nielsen

Nielsen Monitor Application 1.4

User Guide

Revision B

Revision History

Revision	Date	Description	Engineer
A	2019-03-21	Initial version	Lois Price Lore Eargle (editor)
B	2019-04-26	Release 1.3: added timestamps to Summary Report	Lois Price Lore Eargle (editor)

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1. Introduction

1.1. Purpose of this Document

The Nielsen Monitor Application provides a minute-by-minute synopsis of the Nielsen audio codes embedded in a watermarked WAVE PCM audio file. While processing the audio stream, the application reports at sixty-second intervals:

- A list of Nielsen codes detected since the last report
- A list of alarms arising from error conditions encountered during the same period.

This document describes the constraints, functionality, and output of the application and the usage of its command-line interface.

1.2. Out of Scope

This document does not describe the technical details of Nielsen audio codes.

1.3. Terminology

Throughout this document, the term “you” refers to anyone using the Nielsen Monitor Application to view and/or analyze Nielsen codes in a PCM audio stream.

- This document uses the term *monitor* and *application* interchangeably to refer to the running Nielsen Monitor Application.
- It uses the terms *watermarks* and *audio codes* interchangeably to refer to the markers that Nielsen encoders embed in audio streams for identifying broadcast content.
- It uses the terms *NAES 6* and *Nielsen Watermarks* interchangeably. The abbreviations *N6* and *NW* both represent *Nielsen Watermarks*.
- It uses the term *CSID* to refer to a CBET Station ID.
- The narrow definition of the term *SID* is the NAES (Nielsen Audio Encoding System) Station ID.
- Occasionally, this document uses the term *SID* to refer to a generic station ID, regardless of whether the type is NAES or CBET.

2. Application Usage

2.1. Constraints

In order to run the Nielsen Monitor Application successfully, you must supply it with a PCM audio stream with these characteristics:

- Encoded with Nielsen watermarks
- 48 kHz or 24 kHz sample rate
- 16-, 24-, or 32-bit sample size, properly identified in the WAVE header
- From 1 through 8 audio channels
- Stored in a WAVE (RIFF) file located on a local or properly mounted network drive. The user must be able to use a path string to open the file (with read permission) from a Windows console or Linux terminal. The application works best with files that are less than 4GB in size, but it can be forced to process larger files if you use a special command-line option.
- The WAVE file must hold at least 1-1/2 minutes of audio content.

For details on audio input constraints, see Section 4.

2.2. Functionality

The monitor reads and interprets your command-line arguments (defined in Section 7) If your proposed settings are incorrect, the monitor prints an error message on the screen and exits. After validating your command-line instructions, the application reads the WAVE header to detect and validate these stream characteristics:

- Audio sample size (must be 16, 24, or 32 bits)
- Audio sample rate (must be 24 or 48KHz if the stream includes NAES 2 High-Frequency watermarks, which are used in encoding commercials)
- Number of channels in the audio stream (must be between 1 and 8, inclusive)
- Total number of bytes of audio data in the file (up to 4GB)

Assuming that the stream complies with these constraints, the application begins to process buffers of audio data, aggregating the data and reporting the results at sixty-second intervals.

See Section 2.3 for a description of the application output files.

2.3. Output Files

The application generates two types of output files: a single log file and a separate report file for each channel of audio.

2.3.1. Log File

The monitor generates a single log file, which documents:

- Name of the audio input file
- Characteristics of the audio stream, read from the WAVE header. For definitions of the reported characteristics, do an online search on *WAVE files.*
- A list of the audio channels to be processed. Each entry in the list includes the name and version number of the Nielsen Audio SDK processing the channel.
- Status and error messages, if any, pertaining to the processing of the file
- The number of audio bytes processed, compared to the number of audio bytes specified in the WAVE header.

Note If you use the -a option, and if your input file is larger than 4GB, the final line of the log file may indicate that the monitor processed more audio bytes than the number of bytes included in the file.

```
: Monitor SDK Version: 1.3.0
: File info for Out1555936184.wav:
:   ------------------------
:   File size = 71072804
:   Data bytes = 71072768
:   Data offset = 44
:   Compression code = 1
:   Channel count = 2
:   Sample rate = 48000
:   Bytes per second = 192000
:   Block align = 4
:   Bits per sample = 16
:   Extra bytes = 0
:   ------------------------
Channel 1: Audio SDK Version 4.2.2
: Processed 71072768 bytes of 71072768 bytes of audio data in the file.
```

Figure 1: Example Log File

2.3.2. The Report File

For each processed audio channel, the monitor creates a separate report file with a name that specifies the channel to which the report applies. Each channel-specific file may hold one or more of the following three reports gathered during the previous sixty seconds:

- **Summary report**: a listing of all audio codes detected and confirmed during the past minute, as well as any alerts issued during that one-minute period. An example summary report is shown in Figure 2, below. Note that the report lists three SIDs, each followed by a raw timestamp, a date/time string, and the Nielsen audio-code type. Section 3 of this document explains the audio-code

types (Section 3.1), the SIDs (Section 3.2), and the two time-related fields (Section 3.3).

```
Monitor SDK Version: 1.3.0

*** Elapsed time: 60 ***
*** SUMMARY REPORT ***
9000 - 2914486719 - 04/22/2019 08:24:31 - N2FD
0x1233 - 1555935840 - 04/22/2019 12:24:00 - CBL5
9000 - 293617470 - 04/22/2019 08:24:30 - NWFD
```

Figure 2: Example Summary Report

- **Warning report**: a listing of any significant issues that the monitor encountered during the past minute. Figure 3 shows a typical warning report. The report lists the SID and type of erroneous audio code, followed by the infraction or alert type. Table 3 in Section 4 lists the alert types.

```
*** Elapsed time: 1260 ***
*** WARNING REPORT ***
9000 N2FD: Audio Code Type Error
```

Figure 3: Example Warning Report

- **Detailed report**: a listing of the code counts and the error counts that influenced the summary report. Figure 4 shows an example detailed report. For each SID observed during the previous period, the report lists the SID, audio-code-type, number of valid unique codes with that SID, number of duplicate codes (same SID, timestamp, and code type as another code), number of time-code errors, and number of PC/FD conflicts for that SID. Section 5 covers these report elements in more detail.

  The detailed report is included if and only if you use the -d option on the command line.

```
*** Elapsed time: 120 ***
*** DETAILED REPORT: 120***
Type, SID, Count, Duplicates, TC Errors, PC-FD Conflicts
N2FD 9000: 30, 0, 0, 0
CBL5 0x1233: 11, 0, 0, 0
NWFD 9000: 10, 5, 3, 0
N2Undef 25877: 1, 0, 0, 0
```

Figure 4: Example Detailed Report

3. Summary-Report Elements

3.1. Audio Code Types

An audio stream may hold any of the following types of Nielsen audio codes:

Table 1: Audio Code Types

Audio Code Type	Description	Label
NAES 2 FD	Final distributor watermark that may exist as the only NAES 2 code in the stream, or may share the NAES 2 slot with NAES 2 PC codes.	Designated as N2FD in the JSON report string
NAES 2 PC	Program content watermark that may exist as the only NAES 2 code in the stream, or may share the NAES 2 slot with NAES 2 FD codes.	Designated as N2PC in the JSON report string
NAES 6 FD	Final distributor watermark that may exist as the only NAES 6 code in the stream, or may share the NAES 6 slot with up to two other NAES 6 codes (for a total of one PC and two FDs or for a total of 3 FD codes)	Designated as NWFD in the JSON string
NAES 6 PC	Program content watermark that may exist as the only NAES 6 code in the stream, or may share the NAES 6 slot with up to two other NAES 6 codes (for a total of one PC and two FD codes)	Designated as NWPC in the JSON report string
NAES 2 High Frequency	NAES 2 code used with short commercial (ad) content	Designated as N2HF in the JSON report string
NAES 6 Commercial Code	NAES 6 code used with short commercial (ad) content	Designated as NWCC in the JSON report string
CBET, Layers 2, 4, and 5		Designated as CBL2, CBL4, and CBL5
INFO SID	NAES 6 code used to uniquely identify the source encoder. If present, appears twice per hour, at 3 minutes past the hour.	Designated as Info-SID in the JSON string. The SID setting indicates that this is part 1, part 2, or part 3 of a three-part INFO SID.
RT-VOD	NAES 6 code used to indicate that the content is recently-telecast TV content, retransmitted as VOD	SID setting indicates that this is an RT-VOD flag

In both the summary and the detailed reports, the audio code types are identified by the labels shown in Table 2

Table 2: Code Types and Descriptions

Code	Label
NAES 2 FD	N2FD
NAES 2 PC	N2PC
NAES 2 High Frequency	N2HF
Nielsen Watermark FD	NWFD
Nielsen Watermark PC	NWPC
Nielsen Watermark Commercial Code	NWCC
CBET Layer 2, SID reported in hexadecimal format	CBL2
CBET Layer 4, SID reported in hexadecimal format	CBL4
CBET Layer 5, SID reported in hexadecimal format	CBL5
RT-VOD	RT-VOD
INFO-SID	Info-SID

3.2. Station Identifiers (SIDs)

Most Nielsen audio codes include a station-identifier, a value that, in most cases, uniquely identifies the source encoder as well as the station or content to be credited for the viewing.

For RT-VOD and INFO SID watermarks, the SID field is used as an audio-code type designator, not as a station or content identifier.

Note that NAES 2 PC and NAES 6 PC may share the same SID. Likewise, the NAES 2 FD SID and the NAES 6 FD SID may have the same value. NAES SIDs usually appear in decimal format.

CBET SIDs are often referred to as *media codes or CSIDs*. They usually appear in hexadecimal format.

3.3. Timestamps

Most Nielsen audio codes include a timestamp field, a 4-byte value that provides information about when the content was encoded. For some types of audio codes, it is associating a date/time string with the timestamp is useful. For others, the timestamp carries information that is not directly related to a specific date and time. The remainder of this section of the document describes the interpretation of the timestamp field for each of the audio-code types.

3.3.1. NAES 2 and Nielsen Watermark Timestamps

In most cases, the NAES-2 and Nielsen Watermark timestamp represents the date/time when the content was encoded *in the local time zone to which the encoder clock was set*. For example, if the monitor delivers a NAES date/time of *04/21/2019 14:33:00*, and if the NAES encoder clock was set to Pacific Daylight Time, we know that it was 2:33 PM on April 21, 2019, in the time zone to which the encoder clock was set.

NAES (N2 and NW) PC codes may be the exception to this rule. If the 4-byte timestamp field is a TIC (time in content) representing an offset from the beginning of pre-recorded content (VOD, for example), then the value should not be interpreted as a date/time.

3.3.2. CBET Timestamps

As opposed to NAES audio codes, CBET timestamps represent the time when the content was encoded *as a Coordinated Universal Time (UTC).* For example, if the Monitor SDK libraries deliver a CBET date/time of *04/21/2019 14:33:00*, we know that the content was encoded at 2:33 PM on April 21, 2019 [UTC ++00]. Because CBET date/time strings are expressed as UTC, while NAES date/time strings represent local time, reported CBET times are offset by NAES times by several hours.

When CBET audio codes are used to identify VOD (or other time-shifted viewing), the timestamp field does not translate reliably to a date/time string.

3.3.3. NW CC and N2 HF Audio Codes

For commercial codes (both NAES 6 and NAES 2), the time-code field does not represent a clock-time when the content was encoded. Therefore, no date/time string is associated with the raw timestamp.

3.3.4. NAES 6 INFO SIDs

The timestamp field in some NAES 6 audio codes (including INFO SIDs and RT-VOD codes) holds information that is not at all related to either a time-offset or a clock time. Therefore, no date/time string is associated with the raw timestamp.

4. Warning-Report Alerts

If the monitor detects anomalies with the audio codes that it detected during the past minute, it logs an alert as part of the sixty-second summary report. Table 3 shows the alerts that may be raised. Table 3 shows the coded warnings that may appear in the warning list.

Table 3: Coded Warnings in Warning List

Label	Meaning
Audio Code Type Error	Watermarks with the same NAES 2 SID detected in the past minute had conflicting PC/FD types, probably due to a decoding error
Duplicate Code Error	In the past minute, the number of duplicate watermarks with this SID outnumbered the number of unique watermarks. A duplicate watermark is one that has the same SID, type, and timestamp as a previously reported watermark.
Insufficient Code Count	Issued when three or more of the last five 1-minute intervals had two or fewer watermarks with the designated SID but there were at least four watermarks altogether
Timecode Error	In the past minute, the number of watermarks with this SID that had invalid timestamps outnumbered the number of watermarks with the same SID that had valid timestamps

5. Detailed-Report Elements

The summary report that is issued at 60-second intervals is based on SID-specific information collected during the previous minute. Table 4 shows the tallies that are kept for each SID:

Table 4: Detailed Report Elements

Label	Meaning
Type / SID	Unique key to each record in the detailed report, the combined audio-type/SID field. The following four counts in this table apply only to audio codes that are detected during the previous minute and that have the same audio-type/SID.
Count	Number of error-free audio codes detected during the previous minute
Duplicates	Number of audio codes for which the timestamp setting is the same as the timestamp setting of the previously detected audio code
Time code errors	Number of audio codes for which the timestamp setting is less than the timestamp setting of the previously detected audio code
PC/FD Conflicts	Number of audio codes for which the PC/FD designation is not the same as that of the majority of audio codes with this SID and NAES type

6. Audio Input

6.1. Overview

The application supports uncompressed (PCM) audio streams of 24-bit or 16-bit resolution with a sample rate of 48KHz or 24KHz.

6.2. 16-, 24- and 32-bit Sample Size Audio Processing

The application processes only PCM audio of 16- and 24-bit sample sizes; however, the 24-bit audio may be packed in a 32-bit container, which requires a padding byte to be placed before or after the 24 bits of actual data. Below are the four possible layouts. All layouts assume the sample is in little-endian byte order. For the last two of these configurations you will need to supply the -p command-line option, as specified below.

1. Figure 5 shows the layout for 16-bit audio packed in 2 bytes. You do not need to provide the -p command-line option.

Figure 5: 16-Bit Audio Packed in 2 Bytes

2. Figure 6 shows the layout for 24-bit audio packed in 3 bytes. Use the command-line -p 0 option.

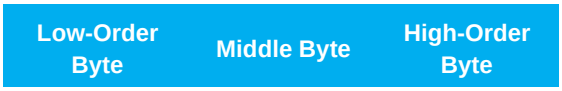

Figure 6: 24-Bit Audio Packed in 3 Bytes

3. Figure 7 shows the layout for 24-bit audio packed in 4 bytes with MSB padding. The padding byte is the most significant byte of the 32-bit sample. The order is assumed to be little-endian byte. Use the command-line -p 1 option.

Figure 7: 24-Bit Audio Packed in 4 Bytes with MSB Padding

4. Figure 8 shows the layout for 24-bit audio packed in 4 bytes with LSB padding. The padding byte is the least significant byte of the 32-bit sample. The order is assumed to be little-endian byte. Use the command-line -p 2 option.

Figure 8: 24-Bit Audio Packed in 4 Bytes with LSB Padding

7. Command-Line Options

The Nielsen Monitor Application accepts up to seven command-line options, described below. Each option is marked as [Optional] or [Required] to indicate whether you must supply the argument with your command-line instructions.

```
-i <infile> -o <output report file> -l <log file>
[-c selected channel] [-p packing mode][-a][-d]
```

Where:

- -i <file> is the full path and file name of the WAVE file to process. [Required]
- -o <output data file> is the full path name of the file that holds the generated reports and alarms. One output file is generated for each processed channel. For each channel-based output file, the application adds to the output file name the string "_chX" (where *X* is set to the channel number). [Required]

- -l <log file> is the full path name of the file that holds error and status reports. The application generates only one log file per session. [Required]
- -p <packing mode> is required to process audio with 24-bit samples. When processing WAVE files whose audio has 24-bit (or 24-bit packed as 32-bit) samples, you must specify the packing mode. For audio with 16-bit samples, the -p option is not required, but you may use -p 3. [Required only for 24-bit- and 32-bit samples]

  3 = 16-bit samples, with 2-byte alignment

  0 = 24-bit samples, with 3-byte alignment

  1 = 24-bit samples, with 4-byte alignment, padding in most significant byte

  2 = 24-bit samples, with 4-byte alignment, padding in least significant byte
- -c <selected channel> allows the user to select a single audio channel in the range 1 through 8, where channel 1 represents the sample presented first in a block of audio samples. If you would like to process all channels in the audio stream simultaneously, use the -c 0 option. [Optional. Defaults to 1 if you do not include the argument on the command line].
- -d indicates that you would like to generate detailed reports as well as summary reports. [Optional. Defaults to summary reports only]
- -a indicates that, if the file is larger than 4GB in size and that you would like the application to read and process data until it reaches the end of the file instead of processing just the number of bytes specified in the WAVE header, where the audio-size specification is limited to a 4-byte unsigned integer value. [Optional. Defaults to ending the processing when the application has read and processed the number of bytes specified in the WAVE header]
- -h displays an explanation of command-line usage. [Optional. Supersedes all other arguments]