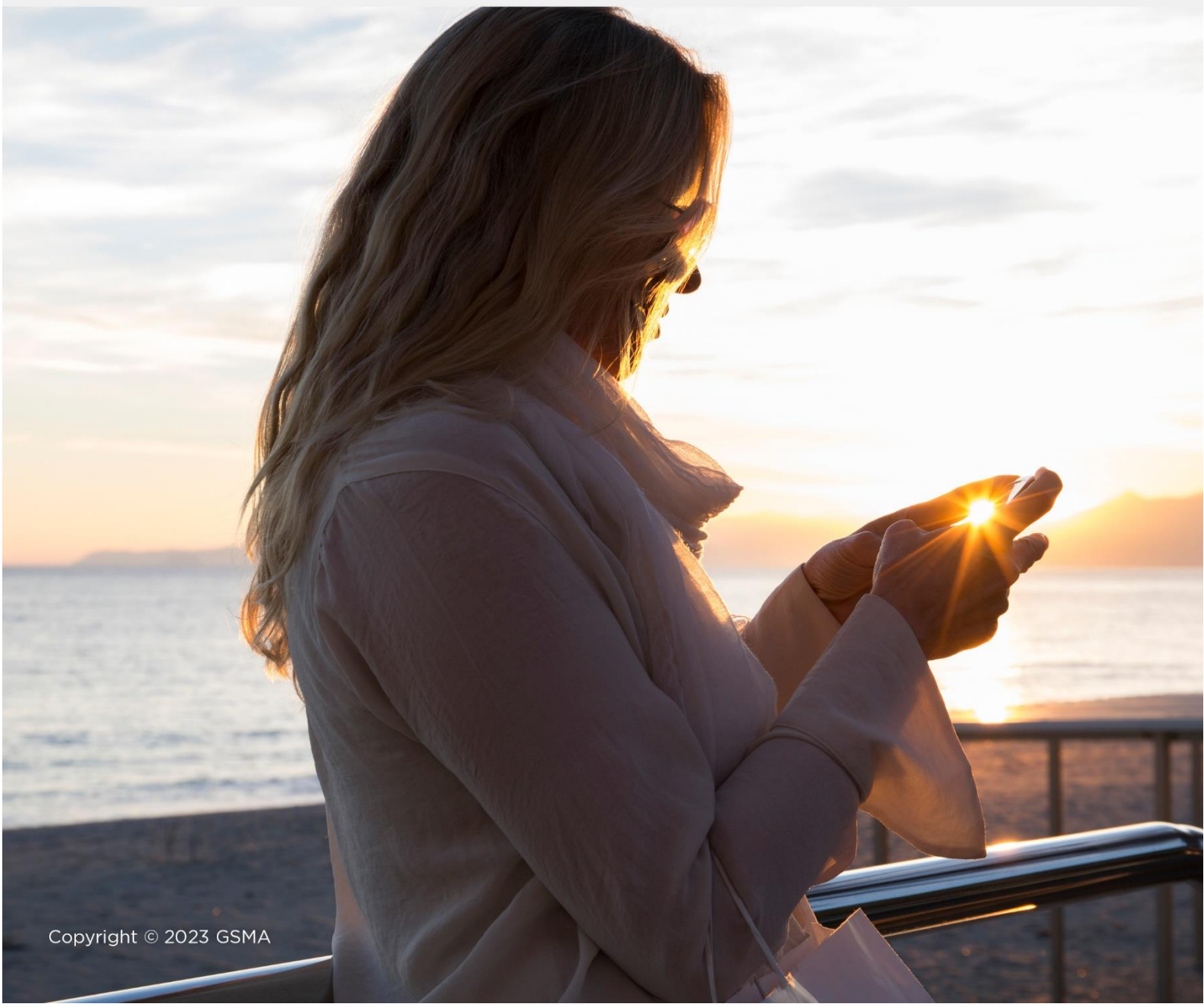# The Ecosystem for Open Gateway NaaS API Development

June 2023

GSMA Open Gateway is a framework of common network Application Programmable Interfaces (APIs) designed to provide universal access to operator networks for developers[1]. With the support of 25 mobile network operators (as of April 2023), GSMA Open Gateway helps application developers enhance and deploy services more quickly across operator networks via single points of access to the world's largest connectivity platform.

This white paper introduces some concepts of an Open Gateway Network as a Service (NaaS) architecture and sheds light on the relevant demarcation points, to let GSMA Open Gateway stakeholders (customers, operators, aggregators, and technology providers) know the scope and touchpoints of the participating organizations and understand how each of them contribute.

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[1] For further details: https://www.gsma.com/futurenetworks/gsma-open-gateway/

1. Introduction

GSMA Open Gateway allows operators to expose and monetize telco capabilities to third party service providers in a programmatic manner through Application Programming Interfaces (APIs). These APIs pave the way for transforming telco networks into programmable service platforms, enabling the integration of the network with third-party applications, with frictionless interactions between them.
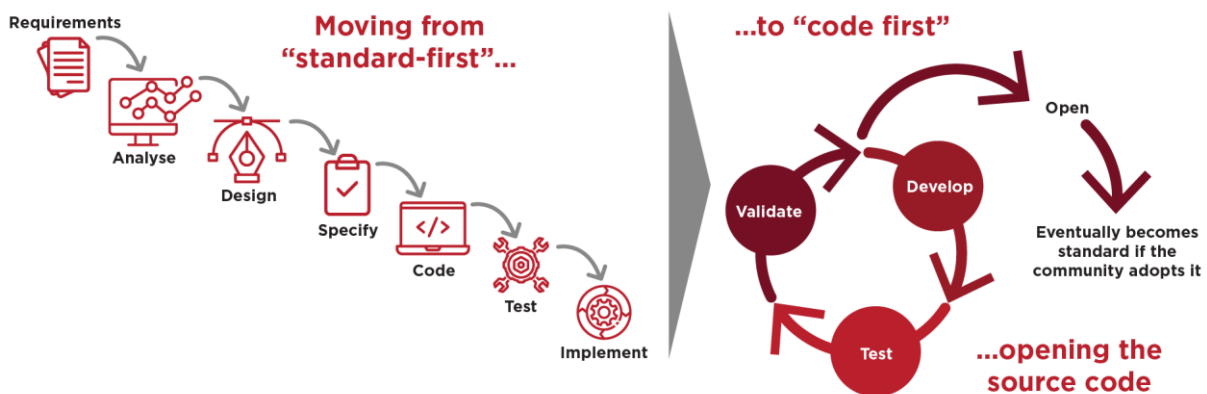
This is a win-win situation for the stakeholders involved. For Communication Service providers *(CSPs),* this represents a business opportunity to generate new revenue streams, and one of the ways to better monetize investment in fiber, edge computing and 5G. For *third parties*, it releases them from the constraints of traditional over-the-top, best-effort service delivery approaches, tapping into new capabilities to provide enhanced user experiences and contribute to the digital ecosystem with new services.

To ensure wide market adoption of NaaS, it is essential to push the **development and industrialization of third party-facing APIs**, featuring these tenets:

- **Scale**. Third party-facing APIs need to be massively adopted by customers (both application service providers and enterprises) by reaching into their ecosystems, where they typically use a rich set of functionality, libraries, and tools.
- **Global reach**. The implementation of these user APIs by network operators provides third parties with an easily deployable and consistent API developer and service experience in a global footprint, facilitating the effortless portability of their applications (and therefore easy service replicability) across different telco platforms. The fact that operators expose APIs with the same capabilities and common data structures is key to onboarding and integrating third parties, enabling an attractive economy of scale for them. This is achieved through both the wide federation of operator capabilities and through existing and new marketplaces.
- **Simple**. Potential third-party API consumers typically have no telco expertise and demand APIs to be easy-to-use and require low coding effort. Therefore, operators need to offer third party APIs that hide unnecessary telco complexity, avoiding, for example, low-level network or IT system configuration parameters; and with semantics which focus on their business and operational needs.
- **Security & privacy**: API consumers (application developer and aggregator) must trust these APIs, both from a technical security (data storage, etc..) point of view as well as regulation conformance (GDPR rules, consent management, Net neutrality), for the benefit of the end users. To achieve these objectives, the APIs are to be secure by design and use industry approved standards.
- **Demand-driven, customer-oriented:** developed as a result of the interaction and collaboration with customer communities.

To make the above happen, standards is the only path. But we need to follow a modern approach to standards development, where the APIs are **designed, developed, and tested in short cycles**, following **transparent and inclusive processes**, as it occurs today in top-tier developer communities. As shown in Figure 1, the **recommendation is to move** from classical waterfall **towards more agile, "code-first" and crowd-sourcing approaches, eventually opening the source code** so that industry community can adopt it, becoming a de-facto standard solution.

Figure 1. Evolution from standard-first to code-first in the Telco industry.

This approach has been followed to develop most of the current software and cloud standards and has also been proven in the Telco Industry by the TM Forum Open API program (for Operation and Management APIs) which, through its Open Digital Architecture program, has created more than 70 Apache 2.0 licensed Open APIs that are now widely adopted across the telecoms IT market.

To comply with the recommendations noted above, several industry partners launched a new initiative at MWCB22: CAMARA.

CAMARA is an open-source project launched at Linux Foundation with the collaboration of the GSMA whose mission is to **foster the definition, development, and validation of user NaaS APIs.** To promote the usage of these APIs, **CAMARA has adopted an open-source approach, based on using Apache 2.0 license for API definitions and reference implementations**. This IPR-free spirit reduces entry barriers for developers, encouraging more use cases which ultimately accelerates industrialization. CAMARA counts on an open and ever-growing community which gathers frontline industry stakeholders, including vendors, CSPs, Hyperscalers, solution integrators, and customers.

2. GSMA Open Gateway NaaS system architecture

At MWC Barcelona 23, The GSMA announced the GSMA Open Gateway initiative, in which operators committed to launch universal NaaS API services in 2023. Operators participating in the GSMA Open Gateway initiative have agreed that the interaction between CSPs and customers (enterprise customers, application developers, application service providers) shall be implemented using the APIs provided by the CAMARA project. The reason is that these APIs are purposely built following the design tenets: scale (developer-oriented), global reach (they are offered and federated by multiple operators) and simple (user-friendly semantics, easy to use and operate).

Figure 2: Open Gateway NaaS Architecture and contributing stakeholders.
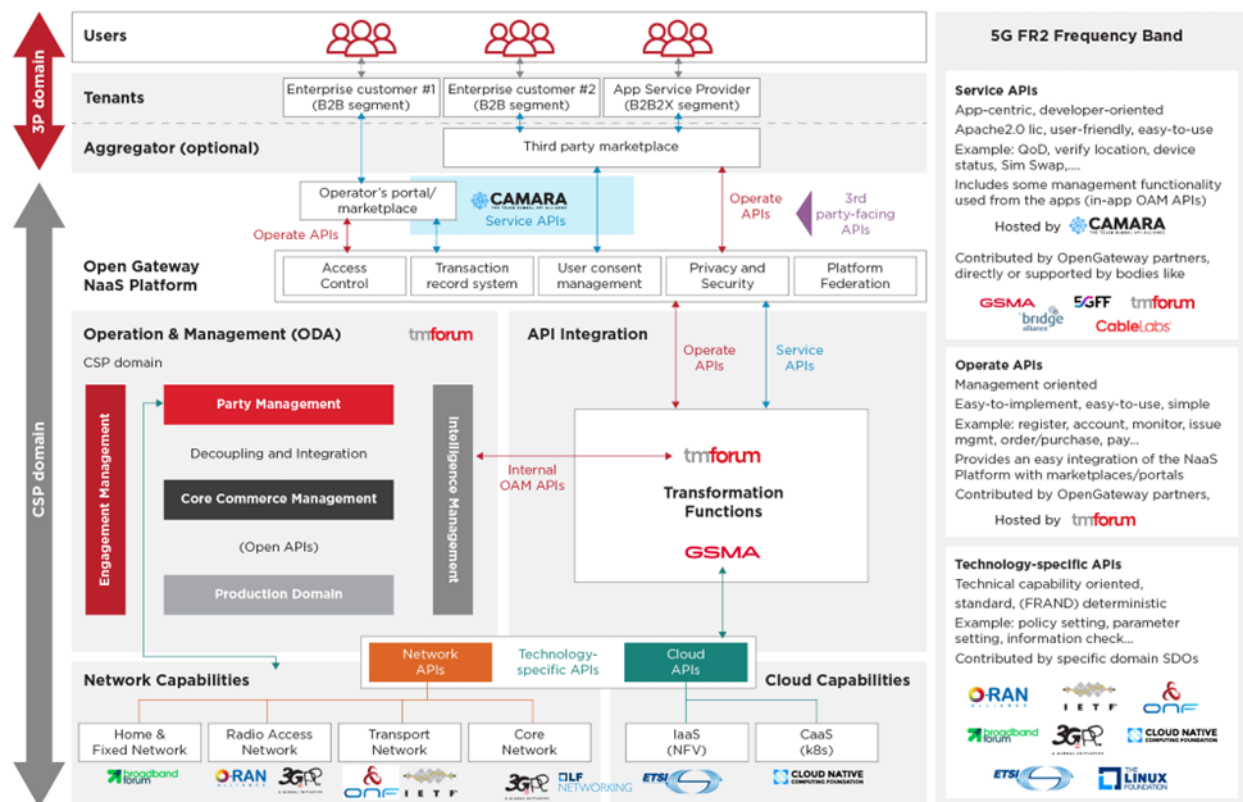

Figure 2 illustrates a simple graphical representation of an Open Gateway NaaS system architecture. As shown, CAMARA APIs have implications in the third-party domain (how APIs are made available for consumption) and CSP domain (how APIs are implemented based on the operators' internal capabilities).
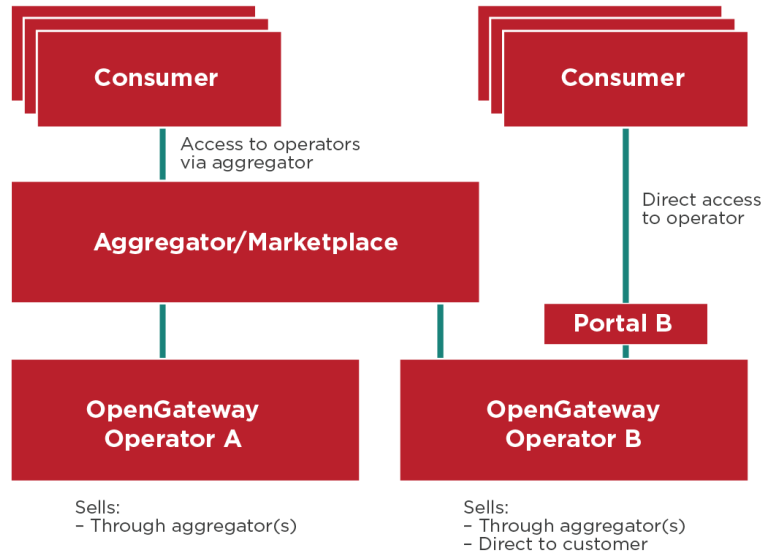
To maximize availability and uptake, CAMARA APIs can be exposed to the actual tenant either directly, through an aggregator (e.g., hyper-scaler or OTT) or through federation (in this case, one or several operators act as aggregators).

Figure 3: Different relationship models for Open Gateway.

The **Consumer** is a Developer, Application Service Provider (ASP), ISV, Enterprise Customer, Service Integrator... that creates code that invokes the Service APIs

The **Aggregator** may be an operator or a third party (hyperscaler, OTT...). It sells on behalf of the Open Gateway community and is effective when it represents a high number of operators

Each **Operator** sets its own T&Cs with the channels, but there needs to be full alignment on product (standard APIs) and business framework

In the aggregator model (as already stated, applicable as well to an inter-operator federation), the marketplace enables a single channel for tenant applications to gain access to capabilities from multiple CSPs, without the need for the customer to set up a contractual relationship with each of them. This marketplace may optionally enrich/combine CAMARA APIs with other functionality, or abstracting it even more, to facilitate third party use and adoption. The federation and aggregation models could allow fast reach to third parties, which include application service providers and enterprise customers, as these are used to working with existing marketplaces, either from third parties or from operators, that offer them a rich development environment.

From a CSP domain standpoint, it is noted that third party-facing APIs are constructions that result from the abstraction, aggregation, and enrichment of the operator's internal APIs (technology-specific APIs and OAM APIs). This abstraction is performed by the "transformation function". A summary of their scope is as follows:

- **CAMARA APIs**: these are the APIs exposed to customers, directly or through aggregators. Depending on their semantic scope, CAMARA APIs can be clustered into two groups:
  - **Service APIs**, each providing a purpose-specific capability to third parties, e.g., Quality on Demand (QoD), Device Location, Edge Discovery and Selection, etc. Service APIs are defined in separate CAMARA Subprojects. These APIs are provided by operators directly or with the support of bodies like GSMA, 5GFF, CableLabs, BridgeAlliance, TM Forum, etc, and are typically developed and validated in collaboration with customers.
  - **Service Management APIs**, allowing the application developer to run certain management functions from within the application, like ordering the enablement of a certain functionality for that application, monitoring, eligibility check or consumption

check. These APIs constitute specific families and may have its own Subprojects. The requirements for these APIs are intended to be defined in the CAMARA Commonalities Workstream. These APIs may be contributed by CAMARA partners from TM Forum and are typically designed and tested, partnering with application developers. The design and development of Service Management APIs follow the same guidelines and scale, reach and simplicity principles that are applied for the Service APIs.

- **Operate APIs**: offering programmable access to Operation, Administration and Management (OAM) capabilities to facilitate the integration of the Open Gateway NaaS Platform with portals, marketplaces and other aggregator platforms.
  - They provide all the transversal/non-service specific functionality that is required to make a commercial product out of the Service APIs, making them operable and monetizable. Examples of functions provided by the Operate APIs include ordering, monitoring, trouble ticketing, accounting, billing, payment, etc, but also API discovery, user registration and consent management, etc.
  - They are made available by the operator's IT stacks, which typically includes operating and business support systems, and on-line charging systems, now structured following a new digital architecture. TM Forum is the body leading the definition and development of these APIs, with over 70 Open APIs available and widely implemented today under the Apache 2.0 license. TM Forum is assisted by 3GPP SA5 for those cases where OAM APIs trigger FCAPS management operations on 5G configurable resources (e.g., network functions, network slices).
  - Because of the extensible design of TM Forum Open APIs, these Operate APIs may make use of a TM Forum approach called Domain Context Specialization to create targeted APIs focused on facilitating the integration with non-telco environments (aggregators, third-party marketplaces and portals) by defining a simplified, restricted API payload for specific scenarios, and taking into consideration the third-party requirements and way of working.
  - These APIs are typically contributed by GSMA Open Gateway partners from TM Forum and are developed and validated in collaboration with aggregators and marketplaces.

- **Technology-specific APIs**: operator internal APIs offering programmable access to telco infrastructure and network, service and IT capabilities. They are made available by operator's underlying systems, including network systems (e.g., network functions/elements from fiber access mobile access, transport, and core domains), cloud systems (including edge platforms) and IT systems (e.g. ordering, billing). These APIs are typically defined in standardization bodies (e.g., 3GPP, IETF, ETSI, TM Forum) and cloud communities (CNCF) and are typically tied to the underlying technology.

- **Transformation Function**: Translates CAMARA API calls into calls to technology specific APIs, executing the workflows that implement this mapping. Apart from decoupling customer-facing call flows from operator-facing processes, this component shall be featured with scalability and observability capabilities. In this vein, a modern

cloud-native architecture, based on microservices, is expected for the transformation function. GSMA and TM Forum will both provide support for the implementation of the transformation functions via non-prescriptive guidelines and recommendations. GSMA OPAG (Operator Platform API Group) provides advice on the mapping of CAMARA Service APIs to internal APIs, mainly technology-specific ones, while TM Forum plays the same role for the CAMARA Service Management APIs, mapping mainly to internal OAM APIs. These guidelines and recommendations are not a prerequisite to start the development, testing and validation cycles in CAMARA, but intend to facilitate APIs to achieve scale in terms of market reach once the API is consolidated in CAMARA.

- **Operator Federation and Interconnection**. Transparent federation between operators through simple APIs will allow developers to deploy CAMARA API-based applications across wide regions without concern of identifying the serving operator and without the need for establishing technical or commercial relationship with multiple operators.

Finally, when coming down to production networks, a CSP shall offer a single entry-point for third parties to gain quick and easy access to CAMARA APIs. This is captured in Figure 2 with the definition of the **Open Gateway NaaS platform**. This platform provides all the features that are needed to policy manage the interaction between the CSP and the third-party domains (other operators and third party aggregators), including API publication & discovery, access control (registration, authentication, authorization), auditing and user consent management, among others.
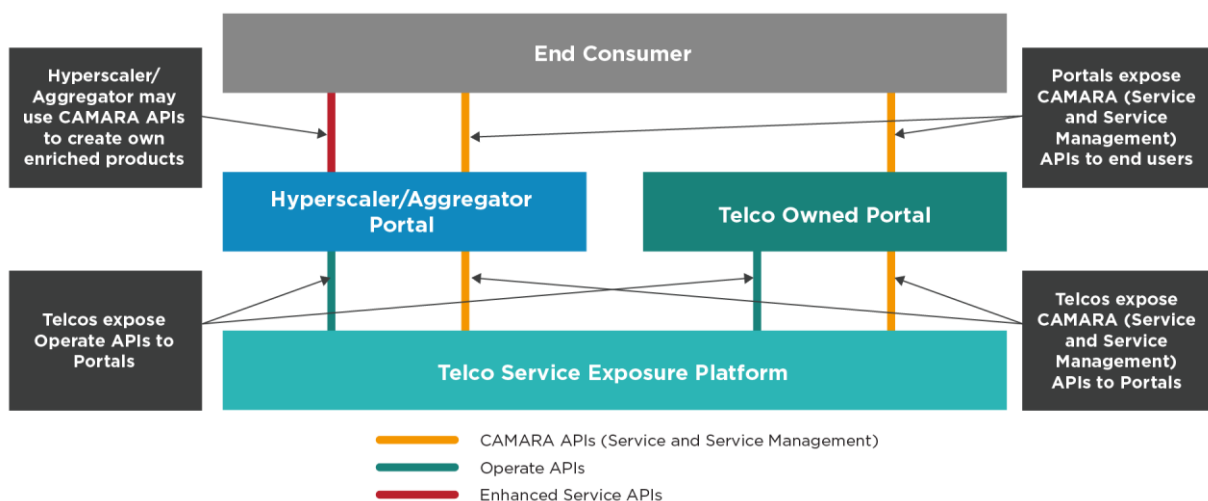
3. Roles and contribution of the different stakeholders

The Open Gateway NaaS system architecture reported in this white paper aims to shed light on the intended demarcation points, so that different stakeholders (customers, operators, and aggregators) know the scope and touchpoints of the participating organizations and understand how each of them contribute. The bullets below summarize the key points.

- **Third party-facing APIs:** these are the APIs exposed to third parties, including enterprise customers and aggregators. They are defined as abstraction, aggregation, and enrichment of operator internal APIs (technology-specific APIs and OAM APIs). This definition is a "top-down" journey that compares third party expectations against CSP managed capabilities, looking for simplifications in the API data model and structure. The result are APIs which are easy-to-consume (CAMARA "Service" APIs, the "run-time" APIs) and easy-to-manage (via CAMARA "Service Management APIs" and TM Forum "Operate APIs"). CAMARA is a contribution-driven open-source project that hosts the development of the "Service" and "Service Management" APIs. Its APIs are provided by different organizations, operators, and stakeholders, that commit to maintain and evolve them.
- **Operator internal APIs**: Incumbent telco standard bodies and cloud communities lead the specification of technology-specific APIs, whereas TM Forum Open API program (backed by 3GPP SA5) accounts for the definition and development of OAM APIs.

Role of the different entities using the APIs

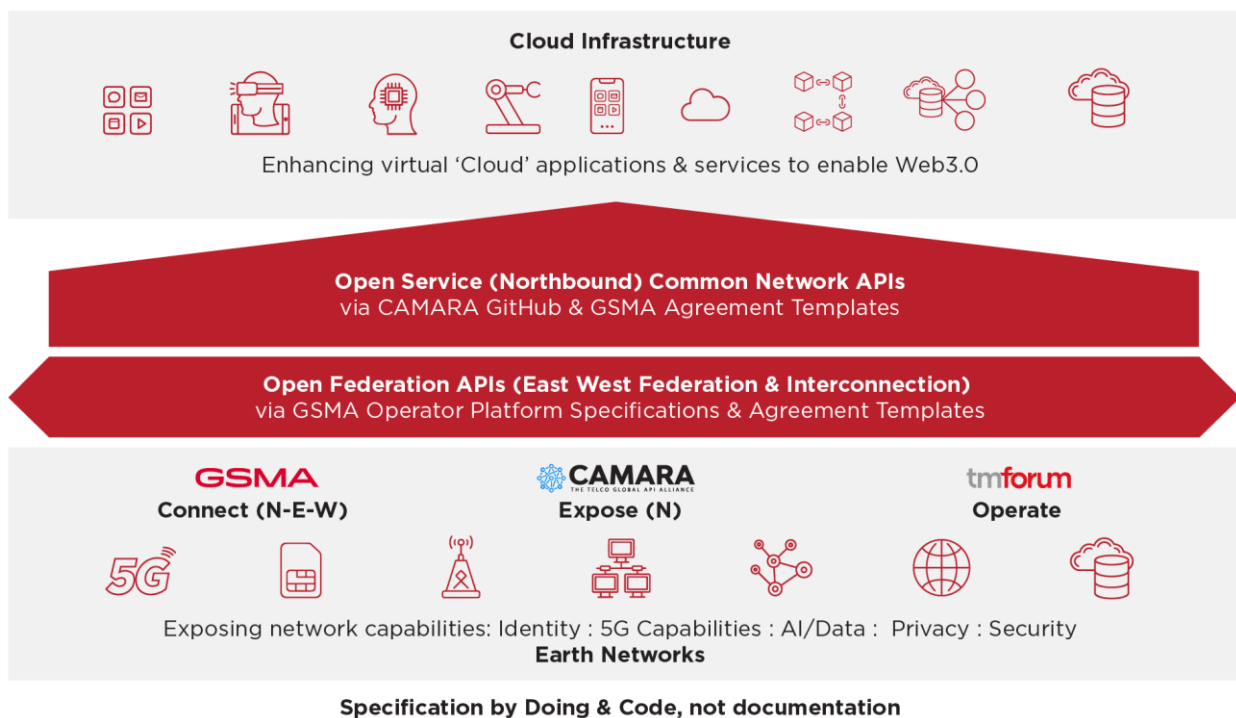Figure 4. Usage of the different API types by each stakeholder.

Telcos expose through its service exposure platform CAMARA APIs to be sold by several aggregators/channels, or by the telco itself using its portal. These CAMARA APIs are used by the API Consumers in their applications (yellow lines in Figure 4). The Aggregators may develop and expose additional "Enriched APIs" by adapting or combining CAMARA APIs (pink line).

Telcos expose Operate APIs for integration with marketplaces and portals (own or from third parties, green lines).

Role of the different organization in the API business and technical development

Figure 5. Main organizations in the NaaS Ecosystem.

CAMARA, GSMA and TM Forum are the main organizations contributing to the NaaS API development, as shown in Figure 2, whose role is specific and complementary:

- **CAMARA** represents the "exposure" doctrine, i.e., how capabilities are exposed for external consumption via APIs. CAMARA provides the repositories for the different families of Consumer-facing APIs. The definition, development and validation of Service APIs is done in the different CAMARA Sub-Projects. The Service Management APIs are worked out as specific API families in CAMARA. The CAMARA Commonalities working group defines and documents the API design guidelines, which prescribe how APIs in CAMARA must be written in terms of header, naming convention, error codes, etc. to facilitate a uniform API language for the developers. Every Service API must comply with these guidelines, which have been drafted following a developer-friendly approach.

- **GSMA** presents the "technical" and business principle, i.e., how CAMARA APIs are to be supported by underlying telco capabilities and commercial arrangements. GSMA conducts the technical work through GSMA OPAG (Operator Platform API Group), that a) aligns the service API roadmap with the roadmap of network/cloud vendors, making sure the corresponding technical capabilities are commercially available on time, b) defines the technical elements of the federation, interconnection and roaming aspects (such as identification, discovery & routing) that allow the NaaS APIs to become a universal service and c) drafts non-prescriptive recommendations on mapping between CAMARA APIs and technology-specific APIs (from bodies like 3GPP SA2/SA6, IETF, CNCF, ETSI NFV…) including requesting further study in those bodies where additional functionality is required to service proposed CAMARA APIs. This provides guidance to less qualified operators and partners in their implementation of transformation functions towards cloud/network resources, facilitates certain uniformity in the CAMARA API behavior and performance and ensures the availability of the required telco capability to support the development of the CAMARA APIs. The implementation of the APIs remains the responsibility of each individual operator.
  - Next to the work in OPAG, GSMA WAS Working Group defines the voluntary agreement templates for federation between the operator networks and for relationship with third parties (aggregators, marketplaces…) ensuring a consistent commercial framework for exposing services.

- **TM Forum** presents the "operational" doctrine, i.e., how API services are to be operated and managed and, in general, how the IT capabilities of the operator are used to deliver the CAMARA API service. Representing the IT side of CSPs, that includes the OAM functions for NaaS capabilities e.g. service provision, service activation etc., as per the Telco industry Open Digital Architecture (ODA) patterns, TM Forum will have a key role in the design and guide of the implementation of the OAM functionality, by a) providing a modular design and a standard APIfication of the IT systems (ODA-based) utilizing their widely used Apache 2.0 Open APIs, facilitating their integration with network & cloud resources for FCAPS management purposes, and b) drafting non-prescriptive guidelines on mapping between Operate APIs and internal OAM APIs (TMF Open APIs, occasionally assisted by SA5 APIs). This may facilitate the implementation of the transformation function towards ODA systems to less skilled operators and partners and result in a more uniform way to operate API services across different platforms.

4. Conclusions

NaaS represents a paradigm shift with great impact on the industry landscape. Its development requires a collaborative workspace that brings together incumbent telco standards bodies with IT and cloud communities, industry associations and open-source projects. An effective collaboration among organizations needs to be based on **a clear demarcation on their scope of work**, **avoiding that participating organizations run overlapping activities or duplicate efforts**; otherwise, NaaS may risk ending up with a fragmented ecosystem. CSPs and vendors must support and adhere to the outcome produced by these bodies, and ensure their internal teams are aligned.

The NaaS system architecture reported in this white paper aims to shed light on the intended demarcation points, so that different stakeholders (customers, operators, and aggregators) can know the scope and touchpoints of the participating organizations and understand how each of them contribute.

5. Glossary and Acronyms

API: Application Programming Interface

CNCF: Cloud Native Computing Foundation

CSP: Communication Service Provider

ETSI: European Telecommunications Standards Institute (etsi.org)

FCAPS: Fault, Configuration, Accounting, Performance and Security

GSMA: Association representing the Mobile Industry (Groupe Speciale Mobile Association)

IETF: Internet Engineering Task Force (ietf.org)

IT: Information Technology

MWCB: Mobile World Congress Barcelona (GSMA's annual event in Barcelona)

OAM: Operation, Administration and Management

ODA: (TM Forum) Open Digital Architecture

OPAG: (GSMA) Operator Platform API Group

NaaS: Network as a Service

NFV: Network Function Virtualization

3GPP: Third Generation Partnership Project, the Mobile Broadband Standards Partnership Project (3gpp.org)

SA5: (3GPP) Service Architecture 5 Group, dedicated to Management, Orchestration and Charging requirements, solutions and protocol specific definitions.

TMF: TM Forum (tmforum.org)

WAS: (GSMA) Wholesale Agreements and Solutions Group