Operator Platform Concept

Phase 1: Edge Cloud Computing

January 2020

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Operator Platform Overview

There is a growing industry consensus that, while consumers will be the biggest initial adopters of 5G, the enterprise segment offers the significant incremental revenue opportunity for operators in the 5G era [1]. Ericsson's latest Mobility Report (Oct-2019) forecast [2] suggests that the operator-addressable 5G for verticals opportunity could be worth $700bn in 2030 for B2B and B2B2C uses. For reference, GSMA Intelligence forecasts that total operator revenues for 2025 will be $1143bn [3].

Given the wide diversity of use cases that operators will be tasked to address, from healthcare to industrial IoT, it seems logical for operators to create a generic platform that can package the existing assets and capabilities (e.g. voice, messaging, IP data services, billing security, identity management etc…) as well as the new ones that 5G makes available (e.g. Edge cloud, network slicing etc) in such a way as to create the necessary flexibility required by this new breed of enterprise customers.

Owing to the competitive pressure from global players, operators will want to make their assets and capabilities consistently available across networks and across national boundaries. Hence we envisage that operators will collaborate to offer a unified "operator platform". In Phase 1, the Operator Platform will federate multiple Operators' edge computing infrastructure to give application providers access to a global edge cloud to run innovative, distributed and low latency services through a set of common APIs.

Consider for example a smart glasses. Smart glasses currently have considerable compute capability; to significantly increase their market attractiveness, they need to reduce their price considerably. This reduction can be achieved by removing much of their compute capability, placing this at the edge of the mobile network. Smart glasses services also have various latency-critical requirements that would benefit from computing provided at the edge of the network, as close as possible to the glasses current location

It would be simpler, from an operational /commercial perspective, for the manufacturers of the glasses to deal with the common "operator platform", instead of separately with many operators. It would also be beneficial technically, since the "operator platform" can offer a single, unified API to access the edge computing of the various operators underlying the operator platform. This also implies that the edge computing service continues seamlessly as the glasses users moves, including if they travel from one operator's network to another's.

Note that the operator platform is invisible to the end users (the smart glasses wearer in the example above) and to the application providers (who develop the smart glasses capabilities); they do not need to know that it is through the operator platform that the capabilities are made available to them.

In Phase 1, the Operator Platform will federate multiple Operators' edge computing infrastructure to give application providers access to a global edge cloud to run innovative, distributed and low latency services through a set of common APIs.

[1] "The 5G era: Age of boundless connectivity and intelligent automation", GSMA, 2017, https://www.gsma.com/futurenetworks/wp-content/uploads/2017/02/GSMA-The-5G-Era.pdf
[2] "5G for Business: a 2030 market compass report", Ericsson, 2019, https://www.ericsson.com/en/5g/forms/5gforbusiness-2019-report
[3] "The Mobile Economy 2019", GSMA Intelligence, 2019, https://www.gsmaintelligence.com/research/?file=b9a6e6202ee1d5f787cfebb95d3639c5&download

The Operator Platform can leverage (1) operators' existing relationships with enterprises who already have use cases requiring edge, (2) their vast local footprint/real estate, (3) an enviable position for stringent security and data privacy, residency, sovereignty and (4) the organisational competence from the experience of providing highly reliable (five '9's) services. Cloud capabilities will be treated as a subset of edge. It is for future study to extend the operator platform to other capabilities.

Future revenue opportunities can be broadly categorised into two families: business to business enterprise applications (B2B) and business to business to consumer third-party services (B2B2C).

For operator to serve those opportunities through their new capabilities, two main criteria need to be fulfilled:

- Traditional B2C and local B2B services can be provided from internal operator network and edge cloud resources. However, global B2B and B2B2X opportunities will require interconnection of services, and most of operators will require to achieve global reach and universal opportunity, upscaling their market beyond their footprint and customers.
- Enterprises will require in parallel a simple and universal way to interact with customers and those networks and services capabilities. Operators will need to package their solutions as open platforms that can be used by enterprises to deliver services to their customers.

GSMA will draw from the experience gained in developing global platforms such as Mobile Connect as well as less successful projects such as OneAPI or WAC. Insights from the analysis of these project will be taken into account to formulate a solid value proposition, outline the unique selling points of the operator platform compared to competitors offerings, define a clear commercial framework, ensure users of the platform (developers and application providers) are involved at an early stage in the design and have their needs taken care of.

Abbreviations and Definitions

Term	Description
5G	5th Generation Mobile Network
API	Application Programming Interface
AR	Augmented Reality
B2B	Business to Business
B2B2C	Business to Business to Consumer
B2C	Business to Consumer
CMP	Cloud Management Platform
EWBI	East-Westbound Interface
eMBB	Enhanced Mobile Broadband
GPU	Graphic Processing Unit
IoT	Internet of Things
MEC	Multi-access Edge Computing
MR	Mixed Reality
NBI	Northbound Interface
OP	Operator Platform
OTT	Over The Top
PRD	Permanent Reference Document
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
SBI	Southbound Interface
UE	User Equipment
UNI	User to Network Interface
VR	Virtual Reality
WAC	Wholesale Application Community

The terms "Cloud Computing", "Cloud Service", "Cloud Service User", are used in this document as defined in Rec. ITU-T Y.3500 (08/2014)

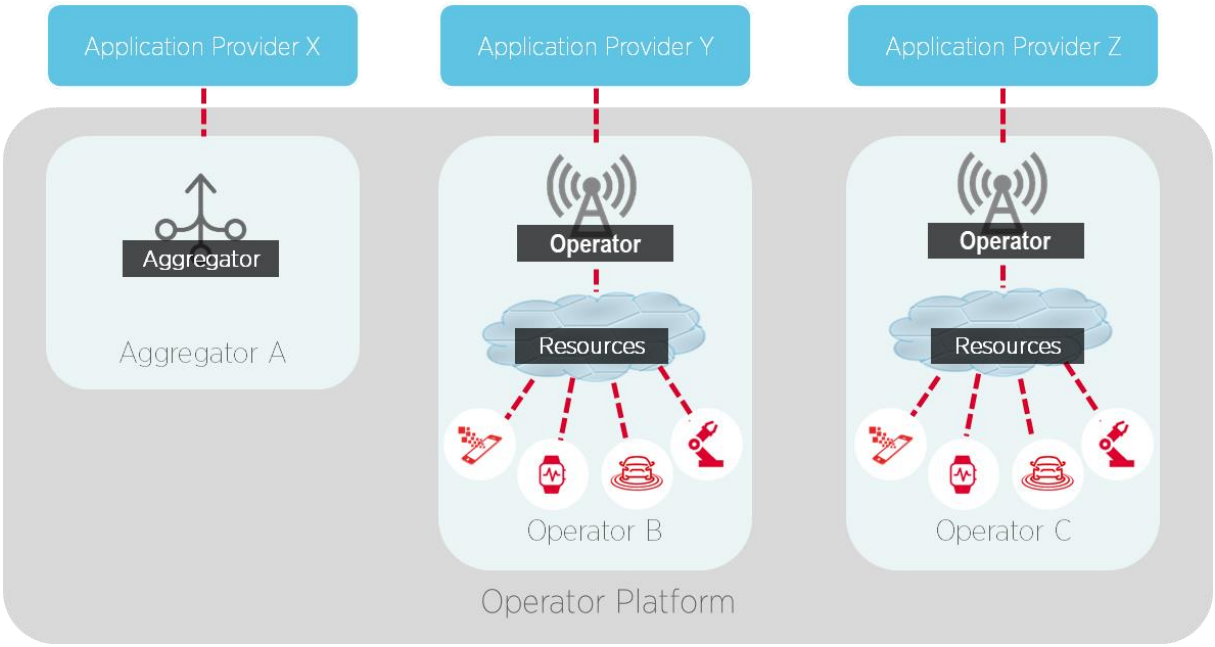
1

Operator Platform Concept

1.1 Introduction

Operator Platform (OP) is a set of functional modules that enables an operator to place the solutions or applications of Enterprises in close proximity to their customers. Operators can monetize and exploit 5G era capabilities such as edge cloud computing capabilities, IP communications or slicing in a scalable way, and in a federated manner with other operators. In order to compete with other major stakeholders, Operator Platform must provide to application providers/customers/enterprises a cohesive vision of the underlying capabilities across federated operators in such a way that the exposed capabilities can be used seamlessly across the federation footprint. As shown in Figure 1, an OP associated with an operator, or several operators joined by a services aggregator, will serve as an access point to external application providers to reach network and services capabilities. For instance, Aggregator A has presence in Europe and Network Operator B has presence in Latin America, serving from multiple joined operator under its footprint. Aggregator A can offer network and services capabilities to Application Provider X to deploy its application over a footprint comprising Latin America and Europe, providing end users with continuous and homogeneous services. Aggregator A´s OP is technically tied with Network Operator B's OP in a way that network and services capability is offered seamlessly as a single industry to Application Provider X through Application Provider´s X access to Aggregator A's OP.

Figure 1: OP example for inter-cloud federation



1.2 OP architecture concept

OP is based on each operator holding an instance independent of the deployment in other operators. Usually this architecture consists of a common exposure & capability framework, including some kind of federation interface towards other operators, and the platforms that actually provides the capabilities themselves.

The OP common framework aims to expedite the integration towards and from third parties joining application providers or third party enterprises. Proposed OP architecture for this purpose is based on four sides approach:

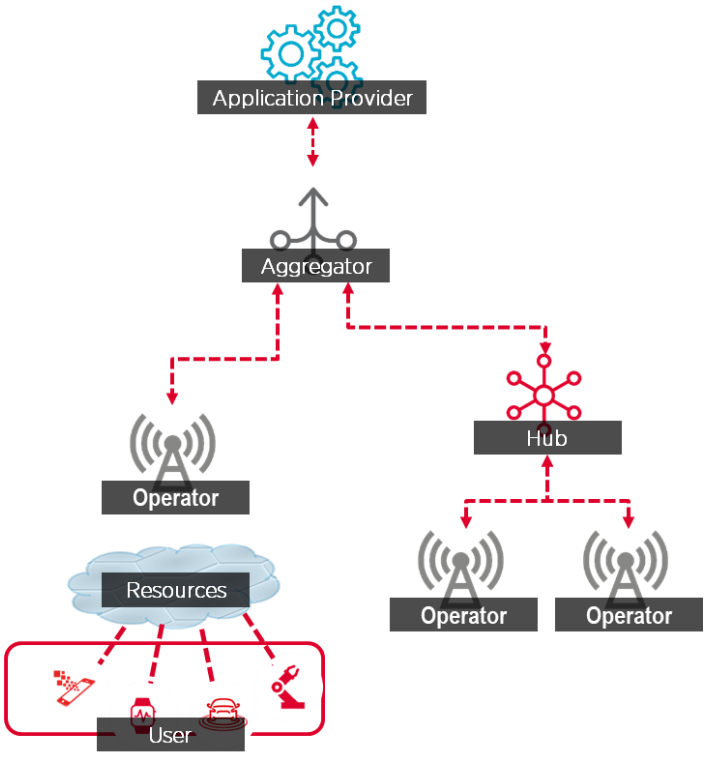
- Northbound interface (NBI) APIs, in charge of service management and enabling fulfilment of enterprise and application

provider use case requirements. The northbound interfaces will follow and adopt existing cloud API principles to ease the use out of existing cloud platforms (where application providers are at home). Network capability and services consumer could be an application provider, another enterprise or a service provider.

- East-Westbound interface (EWBI) APIs, extending operator reach beyond own footprint by Operators federation, this is the interface used for Operators to exchange information.
- Southbound interface (SBI) APIs, connecting the operator platform with the specific operator infrastructure that will deliver the network services and capabilities to the user.
- User-Network Interface (UNI) APIs meant for final equipment to set communications towards OP, opening new capabilities at user level, for instance dynamic service requests or location data.

From the Operator point of view, Operator Platform shall enable capabilities to be tied to network and services functions so that they can be offered to application providers in the form of the Northbound APIs.

Figure 2: Operator Platform roles and their relationship



1.3 Federation concept

For understanding the federation scope in OP concept, it is important to clarify the different roles that the players may have in the architecture:

- Application provider: It is the owner of the application/service. The application provider offers certain service to end users through network capabilities such as cloud or edge and uses the Operator Platform for reaching those resources.
- Aggregator: An aggregator is in charge of the relationship with the application provider. It can aggregate different operator capability resources to be offered to the application provider.

- Operator: the owner of the network and service capabilities. The operator offers connectivity to the end user to access the applications enabled by the capabilities provided.
- Hub: Since there will be multiple operators and aggregators being federated among them, an intermediate hub can be used for abstracting the complexity of those connections and avoid the need for a connections mesh.
- Network resources and service capabilities: The network capabilities or cloud service features that are used by the application provider to offer certain service to end users.
- End user: The customer, having a relationship with the operator (connectivity) and the application provider (business service) that accesses the application through network resources.

Figure 3: Federation among multiple OP instances

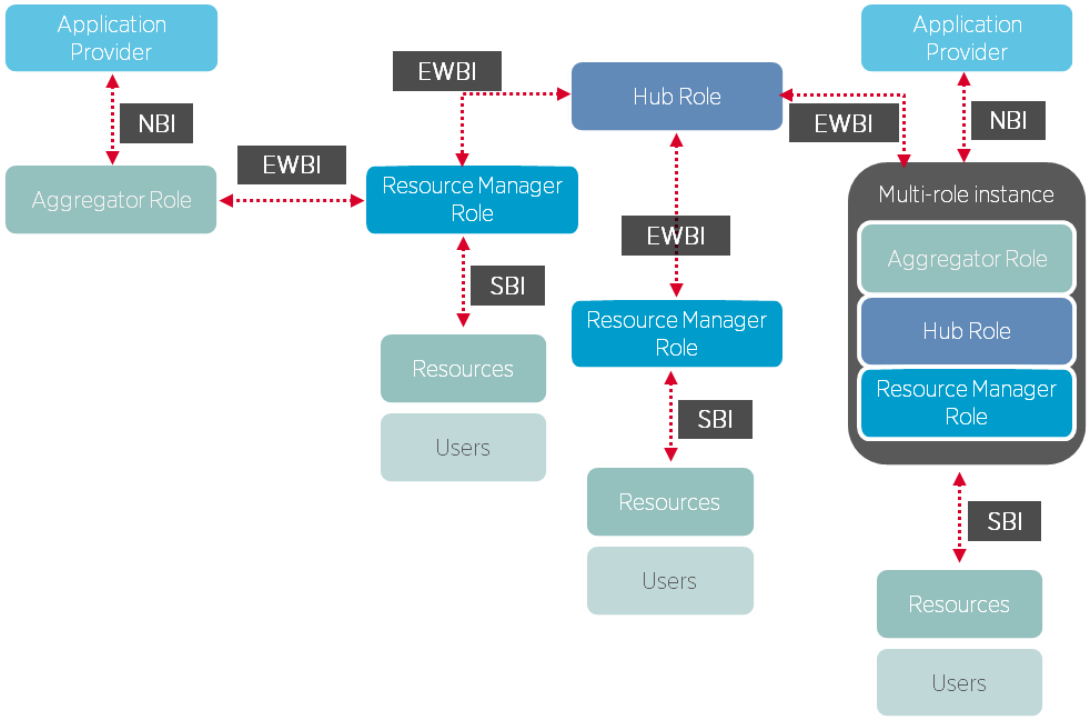


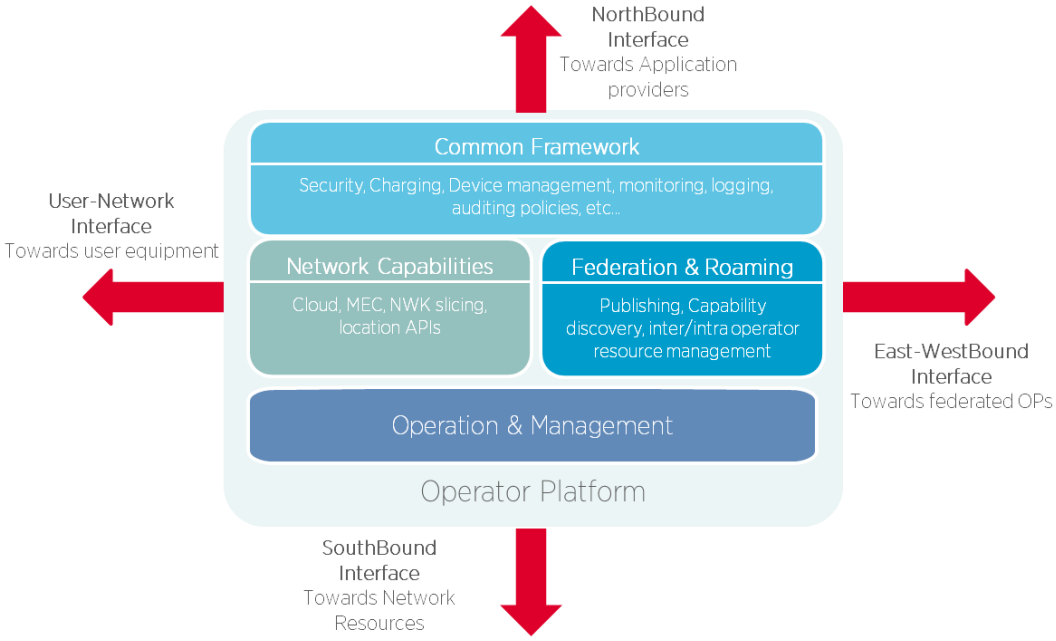
Figure 3 illustrates the different players and relationships among them in relation to the federation. Federation among multiple OP instances allows Application Providers to reach a wider geographical area and user base. OP concept facilitates each player in the ecosystem to execute its role. Depending on the role each player has, there will be different "flavours" of the OP, implementing a subset of the functionalities defined for OP as follows:

- Resource Manager role: An Operator Platform instance that has direct access to network and services capabilities including resources from a specific operator domain, via Southbound interfaces. It will also be in charge of UNI communication towards End Users' devices. Apart from that, this OP will support EWBI interfaces for reaching other OPs/Hubs/Aggregators for the federation, and exposing Northbound interfaces for either Application Providers or Aggregators.
- Aggregation role: An Operator Platform instance that is accessed from Application Providers via NBI to request via EWBI network and services capabilities exposed by an

operator, and thus is reached by the federation interconnection between each OP instance. This kind of platform will provide NBI and EWBI interfaces, for Application Provider communication and federation with other instances. In this role, OP does not implement SBI nor UNI.

- HUB role: An Operator Platform instance that gets in charge of different instances interconnection, mainly for federation purposes. This OP would only implement EWB interfaces, as the relationship with Application Providers and network and services capabilities is out of its scope.

Figure 4: High level platform building blocks



Of course, an OP instance could be playing multiple roles simultaneously e.g. an operator could deploy an OP instance to play the simultaneous role of an Aggregator and Hub.

It has to be noted that an actor in the ecosystem such as an Operator could endorse the different roles (operator, Aggregator, HUB).

1.4 High level platform building blocks

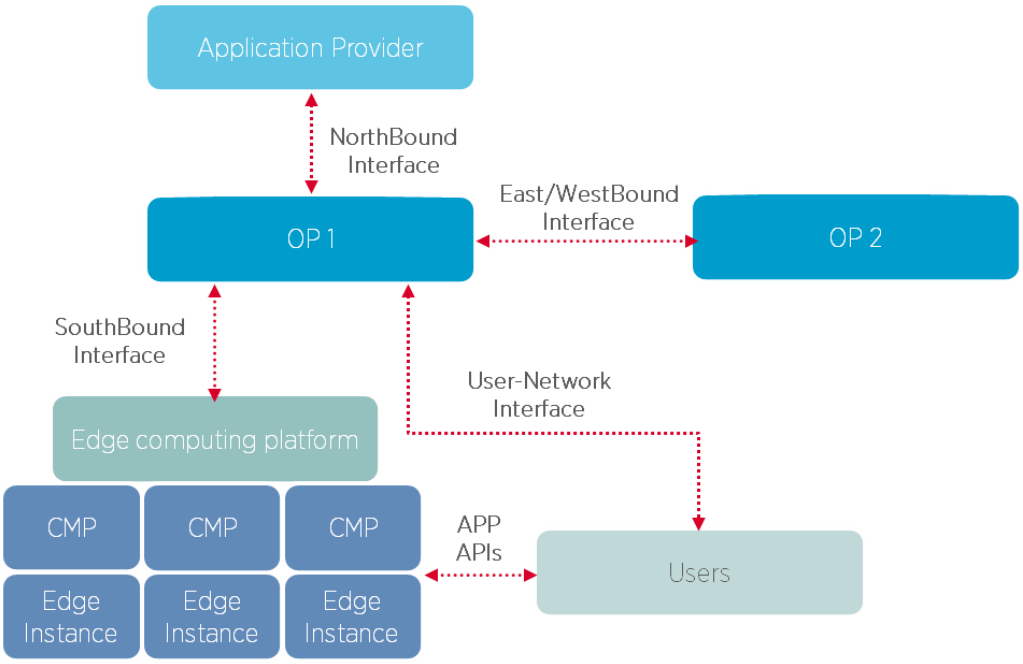
Common framework: The aspects related to all communications among all players can be treated in a common perspective, in charge of interface management, for instance:

- Security, including authentication, authorization, topology hiding or encryption
- Settlement and charging for capabilities usage monetization
- Identity management
- Monitoring and logging
- Network resources and service capabilities: Ensure the exposure of network resources to application providers and end users, including functionalities provided by operators.

Federation and service availability in visited network: In order to enable capability federation, OP shall be able to publish and discover the capabilities available in each operator, apart from the commonly known management of the relationship communications, related to common framework liabilities. Application providers will be connected to an aggregator, the one which is commercially tied to the application provider and acts as a single point of entrance for him but will be able to deploy

transparently its applications on edge platforms sited in other operator venues.

Figure 5: OP high level architecture for edge computing



1.5 OP High level architecture for edge computing

Figure 5 shows the high level architecture of the OP for edge computing. It consists of the following elements:

- Operator Platform: Single point of entrance for application providers for delivering edge computing capabilities at the location of the users. OP interconnects edge computing capabilities across different footprints.
- Application provider: Uses NBI APIs to request edge capabilities through OP, including onboarding, instantiation, resources and application provider
- Edge Computing Platform: Edge computing platform, connects to the OP by SBI for resources management.
- CMP: Cloud Management Platform, access point which combines a set of features or modules which enable the management of different cloud environments and resources, ensuring proper capacity handling. This element is associated to cloud edge resources and interacts with the edge computing platform.
- End user: Final service user, who request app usage by UNI APIs and make use of resources allocated on a proper edge instance, which selection is based on user location or network requirements/status.

2 Edge Cloud Computing in Operator Platform

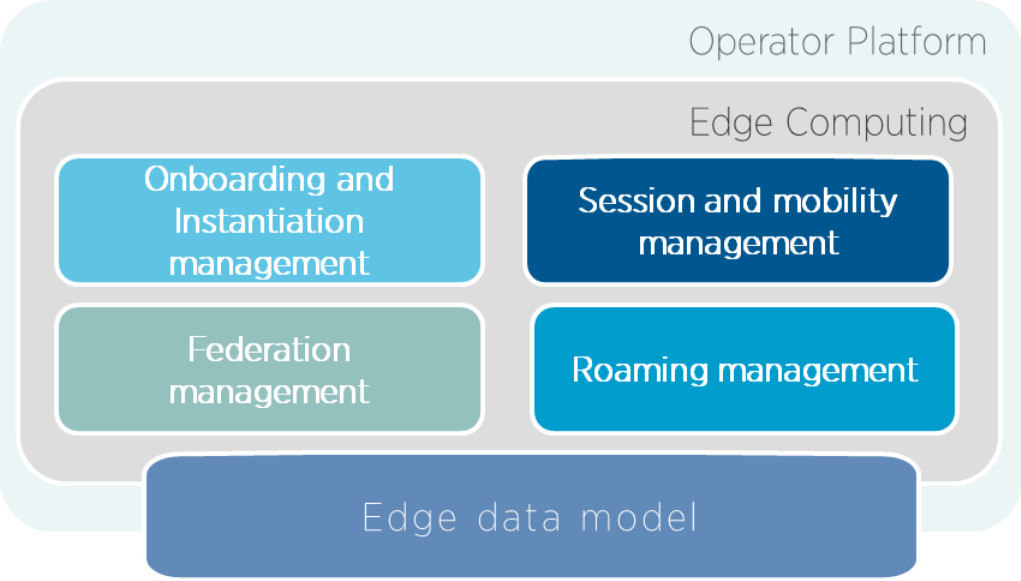
2.1 Edge cloud computing concept

A n application provider may require deploying certain load (from a simple user app to a complete operating system with a complex and high resources consumption service) in computing resources located out of its premises, which are known as cloud resources. Based on different application requirements, the resources would need to provide specific service features, such as low latency or assured bandwidth, which shall be provided from an edge compute node, ensuring an optimal user to service connection.

Existing vision is that edge will approximate the application to the user in terms of network proximity, not necessarily tied to geographical aspects. Edge will allow the user to access services directly available in its network provider domain, avoiding hops in the transport networks and unnecessary interconnections.

Currently, each operator can only offer resources over which it has full control therefore limiting the capabilities and reach. Operator Platform proposes to unify the access methods for application providers to these edge cloud capabilities, allowing to extend application reach to different regions and locations by the federation with other providers, in a seamless way for both application providers and customers.

Figure 6: Functionality and data model of OP for edge



The Operator Platform shall allow unifying the access methods to application providers and end users to these cloud edge capabilities by ensuring federation between the different operators and aggregators players. Thus, as Figure 6 depicts, Operator Platform for edge comprises functionalities and data model for Onboarding and instantiation management, Session & Mobility Management, Federation Management and Service Availability in Visited Networks management that will be explained in the following sections.

In operator networks, each edge node will optimally serve a defined area associated to the user plane network gateway that the final user will be connected to. Multiple network gateways can be served by the same edge node instance, but a one to one relation can be assumed for simplicity, which is considered the best case.

2.1.1 Value proposition

Edge can provide differentiating value for applications that demand specific requirements to be accomplished by the network:

- Strict latency normally associated to network proximity.

- Transport efficiency, suppressing the need for unnecessary hops, transport links or interconnection that will increase latency and failure probability and decrease the effective connection bandwidth.
- Compliance to security and regulatory policies, for instance having to ensure that a given application/user data is contained over a specific territory.

In the short/midterm, only the following functionality can be offered to application provider from a network perspective:

- Deploying applications in the edge, understood as the nearest network access point to the final user, versus deploying in a standard cloud environment.
- Dynamic vs static instantiation of the application, optimizing resources and providing flexibility to application providers.

Most modern applications will be initially developed and deployed within one of the dominant public cloud ecosystems. It is therefore important that an Application Provider/Developer can overcome the limitations of these environments and be able instead to deploy the latency or privacy sensitive parts of an application outside the public cloud and onto the operator edge cloud instead. The following features will be supported:

- Applications can be deployed to edge unmodified from any cloud
- Edge Control Plane offers cross domain orchestration between different cloud providers and heterogeneous infrastructure transparently from application
- Application providers/developers will have easier operating and management model for applications on edge compared to Public Cloud i.e. a more declarative model vs imperative model

2.1.2 User definitions

From the consumer perspective, application providers are those stakeholders that have a relationship with a given operator or aggregator to deploy apps that require edge features.

The users of such apps normally come from a universal scope, like the customers of OTT apps in the current market. However, up to this moment, Edge value can be provided in its maximum expression only to operator subscribers. Through federation, a given operator can offer to application providers a universal base of customers that can access the application.

As for the control of the resources consumed by end users, an operator directly manages the edge computing and the networking resources, whereas an aggregator manages resources indirectly through the EWBI with an operator.

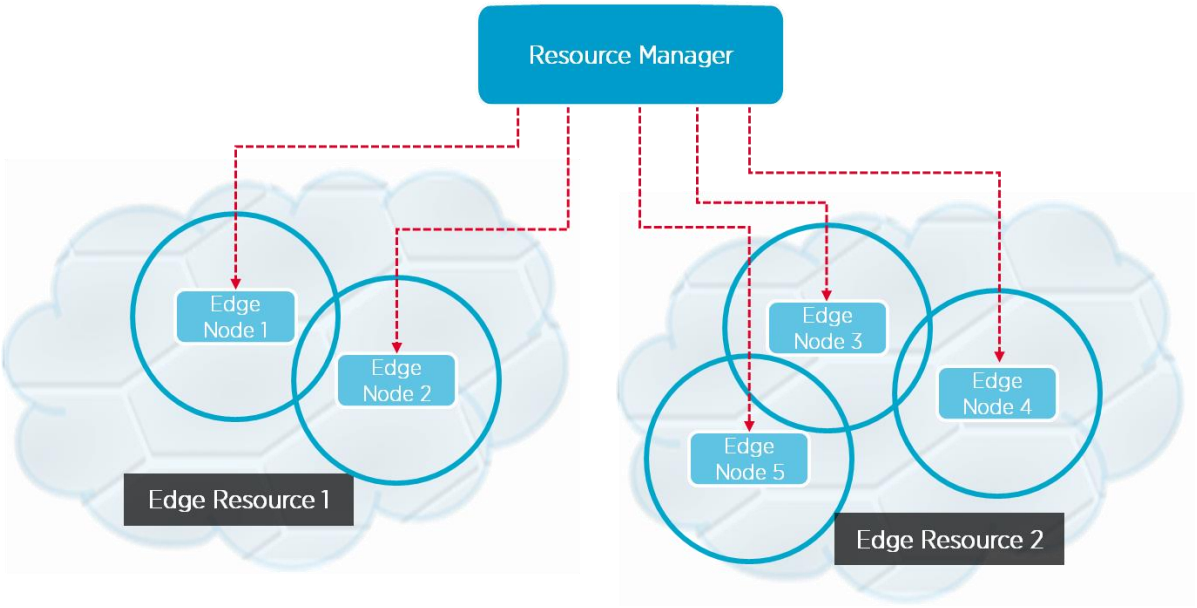
2.1.3 Deployment Criteria

Considering the nature of edge services, one of the most important issues to solve is determining the deployment location of the application serving the user. From the decision perspective, two deployment sides can be assumed:

- Application provider's deployment criteria. The application provider shall be able to request some KPIs to be achieved when the edge instance is chosen for a specific user. The parameters the Application provider can request include:
  - Geographies, ensuring that the user is served by the nearest possible instance, directly tied to the network quality and latency perceived.
  - Latency and other edge features, which the Operator Platform can use as a threshold for discarding edge instances that do not meet application requirements.
  - Sensitiveness to mobility, that is whether the application is able to manage network session discontinuities or not.
  - Dynamic or static deployment, ensuring the application is always available in all edge instances or that it is dynamically installed in response to user triggering.
  - Policies, which allow the application provider to manage those circumstances where user conditions do not comply with the deployment criteria.
- Network deployment criteria: from the point of view of the operator platform, the location of the edge serving node can be chosen from:

- Optimal network point, related to the access element tied to the user, which is supposed to be given for a limited geographical area.
- Load status on the edge node and/or on the network elements connecting the user, so that operator can be able to optimize network resources.

Figure 7: Relation between edge nodes and geographical zones



2.2 Onboarding and instantiation management

As happens in pure cloud scenarios, it is important to clearly differentiate between application onboarding (or resources request) and application instantiation.

An application provider may require covering a broad area, covered by one or more edge nodes. Thus, the application shall be available in those locations for users, possibly on-boarded in each node in a standby status until a user requires to access the application. The following functionality are to be provided:

- Resources request/release. Application provider shall be able to request resources for its application for further use, being sure that they will be available in the required moment. Releasing previously reserved resources shall also be possible from the same Northbound interface.
- Load onboarding/unloading. The payload to be applied shall be available in the cloud environment previously to its instantiation. For that, the application provider shall be able to upload its application (e.g. image and template) and modify/delete it on the fly.
- Instantiation/instance deletion. When the application provider decides that the application needs to be available for final users (or triggered by any other event), the platform shall perform the instantiation procedures.
- Upscaling/downscaling. During the application runtime and due to load/usage evolution or any other event or requirement, the platform shall provide a way for managing the application consumed capabilities for increasing or decreasing the available resources (computing or storage, for instance).

For mobility, it's important to consider that the application may be available (instantiated) in new location prior to user edge handover.

2.3 Edge session and Mobility management in cellular access

It is assumed that each edge node covers a specific geographical area, normally associated with the area covered by one or more given user plane gateways. The user equipment establishes a Packet Switched context towards that network element, which normally would be located based on the UE geographical position criteria.

There is no easy way to embed device mobility triggers like location updates into the application backend without changing significantly its logic. Commercial applications shall be run at the edge in cloud-native form as they are run in hyperscaler's environment today. The device mobility and location updates should be handled as a network service provided by the edge platform.

Figure 7 shows the relation between edge nodes and geographical zones. Each edge node may serve an area in which the service meets certain edge requirements or limitations, for instance, referred to latency. Several edge nodes will cover an area with similar capabilities, identified as edge resource, which will allow managing the federation concerns (see following sections).

In the first interaction, the UE shall query to the Edge Computing Platform (e.g. a component "application discovery engine") for the most suitable edge node to connect to, ensuring that the edge application is available in that location. The most suitable edge node is not necessarily the nearest one, but the one meeting certain criteria like already deployed edge application backends, available resources on edge locations (e.g. GPUs for machine learning applications), requested QoE/latency and further policies.

When edge feature conditions are not accomplished, for instance, measured latency (between device and edge application backend) or the device moves out of the geographical area covered by the serving edge node, a mobility request has to be triggered, and the same request performed in the initial setup needs to be made again for selecting the new serving edge node.

Although the device can trigger queries to the network, the final mobility decision is taken by the Edge computing platform and instructed to the user device upon those queries.

The OP, based on network status, device information, measured QoE/latency or any other condition, can also trigger a modification of the edge node serving the user request.

Considering the User-Network interface, in charge of the device to platform communication, the two main tasks to perform are:

- Edge node selection request: The device, either by an initial connection to the application or triggered by any connectivity change, will request OP to provide the most suitable node according to its situation (location, connectivity, network load…)
- Edge node selection enforcement: The OP, based on the request received by the device and the network information, determines the node which shall serve the final user. By this primitive, the OP provides the connectivity information to the user's application to perform the connection.

It is assumed that more than one edge application will be running on an end user's device at the same time. Mobility decisions that require network reconnection or could affect the continuity of any application shall be considered based on the sensitiveness of such apps to mobility events.

The Operator Platform should be able to report the end user connection information to the application provider and to the edge application. Part of this information could be, but not limited to:

- The end user network connectivity status
- The level of latency experienced per application and per device in the network
- The end user location

The application provider should be able to act upon the end user mobility/connectivity status through the Operator Platform. Indeed, the application provider should be able to request actions such as disconnection, reconnection and enforcement of specific QoS to the network associated to the edge application consumed by the end user.

The application could also adapt its behaviour based on this end user connection information.

Note: Latency guarantee is not a solved problem because of RAN constraints. Unless the programmability for latency is available at enodeB/gNodeB from RAN vendors, the capability to offer latency guarantee will have to be addressed in a later phase.

2.4 Management of edge service availability in visited networks

An end user while away from the home network should be able to get the same edge cloud services in the visited network if the visited network is federated with their home network. Two conditions shall be fulfilled to achieve such roaming capability:

1. User plane local breakout shall be made available for the end user in the visited network.
2. Edge allocation decisions shall be based on home network, visited network and application provider policies.

If the visited network is part of the federation and has a Local Breakout configuration for the visiting user, the Operator Platform will select the most appropriate edge node in the visited network with the requested edge application based on the policies set for the user, the involved networks and the application.

2.5 Federation management for edge computing

Federation between Operator Platform domains is meant to broaden the application provider's application reach out of the operator domain the application provider is related with.

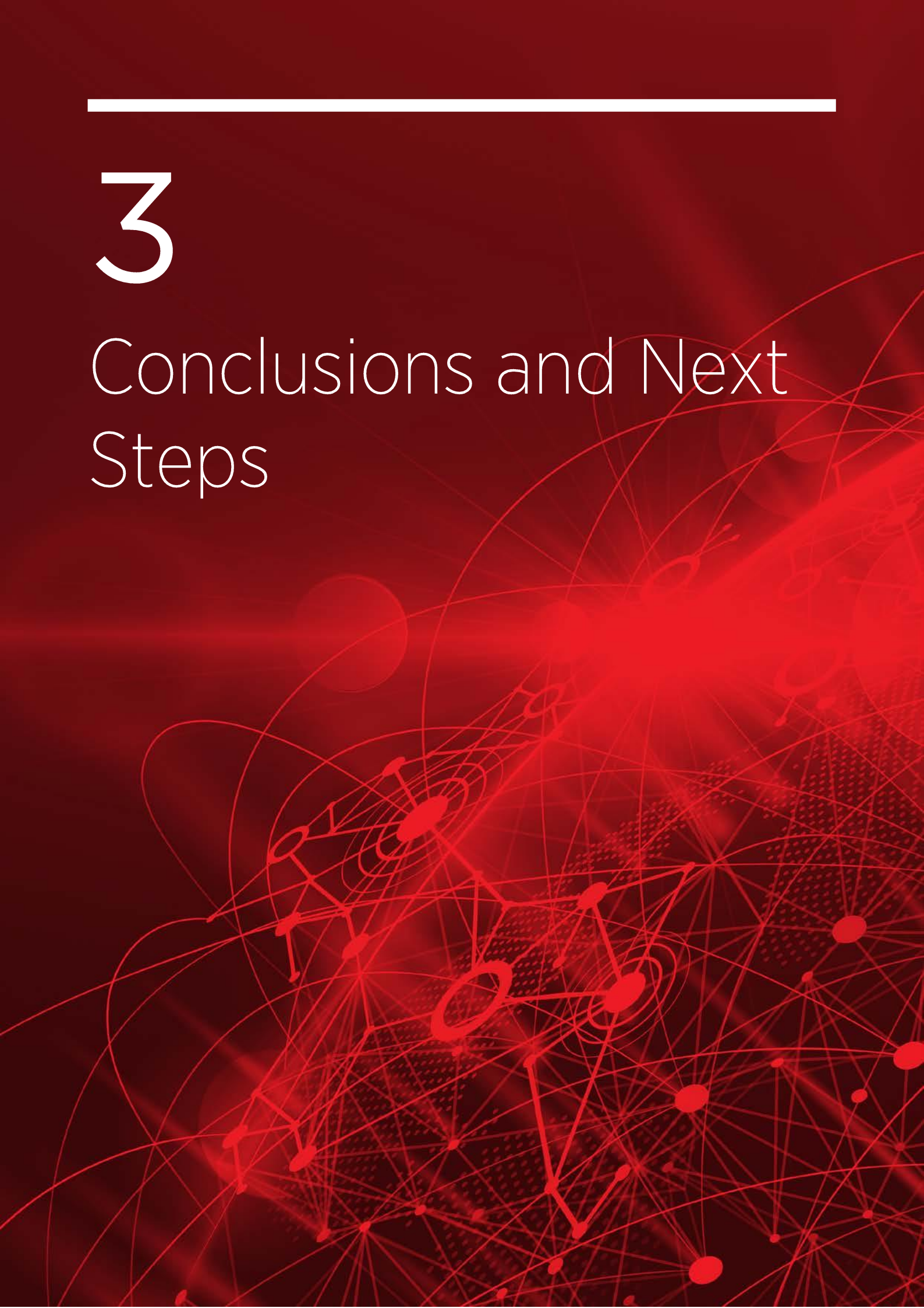
The previously defined East/Westbound interface (EWBI) will be in charge of the federation management among multiple OP instances. This interface shall then perform two main tasks, synchronisation of the catalogue and the execution of northbound-related requests, which is described in the following sections. As explained previously, through federation, OP can offer application providers a catalogue of edge resources to be queried, booked, and used to deploy applications transparently of the operators actually implementing such edge resources, as well as runtime services once the application is running on the edge resources, e.g. monitoring.

Thus, the EWBI is mainly addressing catalogue administration and onboarding related tasks. No actual application traffic is flowing through EWBI. The application traffic as such flows between the application software at the user device and the application software deployed in the edge nodes.

Furthermore, the level of abstraction assumed for the federation does not provide detailed edge node information or topology of such nodes from a given operator to remote OPs which are federated with the operator. This is considered in the catalogue design and the synchronization of catalogue information across the EWBI.

3

Conclusions and Next Steps



Conclusions

As discussed in this white paper, the GSMA and its members aim to provide application providers, enterprises and other potential customers with a common way to access key capabilities of network operators in order to build and enhance services in the 5G era: this is the Operator Platform concept.

For this concept to be successful and avoid fragmentation, federation of these capabilities among operators is key in order to provide a unified and seamless approach to the customers.

The first key capability tackled in this document is Edge Computing, where operators will play a key role to grant access to applications closer to the end user fostering the development of new services and solutions that make full use of 5G capabilities.

Furthermore, the edge and platform concept described in this document highlights that key enhancements are needed to go beyond simple data centres with distributed computing capabilities.

Those are:

- The capability to federate operators, so that edge computing is offered as a unified service by an Operator Platform
- The capability to select which edge computing node is used, optimising for the current location of the cloud service user (and other criteria, potentially)
- The capability to perform edge computing re-selection, typically as the end user moves
- The provision of a common API for the Operator Platform (whichever of the underlying operators is actually being used)

For the operator initiative to be successful, the GSMA believes that:

- The solution needs to be built considering the enhanced capabilities described above to provide a clear differentiator to the market.
- Mass market adoption will be ensured by engaging application developers and other customers and partners in the initiative.
- Operators must go beyond the standard approach of defining common APIs and data models. They should ensure technology development and availability based on iterative models for software development instead of the specification-based waterfall model. “More running code and less paper” is a recommended principle.
- Operators should not work in isolation and engage with players that have already solutions or communities on Edge Cloud, moving from a pure Telco initiative to a wider industry initiative.

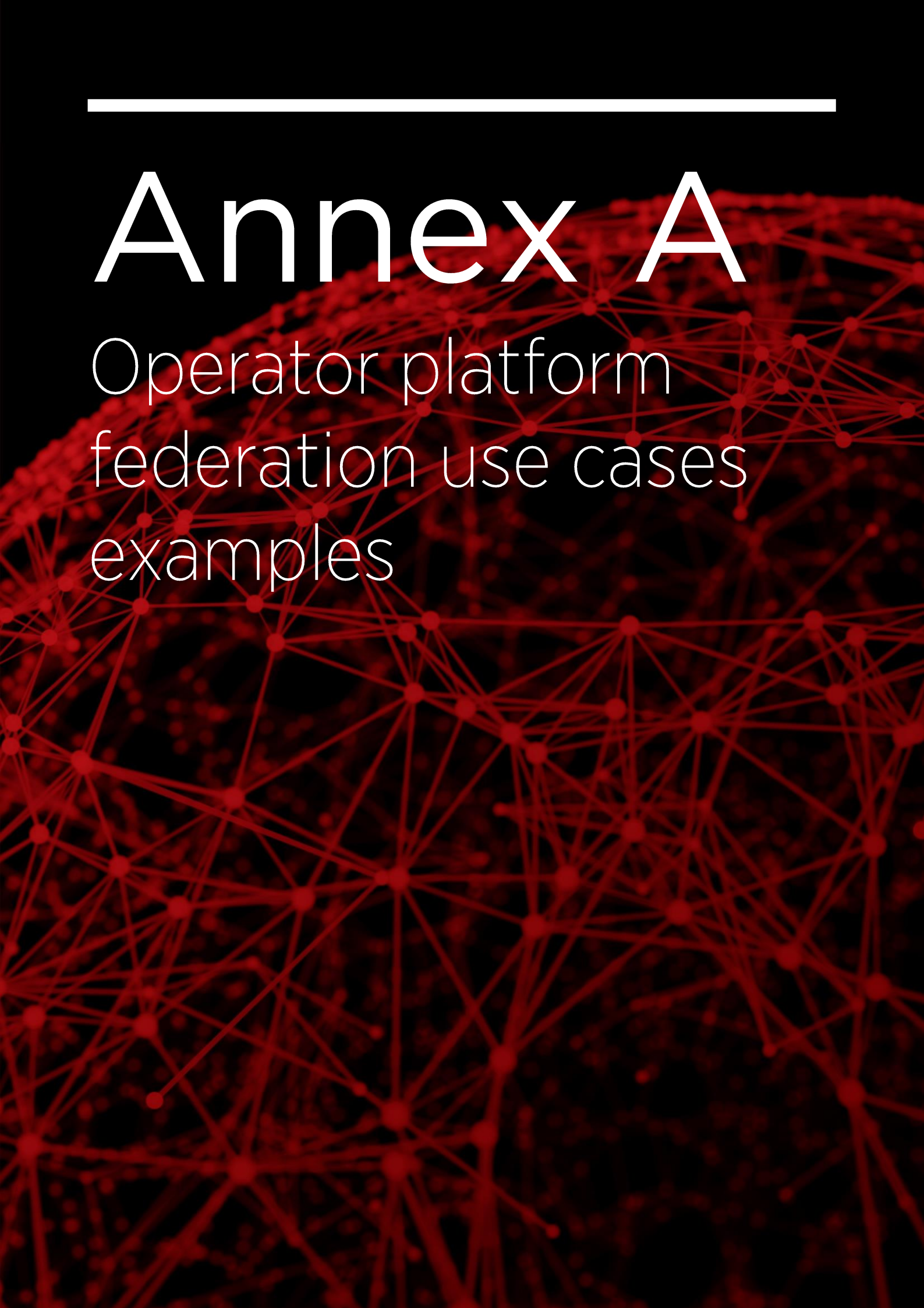
Next steps

The next steps following this paper are:

- Create a GSMA PRD to invite the Industry to define and develop the operator platform requirements / specification concept.
- Ensure an open source approach for the technology development associated to the operator platform.
- Make available to the Industry labs and a reference platform.
- Ensure enhancement and availability of the end-to-end ecosystem: devices, networks, infrastructures and platforms to thrive in service creation and enhancement in the 5G era.
- Interconnection testing: Run a test case where an end user moves beyond their home network into a visited network, to check whether the serving edge node is replaced by a new one in the visited network.
- Test the OP concept through an early market trial.
- Following the completion of phases 1 the Operator Platform should expose additional capabilities such as network slicing and enhanced communication services.

Annex A

Operator platform federation use cases examples



A.1 The edge cloud federation

The Edge Cloud, which is one of the fundamental elements of the operator platform, is the only technology that can relocate any service/application previously hosted outside of Operator Network (e.g. Public Cloud) into that network. By relocating existing services/applications into operator's Edge Cloud, operators can provide guaranteed low latency and high throughput to application providers.

However, as the edge cloud platform resides within the operator network, multilateral efforts are required to ensure service reach when using a multi-operator edge cloud. On the other hand, public cloud can easily provide cross-border services. This is a major obstacle to expanding and widening the adoption of telco edge cloud based services.

To address these shortcomings, the operator platform defines the interworking model between heterogeneous edge clouds from different operator. The operator platform allows maintaining the same user experience as with the public cloud and guarantees easier service deployment model over the multi-operator edge cloud.

As stated in the beginning, the beauty of Operator Platform is in the federation of operator platforms. This will provide consistent user experience across different networks and markets while delivering the benefit of 5G technology in terms of latency and bandwidth.

This annex briefly describes two use cases of Operator Platform federation. The use cases are planned to be implemented and commercialized in the near future.

A.2 Cloud XR

Enhanced Mobile Broad Band (eMBB) is one of the main 5G service categories. eMBB supports the processing and delivery of large volumes of ultra-high definition media that can be applied for some relevant B2C and B2B2C use cases, like AR (Augmented Reality), VR (Virtual Reality) and MR (Mixed Reality).

Starting from VR, it is currently delivered mainly on fixed line. 5G will enable mobility for VR. Due to the challenging requirements of infrastructure performance in terms of compute, storage and network, it is inevitable to install and operate the VR service in operator's Edge Cloud to harness the potential of 5G mobile network. Moreover, when it comes to a service with global scale, the federation across Operator Platforms allows the solution to satisfy both application provider and end users.

A.3 Cloud Gaming

Cloud gaming with ultra-high definition video quality is also one of the promising use cases for Operator Platform with Edge Cloud. This requires 5G network capabilities such as enhanced Mobile Broadband and Ultra Low Latency.

Many game companies and device companies are already focusing on high-quality video games as killer applications of 5G. Operator Platform can assist this kind of companies with a federated platform that may deliver their services in a holistic way at a global scale.

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