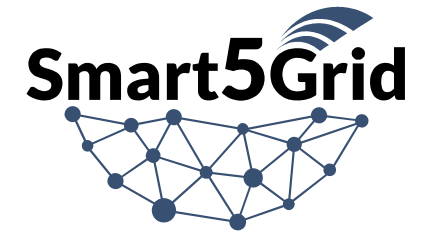


Open APIs: Simplifying Telco Network Access for Mobile Applications

Dr. Andrés Cárdenas Córdoba

April 19th - 2024



Demonstration of 5G solutions for
SMART energy GRIDs of the future



About the Speaker



Biography

Dr. Andrés Cárdenas is researcher in the Software Network Area at i2CAT Foundation and Assistant Professor at Universidad Politécnica de Catalunya (UPC). He received the M.S. degree in network engineering and telematic services and Ph.D. degree in telematic service engineering from Universidad Politécnica de Madrid (UPM), Spain in 2016 and 2022 respectively. During his doctoral studies he was the winner of a research project funded by Huawei under the UPM-5G Chair agreement. He is currently involved in several European H2020/6GSNS research projects in some of which he performed as WP coordinator such as ETHER Project. Similarly, he participates in Spanish national projects and industry projects related to B5G/6G networks such as 6G-DIFERENT, Open-VERSO and Neutron Startup. He is involved in some standardization working groups such as the Software Networks WG of 6GSNS, and ETSI OSM WG. He has participated in world telecommunications events as a speaker given talks on Next Generation Networks and Network Virtualization. He is an active collaborator as reviewer in different journals such as IEEE Access, Elsevier Computer Networks Journals and IEEE TNSM.

Contact

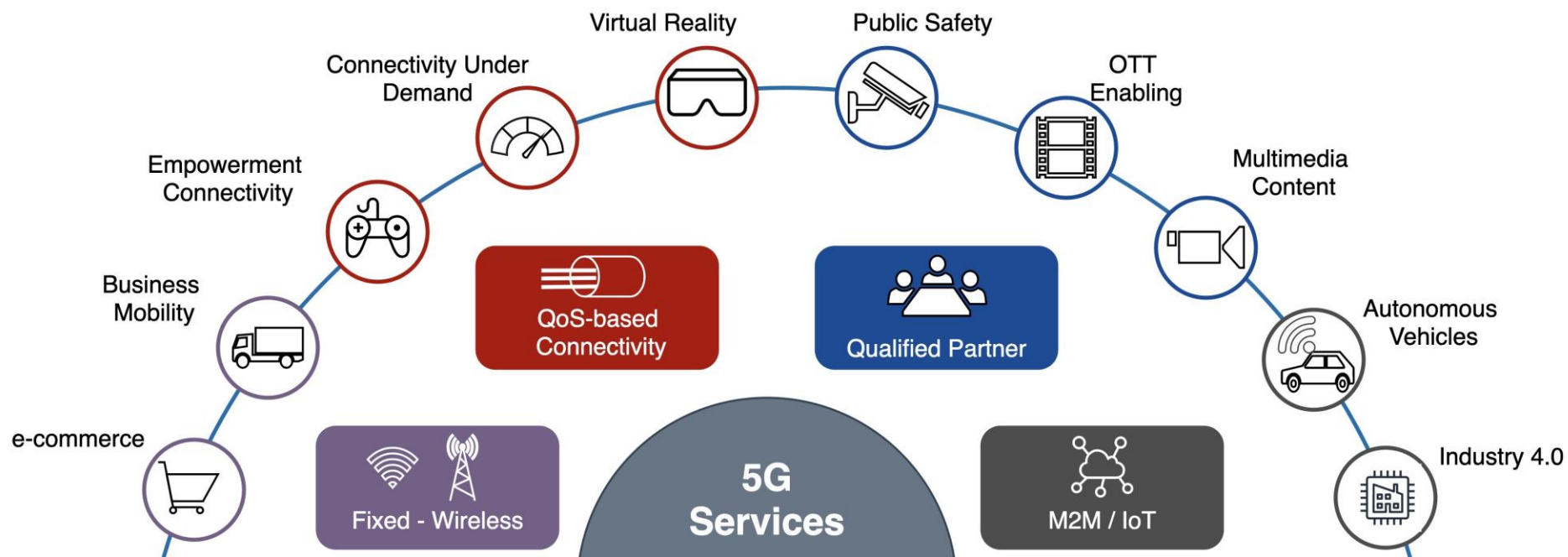
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AGENDA

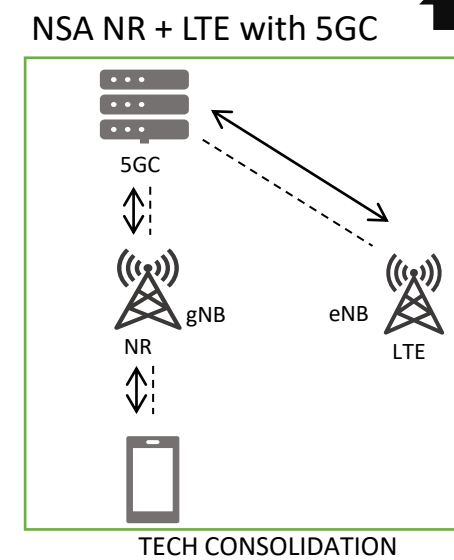
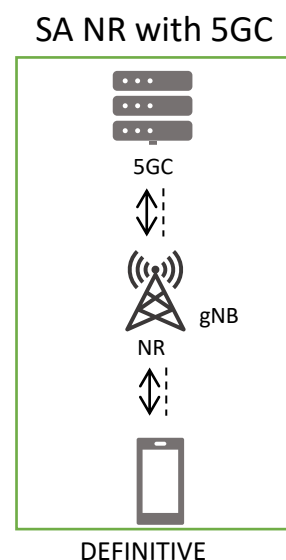
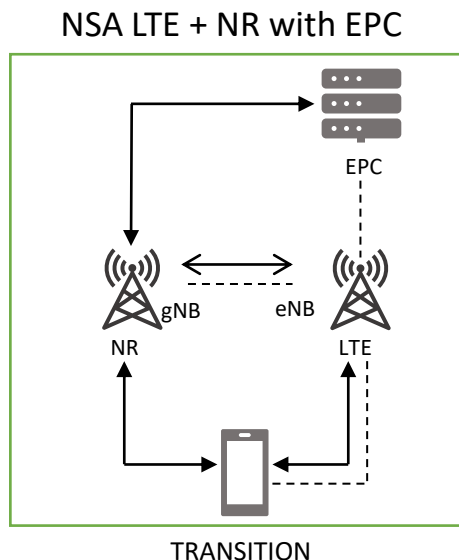
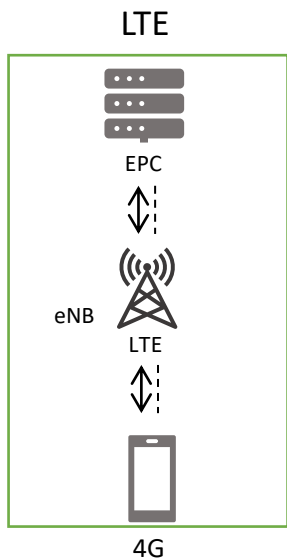
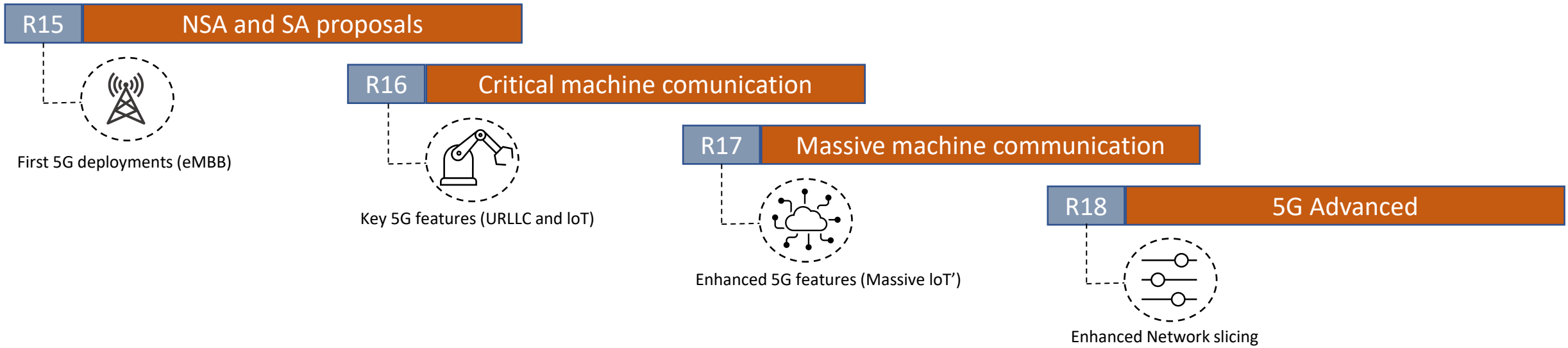
- 5G Networks
 - What & Why
- Towards API standardization
 - CAMARA Project
 - Roles of the Stakeholders
 - 3GPP CAPIF
- Conclusions
- Q&A

Brief overview:

- Digital transformation to foster their business models (cloud-native solutions) → **Network Application paradigm**
- Customized and flexible connectivity solutions (constrains on-demand) → **Programmable Networks**



5G NETWORKS



↑ TODAY

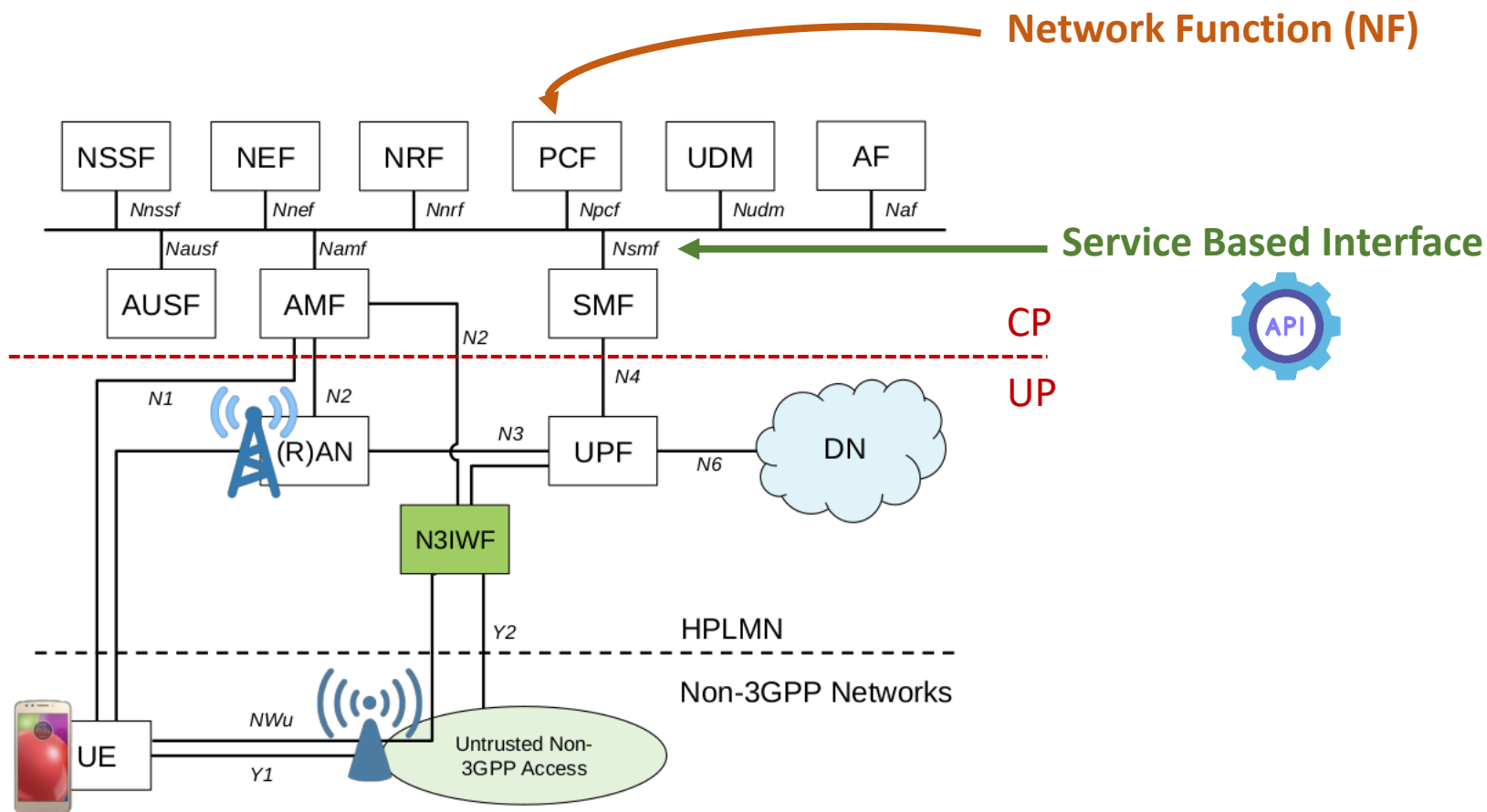
What it is?

- The fifth generation of mobile network technology, succeeding 4G LTE.
- Designed to address the limitations of previous generations:
 - Increased data speeds
 - Lower latency (response time)
 - Greater network capacity

Key Characteristics

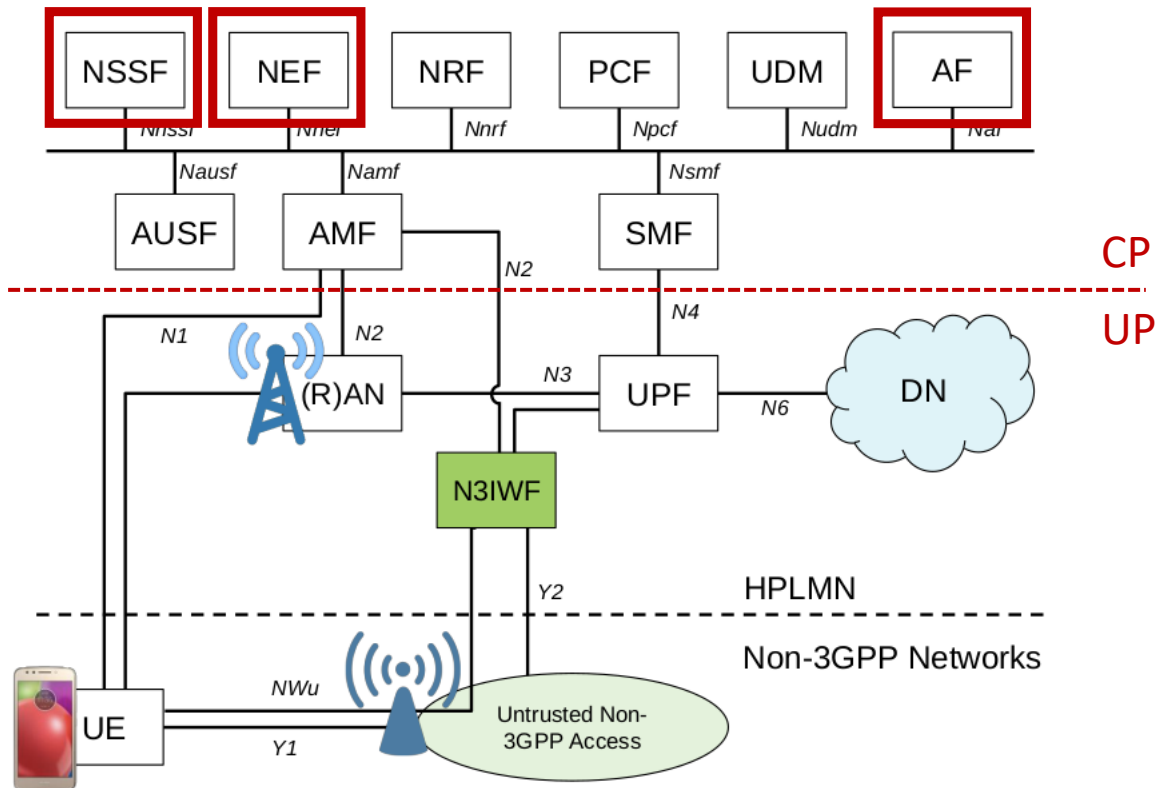
- **Enhanced Mobile Broadband (eMBB):** Significantly faster download and upload speeds (potentially up to 20 Gbps) for richer multimedia experiences.
- **Ultra-Reliable Low-Latency Communication (uRLLC):** Extremely low response times (less than 1 millisecond) for real-time applications like remote surgery and autonomous vehicles.
- **Massive Machine-Type Communication (mMTC):** Efficiently connects a massive number of devices (e.g., sensors, wearables) for the Internet of Things (IoT).

Service-based 5G Network Architecture



Source: A. Cárdenas, "Contribución al modelo de gestión y orquestación de redes particionadas 5G en entornos multi-dominio y multi-cliente. Tesis (Doctoral)", E.T.S.I. Telecomunicación (UPM), 2022, <https://oa.upm.es/view/institution/Telecomunicacion/>. <https://doi.org/10.20868/UPM.thesis.72286>

Service-based 5G Network Architecture



Benefits for Operators

- Softwarization of Network Functions (VNFs – CNFs)
- Separation of Control and User Plane
- Native support of isolated networks → Network Slicing
- Enables interaction with external applications
- Enables Multi Radio Access Technologies.

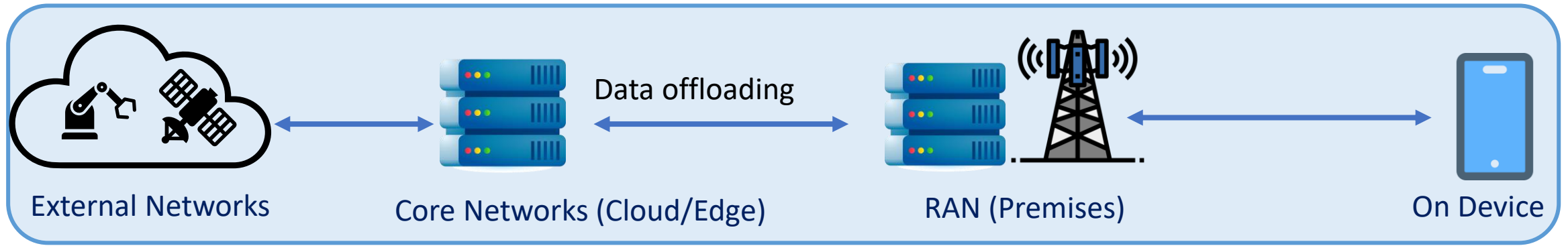
Benefits for Customers:

- Faster download and upload speeds
- Improved responsiveness and reduced lag
- Support for a wider range of devices and applications

Benefits for Service Providers:

- Enhanced efficiency and productivity in various sectors
- Development of innovative applications and services

Challenges of 5G Implementation

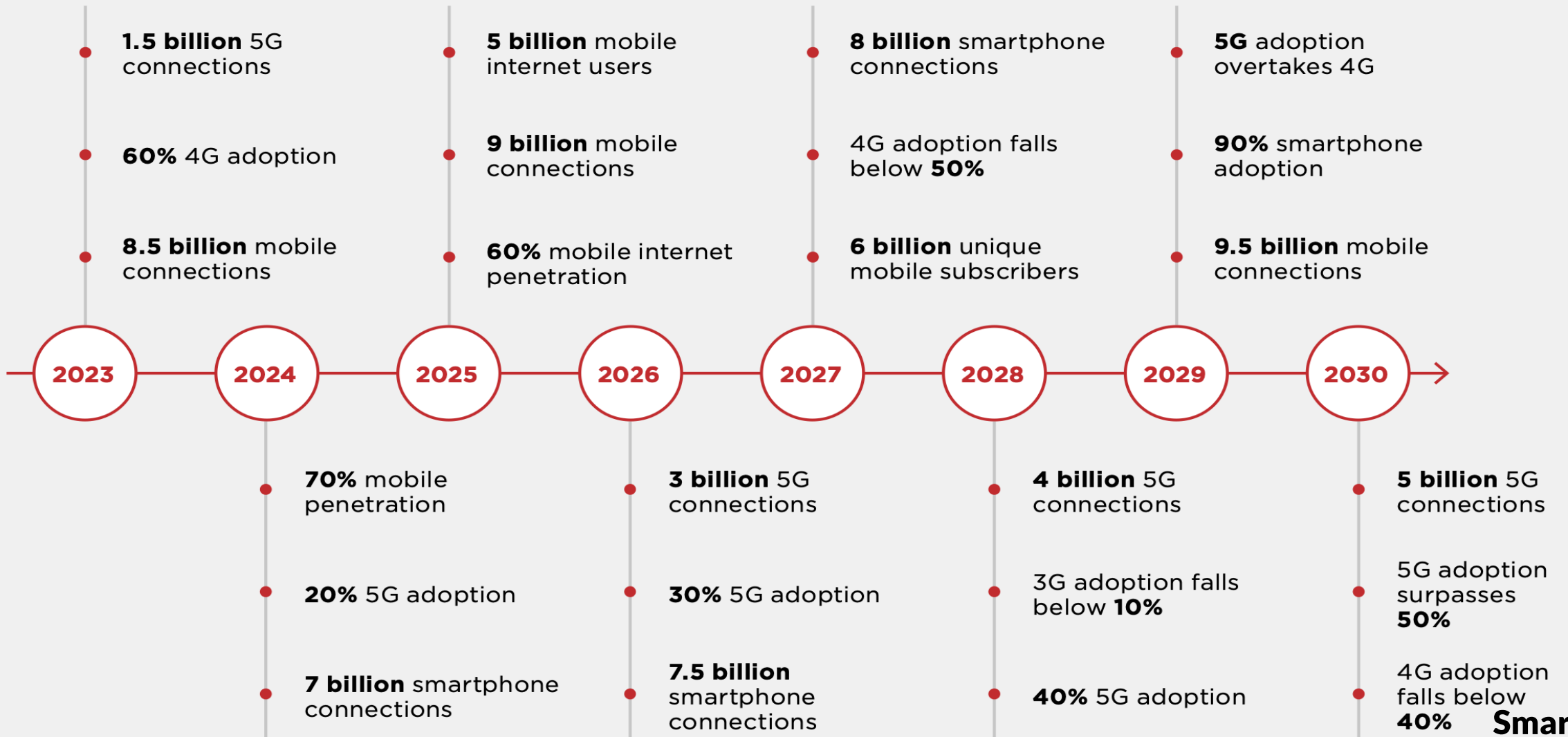


Challenges:

- Infrastructure deployment costs → CAPEX / OPEX
- Spectrum availability and regulations
- Security concerns and vulnerabilities
- Device compatibility and adoption
- Compatibility with non-3GPP Networks (industry networks, satellite networks)

TOWARDS APIs STANDARDIZATION

TOWARDS APIs STANDARDIZATION



TOWARDS APIs STANDARDIZATION

Regulation



Industry alignment

Requirements Evalua.

Proposals

IMT-2030 Specs.

Innovation



EU 5G-PPP



EU SNS Ph 1



US Next GA

Standardization

R15/R17

5G eMBB and URLLC

R18/R19/R20/21

5G Advanced

6G reqs.

6G study

6G specs.

6G specs. v2



A GLOBAL INITIATIVE

3GPP 6G WS

Key 6G arch. decisions

First 6G spec.

Commercial 6G deployment

2019

2020

2021

2022

2023

2024

2025

2026

2027

2028

2029

2030

TODAY



TOWARDS APIs STANDARDIZATION

Where we are

5G



High quality video
(4K-8K)



Object driven
digital twinning
(e.g. an engine)



Data communication
and control

2019

5G-Advanced



XR - fully immersive
user experience



Large scale digital
reconstruction
(e.g. a vertical farm)



Provide precise location
and timing services that
complement GNSS

2025

Onward we go!

6G



Holographic
transmissions

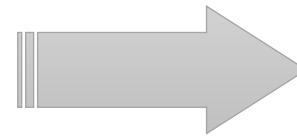


Broad based digital twins
with RT synchronous
updates (e.g., smart city)



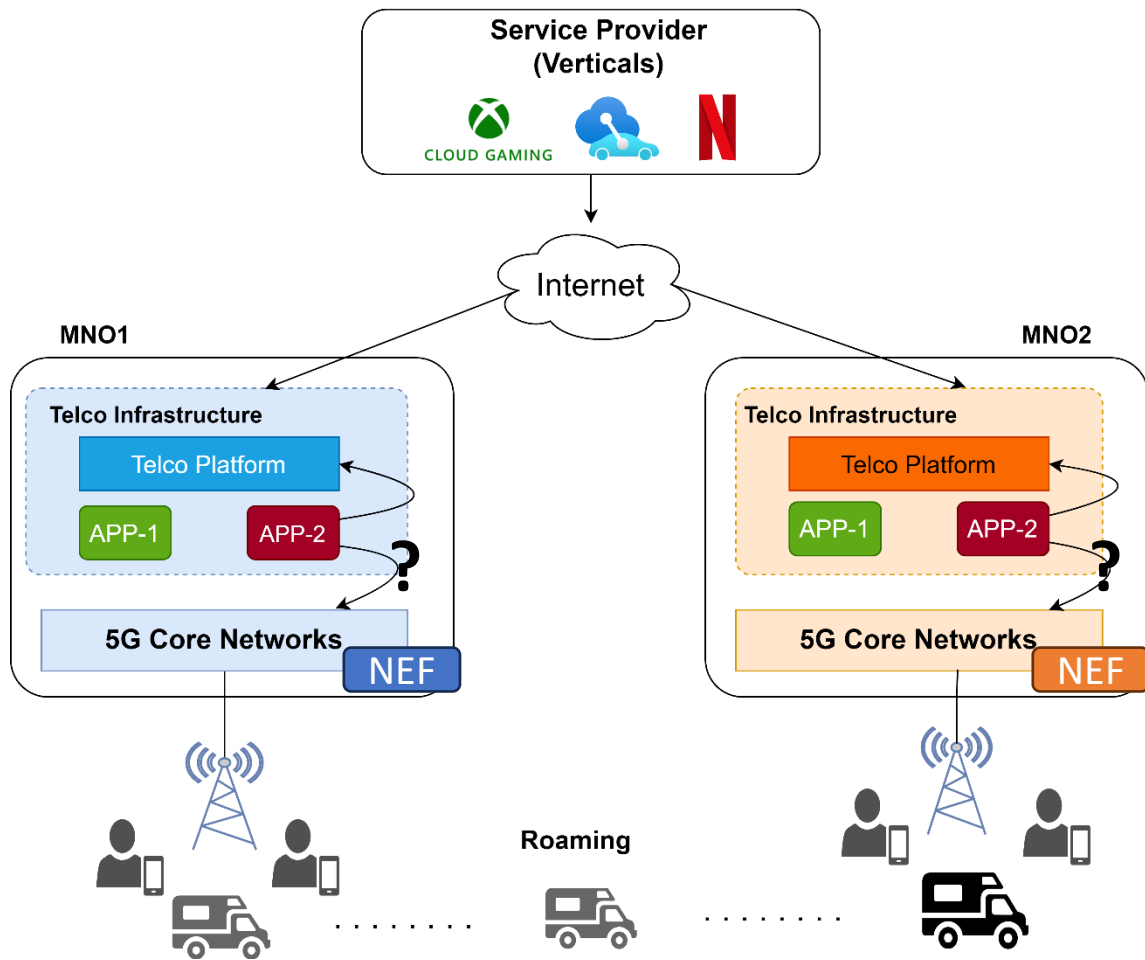
Network with a 6th sense

2030



TOWARDS APIs STANDARDIZATION

How to span applications along different providers?



Challenges:

- Developers must adapt the apps to each MNO's platform.
- Limited access to network information of MNOs.
 1. MEC Services (ETSI MEC)
 2. Network Exposure Function (NEF) (3GPP)
- Time consuming during Apps development
- Limited (required) Application's interaction with MNO's telco platforms.
- Difficult to adapt applications to non-static user requirements.
- Each Telco Platform has their own (customized) APIs for App's lifecycle

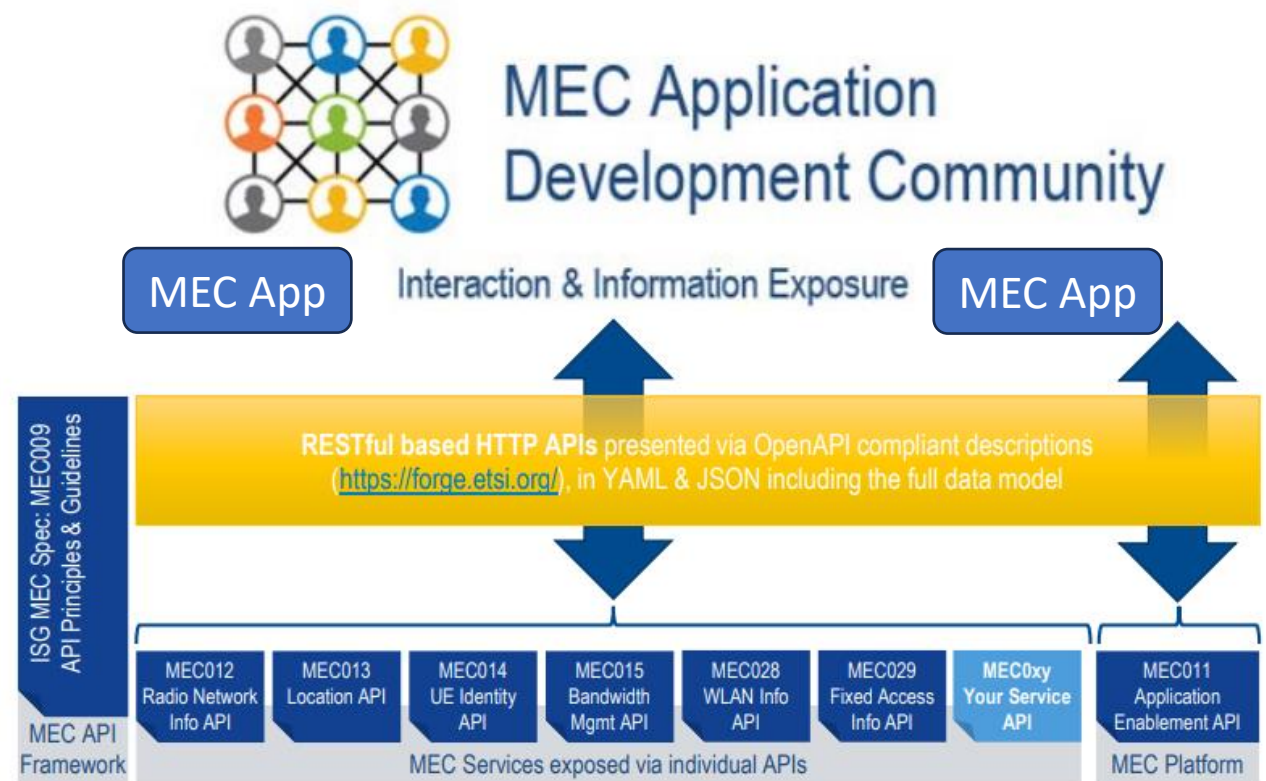
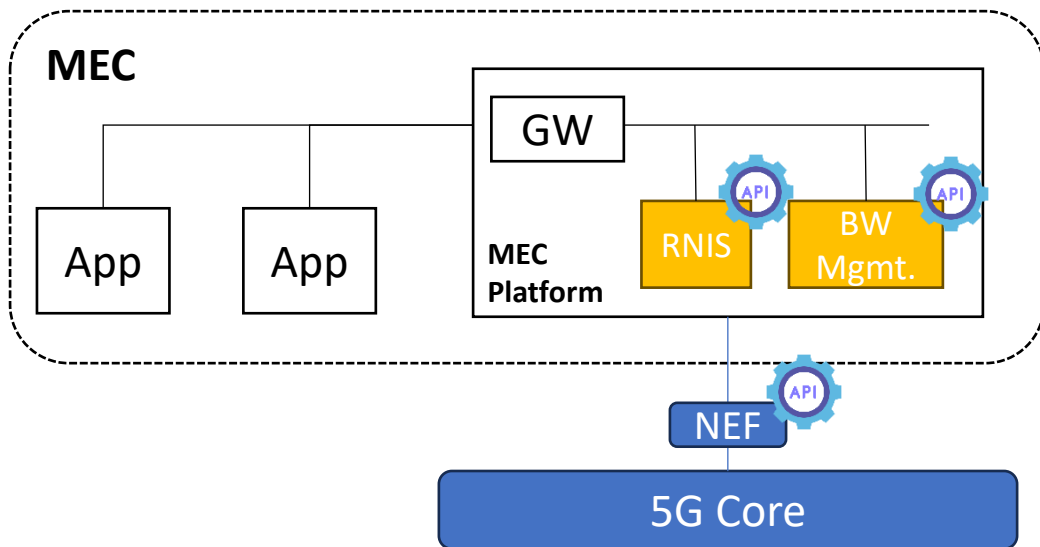


How to harmonize the plenty of APIs belonging to different operators.

TOWARDS APIs STANDARDIZATION

ETSI MEC Services

An MEC service represents a functionality that can be consumed or exposed by either the MEC platform or applications hosted on it. Applications have the option to register their services for discovery and consumption by others.



TOWARDS APIs STANDARDIZATION

3GPP NEF

The NEF (Network Exposure Function) sits between the 5G Core (CN) and external Application Functionaries (AFs), both third-party and possibly internal NF. It manages access to the exposed network data (open APIs) and acts as a mandatory gateway for any external AF seeking access to internal CN data.

NEF APIs as of R18:

- ResourceManagementOfBdt
- PfdManagement
- MonitoringEvent
- DeviceTriggering
- CpProvisioning
- ChargeableParty
- AsSessionWithQoS
- MsisdnLessMoSms
- NpConfiguration
- NIDD
- RacsParameterProvisioning
- ECRControl
- TrafficInfluence
- NiddConfigurationTrigger
- AnalyticsExposure
- 5GLANParameterProvision
- IPTVConfiguration
- LpiParameterProvision
- ServiceParameter
- ACSPParameterProvision

MonitoringEvent API Subscription level POST Operation

POST /{scsAsId}/subscriptions Creates a new subscription resource for monitoring event notification

Name	Description
scsAsId * required	Identifier of the SCS/AS
string (path)	<input type="text" value="scsAsId"/>

Request body required

Subscription for notification about monitoring event

Examples:

Example Value | Schema

```
{
  "msisdn": "1234567890123456",
  "notificationDestination": "http://scsas-server/notifyMe",
  "monitoringType": "LOCATION_REPORTING",
  "locationType": "CURRENT_LOCATION",
  "accuracy": "CGI_ECGI",
  "maximumNumberOfReports": 2
}
```


CAMARA INITIATIVE

WHAT IS CAMARA?

Brief overview:

- CAMARA is a project supported by Linux Foundation with the collaboration of the GSMA
- Its mission is to foster the definition, development, and validation of open and standardized APIs.
- CAMARA counts on an open and ever-growing community including vendors, CSPs, Hyperscalers, solution integrators, and customers.
- CAMARA has adopted an open-source approach, based on using Apache 2.0 license for API definitions and reference implementations.



WHAT IS CAMARA?

Key aspects addressed by CAMARA:



Scaling

Apps, Products, or Services should be present in all relevant markets and networks globally.



Consistency

Verticals don't want APIs that work in a single network in a single country.



Simplicity

Telco Networks are complex, and every network is different. Developers want simple and user-centric APIs.

WHY THE INITIATIVE?

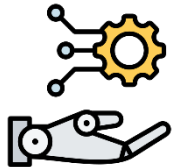
Network Providers (MNOs)



Need to evolve the Network Infrastructure and Services to All-software and Cloud-native solutions.



Need to monetize the new set of sophisticated network and computing capabilities that enable enhanced characteristics for the next generation of services.



Prepare for new communication paradigms, with minimal human intervention, to interact with the physical and virtual infrastructures

- **How to enable an smoothly integration between Vertical Industries and Network Providers (MNOs)?**
- **How to take advantage from this integration?**

WHICH IS THE FRAMEWORK?

GSMA Open Gateway NaaS System is a framework of common network APIs designed to provide universal access to operator networks for developers.

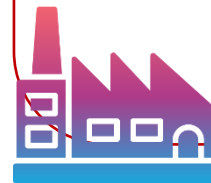
MNOs

- Allows to expose and monetize telco capabilities to third party service providers in a programmatic manner through APIs.
- Allows to transform telco networks into programmable service platforms
- Represents a business opportunity to generate new revenue streams and monetizing investment in fiber, edge computing and 5G

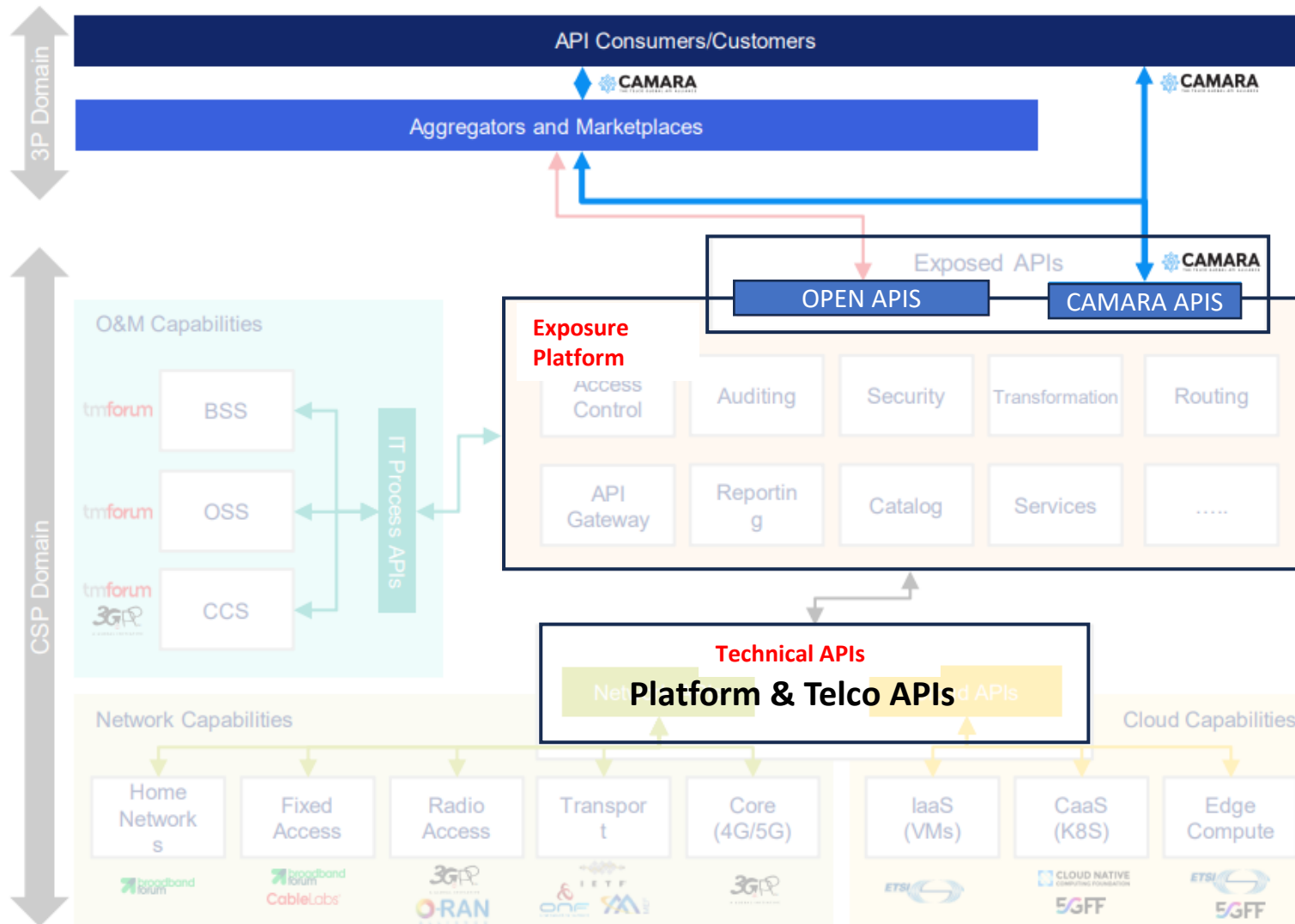


Verticals

- It releases them from the constraints of traditional over-the-top, best-effort service delivery approaches.
- New capabilities to provide enhanced user experiences and contribute to the digital ecosystem with new services



CAMARA ARCHITECTURE

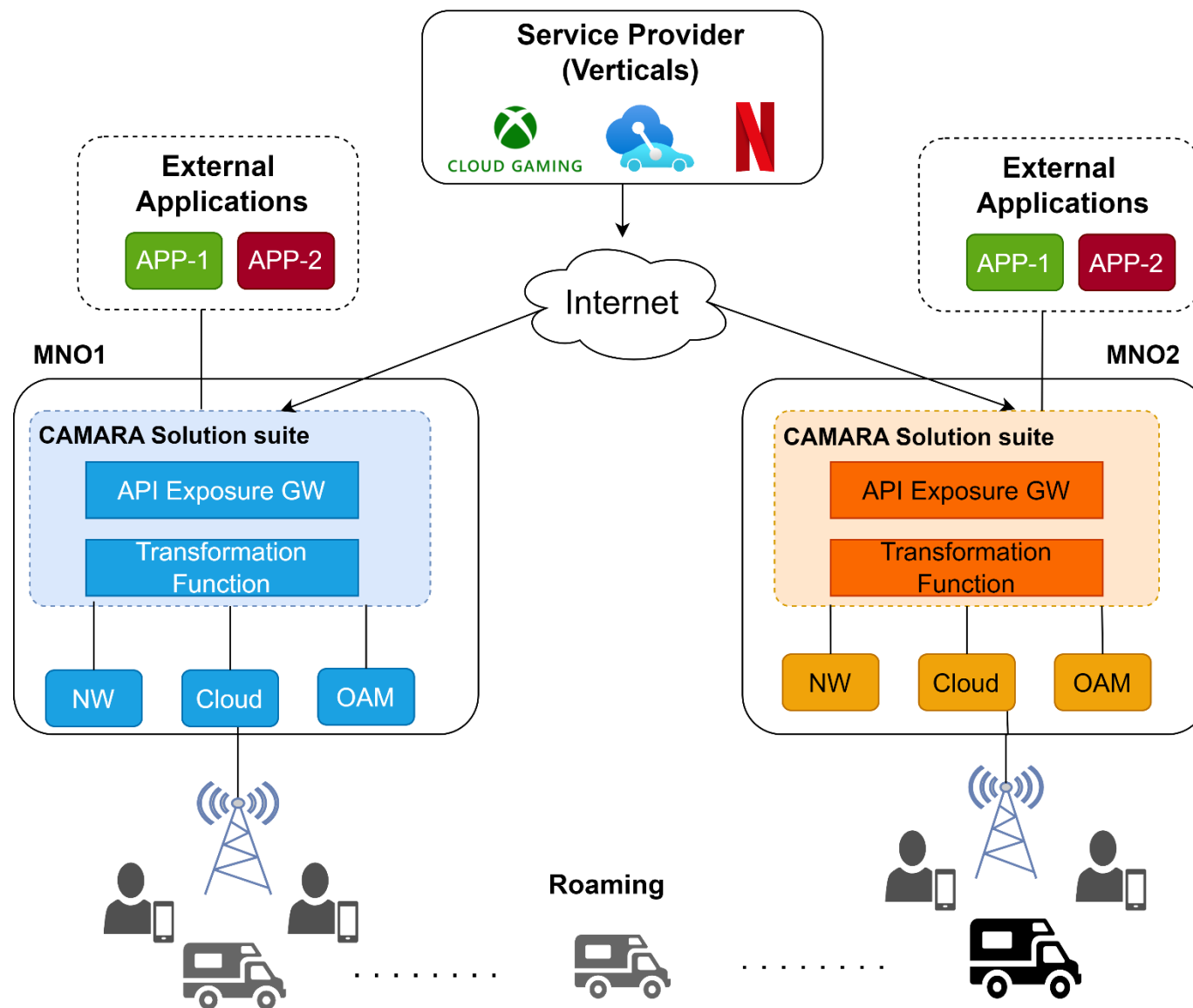


CAMARA APIs	Open APIs	Technical APIs
Developer oriented, User Friendly	Service Management, Flexible, Extensible	Domain Specific Focus, Standardized, (FRAND)
Single Place for Developers to use Telco APIs both for user and management activities	Interaction between CSPs and Aggregators to manage Products, Services, and Users	Multiple SDOs and initiatives that work to develop domain specific technical APIs

Source: 5G Futures Summit, MWC, GSMA



CAMARA ARCHITECTURE



ROLE OF THE STAKEHOLDERS

Cloud Infrastructure



Enhancing virtual 'Cloud' applications & services to enable Web3.0

Open Service (Northbound) Common Network APIs
via CAMARA GitHub & GSMA Agreement Templates

Open Federation APIs (East West Federation & Interconnection)
via GSMA Operator Platform Specifications & Agreement Templates

GSMA
Connect (N-E-W)

CAMARA
THE TELCO GLOBAL API ALLIANCE
Expose (N)

tmforum
Operate



Exposing network capabilities: Identity : 5G Capabilities : AI/Data : Privacy : Security
Earth Networks

Customers/ 3rd Parties

- Consume abstracted, aggregated and enriched APIs exposed by the MNOs.
- Consume service-oriented APIs and service-management oriented APIs

MNO/ Internal APIs

- Technology-specific APIs defined by standardization bodies (3GPP, GSMA, TM Forum, ETSI), etc.
- How IT capabilities are to be operated and managed for NaaS provision
- Design and guide of the implementation of modular and standardized **APIfication** of the IT system

CAMARA PROJECT

Relevant APIs:

Anonymized Subscriber ID

Identify a client device trying to access network services

Carrier Billing Checkout

Purchase, pay, and follow up on fulfilment of products

Device Identifier

Check the identity of the subscribers' device

Device Location

Check the location of a device.

Device Status

Check the network connection and roaming status of a device

Edge Cloud

Provide and manage network and compute resources for an application

Home Devices QoS

Request prioritization of traffic on a specific device on the home network.

Identity and Consent Mgmt

Provides solutions to capture, store and manage user consent

Number Verification

Allows users to verify the phone number of the connected device

OTP Validation

To offer secure user authentication to service providers.

Quality on Demand

Allows users to set mobile connection quality and get notifications

SIM Swap

Allows users to get information on SIM pairing changes

Family of APIs:

Open Gateway API Portfolio Overview

API Portfolio	Anti-Fraud	Mobile Connectivity / Value-Added Services		Fixed Connectivity	Cloud & Edge	Payments
API Product Family	Subscriber Identity	Location	Network Quality/ Optimisation	Network Quality/ Optimisation	MEC	Payments and Charging
CAMARA API	Device Status	Device Location Verification	Connectivity Insights	Home Devices QoD	Simple Edge Discovery	Carrier Billing
	IMEI Fraud	Geofencing	Mobile Quality on Demand		Traffic Influence	
	KYC Fill-in	Location Retrieval				
	KYC Match					
	Number Verification					
	SIM Swap					
	SIM Swap Subscription Notification					
	One Time Password SMS					

- How to manage this bundle of APIs?
- Is it possible to manage and expose non-standardized and from 3rd parties APIs?



3GPP CAPIF

3GPP COMMON API FRAMEWORK

Purpose and Scope:

- Release 15 introduced CAPIF, a unified Northbound API framework for all 3GPP network functions, to promote consistency and streamlining development approach (Refer to 3GPP TS 23.222, TS 33.122 and TS 29.222).
- CAPIF offers a flexible framework that can host network and service APIs, developed by the mobile network operator (PLMN) or third-party companies.
- CAPIF successfully integrates with established Northbound APIs from 3GPP's SA2 (SCEF/NEF) and SA4 groups.

Key Features:

- On-boarding/off-boarding API invoker
- Register/de-register APIs
- Discovery of APIs
- Support for 3rd party API providers
- Support for interconnection between two CAPIF providers
- Federation of CAPI functions
- Entity Authentication/Authorization
- CAPIF events subscription/Notification

3GPP COMMON API FRAMEWORK

Architecture:

CAPIF Core Function (CCF):

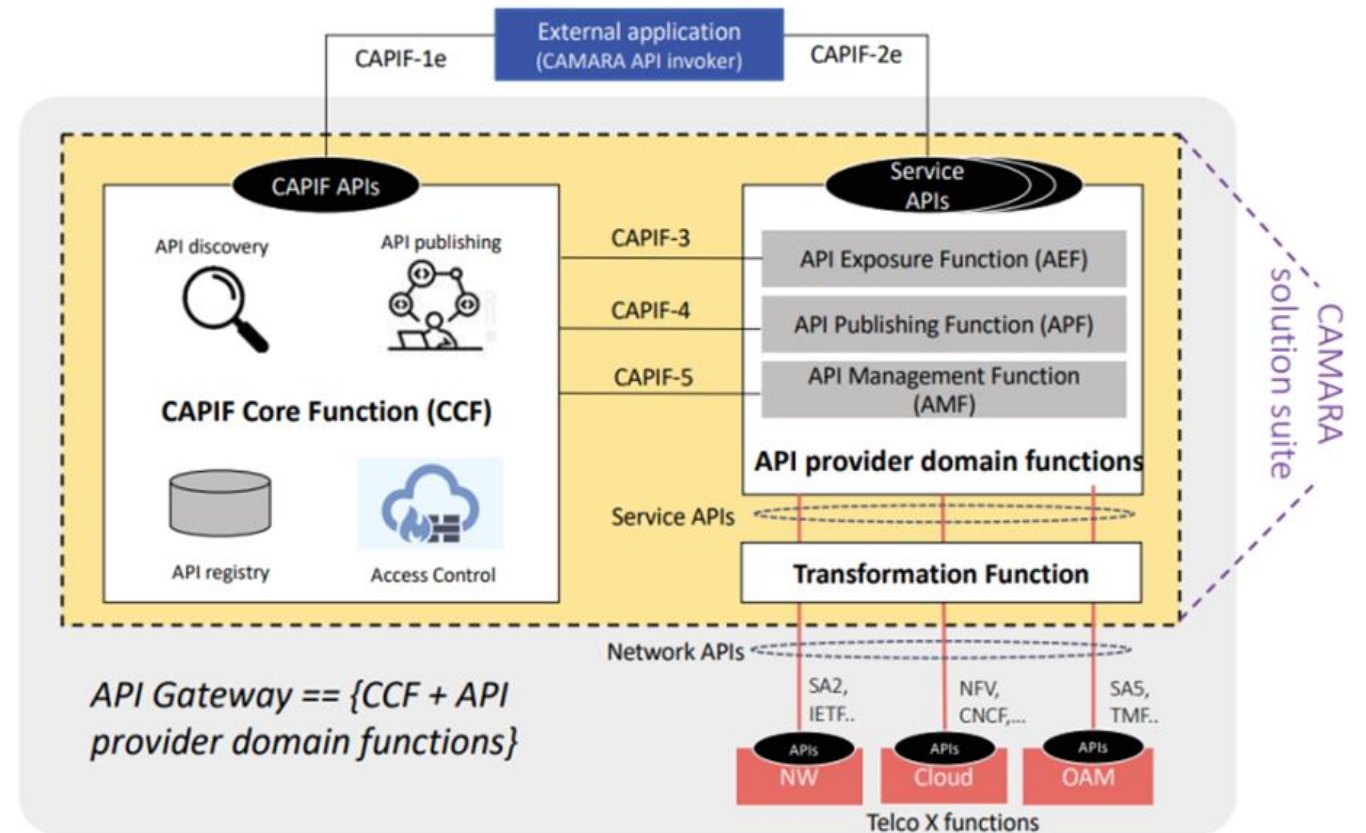
- Repository of all service APIs
- Allows discovery of the stored APIs
- Authenticates and authorize API invokers
- Logging and charging the API invocations

API Exposing Function (AEF):

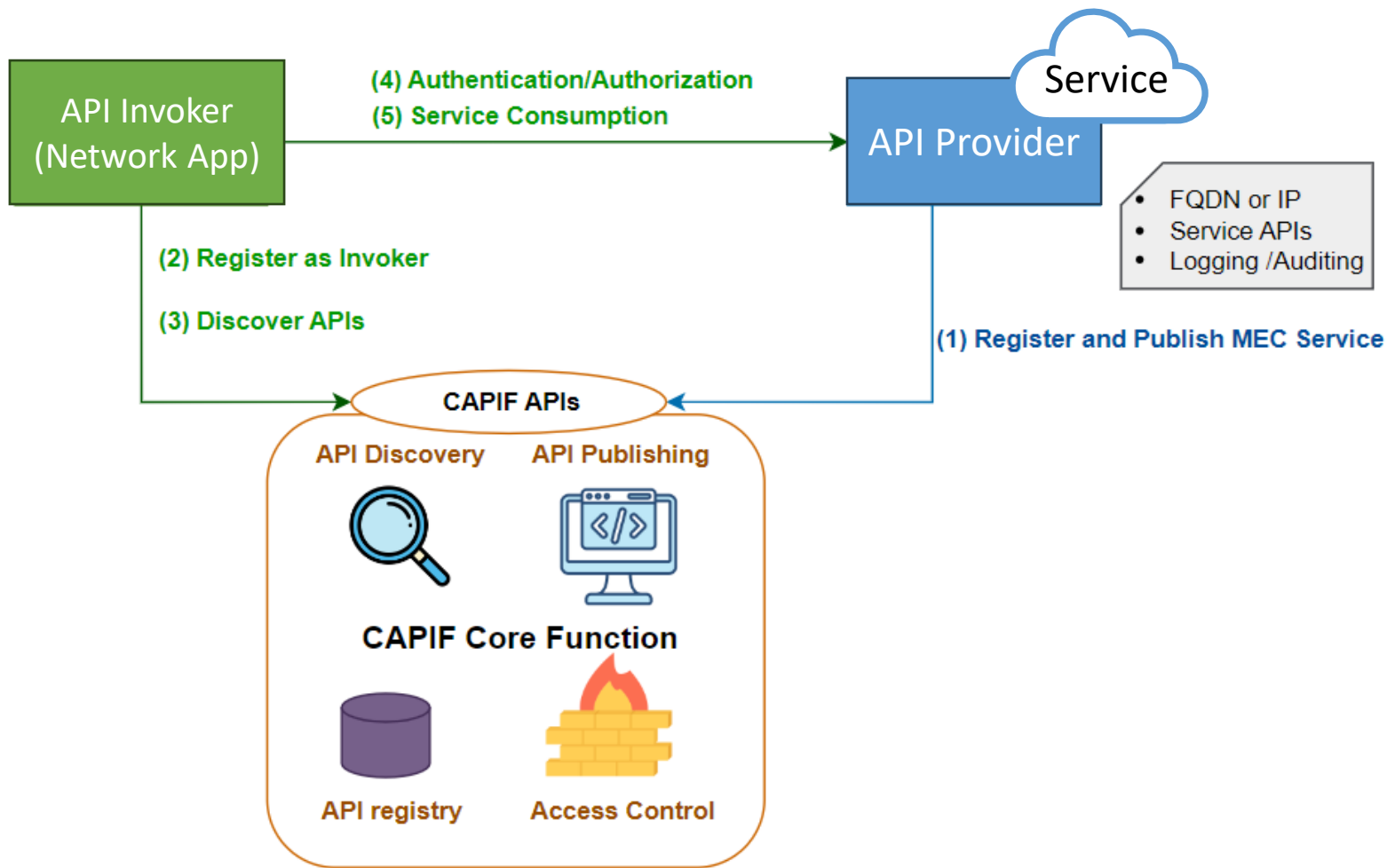
- Provider of the service APIs
- Validates the authorization of the API invokers
- Expose the service to API invokers
- Logs the invocations on the CCF and charging

API Invoker:

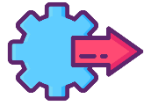
- Typically an app requiring a service
- Discovers the service APIs from CCF
- Seeks authorization for API invocations



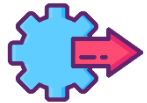
Basic Workflow Using CAPIF:



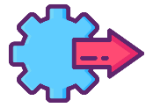
CONCLUSIONS



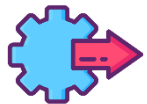
Open APIs approach is leading a paradigm shift with great impact on the industry landscape



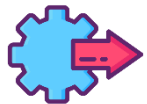
Vertical's applications can work dynamically adapting their services to the context of the users



CAMARA requires a collaborative workspace that brings together incumbent telco standards bodies with IT and cloud communities, industry associations and open-source projects.



Verticals can take advantage from the NaaS system to evolve their bussiness models reducing their devops procedures.



Allows the development of network-aware and user-centric services

THANK YOU!