



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

Driving Standards and Software
for Connected Media Experiences

Media Applications
supported by **internet-based** tech and networks

Connectivity
leveraging **ubiquity, computing** and **APIs**



Standards
for global **scalability** and
seamless **interoperability**

Open-Source
fostering **trust** towards
services and **products**

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

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

5G REFERENCE
MAG < TOOLS />



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

Mobile Connectivity

Global APIs

Multimedia Systems

Content Delivery

Formats, Protocols



A GLOBAL INITIATIVE

Streaming, XR, Gaming

Broad device ecosystem

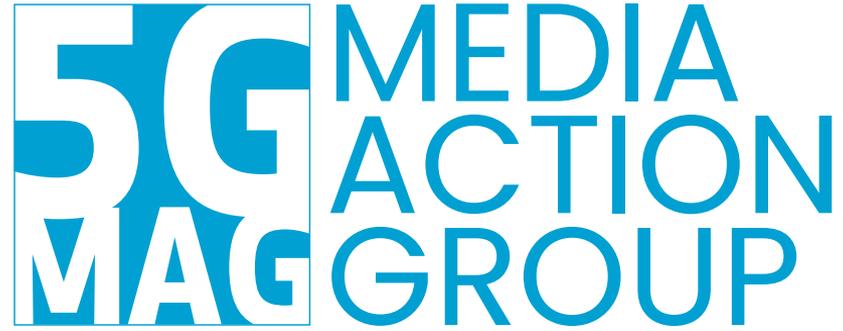
Global footprint

Advanced Codecs

Real-Time Communications



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



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



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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

SWS_240007

Views from 5G-MAG towards IMT-2030
5G-MAG MEDIA ACTION GROUP
www.5g-mag.com

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

	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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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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REFERENCE
< TOOLS / >

About Software...

Transforming Specifications into Products



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



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5G-MAG Reference Tools – The Projects



5G Media Streaming Architecture

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UE Data Collection, Reporting & Event Exposure

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5G Broadcast: TV, Radio and Emergency Alerts

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5G Multicast Broadcast Services

5G REFERENCE
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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

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Volumetric Video Experiences with MPEG V3C

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Beyond 2D Video Experiences

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AI/ML in Mobile Media Services

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Multimedia Content Delivery Protocols

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DVB-I Services over 5G Systems

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Towards 6G Media

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Reference Tools – The Projects

Media Delivery & Content Distribution

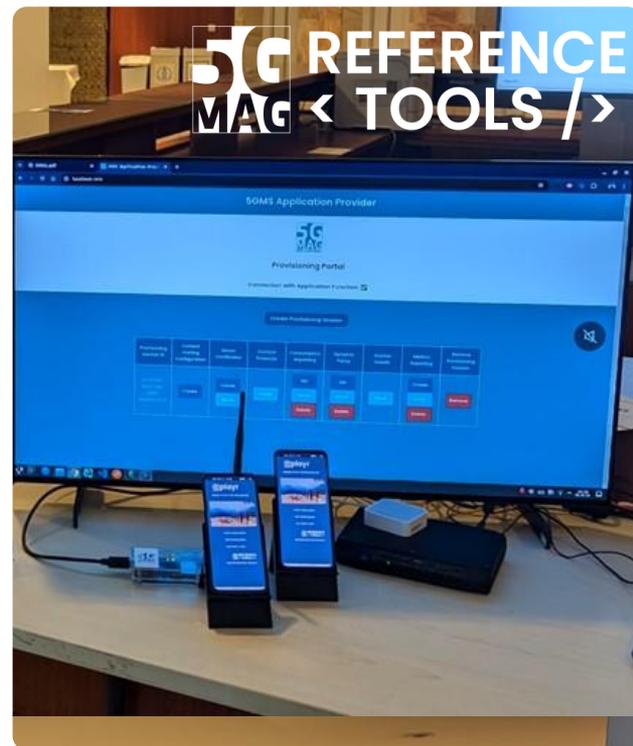
 **5G Media Streaming Architecture**
hub.5g-mag.com/Getting-Started/pages/5g-media-streaming/

 **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

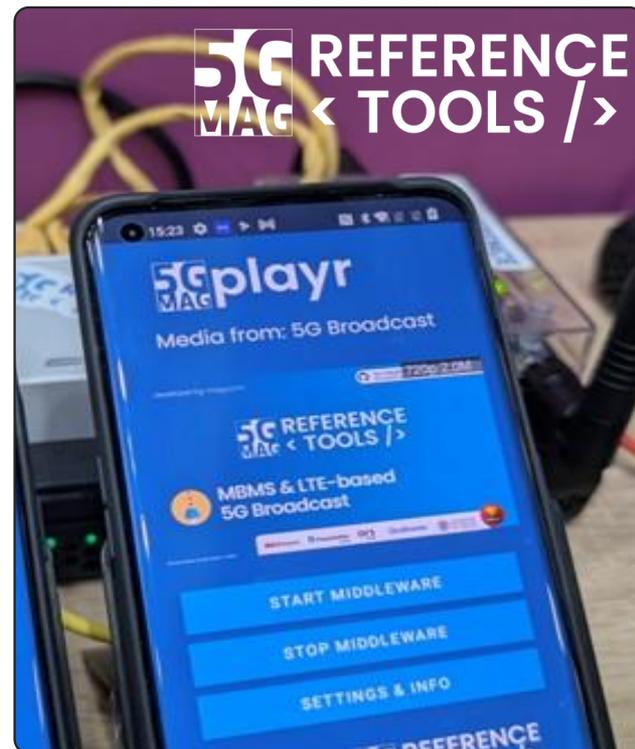
 **5G Broadcast: TV & Radio Hybrid Services**
hub.5g-mag.com/Getting-Started/pages/lte-based-5g-broadcast/tutorials.html

 **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)

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



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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 contributor your code

OFFICIAL CONTRIBUTORS WITH A SIGNED CLA



More information at developer.5g-mag.com and 5g-mag.github.io

Join the Software Developer Community



GITHUB

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

Sahaib 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

Bitstern 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



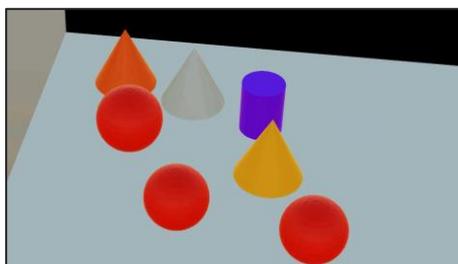
5G Multicast Broadcast Services

Initial support of 5MBS core network functions

Borja Iñesta 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

General Assembly
(All members)

Steering Group
(elected by members)

WG TECH

Members' Workgroup
**Technology
& Standards**

WG DEV

Members' Workgroup
**Development &
Ecosystem-drive**

WG PC

Members' Workgroup
Promotion & Communication

FORUM

Members' Forum
Collaborative Activity Hub

PUBLIC/EXTERNAL

Developer Community
5G-MAG Reference Tools



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>



More information at <http://www.5g-mag.com/partnerships>



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

Eva Markvoort – Membership
markvoort@5g-mag.com

Jordi J. Gimenez – Technology
gimenez@5g-mag.com



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 are navigation tabs for various 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 Experi. A search bar is located below the tabs with the text 'Filter by keyword or by field'. The main content is organized into five columns representing different project statuses:

- Candidates (1):** This is a candidate for future work. It contains one item: Tech #25, 'Integration of 5GMS clients with commercial OTT app', with the topic '5G Media Streaming'.
- Under Study (2):** This is under study. It contains two items: Tech #17, 'Testing of 5G Media Streaming Reference Tools in Testbeds', and Tech #19, 'Documentation', both with the topic '5G Media Streaming'.
- Work in Progress (6):** This is actively being worked on. It contains three items: Tech #24, 'Report on Uplink Media Delivery', 'Generation of Docker instances for 5GMS collaboration scenarios', and Tech #22, 'Implementation of Reference Tools (Rel-18)', all with the topic '5G Media Streaming'.
- Completed (1):** This has been completed. It contains one item: Tech #23, 'Gathering requirements towards FS_AMD', with the topic '5G Media Streaming'.
- Not pursued (0):** This is disregarded. It contains no items.

Each column has a '+ Add item' button at the bottom. A large black text box is overlaid on the 'Work in Progress' column, containing the text: 'What members have done, are doing or are planning to do'. At the bottom of the dashboard, there is a large black banner with the URL: <https://github.com/orgs/5G-MAG/projects/44>.

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-1 V3C Immersive Platform

label:"Project: 5G Media Streaming"

Candidates 1
This is a candidate for future work.

- Getting-Started #126
Advanced Media Delivery (AMD) - In-band reporting of CMCD information

Under Study 1
This is under study.

- Getting-Started #137
Cloud Deployment support

Under Development 4
This is actively being worked on.

- Getting-Started #132
Dynamic Policies (M1 Policy Templates API + M5 Dynamic Policies API)

Completed 0
This has been completed.

Completed + Tested 6

- Getting-Started #134
Consumption collection and reporting
- Getting-Started #130
Implementation of M1d Provisioning APIs
- Getting-Started #133
QoE metrics collection and reporting
- Getting-Started #129
Implementation of AF to AS RESTful OpenAPI (M3)
- Getting-Started #128
Support for basic media session handling (Application Function + Media Session Handler)
- Getting-Started #127
Support for basic media stream handling (Application Server + Media Stream Handler)

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

5G-MAG Reference Tools – Standards Feedback

The screenshot displays the '5GPP Specifications - Feedback' interface, which is organized into several columns representing different stages of the standardization process:

- Pre-Acceptance:** Contains items like 'TS 26.512: Add missing 'NINr' parameter to ServiceDataInformation', 'Discussion: SD-WAN Network Assistance - Signaling with CM-Allowed Common Media Server Data (CMSCD)', and 'Discussion: Inter-Signaling of SD-WAN Information via ServiceDataInformation'.
- Adopted:** Contains items like 'TS 26.512: Policy: Stripmap state change events', 'TS 26.512: MIP: Policy: Stripmap: Provisioning - Return codes for error handling of put operation', and 'TS 26.512: MIP: Policy: Stripmap: Return codes for error handling of put operation'.
- Change contribution drafting:** This column is currently empty.
- Contributed to Working Group:** Contains 'TS 26.512: MIP: M3: Change: Consistent between normative tables and OpenAPI YAML'.
- Agreed/endorsed by Working Group:** This column is currently empty.
- Approved for publication by Technical Group:** Contains 'TS 26.512: Discrepancy between table and YAML for properties marked as read-only', 'TS 26.512: Gaps identified in support for Background Data Transfer at reference point M7', and 'TS 26.512: Gaps identified in support for Background Data Transfer at reference point M6'.
- Published:** Contains 'TS 26.512: MIP: Dynamic: Policies: API and Network Assistance API - Potential inconsistency in the resource structure', 'Clarification on the use of Content-Location Configuration in different routing scenarios', 'Clarification: Signaling additional H-LS values in a SA for inter-site handover between 5G and 4G', 'Clarification: Signaling additional H-LS values in a SA for inter-site handover between 5G and 4G', 'Clarification on use of optional properties in NetworkAssistanceGenders', and 'Clarification on use of optional properties in NetworkAssistanceGenders'.
- Not adopted:** Contains 'Clarification on the use of optional properties in NetworkAssistanceGenders', 'Clarification on use of optional properties in NetworkAssistanceGenders', and 'How is congestion reporting triggered?'.

Each item in the interface includes a title, a brief description, and a set of colored buttons for actions such as 'Improve', 'Adopt', 'Discontinue', 'Clarification', and 'Add Item'.

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

Standards and Software – Outcomes



GITHUB

[hub.5g-mag.com](https://github.com/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](https://github.com/hub.5g-mag.com/Tech)

- Technology analysis, discussion and documentation
- Reports and Explainers



GITHUB

[hub.5g-mag.com/Standards](https://github.com/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](https://github.com/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:

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

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