

Standards and Software for Connected Media Experiences

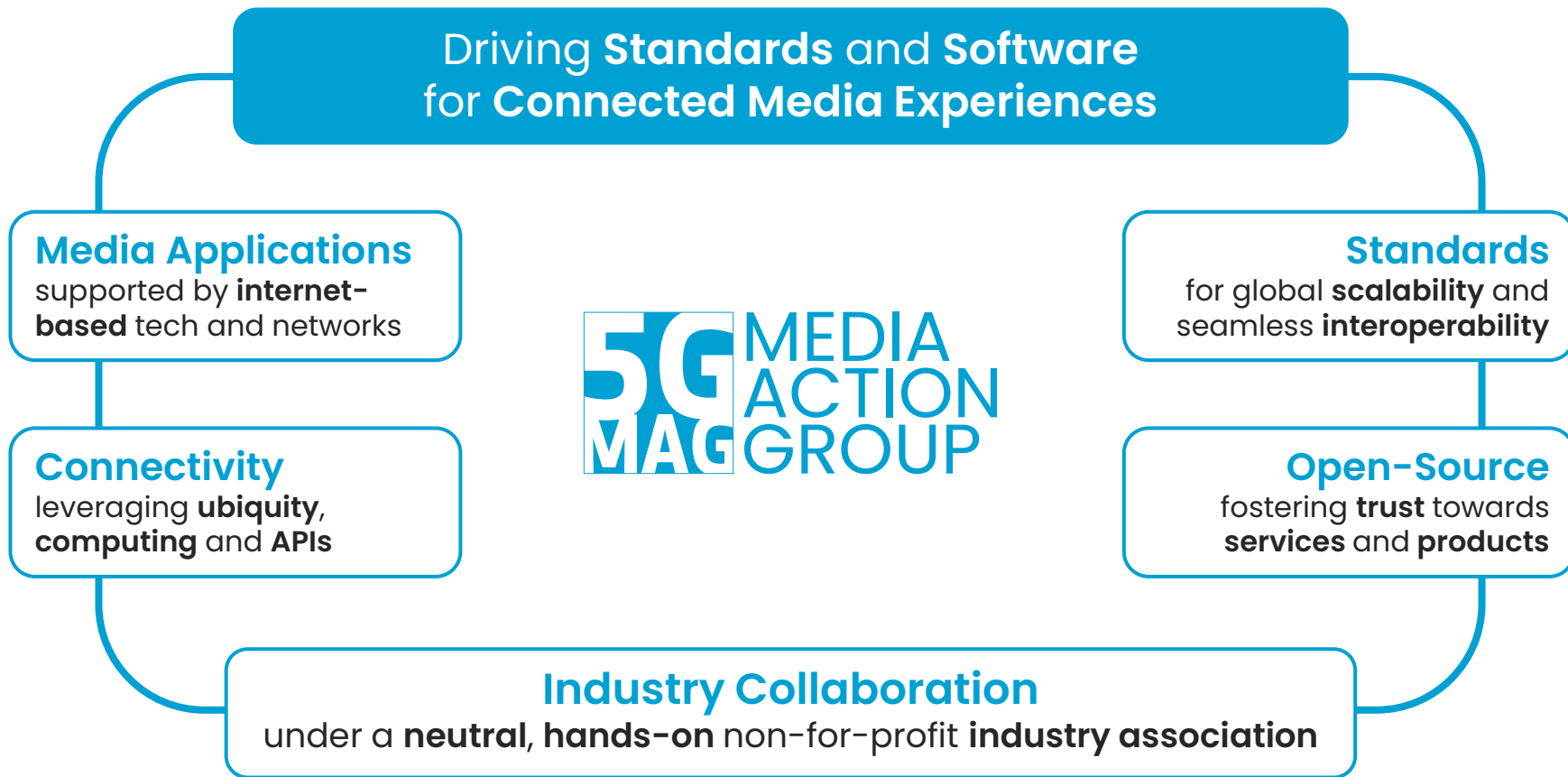
Dr. Jordi J. Giménez

Head of Technology 5G-MAG

gimenez@5g-mag.com

Updated in November 2025

About us



Our Work in 3 steps

1

Pre-Standardization

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

2

Supporting Standards Development

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

3

Post-Standardization

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



Member-driven Topics and Projects...

Internet-based
Media
Delivery



Media Production over
Mobile
Networks

5G Broadcast

Towards 6G Media

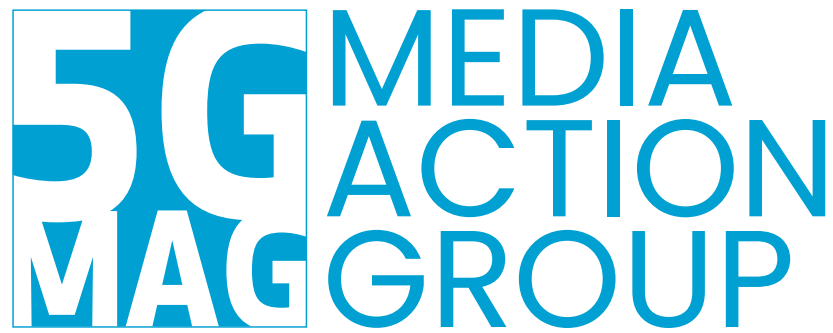
eXtended Reality (XR)
and
Immersive Media Experiences



... supported by global connectivity standards

5G-MAG is a **3GPP Market Representation Partner (MRP)**
and supports the ecosystem of standards for connected media





About Standards...

Internet-based Media Delivery

Supporting **Audiovisual content** (including TV/radio) increasingly consumed over the **internet** and **mobile networks**



5G Media Streaming Architecture



UE Data Collection, Reporting & Event Exposure



5G Multicast Broadcast Services



Real-Time Media Communication



Network Capability Exposure through APIs



Non-Terrestrial Networks



Multimedia Content Delivery Protocols



DVB-I Services over 5G Systems

- Streaming platforms
- Collaboration with mobile networks
- Network assistance, throughput estimation, QoS policies,...
- Data collection and event reporting
- Scalability through multicast
- RTC and low-latency comms



hub.5g-mag.com/Tech
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Media Production over Mobile Networks

Content creation and media transport simplified by ubiquitous connectivity (NPNs, venues, NTN,...)



Non-Public Networks



Time Sensitive Communication



5G Media Streaming Architecture



UE Data Collection, Reporting & Event Exposure



Real-Time Media Communication



Network Capability Exposure through APIs



Non-Terrestrial Networks

- Uplink video contribution
- Non-Public Network (Private Networks) for Media Production
- UE Credentials and Remote Provisioning
- Time Synchronization
- Network APIs for Communication Quality
- Advanced Media Delivery



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5G Broadcast

Scalability for streaming services (TV/Radio) over dedicated broadcast networks



5G Broadcast: TV & Radio Hybrid Services



5G Broadcast: Emergency Alerts



5G Media Streaming Architecture



UE Data Collection, Reporting & Event Exposure

- Dedicated broadcast networks
- Receive-only mode
- Single-frequency networks
- DASH/HLS/CMAF
- Integration with streaming services to mobile devices
- Dynamic unicast/broadcast switching
- Broadcast-on-Demand








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eXtended Reality and Immersive Media

Immersive experiences maturing with more accessible devices, computing capabilities,...



-  **XR Media with MPEG-I Scene Description**
-  **Volumetric Video Experiences with MPEG V3C**
-  **Real-Time Media Communication**
-  **Beyond 2D Video Experiences**
-  **AI/ML in Mobile Media Services**

- XR Scene Representation
- Integration of Media in XR Scenes
- Volumetric Video Experiences and Beyond 2D
- Real-Time Media Comm



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Towards 6G Media



Enabling next-generation media use cases
for 2030 and beyond

6GWS-250137

6G & MEDIA
General views and priorities
Cross-TSG aspects

5G-MAG Media Action Group
info@5g-mag.com

3GPP Workshop on 6G
Incheon, Korea, March 10-11, 2025

5G MAG
MEDIA ACTION GROUP

3GPP
Views from 5G-MAG
towards IMT-2030

5G-MAG MEDIA ACTION GROUP
www.5g-mag.com

5G MAG

3GPP Stage 1 Workshop
on IMT2030 Use Cases
September 30,
08 - 10 May 2024

SWS_240007

	Security	AI	Immersive Com	Sustainability, Energy Efficiency	Ubiquitous and resilient coverage	Sensing	"Smart life"	Native Vo6G	FWA-FWC	LPWA	Northbound API	Healthcare	Autonomous Driving	Positioning	Backward Compatibility
GSMA	✓	✓	✓	✓			✓								
NGMN	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
5GAA	✓	✓	✓	✓	✓	✓							✓	✓	
5G-ACIA	✓	✓	✓	✓		✓					✓				✓
5G-MAG	✓	✓	✓	✓	✓	✓	✓				✓				
GSOA	✓				✓									✓	
TCCA	✓	✓			✓										✓
WBA	✓	✓				✓									
B5GPC	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		
6GForum	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		
IMT-2030RG	✓	✓	✓	✓	✓	✓	✓							✓	
B6GA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
NextGA	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	
6GSNS-ICE	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓	✓
ITU	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	

<https://5g-mag.github.io/Standards/pages/requirements.html>

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[hub.5g-mag.com/Standards](https://5g-mag.com/Standards)
[hub.5g-mag.com/Getting-Started](https://5g-mag.com/Getting-Started)



Standards – The Topics



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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About Software...

Transforming Specifications into Products



**REFERENCE
< TOOLS />**

Open-source Toolbox for
Connected Media Applications



Standards validation & verification,
early demonstrations and testing



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



Shared development effort avoids
duplication across companies



Transparency, trust and
collaborative enhancements



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



5G-MAG Reference Tools – The Projects



5G Media Streaming Architecture

5G REFERENCE
MAG < TOOLS />



UE Data Collection, Reporting & Event Exposure

5G REFERENCE
MAG < TOOLS />



5G Broadcast: TV, Radio and Emergency Alerts

5G REFERENCE
MAG < TOOLS />



5G Multicast Broadcast Services

5G REFERENCE
MAG < TOOLS />



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

5G REFERENCE
MAG < TOOLS />



Volumetric Video Experiences with MPEG V3C

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Beyond 2D Video Experiences

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AI/ML in Mobile Media Services

5G REFERENCE
MAG < TOOLS />



Multimedia Content Delivery Protocols

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DVB-I Services over 5G Systems

5G REFERENCE
MAG < TOOLS />



Towards 6G Media

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




Reference Tools – The Projects

Media Delivery & Content Distribution

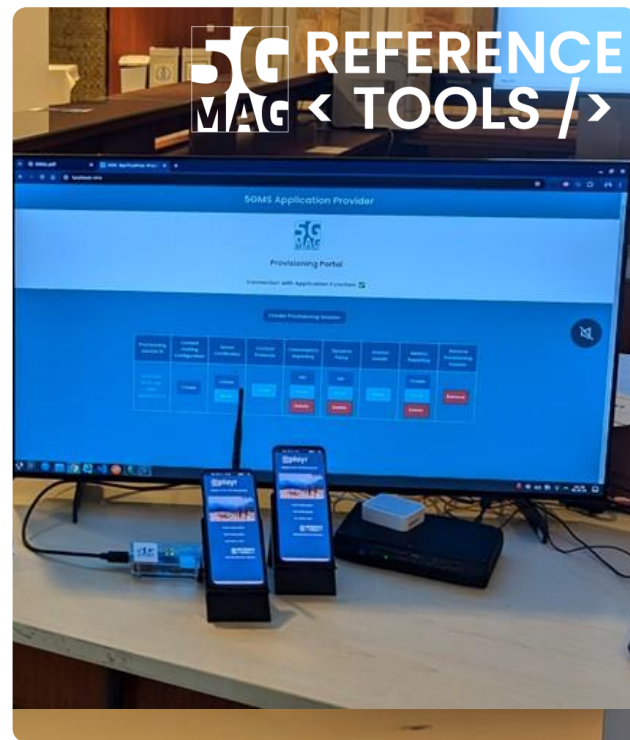
 **5G Media Streaming Architecture**
hub.5g-mag.com/Getting-Started/pages/5g-media-streaming/

 **5G Core Service Consumers**
hub.5g-mag.com/Getting-Started/pages/5g-core-service-consumers/

 **UE Data Collection, Reporting and Event Exposure**
hub.5g-mag.com/Getting-Started/pages/ue-data-collection-reporting-exposure/

+ Complementary Projects

 **DVB-I Services over 5G Systems**
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Reference Tools – The Projects

5G Broadcast Hybrid Services



5G Broadcast: TV & Radio Hybrid Services

hub.5g-mag.com/Getting-Started/pages/lte-based-5g-broadcast/tutorials.html



5G Broadcast: Emergency Alerts

hub.5g-mag.com/Getting-Started/pages/emergency-alerts/

+ Complementary Projects



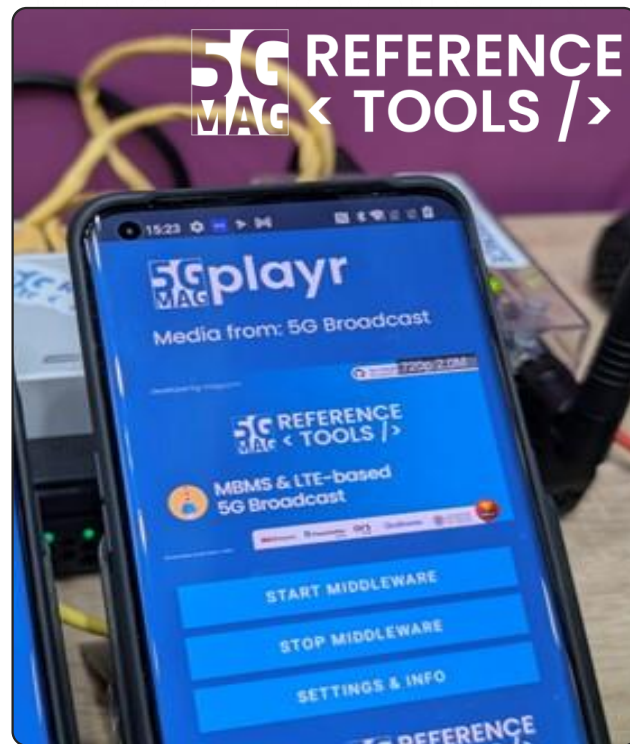
Multimedia Content Delivery Protocols (FLUTE and ROUTE)

hub.5g-mag.com/Getting-Started/pages/multimedia-content-delivery/



DVB-I Services over 5G Systems

hub.5g-mag.com/Getting-Started/pages/dvbi-over-5g/



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Reference Tools – The Projects

5G Multicast Broadcast & MBS User Services



5G Multicast Broadcast Services

hub.5g-mag.com/Getting-Started/pages/5g-multicast-broadcast-services/

+ Complementary Projects



Multimedia Content Delivery Protocols (FLUTE and ROUTE)

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Reference Tools – The Projects

eXtended Reality and Immersive Media

XR Media with MPEG-I Scene Description

hub.5g-mag.com/Getting-Started/pages/xr-media-integration-in-5g/

V3C Immersive Platform

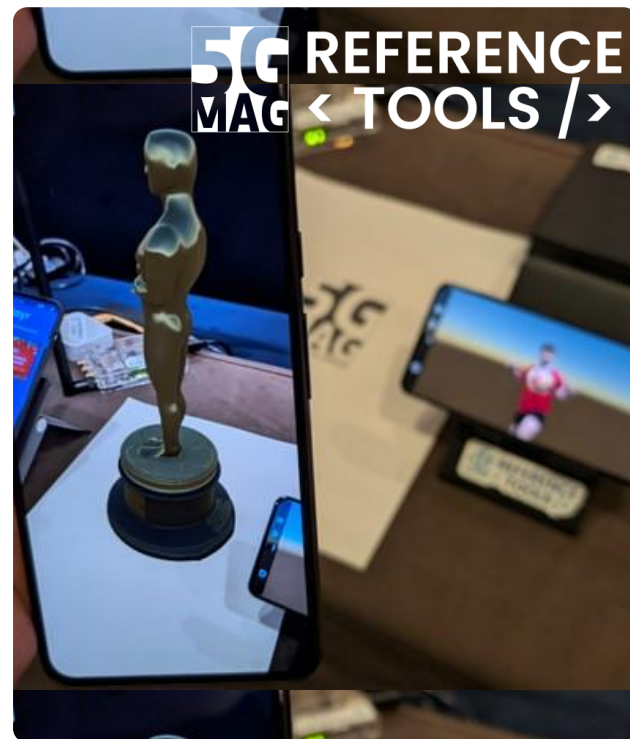
hub.5g-mag.com/Getting-Started/pages/v3c-immersive-platform/

Beyond 2D Video Experiences

hub.5g-mag.com/Getting-Started/pages/beyond-2d-evaluation-framework/

AI/ML in Mobile Media Services

hub.5g-mag.com/Getting-Started/pages/ai-ml-evaluation-framework/



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Join our Public Software Developer Community

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



UNIVERSITAT
POLITÀCNICA
DE VALÈNCIA



Join the Software Developer Community



GITHUB

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

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

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



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 UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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

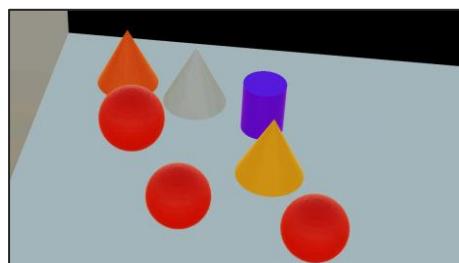
5G Multicast Broadcast Services

Initial support of 5MBS core network functions

Borja Inesta Hernández
ITEAM - UPV

Tutorial

BBC UNIVERSITAT POLITÈCNICA DE VALÈNCIA

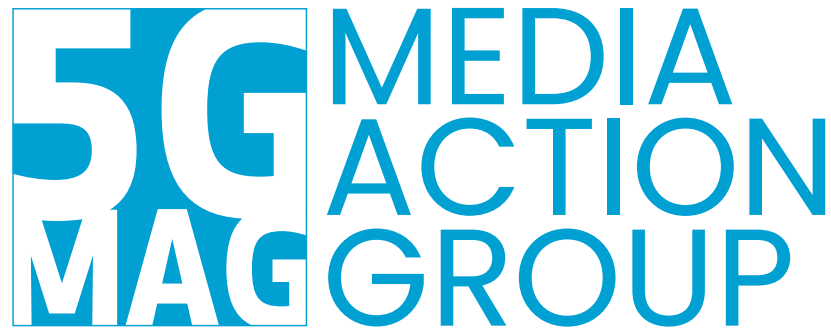


V3C Immersive Platform

Unity Player for Android with DASH Streaming Server

Tutorial

Interdigital PHILIPS



Join us and support the activities!

Our Structure

Member-driven

Bottom-up work and topics

Minimum bureaucracy

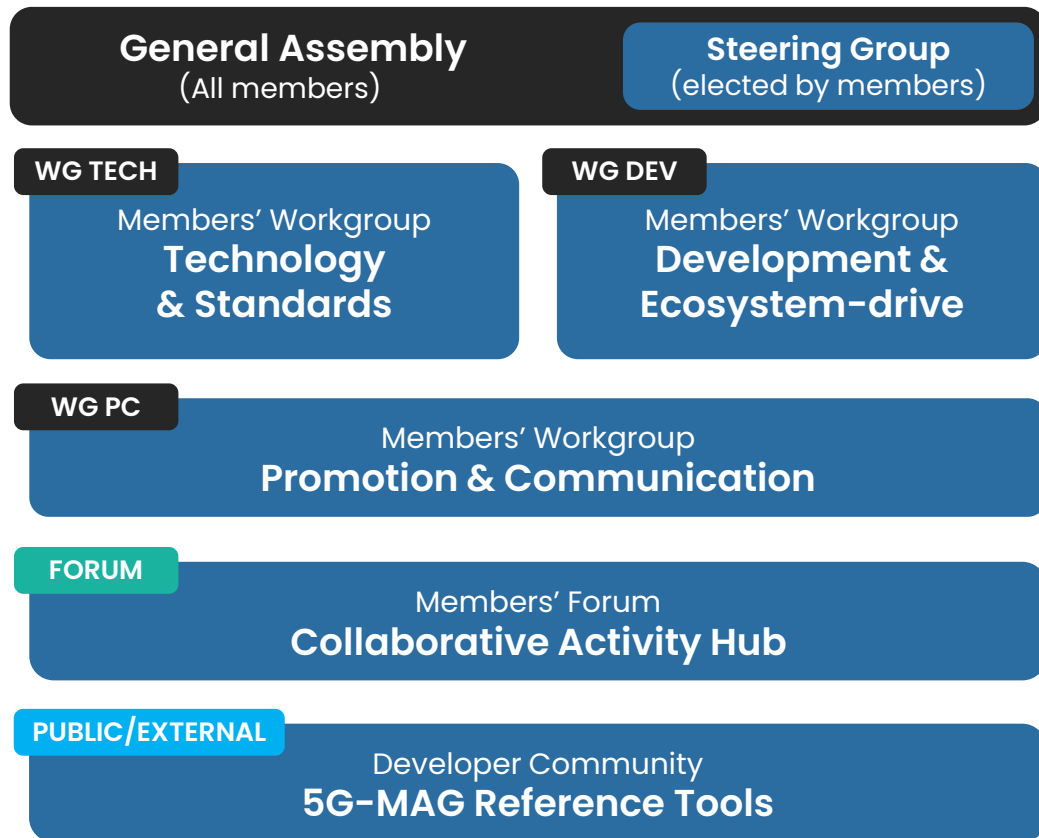
to concentrate on the actual work

Maximizing efficiency

by limited telcos & on-line work

Contribution-driven

to ensure relevance of the work



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



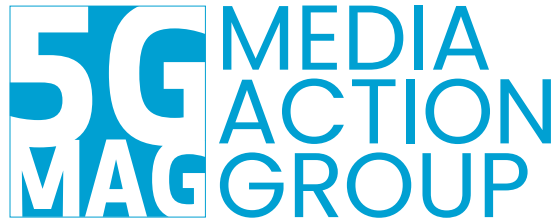
Part of the Metaverse Standards Register

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



Promoting Technology and Members' Efforts

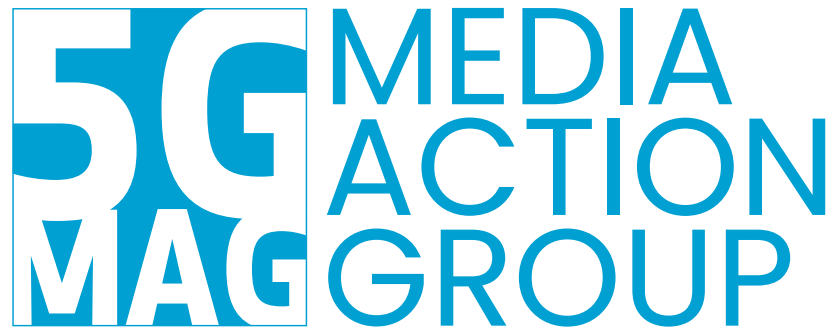




**Visit www.5g-mag.com or
contact us for more information**

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Back-up slides: Some more details...

More details about our structure

WG TECH

Technology & Standards

Requirements gathering (e.g. 3GPP workshop, GitHub requests, feedback from implementation)
Profiles and Guidelines (e.g. documentation in GitHub pages, explainers, ETSI specifications,...)
Technical liaison with standards bodies (e.g. LS and members' input towards 3GPP)
Management of [5G-MAG - Execution Plans](#) together with the Project Office

WG DEV

Development & Ecosystem-drive

Coordination of software development [5G-MAG Reference Tools Roadmaps](#)
Maintenance of Tutorials, Documentation (e.g. documentation in GitHub pages,...)
Drive engagement with technology "users" and testbeds
Management of [5G-MAG - Execution Plans](#) together with the Project Office

WG PC

Promotion & Communication

5G-MAG's engagement in events and promotion opportunities
Communication of association and members' activities
Maintenance of liaisons with external associations/industry bodies

FORUM

Collaborative Activity Hub

Discussion forum open to all members to explore opportunities for collaborative projects

PUBLIC/EXTERNAL

5G-MAG Reference Tools

Open-Source software developer community
Sponsored by 5G-MAG members. Open to the industry, academia, software developers,...

5G-MAG – Execution Plans

The screenshot displays the '5G-MAG - Execution Plans' dashboard. At the top, there's a navigation bar with tabs for different project areas: All, 5G Media Streaming, UE Data Collection, 5G Broadcast, 5G Multicast Broadcast, RTC, Network APIs, Non-Terrestrial Network, Non-Public Networks, Time Sensitive Commu, and XR Media Experienc. Below this is a search bar labeled 'Filter by keyword or by field'. The main content area is divided into five columns representing project statuses: Candidates (1), Under Study (2), Work in Progress (6), Completed (1), and Not pursued (0). Each column contains a list of projects with details like 'Tech #25', 'Tech #17', 'Tech #24', 'Tech #23', and 'Tech #19'. A large black text box is overlaid in the center, stating: 'What members have done, are doing or are planning to do'. At the bottom, there's a dark blue banner with the URL: <https://github.com/orgs/5G-MAG/projects/44>. Each status column has a '+ Add item' button at the bottom.

5G-MAG - Execution Plans

Filter by keyword or by field

Candidates 1
This is a candidate for future work.

- Tech #25
Integration of 5GMS clients with commercial OTT app
Topic: 5G Media Streaming

Under Study 2
This is under study.

- Tech #17
Testing of 5G Media Streaming Reference Tools in Testbeds
Topic: 5G Media Streaming
- Tech #19
Documentation
Topic: 5G Media Streaming

Work in Progress 6
This is actively being worked on.

- Tech #24
Report on Uplink Media Delivery
Topic: 5G Media Streaming
- Generation of Docker instances for 5GMS collaboration scenarios
Topic: 5G Media Streaming
- Tech #22
Implementation of Reference Tools (Rel-18)
Topic: 5G Media Streaming

Completed 1
This has been completed.

- Tech #23
Gathering requirements towards FS_AMD
Topic: 5G Media Streaming

Not pursued 0
This is disregarded.

What members have done, are doing or are planning to do

<https://github.com/orgs/5G-MAG/projects/44>

+ Add item

5G-MAG Reference Tools – Roadmaps

5G-MAG Reference Tools - Roadmaps

All | 5G Media Streaming | 5GC Components | UE Data Collection | 5G Broadcast | Emergency Alerts 5G | Multicast Broadcast Se | Multimedia Content D | XR Media with MPEG-I | 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	+ Add item	+ Add item	+ Add item	+ Add item

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

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

5G-MAG Reference Tools – Standards Feedback

[illegible]

Standards and Software – Outcomes



GITHUB

hub.5g-mag.com

- Access to all repositories: github.com/5G-MAG/
- 5G-MAG EXECUTION PLANS: github.com/orgs/5G-MAG/projects/44
- 5G-MAG REFERENCE TOOLS ROADMAPS: github.com/orgs/5G-MAG/projects/48



GITHUB

hub.5g-mag.com/Tech

- Technology analysis, discussion and documentation
- Reports and Explainers



GITHUB

hub.5g-mag.com/Standards

- Requirements towards SDOs: hub.5g-mag.com/Standards/pages/requirements.html
- Liaison Statement and Inputs to SDOs: hub.5g-mag.com/Standards/pages/lis.html
- Feedback to Specifications: hub.5g-mag.com/Standards/pages/feedback.html
- Work Items, Specifications and Technical Reports: hub.5g-mag.com/Standards/pages/standards.html
- Issues: github.com/5G-MAG/Standards/issues
- Project board: github.com/5G-MAG/Standards/projects
- Discussions: github.com/5G-MAG/Standards/discussions



GITHUB

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

- Access to 5G-MAG Reference Tools (information, repositories, tutorials,...)



More information at www.5g-mag.com/work

Software Contributors and License Model

The 5G-MAG Reference Tools software makes use of **various licenses** to distribute and accept contributions from the community, including the:

5G-MAG Public License v1.0

More information at <https://www.5g-mag.com/license>

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