

# SIMULTANEOUS USE OF HFP, A2DP, AND AVRCP PROFILES

*Bluetooth*<sup>®</sup> White Paper



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**Abstract:**

**This White Paper recommends procedures for use of HFP, A2DP and AVRCP for different common use cases.**

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## 1 Terms and Abbreviations

Abbreviation	Term
A2DP	Advanced Audio Distribution Profile
AG	Audio Gateway (as in HFP)
AG_MP	Audio Gateway and Media Player
AVDTP	Audio Video Distribution Transport Protocol
AVRCP	Audio Video Remote Control Profile
GAVDP	Generic Audio/Video Distribution Profile
HF	HandsFree (as in HFP)
HF_RD	HandsFree and Rendering Device
HFP	HandsFree Profile
Inband ring tone	Any audio using (e)SCO for ringing
HQ ring tone	Any audio using A2DP for ringing
MP	Media Player
NA	Not Applicable
RC	Remote Controller
RD	Rendering Device
SNK	Sink (as in A2DP)
SRC	Source (as in A2DP)
UI	User Interface Some possibility for the user to interact with the system. Can be just some buttons or a more complex UI may be e.g. a display with keyboard or touch screen.

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## 2 Document Terminology

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The Bluetooth SIG has adopted Section 13.1 of the IEEE Standards Style Manual, which dictates use of the words “shall”, “should”, “may”, and “can” in the development of documentation, as follows:

The word *shall* is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall equals is required to*).

The use of the word *must* is deprecated and shall not be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

The use of the word *will* is deprecated and shall not be used when stating mandatory requirements; *will* is only used in statements of fact.

The word *should* is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is deprecated but not prohibited (*should equals is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may equals is permitted*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can equals is able to*).



## 3 Scope

This White Paper describes how A2DP and AVRCP should be used together and in conjunction with HFP, to achieve high interoperability in all functions defined in the profiles. The scenarios and the sequences of the procedures defined in this White Paper are not mandatory and there is no requirement from Bluetooth SIG that they shall be followed.

The A2DP profile should be seen as a way to set up and configure the actual transport of a streaming audio link, the A2DP profile should not be used to control the applications streaming data for which the AVRCP profile should be used.

### 3.1 Relationship to Multi Profile Specification (MPS)

In version 1.2 of this White Paper, some recommendations and scenarios have been removed. Those are now covered by the Multi Profile Specification. The Multi Profile Specification is compatible with the behavior of these removed recommendations. The reason for removing these recommendations from this White Paper is due to the removal of redundant aspects. It is recommended that devices implement MPS instead of former versions of this White Paper. Devices not formally qualifying for MPS for any reason should still follow the behavior specified in the applicable features of MPS. Below is a mapping of Recommendations and Scenarios from former versions of this White Paper to MPS sections:

Former White Paper Version Recommendation Title	MPS v1.0 section / scenario
Signaling channel establishment point of time	Profile (Dis-)Connection Behavior
AVDTP before AVCTP	Profile (Dis-)Connection Behavior
Sniff mode	Sniff Mode Handling
Unsniff before AVDTP signaling	Sniff Mode Handling
Sniff during Streaming	Sniff Mode Handling
AVCTP and AVDTP disconnection	Profile (Dis-)Connection Behavior
Start Playback	Start Audio Streaming after AVRCP_Play (MPSD)
AVDTP reestablishment after AVRCP_PLAY	Profile (Dis-)Connection Behavior
GAVDP_START responsibility	HFP Call Termination during AVP Connection
Media Player control over AVRCP	MPS AVP Suspension Procedure
AVRCP_PAUSE relation to AVRCP_PLAY	Start Audio Streaming after AVRCP_Play (MPSD) Suspend Audio Streaming after AVRCP_Pause (MPSD)
HFP, AVDTP and AVCTP connection order	Profile (Dis-)Connection Behavior

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Former White Paper Version Recommendation Title	MPS v1.0 section / scenario
HF_RD should not open (e)SCO	Answer Incoming Call during Audio Streaming (MPSD)
Incoming call from AG while streaming from separate MP	Answer Incoming Call during Audio Streaming (MPMD)
Stream handling before (e)SCO establishment	Answer Incoming Call during Audio Streaming Outgoing Call during Audio Streaming
Stream restart by AG_MP	HFP Call Termination during AVP Connection
Restart streaming from MP after call from separate AG	HFP Call Termination during AVP Connection (MPMD)
AG_MP responsibility in call handling	Answer Incoming Call during Audio Streaming Outgoing Call during Audio Streaming
AVDTP/AVCTP/HFP disconnect conditions	Profile (Dis-)Connection Behavior
AVDTP/AVCTP connect without HFP	Profile (Dis-)Connection Behavior
Playback resume after connection re-establishment	Start Audio Streaming after AVRCP_Play (MPSD)

Former White Paper Version Scenario Title	MPS v1.0 section
AVDTP+AVCTP CONNECTION ESTABLISHMENT	Profile (Dis-)Connection Behavior
AVDTP+AVCTP: USE OF SNIFF MODE	Sniff Mode Handling
AVDTP+AVCTP IN IDLE STATE	Covered by Recommendation 1 in this White Paper
AVDTP+AVCTP CONNECTION RELEASE	Profile (Dis-)Connection Behavior
AVDTP+AVCTP CONNECTION RE-ESTABLISHMENT	Covered by Recommendation 3 in this White Paper
A2DP/VDP+AVRCP: START OF STREAMING MEDIA	HFP Call Termination during AVP Connection Start Audio Streaming after AVRCP_Play (MPSD) Profile (Dis-)Connection Behavior
A2DP/VDP+AVRCP: STOP OF STREAMING MEDIA	Start Audio Streaming after AVRCP_Play (MPSD) Suspend Audio Streaming after AVRCP_Pause (MPSD) MPS AVP Suspension Procedure

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Former White Paper Version Scenario Title	MPS v1.0 section
HFP+AVDTP+AVCTP CONNECTION ESTABLISHMENT	Profile (Dis-)Connection Behavior
HFP+AVDTP+AVCTP: USE OF SNIFF MODE	Sniff Mode Handling
HFP+AVDTP+AVCTP CONNECTION RELEASE	Profile (Dis-)Connection Behavior
HFP+AVDTP+AVCTP CONNECTION RE-ESTABLISHMENT	Covered by Recommendation 3 in this White Paper
HFP+A2DP/VDP+AVRCP INCOMING CALL WHEN LISTENING TO MUSIC FROM THE SAME DEVICE, NO HQ RING SIGNAL	Answer Incoming Call during Audio Streaming Outgoing Call during Audio Streaming HFP Call Termination during AVP Connection
HFP+A2DP/VDP+AVRCP INCOMING CALL WHEN LISTENING TO MUSIC FROM A THIRD DEVICE, NO HQ RING SIGNAL	Answer Incoming Call during Audio Streaming (MPMD) HFP Call Termination during AVP Connection (MPMD)
HFP+A2DP/VDP+AVRCP OUTGOING CALL WHILE LISTENING TO MUSIC FROM A THIRD DEVICE	Outgoing Call during Audio Streaming (MPMD) HFP Call Termination during AVP Connection (MPMD)
HFP+A2DP/VDP+AVRCP OUTGOING CALL WHILE LISTENING TO MUSIC	Outgoing Call during Audio Streaming (MPSD) HFP Call Termination during AVP Connection (MPSD)

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**Remark:** v1.1 of this White Paper contained references to VDP. Those references have been removed in v1.2 of this White Paper because they have not been considered relevant for the target use cases.

## 4 Configuration and Roles

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### 4.1 Media Player (MP)

The media player can, amongst other device types, be a portable media player (MP3 player, video player or mobile phone) or a fixed media player (home audio/video system or in-car audio/video system).

#### 4.1.1 Recommendation

The media player should support the following roles

- A2DP SRC.
- AVRCP 1.3 TG, category 1 and at minimum supporting PlayStatus and the Play, Pause and Stop commands.
- AVRCP 1.3 CT, category 2 and at minimum supporting AbsoluteVolume command and reporting functionality and the Volume Up and Down commands if A2DP SRC is supported.
- AVRCP TG, category 2 and at minimum supporting the Volume Up and Down commands if A2DP SRC is supported.

#### 4.1.2 Motivation

The media player should support A2DP SRC role to enable streaming of audio/video to an A2DP SNK device. It should support the AVRCP TG role to be able to receive incoming Play, Stop and other commands from the rendering device or the remote controller. It should also support the AVRCP CT role to be able to send volume up/down commands to the Rendering Device (RD, see Section 4.2). The third bullet above is important since not all rendering devices will have a local volume control or the rendering device (e.g., a loudspeaker, is not in the vicinity of the user).

The reason for the MP to be an AVRCP TG for category 2 is to allow a RC to connect to the MP and send Volume Up/Down commands to it.

### 4.2 Rendering Device (RD)

The rendering device can, amongst other device types, be headphones, loudspeakers, in-car audio systems or a video display with optional audio capabilities.

#### 4.2.1 Recommendation

The rendering device should support the following roles

- A2DP SNK.
- AVRCP 1.3 CT, category 1, supporting at minimum the Play, Pause, Stop and GetPlayStatus commands and the EVENT\_PLAYBACK\_STATUS\_CHANGED notification.

- AVRCP 1.3 TG, category 2, supporting at minimum AbsoluteVolume command and reporting functionality and the Volume Up and Down commands in case A2DP SNK is supported.

#### 4.2.2 Motivation

The rendering device should support A2DP SNK role to be able to receive audio from a media player. It should support the AVRCP CT role to be able to send AVRCP Play, Pause, Stop, Forward, Rewind and GetPlayStatus commands, among others, to the media player. The EVENT\_PLAYBACK\_STATUS\_CHANGED notification will ensure that the RD knows the play back state of the media player. It should also support the AVRCP TG role to allow the media player to change the volume on the rendering device by sending AVRCP Volume Up/Down commands to it.

Rendering devices without user input capabilities (e.g., home audio system loudspeakers, should not support the AVRCP CT role).

### 4.3 Remote Controller (RC)

The Remote Controller can, among other devices, be a device that only has the functionality of an RC; it can also be a multifunctional device that supports other functionality. Headphones can be seen as one example of a multifunctional device.

#### 4.3.1 Recommendation

The RC should support the following role

- AVRCP 1.3 CT, category 1 supporting at least the Play, Pause, Stop and GetPlayStatus commands and the EVENT\_PLAYBACK\_STATUS\_CHANGED notification.
- AVRCP 1.3 CT, category 2 supporting Volume Up and Down.

#### 4.3.2 Motivation

The RC should support the AVRCP CT role to be able to send play, stop, pause, and other commands to the media player. The EVENT\_PLAYBACK\_STATUS\_CHANGED notification will ensure that the RC knows the play back state of the media player.

### 4.4 Audio Gateway with Media Player (AG\_MP)

This kind of device has the capabilities defined in the HFP specification for AG (see [1]) and has the capabilities from Section 4.1. Typical devices are mobile phones.

#### 4.4.1 Recommendation

The Audio Gateway with Media Player should support the following roles:

- HFP 1.6 AG with Codec Negotiation.
- The same recommendation as Section 4.1.1.

#### 4.4.2 Motivation

The Audio Gateway with Media Player should support HFP AG role in order to handle voice calls as defined in HFP. Version 1.6 or higher of HFP should be supported because

- It clarifies who is responsible for opening (e)SCO.
- The recommended T2 settings for HFP (e)SCO configuration enhance the multi profile user experience by freeing more baseband slots for concurrent profiles.
- Codec Negotiation clarifies which device should connect the HFP audio link and when

For further motivation, see also Section [4.1.2](#).

### 4.5 Handsfree with Rendering Device Capabilities (HF\_RD)

This kind of device has the capabilities defined in the HFP specification for HF (see [\[1\]](#)) and has the capabilities for a rendering device (see Section [4.2](#)). Typical devices are headsets or car kits.

#### 4.5.1 Recommendation

The Handsfree with Rendering Device Capabilities should support the following roles:

- HFP 1.6 HF with Codec Negotiation.
- The same recommendation as [4.2.1](#).

#### 4.5.2 Motivation

The Handsfree with Rendering Device Capabilities should support HFP HF role in order to handle voice calls as defined in HFP. For further motivation, also see Sections [4.2.2](#) and [4.4.2](#).

## 5 Recommendations and Motivations

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This section summarizes all motivations and recommendations used in the different use cases.

### **Recommendation 1:**

In IDLE and ACTIVE states, the AVDTP and AVCTP signaling connections should not be released until the device is powered off or by explicit user action. This applies to both RD and MP.

### **Motivation 1:**

If the AVDTP connection is already established, the interval between streaming initiation to when audio starts streaming over the Bluetooth link is minimized because the re-establishment of the AVDTP/ACL connection can take a long time.

---

### **Recommendation 2:**

If there is no audio to stream from the MP to the RD, silence data patterns should not be sent. The streaming connection should be released or suspended by the MP instead.

### **Motivation 2:**

If silence data patterns are streamed between the MP and the RD, or no data sent but the connection remains in STREAMING state for a long time the battery lifetime will be significantly reduced.

---

### **Recommendation 3:**

An automatic reconnection policy can be used to reconnect the signaling connections after link loss. In this case only the RD side should reconnect. The number of attempts and periodicity are implementation dependent, but it is recommended to have a relatively small limit on the number of attempts to avoid battery drainage.

### **Motivation 3:**

Since a link loss is an unexpected behavior for the user, an automatic action of attempting to reconnect improves the user experience. MP should not try to reconnect to avoid collisions.

---

### **Recommendation 4:**

If an RD requests to play the next song (or any song in the play list) while AVDTP State is CONFIGURED/OPEN or STREAMING, the MP should check the encoding parameters of the song and may need to reconfigure the stream or release-establish-start the stream with the best CODEC parameters for the next song.

### **Motivation 4:**

This ensures better interoperability with older headsets.

---

### **Recommendation 5:**

If volume is changed on the RD, the RD should not send an AVRCP volume command to the MP device.

### **Motivation 5:**

Sending an AVRCP volume command to the MP may cause the MP to send again an AVRCP volume command to the RD device which could lead to an endless loop of AVRCP volume commands.

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**Recommendation 6:**

If a device receives an AVRCP volume command, it should not send back an AVRCP volume command.

**Motivation 6:**

This will ensure that an endless loop of volume commands does not happen with existing devices which do not comply with the recommendation.

---

**Recommendation 7:**

If any kind of inband ring tone is enabled, the HF\_RD should not produce an out-of-band ringing tone by itself.

**Motivation 7:**

This ensures that the user hears the AG\_MP generated ringing signal and not a mixture of this one and a locally generated ring tone.

---

**Recommendation 8:**

An AVRCP volume command should not change the HFP volume level in the HF\_RD device.

**Motivation 8:**

HFP has its own volume level commands. This simplifies the device state machine and avoids problems with volume levels in different states.

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**Recommendation 9:**

The HFP volume command should not change the volume on A2DP.

**Motivation 9:**

HFP has its own volume level commands. This simplifies the device state machine and avoids problems with volume levels in different states.

---

**Recommendation 10:**

The SBC stream should be encoded at maximum gain, and any volume adjustments should be done at the RD after decoding the SBC stream.

**Motivation 10:**

If the SBC stream is encoded at less than maximum level, and then the volume is increased at the RD, there will be a loss of precision that can result in lower audio quality.

---

**Recommendation 11:**

The media player application on the MP device should be aware of and handle the situation arising from the fact that the RD may send media player control commands at the same time as the device locally receives commands via the local UI or via a connected RC device

**Motivation 11:**

This will ensure that the MP does not go into a wrong state if the user initiates conflicting commands on two different UI devices at the same time.

---



**Recommendation 12:**

The commands sent from the RD should be interpreted as if they were entered locally on the MP device, as long as the normal behavior of the MP follows the other recommendations in the WP.

**Motivation 12:**

This will ensure that the user experience is the same regardless if the MP is controlled locally or using the CT.

---

**Recommendation 13:**

If a device uses GAVDP\_Suspend to pause/stop the stream, the same device is responsible to send GAVDP\_START.

**Motivation 13:**

The device suspending a stream knows when it is possible to resume the streaming again.

---

## 6 Scenarios

### 6.1 Use Cases for A2DP Together with AVRCP

For cases 6.1.1 to 6.1.3 the applicable devices are MP and RD.

#### 6.1.1 A2DP +AVRCP Handling a Playlist

##### 6.1.1.1 Pre-conditions

In [Table 1](#), the pre-conditions for this scenario are listed.

Device	MP	RD	RC
Paired with	RD, RC	MP	MP
AVCTP Signaling Channel established with	RD	MP	-
AVDTP Signaling Channel established with	RD	MP	-
AVDTP State	IDLE or STREAMING	IDLE or STREAMING	N/A

*Table 1: Pre-conditions; A2DP +AVRCP Handling a Playlist*

##### 6.1.1.2 User Actions

The following describes the use case scenario with user actions to start or skip audio tracks from any device.

Note: The actions done on the RC device can also be done from the RD device.

- User presses Play on MP, RD or RC.
- On MP, song end reached and next song started automatically.
- User presses Next on MP, RD or RC.

##### 6.1.1.3 Post Conditions

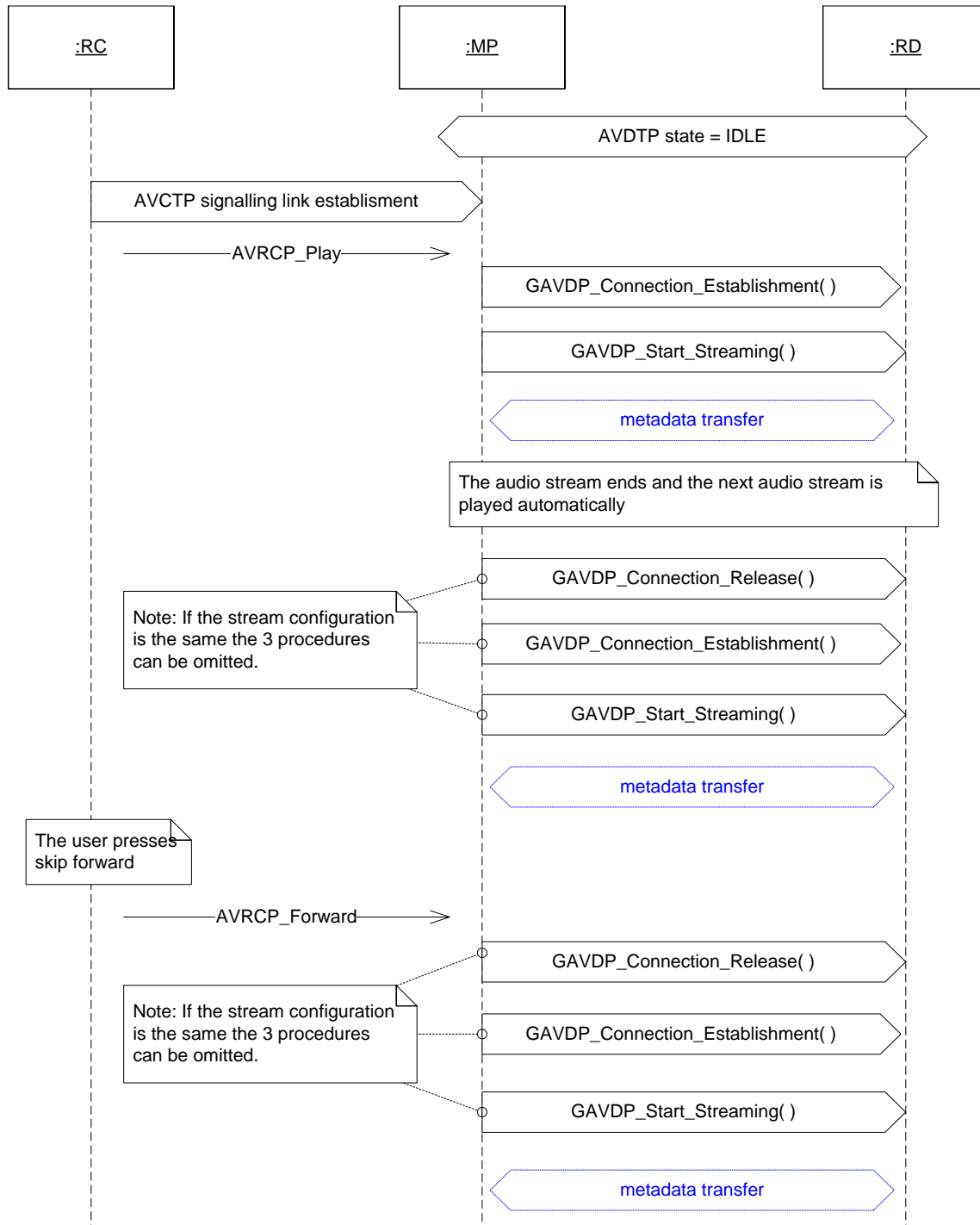
Device	MP	RD	RC
Paired with	RD, RC	MP	MP
AVCTP Signaling Channel established with	RD, RC	MP	MP
AVDTP Signaling Channel established with	RD	MP	-
AVDTP State	STREAMING	STREAMING	N/A

*Table 2: Post-conditions; A2DP +AVRCP Handling a Playlist*

##### 6.1.1.4 Recommendation

See [Recommendation 4](#) from [Section 5](#).

6.1.1.5 Message Sequence Charts



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Figure 6.1: A2DP +AVRCP Handling a Playlist

## 6.1.2 A2DP +AVRCP Change of Volume

### 6.1.2.1 Pre-conditions

In [Table 3](#), the pre-conditions for this scenario are listed.

Device	MP	RD	RC
Paired with	RD, RC	MP	MP
AVCTP Signaling Channel established with	RD, RC	MP	MP
AVDTP Signaling Channel established with	RD	MP	-
AVDTP State	Any	Any	N/A

**Table 3:** Pre-conditions; A2DP +AVRCP Change of volume

### 6.1.2.2 User Actions

The following describes the step that the user takes to increase the volume in the headset.

- From MP or RC: The user changes the volume either on the MP or RC.

### 6.1.2.3 Post Conditions

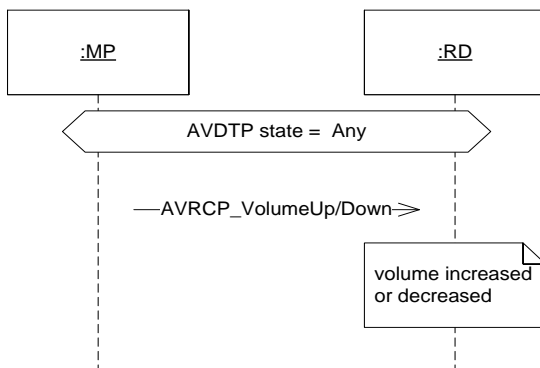
Device	MP	RD	RC
Paired with	RD, RC	MP	MP
AVCTP Signaling Channel established with	RD, RC	MP	MP
AVDTP Signaling Channel established with	RD	MP	-
AVDTP State	Any	Any	N/A

**Table 4:** Post-conditions; A2DP +AVRCP Change of volume

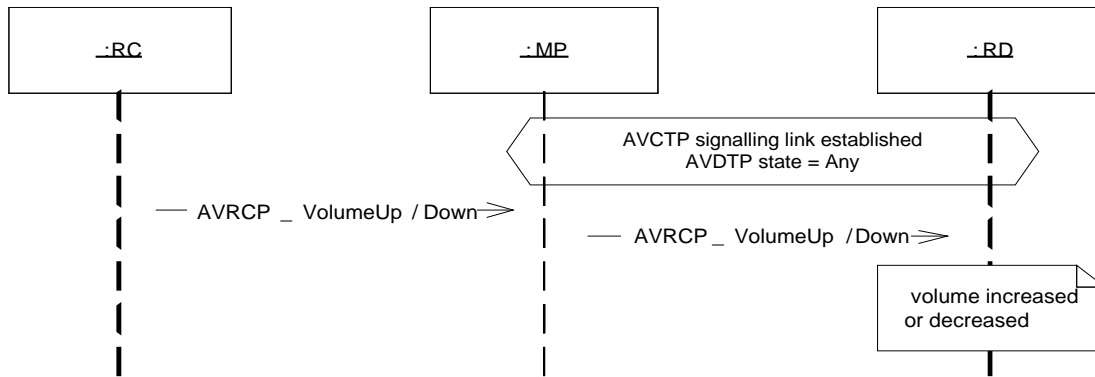
### 6.1.2.4 Recommendation

See [Recommendation 5](#) and [Recommendation 6](#) from Section 5.

### 6.1.2.5 Message Sequence Charts



**Figure 6.2:** A2DP +AVRCP Change of volume initiated from MP



**Figure 6.3:** A2DP +AVRCP Change of volume initiated from RC

The volume command from RC is forwarded by MP to the RD, which leads to a volume increase or decrease in RD.

## 6.2 Use Cases for HFP + A2DP + AVRCP

### 6.2.1 HFP+A2DP +AVRCP Change of Volume

#### 6.2.1.1 Pre-conditions

The pre-conditions are the same as stated in Section 6.1.2.1. In addition, a HFP service level connection between AG\_MP and HF\_RD has been established.

#### 6.2.1.2 User Actions

The user actions are the same as stated in Section 6.1.2.2.

#### 6.2.1.3 Post Conditions

The post-conditions are the same as stated in Section 6.1.2.3. In addition a HFP service level connection between AG\_MP and HF\_RD has been established.

#### 6.2.1.4 Recommendation

The recommendations are the same as stated in Section 6.1.2.4.

See [Recommendation 8](#) and [Recommendation 9](#) from Section 5.

#### 6.2.1.5 Message Sequence Charts

The message sequence charts are the same as shown in Section 6.1.2.5.

## 7 References

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Item	Title
[1]	HFP specification 1.6 (HFP_1.6_SPEC_V10) or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[2]	AVDTP specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[3]	A2DP specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[4]	AVCTP specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[5]	AVRCP specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[6]	GAVDP specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>
[7]	MPS specification 1.0 or later from <a href="http://www.bluetooth.org">www.bluetooth.org</a>

## Appendix: List of Supported Recommendations

The following table may be used to communicate which recommendations from this White Paper are supported in a certain product. It may for example voluntarily be attached to a Bluetooth device listing on qualweb or be used in communications between companies.

The *Support* column may also be used to provide any additional useful information on the support of a certain recommendation in a product in textual form.

Product Name	[insert your product name here]
QD ID /QP ID	[insert ID here]
Role	Support (y, n, comment)
Media Player	
Rendering Device	
Remote Controller	
Audio Gateway with Media Player	
Handsfree with Rendering Device Capabilities	

Recommendation	Role	Support (y, n, comment)
1	Signaling channel release point of time	
2	No silence data pattern streaming	
3	Re-connect after link loss	
4	Codec configuration for new track	
5	No AVRCP volume command from RD	
6	No sending back of AVRCP volume command	
7	HF_PRD should not generate ring signal	
8	Volume relationship AVRCP -> HFP	
9	Volume relationship HFP -> AVRCP	
10	SBC stream encoded volume level	
11	Coexistence AVRCP with local user action on MP	
12	Identity AVRCP with local user action on MP	
13	Restart streaming from MP after RD suspends	

V1.2