ETSI MEC: An Introduction
(almost) everything you want to know about ETSI MEC

ETSI MEC Leadership Team

For: Public consumption
Last update: May 2023
ETSI MEC: Enabling *Edge* through *Standardization*

*Foundation for Edge Computing* – Fully standardized solution to enable applications in distributed cloud created by ETSI MEC + 3GPP

**Watch the new video on MEC**

https://www.youtube.com/watch?v=crnPWql-000

**ETSI ISG MEC**

**ISG: Industry Specification Group**

open to all of industry, regardless of ETSI membership and focused on all industry needs

**MEC: Multi-access Edge Computing**

Cloud Computing at the Edge of the network.

**ETSI: The Standards People**

producing globally applicable standards for ICT-enabled systems

Application Life Cycle Management

RESTful based APIs for Runtime Application Services

- **MEC**
  - NFV
  - Continuously growing MEC membership: 127 (in April 2023); e.g. in June 2021 it was 114
  - **Diverse ecosystem**: Operators - Technology Providers - IT players - Application developers - Startups - ...

ETSI MEC – Foundation for Edge Computing

MEC offers to application developers and content providers cloud-computing capabilities and an IT service environment at the edge of the network.

Basic principles:

- **Open standard** → allowing multiple implementations and ensuring interoperability
- MEC exploiting ETSI NFV framework and definitions → enabling MEC in NFV deployments
- Alignment with 3GPP based on fruitful collaboration of common member companies → enabling MEC in 5G
- Access-agnostic nature (as per MEC acronym - Multi-access Edge Computing) → enabling other accesses
- Addressing the needs of a wide ecosystem → enable multiple verticals (e.g. automotive), federations

MEC is focused on existential questions of applications “on the edge”
MEC supports many 5G use cases and market segments

More info at this ETSI White Paper on MEC

https://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp11_mec_a_key_technology_towards_5g.pdf
MEC and vertical industries

MEC is a key enabler for many vertical market segments.

Several (specialized) use cases driven by different verticals:

- automotive,
- industrial automation,
- VR/AR,
- Videostreaming,
- Gaming,
- e-health,
- Smart Cities,
- Etc ...

Edge Exposure Day (Sept 18th, 2022, Kfar Saba, Israel) supported by ETSI

Attendance from diverse people, e.g., local companies, MEC participants, representatives from 5GAA and AECC, ...
MEC reference architecture

APIs
- Application Support
- Service Management
- Radio Network Information
- Location
- UE Identity
- Bandwidth Management
- Fixed Access Information
- WLAN Information
- V2X Information Service

- Application Package lifecycle and operation granting
- Device application interface
MEC Standard work: from Phase 1 to Phase 3

- **Key overall specification**
  - Technical Requirements (MEC 002)
  - Framework and Ref. Arch. (MEC 003)
  - MEC PoC Process (MEC-IEG 005)
  - API Framework (MEC 009)

- **IaaS Management APIs**
  - Platform mgmt. (MEC 010-1)
  - Application mgmt. (MEC 010-2)
  - Device-triggered LCM operations (MEC 016)

- **PaaS Service Exposure**
  - Required Platform Svcs / App. Enablement (MEC 011)
  - Service APIs (MEC 012, 013, 014, 015)

- **Key Studies for Future Work**
  - Study on MEC in NFV (MEC 017)
  - Study on Mobility Support (MEC 018)

- **Evolution of Phase 1 and closing open items**
  - Application Mobility (MEC 021 – published)
  - Lawful Intercept (MEC 026 – published)

- **Addressing key Industry Segments**
  - V2X (MEC 022 – published; MEC 030 – published)
  - Industrial Automation, VR/AR

- **Key use-cases and new requirement**
  - Network Slicing (MEC 024 – published)
  - Container Support (MEC 027 – published)

- **Normative work for integration with NFV**
  - Incorporate in v2 of existing specs as needed

- **From “Mobile” to “Multi-Access”**
  - Wi-Fi (MEC 028 – published)
  - Fixed Access (MEC 029 – published)

- **MEC integration in 5G networks (MEC 031)**

- **Developer community engagement**
  - API publication through ETSI Forge (more overleaf)
  - Hackathons, MEC Deplyment Trials

- **Testing and Compliance** (MEC-DEC 025 – published; multipart specification MEC-DEC 032-x)

- **Full Phase 3 work ongoing (just completing some outstanding Phase 2 work).**

- **MEC as heterogeneous clouds**
  - Expanding traditional cloud and NFV LCM approaches
  - Inter-MEC systems and MEC-Cloud systems coordination: “MEC Federation” (MEC 035 – published / MEC040 – ongoing)
  - Mobile/intermittently connected and resource constrained devices (MEC 036), MEC IoT API (MEC 033)

- **MEC Security (GR MEC 041)**

- **MEC deployments (MEC in Park enterprises: MEC 038)**

- **MEC Application Slices (MEC 044)**

- **Continuing emphasis on enabling developers**
  - Application Package Format and Descriptor Specification (MEC 037)
  - API Serialization
  - MEC Sandbox development
  - Testing and compliance

- **Continue to define services that meet industry demand (e.g. Abstracted Radio Network Info for Industries, GR MEC 043)**

- **Maintain and enhance existing APIs (e.g. MEC 013)**

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2015 ETSI MEC phase 1 (Completed)  
2018 ETSI MEC phase 2 (Completed)  
2021 ETSI MEC phase 3 (ongoing)
MEC toward 6G

- CAVEAT: nobody knows yet what 6G will be! So, we cannot claim (still) what MEC in 6G will be, of course.
- On the other hand, MEC evolution and vision can be shaped (in a pragmatic way).
- The newly approved ToR#5 of MEC (available here) is related to the period 2023-2024.
  - Thus, it will include also the beginning of MEC Phase 4 (2024-2026).
- So, at least, we could draw (from the ToR#5) some differences between MEC Phase 3 (2021-2023) and Phase 4 (2024-2026).
MEC toward 6G: planning MEC Phase 4

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*In a nutshell, a transition from MEC Phase 3 to MEC Phase 4 can lead to:*

- more consolidated work on MEC Federation, including exposure of resources managed by multiple operators, e.g. addressing **multi-domain and multi-tenancy slicing and MEC support for application slicing**;
- MEC architectural/service updates needed to support cloud native communication systems and edge native design for app developers (also with container support);
- introduction of proper normative work to improve security and privacy in MEC systems
- Further promotion of MEC as an attractive development environment for the industry by creating “developer-friendly environments” (e.g. portals, SDK) that enable convergence of key industry ecosystem, e.g. app developers and operators
- Further outreach efforts, e.g. Hackathons/trials in collab with open source communities, industry groups (e.g. 5GAA, etc.).
Our Standards
Basic principles:

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## ETSI MEC – Foundation for Edge Computing

<table>
<thead>
<tr>
<th>Application Enablement and Framework</th>
<th>API Principles</th>
<th>Specific service-related APIs</th>
<th>Management and Orchestration related APIs</th>
</tr>
</thead>
</table>
| Service definition framework and baseline platform services authorized applications.  
- Registration, discovery and notification;  
- Methodology for authentication and authorization of apps providing/consuming services;  
- Communication support for services (query/response and notifications). | Principles and guidance for developing and documenting APIs  
- Developer-friendly approach to foster development  
  *Ensures that a consistent set of APIs* are used by developers.  
- Defines approach for authentication and authorization of apps providing/consuming services  
- Based on TMF and OMA best practices | Standardized service-exposure APIs for key services that  
- Expose network and context information  
- Allow definition of localized, contextual services  
- Support key use cases (e.g. enterprise, vehicular)  
- Allow fine-grained edge traffic management | Management of MEC hosts either as *stand-alone* entities or part of a larger *NFV-managed* framework  
- Facilitate running of 3rd party application  
- Enable deployment at the correct location at the right time, based on technical and business parameters  
- Integrate into telco operations systems, e.g. OSS |

Enables a myriad of new use cases across multiple sectors as well as innovative business opportunities
Enabling Global Application Portability

RESTful based HTTP APIs presented via OpenAPI compliant descriptions ([https://forge.etsi.org/](https://forge.etsi.org/)), in YAML & JSON including the full data model.

MEC Services exposed via individual APIs:
- MEC012 Radio Network Info API
- MEC013 UE Identity API
- MEC015 Bandwidth Mgmt API
- MEC028 WLAN Info API
- MEC029 Fixed Access Info API
- MEC0xy Your Service API

MEC Platform

ISG MEC Spec MEC009 API Principles & Guidelines

✓ Simple to use, well documented APIs, published with OpenAPI Framework
✓ Create innovative applications quickly and easily, reducing time-to-revenue
✓ New APIs (compliant with the MEC API principles) can be added
✓ Increase the Total Addressable Market (TAM)
Application portability via the ETSI MEC APIs ecosystem

That’s all you need as a MEC App developer

✅ Discover network, users, capabilities and local services

✅ Manage traffic, DNS, mobility, V2X, etc.

✅ Register your own service and discover third party services available locally

✅ Plus: APIs for interoperability among MEC systems and infra
MEC and Management: The Killer Use Case for Automation

MEC deployments present challenging environment
• (large scale: geography) x (small scale: cloud footprint)
• Unmanned/lights out location
• Outside traditional service areas

While supporting “critical infrastructure”
• Telco, public safety, etc.
• “9’s” of availability requirements

Unique requirements and processes
• Minimize need for human presence
• Maximize service time intervals
• Minimize skills required from those on site

In other words
• Get as close as possible to the web-scale maintenance model
• In a very non-web-scale environment

The following ETSI White Papers address the MEC deployment aspects:
- WP#23: Cloud RAN and MEC: A Perfect Pairing
- WP#24: MEC Deployments in 4G and Evolution Towards 5G
- WP#28: MEC in 5G networks
- WP#30: MEC in an Enterprise Setting: A Solution Outline

All white papers are available in https://portal.etsi.org/TBSiteMap/MEC/MECWhitePapers.aspx
A key part of ETSI Network Automation Standards

Device-triggered LCM Enablement (MEC 16)

Inter-MEC & MEC-Cloud (MEC 035 Study)

Management of MEP as a VNF (MEC 10-1)

LCM Mgmt of 3rd party Apps (MEC 10-2)

ZSM: overall approach

NFV, OSM: managing telco clouds

MEC: managing edge telco clouds
MEC White Papers: A view of a whole picture

Standards are necessarily tools, not solutions

- Enable interoperability
- Support a broad range of use cases and system architecture
- Address only a specific part of the whole picture

MEC White Papers: how we help industry see the whole picture

- Harmonizing Standards for Edge Computing: a synergized architecture leveraging ETSI MEC and 3GPP

- MEC in an Enterprise Setting

- MEC in 5G Networks:

- MEC deployment in 4G and towards 5G:

- Enhanced DNS Support towards Distributed MEC Environment (September 2020):

- CRAN and MEC: A Perfect Pairing:

- Developing Software for MEC (2nd Ed.)


...and many more to come!
ETSI White paper on MEC Federation: deployment considerations

Key considerations in the paper:

- Introduces the business stories that enable readers to understand how MEC federation is beneficial for MEC system providers
- Based on these business stories, corresponding deployment options are introduced.
- Provide insights for edge stakeholders, and all readers in general, to better understand how to choose the appropriate deployment options

- This White Paper focuses on the deployment options related to MEC federation, especially from an architectural point of view, and with a key focus on ETSI MEC implementations, but also with the aim to provide an open approach considering other standards and technologies.
- For this purpose, the White Paper firstly analyzes the recent publications of GSMA OPG and recent updates in ETSI MEC and 3GPP specifications, then introduces the synergized architecture supported by both standards organizations, which indicates the background information for the deployment of MEC federation.

MEC security: status of standards support and future evolutions

- **MEC scenarios** are characterized by a complex multi-vendor, multi-supplier, multi-set of equipment including both HW and SW devices. Given this overall level of system heterogeneity, areas of security, trust, and privacy are key topics for the edge environments.

- In that perspective, MEC stakeholders should pay attention to the vulnerability and integrity of any third-party elements, and a truly end-to-end approach to MEC security needs to consider not only the current standards in ETSI ISG MEC, but also the other available standards that can be applicable to the MEC environment.

- **ETSI white paper**, authored by many experts (in the domain of edge computing, security and involved in various standard bodies), provides an overview of **ETSI MEC standards** and current support for security, which is also complemented by a description of other relevant standards in the domain (e.g. ETSI TC CYBER, ETSI ISG NFV, 3GPP SA3) and cybersecurity regulation potentially applicable to edge computing.


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Focus on MEC Federation
MEC Phase 3: expanding the scope to MEC Federation

Starting from Industry requirements ...

... ETSI MEC published a very first work on MEC federation

ETSI GR MEC 035 v3.1.1: “Multi-access Edge Computing (MEC); Study on Inter-MEC systems and MEC-Cloud systems coordination ”, June 2021, https://www.etsi.org/deliver/etsi_gr/MEC/001_099/035/03.01.01_60/gr_mec035v030101p.pdf
MEC Phase 3: expanding the scope to MEC Federation

Intra MEC

Inter MEC host (Intra MEC system) management already supported by ETSI MEC

Inter MEC

MEC - Cloud

Main scope for MEC 035 study

Ongoing normative work (e.g. GS MEC 040, MEC 003), in alignment with GSMA OPG requirements

Ref: ETSI GR MEC 035 v3.1.1, June 2021, https://www.etsi.org/deliver/etsi_gr/MEC/001_099/035/03.01.01_60/gr_mec035v030101p.pdf
MEC Study on Inter-MEC systems and MEC-Cloud systems coordination (MEC 035)

Many Use cases

#1: MEC federation scenario of V2X services

Inspired by 5GAA use cases including multi-MNO, multi-OEM, multi-MEC

Requirements for MEC:
- MEC system discovery
- MEC platform discovery
- MEC platform level information exchange

Ref: ETSI GR MEC 035 v3.1.1, June 2021, https://www.etsi.org/deliver/etsi_gr/MEC/001_099/035/03.01.01_60/gr_mec035v030101p.pdf
Study (MEC 035) on inter-MEC system and Cloud-MEC system coordination

Multi-operator agreements enabling MEC Federation for V2X services

- Type-1 use case - national roaming like scenario: customers of operator A could access the edge infrastructure of operator B to ensure the best possible service.
- Type-2 use case: An app developer has a commercial relationship with operator A. Federation agreements could allow the app developer to deploy its App in operator B’s MEC system.
- Type-3 use case - federation broker: a federation broker has a set of agreements with several MNOs.

Ref: ETSI GR MEC 035 v3.1.1, June 2021, https://www.etsi.org/deliver/etsi_gr/MEC/001_099/035/03.01.01_60/gr_mec035v030101p.pdf
MEC Study on Inter-MEC systems and MEC-Cloud systems coordination (MEC 035)

Many Use cases

#6: MEC federation scenario for immersive AR game

Ref: ETSI GR MEC 035 v3.1.1, June 2021, https://www.etsi.org/deliver/etsi_gr/MEC/001_099/035/03.01.01_60/gr_mec035v030101p.pdf
GSMA OPG (Operator Platform Group) mapping with ETSI MEC


Note: GSMA is listed as a MEC Participant, can submit contributions to ISG MEC for Discussion or Decision, and not only for Information. Dually, ETSI MEC nominated 2 observers, to represent the ISG in GSMA OPG.

ETSI MEC is aligning also with 3GPP to create a consistent standard and avoid duplication of work.
MEC federator (MEF): enables a MEC federation between MEC systems

- A MEF interfaces to at least one MEO
- Each MEF enables information exchange with at least one other MEF
- A MEF may serve as a single point of contact for multiple MEFs in the MEC federation

MEF may support the following functionality:
- registration of MEC system information by a MEO;
- MEC system discovery;
- broker capability acting as a one to many intermediary between MEFs;
- information (e.g. MEC system information) exchange;
- application lifecycle management (e.g. on-boarding/instantiation/termination) across different MEC systems;
- application monitoring across different MEC systems.

Reference: https://www.etsi.org/deliver/etsi_gs/MEC/001_099/003/03.01.01_60/gs_MEC003v030101p.pdf
Federation Enablement APIs offer services such as discovery, information exchange and application life cycle management to enable the inter-work of one MEC system with another MEC system:

- Registration/Update/Deregistration of MEC system(s) to the federation
- MEC system discovery
- MEC application instance discovery
- MEC service discovery
- Application package mgmt and App instance LCM
- Providing/updating MEC system-wide MEC App instance information updates to MEF

Example (MEC System Discovery):

- Information flow used for enabling MEO to be aware of another MEC system
- The MEC system discovery is the primitive and essential procedure for enabling the other functionalities relating to the Feature MEC Federation

Reference: https://www.etsi.org/deliver/etsi_gs/MEC/001_099/040/03.01.01_60/gs_MEC040v030101p.pdf
A possible relationship could consist in the following high-level steps:

1. GSMA asks SDOs to cover standards for the OP architecture (and OSCs to complement with open source)
2. Worksplit (ETSI, 3GPP, OSCs,...) and consequent std work, publication of standards etc..
3. Finally, GSMA will certify OP compliance
WG DECODE: Enabling MEC Deployment and Ecosystem Development
ETSI ISG MEC DECODE Working Group: MEC Deployment and Ecosystem engagement activities

- OpenAPI representations: ETSI Forge
- Testing and Conformance
- MEC Ecosystem wiki
- PoCs (proof-of-concepts)
- MDTs (MEC Deployment Trials)
- MEC Sandbox
- Collaborations: Akraino
- Hackathons
- Plugtests
- MEC Tech Series

https://apiportal.akraino.org/apimap.html
https://try-mec.etsi.org/

EDGE COMPUTING WORLD
11-12 Oct 2022,
https://www.edgecomputingworld.com/
edge-hackathon-2022/

1 - 15 Oct 2021
NFV&MEC IOP Plugtests 2021
MEC: DECODE Working Group

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Navigating with the Swagger UI

Discover the APIs on forge.etsi.org/rep/mec
OpenAPI representations: ETSI Forge

POST Creates a subscription for area change notification

Creates a subscription to the Location Service for an area change notification.

REQUEST BODY SCHEMA: application/json

Subscription to be created

- circleNotificationSubscription

A type containing data for notifications, when the area is defined as a circle.

News: new STF (Special Task Force) for OpenAPI implementation

Status: accepted by ETSI Board with work to start early 2023

Navigating with the ReDoc UI
MEC: DECODE Working Group

- OpenAPI representations: ETSI Forge
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News: Guidelines on Interoperability testing published Nov 2022
Follow-on API Conformance ETSI TTF launched for 2023

General testing framework for MEC Technologies (MEC 0025)

API Conformance testing developed for server implementations
- Standardized test suite (MEC-DEC 032) Test implementations in Robot Framework and TTCN-3
- Openly available and released under BSD-3 license
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PoCs

MEC Deployment Trials

MEC Ecosystem

New MDTs

New implementations

For further details, please see: http://mecwiki.etsi.org or contact CTI_Support@etsi.org

We encourage new submissions to ETSI MEC!
MEC PoCs: Show off YOUR cool Edge

Recent PoCs (9 are complete)

PoC #10
Service-Aware MEC Platform to Enable Bandwidth Management of RAN
Industry Technology Research Institute - Linker Network - FarEasTone

PoC #11
Communication Traffic Management for V2x
KDDI Corporation - Saguna Networks Ltd. - Hewlett Packard Enterprise

PoC #12
MEC Enabled OTT Business
China Unicom, ZTE, Intel, Tencent, Wo video, UnitedStack

PoC #13
MEC infotainment for smart roads and city hot spots
TIM, Intel, Vivida, ISMB, City of Turin

We encourage new POC submissions to ETSI MEC!

For further details, please see: http://mecwiki.etsi.org or contact CTI_Support@etsi.org
MEC Deployment Trial: MEC in action in Live Networks

Next step from MEC PoC to keep engaging the ecosystem in MEC standards based deployments

✔️ From Proof of Concept to proof of viability in a Live Network environment

✔️ Follows the proven MEC PoC framework with a new set of acceptance criteria
  1. Trial deployed in Live Network
  2. Demonstrated to the industry, e.g., in an industry event or in ISG MEC
  3. Feedback to MEC standardization; improvement proposals, lessons learnt, next steps

✔️ Currently the following MDTs are active:

<table>
<thead>
<tr>
<th>MDT #3</th>
<th>Edge-Cloud VR cloud game scheme based on 5G network</th>
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<tbody>
<tr>
<td>China Unicom, Huawei, Tencent, Intel</td>
<td></td>
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<table>
<thead>
<tr>
<th>MDT #4</th>
<th>ARVR navigation based on 5G MEC</th>
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<tbody>
<tr>
<td>China Telecom, Huawei, ZTECN</td>
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<tr>
<th>MDT #5</th>
<th>Smart Factory over MEC</th>
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<tr>
<td>SK telecom, MyungWha Corporation</td>
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<tr>
<th>MDT #6</th>
<th>Federated Edge Hub on MEC</th>
</tr>
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<tbody>
<tr>
<td>SK telecom, Singtel Hewlett Packard Enterprise</td>
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We encourage new MDT submissions to ETSI MEC!
MEC: DECODE Working Group

- OpenAPI representations: ETSI Forge
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- PoCs (proof-of-concepts)
- MDTs (MEC Deployment Trials)
- MEC Sandbox
  - New features and APIs implemented
- Collaborations: Akraino
- Hackathons
- Plugtests
- MEC Tech Series

https://try-mec.etsi.org/

A simulator of a real 4G/5G network as seen via the MEC APIs
- 4G/5G/Wifi access points
- Steady and moving UE (~devices)
- API Console, integrated Swagger UI, & more
- Real MEC Apps can interact with the Sandbox and can register services
ETSI MEC Sandbox - Introduction

• Rational for the MEC Sandbox:
  – Developers indicated the ETSI Forge Open API representations are an excellent resource to learn MEC API syntax
  – However, developers also need to understand the behavior of MEC services, which can only be achieved by interaction

• Interactive MEC emulation environment enabling edge app developers to learn & experiment with “live” ETSI MEC Service APIs from anywhere in the world:
  – App developers can remotely call MEC service end-points from their edge application of environment
  – Alternatively, developers may interact with MEC services via a web-portal “Try-it” Swagger interface
ETSI MEC Sandbox – Features and MEC Services

The MEC Sandbox emulates an edge system set in Monaco, including user selectable 4G, 5G, and WiFi network topology configurations (scenarios).

MEC Services:
- MEC 011: Application and Service Enablement
- MEC 012: Radio Network Information Service
- MEC 013: Location Service
- MEC 021: Application Mobility Service
- MEC 028: WLAN Access Information Service

Edge Network Scenarios:
- 4G Macro – Single MEC Platform
- 4G/5G Macro – Single MEC Platform
- 4G/5G/WiFi – Single MEC Platform
- 4G/5G/WiFi – Dual MEC Platform
- 4G/5G/WiFi – Dual MEC + Short Terminal Mobility Paths
Putting it all together...with ETSI GS MEC 013 – Location API

**Specification Document**

**ETSI Forge – Open API** (human and machine readable)

**MEC Sandbox** (live interaction - try-mec.etsi.org)

[Images and links are shown in the slides]

/ gs_mec013v020101p.pdf

forge.etsi.org - LocationAPI.yaml
Check out the MEC Sandbox!!

try-mec.etsi.org

Available MEC Services:
- Application and Service Enablement APIs (MEC 011)
- Location (MEC 013)
- Radio Network Information (MEC 012)
- WLAN Access Information (MEC 028)
- Application Mobility Service (MEC 021)

Added in 2022:
- V2X API (MEC 030)
- Bandwidth Management and Traffic Steering Service (MEC 015)
- UE Application API (MEC 016)
Additional Resources to learn more...

“Getting Started with the MEC Sandbox” –  
ETSI Webinar Recording (Feb 2021) –  
etsi.org/events/getting-started-with-the-mec-sandbox

MEC Tech Series playlist on ETSI’s YouTube channel:  
mecwiki.etsi.org/MEC_Tech_Series

Sandbox in use –  
MEC Hackathon 2022

MEC Sandbox Slack Workspace –  
Join the discussion board – Link

Detailed Technical Information –  
- MEC Sandbox Wiki (User guide):  
- MEC Sandbox’s underlying Edge Emulation Engine:  
  https://github.com/InterDigitalInc/AdvantEDGE

Insights for Edge Software Developers
- Episode #4 – MEC Sandbox
- Episode #9 – VIS API in MEC Sandbox
MEC: DECODE Working Group

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- Hackathons
- Plugtests
- MEC Tech Series

Past MEC Hackathons:

- **18-19 September 2018**: 3 parallel events ([link](https://www.edgecomputingworld.com/hackathon/))
  - Berlin (co-located with Edge Computing Congress)
  - Beijing (China)
  - Turin (Italy)

- **17-18 September 2019**: 2 parallel events ([link](https://www.edgecomputingworld.com/hackathon/))
  - London, UK (co-located with Edge Computing Congress)
  - Shenzen (China)

- **18 November 2019**, in collab. with LF Edge and Akraino ([link](https://www.edgecomputingworld.com/hackathon/))
  - San Diego (USA) (with KubeCon + CloudNativeCon North America)

- **25-26 November 2020**
  - 2020 Droidcon MEC Hackathon (co-located with Droidcon Italy)

MEC Hackathon 2021 & 2022

https://www.edgecomputingworld.com/hackathon/
Collaboration between ETSI MEC, the LINUX Foundation (LF Edge), and the 5G Automotive Association (5GAA)

“Hackathon Call for Edge Computing Developers”:
Realize an innovative edge application, solution, or use-case utilizing ETSI MEC Service APIs and LF Edge Akraino Blueprints

World-wide Edge Hackathon includes fifteen teams completing in three application verticals:
- **Automotive, Mixed & Augmented Reality, and Edge Computing & 5G**
- Asia = 11 teams (China, India, Korea); Europe = 2 teams (Spain); the Americas = 2 teams (USA)

**Hackathon Format:**
- Remote Competition from July 1st – September 23rd
  - Teams provided with access to the MEC Sandbox to interact with ETSI MEC Service APIs
- **Onsite Competition** - EWC Developer Conference; Oct. 11-12th, 2022
  - Best team in each application vertical will be invited to compete in on-site demos and a live “pitch-off” session in Santa Clara, California.

https://www.edgecomputingworld.com/edge-hackathon-2022/
MEC: DECODE Working Group

- OpenAPI representations: ETSI Forge
- Testing and Conformance
- MEC Ecosystem wiki
- PoCs (proof-of-concepts)
- MDTs (MEC Deployment Trials)
- MEC Sandbox
- Collaborations: Akraino
- Hackathons
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- 3 – 7 June 2019
  4th NFV Plugtests 2019
- 15 – 9 June 2020
  NFV&MEC Plugtests 2020
- 1 – 28 Feb 2021
  NFV&MEC API Plugtests 2021
- 1 - 15 Oct 2021
  NFV&MEC IOP Plugtests 2021
MEC: DECODE Working Group

- OpenAPI representations: ETSI Forge
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Get involved with MEC!

❖ Learn and implement MEC APIs on ETSI Forge ([forge.etsi.org](http://forge.etsi.org))
❖ Experiment with MEC APIs in the MEC Sandbox ([try-mec.etsi.org](http://try-mec.etsi.org))
❖ Share your projects on the MEC Ecosystem wiki ([mecwiki.etsi.org](http://mecwiki.etsi.org))
❖ Consider joining a MEC Hackathon as a participant or organizer ([link](http://link))
❖ Share your insights by volunteering to produce a MEC Tech Series episode on a topic of your choice ([link](http://link))
❖ Join the discussion on social media (#MEC, #ETSI, #theStandardsPeople)
❖ Register for the NFV&MEC Plugtest program / events ([link](http://link))
❖ Join ISG MEC for design, standardization, and ecosystem development activities ([link](http://link))
The larger Telco World: ETSI MEC and 5G
MEC Phase 2 – Study Item MEC in 5G (MEC 031)

✔ The ETSI white paper MEC in 5G networks sets the scene for this study item
✔ ISG MEC investigates the opportunities offered to MEC by the 5G system and its edge computing enablers
✔ The scope includes the following
  1. C-plane interactions with 5GC,
  2. Functional split between MEC and 5GC wrt. API framework,
  3. Organization of MEC as an AF,
  4. Pertinent interactions of MEC with (R)AN
MEC as an AF (Application Function) can request the 5GC to
- Select a local UPF near the target (R)AN node
- use the local UPF for PDU sessions of the target UE(s)
- control the traffic forwarding from the local UPF so that the UL traffic matching with the traffic filters received from MEC (AF) is diverted towards MEC hosts while other traffic is sent to the Central Cloud
In case of UE mobility, the 5GC can
- re-select a new local UPF more suitable to handle application traffic identified by MEC (AF)
- notify the AF about the new serving UPF
MEC as an AF can provide the following to 5GC

- traffic filters identifying MEC applications deployed locally on MEC hosts in Edge Cloud
- the target UEs (one UE identified by its IP/MAC address, a group of UE, any UE)
- information about forwarding the identified traffic further e.g. references to tunnels towards MEC hosts
3GPP enablers for MEC – Mobility event notifications

5GC allows MEC as an AF
- subscribe to UE mobility events that may affect traffic forwarding to MEC applications
- Receive notifications of UE mobility events affecting MEC application instances

- Selection & re-location of UPF
- AF influence on traffic routing
- Mobility event notifications from SMF
- Concurrent access to local and central DN
3GPP enablers for MEC - Concurrent access to local and central DN

Same UP session allows the UE to obtain content both from local server and central server

Service continuity enabled by IP address anchoring at the centralized UPF.
No impact on UE in case of Uplink Classifier (ULCL) option is used.

Edge Cloud for Ultra-low latency, high reliability services

Central Cloud a.k.a. Conventional “internet”

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MEC harmonized architecture with SA6 EDGEAPP

• Joint white paper (*) from both ETSI and 3GPP officials
• 3GPP TS 23.558 “Architecture for enabling Edge Applications; (Release 17)” v1.1.0, Oct. 2021 (informative Annex C)
• Alignment between 3GPP and ETSI MEC is currently in scope of eEDGEAPP in 3GPP SA6 (ref. S6-211858 and TR 23.958).

Notes:
• In 5G, alignment of the 2 standards is the key.
• General consensus to align ETSI and 3GPP in order to avoid duplication of work.
• Anyway, alignment doesn’t mean equivalence
(Note: ETSI MEC is Multi-access Edge Computing, thus including also Wi-Fi, fixed access, etc.)

(*) Ref. ETSI White paper: “Harmonizing standards for edge computing - A synergized architecture leveraging ETSI ISG MEC and 3GPP specifications”, July 2021, link here
MEC and NFV
a common approach to management
MEP as a VNF: must be running for any other VNF/app to run

MEPM: EMS for MEP

MEPM is (part of) App’s EMS

MEPM can be App’s VNFM

App can be a VNF: even if it doesn’t know it
MEC management: MEC-specific Operations

**Mm1** required APIs:
- Application Package Management
- Application Lifecycle Management

**Mm3** required APIs:
- Application Package Management
- Application Lifecycle Management
- Application Lifecycle Change Notification

These NFV semi-agnostic
- Information models designed to be feasible without NFV
- Data models are NFV-consistent and compatible
3 “Hybrid” Reference points identified as shown

- **Mv3**: at this point no specific changes to Ve-Vnfm-vnf are expected (i.e. it can be used as is)
- **Mv2**: Necessary changes are being addressed by NFV IFA as part of FEAT12 work (MECinNFV)
- **Mv1**: work identified, coordination plan is on-going

Additionally, MEC descriptor (AppD) must be linked to NFV descriptor (VNFD). This has been addressed as part of Rel 3 work using Non-MANO artifact capability as defined in Annex B of ETSI GS NFV-SOL 004 v. 2.5.1 and higher.
Thank you for your attention
**Epilogue**

ETSI ISG MEC is the leading voice in standardization & industry alignment around MEC

- Key building block in the evolution of mobile-broadband networks, complementing NFV & SDN
- Key enabler for IoT and mission-critical, vertical solutions
- Widely recognized as one of the key architectural concepts and technologies for 5G
  - Can be used to enable many 5G use cases without a full 5G roll-out (i.e. with 4G networks)
- Enable a myriad of new use cases across multiple sectors as well as innovative business opportunities