

Standards and Software for Connected Media Experiences

5G-MAG Association
Activity recap
January 2026

Reach out for more information at info@5g-mag.com

5G-MAG, The Media Connectivity Association

Driving **Standards** and **Software**
for **Connected Media Experiences**

Media
streaming **real-time**
broadcast **immersive...**

Connectivity
5G networks APIs
computing devices...

Standards
scalability **interop**
trust **sovereignty**

Open-Source
adoption testing
collaboration efficiency



Industry Collaboration
under a **neutral, hands-on** non-for-profit **industry association**

Scope of the work – Member-driven activities

Driving together interoperability through open standards

Audiovisual content
delivered over the
internet and **mobile**
networks

Content creation
simplified by ubiquitous
connectivity and
global **APIs**

Immersive experiences
powered by **devices**,
computing
capabilities,...



Driving Standards...

Transforming technology into practical solutions

Networks
Protocols
APIs
Devices
Apps

Streaming
RTC
Broadcast
Multicast
Computing

Live Media
XR Scenes
Volumetric
Avatars
Audio

Feasibility Studies
Architectures and Features
Profiles and Guidelines
Support towards Implementation
Feedback to Standards
Demos, Trials, PoCs, Deployments

Collaborating with the organizations that drive technology

5G-MAG is a **3GPP Market Representation Partner (MRP)**



Displayed logos illustrate a subset of organizations connected to our technology work.

... and Developing Products

Transforming specifications into reference implementations



Standards validation, interop, early prototyping and testing



Ready-to-use code in production environments and as benchmark



Shared development effort avoids duplication across companies



Transparency, trust and collaborative enhancements

Open-source Toolbox for Connected Media Applications



Our Work in 3 steps

Pre-Standardization

- Collaboration scenarios & use cases
- Adequate architectures and Features
- Market-driven requirements and features

Supporting Standards Development

- Standards tracking and roadmaps
- Providing Feedback to Standards
- Implementation and deployment guidelines

Post-Standardization

- Open source developer community
- Validating Standards & Applications
- Prototyping, Trials and Ecosystem-drive

1

Discovery & Scouting

2

Selection & Evaluation

3

Development & Deployment

Our Structure

Member-driven

Bottom-up work and topics

Minimum bureaucracy

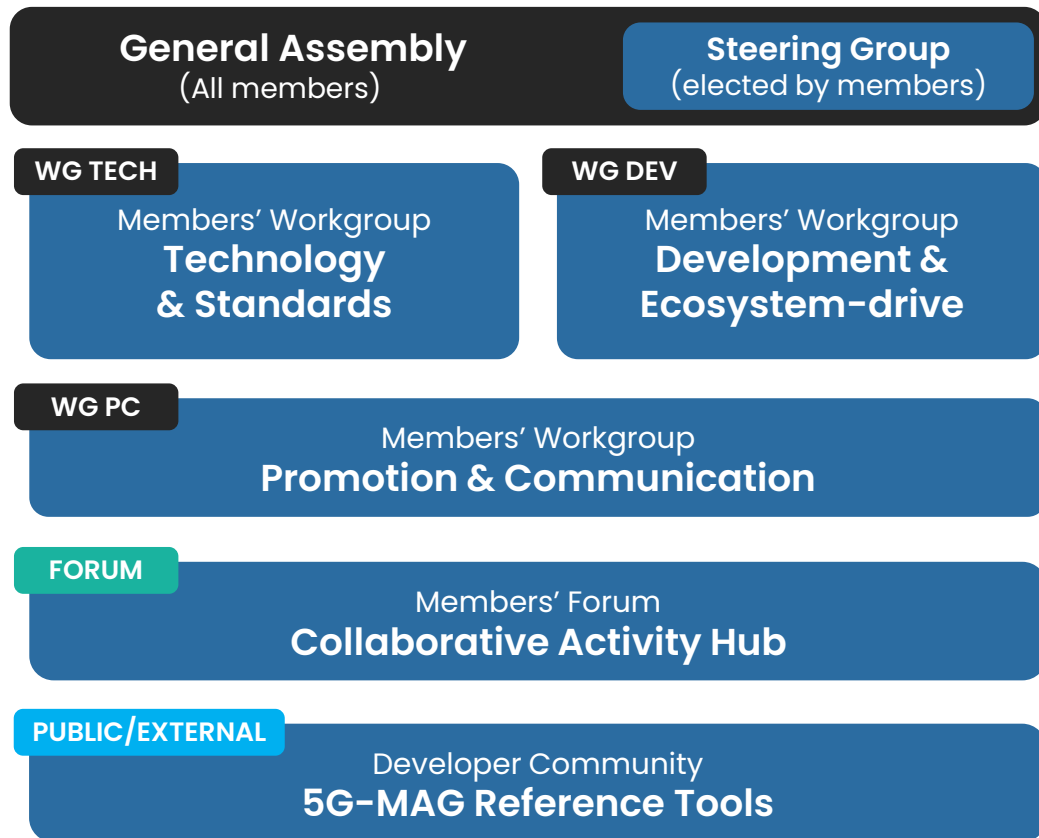
to concentrate on the actual work

Maximizing efficiency

by limited telcos & on-line work

Contribution-driven

to ensure relevance of the work





Join us and support the activities!

How does 5G-MAG support the industry and you?

← 5G-MAG supporting the industry

Driving the development of **open standards** for connected media services

Contributing industry's feedback to SDOs in a coherent way

Supporting open-source software implementations towards products

Accelerating adoption of global **connectivity solutions** for media

Fostering tech interoperability and trust

→ 5G-MAG supporting you

Understanding standards, specifications and **technologies**

Creating collaboration opportunities with partners

Contributing consensus-driven requirements to SDOs

Scouting opportunities for projects and funding aligned to 5G-MAG's work

Promoting your work at events

Who is supporting our work?



Join, support the work and benefit

Who is supporting our work?

Check the list of members at www.5g-mag.com/membership

Membership Fee Category LARGE	Annual Revenues > €1 billion	Annual Membership Fee € 15.000
Membership Fee Category MEDIUM	Annual Revenues €100 million – €1 billion	Annual Membership Fee € 10.000
Membership Fee Category SMALL	Annual Revenues €5 million – €100 million	Annual Membership Fee € 5.000
Membership Fee Category MICRO	Annual Revenues < €5 million	Annual Membership Fee € 2.000

The **Micro** category also includes: **Universities, Regulators, Public research bodies, Institutions, NGOs, and non-for-profit organizations**

Fostering industry collaboration

Workshops

www.5g-mag.com/workshops

Open-Source Media Application Reference Tools (OSMART)

<https://osmart-community.github.io/>



Open-Source Core Applications RAN (OSCAR)

www.5g-mag.com/oscar



Part of the Metaverse Standards Register

<https://register.metaverse-standards.org/pogs>



Promoting Technology and Members' Efforts



Follow The Handshake by 5G-MAG



The Handshake

by  The Media
Connectivity
Association

Now available on



**Visit www.5g-mag.com or
contact us for more information**

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In more detail...



More information at 5g-mag.com and hub.5g-mag.com

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hub.5g-mag.com/Standards
hub.5g-mag.com/Getting-Started





5G Media Streaming Architecture



+



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5G Media Streaming Architecture

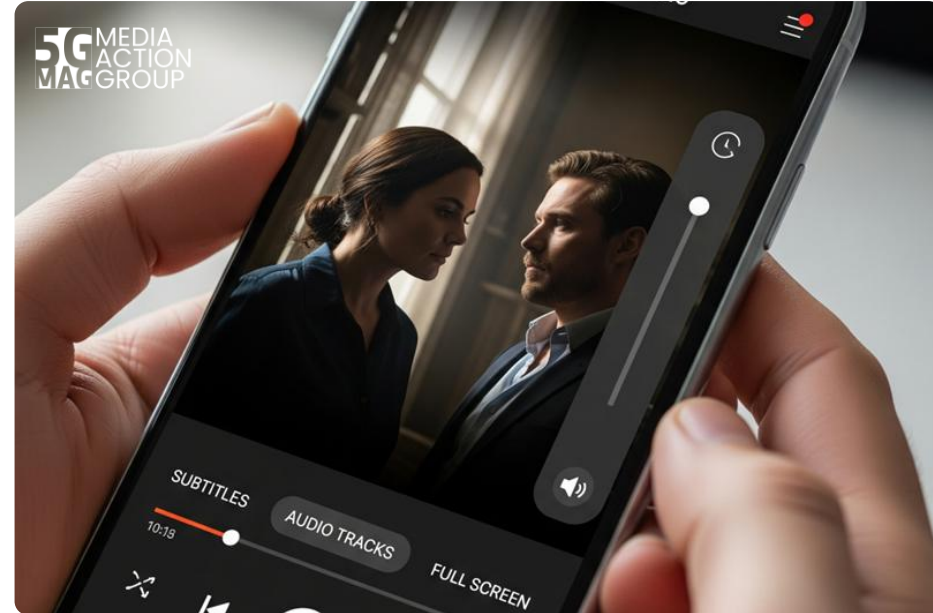
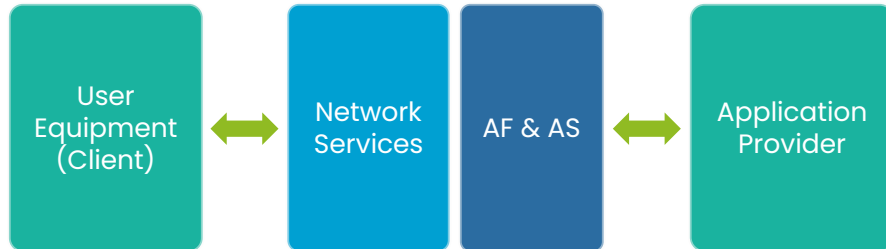
Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Improving **quality of experience (QoE)** for media **streaming** by applications sharing knowledge with the network.

Helping the application deliver a **better streaming experience** by:

- **Content Hosting and Preparation**
- **Invoking Dynamic QoS Policies**
- **Network Assistance** (Bit rate recommendation, delivery boost)
- **Consumption reporting** (feedback reports on consumed content)
- **QoE Metrics reporting** (client uploads of metrics reports)



WHERE TO LOOK AT?

Technical Resources Standards

Reference Tools available:

- [Project: 5G Media Streaming Architecture](#)
- [Project: 5G Core Service Consumers](#)



UE Data Collection, Reporting & Event Exposure





UE Data Collection, Reporting and Event Exposure

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

The **Network Data Analytics Function (NWDAF)** is a key component of the 5G System designed to analyze data collected from various Network Functions and UEs.

- This enables a **closed-loop system** where consumers can use the analyzed data to modify and **optimize the 5G System's configuration in real-time**.
- An extended architecture introduces a **Data Collection AF** that **receives data from UEs and Application Servers**.
- This framework also incorporates Data Access Profiles with aggregation functions to ensure data protection, and allows for third-party Application Service Providers (ASPs) to consume these events for their own application optimization.



WHERE TO LOOK AT?

Check the [Execution Plan](#)
All the [Technical Resources](#)
Information on [Standards](#)
Reference Tools available:

- [Project: UE data collection, reporting and event exposure](#)



5G Broadcast Hybrid Services



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5G Broadcast

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Ability to **deliver content** to 3GPP-based devices **without** the need of a **SIM-card nor uplink** capabilities and by using **broadcast and/or cellular infrastructure**.

- Integration of broadcast reception into **3GPP-based** user equipment
- Delivery of **TV and Radio streaming services** over broadcast
- Integration within **OTT applications** and **smart devices**
- Broadcasting of **emergency alerts** alongside media services



WHERE TO LOOK AT?

Check the [Execution Plan](#)
All the [Technical Resources](#)
Information on [Standards](#)
Reference Tools available:

- [Project: 5G Broadcast Hybrid Services](#)
- [Project: Emergency Alerts over 5G Broadcast](#)



5G Multicast Broadcast Services



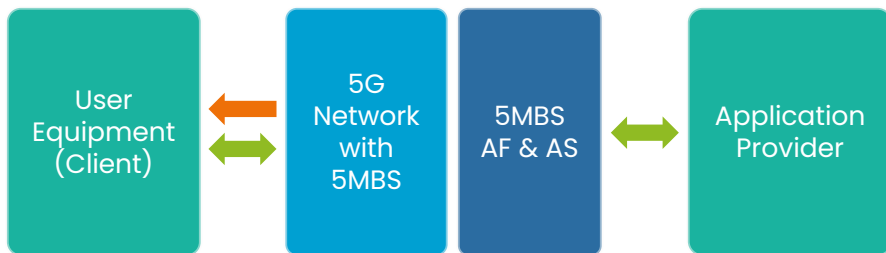
5G Multicast Broadcast Services

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Ability to integrate **multicast** and **broadcast** capabilities within the **5G network** for content delivery at scale.

- Integration of one-to-many and broadcast capabilities into **3GPP-based** user equipment
- Delivery of content to a determined **group of users over multicast** with HARQ and resilience mechanisms similar to those applied in unicast
- Delivery of content to an arbitrarily **large amount of users over broadcast** within a coverage area



WHERE TO LOOK AT?

Check the [Execution Plan](#)
All the [Technical Resources](#)
Information on [Standards](#)
Reference Tools available:

- [Project: 5G Multicast Broadcast Services](#)



Real-Time Media Communication





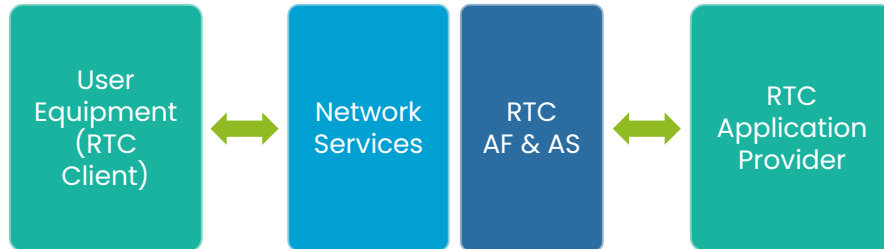
Real-Time Media Communication

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Architecture for **real-time media communication** within the 5G System (5GS) supporting services from both Mobile Network Operators (MNOs) and third parties.

- Enabling **services** like video calls, online gaming, and augmented reality (AR) **over mobile networks**.
- Support for collaboration scenarios including those for **augmented reality (AR)** services with specific functionalities such as **split-rendering** or **spatial computing** within a 5G System.



Check the [Execution Plan](#)
All the [Technical Resources](#)
[Information on Standards](#)
Reference Tools Project

WHERE TO LOOK AT?



Network Capability Exposure through APIs



CAMARA
THE TELCO GLOBAL API ALLIANCE

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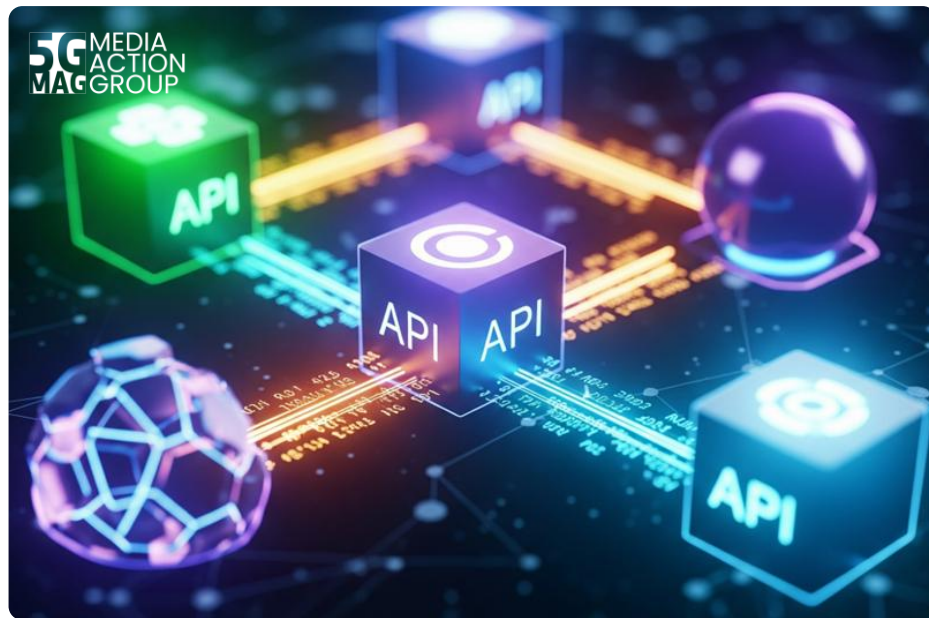
Network Capability Exposure through APIs

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

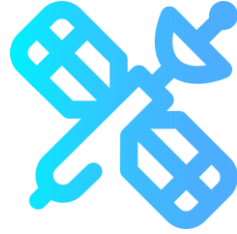
Standardized access to network capabilities offered by telecom operators.

- Developers who wanted to integrate network functionalities had to create custom integrations for each individual mobile network operator. This made it difficult and time-consuming to build applications that could work across different countries and networks.
- As an example of new initiatives aiming at **reducing fragmentation**, CAMARA APIs provide a unified, "write-once, run-anywhere" approach which allows developers to write code that works with any network operator that implements the CAMARA standard. This **simplifies development, accelerates innovation**, and makes it easier to **create globally portable applications**.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
Reference Tools Project



Non-Terrestrial Networks





Non-Terrestrial Networks

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Use of emerging **satellite connectivity platforms** to access media applications.

- **Global Media Delivery:** NTN networks are well-suited for broadcasting and multicasting content to a large, geographically dispersed audience
- **Media Streaming in Remote Locations:** LEO constellations can provide the necessary bandwidth and low latency to support mobile broadband services for users on planes, ships, or in remote areas. This enables seamless video calls and streaming
- **Backhaul for Media Services:** NTN networks can also serve as backhaul, connecting remote "islands" of terrestrial 5G networks to the core network.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools Project



Non-Public Networks





Non-Public Networks

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

A powerful solution for the demanding requirements of media production, where reliable, low-latency, and secure connectivity is crucial.

- Guaranteed **Quality of Service (QoS)** through access to dedicated network resources for specific **media flows** (e.g. live video feeds, return video, and control signals).
- An NPN provides a **secure, isolated network** with only authorized devices able to connect.
- Deployable in **fixed locations** or as **nomadic** networks.
- Deployable as completely **isolated networks** or with the **support of a public mobile network operator**, leveraging the operator's existing infrastructure while maintaining data isolation and custom QoS.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools Project



Time Sensitive Communication



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Time Sensitive Communication

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Time-Sensitive Communication (TSC) in 3GPP is a key enabler applications that require deterministic and reliable communication with bounded latency.

- Time Synchronization: The 5G system is designed to be a **"time-aware system"** that can distribute timing information with high accuracy.
- Ability to use the **5G reference clock** to synchronize devices connected to the network.
- Ability to transport **timing information** and **align devices** connected to different network domains.



WHERE TO LOOK AT?

Check the [Execution Plan](#)
All the [Technical Resources](#)
Information on [Standards](#)
Reference Tools Project



XR Media with MPEG-I Scene Description



XR Media with MPEG-I Scene Description

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

MPEG-I Scene Description (MPEG-I SD) is a standard for immersive media experiences which defines the **structure and composition of a 3D scene**, providing a framework for how different media assets are arranged, animated, and rendered.

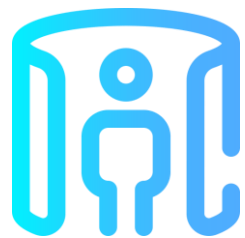
- Based on a **scene graph**, a hierarchical data structure organizes all the elements of a 3D scene. This includes 2D and 3D objects, lights, cameras, and their relationships.
- Built upon the **glTF standard**, with **extensions to handle real-time and dynamic media**, allowing developers to reference external media streams, such as live video feeds, spatial audio, and dynamically changing mesh data, and integrate them seamlessly into the 3D scene.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: XR Media with MPEG-I Scene Description](#)



Volumetric Video

Experiences with MPEG V3C



Volumetric Video Experiences with MPEG V3C

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Creation, encoding, rendering and presentation of Volumetric Video assets

- MPEG V3C (Visual Volumetric Video-based Coding) is a standard for **compressing and streaming volumetric video content**, which allows viewers to navigate a 3D scene with six degrees of freedom (6DoF).
- **Video-based Point Cloud Compression (V-PCC)**: This part of the standard efficiently compresses 3D point clouds by projecting them onto 2D views, which are then compressed using existing video codecs.
- **MPEG Immersive Video (MIV)**: This component handles the compression of immersive video captured by multiple cameras, enabling the creation of a seamless, navigable 3D scene.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: V3C Immersive Platform](#)



Beyond 2D Video Experiences



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Beyond 2D Video Experiences

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Advanced capture and display technologies is driving the evolution of video services **from traditional 2D to beyond 2D**.

- Format and Codec Diversity: The wide array of **beyond 2D video formats** (e.g., Multi-view, Point Clouds, Dynamic Mesh) **and codecs** (e.g., MPEG, Khronos, non-standardized solutions) creates **interoperability** issues.
- Network and Device Limitations: Beyond 2D video requires transmitting and processing **massive amounts of data**, which can strain both network bandwidth and the computational power of user equipment (UE).
- Service Extension and Feature Support: To fully leverage beyond 2D video, existing **3GPP services need to be extended** to support features like 2D-to-beyond 2D conversion. Additionally, communication and networking solutions must be optimized to meet the strict latency and bitrate requirements of these new services.



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: Beyond 2D Evaluation Framework](#)



AI/ML

In Mobile Media Services





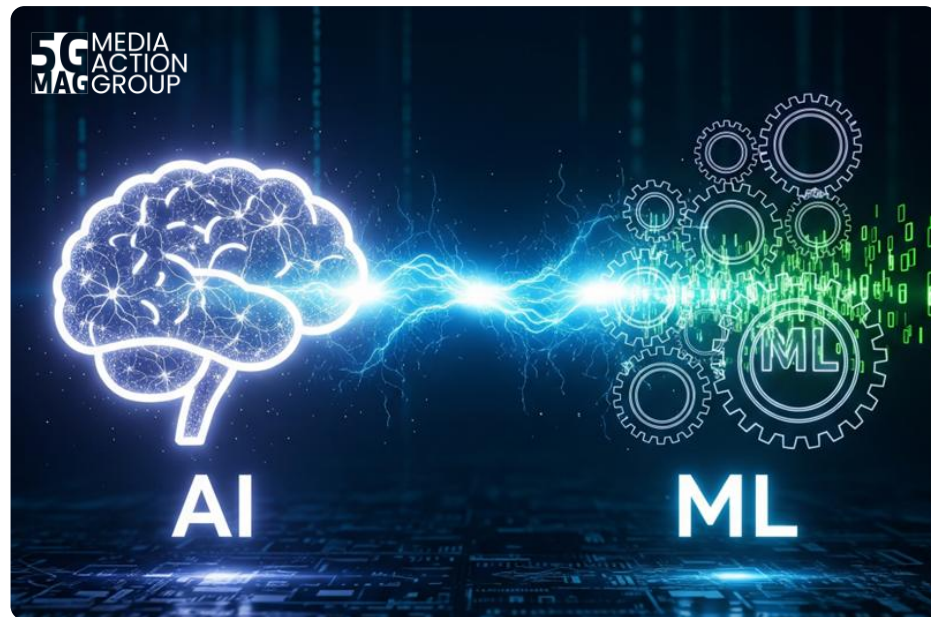
Artificial Intelligence & Machine Learning in 5G Media Services

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

The 3GPP FS_AI4Media (Feasibility Study on Artificial Intelligence and Machine Learning for Media) in 3GPP explores how **AI/ML can be integrated into 5G media services**. The study identifies three core operations that require the exchange of AI/ML and media data over a 5G system:

- **AI/ML Model/Data Distribution:** This involves sending AI/ML models from a network endpoint to a user device (UE) as needed.
- **AI/ML Operation Splitting:** This involves dividing an AI/ML task between a UE and a network endpoint
- **Distributed/Federated Learning:** This is a collaborative process where multiple UEs train a single global model



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: AI & ML Evaluation Framework](#)



Multimedia Content Delivery Protocols





Multimedia Content Delivery Protocols

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

Support the implementation of unidirectional media delivery with a special attention to:

- FLUTE (**F**ile **D**elivery **o**ver **U**nidirectional **T**ransport)
- ROUTE (**R**eal-time **O**bject delivery over **U**nidirectional **T**ransport)



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: Multimedia Content Delivery Protocols](#)



DVB-I Services over 5G Systems





DVB-I Services over 5G Systems

Overview of the work, outcomes, Execution Plan and Technical Resources

What is this project about?

DVB-I enables broadcasters to deliver content across various networks, including 5G. Viewers can access a seamless, **unified Electronic Program Guide (EPG)** that **integrates both broadcast and IP-delivered channels**. The combination of DVB-I with 5G Systems enables scalability and hybrid delivery capabilities

- The standards supports the delivery of **DVB-I Services over 5G Media Streaming and LTE-based 5G Broadcast**
- This integration is a result of collaboration between the DVB Project and 5G-MAG



WHERE TO LOOK AT?

[Check the Execution Plan](#)
[All the Technical Resources](#)
[Information on Standards](#)
Reference Tools available:

- [Project: DVB-I Services over 5G Systems](#)



REFERENCE < TOOLS / >

Software Projects

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Public Software Development Community

Transforming specifications into reference implementations



Standards validation, interop, early prototyping and testing



Ready-to-use code in production environments and as benchmark



Shared development effort avoids duplication across companies



Transparency, trust and collaborative enhancements

Open-source Toolbox for Connected Media Applications



5G-MAG Reference Tools' Projects

Projects leading to open-source tools



5G Media Streaming Architecture



UE Data Collection, Reporting & Event Exposure



5G Broadcast: TV, Radio and Emergency Alerts



5G Multicast Broadcast Services



Real-Time Media Communication



Network Capability Exposure through APIs



Non-Terrestrial Networks



Non-Public Networks



Time Sensitive Communication



XR Media with MPEG-I Scene Description



Volumetric Video Experiences with MPEG V3C



Beyond 2D Video Experiences



AI/ML in Mobile Media Services



Multimedia Content Delivery Protocols



DVB-I Services over 5G Systems



Towards 6G Media

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hub.5g-mag.com/Getting-Started



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Sponsored by 5G-MAG Members

Define the **roadmap** and **prioritization** of 5G-MAG's resources

Open to the Industry, Academia, Independent Developers,...

To **collaborate** and **contribute** your code

OFFICIAL CONTRIBUTORS WITH A SIGNED CLA



OPERATING EUROVISION AND EURORADIO



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Join the Software Developer Community



GITHUB

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Getting Started guides with documentation, access to repos, projects, releases, tutorials,...



GITHUB

<https://github.com/5G-MAG>

Software Development is handled in GitHub. Find there all the repositories



5G-MAG Dev Community

Join us in Slack for communication between developers

tinyurl.com/join5gmagslack



Groups

Mailing List with Releases & News

Announcements and publication of new projects, software releases and documentation

tinyurl.com/join5gmaggroupp



Join the Developer Calls

WG DEV: Every Friday for 5G-MAG members

Public Friday Calls

Last Friday of the month from 13:00 to 14:30 CET for everybody
5g-mag.com/community#calendar



5G-MAG Reference Tools – Roadmaps

5G-MAG Reference Tools - Roadmaps

All | 5G Media Streaming | 5G Components | UE Data Collection | 5G Broadcast | Emergency Alerts 5G | Multicast Broadcast Se | Multimedia Content D | XR Media with MPEG- | V3C Immersive Platform

Q label: "Project: 5G Media Streaming"

Candidates 1	Under Study 1	Under Development 4	Completed 0	Completed + Tested 6
<p>This is a candidate for future work.</p> <p>Getting-Started #126 Advanced Media Delivery (AMD) - In-band reporting of CMCD information</p>	<p>This is under study.</p> <p>Getting-Started #137 Cloud Deployment support</p>	<p>This is actively being worked on.</p> <p>Getting-Started #132 Dynamic Policies (M1 Policy Templates API + M5 Dynamic Policies API)</p>	<p>This has been completed.</p>	<p>Getting-Started #134 Consumption collection and reporting</p> <p>Getting-Started #130 Implementation of M1d Provisioning APIs</p> <p>Getting-Started #133 QoE metrics collection and reporting</p> <p>Getting-Started #129 Implementation of AF to AS RESTful OpenAPI (M3)</p> <p>Getting-Started #128 Support for basic media session handling (Application Function + Media Session Handler)</p> <p>Getting-Started #127 Support for basic media stream handling (Application Server + Media Stream Handler)</p>

+ Add item

All the contributions, on-going developments and opportunities for contributors

<https://github.com/orgs/5G-MAG/projects/48>

The screenshot displays the 5G-MAG Standards Hub website, which serves as a central repository for 5G-related standards and projects. The interface is organized into a grid of project cards, each representing a specific standard or project. The cards are categorized into columns based on their status: Pre-acceptance, Adopted, Change contribution drafting, Contributed to Working Group, Agreed/endorsed by Working Group, Approved for publication by TCWG, Published, and Not adopted. Each card provides detailed information, including the standard number (e.g., TS 26.512, TS 26.513), the title, a brief description, and a progress bar indicating the current stage of development or approval. The progress bar includes various status indicators such as 'Drafting', 'Adopted', 'Approved', and 'Published'. The website also features a search bar at the top and a sidebar on the right for navigation.

Tutorials and Developer Xchange

Multimedia Content Delivery Protocols

GPAC Flute interop with 5G-MAG Reference Tools

Sohaib Larbi
Motion Spell

Tutorial

BBC Dolby Fraunhofer FOKUS Qualcomm

5G Media Streaming Architecture

5G Media Streaming in the BBC standalone testbed

Richard Bradbury, David Waring,
Dev Audsin and John Elliott
BBC R&D

Tutorial

BBC Dolby Fraunhofer FOKUS Qualcomm

5G Broadcast TV and Radio Hybrid Services

Unicast/Broadcast Seamless Switching

Klaus Kühnhammer
ITEAM-UPV

Daniel Silhavy
Fraunhofer FOKUS

Tutorial

Bitstream Fraunhofer FOKUS ORS Qualcomm

XR Media with MPEG-I Scene Description

XR Unity Player in 5G-MAG Reference Tools

Imed Bouazizi
Qualcomm

Tutorial

Qualcomm Interdigital

5G Media Streaming Architecture

5GMS with Application Provider Portal

Vuk Stojkovic
Fraunhofer FOKUS

Tutorial

BBC Dolby Fraunhofer FOKUS Qualcomm



UE Data Collection, Reporting & Event Exposure

Docker Setup with Insomnia REST Client

Daniel Silhavy
Fraunhofer FOKUS

Tutorial

BBC Fraunhofer FOKUS

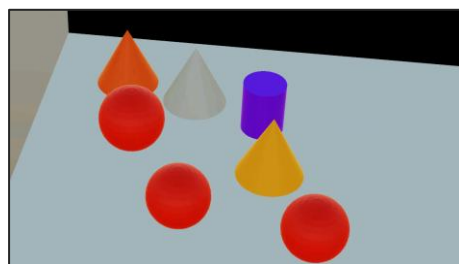
5G Multicast Broadcast Services

Initial support of 5MBS core network functions

Borja Inesta Hernández
ITEAM - UPV

Tutorial

BBC UNIVERSITAT DE VALÈNCIA



V3C Immersive Platform

Unity Player for Android with DASH Streaming Server

Tutorial

Interdigital PHILIPS

Software Contributors and License Model

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