**3GPP TSG- Meeting #**

**Fukuoka, Japan, 19th May 2025 - 23rd May 2025 revision of S4-250523**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:***  |  |
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| ***Source to WG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** | ss |
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| ***Category:*** |  |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | SR\_IMS has defined split rendering profiles that complement those defined in SR\_MSE and corresponding functions and procedures. These DELAY\_ADAPTIVE, feature is also relevant in SR\_MSE. |
|  |  |
| ***Summary of change:*** | Add the processing delay adpatation feature: 1. Add call flow
2. Add information message format
3. Add extra configuration
4. Add metadata capability in the SR profiles
5. Add enabler to use the processing delay adpatation feature with Adaptive Split rendering profile.
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| ***Consequences if not approved:*** | Missing features from SR\_IMS in SR\_MSE. |
|  |  |
| ***Clauses affected:*** | 5.2.3, 8.3.2, 8.4.2, C.1.2.2.3, C.1.2.3.6, C.1.3.2.3, C.1.3.3.5, C.2.1, and C.2.2  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

FIRST change

### 5.2.3 Call flow for Processing Delay Adaptation

For processing delay adaptation, the general procedures and call flows in clause 5.2.2 applies with the following additions and modifications.

- The SRS and SRC agree on the QoE metrics considered for delay adaptation. That may contain all or a subset of the QoE latency metrics (e.g., poseToRenderToPhoton, roundtripInteractionDelay) negotiated in the configuration message in clause 8.4.2.3.

- In the rendering loop, The SRC measures and collects the QoE metrics considered for delay adaptation. The SRC may send periodically the delay adaptation information to the SRS when the measured QoE metrics goes out of the target delay range.

Figure 5.2.3-1 illustrates a high-level call flow set up and operation for a split rendering session which supports the processing delay adaptation profile.



Figure 5.2.3-1: High level call flows for Processing Delay Adaptation Profile

The steps are:

Steps 0 to 4 are as described in clause 5.2.2.

5. The Source Manager shares the pose predictions and user input actions. In addition, the metadata may include a delay adaptation information message to the SRS. The trigger to send the delay adaptation information message is based on the configured periodicity to inform the SRS that the measured delay of a QoE latency metric is out of the target delay range. For example, the measured poseToRenderToPhoton QoE latency metric goes out of the target delay range due to new network conditions.

6a The SRS may adjust the processing delay based on the delay adaptation information message.

NOTE: For example, the SRS may change the LoD of the objects that are part of the scene for the delay adaptation.

6b The SRS renders the frame.

7 to 10: As described in clause 5.2.2.

Next change

### 8.3.2 Metadata Formats

#### 8.3.2.1 General

Both SRC and SRS shall support the usage of the WebRTC data channel for the exchange of split rendering metadata. The WebRTC data channel shall declare “3gpp-sr” as the data channel sub-protocol. The message content format depends on the type of the message. The data channel sub-protocol is defined in clause 8.3.3.

Message types shall be unique identifiers in the URN format. This clause defines a set of message types and their formats. The messages are derived from the OpenXR API to ensure smooth operation with AR devices that support OpenXR. In case other XR APIs are used, mapping the message payload to the appropriate XR API structures shall be performed by the split rendering client.

#### 8.3.2.2 Pose Format

The pose format that is used by all split rendering profiles defined by this specification shall comply with the format defined in TS 26.119 [4] clause 12.2. The pose information shall be carried as part of the data channel messaging mechanism defined in clause 8.3.3 and shall be provided in JSON format. The message type shall be “urn:3gpp:split-rendering:v1:pose”.

#### 8.3.2.3 Action Format

The action information format that is used by all split rendering profiles defined by this specification shall comply with the format defined in TS 26.119 [4] clause 12.3. The action information shall be carried as part of the data channel messaging mechanism defined in clause 8.3.3 and shall be provided in JSON format. The message type shall be “urn:3gpp:split-rendering:v1:action”.

#### 8.3.2.4 Processing Delay Adaptation Format

During a split rendering session, the operating environment of the split rendering server, the split rendering client or the network conditions may change. Consequently, the roundtrip delay may need to be adjusted to deliver a consistent QoE.

When processing delay adaptation procedure is enabled, the SRC checks for the QoE metrics being monitored whether the measured delays are within the target delay range or not. When a measured delay is outside the target delay range for a QoE metric, the SRC may report the measured delay based on the configured periodicity.

The delay adaptation information message format shall comply with the format defined in Table 8.3.2.4-1. The delay adaptation information shall be carried as part of the data channel messaging mechanism defined in clause 8.3.3 and shall be provided in JSON format. The message type shall be “urn:3gpp:split-rendering:v1:daqoe:information”.

Table 8.3.2.4-1 Message format for Delay Adaptation information

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Cardinality | Description |
| id | string | 1..1 | A unique identifier of the message in the scope of the IMS-based split rendering session. |
| type | string | 1..1 | urn:3gpp:split-rendering:v1:daqoe:information |
| message | object | 1..1 | Message content  |
|  qoeMetrics | array | 1..1 | An array of the QoE metrics for which delay adaptation is needed. This qoeMetrics array may contain all or a subset of the QoE metrics negotiated in the configuration message in clause 8.4.2.3. |
|  qoeMetricId | string | 1..1 | A unique identifier of the QoE metric within the scope of the split rendering session. |
|  delayValue | number | 1..1 | The measured delay value of that QoE metric. |

Next change

### 8.4.2 Split Rendering Configuration Format

#### 8.4.2.1 Introduction

The Split Rendering client establishes an XR session locally based on the device configuration and user selection. The SR client defines the view configuration (e.g. mono or stereo views), the projection format (such as projection, equirectangular, quad, or cubemap), the swap chain image configuration, etc.

In addition, XR space and action configurations are negotiated between the SR client and server. This includes defining common XR spaces and defining and selecting actions and action sets.

The format is extensible to support the exchange of additional/future configuration information.

#### 8.4.2.2 Split Rendering Configuration Format

The session configuration information shall be in JSON format. It shall have the following format:

Table 8.4.2.2-1 Split Rendering Configuration Format

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Cardinality** | **Description** |
| renderingFlags | Array(SR\_CONFIG\_FLAGS) | 0..1 | Provides a set of flags to activate/deactivate selected rendering functions. The defined SR\_CONFIG\_FLAGS are:- FLAG\_ALPHA\_BLENDING- FLAG\_DEPTH\_COMPOSITION- FLAG\_EYE\_GAZE\_TRACKING |
| processingFlag | boolean | 0..1 | Provides a flag to activate/deactivate processing delay adaptation feature.  |
| splitRenderingProfile | array(URI) | 0..1 | A list of supported split-rendering profile identifiers on the UE. The profile identifiers are listed in Annex C for each profile. |
| deviceCapabilities | Object | 0..1 | Device capabilities as defined in TS 26.119 [4], clause 6.1. |
| spaceConfiguration | Object | 0..1 | The space configuration is typically sent by the split rendering server to the split rendering client. Upon reception of this information, the SR client uses this information to create the reference and action spaces as well as to agree on common identifiers for the XR spaces. |
|  referenceSpaces | Array | 0..1 | An array of reference spaces and their identifiers. |
|  id | number | 1..1 | A unique identifier of the XR space in the context of the split rendering session. |
|  refSpace | enum | 1..1 | One of the defined reference spaces in OpenXR. These may be: XR\_REFERENCE\_SPACE\_TYPE\_VIEW, XR\_REFERENCE\_SPACE\_TYPE\_LOCAL, or XR\_REFERENCE\_SPACE\_TYPE\_STAGE. |
|  actionSpaces | Array | 0..1 | An array of action spaces that need to be defined by the split rendering client in the XR session.  |
|  id | number | 1..1 | A unique identifier of the XR space in the context of the split rendering session. |
|  actionId | number | 1..1 | Provides the unique identifier of the action. |
|  subactionPath | string | 1..1 | The subaction path identifies the action, which can then be mapped by the XR runtime to user input modalities. |
|  initialPose | Pose | 0..1 | Provides the initial pose of the new XR space’s origin. |
| viewConfiguration | Object | 0..1 | Conveys the view configuration that is configured for the XR session. |
|  type | Enum  | 1..1 | The type indicates the view configuration. Defined values are MONO and STEREO. Other values may be added. |
|  width | number | 1..1 | The recommended width of the swapchain image. |
|  height | number | 1..1 | The recommended height of the swapchain image. |
|  compositionLayer | string | 1..1 | An identifier of the selected composition layer. |
|  minPoseInterval | number | 0..1 | The minimum time interval between two consecutive pose information instances sent to the network, in milliseconds. |
|  fovs | Array | 0..1 | An array that provides a list of the field of views (FoV) associated with each view. |
|  fov | Object | 1..n | Indicates the four sides of the field of view used for the projection of the corresponding XR view.The number of views n is determined by the *type* enum of the *viewConfiguration*. Both the *viewPoses* in the Pose Format and the *fovs* arrays shall be ordered in a consistent way (i.e., a same index can be used to retrieve the view pose and the related FoV information). |
|  angleLeft | number | 1..1 | The angle of the left side of the field of view. For a symmetric field of view this value is negative. |
|  angleRight | number | 1..1 | The angle of the right side of the field of view. |
|  angleUp | number | 1..1 | The angle of the top part of the field of view. |
|  angleDown | number | 1..1 | The angle of the bottom part of the field of view. For a symmetric field of view this value is negative. |
|  environmentBlendMode | enum | 1..1 | The type indicates the environment blend mode configuration. Defined values are OPAQUE, ADDITIVE and ALPHA\_BLEND. Other values may be added. |
| actionConfiguration | Array | 0..1 | This contains a list of the actions that are to be defined by the SR client. |
|  action | Object | 1..n | A definition of a single action object. |
|  id | number | 1..1 | A unique identifier of the action. |
|  actionType | enum | 1..1 | The type of the action state. This can be a Boolean, float, vector2, pose, vibration output, etc. |
|  subactionPaths | string | 1..n | An array of subaction paths associated with this action. The split rendering client will provide the state of all defined sub-action paths. |
| extraConfigurations | Object | 0..1 | A placeholder for addition configuration information. |

#### 8.4.2.3 Processing Delay Adaptation Configuration Format

The configuration format defined in clause 8.4.2.2 with the additional fields defined in Table 8.4.2.3-1 shall be used for split rendering configuration exchange in processing delay adaptation procedure. This delayAdaptation object shall be present as part of the extraConfigurations Object as defined in clause 8.4.2.2 for extensibility of split rendering configuration format.

Table 8.4.2.3-1 - Configuration message format for Processing Delay Adaptation based on QoE metrics

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Cardinality | Description |
| delayAdaptation | Object | 1..1 | An object containing the configuration parameters for the processing delay adaptation based QoE metrics. |
|  qoeMetrics | array | 1..1 | An array of the QoE metrics for which delay adaptation is considered. This qoeMetrics array may contain all or a subset of the QoE latency metrics negotiated in the Metrics reporting configuration defined in clause 8.11.3 of TS 26.510 [9]. |
|  qoeMetricId | string | 1..1 | A unique identifier of the QoE metric within the scope of the split rendering session. The name of that QoE metric is chosen as unique ID, this name should be consistent with the name provided in the metrics reporting configuration as defined in clause C.1 of TS 26.113 [6]. |
|  periodicity | string | 1..1 | The periodicity of the delay adaptation information for that QoE metric. This periodicity value shall be lesser than or equal to the samplingPeriod value of the MetricsReportingConfiguration defined in clause 8.11.3 of TS 26.510 [9].Whenever a delay adaptation information message is sent, the SRC shall reset its timer to the value of the periodicity property, and it shall begin countdown of the timer again. |

NOTE: The target delay range for a QoE metric is delimited by the positiveCrossingThresholds and the negativeCrossingThresholds properties provided to the SRC in the clientMetricsReporting‌Configurations resource of ServiceAccessInformation as defined in clause 9.2.3.1 of TS 26.510 [9].

Next change

### C.1.2.2 SRC Capabilities

#### C.1.2.2.1 Overview

Requirements for UE-based SRC functionalities for following functions are defined in this clause:

- Media Decoding

- Media Encoding

- Metadata Formats

The capabilities of the receiving UE are shared with the split rendering server prior to the start of the split rendering session.

#### C.1.2.2.2 Media Capabilities

The SRC shall support the media capabilities of a device type 3 as defined in TS 26.119 [4], clause 10.4.

#### C.1.2.2.3 Metadata Formats

**XR-Pose-Cap 1:** the SRC shall be able to retrieve one or more pose predictions for each view and for every frame to be rendered. The pose prediction shall be formatted according to clause 8.3.2.2.

**XR-Pose-Cap 2:** the SRC shall be able to retrieve and collect the user actions that occurred during an identified time interval. The action information shall be formatted according to clause 8.3.2.3.

**XR-DelayAdapt-Cap 1:** the SRC shall be able to handle the processing delay adaptation of QoE metrics in a split rendering session during an identified time interval. The processing delay adaptation information shall be formatted according to clause 8.3.2.4.

### C.1.2.3 SRS Capabilities

#### C.1.2.3.1 Overview

Requirements for network-based SRS functionalities for following functions are defined in this clause:

- Media Encoding

- Media Decoding

- Metadata Formats

The capabilities of the SRC are shared with the SRS prior to the start of the split rendering session.

#### C.1.2.3.2 Video encoding

The SRS shall at least be able to support the encoding of video that complies to the capabilities in clause 10.4.3 of TS 26.119 [4].

#### C.1.2.3.3 Audio and Speech encoding

The SRS shall at least be able to support the encoding of audio that complies to the capabilities in clause 10.4.4 of TS 26.119 [4].

#### C.1.2.3.4 Video decoding

The SRS has no requirements for the decoding of video streams.

#### C.1.2.3.5 Audio and Speech decoding

The SRS has no requirements for the decoding of audio or speech streams.

#### C.1.2.3.6 Metadata Formats

The SRS shall support the exchange of Pose and action information as defined in clause 8.3.2.

The SRS shall support the exchange of processing delay adaptation information as defined in clause 8.3.2.4.

Next change

### C.1.3.2 SRC Capabilities

#### C.1.3.2.1 Overview

Requirements for UE-based SRC functionalities for following functions are defined in this clause:

- Media Decoding

- Media Encoding

- Metadata Formats

The capabilities of the receiving UE are shared with the split rendering server prior to the start of the split rendering session.

#### C.1.3.2.2 Media Capabilities

The SRC shall support the media capabilities of a device type 1 as defined in TS 26.119 [4], clause 10.2.

If the device is a device type 2 as defined in TS 26.119 [4], clause 10.4, it shall also support the media capabilities of a device type 2 as defined in TS 26.119 [4], clause 10.3.

If the device is a device type 4 as defined in TS 26.119 [4], clause 10.5, it shall also support the media capabilities of a device type 2 as defined in TS 26.119 [4], clause 10.5.

#### C.1.3.2.3 Metadata Formats

**XR-Pose-Cap 1:** the SRC shall be able to retrieve one or more pose predictions for each view and for every frame to be rendered. The pose prediction shall be formatted according to clause 8.3.2.2.

**XR-Pose-Cap 2:** the SRC shall be able to retrieve and collect the user actions that occurred during an identified time interval. The action information shall be formatted according to clause 8.3.2.3.

**XR-DelayAdapt-Cap 1:** the SRC shall be able to handle the processing delay adaptation of QoE metrics in a split rendering session during an identified time interval. The processing delay adaptation information shall be formatted according to clause 8.3.2.4.

### C.1.3.3 SRS Capabilities

#### C.1.3.3.1 Overview

Requirements for network-based SRS functionalities for following functions are defined in this clause:

- Media Encoding

- Media Decoding

- Metadata Formats

The capabilities of the SRC are shared with the SRS prior to the start of the split rendering session.

#### C.1.3.3.2 Video encoding

The SRS shall at least be able to support the encoding of video that complies to the capabilities in clause 10.4.3 of TS26.119.

#### C.1.3.3.3 Audio and Speech encoding

The SRS shall at least be able to support the encoding of audio that complies to the capabilities in clause 10.4.4 of TS26.119.

#### C.1.3.3.4 Video decoding

The SRS has no requirements for the decoding of video streams.

#### C.1.3.3.5 Audio and Speech decoding

The SRS has no requirements for the decoding of audio or speech streams.

The SRS shall support the exchange of processing delay adaptation information as defined in clause 8.3.2.4.

#### C.1.3.3.6 Metadata Formats

The SRS shall support the exchange of Pose and action information as defined in clause 8.3.2.

Next change

# C.2 Adaptive Split Rendering Profile

## C.2.1 Introduction

This profile defines procedures and requirements for SRS and SRC to support split rendering features beyond a remote rendering paradigm.

Adaptive split rendering profile allows the SRC to render some objects of a scene locally and the rendering split can be adapted between the SRS and SRC during a session. The adaptation of the rendering split may be triggered either by the SRS or the SRC to maintain a consistent QoE of the SR session or to accommodate changes in operating conditions. The triggers may be, for example, channel conditions, SRC or SRS conditions or defined by the application provider.

To successfully render two parts of a scene separately in a split fashion, additional aspects of the rendering process need to be considered. Two basic requirements are maintaining a coherent state of the scene between the SRS and SRC and awareness of rendering split. Another requirement is seamless composition and display of the media rendered by the SRS and SRC into a frame to be displayed.

The processing delay adaptation procedure can be used with the Adaptive split rendering profile. The processing delay adaptation procedure may include adjusting various round-trip delays between the SRC and the SRS during a split rendering session. The delay adaptation allows the SRS to adjust the rendering task delay to maintain a consistent round-trip delay (e.g., pose-to-render-to-photon or roundtrip interaction delay).

Next change

## C.2.2 Procedures and Call Flows

For adaptive split rendering, the general procedures and call flows in clause 5.2 are followed with the following additions and modifications.

- The SRS and SRC should share a scene description. The implementation details may vary. The application provider may decide whether to provide identical scene descriptions to the SRS and the SRC or whether to provide a truncated version of the scene description to the SRC.

Note: The Application Service Provider may provide the scene description resource to the SRS and SRC, for example, via M8 to SRC and via M2 to SRS.

- The SRS and SRC agree on an initial rendering split during session negotiation and the states to be synchronized, for example, in Step 5 of the procedure in clause 5.2.1.2.

- The initial rendering split and states to be synchronized are indicated in the SR configuration.

- In the rendering loop, exchange of split adaptation messages and state synchronization messages between the SRS and SRC is supported.

- When the processing delay adaptation procedure is used, the SRC shall send delay adaptation information to the SRS.

Figure C.2.2-1 illustrates a high level call flow set up and operation for a split rendering session which supports the adaptive split rendering profile.



Figure C.2.2.‑1: High level call flows for Adaptive Split Rendering Profile

The steps are:

0. In this optional step the SRC and the SRS acquire scene description of the scene to be rendered during the split rendering session. The actual implementation of delivery of the scene description by to the SRC and SRS is up to the application provider.

1. The Presentation Engine discovers the split rendering server and sets up a connection to it. It provides information about its rendering capabilities and the XR runtime configuration, e.g the OpenXR configuration may be used for this purpose. States to be synchronized and the initial rendering split is negotiated during this step.

2. In response, the split rendering server creates a description of the split rendering output and the input it expects to receive from the UE.

3. The Presentation Engine requests the buffer streams from the MAF, which in turn establishes a connection to the split rendering server to stream pose and retrieve split rendering buffers.

4. The Source Manager retrieves pose and user input from the XR runtime and state changes in negotiated states and possible requests from the Scene Manager.

5. The Source Manager shares the pose predictions and user input actions , state changes and possible split adaptation messages with the split rendering server.

6. a. The split rendering server uses that information to, update states, render the frame and possibly update the split.

 b. The Scene Manager update states, renders a frame and possibly updates the split.

7. a. The rendered frame is encoded and streamed to the MAF.

 b. Possible split adaptation and state change messages are shared with the presentation engine,

8. The received media frames decoded and processed,

9. The raw buffer frames are passed to the Scene Manager, this includes the frames received from the SRS and the frames rendered locally by the PE,

10. The scene manager prepares composition layers and their corresponding swapchain images.

11. The swapchain images are forwarded to the XR runtime for composition and rendering,12. The frames are composed and displayed.

The final composition of a frame from media received from the SRS and locally rendered objects depends on the application logic. Implementation guidelines in C.2.7 provide a simple example.

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