



# Nielsen ID3 Tag Solution

White Paper

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#### Revision History

Revision	Date	Change Made	Author
1	2/2/15	Initial version.	Alan Bosworth
2	5/2/16	Added MPEG-DASH proposed carriage of ID3 in emsg using in-band event	Alan Bosworth
3	5/23/16	Incorporated comments	Alan Bosworth
4	11/3/16	Added Appendix C – DASH emsg data structure	Alan Bosworth
5	3/15/17	Added note to include entire 271-byte ID3 tag in the emsg box	Lois Price
6	3/21/17	Further clarified the Nielsen implementation of an ID3 Tag PRIV Frame.	Lois Price

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## Introduction

Nielsen uses proprietary algorithms to insert non-audible code into broadcast content. This audio watermarking technique is part of a system that accurately measures the TV & Media consumption and provides the currency for a 70+ billion dollars ecosystem.

Some of the key metrics such as C3 or C7 (average commercial minutes for the first 3 or 7 days of live airing) are highly desirable by the industry as they apply to the growing mobile/digital viewing audience.

This document will provide an overview of the solution and the detail information about Nielsen ID3 metadata structure and its carriage in the streaming media, a key component in the measurement of C3/C7 via adaptive streaming distribution.

## Background

This document is intended for technical personnel of companies that support Media publishers who use online video players (OVP) or specialized video players for non-iOS platforms. Such players typically support adaptive bitrate streaming (ABR) formats such as Apple's HLS (Http Live Streaming) and MPEG-DASH.

Knowing the details and enabling the support of Nielsen ID3 metadata will provide added value to differentiate and be part of the fast growing media streaming ecosystem of mobile, online and OTT devices.

As mentioned in the introduction, to meet the C3/C7 requirements and provide the solution for mobile/digital measurement, there are unique challenges that Nielsen engineers must and have overcome. The solution relies on industry-standard specifications:

- ID3.org – [Private Data Frame](#)
- Apple HLS Specification – [Timed Metadata in HTTP Live Stream](#)
- MPEG-DASH – [Inband event scheme](#)

Nielsen met with many industry representatives, content owners, content distributors and equipment and workflow providers; we reviewed the proposed solution for measuring C3/C7 contents on mobile, desktop/laptop, SmartTV and OTT devices. This representative group was very supportive and many have implemented this solution into their respective products.

Below are just three challenges we must solve for:

- A. Measure C3/C7 content on iOS devices\*\*. Since iPad and iPhone provided significant viewership, the industry seeks a solution ASAP. However, accessing the audio of streaming content is prevented by the iOS programming API call. This prevents Nielsen from using the classic technique of accessing the audio stream and decoding the watermark.
 

*\*\*Note: Since the early days of 2013, HLS streaming has expanded beyond just iOS devices. HLS is currently the dominant ABR streaming format and is supported on Android devices, Desktop (HTML5), OTT devices (Roku, AppleTV, ChromeCast, Amazon Fire etc.) plus game consoles and SmartTV's.*
- B. Protect the user experience. Any heavy computation on the device could potentially reduce the charge of the battery on the device. We all know this is a user experience we must not impact.
- C. Fragmentation and proper support of HLS\*\* and ID3 timedMetadata.

*\*\*Note: MPEG-DASH inband event support is defined in this update of the document*

This document will provide the detailed information of the Nielsen ID3 data package. The Video Player can use it as a reference to confirm proper implementation for supporting this metadata. Nielsen data payload is private and encrypted but the structure is fully compliant with ID3.org PRIV frame structure.

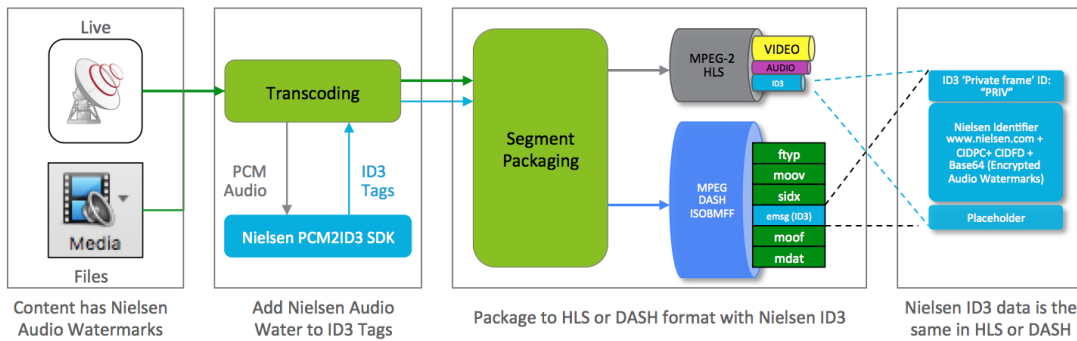
The HLS and MPEG-DASH specifications define the detailed implementation requirements for the insertion of ID3 timedMetadata into HLS stream and ID3 data into the emsg box and in-band event in MPEG-DASH stream.

# Nielsen ID3 Tag Solution

The solution consists of two major processes.

1. ID3 insertion process - this step is done at the creation of the streaming content via transcoding assets from live or Mezzanine formats into ABR streaming formats like HLS or DASH\*\*. The process consists of decoding the audio watermarks, packaging the code into ID3 structure and multiplexing the resulting ID3 metadata into the stream. See Figure 1, noting that the caption under the second block should be “Add Nielsen Audio Watermarks to ID3 Tags.”

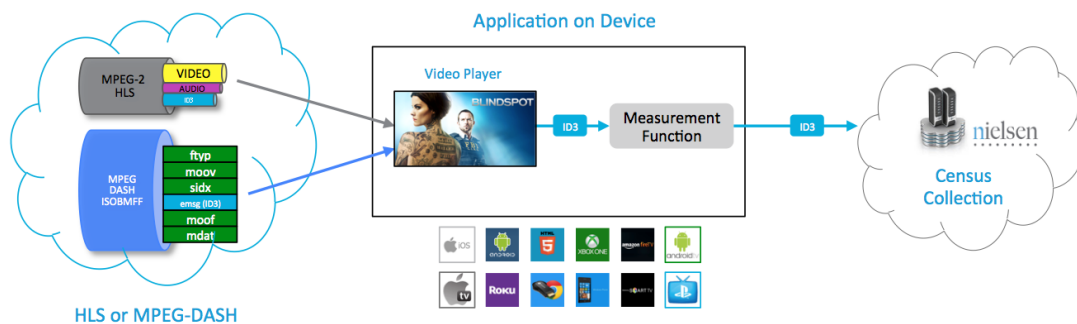
*\*\*Note: The carriage of Nielsen ID3 in MPEG-DASH is being proposed to use the emsg box and <InbandEventStream> mechanism.*



**Figure 1 – Nielsen ID3 Insertion**

2. ID3 extraction process – this step is done at the viewing session on the device. ID3 metadata from HLS or DASH\*\* streams are events emitted by the video player. The application can subscribe to the event and pass Nielsen’s ID3 metadata to a Nielsen collection system for measurement purposes. Nielsen provides native SDKs for iOS and Android platforms, as well as a Cloud API as a platform-agnostic way to instrument applications for audience measurement.

*\*\*Note: The carriage of Nielsen ID3 in MPEG-DASH is being proposed to use the emsg box and <InbandEventStream> mechanism.*



## Figure 2 – Nielsen ID3 Extraction

### Quick Note on the solution's progress:

The HLS format continues to expand beyond the iOS ecosystem. It is by far the leading and most mature streaming format among the other competing standards. A recent white paper from Encoding.com assessed a ~75% share as compared to ~25% share for Microsoft Smooth Streaming. Adobe HDS and MPEG-DASH formats are at ~5%.

Even though MPEG-DASH is not widely adopted, it is gaining traction and is considered by many companies to be the up and coming standard. As discussed earlier, Nielsen is prototyping a proposed method to carry the same ID3 data in emsg box for MPEG-DASH ISOBMFF.

Much progress had been made with the tag-insertion process. Nielsen has worked with and certified many transcoder equipment providers as they integrate Nielsen ID3-tagging into their products.

In terms of the extraction process on the video player side, there are gaps in coverage due fragmentation of implementation and the lag in implementing industry standards.

**iOS** - the AV Foundation player in iOS provides ID3 timedMetadata events natively. iPad and iPhone were the first targeted devices and met the goals of the solution very nicely.

**Android** video players starting from ICS support HLS but lack support of ID3 timedMetadata. However most media companies use 3<sup>rd</sup> party video players for quality and these players do support ID3 – NexStreaming, VisualOn, NeuLion, BrightCove and Adobe PrimeTime are examples.

**Online Video Players** for desktop browsers for PC and MAC is another area of fragmentation. They support HLS via Flash plug-in or some other customization. There is a lack of ID3 support here as well. We have reached out to a number of the video player companies. The general consensus is the task relatively straightforward and they understood the importance and the need to support ID3 timedMetadata in HLS streams.

**HTML5** browsers beginning to support MSE can support HLS and MPEG-DASH formats. Some browsers are providing access to timedMetadata (ID3) with custom events that allow applications to process this data. However, the W3C HTML5 spec has defined a standardized way to map this metadata into textTrack events.

**OTT devices** like Roku , ChromeCast , AppleTV, Amazon Fire natively support HLS and ID3 timedMetadata. This makes it easy to meet the C3/C7 metrics requirements.

**SmartTVs** are converging on using the HTML5 standard for their UI. This standard has a provision to carry metadata in textTrack elements. We are actively monitoring and providing input in this area to ensure ID3 from HLS can be mapped into textTrack elements.



## Nielsen ID3 Tag Format

Nielsen ID3 tags contain the actual data extracted from Nielsen Audio Watermarks as inserted in the media.

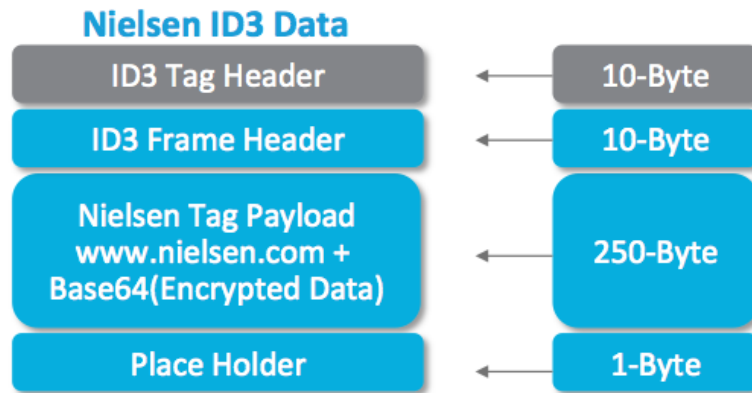


Figure 3 – Layout of Nielsen ID3 Tag

The Nielsen ID3 tag is 271 bytes long. It consists of four parts:

- A 10-byte ID3 tag header, as defined in the document “ID3 Tag Version 2.4.0 – Main Structure” (<http://id3.org/id3v2.4.0-structure>).
- An ID3 “PRIV” frame header, as defined in section 4.27 of the Nilsson document “ID3 Tag Version 2.4.0 – Native Frames” (<http://id3.org/id3v2.4.0-frames>).
- A null-terminated Owner Identifier text string (a required part of the “PRIV” frame). Note that the Owner Identifier string includes the entire 249-byte *Nielsen payload*, as well as the required null-terminator.
- The required private-data segment of the “PRIV” frame. In the Nielsen ID3 tag, the private-data segment consists of a single byte, the ASCII character ‘A’.

Each Nielsen ID3 tag holds just a single “PRIV” frame.

The tables on the following pages show the byte-by-byte layout of the ID3 Tag header, the “PRIV” frame header, and the Owner Identifier segment of the Nielsen ID3 Tag. As noted above, the private-data segment consists of a single byte, the ASCII character ‘A’; therefore, no table is required to show its contents.

## The ID3 Tag Header

The table below (Table 1) shows the format of the ID3 Tag header.

**Table 1 – Format of Tag Header**

Byte Position	Byte Count	Field	Value
0 – 2	3	ID3v2/file identifier	“ID3”
3 – 4	2	ID3v2 version	0x04 00
5	1	ID3v2 flags	‘0010 0000’
6 – 9	4	ID3v2 size	Syncsafe (261)

## The ID3 Private Frame Header

Each Nielsen ID3 tag holds a single ID3 “PRIV” frame. For a detailed description of ID3 private frames, please refer to section 2.7 of Nilsson’s “ID3 Tag Version 2.4.0 – Native Frames.” document. The frame header of each Nielsen ID3 tag is formatted as shown below (Table 2).

**Table 2 – Format of Frame Header**

Byte Position	Byte Count	Field	Value
0-3	4	Frame ID	“PRIV”
4-7	4	Frame Size	Syncsafe (251)
8-9	2	Flags	0x00 00

## The Owner Identifier string, including the *Nielsen Payload*

The structure of the Owner Identifier is shown in Table 3.

**Table 3 – Fields of Owner Identification String**

Position within Owner-ID String	Position within Tag	Size in Bytes	Description/Value
0-14	20-34	15	<b>Nielsen URL</b> <a href="http://www.nielsen.com">www.nielsen.com</a>
15	35	1	Field separator: ‘/’
16-248	36-268	234	<b>Nielsen Payload</b> Encrypted watermark data, with Base64 encoding applied after encryption.
249	269	1	Null terminator

## Conclusion

Nielsen developed a complete solution to provide the C3 and C7 metrics for mobile, Desktop and OTT media measurement. The key to these metrics is the audio watermarks that deterministically identify the content as well as the distribution path; through the use of ID3 tags, traditional Nielsen watermarks are embedded in streaming formats such as HLS and MPEG-DASH.

The industry is looking for a holistic cross-platform measurement solution that covers all devices – linear TV, Mobile, Desktop, OTT, and Smart TV. It is looking for a solution that is based on industry-accredited methodology to help monetize all the distribution paths.

Transcoder and video players that provide the ability to support the emission of ID3 timedMetadata in HLS streams and ID3 EventStreams in MPEG-DASH will greatly differentiate their value proposition with clients.

## References

Apple Inc., “Timed Metadata for HTTP Live Streaming, Networking & Internet: Protocol Streams,”  
[http://developer.apple.com/library/ios/documentation/AudioVideo/Conceptual/HTTP\\_Live\\_Streaming\\_Metadata\\_Spec/HTTP\\_Live\\_Streaming\\_Metadata\\_Spec.pdf](http://developer.apple.com/library/ios/documentation/AudioVideo/Conceptual/HTTP_Live_Streaming_Metadata_Spec/HTTP_Live_Streaming_Metadata_Spec.pdf)

MPEG-DASH – [Inband event scheme](#)

*International Standard ISO/IEC 13818-1:2007* (Information Technology – Generic coding of moving pictures and associated audio information: Systems)

Nilsson, M. “ID3 Tag Version 2.4.0 – Main Structure”. <http://www.id3.org/id3v2.4.0-structure>

Nilsson, M. “ID3 Tag Version 2.4.0 – Native Frames”. <http://www.id3.org/id3v2.4.0-frames>.

Nielsen Engineering Document, “Nielsen ID3 Tag EDU Payload Format.”

Encoding.com, 2015 Global Media Format Report.pdf

## APPENDIX A: Nielsen ID3 Tags Example

Below is an example of a Nielsen ID3-tag, excluding the ID3 headers and the trailing one-byte private data segment. In other words, this example shows only the *Nielsen payload* component of the Owner Identification string (please refer to Page 8 of this document). Since the payload is Base64 encoded and if the OVP player makes the ID3 data accessible, this payload can be easily consumed by JavaScript in browser environments (desktop or mobile).

```
www.nielsen.com/X100zdCIGellgZnkYj6UvQ==/JsBcioTtfZudDZ4eU2Nzbw==/8DECUHugD_a4-FZGacH8ggrDBLFhKu-
3sW2gfjLAiwQIGQJQ3AV3oa7HlcpGdSygh80vr8jb-8-
Mmn23SgQOHxRmX7ZEJ89RianN0ko8ddEqc2BfXTTN0lgZ4iWBmeRiPpS9X100zdCIGellgZnkYj6UvVsyuZJUsrcmPNo=/00000
/35859/01
```

A zip file of a low bandwidth HLS with Nielsen ID3:

<http://www.nielseninternet.com/VOD/NielsenConsumer/zip/nielsenconsumer.zip>

The zip package contains the .m3u8 and all .TS segments for the video.

Additionally, an output file with expected ID3 tags is included to help with validation - NielsenConsumerID3.txt.

A URL to stream the same HLS:

[http://www.nielseninternet.com/VOD/NielsenConsumer/prog\\_index.m3u8](http://www.nielseninternet.com/VOD/NielsenConsumer/prog_index.m3u8)

We have additional tools to assist with the integration of Nielsen ID3 tagging into your product. Please contact your Nielsen representative to discuss accessing the full tool set.

## APPENDIX B: NIELSEN ID3 Tags in an MPEG2-TS PES

Each 271-byte Nielsen ID3 Tag is encapsulated in a single PES packet (Section 2.4.3.6 of ISO/IEC 13818-1) in compliance with the recommendations of “Timed Metadata for HTTP Live Streaming.”

Each PES packet is encapsulated in two 188-byte transport packets. In Nielsen’s recommended implementation, the first 170 bytes of the tag are included in the first transport packet. The second 101-byte segment of the tag is inserted into the second transport packet. The tables on the following pages show the recommended placement of a Nielsen ID3 Tag within two transport packets.

### Nielsen ID3 Tag PES Packets

Blue color rows indicates Nielsen ID3 payload

#### First Segment of PES Packet (Transport Packet 1)

Position in		Bit Count	Cumulative Byte Count	Field	Value
Transport Packet	PES Packet				
0-7		8 bits	1	Sync byte	0x47
8		1 bit		Transport error indicator	'0'
9		1 bit		Payload unit start indicator	'1'
10		1 bit		Transport priority	'0'
11-23		13 bits	3	PID (13 bits)	PID for this ID3 Tag Stream
24-25		2 bits		Scrambling control	'00'
26-27		2 bits		Adaptation Field Control	'01'
28-31		4 bits	4	Continuity Counter	[0 to 0xf]
32 – 55	0-23	24 bits	7	Packet Start Code Prefix	0x00 00 01
56-63	24-31	8 bits	8	Stream ID (Private Stream 1)	0xBD
64-79	32-47	16 bits	10	PES Packet Length	279
80-81	48-49	2 bits		Fixed bits	'10'
82-83	50-51	2 bits		PES Scrambling control	'00'
84	52	1 bit		PES Priority	'0'
85	53	1 bit		Data Alignment Indicator	'1'
86	54	1 bit		Copyright	'0'
87	55	1 bit	11	Original or copy	'0'
88-89	56-57	2 bits		PTS-DTS flags	'10'
90	58	1 bit		ESCR flag	'0'
91	59	1 bit		ES rate flag	'0'
92	60	1 bit		DSM trick mode flag	'0'
93	61	1 bit		Additional copy info flag	'0'

94	62	1 bit		PES CRC flag	'0'
95	63	1 bit	12	PES extension flag	'0'
96-103	64-71	8 bits	13	PES header data length	5 (for 5-byte PTS)
104-107	72-75	4 bits		Fixed bits	'0010'
108-110	76-78	3 bits		PTS [32-30]	From audio PES
111	79	1 bit	14	Marker bit	'1'
112-126	80-94	15 bits		PTS[29-15]	From audio PES
127	95	1 bit	16	Marker bit	'1'
128-142	96-110	15 bits		PTS[14-0]	From audio PES
143	111	1 bit	18	Marker bit	'1'
144	112	170 byte	188	First 170 bytes of ID3 Tag	

### Second Segment of PES Packet, Transport Packet 2

Position in		Bit Count	Cumulative Byte Count	Field	Value
Transport Packet					
0-7		8 bits	1	Sync byte	0x47
8		1 bit		Transport error indicator	'0'
9		1 bit		Payload unit start indicator	'0'
10		1 bit		Transport priority	'0'
11-23		13 bits	3	PID (13 bits)	PID for this ID3 Tag Stream
24-25		2 bits		Scrambling control	'00'
26-27		2 bits		Adaptation Field Control	'11'
28-31		4 bits	4	Continuity Counter	[0 to 0xf]
4 bytes	0	1 byte	5	Adaptation Field Length	81
5	1	1 byte	6	Adaptation flags	0
6	2	81 bytes	87	Stuffing bytes	0xff
87	83	101 bytes	188	Last 101 bytes of ID3 Tag Payload	

## APPENDIX C: NIELSEN ID3 Tags in a MPEG-DASH

According to ISO/IEC-23009-1, the syntax of ‘emsg’ box is defined as:

```
aligned(8) class DASHEventMessageBox extends FullBox('emsg', version = 0, flags = 0)
{
    string scheme_id_uri;
    string value;
    unsigned int(32) timescale;
    unsigned int(32) presentation_time_delta;
    unsigned int(32) event_duration;
    unsigned int(32) id;
    unsigned int(8) message_data[];
}
}
```

Field	Expected Value	Comment
scheme_id_uri	www.nielsen.com:id3:v1	This URI defines Nielsen In-Band event scheme
value	1	
timescale	90000	
presentation_time_delta	'earliest_presentation_time' of 'sidx' box	
event_duration	0xFFFF	
id	Value of time calculation from PCM audio	Reset to 0 when overflow beyond 32-bit
message_data[]	271-byte Nielsen ID3 Tag	Complete ID3 tag returned by Nielsen PCM-to-ID3 SDK callback.

- The ‘emsg’ containing the Nielsen ID3 Tag shall be stored with the audio representation
- The entire 271-byte Nielsen ID3 tag, as generated and delivered by the PCM-to-ID3 SDK, shall be included in the emsg component.
- If 2 or more ID3 tags were generated within the same segment duration, include all of them in the message\_data[] array and add an ‘eol’ (0x0a) separation character between the ID3 tags. This condition occurs when an “INFO” tag (generated at 5-minute intervals) is released in the same time period as a “DATA” tag (generated at roughly 10-second intervals).