RW BLE Audio Mode 0 - Hearing Aid Service (HAS) Interface Specification

Interface Specification
RW-BLE-PRF-AM0-HAS-IS
Version 8.00
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Revision History

Version	Date	Revision Description	Author
8.00	2016-01-22	First Document version	FBELOUIN

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Abbreviations

Abbreviation	Original Terminology
AM0	Audio Mode 0
API	Application Programming Interface
AS	Authentication Service
BLE	Bluetooth Low Energy
DIS	Device Information Service
GAP	Generic Access Profile
GATT	Generic Attribute Profile
HAS	Hearing Aid Service
RW	RivieraWaves

1 Overview

1.1 Document Overview

This document describes the non-standard interface of the RW BLE Hearing Aid Service for AM0 implementation. Along this document, the interface messages will be referred to as API messages for the profile block(s).

Their description will include their utility and reason for implementation for a better understanding of the user and the developer that may one day need to interface them from a higher application.

1.2 Protocol Overview

The Hearing Aid Service is a proprietary profile for configuring the Hearing Aid device over a BLE link. This profile service is also used to authenticate device using a RSA-1024 signature mechanism.

Within the profile, one role is supported: **Sensor**. The Sensor must support the GAP Peripheral role.

Note: Device Information Service should also be present to fully support Hearing Aid Service.

1.3 Firmware Implementation Overview

Basically, if a device needs only be Hearing aid device, the firmware should be compiled with sensor role only. Hearing Aid Service and Authentication Service databases are created dynamically in peripheral role.

The Applications which will control the roles on end-products are responsible with creating the connection between the devices, using suggested advertising intervals and data, connection intervals, security levels, etc. The Profile implementation allows modulating the behavior depending on the final needs. Profile role enabling should be immediate after connection creation in order to allow correct profile behavior with the peer device.

2 Hearing Aid Service

This role is meant to be activated on the device that acts as Hearing Aid Device in order to provide configuration interface and Device Authentication service over GATT protocol. Please refer to “am0_has_task.h” for implementation of this API.

2.1 Authentication Service Information

Certificate key shall be in DER format with a size less or equals 1024 bytes. This certificate must be divided in two parts:

- Cert_Part_A: First 512 bytes of certificate key
- Cert_Part_B: Second part of certificate that starts from byte 512 to last byte of certificate.

Private Key contains only five 64 bytes sub keys (p, q, dp, dq and qInv) of Private key in DER Format.

You can find all sub keys of a private key in DER format using following command:

```
openssl asn1parse -inform DER -in priv_key.der
```

```
  0:d=0  hl=4 l= 605 cons: SEQUENCE
  4:d=1  hl=2 l=   1 prim: INTEGER           :00
  7:d=1  hl=3 l= 129 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key n
139:d=1  hl=2 l=   3 prim: INTEGER           :010001             --> Sub Key e
144:d=1  hl=3 l= 128 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key d
275:d=1  hl=2 l=  65 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key p
342:d=1  hl=2 l=  65 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key q
409:d=1  hl=2 l=  64 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key dp
475:d=1  hl=2 l=  65 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key dq
542:d=1  hl=2 l=  65 prim: INTEGER           :00AABBCCDDEEFF …   --> Sub Key qInv
```

This task only has two states, IDLE and BUSY.

2.2 Initialization / Database Creation

During the initialization phase of the device, to use the Hearing Aid Service task, the AM0_HAS task has to be allocated and corresponding attribute database initialized, using GAPM API. Application has to send GAPM_PROFILE_TASK_ADD_CMD [4] with specific device required security level and following parameters.

Parameters:

Type	Parameters	Description
uint32_t	ava_progs_version	Available Program Version
uint8_t	ear	Left or Right ear (see Table 6)
uint8_t	audio_mix_support	Audio Mixing support (see Table 7)
uint8_t	mic_volume	Microphone volume (range [0:255] 0 = mute)
uint8_t	sec_stream_volume	2nd Stream volume (range [0:255] 0 = mute)
uint8_t	active_prog_id	Active program identifier
uint8_t	batt_lvl	Current Battery Level (range [0:10])

Please note that the Hearing Aid Service requires the presence of three DIS characteristic: *Manufacturer Name String, Model Number String, Hardware Revision String, Firmware Revision String, PnP ID, Vendor Identifier and Product Identifier*. It is application's responsibility to add an instance of the DIS into the database by using the DISS_CREATE_DB_REQ API message (please see the RW BLE Device Information Service Interface Specification document [6]).

2.3 AM0_HAS_CMP_EVT

Parameters:

Type	Parameters	Description
uint8_t	status	Status Code of the executed operation (see 3.1)

Response:

None

Description:

This API message is used when operation is over to give back status of proceed operation.

2.4 AM0_HAS_SET_PAIRABLE_MODE_CMD

Parameters:

Type	Parameters	Description
uint8_t	mode	Pairable, non-pairable mode (see Table 9)

Response:

AM0_HAS_CMP_EVT

Description:

This API message is used for configuring the service in set the pairable mode or not (it means if pairing has been performed or not).

2.5 AM0_HAS_RESTORE_BOND_DATA_CMD

Parameters:

Type	Parameters	Description
uint8_t	conidx	Connection index
uint8_t	last_active_prog_id	Last active program identifier
uint16_t	ntf_cfg	Notification configuration
uint32_t	last_progs_version	Last programs version
uint8_t	last_batt_lvl	Last Current Battery Level (range [0:10])
uint8_t	last_mic_volume	Last Microphone volume (range [0:255] 0 = mute)
uint8_t	last_sec_stream_volume	Last 2nd Stream volume (range [0:255] 0 = mute)

Response:

AM0_HAS_CMP_EVT

Description:

This API message is used for restoring bond data on a specific connection.

2.6 AM0_HAS_UPDATE_VAL_CMD

Parameters:

Type	Parameters	Description
uint8_t	value	Value to update (see Table 4) - AM0_HAS_AVA_PROGS_VERSION - AM0_HAS_BATT_LVL - AM0_HAS_MIC_VOLUME - AM0_HAS_2ND_STREAM_VOLUME - AM0_HAS_ACTIVE_PROG_ID
union am0_has_up	up	Updated value (see Table 1)

❖ union am0_has_up

Type	Parameters	Description
uint32_t	progs_version	programs version (value = AM0_HAS_AVA_PROGS_VERSION)
uint8_t	batt_lvl	Current Battery Level (value = AM0_HAS_BATT_LVL)
uint8_t	volume	Volume (value = AM0_HAS_MIC_VOLUME or AM0_HAS_2ND_STREAM_VOLUME)
uint8_t	prog_id	Program identifier (value = AM0_HAS_ACTIVE_PROG_ID)

Table 1: Updated value

Response:

AM0_HAS_CMP_EVT

Description:

This API message is used for updating service value and inform peer device if notification are enabled

2.7 AM0_NTF_CFG_UPDATE_IND

Parameters:

Type	Parameters	Description
uint8_t	conidx	Connection index
uint16_t	ntf_cfg	Notification bit field to store in non-volatile memory

Response:

None

Description:

Event triggered when notification configuration for specific connection has been updated.

2.8 AM0_HAS_READ_VAL_REQ_IND

Parameters:

Type	Parameters	Description
uint8_t	value	Value to read (see Table 4) - AM0_HAS_IDENTIFIER - AM0_HAS_OTHER_IDENTIFIER - AM0_HAS_AVA_PROGS_BIT_MASK - AM0_HAS_SELECTED_PROG_NAME - AM0_HAS_SELECTED_PROG_ID - AM0_HAS_SELECTED_PROG_CAT

Response:

AM0_HAS_READ_VAL_CFM

Description:

This Event is triggered when a peer device request for a Hearing Aid service information.

2.9 AM0_HAS_READ_VAL_CFM

Parameters:

Type	Parameters	Description
uint8_t	value	Value information (see Table 4) - AM0_HAS_IDENTIFIER - AM0_HAS_OTHER_IDENTIFIER - AM0_HAS_AVA_PROGS_BIT_MASK - AM0_HAS_SELECTED_PROG_NAME - AM0_HAS_SELECTED_PROG_ID - AM0_HAS_SELECTED_PROG_CAT
uint8_t	status	Status Code of the request (see 3.1)
union am0_has_res	res	Result value (see Table 2)

❖ union am0_has_res

Type	Parameters	Description
struct am0_has_array	array	Array value (see Table 10) (value = AM0_HAS_IDENTIFIER, AM0_HAS_OTHER_IDENTIFIER, AM0_HAS_AVA_PROGS_BIT_MASK or AM0_HAS_SELECTED_PROG_NAME)
uint8_t	prog_id	Program identifier (value = AM0_HAS_SELECTED_PROG_ID)
uint8_t	category	Program Category (value = AM0_HAS_SELECTED_PROG_CAT)

Table 2: Result value

Response:

None

Description:

This API is used for providing Hearing Aid service information requested by peer device.

2.10 AM0_HAS_WRITE_VAL_REQ_IND

Parameters:

Type	Parameters	Description
uint8_t	value	Value to read (see Table 4) - AM0_HAS_SELECTED_PROG_NAME - AM0_HAS_MIC_VOLUME - AM0_HAS_2ND_STREAM_VOLUME - AM0_HAS_ACTIVE_PROG_ID - AM0_HAS_SELECTED_PROG_ID - AM0_HAS_SELECTED_PROG_CAT
union am0_has_req	req	Requested value (see Table 3)

❖ union am0_has_req

Type	Parameters	Description
struct am0_has_array	array	Array value (see Table 10) (value = AM0_HAS_SELECTED_PROG_NAME)
uint8_t	volume	Volume (value = AM0_HAS_MIC_VOLUME or AM0_HAS_2ND_STREAM_VOLUME)
uint8_t	prog_id	Program identifier (value = AM0_HAS_ACTIVE_PROG_ID or AM0_HAS_SELECTED_PROG_ID)
uint8_t	category	Program Category (value = AM0_HAS_SELECTED_PROG_CAT)

Table 3: Requested value

Response:

AM0_HAS_WRITE_VAL_CFM

Description:

This Event is triggered when a peer device request to update information, configuration of the Hearing Aid service.

2.11 AM0_HAS_WRITE_VAL_CFM

Parameters:

Type	Parameters	Description
uint8_t	value	Value information (see Table 4) - AM0_HAS_SELECTED_PROG_NAME - AM0_HAS_MIC_VOLUME - AM0_HAS_2ND_STREAM_VOLUME - AM0_HAS_ACTIVE_PROG_ID - AM0_HAS_SELECTED_PROG_ID - AM0_HAS_SELECTED_PROG_CAT
uint8_t	status	Status Code of the request (see 3.1)

Response:

None

Description:

This API is used for confirming if information or configuration requested by peer device has been applied in Hearing Aid device.

2.12 AM0_HAS_GET_AUTH_INFO_REQ_IND

Parameters:

Type	Parameters	Description
uint8_t	info	Information to retrieve (see Table 5)

Response:

AM0_HAS_GET_AUTH_INFO_CFM

Description:

This Event is triggered when a peer device is using authentication service to challenge the device and verifies if it's authorized.

2.13 AM0_HAS_GET_AUTH_INFO_CFM

Parameters:

Type	Parameters	Description
uint8_t	value	Information retrieved (see Table 5)
uint8_t	status	Status Code of the request (see 3.1)
struct am0_has_array	array	Array value of different certificate or key requested(see Table 10)

Response:

None

Description:

This API is used for providing Authentication service information required to authentify service.

3 Miscellaneous

3.1 Error Codes

See RW BLE Host Error Code Interface Specification [3]

3.2 Types

❖ am0_has_char

Value	Flag	Description
0x00	AM0_HAS_INVALID	Invalid value characteristic
0x01	AM0_HAS_BATT_LVL	Device Battery Level
0x02	AM0_HAS_IDENTIFIER	Hearing Aid Identifier
0x03	AM0_HAS_OTHER_IDENTIFIER	Other ear Hearing Aid Identifier
0x04	AM0_HAS_MIC_VOLUME	Microphone volume
0x05	AM0_HAS_2ND_STREAM_VOLUME	2nd Stream volume (range [0:255] 0 = mute)
0x06	AM0_HAS_AVA_PROGS_BIT_MASK	Available programs bit mask
0x07	AM0_HAS_ACTIVE_PROG_ID	Active program identifier
0x08	AM0_HAS_AVA_PROGS_VERSION	Available programs version
0x09	AM0_HAS_SELECTED_PROG_ID	Selected program Identifier
0x0A	AM0_HAS_SELECTED_PROG_NAME	Selected program Name
0x0B	AM0_HAS_SELECTED_PROG_CAT	Selected program Category

Table 4: Hearing Aid Service configuration

❖ am0_as_char

Value	Flag	Description
0x0C	AM0_AS_CERTIFICATE_PART_A	First part of the X.509 certificate (bytes 0 to 511)
0x0D	AM0_AS_CERTIFICATE_PART_B	Second part of the X.509 certificate (bytes 512 to end of certificate)
0x0E	AM0_AS_PRIVATE_KEY	Authentication Private Key to calculate the challenge response using RSA (only 64 bytes sub keys p, q, dp, dq and qInv, see 2.1)

Table 5: Authentication Service information

❖ am0_ear

Value	Flag	Description
0x00	AM0_EAR_LEFT	Left ear
0x01	AM0_EAR_RIGHT	Right ear

Table 6: Left or Right ear

❖ am0_audio_mix

Value	Flag	Description
0x00	AM0_MIX_NOT_SUPPORTED	Audio mixing not supported
0x01	AM0_MIX_SUPPORTED	Audio mixing supported

Table 7: Audio mixing support

❖ am0_prog_cat

Value	Flag	Description
0x00	AM0_CAT_RESERVED	Reserved
0x01	AM0_CAT_DEFAULT	Default
0x02	AM0_CAT_RESTAURANT	Restaurant
0x03	AM0_CAT_CONCERT	Concert
0x04	AM0_CAT_CAR	Car
0x05	AM0_CAT_OUTDOORS	Outdoors
0x06	AM0_CAT_TELEVISION	Television
0x07	AM0_CAT_USER_DEFINED	User Defined
[0x08-0xC7]		Reserved
0xC8	AM0_CAT_TELECOIL_STREAMER	Telecoil Streamer
0xC9	AM0_CAT_TELEVISION_STREAMER	Television Streamer
[0xCA-0xFE]		Reserved
0xFF	AM0_CAT_GENERIC_STREAMER	Audio mixing supported

Table 8: Audio program categories

❖ am0_has_mode

Value	Flag	Description
0x00	AM0_MODE_NON_PAIRABLE_MODE	Non Pairable mode (when a pairing has been already performed)
0x01	AM0_MODE_PAIRABLE_MODE	Pairable mode (expect a pairing to be performed)

Table 9: Pairable, non-pairable mode

❖ am0_has_array

Type	Parameters	Description
uint16_t	len	Data length
uint8_t[len]	data	Data value

Table 10: Array value

References

[1]	**Title**	Device Information Service		
	Reference	DIS_SPEC_V10		
	Version	V10r00	**Date**	May 24th 2011
	Source	Bluetooth SIG – Medical Working Group		

[2]	**Title**	Device Information Service (DIS) 1.0		
	Reference	DIS.TS.1.0.0		
	Version	1.0.0	**Date**	May 24th 2011
	Source	Bluetooth SIG		
[3]	**Title**	RW BLE Host Error Code Interface Specification		
	Reference	RW-BLE-HOST-ERR-CODE-IS		
	Version	8.01	**Date**	2015-10-26
	Source	RivieraWaves SAS		

[4]	**Title**	GAP Interface Specification		
	Reference	RW-BLE-GAP-IS		
	Version	8.03	**Date**	2015-10-26
	Source	RivieraWaves SAS		

[5]	**Title**	GATT Interface Specification		
	Reference	RW-BLE-GATT-IS		
	Version	8.02	**Date**	2015-10-22
	Source	RivieraWaves SAS		

[6]	**Title**	DIS Interface Specification		
	Reference	RW-BLE-DIS-IS		
	Version	8.0	**Date**	2015-07-29
	Source	RivieraWaves SAS		