



BlueCore[®]

BC6145[™] and CSR86xx Voice Prompts

Application Note

Issue 2



Document History

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1. Introduction

Voice prompts refer to audio data stored in external EEPROM or SPI Flash to be streamed into the DAC over the I²C bus. These fixed audio prompts can be associated with headset events to enable more meaningful user feedback.

This document gives an overview of the operation of voice prompts in the firmware and the headset application and details of how to add and configure voice prompts in a headset application using the Headset Configuration Tool.

2. VM Traps

The VM trap `StreamFileSource` enables data access from the file system using the streams interface.

The VM traps, `StreamI2cSource` and `StreamSpiflashSource` enable data access over I²C and SPI using the streams interface.

`StreamI2cSource` takes the following arguments:

- The I2C device address of the external EEPROM
- The array address in the EEPROM to read from
- The number of bytes to read

`StreamSpiflashSource` as used in BC6145 and CSR86xx ROMs takes the following arguments, although this interface is not currently available to external developers and is subject to change:

- The array address in the SPI flash to read from
- The number of bytes to read
- The protocol to use

This information gives the location in external storage from which the generated stream is to read data. As data is read and dropped from the stream's source further information is read into the stream from the external storage until the specified amount of data has been read. When all data in the stream has been dropped, the stream is closed and destroyed.

VM trap `TransformAdpcmDecode` provides an additional transform to decompress IMA ADPCM encoded data from any source, including `StreamI2cSource` and `StreamSpiflashSource`.



3. Wav to EEPROM

The wav to EEPROM python script generates header information and voice prompt files for the file system, EEPROM and SPI flash.

Note:

An executable version of the python script is available within the Configuration Tool installation package.

Header information is required to provide a single point of indexing for voice prompts and to store playback information such as file encoding and playback rate.

Table 3.1 shows how the header information for each prompt is stored.

Byte	Data			Values		
[0]	Type			0x00 – EEPROM 0x01 – SPI Flash 0x02 – File System		
[1]	EEPROM Device Address	Unused	Unused	0x0000 to 0xffff	0xXX	0xFFFFFFFF
[2]		SPI Flash Array Address		0x0000 to 0xffff	0x000000 to 0xffffffff	
[3]	EEPROM Array Address					
[4]						
[5]	Unused	Size	Unused	0XXXXX	0x00000000 to 0xffffffff	0xFFFFFFFF
[6]						
[7]	Size					
[8]						
[9]	Compression			0x00 – None 0x01 – IMA ADPCM 0x02 – SBC 0x03 – MP3 0x04 – AAC		
[10]	Playback Rate			0x0000 to 0xffff		
[11]						

Table 3.1: Storage of Voice Prompt Header Information

When running the script the following options are available:

- -h: Display help dialog
- -r: Disable IMA ADPCM encoding of voice prompts
- -s: Use SBC voice prompts (files must already be SBC encoded)
- -o [filename]: Set the output filename
- -f [e2bluecmd/e2util]: Set the format of the EEPROM file (.e2)
- -p [size]: Set the size in EEPROM reserved for PS Keys (by default this is 32kbits)



- `-t [e/f/s]`: Set where the header information will be stored (EEPROM, SPI Flash or File System)
- `-i`: Set the location of the image directory, this is where file system prompts will be generated
- `-b`: Set the playback rate (8kHz by default)

After the arguments, a list of files to convert into voice prompts is required. For each file the storage type is specified using `file.wav=e/f/s` as for the `-t` argument. The index of each prompt in the header information is determined by the order in which the files are passed to the script.

Note:

The `.wav` files to be encoded should be mono 16-bit 8kHz raw PCM.

The script generates separate output files for each storage type, `out.spi` for SPI Flash, `out.e2` for EEPROM and `.prm` files in the prompts folder for File System prompts. If the header information is stored in the File System, `.idx` files are generated in the headers folder.

The EEPROM image `out.e2` can be downloaded using `e2bluecmd` (which is shipped as part of BlueSuite).

The file system prompts can be downloaded by rebuilding the application image with the prompts and headers folders in the image folder and downloading the resultant `merge.xpv/xdv` files to the IC using BlueFlash.

SPI flash prompts can be downloaded to SPI Flash on Wembley using `spiflashBlueCmd`.

Note:

Wav to EEPROM does not limit the output size; downloading prompts may fail if resultant images are too big for storage.



4. Headset

4.1. Application and Configuration

The location of the header information is stored in PSKEY_USR21. Table 4.1 shows the three words in the PS Key that configure the header location.

Word	Data			Values		
0	Type			0x00 – EEPROM 0x01 – SPI Flash 0x02 – File System		
1	EEPROM Device Address	Unused	Unused	0x0000 to 0xffff	0xFF	0xFFFFFFFF
2	EEPROM Array Address	SPI Flash Array Address		0x0000 to 0xffff	0x000000 to 0xffffffff	
3	Padding word			0x0000		

Table 4.1: Storage of Header Information Location in PSKEY_USR_21

The number of voice prompts, voice prompt languages and event/prompt mappings are stored in PSKEY_USR9.

In most cases, this should be set up as follows:

- Number TTS Events: The number of events configured in PSKEY_USR11
- Number TTS Languages: The number of languages
- Number LED Filters: 0009 (default)
- Number LED States: 000b (default)
- Number LED Events: 0005 (default)
- Number Tone Events: This is already set if tones were configured with the Configuration Tool. Otherwise, use the default value 0025.
- Number Voice Prompts: The total number of prompts (including all languages).
- Number of user tones: 0000 (default)

Voice prompts can then be associated with events using PSKEY_USR11. Two words in the PS Key configure each event/prompt mapping. The first byte specifies the event and the second byte the prompt index. The second word specifies a headset state mask in which the prompt is valid. If an event occurs in a state where the associated prompt is not valid, a tone will be played instead (if one is configured on that event).

Note:

Multiple prompts can be associated with one event and are played in the order they are entered into this PS Key.



5. Limitations

5.1. Configuration Limitations

Each event/prompt mapping takes two words in PSKEY_USR11, which has a maximum length of 64 words; therefore, there can be a maximum of 32 mappings per language.

5.2. EEPROM Limitations

Because the array address taken by `StreamI2cSource` is 16 bits the maximum size EEPROM that can be addressed is 512kbits. However, multiple devices can be addressed on the I²C bus, therefore larger devices that behave as though they were separate 512kbit EEPROMs can be addressed by the `StreamI2cSource` VM trap.

The size taken by `StreamI2cSource` is 16 bits and so the maximum length of any one voice prompt in EEPROM is 512kbits.

The raw audio fed into the DAC needs to be 16-bit 8kHz mono PCM data. PS Keys take up 32kbits of space in EEPROM leaving 480kbits of space for voice prompts on a 512kbit EEPROM.

As the audio is compressed 4:1, the total length of audio that can be stored on a single 512kbit EEPROM is 15 seconds. A further 16 seconds of prompts is possible for every additional 512kbit EEPROM used.

5.3. SPI Flash Limitations

For SPI flash prompts the array address is 24 bits, meaning the maximum size of SPI Flash that can be addressed is 16MB.

The maximum size of a voice prompt in SPI flash is therefore also 16MB.

Only one CS line is available, therefore only a single SPI flash chip can be used.

SPI flash streams use the standard read instruction (0x03) to read data from the SPI flash, only SPI flash parts supporting this instruction may be used for SPI flash voice prompts.



6.1. Configuring SpiFlash Prompts

This section describes how to configure voice prompts for SpiFlash storage using the BC6145 Configuration Tool:

1. Select the **SpiFlash** option in the **Storage** field and the size of the device in the **Size of storage fitted to headset** drop down box.

Note:

The size definition is used to calculate if it is possible to fit all voice prompt audio files into the device being used. An error message is displayed if the voice prompt data cannot be fitted in the chosen size of SpiFlash device.

2. Set the number of events that trigger voice prompts using the slider or text entry box,
3. Set the required number of languages, e.g. if only 1 language is required ensure this option is set to 1.

Note:

The voice prompt data entry grid resizes automatically to fit the number of events and languages selected.

4. Configure each voice prompt ensuring that each option is completed, i.e. select:
 - 4.1. Event: Click on the **Event** column cell to view the **Event Selection** dialogue box.
 - 4.2. The `.wav` file name for each supported language.

Note:

When changing between languages the headset automatically speaks the name of the language currently chosen, the voice prompt audio file for this is selected in the **Event** row of the grid, see Figure 6.1.

It is not mandatory to choose an audio prompt for the language selection and it is valid to leave this entry as 'No File Selected'.

When all grid cells have been filled click the **Download Prompts To Device** button this converts the `.wav` files to ADPCM format and downloads them to the SpiFlash device, it also sets the relevant PS Key values. If any other configuration changes have been made it is also necessary to click the **Write Device** button to update the rest of the PS Key configuration options on the headset.

Some other useful SpiFlash/voice prompt functions within the **Diagnostic Device Functions** field to allow devices to be read and the voice prompt configuration to be stored locally.

6.2. Configuring EEPROM Based Prompts

This section describes how to configure voice prompts for EEPROM storage using the BC6145 Configuration Tool:

1. Select the EEPROM option as the storage type.
2. The configuration is then the same as the SpiFlash based prompts with the exception that it is necessary to set the amount of reserved space in the EEPROM. This reserved space is used by the configuration data of the headset as both the configuration and voice prompt data are sharing the same storage device.

If the required amount of configuration data storage is not set correctly the configuration or voice prompt data may be corrupted.



Terms and Definitions

ADPCM	Adaptive Differential Pulse code Modulation
BlueCore®	Group term for CSR's range of Bluetooth wireless technology ICs
Bluetooth®	Set of technologies providing audio and data transfer over short-range radio connections
CSR	Cambridge Silicon Radio
DAC	Digital-to-Analogue Converter
EEPROM	Electrically Erasable Programmable Read Only Memory
etc	et cetera, and the rest, and so forth
IC	Integrated Circuit
i.e.	Id est, that is
I ² C	Inter-Integrated Circuit
IMA	Interactive Multimedia Association
PCM	Pulse Code Modulation
PS	Persistent Store
ROM	Read Only Memory
SPI	Serial Peripheral Interface
TTS	Text-To-Speech
VM	Virtual Machine