

# SMPTE RECOMMENDED PRACTICE

## Audience Measurement Using OBID and OBID-TLC



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## Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards,

Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 24TB.

## Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

## Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

This document is intended to provide guidance to implementers of SMPTE ST 2112-10, which standardizes the method of binding content identifiers, and SMPTE ST 2112-20, which standardizes the method of binding distribution channel identifiers and timestamps.

## 1 Scope

This Recommended Practice covers the use of SMPTE's Open ID (OBID and OBID-TLC) binding as applied to the Audience Measurement use case.

## 2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; then formal languages; then figures; and then any other language forms.

## 3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 2112-10:2018, Open Binding of Content Identifiers (OBID)

## 4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

### 4.1 Acoustic Detection/Recovery

detection and recovery of an OBID or OBID-TLC mark via sound waves traveling through the air in a detection environment.

### 4.2 Direct Detection/Recovery

detection and recovery of an OBID or OBID-TLC mark via direct (electronic) connection to a receiving device.

### 4.3 Editing Rules

rules commonly used in electronic audience measurement systems that are designed to fill-in incomplete detection of watermarks. These are also referred to as bridging rules.

To account for the possibility that there may be decoding latency (i.e. a time lag between when a meter/device first detects a watermark and when it recognizes and registers that watermark) a lead-in or bridging edit may be applied to the beginning of each audio exposure event to ensure that the media outlet receives credit immediately after exposure. A typical lead-in or bridging edit will add 15 to 60 seconds immediately prior to the first watermark detection.

## 5 Mark Properties, Workflow and Signal Flow

### 5.1 General Principles – OBID Marks (informative)

OBID marks, which are defined in ST 2112-10, are used for carrying identifiers that uniquely identify the content being marked. There are several requirements with which the OBID mark was designed to comply. These are stated below.

#### 5.1.1 Payload

The OBID mark carries either an Ad-ID or an EIDR (but not both simultaneously). The payload of the OBID mark is 32 bits in the case of Ad-ID and 96 bits in the case of EIDR, with an additional 8 bits for payload identification in each case. Refer to ST 2112-10 for the specifics of the form and carriage of these identifiers.

#### 5.1.2 Survivability Across Platforms

Audio watermarking was chosen as an appropriate technology, due in part to its ability to survive across all common distribution platforms, and all other associated processing.

### **5.1.3 Recording And Playback**

It is crucial that the OBID binding survive commonly used recording and replay methods in both the professional and consumer realms.

### **5.1.4 Granularity**

The transition to or from one OBID mark to another has to be detected within 1 second of the transition when electronic (direct) detection is used, and 30 seconds when acoustic detection is used. This transition detection is not to be confused with recovery of the actual content ID.

### **5.1.5 Retrievability**

When using electronic detection, OBID identifiers themselves must be recoverable from any continuous 3 second segment of content in the case of Ad-IDs, or any continuous 5 second segment of content in the case of EIDRs.

When using acoustic detection, OBID identifiers themselves must be recoverable from any continuous 30 second segment of content in the case of Ad-IDs, or any continuous 60 second segment of content in the case of EIDRs.

### **5.1.6 ID Replacement**

In cases where content with an ID is re-aired, used within a new work, such as a composite work or similar situations, it must be capable of being removed or overwritten with the ID for the new work. A common example of this is the incorporation of short segments of content from sporting events in a sports highlight show. Removal and replacement or overwriting of marks is not transparent; it can have an adverse effect on the subjective quality of the audio and on the recoverability of the mark. Users are strongly advised to avoid multiple replacements or overwrites of OBID marks.

### **5.1.7 Insertion and Detection Points**

OBID marks are to be inserted as the last step in the production process because changes to the audio content after mark insertion can have deleterious effects on the recoverability of the marks. Insertion of OBID marks later in the distribution chain is required to be possible but is undesirable because it can result in unmarked versions of content being distributed.

### **5.1.8 Quality**

The presence of an OBID mark must not degrade the perceptible quality of audio and/or video, including lip sync, at the consumer's reception point.

### **5.1.9 Non Interference**

The OBID watermark must not interfere with any existing watermarks in use.

### **5.1.10 Linear and Non-Linear Support**

It is expected that insertion of OBID watermarks will be useful in both the linear and non-linear (file-based) environments.

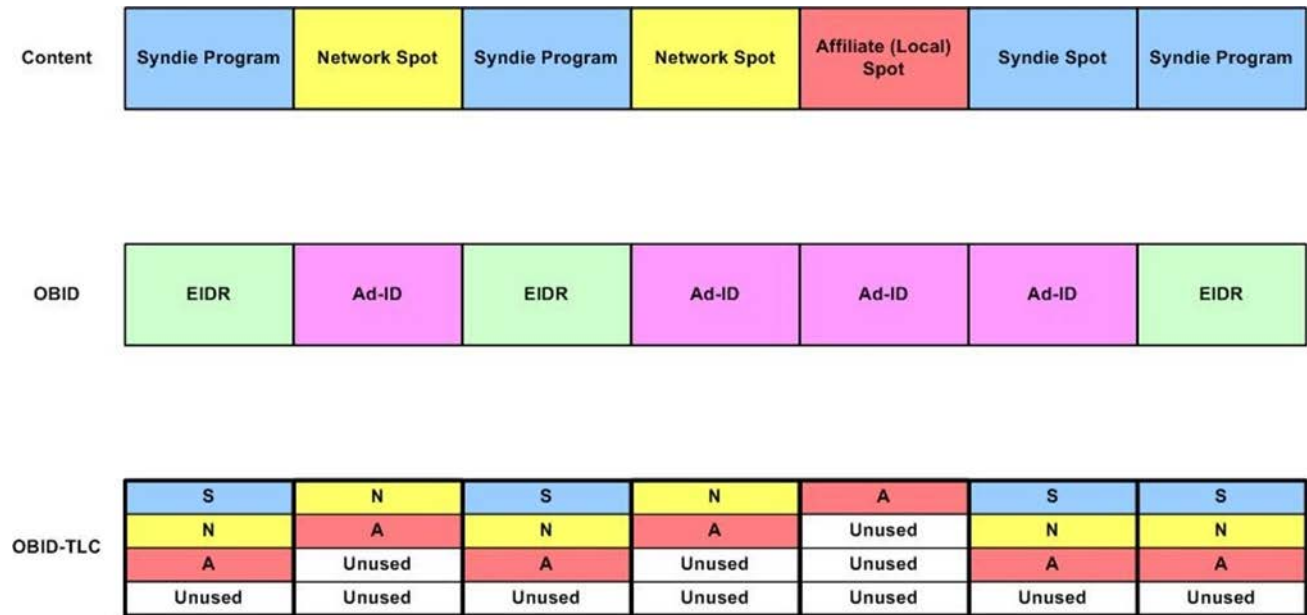
**5.1.11 Performance Impact**

Processing required on the detection side must not cause noticeable performance degradation on typical consumer devices

**5.2 General Principles – OBID-TLC Distribution Marks (Informative)**

OBID-TLC Distribution Marks, which are defined in SMPTE ST 2112-20, are used for carrying timestamps and distribution identifiers which, alongside the OBID mark, help to provide all information needed to enable audience measurement. While the OBID mark provides information as to what content is being consumed, the OBID-TLC Distribution Mark is designed to provide information as to how the content reached the consumer. The OBID-TLC Distribution Mark is not designed to be replaced or overwritten.

OBID-TLC Distribution Marks can be used to identify up to four entities involved in the content distribution chain. Figure 1 illustrates how this might appear.



**Figure 1 – OBID and OBID-TLC Binding Example**

There are several requirements to which the OBID-TLC Distribution Mark was designed to comply. Those are outlined in the subsections that follow.

**5.2.1 Distribution Channel ID**

Distribution Channel IDs uniquely identify any of the entities potentially involved in the distribution of content to consumers. The structure provides for 2<sup>32</sup> (approximately 4.3 billion) entities to be identified by each Distribution Channel ID. At least four Distribution Channel IDs can be supported in association with any one distribution stream.

**5.2.2 Timestamps**

Timestamps identify points in the media timeline with a resolution of one second or better. Timestamps are unique over a period of at least 366 days. Placement accuracies of Timestamps are such that it is possible to

identify any given instant on the timeline with an accuracy of 10 milliseconds or better. A Timestamp is associated with each instance of a Distribution Channel ID.

### **5.2.3 Direct (Electronic) Recovery**

As with OBID marks, OBID-TLC Distribution Marks are recoverable via direct (electronic) connection, across all common distribution platforms and all associated processing.

### **5.2.4 Acoustic Recovery**

As with OBID marks, OBID-TLC Distribution Marks are also recoverable acoustically. In addition to modifications due to acoustic propagation alone (including reverberation and attenuation), the binding technique is intended to survive the addition of noise of power lower than or equal to that of the source signal, with such noise including conversation and typical household noises.

Survivability in certain out-of-home environments (i.e. office, taxi, theatre) is optional.

### **5.2.5 Recording and Playback**

OBID-TLC Distribution Marks must survive commonly used recording and replay methods used in the professional environment and in delivery to the consumer.

### **5.2.6 Granularity**

The transition between two identified segments or an identified and unidentified segment must be detectable within 1 second for direct (electronic) recovery, and 2 seconds with a 90% confidence, for acoustic recovery.

### **5.2.7 Retrievability**

When using electronic detection, OBID-TLC identifiers themselves must be recoverable from any continuous 30 second segment of content with 100% confidence.

When using acoustic detection, OBID-TLC identifiers themselves must be recoverable from any continuous 30 second segment of content with 75% confidence.

### **5.2.8 Multiplexing OBID-TLC Distribution Marks**

Up to four OBID-TLC Distribution Marks can be present in any one stream, identifying up to four different entities involved in the distribution of the content to the consumer.

### **5.2.9 Insertion and Detection Points**

OBID-TLC Distribution Marks can be inserted at any point between production and viewing by consumers. Preferred insertion points are given in Clause 5.3

### **5.2.10 Quality**

The presence of OBID marks and OBID-TLC Distribution Marks must not degrade the perceptible quality of audio and/or video, including lip synch, at the consumer's reception point.

### 5.2.11 Non Interference

Neither the OBID watermark nor the OBID-TLC watermark interfere with any existing watermarks in common use.

### 5.2.12 Linear and Non-Linear Support

Insertion of OBID-TLC watermarks is possible in both the linear and non-linear (file-based) environments.

### 5.2.13 Performance Impact

Processing required on the detection side must not cause noticeable performance degradation on typical consumer devices

### 5.2.14 Compressed Bitstream Support

OBID-TLC insertion must operate without introducing undue latency when utilized in scenarios where insertion is performed into a compressed ATSC A/52:2018 bitstream.

## 5.3 Binding of Marks

Binding of OBID and OBID-TLC marks should happen at a specific set of points, as described below. See Figure 2 In this figure, “channel” is synonymous with distributor.

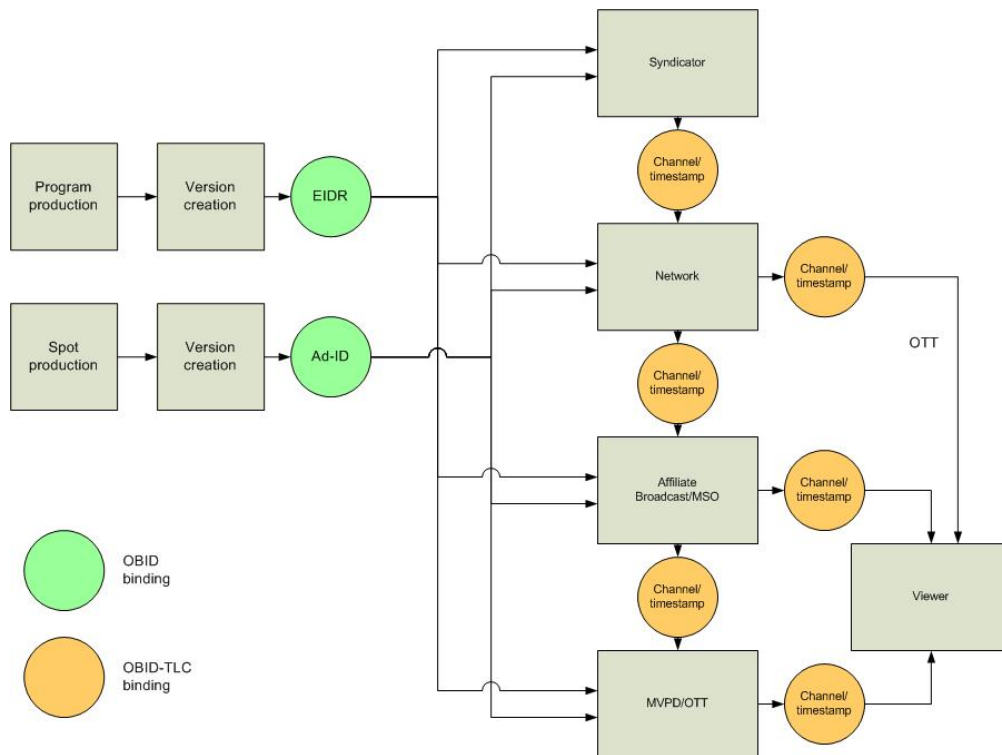


Figure 2 – OBID and OBID-TLC Binding

### 5.3.1 OBID Binding Point

The OBID binds a content identifier, so it should be inserted as far upstream as possible, ideally immediately upon completion of post-production of the final version of the content, prior to dissemination of the content to the distributor or distributors (syndicator, network, station or MVPD). See Figure 2.

### 5.3.2 OBID-TLC Binding Points

The OBID-TLC binds a distribution channel identifier and timestamp to the content being distributed, so in each instance it should be inserted at the point immediately before the content stream leaves the distributor's facility. See Figure 2.

If the content stream is carried through the facility as uncompressed audio and video, the OBID-TLC should be inserted prior to compression for distribution. If the content stream is carried through the facility in compressed form, the OBID-TLC should be inserted just prior to dissemination through the identified channel. System designers should take these requirements into account when configuring distribution schemes with m-for-n redundancy to avoid the possibility of misidentified content streams.

As previously specified, up to four OBID-TLC marks may be bound to a single program stream, a different one at each distribution stage. In a case where a single facility serves multiple stages of the distribution process, such as a release facility that serves both a network and a local station, the binding points for the OBID-TLCs for each stage should be inserted separately at the points in the content stream flow identified above. If the facility's system architecture is such that the workflows are logically separate but physically merged, particular care shall be taken to ensure that the OBID-TLC marks are inserted in the correct order.

## 5.4 Detection and Decoding In More Detail

The detection and decoding of OBID-TLC Distribution Marks can be affected positively or negatively by various factors. For acoustic detection, the nature of the environment can have a negative effect, such as a noisy environment where the ambient noise in a room begins to mask the actual program audio. Another factor is an environment which includes lots of multipath or reflections, which can cause various microphone pickup timing delays. Other factors could involve the specific characteristics of the device presenting the audio, such as a TV with a blown speaker or a specific failure or characteristic in the audio circuit itself.

Additionally, frequency dithering or addition or deletion of audio samples, which could happen in time compression equipment at a content producer or distributor, will have an impact as the frequencies the decoder is evaluating could be shifted or portions of the audio could be deleted, repeated or merged, disrupting the watermarks. Therefore, it is strongly recommended that any time compression should be implemented upstream of the OBID mark inserter.

Another factor that can affect the ability to decode watermarks is related to 5.1 channel audio content that has delays in interchannel timing. Time delays among center, left, right, left rear, and right rear can cause frequency cancellations or phase shifts when the content is down mixed to stereo. These frequency cancellations or phase shifts can cause portions of marks to be eliminated or altered or can remove the masking audio of the mark, therefore rendering the mark unrecoverable or audible. To prevent this, all channels of a multichannel audio program shall be kept in sync with each other.

Certain households have set top boxes or over the top devices in which the audio levels can be adjusted separately from the TV audio. It has been observed that if a user has the set top box audio set to a low level without realizing it, they may overcompensate by adjusting the TV audio louder. This has the effect of raising the noise floor of the program audio which, depending on the watermarking technology used, can reduce the decoder's ability to detect watermarks reliably.

Other factors that may affect the ability to decode the watermarks include the detection device and how it is being carried. If a portable metering device is carried in a pocket for instance, the clothing rubbing against the microphone could affect the device's ability to properly decode the watermarks. Addressing these issues is outside the scope of the Recommended Practice.

#### **5.4.1 Detection Environments**

There are two distinct environments in which OBID and OBID-TLC marks are detected: acoustic and electronic (direct). The former is the more challenging, and is addressed in more detail below.

##### **5.4.1.1 Acoustic**

A factor to consider with a portable acoustic detection device is the impact of audio spillover from other audio sources or rooms. For instance, if a listener is in the living room with a TV at normal volume, and a TV in an adjacent room has a loud volume, it is possible the audio and watermarks from the adjacent room could be detected by the acoustic meter in the living room, presenting a potential crediting error situation. It may be possible for editing rules or other crediting system enhancement in back office systems to compensate for some of this.

##### **5.4.1.2 Electronic**

Directly detecting the presence of a watermark by electronic means is a far simpler and better-controlled use environment than acoustic detection. Factors such as room size, speaker configuration, ambient noise, and the like are non-issues, as the watermark is detected internally within the device that is receiving the audio signal directly (e.g. a Smart TV, set top box, directly wired audio connection, etc.).

#### **5.4.2 Detection Devices**

Various detection devices could be used to decode and extract codes from the program audio. These devices could be a hardwired meter attached to the TV speaker and every device at a viewing site. Each device's audio signal at a viewing site must be attached to a hardwired meter if source detection is a requirement. Source detection is accomplished through audio correlation between what is received from the TV speaker to what audio is output from each device. The hardwired meter contains the decoding software or ASIC for extracting the watermarks. The devices have a communication means to a back office for reporting ratings. Hardwired meters are often referred to as set meters, however a set meter can be a microphone based meter as well.

Other detection devices to measure in home and out of home media consumption are portable microphone based meters. These meters can be custom devices or they can be off the shelf devices like smart phones and tablets. These devices have the watermark decoding software running in the background on the device. They typically also have a means to send data collected to a back office for collection and reporting. One of

the difficulties with using off the shelf devices is not all microphone designs are consistent which can result in varying levels of watermark recovery reliability.

## **5.5 Distribution Issues that Can Affect Code Insertion and Recovery**

There are several things to consider with watermarking systems and signal distribution to optimize audio code insertion and recovery. In general, the better the quality of the audio input into the watermark inserter, the better the number and quality of codes inserted. There are several system and signal factors to consider with watermarking systems:

### **5.5.1 Avoid excessive use of noise gates**

Some content producers want to use noise gates during talk and interview type programming to make the listener feel like they are directly involved in the interview. The net effect of this is periods of silence between speaking that have no noise floor to mask codes. A noise gate set up in this fashion creates long periods of “digital 0” audio, which does not allow for masking of codes, and therefore should be avoided.

### **5.5.2 Check for inter-channel phase delays for 5.1 content**

If there are inter-channel phase delays between any of left, center, right, left surround, or right surround, problems will arise during 5.1 to stereo down-mixing. This is because when the content is down-mixed, frequency cancellations will occur which could result in masking frequencies being eliminated which will make to code audible, or code frequencies being eliminated, which would eliminate the code. Both ST 2112-10 and ST 2112-20 require that watermarks be inserted in all channels at the same instant.

### **5.5.3 Improper use of equalization of audio can diminish masking frequencies**

If the frequencies of interest are attenuated or eliminated, then a watermark inserter will not be able to find masking energy to hide the watermark, and few or no watermarks will be inserted.

### **5.5.4 Improper audio signal levels including dynamic range**

The more dynamic range, the better. Audio watermarks are inserted at a level below the masking audio. If the dynamic range is reduced watermarks may not be able to be inserted or recovered.

### **5.5.5 Improper or excessive use of audio processing**

Audio processing downstream of a watermark inserter could have an impact on watermarks inserted depending upon the audio processor configuration. Typically the default configurations work fine, but custom configurations have been observed to have a negative impact.

### **5.5.6 Encoder inadvertently ‘by-passed’ during maintenance periods or control room reconfigurations**

This is also related to having some sort of monitoring or alarm system to monitor and alert loss of codes in a facility. Loss of codes should trip an alert if encoding fails in any way. If the distribution facility has redundant distribution channels, each should be equipped with its own watermark inserters.

### **5.5.7 Encoder not connected to master clock**

Since for OBID-TLC a time stamp is present, the encoder shall be connected to a master clock source such as NTP, GPS time, or an accurate LTC source.

### **5.5.8 Encoder installed prior to time compression and/or pitch correction equipment (a.k.a. “Lexiconing” or electronic time adjustment)**

Time compression and or pitch correction can modify the frequencies of interest or remove or repeat sections of audio, making the audio watermarks impossible to decode. If time compression or pitch correction are used, the marked content should be checked prior to air to ensure that the identifiers can be recovered. If they cannot, the content should be re-encoded, preferably by starting with an unmarked version of the content.

### **5.5.9 Station primary and back-up encoder used simultaneously in tandem (resulting in double encoding)**

Backup encoders shall be installed in a parallel configuration with a changeover and shall not be installed in series.

## **5.6 Security**

During the development of the OBID and OBID-TLC standards, much discussion was dedicated to this topic. A deliberate decision was made to document this as an open standard. Anyone can write, read, and replace OBID marks using this suite of documents. Implementers could build products that add security around this, but that would not be compliant with this suite of documents.

# **6 Real-Time Applications**

## **6.1 Encoding Latencies**

Signal latencies are a major issue for broadcasters. Latency added by the encoding process contributes to the overall propagation delay of the broadcast chain. TV networks have affiliated TV stations through whom their programming is distributed. Both the network and the stations try to run their broadcast systems “on the clock”. The absolute minimum latency is desired to keep those Network/affiliate timings as close to real time as possible. This is especially important for live events where identifiers cannot be pre-encoded prior to broadcast.

An audio watermark encoder should introduce as little latency as possible. The latency introduced by the encoder has two effects: one is to disrupt lip sync, the other is to introduce a timing error with respect to the time of the stream being marked (this is specific to the OBID-TLC). The lip sync error should be compensated for with a corresponding video delay, ideally contained within or closely tied to the encoder. The stream marking latency, which might be different than the lip sync delay and might be considerably longer, should not be compensated for by the encoder but should be deterministic and identical for all implementations of the encoding process. The reason for this is that there may be up to four concatenated encodes, one for each possible instance of an OBID-TLC. If the stream marking latency is deterministic and is known to the decoder, the decoder can compensate for it during the detection and decoding process by

application of an offset to the timestamp. This compensation is separate and independent of the decoding latencies discussed below.

## **6.2 Decoding Latencies**

Decoding latencies should also be considered for real-time applications. There are various latencies that can be present in a watermarking system. One such latency is dwell time, or the amount of time it takes to begin acquiring and decoding watermarks. Another is pipeline delay, or the amount of time it takes to process and decode watermarks from the audio. Each of these should be considered for systems that must operate in real-time with efforts made to minimize as much as possible. However, it is expected that in the detection process, appropriate editing rules will be implemented to compensate for decoding latencies, such as a 'lead-in' or 'bridging' edits.

## **7 Use Cases (Informative)**

What follows are some potential examples of how the cross-platform measurement solutions that the OBID/OBID-TLC system enables would utilize the Open IDs for both EIDRs and Ad-IDs:

### **7.1 Hybrid Measurement for TV Content**

A 30 minute show is broadcast on a network. Vendor A is tracking the playout via Return Path Data (RPD) from a set-top box. Vendor B is tracking the video on demand (VOD) views as reported by the MVPD. Additionally, Vendor C has a panelist who is watching the show and detects a Content ID Code on their meter or portable device app. These data can be combined, so that the RPD and the VOD views can provide usage volumetrics, and the panel can provide a demographic measurement and de-duplication between linear/VOD for the same show for the same user. They would be linked by the Content ID Codes, Time/Date Stamps, and Distribution Channel Identifiers.

### **7.2 Measuring the same piece of content as an individual moves across devices**

A panelist has volunteered to have all his cross-platform TV/ video consumption measured. He starts to watch a show on television, which has been encoded with a Content ID, and halfway through the show, he switches to streaming it digitally on his tablet, using his headphones for audio. The tablet has an app open for digital measurement that can track the remainder of the show, and add it into the duration from the initial TV measurement. If both shows have the same EIDR code and time codes, the viewing could be added together for the same individual.

### **7.3 Hybrid measurement of ad exposure across linear TV channels**

An advertiser has a 30 second spot that is airing in a campaign across a number of linear cable and broadcast networks and VOD. The ad contains an Ad-ID Code, so its playout can be detected by devices such as a set-top box, streaming device, game system or Smart TV to enable a census count of ad exposures across all networks. Additionally, it can be detected by a panelist in an audience measurement panel that is carrying a device to detect playout. These datasets can be combined using timestamps and Ad-ID Codes, so that the Return Path Data and VOD data provide the volume of exposure (total usage) and the panel provides demographics and de-duplication (audience characteristics of users).

#### 7.4 Measuring ad exposure across TV and digital platforms

A panelist in a cross-media measurement panel watches TV for 2 hours on Monday evening across three channels. He sees Advertiser A's 30 second spot a total of four times during this time across different networks. During this time, he also goes online on his tablet, and watches a short sports clip of a goal in a soccer game. There is a 15 second pre-roll ad for the same product. His 15 year old son then watches the same clip several times on the tablet, and sees this ad several more times. Then, Joe also goes online on his smart phone and watches a short news clip that contains the same 15 second pre-roll ad for the same product. An advertiser needs to add up all these instances of 15 and 30 second spots for the same product to determine unduplicated reach and frequency for individuals and households, and also to separate the digital-only viewing by other household members. Ad-ID codes in the OBID can help to link the data across linear TV and digital devices, while the OBID-TLC timestamp and Distribution Channel IDs can identify the source of each exposure instance.

### 8 Privacy

Audience measurement necessarily involves the collection of data about individuals' viewing. As such, it may be subject to data privacy regulations. These regulations differ widely among countries and regions, and may be expected to change over time. While panel methods rely on volunteers who opt into collection of this data, census methods do not. Discussion of all of the implications of data privacy regulations is outside the scope of this document. However, it is necessary that implementers of audience measurement systems be aware that such regulations exist and can be expected to change over time, and that penalties for non-compliance can be severe.

## **Bibliography**

ATSC A/52:2018: Digital Audio Compression (AC-3) (E-AC-3) Standard