Device Specification

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Device Specification Version 1.0.7r2

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1 Document Description

1.1 Scope

This document specifies mandatory and optional features of DECE Devices; the features are operational when the Device joins a DECE Account via a domain-bound DRM Client.

The following features are outside the scope of this document, as they do not require a DECE-approved DRM Client or domain membership:

- Purchasing DECE content from on-line Retailers;
- Receiving streamed content from DECE services (LASP's);
- Burning DECE content to DVD or other discrete media.

1.2 Document Organization

This document is organized as follows:

1. Introduction—Provides background, scope and conventions
2. DECE Devices and DECE Ecosystem – Describes how DECE Devices interact with other elements of the Ecosystem
3. Communications – Internet communications and browser support
4. Adding and Removing Devices from Account
5. Content Rights Purchase
6. Container Fulfillment – process for locating DECE Common File Format (CFF) Containers (DCC) and downloading them
7. DRM License Acquisition
8. Playing Content – Device requirements and limitations on decoding and presenting media
9. User-Related Requirement – Additional user interface functions
10. DLNA – Information on DECE Devices interacting with Digital Living Network Alliance (DLNA) devices
11. DECE Media Package (DMP) Support – Describes Device requirements related to DMPs

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12. File Management – Information about placement and management of files

1.3 Document Notation and Conventions

Except where noted, notations and conventions are as per DECE Coordinator API Specification.

The following terms are used to specify conformance elements of this specification. These are adopted from the ISO/IEC Directives, Part 2, Annex H [ISO-P2H]. For more information, please see that work.

SHALL and SHALL NOT indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

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.

MAY and NEED NOT indicate a course of action permissible within the limits of the document.

Terms defined to have a specific meaning within this specification will be capitalized, e.g. “Track”, and should be interpreted with their general meaning if not capitalized. Normative key words are written in all caps, e.g. “SHALL”.

1.4 Normative References

1.4.1 DECE References

[DSystem]	System Specification
[DCoord]	Coordinator API Specification
[DMeta]	Content Metadata Specification
[DMedia]	Common File Format& Media Format Specification
[DSecMech]	Message Security Mechanisms

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1.4.2 Other Normative References

[IANA-LANG]	IANA Language Subtag Registry. http://www.iana.org/assignments/language-subtag-registry
[RFC2141]	IETF RFC 2141, URN Syntax, May 1997. http://tools.ietf.org/html/rfc2141
[RFC2460]	IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification, December 1998. http://tools.ietf.org/html/rfc2460
[RFC2616]	IETF RFC 2616, Hypertext Transfer Protocol -- HTTP/1.1, June 1999. http://tools.ietf.org/html/rfc2616
[RFC2617]	IEFT RFC 2617, HTTP Authentication: Basic and Digest Access Authentication, June 1999. http://tools.ietf.org/html/rfc2617
[RFC2782]	IETF RFC 2782, A DNR RR for specifying the location of services (DNS SRV), February 2000. http://tools.ietf.org/html/rfc2782
[RFC4346]	IETF RFC 4346, The Transport Layer Security (TLS) Protocol, Version 1.1, April 2006, http://tools.ietf.org/html/rfc4346
[RFC4647]	Philips, A., et al, *RFC 4647, Matching of Language Tags*, September 2006. http://www.ietf.org/rfc/rfc4647.txt
[RFC5646]	Philips, A, et al, *RFC 5646, Tags for Identifying Languages*, IETF, September, 2009. http://www.ietf.org/rfc/rfc5646.txt
[MPEG4S]	ISO/IEC 14496-1:2010, "Information technology — Coding of audio-visual objects — Part 1: Systems"
[UNICODE]	UNICODE 6.0.0, "The Unicode Standard Version 6.0", http://www.unicode.org/versions/Unicode6.0.0/
[ZIP]	ZIP File Format Specification from PKWARE, Inc., version 6.3.0 (2006), as specified in http://www.pkware.com/documents/casestudies/APPNOTE.TXT.

1.4.3 Informative References

[ISO-P2H]	ISO/IEC Directives, Part 2, Annex H: http://www.iec.ch/tiss/iec/Directives-Part2-Ed5.pdf
[UPNPCDS3]	*ContentDirectory:3 Service Template Version 1.01*, September 30, 2008, www.upnp.org/specs/av/UPnP-av-ContentDirectory-v3-Service.pdf

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1.5 Terminology and Requirements Scope

Device-related terminology is defined in [DSystem].

DCCs may be contained in DECE Media Packages (DMPs). In all cases, except where noted, when a DCC is discussed this normatively refers to a DCC either by itself or as part of a DMP.

1.6 XML Change Management

DECE Devices SHALL comply with XML Change Management defined in [DSystem], Section 1.6.

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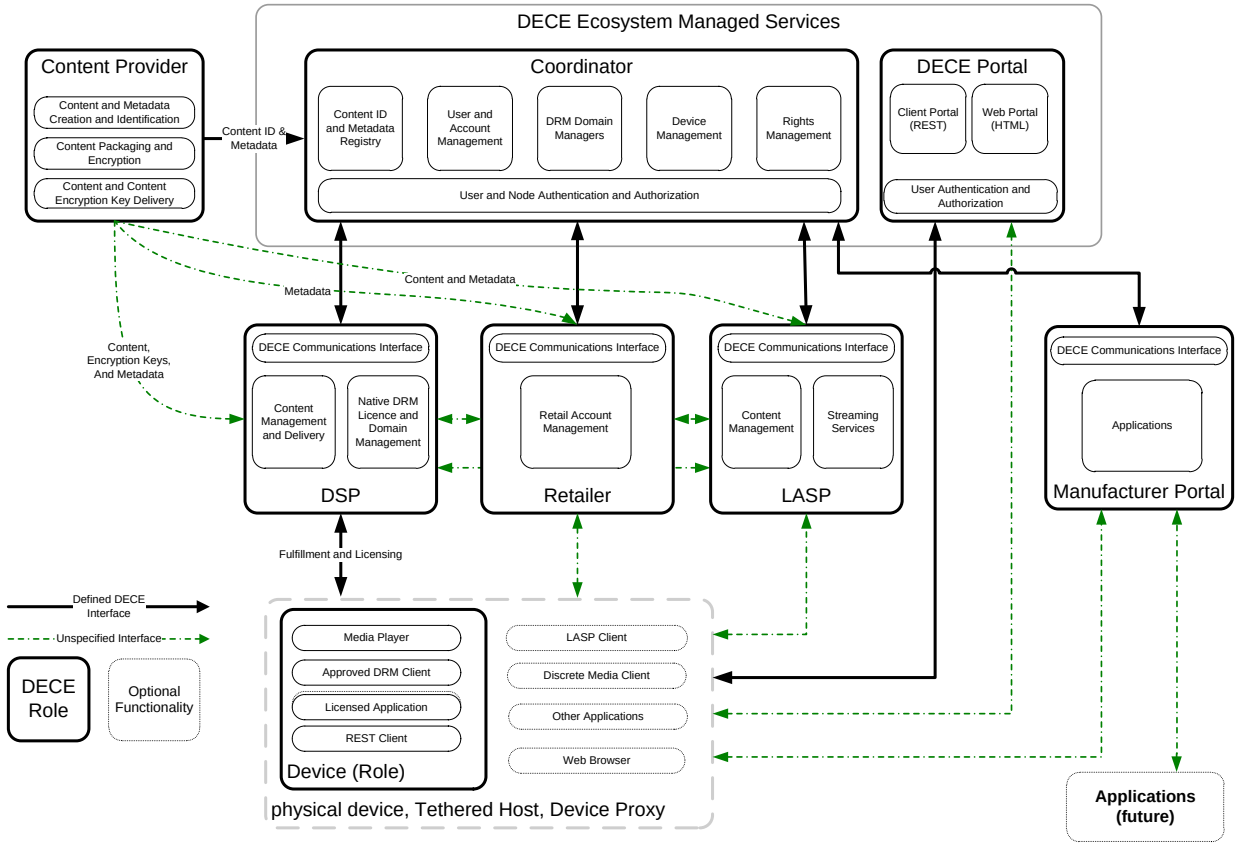
2 DECE Devices and DECE Ecosystem

This specification defines functionality associated with the "Device Role" which is specified in this document. A DECE Device is a hardware or software product or combination of products that implement a Device Role. DECE Devices include a DRM Client and a Licensed Application. DECE Devices are produced by Client Implementers.

As illustrated below, the DECE Device interacts with several components of the Ecosystem, such as

- Device Portal via REST APIs and/or Web Portal using a Browser
- DSPs to obtain content and licenses
- Coordinator for DRM domain management (e.g., joining the Ecosystem)

DECE Devices may, via non-DECE interfaces including Proxies, also have interfaces to Retailers and LASPs (for streaming).



The DECE Coordinator manages DECE Devices as part of Users' Accounts. It counts DECE Devices towards an Account's maximum allocation. A DECE Device with multiple DRM Clients would be

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managed by the Ecosystem as multiple DECE Devices. For example, a general purpose computer running three DRMs would count as three DECE Devices.

Separate from the DRM-specific interfaces, the DECE Device can communicate with the DECE Coordinator in three possible ways:

- To the Web Portal, using HTML and username/password authentication [DSecMech], Section 6;
- To the Device Portal, using the DECE Coordinator API [DCoord];
- Via an Access Portal using a proprietary Device-Retailer interface.

Which communication paths are required for various functions are described elsewhere in this specification.

When a Device joins a DECE Account, DECE records the unique identity of the DRM Client on that Device; to the DECE Coordinator, the identity of the Device is equivalent to the identity of the DRM Client on the Device. A physical device containing multiple DRM Clients either from different DRMs or from the same DRM but with different Native DRM Client IDs would be managed by the Ecosystem as if it were multiple Devices; the DECE Coordinator counts Devices towards an Account's maximum allocation.

DECE functionality may reside either within the DRM Client or in other DECE-aware applications, such as a Licensed Application (e.g., Media Player or Download Manager.)

The software in the DECE Device other than the DRM Client that performs functions specified by DECE is called a Licensed Application.

In any DECE Device implementation, DRM decryption and playback function must be performed in a single physical device. For avoidance of doubt, playback function of a DECE Device may include re-encryption of content without decoding by an Approved Output Technology. These physical devices may be connected to Tethered Hosts, typically a general purpose computer in the possession of a User, or to a Device Proxy, typically a server under the control of the Client Implementer.

Unless otherwise prohibited, any function assigned to a DECE Device MAY be implemented on a Tethered Host, a Device Proxy or a combination. Playback distribution is not allowed as per Section 8.6.

Some DRM Systems offer the ability for multiple applications to access a single instance of a DRM Client. In this case, a DECE Device could have multiple Licensed Applications.

When creating a Licensed Application resource in the Coordinator, it is necessary to include Device information.

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The Coordinator may consolidate multiple Licensed Application/DRM Client pairs into a single Device resource if the DRM Client has the same DRM ID ([DSystem] Section 5.4.1) and is in the same DRM Domain.

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3 Communications Requirements

3.1 Internet Communications

Connected Licensed Applications SHALL be able to communicate with the DECE Coordinator. Licensed Applications that communicate directly with the Coordinator SHALL

- Comply with [DCoord] for all APIs used by the Licensed Application
- Enable all required DRM Client interfaces and APIs, as specified in [DSystem], including license acquisition, domain join and leave operations, and the DRM-specific triggers for these operations.

In the case of Tethered DECE Devices, these communications functions will be on a Tethered Host device that is physically separate from the physical device containing the DRM Client. In the case of DECE Devices that use Device Proxies, these communications functions will be on a Proxy server device that is physically separate from the physical device containing the DRM Client.

In order to locate a preferred DECE Coordinator endpoint, a Device can do a DNS lookup for the SRV record. Licensed Applications SHOULD use SRV Records in the Coordinator and Portal DNS entries as specified in [DCoord], Section 3 and [RFC2782]. When a Licensed Application authenticates, it SHALL do so using one of the following mechanisms:

  - HTTP Basic Authentication as defined in [RFC2617] for subsequent communications with the Coordinator, or
  - Obtain a Security Token from the Coordinator using the `SecurityTokenExchange` API as defined in [DSecMech], Section 8.

When using Security Tokens, Licensed Applications SHALL handle Security Tokens in accordance with [DSecMech], Section 3.5.

DECE Devices communicating with a Device Proxy SHALL implement Confidentiality and Privacy Mechanisms as per [DSechMech], Section 3.2.

DECE Devices SHOULD support IPv6, as per [RFC2460].

DECE Devices SHALL authenticate themselves to the Coordinator via one of the profiles defined in [DCoord], Section 2.6.

DECE Devices SHALL include an Application Authorization Token in every Coordinator API invocation in accordance with [DCoord] Section 2.6.

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4 Adding and Removing Devices to and from Account

The process of adding a DECE Device to a DECE Account involves both interaction with the Coordinator and a DRM-specific interaction with the Coordinator's Domain Manager. These are described in the [DSystem], Section 7.3. Coordinator APIs for Domain operations are found in [DCoord] Section 9.

4.1 Device Join

Device Join operations are assumed to be performed by a User who has a DECE Account.

4.1.1 Authentication and Obtaining a Join Trigger

Licensed Applications SHALL provide at least one of the following mechanisms for authenticating and obtaining a Join Trigger:

- Device Standalone Join – designed for DECE Devices with usable keyboards, network access and the ability to implement DECE REST APIs. Tethered DECE Devices use this method from a Tethered Host.
- Node Initiated Join (formerly Web Portal Initiated Join) – designed for Devices with limited data entry, particularly numeric digit entry
- Proxy Join – designed for DECE Devices that use Device Proxies.

Licensed Applications MAY also implement the following:

- Point of Sale Join – allows DECE Retailers to perform a partial Join of DECE Devices to an Account.

4.1.1.1 Device Standalone Join

In a Standalone Join, the Licensed Application first authenticates, then obtains the DRM-specific Join Trigger using REST APIs through the DECE Portal using the REST Interface.

The following applies to DECE Devices implementing Device Standalone Join.

The Licensed Application SHALL perform the following operations:

- Authenticate the User if not done so already

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- Perform a LicAppCreate() function as defined in [DCoord]. {LicAppID} is returned in the URL reference to the newly created resource. Then perform a LicAppJoinTriggerGet() call as defined in [DCoord].

If a Licensed Application determines a User does not have a DECE Account, the Licensed Applications SHALL inform the User that a DECE Account is required prior to a Join Operation.

4.1.1.2 Node Initiated Join (formerly Web Portal Initiated Join)

A Node Initiated Join begins with a User authenticating to an authorized Node, such as the DECE Portal, and initiating the process of adding a DECE Device. The Node provides the User with a numeric '*Device Authentication Code*'.

The following applies only to DECE Devices implementing Node Initiated Join.

A Licensed Application supporting Node Initiated Join SHALL:

- Provide a means for the User to initiate the transaction and enter the Device Authentication Code
- Obtain a Security Token from the Coordinator using the Device Authentication Code variant of the `SecurityTokenExchange` API as defined in [DSecMech], Section 8.
- Perform a LicAppCreate() function as defined in [DCoord]. {LicAppID} is returned in the URL reference to the newly created resource. Then perform a LicAppJoinTriggerGet() call as defined in [DCoord].

Licensed Applications SHALL accept numeric Device Authentication Codes up to DCOORD_DEVICE_JOIN_CODE_MAX_LENGTH numerals. DCOORD_DEVICE_JOIN_CODE_MAX_LENGTH is defined in [DCoord], Section 9 as part of DeviceAuthToken-type definition and in [DCoord], Section 23.

During entry Licensed Applications SHOULD display Device Authentication Codes in groups of three digits.

4.1.1.3 Proxy-based Join

Some Licensed Applications perform Domain Join operations with the participation of a Device Proxy which obtains a Domain Join Trigger. Details of this operation are described in the [DSystem].

The interface between the Licensed Application and Device Proxy are not specified by DECE, but SHALL result in a Device resource posted at the Coordinator, and a Domain Join Trigger for the appropriate DRM being delivered to the Licensed Application, equivalent to LicAppCreate() as defined in [DCoord].

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The Device Proxy is required to perform the same operations as a Connected Device including authentication as defined in Section 4 above; and LicAppCreate() and LicAppJoinTriggerGet() as defined in [DCoord], Section 9.

If a Device Proxy determines a User does not have a DECE Account, the Licensed Applications SHALL inform the User that a DECE Account is required prior to a Join Operation.

4.1.1.4 Point of Sale (POS) Join

Point of Sale Join (POS Join) allows Retailers to add Devices to a User's Account, and allows a Device to Join a DRM Domain without the User entering additional data. POS Join is subject to constraints on the Retailer that are not specified here. Point of Sale Join requires that a User have a DECE Account. It is the responsibility of the Retailer to ensure that an appropriate DECE Account exists prior to attempting the POS Join process.

From the Licensed Application perspective, the POS Join is similar to a Node Initiated Join. The difference is that `DeviceHandle` generated from information internal to the Device is used in lieu of Portal-provided Domain Join Code.

POS Join requires a common secret[1], called a *DeviceUniqueString*, shared between the Retailer and the Device. It should not be practical for a third party to obtain or derive the DeviceUniqueString, for example by reading a bar code on outside of the box. For example, a string is generated by the Client Implementer and shared with the Retailer; and a code is put on the box that allows the Retailer to identify that string.

The Retailer posts the DeviceUniqueString to the Coordinator, creating a temporary record. At a later time, the Licensed Application uses the DeviceUniqueString as part of requesting the Join Trigger, and at that time, the Coordinator uses this information to match the Licensed Application to the temporary Retailer-created record and creates a Device record.

<DeviceUniqueString> need only be unique within the organization referenced by <OrgID>.

A Licensed Application supporting Point of Sale Join SHALL:

- Provide a means for the User to initiate the transaction
- Obtain a Security Token from the Coordinator using the Device Unique String variant of the `SecurityTokenExchange` API as defined in [DSecMech], Section 8.

[1] This is reasonably protected, but not necessarily on par with highly protected secrets such as DRM keys.

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- Perform a LicAppCreate() function as defined in [DCoord]. {LicAppID} is returned in the URL reference to the newly created resource. Then perform a DeviceJoinTrigger() call as defined in [DCoord].

DeviceHandle is constructed as follows:

'DeviceString/'+<DeviceUniqueString>

<DeviceUniqueString> is Device Unique String defined in [DCoord], Section 9.4.3.4.

4.1.1.5 Superdistribution-based Join

This is not a distinct Join mechanism, but is a special case precursor to other Join operations.

The DECE Device receives a DCC before the Device is Joined to a DECE Domain. When the User attempts to play the DCC, the Licensed Application SHOULD offer the User the opportunity to Join the Device to a DECE Domain.

At this point, the Join becomes a Join by one of the other described mechanisms.

In the contingency that the DECE Device's User does not have a DECE Account, the Licensed Application SHOULD provide the User information on how to obtain a DECE Account.

4.1.2 DRM Join

4.1.2.1 DRM Join Operations

Licensed Applications SHALL be able to join a DRM Domain associated with a DECE Account, using the DRM's domain join mechanism.

Licensed Applications SHALL provide via DRM-specific mechanisms identification as follows:

- manufacturer and model, where manufacturer and model are sufficient to disambiguate Licensed Applications, otherwise
- manufacturer, model and Licensed Application identification.

Licensed Applications SHALL provide via DRM-specific mechanisms the `LicAppHandle`.

The application identifier is required when multiple applications could exist on a single device and must be distinguished.

Note that these data are not the `LicAppID` found in the `LicApp` resource.

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4.1.3 Post DRM-Join Functions

If a DRM Join is unsuccessful, the Licensed Application SHALL remove residual data obtained as part of the Join process, including but not limited to Security Tokens.

4.1.4 Licensed Application Handle

A Device record in the Coordinator can have multiple Licensed Applications.

To limit access on certain functions, it is necessary to have a modestly protected piece of information shared between the Coordinator and the Licensed Application. This is handled via a value called a Licensed Application Handle (`LicAppHandle` attribute) in the Licensed Application record. `LicAppHandle` is a random number, sufficiently large to differentiate the Licensed Application from other Licensed Applications in the physical device.

The Licensed Application SHALL generate `LicAppHandle` value sufficiently random and large to avoid collision with other `LicAppHandle` values in a `LicApp` resource in a `Device` resource.

4.2 Device Leave

This section describes the mechanism for a DECE Device to leave a DECE Account's Domain in an orderly fashion, called a *Verified* Leave. That is, the Coordinator, including the Domain Manager, knows the DECE Device is not active, and the DRM Client on the Licensed Application removes credentials such that Containers licensed to the Domain no longer play.

Circumstances such as theft, damage or loss may result in a DECE Device no longer being part of the DECE Account's, although Verified Leave process has not occurred. This is called an *Unverified Leave.* Unverified Leave does not have DECE Device involvement and is therefore not covered in this specification. Further details can be found in [DSystem], Section 7.3.4.

4.2.1 Leave Warning

Prior to removing a Device from a DECE Account, the Licensed Application SHALL provide a warning to the User. This warning SHALL contain at least the following information:

- Content licensed for that DECE Device's Domain will no longer play

Note that a Device Move is a special case of Leave, so this notice is also part of a Move.

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4.2.2 Obtaining a Leave Trigger

DRMs that allow or require a Leave Trigger to leave a DECE Domain can obtain a Leave Trigger.

Licensed Applications MAY provide at least one mechanism for obtaining a Leave Trigger.

The means of obtaining a Leave Trigger are as follows:

- Device Standalone Leave
- Proxy Leave

4.2.2.1 Device Standalone Leave

In a Standalone Leave, the Licensed Application directly obtains the DRM-specific Leave Trigger using REST APIs through the DECE Portal using the REST Interface.

The following applies to Licensed Applications implementing Device Standalone Leave:

- When obtaining a Leave Trigger, the Licensed Application SHALL perform a LicAppLeaveTriggerGet() function as defined in [DCoord], Section 9.

4.2.2.2 Proxy Leave

Some Licensed Applications perform Domain Leave operations with the participation of a Device Proxy which obtains a Domain Leave Trigger. Details of this operation are described in [DSystem] Section 7.3.

The interface between the Licensed Application and Device Proxy are not specified by DECE, but SHALL result in obtaining a Domain Leave Trigger for the DRM Client, equivalent to LicAppLeaveTriggerGet () as defined in [DCoord]. Note the Device Proxy must perform the LicAppLeaveTriggerGet (), but Device Proxy specification is outside the scope of this spec.

4.2.3 DRM Leave

Licensed Applications SHALL be able to leave a DRM Domain associated with a DECE Account, using the DRM's domain leave mechanism.

Licensed Applications SHALL perform a DRM-specific Leave.

4.2.4 Device Leave Cleanup

When a DECE Device leaves a DECE Domain, the Licensed Application SHALL remove the following:

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- Account-specific, Domain-specific and User-specific identification information. This includes removing DECE Security Tokens in accordance with [DSecMech], Section 3.5, and all data unique to the Account that facilitates playing DCCs.

After Domain Leave, DCCs licensed to the Account Domain SHALL be unplayable.

4.3 Device Move

Device Move is a combination of a Device Leave and a Device Join.

Device Move is generally initiated by an attempt to Join a DECE Device to another Account.

A Licensed Application SHALL perform a complete Device Leave prior to performing a Device Join.

4.4 Multiple Licensed Applications and DRM Clients

Some Licensed Applications are capable of accessing multiple DRM Clients. Some DRM Clients support the use of multiple Licensed Applications.

A Licensed Application that uses multiple DRM Clients SHALL perform a DRM Join for each DRM Client.

A Licensed Application that uses multiple DRM Clients SHALL perform a DRM Join in only one DECE Domain.

A Licensed Application SHALL perform a Leave operation on all associated DRM Clients before Joining the new Domain.

DRM Clients SHOULD prevent multiple instances of the DRM Client being in separate DECE Domains on a single hardware device.

A Licensed Application SHOULD NOT allow multiple DRM Clients to be in different DECE Domains on a single hardware device.

DRM Clients SHALL enable any mechanisms available that prevent or can help prevent multiple instances or multiple applications of the DRM to join independent DECE Domains on a piece of physical hardware. For example, DRM systems that can provide a unique ID that is mapped to the physical hardware must enable such mechanisms.

Any Licensed Application MAY perform a LicAppCreate().

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5 Content Rights Purchase Support

The process of obtaining content Rights (i.e., purchasing) is not part of this specification as the device has no normative role in the process, with one exception. That exception relates to superdistributed content and is described below.

5.1 Purchase of Content Rights

Content Rights are sold by DECE Retailers and posted to the Coordinator. In general, any involvement of a DECE Device in the purchase process is outside of the scope of DECE specification. Interfaces are considered proprietary to the Retailer and purchase applications. This section assumes a purchase application associated with a DECE Device running on the same physical device or otherwise implemented in conjunction with the Licensed Application. The purchase application may provide information to a Licensed Application.

A Retailer may return information to a purchase application that can help the Licensed Application download the DCCs associated with the purchased Right. This is desirable because it saves the step of the Licensed Application locating the DCC (see DCC Acquisition below). For example, the information returned may include one or more of the following:

- An HTML page containing links leading to DCC download,
- An HTML page containing a link to a Download Manifest,
- A Download Manifest.

If the Licensed Application receives a Download Manifest, it is expected that a Download Manager on the Device is able to parse that document and proceed to download the files. The format of the DECE Download Manifest is defined in DECE System Design [DSystem].

If a purchase application associated with a Device attempts to purchase Rights before the Device has joined any DECE Account, the application may give the user the opportunity to join the Device to a DECE Account. This process is also outside the scope of this specification.

5.2 Purchasing Rights for Superdistributed Content

DCCs can arrive at DECE Devices through Superdistribution (see [DSystem], Sections 1.4 and 15). Typically, a User is expected to obtain a DCC and attempt to play it on one of their DECE Devices. As the Superdistributed file does not contain a license for the User's Account and the Device's DRM, it will not play. This process is described under DRM License Acquisition below.

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If the User wishes to purchase a Right to play the DCC, it is necessary to identify a Retailer that sells Rights to the Superdistributed DCC. Although a general mechanism for locating a Retailer who sells the Rights to a DCC is not specified by DECE, it is possible to find one such Retailer by using the a Purchase URL (PURL) that can be derived from information in the DCC.

5.2.1 Purchase URL (PURL) Construction

The DCC may optionally include a Base PURL Location that can be used to create a PURL.

The Purchase URL provides a location where a Right may be purchased via a web browser. There is no implicit guarantee that the Right can be purchased (e.g., Retailer may have stopped selling that content), but there is a guarantee that if the Right is purchased, the DCC with the PURL will be licensable under that Right.

If the DCC includes a BasePurlLocation as described in [DMedia], Section 2.2.3, a Licensed Application MAY construct the PURL in accordance with [DSystem], Section 8.3.3 and use a web browser to enable purchase.

At least once, a Licensed Application SHALL obtain <decedomain> from the Coordinator using DeviceDecedomain().

The Licensed Application SHALL validate that Base PURL Location uses RFC-conformant syntax and ensure the domain name ends with <decedomain> as per [DSystem], Section 8.3.3. This prevents situations where the BasePurlLocation would result in a PURL that refers to a domain not under DECE control. For example, a BasePurlLocation of 'phishingdomain.com/' would be rejected as it would result in a PURL such as 'http://purchase.phishingdomain.com/.uvvu.com/?index.html?apid=…'

5.2.2 Alternate Mechanisms for locating Retailers

Although not specified by DECE, a Licensed Application may use other methods to locate a Retailer, including use of third party services, or having a pre-existing relationship with one or more DECE Retailers.

5.2.3 Base Location Updates

The following applies only to Devices that are Joined to an Account.

After purchase, the Licensed Application SHALL query the Rights Token to see if `LicenseAcqBaseLoc` in the Rights Token is different from `BaseLocation` field in the DCC as defined in [DMedia], Section 2.2.3.

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If the `LicenseAcqBaseLoc` obtained from the Rights Token is different from the DCC's `BaseLocation`, Licensed Applications on devices that support Outbound File Transfer SHALL replace the DCC's `BaseLocation` with `LicenseAcqBaseLoc`.

Licensed Application on devices that do not support Outbound File Transfer SHALL use the new Base Location, although they do not need to write it to the DCC.

This is necessary because the Base Location is used for licensing and an incorrect Base Location will cause unnecessary redirects as part of the licensing process.

5.2.4 License Acquisition after Download

The following applies only to Devices that are Joined to an Account.

After purchase, a Licensed Application SHALL attempt to license the DCC that is downloaded. See License Acquisition, below, for requirements associated with license acquisition after download.

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6 DCC Fulfillment

DECE supports several methods of delivering content to Devices and incorporating that content into the Device's storage. Fulfillment is the term used to describe the process of delivering licensed DECE Content in the form of DCCs to the Device.

Devices SHALL be able to acquire any DCCs consistent with their supported profiles from a DSP.

6.1 Initiating Fulfillment

Fulfillment may be initiated through a Retailer, through the Web Portal or via a Rights Locker query to the Device Portal. The Retailer and Web Portal cases are web-based or use proprietary interfaces between the Retailer and the DECE Device; and are outside the scope of this specification (see [DSystem], Section 11.)

Before initiating a download, a Licensed Application must first obtain either a URL pointing to a download web site (called a Fulfillment Web Location) or a URL point to a manifest file that includes information for downloading one or more DCCs.

These locations can be obtained from the Coordinator via the Rights Token query APIs. Licensed Applications MAY support RightsTokenGet() as defined on [DCoord], Section 7.

The particular relevant elements of the Rights Token are `FulfillmentWebLoc` and the `FulfillmentManifestLoc`. At least one of each will exist, and there may be more than one. These location elements each contain a URL and optionally an element called Preference defined as an integer. Preference defines an ordering.

Licensed Applications SHOULD use the URLs with the following precedence:

1. URLs with lower `Preference` value are used before URLs with higher `Preference` value
2. URLs with `Preference` are used before URLs without Preference
3. Two or more URLs with the same `Preference` may be used in any order
4. Two or more URLs without `Preference` may be used in any order

`FulfillmentWebLoc` MAY be passed to a browser in the Licensed Application.

`FulfillmentWebLoc` MAY be passed outside of the Licensed Application. For example, it may be passed to another device with a web browser.

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`FulfillmentManifestLoc` MAY be used by a Download Manager in a DECE Device.

`FulfillmentManifestLoc` MAY be passed outside of the Licensed Application. For example, it may be passed to another device with a Download Manager.

6.2 Download Manager and Web Download

6.2.1 Protocol

Protocol applies to both Download Manager and Web Download.

Licensed Applications that support Download Manager SHALL support HTTP and HTTPS in accordance with [RFC2616] and TSL 1.1 [RFC4346].

Licensed Applications SHOULD support Range GETs for resuming partial downloads [RFC 2616], Section 14.35 'Range'.

6.2.2 Download Manager

The Download Manager knows which files to download based on a Fulfillment Manifest and Fulfillment Manifest File as defined in the System Design Specification [DSystem] Section 11.1.

The first step is to download the Fulfillment Manifest File. It is downloaded using HTTP GET as specified under Protocol above.

The DCC download process is at the discretion of the Licensed Application.

A Licensed Application MAY interact with the User to select which files to download.

Licensed Applications SHOULD support continuation of downloads that were interrupted.

6.2.3 Web Download

Web download is via standard web download mechanisms.

6.3 DCC Download Options

Licensed Applications SHALL support DCC acquisition from DSPs by either downloading directly from the DSP or by supporting the ability to transfer DCCs from devices that download directly from DSPs.

Licensed Applications SHOULD support DCC acquisition via Superdistribution.

Licensed Applications MAY support DCC acquisition via other mechanisms.

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6.3.1 Download from DSP

Download is performed through a connection between the DECE Device and a DSP. DECE Devices include Tethered DECE Devices, although the connection may be performed by the Tethered Host.

A Connected DECE Device MAY support Direct Download of DCCs, either via Web Download or Download Manager, or both.

A DECE Device that supports download SHOULD support the Download Manager mechanism.

6.3.2 Separate Download and Copy

Download may be initiated by a physical device other than the DECE Device. The downloaded file is then copied to the DECE Device.

Retailers and DSPs may present mechanisms to download files to a User. For example, the Retailer may implement a web site with links to locations where DCCs may be downloaded. Alternatively, Retailers or 3rd parties might supply download applications that will download DCCs.

These mechanisms result in a DCC available to a DECE Device.

DECE Devices SHOULD accept files downloaded via indirect downloads and copied to the DECE Device.

6.3.3 Other Loading Mechanisms

Tethered DECE Devices SHALL accept DCCs via a Tethered Host.

DECE Devices MAY accept DCCs via copying. Copying is the process of delivering content to a device through a mechanism other than the Internet or tethering. Copying may occur via portable media or local wired or wireless connection. Sometimes the term sideloading is used in reference to copying to a device and should be interpreted the same as copying.

6.4 Progressive Download

Licensed Applications MAY begin playback during download.

6.5 License Acquisition after Download

After download, if a DCC is not already licensed for the DRM Client supported by the Device, the Licensed Application SHALL attempt to license that DCC. See License Acquisition, below, for requirements associated with license acquisition after download. In the case of a DCC within a DMP, this requirement refers only to DCCs meeting the playability conditions of Section 8.2.

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7 DRM License Acquisition

7.1 Acquisition of Content License

Devices must be able to acquire a DRM license for any DCC present on the Device and whose rights are present in the DECE Account, regardless of which Retailer the content was originally purchased from or which DSP the DCC was originally downloaded from.

To obtain a license in this circumstance, the Device locates a DECE DSP with a DRM License Server from which it can request and obtain a DRM-specific license for the DCC in question; such a DSP must (a) support the same DRM that the DECE Device supports, and (b) have rights to create licenses for the content in the DCC in question. There are two mechanisms for locating a license server and the DECE Device SHALL support both:

1. DCC-based location: using DRM-specific information in the DCC
2. Coordinator-based referral: using information obtained from the Coordinator

The Device SHOULD first attempt to obtain a license using the first mechanism (DCC-based location), and only use the second mechanism (Coordinator-based location) if the first mechanism fails.

7.2 License Acquisition Flow

This section defines the sequence of events associated with locating a license server and acquiring a license. An explanation of each step is provided below.

7.2.1 Support for License Acquisition Flow

There are three conditions that potentially require a licensing attempt by a DECE Device: Purchase, Ingest and Play.

Purchases performed by the Device using the PURL mechanism may result in a licensing attempt as per Section 5.2.3, Base Location Updates.

Ingest occurs when a DECE Device obtains a DCC by download, file copy, transfer through a tether or other transfer operation that results in a new DCC on that DECE Device. The goal of licensing upon ingestion is to increase the likelihood that a DCC is playable, even if the DECE Device is offline when a play is attempted (e.g., on an airplane without broadband). DCCs installed in a DECE Device prior to delivery to a User (i.e., Preloaded Content) are not considered 'ingested' in the context of this definition.

Play occurs when there is an attempt to play the DCC.

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A DECE Device SHALL be joined to a DECE Domain prior to attempting to acquire a license. Device Joining is described in Section 4.1, Device Join.

A DECE Device MAY attempt to license a file using *General License Acquisition Flow* at any time.

A DECE Devices SHALL comply with *General License Acquisition Flow* when a DCC is ingested into the DECE Device. This does not apply to preloaded content as per DECE System Design [DSystem] Section 15.

A DECE Device SHALL comply with the *General License Acquisition Flow* when attempting to play a DCC.

7.2.2 General License Acquisition Flow

The following flow chart defines the sequence of events associated with locating a license server and acquiring a license; this sequence is called the "General License Acquisition Flow". An explanation of each step is provided below.

The following conditions are assumed to hold before the beginning of the Flow:

- A DCC is present in the Device;
- The Device is joined to a DECE Account; and
- The Rights to the Asset in the DCC are present in the Coordinator, for the Account in question.

This flow is initiated at 'Start' when a DCC is ingested into a DECE Device, when there is an attempt to play a DCC, or at any time the DECE Device otherwise determines a licensing operation is appropriate.

The first operation checks to see if a license is present. If so, the process is complete.

If not, it attempts to obtain a license using the Base Location to construct a LAURL and use that LAURL to locate a license server, and then obtain a license. If that operation is successful, the process is complete.

If license is not either initially available or available through the LAURL process, at attempt is made to locate the license server through the Coordinator and obtain the license at the indicated location.

If the attempt to obtain a license through the Coordinator fails, the overall operation fails and a license is not obtainable. Following failure, the DECE Device has the option of initiating a purchase operation as described above in Section 5, Content Rights Purchase.

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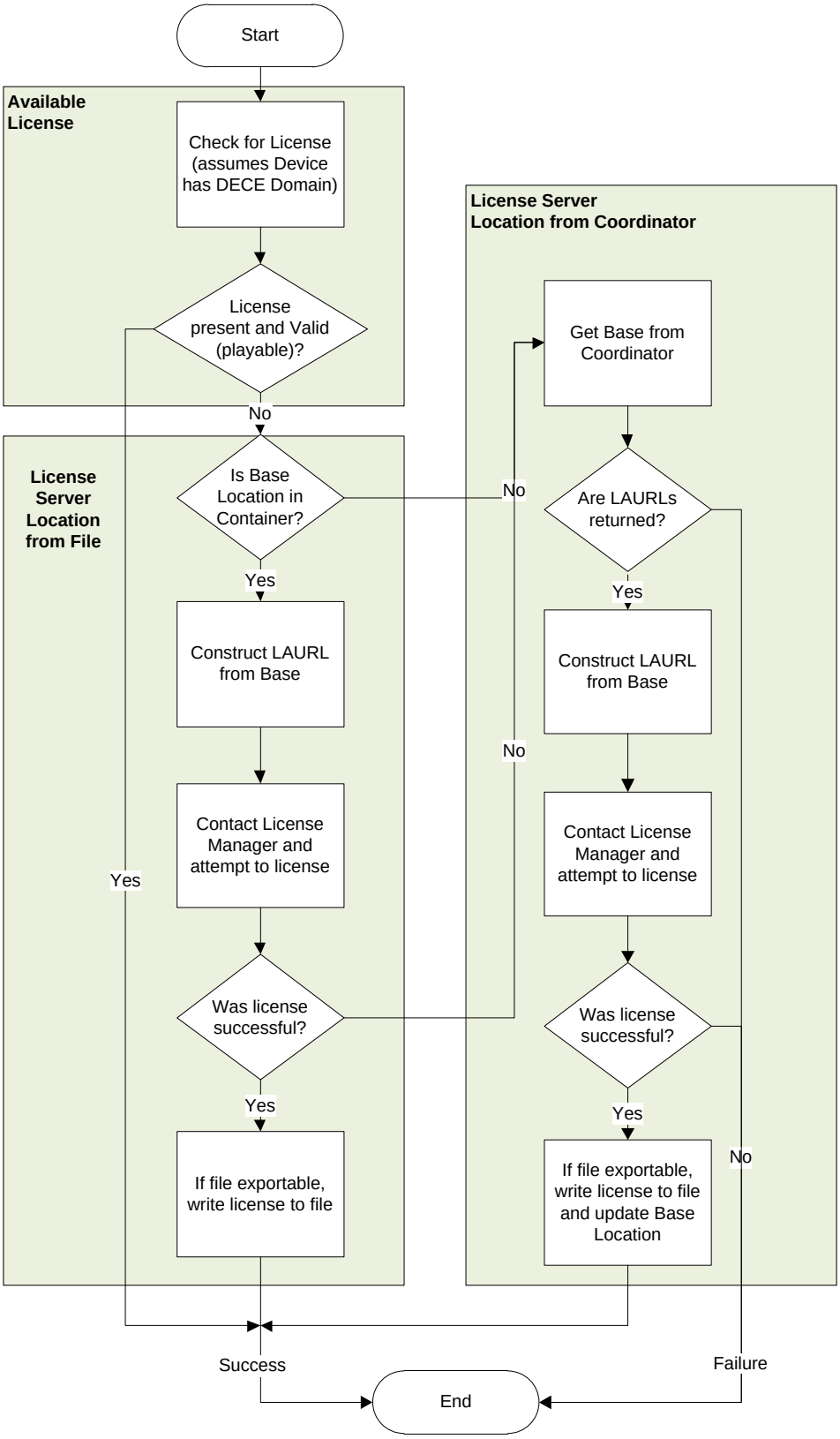

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7.2.3 License Server Location Obtained from DCC

A DECE Device SHALL be able to obtain Base Location information from a DCC, as defined in [DMedia], Section 2.2.3 and [DSystem], Section 8.3.

License Server location information can be derived from the Base Location. If the Base Location information is present in the DCC, the Device SHALL be able to retrieve and act upon such information to request and obtain the License from the License Server.

The following steps are involved in locating a license server,

(1) the DECE Device retrieves the location information from the DCC,

(2) the DRM Client contacts the DRM-specific License Server with information is necessary for Rights verification.

(3) If the Domain has the Right to play the Content, a DRM-specific License is delivered.

7.2.3.1 License Acquisition Location (LALOC)

If a file needs to be licensed, the Base Location is identified in the DCC.

Assuming a Base Location, the License Acquisition Location (LALOC) is constructed. The LALOC is constructed from the Base Location as follows:

- License Acquisition Location (LALOC) SHALL be constructed as defined in [DSystem], Section 12.2.
- The DECE Device SHALL validate that LALOC uses RFC-conformant syntax and ensure the domain name ends with <decedomain> as per [DSystem] Section 8.3.4. This prevents situations where the BaseLocation would result in a LALOC that refers to a domain not under DECE control. For example, a BaseLocation of 'phishingdomain.com/' would be rejected as it would result in a LALOC of the form 'http://<DRMname>_license.phishingdomain.com/.uvvu.com.

7.2.3.2 Licensing

A DECE Device SHALL contact a DRM-specific license manager at the location specified by the LALOC and obtain a license using DRM-specific protocol.

If licensing succeeds, the DECE Device proceeds with conditionally writing the License as defined below.

If the licensing fails, the DECE Device proceeds as per Section 7.2.4 *License Server Location Obtained from Coordinator*.

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7.2.3.3 Writing License

When a license is obtained by a DECE Device capable of Outbound File Transfer, the DECE Device SHALL write the license as defined in Section 7.2.5, *License Management in DCC*.

The following definitions are used for requirements in this section:

- Total License Space is defined as the sum of all 'pssh' Boxes sizes and the 'free' Box in the 'moov' Box.
- License Space Consumed is the sum of 'pssh' Boxes sizes.
- Excess License Space is defined as the magnitude of the difference between License Space Consumed after and License Space Consumed before the license was added. For example, if 25KB was used before and 30KB were used after, the Excess License Space is calculated as 5KB = 30KB – 25KB.
- License Default Allocation is 20KB, for the 'pssh' Box in the 'moov' Box, unless otherwise specified in the [DSystem], Appendix B.

When writing a license would result in expanding License Space Consumed and would result in exceeding the DECE Device's DRM's License Default Allocation, the DECE Device SHALL reformat the DCC to expand the Total License Space by at least the Excess License Space.

DECE Devices SHOULD have the ability to reformat DCCs to expand the Total License Space if there is not enough Available License Space to write a license.

7.2.4 License Server Location Obtained from the Coordinator

If Base Location is either not available, or does not lead to successful license acquisition, the Coordinator can provide a set of LALOCs for the asset, assuming that the DRM Client's Domain is part of a DECE Account that holds a Right for that DCC.

Use of LALOC is described in [DSystem] Section 12.2.2.

7.2.4.1 License Acquisition Location (LALOC)

If the DCC does not have a suitable License Server location, the DECE Device SHALL obtain locations from the either the Device Portal or an Access Portal. Access Portal interface to the Device is not specified by DECE.

DECE Devices obtaining License Server location information from the Device Portal SHALL use Rights Token GET APIs [such as, RightsTokenGet() and RightsTokenDataGet()] as defined in [DCoord], Section 7.

If Rights Token GET APIs fails the licensing operation has failed and the User should be informed and may be offered the opportunity to purchase the content as per Purchasing Content above.

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The following assumes Rights Token GET APIs succeeds.

The particular relevant element of the Rights Token is `LicenseAcqBaseLoc`. LALOC is constructed from `LicenseAcqBaseLoc` as described above.

7.2.4.2 Licensing

A DECE Device SHALL contact a DRM-specific license manager at the location specified by the LALOC and obtain a license using DRM-specific protocol.

7.2.4.3 Writing License and Base Location

When a license is obtained by a DECE Device capable of Outbound File Transfer, the DECE Device SHALL write the license as defined in Section 7.2.5, *License Management in DCC.*

When a license is obtained by a DECE Device capable of Outbound File Transfer using a License Server Location obtained from the Coordinator, the DECE Device SHALL write the `LicenseAcqBaseLoc` obtained from the Rights Token into `BaseLocation` field in the DCC as defined in [DMedia], Section 2.2.3.

When a DCC is part of the DMP, writing anything to that DCC would require calculating the checksum on that DCC and writing that checksum to the ZIP directory. This can be time consuming.

If the DCC is part of a DMP, the DECE Device SHOULD NOT write the license to the DCC.

If the DCC is part of a DMP, the DECE Device SHOULD NOT write the base location to the DCC.

If the DCC is part of a DMP, the DCC Device SHOULD write the license to the DMP in accordance with Section 11.3.

If the DCC is part of a DMP, the DCC Device SHOULD write the base location to the DMP in accordance with Section 11.3.

7.2.5 License Management in DCC

When a license is to be written to a DCC or removed from a DCC, the DECE Device SHALL do so as follows.

7.2.5.1 Scheme

The section applies to Scheme-signaled DRM-specific information.

Within a DCC, licenses are in ‘pssh’ Boxes as outlined in [DMedia], Section 3.1.

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A ‘pssh’ Box corresponds with a particular DRM if the `SystemID` field corresponds with that DRM’s ID as defined in [DSystem].

To add a license, the DECE Device SHALL:

1. Check for a DRM specific ‘pssh’ Box for the intended DRM
2. Create ‘pssh’ Box if missing
3. Add license to DRM specific ‘pssh’ Box, managing any pre-existing information in accordance with DRM rules (add to license acquisition information, add to pre-existing license, replace pre-existing license or acquisition information, etc.), and not exceeding the maximum size specified for each ‘pssh’ Box.
4. Adjust size of ‘free’ Box in ‘moov’ to prevent change of DCC size or reformat the DCC.

To remove a license, the DECE Device SHALL

1. Check for a DRM specific ‘pssh’ Box for the intended DRM, remove if necessary
2. If ‘pssh’ Box removed or changed, adjust size of ‘free’ Box in ‘moov’ to prevent change of DCC size.

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8 Playing Content

This section describes the playback process.

Before a DECE Device can play a DCC, the following conditions must be met:

1. The DECE Device must be in a Domain
2. A valid DCC must be available to the DECE Device;
3. A valid license to the DCC bound to DECE Device's DRM Domain must be available to the DECE Device

DECE Devices MAY be pre-loaded with DCCs and Licenses at the time of Device purchase or manufacture.

8.1 Profile Support

A DECE Device is classified by DECE Media Profile: HD or SD. Each Media Profile is associated with a set of picture formats, audio and video codecs, metadata, and other parameter values in the [DMedia]. To support any particular Media Profile, a DECE Device SHALL be able to handle all of the allowed format, codec and parameter options for that Profile.

Profile support is downwardly inclusive:

- A DECE Device with an HD Profile SHALL play HD and SD Content
- A DECE Device with an SD Profile SHALL play SD Content.

Profile support is upwardly exclusive:

- A DECE Device with an SD Profile SHALL NOT play HD Content.

8.2 DCC Support

Devices SHALL be able to decode and present all DCCs under the following conditions:

- A valid DRM license consistent with the Device's Domain is available to the Device, possibly in the DCC as outlined in [DMedia], Section 3.1;
- The DCC's media Profile (SD or HD) is supported by the Device;

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- The DCC conforms with DMedia v1.0.7 or any versions adopted up to the DMedia specification defined by DMedia Annex E {DMEDIA_VERSION_POINTS}.
- The DCC has an Asset Information Box (ainf) with version="0"
- Content protection rules are met
- The DCC is valid as per all relevant DECE specifications.
    - Note: The 'ftyp' major_brand field is set to 'ccff' (0x63636666) per DMedia Section 2.3.1, thus establishing the file as some form of DCC.
    - Note: The 'ftyp' minor_version field can be any value.

If the DCC has ainf version=0 and the profile_version field does not conform to DMedia v1.0.7 or any version adopted since then up to the DMedia specification defined by DMedia Annex E {DMEDIA_VERSION_POINTS}, DECE Devices SHALL ignore the value of the least significant 24-bits of the profile_version field.

Note: DCCs with an Asset Information Box (ainf) which has a version!="0" (unknown to 1.0.7 Devices) generally cannot be decoded.

DECE Devices SHALL locate Licenses as defined in Section 7.2.5, License Management in DCC.

Note that since DCC are ISO File Format compliant, additional boxes not specified in [DMedia] may be present in the DCC.

Client Implementers should note that encoding rates and allowable numbers of tracks can result in DCC sizes larger than 2^32 bytes (~4 GB), so therefore Device filesystems will need to support files of that size.

8.2.1 File Media Type and Filename Extension

Devices SHALL recognize files with the following Media Type (MIME type) or extension as DCCs:

Extensions	Description	Media Type	Parameters
.uvu, .uvvu	DCC File	video/vnd.dece.mp4	profile_level-id: [SD, HD, …] encrypted: [0, 1]

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8.2.2 Content Encryption

Devices SHALL be able to decrypt content using AES CTR Mode as defined in [DMedia], Section 3.

8.3 Audio, Video and Subtitle Elementary Stream Requirements

Full details of the audio and video codecs and how the corresponding elementary streams are placed in the DCC can be found in [DMedia].

DECE Devices that support the SD Profile SHALL play media in accordance with [DMedia] Annex B.

DECE Devices that support the HD Profile SHALL play media in accordance with [DMedia] Annex C.

DECE Devices NEED NOT support 25 Hz or 50 Hz Content as defined in [DMedia] Tables A-2, B-2 and C-2.

8.3.1 Audio Requirements

DECE Devices SHALL decode and present audio as defined in the [DMedia], Section 5.

DECE Devices SHALL decode and present the Selected Audio Track in accordance with Section 8.3.4.

8.3.1.1 AAC LC Stereo Support

DECE Devices SHALL be able to decode AAC LC stereo audio as defined in the [DMedia], Section 5.3.2.

DECE Devices SHALL be capable of decoding MPEG-4 AAC LC stereo content at bit rates 320 kbps or less, and that were encoded at a sample rate of 44.1 kHz.

Note that this requirement is intended to assist backward compatibility of devices with future DECE versions that include music-only media files.

When decoding AAC LC stereo audio, DECE Devices NEED NOT interpret the following MPEG-4 AAC elementary stream elements:

- fill_element (FIL)
- data_stream_element (DSE)

8.3.1.2 Other Audio Codecs

The DCC also supports other optional audio codecs.

DECE Devices MAY implement any Audio CODEC from the [DMedia], Section 5.

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8.3.1.3 Audio Downmixing

If decoding a multi-channel audio track to an output supporting fewer channels, the DECE Device SHALL downmix to the available output channels according to the audio codec recommendations.

For example, when playing a 5.1 channel mix on a 2-channel output, 5.1 channels is downmixed to 2 channels.

8.3.1.4 Output of Encoded Audio

If an SD or HD Device has a digital audio output (e.g. SPDIF, HDMI, etc.) that supports the transport of an encoded audio, then the Device SHALL be able to pass-through a multi-channel codec other than AAC to the audio output. This includes minor transport conversions necessary to convert from the DCC packaging to the output port packaging.

8.3.2 Video Requirements

DECE Devices SHALL decode and present video as defined in the [DMedia], Section 4.

DECE Devices SHALL support scaling in a manner that supports subsampling as defined in [DMedia].

8.3.3 Subtitles

The following sections include requirement for subtitles. Note that this includes what are commonly referred to as 'captions'.

For this section, for a subtitle track, Subtitle Track Language is defined as the value of of MetadataMovie/TrackMetadata/Track/Subtitle/Language (as specified in [DMeta], Section 4) corresponding with the subtitle track.

A match is found between Subtitle Track Language and 'Language Subtags' of [DMedia], Annex D.2, Table D-1 by performing a Lookup ([RFC4647], Section 3.4) of the Subtitle Track Language with all Language Subtags in [DMedia], Annex D.2, Table D-1 as the language priority list ([RFC4647], Section 2.3). If this operation results in 'default', then no match is found.

DECE Devices SHALL decode and present both text profile and image profile subtitles as per DMedia v1.0.7, and all versions adopted up to the DMedia specification defined by DMedia Annex E {DMEDIA_VERSION_POINTS}. If the schema location field of SubtitleSampleEntry in the CFF-TT subtitle track Sample Description Box ('stsd') does not conform to DMedia v1.0.7 or any version adopted up to the DMedia specification defined by DMedia Annex E {DMEDIA_VERSION_POINTS}, DECE Devices SHALL ignore the value of the schema location field of SubtitleSampleEntry.

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Note: see also [DSystem] Section 1.6 for requirements related to XML Change Management.

8.3.3.1 Subtitling Track Selection

DECE Devices SHALL determine Primary Subtitling Presentation Track, as defined in [DMeta] in accordance with Section 8.3.4.

DECE Devices SHALL determine Alternate Subtitling Presentation Track, as defined in [DMeta] in accordance with Section 8.3.4.

For purpose of track selection, a text track SHALL NOT be considered playable if both of the following are true:

- the Subtitle Track Language matches a 'Language Subtags' of [DMedia], Annex D.2, Table D-1
- the DECE Device does not support rendering of all glyphs that correspond to the Unicode Code Points defined for matching Language Subtag in [DMedia], Annex D.2, Table D-1

A DECE Device SHALL NOT select tracks that are not playable.

8.3.3.2 Subtitling Mode

A DECE Device SHALL be in either Primary Subtitling Presentation Mode or Alternate Subtitling Presentation Mode.

As an initial condition, unless otherwise specified, a DECE Device SHALL be in Alternate Subtitling Presentation Mode.

If a Primary Subtitling Presentation Track is selected through the Subtitling Track Selection process (Section 8.3.3.1), the DECE Device SHALL be in the Primary Subtitling Presentation Mode, unless the User has opted to turn subtitles off. That is, when a Primary Subtitling Presentation Track is selected, the Device is in Primary Subtitle Presentation Mode unless the User selects otherwise.

When a Primary Subtitling Presentation Track is selected through the Subtitling Track Selection process (Section 8.3.3.1), DECE Devices SHOULD provide the means for a User to turn subtitles off (Alternate Subtitling Presentation Mode) and on (Primary Subtitling Presentation Mode).

8.3.3.3 Subtitle Playback

During playback, when in Primary Subtitling Playback Mode, the DECE Device SHALL decode and present the Primary Subtitling Mode Track.

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During playback, when in Alternate Subtitling Playback Mode and an Alternate Subtitle Presentation Track has been selected through the Subtitling Track Selection process (Section 8.3.3.1), DECE Devices SHALL decode and present forced elements as per [DMedia] Section 6 from the Alternate Subtitle Presentation Track. In the case of a Forced Subtitle Track, this is all elements.

DECE Devices SHALL NOT decode and present more than one subtitle track simultaneously.

DECE Devices SHALL decode and present subtitles as per [DMedia], Section 6.

Note that Devices process both text profile and image profile subtitles.

DECE Devices SHALL render Graphic and Format Unicode Code Points encountered in textual content within CFF-TT subtitles. The Glyph rendered for Graphics and Format Unicode Code Points SHALL correspond with the character represented by the Unicode Code Point as per [UNICODE] or, in the case where the Unicode Code Point is not supported by the DECE Device, the Glyph rendered SHALL correspond with Unicode Code Point U+25A1 ("WHITE SQUARE") or Unicode Code Point U+005F ("LOW LINE").

DECE Devices SHALL ignore Control Codes Unicode Code Points (U+0000..U+001F and U+007F..U+009F) encountered in textual content within CFF-TT subtitles. An ignored Control Code does not affect presentation. No glyph is rendered for a Control Code.

DECE Devices SHALL support rendering of all glyphs that correspond to the Unicode Code Points defined for the “x-ALL” Language Subtag sequence in [DMedia], Annex D.2, Table D-1. Note that this includes support for ‘en’ (English).

DECE Devices SHOULD support rendering of all glyphs that correspond to the Unicode Code Points defined the "da", "nl", "fi", "fr", "de", "it", "no", "sv", “es” and “pt” Language Subtags in [DMedia], Annex D.2, Table D-1. Note that this requirement will become normatively ‘SHALL’ in a future version of this specification.

DECE Devices SHALL satisfy the observed presentation behavior of subtitle rendering model defined in [DMedia], Section 6, including the behavior seen with the minimum performance requirements defined in [DMedia] Annexes A, B and C. DECE Devices are allowed to use any implementation that satisfies the observed behavior defined by the model and are allowed to have higher decoding, drawing or text rendering rates.

DECE Devices are allowed to render/paint and scale to different resolutions than the SMPTE TT root container in order to optimize for presentation to the display connected to (or integrated as part of) the DECE Device, provided that they maintain relative position between subtitles and video. DECE Devices

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SHALL maintain subtitle and video relative position (regardless of differences in resolution between the display and SMPTE TT root container).

DECE Devices supporting either SD or HD profiles SHALL composite subtitles on to a minimum of 16-bit full color Subtitle Plane as per [DMedia] Section 6.

DECE Devices SHALL match the Subtitle Plane and Video Plane color space for subtitle overlay.

For random access or subtitle track switching, DECE Devices SHOULD search for the subtitle fragment that includes the composition time for the random access video sample, and prepare subtitles for presentation from the random access point into the video presentation.

Note that Media Clients will need to acquire the 'mfra' Box at the end of the file to properly random access subtitle fragments.

8.3.4 Audio and Subtitle Track Selection

The purpose of this section is to define behavior for Devices with respect to audio and subtitle track selection. This allows Devices to select default tracks consistent with the intent of the Content Providers.

Information is provided to assist Devices in selecting the appropriate audio and subtitle information. Information is contained in MetadataMovie/TrackMetadata and MetadataMovie/TrackSelections, both defined in [DMeta].

Track selection is made based on Device defaults (e.g., region and language), User preferences (e.g., language, accessibility), available tracks, TrackMetadata information and, if available, TrackSelections information. Generally, Users may override Device track selection. However, there are no overrides for Alternate Subtitle Presentation Track.

Additional terminology used in this section is defined in [DMeta], Section 5.

8.3.4.1 Default Track Selection

Container Metadata provides information that can be used to select default tracks in accordance with the Content Provider's intent. These data are defined in [DMeta], Section 4.1.5, and the assumed algorithm in [DMeta] Section 5.

System Language and other language preferences SHALL be at least one language that can be represented as Language Tags as per [RFC5646] from the IANA Language Subtag Registry [IANA-LANG].

DECE Devices SHALL set the System Language.

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DECE Devices SHOULD set the default System Language to match the user Interface language or Operating System language.

Devices SHOULD provide the means for Users to set the System Language.

Devices SHOULD provide System Language settings to include dialects. For example, “Latin Spanish” (IANA tag ‘es-419’) should be distinguished from “Castilian Spanish” (IANA tag ‘es’).

Devices SHOULD provide the means for User to select an audio preference for Type compatible with MetadataMovie/TrackMetadata/Track/Audio/Type. For example, the User can select a Type of ‘dialogcentric’.

Devices SHALL provide the means for User to select a subtitle preference for Type compatible with MetadataMovie/TrackMetadata/Track/Subtitle/Type. For example, the User can select a Type of ‘SDH’.

Devices SHALL provide the means for User to select a language preference for audio.

Devices SHALL provide the means for User to select a language preference for subtitles.

Devices SHOULD provide the means for User to select a preference dubbed audio or original audio.

Prior to playback, DECE Devices SHALL use track selection methods described in [DMeta], Section 5 to select default audio and subtitle tracks.

8.3.4.2 User Track Selection

DECE Devices SHALL provide the ability for a User to select the Selected Audio Track.

DECE Devices SHALL provide the ability for a User to select the Primary Subtitling Presentation Track.

DECE Devices SHALL NOT allow a User to select a Forced Subtitle as the Primary Subtitling Presentation Track.

DECE Devices SHALL NOT allow the User to select the Alternate Subtitling Presentation Track.

DECE Devices MAY persistently store User track selections for later use. In the future, these can be used in lieu of default track selection for this DCC.

8.3.5 Synchronization

DECE Devices SHALL synchronize audio and video presentation within 15-millisecond accuracy.

DECE Devices SHALL synchronize subtitle and video presentation with frame accuracy.

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Devices SHALL support an Edit List Box with a Timeline Mapping Edit entry as described in [DMedia] 2.4, and if included, shift the media timeline relative to the presentation timeline so that the specified Media-Time in the media timeline is mapped to the start of the presentation timeline.

Note: If an Edit List Box exists, inter-track synchronization is based on the Device appropriately processing the Edit List Box and mapping the media timeline to the presentation timeline.

8.3.6 Chapters

When random accessing a chapter from EntryTimecode (as defined in [DMeta] 4.1.4), DECE Devices SHOULD start presentation at the video frame at or immediately following that time on the movie presentation timeline. For the avoidance of doubt, if the referenced picture is not a video random accessible sample, decoding may need to begin at a previous random accessible sample and prior pictures not presented.

When DECE Devices begin playback from a Chapter time, they SHOULD start Audio presentation on the next sync sample on the movie timeline at or after the first video frame presented.

When DECE Devices begin playback from a Chapter time, they SHOULD start Subtitle presentation with the next Subtitle Event on the movie timeline at or after the first video frame presented.

For avoidance of doubt, as with all playback, video, subtitle, and audio synchronization to the movie presentation timeline is to be maintained.

DECE Devices MAY display chapter images as referenced in the Chapter element.

DECE Devices MAY display text as included in the Chapter/DisplayLabel element.

If multiple instances of DisplayLabel are provided, the DECE Device SHOULD determine the best language as if the DisplayLabel element is a Subtitle track (i.e., DisplayLabel/@language is equivalent to Track/Subtitle/Language element). For example, if DisplayLabel and Subtitle have the same languages, DisplayLabel will have the same language as subtitles.

DECE Devices MAY create and display their own text or images for chapter selection. For example, “Chapter 1”.

8.4 Trickplay

DECE Devices MAY be capable of trickplay. Examples of trickplay are fast forward, rewind and skip.

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8.5 Licensed Applications

A DRM Client in a DECE Domain SHALL NOT allow an unlicensed Licensed Application to decrypt DECE licensed DCCs.

8.6 Restrictions on Distributing DECE Device Functions

Although some functions may be distributed to Tethered Hosts and Device Proxies, playback may not. Playing Content function includes DRM Client's decryption function, decoding and output control functions including re-encrypting content using Approved Output Technologies.

DECE Devices SHALL NOT distribute Playing Content functionality to Tethered Hosts, Device Proxies, or Access Portals.

8.7 DECE Media Package (DMP) Playback Support

DECE Devices SHALL be able to play one or more DCCs, in accordance with Section 8.2, from a DECE Media Package (DMP) file formatted in accordance with [ZIP] and with the requirements in Section 11.

If there is more than one DCC in the DMP that would be playable were those DCCs not in a DMP DECE Devices SHALL provide a method for the User to select from those DCCs for playback. This refers to DCCs that conform with playability provisions of this section (Section 8), such as Media Profile and InteractiveCapabilityLevel. Container metadata is defined in [DMedia], Section 2.3.4, and [DMeta], Section 4.

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9 User-Related Requirements

9.1 User Authentication

Devices SHALL manage Security Tokens in accordance with [DSecMech], Section 3.5.

9.2 Rights Locker Query and Display

9.2.1 Rights Query

DECE Devices MAY support Rights Query operations as defined in [DCoord] Section 7, and [DMeta], Section 3.

9.2.2 Rights Display

A DECE Device MAY display Rights information obtained from the DECE Device Portal.

Proportional scaling is a transformation on an image that changes the number of horizontal and vertical pixels in the same ratio within single-pixel rounding errors. Aspect ratio is maintained. Non-proportional scaling changes horizontal or vertical sizes in different ratios.

DECE Devices MAY proportionally scale images in a Container if such image is the desired aspect ratio but not the desired size. DECE Devices SHOULD scale larger images to a smaller images rather than scaling smaller to larger.

DECE Devices SHALL NOT crop images from a Container if an image of the desired aspect ratio is present in the Container. If a DECE Device crops an image it MAY also proportionally scale that image.

DECE Devices SHALL NOT scale non-proportionally.

9.3 Ratings Enforcement

Devices SHALL restrict Content playback based on ratings in DCCs. Ratings in DCCs is in Mandatory Metadata as defined in [DMedia] Section 2.3.4.

A DECE Device SHOULD restrict the display of Rights based on Rating information in Metadata associated with the Right (such as, metadata obtained from the Portal as part of the Rights query).

A Device MAY have a user-modifiable device-specific parental control setting.

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Parental Control information can be obtained from the Coordinator using the Policy query mechanism defined in [DCoord], Section 5.6 using Parental Control Policies as defined in [DCoord], Section 5.5.3.

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10 DLNA (Informative)

This section is for information purposes only.

It is envisioned that some DECE Devices will also be DLNA devices. In order for such a device to render content in a similar way as that defined in DLNA, DECE-related metadata needs to be placed in the DLNA Content Directory Service (CDS) in a standardized way. This section explains how a DLNA Digital Media Server (DMS) that serves UPnP AV CDS places such metadata into a CDS item that refers to a DCC.

Upon acquisition of a DCC, a DECE Device which also hosts a DLNA DMS or a UPnP MediaServer Device which supports ContentDirectory Service:3 [UPNPCDS3] or higher SHOULD create a CDS item which encapsulates the Required Metadata found in the DCC as defined in [DMeta], Section 4.1 in a *upnp:foreignMetadata* property; if it does so, it SHALL use the values indicated in the table below:

UPnP CDS Property	Value
upnp:foreignMetadata@type	"uvvu.com_mddece"
upnp:foreignMetadata::fmId	Value of mddece:APID
upnp:foreignMetadata::fmClass	"UltraViolet Container" + value of mddece:DECEMediaProfile
upnp:foreignMetadata::fmProvider	Value of mddece:Publisher
upnp:foreignMetadata::fmBody@xmlFlag	1
upnp:foreignMetadata::fmBody::fmEmbeddedXML	mddece:MetadataMovie including all child elements
dc:title	value of mddece:TitleDisplay60
res@duration	Value of RunLength converted to "H+:MM:SS" format
dc:date	Value of mddece:ReleaseDate converted to [ISO 8601] format
dc:description	Value of mddece:Summary190
res@protocolInfo	"http-get:*:video/vnd.dece.mp4:*"

The values of APID and DECEMediaProfile can be found in the 'ainf' box; all other metadata referenced in this table can be found in the 'meta' box in the DCC.

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11 DECE Media Package (DMP) Support

The DECE Media Package (DMP) format allows one or more DECE CFF Containers (DCCs) to be stored, together with additional metadata and application data, in a single archive in the ZIP file format (see [ZIP]).

To ensure compatibility with future versions of the DMP format, playability of DCCs is indicated by the Interactive Capability Level (ICL) field of mandatory metadata.

11.1 Reading DMPs

Devices SHALL be able to read one or more DCCs, in accordance with Section [8.2], from a DECE Media Package (DMP) file formatted in accordance with [ZIP] and with the following normative requirements.

Local File Header:

local file header signature	SHALL verify = 0x04034b50
version needed to extract	SHALL support 1.0 as baseline, 4.5 for Zip64, 6.3 for UTF-8 *[Note 1]*
general purpose bit flag	
bit 0 (encryption)	SHALL support if 0 (not encrypted)
bits 1-2	MAY ignore
bit 3 (CRC and size values follow file data)	SHALL support
bits 4-15	MAY ignore
compression method	SHALL support if 0 (no compression)
last mod file time	MAY ignore
last mod file date	MAY ignore
crc-32	SHOULD verify
compressed size	SHALL support both 4- and 8-byte fields
uncompressed size	SHALL support both 4-and 8-byte fields
file name length	SHALL support
extra field length	SHALL support
file name (variable size)	SHALL support
extra field (variable size)	SHALL support ID 0x0001 (zip64), MAY ignore others

Note 1: Only the Zip64 feature of ZIP 4.5 and the UTF-8 encoding feature of ZIP 6.3 are required.

Devices SHALL support file data.

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Devices SHALL support data descriptor.

Devices MAY ignore Archive decryption header.

Devices MAY ignore Archive extra data record.

Central Directory File Header (same as Local File Header except):

central file header signature	SHALL verify = 0x02014b50
version made by	MAY ignore
file comment length	SHALL support
disk number start	SHALL support if 0
internal file attributes	MAY ignore
external file attributes	MAY ignore
relative offset of local header	SHALL support
file name (variable size)	SHALL support
extra field (variable size)	SHALL support ID 0x0001 (zip64), MAY ignore others
file comment (variable size)	MAY ignore

Zip64 end of central directory record (same as Local File Header except):

zip64 end of central dir signature	SHALL verify = 0x06064b50
size of zip64 end of central directory record	SHALL support
number of this disk	SHALL support if 0
number of the disk with the start of the central directory	SHALL support if 0
total number of entries in the central directory on this disk	MAY ignore
total number of entries in the central directory	MAY ignore
size of the central directory	MAY ignore
offset of start of central directory with respect to the starting disk number	MAY ignore
zip64 extensible data sector	MAY ignore

Zip64 end of central directory locator:

zip64 end of central dir locator signature	SHALL verify = (0x07064b50)
number of the disk with the start of the zip64 end of central directory	SHALL support if 0

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relative offset of the zip64 end of central directory record	SHALL support
total number of disks	SHALL support if 1

End of central directory record:

end of central dir signature	SHALL verify = (0x06054b50)
number of this disk	SHALL support if 0
number of the disk with the start of the central directory	SHALL support fi 0
total number of entries in the central directory on this disk	MAY ignore
total number of entries in the central directory	MAY ignore
size of the central directory	MAY ignore
offset of start of central directory with respect to the starting disk number	SHALL support
.ZIP file comment length	SHALL support
.ZIP file comment	MAY ignore

For convenience, the primary characteristics of DMPs are summarized as an informative list below. See the tables above for normative details.

- Compression is not used for DCCs or the central directory (compression method 0, “stored,” is used).
- Encryption is not used for DCCs or the central directory.
- UTF-8 encoding of DCC filenames and comment fields is allowed.
- DCCs may be stored in Zip64 format.
- The DMP is not split into multiple files and does not span multiple volumes.

Devices SHALL recognize files with the following Media Type (MIME type) or extension as DMPs:

Extension	Description	Media Type	Parameters
.uvp .uvvp	UltraViolet Package	application/vnd.dece.zip	[none]

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11.2 Update of DCC in DECE Media Package

When a Device is required to update a DCC, in accordance with Sections 5.2.3 or 7.2.4.3 the Device SHALL write the data in place in the DMP, calculate a new crc-32 value in accordance with [ZIP], and write the calculated crc-32 value into the file header in the DMP.

11.3 Licenses and Base Locations in DMPs

DRM License and Base Location information can be added as files to a DMP without re-writing a DCC.

DRM License files SHALL contain a single entire 'pssh' box as defined in DMedia.

When DRM License files for a DCC are written to a DMP they SHALL have the filename of the form: `/Licenses/<DRM>/<APID>.uvl` where:

- <APID> is the APID for the associated DCC.
- <DRM> is DRM Name as per [DSystem], Section 17.

Base Location files SHALL be XML documents containing a BaseLocations element as defined in [DMeta], Section 4.

When Base Location data for a DCC is written to a DMP it SHALL have the filename of the form: `/<APID>/BaseLocations.xml` where

- <APID> is the APID for the associated DCC.

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12 File Management

12.1 Default File Locations

This section specifies where Licensed Applications are encouraged to store DECE files. In this context, a DECE file is a DCC or DMP stored in a filesystem.

There are two categories of devices where it is applicable for Licensed Applications to store files in a specific location

- Devices that are capable of Outbound File Transfer, including devices where Licensed Applications are capable of writing removable media
- Devices or collection of devices where multiple Licensed Applications can share a filesystem. Note that the filesystem might be internal such as on a general purpose computer, or external, such as on a Network Attached Storage (NAS) device.

Although there might be other conditions where writing files to a known location applies, this section assumes that files will be written in specific file locations given those conditions.

All requirements in this section assume the feasibility of writing files to the locations indicated. That is, the requirements are irrelevant if it is not feasible for the Licensed Application to write to or read from the specified location as applicable.

12.1.1 Using Default File Locations

The following requirements are written towards Licensed Applications. However the requirements are strongly recommended for all other entities accessing DECE files such as Download Managers that are independent of Licensed Applications.

12.1.1.1 Storing Files

Licensed Applications storing DECE files on a local filesystem or removable media SHOULD by default store DECE files at the applicable Default File Location.

Licensed Applications storing DECE files on a local filesystem or removable media SHALL provide Users the ability to select the Default File Location as the default location for storing DECE files.

If the Licensed Application intends to store a DECE file at the Default File Location, but that location does not exist, the Licensed Application SHALL create the location associated with the Default File Location, if possible.

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12.1.1.2 Locating Files

Licensed Applications searching for DECE files on a local filesystem or removable media SHOULD by default first search for DECE files at the applicable Default File Location.

Licensed Applications accessing DECE files from a local filesystem or removable media SHALL provide Users the ability to select the Default File Location as the default location for searching for DECE files.

12.1.1.3 Setting Location for Reading and Storing Files

Licensed Applications that do not by default store files in the Default File Location SHALL provide a means for the User to change the storage location to the Default File Location, where feasible.

Licensed Applications that do not by default search for files in the Default File Location SHALL provide a means for the User to add the Default File Location to the search path, where feasible.

In multi-user environments, Devices MAY provide an option to store files in the "public" folder to make them discoverable by other users.

12.1.2 Default File Locations

Default File Locations identify for a given operating system and/or the storage medium the default location for DECE files. This section indicates the correct Default File Location for various operating systems and for removable storage.

Licensed Applications SHALL use Default File Location as specified in this section.

12.1.2.1 Microsoft Windows

The Default File Location for Microsoft Windows operating systems is not a fixed location. Rather it is obtained using the following steps:

- Default path for Windows 7 and newer is: %USERPROFILE%\Videos\UltraViolet, derived as follows:
  - Pass FOLDERID_VideosLibrary to IKnownFolder to determine default video save location.
- Default File Location for Widows versions older than Windows 7 is: %USERPROFILE%\My Documents\My Videos\UltraViolet, constructed as follows:
  - Use FOLDERID_Videos if available, otherwise use CSIDL_VIDEOS if available
  - If GUIDs not available, use legacy default path below.
  - If %USERPROFILE% not available substitute null and use default drive

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12.1.2.2 Apple Mac OS X

The Default File Location for Apple Mac OS X is: `/Users/<username>/Movies/UltraViolet`

Where `<username>` is the Mac OS username.

12.1.2.3 Unix, Linux and Posix OS

The Default File Location of Unix, Linux, Posix and other Unix variants is:
`/home/media/UltraViolet`

12.1.2.4 Android OS

- For API Level 8 or above, Default File Location is determined as follows: `getExternalStoragePublicDirectory(DIRECTORY_MOVIES)`, create "UltraViolet" subdirectory if not present
- For APIs prior to API Level 8, the Default File Location is `/sdcard/Movies/UltraViolet`. If not available, for Default File Location use: `/Movies/UltraViolet`

12.1.2.5 General Media (FAT, NTFS, HFS, etc.)

General Media refers to storage such as other fixed media, removable storage media (such as, USB, SD card, hard disk, optical discs, etc.), and external media such as NAS. File location is independent of operating system. A hierarchical filesystem (i.e., one with a top level directory and subdirectories) is assumed.

The Default File Location is: <root>`Movies`<path separator>`UltraViolet`

Where

- <root> is the indicator of the root directory; for example “/” or “\”. Where practical, root should be a shared location, rather than a user-specific path. An example of impractical is where multiple users to not have write privileges to a shared location.
- <path separator> is the character or characters used to separate directory levels in a path, typically “/” or “\".

The term “UV” SHALL be substituted for “UltraViolet” in filesystems where that substitution would convert an invalid Default File Location into a valid Default File Location.

12.1.2.6 iOS

iOS does not currently have a default location.

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END

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