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Abstract:	Date: 2022-07-08 <p>Content distributors often use multiple Content Delivery Networks (CDNs) to distribute their content to the end-users. They may upload a copy of their catalogue to each CDN, or more commonly have all CDNs pull the content from a common origin. Alternate URLs are generated, one for each CDN, that point at identical content. DASH players may access alternate URLs in the event of delivery problems. Content steering describes a deterministic capability for a content distributor to switch the content source that a player uses either at start-up or midstream, by means of a remote steering service. The DASH implementation of Content Steering also supports the notion of a proxy steering server which can switch a mobile client between broadcast and unicast sources.</p>
Disclaimer:	<p>This document is a candidate Technical Specification. DASH-IF is expecting to publish this initially, but to submit the specification to a formal specification organization. The primary choice is ETSI, for which DASH-IF has a PAS agreement.</p> <p>This document is not yet final. It is provided for public review until the deadline mentioned below. If you have comments on the document, please submit comments by one of the following means:</p> <ul style="list-style-type: none"> - at the github repository https://github.com/Dash-Industry-Forum/Content-Steering/issues, or - the mailing list at iop@dashif.org <p>Please add a detailed description of the problem and the comment.</p> <p>Based on the received comments a final document will be published latest by the expected publication date below if the following additional criteria are fulfilled:</p> <ul style="list-style-type: none"> - All comments from community review are addressed - A time plan for test, conformance and reference tools are available. This includes availability of test services and an implementation oin the dash.js reference tools
Commenting Deadline:	Sep 30, 2022
Expected Publication:	Dec 31, 2022
Other Comments	Beyond this specification, it is expected that DASH-IF IOP Guidelines are updated to reference this specification, in particular the client requirements.



**DASH-IF Candidate Technical Specification:
Content Steering for DASH**

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Important notice

The present document can be downloaded from:
<http://www.dashif.org/guidelines>

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Foreword

This Technical Specification (TS) has been produced by the DASH-IF Technical Working Group.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in deliverables except when used in direct citation.

Executive summary

Content distributors often use multiple Content Delivery Networks (CDNs) to distribute their content to the end-users. They may upload a copy of their catalogue to each CDN, or more commonly have all CDNs pull the content from a common origin. Alternate URLs are generated, one for each CDN, that point at identical content. DASH players may access alternate URLs in the event of delivery problems. Content steering describes a deterministic capability for a content distributor to switch the content source that a player uses either at start-up or midstream, by means of a remote steering service. The DASH implementation of Content Steering also supports the notion of a proxy steering server which can switch a mobile client between broadcast and unicast sources.

1 Scope

The present document specifies Content Steering for DASH.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, DASH-IF cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document:

- [1] HTTP Live Streaming 2nd Edition, <https://datatracker.ietf.org/doc/html/draft-pantos-hls-rfc8216bis-10>
- [2] ISO/IEC 23009-1:2021: “Information technology -- Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and segment formats”
- [3] RFC3986 Uniform Resource Identifier (URI): Generic Syntax <https://datatracker.ietf.org/doc/html/rfc3986>

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

- [i.1] DASH-IF Interoperability Points, Part 1: Overview, architecture and interfaces
- [i.2] ISO/IEC 14496-12:2021 “Information technology -- Coding of audio-visual objects -- Part 12: ISO base media file format”
- [i.3] ISO/IEC 23000-19:2020 “Information technology -- Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media”
- [i.4] CTA-5004: Web Application Video Ecosystem-Common Media Client Data. [Online] Available: <https://cdn.cta.tech/cta/media/media/resources/standards/pdfs/cta-5004-final.pdf>

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Content Steering Server: A network element that provides steering information to one or several or many DASH Players for DASH operation across multiple CDNs.

DASH Content Steering Manifest: A document that includes steering instructions to a DASH player provided by a Content Steering Server

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CDN	Content Delivery Network
CMAF	Common Media Application Format
CMCD	Common Media Client Data
CTA	Consumer Technology Association
DASH	Dynamic Adaptive Streaming over HTTP
DCSM	DASH Content Steering Manifest
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ISO	International Standards Organization
MPD	Media Presentation Description
TTL	Time-To-Live
URL	Uniform Resource Locator

4 Overview and Architecture

Content distributors often use multiple Content Delivery Networks (CDNs) to distribute their content to the end-users as shown in Figure 4-1. They may upload a copy of their catalogue to each CDN, or more commonly have all CDNs pull the content from a common origin. In the DASH Media Presentation Description (MPD) as defined in ISO/IEC 23009-1 [2], multiple URLs are provided, one for each CDN, that point at identical content. Typically, a DASH player will access content from one single location, using the default location defined by the MPD.

If the DASH player then observes delivery problems, it may chose to access content via the alternate URLs. This operation is completely client-driven, is not standardized between players and may not be the desired behaviour of the content distributor.

Content steering provides a deterministic capability for a content distributor to switch the content source that a player uses either at start-up or midstream, by means of a remote steering service. The DASH implementation of Content Steering also supports the notion of a proxy steering server which can switch a mobile client between broadcast and unicast sources.

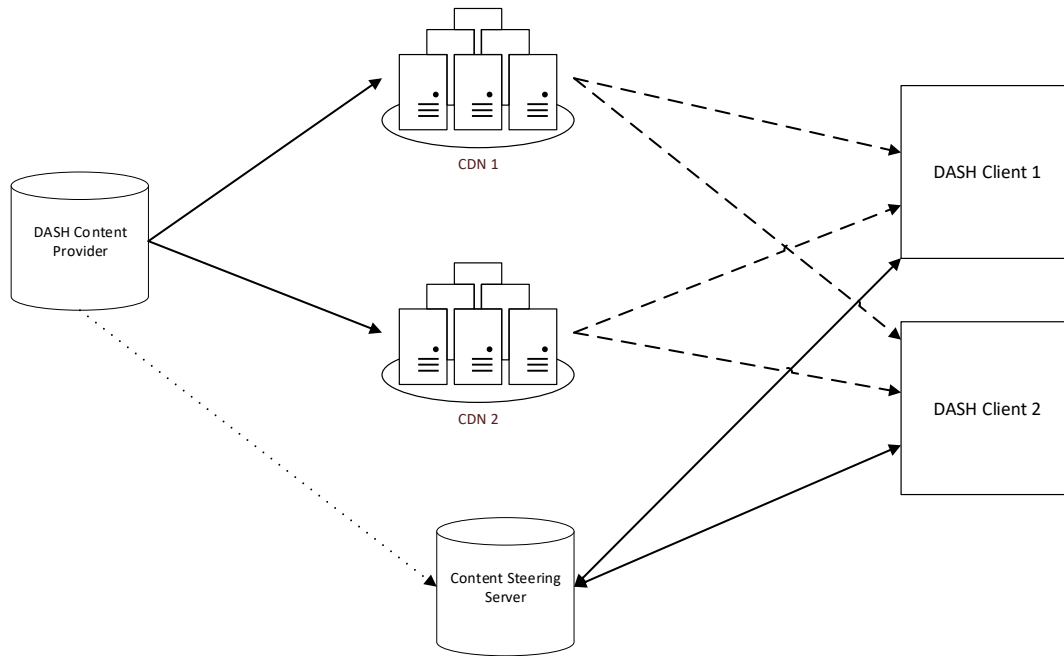


Figure 4-1 Basic Architecture with Content Steering

Steering is accomplished by having the DASH client periodically access a content steering server to retrieve a steering manifest, which instructs the player as to the availability and priority of content sources.

The typical procedures followed when content steering is in use are shown in Figure 4-2 for the case when the content is provided on two CDNs. The DASH content provider generates an MPD that includes Base URLs to CDN1 and CDN2, as well as an address where the clients can access the content steering server. The provider also uploads the MPD and the Content segments to both CDNs. At the start of playback, the DASH client requests the MPD from one CDN, in this case from CDN2. It finds the content steering server URL, and it may find information that instructs it to contact the content steering server prior to the first segment request versus the default behaviour of making the request once its starting buffer is full. The player then makes a request to the content steering server. The content server responds with a content steering manifest and the DASH client uses the information within to prioritize the segment source, in this case from CDN2. After some time, the content provider may collect operational information from the participating clients, for example by using Common Media Client Data (CMCD) as defined in CTA-5004 [i.4]. Based on this information, the content provider may update the content steering server, and based on this updated information, the content steering manifest may change. When the client requests an update to the content steering manifest, new information may be provided that instructs the DASH client to request the Segments from CDN1 instead of CDN2. The DASH client then switches smoothly, at a segment boundary, to download the Segments from CDN1 instead of CDN2.

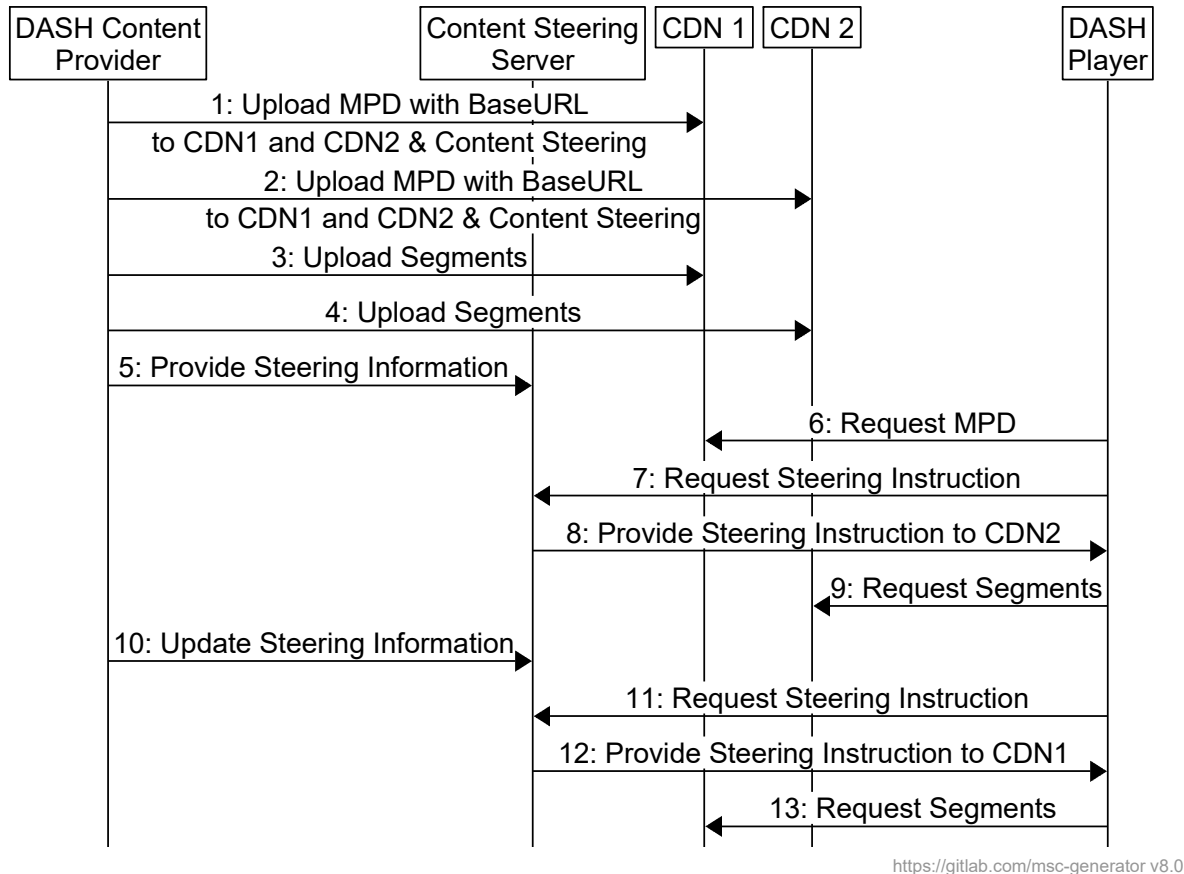


Figure 4-2 Typical procedures in Content Steering operation

This specification provides the following detailed information to support interoperable operation of content steering in DASH Media Presentations:

- Clause 5 provides the details on how to signal different alternate CDNs in the DASH MPD using existing **BaseURL** elements as well as an extension to the DASH MPD in order to provide the location of the Content Steering server as well as some additional instructions to the client. This includes the semantics and XML syntax of the new **ContentSteering** element.
- Clause 6 provides the details on the DASH content steering manifest (DCSM) and the behaviour of the content steering server, in particular the semantics and JSON syntax of the steering server response.
- Clause 7 defines the DASH player behaviour in detail. A DASH player supporting Content Steering is required to implement the detailed procedures documented in this clause.
- Clause 8 provides guidelines on the usage of DASH Annex I for providing the client identity as part of the DASH player to content steering server communication.
- Annex A provides operational examples of a DASH MPD as well as of the response of the content steering server.

5 Content Steering Signalling in DASH MPD

5.1 Overview

Content distributors often use multiple Content Delivery Networks (CDNs) to distribute their content to the end-users. They may upload a copy of their catalogue to each CDN, or more commonly have all CDNs pull the content from a common origin. Alternate URLs are generated, one for each CDN, that point at identical content.

The DASH MPD supports the **BaseURL** element to allow the listing of these alternate URLs. DASH players may access alternate URLs in the event of delivery problems. Content steering describes a deterministic capability for a content distributor to switch the content source that a player uses either at start-up or midstream, by means of a remote steering service. The DASH implementation of Content Steering also supports the notion of a proxy steering server which can switch a mobile client between broadcast and unicast sources.

NOTE: Overlapping @serviceLocation names for steerable and non-steerable BaseURLs is discouraged. i.e. if a server-side ad insertion provides BaseURLs with an overlapping @serviceLocation value it could cause unintended behavior.

To enable content steering, a new element **ContentSteering** is introduced in the MPD.

In addition, the **BaseURL** element is use and in particular, if the value of the @serviceLocation shall be a non-empty strings and for interoperability with other formats shall only contain characters from the set [a..z], [A..Z], [0..9], '!', '!', and '_!.

The DASH MPD schema must be extended to include a reference to the new **ContentSteering** element as follows.

```
<xs:complexType name="MPDtype">
  <xs:annotation>
    <xs:documentation xml:lang="en">MPD Type</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="ContentSteering" type="ContentSteeringType" minOccurs="0"
maxOccurs="1"/>
    <xs:element name="ProgramInformation" type="ProgramInformationType" minOccurs="0"
maxOccurs="unbounded"/>
    ...
  </xs:sequence>
```

NOTE: DASH-IF is aware that such an extension needs to be coordinated with MPEG to address this in ISO/IEC 23009-1. DASH-IF will seek guidance if this approach is appropriate, or if an extension element is preferred to use a DASH-IF namespace.

This element defines the URL of a steering server. Additional optional attributes may be provided in the Content Steering element in order to define a default service location, to provide an indication whether the content steering server needs to be contacted prior to requesting the first Segment and to define a potential proxy server URL. For details refer to clause 5.2.

The **ContentSteering** element shall appear at most once in an MPD and only at the MPD level.

The semantics of the attributes and elements for Content Steering are provided in subclause 5.2, Table 5.2-1. The XML syntax of the Content Steering element is provided in subclause 5.3, Table 5.3-2.

5.2 Semantics

Table 5.2-1 — Semantics of the Content Steering element

Element or Attribute Name	Use	Description
ContentSteering		A URL that can be used to access the Content Steering server. The URL points to a DASH Content Steering Manifest (DCSM) as defined in clause 6.

Element or Attribute Name		Use	Description
	@defaultServiceLocation	O	<p>This attribute specifies that the default BaseURL to be used for playback shall be the BaseURL element whose @serviceLocation value matches the value of this attribute.</p> <p>For interoperability with other formats, the default service location string shall only contain characters from the set [a..z], [A..Z], [0..9], '.', '-', and '_'.</p>
	@queryBeforeStart	OD Default: false	<p>If true, specifies that the player must resolve the response from the Steering Server prior to starting playback.</p> <p>Default value is false.</p>
	@proxyServerURL	O	<p>If present, specifies a proxy server to which the client should preferentially address its steering requests, while transferring the original content steering server URL as a query parameter. See clause 6 for details.</p>
<p>Key For attributes: M=mandatory, O=optional, OD=optional with default value, CM=conditionally mandatory For elements: <minOccurs>...<maxOccurs> (N=unbounded) Elements are bold; attributes are non-bold and preceded with an @.</p>			

5.3 XML syntax

Table 5.3-2 – XML Syntax of the ContentSteering element

<pre> <!--ContentSteering --> <xs:complexType name="ContentSteeringType"> <xs:simpleContent> <xs:extension base="xs:anyURI"> <xs:attribute ref="defaultServiceLocation"/> <xs:attribute name="queryBeforeStart" type="xs:boolean" default="false"/> </xs:extension> </xs:simpleContent> </xs:complexType> <xs:attribute name="proxyServerURL" type="xs:anyURI"/> <xs:simpleType> <xs:restriction base="xs:string"> <xs:pattern value="[a-zA-Z0-9_.-]"/> </xs:restriction> </xs:simpleType> </xs:attribute> </pre>

6 DASH Steering Manifest and Server Behaviour

6.1 Overview

Based on the description in clause 4, the DASH Steering server provides a Steering Manifest on a request from a DASH client.

The DASH Content Steering Manifest (DCSM) is a json document and shall be formatted according to the JSON schema provided in clause 6.2.

The semantics of the key-value pairs of the DCSM are defined in clause 6.3.

A client shall ignore any key of the DCSM that it does not recognize. DCSM keys are case-sensitive.

Note: this structure is intentionally similar to that defined by [1] Section 7.1. for HLS for the purposes of interoperability. The DASH variant and versioning are defined in this document and intentionally exclude features in the HLS design (such as pathway cloning) which are not applicable for DASH.

6.2 JSON Syntax

```
{
  "VERSION": number,           // REQUIRED, must be an integer
  "TTL": number,               // REQUIRED, number of seconds
  "RELOAD-URI": string,        // OPTIONAL, URI
  "SERVICE-LOCATION-PRIORITY": [ // REQUIRED, array of ServiceLocation
    identifiers in order of preference ]
}
```

6.3 Semantics

The semantics of the DCSM are defined in Table 6.3-1.

Table 6.3-1 — Semantics of the DASH Content Steering Manifest

Key	Use	Description
DCSM		A URL that can be used to access the Content Steering server. The URL points to a DASH Content Steering Manifest (DCSM) as defined in clause 6.
VERSION	M	<p>The version of DCSM.</p> <p>This specification defines DASH Steering Manifest version 1.</p> <p>A client shall refuse to use a DCSM with an unrecognized value for this key.</p>
TTL	OD Default: 300	<p>specifies how many seconds the client shall wait before reloading the DCSM.</p> <p>The default and recommended value is 300 seconds .</p> <p>The Steering Server may vary the TTL by client and the TTL may vary with each reload of the steering server manifest</p>
RELOAD-URI	O	<p>if present, specifies the URI the client shall use the next time it obtains the DCSM. The RELOAD-URI may be relative to the current DCSM Manifest URI.</p> <p>If not present, the current DCSM Manifest URI shall be used.</p>

Key	Use	Description
SERVICE-LOCATION-PRIORITY	OD Default: false	<p>SERVICE-LOCATION-PRIORITY is an array of BaseURL@serviceLocation IDs.</p> <p>Elements in the SERVICE-LOCATION-PRIORITY array are ordered by preference of the BaseURL to be selected, with the first being most preferred.</p> <p>The value of this key shall contain at least one element for serviceLocation.</p> <p>A serviceLocation ID in the SERVICE-LOCATION-PRIORITY array shall not appear more than once.</p> <p>Clients shall ignore unrecognized serviceLocation IDs in the SERVICE-LOCATION-PRIORITY array.</p>
Key M=mandatory, O=optional, OD=optional with default value, CM=conditionally mandatory		

7 Normative DASH Client Steering behaviour

A DASH client supporting DASH Content Steering as defined in this specification shall adhere to the following procedures:

1. If the **ContentSteering** element is present in the MPD, then the client shall parse the element and extract the server URI, as well as the @defaultServiceLocation, @queryBeforeStart and @proxyServerURL attributes, if present.
2. If any extended HTTP GET request parametrization instructions as defined in clause 8 are present in the MPD which target the **ContentSteering** element, then they shall be executed at this stage to modify the server URI.
3. If @proxyServerURL is present, then the client shall construct the STEERING-SERVER-URL to be the value of the @proxyServerURL with the addition of a query argument "url" and a value equal to the URLEncoded server URI as defined in RFC 3986 [3]. If the @proxyServerURL contains no query parameters, then the query argument shall be preceded by a question mark Unicode 0x2C. If query parameters are already present in the @proxyServerURL, then the query argument shall be preceded by an ampersand Unicode 0x26.
4. If @proxyServerURL is absent, then the client shall use the server URI as the STEERING-SERVER-URL.
5. If @queryBeforeStart is absent, or present and set to false, then the client shall follow its default start-up sequence. Once playback has started and the client has reached its target buffer, it shall proceed to the next step.
6. The client shall make a GET request to the STEERING-SERVER-URL.
7. The GET request should be accompanied by two optional query parameters:
 - a. The _DASH_pathway parameter shall contain a value of the currently selected **BaseURL**@serviceLocation, contained in double-quotes. If playback has not yet started due to this being the first request with @queryBeforeStart set to true, then the _DASH_pathway parameter shall be omitted.
 - b. The _DASH_throughput parameter represents a current prediction of media download throughput observed by the client, in units of integer bits per second, from the applied @serviceLocation. The exact method of bit rate estimation may vary by client. If playback has not yet started due to this being

the first request with `@queryBeforeStart` set to true, or if the throughput value is unknown for other reasons, then the `_DASH_throughput` parameter should be omitted.

8. Upon receipt of the steering server response, the client should parse it and retrieve the `VERSION`, `TTL`, `SERVICE-LOCATION-PRIORITY` array and optional `RELOAD-URI`. The client shall ignore any steering manifest keys it does not recognize. Manifest keys are case-sensitive.
9. The client sets a timer to re-request the `STEERING-SERVER-URL` after `TTL` seconds.
10. If `RELOAD-URI` is present, then the client shall update the `STEERING-SERVER-URL` to match that specified by `RELOAD-URI`. The `RELOAD-URI` may be relative to the current server URI.
11. If the `VERSION` is a value other than 1, then the client shall abort any further steering behavior.
12. The string entries in the `SERVICE-LOCATION-PRIORITY` array represent a prioritized list of serviceLocations from which playback should take place, with the highest priority option listed first. This highest priority item is termed the preferred service location. The `SERVICE-LOCATION-PRIORITY` array is applicable across all periods present in the manifest as long as they include one or more `<BaseURL>` elements with a `serviceLocation` attribute value included in the `SERVICE-LOCATION-PRIORITY` array, or inherit from top level **BaseURL** elements with a `@serviceLocation` attribute value included in the `SERVICE-LOCATION-PRIORITY` array.
13. If the client is playing content defined by a `BaseURL` element with a `serviceDescription` not equal to the preferred service location, then the client shall immediately switch to retrieving future content from the **BaseURL** referenced by the preferred service location. Note that existing requests against a prior `serviceLocation` should be allowed to complete and forward buffers should not be trimmed. If the preferred service location is not described in the DASH MPD, then the client should attempt to switch to the next highest priority service location. If no `serviceLocations` match the manifest, then the client may ignore the current `SERVICE-LOCATION-PRIORITY` array. It should still reload the `RELOAD-URI` after the specified `TTL` interval in case new service locations are added.
14. If the client encounters playback problems which would normally cause it to try an alternate **BaseURL**, it may continue to make that local switching decision, while following these constraints:
 - a. The client may only try `serviceLocations` which were present in the last steering server response.
 - b. The client shall try these `serviceLocations` in the order in which they were prioritized in the last steering server response.
 - c. As it switches away from the highest priority `serviceLocation` for local performance reasons, it shall exclude that `serviceLocation` for a time-limited period equal to the last steering server `TTL` that it received. Effectively this means that if the next steeringServer response again assigns the excluded `serviceLocation` as the highest priority, the client shall ignore that instruction and instead process the `SERVICE-LOCATION-PRIORITY` array as if the excluded `serviceLocation` were not present.

8 Extended HTTP GET request parametrization instructions

8.1 URL Query information for Content Steering

Query arguments attached to the request if the DCSM can be used to initialize content steering parameters.

In order to do so, it is recommended that the URL substitution mechanism and syntax as defined in MPEG-DASH ISO/IEC 23009-1 [2], clause I.3, "Extended HTTP GET request parametrization" is used. In order to fully support functionality, the substitution mechanism needs to be extended. Details of this is provided in clause 8.2.

The following provides guidelines on how to make use of this functionality.

Consider a MPD URL of the following form

`https://cdn.distributor.com/content/common-cachable-manifest.mpd?steeringToken=12345`

with relevant contents shown as:

```
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd" type="dynamic"
minimumUpdatePeriod="PT30S" timeShiftBufferDepth="PT30M" availabilityStartTime="2022-02-
25T12:30:00" minBufferTime="PT4S" profiles="urn:mpeg:dash:profile:isoff-live:2011">
<EssentialProperty schemeIdUri="urn:mpeg:dash:urlparam:2014"
xmlns:up="urn:mpeg:dash:schema:urlparam:2014">
<up:ExtUrlQueryInfo queryTemplate="token=$query:steeringToken$" useMPDUrlQuery="true"
includeInRequests="steering"/> </up:ExtUrlQueryInfo>
<ContentSteering defaultServiceLocation="alpha"
queryBeforeStart="false">https://steering.service.com/app/instance1234</ContentSteering>
<BaseURL serviceLocation="alpha">https://cdn1.example.com/</BaseURL>
<BaseURL serviceLocation="beta">https://cdn2.example.com/</BaseURL>
<Period id="1">
...
</Period>
</MPD>
```

In this example the request to the steering server would be processed as

`https://steering.service.com/app/instance1234?steeringToken=12345&_DASH_pathway=alpha&_DASH_throughput=5140000`

If the **ContentSteering** element had specified a `@proxyServerURL` attribute as shown below

```
<ContentSteering defaultServiceLocation="alpha" proxyServerURL="http://127.0.0.1:8844"
queryBeforeStart="true">https://steering.service.com/app/instance1234</ContentSteering>
```

then the request to the steering server would be processed as

`http://127.0.0.1:8844?url=
https%3A%2F%2Fsteering.service.com%2Fapp%2Finstance1234%3FsteeringToken%3D1234
5&_DASH_pathway=alpha&_DASH_throughput=5140000`

8.2 Updates to Annex I - Flexible Insertion of URL Parameters

8.2.1 Introduction

In order to fully support the functionality of content steering, extensions to ISO/IEC 23009-1 [2], clause I.3, "Extended HTTP GET request parametrization" are needed. These documented in the following and communication with MPEG is initiated to address this.

8.2.2 Updates to Table I.3 - description

Table I.3 of ISO/IEC 23009-1 [2] specifies which HTTP GET requests are required to carry the URL Parameters. Value is a white spaced concatenated list with keys. In order to support the functionality, a key for content steering needs to be provided, e.g.

- 7) "content steering" (requests to Content Steering servers)

8.2.3 Updates to I.2.4.5

The intent is to re-use the URL parameters of the MPD URL in the Content Steering URL.

Assuming the DASH MPD is accessible through:

`http://www.example.com/dash/urlparam1.mpd?token=1234&sessionID=h48djn`

Then

- 1) Computation of an initial query string

```
initialQueryString="token=1234&sessionID=h48djn"
```

2) Computation of a final query

```
finalQueryString="token=1234&sessionID=h48djn"
```

and the corresponding MPD looks as follows:

```
<MPD
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd urn:mpeg:dash:schema:urlparam:2014
DASH-MPD-UP.xsd"
type="static" mediaPresentationDuration="PT3256S" minBufferTime="PT1.2S"
profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">
<EssentialProperty schemeIdUri="urn:mpeg:dash:urlparam:2014"
xmlns:up="urn:mpeg:dash:schema:urlparam:2014">
    <up:UrlQueryInfo includeInRequests="7" queryTemplate="$querypart$"
useMPDUrlQuery="true"/>
</EssentialProperty>
    <ContentSteering defaultServiceLocation="beta" queryBeforeStart="true">
https://steeringservice.com/app/instance1234</ContentSteering>
    <Period>
...
</Period>
</MPD>
```

8.2.4 Modified content steering server URLs building process

In order to create modified content steering server URLs for example as

```
https://steeringservice.com/app/instance1234?token=1234&sessionID=h48djn&_DASH_pathway=beta&_DASH_throughput=5140000
```

the `_DASH_` parameters are added automatically by the player as part of the processing rules for Content Steering according to clause 7 and are independent of the URL building mechanisms described in Annex I of ISO/IEC 23009-1 [2].

Annex A Example implementations (informative)

A.1 Basic workflow example

This case illustrates service location changes along with performance override.

A DASH MPD is presented to a player.

```
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd" type="dynamic"
minimumUpdatePeriod="PT30S" timeShiftBufferDepth="PT30M" availabilityStartTime="2022-02-
25T12:30:00" minBufferTime="PT4S" profiles="urn:mpeg:dash:profile:isoff-live:2011">
  <ContentSteering defaultServiceLocation="beta"
queryBeforeStart="true">https://steering-service.com/app/instance1234?token=234523452</ContentSteering>
  <BaseURL serviceLocation="alpha">https://cdn1.example.com/</BaseURL>
  <BaseURL serviceLocation="beta">https://cdn2.example.com/</BaseURL>
  <Period id="1">
    <AdaptationSet mimeType="video/mp4" codecs="avc1.4D401F" frameRate="30000/1001"
segmentAlignment="true" startWithSAP="1">
      <BaseURL>video/</BaseURL>
    ...
  </AdaptationSet>
</Period>
</MPD>
```

The player would parse the **ContentSteering** element upon receiving the MPD. Since the @queryBeforeStart attribute is present and set to true, instead of starting playback using the @defaultServiceLocation of "beta", it would make a request to the steering server at https://steering-service.com/app/instance12345. This request would be

```
https://steering-service.com/app/instance1234?token=234523452
```

Note the `_DASH_` params are not attached to this request since the player has not yet started playback. The server may then return the JSON response below:

```
{
  "VERSION": 1,
  "TTL": 300,
  "RELOAD-URI": "https://steering-service.com/app/instance12345?session=abc"
  "SERVICE-LOCATION-PRIORITY": ["alpha", "beta"]
}
```

The player would recognize that the highest priority serviceLocation specified is "alpha", so it would use the BaseURL construct of https://cdn1.example.com/ as it begins to request content. The player would then set a timer so that in 300s, when the throughput it was estimating is 5.14Mbps, it would again query the steering server, with the URL

```
https://steering-service.com/app/instance12345?session=abc&_DASH_pathway=alpha
&_DASH_throughput=5140000
```

At that time the steering server may return

```
{
  "VERSION": 1,
  "TTL": 250,
  "RELOAD-URI": "https://steering-service.com/app/instance12345?session=abc"
  "SERVICE-LOCATION-PRIORITY": ["beta", "alpha"]
}
```

The player would then switch to loading the next media objects using the BaseURL of https://cdn2.example.com/. 250s later it would again request the steering service and the cycle would continue until end-of-stream was reached.

Let's now assume that the player runs in to a delivery problem 100s after the last steering server response. This problem may be triggered by 404 responses, or throughput degradation. The player decides that "beta" is not a good source and makes a local decision to switch to the next highest priority serviceLocation "alpha" and to blacklist "beta". This blacklist last for a time-period equal to the last TTL received, which is 250s. 150s after taking this action, the player calls the steering server and reports the serviceLocation it is currently playing using the `_DASH_pathway` parameter:

```
https://steering-service.com/app/instance12345?session=abc&_DASH_pathway=alpha
&_DASH_throughput=4880000
```

Since the steering server is stateful, it knows that it last assigned "beta" but the player is now reporting "alpha" implying a client-initiated change. The steering server can take this signal in to account when making its steering decisions. It may however still reply with

```
{
  "VERSION": 1,
  "TTL": 250,
  "RELOAD-URI": "https://steering-service.com/app/instance12345?session=abc"
  "SERVICE-LOCATION-PRIORITY": ["beta", "alpha"]
}
```

Since the client has excluded "beta" for performance reasons for 250s since the switch was made, it processes the SERVICE-LOCATION-PRIORITY array as if "beta" were not present and continues to play "alpha". At the next steering server response, the exclusion would have expired and the client should apply the conventional processing rules to the response.

A.2 Usage of Proxy Server URL

The following example shows the usage of Content Steering with a proxyServer URL and URL query modification.

Assume a DASH player requests a manifest using

```
https://cdn.distributor.com/content/common-cachable-
manifest.mpd?steeringToken=12345
```

which returns the following content:

```
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd" type="dynamic"
minimumUpdatePeriod="PT30S" timeShiftBufferDepth="PT30M" availabilityStartTime="2022-02-
25T12:30:00" minBufferTime="PT4S" profiles="urn:mpeg:dash:profile:isoff-live:2011">
  <EssentialProperty schemeIdUri="urn:mpeg:dash:urlparam:2014"
xmlns:up="urn:mpeg:dash:schema:urlparam:2014">
    <up:UrlQueryInfo includeInRequests="7" queryTemplate="$querypart$"
useMPDUrlQuery="true"/>
  </EssentialProperty>
  <ContentSteering defaultServiceLocation="beta" queryBeforeStart="false"
proxySteer="http://127.0.0.1:3455/steer">https://steering-service.com/app/instance1234?id=abc123<
/ContentSteering>
  <BaseURL serviceLocation="alpha">https://cdn1.example.com/</BaseURL>
  <BaseURL serviceLocation="beta">https://cdn2.example.com/</BaseURL>
  <BaseURL serviceLocation="embms">http://127.0.0.1:3344/</BaseURL>
  <Period id="1">
    <AdaptationSet mimeType="video/mp4" codecs="avc1.4D401F" frameRate="30000/1001"
segmentAlignment="true" startWithSAP="1">
      <BaseURL>video/</BaseURL>
      ...
    </AdaptationSet>
  </Period>
</MPD>
```

Since `@queryBeforeStart` is FALSE, the player begins playback using serviceLocation "beta". Once it has reached steady state at its target buffer, it constructs a request to the proxy steering server, which would look like

```
http://127.0.0.1:3455/steer?url=
https%3A%2F%2F%20https%3A%2F%2Fsteeringsservice.com%2Fapp%2Finstance1234%3F%20
id%3Dabc123%26steeringToken%3D12345&_DASH_pathway=beta&_DASH_throughput=51400
00
```

The proxy server may respond

```
{
  "VERSION": 1,
  "TTL": 6,
  "RELOAD-URI": "http://127.0.0.1:6622"
  "SERVICE-LOCATION-PRIORITY": ["embms", "beta", "alpha"]
}
```

The player would immediately switch over to the "embms" serviceLocation, which in this example happens to be a local service delivering segments distributed via broadcast. At 6s after the initial request, the player would query the server URL specified by the RELOAD-URI. Note that it still appends a query arg specifying the original steering server URL.

```
http://127.0.0.1:6622?url=
https%3A%2F%2F%20https%3A%2F%2Fsteeringsservice.com%2Fapp%2Finstance1234%3F%20
id%3Dabc123%26steeringToken%3D12345&_DASH_pathway=embms&_DASH_throughput=7230
000
```

Annex (informative): Change History

Date	Version	Information about changes
2022-07-10	0.9.0	Version published for community review