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| 3GPP TR 26.956 V0.0.1 (2024-04) |
| Technical Report |
| 3rd Generation Partnership Project;Technical Specification Group Services and System Aspects;Evaluation and Characterization of Beyond 2D Video Formats and Codecs(Release 19) |
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| ***3GPP***Postal address3GPP support office address650 Route des Lucioles - Sophia AntipolisValbonne - FRANCETel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16Internethttp://www.3gpp.org |
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Contents

Foreword 4

Introduction 5

1 Scope 6

2 References 6

3 Definitions of terms, symbols and abbreviations 7

3.1 Terms 7

3.2 Symbols 7

3.3 Abbreviations 7

4 Beyond 2D Video Format 7

4.1 Introduction 7

4.2 Overview of Beyond 2D Video in Release 18 7

4. x <Title for a Beyond 2D Video format> 8

4.x.1 Definition 8

4.x.2 Production and Capturing System 8

4.x.3 Format Description 8

4.x.3.1 Representation and Compression Formats 8

4.x.3.2 Storage Formats 8

4.x.3.3 Rendering 8

4.x.4 Display Devices 8

4.x.5 Mapping to 3GPP Services 8

5 Relevant Scenarios 8

5.1 Introduction 8

5.2 Scenario 1: <tbd> 8

5.3 Scenario 2: <tbd> 8

5.4 Scenario 3: <tbd> 8

5.x Scenario x: <tbd> 8

6 Test Conditions and Evaluation Framework 8

6.1 Introduction 8

6.2 Test Sequences 8

6.3 Key Performance Indicators and Metrics 8

6.4 Reference Software Tools 8

7 [Characterization and Evaluation Result] 9

8 Gaps and Optimization Potential 9

8.1 Identified Gaps and Deficiencies with Existing Codecs 9

8.2 Potential Requirements for New Codecs 9

8.3 In-Network Optimizations 9

9 Conclusions and Proposed Next Steps 9

A.1 Introduction 9

A.2 Template 9

For definitive guidance on drafting 3GPP TSs and TRs, see [3GPP TS 21.801](http://www.3gpp.org/DynaReport/21801.htm) supplemented by the 3GPP web page <http://www.3gpp.org/specifications-groups/delegates-corner/writing-a-new-spec>.

Ensure all blue guidance text is removed before submitting the TS/TR to the TSG for approval.

# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# Introduction

In recent years, video services are evolving from traditional two-dimensional formats to beyond 2D video, which offer users a more lifelike and immersive experience. Research studies indicate that the beyond 2D market was valued at approximately multi-million USD in 2023 and is anticipated to register a CAGR (Compound Annual Growth Rate) of over 24.5% between 2024 and 2032 [2][3][4].

A variety of beyond 2D video formats and video compression technologies are available and emerging. Therefore, in order to determine appropriate beyond 2D video formats for different services, it is essential to evaluate their feasibility and performance, considering implementation constraints, performance indicators, and interoperability considerations. In addition, advanced network capabilities and service extension also need to be investigated to meet the delay and data rate requirements of beyond 2D-related services.

This document provides an overview of available and emerging beyond 2D video formats and compression technologies, which are mostly related to specific types of capturing systems and display technologies; documents a set of end-to-end reference scenarios and workflows for beyond 2D video; analyzes 3GPP-defined video compression technologies and potential new technologies to support each documented scenario; identifies gaps and offer recommendations to potentially extend 3GPP video specifications and capabilities.

# 1 Scope

The present document collects beyond 2D video formats within 3GPP services, as well as a set of beyond 2D video end-to-end reference scenarios and corresponding workflows. It also documents relevant implementation constraints, performance characteristics, and interoperability requirements of existing 3GPP codecs as well as potentially new codecs to support these scenarios. [The primary scope of the present document includes the following aspects:

1. Identify and document beyond 2D formats, that are market-relevant within the few next years, generated from established and emerging capturing systems (including cameras for spatial video capturing), contribution, and usable on display technologies (smartphones, VR HMDs, AR glasses, autostereoscopic and multiscopic displays).

2. Establish and document a set of beyond 2D video end-to-end reference scenarios, including real-time communication, streaming services, split rendering, and messaging and corresponding workflows (capturing, encoding, packaging, delivery, decoding, rendering, including general constraints on latency, as well as complexity) to support 3GPP network related delivery and devices leveraging the generation or display technologies. This includes identifying and defining relevant beyond 2D formats in the context of above workflows, and representation technologies to support delivery of these formats within 3GPP networks.

3. Prioritize the scenarios and the associated formats based on market relevance for further evaluation.

4. Define concrete evaluation framework per scenario (test conditions, KPIs, Metrics, test sequences, agreed reference signals) based on the above prioritized reference scenarios, and evaluate the feasibility and performance of existing 3GPP codecs as well as potentially new codecs to support the scenarios.

5. Based on the findings in steps 1, 2, and 4 document (i) interoperability requirements, (ii) traffic characteristics and (iii) potential QoS optimizations or requirements, to support the above workflows and evaluate the feasibility of new formats with different services, considering the implementation constraints and performance indicators such as encoding, decoding, and rendering complexity, bandwidth utilization, and interoperability considerations.

6. Based on the findings in steps 1, 2, 4 and 5, identify potential gaps or deficiencies of existing 3GPP codecs, and offer recommendations to potentially extend 3GPP video specifications and capabilities.

1. Identify potential areas for normative work as the next phase and communicate with other 3GPP WGs regarding relevant aspects related to the study to the extent needed.]

Editor’s note: The scope may be updated as study progressed.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] Allied Market Research, “3D Technology Market Size, Share, Competitive Landscape and Trend Analysis Report by Product, Application : Global Opportunity Analysis and Industry Forecast, 2021-2030.”, [www.alliedmarketresearch.com/3d-technology-market.](http://www.alliedmarketresearch.com/3d-technology-market.)

[3] Mordor Intelligence, “Mobile 3D Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029).”, <https://www.mordorintelligence.com/industry-reports/mobile-3d-market.>

[4] Grand View Research, “Immersive Technology Market Size, Share & Trends Analysis Report By Component (Hardware, Software, Services), By Technology, By Application, By Industry, By Region, And Segment Forecasts, 2023 - 2030.”, [https://www.grandviewresearch.com/industry-analysis/immersive-technology-market-report.](https://www.mordorintelligence.com/industry-reports/mobile-3d-market.)

[5] 3GPP TR 26.928: "Extended Reality over 5G".

[6] 3GPP TR 26.998: "Support of 5G glass-type Augmented Reality / Mixed Reality (AR/MR) devices".

[7] 3GPP TS 26.119: "Media Capabilities for Augmented Reality".

# 3 Definitions of terms, symbols and abbreviations

This clause and its three subclauses are mandatory. The contents shall be shown as "void" if the TS/TR does not define any terms, symbols, or abbreviations.

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Definition format (Normal)

**<defined term>:** <definition>.

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

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

Symbol format (EW)

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

<ABBREVIATION> <Expansion>

# 4 Beyond 2D Video Format

## 4.1 Introduction

Editor’s note: This clause documents beyond 2D video formats that are market-relevant within next few years.

## 4.2 Overview of Beyond 2D Video in Release 18

Editor’s note: This clause summarized existing beyond 2D video format in 3GPP from at least TS.26.119 and TS.26.118.

## x <Title for a Beyond 2D Video format>

Editor’s note: This clause is for documenting beyond 2D video format which haven’t been covered by 3GPP. The documented format should be referenced by at least one scenario in clause 5, and the following aspects may be provided.

### 4.x.1 Definition

### 4.x.2 Production and Capturing System

### 4.x.3 Format Description

#### 4.x.3.1 Representation and Compression Formats

#### 4.x.3.2 Storage Formats

#### 4.x.3.3 Rendering

### 4.x.4 Display Devices

### 4.x.5 Mapping to 3GPP Services

# 5 Relevant Scenarios

## 5.1 Introduction

Editor’s note: This clause collects end-to-end scenarios and corresponding workflows for beyond 2D video, based on the template defined in Annex A. Alignment with the generalized media delivery architecture defined in TS 26.501/506 is expected, primarily addressing reference points M2 and M4.

## 5.2 Scenario 1: <tbd>

## 5.3 Scenario 2: <tbd>

## 5.4 Scenario 3: <tbd>

## 5.x Scenario x: <tbd>

# 6 Test Conditions and Evaluation Framework

## 6.1 Introduction

Editor’s note: This clause defines test conditions and parameters, KPIs, Metrics, test sequences, agreed reference signals per scenario.

## 6.2 Test Sequences

## 6.3 Key Performance Indicators and Metrics

## 6.4 Reference Software Tools

# 7 [Characterization and Evaluation Result]

Editor’s note: This clause collects codec evaluation results and network traffic characteristic per scenario.

# 8 Gaps and Optimization Potential

## 8.1 Identified Gaps and Deficiencies with Existing Codecs

## 8.2 Potential Requirements for New Codecs

## 8.3 In-Network Optimizations

# 9 Conclusions and Proposed Next Steps

Editor’s note: This clause provides conclusion and potential areas for normative work as the next phase.

Annex A
Scenario Template

## A.1 Introduction

This annex provides a proposed template to introduce a Scenario for Beyond 2D Video. This template has been used to collect the scenarios in this report. The text in blue corresponds to guidelines on the information to be provided with a scenario proposal.

## A.2 Template

The following aspects are considered for a scenario:

1. **Scenario name**
2. **Motivation for the scenario**

*What is the market relevance of the proposed scenario within the next few years? Are there any commercially available or pre-released products or prototypes?*

1. **Description of the scenario**

*This provides a description of beyond 2D video end-to-end workflows, which includes identifying and defining beyond 2D formats being used in the context and representation technologies to delivery these formats. The following aspects may be considered for each workflow:*

1. *Capturing and processing*
2. *Encoding*
3. *Packaging and delivery*
4. *Decoding*
5. *\*Post-processing*
6. *Rendering*
7. *General constraints on latency, bandwidth, reliability and complexity*
8. **Supporting companies and 3GPP members**
9. *This documents the 3GPP members that support this scenario in terms of providing the information, test material, test requirements and the characterization for the tests. For each of the identified necessities, a tick box is created in the template.*
10. *Preferably several 3GPP members are included in the support, and in addition a video service provider may be included (not necessarily a 3GPP member).*
11. *Cross-verification is preferably done by the supporters of the scenario.*
12. **Source format properties**

*This defines a clear range of the considered and relevant source formats, including the signal properties, but also the characteristics of the content. As an example, the texture and depth format properties of the source may be used which include:*

1. Spatial resolutions
2. Chroma Format
3. Chroma Subsampling
4. Aspect ratios
5. Frame rates
6. Colour space formats
7. Transfer Characteristics
8. Bit depth
9. Viewpoints
10. Other signal properties
11. **Encoding and decoding constraints and settings**

*Typical encoding constraints and settings such as*

1. *Relevant Codec and Codec Profile/Levels according to 3GPP TS (e.g., TS 26.119),*
2. *Random access frequency*
3. *Error resiliency requirements*
4. *Bitrates and quality requirements*
5. *Bitrate parameters (CBR, VBR, CAE, HRD parameters)*
6. *ABR encoding requirements (switching frequency, etc.)*
7. *Latency requirements and specific encoding settings*
8. *Encoding context: real-time encoding, on device encoding, cloud-based encoding, offline encoding, etc.*
9. *Required decoding capabilities*
10. *Synchronization requirements*
11. **Performance Metrics and Requirements**
12. *A clear definition on how the performance needs to be evaluated including metrics, etc addressing the main KPIs of the scenario.*
13. *Objective measures such as PSNR, VMAF, etc, may be used*
14. *Justification on whether objective metrics are sufficient and representative of the subjective performance.*
15. **Interoperability Considerations for the application**
16. *Streaming with DASH/HLS/CMAF/QUIC*
17. *RTP based delivery*
18. **Test Sequences**

*A set of selected test sequences that are provided by the proponents in order to do the evaluation. They should cover a set of source format properties*

1. **Detailed test conditions**

*Provides a proposal for detailed test conditions, for example based on a reference software together with the sequences and configuration parameters.*

1. **External Performance data**

*References to external performance data that can be added, for example other SDOs, public documents and so on.*

1. **Additional Information**

Annex <X> (informative):
Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2024-04 | SA4#127-bis | S4-2xxxxx |  |  |  | Initial Version | 0.0.1 |