



ATSC

ADVANCED TELEVISION
SYSTEMS COMMITTEE

ATSC Recommended Practice: Digital Rights Management (DRM)

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Revision History

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Table of Contents

1. SCOPE	5
1.1 Introduction and Background	5
1.2 Organization	5
2. REFERENCES	5
2.1 Informative References	5
3. DEFINITION OF TERMS	6
3.1 Compliance Notation	6
3.2 Treatment of Syntactic Elements	6
3.2.1 Reserved Elements	6
3.3 Acronyms and Abbreviations	7
3.4 Terms	8
4. SYSTEM OVERVIEW	8
4.1 MPEG Common Encryption (CENC)	8
4.1.1 Introduction	8
4.1.2 CENC Overview	8
4.2 W3C Encrypted Media Extensions (EME) Overview	9
4.3 A/344 Encrypted Media Extensions (EME) Overview	10
5. ROUTE/DASH CLIENT PROCESSING FOR CENC AND DRM OPERATION API	11
5.1 Introduction	11
5.2 Basic CENC Operation in ROUTE/DASH	11
5.3 MPD Support for Encryption and DRM Signaling	12
5.3.1 Overview	12
5.3.2 Use of the Content Protection Descriptor for mp4 Protection Scheme	12
5.3.3 Use of Content Protection Descriptor for uuid Scheme	12
5.3.4 Protection System Specific Header Box in the MPD	13
5.3.5 Use of License Acquisition URL Descriptor in the MPD	13
5.4 Solution Framework for DRM and CENC	14
5.5 Use of A/344 APIs	14
5.5.1 Notifications for License Request	16
5.5.2 Provide a License	16
5.5.3 Generate a License Request	17
5.5.4 Notifications for Provisioning Request	18
5.5.5 Notifications for Server Certificate Request	19
5.5.6 Error Codes	20
ANNEX A LICENSE ACQUISITIONS EXAMPLES	21
A.1 License acquisition – Broadcast Application, connected	21
A.2 License acquisition – Receiver Application, connected	23
A.3 License acquisition – Receiver Application, unconnected	25
A.4 License acquisition – Broadcast Application, unconnected	27
ANNEX B SIGNALING EXAMPLES	29
B.1 Service is “Protected”	29

Index of Figures and Tables

Figure 4-1 Encrypted Media Extensions workflow.....	10
Figure 4-2 A/344 Web Socket workflow.....	11
Figure A-1 License acquisition – Broadcast Application, connected.....	21
Figure A-2 License acquisition - Receiver Application, connected.	23
Figure A-3 License acquisition – Receiver Application, unconnected.....	25
Figure A-4 License acquisition – Broadcast Application, unconnected.....	27

ATSC Recommended Practice: Digital Rights Management (DRM)

1. SCOPE

This Recommended Practice provides best industry practices for implementers of A/360 [11] and the security and content protection provisions of A/344 [12].

1.1 Introduction and Background

This document is a collection of material that was previously located in A/344 and A/360, and then published in Technology Group Report, “DRM Guidelines”. This RP supersedes and replaces that document.

1.2 Organization

This document is organized as follows:

- Section 1 – Outlines the scope of this document and provides a general introduction.
- Section 2 – Lists references and applicable documents.
- Section 3 – Provides a definition of terms, acronyms, and abbreviations for this document.
- Section 4 – System overview
- Section 5 – ROUTE/DASH client processing
- Annex A – Example message flows
- Annex B – Example SLT

2. REFERENCES

All referenced documents are subject to revision. Users of this Standard are cautioned that newer editions might or might not be compatible.

2.1 Informative References

The following documents contain information that may be helpful in applying this Standard.

- [1] IEEE: “Use of the International Systems of Units (SI): The Modern Metric System,” Doc. SI 10, Institute of Electrical and Electronics Engineers, New York, N.Y.
- [2] ISO/IEC: ISO/IEC 23001-7:2016, “Information technology — MPEG systems technologies — Part 7: Common encryption in ISO base media file format files.”
- [3] W3C: “Encrypted Media Extensions,” W3C Recommendation 18 September 2017, World Wide Web Consortium, <https://www.w3.org/TR/encrypted-media> ; a newer work in process is available at: <https://w3c.github.io/encrypted-media/>.
- [4] W3C: “Media Source Extensions”, W3C Recommendation 17 November 2016, World Wide Web Consortium, <https://www.w3.org/TR/media-source>.
- [5] DASH-IF: “Guidelines for Implementation: DASH-IF Interoperability Points for ATSC 3.0”, Version 1.1, DASH Industry Forum, Beaverton, OR, 12 June 2018.
- [6] ATSC: “ATSC Standard: Signaling, Delivery, Synchronization and Error Protection,” Doc. A/331:2019, Advanced Television System Committee, Washington, D.C., 20 June 2019.
- [7] ISO/IEC: “Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 1: MPEG media transport (MMT),” Doc. ISO/IEC

- 23008-1:2017(E), International Organization for Standardization/ International Electrotechnical Commission, Geneva Switzerland.
- [8] DASH-IF: “Guidelines for Implementation: DASH-IF Interoperability Points”, Version 4.2, DASH Industry Forum, Beaverton, OR, 9 April 2019.
- [9] DASH-IF: “Guidelines for Implementation: DASH-IF Interoperability Points”, [Working Draft](#) Version 5, DASH Industry Forum, Beaverton, OR.(work in process)
- [10] ISO/IEC: “ISO/IEC 23009–1:2019, Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats,” International Organization for Standardization, Geneva, 3rd Edition, 12 August 2019.
- [11] ATSC: “Security and Service Protection”, Doc. A/360:2019, Advanced Television System Committee, Washington, D.C., 20 August 2019.
- [12] ATSC: “Interactive Content”, Doc. A/344:2019, Advanced Television System Committee, Washington, D.C., 2 May 2019. Amendment No.1, 29 July 2019, Amendment No. 4, [date], Amendment No. 10, [date] <https://members.atsc.org/apps/org/workgroup/s38/download.php/61569/S38-128r0-A344-WD-AMD-RMP-State.docx>.
- [13] ISO/IEC: “ISO/IEC 14496-12:2015, “Information technology — Coding of audio-visual objects – Part 12: ISO base media file format,” International Organization for Standardization, Geneva, 5th Edition, 15 December 2015.
- [14] ATSC: “Technology Group Report: DRM Guidelines”, Advanced Television System Committee, Washington, D.C., 12-March-2019 <https://www.atsc.org/standards/other-technical-documents/>

3. DEFINITION OF TERMS

With respect to definition of terms, abbreviations, and units, the practice of the Institute of Electrical and Electronics Engineers (IEEE) as outlined in the Institute’s published standards [1] should be used. Where an abbreviation is not covered by IEEE practice or industry practice differs from IEEE practice, the abbreviation in question will be described in Section 3.3 of this document.

3.1 Compliance Notation

This section defines compliance terms for use by this document:

should – This word indicates that a certain course of action is preferred but not necessarily required.

should not – This phrase means a certain possibility or course of action is undesirable but not prohibited.

3.2 Treatment of Syntactic Elements

This document contains symbolic references to syntactic elements used in the audio, video, and transport coding subsystems. These references are typographically distinguished by the use of a different font (e.g., `restricted`), may contain the underscore character (e.g., `sequence_end_code`) and may consist of character strings that are not English words (e.g., `dynrng`).

3.2.1 Reserved Elements

One or more reserved bits, symbols, fields, or ranges of values (i.e., elements) may be present in this document. These are used primarily to enable adding new values to a syntactical structure

without altering its syntax or causing a problem with backwards compatibility, but they also can be used for other reasons.

The ATSC default value for reserved bits is ‘1’. There is no default value for other reserved elements. Use of reserved elements except as defined in ATSC Standards or by an industry standards-setting body is not permitted. See individual element semantics for mandatory settings and any additional use constraints. As currently-reserved elements may be assigned values and meanings in future versions of this Standard, receiving devices built to this version are expected to ignore all values appearing in currently-reserved elements to avoid possible future failure to function as intended.

3.3 Acronyms and Abbreviations

The following acronyms and abbreviations are used within this document.

AMP	Application Media Player
ATSC	Advanced Television Systems Committee
BMFF	Base Media File Format
CDM	Content Decryption Module
CENC	Common Encryption
CID	Content Identifier
DASH	Dynamic Adaptive Streaming over HTTP
DRM	Digital Rights Management
EME	Encrypted Media Extensions
HEVC	High Efficiency Video Codec
HTML	Hypertext Markup Language
IEC	International Electrotechnical Commission
IF	Industry Forum
IOP	InterOperability Points
ISO	International Organization for Standardization
IV	Initialization Vector
KID	Key ID
MPD	Media Presentation Description
MPEG	Moving Picture Experts Group
NAL	Network Abstraction Layer
RMP	Receiver Media Player
ROUTE	Real-Time Object Delivery over Unidirectional Transport
SHVC	Scalable HEVC
SLT	Service List Table
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
UUID	Universal Unique Identifier
VOD	Video on Demand
W3C	World Wide Web Consortium

3.4 Terms

The following terms are used within this document.

Broadcast Application – As defined in ATSC A/344 [12].

reserved – Set aside for future use by a Standard.

4. SYSTEM OVERVIEW

This is a Recommended Practice that mainly addresses DRM operation covering ATSC3 ROUTE/DASH (A/331 [6]) and Interactive Content (A/344 [12]). ATSC constrains DRM technology through the DASH-IF ATSC IOP [5], which relies on the core DASH-IF IOP [8], which in turn relies on various ISO MPEG standards, notably including DASH [10] and Common Encryption [2]. References are generally made to the most constrained document (DASH-IF). However, readers will need all the above documents to understand this RP.

This section provides an overview of MPEG Common Encryption (CENC), W3C Encrypted Media Extensions (EME) and A/344 applicable APIs, which are essential to DRM operation on AMP and RMP respectively.

4.1 MPEG Common Encryption (CENC)

4.1.1 Introduction

Encryption, including the use of DRM systems, is addressed in DASH-IF ATSC IOP [5] Section 7, which relies on the core DASH-IF IOP [8] Section 7. This work is all based on MPEG Common Encryption defined in ISO 23001-7 [2] (“CENC”).

4.1.2 CENC Overview

The CENC protection scheme specifies encryption parameters that can be applied by a scrambling system, along with key mapping methods via common key identifier (KID). KIDs are for use by multiple DRM systems, such that the same encrypted version of a file can be decrypted by different DRM systems. The licensing and key acquisition is generally via proprietary information stored in metadata boxes of the ISO BMFF Segments – specifically, the Protection System Specific Header Box (‘pssh’).

The key advantage of CENC is that by providing a common way to encrypt content, it decouples the content encryption from the licensing and key acquisition and thus provides support for multiple DRM systems.

The CENC mechanism only encrypts media samples or parts thereof and leaves the ISO BMFF metadata such as the file and track structure boxes un-encrypted to enable players to recognize and read the file correctly and acquire any required license. CENC supports the encryption of NAL-based video encoding formats such as HEVC, thus offering sub-sample encryption capability, where only the video data of a sub-sample is encrypted, while the NAL header is not. This flexibility can be used to offer a free preview of the video, enable editing and processing of the video, or provide free access to some service components such as audio. By providing offsets to the encrypted byte ranges inside a sample in an ISO BMFF ‘mdat’ box, players can easily process the file and pass the encrypted chunks to the decryption module for decryption and playback.

For decryption to work, CENC provides the following information in the ISO BMFF (Note that more commonly everything needed for decryption is (also) signaled in the MPD. See Section 5.3.):

- **Key Identifiers (KID):** A key ID must be associated with every encrypted sample in a track even in the case that a single key is used for the whole track.

- Initialization Vectors (IV): The IV, a random number used to initialize an encryption function, is used for randomization and removal of semantics and is essential for strong protection. For every sample, the IV must be known in order to be able to construct the decryption key.
- License Acquisition Information: Information about license acquisition includes some common signaling and some aspects that are specific to each DRM system. The player needs to support at least one of the DRM systems that offer access to the encrypted tracks.

CENC defines a way to store the previous information in the ISO BMFF. The Key Identifiers may be provided:

- as opaque data in the DRM-specific content protection header, ‘pssh’,
- as the default_kid in the track encryption box ‘tenc’, when a single key applies to the whole track,
- as content protection elements in the MPD, or
- as a key for a set of samples that share the same encryption key, provided in a sample grouping structure using the sample group description box ‘sgpd’.

The IV for every sample is provided as part of the sample auxiliary information in the ‘mdat’ box or in the ‘senc’ box together with information about the position of the encrypted chunks.

The license acquisition information is provided as part of the protection system specific header box ‘pssh’, where each DRM system is identified by a SystemID. The ‘pssh’ box also provides a list of the provided Key Identifiers and opaque system-specific information that enables the acquisition of the keys identified by the supported key ids. For more information on license acquisition, see Section 5.

4.2 W3C Encrypted Media Extensions (EME) Overview

This section is specific to the Application Media Player (AMP) and does not necessarily apply to the Receiver Media Player (RMP). See A/344 [12] Section 7.

W3C Encrypted Media Extensions (EME) [3] specifies JavaScript APIs that enable a web application to facilitate the exchange of decryption keys. This is an interface between a device-resident DRM system agent, referred to as the Content Decryption Module (CDM), and a key source or license server located somewhere on the network. EME is based on the HTML5 Media Source Extensions (MSE) specification [4], which enables adaptive bitrate streaming in HTML5 using DASH-IF ATSC IOP [5] with MPEG-CENC (Common Encryption) [2] protected content. The architecture of EME is illustrated in Figure 4-1, which depicts the primary interactions of the EME workflow between the functional entities involved in the detection of encrypted content and the subsequent acquisition of license and key material, to enable content decryption and playout.

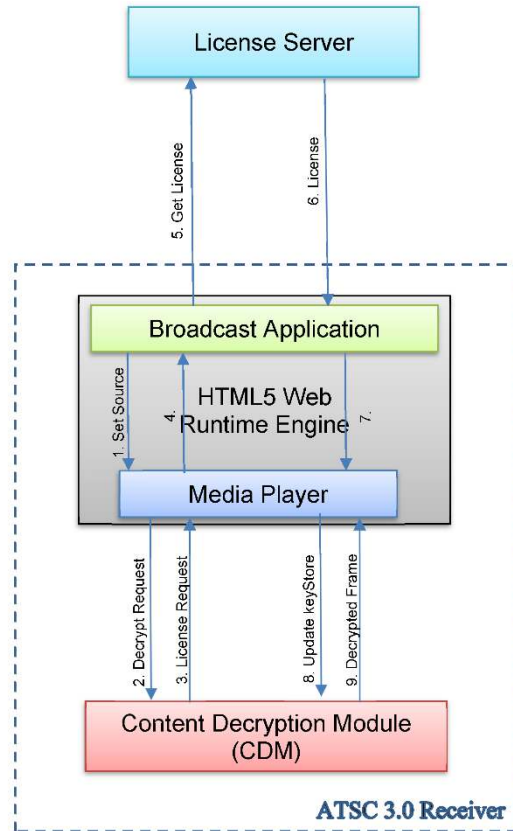


Figure 4-1 Encrypted Media Extensions workflow.

The principal objects in EME are `MediaKeySession` and `MediaKeys`. The Broadcast Application creates a `MediaKeySession` object, which represents the lifetime of a license and its key(s), by calling `createSession()` on the `MediaKeys` object. The Broadcast Application initiates the request for a license by passing the media data obtained in the encrypted event handler to the CDM. In turn, the CDM for the selected DRM system will generate a data blob (license request) and deliver it back to the app, which will then send that request to the license server. The returned license from the server is then passed by the Broadcast Application to the CDM, by using the `update()` method of the `MediaKeySession`. The CDM and/or the browser will use keys stored in the key session to decrypt media samples as they are encountered. The CDM may be either embedded in the web browser, or run in a trusted environment, depending on the required level of security, in passing the decrypted frames to a decoder.

4.3 A/344 Encrypted Media Extensions (EME) Overview

This section is specific to the Receiver Media Player (RMP) and does not necessarily apply to the Application Media Player (AMP). See A/344 [12] Section 7.

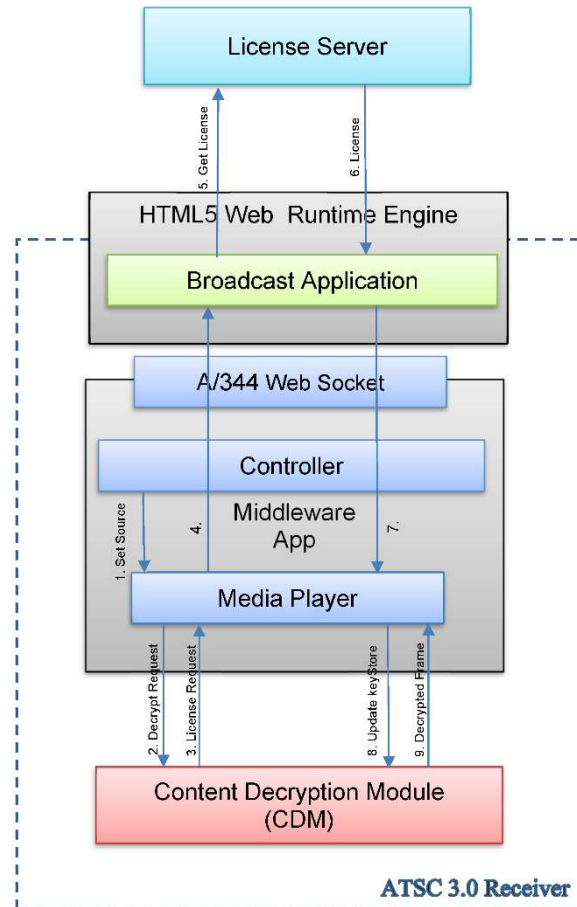


Figure 4-2 A/344 Web Socket workflow.

5. ROUTE/DASH CLIENT PROCESSING FOR CENC AND DRM OPERATION API

5.1 Introduction

This section describes the operation of a ROUTE/DASH receiver when accessing CENC-protected media. ROUTE/DASH supports the Common Encryption (CENC) framework for multiple DRM systems to protect DASH ISO BMFF-formatted content. ROUTE/DASH includes protection system specific and proprietary signaling information delivered in two ways:

- in the MPD, or
- carried in-band in designated metadata boxes of the ISO BMFF Segments.

The former is common today and is preferred; and the latter is required by CENC.

5.2 Basic CENC Operation in ROUTE/DASH

This section describes the basic mechanisms of how DASH-formatted streaming content, protected by a DRM system and delivered by the ROUTE protocol, can be decrypted and played out. It describes, in the context of CENC and A/344 Web Socket APIs, the required interactions within the receiver and between the receiver and a Broadcast Application and/or a license server, for license and key acquisition and subsequent content decryption and payout.

In the first (see Section A.1), acquisition of the DRM license and content key by the CDM occurs during the program delivery via a Broadcast Application for a connected receiver.

In the second method (see Section A.2), acquisition of the DRM license and content key by the CDM occurs during the program delivery via the connected receiver.

In the third method (see Section A.3), acquisition of the DRM license and content key by the CDM occurs during the program delivery via an unconnected receiver.

In the fourth method (see Section A.4), acquisition of the DRM license and content key by the CDM occurs during the program delivery via a Broadcast Application for an unconnected receiver.

5.3 MPD Support for Encryption and DRM Signaling

5.3.1 Overview

In addition to the ISO BMFF signaling of DRM-related items, these items are also commonly included in the MPD (and should be), which provides more timely delivery and faster decoding. This starts with the **ContentProtection** element which is typically on the **AdaptationSet** element. There is one of these per DRM system, which may include generic CENC signaling as defined in CENC [2]. Within the **ContentProtection** element, there may be standardized license acquisition URL element (see DASH-IF IOP [9] Section 7.6.2.4 **Laur1**); a mechanism for identifying the content to the DRM system, e.g. “content ID” (beyond **AssetIdentifier**); as well as DRM system-specific elements.

5.3.2 Use of the Content Protection Descriptor for mp4 Protection Scheme

As described in DASH-IF IOP, a **ContentProtection** descriptor with @schemeIdUri value of "urn:mpeg:dash:mp4protection:2011" indicates that the content is encrypted with the scheme as indicated in the @value attribute. The file structure of content protection schemes is specified in MPEG-DASH [10], Section 5.8.5.2, and the @value is ‘cenc’ in denoting the Common Encryption scheme. Such value for the @schemeIdUri of the **ContentProtection** descriptor along with @cenc:default_KID as defined within the “urn:mpeg:cenc:2013” extension namespace may be sufficient for the receiver to acquire a DRM license, or identify a previously acquired license that can be used to decrypt the Adaptation Set.

When the @cenc:default_KID is present for each Adaptation Set, it allows a player to determine if a new license needs to be acquired for each Adaptation Set by comparing their **default_KIDs** with each other, and with the **default_KIDs** of stored licenses. A player can simply compare these KID strings and determine what unique licenses are necessary without interpreting license information specific to each DRM system.

5.3.3 Use of Content Protection Descriptor for uuid Scheme

A UUID **ContentProtection** descriptor in the MPD may indicate the availability of a particular DRM scheme for license acquisition. An example is shown below:

```
<ContentProtection
  schemeIdUri="urn:uuid:xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx"
  value="DRMNAME version"/>
```

The schemeIdUri uses a UUID URN with the UUID string equal to the registered SystemID for a particular DRM system which can be found in the DASH identifier repository at: https://dashif.org/identifiers/content_protection/.

5.3.4 Protection System Specific Header Box in the MPD

A ‘pssh’ box is defined by each DRM system for use with their registered SystemID, and is nominally stored in the movie box (‘moov’) and additionally may be present in the movie fragment box (‘moof’). The same box should be stored in the MPD within a **ContentProtection** Descriptor for a UUID scheme using the extension element **cenc:pssh** in the "urn:mpeg:cenc:2013" namespace, as defined by ISO/IEC 23001-7 [2]. Carrying the **cenc:pssh** element and also the **cenc:default_KID** attribute as defined by the same "urn:mpeg:cenc:2013" extension namespace in the MPD can be useful in supporting key identification, license evaluation, and license retrieval before the availability of Initialization Segments for live content. This enables ATSC receivers, via the broadband network, to be able to acquire license requests prior to the start of the program. Also, spreading out license requests over time avoids potential overloading of the license server due to a high volume of simultaneous license requests from many viewers, starting when an Initialization Segment containing license acquisition information in ‘pssh’ becomes available. With **cenc:default_KID** indicated in the mp4protection **ContentProtection** descriptor for each Adaptation Set, the DRM client in the receiver can determine whether:

- the associated decryption key for the program is available to the viewer (e.g., without purchase or subscription),
- the key has been downloaded, or
- which license the client may download before the @availabilityStartTime of the program, based on the default_KID of each Adaptation Set element selected.

5.3.5 Use of License Acquisition URL Descriptor in the MPD

A **Laur1** element may be added under the **ContentProtection** descriptor providing information for ATSC receivers to access the license server directly. An additional **licenseType** attribute is available defining the type of applicable license.

```
<dashif:Laur1 licenseType="license-1.0">https://license-
server.com/license</dashif:Laur1>
```

ATSC receivers may POST the license request data from the CDM to the License Server to return a valid license. The returned license shall be passed to the CDM for the protected content to be decrypted by the given DRM System.

Additional **Laur1** elements may be added under the **ContentProtection** descriptor to provide more than one method to retrieve a valid license. ATSC3 receivers should use the **licenseType** to differentiate the different types.

- **license-1.0** Direct license acquisition by ATSC3 receivers and the URI scheme is a valid endpoint for access.\

```
<dashif:Laur1 licenseType="license-1.0">https://license-
server.com/license</dashif:Laur1>
```

- **groupLicense-1.0** Provides a path for a group-based license. The URI may need to be parsed specific to that DRM System by the ATSC3 Receiver to access any local group licenses.

```
<dashif:Laur1 licenseType="groupLicense-1.0">file://groupLicense.lic
</dashif:Laur1>
```

- **contentId-1.0** Provides information for the DRM specific content identifier used to generate the KIDs. The URI should be parsed to extract relevant information using REST based notation.

```
<dashif:Laur1 licenseType="contentId-
1.0">file://contentId/superball2019</dashif:Laur1>
```

5.4 Solution Framework for DRM and CENC

ISO-IEC 23001-7 [2] represents the normative standard for common encryption in conjunction with ISO BMFF [13], and includes the following technology components used for DRM protection of streaming media carried by ROUTE/DASH:

- Common encryption of NAL structure video and other media with AES-128 CTR mode
- Support for decryption of individual Representations by one or more DRM systems
- Key rotation to enable the change of the content encryption keys over time
- Extension of the **ContentProtection** descriptor to enable the signaling of `default_KID` and ‘pssh’ parameters in the MPD

The primary DRM related signaling components and tools available for use in ROUTE/DASH are as follows:

- 1) The **ContentProtection** descriptor in the MPD which contains the URI for identifying the use of Common Encryption or specific DRM scheme(s) being used.
- 2) Parameters of the ‘tenc’ box, carried as part of protection scheme information in the movie box (‘moov’) of the Initialization Segment, which specify encryption parameters and `default_KID`. The `default_KID` information should also be carried out-of-band in the MPD.
- 3) Signaling of common encryption sample auxiliary information in the form of initialization vectors and subsample encryption ranges, if applicable, using the ‘senc’ box as defined in ISO/IEC 23001-7 [2], or via the `sampleAuxiliaryInformationSizesBox` (‘saiz’) and a `sampleAuxiliaryInformationOffsetsBox` (‘saio’).
- 4) ‘pssh’ license acquisition data or keys for each DRM system in a format that is protection system specific. ‘pssh’ may be stored in the Initialization Segment or in Media Segments. It should also be present in a **cenc:pssh** element in the MPD. Note that while the presence of **cenc:pssh** information in the MPD increases the MPD size, it may allow faster parsing, earlier access, and addition of DRM systems without content modification.
- 5) Key rotation to enable modification over time in the entitlement for access to continuous live content. Details on how key rotation operates in the protection of broadcast DASH streaming content can be found in the DASH-IF IOP [8] Section 7.5, DASH_IF ATSC IOP [5] Section 7.4.

5.5 Use of A/344 APIs

This section describes how the DRM APIs defined in Section 9.15 of [12] are profiled to align with W3C EME APIs, however limiting the number of returned journeys.

The key/value pairs used in the proprietary message structure should provide some minimum information, that a Broadcast Application will be required in order to handle the DRM services.

```
<-- Notification
{
  "jsonrpc": "2.0",
  "method": "org.atsc.notify",
  "params": {
    "msgType": "DRM",
```

```

    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{"<proprietary>":"<proprietary>"}]
  }
}

```

Application Request

```

--> {
  "jsonrpc": "2.0",
  "method": "org.atsc.drmOperation",
  "params": {
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{"<proprietary>":"<proprietary>"}]
  }
  "id": 101
}

```

Below provides a minimum set of core pairs that are required to manage DRM message handling.

```

"message": [{
  "kid": "34e5db32-8625-47cd-ba06-68fca0655a72",
  "drmSessionId": "MzRlNWRiMzItODYyNS00N2NkLWJhMDYtNjhmY2EwNjU1YTcy",
  "drmMsgType": "<array_of_message_types>",
  "drmData": "base64-private-data",
}]

```

The `kid` pair should provide the information relating to the adaptation the notification relates to. Broadcast Applications may use this value to determine further track information from the MPD and how the Broadcast Application should handle the request.

The `drmSessionId` is an optional pair that may be provided by the ATSC3 receiver, so reciprocal responses shall contain the same `drmSessionId` value in order to pair requests and responses together for the receiver.

The `drmMsgType` provides the type of message the `drmData` relates to and therefore how the Broadcast Application should react to the DRM Message Type. Further information on the different supported types is detailed in the sub-sections below but summarized here for convenience.

- `licenseRequest`
- `update`
- `generateRequest`
- `individualizationRequest`
- `individualizationResponse`
- `serverCertificateRequest`
- `serverCertificateResponse`

The `drmData` is a base64 encoded data format from the underlying DRM System. This provides the ability for the `drmData` to be transferred to license servers for processing.

Table 8.2 “JSON_RPC ATSC error Codes” of [12] defines a list of reserved error codes. The range of -32000 to -32099 is reserved for implementation-defined server errors and should be

specific for the Content Protection system being used; however there are some generic error codes that should be used. These are defined in Section 5.5.6.

5.5.1 Notifications for License Request

The `drmMsgType` should have a value from the CDM that contains the `licenseRequest` information for the specific `keyId`. It is recommended that a single notification per `keyId` is raised for each `AdaptationSet` set to the Media Player.

```
<-- Notification
{
  "jsonrpc": "2.0",
  "method": "org.atsc.notify",
  "params": {
    "msgType": "DRM",
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "kid": "34e5db32-8625-47cd-ba06-68fca0655a72",
      "drmSessionId": "MzRlNWRiMzItODYyNS00N2NkLWJhMDYtNjhmY2EwNjU1YTcy",
      "drmMsgType": "licenseRequest",
      "drmData": "....."
    }]
  }
}
```

One example is an MPD containing three adaptations, a Video and two Audio adaptations. The default Audio and Video is set to the Media Player, therefore two `licenseRequest` notifications are raised by the ATSC3 Receiver. If the second Audio is set to the Media Player, a new notification should be issued if it contains encrypted content, where the CDM does not find an applicable license.

Another example of when new notifications should be issued, is when an MPD period ends and a new period starts, or that the MPD changes and no licenses are found by the CDM.

ATSC3 receivers may hold a notification until a Broadcast Application has been loaded and subscribed to DRM notifications and then issue the notification.

5.5.2 Provide a License

A Broadcast Application should use the `licenseRequest` data to retrieve a valid license from the license server. The Broadcast Application may use the `Laur1` element where the `licenseType` has a value of `contentId-1.0`. The content identifier may be more useful to retrieve a license for all the supported adaptations, thus only making a single HTTPS call to the license service. The Broadcast Application should return the same license for each notification received if the `kid` is applicable to the same content identifier.

The Broadcast Application should use the `org.atsc.drmOperation` API and set the `drmMsgType` to `update` and place the base64 encoded license message into the `drmData` element.


```
--> Application Request
```

```
{
  "jsonrpc": "2.0",
  "method": "org.atsc.drmOperation",
  "params": {
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "kid": "34e5db32-8625-47cd-ba06-68fca0655a72",
      "drmSessionId": "MzRlNWRiMzItODYyNS00N2NkLWJhMDYtNjhmY2EwNjU1YTcy",
      "drmMsgType": "update",
      "drmData": "<base65-encoded-licenseMessage>"
    }]
  },
  "id": 100
}
```

```
<-- Successful Response
```

```
{
  "jsonrpc": "2.0",
  "result": {},
  "id": 100
}
```

```
<-- unsuccessful Response
```

```
{
  "jsonrpc": "2.0",
  "error": {
    "code": -TBD,
    "message": "invalid license"
  },
  "id": 100
}
```

5.5.3 Generate a License Request

There are use cases where additional **AdaptationSets** require a different license. These examples may require additional authorization. A Broadcast Application should read the MPD and extract the PSSH of the required track and request to the ATSC receiver to generate request. The response should be no different than that of a normal notification.

```
--> Application Request
```

```
{
  "jsonrpc": "2.0",
  "method": "org.atsc.drmOperation",
  "params": {
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "kid": "34e5db32-8625-47cd-ba06-68fca0655a72",
      "drmMsgType": "generateRequest",
      "drmData": "<base64-encoded-psshData>"
    }]
  },
  "id": 100
}
```

```

    "id": 101
  }

<-- Response

{
  "jsonrpc": "2.0",
  "result": {
    "message": [{
      "kid": "34e5db32-8625-47cd-ba06-68fca0655a72",
      "drmSessionId": "MzRlNWRiMzItODYyNS00N2NkLWJhMDYtNjhmY2EwNjU1YTcy",
      "drmMsgType": "licenseRequest",
      "drmData": "....."
    }]
  },
  "id": 101
}

```

5.5.4 Notifications for Provisioning Request

Most DRM systems require unique device provisioning or certificates. For some systems, this is carried out in the factory or online. The example below shows how a provisioning request notification may be sent to the Broadcast Application for the ATSC3 receiver to be provisioned.

```

<-- Notification

{
  "jsonrpc": "2.0",
  "method": "org.atsc.notify",
  "params": {
    "msgType": "DRM",
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "drmMsgType": "individualizationRequest",
      "drmData": "<base64-encoded-individualization-data-request"
    }]
  }
}

```

When a provisioning request is sent to a server, the server should respond with a unique provisioning response. The response should be posted back to the ATSC3 receiver as shown below to complete the process.

```

Application Method

--> {
  "jsonrpc": "2.0",
  "method": "org.atsc.drmOperation",
  "params": {
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "drmMsgType": "individualizationResponse",
      "drmData": "<base64-encoded-provisioning-response>"
    }]
  },
}

```

```

    "id": 101
  }

<-- Response

{
  "jsonrpc": "2.0",
  "result": {},
  "id": 101
}

```

An ATSC3 receiver once provisioned should either raise a [serverCertificateRequest](#) or a [licenseRequest](#) notification to continue the process that triggered the provisioning request in the first place.

5.5.5 Notifications for Server Certificate Request

An additional layer that a receiver may support is server certificate as defined in [3] that provides an additional layer of protection between the ATSC3 Receiver and the CDM. If supported by a receiver, then the method outlined below should apply.

```

<-- Notification

{
  "jsonrpc": "2.0",
  "method": "org.atsc.notify",
  "params": {
    "msgType": "DRM",
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "drmMsgType": "serverCertificateRequest",
      "drmData": "<base64-encoded-serverCertificate-data-request"
    }]
  }
}

```

The **serverCertificate** request sent to a server, should respond with a **serverCertificateResponse** response. The response should be posted back to the ATSC3 receiver as shown below to complete the process.

Application Method

```

--> {
  "jsonrpc": "2.0",
  "method": "org.atsc.drmOperation",
  "params": {
    "systemId": "urn:uuid:1077efec-c0b2-4d02-ace3-3c1e52e2fb4b",
    "service": "http://doi.org/10.5239/8A23-2B0",
    "message": [{
      "drmMsgType": "serverCertificateResponse",
      "drmData": "<base64-encoded-serverCertificate-response>"
    }]
  },
  "id": 101
}

```

<-- Response

```
{  
  "jsonrpc": "2.0",  
  "result": {},  
  "id": 101  
}
```

5.5.6 Error Codes

See A/344 Table 8.2 JSON-RPC ATSC Error Codes [12].

Annex A License Acquisitions Examples

A.1 LICENSE ACQUISITION – BROADCAST APPLICATION, CONNECTED

Figure A-1 is an example message flow illustrating the method whereby the **ContentProtection** descriptor in the MPD is used to provide the affiliated metadata, such as the default KID to the CDM. This triggers the CDM to request and obtain the DRM license, and associated keys material.

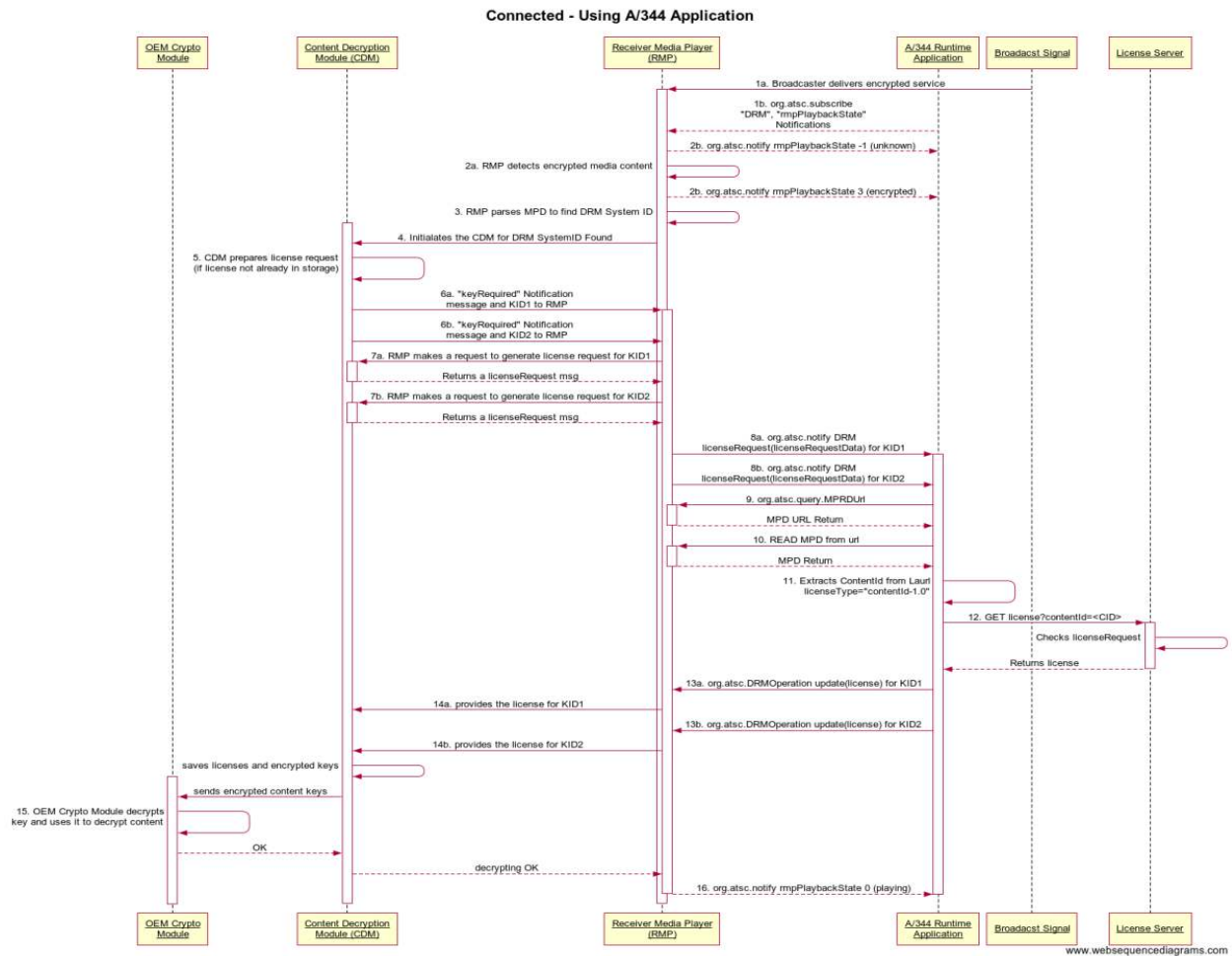


Figure A-1 License acquisition – Broadcast Application, connected.

- 1) A user selects a Service with encrypted audio and video. A Broadcast Application is also present in the definition of the Service, and the Receiver downloads and executes it when the package containing it has been retrieved and validated.
- 2) The RMP discovers the service is encrypted and sets rmpPlaybackStateChange to 3.

- 3) The RMP parses the MPD in the Service Layer Signaling (SLS), specifically the **ContentProtection** element, to discover whether or not it lists a DRM System ID that the RMP supports. If one is found, then processing continues.
- 4) The RMP initiates the relevant CDM for the given DRM System ID.
- 5) The Content Decryption Module (CDM) in the Receiver associated with the DRM System ID checks to see whether the license key required to decrypt the video and audio is already in storage. In this example, the CDM determines that no pre-existing license for this content is available and prepares a license request for the key.
- 6) The CDM notifies the RMP that a key is required for the KID1 and KID2.
- 7) The RMP player needs a valid license request message from the CDM for both KID1 and KID2 to forward on to the Broadcast Application.
- 8) The RMP notifies the Broadcast Application using the DRM Notification API, passing the DRM system ID and a message understood by Broadcast Applications which support that system ID. The message in the notification would typically include the Key ID associated with this content, and a request for a license.
- 9) The Broadcast Application requires the content identifier associated with the KID1 and KID2 contained in the MPD. The Broadcast Application uses the `org.atsc.query.MPDUrl` to retrieve the location of the MPD.
- 10) The Broadcast Application reads the MPD from the URL provided by the receiver.
- 11) The Broadcast Application locates the elements containing the corresponding KID1 and reads the `licenseType=contentId-1.0` value from the `Laur1` element.

```
<dashif:Laur1 licenseType="contentId-1.0">
file://contentId/superball2019
</dashif:Laur1>
```
- 12) The Broadcast Application executes a process to retrieve a license for the requested content. This process involves interaction with the user, and interaction with a Web Server operated by the broadcaster and a License Server associated with the DRM system employed using the `contentId`. Interaction between the Broadcast Application and the License Server includes information the Broadcast Application needs to create a user interface to present to the user. The License Server determines that the user is entitled to access the requested content. The License Server delivers the license to the Broadcast Application using proprietary messaging.
- 13) The Broadcast Application issues the DRM Operation API with the DRM system ID and a message including the license for the content for each KID notification received by the RMP.
- 14) The RMP issues the license to the CDM for each of the KIDs.
- 15) The CDM receives the license, saves it, and uses it to derive the key needed to decrypt the content, sending that key to the OEM Crypto Module.
- 16) The OEM Crypto Module decrypts the enhancement layer and the user enjoys watching the service. The RMP player notifies the Broadcast Application with `rmpPlaybackStateChange` set to **0**.

A.2 LICENSE ACQUISITION – RECEIVER APPLICATION, CONNECTED

Figure A-2 is an example message flow illustrating the receiver retrieving the license from the license server directly using the details contained in the `Laur1`.

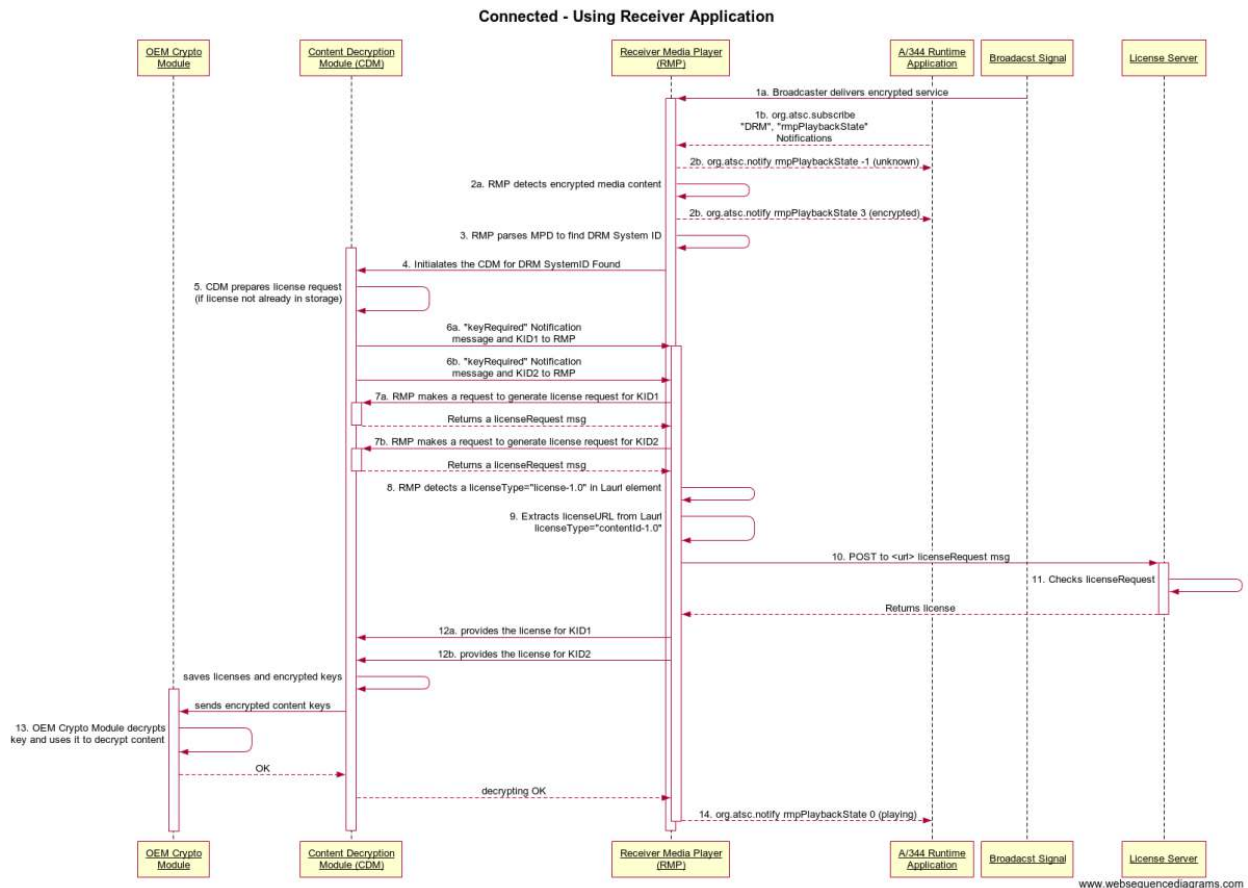


Figure A-2 License acquisition - Receiver Application, connected.

- 1) A user selects a Service with encrypted audio and video. A Broadcast Application is also present in the definition of the Service, and the Receiver downloads and executes it when the package containing it has been retrieved and validated.
- 2) The RMP discovers the service is encrypted and the RMP sets `mpPlaybackStateChange` to **3**.
- 3) The RMP parses the MPD in the Service Layer Signaling (SLS), specifically the **ContentProtection** element, to discover whether it lists a DRM System ID that the RMP supports. If one is found, then processing continues.
- 4) The RMP initiates the relevant CDM for the given DRM System ID.
- 5) The Content Decryption Module (CDM) in the Receiver associated with the DRM System ID checks to see whether the license key required to decrypt the video and audio is already in storage. In this example, the CDM determines that no pre-existing license for this content is available and prepares a license request for the key.
- 6) The CDM notifies the RMP that a key is required for the KID1 and KID2.

- 7) The RMP player needs a valid license request message from the CDM for both KID1 and KID2 to forward onto the Broadcast Application.
- 8) The RMP detects that the **licenseType**="license-1.0" is available and recognizes that a license can be fetched directly by the receiver.
- 9) The RMP extracts the URL value from the element.

```
<dashif:Laur1 licenseType="license-1.0">  
https://server.com:9873/getlicense?contentid=12345&token=abcd  
</dashif:Laur1>
```
- 10) The Broadcast Application executes a process to retrieve a license for the requested content. This process does not involve interaction with the user.
- 11) The License Server determines if the request is authentic. The License Server delivers the license to the Broadcast Application using proprietary messaging.
- 12) The RMP issues the license to the CDM for each of the KIDs.
- 13) The CDM receives the license, saves it, and uses it to derive the key needed to decrypt the content, sending that key to the OEM Crypto Module.
- 14) The OEM Crypto Module decrypts the enhancement layer and the user enjoys watching the service. The RMP player notifies the Broadcast Application with `rmpPlaybackStateChange` set to **0**.

A.3 LICENSE ACQUISITION – RECEIVER APPLICATION, UNCONNECTED

Figure A-3 is an example message flow illustrating the receiver retrieving the license locally on a receiver that is unconnected to the internet.

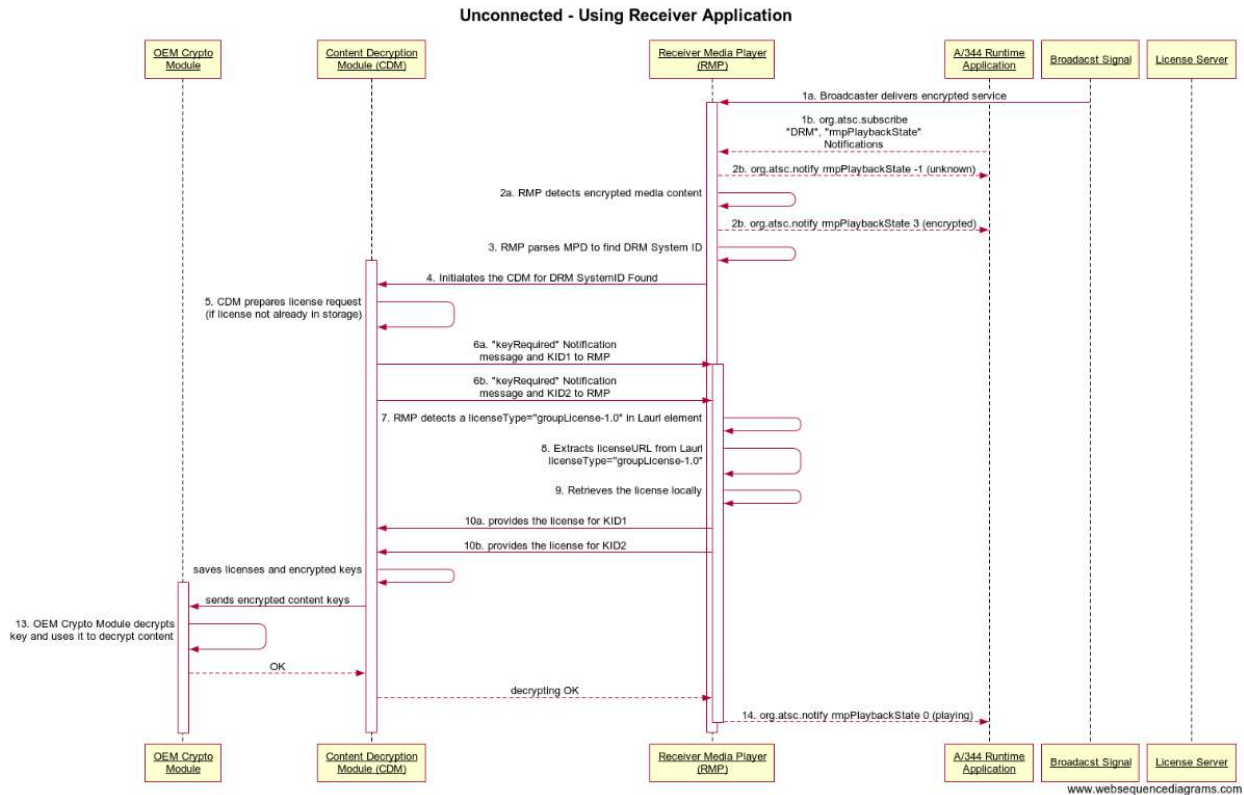


Figure A-3 License acquisition – Receiver Application, unconnected.

- 1) A user selects a Service with encrypted audio and video. A Broadcast Application is also present in the definition of the Service, and the Receiver downloads and executes it when the package containing it has been retrieved and validated.
- 2) The RMP sets `mpPlaybackStateChange` to `-1`. The RMP discovers the service is encrypted and sets `mpPlaybackStateChange` to `3`.
- 3) The RMP parses the MPD in the Service Layer Signaling (SLS), specifically the **ContentProtection** element, to discover whether or not it lists a DRM System ID that the RMP supports. If one is found, then processing continues.
- 4) The RMP initiates the relevant CDM for the given DRM System ID.
- 5) The Content Decryption Module (CDM) in the Receiver associated with the DRM System ID checks to see whether the license key required to decrypt the video and audio is already in storage. In this example, the CDM determines that no pre-existing license for this content is available and prepares a license request for the key.
- 6) The CDM notifies the RMP that a key is required for the KID1 and KID2.
- 7) The RMP detects that the `licenseType="groupLicense-1.0"` is available and recognizes that a license can be fetched locally by the receiver.
- 8) The RMP extracts the URL value from the element.

```
<dashif:Laur1 licenseType="groupLicense-1.0">  
File://atsc3-license.lic  
</dashif:Laur1>
```

- 9) The Broadcast Application locates the license locally. This process does not involve interaction with the user.
- 10) The RMP issues the license to the CDM for each of the KIDs.
- 11) The CDM receives the license, saves it, and uses it to derive the key needed to decrypt the content, sending that key to the OEM Crypto Module.
- 12) The OEM Crypto Module decrypts the enhancement layer and the user enjoys watching the service. The RMP player notifies the Broadcast Application with `rmpPlaybackStateChange` set to **0**.

A.4 LICENSE ACQUISITION – BROADCAST APPLICATION, UNCONNECTED

Figure A-4 is an example message flow illustrating the Broadcast Application attempting to retrieve the license from the license server directly using the details contained, however the receiver is not connected to the internet.

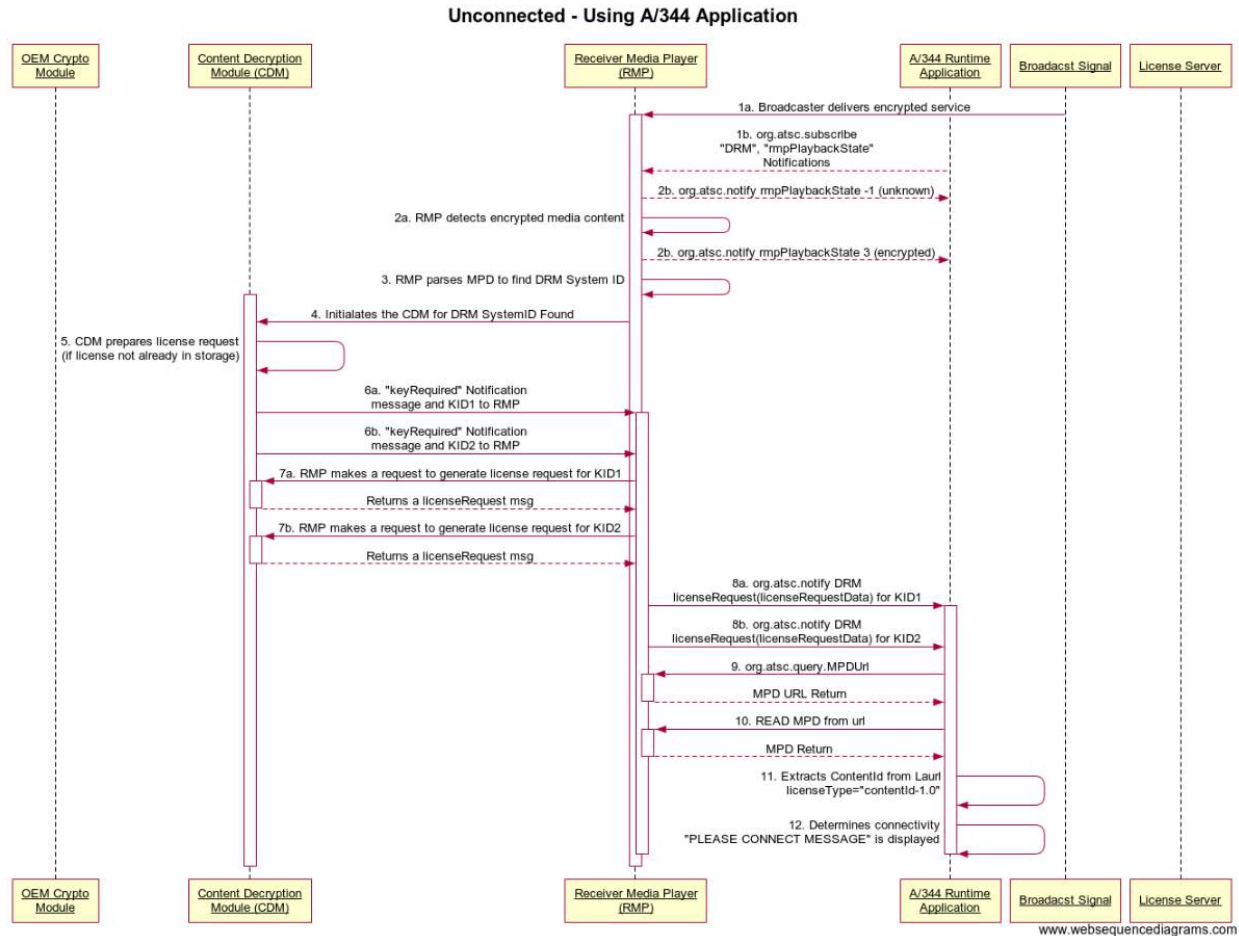


Figure A-4 License acquisition – Broadcast Application, unconnected.

- 1) A user selects a Service with encrypted audio and video. A Broadcast Application is also present in the definition of the Service, and the Receiver downloads and executes it when the package containing it has been retrieved and validated.
- 2) The RMP sets `rmpPlaybackStateChange` to `-1`. The RMP discovers the service is encrypted and sets `rmpPlaybackStateChange` to `3`.
- 3) The RMP parses the MPD in the Service Layer Signaling (SLS), specifically the **ContentProtection** element, to discover whether or not it lists a DRM System ID that the RMP supports. If one is found, then processing continues.
- 4) The RMP initiates the relevant CDM for the given DRM System ID.
- 5) The Content Decryption Module (CDM) in the Receiver associated with the DRM System ID checks to see whether the license key required to decrypt the video and audio is already in storage. In this example, the CDM determines that no pre-existing license for this content is available and prepares a license request for the key.

- 6) The CDM notifies the RMP that a key is required for the KID1 and KID2.
- 7) The RMP player needs a valid license request message from the CDM for both KID1 and KID2 to forward onto the Broadcast Application.
- 8) The RMP notifies the Broadcast Application using the DRM Notification API, passing the DRM system ID and a message understood by Broadcast Applications which support that system ID. The message in the notification would typically include the Key ID associated with this content, and a request for a license.
- 9) The Broadcast Application requires the content identifier associated with the KID1 and KID2 contained in the MPD. The Broadcast Application uses the `org.atsc.query.MPDUrl` to retrieve the location of the MPD.
- 10) The Broadcast Application reads the MPD from the url provided by the receiver.
- 11) The Broadcast Application locates the elements containing the corresponding KID1 and reads the `licenseType=contentId-1.0` value from the `Laur1` element.

```
<dashif:Laur1 licenseType="contentId-1.0">
file://contentId/superball12019
</dashif:Laur1>
```
- 12) The Broadcast Application determines it is not connected to the Internet. The Broadcast Application provides an additional message on why to connect to the internet in order to receive the provided service. The `rmpPlaybackState` remains with the value of **3**.

Annex B Signaling Examples

B.1 SERVICE IS “PROTECTED”

The SLT table of a given service shall have the protection attribute set to TRUE (see green highlight below). This provides an indication on whether a service has components which are encrypted either all or part of the time.

```
<?xml version="1.0" encoding="UTF-8"?>
<SLT
xmlns="tag:atsc.org,2016:XMLSchemas/ATSC3/Delivery/SLT/1.0/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="tag:atsc.org,2016:XMLSchemas/ATSC3/Delivery/SLT/1.0/ SLT-1.0-
20180228.xsd"
bsid="369"> <!-- 0x0171 -->
  <Service protected="true" majorChannelNo="14" minorChannelNo="5" serviceId="5"
globalServiceID="https://doi.org/10.5239/8A23-2B0B" sltSvcSeqNum="0"
serviceCategory="1" shortServiceName="KPBS-DT">
    <BroadcastSvcSignaling
slsSourceIpAddress="10.1.1.1"
slsDestinationUdpPort="8100" slsProtocol="1"
slsDestinationIpAddress="239.255.14.5"/>
  </Service>
</SLT>
```

– End of Document –