



# Telco Edge Cloud Value & Achievements

Whitepaper  
March 2022



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### **About the GSMA**

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

We invite you to find out more at [www.gsma.com](http://www.gsma.com)

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### **About the Telco Edge Cloud Forum**

The Telco Edge Cloud Forum is a body that monitors and guides the developments in the Telco Edge Cloud (TEC) and associated services (IaaS, PaaS, CaaS, NaaS) and aims to promote compatibility, portability and interconnection of parallel deployments.

The TEC Forum currently consists of 24 operators and platform providers and holds several in-person or virtual events scheduled around GSMA events throughout the year.

# Executive Summary

The Telco Edge Cloud (TEC) initiative was launched in the GSMA in March 2020 by 19 operators to design and develop a global edge computing service based on the federation of the edge infrastructures and platforms from a set of operators and edge service providers. Being open and inclusive, the TEC community within the GSMA has grown to include technology and platform providers, counting 24 members at the time of writing this edition of this whitepaper and has set the basis for the global service launch. In this document, you can find a description of the basic services the Telco Edge Cloud will provide.

This whitepaper is complemented by other documents produced by the GSMA, like the ones issued by the Operator Platform Group (OPG) (see References), which describes the technical framework and requirements of the platform that will support the Telco Edge Cloud service, and the Telco Edge Cloud: Edge Service Description & Commercial Principles Whitepaper, which provides a set of commercial principles around the scope of services, stakeholder relationships and possible charging schemes.

The document will help:

- **TEC customers (among others: enterprise customers, ISVs, solution providers and application developers):**
  - understand the value that TEC services will deliver to them and their end-users,
  - how TEC fulfils the requirements of the different stakeholders and the development and execution of edge-native applications,
  - see that Telecom Operators are active where edge computing is being defined and are considering their requirements in the development of their edge and NaaS solutions,
  - view the potential, in terms of global reach, TEC has.
- **Operators and other service providers:**
  - understand the benefit of participating in TEC's global network and enjoy the resulting ecosystem to monetise their compute and network capabilities, and
  - ultimately understand the roles they may play in this new ecosystem
- **Technology providers** to identify potential ways to contribute to TEC (along with the technical work at OPG) and orient them in the development of their platforms and solutions;
- **And demonstrate:**
  - collaboration efforts across the multiple TEC stakeholders and regions,
  - key contributions made by TEC,
  - TEC as the primary reference in the industry for federated edge computing and NaaS services

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# 1. Introduction

## 1.1 Overview

Edge computing is opening up new use cases that are computing and data-intensive, latency-sensitive, or require data residency, security or resilience. As edge becomes a commercial reality and more players compete in the space, the Mobile Network Operators (MNO) community is acting fast to claim a stake in the edge value chain by capitalising on its edge and network capabilities.

## 1.2 Description of the Telco Edge Cloud

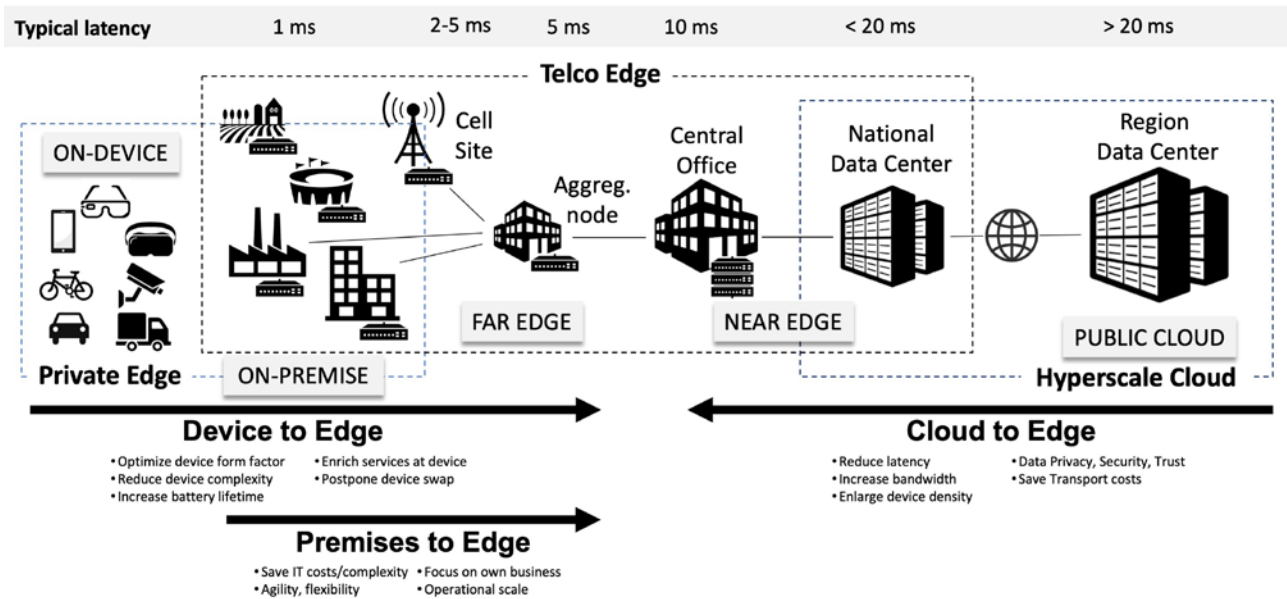
The Telco Edge Cloud (TEC) is a global platform solution to expose, manage and market Edge Computing, Network resources and capabilities across different operators and national boundaries, leveraging existing and future network assets. The initiative was formed within the GSMA in March 2020 and reaches multiple MNOs across Europe, Middle East, Asia-Pacific and the Americas.

TEC aims to become a digital “one-stop-shop” that packages and offers MNOs’ unique edge computing and network resources and capabilities for customers to deliver, and end-users to consume, commercial edge services across different network seamlessly.

Together with relevant technology partners, TEC is deploying a platform based on a combination of open technologies and telco standards. It federates operators’ telco edge resources enabling a global footprint and giving TEC customers access via a unified interface to leverage single sign-on, global distribution, and a consistent and fast go-to-market.

TEC enables MNOs to monetise their edge resources. To capture this opportunity, MNOs are partnering to develop and implement a platform approach that makes it easy for TEC customers to deploy their services worldwide across a telco edge to deliver new or improved experiences for their end-users. Therefore, TEC encourages future customers and ecosystem partners to participate in trials with multiple MNOs to explore, validate, and further evolve the telco edge cloud service. The initiative has already delivered great results showcasing edge applications like drone orchestration, cloud XR gaming, AR-based virtual human guide, holographic videoconference, or assisted driving (C-V2X, Cellular Vehicle-to-Everything) across multiple operators and countries, that has shown practically the feasibility and flexibility of the edge federation mechanisms defined at the GSMA. It regularly launches new waves of field tests through the TEC Trials workshops.

**Figure 1: Scope of Telco Edge and drivers to use it.**



### 1.3 How is Telco Edge Cloud Different?

As a difference to other Edge Computing solutions, the telecom operators deliver an optimal solution for the Edge that combines the best performance in computing and networking to support the optimal quality of experience for edge-native applications, especially those requiring stringent performance levels to mobility or security. This is achieved through tight integration with the 3GPP systems that allow efficient mobility management support, ensuring session continuity to mobile devices while moving and access to the edge service even while roaming in other networks. All this is done over the trusted environment that mobile networks provide.

TEC Customers can control the edge application experience not just by choosing and dynamically scaling the right computing resources but also by controlling the characteristics of the connectivity or getting access to information about the network status to adapt the application's behaviour to the existing conditions.

TEC is open and relies on standards. That approach facilitates portability, compatibility and interoperability of the edge applications developed in any of its federated platforms.

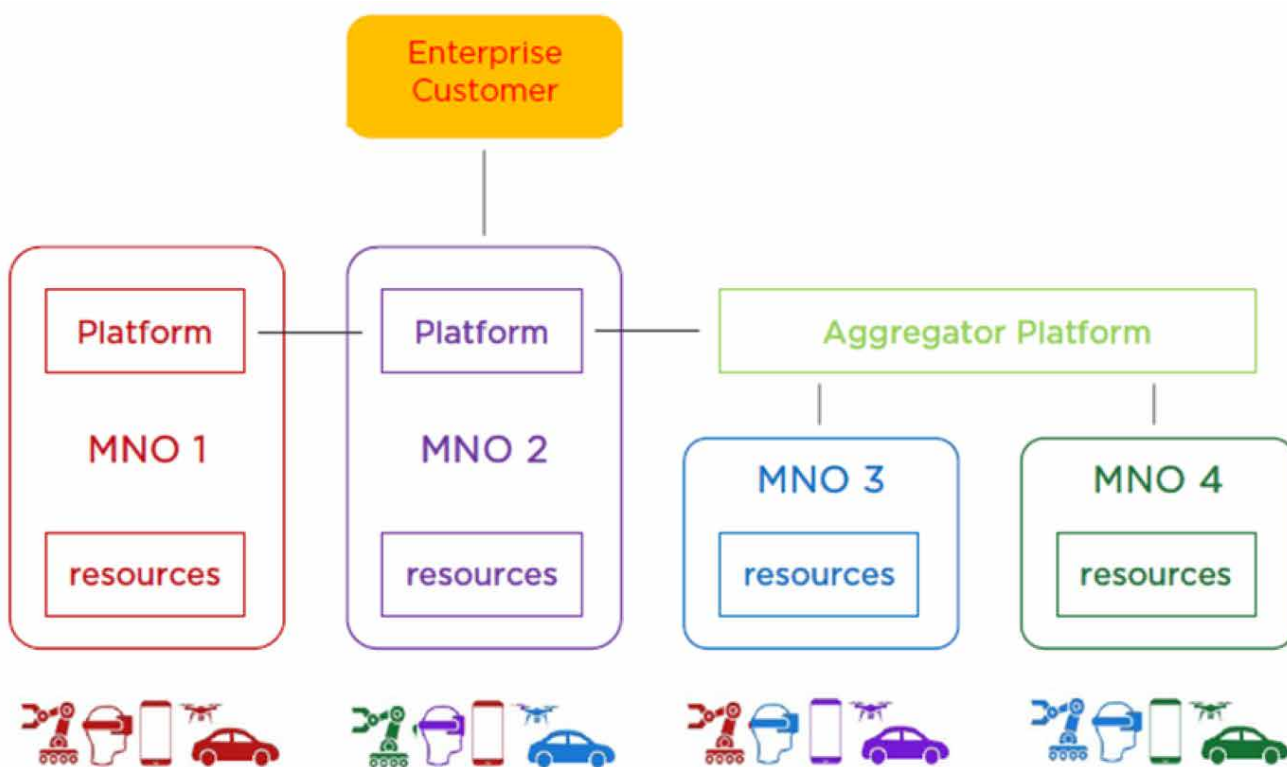
Customers can be involved and collaborate with the operator in the future network evolution and have access to an easy-to-use environment and a federated global footprint for application development.

For MNOs, TEC represents a way to leverage network assets and capabilities through an open and standard edge cloud solution. This solution can be interconnected to a global network to provide services, like Edge Computing, Network-as-a-Service (NaaS) or network slicing, in a universal way, as other services traditionally delivered in the telco industry such as voice and internet access.

Thanks to the standard federation mechanisms it supports, TEC offers MNOs the ability to expedite the creation of a global network by combining the parallel efforts of multiple operators worldwide, providing an attractive alternative for customers demanding a global reach.

The TEC concept and architecture is not just advantageous for MNOs but can also be used by other service and edge providers to enhance their service as capabilities like NaaS are also made available to these third parties. Consuming TEC NaaS capabilities and incorporating those into their platform offerings, other edge and cloud providers can offer mechanisms to their application development communities to optimise the edge application performance and experience.

**Figure 2: Operator Platform Federation Concept**



# 2. Value of Telco Edge Cloud

## 2.1 A platform for Edge native applications

An application is considered Edge-native when it takes full advantage of the intrinsic benefits edge computing provides (like low latency, performance, security or proximity), using an architecture specifically designed to run on a distributed network of edge nodes.

To run in such distributed processing environments, edge-native applications demand a tighter integration with the underlying networks, over and above “basic” edge hosting capabilities. Such network-integrated applications are typically designed following a different set of principles to non-edge-native applications (also known as “Over the Top”). In addition to a modular design to facilitate the deployment to multiple locations, edge-native applications are flexible and portable to be able to run on different types of edge hardware and show some specific characteristics:

- **Performance Critical**

Deployed at the edge, edge native applications are usually expected to provide low-latency and high performing services to the end-users, which requires the edge native application to have a flexible architecture and run efficiently, with real-time characteristics.

In many cases, like gaming or entertainment, ensuring that end-to-end latency remains below a pre-defined maximum level (otherwise known as maximum jitter) is just as important as delivering an acceptable average latency performance.

The TEC could provide an efficient development environment for edge native application developers and a fully virtualised infrastructure to run applications by adopting the latest cloud computing technology.

- **Service Continuity**

Unlike typical cloud computing services, which can serve a wide area, edge native services usually deliver the right service quality only over a limited area. Devices connected to the edge computing facilities may include mobile phones, drones, cars which can move across different regions and even countries. This implies the edge native applications

need to handle end-user mobility and ensure service continuity.

For this reason, edge applications tend to follow an event-driven design to allow for seamless application mobility and loose coupling within the environment, migrating application logic between edge locations depending on network or computing conditions or user mobility.

By connecting multiple MNOs’ edge computing and networking resources, the TEC could provide dynamic resource scheduling and allocation within a global scope and help the applications to provide services across different areas or even across different MNOs.

- **Highly Secure**

Besides high performance, another typical reason to choose telco edge computing is higher security. Keeping the data and processing local to the edge devices, edge native applications can provide better data privacy for enterprises and end-users.

The Telco Edge Cloud, as other telco facilities, sees security as the top priority. Hosting applications on the TEC platform, the MNO can ensure the customer’s data and applications have similar security protections as the usual telco network functions.

- **Reliable**

The edge native applications may provide services to enterprises that are critical to their manufacturing or management activities. Error or failure of such services may lead to a significant loss for the customer. Therefore, edge native applications are expected to provide highly reliable services under power loss or connection failure cases.

Compared to the public cloud, telco infrastructures like TEC are expected to deliver higher levels of reliability and service availability. TEC customers running their applications on Telco Edge Cloud platforms can benefit from Operators’ extensive experience operating the telco networks that have been traditionally huge distributed processing infrastructures.

TEC is a platform designed to provide support and maximise the performance of edge-native applications.



## 2.2 Fit for all edge-native application categories

The Telco Edge Cloud Forum collaborates with partners and customers to demonstrate use cases for telco edge cloud on interconnection (e.g., federation) and edge native applications, including network, immersive, real-time data and vehicle control applications. Since 2019, the TEC initiative has conducted trials regularly involving multiple mobile network operators in more than ten countries.

Each trial generated new proof points and promoted the benefits of the Telco Edge Cloud to early adopter customers such as Continental and Unmanned Life. The trials also demonstrated the power and capability of the Operator Platform to federate across multiple mobile network operators to deliver low latency and high bandwidth environments to run a new generation of edge native applications such as V2X collision warning systems and drone automation. The goal of the trials is to demonstrate global compatibility, portability, and interconnection of parallel telco edge cloud deployments.

TEC Forum delivers customers early access to the Telco Edge Cloud benefits such as access to resources across the combined telco edge footprint of multiple operators, support for end-user mobility and roaming, premium customer experience, and real-time operational capabilities. These new benefits customers can achieve can only be found through unified service delivery and efficient use of network resources, computation and storage required by edge native applications.

### 2.2.1 Categorizing Telco Edge Cloud Service Applications

To show how the Telco Edge Cloud delivers on its promises, the TEC Forum has run trials that demonstrate some of the main TEC Service Application Categories, including networking, real-time data, immersive and vehicle control applications. Each application requires several capabilities, including access to edge and network resources in the operator's network, network connectivity services delivering requirements like low latency or high bandwidth and a device SDK (software development kit) enabling proper mobility for the customer.

Figure 3: Main TEC service application categories

# Telco Edge Cloud Service Application Categories

## Categories



### Network

- 4G, 5G, 6G
- Developer consumption experience



### Real Time Data

- Pipeline automation
- CV, ML, AI
- Services along the flow



### Immersive

- Pervasive
- Multi-Model, Multi-Device
- Personalization
- Interactive
- Local content
- AR/MR
- Metaverse



### Autonomous Control

- M2M
- Devices that move or execute independent actions

- **Network Applications**

Networking applications manage operations, performance, and monetisation of mobile network infrastructure, at the telco edge. Network applications require a cloud-native environment to host the Virtual Network Functions (VNFs) or Cloud Native Functions (CNFs) and bring core, transport and radio operations to the telco edge. The telco edge cloud offers optimised workload management, monetisation of networking as a service, and reduced network infrastructure and management costs.

TEC Forum members have demonstrated network application use cases, including multi-MNO Operator Platform federation and user control plane integration with the edge.

- **Real-time Data Applications**

Real-time Data applications manage bi-directional, location-specific data streams that require real-time processing to enable actions, functions, or events. Many Real-time Data applications use artificial intelligence or machine learning to automate data processing. Examples of real-time data applications include video search, predictive maintenance and foot traffic analysis. These applications leverage precise location, ultra-low latency, and high bandwidth optionality to support bi-directional data flows and computation at the telco edge. Telco edge cloud offers guaranteed performance and optimised data flows to lower transport and compute costs.

TEC Forum members have trialled real-time data applications, including use cases like drone-based video surveillance.

- **Immersive Applications**

Immersive applications manage the metaverse shared reality experiences through dynamic content, such as upload, local content, and hybrid participation. Immersive applications require real-time, hyper-local synchronisation across multiple participants and device form factors. Dynamic content data streams from these devices require high bandwidth to ensure optimisation and quality of experience. Telco edge cloud offers immersive applications location, latency, and bandwidth to support real-time, dynamic content for enhanced quality of experience.

TEC Forum members have explored immersive applications testing services like a virtual human guide for the tourism sector, multi-player mobile cloud gaming or holographic videoconferencing.

- **Vehicle Control Applications**

Control applications manage operations, traffic and control systems and environments for independent and fleet mobility, including terrestrial or aerial vehicles, like cars or drones, and mobile robotics. Vehicle Control applications require secure environments for sensing, remote control, and lifecycle management. Telco edge cloud offers vehicle control applications a safe environment with stable and predictable low latency across multiple network operators. This requires an optimal interconnection of their networks and edge nodes and mobility management to ensure session continuity as the vehicles moves providing applications performance predictability on optimised telco edge clouds.

TEC Forum members have demonstrated autonomous applications, including cases like C-V2X collision warning or autonomous drone swarm orchestration.

## **2.2.2 Demonstrating the Value of the Telco Edge Cloud**

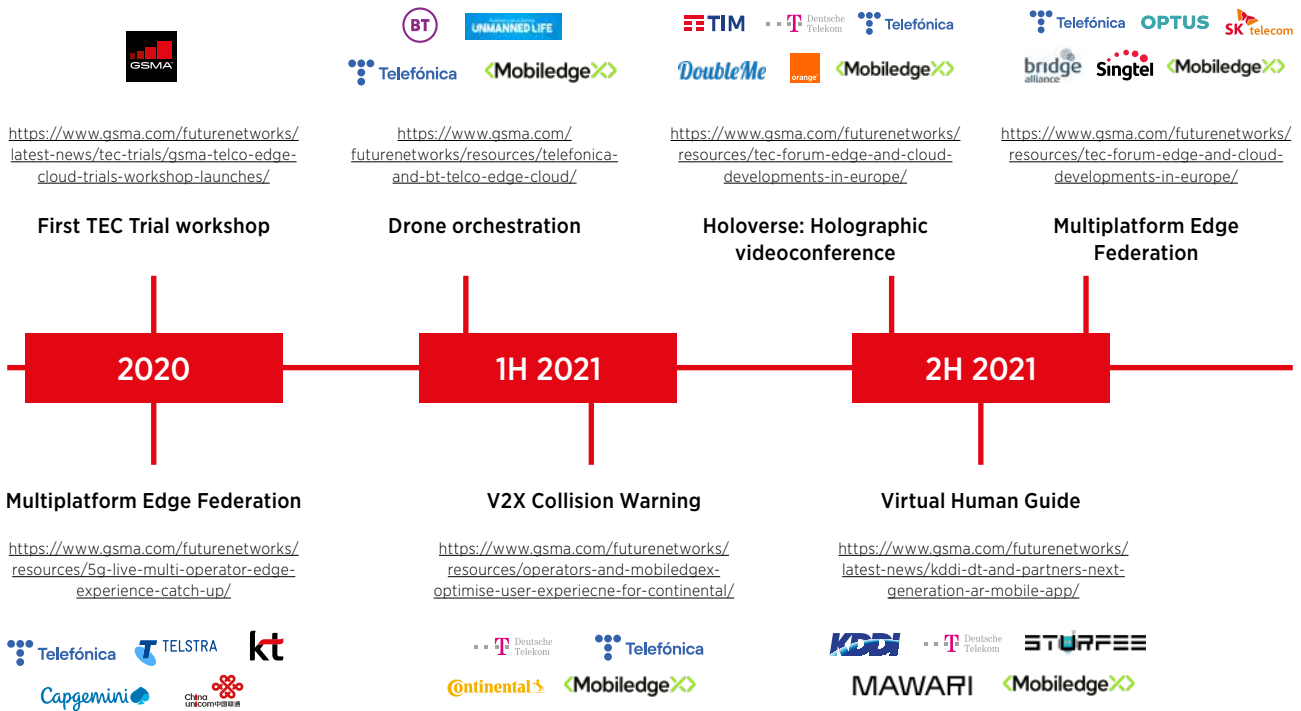
Since 2020, TEC Forum members have participated in six trials across eleven mobile network operations in different markets worldwide, with special intensity in North America, Europe and Asia-Pacific. The field tests have demonstrated some of the above-described edge application categories. They have involved multiple mobile network operators across regions and countries, showcasing a unified telco edge cloud service that offers controlled quality of service, low latency, high bandwidth and mobility management for their customers.

Each trial involved several mobile network operators, a customer or developer enablement platform and an operator platform provider, such as MobileEdgeX, Cag Gemini, or Bridge Alliance, orchestrated or federated to enable a seamless service across mobile operators.

Figure 4: Telco Edge Cloud Trials along 2020/21.

# Telco Edge Cloud Service Application Categories

## Progress To Date



# MultiOperator MEC Federation Experience

## Problem

MEC roaming mechanism allows mobile users visiting abroad to leverage nearby MEC infrastructure for optimal MEC experience beyond their home networks. Without this mechanism, mobile users abroad will have to resort to MEC infrastructure located back in home country, significantly undermining the low-latency feature at the expense of user experience.

## Solution

Telefónica, KT Corporation and China Unicom collaborated to verify 5G Multi-access edge computing (MEC) technology for global roaming infrastructure and federation among different edge platforms. This scenario was successfully tested between KT and Telefonica. The platforms used have been based on Altran technology and China Unicom in house technology.

This groundwork for enterprises and private developers to be able to make inroads into domestic and global markets with a single service development that satisfies common standards.

**Edge Category:** Network

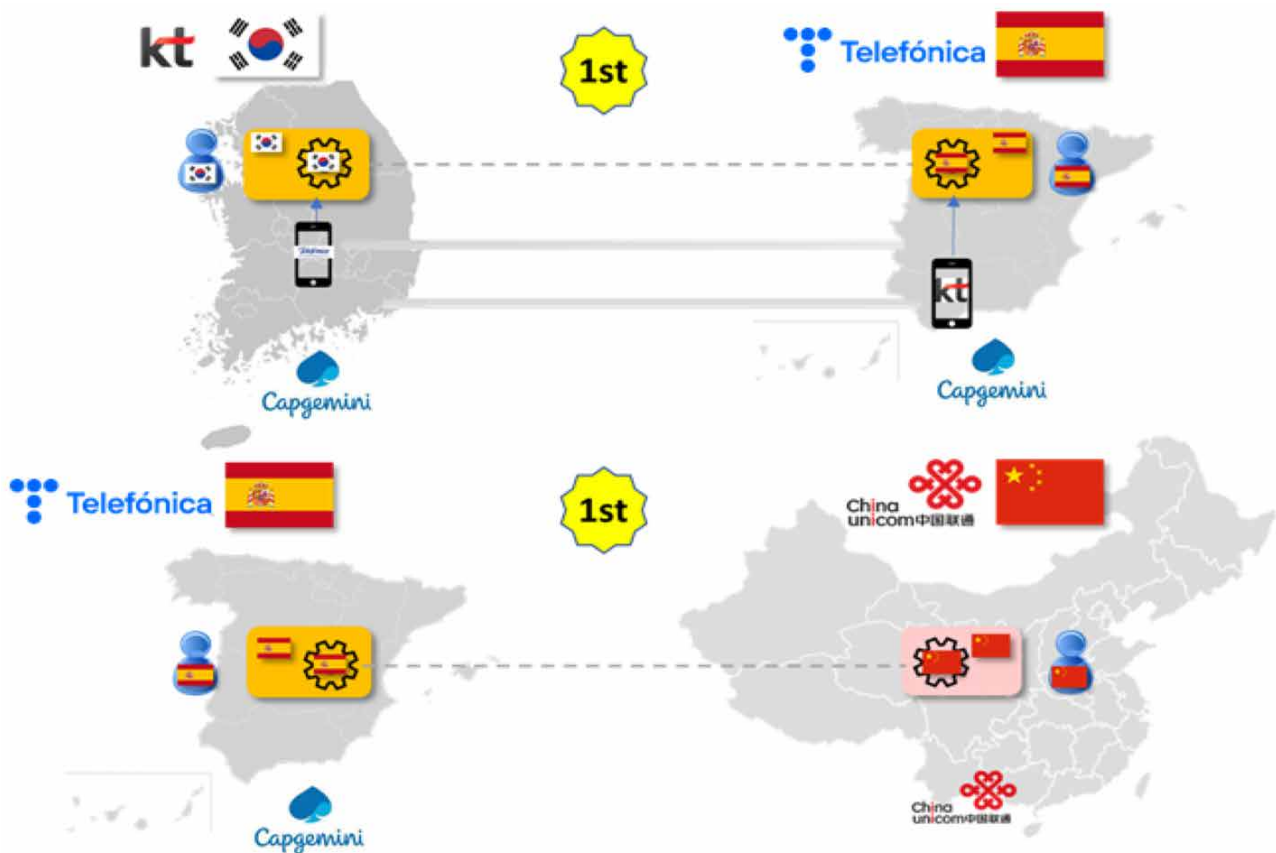
**Use Case:**

**Vertical:** Telecommunications

**Partners:** Telefonica, Telstra, KT, China Unicom, Capgemini

**Region:** Europe, Asia

**Date:** March 4, 2020, [Telefonica PR<sup>1</sup>](#)



<sup>1</sup> <https://www.telefonica.com/en/communication-room/telefonica-signs-an-agreement-with-kt-corp-china-unicom-and-telstra-to-collaborate-on-the-multi-operator-edge-computing-experience/>

# Unmanned Life: Drone Orchestration

## Problem

Unmanned Life needed the ability to launch a universal app across multiple telco edge cloud environments serviced by multiple mobile network operators. This app enables autonomous drone swarm managing using machine learning and image recognition for public safety. The TEC Trial demonstration featured an emergency response scenario where search and rescue drone are deployed as part of an integrated workforce.

## Solution

BT and Telefonica enable interconnected federation to provide multi-operator, multi-location quality of service for Unmanned Life drone swarm management application. This enabled Unmanned Life developers to launch one application across multiple telco edge cloud environments with multiple mobile network operators using MobileEdgeX.

**Edge Category:** Vehicle Control

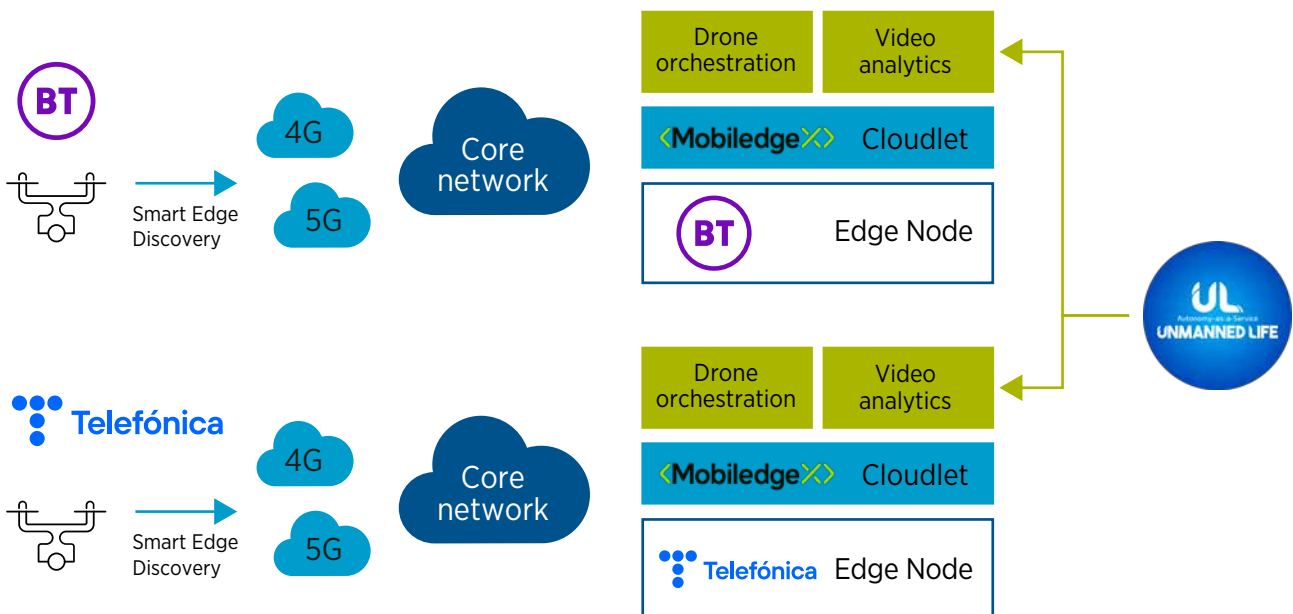
**Use Case:** Drone Swarm Management

**Vertical:** Government/Public Safety

**Partners:** Telefonica, BT, Unmanned Life, MobileEdgeX

**Region:** Europe (Spain, UK)

**Date:** April 6, 2021, [Press Release](#)<sup>2</sup>, [Demo Video](#), [MWC21 Session](#)<sup>3</sup>



<https://www.gsma.com/futurenetworks/resources/telefonica-and-bt-telco-edge-cloud/>

<sup>2</sup> <https://www.gsma.com/futurenetworks/resources/telefonica-and-bt-telco-edge-cloud/>

<sup>3</sup> <https://www.youtube.com/watch?v=dqVhnx2Cl6E&t=1043s>

# Continental: V2X Collision Warning

## Problem

Continental Smart Mobility solutions require reliable and predictable low latency to ensure safe and efficient operations on MEC infrastructure. Continental explored how to build a future-proof set up to support low latency requirements for smart mobility services.

## Solution

DT and Telefonica enabled end-to-end latency across distributed telco edge cloud computing resources interconnected via Quality of Service (QoS) optimized mobile operator networks. MobileEdgeX provided the independent operator platform to interconnect DT and Telefonica MEC QoS for a seamless Continental developer experience.

## Customer Success

"..[W]e are excited that we achieved in this trial a significantly better latency performance than we observed with any alternative setup." said Dr. Snigdhan Mahanta, Product Owner, Cloud Technologies and Solutions, Automotive Technologies, Continental Automotive.

**Edge Category:** Vehicle Control

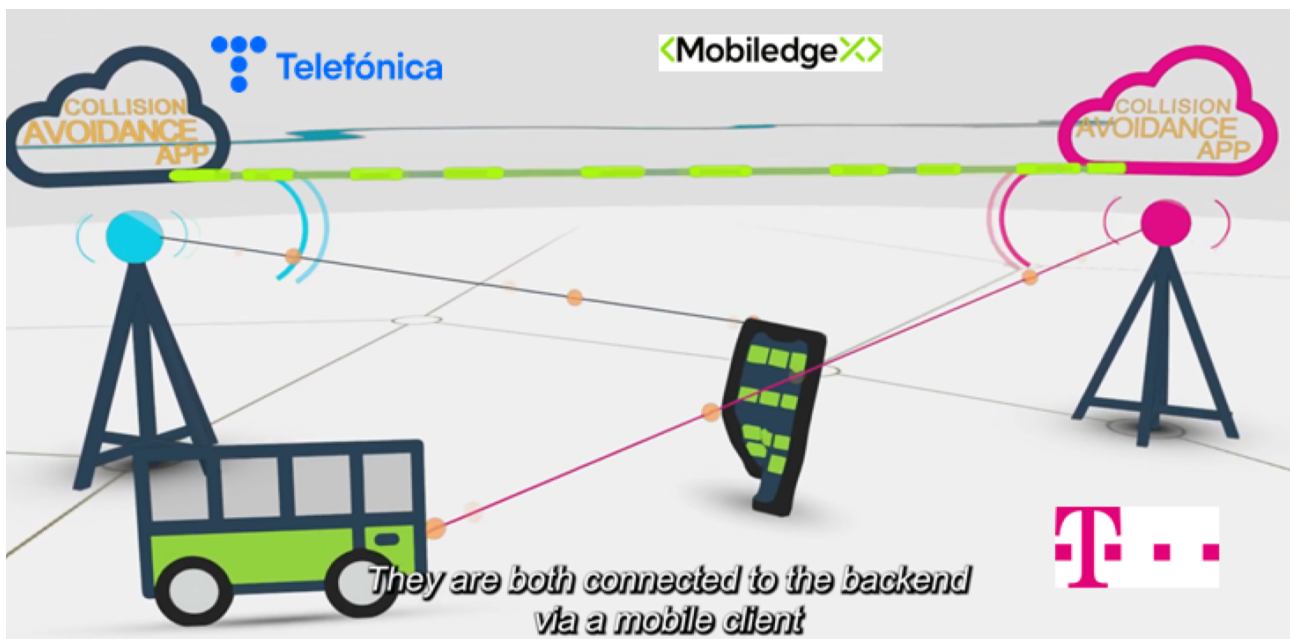
**Use Case:** V2X Collision Warning

**Vertical:** Transportation, Automotive

**Partners:** Telefonica, DT, Continental, MobileEdgeX

**Region:** Europe (Germany)

**Date:** Sept 9, 2021, [Press Release](#)<sup>4</sup>, [Demo Video](#)<sup>5</sup>



<sup>4</sup> <https://www.gsma.com/futurenetworks/resources/operators-and-mobiledgex-optimize-user-experience-for-continental/>

<sup>5</sup> <https://www.youtube.com/watch?v=SYCLpQuBX8>

# DoubleMe: Holographic Video Conferencing

## Problem

For this trial, DoubleMe integrated HoloPort, a holographic video conferencing software and World Engine, a real-time mapping system that tracks the location of mixed reality contents into the HoloVerse project. Both technologies require large-capacity and low-latency network infrastructure.

## Solution

European MNOs interconnected through MobileEdgeX to provide seamless edge discovery, low latency and reduction in jitter for enhanced TwinWorld metaverse experience. By working together, MNOs were able save on transport bandwidth and offloading graphic processing from the device to the network.

**Edge Category:** Immersive

**Use Case:** Holographic Video Conferencing

**Vertical:** Cross-Industry

**Partners:** Telefonica, Orange, TIM, DT, Double Me, MobileEdgeX

**Region:** Europe (Spain, Italy, France, Germany)

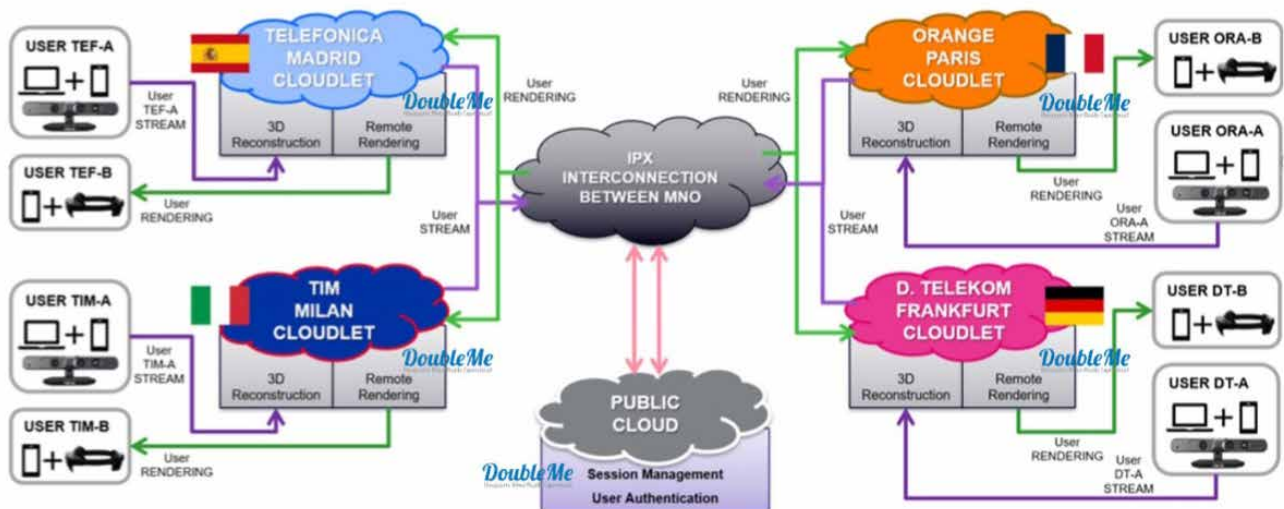
**Date:** June 20, 2021, [Press Release](#)<sup>6</sup>, [Double Me PR](#)<sup>7</sup>

## Customer Success

“Through this project, we plan to discover a variety of TwinWorld-based real-world metaverse services, such as education, tourism, and entertainment, and grow our vision on a global scale.” said Albert Kim, CEO, Double Me.



## Deployment Architecture over the TEC



<sup>6</sup> <https://www.gsma.com/newsroom/press-release/gsma-announces-details-of-innovative-edge-cloud-applications-and-dedicated-telco-edge-cloud-forum/>

<sup>7</sup> <https://currently.att.yahoo.com/att/real-world-metaverse-twinworld-selected-161500696.html>

# Sturfee & Mawari: Virtual Human Guide

## Problem

XR apps require close proximity to deliver the QoS and scale. User generated content is not synchronized and creates a poor user experience. Edge developers need an easy and consistent way of developing and deploying XR applications across global multiple operator MECs.

## Solution

Multi-MNO XR platform that brings together augmented reality (AR) application leveraging remote rendering system (Mawari) and visual positioning system (Sturfee) to run on common platform (MobileEdgeX) across multiple mobile operator telco edge cloud provided by KDDI and Deutsche Telekom. SDK is available for AR application on device.

This trial uses Mawari's cloud rendering for 3D hyper-realistic and rich interactive content and Sturfee's visual positioning service (VPS) for instant and precise localisation, both of which can be key enablers for fusion of Virtual and Real worlds as an important aspect of post-COVID 5G/MEC service. Part of these technologies has been implemented on AWS Wavelength as well.

**Edge Category:** Immersive

**Use Case:** Cloud Rendering and Visual Positioning Service (VPS)

**Vertical:** Media & Entertainment

**Partners:** KDDI, DT, Sturfee, Mawari, MobileEdgeX

**Region:** Germany, Japan

**Date:** June 29, 2021, [Press Release](#)<sup>8</sup>, [GSMA Press Release](#)<sup>9</sup> / October 26, 2021, [Press Release](#)<sup>10</sup>, [GSMA News](#)<sup>11</sup>

STURFEE

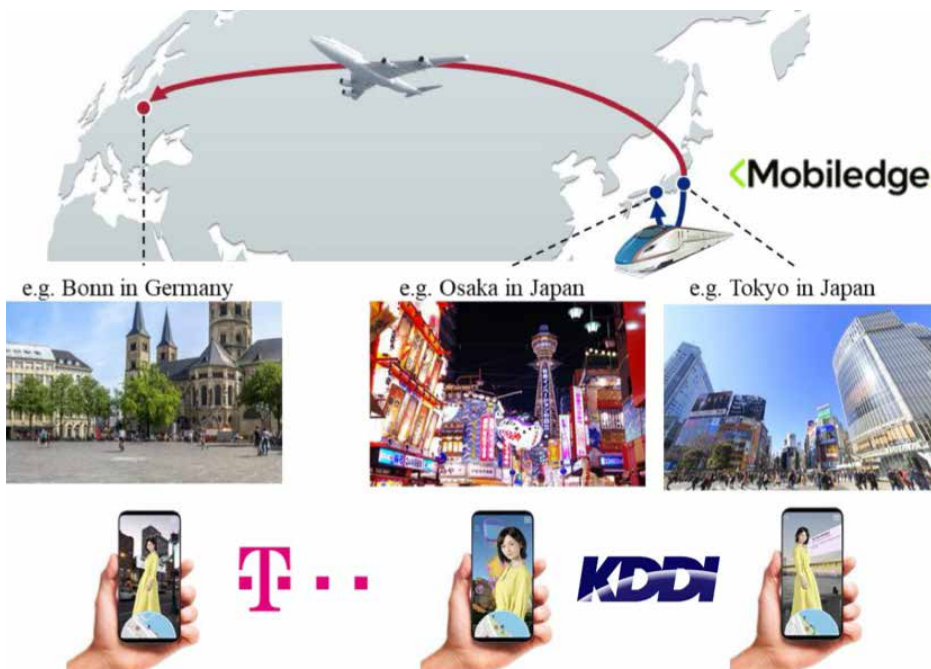
MAWARI

KDDI

Deutsche Telekom

MobileEdgeX

GSMA



Virtual Humans will guide you to destinations both in Japan and Germany

All images shown are for illustration purposes only.

<sup>8</sup> <https://news.kddi.com/kddi/corporate/english/newsrelease/2021/06/29/5213.html>

<sup>9</sup> <https://www.gsma.com/newsroom/press-release/gsma-announces-details-of-innovative-edge-cloud-applications-and-dedicated-telco-edge-cloud-forum/>

<sup>10</sup> <https://mobileedge.com/press-releases/2021/10/26/kddi-deutsche-telekom-mobileedge-x-sturfee-and-mawari-to-demonstrate-bloom-city-next-generation-ar-mobile-app-experience-in-alignment-with-gsma-foundry-telco-edge-cloud-tec-trials-initiative/>

<sup>11</sup> <https://www.gsma.com/futurenetworks/latest-news/kddi-dt-and-partners-next-generation-ar-mobile-app/>



# Multi-Platform Edge Federation

## Opportunity

Bridge Alliance, MobileEdgeX, Singtel and Telefonica achieved interconnection between two heterogenous multi-access edge computing (MEC) platforms. Allowing customers, developers, and partners to discover, and order cross-regional edge resources and deploy applications through a unified interface, ensuring a uniform application deployment experience across different networks and markets in these regions.

## Solution

Hub-to-hub interconnection between the Bridge Alliance Federated Edge Hub (FEH) and MobileEdgeX Edge-Cloud platform allows edge applications to be deployed across different edge platforms and regions served by each hub. Singtel's MEC is connected to FEH while Telefonica's MEC is enabled by MobileEdgeX's Edge-Cloud platform.

## Customer Success

Telefonica's user (edge application provider) was able to deploy and run a containerised edge application on Singtel MEC through the hub-to-hub interconnection and vice versa.

**Edge Category:** Network

**Use Case:** Multi-Operator Platform Interconnect

**Vertical:** Telecommunications

**Partners:** Telefonica, Singtel, Bridge Alliance, Singtel, MobileEdgeX

**Region:** Europe, Asia

**Date:** Feb 25, 2022, [Press Release](#)<sup>12</sup>

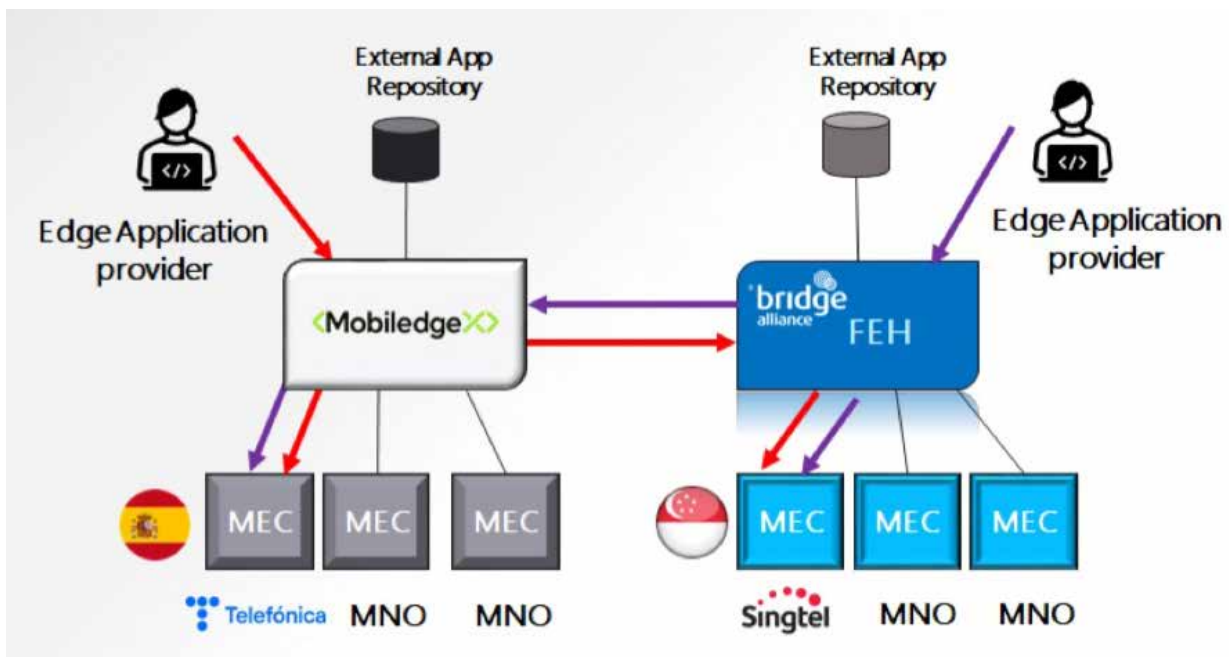


Image credit: Bridge Alliance

<sup>12</sup> <https://www.telefonica.com/en/communication-room/bridge-alliance-mobileedge-x-singtel-and-telefonica-achieve-world-first-interconnection-of-heterogenous-multi-access-edge-computing-mec-platforms-utilising-hub-to-hub-architecture/>

### **2.2.3 Activating the TEC Ecosystem**

Beyond the GSMA Foundry TEC Trials, the Telco Edge Cloud ecosystem has been actively testing and evaluating telco edge cloud worldwide. The ecosystem has been developing edge native solutions, including NaaS, to advance the community's innovation towards a global, federated service. Here are a few examples of their activities.

#### **Real-time data edge applications for Factories**

In China, mobile network operators have conducted telco edge trials across verticals, including manufacturing, multimedia and mobile health. Some of the use cases are described in the quarterly report to Networld Europe<sup>13</sup>. Among them, the Haier Smart Factory use case shows how a Telco Edge Cloud, together with 5G, can bring much value to the enterprises' edge applications, including machine vision, defect inspection and intelligent security.

The 5G deterministic network and edge computing technology have provided guaranteed low latency and service assurance fulfilling the high requirements of the manufacturing applications, and network slicing technology provided the required data security. By deploying 5G+MEC+AI solutions, the product quality is improved by 28%, and production efficiency is improved by 40%.

<sup>13</sup> <https://www.networldurope.eu/wp-content/uploads/2020/12/3-china-5g-vertical-use-cases-quarterly-report-q4-2020.pdf?x70854>

# Video Search

## Problem

Live video streams and archived video files process massive amounts of data to deliver real-time notifications using AI engines. In order to accomplish this at the edge, compute processing with physical Graphics Processing Unit (GPUs) handle the mathematical algorithms that filter videos based on the AI engine being utilized.

## Solution

Instead of deploying compute clusters at each site to support thousands of cameras, the Converged Edge Platform can be centrally located to run the MobicedgeX cloudlet and AICUDA application, which lowers the cost to the consumer using bandwidth thinning along with meeting the lower latency requirements for operating at the edge.

With MobicedgeX, Vaidio™ can off-load compute intensive activities to the telco edge cloud. MNOs are perfectly suited for real-time video analytics applications as the delay between computing the video streams and presenting the alerts to the user is minimized. There is also a growing demand to integrate Vaidio™ AI-powered analytics in mobile edge devices like body worn cameras and drones. With extreme high bandwidths, low latency and assured high speed mobile connectivity MNOs worldwide can deliver what Vaidio™ customers are looking for.

**Edge Category:** Read-Time Data

**Use Case:** Video Search

**Vertical:** All

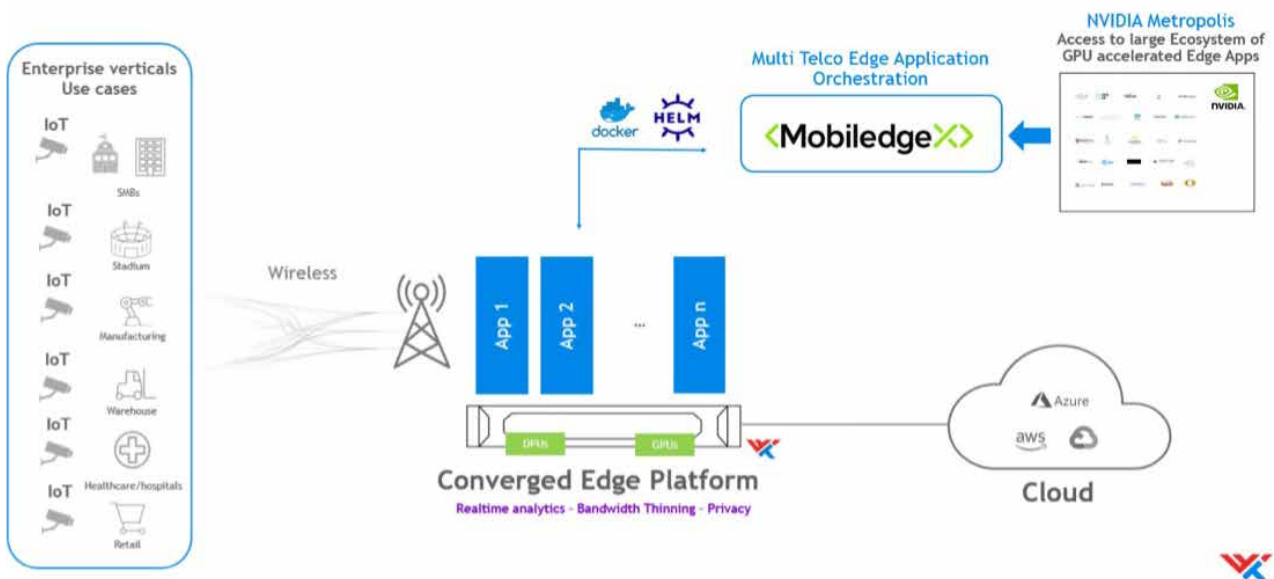
**Partners:** AICUDA, MobicedgeX, WWT, NVIDIA

**Region:** US, Germany

**Date:** Oct 28, 2021, [WWT Spotlight](#)<sup>14</sup>, [Aicuda Partner Page](#)<sup>15</sup>



## Enabling Telco Edge Applications



<sup>14</sup> <https://www.wwt.com/article/aicuda-voidio-converged-edge-platform-isv-spotlight>

<sup>15</sup> <https://aicuda.world/2021/04/12/real-world-edge/>

### **Network As a Service (NaaS) for bandwidth control**

Singtel has run a field trial around surveillance drones. These drones send SD (standard definition) video to a central control centre. When a human operator at the central control centre observes a specific event or anomaly in the video sent by one of the drones, the operator may need a more detailed view with a higher resolution. With one click, the operator requests the drone to send HD (high definition) video to the control centre to immediately see in greater detail the thing the operator wishes to inspect.

From a network connectivity point of view, all drones, during regular operation, are sending video in standard definition resolution to optimise the mobile data bandwidth usage. However, the drone application allows the user to switch to high-definition resolution in real-time via a NaaS (Network-as-a-Service) API, which enables to change device connectivity characteristics such as data bandwidth, as in this case, or the Quality of Service (QoS) literally on the fly.

# 5G User Plane Function

## Problem

Since the introduction of mobile packet data in 3G, all data traffic, irrespective of source, destination, and requesting application, has been tunneled back to a limited number of fixed (packet gateway) anchor points inside the mobile networks. This is increasingly inefficient, non-performant, and prone to bottlenecks.

## Solution

DT, Maviner and MobileEdgeX demonstrated and validated the reference design for deploying cloud-native 5G User Plane Function (UPF) to support Multi-Access Edge Computing (MEC) applications, tailored to each use case need for proximity and performance. The reference design is fully cloud-native, abstracted away from underlying cloud architecture, infrastructure vendor and operating owner.

## Scenario: Video Application Traffic

A video application is initiated on a 5G phone in Location A. This request is sent to a 5G core that selects UPF placement in Location A. Tunneling between the two is established. The video request is then passed to the local edge content delivery network for delivery. An identical request is made in Location B. Traffic is then established to Location B and local fulfillment occurs. The MNO dynamically controls traffic including secure placement, lifecycle management and traffic routing of the UPF and video application at the telco edge.

**Edge Category:** Network

**Use Case:** 5G User Plane Function

**Vertical:** Telecommunications

**Partners:** DT, MobileEdgeX, Mavener

**Region:** Germany, USA

**Date:** June 22, 2021, [Mavener PR](#)<sup>16</sup>



<sup>16</sup> <https://www.fiercewireless.com/tech/mobilegedex-mavener-collaborate-5g-edge-deutsche-telekom>

### 2.3 Telco Edge Cloud Footprint (February 2022)

The GSMA's Operator Platform group and TEC Forum have strong participation from the industry, including more than 40 mobile network operators and 30 technology partners. It is a good representation of the global ecosystem, including most markets where 5G is already launched or about to become commercial.

**Figure 5: Markets with operators in OPG/TEC as of February 2022 (Source: GSMA, Ecosystem)**



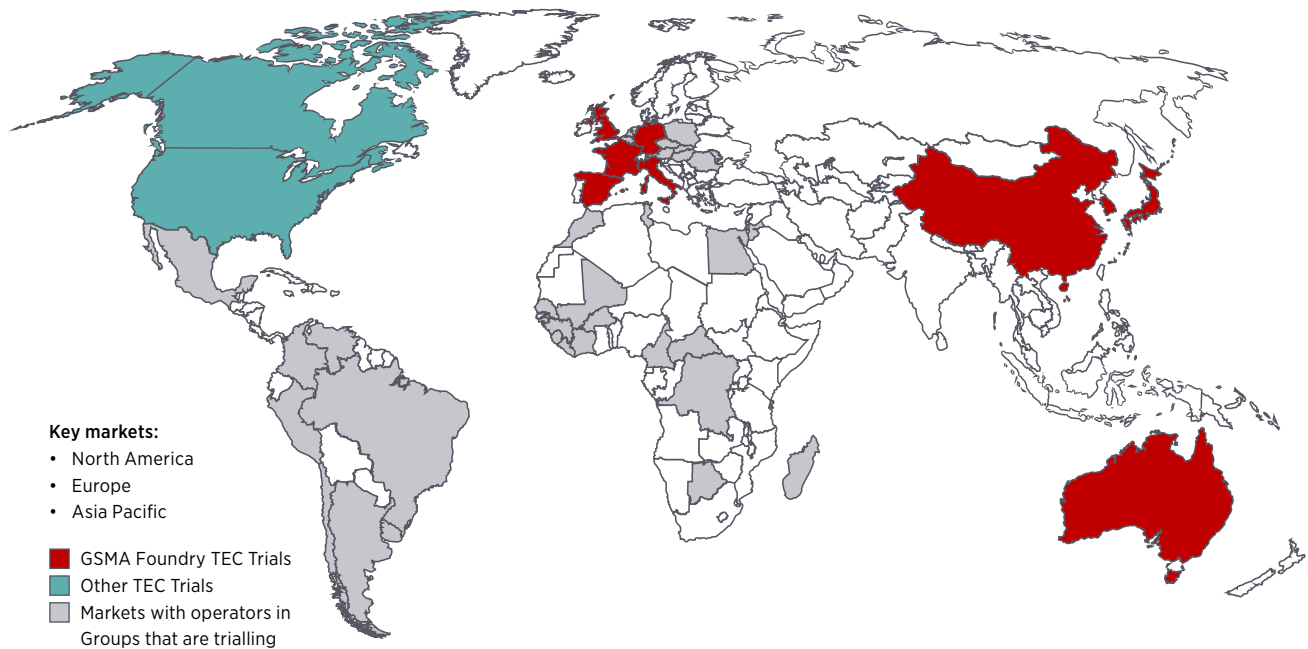
## 33% 45 out of 136 5G MNOs

One third of all MNOs who have launched 5G today participates in the Telco Edge Cloud development and commercialization efforts at GSMA; i.e. in OPG and/or TEC.

**This shows a high potential for OPG/TEC development, with:**

- Asia and North America representing the largest 5G subscriber base that would be telco edge cloud ready
- Europe leading the way on global federation across markets and number of market participants

**Figure 6: Telco Edge Cloud trials as of February 2022 (Source: GSMA, Ecosystem)**



## 11 MNOs active in OPG/TEC trials

- To date, 11 MNOs have participated in multi-operator trials as part of the GSMA TEC Trials initiative, demonstrating the value of the telco edge cloud, with particular intensity in Europe and Asia-Pacific. Some other trials and demonstrations from operators that are part of the TEC Ecosystem were documented<sup>17</sup>.
- Counting all edge trials (inside and outside the GSMA TEC Trials initiative) around a third of the operators participating at OPG/TEC have demonstrated telco edge services and/or federation across multiple operators, countries and regions within the last 24 months.

<sup>17</sup> GSMA Thrive Asia Pacific Nov 2020: <https://www.gsma.com/futurenetworks/resources/thrive-apac-5g-live-catch-up/> and GSMA Thrive North America Oct 2020: <https://www.gsma.com/futurenetworks/resources/thrive-na-5g-live-operator-platform-catch-up/>

# 3. Benefits for Stakeholders

TEC serves three main stakeholders, defined as follows:

This section describes the benefits of Telco Edge Cloud for the different stakeholders. TEC serves three main stakeholders, defined as follows:

- Tenants: customers and partners (developers, solution providers, system integrators, ISVs and enterprises) developing or offering their applications or services on the TEC platform,
- Mobile Network Operators (MNOs) seeking new ways to monetise their edge infrastructure and network capabilities which form the TEC platform that hosts the customers' services, and
- End-Users consuming the applications and services hosted in TEC (connected cars, online gamers, etc.)

Other types of stakeholders may emerge as the market evolves, like the Federation Brokers who facilitates MNOs the interconnection/federation to the global TEC network, or Aggregators who may support MNOs in the orchestration and commercialisation of their edge and NaaS capabilities.

The TEC platform provides an efficient and developer-friendly way for customers to host and execute their applications or services globally in closer proximity to their end-users than is possible with today's centralised cloud services. The improved Quality of Experience (QoE) enables TEC Customers to innovate and enrich their service offering on new or evolved consumer and enterprise devices.

The Telco Edge Cloud allows their customers to reach their end-users in each market and across different networks. TEC connects multiple customers and MNOs, offering customers a simple unified interface that gives them access to an extensive network of national and global edge and network resources enabled by open and standard federation mechanisms without the need to deal directly with each MNO.

MNOs and existing cloud players, developers, system integrators, and aggregators can utilise TEC to provide their edge computing and NaaS services, utilising their known and trusted Cloud-based interfaces and APIs with additions for the enhanced mobile capabilities.

## **Managing the value chain**

The TEC platform ensures fairness and transparency in the value chain and commercial relationships to ensure all participants provide the agreed service and receive appropriate payment. The main features:

- Facilitate and accelerate the deployment of Edge and NaaS services worldwide.
- Manage the entire value chain from Enterprise/ Developer to End-Users.
- Manage settlement conditions and payment terms.
- Provide a fast route to a large market through a fully automated platform.

The platform is designed to simplify onboarding and distribution by digitalising the management, tracking, deployment, and federation of domestic and international edge computing resources. Customers will have seamless access to the Telco Edge Cloud platform's compute and network resources via a common interface - whether through an Operator, Cloud provider, System Integrator or Aggregation Platform partner.



### 3.1 Enterprise customers

The TEC platform helps enterprise TEC Customers in the following ways:

**1. Device Augmentation.** By offloading features and functionality to the edge:

- a. Customers can use simpler and cheaper devices (less demanding in power, memory and central processing unit requirements) to deliver sophisticated services.
- b. End-Users' experience improves as devices extend their battery life due to a good part of the processing being taken to the edge. This can significantly reduce the cost of consumer equipment.
- c. Consequently, additional functionality can be added without needing to extend processing or storage capacity in the device, extending its lifetime and postponing the moment when the End-User needs to replace his device, either smartphones or IoT.
- d. Finally, smaller form factors will be made possible, enabling a new age of devices, like AR glasses or next generations of connected things.

**2. Network Intelligence.** The Network monitors and manages information that is relevant for optimising the edge computing service like:

- a. user location and identity; leveraging network and device data unique to the operator (e.g, IMSI, IMEI, SNR Data),
- b. network capacity, performance and external events; leveraging the networks ability to monitor and predict traffic and Consumer usage.

The application can leverage the network intelligence to adapt to the conditions for optimum performance.

**3. Network Control.** TEC can control specific network parameters like jitter or peak latency, increasing efficiency and performance adaptability.

By having computing and storage inside the fixed and mobile access networks and close to the Consumer, TEC constantly monitors, manages and optimises the end-to-end latency and other parameters and may dynamically and efficiently select the right node to serve the End-User at each point in time. Either QoE, Latency, or a combination of both can determine load location.

The upstream traffic (data created by the End-User) can be distributed directly to other nodes via peering back-ends, avoiding bottlenecks at backbone or internet networks.

**4. End-to-end Security and Privacy.** Data stays within the trusted network and computing environment, avoiding the open Internet where the users are much more vulnerable/ susceptible to security and privacy breaches. Bundling wireless network security with the applications deployed within the network (Telco Edge) by design will bring unprecedented security levels, leveraging existing standards and initiatives like usage of SUCI in 5G, which conceals user identifiable data like IMSI from advanced threats. This approach provides multiple layers of protection covering various domains like user, access, application, etc.

**5. Flexibility.** Edge deployment allows deploying applications very close to major enterprises and factories, enabling the very low latency and highly available computing they need to control their business assets. This provides agility, flexibility, and scalability in deploying and distributing IT applications to their need.

### The voice of the customer

**Haier** is a global manufacturer of home and medical appliances using applications at the edge for error prevention, inspections, data collection, video surveillance, AR/VR assistance. Haier uses the edge to reduce resource waste and deployment costs, implement centralised management, reduce the volume of transmitted data, enable real-time analysis and operations and protect sensitive data.

*“The value of the Telco Edge Cloud includes realising the centralised management of traditionally distributed deployed control applications, enabling real-time analysis and operations, and keeping sensitive data in the local site. The overall network performance is important for the business, and among them, latency and bandwidth may have higher requirements”.*

**SAP** is a multinational software company focused on designing business management systems, applications and products. One of their products, the SAP IoT solution, helps users reimagine business processes and models with embedded IoT services and data. SAP IoT Edge extends business processes to the edge and provides distributed computing and storage capacity. SAP IoT Edge provides secure connectivity for industrial equipment to ingest industrial IoT data. Once ingested, the data can be persisted and processed by the Edge.

*“The value of the edge is to be close to the factory to ensure, depending on the use case, data sovereignty, low-latency and low jitter that can be crucial or a nice to have. APIs to control the network are mostly needed on-site for the private network.”*

**ABB** is a leading global technology company specialised in robotics, electricity generation, automation, industrial equipment and other engineering technologies. ABB Robotics is a pioneer in robotics, machine automation and digital services. ABB Robotics provides innovative solutions for a diverse range of industries, from automotive to electronics to logistics. In this context, warehousing and logistics seem to be good candidates for 5G and Edge use cases in the shorter term, with AGVs being the first robots that may benefit from wireless connectivity and Edge to run fleet management and control applications.

*“The convergence of OT/IT/NT provides the chance to access and process data fast and in high volumes, enabling the improvement of the manufacturing processes in real-time at the factory. 5G (NT) provides fast access to high volumes of data, and Edge (IT) provides the capability to process high volumes close to the source.”*

### 3.2 Application Developers and Solution Providers

For application developers, TEC brings additional benefits:

- 1. Partnering & Ecosystem.** Optimising R&D spent in a community that facilitates the shared development of both scale and niche solutions. Specialised edge application developers and technologies are available at the Telco Edge Cloud community, providing a rich playground for innovation in edge-based solutions.
- 2. End-users’ Reach:** the wide coverage of the Telco Edge Cloud allows both the export of solutions developed in smaller markets to a worldwide footprint and the adaptation of global solutions to specific local markets. The global coverage allows developers a faster return on their investment effort.
- 3.** Telco Edge provides a **seamless experience** both in terms of end-to-end service and app run time.

### The voice of the customer

**GenyMobile** started with a widely adopted Android emulator, Genymotion, which has evolved into a full-fledged Android platform, available across multiple channels both in the cloud and on the desktop. GenyMotion’s “mobile in the cloud” service runs customer applications (e.g., native Android apps) and serves them from regional data centres. Deploying at the edge provides a faster response to mobile and has the potential to be coupled with GPU resources to run more complex applications (e.g., high-resolution imaging) without overutilisation of the mobile CPU and battery.

*“Essentially, a completely virtualised phone can use fewer mobile resources (memory, CPU, battery). Security is improved as data does not need to reside on the mobile device but rather in a secure cloud/edge environment. Our prioritisation of network APIs that provide information and control over network quality and performance are (1) network load, (2) number of devices connected, (3) network congestion/packet loss and (4) connection/bitrate.”*

**Proxy42** is a company that develops a new generation of games based on Artificial Intelligence and Augmented Reality, building a bridge between the physical and digital world and making it universally accessible & actionable.

*“Low latency and jitter are crucial for interactive AR and gaming. In addition, network information to support the gaming use case, such as connectivity and location, is very helpful for optimisation and fraud prevention.”*

**Tencent** is a world-leading internet, entertainment and technology company that develops innovative products and services to improve the quality of life of people around the world. Tencent’s communication and social services connect more than one billion people around the world. It publishes some of the world’s most popular video games and other high-quality digital content, enriching interactive entertainment experiences for people around the globe. It also offers a range of services, such as cloud computing, advertising, FinTech, and other enterprise services to support their clients’ digital transformation and business growth.

*“Using edge compute for live streaming, cloud gaming and industrial site application areas, the key benefit is to reduce network latency and cost, where edge compute shows significant improvement. Latency, jitter and guaranteed bandwidth are essential to their business”.*

### 3.3 End-Users

TEC brings significant benefits for end-users:

1. End-Users enjoy services with **less reliance on hardware**. For them, the infrastructure and technology platform should be transparent.
2. End-Users enjoy **new and more intelligent services** both over their current devices, without degrading their battery duration, and the next generation of smart devices that can be lighter and more powerful, as they rely on a good part of the processing done in the network.
3. Applications are provided from the MNO’s Network Edge, avoiding the public Internet and offering **greater security, fraud prevention and privacy** through the trusted operator mechanisms: SIM, device, network and user data.
4. The edge application “follows” the End-User as they move, ensuring a consistent **service experience while moving** even in a visited network (roaming).
5. The TEC user can enjoy the edge services over an extensive footprint that replicates today’s global mobile network. This means that if the user moves beyond his home network, they will still have the same service experience.
6. Connected vehicle owners will improve their service **experience in border areas** thanks to TEC’s federation, mobility and roaming management capabilities.

### 3.4 MNOs and Service Providers

TEC serves as a marketplace for MNOs to expose and monetise their Edge capacity and advanced network services to TEC customers and partners and ultimately make it available to their end-users. The TEC platform has several advantages for operators:

- 1. Global Scale.** Hyperlocal infrastructure is available globally for sales through multiple partners via an open, standard, and simple interface. It offers the operator better commercial conditions, being able to sell services via fewer intermediaries. This should allow to better monetise edge capabilities directly and by improving operators' competitive position. It allows the operator to increase scale for brand and partnerships. TEC is attractive both as a global brand and as a global partner.
- 2. Control over traffic loads.** Integration of the infrastructure and the network allows to steer traffics as required to optimise the entire network, compared to the typical case in external Content Delivery Networks (CDN) and cloud deployments, which are "black-box" from a traffic perspective.
- 3. Improve network infrastructure scale.** Allows mutualising infrastructure for Network Function Virtualization (VNFs/CNFs) and third-party usage reaching greater scale and lower costs for both uses.
- 4. Innovative development and product evolution.** The Telco Edge Cloud supports open-source software development, providing stability in R&D, enabling spaces for innovation, and ensuring product evolution. The developer community is supported by Tier1 operators and edge cloud technology providers worldwide. It allows operators to mutualise the solution identification and development and open source the edge technology stacks.

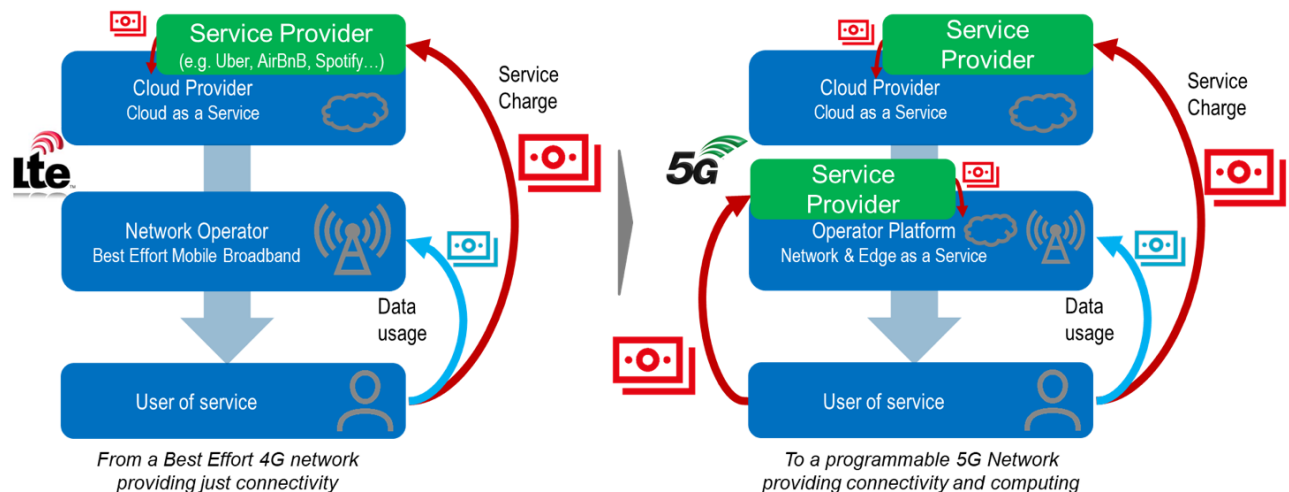
- 5. Open and Standard Edge Cloud** that leverages network capabilities, compared to closed proprietary clouds. This cloud allows monetising capabilities like localisation, identity and access management, security and privacy, network monitoring, performance and capacity management, and extracting value from traditional telco mechanisms (e.g. IMSI, IMEI, SNR data have a commercial value). Operators in TEC are encouraged to participate in the design, development and evolution of standards, open-source components and resulting edge cloud technology.

#### The voice of the customer

**Broadpeak** designs and manufactures video delivery components for Content Providers and Network Service Providers deploying IPTV, Cable, Satellite, OTT and mobile services. The primary motivation for using the Edge is network offload and reliability of the video delivery, which directly impacts network costs and end-user quality of experience (QoE).

*"Moving CDN capacity to the edge makes it easier to limit congestion, which is expected to significantly increase with the migration of legacy broadcast technologies towards streaming. There is no sophisticated processing at the edge with basic CDN functions, but the integration with the mobile network (e.g., using RAN APIs) and the addition of AI/ML engines in the cache server to enhance the streaming efficiency are changing the game."*

**Figure 7. TEC offers MNOs the opportunity to monetise their 5G and Edge capabilities using a platform model.**



# 4. Roadmap - Vision for the Future

## Vision for the Future: The Telco Edge Cloud Agenda

Our vision at the TEC Forum is a global, federated and competitive Telco Edge Cloud to enable access to compute and network infrastructure and services to Customers and End-users worldwide. Underlying this vision is the development and deployment of the Operator Platform concept to enable a global federation of edge computing and NaaS services across MNOs worldwide. This platform concept will provide TEC Customers access to the telco edge cloud for new, innovative, distributed, and low latency services via common and open APIs and network interfaces.

To bring this vision to reality within the first year of the TEC Forum, members have demonstrated multiplatform federation, low latency and high bandwidth edge native services for transportation, gaming, and government customers.

Moving forward, the TEC Members will continue to work together to launch a global test and validation program for Telco Edge Cloud, refer and collaborate on Open APIs for edge service commercialisation and on global interconnect, retail, and wholesale service terms to enable a seamless service delivery across any mobile network. The TEC Forum will intensify its contacts with potential Customers and Industry Associations to continue capturing requirements, transfer them as input for the technical work developed by the GSMA Operator Platform group and the associated standardisation bodies and communities, and keep on offering them opportunities for testing and trial the TEC services and solutions.

# Telco Edge Cloud Roadmap to Commercialisation

## 2022 – Operator Platform and Network Service Test and Validation

- Complete product requirements document for the Operator Platform
- Complete Operator Platform network interface definition for Customer-facing, End-user-facing and Federation APIs
- Prioritise and refer Customer-facing service and End-user-facing APIs for open reference documentation with the developer community within the Linux Foundation
- Launch first Customer-facing service API for public beta (e.g., Edge application deployment, Quality on Demand)
- Launch TEC Labs to enable open testing and validation of the Operator Platform, including multi-operator federation and network service APIs.
- Complete pre-commercial terms for telco edge computing and network service APIs



2022

## 2023 – Operator Platform Interconnection and Edge Service Traction

- Complete open reference documentation for Federation, Resource-facing and BSS-facing (charging-oriented) APIs with the developer community within the Linux Foundation
- Formal commercial terms development within GSMA Wholesale Agreements and Solutions (WAS) Group
- Formal cross-carrier interconnections
- Launch pre-commercial terms for interconnectivity and network services
- First customer assessment of Telco Edge Cloud infrastructure and network service APIs
- Launch global marketing campaign on the value of Telco Edge Cloud

2023

## 2024 – Full-Service Telco Edge Cloud Commercialization

- Launch universal agreements for interconnection, wholesale, and retail services.

2024

# 5. Join Us / Get involved

For discussions and collaborations around TEC and associated services (IaaS, PaaS, CaaS, NaaS), please contact [TEC@gsma.com](mailto:TEC@gsma.com).

For more information visit our website [www.gsma.com/futurenetworks/operator-platform-hp/](http://www.gsma.com/futurenetworks/operator-platform-hp/)



# 6. Conclusions

As a result of the combined effort with the GSMA Operator Platform Group and other industry bodies, the Telco Edge Cloud Forum has taken significant steps in the last two years towards demonstrating the feasibility and value of a platform proposition that offers a wide range of potential customers and partners access to MNO's worldwide compute and network capabilities through open, standard and easy-to-use interfaces, developed in the main bodies of the telco and cloud industries.

The execution of a sequence of multi-operator trials showing the support of edge-native applications in different categories (real-time data, immersive, vehicle control and network) have shown the differential value of TEC and sets the path for the next steps, with plans for creating TEC Labs, a global network of interconnected operator platform-based edge computing systems to be used as a permanent testbed for edge-native applications, and initiating the definition of commercial terms for the TEC ecosystem.

Finally, our interaction in several surveys and interviews with different stakeholders, enterprise customers, service providers, application developers and operators have given us clear feedback that the value proposition of TEC meets the needs and expectations of the next generation of 5G and edge services; and applications that will provide support to the digital transformation of our economy, industry and society. Parameters like latency, jitter, bandwidth, privacy, security, mobility and global reach appeared quite often in this interaction, confirming the interest of the market in a proposition like the one TEC brings.

# References

<b>Title</b>	<b>Link</b>
Operator Platform Concept Whitepaper (Feb 2020)	<a href="https://www.gsma.com/futurenetworks/resources/operator-platform-concept-whitepaper/">https://www.gsma.com/futurenetworks/resources/operator-platform-concept-whitepaper/</a>
Operator Platform Telco Edge Proposal (October 2020)	<a href="https://www.gsma.com/futurenetworks/resources/op-telco-edge-proposal-whitepaper/">https://www.gsma.com/futurenetworks/resources/op-telco-edge-proposal-whitepaper/</a>
Telco Edge Cloud: Edge Service Description & Commercial Principles (October 2020)	<a href="https://www.gsma.com/futurenetworks/resources/telco-edge-cloud-october-2020-download/">https://www.gsma.com/futurenetworks/resources/telco-edge-cloud-october-2020-download/</a>
Operator Platform Evolution: Use Cases and Concepts (OPG 1.0) (February 2021)	<a href="https://www.gsma.com/futurenetworks/resources/op-evolution-use-cases-and-concepts/">https://www.gsma.com/futurenetworks/resources/op-evolution-use-cases-and-concepts/</a>
Operator Platform: Telco Edge Requirements (OPG 2.0) (June 2021)	<a href="https://www.gsma.com/futurenetworks/resources/gsma-operator-platform-telco-edge-requirements-2021/">https://www.gsma.com/futurenetworks/resources/gsma-operator-platform-telco-edge-requirements-2021/</a>

# Definitions and abbreviations

The following definitions and abbreviations have been used in this document.

## Definitions

Term	Definition
Cloud Computing	Cloud computing is the on-demand availability of computer system resources, mainly storage and computing capabilities, without direct active management by the user. Cloud computing is delivered by a set of networked elements located in multiple data centres available to many users over the Internet. The elements are not individually addressed or managed by the users. Instead, the provider manages the entire suite of hardware and software that is presented to the user as an amorphous cloud, as a set of abstract or virtual computing capabilities.
Edge Computing	Cloud computing provided from locations closer to the end-user and optimally integrated with the network so as to provide specific service characteristics like low latency, low jitter, guaranteed bandwidth, etc, while ensuring transport efficiency and security.
TEC Customer	A company that uses the TEC to deploy edge applications in locations that are closer to the End-Users than the traditional public cloud data centres. This includes application developers, solution providers, system integrators, ISVs and enterprise customers.
Edge Node	In this document, it is referring to a point of presence in an Edge Cloud that hosts computing, storage and networking resources that are used to host Customers' applications and data.
TEC Service Provider	A company providing commercial edge cloud computing services (potentially IaaS, CaaS, PaaS, SaaS, NaaS and a marketplace) to market, aggregating multiple operator edge and network capabilities and exposing them to its customers via a TEC platform.
TEC End-User	Person, object or device, that uses an application or capability that is provided from the Telco Edge Cloud.
Federation	Agreement among several operators and service providers to cooperate so as to offer Customers a cohesive edge compute service across their combined footprint. It refers also to the mechanisms to implement such cooperation.
Operator	A provider of fixed and/or wireless communications services that may include licence, ownership and operation of network infrastructure and associated systems and services, and radio spectrum allocation.

## Definitions

<b>Term</b>	<b>Definition</b>
Operator Platform	Platform that facilitates access to the Edge Cloud and Network capabilities of an Operator or federation of Operators by using a set of open and standard APIs. NOTE: See the document in the “References” section for more details on the Operator Platform.
Service Providers	A company that provides solution development, system integration, IT, or technology operations services. Such companies include application providers, Operator enterprise business units and Hyperscalers.
Software Defined Storage	Software for policy-based provisioning and management of data storage independent of the underlying hardware. SDS implements storage virtualisation to separate the storage hardware from the software that manages it.
TEC Federation Hub	TEC component that implements the Federation Broker role defined by [OPG.01]
Telco Edge Cloud	A type of the Operator Platform that exposes Edge Cloud capabilities (Naas, IaaS, and PaaS) to Customers and Service Providers.

## Abbreviations

<b>Term</b>	<b>Definition</b>
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
CaaS	Container as a Service
CDN	Content Delivery Network
CNF	Cloud Native Functions
CNF	Containerized Network Function
CPU	Central Processing Unit
C-V2X	Cellular-based vehicular communication
GDPR	General Data Protection Regulation
GPU	Graphics Processing Unit
IaaS	Infrastructure as a Service, as defined in ITU-T Y.3500
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IoT	Internet of Things
ISV	Independent Software Vendor
IT	Information Technology
KPI	Key Performance Indicator
MEC	Multi-Access Edge Computing
ML	Machine Learning
MNO	Mobile Network Operator
NaaS	Network as a Service, as defined in ITU-T Y.3500
NFVs	Network Function Virtualisation
NPU	Network Processing Unit

## Abbreviations

<b>Term</b>	<b>Definition</b>
NT	Network Technology
OPG	Operator Platform Group
OT	Operational Technology
PaaS	Platform as a Service, as defined in ITU-T Y.3500
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
SaaS	Software as a Service, as defined in ITU-T Y.3500
SDK	Software Development Kit
SLA	Service-Level Agreement
SNR	Signal to Noise Ratio
SUCI	Subscription Concealed Identifier
TEC	Telco Edge Cloud
UPF	User Plane Function
VIM	Virtual Infrastructure Manager
VNF	Virtual Network Function
VR	Virtual Reality
V2X	Vehicle-to-Everything, vehicular communications
XR	EXtended Reality





Find out more at  
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