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

Presented by: ETSI MEC Leadership Team  For: Public consumption

Last update: April 2022
ETSI MEC: Enabling *Edge* through *Standardization*

**ETSI ISG MEC**

**ETSI: The Standards People**
We produce globally applicable standards for ICT-enabled systems, applications and services deployed across all sectors of industry and society

**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.

Standards + Industry Enablement + Telco Edge Focus

Watch the new video on MEC

[https://www.youtube.com/watch?v=crnPWql-0oo](https://www.youtube.com/watch?v=crnPWql-0oo)
ETSI MEC – What we do

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

Welcome to ETSI Forge
Collaborative tools for standardized technologies

Activity from ETSI groups

Application Life Cycle Management

RESTful based APIs for Runtime Application Services

125 members - Operators – Technology Vendors – IT players – Application developers

Look at the new webpage with the ISG MEC Leaders and Support Team


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The essence of MEC

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

MEC is focused on existential questions of applications “on the edge”

- How do I reach my cloud service?
- What is my QoS?
- Where am I?
- What is around me?
- How many users am I serving? And where
- How to be sure I am running when and where needed?
- What if my users move?
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
3rd 3-year Phase of work under way

- **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)
  - IoT (MEC 033), 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 Deployment Trials

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

- **Full Phase 3 work started already, while completing 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 or intermittently connected components, and resource constrained devices (MEC 036)

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

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

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

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

- **Maintain completed APIs**

- **Continue to define services that meet industry demand (e.g., GR MEC 043)**
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

In 2021 5GAA joined the MEC membership
## Application Enablement and Framework

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).

## API Principles

- 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

## Specific service-related APIs

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 and Orchestration related APIs

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

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**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/), in YAML & JSON including the full data model

MEC Services exposed via individual APIs

MEC API Framework

 ✓ 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
A key part of ETSI Network Automation Standards

- Device-triggered LCM Enablement (MEC 16)
- 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:
- CRAN and MEC: A Perfect Pairing:
- Developing SW for MEC (2nd Ed.)

...and many more to come!
MEC security

• **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](https://www.etsi.org/newsroom/press-releases/1933-etsi-releases-a-white-paper-on-edge-computing-security), 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.
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 Federation: “federated model of MEC systems enabling shared usage of MEC services and applications”
MEC Phase 3: expanding the scope to MEC Federation

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

Main scope for MEC 035 study

Ongoing normative work (e.g. GS ME 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](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
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.
MEC 003 – introducing Architecture variant for MEC federation

Phase 3 deliverable published in March 2022

**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
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/

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Discover the APIs on forge.etsi.org/rep/mec

News: new STF (Special Task Force) for OpenAPI implementation
Status: accepted by ETSI Board and work started early Nov 2021
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News: new Work Item MEC-DEC0042 for Testing an Interoperability

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

We encourage new submissions to ETSI MEC!

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

New MDTs

New implementations
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

The next PoC
IMAGINE YOUR BEST HERE
Thought Leaders in Edge Computing

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 #</th>
<th>MEC Deployment Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CDN at the Edge</td>
</tr>
<tr>
<td></td>
<td>China Mobile, Nokia</td>
</tr>
<tr>
<td>2</td>
<td>MEC in Factory Network</td>
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<tr>
<td></td>
<td>China Mobile, Huawei</td>
</tr>
<tr>
<td>3</td>
<td>Edge-Cloud VR cloud game scheme based on 5G network</td>
</tr>
<tr>
<td></td>
<td>China Unicom, Huawei, Tencent, Intel</td>
</tr>
<tr>
<td>4</td>
<td>ARVR navigation based on 5G MEC</td>
</tr>
<tr>
<td></td>
<td>China Telecom, Huawei, 21CN</td>
</tr>
</tbody>
</table>

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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

https://try-mec.etsi.org/
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Past MEC Hackathons:

- **18-19 September 2018**: 3 parallel events (link)
  - Berlin (co-located with Edge Computing Congress)
  - Beijing (China)
  - Turin (Italy)

- **17-18 September 2019**: 2 parallel events (link)
  - London, UK (co-located with Edge Computing Congress)
  - Shenzen (China)

- **18 November 2019**, in collab. with LF Edge and Akraino (link)
  - San Diego (USA) (with KubeCon + CloudNativeCon North America)

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

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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

2021 editions
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The larger Telco World: ETSI MEC and 5G
MEC Phase 2 – Study Item MEC in 5G (MEC 031)

 suk The ETSI white paper MEC in 5G networks sets the scene for this study item
 s 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 SGC,
  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 SGC 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
3GPP enablers for MEC – Selection & re-location of UPF

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
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
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.

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

Edge Cloud for Ultra-low latency, high reliability services

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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)” (informative Annex C)
- Alignment between 3GPP and ETSI MEC is currently in scope of eEDGEAPP in 3GPP SA6 (ref. **S6-211858**).

(*) Ref. ETSI White paper: “Harmonizing standards for edge computing - A synergized architecture leveraging ETSI ISG MEC and 3GPP specifications”, July 2020, link [here](#).
MEC and NFV a common approach to management
MEC and NFV: MANO for the Telco Edge

MEPM is (part of) App’s EMS

MEPM can be App’s VNFM

MEP as a VNF: must be running for any other VNF/app to run

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.
The END
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