing modes		
	Non-pairable mode	O	O
	Pairable mode	O	O

Table 6.1: Modes

6.2 Security Aspects

No changes to the requirements as stated in the Generic Access Profile [3].

6.3 Idle Mode Procedures

Support for general inquiry mode is mandatory in the AG.

7 References

- [1] International Telecommunication Union, "ITU-T Recommendation V.250"
- [2] ETS 300 916 (GSM 07.07) version 5.6.0
- [3] Specification of the Bluetooth System; Core, v1.2 or later

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