

Nielsen Monitor Application

User Guide

Revision A

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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 the purpose of 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 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 4 GB 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.

Please refer to section 4 of this document for more detailed information regarding audio input constraints.

2.2. Functionality

The monitor reads and interprets your command-line arguments (defined in section x.x), printing an error message on the screen and exiting if your proposed settings are incorrect. 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 48 kHz if the stream includes NAES 2 High-Frequency watermarks, 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 4 GB)

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. The 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. Definitions of each of the reported characteristics is clearly defined by widely available online sources pertaining to 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 that if you use the -a option, and if your input file is greater than 4 GB in size, 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.

```
: File info for TestFile.wav:
: -----
:   File size = 4294967295
:   Data bytes = 4294967295
:   Data offset = 102
:   Compression code = 65534
:   Channel count = 6
:   Sample rate = 48000
:   Bytes per second = 576000
:   Block align = 12
:   Bits per sample = 16
:   Extra bytes = 22
: -----
Channel 1: Audio SDK Version 4.2.2
Channel 2: Audio SDK Version 4.2.2
Channel 3: Audio SDK Version 4.2.2
Channel 4: Audio SDK Version 4.2.2
Channel 5: Audio SDK Version 4.2.2
Channel 6: Audio SDK Version 4.2.2
: Processed 4295232000 bytes of 4294967295 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 whose name specifies the channel to which the report applies. Each channel-specific file may hold up to three types reports of information gathered during the past 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 7 SIDs, each followed by a Nielsen audio-code type. Section 3 of this document explains both audio-code types (Section 3.1) and SIDs (Section 3.2).

```
*** Elapsed time: 1260 ***
*** SUMMARY REPORT ***
0xd623 - CBL2
4791 - N2FD
4791 - NWFD
1452 - N2HF
1452 - NWCC
1451 - N2HF
1451 - NWCC
```

Figure 2: Example Summary Report

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

```
*** Elapsed time: 1260 ***
*** WARNING REPORT ***
4791 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. An example detailed report is shown in Figure 4, on the next page. As you can see, 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, same time stamp, same code type as another code), number of time-code errors, and number of PC/FD conflicts for that SID. These report elements are described in more detail in section 5.

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



```
*** Elapsed time: 1260 ***
*** DETAILED REPORT: 1260***
Type, SID, Count, Duplicates, TC Errors, PC-FD Conflicts
CBL2 0xd623: 12, 0, 0, 0
N2FD 4791: 27, 0, 0, 2
NWFD 4791: 16, 0, 0, 0
N2HF 1452: 13, 0, 0, 0
NWCC 1452: 19, 0, 0, 0
N2HF 1273: 0, 0, 0, 0
NWCC 1273: 0, 0, 0, 0
N2HF 1335: 0, 0, 0, 0
NWCC 1335: 0, 0, 0, 0
N2HF 1451: 4, 0, 0, 0
NWCC 1451: 10, 0, 0, 0
N2HF 1455: 0, 0, 0, 0
NWCC 1455: 0, 0, 0, 0
N2Undef 22261: 0, 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:

- NAES 2 FD – a 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 – a 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 - a 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 2 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 - a 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 2 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 – a NAES 2 code used with short commercial (ad) content. Designated as N2HF in the JSON report string.
- NAES 6 Commercial Code – a 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 – a NAES 6 code used to uniquely identify the source encoder. Designated as Info-SID in the JSON string. If present, appears twice per hour, at 3 minutes past the hour. The SID setting indicates that this is part 1, part 2, or part 3 of a three-part INFO SID.
- RT-VOD – a NAES 6 code used to indicate that the content is recently telecast TV content, retransmitted as VOD. The 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.

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	"N2FD"

Table 1: Nielsen Audio Code Types

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 are usually displayed in decimal format.

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



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.

Label	Meaning
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
Audio Code Type Error	Watermarks with the same NAES SID detected in the past minute had conflicting PC/FD types, probably due to a decoding error.
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.
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.

Table 2: Report Alert Types



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. These are the tallies that are kept for each SID:

Label	Meaning
Type / SID	The unique key to each record in the detailed report is the combined audio-type/SID field. The following four counts in this table apply only to audio codes detected during the past minute that have the same audio-type/SID .
Count	The number of error-free audio codes detected during the past minute.
Duplicates	The number of audio codes for which the timestamp setting is the same as the timestamp setting of the previously detected audio code.
Timecode Errors	The number of audio codes for which the timestamp setting is less than the timestamp setting of the previously detected audio code.
PC/FD Conflicts	The 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.

Table 3: Detailed-Report Elements

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 48 kHz or 24 kHz.

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.

- 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

- 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

- 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

- 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]
 - 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
 - 3 = 16-bit samples, with 2-byte alignment
- `-c <selected channel>` allows the user to select a single audio channel in the range 1 through 8, where channel 1 is 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 4 GB in size, 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. Supercedes all other arguments]