



# Edge Computing for 5G Networks with AWS Wavelength

Consumers and enterprises expect highly responsive experiences on new 5G networks. But data transported by 5G often needs to hop across multiple networks to reach application servers. These latencies can often exceed 10s of milliseconds – diminishing the user experience, even on fast 5G mobile networks. With AWS Wavelength you can build and deploy applications closer to your customers, using familiar AWS services and tools, to deliver innovative 5G applications and next-generation user experiences.

**AWS Wavelength** brings AWS services to the edge of the 5G network, minimizing latency when connecting to an application from a mobile device.

## Why do 5G networks need edge computing?

Advances in radio technology have enabled 5G networks to provide high-density radio (air) interfaces with extremely high bandwidth and reliability. However, improvements in the radio network alone are not enough to meet the low latency requirements set forth in the 5G standards. Today, most consumer and enterprise applications that are accessed on mobile devices and other mobile end-points are hosted on application servers outside of the communications service provider's network. Enabling applications to be run in edge computing infrastructure, close to end users, is essential to improving network transit latency.

Edge computing coupled with the 5G network will enable new classes of cloud applications in such areas as industrial robotic/drone automation, connected vehicles, and AR/VR infotainment. Innovations in business models will follow. Edge computing is essential for many emerging applications, which need local processing of information to reduce the volume of traffic transported back to centralized datacenters for processing. By enabling compute capabilities closer to end users, developers and enterprises can provide new innovative 5G applications and deliver immersive experiences to a wide audience.

## Edge computing with AWS

With global infrastructure that spans of 77 Availability Zones in 24 AWS Regions, AWS enables developers to serve end-users with low latencies worldwide. However, emerging interactive applications, like game streaming, virtual reality, and real-time rendering, require even lower latencies, sometimes in the single-digit milliseconds. In addition, use-cases like industrial automation, smart cities, IoT, and autonomous vehicles require data processing to take place close to the source to conserve resources like device memory and power. In many use cases where applications involve collecting a lot of data, processing that data closer to the source saves on network bandwidth as well. Easy access to feature-rich cloud services at the 5G edge will enable opportunities for enterprises, ISVs, and start-ups to develop innovative 5G applications and create new business segments.

AWS edge computing services provide infrastructure and software that move data processing and analysis as close to the endpoint as necessary. These include deploying AWS-managed hardware and software in locations outside AWS datacenters, and even onto customer-owned devices themselves. AWS gives you more edge specific capabilities than any other cloud provider. Learn more about AWS for the Edge at <https://aws.amazon.com/edge>

## Why AWS for the edge?

- **Use the most extensive global cloud infrastructure** – AWS has the largest global infrastructure footprint of any provider. AWS infrastructure is designed to meet the most stringent security requirements in the world and has the highest network availability of any cloud provider.
- **Move cloud closer to the endpoint** – Extend to the edge, beyond Regions, with the same network, control plane, APIs, and AWS services in each deployment.
- **Securely connect and manage devices at scale** – Use managed hardware at edge locations, with support for more security standards and compliance certifications than any other offering.
- **Use the deepest range of services and capabilities** – AWS has 175+ cloud and device services, more than any other cloud provider, plus capabilities for specific edge use cases like IoT or 5G.
- **Build more quickly and reduce costs** – Use a single programming model for the cloud and local devices. Build an application once and deploy it on the cloud or at the edge with consistent performance. This significantly shortens the development lifecycle and reduces development costs.

## AWS gives you more edge specific capabilities than any other cloud provider

### Infrastructure

- AWS Local Zones
- AWS Outposts
- AWS Wavelength

### Rugged & Disconnected Edge Devices

- AWS Snow Family

### Robotics

- AWS RoboMaker

### Networking

- Amazon CloudFront

### IoT

- AWS IoT Greengrass
- FreeRTOS
- Alexa Voice Service Integration for AWS IoT Core

### Machine Learning

- Amazon SageMaker Neo

### Storage

- AWS Storage Gateway

### Analytics

- AWS Kinesis Video Streams

## AWS Wavelength

AWS Wavelength brings AWS services to the edge of the 5G network. Wavelength Zones are AWS infrastructure deployments that embed AWS compute and storage services within communications service providers' datacenters at the edge of the 5G network, so application traffic can reach application servers running in Wavelength Zones without leaving the telecommunications network. This avoids the latency that would result from application traffic having to traverse multiple hops across the Internet to reach their destination, enabling customers to take full advantage of modern 5G networks.

### Benefits of AWS Wavelength

#### • Ultra-low latency for 5G applications

Wavelength combines AWS compute and storage services with the high bandwidth and low latency of 5G networks to enable developers to innovate and build a whole new class of applications that serve end-users with ultra-low latencies over the 5G network.

#### • A consistent AWS experience

Wavelength enables you to use familiar and powerful AWS tools and services, such as Amazon VPC, Amazon EC2, Amazon ECS, and AWS IAM, to build, manage, secure, and scale your applications. You get the same AWS benefits, like elasticity, high-availability, and pay-as-you-go pricing.

#### • Scale and flexibility

You can develop your application once and deploy it to any Wavelength Zone globally. A high-bandwidth, secure connection to the parent AWS Region allows developers to seamlessly connect to the full range of services in the AWS Region through the same APIs and tool sets.

#### • A global 5G network

Wavelength will be available within CSP networks such as Verizon, Vodafone, KDDI, and SK Telecom in places like the United States, Europe, Japan, and Korea to enable you to deliver ultra-low latency applications to your global base of end-users and connected devices.

## What is a Wavelength Zone?

- AWS Global Infrastructure deployment within a communications service providers' facility.
- Allows application traffic to reach application servers without leaving the telecommunications network.
- Each Wavelength Zone is specific to a carrier and location. Wavelength Zones are connected to the parent Region through a redundant and high-bandwidth private network, which provides the applications running in Wavelength Zones fast, secure, and seamless access to the rest of AWS' services.

## Services available in Wavelength Zones

You can create Amazon EC2 instances, Amazon EBS volumes, and Amazon VPC subnets and carrier gateways in Wavelength Zones. You can also use services that orchestrate or work with EC2, EBS and VPC such as Amazon EC2 Auto Scaling, Amazon EKS clusters, Amazon ECS clusters, Amazon EC2 Systems Manager, Amazon CloudWatch, AWS CloudTrail, and AWS CloudFormation. The services in Wavelength are part of a VPC that is connected over a reliable, high-bandwidth connection to an AWS Region for easy access to services including Amazon DynamoDB and Amazon RDS



### Compute

**General purpose compute:** Wavelength Zones currently support t3.medium, t3.xlarge and r5.2xlarge instances for applications that need cost effective general purpose compute.

**Accelerated compute:** Wavelength Zones support g4dn.2xlarge instances for applications that require GPUs, such as game streaming and machine learning (ML) inference at the edge.



### Storage

All EC2 instances are EBS-based. Users can also connect to Amazon S3 over a reliable and high-bandwidth connection to the Wavelength Zone's parent Region.



### Networking

**VPC:** Amazon VPCs in an account can be extended to span multiple Availability Zones, including Wavelength Zones. Amazon EC2 instances and related services will appear as part of the user's regional VPC.

**Carrier gateway:** Wavelength also introduces a new component to the network setup – the Carrier Gateway. The Carrier Gateway enables connectivity from the user's subnet in the Wavelength Zone to the CSP's network, the Internet, or the AWS Region through the CSP's network.



### Management and monitoring

AWS tools such as AWS CloudFormation, Amazon CloudWatch, AWS CloudTrail, and others can be used to run and manage workloads in Wavelength Zones as they do for cloud workloads today. You can use AWS Cost Explorer to monitor costs.

## Security in AWS Wavelength

Security at AWS is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations. Security is a shared responsibility between AWS and you. [The shared responsibility model](#) describes this as security *of* the cloud and security *in* the cloud:

- **Security of the cloud** – AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. AWS also provides you with

services that you can use securely. Third-party auditors regularly test and verify the effectiveness of our security as part of the [AWS Compliance Programs](#).

- **Security in the cloud** – Your responsibility is determined by the AWS service that you use. You are also responsible for other factors including the sensitivity of your data, your company's requirements, and applicable laws and regulations.

## Architecting Applications for AWS Wavelength

AWS recommends that you architect the edge applications in a hub and spoke model with the Region to provide the most scalable, resilient, and cost-effective options for components. Run the following components in the Region:

- Components that are less latency sensitive
- Components that need to be shared across Zones
- Components that need to persist state, such as databases

Run the application components that need ultra-low latency, higher bandwidth, or increased quality of service over 5G mobile networks in Wavelength Zones.

### AWS Wavelength enables innovative use cases

AWS Wavelength enables applications that deliver interactive and immersive experiences, like game streaming, virtual reality, and in-venue experiences for live events. Wavelength also enables offload of data processing tasks from 5G devices to the network edge to conserve resources like power and bandwidth in use cases like autonomous vehicles and smart factories.



#### Connected vehicles

Cellular Vehicles to Everything (C-V2X) is an increasingly important platform for enabling intelligent driving, real-time HD maps, road safety, and more. Low latency access to compute infrastructure needed to run data processing and analytics on AWS Wavelength enables real-time monitoring of data from sensors for secure connectivity, in-car telematics, and autonomous driving.



#### Interactive live video streams

Wavelength provides the ultra-low latency needed to livestream high-resolution video and high-fidelity audio, as well as to embed interactive experiences into live video streams. Additionally, real-time video analytics provide the ability to generate real-time stats that can enhance live event experiences.



## AR/VR

By accessing compute resources on AWS Wavelength, AR/VR applications can reduce Motion to Photon (MTP) latencies to meet the <20 ms benchmark needed to offer a realistic user experience. Wavelength enables offering AR/VR in locations where it is not desirable or possible to run local server systems.



## Smart factories

Industrial automation applications use ML inference at the edge to analyze images and videos, in order to detect quality issues on fast-moving assembly lines and trigger actions to remediate the problem. AWS Wavelength enables these applications to be realized without having to use expensive, GPU-based servers on the factory floor.



## Real-time gaming

Real-time game streaming depends on low latency to preserve user experience. With AWS Wavelength, the most demanding games can be made available on end-user devices that have limited processing power by streaming these games from game servers in Wavelength Zones.



## ML-assisted diagnostics for healthcare

AI/ML-driven video analytics and image matching solutions help doctors speed up diagnosis of observed conditions, such as recognizing polyps during colonoscopies. The image or video streams from medical can be processed in a Wavelength Zone and the response returned to the medical device for the surgeon to use. devices can be processed in a Wavelength Zone and the response returned to the medical device for the surgeon to use.

## Get started now

It's easy to deploy your application in AWS Wavelength Zones.

1. Log into the AWS Management Console and enable Wavelength Zones
2. Configure your network
  - Step 1: Create a VPC and subnet in the Wavelength Zone
  - Step 2: Create a carrier gateway
  - Step 3: Create a route table
  - Step 4: Add a route to send traffic to the telecom provider using the carrier gateway
  - Step 5: Associate the route table with the subnet
3. Launch AWS resources, such as Amazon EC2 instances, that are available in the Wavelength Zone. Test connectivity to your AWS Region.

**That's it – you're ready to deploy the portions of an application that need ultra-low latency in a Wavelength Zone.**



**AWS Wavelength is ushering in a new era of interactive applications and immersive experiences built for 5G networks. To learn more visit <https://aws.amazon.com/wavelength>**

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## **PARTNERS**

AWS is collaborating with leading Communications Service Providers to launch AWS Wavelength Zones in locations across the globe.



More locations and carrier partners are coming soon.