

Simply Blue Audio Link Support

Texas Instruments
Application Note 1712
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1.0 Introduction

This document gives an introduction on the audio support on Simply Blue Bluetooth modules from Texas Instruments.

2.0 Audio Support on Simply Blue

2.1 AUDIO SUPPORT

The Simply Blue Modules LMX9830 and LMX9838 from Texas Instruments can support up to 7 active data links and 1 active audio link at a time.

Each module offers commands allowing to establish or to accept synchronous audio links. The audio data will be routed within the Simply Blue Module between the bluetooth base-band connection and the Advanced Audio interface. In order to encode or decode the PCM stream generated by the internal CVSD codec, an external codec or DSP has to be connected to the advanced audio interface. Alternatively the data can be used for further digital processing.

It also gives guidelines on audio link creation from or to a Simply Blue Bluetooth module.

For more details on the audio support and management please refer to [1].

The AAI is configured by predefined codec settings, selected in NVS. The NVS setting configures the bit rate as well as the format like PCM log or linear. In addition, the interface can be configured to "PCM Slave" in which the external codec or DSP needs to provide the synchronous clock and frame sync signal. Please refer to [1] for more details.

The Bluetooth standard defines CVSD, u-Law and A-Law to be used as format on the bluetooth link. This settings is also configured within the NVS.

Figure 1 shows a typical application block diagram, how to connect the audio codec.

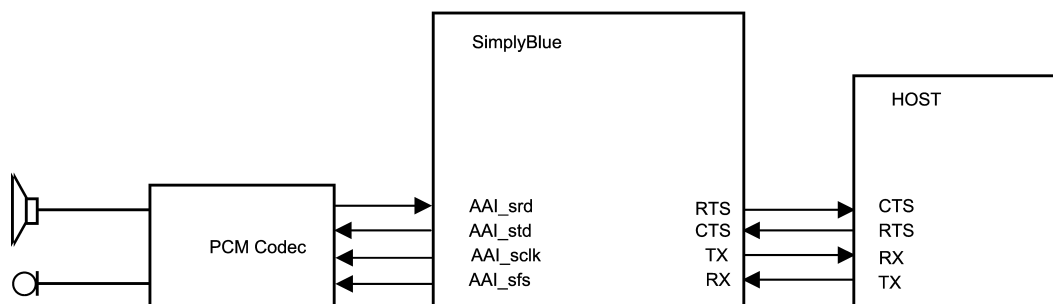


Figure 1. Typical audio connection on Simply Blue

2.2 BLUETOOTH BACKGROUND

A standard bluetooth link consists of asynchronous connection less (ACL) links, meaning, data are sent by request from the master to slave. Since the slave has to wait for the master polls to be able to transmit data, these ACL links are not suitable for audio links. For this, the bluetooth specification defines the synchronous connection-oriented (SCO) links., which are used to transport real-time audio data. On SCO links, master and slave communicate on dedicated reserved slots. The frequency on which the master and slave will exchange packages is defined by the package type.

The existing different SCO package types are the following:

- HV3:
 - 30 bytes per package
 - no FEC — Master and slave exchange data every 6 slots; link consumes about 33% of the complete bluetooth bandwidth
- mostly used since it leaves most flexibility for other bluetooth links.
- HV2:
 - 20 bytes per package
 - 2/3 FEC — Master and slave exchange data every 4 slots; link consumes 50% of the complete bluetooth bandwidth
- HV1:
 - 10 bytes per package
 - 1/3 FEC — Master and slave exchange data every 2nd slot; link consumes 100% of the complete bluetooth bandwidth, no other link possible

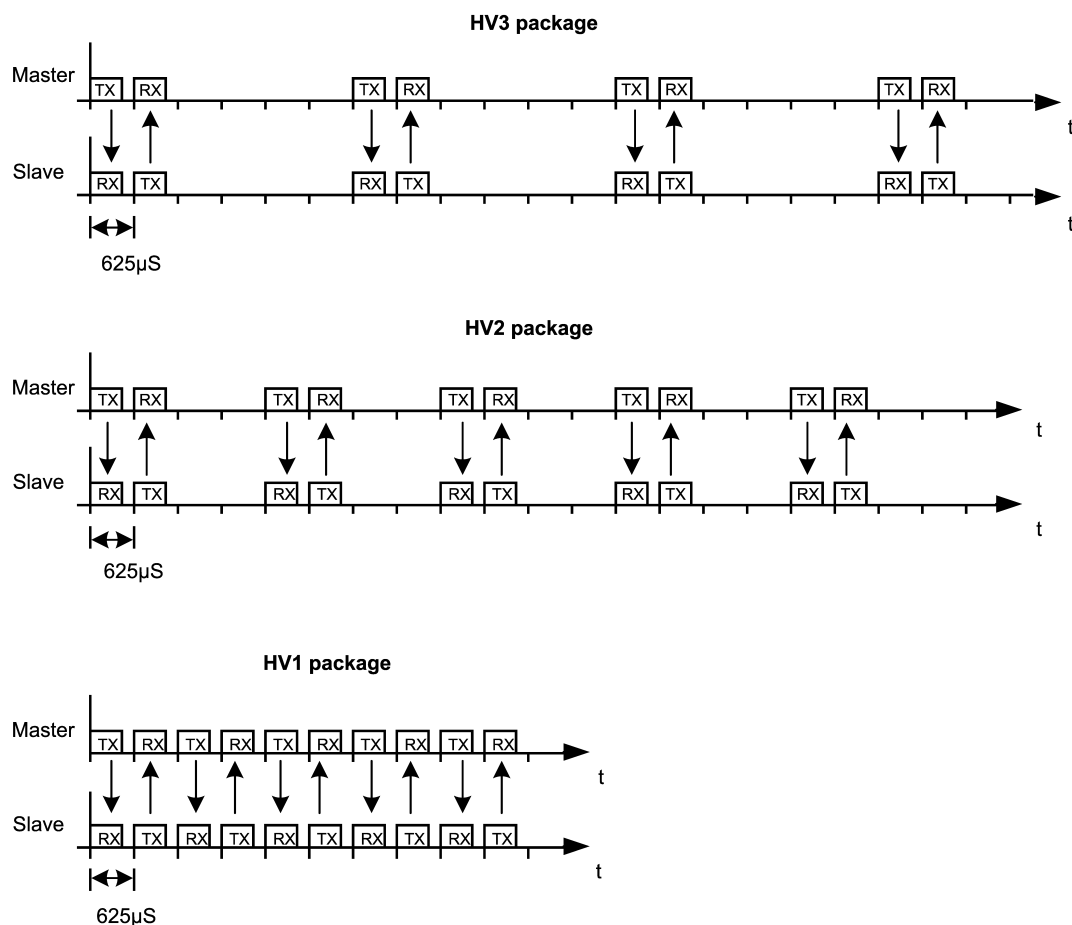


Figure 2. SCO link bandwidth requirements

2.3 ROUTING OF AUDIO DATA

The Simply Blue Module offers the Advanced audio interface (AAI), also called PCM interface, in order to connect an external PCM codec. The codec is used to convert the analog microphone signals into the digital PCM stream, which is then directly routed to an existing bluetooth SCO link. The same way, any incoming SCO data will be directly routed to the PCM interface to be converted into analog loudspeaker signals by the external codec.

Each SCO link is based on a previously established ACL link. The ACL link is used for the standard SPP profile. Because of this it is possible to have simultaneous data and voice transmissions. See Figure 3 on page 2 for the split between SCO and ACL/SPP data routing.

NOTE: Simultaneous data transmission is always possible even if SCO package type HV1 is used. Invisible to the user, the bluetooth link will use the mixed data/voice package DV, which allows to transport both data and synchronous audio.

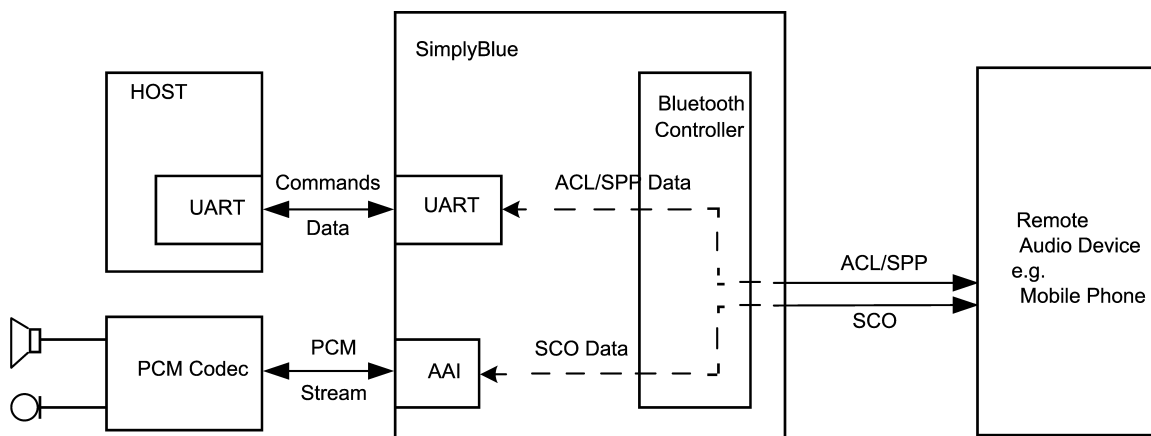


Figure 3. SCO and ACL/SPP routing within Simply Blue Module

3.0 Audio Link on Simply Blue modules

3.1 DEVICE CONFIGURATION

To get a successful audio link with a Simply Blue module the following steps should be performed.

- 1) Set Audio Settings
- 2) Create a service record in the Service Database
- 3) Set Ports to open
- 4) Get the remote port to connect to
- 5) Create SPP link
- 6) Create SCO link

definition includes the air interface type and the codec settings. The air interface can be

- CVSD
- A-Law
- μ -Law

The codec settings can be one of the following

- PCM Master OKI type
- PCM Master Winbond type
- PCM Slave. In that case the Simply Blue module requires the PCM Slave settings as well.

The audio parameters are set in the module by sending the SET_DEFAULT_AUDIO_SETTINGS command.

3.1.1 Set Audio Settings

The first step to proceed with is to define the audio parameters to be in use on the Simply Blue module. This setting

Table 1 shows an example of setting the air interface to CVSD and the codec setting to PCM Master OKI codec type using Simply Blue commander as reference.

Table 1. Audio setting definition on Simply Blue

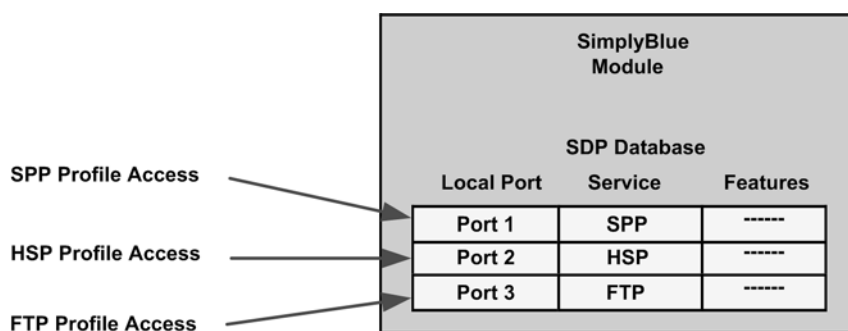
Direction	What	Hex Code	Interpreted by Simply Blue Commander
TX	Request	02,52,5B,02,00,AF,02,00,03	Tx: Cmd: Set Default Audio Settings, Codec Type: 02, Air Format: 00
RX	Confirm	02,43,5B,01,00,9F,00,03	Rx: Event: Set Default Audio Settings, Status: 00

For more details on the command and the settings options, refer to [1].

3.1.2 Create a service record in the Service Database

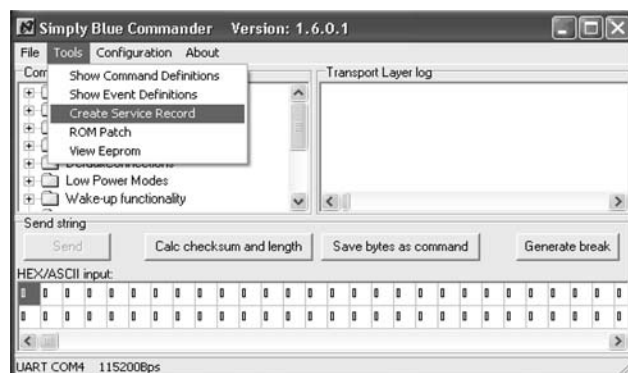
The Service Database contains a list of supported services and their features. A service must be created and stored in

the internal database for each supported Profile. In the example below, the end system shall support SPP profile, Headset Profile, File Transfer Profile. Therefore a list of 3 records is created and stored within the Simply Blue Module.



Example of a Service Database stored in a SimplyBlue module

To create a record using Simply Blue commander, go to Tools -> Create Service Record.



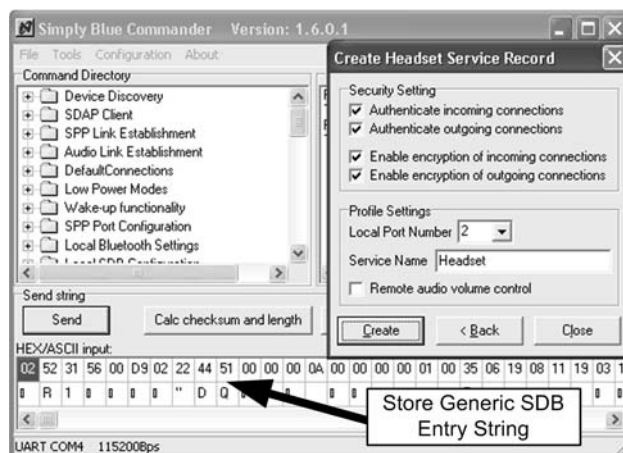
Select the service desired and the local port to be mapped to.



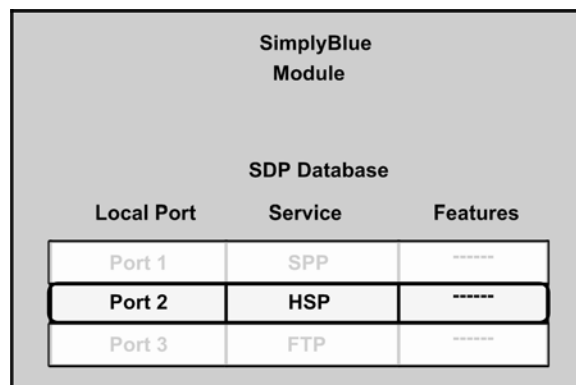
In this example we create a Headset record mapped to the local port 02.



Press the Create button to create the record. The command line of Simply Blue commander will be automatically filled by the SEND_GENERIC_SDB_ENTRY command with the selected service and its features as parameters. Press Send button to send the command to the module.



At this point the module has the default SPP service record, mapped to local port 01, stored in the SDB base at index 00 and the HSP service record, mapped to local port 02, stored in the SDB base at index 01.



3.1.3 Set Ports to open

To be able to create a Bluetooth link on between the module and the remote device, the specific ports to be used must be opened on both devices. In our example we suppose the remote device giving access to all available ports.

A port can be opened on a Simply Blue device using the SET_PORTS_TO_OPEN command. Table 2 shows the communication exchange between the module and the host device when opening the local ports 1, 2 and 3.

Table 2. Open Local Ports 1, 2 and 3 on Simply Blue

Direction	What	Hex Code	Interpreted by Simply Blue Commander
TX	Request	02,52,22,04,00,78,07,00,00,00,03	Tx: Cmd: Set Ports To Open, Ports: 07000000
RX	Confirm	02,43,22,01,00,66,00,03	Rx: Event: Set Ports To Open, Status: 00

For more details on the command and the settings options, refer to [1].

3.1.4 Get the remote port to connect to

A Bluetooth link is established between the local port of the local device and the local port of the remote device also called remote port. This remote port must be known in order to establish a Bluetooth link. To get the remote port of a device, an SDAP procedure as indicated below must take place:

- 1) Perform an SDAP connection to the remote device to inquire
- 2) Send an SDAP Browse, Search or Request to get the list of the supported devices and their assigned ports.
- 3) Disconnect

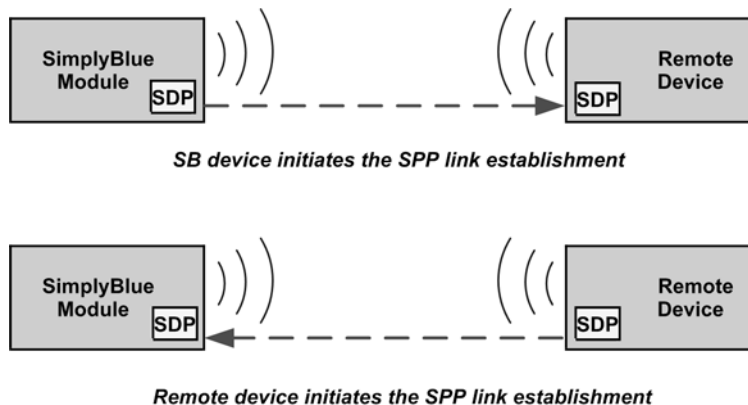
Table 3 shows the communication flow of an SDAP procedure as reference.

Table 3. Get the remote port of a specific service

Direction	What	Hex Code	Interpreted by Simply Blue Commander
TX	Request	02,52,32,06,00,8A,72,0B,7A,E0,20,00,03	Tx: Cmd: SDAP Connect, BdAddr: 720B7AE02000
RX	Confirm	02,43,32,01,00,76,00,03	Rx: Event: SDAP Connect, Status: 00
TX	Request	02,52,35,02,00,89,12,11,03	Tx: Cmd: Service Browse, Browse Group ID: 1211
RX	Confirm	02,43,35,16,00,8E,00,01,02,10,12,11,07,0E,41,75,64,69,6F,20,47,61,74,65,77,61,79,00,03	Rx: Event: Service Browse, Status: 00, Browse Group ID:0210, Service ID:1211, PortNo:07, Service Name:Audio Gateway
TX	Request	02,52,33,00,00,85,03	Tx: Cmd: SDAP Disconnect
RX	Confirm	02,43,33,01,00,77,00,03	Rx: Event: SDAP Disconnect, Status: 00

3.1.5 Create SPP link

An SPP link needs to be established between the remote device and the Simply Blue module. The link can be initiated by either part.



In case the Simply Blue module initiates the link, the host needs to send the SPP_ESTABLISH_LINK command to the module with as parameters the local port and remote port corresponding to the profile to be used. In our example, the Headset service is mapped to the local port 02 (see Section 3.1.2) and the Audio Gateway service is mapped to the remote port 07 (see Section 3.1.4).

Once the link is successfully established, the module sends the LINK_ESTABLISHED indicator with status 0.

Table 4 shows the communication flow of the module establishing the link.

Table 4. Simply Blue module establishes the SPP Link

Direction	What	Hex Code	Interpreted by Simply Blue Commander
TX	Request	02,52,0A,08,00,64,02,72,0B,7A,E0,20,00,07,03	Tx: Cmd: Establish Link, Local Port: 02, BdAddr: 720B7AE02000, Remote Port Number: 07
RX	Confirm	02,43,0A,02,00,4F,00,02,03	Rx: Establish Link, Status: 00, Local Port: 02
RX	Indicator	02,69,0B,09,00,7D,00,72,0B,7A,E0,20,00,02,07,03	Rx: Event: Link Established, Status: 00, BdAddr: 720B7AE02000, Local Port: 02, Remote Port Number: 07

3.1.6 Create SCO link

The SCO link can be established between the Simply Blue module and the remote device when the SPP link is successfully established (see Section 3.1.5).

The establishment of the SCO link can be done by either part, depending on the profile implementation and features.

To establish the SCO link from the Simply Blue module, the GAP_ESTABLISH_SCO_LINK command needs to be sent with the Bd Address of the remote device as parameter.

Table 5 shows the communication flow of the module establishing the SCO link using HV3 packet type.

Table 5. Simply Blue module Establishes the SCO Link

Direction	What	Hex Code	Interpreted by Simply Blue Commander
TX	Request	02,52,5D,08,00,B7,72,0B,7A,E0,20,00,80,00,03	Tx: Cmd: Establish SCO Link, BdAddr: 720B7AE02000, Packet Type 8000
RX	Confirm	02,43,5D,07,00,A7,00,72,0B,7A,E0,20,00,03	Rx: Establish SCO Link, Status: 00, BdAddr: 720B7AE02000
RX	Indicator	02,69,5D,07,00,CD,00,72,0B,7A,E0,20,00,03	Rx: Event: SCO Link Established, Status: 00, BdAddr: 720B7AE02000

3.1.7 General Notes

Once an SPP link is created between the module and the remote device, the module might receive informations relative to the profile like the list of supported features on the remote device, a RING message representing a call and other features. The SCO link might be accepted or not by the remote device depending on the profile implementation.

It is recommended to check the reason of an error code (i.e Status Byte different than 0). See [1] for reference.

Also for profile implementation, refer to [1], [2] and the specific profile specification available on the Bluetooth SIG web page.

4.0 Bibliography

- [1] AN1699 - LMX9838 Software User's Guide
- [2] LMX9830 Software User's Guide
- [3] AN1707 - Simply Blue Bluetooth Profile Application Note
- [4] Bluetooth SIG: Specification of the Bluetooth System 1.2, November 05 2003
- [5] Bluetooth SIG: Specification of the Bluetooth System 1.1, Volume 2 / Profiles, Version 1.1, February 22 2001
- [6] Bluetooth SIG: Bluetooth Assigned Numbers, <https://programs.bluetooth.org/technical/assignednumbers/home.htm>
- [7] Bluetooth SIG: Bluetooth Profile Specifications: https://programs.bluetooth.org/apps/content/?doc_id=44515

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