

The background features a dark blue gradient on the left, transitioning into a large, abstract, curved shape on the right. This shape is composed of various shades of purple and blue, with a bright orange-yellow highlight along its bottom edge. The overall design is modern and dynamic.

# aws SUMMIT

ATLANTA | MAY 18-19, 2022

CMP206

# Harnessing the power of 5G and edge computing to innovate

Bala Thekkedath

Principal Product Marketing Manager

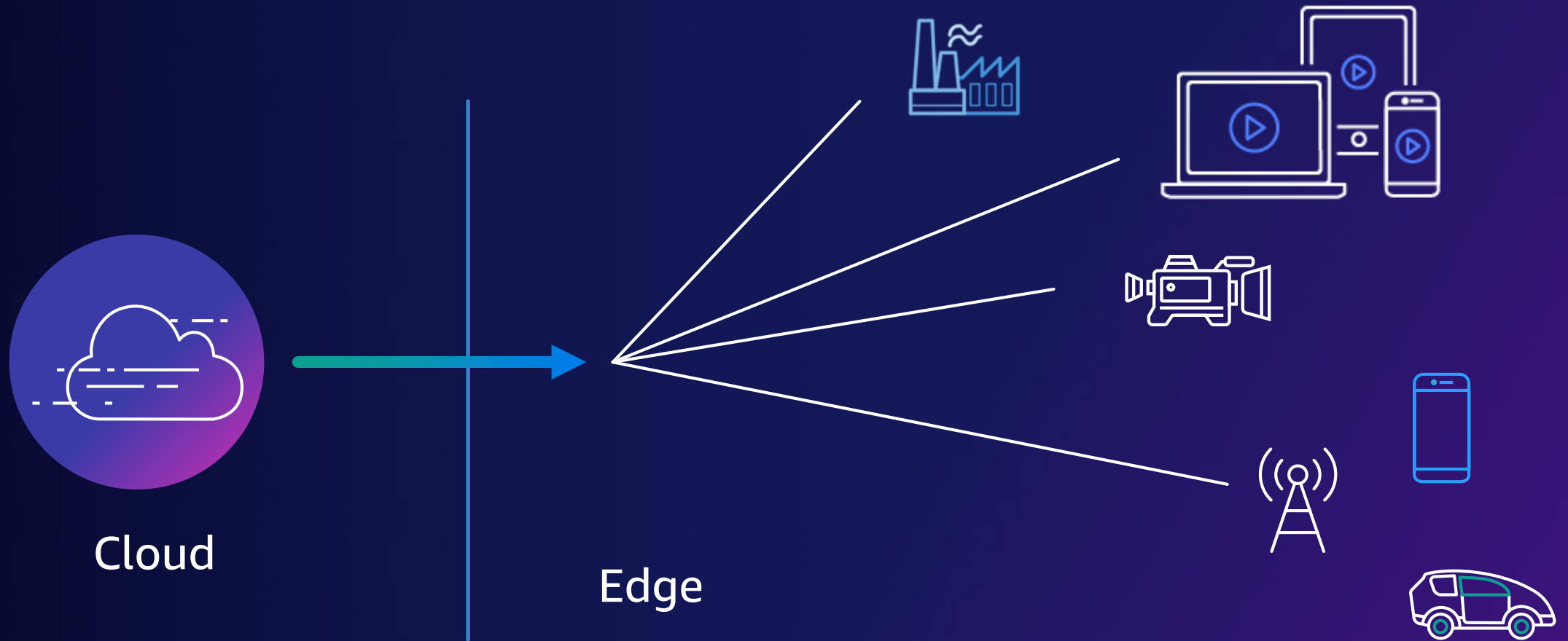
5G & Edge Computing Solutions

AWS



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# Perception



# Listening carefully to customers

## Customer feedback



AWS services closer  
to end users or data source

## Use cases



Low-latency applications



Migrate and modernize



Satisfy data residency

## Solution today



Complexity

Cost

Maintenance

# Application continuum

VARYING APPLICATION REQUIREMENTS

## AWS Regions

### Web and enterprise



Most web and enterprise applications, such as email, collaboration, and intranet applications, are easily migrated to AWS Regions

## AWS Regions or on premises

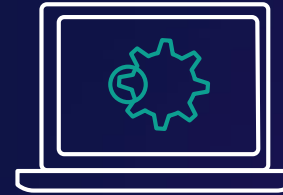
### Residency



Regulations or contractual obligations dictate that data and infrastructure reside in specific countries, states, or provinces

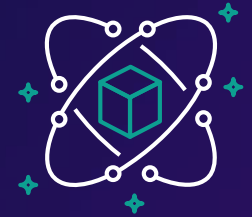
## On premises

### Local data processing



Transcoding, filtering, caching, and alerting applied at the edge; large datasets that can't be easily moved

### Low latency



Equipment and processes sensitive to compute latency; interactive workloads such as AR/VR, design, and visualization; complex workloads that span a variety of local host or storage systems

Move to cloud

# Extend the AWS Cloud



# Customers want the same experience

ACROSS ON PREMISES, THE EDGE, AND THE CLOUD



Same reliable, secure,  
and high-performance  
infrastructure



Same  
operational  
consistency



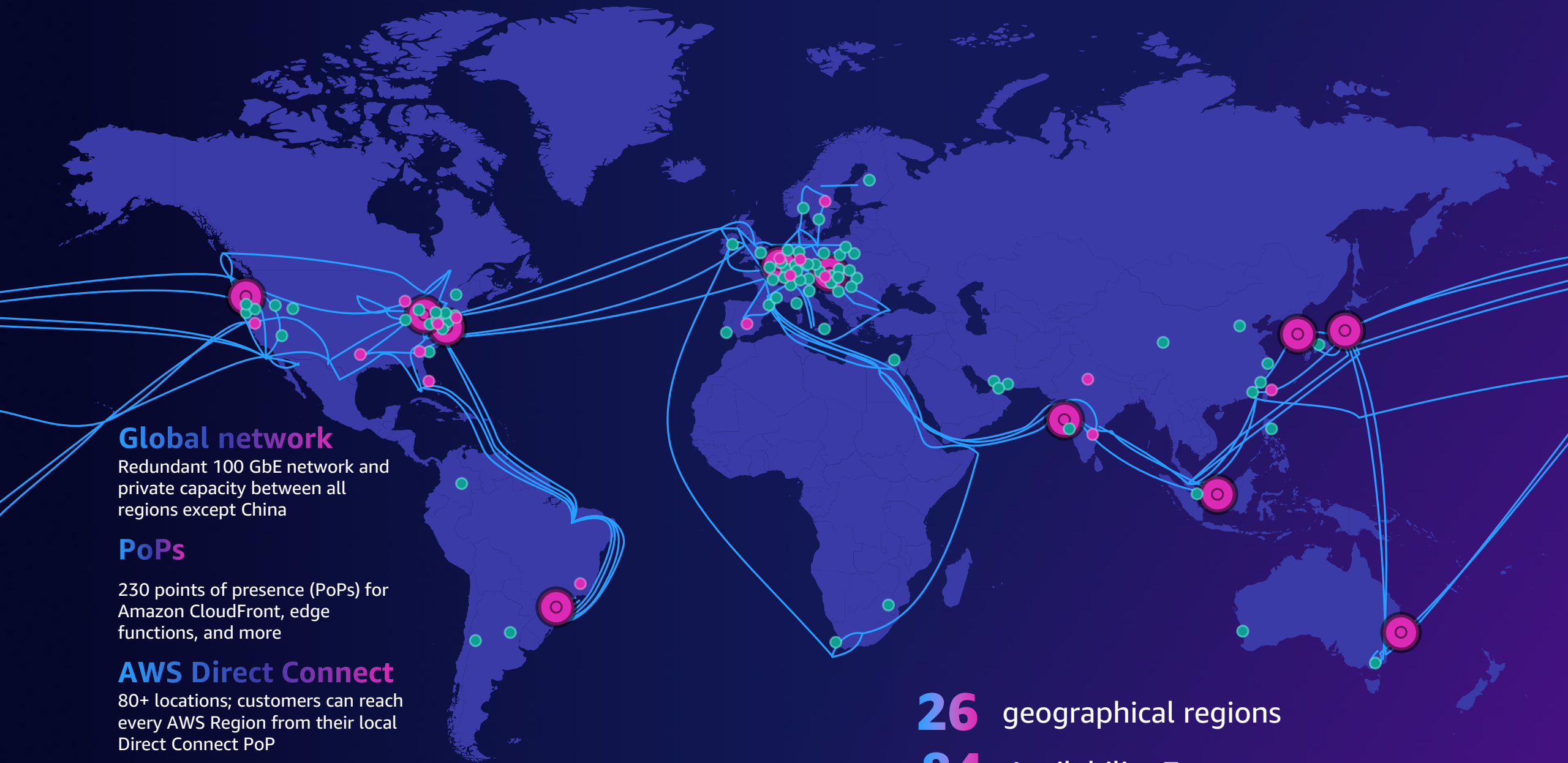
Same services  
and APIs



Same tools for  
automation,  
deployments, and  
security controls



Same pace  
of innovation as  
in the cloud



## Global network

Redundant 100 GbE network and private capacity between all regions except China

## PoPs

230 points of presence (PoPs) for Amazon CloudFront, edge functions, and more

## AWS Direct Connect

80+ locations; customers can reach every AWS Region from their local Direct Connect PoP

**26** geographical regions

**84** Availability Zones

# Extending AWS to where customers need it

GLOBAL  
INFRASTRUCTURE



AWS Regions

METRO CENTERS



AWS Local Zones

5G NETWORKS



AWS Wavelength

ON-PREMISES



AWS Outposts

SMART DEVICES



AWS IoT

RUGGED EDGE



AWS Snow Family

# Real-time interactive applications

MCAD Gaming or live streaming **ERP** Medical HER / EMR data **3D modeling**

SharePoint Web apps **Robotics** Factory floors **Healthcare operations**

Records management systems

## Data processing and integrity

Genomic sequencing Autonomous vehicles ecommerce EDA

Home shares

**High-fidelity image analysis**

## Enterprise apps

Databases

**Manufacturing automation**

PACS or patient imaging

## Edge processing SCADA systems

Sports books

Processing time series of video, image, or audio data

**Inference and training at the edge**

## Telco Transformation

3D modeling Inference computing

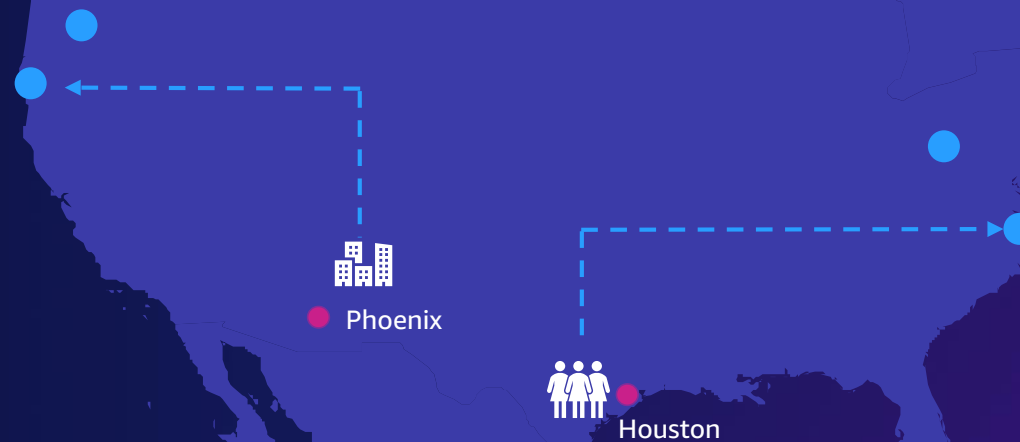
**Medical imaging**

## Audio/video processing

# Extend the cloud in metros



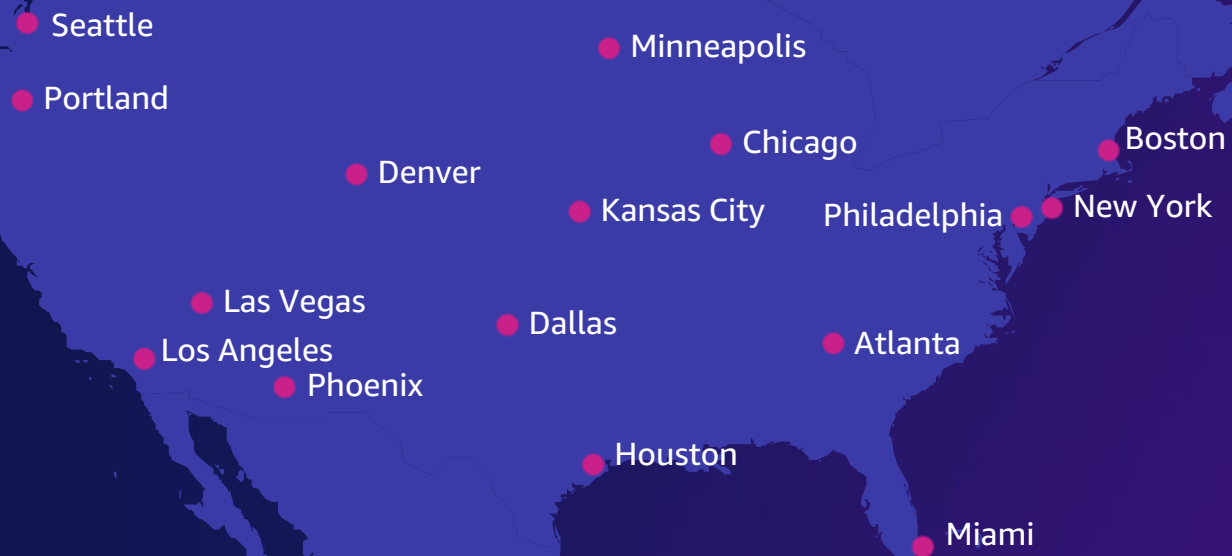
- **Local Zones**  
Bring compute closer to users



# Local Zones in the US

## 16 in GA

● Generally available



# Netflix: Content creation

## The challenge

Artist workstations require less than 5 millisecond latency from their offices or animation hubs to their workstations to have a smooth, jitter-free content creation experience. Historically, artist workstations have stayed on the studio premises to meet the latency requirements to power their tools.

## Solution

Netflix uses LA Local Zones (AWS Direct Connect service) to achieve 1–2 millisecond latency from their animation hub to the Local Zones, running latency-sensitive workloads such as live production video editing closer to artists

## Business outcome

Netflix can support their artists with smooth remote workstations across cities in the US because of their proximity to the 17 Local Zones

“

AWS Local Zones brings cloud resources closer to our artists and have been a game changer for these applications.

By taking advantage of AWS Local Zones, we have migrated a portion of our content creation process to AWS while ensuring an even better experience for artists.

We are excited about the expansion of AWS Local Zones globally, which brings cloud resources closer to creators, allowing artists to get to work anywhere in the world and create without boundaries.”

**Stephen Kowalski**

Director of Digital Production Infrastructure Engineering, Netflix







 **32 new**  
**Local Zones**  
Generally available starting 2022



# Extend the cloud on premises



# AWS Outposts Family

## Outposts rack



Bring the same AWS APIs, services, and features to virtually any data center or collocation space

## VMware Cloud on AWS Outposts



Deliver fully managed VMware Cloud on Outposts rack

## Outposts servers



Run Outposts in locations with limited space or smaller capacity requirements

# AWS Outposts rack

- Industry standard **42U rack**
- **Fully assembled**, ready to be rolled into final position
- **Installed by AWS**; simply plug in power and network
- **Centralized redundant power conversion unit** and dc distribution system for higher reliability, energy efficiency, easier serviceability
- **Redundant active components** including top-of-rack switches



# Accelerate business expansion while meeting data residency requirements

## The challenge

- Rapidly expand to more states in the US while adhering to data residency obligations from performance and customer stability perspectives

## The solution

- Migrated betting platforms from OpenStack and VMware to AWS
- Prestage environments in test and development, and quickly deploy production-ready instances with Outposts
- Offloaded day-to-day infrastructure and hardware management to AWS
- Let engineers focus on building apps that delight customers
- Worked with regulators to understand data residency requirements and deliver responsible gaming

## Business outcomes

- Faster time to market, from 15–16 weeks to less than 20 days
- 30%–40% improvement in application performance
- OpEx savings by spending less time managing infrastructure



“Using AWS Outposts and standardizing on AWS across our cloud and on-premises operations, we were able to comply with data residency requirements while decreasing our time to market from 15 to 16 weeks down to less than 20 days. Overall, our latency between applications has been completely optimized, such that we are seeing 30 to 40% performance improvements by running on AWS Outposts compared to server vendor hardware that we had been using previously.”

**Shane Sweeney**, VP of IT, FanDuel



# Low-latency gaming anywhere

## The challenge

- A global launch for Riot's new *Valorant* game, under tight deployment timelines
- Competitive multiplayer titles require consistent, low latency to end users
- Ensure engaging, high-quality experience for all players in countries or metro areas far from AWS Regions

## The solution

- Outposts provides low-latency compute and storage services in a location the customer chooses
- Deployed Outposts in 4 cities across 3 countries globally to support the game release
- Riot was able to rapidly move production workloads to the Outposts with no changes to their server application because Outposts uses the same AWS infrastructure, services, APIs, and tools as AWS Regions



"Using AWS Outposts, we were able to reduce *Valorant* latency by 5–10 ms for players in strategic regions during the COVID-19 epidemic. Rapidly lowering latency for hard to reach areas without the need to deploy and manage hardware was a huge win."

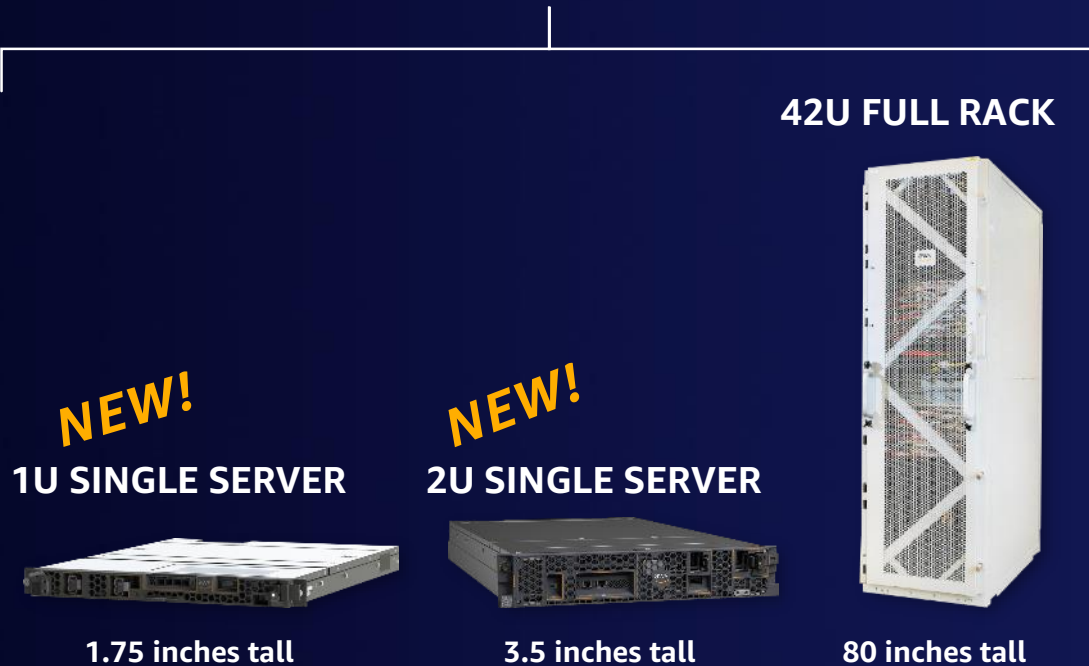
**Zach Blitz**, Head of Infrastructure, Riot Games



# AWS Outposts servers

RUN AWS OUTPOSTS IN LOCATIONS WITH LIMITED SPACE OR CAPACITY REQUIREMENTS

## AWS OUTPOSTS FAMILY



Offers the same AWS infrastructure, services, APIs, and tools on premises, now with a smaller form factor

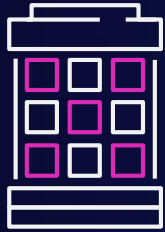
Choose between a 1U form factor with an AWS Graviton2 processor or a 2U form factor with an Intel processor

Run AWS services locally, like Amazon EC2, and edge services like AWS IoT Greengrass

Ideal for workloads that require low latency and local processing needs

Simple device installation by either your own on-premises personnel or an AWS preferred third-party vendor

# AWS Outposts 1U and 2U specialized use cases



---

**Retail stores or branch offices** are running point-of-sale, security, and network administration systems



---

**Healthcare providers** want to use the latest technology to assess patient medical images and process data onsite so they can deliver great care quickly



---

**Factories and distribution centers** need compute at the edge to integrate IoT data, monitor systems, and quickly alert operators of relevant changes

# Extending the cloud to private networks

# 5G technology: Refresher

## Latency

1 millisecond latency  
with New Radio

## Speed

Speed of up to 10 Gbps, with the  
ability to configure uplink and  
downlink speed ratio

## Scale

Support up to 1 million devices  
per square kilometer

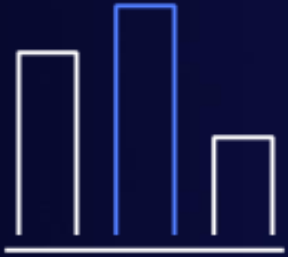
### Private 5G

- Deployed within your on-premises location, usually to augment existing wired or Wi-Fi networks
- Offers high reliability, low latency, and high bandwidth for applications like Industry 4.0 and ML inferencing at the edge, as well as better coverage for large campuses

### Public 5G

- Deployed by communications service providers (CSPs) and mobile network operators (MNOs)
- Spans geographic areas such as cities or metro areas and often provides nationwide coverage
- Traditional consumer offering for mobile communications – evolution of existing commercial LTE networks

# Private 5G technology – Benefits over alternatives



## Improved performance

Low-latency, high-throughput network for applications



## Extended coverage

Secure, reliable, long-range connection for indoors and outdoors



## Granular traffic control

Application-specific traffic policies



## Scale to massive devices

Add more devices as your business needs grow

# Challenges with private 5G network build-out

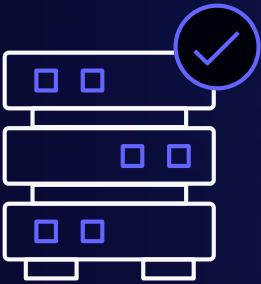
- **Selecting** hardware devices **compatible** with the desired spectrum
- **Ensuring software components are certified** to work with the selected hardware devices
- **Requiring cellular installation experience** for site survey, along with RF planning for small cell configuration (height, tilt, orientation) and coverage-area assessment
- **Building for peak capacity** since it's hard to scale, and bandwidth and capacity demands are difficult to estimate
- **Planning and coordination among multiple vendors**, which is time consuming
- **Undifferentiated heavy lifting for network build-out** that takes away from focusing on business-critical applications and outcomes

# Customer expectations for private 5G networks

- **Ease of ordering and deployment:** can order through a console and API, with self-guided installation
- **Ease of maintenance:** can manage and set traffic policies at SIM level
- **Scalable:** have the option to start out with a small deployment and keep scaling the small cells and SIMs as needed
- **Cloud consumption model:** pay as you grow, where the private network is not provisioned for peak
- **Managed private network:** works like a light switch so you can focus on business-critical applications and needs

# AWS Private 5G

AWS MANAGED SERVICE FOR PRIVATE CELLULAR NETWORKS



Set up a private network **faster**  
**with preintegrated hardware**  
**and software**



**Scale your network**  
**dynamically**  
to add more devices or change  
throughput capacity



**Single pane of management**  
and granular access control for all  
your connected devices

# AWS Private 5G

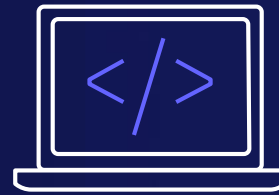
BRINGING THE CLOUD MODEL OF CONSUMPTION TO PRIVATE 5G NETWORKS



Hassle-free  
procurement using  
the AWS  
Management  
Console or APIs



Start as small as you  
want, validate your  
business  
requirement, and  
then scale up  
as needed



A pricing model where  
you pay for the  
throughput capacity  
you need and not the  
number of devices you  
connect

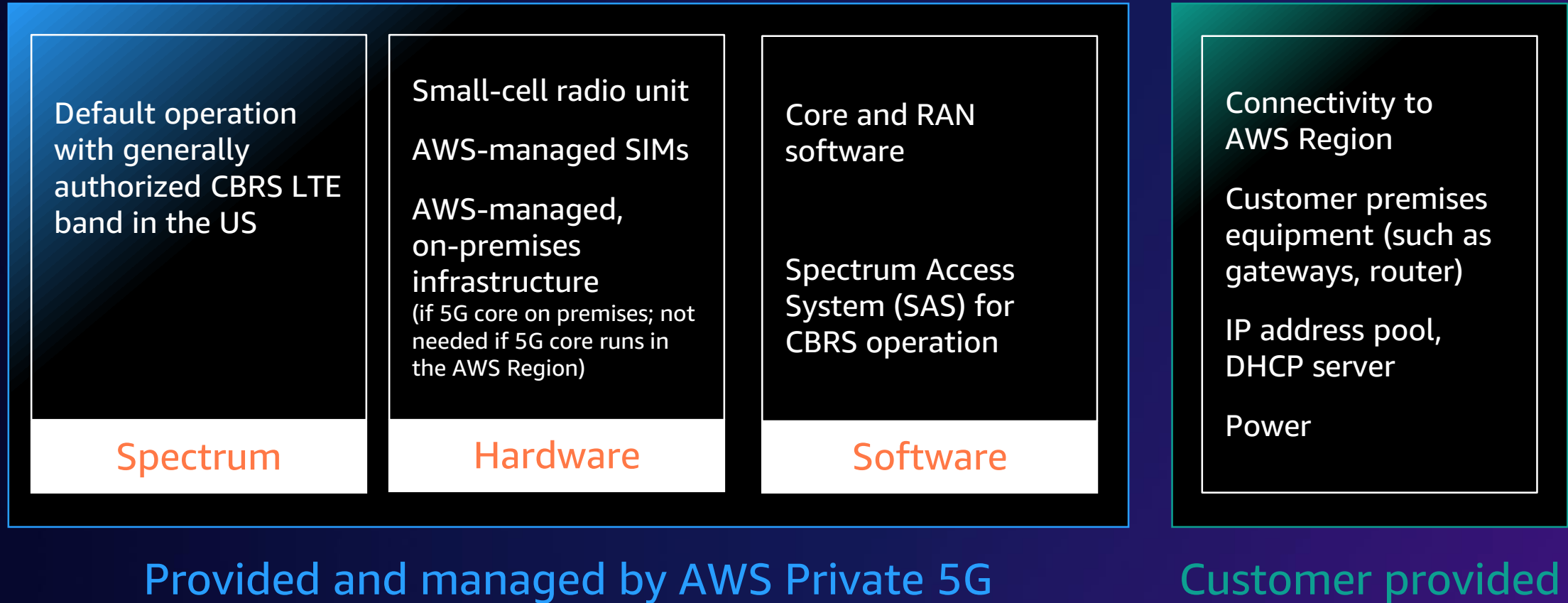


Integrated with AWS  
Identity and Access  
Management (IAM)  
for operational  
consistency



Same pace of  
innovation as  
in the cloud

# Managed with preintegrated components



# AWS Private 5G – Ordering and deployment

## INSTALLATION, SUPPORT, AND PRICING

Customers undertake capacity planning and RF planning as needed

Planning

Orderable from console and API  
  
Specify network site location

Ordering

AWS ships AWS Private 5G hardware kit

AWS Private 5G hardware kit supports self-installation

Installation

Customers can provide the CPI credentials or use AWS-provided credentials for CBRS operation

Customers need to have AWS Enterprise Support

Support

Customers create an AWS support ticket in case of issues

Small-cell radio unit at \$x/RU-hrs with no per-device cost

Pricing

Billed hourly with minimum of 60 days

Detailed pricing information will be available at GA.

Scalable private 5G network for your business needs!



# AWS Private 5G examples

## Connected factory



Connect devices, sensors, machines, or legacy equipment within manufacturing facilities to track assembly line production in real time with reliable data linkage across connected machines

## Enterprise IoT and AR/VR



Support real-time IoT data processing, low-latency augmented and virtual reality (AR/VR) applications for design engineering, product maintenance, customer support, and educational functions across multiple industries

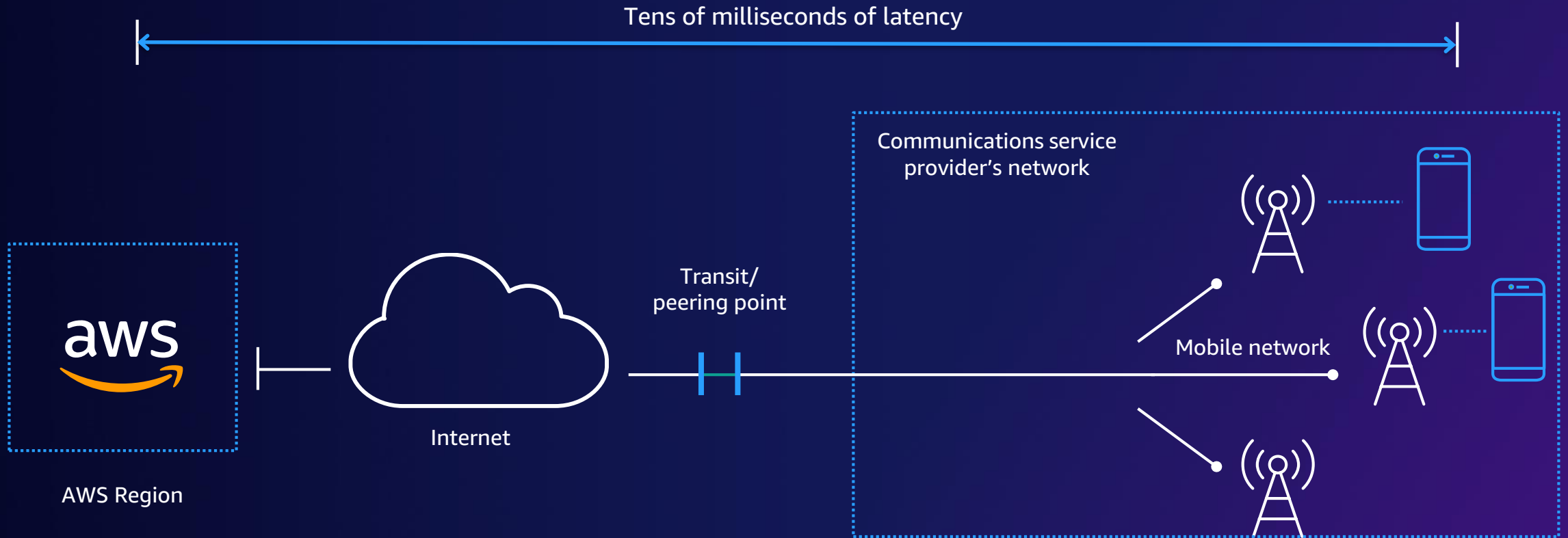
## Reliable campus connectivity



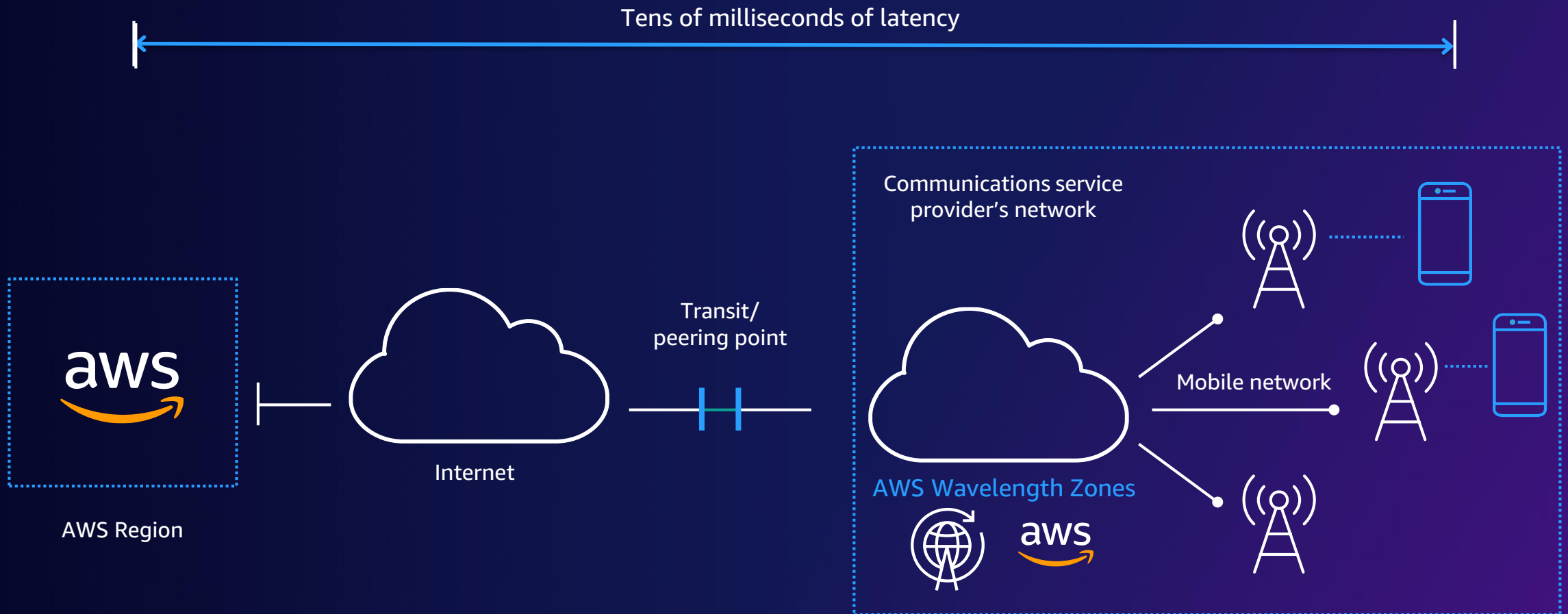
Provide high-quality, reliable indoor/outdoor connectivity at event venues, college campuses, and enterprise facilities. Support data and high-fidelity video communications, security, logistics, and more

# Extend the cloud to public 5G networks

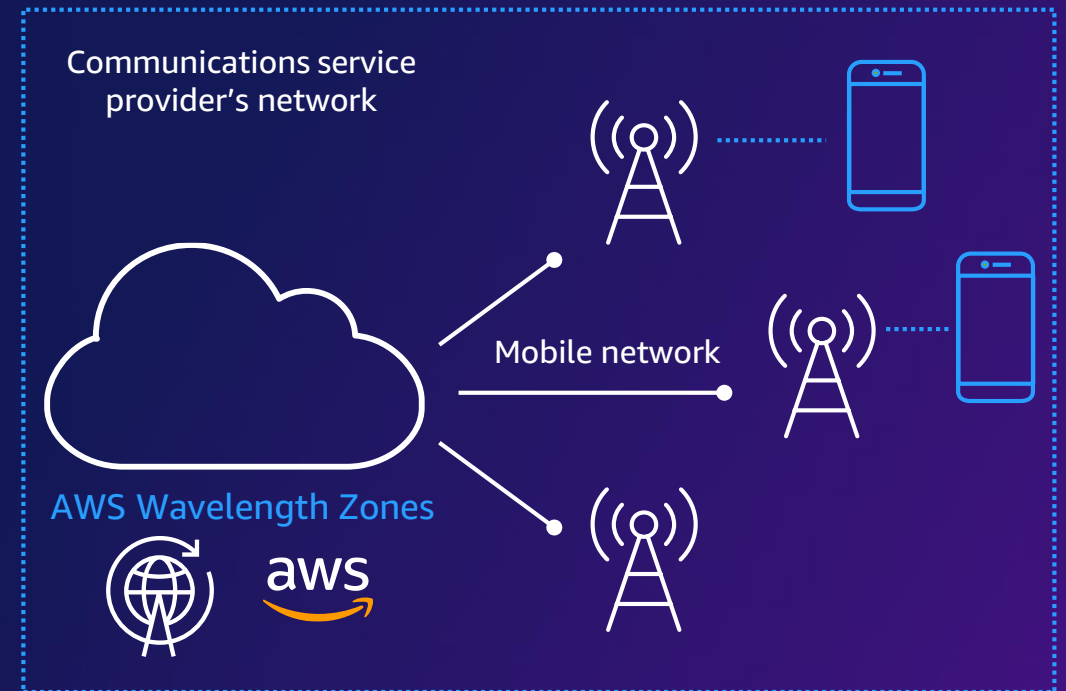
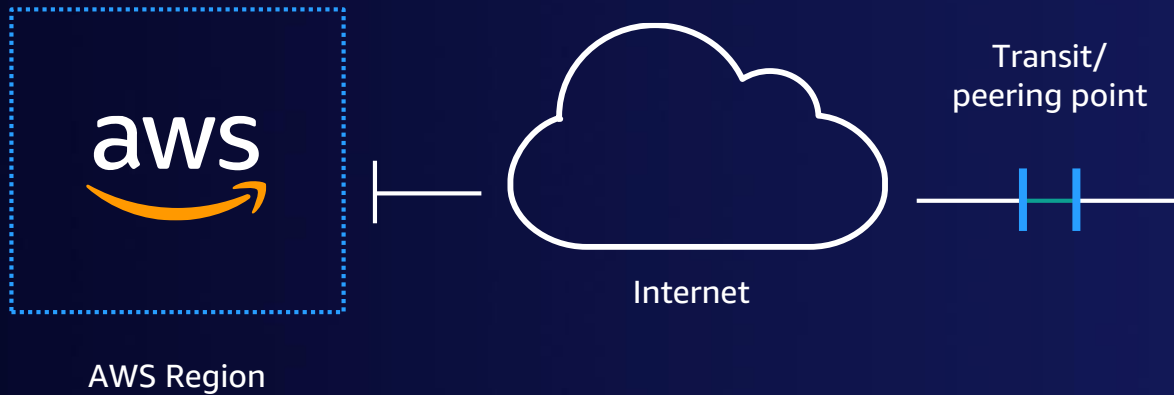
# AWS Wavelength in a 5G network



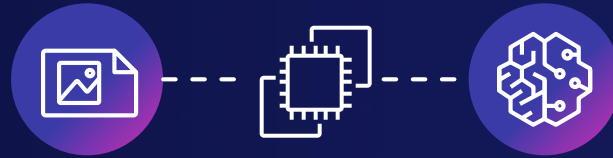
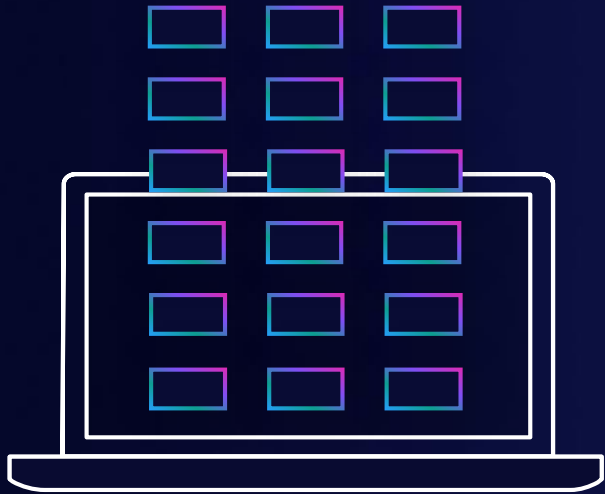
# AWS Wavelength in a 5G network



# AWS Wavelength in a 5G network



# Use familiar AWS services



Amazon EC2 compute, which provides the building blocks for deploying and application



Amazon EKS with node groups for running container workloads



Amazon EBS storage volumes for applications storage requirements



Amazon ECS for running container instances power container apps

# Real-world deployments: Tiny Mile

## CHALLENGE



Operators of remote-controlled robots depend on live video feeds to avoid collisions, so any delays put robots and pedestrians at risk

## SOLUTION



Bell Public MEC with AWS Wavelength offers real-time video analytics to detect obstacles and issue automated stop commands

## BUSINESS OUTCOME



30% reduction in video feed latency so that robots can stop faster than they could before



# Manufacturing: Quality control automation from the 5G edge

TCS is a global system integrator at the forefront of digital transformation, driving business and operational efficiencies across various industries

## CHALLENGE



Driving factory floor automation by transforming mission critical on-premises assembly line applications under the umbrella of Industry 4.0

## SOLUTION



New approach using low-latency 5G network and edge computing for automating quality control at a fast-moving assembly line by using AI/ML-based inference

## BUSINESS OUTCOME



Improved economics by offloading to the edge; increased pace of transformation and innovation



"With critical GPU workloads rendered from AWS Wavelength coupled with 5G's bandwidth, we can achieve the low latency and increased connectivity to deliver a pathway to truly connected factories, where data flows seamlessly between machines and cloud to enable AI-powered real-time decisioning at the edge."

Shanky Viswanathan, Vice President, CTO and Global Head,  
Media and Information Services BU, TCS

# AR experiences for indoor venues

Immersal creates AR experiences that merge digital and physical realities for consumers, industrial use, and ad campaigns. Their AR SDK is used to create AR experiences that save time and money, engage and delight, and do things that were not possible before.



# Automotive – Location and telematics from 5G

HERE is a leading location data and technology platform that equips businesses with an extra dimension of location data for real-time obstacles and hazards to assist drivers and support large-scale automated fleets. It means vehicles can detect obstacles ahead, sending out targeted messages to other road users to warn them.



## CHALLENGE

Keeping countless moving vehicles connected reliably and without fail while processing and delivering real-time information. Increasing safety on the roads with the development of autonomous vehicles and increasing digital traffic.



## SOLUTION

Vodafone Business Distributed Edge with AWS and the HERE location platform uses a three-step process involving detecting information with devices and sensors, processing this information on the edge, and distributing necessary instructions to nearby road users through intelligently coordinated messages. The information is kept on the edge—it's always hyperlocal which means it's always hyperfast.



## BUSINESS OUTCOME

With this solution, customers can experience more enjoyable journeys with fewer incidents and a faster and more efficient fleet, allowing businesses to reduce costs. The solution provides the foundations on which to automate, helping businesses prepare for the future.



*"We believe that 5G, and specifically Edge Computing, can play a critical role when it comes to the future. What 4G did for the consumer app world, 5G and Edge Computing will do for B2B. Because it has so many benefits that industries can leverage, it will unlock a complete new generation of services."*

Carsten Hurasky, Head of Industry Solutions, HERE

# Crowd management – Video analytics at the 5G edge

CrowdVision is a pioneer in the video analytics space; it now offers both vision and LiDAR solutions through a unified user interface. Their video-based pedestrian analytics solution has been widely deployed in many countries.



## CHALLENGE

To generate highly detailed pictures of crowds in public places, counting people in and out of a venue and whether those in queues are properly social distancing. Must do so without installing long cables or on-premises servers.



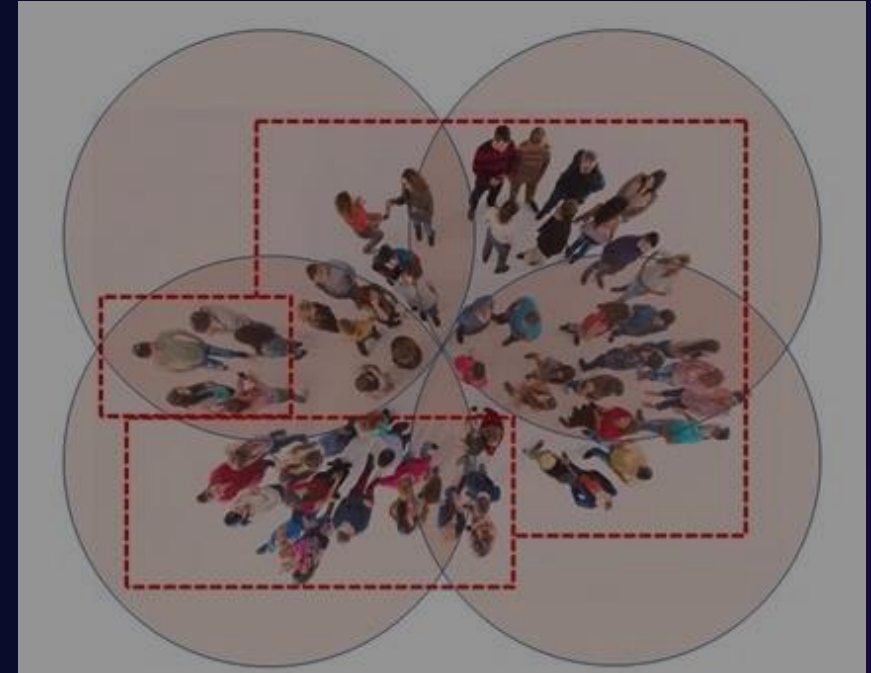
## SOLUTION

New approach using 5G network and edge computing for streaming the sensor data and performing video analytics at the 5G edge faster.



## BUSINESS OUTCOME

Improved operational efficiency with faster deployment of sensors and scalability; can expand to other use cases like security screening at airports and other venues.



*Deploying cameras and LiDAR using a wireless infrastructure that can handle CrowdVision's large bandwidth requirements is a true game changer. By working with Verizon and AWS, we can now extend our analytics solution to places never before accessible. With 5G and MEC, we can improve how large venues manage crowds and apply social distancing controls to deliver not only fun—but also safe—customer and fan experiences.*



Sam Kamel, President of CrowdVision America

# AWS Wavelength

GLOBAL PARTNERSHIPS AND WAVELENGTH ZONE LOCATIONS



5G   
Partners

**Bell**

**verizon**

**KDDI**

 **SK** telecom

 **vodafone**  
business



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# Extend the cloud to IoT



# AWS offers services and solutions to securely connect and manage IoT workloads



Collect, store, and  
analyze IoT data



Secure your IoT  
applications from the  
cloud to the edge

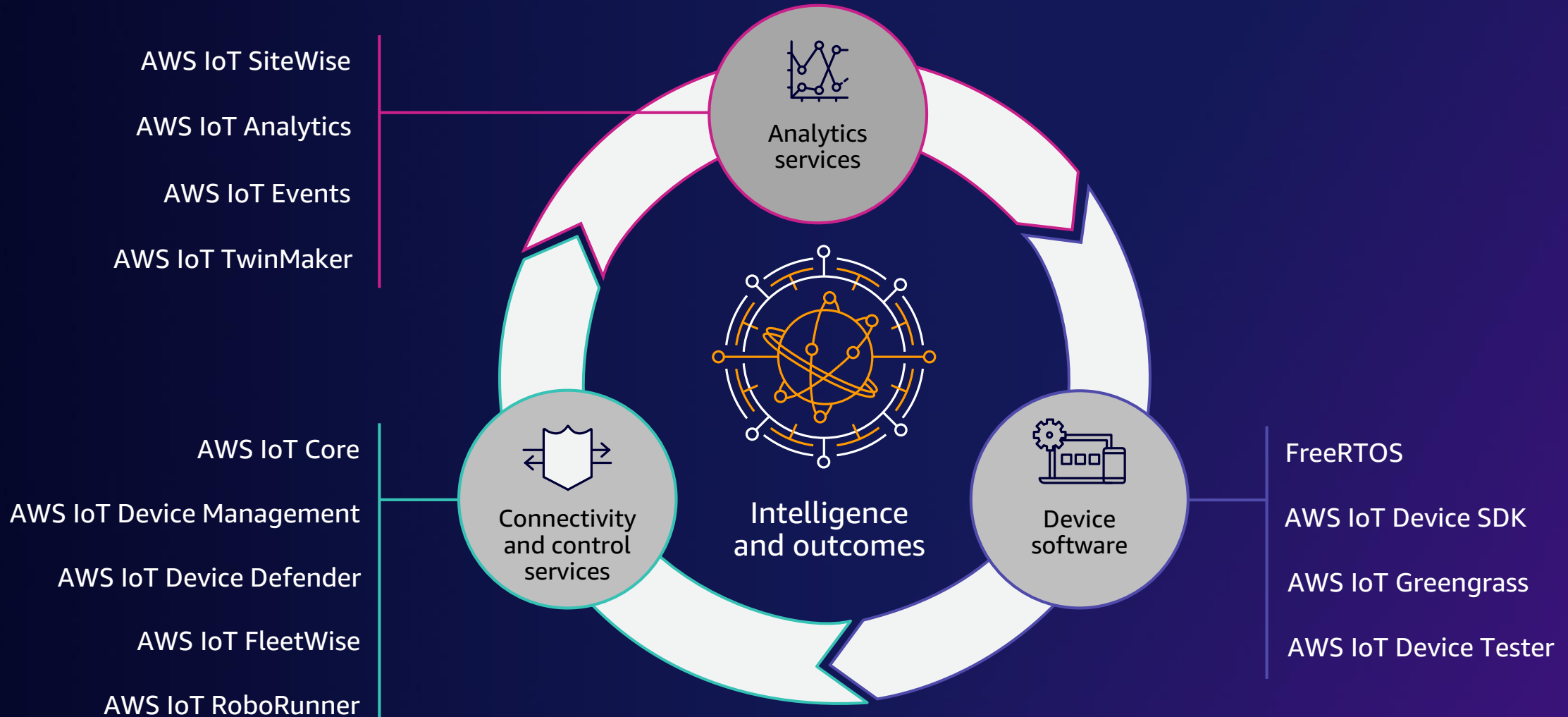


Build intelligent IoT  
solutions with superior  
AI and ML integration



Scale easily  
and reliably

# Internet of Things virtuous cycle





## CHALLENGE

Carrier identified an opportunity to tackle the complexity and fragmentation of the cold chain to improve outcomes for temperature-sensitive cargo, including food, medicine, and vaccines.

## SOLUTION

The Lynx digital platform, being co-developed by Carrier and AWS, is designed to provide customers greater flexibility, visibility, and intelligence across the cold chain.

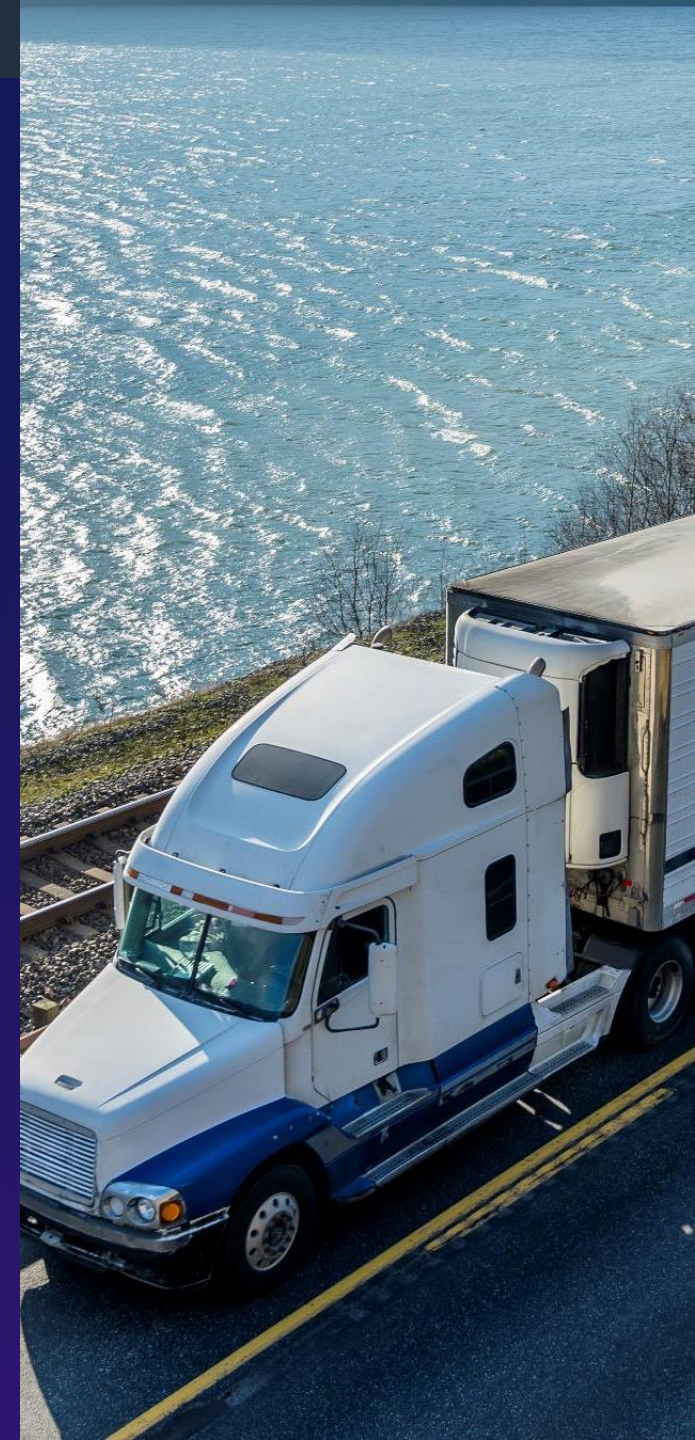
AWS and Carrier plan to introduce capabilities that give the right information at the right time, through proactive recommendations to reduce spoilage and increase sustainability and efficiency.

## IMPACT

- Better match supply from food producers with refrigerated trucks for transport to consumers.
- Provide more efficient routes, enabling transportation companies to take high-quality food farther, potentially to regions that lack access.
- Improve fleet utilization, provide proactive alarms, and deliver recommendations to improve operations and reduce spoilage by improving the reliability and predictability of food transport and related handoffs across the cold chain.

"Carrier is committed to powering a healthy, safe, and sustainable cold chain. Through this collaboration with AWS, we are building on our experience to develop a powerful tool that gives Carrier customers greater flexibility, visibility, and intelligence across the cold chain."

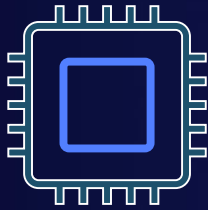
**David Appel, President, Carrier Refrigeration**



# Extend the cloud to the remote edge



# AWS Snowball Edge



## Compute optimized

- 42 TB usable S3-compatible storage
- 52 vCPUs, 208 GiB of memory
- Optional NVIDIA Tesla V100 GPU
- Compute and GPU instances



## Storage optimized

- 80 TB usable S3-compatible storage
- sbe1 instances (equivalent to C5)
- Up to 40 vCPUs, 80 GiB of memory, 1 TB SATA SSD
- Object storage clustering available

Long-term deployment options: 1- and 3-year discounted pricing

# AWS Snowcone

Offline import/export to Amazon S3, online import/export to Amazon S3, Amazon EFS, and Amazon FSx for Windows File Server with AWS DataSync



“One VZN is a leap in innovation for digital cinema distribution, fundamentally changing not only the economics of film distribution for exhibitors and studios around the globe, but enabling new theatrical experiences for viewers. The combination of AWS Snowcone, AWS DataSync, and Amazon S3 are essential to One VZN – the collective services distinguish themselves from any other cloud offerings today.”

*Andy Shenkler, Chief Product & Technology Officer of Deluxe*

[Blog: Deluxe enables same day global theatrical delivery using AWS Snowcone](#)

“AWS is leading in the development of practical, mission-ready edge computing technology that we use to build solutions to help our public sector clients save lives, AWS Snowcone is a great example of AWS innovation for the edge. Snowcone gives us a rugged, secure, and portable edge computing platform that we can use in disaster zones and austere edge locations. In our recent field exercises, Snowcone performed admirably as a sensor hub at the edge for tracking people and assets in a disaster zone.”

*Rob Sheen, SVP Client Operations at Novetta*

[Blog: Novetta delivers IoT and Machine Learning to the edge for disaster response](#)



# Bringing it together

# Learn in-demand AWS Cloud skills



## AWS Skill Builder

Access **500+ free** digital courses and Learning Plans

Explore resources with a variety of skill levels and **16+** languages to meet your learning needs

Deepen your skills with digital learning on demand



Train now



## AWS Certifications

Earn an industry-recognized credential

Receive Foundational, Associate, Professional, and Specialty certifications

Join the **AWS Certified community** and get exclusive benefits



Access **new** exam guides

# Thank you!

Bala Thekkedath

[linkedin.com/in/balathekkedath](https://www.linkedin.com/in/balathekkedath)

