Application Report
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Vocoder Implementation Using TMS470 High-End Timer

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ABSTRACT

The TMS470 family of ARM7 microcontrollers contains a RISC coprocessor referred to as the High-End Timer (HET). The HET can implement complex I/O operations independent from the CPU, one of which is the capability to generate PWM signals. This application report describes using this PWM capability, along with an open source voice algorithm called Speex, to encode 8-bit voice messages without the need for extra hardware.

There are many instances in which voice can be used with a microcontroller; e.g., security systems, smoke alarms, and automatic door controls can issue helpful warning messages rather than just annoying beeps. Metering and measuring systems can issue verbal instructions and transmit verbal information back to the users. This document is focused toward organizations that require the power of an ARM7 along with the ability to transmit voice.

This method of digitizing and encrypting voice into a narrow voice-band channel is referred to in this report as a vocoder. Unlike Peter Frampton's Talk Box or Homer Dudley's Vocoder, the TMS470 method generates clear and concise sounding voice messages that do not sound computer generated or robot-like.

The code is zipped up and available on the same TI web site as this document. Also, included within the zipped file is the WAV file used within this document. This WAV file can be used to verify the WAV-to-Speex conversion method described in this document.

The code is designed to run on the TMS470R1B1M evaluation module. The code is designed to map three separate voice files to the buttons B1, B2, and B3. This example code uses the same voice data within each of the three voice files. The PWM audio data is generated out of the HET0 pin. Therefore, connect a powered speaker between HET0 and GND. The sample code described in this application report can be downloaded from http://www.ti.com/lit/zip/SPNA102.

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1 Introduction

This application report describes a technique in which the TMS470 uses the HET to generate pulse width modulated (PWM) voice-band data without additional hardware, and it uses the Speex voice algorithm to generate the voice-band data. The ARM7 CPU still has the responsibility of processing the voice data using the Speex algorithm and passing the data to the HET. The CPU would still have this task of processing the Speex audio data even if an external audio DAC were used to present the audio to a speaker.

The TMS470 HET peripheral is a complex high-performance RISC coprocessor that operates independently from the main ARM7 CPU and can be used to implement complex I/O operations running in the background. More information on the HET can be found in the *TMS470R1x High-End Timer (HET) Reference Guide* [1].

Speex is an open source/free software, patent-free, audio compression format designed for speech. The Speex Project intends to lower the barrier of entry for voice applications by providing a free alternative to expensive proprietary speech CODECs. Speex is part of the GNU Project and is available under the Xiph.org variant of the BSD license [2]. The Speex algorithm is based on CELP. It is designed to compress voice at bit rates ranging from 2 to 44 kbps. CELP stands for Code Excited Linear Prediction. Speex uses the Ogg file format and the extension for a Speex file is SPX. The mechanism for converting from a WAV file to an SPX file is described in this document.

This demonstration uses the TMS470R1B1M EVM and a powered speaker to generate clear voice-band data. Currently, a WAV file is converted to the SPX format and compiled into the TMS470 as a C-code table. A WAV file is generated from an analog-to-digital conversion into an uncompressed PCM format. The Speex file is compressed audio specifically designed for the voice band. The Speex data is converted back out of the HET as PWM data. This process is shown in Figure 1.

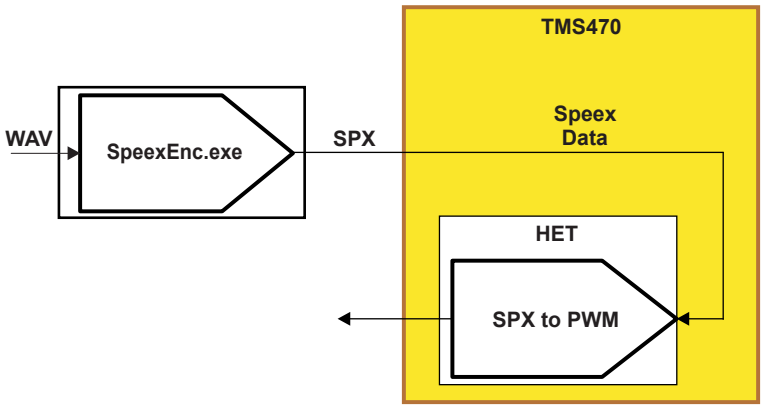

Figure 1. WAV to PWM Flow

2 PWM Description

Pulse Code Modulation (PCM) is produced by an analog-to-digital conversion. It is the digital representation of an analog signal, where the magnitude of the signal is sampled regularly at uniform intervals, then quantized to a series of symbols in a digital code. If the signal is sampled with 4 bits of resolution, this will give 16 points of resolution, as shown along the y-axis of Figure 2.

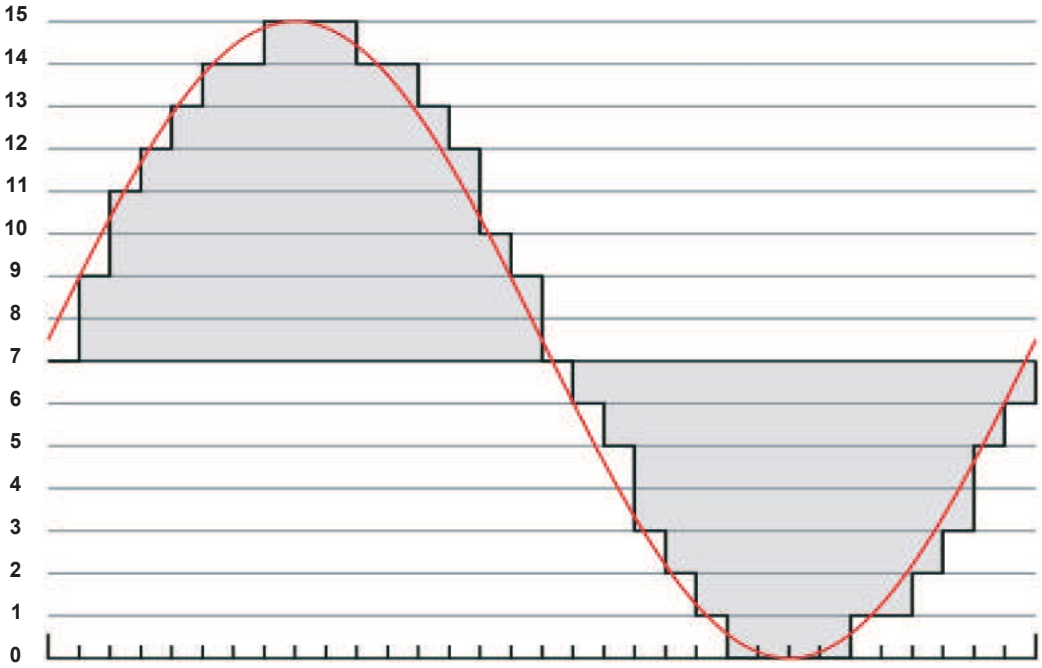

Figure 2. PCM Signal (Courtesy of Wikipedia)

With pulse width modulated (PWM) signals, the amplitude changes between only two magnitude points, and the width of the pulse changes based on the bits of resolution. Figure 3 shows five different pulse width (PW) durations occurring at fixed intervals (Fs). Fs can also be referred to as the carrier frequency. The amount of variation in the pulse width is dependant on the bits of resolution. If the PWM has 4 bits of resolution, there are 16 possible pulse widths available. The speaker integrates the energy applied to it and responds with sound. The longer the pulse duration the more energy is applied to the speaker. The variation in the pulse width produces the audio signal, and the width of the pulse is directly proportional to the amplitude of the modulation signal.

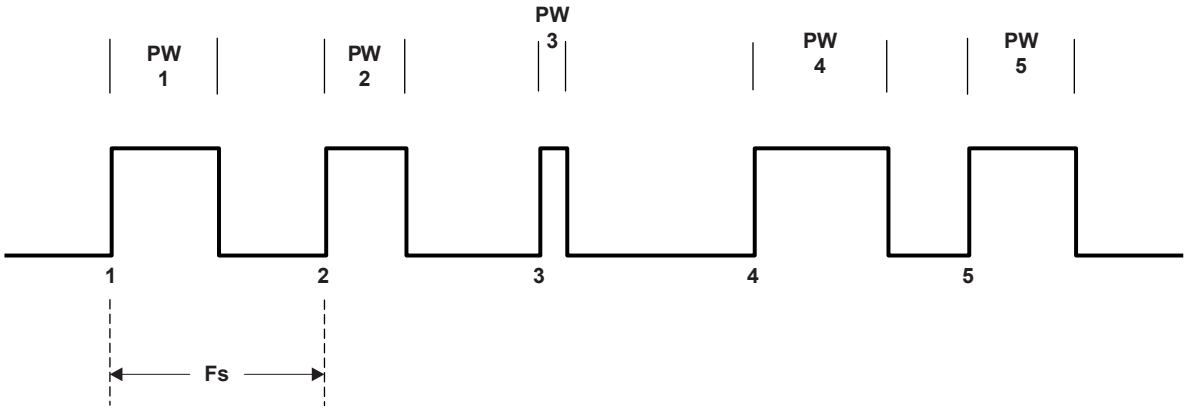

Figure 3. PWM Signal

The voice band ranges from 300 Hz to 3400 Hz. The TMS470 vocoder PWM signal is operating at a carrier frequency (Fs) of 24 kHz. Typically, the carrier frequency is ten times the frequency of the highest frequency of interest in the input signal, which makes the HET PWM carrier frequency in line with typical audio applications. Theoretically, a faster carrier frequency can improve the audio quality and compensate for lower bit resolutions.

3 Speex Algorithm

Speex is based on the Code Excited Linear Prediction (CELP) encoding technique. One of the main reasons is that CELP can scale well to low bit rates. The Speex file description is based on Ogg. Section A.1 contains an example Speex hex file and Section A.2 contains the corresponding format description of this file.

3.1 Ogg File Description

The following describes the Ogg file format courtesy of Wikipedia. Refer to the Speex file example in Section A.2 while reading the following text.

Every Ogg page begins with the 4-byte magic, "OggS". If sync is lost, a decoder can look for the next occurrence of this sequence to begin decoding again. This string is followed by a null byte for Ogg version 0. This is the only official version of Ogg as of 2004, and no new version is planned.

The fifth byte of each page specifies type flags. The value of 1 specifies that contained data is continued from the last page. The value of 2 specifies that this is the first page of the stream, and the value of 4 specifies that this is the last page of the stream. These values can be combined with addition or logical OR.

The next 8 bytes, or 64 bits, is called the absolute granule position and specifies the time offset of the data that can be decoded from the page. The meaning of this number is up to the codec, but it often refers to samples or frames of video data. Some codecs, such as Theora, split this field for key frames and interframes.

The following 8 bytes are the stream serial number to which this page belongs and the page sequence number within the stream. Each field is 32 bits (4 bytes) long.

The next 4 bytes, starting at the 22nd byte of the page, is the CRC checksum of the page. Because the value of this field changes the result of the check the check is computed with this field equal to zero.

Next, the 26th byte of each page specifies the number of segments it contains which ranges from 0 to 255. This is also the size of the following segment table in bytes. Each byte of the segment table provides the length of a segment.

Each segment can be up to 255 bytes in length and is bounded by the page. If a segment is less than 255 it marks the end of a packet, the next segment will begin a new packet. If a packet ends on a multiple of 255, it will end in a segment 0 bytes long. If the last segment of the page is 255 bytes then the last packet is continued on the following page.

4 Vocoder Description

Speex is an open source/free software, patent-free audio compression format designed for speech. The Speex algorithm has a compiler directive to select either a fixed point or floating point processor. The vocoder code is set as a floating point processor for the TMS470.

Figure 4 shows a conceptual overview of the interaction among the different components required for PWM generation as it relates to the Speex vocoder.

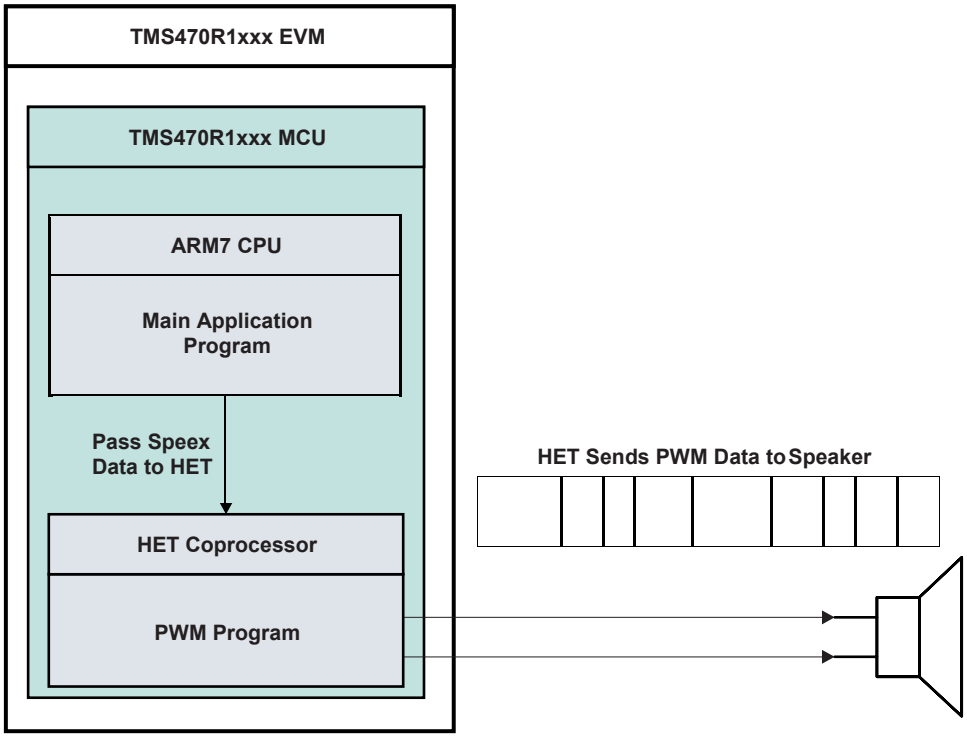

Figure 4. TMS470 HET PWM Implementation

The HET Assembly code is listed in Section 4.1.1 as a reference to how the PWM data is generated. The conversion to C-code is listed in Section 4.1.2 and Section 4.1.3, and the details of this conversion are in the *HET Getting Started Guide* [9].

4.1 WAV to Speex to C-code Conversion

This section describes a method to convert from WAV to an array within the TMS470 vocoder program. The original WAV file is 14,808 bytes, and the SPX compressed file 5500 bytes. This is a 2.69 reduction in size. The resultant payload data included in the C-code is only 5020 bytes. This translates to approximately 1 kbyte of CONST data in TMS470 memory for one second of audio. The overall code memory is around 80 kbytes. The code size is expected to be reduced as low as 10k bytes after it is optimized.

1. Record a voice clip using Windows™ Recorder Utility (or something like that). This tool is part of Windows, and it creates a WAV file.
2. Run the speexenc.exe utility that comes with the Speex software. A batch file has been created which presets the parameters into the speexenc.exe utility, which creates an SPX file. See Appendix B for details on the wav_2_speex.bat utility.
3. View the SPX file with a hex editor. HexEdit works well for this and it is freeware downloadable from the web.
4. The Ogg Header information needs to be separated from the data payload. The SPX file format is described in Section 3.1 and in Section A.1 and Section A.2. The intent is to create a C-code constant table that can be included into a TMS470 program.
5. Delete everything before the start of page 2 data by doing the following:
   a. Search for the first occurrence of OggS, which is encoded in hex as 4F 67 67 53. This marks the beginning of page 0.
   b. Search for the second occurrence of OggS, which is also encoded in hex as 4F 67 67 53. This marks the beginning of page 1.
   c. Search for the third occurrence of OggS, which is also encoded in hex as 4F 67 67 53. This marks the beginning of page 2.
   d. Find the payload associated with page 2 and delete all information from the beginning of the file up to this point. The header of each page contains 27 bytes. The last byte of the header specifies the size of the segment table in bytes associated with that header. The payload starts after the last byte of the segment table. Therefore, delete the header and the segment table only leaving the actual payload for each page (see Section A.2).
6. There may be other pages in the file past page 2. If so then each additional page will need the header information deleted. Only the payload should be included in the TMS470 C-code.
7. Now do the following using HexEdit:
   a. View --> Options --> Window --> Number of columns: 21
   b. Edit --> Select All
   c. Edit --> Copy As C-Source
8. Open a text editor and paste the C-Source into that text file.
9. Insert this data into the program and make the number of frames equal to the number of lines within the text file. Section A.3 is the resultant Speex array in C-code format.

4.1.1 HET PWM Assembly Code

```
; Implement a counter that uses register A and rolls over at 0x7
; Generate interrupt on overflow (used to move data into the MOV32
; data field)

pwm_time_base: CNT {next=pwm_output, reg=A, irq=OFF, max=0x7, data=0}

; PWM

pwm_output: ECMP {next=test_count, reg=A, hr_lr=HIGH, en_pin_action=ON,
            cond_addr=test_count, pin=CC0, action=PULSEHI, irq=OFF,
            data=0x0, hr_data=0x0}

; Every third time the count reaches 0, trigger interrupt. Now the ISR loads
; a new data value into the MOV32 instruction. This reduces CPU interrupts

test_count: ECMP {next=load_new_pwm_data_00, reg=A, hr_lr=HIGH,
                      en_pin_action=OFF, pin=CC0, cond_addr=test_count1,
                      irq=OFF, data=0x0 }


test_count1:   CNT {next=request_new_pwm_data, reg=B, irq=OFF, max=0x2, data=0}

request_new_pwm_data: ECMP {next=load_new_pwm_data_00, reg=B, hr_lr=HIGH,
                      en_pin_action=OFF, pin=CC0, cond_addr=load_new_pwm_data_00,
                      irq=ON, data=0x0 }

; When count reaches 7, load the next ECMP compare value used
; for PWM generation.
load_new_pwm_data_00: ECMP {next=pwm_time_base, reg=A, hr_lr=HIGH,
                      en_pin_action=OFF, pin=CC0, cond_addr=load_new_pwm_data_01,
                      irq=OFF, data=0x7 }

; Load ECMP data value with the value stored in the MOV32 instruction
load_new_pwm_data_01: MOV32 {next=pwm_time_base, remote=pwm_output, control=OFF,
                      init=OFF, type=IMTOREG&REM, reg=NONE, data=0x0, hr_data=0x0}
```

4.1.2 HET PWM Data Structure

```
#define HET_pwm_time_base_0         (e_HETPROGRAM0_UN.Program0_ST.pwm_time_base_0)
#define HET_pwm_output_0            (e_HETPROGRAM0_UN.Program0_ST.pwm_output_0)
#define HET_test_count_0            (e_HETPROGRAM0_UN.Program0_ST.test_count_0)
#define HET_test_count1_0           (e_HETPROGRAM0_UN.Program0_ST.test_count1_0)
#define HET_request_new_pwm_data_0 (e_HETPROGRAM0_UN.Program0_ST.request_new_pwm_data_0)
#define HET_load_new_pwm_data_00_0 (e_HETPROGRAM0_UN.Program0_ST.load_new_pwm_data_00_0)
#define HET_load_new_pwm_data_01_0 (e_HETPROGRAM0_UN.Program0_ST.load_new_pwm_data_01_0)


typedef union
{
     HET_MEMORY     Memory0_PST[7];
     struct
     {
          CNT_INSTRUCTION pwm_time_base_0;
          ECMP_INSTRUCTION pwm_output_0;
          ECMP_INSTRUCTION test_count_0;
          CNT_INSTRUCTION test_count1_0;
          ECMP_INSTRUCTION request_new_pwm_data_0;
          ECMP_INSTRUCTION load_new_pwm_data_00_0;
          MOV32_INSTRUCTION load_new_pwm_data_01_0;
     } Program0_ST;

} HETPROGRAM0_UN;

extern volatile HETPROGRAM0_UN e_HETPROGRAM0_UN;

extern const HET_MEMORY HET_INIT0_PST[7];
```

4.1.3 HET PWM C-Code

```
#include "std_het.h"
HET_MEMORY const HET_INIT0_PST[7] =
{
     /* pwm_time_base_0 */
    {
        0x00001600,
        0x00000007,
        0x00000000,
        0x00000000
    },

     /* pwm_output_0 */
    {
        0x00002000,
        0x00102018,
        0x00000000,
        0x00000000
    },

     /* test_count_0 */
    {
        0x00005000,
        0x00003000,
        0x00000000,
        0x00000000
    },

     /* test_count1_0 */
    {
        0x00004620,
        0x00000002,
        0x00000000,
        0x00000000
    },

     /* request_new_pwm_data_0 */
    {
        0x00005000,
        0x00005003,
        0x00000000,
        0x00000000
    },

     /* load_new_pwm_data_00_0 */
    {
        0x00000000,
        0x00006000,
        0x000000E0,
        0x00000000
    },

     /* load_new_pwm_data_01_0 */
    {
        0x00000401,
        0x0000000E,
        0x00000000,
        0x00000000
    }
};
```

5 References

1. *TMS470R1x High-End Timer Reference Guide* (TI literature number SPNU199)
2. Speex home page, http://www.speex.org/
3. *TMS470R1x System Module Reference Guide* (TI literature number SPNU189)
4. *TMS470R1B1M KickStart™ Development Kit from IAR*, Texas Instruments Inc., http://focus.ti.com/docs/toolsw/folders/print/spnc010.html
5. Vocoder description, http://en.wikipedia.org/wiki/Vocoder
6. Ogg file description, http://en.wikipedia.org/wiki/Ogg
7. Speex algorithm, http://www.speex.org/
8. CELP description, http://en.wikipedia.org/wiki/CELP
9. *High-End Timer (HET) Getting Started Guide* (TI literature number SPNA069)

Appendix A Speex File Example and Description

A.1 Speex File Example

This is a Speex file example. It started with a file called USM_EVAC.wav that was converted to USM_EVAC.spx. This SPX file is displayed below where the bytes "4F 67 67 53" represent the string "OggS" and indicate the beginning of each page. This SPX file contains four pages.

```
4F 67 67 53 00 02 00 00 00 00 00 00 00 00 BF 3E 00 00 00 00 00
00 87 A5 01 62 01 50 53 70 65 65 78 20 20 20 73 70 65 65 78 2D
31 2E 31 2E 36 00 00 00 00 00 00 00 00 00 01 00 00 00 50 00 00
00 80 3E 00 00 01 00 00 00 04 00 00 00 01 00 00 00 FF FF FF FF
40 01 00 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 4F 67 67 53 00 00 00 00 00 00 00 00 00 00 BF 3E 00 00
01 00 00 00 8C 59 39 BF 01 26 1E 00 00 00 45 6E 63 6F 64 65 64
20 77 69 74 68 20 53 70 65 65 78 20 73 70 65 65 78 2D 31 2E 31
2E 36 00 00 00 00 4F 67 67 53 00 00 61 FF 00 00 00 00 00 00 BF
3E 00 00 02 00 00 00 0B A2 76 8A CD 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
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14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 16 85 C2 6E 00 EE EE 07 77 70 39 20 4F 0A
25 27 00 94 BA 0E 16 85 E6 2A 3E 18 CD 3E 0E 4B B6 32 9D 2A C7
27 4B 07 C5 EE 16 85 E6 D6 25 6A 15 7F E9 1B B9 90 CC 8C 5B 27
6C F8 CD EE 16 85 E6 42 2E D4 AB B8 94 E3 E9 11 9D E6 D1 27 0C
F8 46 6E 13 95 CE 4A 3E EF 68 74 B2 2C EF 33 5F F9 F9 27 01 39
D6 8E 16 85 A7 8A 46 16 5E 70 8E 91 CE 2F 27 1F B7 27 6D 29 52
4E 10 0C 81 F6 A0 EE EE 7F 77 71 7A 3B A1 FF 1D 37 63 FF DA EE
10 15 10 EA C0 EE EE 07 77 50 04 4E 25 1C 71 27 01 FB 42 6E 16
9E A6 C3 59 63 EE F7 74 D3 FE E2 89 12 DF 37 38 E5 BD AE 10 11
82 9B C5 33 4C F1 9F 10 CA 01 A8 86 25 3F 78 98 A1 AE 17 97 E6
1F EF 6E ED E8 94 77 74 5C 6A 34 45 37 78 D5 A5 AE 17 97 90 77
FD 34 EB DB 17 8E 94 F3 7F 58 6B 3C EB 16 BD EE 17 97 BA 6F FD
4C C3 ED E6 69 89 4E D6 C2 B5 2F 0E F7 CE 0E 13 97 96 6B F5 E4
23 55 F8 67 FF 98 EB FD 99 2F 15 26 B1 0E 13 80 BA 6B D8 54 66
E9 36 68 19 AE 3C 45 65 3F 60 82 08 4E 13 10 8A 5B BC 11 69 4A
A9 17 0A 7A C3 CD DD 25 BE 02 91 CE 13 11 F5 A3 62 71 78 10 20
83 82 00 47 79 6F 25 DE B4 B1 EE 13 1A E5 3B 71 A4 F2 0B 13 72
5C 1D DB CB 03 25 DE C8 BA 6E 13 1A E4 0F 73 77 D8 1F C3 AF 9F
4C 04 06 CB 25 BF 07 AD CE 13 11 F5 8B 31 5F 8C 0A C4 82 59 9C
D0 EE 2F 25 A7 29 5A CE 13 1E C4 B3 39 08 96 05 C3 31 57 7C 39
40 E5 25 BF 6A 31 6E 11 15 4C 27 21 29 67 EC 0C 40 61 F5 E2 E7
73 37 78 B7 B5 CE 16 10 86 0F 25 B8 EA EF 21 14 E1 57 52 FA D1
27 50 B5 A8 EE 10 19 C7 4B 65 EE EE 91 C6 63 81 6C 8B 7C 07 27
61 F4 BA 4E 10 11 EB 67 C9 E2 CF 66 F5 C0 C9 48 F9 E6 FB 27 48
B7 20 6E 17 9F 96 3F AD 9D B9 8A 6B 80 E8 8A DB 3D F9 3F 74 A7
4B 0E 16 91 52 7F BB 43 5D 7D 5A AB 89 AD 23 D3 BF 2E 5F 4A 3D
6E 16 91 90 73 A2 D3 3A C8 1E 64 75 CA 38 A4 89 25 BE F7 31 2E
16 88 90 AF A0 51 33 7E 17 29 B8 CF 9D A9 79 25 BE D6 4D CE 16
90 92 0F A3 63 FC 2B FC 00 3C FA 51 47 17 39 BE E6 3E 2E 10 CD
D4 93 F9 15 34 E8 8C 3A 0D 9B 50 6D 45 2F 7E C7 BA 0E 10 DD 02
8B F8 0C DA D5 73 5B CF 91 40 55 D9 2F 0D 19 C9 EE 10 DD AF 53
65 87 B3 04 64 98 3A CC C5 DC D9 37 01 7A EA AE 10 10 BB 6B 25
22 4B 76 9F 23 8D AF 46 7C 47 37 59 7A 53 0E 16 9C A3 0F 13 8E
E8 15 2A E7 AE CF 7D 44 7D 27 79 27 41 8E 16 9C 86 1E F3 EC BC
9A 5C 64 DA 3B C1 BD 55 27 78 E7 31 AE 16 9C E6 1E C5 43 53 38
8C 65 F2 CF 00 2A 55 27 79 05 B9 4E 16 1C 10 6B 31 EE E4 77 23
D6 49 0C A3 75 0B 27 7A A3 B5 0E 12 D7 0E 2F 33 BB E3 01 2F 18
```

Speex File Example

```
BB B8 DB F5 45 27 7F 59 6E 0E 12 D4 AE 6B AD 95 23 0B D7 6E D4
E6 F4 7D B7 37 00 95 BE 4E 12 C4 D2 5B AD 12 43 E6 E4 37 36 BD
C6 2B 33 37 14 E6 AD 8E 10 D4 DA 7B CC 2C 6B DC 77 37 44 07 9C
66 FB 34 D0 F8 BE 2E 10 D6 8A 83 C8 E5 DD 23 29 F3 F6 0A CC 4F
71 37 79 18 B9 CE 14 03 94 8B C8 32 41 42 D9 71 89 87 FA CE 5D
37 7F 0A CA 6E 14 00 12 13 C1 2A 9F 19 66 80 9C 6F FD 4A 87 37
7F 3A 4A 2E 14 00 42 17 C0 E9 42 1F FE 56 41 F6 47 99 F5 27 68
D4 98 8E 14 00 0A B3 B8 83 29 DA 14 91 89 8D CC BB 6B 27 42 94
2D AE 14 DA C2 BB A8 D3 DF 41 E5 32 03 CC DD B2 D9 27 2C 84 1C
6E 14 DE 92 C3 88 D3 20 41 2E 71 D0 93 7A 39 D9 27 42 95 A9 CE
10 3F 48 CB 53 1A 9B FE 8B 17 95 4B 9D 68 7F 27 01 08 42 0E 12
FA F4 D7 28 16 6E 3A 22 9F EF B4 F0 4D A3 27 01 06 C5 6E 12 FA
F4 D7 38 63 FB FA AE 6D 0F 94 48 CD A5 27 20 D4 AD 0E 15 A1 68
D7 6C 61 73 37 A9 0E 07 71 76 34 E3 27 0C 52 A5 2E 15 BF 14 D7
93 BD 13 DB 73 23 85 AC 7A D2 55 27 74 B7 3E 0E 10 C6 02 DB D6
E3 C4 39 59 E1 1B 20 B6 AC 7D 37 54 F7 B9 8E 12 D6 40 D7 DF B3
33 3D F7 23 90 B9 4B DC 6D 37 13 38 B6 4E 12 CB 70 D7 9E 63 23
47 76 59 73 BB A6 97 DD 37 55 2A 45 EE 12 CB 70 D7 7F CE EC 39
B3 2A 8B BB 8E DD DD 37 4D 27 DE AE 12 C6 0C DB 8C DC 3E 3F 77
76 F1 AF A4 25 79 37 13 0F C6 4E 12 D6 70 DF AC C6 36 34 97 93
AE 99 9D 79 55 34 AD 06 C2 0E 12 D6 1C EF A8 C5 E3 A7 71 5A 0C
FB 8F A2 2D 37 13 2A EA 2E 12 D6 58 F7 88 55 FE DE 8B 76 D5 7A
7F 86 C7 37 0D 08 3D EE 12 D6 20 FB 88 A6 63 3A FF 1E F8 79 70
7B DD 27 42 C7 31 CE 15 B4 85 0F 9C 81 2B 33 DD DB 8B CC FB A6
67 27 34 A6 2D CE 15 B4 B0 1B 6E 06 69 4A AA CE 8A EA 84 2D 8B
27 42 B6 35 8E 15 B4 D4 07 6D 89 9F 49 B6 31 56 7C 04 E2 C5 27
7E C7 AD CE 15 B6 DA 03 69 61 A9 19 7A 70 CD 8A 52 81 4B 27 12
E8 4A 0E 15 B6 92 03 60 A1 CE 1F BD 0A 77 4C B8 D9 0B 27 13 18
46 0E 15 BA FA 13 43 F7 5F 6E A1 66 6A 7D 1A 33 E5 27 02 F8 29
8E 15 BA FA 13 59 37 A9 0E A0 E8 70 BB 06 41 ED 27 00 D8 45 AE
14 DA 93 6F 0B 12 5F 65 0A 47 9A D8 40 58 3D 27 6D 17 CA 2E 15
BD 9A 12 A0 C9 1A 0B 1A A8 C6 32 05 48 4B 27 6D 5B D6 8E 10 C6
12 0E C1 3B 56 F1 FC 30 29 38 05 31 B3 27 01 6A 4A 0E 10 C6 0A
42 C7 A4 8D 03 58 9C 3B 61 0A 46 21 27 2D 1A BE 0E 13 8F 0A 0A
A0 F3 BF 14 62 44 68 A2 3D 37 7D 27 01 27 B6 2E 13 98 90 36 45
65 DA 71 8E 9B FF B7 8B D1 6B 27 0D 4A 4A 6E 16 85 FA 5A 3E FC
8A 71 4A 8F 53 FE 9E B4 C9 27 63 06 B1 4E 16 96 4E 0F 47 EE EE
97 76 E8 D4 56 05 48 41 3C AB F1 15 6E 16 8E FD 6F 23 3F F6 9A
6E 10 BB 20 80 BD D5 3F 78 E7 36 0E 16 97 78 5B 00 82 D2 39 9B
B8 97 CE C4 58 39 3F 2C F7 35 0E 12 CB 04 8F 28 E6 8E B1 66 5A
1B 31 50 D6 B9 37 0C 96 3E 2E 10 D4 48 7B 9D CE EB 3E DB 31 53
7D 90 74 A7 37 55 06 29 6E 13 82 9A 6B A5 BF 33 EC 5E 66 F1 7E
88 C2 57 2F 3E 94 98 EE 17 04 7A 63 C5 F8 BC EE 1D F5 9C BA EC
99 7D 33 BA 76 B1 CE 17 1B E8 63 D7 8B 3E 20 3C 5A B8 AE FB 71
67 23 DF 06 45 EE 17 1B E8 67 B3 D7 89 EF 45 98 4E 3A 83 E7 A7
33 BE A6 AC EE 17 1B FA 03 6C 05 8F 76 5F 48 CB 79 FB 4B 2D 2F
18 C8 C6 0E 17 1B E8 77 68 9C CE 52 05 7B 27 F8 FB C2 15 2F 7A
F6 B9 0E 17 17 FA 7B 88 9C CA 45 5F 6C E2 FB 35 19 BF 33 BE 76
BD EE 16 99 9A 07 A0 38 83 A8 34 58 55 95 A2 70 3F 39 BE F6 41
CE 16 99 F0 83 8E 62 13 07 8B 11 C1 24 05 5A 65 25 BF 27 21 8E
13 10 EF 7F 71 A4 67 8A 11 C0 49 B0 81 08 F7 25 BE F7 C6 4E 13
11 CE 83 6E 09 DC 1C C4 68 8C EB 0E FE 91 25 DF 08 4D CE 11 11
68 27 55 CC 43 11 05 B8 33 F9 AE E7 71 25 F1 57 C5 CE 16 99 16
F3 88 91 38 F1 CF F0 9D 8F 45 68 9D 2B BE C5 21 2E 15 50 90 9F
5E 05 35 38 B5 51 73 F6 FC B6 F5 37 25 05 BD AE 12 D9 76 8B 2E
64 3C ED E5 93 F3 BB A6 76 C7 32 24 D7 46 2E 12 DD 4E 1B 3D 2A
31 DD 2A 8C F2 EB CB FE 29 3F 0C E8 4A 6E 17 94 98 5F B2 33 63
3A 8F 36 3B 39 3D 0F 1B 3F 60 C6 3D CE 12 03 96 4F FD 32 C6 E9
10 17 48 D8 8D 7D 1D 3C A6 F8 53 4E 14 92 A4 4F EA B5 D3 BF 0B
7E A2 CA DD 6B 8D 2B 81 8A 52 2E 17 08 7A 53 C8 DD 37 46 9F E9
9B 7B BB F2 8B 3F 78 F6 AC 6E 14 8B B4 1F 82 45 CD C3 EE 42 5B
73 57 54 2B 37 38 B4 BE 2E 14 88 9A 07 73 89 9D 9D 2F E8 A8 FB
4F 07 DD 37 41 38 46 AE 13 9E DA 73 25 B5 3A 3A 76 5F 4B F9 BC
5D B5 27 55 28 B1 0E 16 81 DA 8F 25 73 EF 9C 21 D5 71 A8 CB 6B
B5 27 78 92 98 8E 13 80 9A 92 E6 D4 86 F6 D9 F0 3A 4C CB 7D DD
27 0C 75 22 8E 16 95 C6 B3 08 3B EE 3F 77 72 22 BB 3A 6A 2F 37
```

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1F 4F CE EE 10 1F 11 9F 50 EE 5E 01 F1 F1 38 B0 82 C9 F9 2A 6D
AD DA 2E 10 D9 D4 87 F3 B3 26 CD F1 E8 4C E2 C9 35 8F 2A 7E F8
BD AE 10 C0 34 7F E6 21 BE 43 A7 5F DA D3 2F A4 27 2A 43 19 46
2E 10 C9 34 83 8B 9F 88 02 DF 18 39 BB 8B DD C7 27 00 F7 BA 2E
10 D5 34 7E DE A1 F5 77 C5 63 8A AE 3C 37 2D 27 6D 07 BD EE 12
D9 C3 96 85 FB 3B F4 22 91 55 29 1D 87 9D 27 01 89 DB 2E 10 D5
30 B2 87 D6 6B 3A F9 B6 F1 AD 7B F8 39 27 01 7A D2 2E 17 80 CA
3B 80 EE EE 07 77 70 39 54 8A C2 C5 2A 01 FF C2 8E 17 91 10 7B
E8 8B 8E EF 98 E5 48 6C 91 64 E5 2A 66 F7 B9 CE 12 CA E4 6F E6
11 23 E8 EF AA D6 33 90 B8 CD 37 78 F7 3E 2E 12 CE 64 67 E6 EB
45 BE 59 5D 70 CC D6 59 DD 3F 7A F8 C5 CE 12 C1 0C 67 D8 C3 F2
C6 F7 1A B7 B0 CC 7D D7 3F 1E D8 BF 4E 15 FA EC 6B A8 23 3D 3E
8F 1A B5 77 8C 66 D5 3F 7B 28 B1 CE 15 FE EC 6F 67 AE 13 7F 19
9D F9 BB DE 44 7D 3F 39 3D 56 CE 12 C1 4A 73 47 63 1D F8 F5 99
CC BB B1 86 67 27 19 2A 56 0E 16 87 6E 73 68 ED 5E 77 1F 71 CF
BB 98 EF 05 37 BE BA CD 0E 13 80 98 6F BE 54 EF C4 5C 07 D7 CB
C9 20 E7 2F 14 52 94 CE 12 04 18 6F FB DD 3D 34 96 11 B3 0E CC
AD BD 2C FE 76 3E 2E 10 9A F6 6F AF C6 F5 5D 69 AC EA E0 5D DD
79 2F 15 38 BA 0E 10 92 BA 2F 49 DD DE F3 32 2B CA 7A DC 59 C7
37 7F 28 45 EE 13 86 76 82 DE 03 38 F6 5F F9 FF CE FA 97 DF 37
0D 39 D2 2E 10 92 BA 7B 6F E3 E3 83 F9 E9 A9 44 CC 26 4B 2F 7F
17 3A AE 10 92 BA 83 BD 55 99 B1 7E ED 38 F7 49 AD 9F 33 EB 18
D6 4E 10 92 9A 87 C5 2B 5E 47 F1 93 04 EC D5 47 CB 33 FF 5A DE
AE 12 92 16 8B C8 EB C1 99 F7 75 22 FB 3B 99 BF 2F 0F 4D 34 AE
12 92 1B 5B D4 AE 42 55 D7 39 B0 CF CD A3 8D 34 98 54 A1 0E 16
9A 7A 93 C8 63 4D F1 A9 8A 1A F8 C5 90 C5 37 EA 53 20 4E 15 4A
9A 93 47 2C 09 2B 4B 7C D6 ED 9E 7E BD 27 42 A6 3D EE 15 4A 96
8F 5D 4C 31 DF 59 0D F7 8F 91 A6 4B 27 42 C8 49 CE 15 4A 96 87
5B E4 56 36 F2 F7 F6 FB 90 24 4B 37 01 09 5E 8E 15 5E 96 7B 5D
9D DE D9 EF 5A 38 CB 11 6C 6B 27 43 4A C9 EE 12 08 1A 67 DD EE
3E EF 5A 11 8B 8F 6B 47 53 33 C3 47 D7 2E 17 1B 7A 5F CE 9C ED
EE 99 8F 69 38 4D C6 6F 33 83 6A C6 4E 17 08 7A 5F CA 20 D3 37
19 C7 44 AD 03 25 39 33 FF 09 CE 2E 17 03 E8 73 C2 8D D4 C1 CE
70 FC 8F 9A 07 F3 33 FF 09 B9 6E 12 00 54 6F 8A 43 C0 F5 79 18
3B AF 81 DD DD 37 42 F6 E3 EE 16 9B EB 57 1E 8B 3E 49 C7 58 97
88 A6 A9 E1 37 55 5B 39 EE 17 17 FA A7 60 9E EB E9 1F 8D 8D 45
5E 86 BD 2F 7E D8 4E AE 17 1B CA 9F A1 39 EF A2 F2 1B A2 E2 EA
2E CB 2F 7F 08 2D 6E 17 1B CB 87 C1 23 A8 B4 E7 18 CF AF 58 0F
17 2F 7E D5 B9 4E 17 1B CA AF C8 EF 63 5E DF 55 84 E2 D5 DC 65
2F 7E F6 25 AE 17 1F FA B7 C0 8C C3 AC 2E 5D DB AF BA 41 29 2F
2C 73 A0 2E 12 11 F0 BF EC 23 51 79 2D F2 F9 09 77 FD 69 2F 6C
31 88 0E 12 00 F0 DF 91 69 2A 4D 18 98 2C FB 81 C7 D7 27 42 52
B5 6E 16 18 90 56 FE FE C7 F4 B4 77 AE 23 8F DD D1 27 18 D6 3E
6E 10 19 04 37 7B 13 E5 8B 5F 18 E4 EF A7 F9 79 27 78 B6 29 0E
12 DF 30 DB 23 83 97 35 1C C9 C5 3B 10 78 27 27 68 94 A1 4E 10
DD 94 D3 2E 2A E3 D9 EB B5 D8 59 B6 A7 71 27 28 E5 35 CE 12 1C
94 C3 DD 2E 18 F2 77 99 CF FF E5 5D D9 37 12 62 A5 CE 17 1F 92
B7 EE 10 EE 2F 59 17 67 AF B5 ED DD 2F 7E A6 A9 6E 17 03 D2 AF
DB 38 52 D8 77 DA 9A 2A 7B 26 AD 2F 7E C5 29 8E 17 1F 92 AB C1
34 BB EB 30 7E BB BD 5F 79 C7 2F 7F 05 3A 0E 13 9A 82 A7 D6 6B
ED 5E 29 98 2D 4B 81 DD DD 37 38 E4 2B EE 13 8E 5A 3A E0 87 AA
72 CE 19 58 C7 A7 C6 27 27 43 18 BE 2E 15 48 B0 3E BE 32 86 42
89 9B CD 85 9F 87 7D 27 01 39 CF 2E 10 C1 34 C3 1D 3E EE 3D F7
1E F9 8F A1 DC A5 37 43 CE 6F AE 12 C4 A4 93 CD B2 EC EC 7B 09
0B 6D B1 B7 97 37 0B 17 B1 6E 12 D6 AA 93 DB DF ED 45 37 B2 CF
76 F5 AD 79 37 D4 C8 4E CE 10 CF DC 8F FD CC 1D EE 11 F6 33 93
90 DC 57 2F 55 09 CA 6E 10 D7 D6 87 EE A1 2E 3B B6 5D F9 95 4F
64 59 2F 7F 39 D6 CE 11 84 90 83 E6 6E 85 31 59 F7 49 BD 9D A7
85 2F 2D 5A 2D AE 10 C8 48 83 D6 65 B2 D2 0E 9B A3 91 41 B8 79
37 7F 06 35 6E 10 C1 98 93 1E E7 7A 05 7A 3F B5 85 7D 46 CD 27
6C F5 A5 0E 10 CA 90 A3 0F 55 BA BF 1A 18 B2 F9 FA 9D 25 37 00
A7 C6 CE 10 D7 D0 8B 8A EE E3 E2 71 43 5F 21 31 34 AF 2A 3F 87
B1 8E 10 DB DC 7F FD E9 35 E9 41 DE 8E ED 77 B8 7B 2A 00 C7 C6
0E 10 04 54 83 E8 15 4E AA 75 D6 B1 70 AE DD F1 2A 42 F9 46 2E
16 8D 14 0F BE 53 2F 1D 04 00 8C BA F9 DD DD 37 7E F4 27 EE 11
9F 30 82 FD 0F AF 76 6C EF A7 4E CA B8 C3 27 42 E7 4A 2E 15 D6
```

```
16 93 0F BC C1 9B 5F 19 5A 88 50 22 F9 27 62 F8 A1 0E 11 8F 76
8B 05 3A 22 ED B6 EF 68 C8 ED EB 83 27 38 C6 4A 2E 16 88 1A 7B
85 EF 5B EF 65 E6 EF 92 21 5E 6F 2F 52 A5 A5 2E 16 9B DA 73 FB
13 E2 3F C5 75 13 48 58 5B 77 33 C2 63 2A 0E 14 9E E0 6F E6 E3
3B 37 58 E5 C4 FA D7 D8 5D 2A 43 78 C6 2E 11 8A 82 73 E8 E9 ED
9F 72 66 29 05 FA 7D E5 37 7A E7 25 6E 15 B9 DA 7B CF 42 98 5D
ED E1 8C E0 5D B9 DD 27 60 A7 B9 CE 10 20 B0 83 87 12 04 7E 11
F5 D7 93 1D A6 B7 27 42 D7 31 AE 10 3E E8 8B 47 55 24 52 F1 FE
18 78 94 DB DD 27 2A E6 B5 AE 10 3A E0 8B 7B CE 2D A1 6E 26 08
7D 50 8A 99 27 0A B4 A9 4E 15 B9 E0 87 9B 69 12 30 99 5D 7D 88
7E B9 91 37 6A B8 46 6E 10 D9 EC 87 FB DB C3 62 49 EE 8F 5B 5C
BD DB 37 2B 06 2D 4E 10 15 4E 8F E8 3B 3E 59 A9 30 65 05 CF D9
DF 2A 7E F6 2A 4E 17 12 84 9F CE AE 55 0F FE 60 B5 55 5B E6 E7
25 BF 16 2D 0E 13 1A C4 0B 62 0D 82 69 E2 20 90 B4 86 32 C1 25
CA F7 39 8E 13 1E C2 07 4E DB F5 39 9D 10 CF 26 27 BD 11 25 CA
E8 35 2E 16 98 DC 36 E0 69 43 41 07 48 BD 7A E3 DC 7D 37 1B 07
C3 8E 16 11 3A 0F 23 EE E3 70 F7 73 8F BB 92 EA 8B 3F 55 88 66
4E 10 D9 91 C3 A8 DE EE CB 77 77 BB BC FA 6F 5F 3F 1F 19 35 6E
10 C1 9C 73 F2 82 FA BD DE 69 C8 AF AD 9D 7D 37 78 46 36 0E 10
C1 82 07 F3 82 8D 1A 0A D0 6D 2A CA 76 87 37 7E A5 A9 AE 10 07
01 4F 91 08 08 C9 73 DC 4D 39 80 5D D3 27 28 D7 AD 2E 10 07 30
A7 27 49 63 5C 18 9B 88 57 CB 5A CB 27 4C C6 A9 0E 10 19 02 AF
13 45 23 77 D7 27 87 AF 83 C9 1D 27 2C B5 C1 AE 10 18 90 A3 19
E6 89 7F 18 43 BA D0 BA A5 71 37 30 D7 3E 2E 14 05 16 77 A5 EE
B6 17 77 1F 7F 2E 25 64 4D 37 42 9B C2 CE 11 8A E6 6B FD 62 6B
D9 AB 5D 75 4B 17 CC 63 2F 01 3B 4E CE 14 9D B8 6F E8 24 63 FF
89 91 90 CF 3B 55 A9 2F 2D 27 BD 6E 4F 67 67 53 00 04 BC 39 01
00 00 00 00 00 BF 3E 00 00 03 00 00 00 72 AD 03 D8 2F 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
14 14 14 9A F0 77 E8 16 53 C3 0F 1F 4F 09 4A 3C 3B 33 BE B6 B1
8E 10 00 48 87 E5 91 CC 42 19 E3 B1 62 C0 D2 33 2F 2A D7 3D 8E
16 81 3C B3 D9 99 FA 8C 9F 70 86 BB 92 79 17 2A 42 B7 B5 CE 13
94 8C A7 B1 2E E1 2B 19 1E 89 30 D8 7C 6B 2A 42 C7 35 AE 12 DE
B0 A3 AE 1F DE 3E 32 67 FB 9C 4E 7D C7 2F 2A 96 3E EE 12 DA A4
9F F4 D3 DB DE F1 85 E8 4F 2E C7 C7 37 AA D7 32 0E 12 DE F6 9F
B8 51 25 70 A9 57 BE 2F 80 66 77 27 42 E5 25 4E 12 C5 F6 32 FE
A7 51 73 4C 2A 1A DA D0 DA BD 27 6C F7 BD 8E 12 C6 4E A7 65 EE
EE EF 77 77 7B 71 A1 5E 53 37 6D FF A9 8E 12 D7 24 97 A7 15 CE
90 D5 99 EF 3A D1 99 8B 2F 02 B7 D6 2E 12 D7 04 8F A6 CE E2 FA
9D 9E 37 33 30 7D 67 2F 2B 4B CB 6E 12 D7 54 8B 86 68 A4 D1 71
1E 30 D6 FF 31 87 37 19 2B DA 6E 12 D7 54 87 9F B3 B2 57 71 F1
B7 B8 FE BD DD 37 FB AF E3 4E 12 D7 32 83 7D CF E2 32 98 F5 C8
8C D5 C6 67 37 DB 7C DF EE 12 C4 CA 7F BD 1E EE E9 DF 77 7B 08
69 B6 DB 37 5B 6D 41 AE 10 D4 8E 7F CE 76 BE 96 10 F6 AC AC DC
2B 05 22 3E D6 41 CE 10 D6 BE 83 C4 43 ED 5F F7 3E 2F 36 CC 36
DD 3F 54 D5 2D AE 10 C2 96 87 E8 EC 66 A0 F2 65 F2 05 B7 65 7D
2F 5E A5 32 8E 11 8E 9A 8F EB 46 B6 73 59 98 4F AF FA D7 DD 2F
2D 19 4A 4E 11 8E CB 7B 40 5F 39 89 9E 67 B4 96 02 27 87 27 0B
39 31 8E 11 8E A4 72 C0 C6 5C 04 77 C7 84 F8 85 89 67 27 43 3A
5E EE 16 10 69 12 E7 88 3E 3B 47 77 46 E7 11 7B 2D 37 6D 49 BD
CE 13 1A EE B7 47 33 3A D9 FB 2C 5E 31 C5 08 DB 39 81 08 D2 CE
13 1A C9 97 48 CF 88 2B 03 32 3A 06 F2 07 75 39 BF 59 45 6E 13
1E 84 57 43 2E B2 F9 C1 00 9F 80 7D 4D 19 39 BE D6 29 6E 13 12
9A FB 59 D8 46 F2 53 31 62 21 84 00 27 39 8C C6 BD 6E 16 81 A4
07 33 5F D7 3A 33 10 40 05 22 C4 A3 2F 58 C7 29 8E 17 80 88 CF
9C EB EB 1F 6B AB 2B 8F 19 0D 8D 37 0B 34 AD CE 10 0D 00 0F 8F
9B B5 C4 B4 27 BA EF B9 CD F5 37 43 07 EA 2E 17 97 CC 0F 2E 23
90 2E A5 5A 5A FA C1 DD DD 27 43 49 CF EE 17 97 F4 0A C0 A2 2C
1E 57 17 28 29 1C D2 4B 27 43 2A CA 6E 16 8D 5C 0E 40 3C 89 46
D5 52 FF E7 90 C2 93 27 6D 99 C1 8E 13 97 90 06 38 45 28 9E F4
74 C7 0E 1D 99 99 27 10 D8 BE 0E 16 84 19 5A 73 CE 6D 2A F6 46
18 C7 8F CC 15 27 42 C6 31 6E 16 9F D6 0A 8E 81 DA 71 C6 2C C9
AD 3D 8D 8B 27 28 97 39 EE 12 10 BA 0A 4F 8D 9F DA 44 65 FC 7E
3D A9 13 27 6D 18 C2 0E 16 85 A2 6E 53 88 3C 76 2C 79 A8 9F 5F
A8 BD 27 01 18 BE 6E 16 85 FF 22 3E 26 4D C4 CC 91 E4 A7 3D 0D
```

```
A5 27 65 18 39 CE 16 85 86 5E 2E FA AD 7A B3 21 62 66 1D 9D F9
27 6D 08 C6 6E 13 98 90 DE 3E 42 A6 70 B5 57 9A 74 5F 49 2B 27
6D 38 3D AE 16 85 EF 9A 53 6D E2 3F 9F 6A 0F B2 37 2E BB 27 64
E7 BD AE 16 85 8E 16 37 68 52 DC 7A B1 F5 4A C5 4D 5D 27 6D 17
C5 CE 16 85 EF 0A 2F FC CC 7D 47 C0 30 62 BD 59 95 27 01 18 4A
6E 16 85 E7 0A 4F 25 DF 33 76 F7 A9 A1 4F B8 3D 27 01 19 C2 4E
16 85 AF A2 2F 3F 4E F4 13 47 A4 A1 AF A7 0F 27 01 49 C6 2E 16
95 2B 46 2E 64 15 39 12 47 A5 72 0F EB 69 27 64 F8 4A 0E 16 9D
66 F3 25 EE EE F7 77 74 2C 7B B9 DD DD 27 6D FF E3 EE
```

A.2 Speex File Format Analysis

The following is a Speex file format analysis based on the file in Section A.1.

```
     DATA                      #BYTES   DESCRIPTION

Header of Ogg page 0:
---------------------
4F 67 67 53                         4     "OggS"
00                                  1     null character
02                                  1     flags (2=1st page of Ogg stream)
00 00 00 00 00 00 00 00             8     absolute granule position
BF 3E 00 00                         4     stream serial number
00 00 00 00                         4     stream page number within stream
87 A5 01 62                         4     CRC checksum
01                                  1     # segments in this page
50                                  1     Segment table (length of each segment), 0x50 = 80

Segment 1 of Ogg page 0:
------------------------
53 70 65 65 78 20 20 20             8     speex_string: "Speex   "

73 70 65 65 78 2D 31 2E 31 2E      20     speex_version: "speex-1.1.6"
36 00 00 00 00 00 00 00 00 00

01 00 00 00                         4     speex_version_id
50 00 00 00                         4     header_size: 0x00000050
80 3E 00 00                         4     rate: 0x00001F40 = 8000 (Hz)
01 00 00 00                         4     mode: 0x00000000 = narrowband
04 00 00 00                         4     mode_bitstream_version
01 00 00 00                         4     nb_channels
FF FF FF FF                         4     bitrate
40 01 00 00                         4     frame_size: 0x000000A0 = 160
00 00 00 00                         4     vbr
01 00 00 00                         4     frames_per_packet
00 00 00 00                         4     extra_header
00 00 00 00                         4     reserved1
00 00 00 00                         4     reserved2

Header of Ogg page 1:
---------------------
4F 67 67 53                         4     "OggS"
00                                  1     null character
00                                  1     flags (0 = no flag)
00 00 00 00 00 00 00 00             8     absolute granule position
BF 3E 00 00                         4     stream serial number
01 00 00 00                         4     stream page number within stream
8C 59 39 BF                         4     CRC checksum
01                                  1     # segments in this page
26                                  1     Segment table (length of each segment), 0x26 = 38

Segment 1 of Ogg page 1:
------------------------
1E 00 00 00 45 6E 63 6F            38      Speex comment header
64 65 64 20 77 69 74 68
20 53 70 65 65 78 20 73
```

```
70 65 65 78 2D 31 2E 31
2E 36 00 00 00 00


Header of Ogg page 2:
---------------------
4F 67 67 53                      4     "OggS"
00                               1     null character
00                               1     flags (4 = last page of Ogg stream)
61 FF 00 00 00 00 00 00          8     absolute granule position
BF 3E 00 00                      4     stream serial number
02 00 00 00                      4     stream page number within stream
0B A2 76 8A                      4     CRC checksum
CD                               1     # segments in this page, 0xCD = 205

Segment 1 of Ogg page 2:
------------------------
14 14 14 14 14 14 14 14          205     Segment table (length of each
14 14 14 14 14 14 14 14                  segment), 0x14 = 20
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
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14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14

Payload of Ogg page 2: Consisting of 205 * 20 = 4100 bytes
-----------------------------------------------------------
16 85 C2 6E 00 EE EE 07 77 70 39 20 4F 0A 25 27 00 94 BA 0E 16 85 E6 2A 3E 18
CD 3E 0E 4B B6 32 9D 2A C7 27 4B 07 C5 EE 16 85 E6 D6 25 6A 15 7F E9 1B B9 90
CC 8C 5B 27 6C F8 CD EE 16 85 E6 42 2E D4 AB B8 94 E3 E9 11 9D E6 D1 27 0C F8
46 6E 13 95 CE 4A 3E EF 68 74 B2 2C EF 33 5F F9 F9 27 01 39 D6 8E 16 85 A7 8A
46 16 5E 70 8E 91 CE 2F 27 1F B7 27 6D 29 52 4E 10 0C 81 F6 A0 EE EE 7F 77 71
7A 3B A1 FF 1D 37 63 FF DA EE 10 15 10 EA C0 EE EE 07 77 50 04 4E 25 1C 71 27
01 FB 42 6E 16 9E A6 C3 59 63 EE F7 74 D3 FE E2 89 12 DF 37 38 E5 BD AE 10 11
82 9B C5 33 4C F1 9F 10 CA 01 A8 86 25 3F 78 98 A1 AE 17 97 E6 1F EF 6E ED E8
94 77 74 5C 6A 34 45 37 78 D5 A5 AE 17 97 90 77 FD 34 EB DB 17 8E 94 F3 7F 58
6B 3C EB 16 BD EE 17 97 BA 6F FD 4C C3 ED E6 69 89 4E D6 C2 B5 2F 0E F7 CE 0E

13 97 96 6B F5 E4 23 55 F8 67 FF 98 EB FD 99 2F 15 26 B1 0E 13 80 BA 6B D8 54
66 E9 36 68 19 AE 3C 45 65 3F 60 82 08 4E 13 10 8A 5B BC 11 69 4A A9 17 0A 7A
C3 CD DD 25 BE 02 91 CE 13 11 F5 A3 62 71 78 10 20 83 82 00 47 79 6F 25 DE B4
B1 EE 13 1A E5 3B 71 A4 F2 0B 13 72 5C 1D DB CB 03 25 DE C8 BA 6E 13 1A E4 0F
73 77 D8 1F C3 AF 9F 4C 04 06 CB 25 BF 07 AD CE 13 11 F5 8B 31 5F 8C 0A C4 82
59 9C D0 EE 2F 25 A7 29 5A CE 13 1E C4 B3 39 08 96 05 C3 31 57 7C 39 40 E5 25
BF 6A 31 6E 11 15 4C 27 21 29 67 EC 0C 40 61 F5 E2 E7 73 37 78 B7 B5 CE 16 10
86 0F 25 B8 EA EF 21 14 E1 57 52 FA D1 27 50 B5 A8 EE 10 19 C7 4B 65 EE EE 91
C6 63 81 6C 8B 7C 07 27 61 F4 BA 4E 10 11 EB 67 C9 E2 CF 66 F5 C0 C9 48 F9 E6
```

```
FB 27 48 B7 20 6E 17 9F 96 3F AD 9D B9 8A 6B 80 E8 8A DB 3D F9 3F 74 A7 4B 0E

16 91 52 7F BB 43 5D 7D 5A AB 89 AD 23 D3 BF 2E 5F 4A 3D 6E 16 91 90 73 A2 D3
3A C8 1E 64 75 CA 38 A4 89 25 BE F7 31 2E 16 88 90 AF A0 51 33 7E 17 29 B8 CF
9D A9 79 25 BE D6 4D CE 16 90 92 0F A3 63 FC 2B FC 00 3C FA 51 47 17 39 BE E6
3E 2E 10 CD D4 93 F9 15 34 E8 8C 3A 0D 9B 50 6D 45 2F 7E C7 BA 0E 10 DD 02 8B
F8 0C DA D5 73 5B CF 91 40 55 D9 2F 0D 19 C9 EE 10 DD AF 53 65 87 B3 04 64 98
3A CC C5 DC D9 37 01 7A EA AE 10 10 BB 6B 25 22 4B 76 9F 23 8D AF 46 7C 47 37
59 7A 53 0E 16 9C A3 0F 13 8E E8 15 2A E7 AE CF 7D 44 7D 27 79 27 41 8E 16 9C
86 1E F3 EC BC 9A 5C 64 DA 3B C1 BD 55 27 78 E7 31 AE 16 9C E6 1E C5 43 53 38
8C 65 F2 CF 00 2A 55 27 79 05 B9 4E 16 1C 10 6B 31 EE E4 77 23 D6 49 0C A3 75
0B 27 7A A3 B5 0E 12 D7 0E 2F 33 BB E3 01 2F 18 BB B8 DB F5 45 27 7F 59 6E 0E

12 D4 AE 6B AD 95 23 0B D7 6E D4 E6 F4 7D B7 37 00 95 BE 4E 12 C4 D2 5B AD 12
43 E6 E4 37 36 BD C6 2B 33 37 14 E6 AD 8E 10 D4 DA 7B CC 2C 6B DC 77 37 44 07
9C 66 FB 34 D0 F8 BE 2E 10 D6 8A 83 C8 E5 DD 23 29 F3 F6 0A CC 4F 71 37 79 18
B9 CE 14 03 94 8B C8 32 41 42 D9 71 89 87 FA CE 5D 37 7F 0A CA 6E 14 00 12 13
C1 2A 9F 19 66 80 9C 6F FD 4A 87 37 7F 3A 4A 2E 14 00 42 17 C0 E9 42 1F FE 56
41 F6 47 99 F5 27 68 D4 98 8E 14 00 0A B3 B8 83 29 DA 14 91 89 8D CC BB 6B 27
42 94 2D AE 14 DA C2 BB A8 D3 DF 41 E5 32 03 CC DD B2 D9 27 2C 84 1C 6E 14 DE
92 C3 88 D3 20 41 2E 71 D0 93 7A 39 D9 27 42 95 A9 CE 10 3F 48 CB 53 1A 9B FE
8B 17 95 4B 9D 68 7F 27 01 08 42 0E 12 FA F4 D7 28 16 6E 3A 22 9F EF B4 F0 4D
A3 27 01 06 C5 6E 12 FA F4 D7 38 63 FB FA AE 6D 0F 94 48 CD A5 27 20 D4 AD 0E

15 A1 68 D7 6C 61 73 37 A9 0E 07 71 76 34 E3 27 0C 52 A5 2E 15 BF 14 D7 93 BD
13 DB 73 23 85 AC 7A D2 55 27 74 B7 3E 0E 10 C6 02 DB D6 E3 C4 39 59 E1 1B 20
B6 AC 7D 37 54 F7 B9 8E 12 D6 40 D7 DF B3 33 3D F7 23 90 B9 4B DC 6D 37 13 38
B6 4E 12 CB 70 D7 9E 63 23 47 76 59 73 BB A6 97 DD 37 55 2A 45 EE 12 CB 70 D7
7F CE EC 39 B3 2A 8B BB 8E DD DD 37 4D 27 DE AE 12 C6 0C DB 8C DC 3E 3F 77 76
F1 AF A4 25 79 37 13 0F C6 4E 12 D6 70 DF AC C6 36 34 97 93 AE 99 9D 79 55 34
AD 06 C2 0E 12 D6 1C EF A8 C5 E3 A7 71 5A 0C FB 8F A2 2D 37 13 2A EA 2E 12 D6
58 F7 88 55 FE DE 8B 76 D5 7A 7F 86 C7 37 0D 08 3D EE 12 D6 20 FB 88 A6 63 3A
FF 1E F8 79 70 7B DD 27 42 C7 31 CE 15 B4 85 0F 9C 81 2B 33 DD DB 8B CC FB A6
67 27 34 A6 2D CE 15 B4 B0 1B 6E 06 69 4A AA CE 8A EA 84 2D 8B 27 42 B6 35 8E

15 B4 D4 07 6D 89 9F 49 B6 31 56 7C 04 E2 C5 27 7E C7 AD CE 15 B6 DA 03 69 61
A9 19 7A 70 CD 8A 52 81 4B 27 12 E8 4A 0E 15 B6 92 03 60 A1 CE 1F BD 0A 77 4C
B8 D9 0B 27 13 18 46 0E 15 BA FA 13 43 F7 5F 6E A1 66 6A 7D 1A 33 E5 27 02 F8
29 8E 15 BA FA 13 59 37 A9 0E A0 E8 70 BB 06 41 ED 27 00 D8 45 AE 14 DA 93 6F
0B 12 5F 65 0A 47 9A D8 40 58 3D 27 6D 17 CA 2E 15 BD 9A 12 A0 C9 1A 0B 1A A8
C6 32 05 48 4B 27 6D 5B D6 8E 10 C6 12 0E C1 3B 56 F1 FC 30 29 38 05 31 B3 27
01 6A 4A 0E 10 C6 0A 42 C7 A4 8D 03 58 9C 3B 61 0A 46 21 27 2D 1A BE 0E 13 8F
0A 0A A0 F3 BF 14 62 44 68 A2 3D 37 7D 27 01 27 B6 2E 13 98 90 36 45 65 DA 71
8E 9B FF B7 8B D1 6B 27 0D 4A 4A 6E 16 85 FA 5A 3E FC 8A 71 4A 8F 53 FE 9E B4
C9 27 63 06 B1 4E 16 96 4E 0F 47 EE EE 97 76 E8 D4 56 05 48 41 3C AB F1 15 6E

16 8E FD 6F 23 3F F6 9A 6E 10 BB 20 80 BD D5 3F 78 E7 36 0E 16 97 78 5B 00 82
D2 39 9B B8 97 CE C4 58 39 3F 2C F7 35 0E 12 CB 04 8F 28 E6 8E B1 66 5A 1B 31
50 D6 B9 37 0C 96 3E 2E 10 D4 48 7B 9D CE EB 3E DB 31 53 7D 90 74 A7 37 55 06
29 6E 13 82 9A 6B A5 BF 33 EC 5E 66 F1 7E 88 C2 57 2F 3E 94 98 EE 17 04 7A 63
C5 F8 BC EE 1D F5 9C BA EC 99 7D 33 BA 76 B1 CE 17 1B E8 63 D7 8B 3E 20 3C 5A
B8 AE FB 71 67 23 DF 06 45 EE 17 1B E8 67 B3 D7 89 EF 45 98 4E 3A 83 E7 A7 33
BE A6 AC EE 17 1B FA 03 6C 05 8F 76 5F 48 CB 79 FB 4B 2D 2F 18 C8 C6 0E 17 1B
E8 77 68 9C CE 52 05 7B 27 F8 FB C2 15 2F 7A F6 B9 0E 17 17 FA 7B 88 9C CA 45
5F 6C E2 FB 35 19 BF 33 BE 76 BD EE 16 99 9A 07 A0 38 83 A8 34 58 55 95 A2 70
3F 39 BE F6 41 CE 16 99 F0 83 8E 62 13 07 8B 11 C1 24 05 5A 65 25 BF 27 21 8E

13 10 EF 7F 71 A4 67 8A 11 C0 49 B0 81 08 F7 25 BE F7 C6 4E 13 11 CE 83 6E 09
DC 1C C4 68 8C EB 0E FE 91 25 DF 08 4D CE 11 11 68 27 55 CC 43 11 05 B8 33 F9
AE E7 71 25 F1 57 C5 CE 16 99 16 F3 88 91 38 F1 CF F0 9D 8F 45 68 9D 2B BE C5
21 2E 15 50 90 9F 5E 05 35 38 B5 51 73 F6 FC B6 F5 37 25 05 BD AE 12 D9 76 8B
2E 64 3C ED E5 93 F3 BB A6 76 C7 32 24 D7 46 2E 12 DD 4E 1B 3D 2A 31 DD 2A 8C
F2 EB CB FE 29 3F 0C E8 4A 6E 17 94 98 5F B2 33 63 3A 8F 36 3B 39 3D 0F 1B 3F
60 C6 3D CE 12 03 96 4F FD 32 C6 E9 10 17 48 D8 8D 7D 1D 3C A6 F8 53 4E 14 92
A4 4F EA B5 D3 BF 0B 7E A2 CA DD 6B 8D 2B 81 8A 52 2E 17 08 7A 53 C8 DD 37 46
9F E9 9B 7B BB F2 8B 3F 78 F6 AC 6E 14 8B B4 1F 82 45 CD C3 EE 42 5B 73 57 54
```

```
2B 37 38 B4 BE 2E 14 88 9A 07 73 89 9D 9D 2F E8 A8 FB 4F 07 DD 37 41 38 46 AE

13 9E DA 73 25 B5 3A 3A 76 5F 4B F9 BC 5D B5 27 55 28 B1 0E 16 81 DA 8F 25 73
EF 9C 21 D5 71 A8 CB 6B B5 27 78 92 98 8E 13 80 9A 92 E6 D4 86 F6 D9 F0 3A 4C
CB 7D DD 27 0C 75 22 8E 16 95 C6 B3 08 3B EE 3F 77 72 22 BB 3A 6A 2F 37 1F 4F
CE EE 10 1F 11 9F 50 EE 5E 01 F1 F1 38 B0 82 C9 F9 2A 6D AD DA 2E 10 D9 D4 87
F3 B3 26 CD F1 E8 4C E2 C9 35 8F 2A 7E F8 BD AE 10 C0 34 7F E6 21 BE 43 A7 5F
DA D3 2F A4 27 2A 43 19 46 2E 10 C9 34 83 8B 9F 88 02 DF 18 39 BB 8B DD C7 27
00 F7 BA 2E 10 D5 34 7E DE A1 F5 77 C5 63 8A AE 3C 37 2D 27 6D 07 BD EE 12 D9
C3 96 85 FB 3B F4 22 91 55 29 1D 87 9D 27 01 89 DB 2E 10 D5 30 B2 87 D6 6B 3A
F9 B6 F1 AD 7B F8 39 27 01 7A D2 2E 17 80 CA 3B 80 EE EE 07 77 70 39 54 8A C2
C5 2A 01 FF C2 8E 17 91 10 7B E8 8B 8E EF 98 E5 48 6C 91 64 E5 2A 66 F7 B9 CE

12 CA E4 6F E6 11 23 E8 EF AA D6 33 90 B8 CD 37 78 F7 3E 2E 12 CE 64 67 E6 EB
45 BE 59 5D 70 CC D6 59 DD 3F 7A F8 C5 CE 12 C1 0C 67 D8 C3 F2 C6 F7 1A B7 B0
CC 7D D7 3F 1E D8 BF 4E 15 FA EC 6B A8 23 3D 3E 8F 1A B5 77 8C 66 D5 3F 7B 28
B1 CE 15 FE EC 6F 67 AE 13 7F 19 9D F9 BB DE 44 7D 3F 39 3D 56 CE 12 C1 4A 73
47 63 1D F8 F5 99 CC BB B1 86 67 27 19 2A 56 0E 16 87 6E 73 68 ED 5E 77 1F 71
CF BB 98 EF 05 37 BE BA CD 0E 13 80 98 6F BE 54 EF C4 5C 07 D7 CB C9 20 E7 2F
14 52 94 CE 12 04 18 6F FB DD 3D 34 96 11 B3 0E CC AD BD 2C FE 76 3E 2E 10 9A
F6 6F AF C6 F5 5D 69 AC EA E0 5D DD 79 2F 15 38 BA 0E 10 92 BA 2F 49 DD DE F3
32 2B CA 7A DC 59 C7 37 7F 28 45 EE 13 86 76 82 DE 03 38 F6 5F F9 FF CE FA 97
DF 37 0D 39 D2 2E 10 92 BA 7B 6F E3 E3 83 F9 E9 A9 44 CC 26 4B 2F 7F 17 3A AE

10 92 BA 83 BD 55 99 B1 7E ED 38 F7 49 AD 9F 33 EB 18 D6 4E 10 92 9A 87 C5 2B
5E 47 F1 93 04 EC D5 47 CB 33 FF 5A DE AE 12 92 16 8B C8 EB C1 99 F7 75 22 FB
3B 99 BF 2F 0F 4D 34 AE 12 92 1B 5B D4 AE 42 55 D7 39 B0 CF CD A3 8D 34 98 54
A1 0E 16 9A 7A 93 C8 63 4D F1 A9 8A 1A F8 C5 90 C5 37 EA 53 20 4E 15 4A 9A 93
47 2C 09 2B 4B 7C D6 ED 9E 7E BD 27 42 A6 3D EE 15 4A 96 8F 5D 4C 31 DF 59 0D
F7 8F 91 A6 4B 27 42 C8 49 CE 15 4A 96 87 5B E4 56 36 F2 F7 F6 FB 90 24 4B 37
01 09 5E 8E 15 5E 96 7B 5D 9D DE D9 EF 5A 38 CB 11 6C 6B 27 43 4A C9 EE 12 08
1A 67 DD EE 3E EF 5A 11 8B 8F 6B 47 53 33 C3 47 D7 2E 17 1B 7A 5F CE 9C ED EE
99 8F 69 38 4D C6 6F 33 83 6A C6 4E 17 08 7A 5F CA 20 D3 37 19 C7 44 AD 03 25
39 33 FF 09 CE 2E 17 03 E8 73 C2 8D D4 C1 CE 70 FC 8F 9A 07 F3 33 FF 09 B9 6E

12 00 54 6F 8A 43 C0 F5 79 18 3B AF 81 DD DD 37 42 F6 E3 EE 16 9B EB 57 1E 8B
3E 49 C7 58 97 88 A6 A9 E1 37 55 5B 39 EE 17 17 FA A7 60 9E EB E9 1F 8D 8D 45
5E 86 BD 2F 7E D8 4E AE 17 1B CA 9F A1 39 EF A2 F2 1B A2 E2 EA 2E CB 2F 7F 08
2D 6E 17 1B CB 87 C1 23 A8 B4 E7 18 CF AF 58 0F 17 2F 7E D5 B9 4E 17 1B CA AF
C8 EF 63 5E DF 55 84 E2 D5 DC 65 2F 7E F6 25 AE 17 1F FA B7 C0 8C C3 AC 2E 5D
DB AF BA 41 29 2F 2C 73 A0 2E 12 11 F0 BF EC 23 51 79 2D F2 F9 09 77 FD 69 2F
6C 31 88 0E 12 00 F0 DF 91 69 2A 4D 18 98 2C FB 81 C7 D7 27 42 52 B5 6E 16 18
90 56 FE FE C7 F4 B4 77 AE 23 8F DD D1 27 18 D6 3E 6E 10 19 04 37 7B 13 E5 8B
5F 18 E4 EF A7 F9 79 27 78 B6 29 0E 12 DF 30 DB 23 83 97 35 1C C9 C5 3B 10 78
27 27 68 94 A1 4E 10 DD 94 D3 2E 2A E3 D9 EB B5 D8 59 B6 A7 71 27 28 E5 35 CE

12 1C 94 C3 DD 2E 18 F2 77 99 CF FF E5 5D D9 37 12 62 A5 CE 17 1F 92 B7 EE 10
EE 2F 59 17 67 AF B5 ED DD 2F 7E A6 A9 6E 17 03 D2 AF DB 38 52 D8 77 DA 9A 2A
7B 26 AD 2F 7E C5 29 8E 17 1F 92 AB C1 34 BB EB 30 7E BB BD 5F 79 C7 2F 7F 05
3A 0E 13 9A 82 A7 D6 6B ED 5E 29 98 2D 4B 81 DD DD 37 38 E4 2B EE 13 8E 5A 3A
E0 87 AA 72 CE 19 58 C7 A7 C6 27 27 43 18 BE 2E 15 48 B0 3E BE 32 86 42 89 9B
CD 85 9F 87 7D 27 01 39 CF 2E 10 C1 34 C3 1D 3E EE 3D F7 1E F9 8F A1 DC A5 37
43 CE 6F AE 12 C4 A4 93 CD B2 EC EC 7B 09 0B 6D B1 B7 97 37 0B 17 B1 6E 12 D6
AA 93 DB DF ED 45 37 B2 CF 76 F5 AD 79 37 D4 C8 4E CE 10 CF DC 8F FD CC 1D EE
11 F6 33 93 90 DC 57 2F 55 09 CA 6E 10 D7 D6 87 EE A1 2E 3B B6 5D F9 95 4F 64
59 2F 7F 39 D6 CE 11 84 90 83 E6 6E 85 31 59 F7 49 BD 9D A7 85 2F 2D 5A 2D AE

10 C8 48 83 D6 65 B2 D2 0E 9B A3 91 41 B8 79 37 7F 06 35 6E 10 C1 98 93 1E E7
7A 05 7A 3F B5 85 7D 46 CD 27 6C F5 A5 0E 10 CA 90 A3 0F 55 BA BF 1A 18 B2 F9
FA 9D 25 37 00 A7 C6 CE 10 D7 D0 8B 8A EE E3 E2 71 43 5F 21 31 34 AF 2A 3F 87
B1 8E 10 DB DC 7F FD E9 35 E9 41 DE 8E ED 77 B8 7B 2A 00 C7 C6 0E 10 04 54 83
E8 15 4E AA 75 D6 B1 70 AE DD F1 2A 42 F9 46 2E 16 8D 14 0F BE 53 2F 1D 04 00
8C BA F9 DD DD 37 7E F4 27 EE 11 9F 30 82 FD 0F AF 76 6C EF A7 4E CA B8 C3 27
42 E7 4A 2E 15 D6 16 93 0F BC C1 9B 5F 19 5A 88 50 22 F9 27 62 F8 A1 0E 11 8F
76 8B 05 3A 22 ED B6 EF 68 C8 ED EB 83 27 38 C6 4A 2E 16 88 1A 7B 85 EF 5B EF
65 E6 EF 92 21 5E 6F 2F 52 A5 A5 2E 16 9B DA 73 FB 13 E2 3F C5 75 13 48 58 5B
```

```
77 33 C2 63 2A 0E 14 9E E0 6F E6 E3 3B 37 58 E5 C4 FA D7 D8 5D 2A 43 78 C6 2E

11 8A 82 73 E8 E9 ED 9F 72 66 29 05 FA 7D E5 37 7A E7 25 6E 15 B9 DA 7B CF 42
98 5D ED E1 8C E0 5D B9 DD 27 60 A7 B9 CE 10 20 B0 83 87 12 04 7E 11 F5 D7 93
1D A6 B7 27 42 D7 31 AE 10 3E E8 8B 47 55 24 52 F1 FE 18 78 94 DB DD 27 2A E6
B5 AE 10 3A E0 8B 7B CE 2D A1 6E 26 08 7D 50 8A 99 27 0A B4 A9 4E 15 B9 E0 87
9B 69 12 30 99 5D 7D 88 7E B9 91 37 6A B8 46 6E 10 D9 EC 87 FB DB C3 62 49 EE
8F 5B 5C BD DB 37 2B 06 2D 4E 10 15 4E 8F E8 3B 3E 59 A9 30 65 05 CF D9 DF 2A
7E F6 2A 4E 17 12 84 9F CE AE 55 0F FE 60 B5 55 5B E6 E7 25 BF 16 2D 0E 13 1A
C4 0B 62 0D 82 69 E2 20 90 B4 86 32 C1 25 CA F7 39 8E 13 1E C2 07 4E DB F5 39
9D 10 CF 26 27 BD 11 25 CA E8 35 2E 16 98 DC 36 E0 69 43 41 07 48 BD 7A E3 DC
7D 37 1B 07 C3 8E 16 11 3A 0F 23 EE E3 70 F7 73 8F BB 92 EA 8B 3F 55 88 66 4E

10 D9 91 C3 A8 DE EE CB 77 77 BB BC FA 6F 5F 3F 1F 19 35 6E 10 C1 9C 73 F2 82
FA BD DE 69 C8 AF AD 9D 7D 37 78 46 36 0E 10 C1 82 07 F3 82 8D 1A 0A D0 6D 2A
CA 76 87 37 7E A5 A9 AE 10 07 01 4F 91 08 08 C9 73 DC 4D 39 80 5D D3 27 28 D7
AD 2E 10 07 30 A7 27 49 63 5C 18 9B 88 57 CB 5A CB 27 4C C6 A9 0E 10 19 02 AF
13 45 23 77 D7 27 87 AF 83 C9 1D 27 2C B5 C1 AE 10 18 90 A3 19 E6 89 7F 18 43
BA D0 BA A5 71 37 30 D7 3E 2E 14 05 16 77 A5 EE B6 17 77 1F 7F 2E 25 64 4D 37
42 9B C2 CE 11 8A E6 6B FD 62 6B D9 AB 5D 75 4B 17 CC 63 2F 01 3B 4E CE 14 9D
B8 6F E8 24 63 FF 89 91 90 CF 3B 55 A9 2F 2D 27 BD 6E

Header of Ogg page 3:
---------------------
4F 67 67 53                      4     "OggS"
00                               1     null character
04                               1     flags (4 = last page of Ogg stream)
BC 39 01 00 00 00 00 00          8     absolute granule position
BF 3E 00 00                      4     stream serial number
03 00 00 00                      4     stream page number within stream
72 AD 03 D8                      4     CRC checksum
2F                               1     # segments in this page, 0x2F = 47

Segment 1 of Ogg page 3:
------------------------
14 14 14 14 14 14 14 14          47    Segment table (length of each segment), 0x14 = 20
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14 14
14 14 14 14 14 14 14

Payload of Ogg page 3: Consisting of 47 * 20 = 940 bytes
--------------------------------------------------------
14 9A F0 77 E8 16 53 C3 0F 1F 4F 09 4A 3C 3B 33 BE B6 B1 8E 10 00 48 87 E5 91
CC 42 19 E3 B1 62 C0 D2 33 2F 2A D7 3D 8E 16 81 3C B3 D9 99 FA 8C 9F 70 86 BB
92 79 17 2A 42 B7 B5 CE 13 94 8C A7 B1 2E E1 2B 19 1E 89 30 D8 7C 6B 2A 42 C7
35 AE 12 DE B0 A3 AE 1F DE 3E 32 67 FB 9C 4E 7D C7 2F 2A 96 3E EE 12 DA A4 9F
F4 D3 DB DE F1 85 E8 4F 2E C7 C7 37 AA D7 32 0E 12 DE F6 9F B8 51 25 70 A9 57
BE 2F 80 66 77 27 42 E5 25 4E 12 C5 F6 32 FE A7 51 73 4C 2A 1A DA D0 DA BD 27
6C F7 BD 8E 12 C6 4E A7 65 EE EE EF 77 77 7B 71 A1 5E 53 37 6D FF A9 8E 12 D7
24 97 A7 15 CE 90 D5 99 EF 3A D1 99 8B 2F 02 B7 D6 2E 12 D7 04 8F A6 CE E2 FA
9D 9E 37 33 30 7D 67 2F 2B 4B CB 6E 12 D7 54 8B 86 68 A4 D1 71 1E 30 D6 FF 31
87 37 19 2B DA 6E 12 D7 54 87 9F B3 B2 57 71 F1 B7 B8 FE BD DD 37 FB AF E3 4E

12 D7 32 83 7D CF E2 32 98 F5 C8 8C D5 C6 67 37 DB 7C DF EE 12 C4 CA 7F BD 1E
EE E9 DF 77 7B 08 69 B6 DB 37 5B 6D 41 AE 10 D4 8E 7F CE 76 BE 96 10 F6 AC AC
DC 2B 05 22 3E D6 41 CE 10 D6 BE 83 C4 43 ED 5F F7 3E 2F 36 CC 36 DD 3F 54 D5
2D AE 10 C2 96 87 E8 EC 66 A0 F2 65 F2 05 B7 65 7D 2F 5E A5 32 8E 11 8E 9A 8F
EB 46 B6 73 59 98 4F AF FA D7 DD 2F 2D 19 4A 4E 11 8E CB 7B 40 5F 39 89 9E 67
B4 96 02 27 87 27 0B 39 31 8E 11 8E A4 72 C0 C6 5C 04 77 C7 84 F8 85 89 67 27
43 3A 5E EE 16 10 69 12 E7 88 3E 3B 47 77 46 E7 11 7B 2D 37 6D 49 BD CE 13 1A
EE B7 47 33 3A D9 FB 2C 5E 31 C5 08 DB 39 81 08 D2 CE 13 1A C9 97 48 CF 88 2B
03 32 3A 06 F2 07 75 39 BF 59 45 6E 13 1E 84 57 43 2E B2 F9 C1 00 9F 80 7D 4D
19 39 BE D6 29 6E 13 12 9A FB 59 D8 46 F2 53 31 62 21 84 00 27 39 8C C6 BD 6E
```

```
16 81 A4 07 33 5F D7 3A 33 10 40 05 22 C4 A3 2F 58 C7 29 8E 17 80 88 CF 9C EB
EB 1F 6B AB 2B 8F 19 0D 8D 37 0B 34 AD CE 10 0D 00 0F 8F 9B B5 C4 B4 27 BA EF
B9 CD F5 37 43 07 EA 2E 17 97 CC 0F 2E 23 90 2E A5 5A 5A FA C1 DD DD 27 43 49
CF EE 17 97 F4 0A C0 A2 2C 1E 57 17 28 29 1C D2 4B 27 43 2A CA 6E 16 8D 5C 0E
40 3C 89 46 D5 52 FF E7 90 C2 93 27 6D 99 C1 8E 13 97 90 06 38 45 28 9E F4 74
C7 0E 1D 99 99 27 10 D8 BE 0E 16 84 19 5A 73 CE 6D 2A F6 46 18 C7 8F CC 15 27
42 C6 31 6E 16 9F D6 0A 8E 81 DA 71 C6 2C C9 AD 3D 8D 8B 27 28 97 39 EE 12 10
BA 0A 4F 8D 9F DA 44 65 FC 7E 3D A9 13 27 6D 18 C2 0E 16 85 A2 6E 53 88 3C 76
2C 79 A8 9F 5F A8 BD 27 01 18 BE 6E 16 85 FF 22 3E 26 4D C4 CC 91 E4 A7 3D 0D
A5 27 65 18 39 CE 16 85 86 5E 2E FA AD 7A B3 21 62 66 1D 9D F9 27 6D 08 C6 6E

13 98 90 DE 3E 42 A6 70 B5 57 9A 74 5F 49 2B 27 6D 38 3D AE 16 85 EF 9A 53 6D
E2 3F 9F 6A 0F B2 37 2E BB 27 64 E7 BD AE 16 85 8E 16 37 68 52 DC 7A B1 F5 4A
C5 4D 5D 27 6D 17 C5 CE 16 85 EF 0A 2F FC CC 7D 47 C0 30 62 BD 59 95 27 01 18
4A 6E 16 85 E7 0A 4F 25 DF 33 76 F7 A9 A1 4F B8 3D 27 01 19 C2 4E 16 85 AF A2
2F 3F 4E F4 13 47 A4 A1 AF A7 0F 27 01 49 C6 2E 16 95 2B 46 2E 64 15 39 12 47
A5 72 0F EB 69 27 64 F8 4A 0E 16 9D 66 F3 25 EE EE F7 77 74 2C 7B B9 DD DD 27
6D FF E3 EE
```

A.3 Speex Array in C-Code Format

The following is the Speex array in C-code format based on the file in Section A.1 and Section A.2.

```
// This is the Speex compressed voice sample from "USM_EVAC.wav" recording.
// Compression is at 16 kbps.
// The frame size for this mode is 20 ms, corresponding to 160 samples.
// Each frame is also subdivided into 4 sub-frames of 40 samples each.
// In the following data; there are 251 frames,
// 20 bytes/frame compressed, 160 bytes/frame uncompressed or decompressed.
#define NBYTES_ENC3     20     // # bytes in an encoded frame
#define NBYTES_DEC3     160    // # of bytes in a decoded frame
#define NFRAMES3        251    // # of frames
const char data_enc3[] = {
/*0000:*/ 0x16, 0x85, 0xC2, 0x6E, 0x00, 0xEE, 0xEE, 0x07, 0x77, 0x70, 0x39, 0x20, 0x4F, 0x0A,
0x25, 0x27, 0x00, 0x94, 0xBA, 0x0E,
/*0014:*/ 0x16, 0x85, 0xE6, 0x2A, 0x3E, 0x18, 0xCD, 0x3E, 0x0E, 0x4B, 0xB6, 0x32, 0x9D, 0x2A,
0xC7, 0x27, 0x4B, 0x07, 0xC5, 0xEE,
/*0028:*/ 0x16, 0x85, 0xE6, 0xD6, 0x25, 0x6A, 0x15, 0x7F, 0xE9, 0x1B, 0xB9, 0x90, 0xCC, 0x8C,
0x5B, 0x27, 0x6C, 0xF8, 0xCD, 0xEE,
/*003C:*/ 0x16, 0x85, 0xE6, 0x42, 0x2E, 0xD4, 0xAB, 0xB8, 0x94, 0xE3, 0xE9, 0x11, 0x9D, 0xE6,
0xD1, 0x27, 0x0C, 0xF8, 0x46, 0x6E,
/*0050:*/ 0x13, 0x95, 0xCE, 0x4A, 0x3E, 0xEF, 0x68, 0x74, 0xB2, 0x2C, 0xEF, 0x33, 0x5F, 0xF9,
0xF9, 0x27, 0x01, 0x39, 0xD6, 0x8E,
/*0064:*/ 0x16, 0x85, 0xA7, 0x8A, 0x46, 0x16, 0x5E, 0x70, 0x8E, 0x91, 0xCE, 0x2F, 0x27, 0x1F,
0xB7, 0x27, 0x6D, 0x29, 0x52, 0x4E,
/*0078:*/ 0x10, 0x0C, 0x81, 0xF6, 0xA0, 0xEE, 0xEE, 0x7F, 0x77, 0x71, 0x7A, 0x3B, 0xA1, 0xFF,
0x1D, 0x37, 0x63, 0xFF, 0xDA, 0xEE,
/*008C:*/ 0x10, 0x15, 0x10, 0xEA, 0xC0, 0xEE, 0xEE, 0x07, 0x77, 0x50, 0x04, 0x4E, 0x25, 0x1C,
0x71, 0x27, 0x01, 0xFB, 0x42, 0x6E,
/*00A0:*/ 0x16, 0x9E, 0xA6, 0xC3, 0x59, 0x63, 0xEE, 0xF7, 0x74, 0xD3, 0xFE, 0xE2, 0x89, 0x12,
0xDF, 0x37, 0x38, 0xE5, 0xBD, 0xAE,
/*00B4:*/ 0x10, 0x11, 0x82, 0x9B, 0xC5, 0x33, 0x4C, 0xF1, 0x9F, 0x10, 0xCA, 0x01, 0xA8, 0x86,
0x25, 0x3F, 0x78, 0x98, 0xA1, 0xAE,
/*00C8:*/ 0x17, 0x97, 0xE6, 0x1F, 0xEF, 0x6E, 0xED, 0xE8, 0x94, 0x77, 0x74, 0x5C, 0x6A, 0x34,
0x45, 0x37, 0x78, 0xD5, 0xA5, 0xAE,
/*00DC:*/ 0x17, 0x97, 0x90, 0x77, 0xFD, 0x34, 0xEB, 0xDB, 0x17, 0x8E, 0x94, 0xF3, 0x7F, 0x58,
0x6B, 0x3C, 0xEB, 0x16, 0xBD, 0xEE,
/*00F0:*/ 0x17, 0x97, 0xBA, 0x6F, 0xFD, 0x4C, 0xC3, 0xED, 0xE6, 0x69, 0x89, 0x4E, 0xD6, 0xC2,
0xB5, 0x2F, 0x0E, 0xF7, 0xCE, 0x0E,
/*0104:*/ 0x13, 0x97, 0x96, 0x6B, 0xF5, 0xE4, 0x23, 0x55, 0xF8, 0x67, 0xFF, 0x98, 0xEB, 0xFD,
0x99, 0x2F, 0x15, 0x26, 0xB1, 0x0E,
/*0118:*/ 0x13, 0x80, 0xBA, 0x6B, 0xD8, 0x54, 0x66, 0xE9, 0x36, 0x68, 0x19, 0xAE, 0x3C, 0x45,
0x65, 0x3F, 0x60, 0x82, 0x08, 0x4E,
/*012C:*/ 0x13, 0x10, 0x8A, 0x5B, 0xBC, 0x11, 0x69, 0x4A, 0xA9, 0x17, 0x0A, 0x7A, 0xC3, 0xCD,
0xDD, 0x25, 0xBE, 0x02, 0x91, 0xCE,
/*0140:*/ 0x13, 0x11, 0xF5, 0xA3, 0x62, 0x71, 0x78, 0x10, 0x20, 0x83, 0x82, 0x00, 0x47, 0x79,
```

```
0x6F, 0x25, 0xDE, 0xB4, 0xB1, 0xEE,
/*0154:*/ 0x13, 0x1A, 0xE5, 0x3B, 0x71, 0xA4, 0xF2, 0x0B, 0x13, 0x72, 0x5C, 0x1D, 0xDB, 0xCB,
0x03, 0x25, 0xDE, 0xC8, 0xBA, 0x6E,
/*0168:*/ 0x13, 0x1A, 0xE4, 0x0F, 0x73, 0x77, 0xD8, 0x1F, 0xC3, 0xAF, 0x9F, 0x4C, 0x04, 0x06,
0xCB, 0x25, 0xBF, 0x07, 0xAD, 0xCE,
/*017C:*/ 0x13, 0x11, 0xF5, 0x8B, 0x31, 0x5F, 0x8C, 0x0A, 0xC4, 0x82, 0x59, 0x9C, 0xD0, 0xEE,
0x2F, 0x25, 0xA7, 0x29, 0x5A, 0xCE,
/*0190:*/ 0x13, 0x1E, 0xC4, 0xB3, 0x39, 0x08, 0x96, 0x05, 0xC3, 0x31, 0x57, 0x7C, 0x39, 0x40,
0xE5, 0x25, 0xBF, 0x6A, 0x31, 0x6E,
/*01A4:*/ 0x11, 0x15, 0x4C, 0x27, 0x21, 0x29, 0x67, 0xEC, 0x0C, 0x40, 0x61, 0xF5, 0xE2, 0xE7,
0x73, 0x37, 0x78, 0xB7, 0xB5, 0xCE,
/*01B8:*/ 0x16, 0x10, 0x86, 0x0F, 0x25, 0xB8, 0xEA, 0xEF, 0x21, 0x14, 0xE1, 0x57, 0x52, 0xFA,
0xD1, 0x27, 0x50, 0xB5, 0xA8, 0xEE,
/*01CC:*/ 0x10, 0x19, 0xC7, 0x4B, 0x65, 0xEE, 0xEE, 0x91, 0xC6, 0x63, 0x81, 0x6C, 0x8B, 0x7C,
0x07, 0x27, 0x61, 0xF4, 0xBA, 0x4E,
/*01E0:*/ 0x10, 0x11, 0xEB, 0x67, 0xC9, 0xE2, 0xCF, 0x66, 0xF5, 0xC0, 0xC9, 0x48, 0xF9, 0xE6,
0xFB, 0x27, 0x48, 0xB7, 0x20, 0x6E,
/*01F4:*/ 0x17, 0x9F, 0x96, 0x3F, 0xAD, 0x9D, 0xB9, 0x8A, 0x6B, 0x80, 0xE8, 0x8A, 0xDB, 0x3D,
0xF9, 0x3F, 0x74, 0xA7, 0x4B, 0x0E,
/*0208:*/ 0x16, 0x91, 0x52, 0x7F, 0xBB, 0x43, 0x5D, 0x7D, 0x5A, 0xAB, 0x89, 0xAD, 0x23, 0xD3,
0xBF, 0x2E, 0x5F, 0x4A, 0x3D, 0x6E,
/*021C:*/ 0x16, 0x91, 0x90, 0x73, 0xA2, 0xD3, 0x3A, 0xC8, 0x1E, 0x64, 0x75, 0xCA, 0x38, 0xA4,
0x89, 0x25, 0xBE, 0xF7, 0x31, 0x2E,
/*0230:*/ 0x16, 0x88, 0x90, 0xAF, 0xA0, 0x51, 0x33, 0x7E, 0x17, 0x29, 0xB8, 0xCF, 0x9D, 0xA9,
0x79, 0x25, 0xBE, 0xD6, 0x4D, 0xCE,
/*0244:*/ 0x16, 0x90, 0x92, 0x0F, 0xA3, 0x63, 0xFC, 0x2B, 0xFC, 0x00, 0x3C, 0xFA, 0x51, 0x47,
0x17, 0x39, 0xBE, 0xE6, 0x3E, 0x2E,
/*0258:*/ 0x10, 0xCD, 0xD4, 0x93, 0xF9, 0x15, 0x34, 0xE8, 0x8C, 0x3A, 0x0D, 0x9B, 0x50, 0x6D,
0x45, 0x2F, 0x7E, 0xC7, 0xBA, 0x0E,
/*026C:*/ 0x10, 0xDD, 0x02, 0x8B, 0xF8, 0x0C, 0xDA, 0xD5, 0x73, 0x5B, 0xCF, 0x91, 0x40, 0x55,
0xD9, 0x2F, 0x0D, 0x19, 0xC9, 0xEE,
/*0280:*/ 0x10, 0xDD, 0xAF, 0x53, 0x65, 0x87, 0xB3, 0x04, 0x64, 0x98, 0x3A, 0xCC, 0xC5, 0xDC,
0xD9, 0x37, 0x01, 0x7A, 0xEA, 0xAE,
/*0294:*/ 0x10, 0x10, 0xBB, 0x6B, 0x25, 0x22, 0x4B, 0x76, 0x9F, 0x23, 0x8D, 0xAF, 0x46, 0x7C,
0x47, 0x37, 0x59, 0x7A, 0x53, 0x0E,
/*02A8:*/ 0x16, 0x9C, 0xA3, 0x0F, 0x13, 0x8E, 0xE8, 0x15, 0x2A, 0xE7, 0xAE, 0xCF, 0x7D, 0x44,
0x7D, 0x27, 0x79, 0x27, 0x41, 0x8E,
/*02BC:*/ 0x16, 0x9C, 0x86, 0x1E, 0xF3, 0xEC, 0xBC, 0x9A, 0x5C, 0x64, 0xDA, 0x3B, 0xC1, 0xBD,
0x55, 0x27, 0x78, 0xE7, 0x31, 0xAE,
/*02D0:*/ 0x16, 0x9C, 0xE6, 0x1E, 0xC5, 0x43, 0x53, 0x38, 0x8C, 0x65, 0xF2, 0xCF, 0x00, 0x2A,
0x55, 0x27, 0x79, 0x05, 0xB9, 0x4E,
/*02E4:*/ 0x16, 0x1C, 0x10, 0x6B, 0x31, 0xEE, 0xE4, 0x77, 0x23, 0xD6, 0x49, 0x0C, 0xA3, 0x75,
0x0B, 0x27, 0x7A, 0xA3, 0xB5, 0x0E,
/*02F8:*/ 0x12, 0xD7, 0x0E, 0x2F, 0x33, 0xBB, 0xE3, 0x01, 0x2F, 0x18, 0xBB, 0xB8, 0xDB, 0xF5,
0x45, 0x27, 0x7F, 0x59, 0x6E, 0x0E,
/*030C:*/ 0x12, 0xD4, 0xAE, 0x6B, 0xAD, 0x95, 0x23, 0x0B, 0xD7, 0x6E, 0xD4, 0xE6, 0xF4, 0x7D,
0xB7, 0x37, 0x00, 0x95, 0xBE, 0x4E,
/*0320:*/ 0x12, 0xC4, 0xD2, 0x5B, 0xAD, 0x12, 0x43, 0xE6, 0xE4, 0x37, 0x36, 0xBD, 0xC6, 0x2B,
0x33, 0x37, 0x14, 0xE6, 0xAD, 0x8E,
/*0334:*/ 0x10, 0xD4, 0xDA, 0x7B, 0xCC, 0x2C, 0x6B, 0xDC, 0x77, 0x37, 0x44, 0x07, 0x9C, 0x66,
0xFB, 0x34, 0xD0, 0xF8, 0xBE, 0x2E,
/*0348:*/ 0x10, 0xD6, 0x8A, 0x83, 0xC8, 0xE5, 0xDD, 0x23, 0x29, 0xF3, 0xF6, 0x0A, 0xCC, 0x4F,
0x71, 0x37, 0x79, 0x18, 0xB9, 0xCE,
/*035C:*/ 0x14, 0x03, 0x94, 0x8B, 0xC8, 0x32, 0x41, 0x42, 0xD9, 0x71, 0x89, 0x87, 0xFA, 0xCE,
0x5D, 0x37, 0x7F, 0x0A, 0xCA, 0x6E,
/*0370:*/ 0x14, 0x00, 0x12, 0x13, 0xC1, 0x2A, 0x9F, 0x19, 0x66, 0x80, 0x9C, 0x6F, 0xFD, 0x4A,
0x87, 0x37, 0x7F, 0x3A, 0x4A, 0x2E,
/*0384:*/ 0x14, 0x00, 0x42, 0x17, 0xC0, 0xE9, 0x42, 0x1F, 0xFE, 0x56, 0x41, 0xF6, 0x47, 0x99,
0xF5, 0x27, 0x68, 0xD4, 0x98, 0x8E,
/*0398:*/ 0x14, 0x00, 0x0A, 0xB3, 0xB8, 0x83, 0x29, 0xDA, 0x14, 0x91, 0x89, 0x8D, 0xCC, 0xBB,
0x6B, 0x27, 0x42, 0x94, 0x2D, 0xAE,
/*03AC:*/ 0x14, 0xDA, 0xC2, 0xBB, 0xA8, 0xD3, 0xDF, 0x41, 0xE5, 0x32, 0x03, 0xCC, 0xDD, 0xB2,
0xD9, 0x27, 0x2C, 0x84, 0x1C, 0x6E,
/*03C0:*/ 0x14, 0xDE, 0x92, 0xC3, 0x88, 0xD3, 0x20, 0x41, 0x2E, 0x71, 0xD0, 0x93, 0x7A, 0x39,
0xD9, 0x27, 0x42, 0x95, 0xA9, 0xCE,
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/*03D4:*/ 0x10, 0x3F, 0x48, 0xCB, 0x53, 0x1A, 0x9B, 0xFE, 0x8B, 0x17, 0x95, 0x4B, 0x9D, 0x68,
0x7F, 0x27, 0x01, 0x08, 0x42, 0x0E,
/*03E8:*/ 0x12, 0xFA, 0xF4, 0xD7, 0x28, 0x16, 0x6E, 0x3A, 0x22, 0x9F, 0xEF, 0xB4, 0xF0, 0x4D,
0xA3, 0x27, 0x01, 0x06, 0xC5, 0x6E,
/*03FC:*/ 0x12, 0xFA, 0xF4, 0xD7, 0x38, 0x63, 0xFB, 0xFA, 0xAE, 0x6D, 0x0F, 0x94, 0x48, 0xCD,
0xA5, 0x27, 0x20, 0xD4, 0xAD, 0x0E,
/*0410:*/ 0x15, 0xA1, 0x68, 0xD7, 0x6C, 0x61, 0x73, 0x37, 0xA9, 0x0E, 0x07, 0x71, 0x76, 0x34,
0xE3, 0x27, 0x0C, 0x52, 0xA5, 0x2E,
/*0424:*/ 0x15, 0xBF, 0x14, 0xD7, 0x93, 0xBD, 0x13, 0xDB, 0x73, 0x23, 0x85, 0xAC, 0x7A, 0xD2,
0x55, 0x27, 0x74, 0xB7, 0x3E, 0x0E,
/*0438:*/ 0x10, 0xC6, 0x02, 0xDB, 0xD6, 0xE3, 0xC4, 0x39, 0x59, 0xE1, 0x1B, 0x20, 0xB6, 0xAC,
0x7D, 0x37, 0x54, 0xF7, 0xB9, 0x8E,
/*044C:*/ 0x12, 0xD6, 0x40, 0xD7, 0xDF, 0xB3, 0x33, 0x3D, 0xF7, 0x23, 0x90, 0xB9, 0x4B, 0xDC,
0x6D, 0x37, 0x13, 0x38, 0xB6, 0x4E,
/*0460:*/ 0x12, 0xCB, 0x70, 0xD7, 0x9E, 0x63, 0x23, 0x47, 0x76, 0x59, 0x73, 0xBB, 0xA6, 0x97,
0xDD, 0x37, 0x55, 0x2A, 0x45, 0xEE,
/*0474:*/ 0x12, 0xCB, 0x70, 0xD7, 0x7F, 0xCE, 0xEC, 0x39, 0xB3, 0x2A, 0x8B, 0xBB, 0x8E, 0xDD,
0xDD, 0x37, 0x4D, 0x27, 0xDE, 0xAE,
/*0488:*/ 0x12, 0xC6, 0x0C, 0xDB, 0x8C, 0xDC, 0x3E, 0x3F, 0x77, 0x76, 0xF1, 0xAF, 0xA4, 0x25,
0x79, 0x37, 0x13, 0x0F, 0xC6, 0x4E,
/*049C:*/ 0x12, 0xD6, 0x70, 0xDF, 0xAC, 0xC6, 0x36, 0x34, 0x97, 0x93, 0xAE, 0x99, 0x9D, 0x79,
0x55, 0x34, 0xAD, 0x06, 0xC2, 0x0E,
/*04B0:*/ 0x12, 0xD6, 0x1C, 0xEF, 0xA8, 0xC5, 0xE3, 0xA7, 0x71, 0x5A, 0x0C, 0xFB, 0x8F, 0xA2,
0x2D, 0x37, 0x13, 0x2A, 0xEA, 0x2E,
/*04C4:*/ 0x12, 0xD6, 0x58, 0xF7, 0x88, 0x55, 0xFE, 0xDE, 0x8B, 0x76, 0xD5, 0x7A, 0x7F, 0x86,
0xC7, 0x37, 0x0D, 0x08, 0x3D, 0xEE,
/*04D8:*/ 0x12, 0xD6, 0x20, 0xFB, 0x88, 0xA6, 0x63, 0x3A, 0xFF, 0x1E, 0xF8, 0x79, 0x70, 0x7B,
0xDD, 0x27, 0x42, 0xC7, 0x31, 0xCE,
/*04EC:*/ 0x15, 0xB4, 0x85, 0x0F, 0x9C, 0x81, 0x2B, 0x33, 0xDD, 0xDB, 0x8B, 0xCC, 0xFB, 0xA6,
0x67, 0x27, 0x34, 0xA6, 0x2D, 0xCE,
/*0500:*/ 0x15, 0xB4, 0xB0, 0x1B, 0x6E, 0x06, 0x69, 0x4A, 0xAA, 0xCE, 0x8A, 0xEA, 0x84, 0x2D,
0x8B, 0x27, 0x42, 0xB6, 0x35, 0x8E,
/*0514:*/ 0x15, 0xB4, 0xD4, 0x07, 0x6D, 0x89, 0x9F, 0x49, 0xB6, 0x31, 0x56, 0x7C, 0x04, 0xE2,
0xC5, 0x27, 0x7E, 0xC7, 0xAD, 0xCE,
/*0528:*/ 0x15, 0xB6, 0xDA, 0x03, 0x69, 0x61, 0xA9, 0x19, 0x7A, 0x70, 0xCD, 0x8A, 0x52, 0x81,
0x4B, 0x27, 0x12, 0xE8, 0x4A, 0x0E,
/*053C:*/ 0x15, 0xB6, 0x92, 0x03, 0x60, 0xA1, 0xCE, 0x1F, 0xBD, 0x0A, 0x77, 0x4C, 0xB8, 0xD9,
0x0B, 0x27, 0x13, 0x18, 0x46, 0x0E,
/*0550:*/ 0x15, 0xBA, 0xFA, 0x13, 0x43, 0xF7, 0x5F, 0x6E, 0xA1, 0x66, 0x6A, 0x7D, 0x1A, 0x33,
0xE5, 0x27, 0x02, 0xF8, 0x29, 0x8E,
/*0564:*/ 0x15, 0xBA, 0xFA, 0x13, 0x59, 0x37, 0xA9, 0x0E, 0xA0, 0xE8, 0x70, 0xBB, 0x06, 0x41,
0xED, 0x27, 0x00, 0xD8, 0x45, 0xAE,
/*0578:*/ 0x14, 0xDA, 0x93, 0x6F, 0x0B, 0x12, 0x5F, 0x65, 0x0A, 0x47, 0x9A, 0xD8, 0x40, 0x58,
0x3D, 0x27, 0x6D, 0x17, 0xCA, 0x2E,
/*058C:*/ 0x15, 0xBD, 0x9A, 0x12, 0xA0, 0xC9, 0x1A, 0x0B, 0x1A, 0xA8, 0xC6, 0x32, 0x05, 0x48,
0x4B, 0x27, 0x6D, 0x5B, 0xD6, 0x8E,
/*05A0:*/ 0x10, 0xC6, 0x12, 0x0E, 0xC1, 0x3B, 0x56, 0xF1, 0xFC, 0x30, 0x29, 0x38, 0x05, 0x31,
0xB3, 0x27, 0x01, 0x6A, 0x4A, 0x0E,
/*05B4:*/ 0x10, 0xC6, 0x0A, 0x42, 0xC7, 0xA4, 0x8D, 0x03, 0x58, 0x9C, 0x3B, 0x61, 0x0A, 0x46,
0x21, 0x27, 0x2D, 0x1A, 0xBE, 0x0E,
/*05C8:*/ 0x13, 0x8F, 0x0A, 0x0A, 0xA0, 0xF3, 0xBF, 0x14, 0x62, 0x44, 0x68, 0xA2, 0x3D, 0x37,
0x7D, 0x27, 0x01, 0x27, 0xB6, 0x2E,
/*05DC:*/ 0x13, 0x98, 0x90, 0x36, 0x45, 0x65, 0xDA, 0x71, 0x8E, 0x9B, 0xFF, 0xB7, 0x8B, 0xD1,
0x6B, 0x27, 0x0D, 0x4A, 0x4A, 0x6E,
/*05F0:*/ 0x16, 0x85, 0xFA, 0x5A, 0x3E, 0xFC, 0x8A, 0x71, 0x4A, 0x8F, 0x53, 0xFE, 0x9E, 0xB4,
0xC9, 0x27, 0x63, 0x06, 0xB1, 0x4E,
/*0604:*/ 0x16, 0x96, 0x4E, 0x0F, 0x47, 0xEE, 0xEE, 0x97, 0x76, 0xE8, 0xD4, 0x56, 0x05, 0x48,
0x41, 0x3C, 0xAB, 0xF1, 0x15, 0x6E,
/*0618:*/ 0x16, 0x8E, 0xFD, 0x6F, 0x23, 0x3F, 0xF6, 0x9A, 0x6E, 0x10, 0xBB, 0x20, 0x80, 0xBD,
0xD5, 0x3F, 0x78, 0xE7, 0x36, 0x0E,
/*062C:*/ 0x16, 0x97, 0x78, 0x5B, 0x00, 0x82, 0xD2, 0x39, 0x9B, 0xB8, 0x97, 0xCE, 0xC4, 0x58,
0x39, 0x3F, 0x2C, 0xF7, 0x35, 0x0E,
/*0640:*/ 0x12, 0xCB, 0x04, 0x8F, 0x28, 0xE6, 0x8E, 0xB1, 0x66, 0x5A, 0x1B, 0x31, 0x50, 0xD6,
0xB9, 0x37, 0x0C, 0x96, 0x3E, 0x2E,
/*0654:*/ 0x10, 0xD4, 0x48, 0x7B, 0x9D, 0xCE, 0xEB, 0x3E, 0xDB, 0x31, 0x53, 0x7D, 0x90, 0x74,
0xA7, 0x37, 0x55, 0x06, 0x29, 0x6E,
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/*0668:*/ 0x13, 0x82, 0x9A, 0x6B, 0xA5, 0xBF, 0x33, 0xEC, 0x5E, 0x66, 0xF1, 0x7E, 0x88, 0xC2,
0x57, 0x2F, 0x3E, 0x94, 0x98, 0xEE,
/*067C:*/ 0x17, 0x04, 0x7A, 0x63, 0xC5, 0xF8, 0xBC, 0xEE, 0x1D, 0xF5, 0x9C, 0xBA, 0xEC, 0x99,
0x7D, 0x33, 0xBA, 0x76, 0xB1, 0xCE,
/*0690:*/ 0x17, 0x1B, 0xE8, 0x63, 0xD7, 0x8B, 0x3E, 0x20, 0x3C, 0x5A, 0xB8, 0xAE, 0xFB, 0x71,
0x67, 0x23, 0xDF, 0x06, 0x45, 0xEE,
/*06A4:*/ 0x17, 0x1B, 0xE8, 0x67, 0xB3, 0xD7, 0x89, 0xEF, 0x45, 0x98, 0x4E, 0x3A, 0x83, 0xE7,
0xA7, 0x33, 0xBE, 0xA6, 0xAC, 0xEE,
/*06B8:*/ 0x17, 0x1B, 0xFA, 0x03, 0x6C, 0x05, 0x8F, 0x76, 0x5F, 0x48, 0xCB, 0x79, 0xFB, 0x4B,
0x2D, 0x2F, 0x18, 0xC8, 0xC6, 0x0E,
/*06CC:*/ 0x17, 0x1B, 0xE8, 0x77, 0x68, 0x9C, 0xCE, 0x52, 0x05, 0x7B, 0x27, 0xF8, 0xFB, 0xC2,
0x15, 0x2F, 0x7A, 0xF6, 0xB9, 0x0E,
/*06E0:*/ 0x17, 0x17, 0xFA, 0x7B, 0x88, 0x9C, 0xCA, 0x45, 0x5F, 0x6C, 0xE2, 0xFB, 0x35, 0x19,
0xBF, 0x33, 0xBE, 0x76, 0xBD, 0xEE,
/*06F4:*/ 0x16, 0x99, 0x9A, 0x07, 0xA0, 0x38, 0x83, 0xA8, 0x34, 0x58, 0x55, 0x95, 0xA2, 0x70,
0x3F, 0x39, 0xBE, 0xF6, 0x41, 0xCE,
/*0708:*/ 0x16, 0x99, 0xF0, 0x83, 0x8E, 0x62, 0x13, 0x07, 0x8B, 0x11, 0xC1, 0x24, 0x05, 0x5A,
0x65, 0x25, 0xBF, 0x27, 0x21, 0x8E,
/*071C:*/ 0x13, 0x10, 0xEF, 0x7F, 0x71, 0xA4, 0x67, 0x8A, 0x11, 0xC0, 0x49, 0xB0, 0x81, 0x08,
0xF7, 0x25, 0xBE, 0xF7, 0xC6, 0x4E,
/*0730:*/ 0x13, 0x11, 0xCE, 0x83, 0x6E, 0x09, 0xDC, 0x1C, 0xC4, 0x68, 0x8C, 0xEB, 0x0E, 0xFE,
0x91, 0x25, 0xDF, 0x08, 0x4D, 0xCE,
/*0744:*/ 0x11, 0x11, 0x68, 0x27, 0x55, 0xCC, 0x43, 0x11, 0x05, 0xB8, 0x33, 0xF9, 0xAE, 0xE7,
0x71, 0x25, 0xF1, 0x57, 0xC5, 0xCE,
/*0758:*/ 0x16, 0x99, 0x16, 0xF3, 0x88, 0x91, 0x38, 0xF1, 0xCF, 0xF0, 0x9D, 0x8F, 0x45, 0x68,
0x9D, 0x2B, 0xBE, 0xC5, 0x21, 0x2E,
/*076C:*/ 0x15, 0x50, 0x90, 0x9F, 0x5E, 0x05, 0x35, 0x38, 0xB5, 0x51, 0x73, 0xF6, 0xFC, 0xB6,
0xF5, 0x37, 0x25, 0x05, 0xBD, 0xAE,
/*0780:*/ 0x12, 0xD9, 0x76, 0x8B, 0x2E, 0x64, 0x3C, 0xED, 0xE5, 0x93, 0xF3, 0xBB, 0xA6, 0x76,
0xC7, 0x32, 0x24, 0xD7, 0x46, 0x2E,
/*0794:*/ 0x12, 0xDD, 0x4E, 0x1B, 0x3D, 0x2A, 0x31, 0xDD, 0x2A, 0x8C, 0xF2, 0xEB, 0xCB, 0xFE,
0x29, 0x3F, 0x0C, 0xE8, 0x4A, 0x6E,
/*07A8:*/ 0x17, 0x94, 0x98, 0x5F, 0xB2, 0x33, 0x63, 0x3A, 0x8F, 0x36, 0x3B, 0x39, 0x3D, 0x0F,
0x1B, 0x3F, 0x60, 0xC6, 0x3D, 0xCE,
/*07BC:*/ 0x12, 0x03, 0x96, 0x4F, 0xFD, 0x32, 0xC6, 0xE9, 0x10, 0x17, 0x48, 0xD8, 0x8D, 0x7D,
0x1D, 0x3C, 0xA6, 0xF8, 0x53, 0x4E,
/*07D0:*/ 0x14, 0x92, 0xA4, 0x4F, 0xEA, 0xB5, 0xD3, 0xBF, 0x0B, 0x7E, 0xA2, 0xCA, 0xDD, 0x6B,
0x8D, 0x2B, 0x81, 0x8A, 0x52, 0x2E,
/*07E4:*/ 0x17, 0x08, 0x7A, 0x53, 0xC8, 0xDD, 0x37, 0x46, 0x9F, 0xE9, 0x9B, 0x7B, 0xBB, 0xF2,
0x8B, 0x3F, 0x78, 0xF6, 0xAC, 0x6E,
/*07F8:*/ 0x14, 0x8B, 0xB4, 0x1F, 0x82, 0x45, 0xCD, 0xC3, 0xEE, 0x42, 0x5B, 0x73, 0x57, 0x54,
0x2B, 0x37, 0x38, 0xB4, 0xBE, 0x2E,
/*080C:*/ 0x14, 0x88, 0x9A, 0x07, 0x73, 0x89, 0x9D, 0x9D, 0x2F, 0xE8, 0xA8, 0xFB, 0x4F, 0x07,
0xDD, 0x37, 0x41, 0x38, 0x46, 0xAE,
/*0820:*/ 0x13, 0x9E, 0xDA, 0x73, 0x25, 0xB5, 0x3A, 0x3A, 0x76, 0x5F, 0x4B, 0xF9, 0xBC, 0x5D,
0xB5, 0x27, 0x55, 0x28, 0xB1, 0x0E,
/*0834:*/ 0x16, 0x81, 0xDA, 0x8F, 0x25, 0x73, 0xEF, 0x9C, 0x21, 0xD5, 0x71, 0xA8, 0xCB, 0x6B,
0xB5, 0x27, 0x78, 0x92, 0x98, 0x8E,
/*0848:*/ 0x13, 0x80, 0x9A, 0x92, 0xE6, 0xD4, 0x86, 0xF6, 0xD9, 0xF0, 0x3A, 0x4C, 0xCB, 0x7D,
0xDD, 0x27, 0x0C, 0x75, 0x22, 0x8E,
/*085C:*/ 0x16, 0x95, 0xC6, 0xB3, 0x08, 0x3B, 0xEE, 0x3F, 0x77, 0x72, 0x22, 0xBB, 0x3A, 0x6A,
0x2F, 0x37, 0x1F, 0x4F, 0xCE, 0xEE,
/*0870:*/ 0x10, 0x1F, 0x11, 0x9F, 0x50, 0xEE, 0x5E, 0x01, 0xF1, 0xF1, 0x38, 0xB0, 0x82, 0xC9,
0xF9, 0x2A, 0x6D, 0xAD, 0xDA, 0x2E,
/*0884:*/ 0x10, 0xD9, 0xD4, 0x87, 0xF3, 0xB3, 0x26, 0xCD, 0xF1, 0xE8, 0x4C, 0xE2, 0xC9, 0x35,
0x8F, 0x2A, 0x7E, 0xF8, 0xBD, 0xAE,
/*0898:*/ 0x10, 0xC0, 0x34, 0x7F, 0xE6, 0x21, 0xBE, 0x43, 0xA7, 0x5F, 0xDA, 0xD3, 0x2F, 0xA4,
0x27, 0x2A, 0x43, 0x19, 0x46, 0x2E,
/*08AC:*/ 0x10, 0xC9, 0x34, 0x83, 0x8B, 0x9F, 0x88, 0x02, 0xDF, 0x18, 0x39, 0xBB, 0x8B, 0xDD,
0xC7, 0x27, 0x00, 0xF7, 0xBA, 0x2E,
/*08C0:*/ 0x10, 0xD5, 0x34, 0x7E, 0xDE, 0xA1, 0xF5, 0x77, 0xC5, 0x63, 0x8A, 0xAE, 0x3C, 0x37,
0x2D, 0x27, 0x6D, 0x07, 0xBD, 0xEE,
/*08D4:*/ 0x12, 0xD9, 0xC3, 0x96, 0x85, 0xFB, 0x3B, 0xF4, 0x22, 0x91, 0x55, 0x29, 0x1D, 0x87,
0x9D, 0x27, 0x01, 0x89, 0xDB, 0x2E,
/*08E8:*/ 0x10, 0xD5, 0x30, 0xB2, 0x87, 0xD6, 0x6B, 0x3A, 0xF9, 0xB6, 0xF1, 0xAD, 0x7B, 0xF8,
0x39, 0x27, 0x01, 0x7A, 0xD2, 0x2E,
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/*08FC:*/ 0x17, 0x80, 0xCA, 0x3B, 0x80, 0xEE, 0xEE, 0x07, 0x77, 0x70, 0x39, 0x54, 0x8A, 0xC2,
0xC5, 0x2A, 0x01, 0xFF, 0xC2, 0x8E,
/*0910:*/ 0x17, 0x91, 0x10, 0x7B, 0xE8, 0x8B, 0x8E, 0xEF, 0x98, 0xE5, 0x48, 0x6C, 0x91, 0x64,
0xE5, 0x2A, 0x66, 0xF7, 0xB9, 0xCE,
/*0924:*/ 0x12, 0xCA, 0xE4, 0x6F, 0xE6, 0x11, 0x23, 0xE8, 0xEF, 0xAA, 0xD6, 0x33, 0x90, 0xB8,
0xCD, 0x37, 0x78, 0xF7, 0x3E, 0x2E,
/*0938:*/ 0x12, 0xCE, 0x64, 0x67, 0xE6, 0xEB, 0x45, 0xBE, 0x59, 0x5D, 0x70, 0xCC, 0xD6, 0x59,
0xDD, 0x3F, 0x7A, 0xF8, 0xC5, 0xCE,
/*094C:*/ 0x12, 0xC1, 0x0C, 0x67, 0xD8, 0xC3, 0xF2, 0xC6, 0xF7, 0x1A, 0xB7, 0xB0, 0xCC, 0x7D,
0xD7, 0x3F, 0x1E, 0xD8, 0xBF, 0x4E,
/*0960:*/ 0x15, 0xFA, 0xEC, 0x6B, 0xA8, 0x23, 0x3D, 0x3E, 0x8F, 0x1A, 0xB5, 0x77, 0x8C, 0x66,
0xD5, 0x3F, 0x7B, 0x28, 0xB1, 0xCE,
/*0974:*/ 0x15, 0xFE, 0xEC, 0x6F, 0x67, 0xAE, 0x13, 0x7F, 0x19, 0x9D, 0xF9, 0xBB, 0xDE, 0x44,
0x7D, 0x3F, 0x39, 0x3D, 0x56, 0xCE,
/*0988:*/ 0x12, 0xC1, 0x4A, 0x73, 0x47, 0x63, 0x1D, 0xF8, 0xF5, 0x99, 0xCC, 0xBB, 0xB1, 0x86,
0x67, 0x27, 0x19, 0x2A, 0x56, 0x0E,
/*099C:*/ 0x16, 0x87, 0x6E, 0x73, 0x68, 0xED, 0x5E, 0x77, 0x1F, 0x71, 0xCF, 0xBB, 0x98, 0xEF,
0x05, 0x37, 0xBE, 0xBA, 0xCD, 0x0E,
/*09B0:*/ 0x13, 0x80, 0x98, 0x6F, 0xBE, 0x54, 0xEF, 0xC4, 0x5C, 0x07, 0xD7, 0xCB, 0xC9, 0x20,
0xE7, 0x2F, 0x14, 0x52, 0x94, 0xCE,
/*09C4:*/ 0x12, 0x04, 0x18, 0x6F, 0xFB, 0xDD, 0x3D, 0x34, 0x96, 0x11, 0xB3, 0x0E, 0xCC, 0xAD,
0xBD, 0x2C, 0xFE, 0x76, 0x3E, 0x2E,
/*09D8:*/ 0x10, 0x9A, 0xF6, 0x6F, 0xAF, 0xC6, 0xF5, 0x5D, 0x69, 0xAC, 0xEA, 0xE0, 0x5D, 0xDD,
0x79, 0x2F, 0x15, 0x38, 0xBA, 0x0E,
/*09EC:*/ 0x10, 0x92, 0xBA, 0x2F, 0x49, 0xDD, 0xDE, 0xF3, 0x32, 0x2B, 0xCA, 0x7A, 0xDC, 0x59,
0xC7, 0x37, 0x7F, 0x28, 0x45, 0xEE,
/*0A00:*/ 0x13, 0x86, 0x76, 0x82, 0xDE, 0x03, 0x38, 0xF6, 0x5F, 0xF9, 0xFF, 0xCE, 0xFA, 0x97,
0xDF, 0x37, 0x0D, 0x39, 0xD2, 0x2E,
/*0A14:*/ 0x10, 0x92, 0xBA, 0x7B, 0x6F, 0xE3, 0xE3, 0x83, 0xF9, 0xE9, 0xA9, 0x44, 0xCC, 0x26,
0x4B, 0x2F, 0x7F, 0x17, 0x3A, 0xAE,
/*0A28:*/ 0x10, 0x92, 0xBA, 0x83, 0xBD, 0x55, 0x99, 0xB1, 0x7E, 0xED, 0x38, 0xF7, 0x49, 0xAD,
0x9F, 0x33, 0xEB, 0x18, 0xD6, 0x4E,
/*0A3C:*/ 0x10, 0x92, 0x9A, 0x87, 0xC5, 0x2B, 0x5E, 0x47, 0xF1, 0x93, 0x04, 0xEC, 0xD5, 0x47,
0xCB, 0x33, 0xFF, 0x5A, 0xDE, 0xAE,
/*0A50:*/ 0x12, 0x92, 0x16, 0x8B, 0xC8, 0xEB, 0xC1, 0x99, 0xF7, 0x75, 0x22, 0xFB, 0x3B, 0x99,
0xBF, 0x2F, 0x0F, 0x4D, 0x34, 0xAE,
/*0A64:*/ 0x12, 0x92, 0x1B, 0x5B, 0xD4, 0xAE, 0x42, 0x55, 0xD7, 0x39, 0xB0, 0xCF, 0xCD, 0xA3,
0x8D, 0x34, 0x98, 0x54, 0xA1, 0x0E,
/*0A78:*/ 0x16, 0x9A, 0x7A, 0x93, 0xC8, 0x63, 0x4D, 0xF1, 0xA9, 0x8A, 0x1A, 0xF8, 0xC5, 0x90,
0xC5, 0x37, 0xEA, 0x53, 0x20, 0x4E,
/*0A8C:*/ 0x15, 0x4A, 0x9A, 0x93, 0x47, 0x2C, 0x09, 0x2B, 0x4B, 0x7C, 0xD6, 0xED, 0x9E, 0x7E,
0xBD, 0x27, 0x42, 0xA6, 0x3D, 0xEE,
/*0AA0:*/ 0x15, 0x4A, 0x96, 0x8F, 0x5D, 0x4C, 0x31, 0xDF, 0x59, 0x0D, 0xF7, 0x8F, 0x91, 0xA6,
0x4B, 0x27, 0x42, 0xC8, 0x49, 0xCE,
/*0AB4:*/ 0x15, 0x4A, 0x96, 0x87, 0x5B, 0xE4, 0x56, 0x36, 0xF2, 0xF7, 0xF6, 0xFB, 0x90, 0x24,
0x4B, 0x37, 0x01, 0x09, 0x5E, 0x8E,
/*0AC8:*/ 0x15, 0x5E, 0x96, 0x7B, 0x5D, 0x9D, 0xDE, 0xD9, 0xEF, 0x5A, 0x38, 0xCB, 0x11, 0x6C,
0x6B, 0x27, 0x43, 0x4A, 0xC9, 0xEE,
/*0ADC:*/ 0x12, 0x08, 0x1A, 0x67, 0xDD, 0xEE, 0x3E, 0xEF, 0x5A, 0x11, 0x8B, 0x8F, 0x6B, 0x47,
0x53, 0x33, 0xC3, 0x47, 0xD7, 0x2E,
/*0AF0:*/ 0x17, 0x1B, 0x7A, 0x5F, 0xCE, 0x9C, 0xED, 0xEE, 0x99, 0x8F, 0x69, 0x38, 0x4D, 0xC6,
0x6F, 0x33, 0x83, 0x6A, 0xC6, 0x4E,
/*0B04:*/ 0x17, 0x08, 0x7A, 0x5F, 0xCA, 0x20, 0xD3, 0x37, 0x19, 0xC7, 0x44, 0xAD, 0x03, 0x25,
0x39, 0x33, 0xFF, 0x09, 0xCE, 0x2E,
/*0B18:*/ 0x17, 0x03, 0xE8, 0x73, 0xC2, 0x8D, 0xD4, 0xC1, 0xCE, 0x70, 0xFC, 0x8F, 0x9A, 0x07,
0xF3, 0x33, 0xFF, 0x09, 0xB9, 0x6E,
/*0B2C:*/ 0x12, 0x00, 0x54, 0x6F, 0x8A, 0x43, 0xC0, 0xF5, 0x79, 0x18, 0x3B, 0xAF, 0x81, 0xDD,
0xDD, 0x37, 0x42, 0xF6, 0xE3, 0xEE,
/*0B40:*/ 0x16, 0x9B, 0xEB, 0x57, 0x1E, 0x8B, 0x3E, 0x49, 0xC7, 0x58, 0x97, 0x88, 0xA6, 0xA9,
0xE1, 0x37, 0x55, 0x5B, 0x39, 0xEE,
/*0B54:*/ 0x17, 0x17, 0xFA, 0xA7, 0x60, 0x9E, 0xEB, 0xE9, 0x1F, 0x8D, 0x8D, 0x45, 0x5E, 0x86,
0xBD, 0x2F, 0x7E, 0xD8, 0x4E, 0xAE,
/*0B68:*/ 0x17, 0x1B, 0xCA, 0x9F, 0xA1, 0x39, 0xEF, 0xA2, 0xF2, 0x1B, 0xA2, 0xE2, 0xEA, 0x2E,
0xCB, 0x2F, 0x7F, 0x08, 0x2D, 0x6E,
/*0B7C:*/ 0x17, 0x1B, 0xCB, 0x87, 0xC1, 0x23, 0xA8, 0xB4, 0xE7, 0x18, 0xCF, 0xAF, 0x58, 0x0F,
0x17, 0x2F, 0x7E, 0xD5, 0xB9, 0x4E,
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/*0B90:*/ 0x17, 0x1B, 0xCA, 0xAF, 0xC8, 0xEF, 0x63, 0x5E, 0xDF, 0x55, 0x84, 0xE2, 0xD5, 0xDC,
0x65, 0x2F, 0x7E, 0xF6, 0x25, 0xAE,
/*0BA4:*/ 0x17, 0x1F, 0xFA, 0xB7, 0xC0, 0x8C, 0xC3, 0xAC, 0x2E, 0x5D, 0xDB, 0xAF, 0xBA, 0x41,
0x29, 0x2F, 0x2C, 0x73, 0xA0, 0x2E,
/*0BB8:*/ 0x12, 0x11, 0xF0, 0xBF, 0xEC, 0x23, 0x51, 0x79, 0x2D, 0xF2, 0xF9, 0x09, 0x77, 0xFD,
0x69, 0x2F, 0x6C, 0x31, 0x88, 0x0E,
/*0BCC:*/ 0x12, 0x00, 0xF0, 0xDF, 0x91, 0x69, 0x2A, 0x4D, 0x18, 0x98, 0x2C, 0xFB, 0x81, 0xC7,
0xD7, 0x27, 0x42, 0x52, 0xB5, 0x6E,
/*0BE0:*/ 0x16, 0x18, 0x90, 0x56, 0xFE, 0xFE, 0xC7, 0xF4, 0xB4, 0x77, 0xAE, 0x23, 0x8F, 0xDD,
0xD1, 0x27, 0x18, 0xD6, 0x3E, 0x6E,
/*0BF4:*/ 0x10, 0x19, 0x04, 0x37, 0x7B, 0x13, 0xE5, 0x8B, 0x5F, 0x18, 0xE4, 0xEF, 0xA7, 0xF9,
0x79, 0x27, 0x78, 0xB6, 0x29, 0x0E,
/*0C08:*/ 0x12, 0xDF, 0x30, 0xDB, 0x23, 0x83, 0x97, 0x35, 0x1C, 0xC9, 0xC5, 0x3B, 0x10, 0x78,
0x27, 0x27, 0x68, 0x94, 0xA1, 0x4E,
/*0C1C:*/ 0x10, 0xDD, 0x94, 0xD3, 0x2E, 0x2A, 0xE3, 0xD9, 0xEB, 0xB5, 0xD8, 0x59, 0xB6, 0xA7,
0x71, 0x27, 0x28, 0xE5, 0x35, 0xCE,
/*0C30:*/ 0x12, 0x1C, 0x94, 0xC3, 0xDD, 0x2E, 0x18, 0xF2, 0x77, 0x99, 0xCF, 0xFF, 0xE5, 0x5D,
0xD9, 0x37, 0x12, 0x62, 0xA5, 0xCE,
/*0C44:*/ 0x17, 0x1F, 0x92, 0xB7, 0xEE, 0x10, 0xEE, 0x2F, 0x59, 0x17, 0x67, 0xAF, 0xB5, 0xED,
0xDD, 0x2F, 0x7E, 0xA6, 0xA9, 0x6E,
/*0C58:*/ 0x17, 0x03, 0xD2, 0xAF, 0xDB, 0x38, 0x52, 0xD8, 0x77, 0xDA, 0x9A, 0x2A, 0x7B, 0x26,
0xAD, 0x2F, 0x7E, 0xC5, 0x29, 0x8E,
/*0C6C:*/ 0x17, 0x1F, 0x92, 0xAB, 0xC1, 0x34, 0xBB, 0xEB, 0x30, 0x7E, 0xBB, 0xBD, 0x5F, 0x79,
0xC7, 0x2F, 0x7F, 0x05, 0x3A, 0x0E,
/*0C80:*/ 0x13, 0x9A, 0x82, 0xA7, 0xD6, 0x6B, 0xED, 0x5E, 0x29, 0x98, 0x2D, 0x4B, 0x81, 0xDD,
0xDD, 0x37, 0x38, 0xE4, 0x2B, 0xEE,
/*0C94:*/ 0x13, 0x8E, 0x5A, 0x3A, 0xE0, 0x87, 0xAA, 0x72, 0xCE, 0x19, 0x58, 0xC7, 0xA7, 0xC6,
0x27, 0x27, 0x43, 0x18, 0xBE, 0x2E,
/*0CA8:*/ 0x15, 0x48, 0xB0, 0x3E, 0xBE, 0x32, 0x86, 0x42, 0x89, 0x9B, 0xCD, 0x85, 0x9F, 0x87,
0x7D, 0x27, 0x01, 0x39, 0xCF, 0x2E,
/*0CBC:*/ 0x10, 0xC1, 0x34, 0xC3, 0x1D, 0x3E, 0xEE, 0x3D, 0xF7, 0x1E, 0xF9, 0x8F, 0xA1, 0xDC,
0xA5, 0x37, 0x43, 0xCE, 0x6F, 0xAE,
/*0CD0:*/ 0x12, 0xC4, 0xA4, 0x93, 0xCD, 0xB2, 0xEC, 0xEC, 0x7B, 0x09, 0x0B, 0x6D, 0xB1, 0xB7,
0x97, 0x37, 0x0B, 0x17, 0xB1, 0x6E,
/*0CE4:*/ 0x12, 0xD6, 0xAA, 0x93, 0xDB, 0xDF, 0xED, 0x45, 0x37, 0xB2, 0xCF, 0x76, 0xF5, 0xAD,
0x79, 0x37, 0xD4, 0xC8, 0x4E, 0xCE,
/*0CF8:*/ 0x10, 0xCF, 0xDC, 0x8F, 0xFD, 0xCC, 0x1D, 0xEE, 0x11, 0xF6, 0x33, 0x93, 0x90, 0xDC,
0x57, 0x2F, 0x55, 0x09, 0xCA, 0x6E,
/*0D0C:*/ 0x10, 0xD7, 0xD6, 0x87, 0xEE, 0xA1, 0x2E, 0x3B, 0xB6, 0x5D, 0xF9, 0x95, 0x4F, 0x64,
0x59, 0x2F, 0x7F, 0x39, 0xD6, 0xCE,
/*0D20:*/ 0x11, 0x84, 0x90, 0x83, 0xE6, 0x6E, 0x85, 0x31, 0x59, 0xF7, 0x49, 0xBD, 0x9D, 0xA7,
0x85, 0x2F, 0x2D, 0x5A, 0x2D, 0xAE,
/*0D34:*/ 0x10, 0xC8, 0x48, 0x83, 0xD6, 0x65, 0xB2, 0xD2, 0x0E, 0x9B, 0xA3, 0x91, 0x41, 0xB8,
0x79, 0x37, 0x7F, 0x06, 0x35, 0x6E,
/*0D48:*/ 0x10, 0xC1, 0x98, 0x93, 0x1E, 0xE7, 0x7A, 0x05, 0x7A, 0x3F, 0xB5, 0x85, 0x7D, 0x46,
0xCD, 0x27, 0x6C, 0xF5, 0xA5, 0x0E,
/*0D5C:*/ 0x10, 0xCA, 0x90, 0xA3, 0x0F, 0x55, 0xBA, 0xBF, 0x1A, 0x18, 0xB2, 0xF9, 0xFA, 0x9D,
0x25, 0x37, 0x00, 0xA7, 0xC6, 0xCE,
/*0D70:*/ 0x10, 0xD7, 0xD0, 0x8B, 0x8A, 0xEE, 0xE3, 0xE2, 0x71, 0x43, 0x5F, 0x21, 0x31, 0x34,
0xAF, 0x2A, 0x3F, 0x87, 0xB1, 0x8E,
/*0D84:*/ 0x10, 0xDB, 0xDC, 0x7F, 0xFD, 0xE9, 0x35, 0xE9, 0x41, 0xDE, 0x8E, 0xED, 0x77, 0xB8,
0x7B, 0x2A, 0x00, 0xC7, 0xC6, 0x0E,
/*0D98:*/ 0x10, 0x04, 0x54, 0x83, 0xE8, 0x15, 0x4E, 0xAA, 0x75, 0xD6, 0xB1, 0x70, 0xAE, 0xDD,
0xF1, 0x2A, 0x42, 0xF9, 0x46, 0x2E,
/*0DAC:*/ 0x16, 0x8D, 0x14, 0x0F, 0xBE, 0x53, 0x2F, 0x1D, 0x04, 0x00, 0x8C, 0xBA, 0xF9, 0xDD,
0xDD, 0x37, 0x7E, 0xF4, 0x27, 0xEE,
/*0DC0:*/ 0x11, 0x9F, 0x30, 0x82, 0xFD, 0x0F, 0xAF, 0x76, 0x6C, 0xEF, 0xA7, 0x4E, 0xCA, 0xB8,
0xC3, 0x27, 0x42, 0xE7, 0x4A, 0x2E,
/*0DD4:*/ 0x15, 0xD6, 0x16, 0x93, 0x0F, 0xBC, 0xC1, 0x9B, 0x5F, 0x19, 0x5A, 0x88, 0x50, 0x22,
0xF9, 0x27, 0x62, 0xF8, 0xA1, 0x0E,
/*0DE8:*/ 0x11, 0x8F, 0x76, 0x8B, 0x05, 0x3A, 0x22, 0xED, 0xB6, 0xEF, 0x68, 0xC8, 0xED, 0xEB,
0x83, 0x27, 0x38, 0xC6, 0x4A, 0x2E,
/*0DFC:*/ 0x16, 0x88, 0x1A, 0x7B, 0x85, 0xEF, 0x5B, 0xEF, 0x65, 0xE6, 0xEF, 0x92, 0x21, 0x5E,
0x6F, 0x2F, 0x52, 0xA5, 0xA5, 0x2E,
/*0E10:*/ 0x16, 0x9B, 0xDA, 0x73, 0xFB, 0x13, 0xE2, 0x3F, 0xC5, 0x75, 0x13, 0x48, 0x58, 0x5B,
0x77, 0x33, 0xC2, 0x63, 0x2A, 0x0E,
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/*0E24:*/ 0x14, 0x9E, 0xE0, 0x6F, 0xE6, 0xE3, 0x3B, 0x37, 0x58, 0xE5, 0xC4, 0xFA, 0xD7, 0xD8,
0x5D, 0x2A, 0x43, 0x78, 0xC6, 0x2E,
/*0E38:*/ 0x11, 0x8A, 0x82, 0x73, 0xE8, 0xE9, 0xED, 0x9F, 0x72, 0x66, 0x29, 0x05, 0xFA, 0x7D,
0xE5, 0x37, 0x7A, 0xE7, 0x25, 0x6E,
/*0E4C:*/ 0x15, 0xB9, 0xDA, 0x7B, 0xCF, 0x42, 0x98, 0x5D, 0xED, 0xE1, 0x8C, 0xE0, 0x5D, 0xB9,
0xDD, 0x27, 0x60, 0xA7, 0xB9, 0xCE,
/*0E60:*/ 0x10, 0x20, 0xB0, 0x83, 0x87, 0x12, 0x04, 0x7E, 0x11, 0xF5, 0xD7, 0x93, 0x1D, 0xA6,
0xB7, 0x27, 0x42, 0xD7, 0x31, 0xAE,
/*0E74:*/ 0x10, 0x3E, 0xE8, 0x8B, 0x47, 0x55, 0x24, 0x52, 0xF1, 0xFE, 0x18, 0x78, 0x94, 0xDB,
0xDD, 0x27, 0x2A, 0xE6, 0xB5, 0xAE,
/*0E88:*/ 0x10, 0x3A, 0xE0, 0x8B, 0x7B, 0xCE, 0x2D, 0xA1, 0x6E, 0x26, 0x08, 0x7D, 0x50, 0x8A,
0x99, 0x27, 0x0A, 0xB4, 0xA9, 0x4E,
/*0E9C:*/ 0x15, 0xB9, 0xE0, 0x87, 0x9B, 0x69, 0x12, 0x30, 0x99, 0x5D, 0x7D, 0x88, 0x7E, 0xB9,
0x91, 0x37, 0x6A, 0xB8, 0x46, 0x6E,
/*0EB0:*/ 0x10, 0xD9, 0xEC, 0x87, 0xFB, 0xDB, 0xC3, 0x62, 0x49, 0xEE, 0x8F, 0x5B, 0x5C, 0xBD,
0xDB, 0x37, 0x2B, 0x06, 0x2D, 0x4E,
/*0EC4:*/ 0x10, 0x15, 0x4E, 0x8F, 0xE8, 0x3B, 0x3E, 0x59, 0xA9, 0x30, 0x65, 0x05, 0xCF, 0xD9,
0xDF, 0x2A, 0x7E, 0xF6, 0x2A, 0x4E,
/*0ED8:*/ 0x17, 0x12, 0x84, 0x9F, 0xCE, 0xAE, 0x55, 0x0F, 0xFE, 0x60, 0xB5, 0x55, 0x5B, 0xE6,
0xE7, 0x25, 0xBF, 0x16, 0x2D, 0x0E,
/*0EEC:*/ 0x13, 0x1A, 0xC4, 0x0B, 0x62, 0x0D, 0x82, 0x69, 0xE2, 0x20, 0x90, 0xB4, 0x86, 0x32,
0xC1, 0x25, 0xCA, 0xF7, 0x39, 0x8E,
/*0F00:*/ 0x13, 0x1E, 0xC2, 0x07, 0x4E, 0xDB, 0xF5, 0x39, 0x9D, 0x10, 0xCF, 0x26, 0x27, 0xBD,
0x11, 0x25, 0xCA, 0xE8, 0x35, 0x2E,
/*0F14:*/ 0x16, 0x98, 0xDC, 0x36, 0xE0, 0x69, 0x43, 0x41, 0x07, 0x48, 0xBD, 0x7A, 0xE3, 0xDC,
0x7D, 0x37, 0x1B, 0x07, 0xC3, 0x8E,
/*0F28:*/ 0x16, 0x11, 0x3A, 0x0F, 0x23, 0xEE, 0xE3, 0x70, 0xF7, 0x73, 0x8F, 0xBB, 0x92, 0xEA,
0x8B, 0x3F, 0x55, 0x88, 0x66, 0x4E,
/*0F3C:*/ 0x10, 0xD9, 0x91, 0xC3, 0xA8, 0xDE, 0xEE, 0xCB, 0x77, 0x77, 0xBB, 0xBC, 0xFA, 0x6F,
0x5F, 0x3F, 0x1F, 0x19, 0x35, 0x6E,
/*0F50:*/ 0x10, 0xC1, 0x9C, 0x73, 0xF2, 0x82, 0xFA, 0xBD, 0xDE, 0x69, 0xC8, 0xAF, 0xAD, 0x9D,
0x7D, 0x37, 0x78, 0x46, 0x36, 0x0E,
/*0F64:*/ 0x10, 0xC1, 0x82, 0x07, 0xF3, 0x82, 0x8D, 0x1A, 0x0A, 0xD0, 0x6D, 0x2A, 0xCA, 0x76,
0x87, 0x37, 0x7E, 0xA5, 0xA9, 0xAE,
/*0F78:*/ 0x10, 0x07, 0x01, 0x4F, 0x91, 0x08, 0x08, 0xC9, 0x73, 0xDC, 0x4D, 0x39, 0x80, 0x5D,
0xD3, 0x27, 0x28, 0xD7, 0xAD, 0x2E,
/*0F8C:*/ 0x10, 0x07, 0x30, 0xA7, 0x27, 0x49, 0x63, 0x5C, 0x18, 0x9B, 0x88, 0x57, 0xCB, 0x5A,
0xCB, 0x27, 0x4C, 0xC6, 0xA9, 0x0E,
/*0FA0:*/ 0x10, 0x19, 0x02, 0xAF, 0x13, 0x45, 0x23, 0x77, 0xD7, 0x27, 0x87, 0xAF, 0x83, 0xC9,
0x1D, 0x27, 0x2C, 0xB5, 0xC1, 0xAE,
/*0FB4:*/ 0x10, 0x18, 0x90, 0xA3, 0x19, 0xE6, 0x89, 0x7F, 0x18, 0x43, 0xBA, 0xD0, 0xBA, 0xA5,
0x71, 0x37, 0x30, 0xD7, 0x3E, 0x2E,
/*0FC8:*/ 0x14, 0x05, 0x16, 0x77, 0xA5, 0xEE, 0xB6, 0x17, 0x77, 0x1F, 0x7F, 0x2E, 0x25, 0x64,
0x4D, 0x37, 0x42, 0x9B, 0xC2, 0xCE,
/*0FDC:*/ 0x11, 0x8A, 0xE6, 0x6B, 0xFD, 0x62, 0x6B, 0xD9, 0xAB, 0x5D, 0x75, 0x4B, 0x17, 0xCC,
0x63, 0x2F, 0x01, 0x3B, 0x4E, 0xCE,
/*0FF0:*/ 0x14, 0x9D, 0xB8, 0x6F, 0xE8, 0x24, 0x63, 0xFF, 0x89, 0x91, 0x90, 0xCF, 0x3B, 0x55,
0xA9, 0x2F, 0x2D, 0x27, 0xBD, 0x6E,
/*1004:*/ 0x14, 0x9A, 0xF0, 0x77, 0xE8, 0x16, 0x53, 0xC3, 0x0F, 0x1F, 0x4F, 0x09, 0x4A, 0x3C,
0x3B, 0x33, 0xBE, 0xB6, 0xB1, 0x8E,
/*1018:*/ 0x10, 0x00, 0x48, 0x87, 0xE5, 0x91, 0xCC, 0x42, 0x19, 0xE3, 0xB1, 0x62, 0xC0, 0xD2,
0x33, 0x2F, 0x2A, 0xD7, 0x3D, 0x8E,
/*102C:*/ 0x16, 0x81, 0x3C, 0xB3, 0xD9, 0x99, 0xFA, 0x8C, 0x9F, 0x70, 0x86, 0xBB, 0x92, 0x79,
0x17, 0x2A, 0x42, 0xB7, 0xB5, 0xCE,
/*1040:*/ 0x13, 0x94, 0x8C, 0xA7, 0xB1, 0x2E, 0xE1, 0x2B, 0x19, 0x1E, 0x89, 0x30, 0xD8, 0x7C,
0x6B, 0x2A, 0x42, 0xC7, 0x35, 0xAE,
/*1054:*/ 0x12, 0xDE, 0xB0, 0xA3, 0xAE, 0x1F, 0xDE, 0x3E, 0x32, 0x67, 0xFB, 0x9C, 0x4E, 0x7D,
0xC7, 0x2F, 0x2A, 0x96, 0x3E, 0xEE,
/*1068:*/ 0x12, 0xDA, 0xA4, 0x9F, 0xF4, 0xD3, 0xDB, 0xDE, 0xF1, 0x85, 0xE8, 0x4F, 0x2E, 0xC7,
0xC7, 0x37, 0xAA, 0xD7, 0x32, 0x0E,
/*107C:*/ 0x12, 0xDE, 0xF6, 0x9F, 0xB8, 0x51, 0x25, 0x70, 0xA9, 0x57, 0xBE, 0x2F, 0x80, 0x66,
0x77, 0x27, 0x42, 0xE5, 0x25, 0x4E,
/*1090:*/ 0x12, 0xC5, 0xF6, 0x32, 0xFE, 0xA7, 0x51, 0x73, 0x4C, 0x2A, 0x1A, 0xDA, 0xD0, 0xDA,
0xBD, 0x27, 0x6C, 0xF7, 0xBD, 0x8E,
/*10A4:*/ 0x12, 0xC6, 0x4E, 0xA7, 0x65, 0xEE, 0xEE, 0xEF, 0x77, 0x77, 0x7B, 0x71, 0xA1, 0x5E,
0x53, 0x37, 0x6D, 0xFF, 0xA9, 0x8E,
```

```
/*10B8:*/ 0x12, 0xD7, 0x24, 0x97, 0xA7, 0x15, 0xCE, 0x90, 0xD5, 0x99, 0xEF, 0x3A, 0xD1, 0x99,
0x8B, 0x2F, 0x02, 0xB7, 0xD6, 0x2E,
/*10CC:*/ 0x12, 0xD7, 0x04, 0x8F, 0xA6, 0xCE, 0xE2, 0xFA, 0x9D, 0x9E, 0x37, 0x33, 0x30, 0x7D,
0x67, 0x2F, 0x2B, 0x4B, 0xCB, 0x6E,
/*10E0:*/ 0x12, 0xD7, 0x54, 0x8B, 0x86, 0x68, 0xA4, 0xD1, 0x71, 0x1E, 0x30, 0xD6, 0xFF, 0x31,
0x87, 0x37, 0x19, 0x2B, 0xDA, 0x6E,
/*10F4:*/ 0x12, 0xD7, 0x54, 0x87, 0x9F, 0xB3, 0xB2, 0x57, 0x71, 0xF1, 0xB7, 0xB8, 0xFE, 0xBD,
0xDD, 0x37, 0xFB, 0xAF, 0xE3, 0x4E,
/*1108:*/ 0x12, 0xD7, 0x32, 0x83, 0x7D, 0xCF, 0xE2, 0x32, 0x98, 0xF5, 0xC8, 0x8C, 0xD5, 0xC6,
0x67, 0x37, 0xDB, 0x7C, 0xDF, 0xEE,
/*111C:*/ 0x12, 0xC4, 0xCA, 0x7F, 0xBD, 0x1E, 0xEE, 0xE9, 0xDF, 0x77, 0x7B, 0x08, 0x69, 0xB6,
0xDB, 0x37, 0x5B, 0x6D, 0x41, 0xAE,
/*1130:*/ 0x10, 0xD4, 0x8E, 0x7F, 0xCE, 0x76, 0xBE, 0x96, 0x10, 0xF6, 0xAC, 0xAC, 0xDC, 0x2B,
0x05, 0x22, 0x3E, 0xD6, 0x41, 0xCE,
/*1144:*/ 0x10, 0xD6, 0xBE, 0x83, 0xC4, 0x43, 0xED, 0x5F, 0xF7, 0x3E, 0x2F, 0x36, 0xCC, 0x36,
0xDD, 0x3F, 0x54, 0xD5, 0x2D, 0xAE,
/*1158:*/ 0x10, 0xC2, 0x96, 0x87, 0xE8, 0xEC, 0x66, 0xA0, 0xF2, 0x65, 0xF2, 0x05, 0xB7, 0x65,
0x7D, 0x2F, 0x5E, 0xA5, 0x32, 0x8E,
/*116C:*/ 0x11, 0x8E, 0x9A, 0x8F, 0xEB, 0x46, 0xB6, 0x73, 0x59, 0x98, 0x4F, 0xAF, 0xFA, 0xD7,
0xDD, 0x2F, 0x2D, 0x19, 0x4A, 0x4E,
/*1180:*/ 0x11, 0x8E, 0xCB, 0x7B, 0x40, 0x5F, 0x39, 0x89, 0x9E, 0x67, 0xB4, 0x96, 0x02, 0x27,
0x87, 0x27, 0x0B, 0x39, 0x31, 0x8E,
/*1194:*/ 0x11, 0x8E, 0xA4, 0x72, 0xC0, 0xC6, 0x5C, 0x04, 0x77, 0xC7, 0x84, 0xF8, 0x85, 0x89,
0x67, 0x27, 0x43, 0x3A, 0x5E, 0xEE,
/*11A8:*/ 0x16, 0x10, 0x69, 0x12, 0xE7, 0x88, 0x3E, 0x3B, 0x47, 0x77, 0x46, 0xE7, 0x11, 0x7B,
0x2D, 0x37, 0x6D, 0x49, 0xBD, 0xCE,
/*11BC:*/ 0x13, 0x1A, 0xEE, 0xB7, 0x47, 0x33, 0x3A, 0xD9, 0xFB, 0x2C, 0x5E, 0x31, 0xC5, 0x08,
0xDB, 0x39, 0x81, 0x08, 0xD2, 0xCE,
/*11D0:*/ 0x13, 0x1A, 0xC9, 0x97, 0x48, 0xCF, 0x88, 0x2B, 0x03, 0x32, 0x3A, 0x06, 0xF2, 0x07,
0x75, 0x39, 0xBF, 0x59, 0x45, 0x6E,
/*11E4:*/ 0x13, 0x1E, 0x84, 0x57, 0x43, 0x2E, 0xB2, 0xF9, 0xC1, 0x00, 0x9F, 0x80, 0x7D, 0x4D,
0x19, 0x39, 0xBE, 0xD6, 0x29, 0x6E,
/*11F8:*/ 0x13, 0x12, 0x9A, 0xFB, 0x59, 0xD8, 0x46, 0xF2, 0x53, 0x31, 0x62, 0x21, 0x84, 0x00,
0x27, 0x39, 0x8C, 0xC6, 0xBD, 0x6E,
/*120C:*/ 0x16, 0x81, 0xA4, 0x07, 0x33, 0x5F, 0xD7, 0x3A, 0x33, 0x10, 0x40, 0x05, 0x22, 0xC4,
0xA3, 0x2F, 0x58, 0xC7, 0x29, 0x8E,
/*1220:*/ 0x17, 0x80, 0x88, 0xCF, 0x9C, 0xEB, 0xEB, 0x1F, 0x6B, 0xAB, 0x2B, 0x8F, 0x19, 0x0D,
0x8D, 0x37, 0x0B, 0x34, 0xAD, 0xCE,
/*1234:*/ 0x10, 0x0D, 0x00, 0x0F, 0x8F, 0x9B, 0xB5, 0xC4, 0xB4, 0x27, 0xBA, 0xEF, 0xB9, 0xCD,
0xF5, 0x37, 0x43, 0x07, 0xEA, 0x2E,
/*1248:*/ 0x17, 0x97, 0xCC, 0x0F, 0x2E, 0x23, 0x90, 0x2E, 0xA5, 0x5A, 0x5A, 0xFA, 0xC1, 0xDD,
0xDD, 0x27, 0x43, 0x49, 0xCF, 0xEE,
/*125C:*/ 0x17, 0x97, 0xF4, 0x0A, 0xC0, 0xA2, 0x2C, 0x1E, 0x57, 0x17, 0x28, 0x29, 0x1C, 0xD2,
0x4B, 0x27, 0x43, 0x2A, 0xCA, 0x6E,
/*1270:*/ 0x16, 0x8D, 0x5C, 0x0E, 0x40, 0x3C, 0x89, 0x46, 0xD5, 0x52, 0xFF, 0xE7, 0x90, 0xC2,
0x93, 0x27, 0x6D, 0x99, 0xC1, 0x8E,
/*1284:*/ 0x13, 0x97, 0x90, 0x06, 0x38, 0x45, 0x28, 0x9E, 0xF4, 0x74, 0xC7, 0x0E, 0x1D, 0x99,
0x99, 0x27, 0x10, 0xD8, 0xBE, 0x0E,
/*1298:*/ 0x16, 0x84, 0x19, 0x5A, 0x73, 0xCE, 0x6D, 0x2A, 0xF6, 0x46, 0x18, 0xC7, 0x8F, 0xCC,
0x15, 0x27, 0x42, 0xC6, 0x31, 0x6E,
/*12AC:*/ 0x16, 0x9F, 0xD6, 0x0A, 0x8E, 0x81, 0xDA, 0x71, 0xC6, 0x2C, 0xC9, 0xAD, 0x3D, 0x8D,
0x8B, 0x27, 0x28, 0x97, 0x39, 0xEE,
/*12C0:*/ 0x12, 0x10, 0xBA, 0x0A, 0x4F, 0x8D, 0x9F, 0xDA, 0x44, 0x65, 0xFC, 0x7E, 0x3D, 0xA9,
0x13, 0x27, 0x6D, 0x18, 0xC2, 0x0E,
/*12D4:*/ 0x16, 0x85, 0xA2, 0x6E, 0x53, 0x88, 0x3C, 0x76, 0x2C, 0x79, 0xA8, 0x9F, 0x5F, 0xA8,
0xBD, 0x27, 0x01, 0x18, 0xBE, 0x6E,
/*12E8:*/ 0x16, 0x85, 0xFF, 0x22, 0x3E, 0x26, 0x4D, 0xC4, 0xCC, 0x91, 0xE4, 0xA7, 0x3D, 0x0D,
0xA5, 0x27, 0x65, 0x18, 0x39, 0xCE,
/*12FC:*/ 0x16, 0x85, 0x86, 0x5E, 0x2E, 0xFA, 0xAD, 0x7A, 0xB3, 0x21, 0x62, 0x66, 0x1D, 0x9D,
0xF9, 0x27, 0x6D, 0x08, 0xC6, 0x6E,
/*1310:*/ 0x13, 0x98, 0x90, 0xDE, 0x3E, 0x42, 0xA6, 0x70, 0xB5, 0x57, 0x9A, 0x74, 0x5F, 0x49,
0x2B, 0x27, 0x6D, 0x38, 0x3D, 0xAE,
/*1324:*/ 0x16, 0x85, 0xEF, 0x9A, 0x53, 0x6D, 0xE2, 0x3F, 0x9F, 0x6A, 0x0F, 0xB2, 0x37, 0x2E,
0xBB, 0x27, 0x64, 0xE7, 0xBD, 0xAE,
/*1338:*/ 0x16, 0x85, 0x8E, 0x16, 0x37, 0x68, 0x52, 0xDC, 0x7A, 0xB1, 0xF5, 0x4A, 0xC5, 0x4D,
0x5D, 0x27, 0x6D, 0x17, 0xC5, 0xCE,
```

```
/*134C:*/ 0x16, 0x85, 0xEF, 0x0A, 0x2F, 0xFC, 0xCC, 0x7D, 0x47, 0xC0, 0x30, 0x62, 0xBD, 0x59,
0x95, 0x27, 0x01, 0x18, 0x4A, 0x6E,
/*1360:*/ 0x16, 0x85, 0xE7, 0x0A, 0x4F, 0x25, 0xDF, 0x33, 0x76, 0xF7, 0xA9, 0xA1, 0x4F, 0xB8,
0x3D, 0x27, 0x01, 0x19, 0xC2, 0x4E,
/*1374:*/ 0x16, 0x85, 0xAF, 0xA2, 0x2F, 0x3F, 0x4E, 0xF4, 0x13, 0x47, 0xA4, 0xA1, 0xAF, 0xA7,
0x0F, 0x27, 0x01, 0x49, 0xC6, 0x2E,
/*1388:*/ 0x16, 0x95, 0x2B, 0x46, 0x2E, 0x64, 0x15, 0x39, 0x12, 0x47, 0xA5, 0x72, 0x0F, 0xEB,
0x69, 0x27, 0x64, 0xF8, 0x4A, 0x0E,
/*139C:*/ 0x16, 0x9D, 0x66, 0xF3, 0x25, 0xEE, 0xEE, 0xF7, 0x77, 0x74, 0x2C, 0x7B, 0xB9, 0xDD,
0xDD, 0x27, 0x6D, 0xFF, 0xE3, 0xEE,
};
```

Appendix B speexenc.exe Utility Description

B.1 speexenc.exe Input Parameter Description

The speexenc.exe program is available from http://www.speex.org along with more information on this program. Table B-1 lists the input parameters used with this program. The batch file shown in Section B.1.1 considers the required parameters for the Vocoder and puts them in a single file for convenience. This file sets a quality factor of 3 and a bit rate of 8 k. Mono and little-endian are the defaults; therefore, they do not have to be set explicitly. Notice that there are two mutually exclusive options selected in this batch file: quality 3 and bit-rate 8000. The resultant SPX file is the same if the quality factor is changed from 3 to 10; the reason for this is that a low-quality bit-rate of 8 kbps cannot achieve a high quality of 10.

B.1.1 wav_2_speex.bat

```
speexenc --quality 3 --bitrate 8000 -V %1.wav %1.spx
```

Table B-1. speexenc.exe Input Parameters[(1)]

Command	Command Description
-n, --narrowband	Narrowband (8 kHz) input file
-w, --wideband	Wideband (16 kHz) input file
-u, --ultra-wideband	Ultra-wideband (32 kHz) input file
--quality n	Encoding quality (0-10), default 8
--bitrate n	Encoding bit-rate (use bit-rate n or lower)
--vbr	Enable variable bit-rate (VBR)
--abr rate	Enable average bit-rate (ABR) at rate bps
--vad	Enable voice activity detection (VAD)
--dtx	Enable file-based discontinuous transmission (DTX)
--comp n	Set encoding complexity (0-10), default 3
--nframes n	Number of frames per Ogg packet (1-10), default 1
--denoise	De-noise the input before encoding
--agc	Apply adaptive gain control (AGC) before encoding
--comment	Add the given string as an extra comment. This may be used multiple times.
--author	Author of this track
--title	Title for this track
-h	This help
--help	This help
-v	Version information
--version	Version information
-V	Verbose mode (show bit-rate)
Raw input options:	**The Default Raw PCM input is 16-bit, little-endian, mono**
--rate n	Sampling rate for raw input
--stereo	Consider raw input as stereo
--le	Raw input is little-endian
--be	Raw input is big-endian
--8bit	Raw input is 8-bit unsigned
--16bit	Raw input is 16-bit signed

(1) http://www.speex.org/manual.pdf

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