Capgemini

IS IT POSSIBLE TO OUTGROW **THE CLOUD?**

MULTI-ACCESS EDGE COMPUTING (MEC) WILL ACCELERATE TRANSFORMATIVE USE CASES

Cloud computing made accessing data from anywhere at any time a reality for both businesses and consumers. In fact, many believed the concept of having centralized data centers run applications for an infinite number of distant users would be the pinnacle of digital transformation for decades to come. However, as with all technologies, the cloud is constantly evolving to address changing needs.

It's no secret that IoT, ML, and AI lead almost every innovation project's technology lineup these days. The computing demands these technologies require are pushing cloud capabilities to the edge of their performance peak. Fortunately, this edge is not the end but an exciting beginning for what's possible when cloud is extended to be closer to users and data. This type of proximity to end devices is known as edge computing.

THE ANSWER TO EXPONENTIAL CONSUMPTION OF CONNECTIVITY AND INTELLIGENCE

According to leading analysts, the global edge computing market will reach $150 billion by 2030, with a CAGR of around 25–30%. So, what's driving this rapid adoption of a decades-old technology, and why now?

Despite edge computing being around since the late 1990s – or earlier by some estimates – its popularity hasn't really taken off. Businesses were hesitant to embrace the technology mainly because a) there wasn't a need for it and b) they liked the convenience of not administering multiple distributed data centers. For example, with cloud, an organization can manage everything in one location. But there's one big drawback to this: the cloud is too far from where most data is generated.

With the proliferation of IoT devices, smart security cameras, smartphones, AR/VR glasses, drones, and other technologies, there's now more data consumed and generated than ever before, which means it must be processed much faster to ease data congestion and improve application performance. For example, a user playing a VR game will have a smoother and more immersive experience if there's a stable connection with high bandwidth and super low latency. So, how can we prevent uncomfortable lag? Bring compute resources and applications closer to end-user devices.

Innovative use cases involving predictive maintenance, smart factories, digital twins, autonomous vehicles, intelligent transport, security, and gaming are the main reasons why many organizations are revisiting the edge computing paradigm. Specifically, they're focused on four core edge computing attributes, which will also be significant enablers:

1. **Low latency.** With the roll-out of modern 5G technology, edge computing provides ultra-low latency and high-bandwidth networks, allowing for real-time data processing. This makes edge computing an essential tool for applications that require immediate responses.

2. **Localization.** Since edge computing provides the ability to process data locally, it's vital in industries where data privacy concerns exist such as healthcare or in scenarios where it's necessary to bring computing services closer to where data is generated, such as in a smart factory. This localization of data processing helps to ensure that sensitive information remains secure and is not transmitted over long distances.

3. **Backhaul savings.** By processing as much data as possible and as close to where the data originates, organizations can reduce the cost of transferring data to central data centers. This makes edge computing an economically sound solution for businesses looking to optimize their data processing and analysis.

4. **Compute offloading.** Moving data processing from devices with limited resources to more powerful devices or servers can help save battery life and improve performance. It can also lead to lower overall costs if multiple workloads are consolidated.

Additionally, by reducing the need for external systems and minimizing energy consumption from data transmission, organizations will see results in increased reliability, resiliency, and sustainability.

CHALLENGES TO EDGE COMPUTING AT SCALE

Running and maintaining a few independent compute servers is relatively easy to do. The real challenge comes in scaling the intelligent edge: strategically deploying hundreds or even thousands of edge sites and keeping their serviceability to a minimum.

The key to making edge computing work at scale is multi-access edge computing (MEC), which is the integration of edge computing resources into a network. But this comes with a host of application- and platform-related challenges:

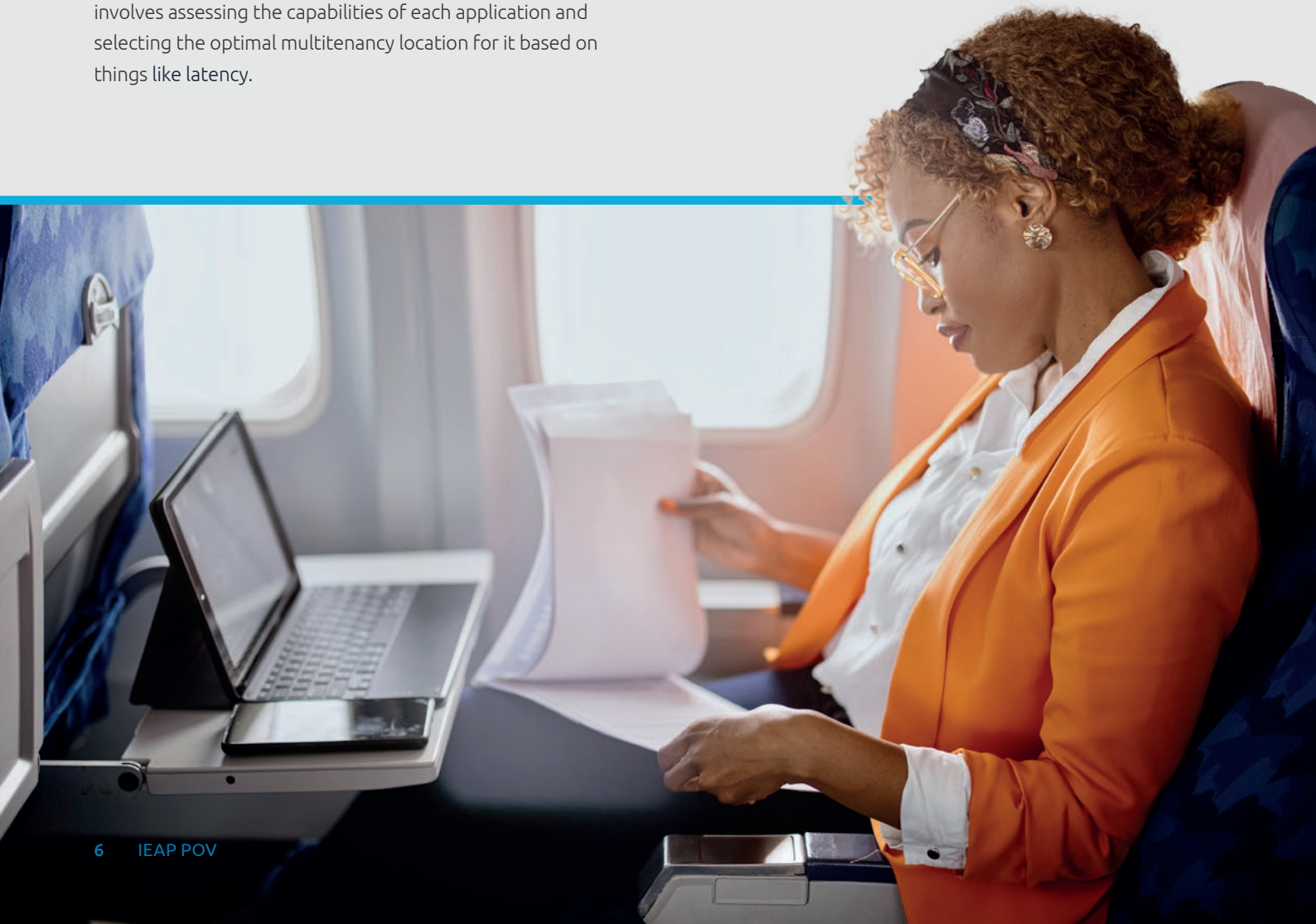
- **Application management.** Developers usually manage applications in a handful of regional data centers. But the highly distributed nature of edge computing means there will now be possibly hundreds of thousands of application instances to deploy, manage, and monitor.
- **Finding the right edge platform.** Running an application everywhere is not a viable solution due to resource constraints and the high costs involved. A more efficient approach is to deploy an application in locations that meet specific criteria, considering the application users, place of consumption, and key requirements such as latency, capacity, and cost.
- **Dealing with different edge networks.** When applications are deployed on edge computing nodes, they are often connected to mobile or WiFi networks. By enabling awareness of the network the application is connected to, the application can adapt to changing network conditions, optimizing performance and delivering better user experience. The question is, how can this network awareness be achieved?
- **Coping with device mobility.** Applications should be instantiated and terminated dynamically as they follow a user device from one edge location to another. This will be especially important for ultra-low latency use cases.
- **Operating edge platforms.** Organizations must be able to manage and operate distributed platform hardware and software in a multitenant environment. Since an ecosystem of edge locations is essentially a distributed cloud, it inherits the operation challenges of a cloud platform with the distributed nature of it on top.
- **Security and multitenancy.** Edge platforms are designed to host applications from multiple domains or providers, so it's expected that they provide adequate security measures for each application and maintain proper tenancy.

SOLVING ALL EDGE COMPLEXITIES WITH A SINGLE MEC PLATFORM

To get from use case definition to use case implementation, organizations will need help in intelligently managing the deployment and operations of edge applications. The decentralized structure of edge computing requires the administration of multiple sites and the need for upgrades, security, and multitenancy. This calls for careful management of limited resources and the ability to start and stop applications based on events (e.g., the appearance of a device at a location). (Unlike with cloud services, the resources at the edge will not be infinite.)

An intelligent MEC platform plays a crucial role in bringing the benefits of edge computing to a variety of applications. Although there are several MEC platform providers in the market today, the very best ones will act as both matchmakers and orchestrators. A dependable MEC platform will match applications with the compute capacity they require. This involves assessing the capabilities of each application and selecting the optimal multitenancy location for it based on things like latency.

For quality-of-service requests, the MEC platform will need to communicate with 5G networks to expose certain APIs. This can be done through 5G's built-in NEF (network exposure function) using a secure MEC abstraction layer. This abstraction makes API access and consumption easier for non-mobile network specialists. With this functionality, in-house and third-party developers can build applications that adapt to the network context to provide users with improved quality of experience. Lastly, some MEC platforms even provide application development services, either generic or vertical related. For example, their libraries could contain a pre-built computer vision use case for security providers to get a heatmap of people in an area. Or a surveillance application could use that same computer vision service for an entirely different purpose. After all, there's no reason to keep reinventing the wheel.



CAPGEMINI'S MEC ANSWER AND STRATEGY

The IEAP (intelligent edge application platform) is our version of how an MEC orchestration platform should be designed. It's been bringing innovative solutions to our clients in four key sectors: manufacturing, mobility and transport, energy and utilities, and telecom.

What sets the platform apart from traditional MEC concepts is its unique, pre-packaged services, which revolutionize the way edge use cases are developed and deployed. We're committed to delivering a frictionless developer experience that lets users rapidly explore, test, and deploy advanced use cases for tangible results in record time.

The platform is also hardware and provider agnostic, meaning it enables consistent integration with a client's existing technology ecosystem. And its application orchestration abilities include onboarding, deployment, platform selection, and instantiation and termination.

Capgemini is at the forefront of driving MEC platform innovations. At the core of our efforts is a focus on standardizing MEC APIs, ensuring seamless and efficient consumption of MEC services by enterprises and developers alike. By establishing standardizations for communication between multiple MEC platforms, we're laying the foundation for a more unified and interoperable ecosystem.

PROVING THE POTENTIAL OF FEDERATED MEC FOR SMART CITIES

MEC infrastructure in 5G systems can support and accelerate the use of connected car technologies for smart cities. The 5G Automotive Association (5GAA), together with eight member companies including Capgemini, conducted a live trial on the streets of Turin, Italy, showcasing the impact of MEC technology on road safety.

The trial demonstrated an MEC federation, where TIM, a telecom provider, served as the home operator and provided live 5G coverage to its own users and roaming users from two other telecoms, BT and Telefonica. The federation of edge platforms enabled the operators to provide a seamless edge experience to their users – even when moving from one operator network to another.

The trial tested two real-world scenarios aimed at avoiding dangerous traffic situations for drivers and pedestrians, using low-latency communication and machine learning algorithms. Using federated MEC and vehicle-to-everything (V2X) services, the trial proved the near-reality of connected car technology.

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