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

ETSI MEC Leadership Team

For: Public consumption
Last update: December 2023
ETSIS ISG MEC

Watch the MEC video
https://www.youtube.com/watch?v=crnPWql-00o

Application Life Cycle Management
RESTful based APIs for Runtime Application Services

MEC: Multi-access Edge Computing
Cloud Computing at the Edge of the network.

ETSI ISG MEC

ISG: Industry Specification Group
open to all of industry, regardless of ETSI membership and focused on all industry needs

ETSI The Standards People
producing globally applicable standards for ICT-enabled systems

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producing globally applicable standards for ICT-enabled systems

• 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 delegates, repr from 5GAA and AECC, ...
MEC Panels Series: meeting vertical industries

A series of live panels with relevant experts from the various vertical market segments.

First event on Drones vertical:
• 26 June 2023, co-located with MEC#34
• 70+ people registered
• 6 keynotes and 1 demo
• Final panel discussion

Other possible verticals (TBD)
• CDN, XR, metaverse
• Industrial automation

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 Deployment Trials

#### Full Phase 3 work ongoing (with some pre-Phase 4).

#### 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 -- published)
- 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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**Timeline:**
- **2015**: ETSI MEC phase 1 (Completed)
- **2018**: ETSI MEC phase 2 (Completed)
- **2021**: ETSI MEC phase 3 (almost completed)
### MEC Phase 3 Work Items
#### MEC Phase 3 (2021-2023)
- **MEC 001** - Terminology
- **MEC 002** v311 - Use Cases and Requirements
- **MEC 002** v321 - Use Cases and Requirements
- **MEC 003** - Context and Integration Model for New Services
- **MEC 037** v311 - MEC NMI
- **MEC 036** v321 - MEC NMI; Part 2: App lifecycle, rules and req mgmt
- **MEC 015** - Traffic mgmt API
- **MEC 016** - Device App Interface API
- **MEC 021** - Phases 3 - Application Mobility Service API
- **MEC 030** v311
- **MEC 030** v321
- **MEC 036** - Constrained Device (impacting **MEC Phase 4**)
- **MEC 037** v311
- **MEC 037** v321 - App Pkg Format Description
- **MEC 040** v311
- **MEC 040** - Federation enablesment APIs
- **MEC 041** - Study on MEC Security
- **MEC 042** - MEC Security
- **MEC 043** - Abstraction of Radio Network Information for Industries (impacting **MEC Phase 4**)
- **MEC 044** - Study on MEC Application Slices
- **MEC 045** - QoS Measurement API
- **MEC 046** - Sensor-sharing API
- **MEC 047** - Distributed Edge Network - (**MEC Phase 4**)
- **MEC 048** - Enablement API for Customer Self-Service
- **MEC-DEC49** - Edge Native Connector - STF 678 - (**MEC Phase 4**)

#### MEC Phase 4 (2024-2026)
- **MEC-DEC23** - Open API (STF 644)
- **MEC-DEC32-1** - API Conf Test Spec; Part 1: Test Req and Impl Conf Statement (ICS)
- **MEC-DEC32-2** - API Conf Test Spec; Part 2: Test Purposes (TP)
- **MEC-DEC32-3** - API Conf Test Spec; Part 3: Abstract Test Suite (ATS)
- **MEC-DEC34** Sandbox - STF 625
- **MEC-DEC49** Edge Native Connector - STF 678 - (**MEC Phase 4**)

#### Legenda
- **early draft**
- **stable draft**
- **final draft**
- **TB approval**
- **completion**

#### Milestone A

#### Milestone B

#### Milestone C

#### Milestone D

#### Milestone E

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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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• So, at least, we could draw (from the ToR#5) some differences between Phase 3 (2021-2023) and Phase 4 (2024-2026).

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
ETSI MEC – Foundation for Edge Computing

Basic principles:

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In 2021 5GAA joined the MEC membership
# ETSI MEC – Foundation for Edge Computing

## 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 Platform

- 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
- WP#56: Unlocking Digital Transformation with Autonomous Networks: ETSI perspectives and major achievements

Suggested reading:

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

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

- Mobile Edge Computing: A key technology towards 5G (September 2015)
- Developing Software for Multi-Access Edge Computing (First edition - September 2017)
- Cloud RAN and MEC: A Perfect Pairing (February 2018)
- MEC Deployments in 4G and Evolution Towards 5G (February 2018)
- MEC in 5G networks (June 2018)
- MEC in an Enterprise Setting: A Solution Outline (September 2018)
- Network Transformation: (Orchestration, Network and Service Management Framework) (October 2019)
- Harmonizing standards for edge computing - A synergized architecture leveraging ETSI ISG MEC and 3GPP specifications (July 2020)
- Enhanced DNS Support towards Distributed MEC Environment (September 2020)
- MEC security: Status of standards support and future evolutions (First edition - May 2021)
- MEC federation: deployment considerations (June 2022)
- MEC security: Status of standards support and future evolutions (2nd edition - September 2022)
- Unlocking Digital Transformation with Autonomous Networks: ETSI perspectives and major achievements (March 2023)
- MEC Support for Edge Native Design: an application developer perspective (June 2023)
- Enabling Multi-access Edge Computing in Internet-of-Things: how to deploy ETSI MEC and oneM2M (June 2023)

NEW!

https://portal.etsi.org/TB-SiteMap/MEC/MEC-White-Papers

...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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MEC Support for Edge Native Design: an application developer perspective

- This White Paper provides an overview and vision about the Edge Native approach, as a natural evolution of Cloud Native. Edge Native was first introduced in 2020 by the Linux Foundation’s Open Glossary of Edge Computing.

- It explains in detail the concept of “Edge Native”, describes what Edge Native means for edge developers to build their applications and introduces how ETSI ISG MEC and other organizations support this Edge Native design paradigm. In particular, the White Paper guides developers in the principles and specific requirements of edge computing and how they can combine them with the modern architectural approach introduced by Cloud Native. It also gives insight into the general technical community interested in ETSI MEC solutions or Edge Native application design concepts.

- The authors of the White Paper conclude that the ETSI MEC standard (synergized with 3GPP specifications) can offer a footprint for interoperability, API basic design principles to ensure universal adoption, and possibly also some guidelines for API abstraction, complementing the work of open-source projects. Therefore, to fully exploit edge capabilities and for the adoption of edge native design principles from application development communities, joint efforts from open source and standards will be needed.


Suggested reading:
ETSI White Paper on “MEC support towards Edge Native Design”
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

Ref: 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

Intra MEC
- MEO
  - App Host A
  - App Host B

Inter MEC
- MEO
  - App Host A
  - App Host B

MEC - Cloud
- MEO
  - App Host A
  - Cloud
  - App

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

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

1. Interop. between MNOs
2. Interop. between MEC vendors/suppliers
3. Interop between OEMs (applications)

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.

**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](https://www.etsi.org/deliver/etsi_gs/MEC/001_099/003/03.01.01_60/gs_MEC003v030101p.pdf)
MEC 040 – introducing MEC Federation Enablement APIs

Phase 3 deliverable v311 ongoing (stable draft @Oct 2022)

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

ETSi Webinar
“MEC Federation Enablement APIs: overview and instructions for use”  Watch it here
Alignment between GSMA OPG, ETSI MEC and 3GPP SA6

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

GSMA PRD document (requirements)
Work from SDOs and OSCs (under the GSMA guidance)
GSMA compliance & OP certification

OSC = Open-Source Community
MEC Federation: the ETSI MEC view

- Tentative standards mapping presented at the joint GSMA OPG workshop, on 21/01/2021 (*)
- A common view on SDO mapping and worksplit is the first step for the collaboration
  - Alignment with 3GPP is also needed to create consistent standards and avoid duplication of work

(*) Recording of the workshop is here; 3GPP slides are here; ETSI MEC slides can be found also here

Note: finalization of this mapping is currently WIP
ETSI MEC APIs, external APIs and API exposure
Extending MEC with new MEC Service APIs

MEC Services: value-added capabilities to enable MEC applications
- “Built-in” MEC standardized services provided via the MEC Platform.
- MEC applications can offer new MEC Services APIs, extending the MEC system

NOTE: ETSI GS MEC 009 is defining General principles, patterns and common aspects of MEC Service APIs

NOTE: also the MEC Sandbox includes capabilities to advertise, discover, and consume New MEC Services
New Service Registration:
- MEC application initializes and confirms it is ready to the MEC Platform (MEP)
- MEC app prepares its new service API
- MEC app registers the new service with the MEP, providing Service Information
- MEP registers the service and allocates a service instance
- The New MEC Service is now available for other MEC Apps in the MEC system
3 – MEC App discovering a new MEC Service

New MEC Service Discovery:

- Case 1: Subscription / Notification
  - Service consuming MEC App creates a Service Availability Subscription
  - When the new service registers and becomes available, the MEP issues a Service Availability Notification, indicating the New Service is available

- Case 2: Service Availability Query
  - Service consuming MEC App issues a service availability query to the MEP
  - MEP responds with the new service’s information, including it’s URI endpoint.

- MEC app utilises the New MEC Service via it’s API and endpoint
MEC Sandbox – try new MEC Service APIs

Available MEC Services:
- MEC Platform Application Enablement & Service Management APIs (MEC 011)
- Radio Network Information (MEC 012)
- Location Service (MEC 013)
- New Bandwidth Management and Traffic Steering (MEC 015)
- New Device Application Interface (MEC 016)
- Application Mobility Service (MEC 021)
- WLAN Access Information (MEC 028)
- V2X Information Service (MEC 030)

The ETSI MEC Sandbox is an interactive environment that enables developers to learn & experiment with “live” ETSI MEC Service APIs from anywhere in the world.

try-mec.etsi.org
API Exposure and cross-consumption in a MEC Federation

- Option for Edge Native applications to consume MEC services in a MEC federation (via CAPIF framework and the CAMARA architecture)

NOTE: this option also facilitates the synergies with ETSI MEC and GSMA OPG architecture, as API exposure can be exploited also in the MEC federation for edge native application development.

ETSI MEC & CAMARA: topics for collaboration
Technical highlights

- CAMARA is focused on NBI “Service APIs”, as abstractions from “Internal APIs”
  - Since CAMARA’s focus is “application developers” interface APIs, the assumption is for them to have limited or zero knowledge of the network and edge infrastructure.

- According to the figure below, ETSI MEC is standardizing some “Internal APIs”

**REMARKS:**
- ETSI MEC standardized APIs are “relevant for NBI”, i.e. can be abstracted in CAMARA, for the actual NBI exposure to app devs
- Also new APIs (i.e. not in need to be standardized in ETSI MEC) can be added, recognized by the MEC Platform, and exposed to authorized Applications
- CAPIF is a well recognized (and standard) reference for universal API exposure

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ETSI MEC & CAMARA: collaboration establishment

Topics of the collaboration:

• Technical work northbound interface and support for ubiquitous API exposure
  • ensuring complementary work on standards / API definitions (CAMARA NBI, SBI by ETSI MEC and cloud federation) and open-source implementations / tests
  • guidelines for API exposure and interwork (e.g., joint white papers)
  • Join forces to engage application development communities (e.g., to better attract application developers, increase the awareness on edge application and help creating API market demand
• Other areas of collaboration (to be further elaborated) may include the work item MEC 043 on Abstracted API for Industries

The MEC Chair is collecting names of volunteering delegates that can practically facilitate the joint work and collaboration with CAMARA.

Link to the ETSI/LF MoU: https://docbox.etsi.org/Partners/Agreements/Linux_Foundation_MoU_2022.pdf
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)
- Collaborations: CAMARA, Akraino
- MEC Sandbox
- Hackathons
- Plugtests
- MEC Tech Series

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

https://www.opencompute.org/summit/global-summit/hackathon
17-19 Oct 2023


https://apiportal.akraino.org/apimap.html

NFV&MEC IOP Plugtests
MEC: DECODE Working Group

- OpenAPI representations: ETSI Forge
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Navigating with the Swagger UI

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

News: STF (Special Task Force) for OpenAPI description automation

Status: Project completed Dec 2023, providing an automated workflow for OpenAPI description creation directly from the ETSI MEC specifications.

Navigating with the ReDoc UI

POST /subscriptions/area/circle
https://localhost/location/v2/subscriptions/area/circle

Payload

```
Content type: application/json

Copy Expand all Collapse all

```
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News: Guidelines on Interoperability testing published Nov 2022
Follow-on API Conformance ETSI TTF launched 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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For further details, please see: http://mecwiki.etsi.org or contact CTI_Support@etsi.org

We encourage new submissions to ETSI MEC!

PoCs

MEC Deployment Trials

MEC Ecosystem

New MDTs

New implementations
MEC PoCs: Show off YOUR cool Edge

Recent PoCs (13 are complete)

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

PoC #14
Network resource allocation for Gaming using MEC BandWidth Management service and TeraFlowSDN
CTTC, xFlow Research, Telefónica

PoC #15
Distributed MEC based AR remote maintenance for logistics transportation
China Telecom, China Telecom Intelligent NETWORK Technology Co., LTD, Huawei

PoC #16
MEC based Smart production and scheduling
China Telecom, China Telecom Intelligent NETWORK Technology Co., LTD, Huawei

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:

MDT #3
Edge-Cloud VR cloud game scheme based on 5G network
China Unicom, Huawei, Tencent, Intel

MDT #4
ARVR navigation based on 5G MEC
China Telecom, Huawei, 21CN

MDT #5
Smart Factory over MEC
SK telecom, MyungWha Corporation

MDT #6
Federated Edge Hub on MEC
SK telecom, Singtel, Hewlett Packard Enterprise

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

We encourage new MDT Submissions to ETSI MEC!
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A simulator of a real 4G/5G network as seen via the MEC APIs
- 4G/5G/Wi-Fi 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/
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
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 GS MEC 013 V2.1.1 (2019-09)
- Multi-access Edge Computing (MEC) Location API
- Act update is in preparation. DETAILS ALERT

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

- ETSI Forge
- forge.etsi.org - LocationAPI.yaml

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

gs_mec013v020101p.pdf

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

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), with further enhancements in 2023 (message distribution)
- Bandwidth Management and Traffic Steering Service (MEC 015)
- Device Application API (MEC 016)

try-mec.etsi.org
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

Episode #4 – MEC Sandbox
Episode #9 – VIS API in MEC Sandbox
Episode #11 – MEC Sandbox Service Enablement

Sandbox in use –
MEC Hackathon 2023

Edge Computing World – MEC Hackathon 2023 – Developer Challenge

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
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REMARKS:
- ETSI MEC standardized APIs are “relevant for NBI”, i.e., can be abstracted in CAMARA, for the actual NBI exposure to app devs.
- Also new APIs (i.e., not in need to be standardized in ETSI MEC) can be added, recognized by the MEC Platform, and exposed to authorized Applications
- CAPIF is a well recognized (and standard) reference for universal API exposure

e.g. MEC 012, MEC 013, ...
e.g. MEC 003, MEC 040, ...

MEC 043 report on AbSTRACTED API for Industries
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Past MEC Hackathons:

- **18-19 September 2018**: 3 parallel events ([link](https://www.opencompute.org/summit/global-summit/hackathon))
  - Berlin (co-located with Edge Computing Congress)
  - Beijing (China)
  - Turin (Italy)
- **17-18 September 2019**: 2 parallel events ([link](https://www.opencompute.org/summit/global-summit/hackathon))
  - London, UK (co-located with Edge Computing Congress)
  - Shenzen (China)
- **18 November 2019**, in collab. with LF Edge Akraino ([link](https://www.opencompute.org/summit/global-summit/hackathon))
  - San Diego (USA) (with KubeCon + CloudNativeCon North America)
- **25-26 November 2020**
  - 2020 Droidcon MEC Hackathon (co-located with Droidcon Italy) ([link](https://www.opencompute.org/summit/global-summit/hackathon))
- **12-14 October 2021 & 10-12 October 2022**, in collab. with LF Edge Akraino
  - 2021 Edge Computing World ([link](https://www.opencompute.org/summit/global-summit/hackathon))
  - 2022 Edge Computing World (Santa Clara, USA) ([link](https://www.opencompute.org/summit/global-summit/hackathon))

MEC Hackathon 2023 ([link](https://www.opencompute.org/summit/global-summit/hackathon))
Teams are challenged to design & prototype an Edge-Native solution, focusing on the use of AI and considering overall application performance optimization.

Utilizing a wide set of developer resources offered from across our supporting organizations.

https://www.opencompute.org/summit/global-summit/hackathon
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Get involved with MEC!

- Learn and implement MEC APIs on ETSI Forge (forge.etsi.org)
- Experiment with MEC APIs in the MEC Sandbox (try-mec.etsi.org)
- Share your projects on the MEC Ecosystem wiki (mecwiki.etsi.org)
- Consider joining a MEC Hackathon as a participant or organizer (link)
- Share your insights by volunteering to produce a MEC Tech Series episode on a topic of your choice (link)
- Join the discussion on social media (#MEC, #ETSI, #theStandardsPeople)
- Register for the NFV&MEC Plugtest program / events (link)
- Join ISG MEC for design, standardization, and ecosystem development activities (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
**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**
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.)
MEC and NFV: a common approach to management
MEC and NFV: MANO for the Telco Edge

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
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