AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

NET216-L

AWS Networking: Making all workloads possible

David Brown (he/him)
Vice President, Amazon EC2
AWS

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1

Largest, most scalable global network

2

Highest performance

3

Most secure

4

A network for every workload

5

Bringing AWS closer to you

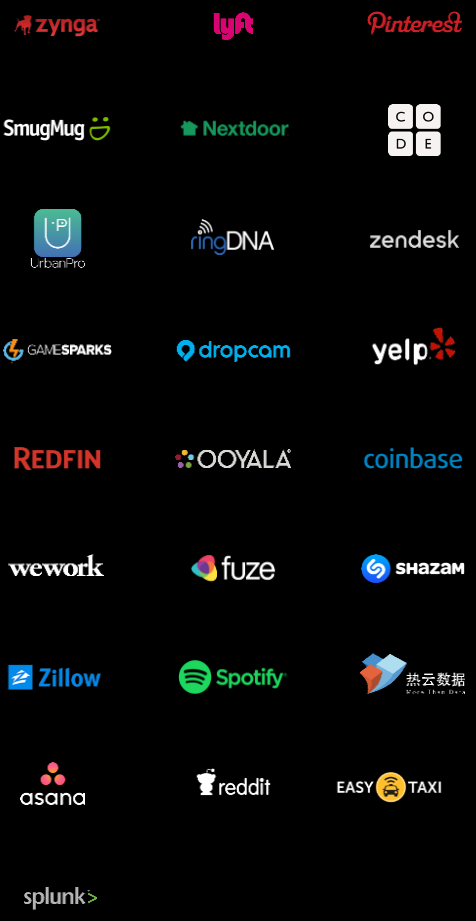
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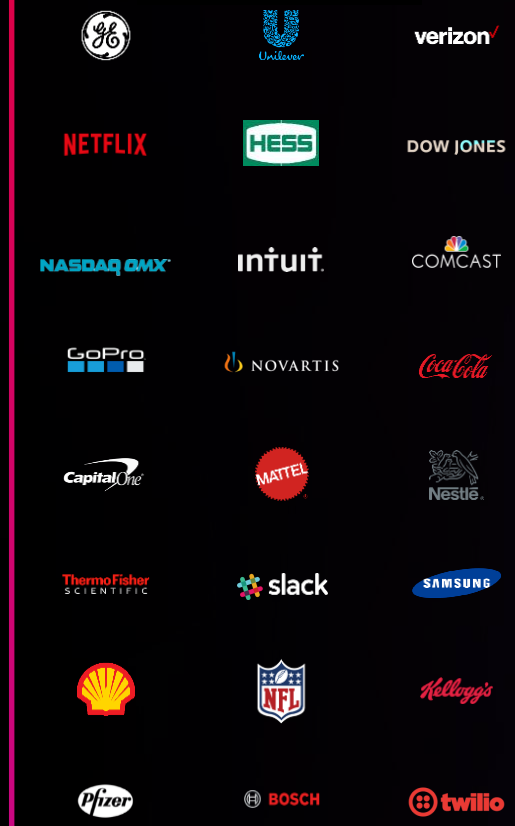
Largest, most scalable global network

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STARTUP



ENTERPRISE



PUBLIC SECTOR



SI AND ISV



aws

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STARTUP

zynga, lyft, Pinterest, SmugMug, Nextdoor, CODE, UrbanPro, ringDNA, zendesk, GAMESPARKS, dropcam, yelp, REDFIN, OOYALA, coinbase, wework, fuze, SHAZAM, Zillow, Spotify, 热云数据, asana, reddit, EASY TAXI, splunk>

ENTERPRISE

GE, Unilever, verizon, NETFLIX, HESS, DOW JONES, NASDAQ OMX, intuit., COMCAST, GoPro, NOVARTIS, Coca-Cola, Capital One, MATTEL, Nestlé, Thermo Scientific, slack, SAMSUNG, Shell, NFL, Kellogg's, Pfizer, BOSCH, twilio

PUBLIC SECTOR

LOCKHEED MARTIN, CLARITAS GENOMICS, NASA, The University of Chicago, American Heart Association., YMR, Ministry of Justice, CDC, HARVARD MEDICAL SCHOOL, Cleveland Clinic, coursera, USDA, FDA, FINRA, Penn, New York Public Library, LWV, wefarm, ROYAL OPERA HOUSE, Landgate, 東京大学 THE UNIVERSITY OF TOKYO, Ocean Conservancy, King County, KAPLAN

SI AND ISV

CODESHIP, LOGGLY, GENESYS, freshdesk, 2ND WATCH, databricks, CHEF, wipro, Adobe, accenture, clearscale, dedalus, Booz | Allen | Hamilton strategy and technology consultants, Cognizant, Capgemini, CloudKinetics, leidos, slalom, ctp Cloud Technology Partners a Hewlett Packard Enterprise company, logicworks

aws

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zynga, Lyft, Pinterest, SmugMug, Nextdoor, Code, UrbanPro, ringDNA, zendesk, GameSparks, dropcam, yelp, Redfin, OOYALA, coinbase, wework, fuze, Shazam, Zillow, Spotify, 热云数据, asana, reddit, Easy Taxi, splunk>

ENTERPRISE

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PUBLIC SECTOR

Lockheed Martin, Claritas Genomics, NASA, University of Chicago, American Heart Association, YMR, Ministry of Justice, CDC, Harvard Medical School, Cleveland Clinic, coursera, USDA, FDA, FINRA, Penn, New York Public Library, LWV, wefarm, Royal Opera House, Landgate, 東京大学, Ocean Conservancy, King County, KAPLAN

SI AND ISV

Codeship, LOGGLY, GENESYS, freshdesk, 2nd Watch, databricks, CHEF, wipro, Adobe, accenture, clearscale, dedalus, Booz | Allen | Hamilton, Cognizant, Capgemini, CloudKinetics, leidos, slalom, ctp Cloud Technology Partners, logicworks

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AWS Global Infrastructure

AWS REGIONS, EDGE LOCATIONS, AND THE GLOBAL BACKBONE



REGIONAL EXPANSION

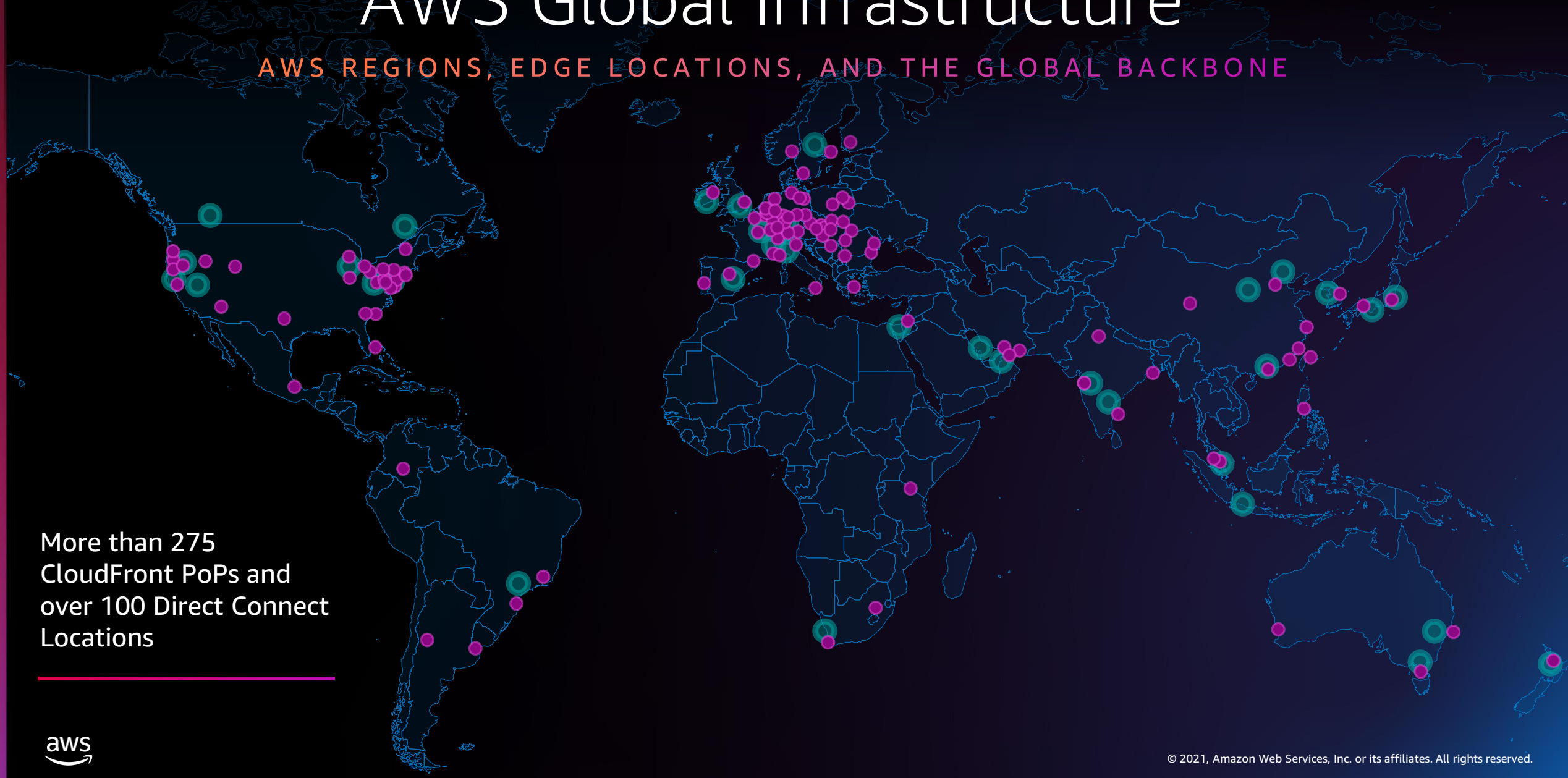
- First 5 years: 4 Regions
- Next 5 years: 7 Regions
- 2016–2020: 14 Regions
- Coming soon: 9 Regions

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AWS Global Infrastructure

AWS REGIONS, EDGE LOCATIONS, AND THE GLOBAL BACKBONE

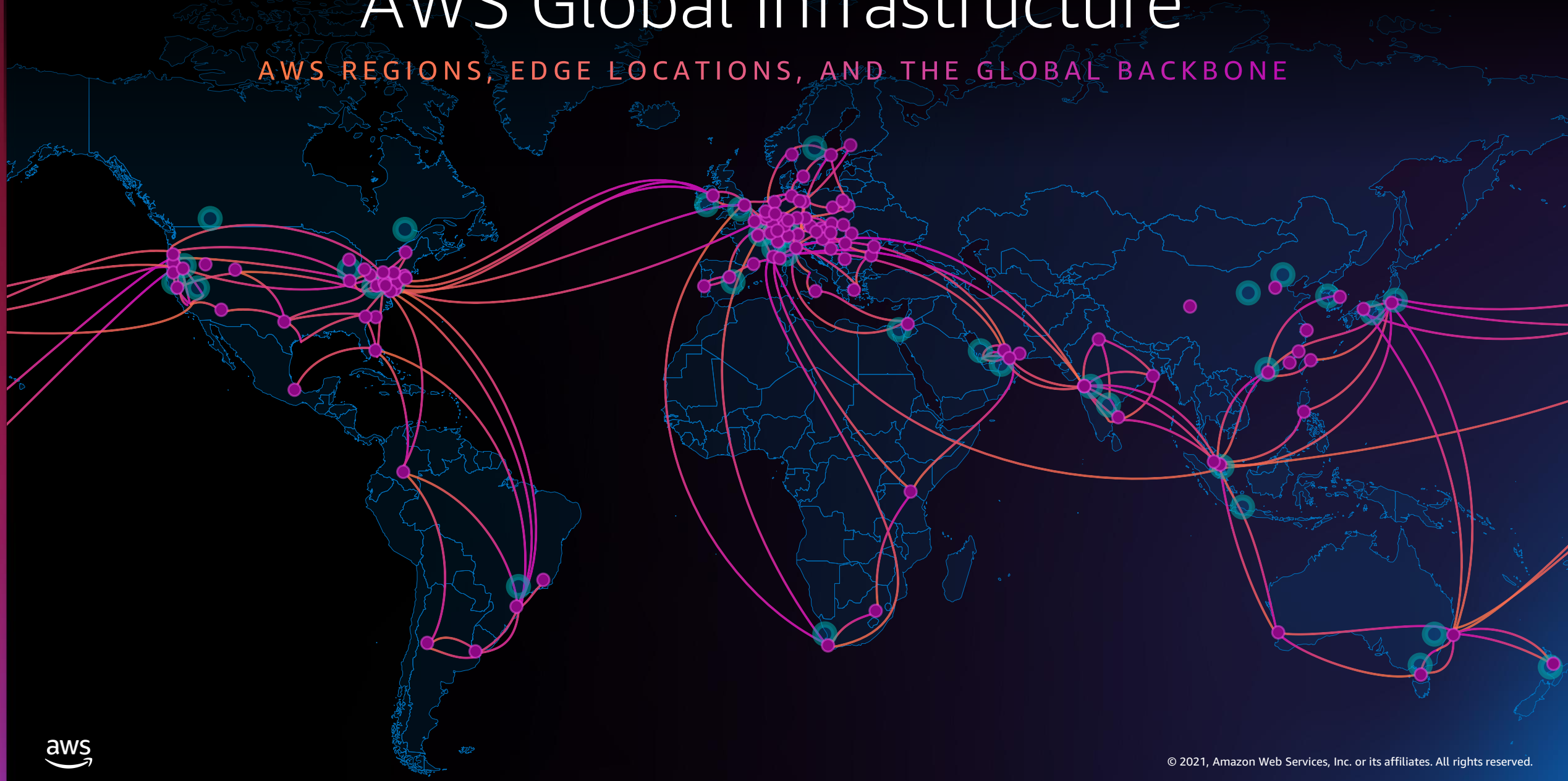


More than 275 CloudFront PoPs and over 100 Direct Connect Locations

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AWS Global Infrastructure

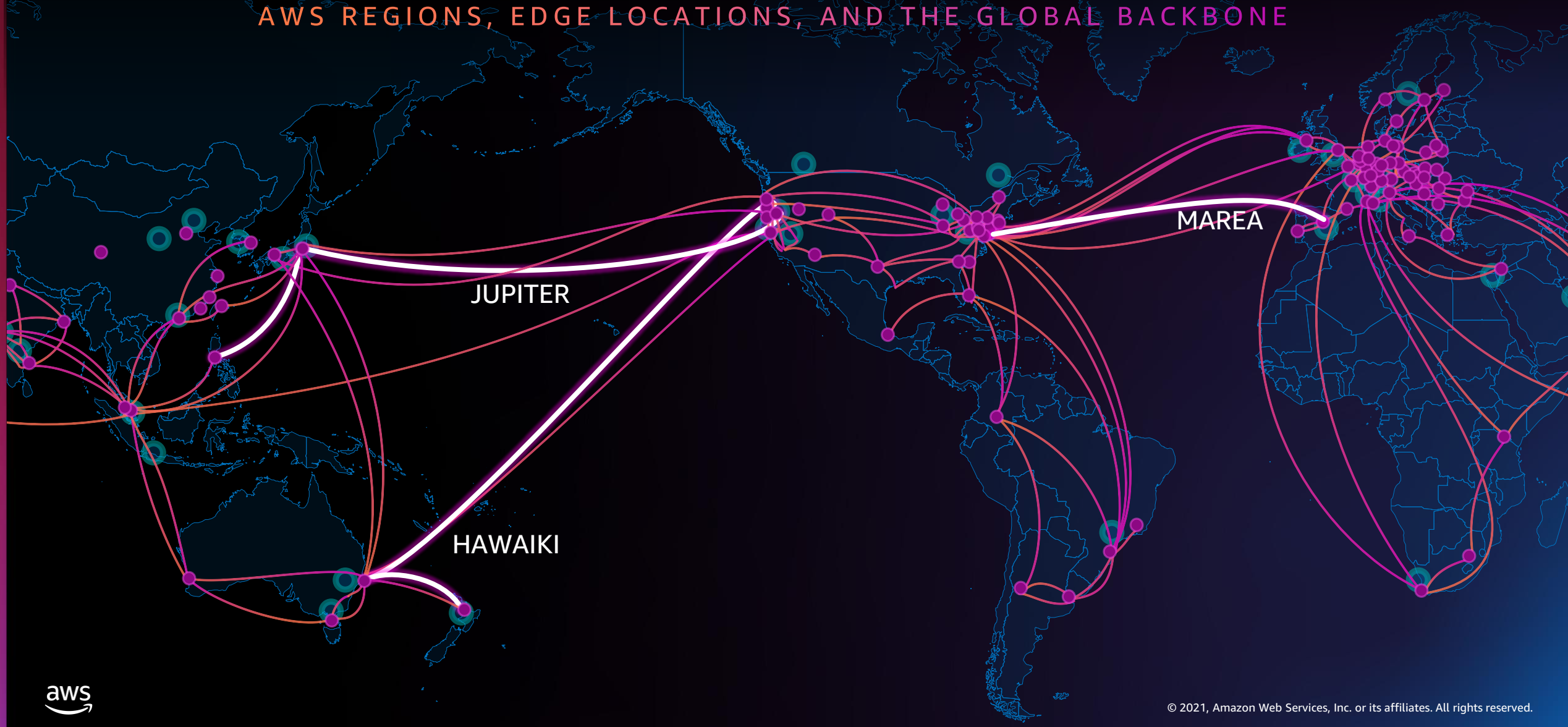
AWS REGIONS, EDGE LOCATIONS, AND THE GLOBAL BACKBONE



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Project Jupiter
Comment ケーブル埋設
管端~10m-50m
Location Shima Japan
Date June 26 2019


KOBELCO

AWS Region infrastructure

AWS REGIONS, EDGE LOCATIONS, AND THE GLOBAL BACKBONE



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AWS Region infrastructure

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2021



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2006



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EC2 LAUNCHED

Amazon EC2 launched on August 26th, 2006 with a single Region in Northern Virginia



EC2 CLASSIC

Single flat subnet for all EC2 instances, protected using security groups



DIRECT ADDRESSING

Each instance had a public IP address and was directly exposed to the Internet

2006

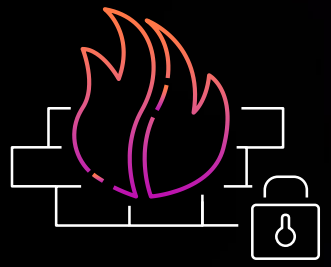


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2007



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PRIVATE ADDRESSING

Private addressing was launched in early 2007 and introduced private IP addresses



SCALING

In May 2007, we started to observe scaling challenges with the NAT devices



RATE OF CHANGE

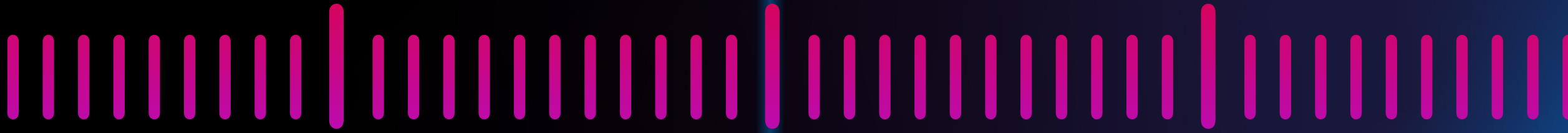
Network devices see a much higher rate of change within the cloud than traditional data centers

2007



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2008

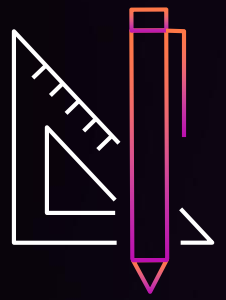


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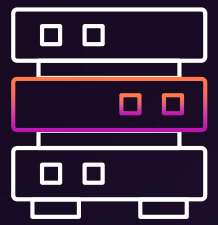
ELASTIC IP

We launched Elastic IP addressing in April of 2008, which led to further scaling challenges



CUSTOM HARDWARE

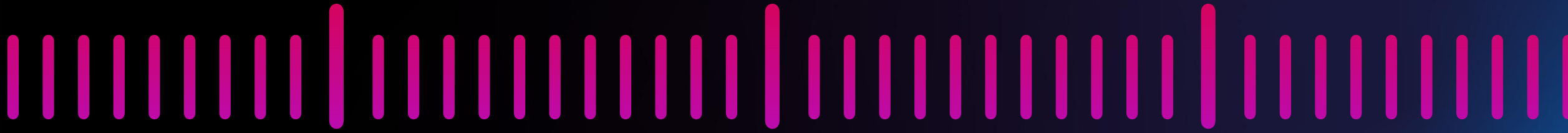
To address the scaling challenges, we started experimenting with custom network hardware



BLACKFOOT

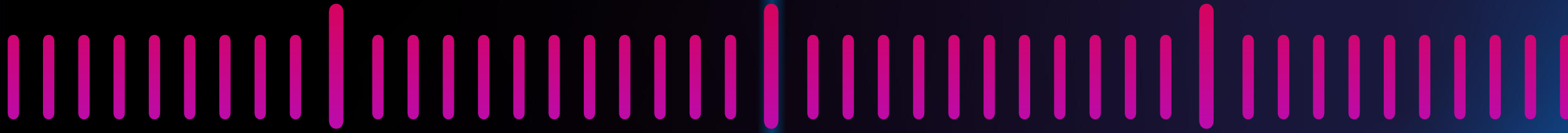
Our first device was a NAT translation layer built on a Linux server

2008

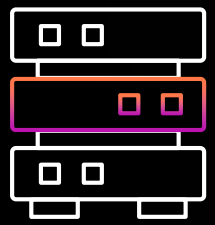


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2009

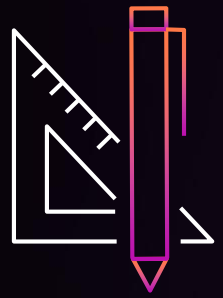


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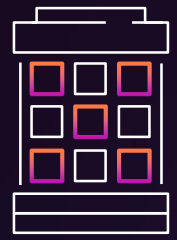
BLACKFOOT

Our custom NAT devices deployed to production, replacing the traditional networking gear



PERFORMANCE

Our simplified approach provided lookup times of less than 1ms, better than anything else at the time



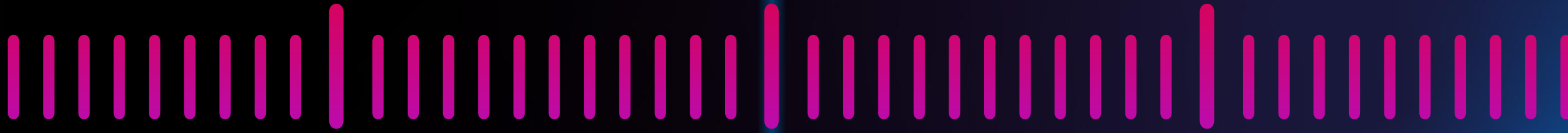
BUILDING

In fact, Blackfoot was so successful that we named our first AWS building after it, and it is still used today

2009

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2010

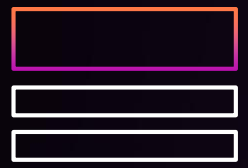


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CUSTOM HARDWARE

Our experience with Blackfoot, helped solidify our plan to invest broadly in custom network hardware



TOP OF RACK

Single chip network devices that performed a relatively simple, but critical, function



TWO PIZZA TEAM

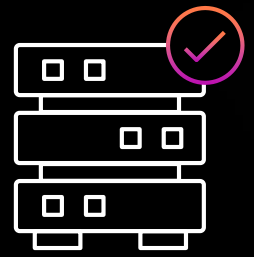
Formed a small two-pizza team to take us from first line of code to production in 10 months

2010

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Rapid innovation in custom hardware

CORE CONCEPTS THAT ALLOWED US TO MOVE QUICKLY



SIMPLE DESIGN

We intentionally kept our software extremely simple, choosing to never implement features that we did not actually need



AVAILABILITY

We designed for high availability, reducing impact to the network when devices are added or removed from service



CONTROL

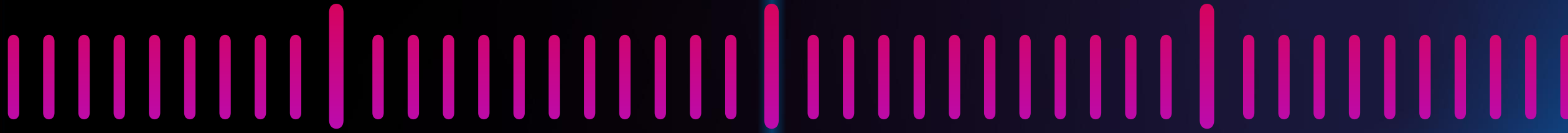
Having complete control of the hardware and software in the network lowered costs, improved security, reliability and performance

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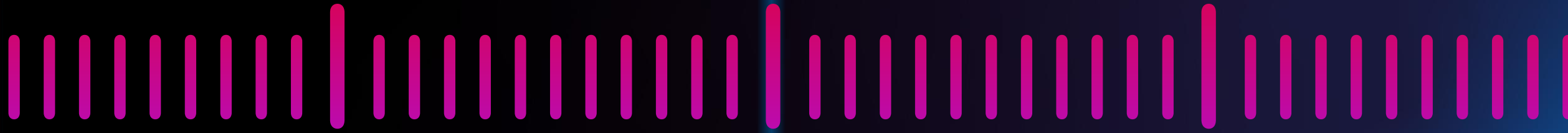
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2010



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2011



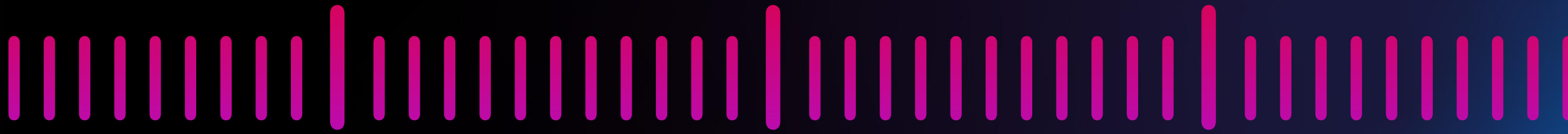
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10 GBPS

100 GBPS

400 GBPS

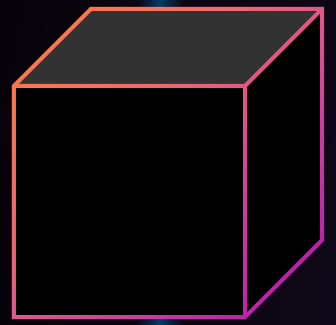
2011



aws

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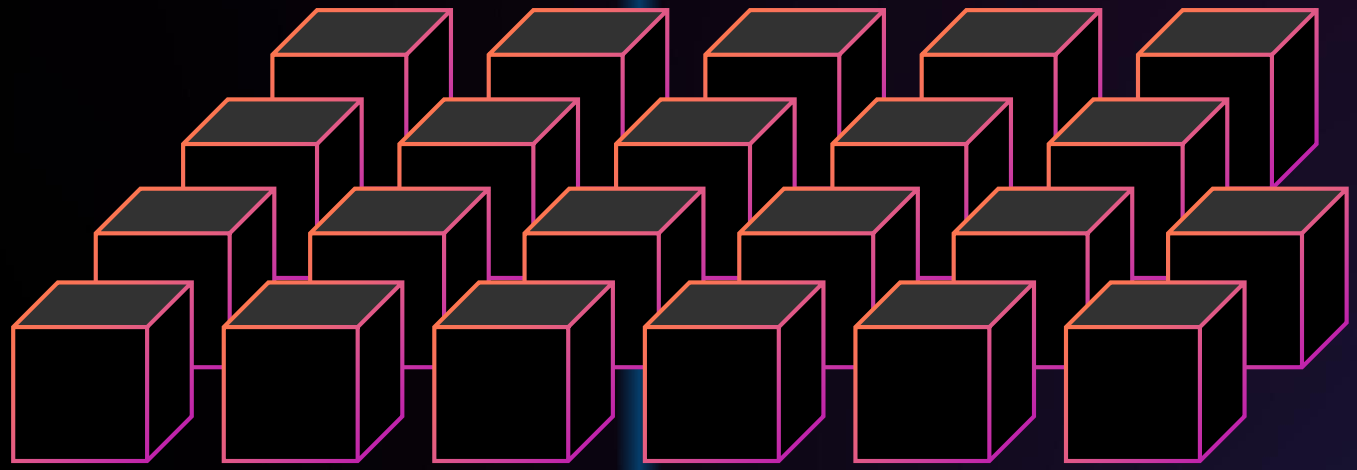
460
TBPS



2013

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10,000
TBPS



2019

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11 TRILLION

2021

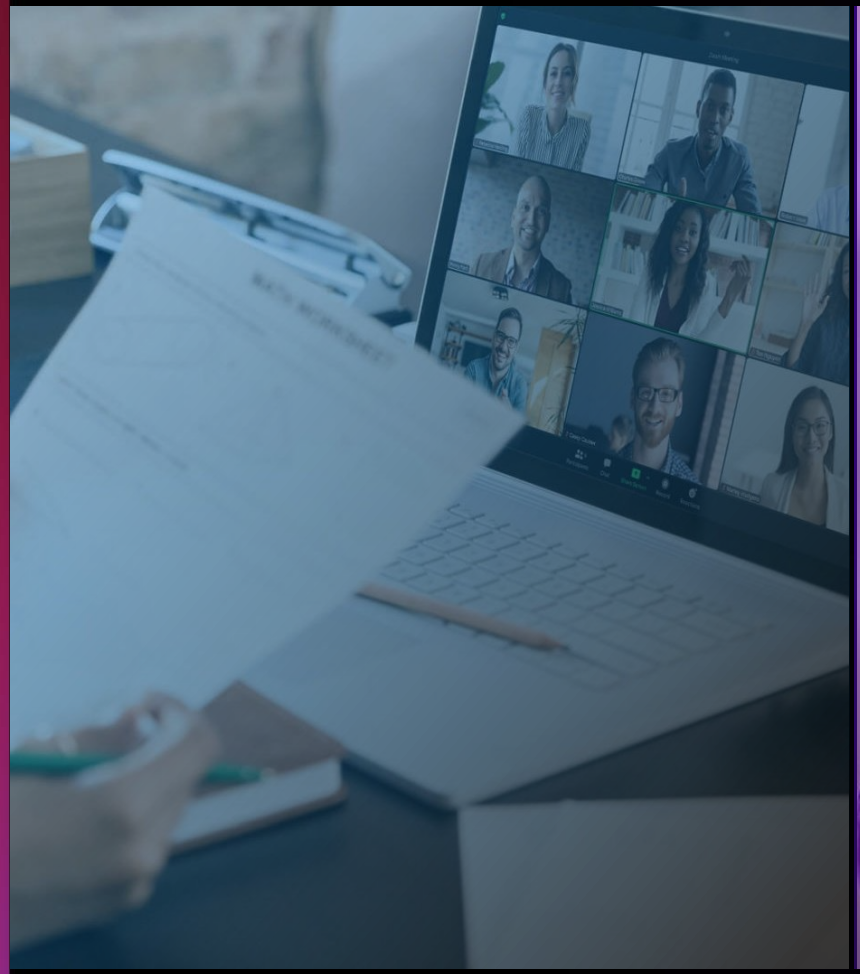


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zoom

PELOTON

robinhood







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Bringing AWS closer to you

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2

Highest performance

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The AWS Nitro System architecture

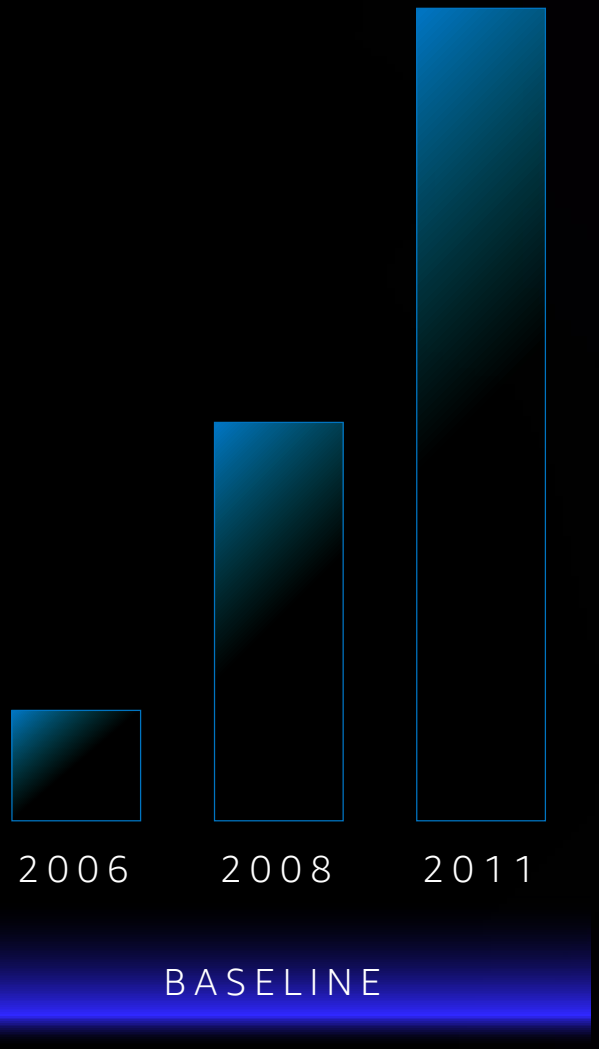
OFFERING THE BEST SECURITY, PERFORMANCE, AND INNOVATION IN THE CLOUD



aws

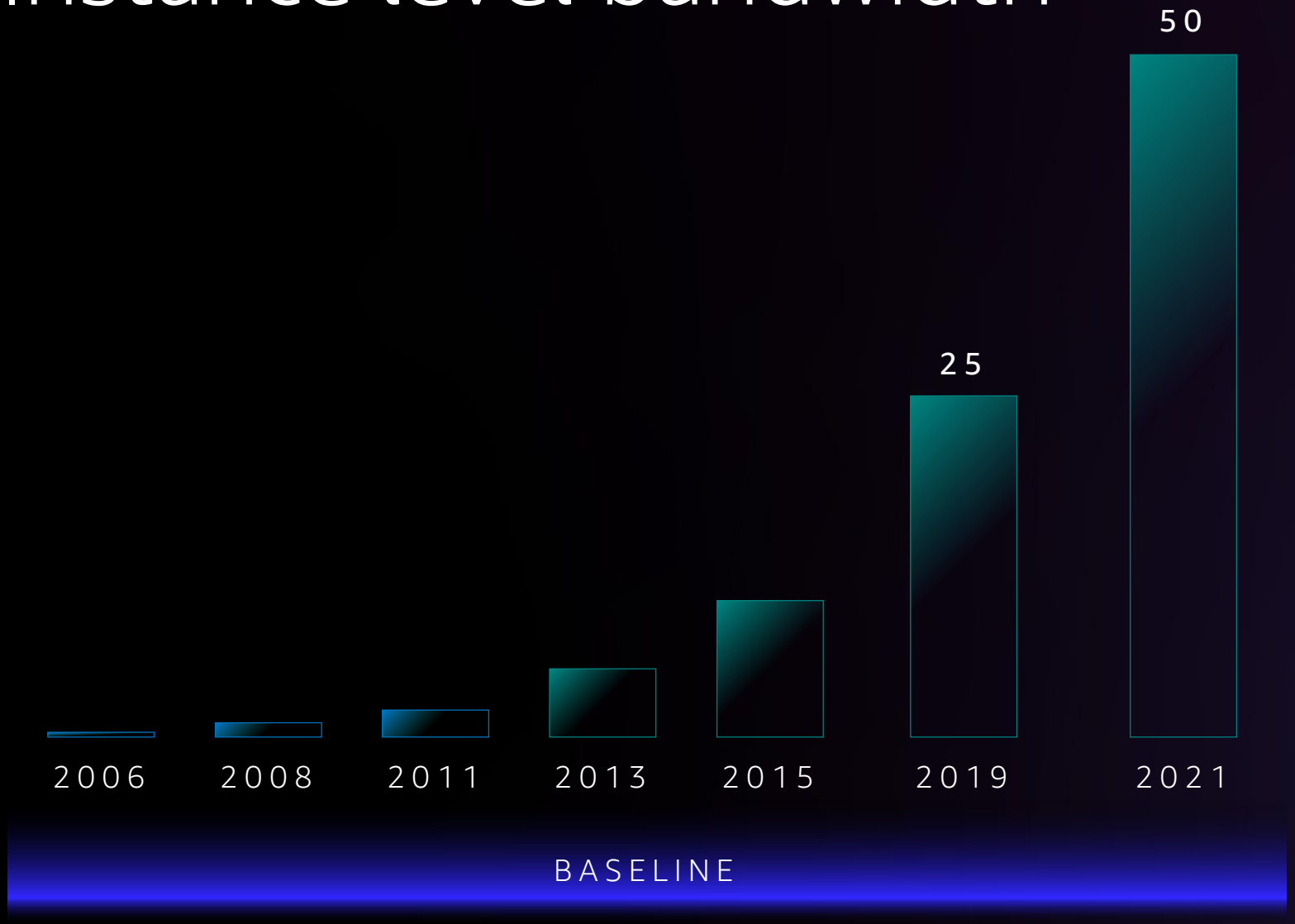
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Instance level bandwidth



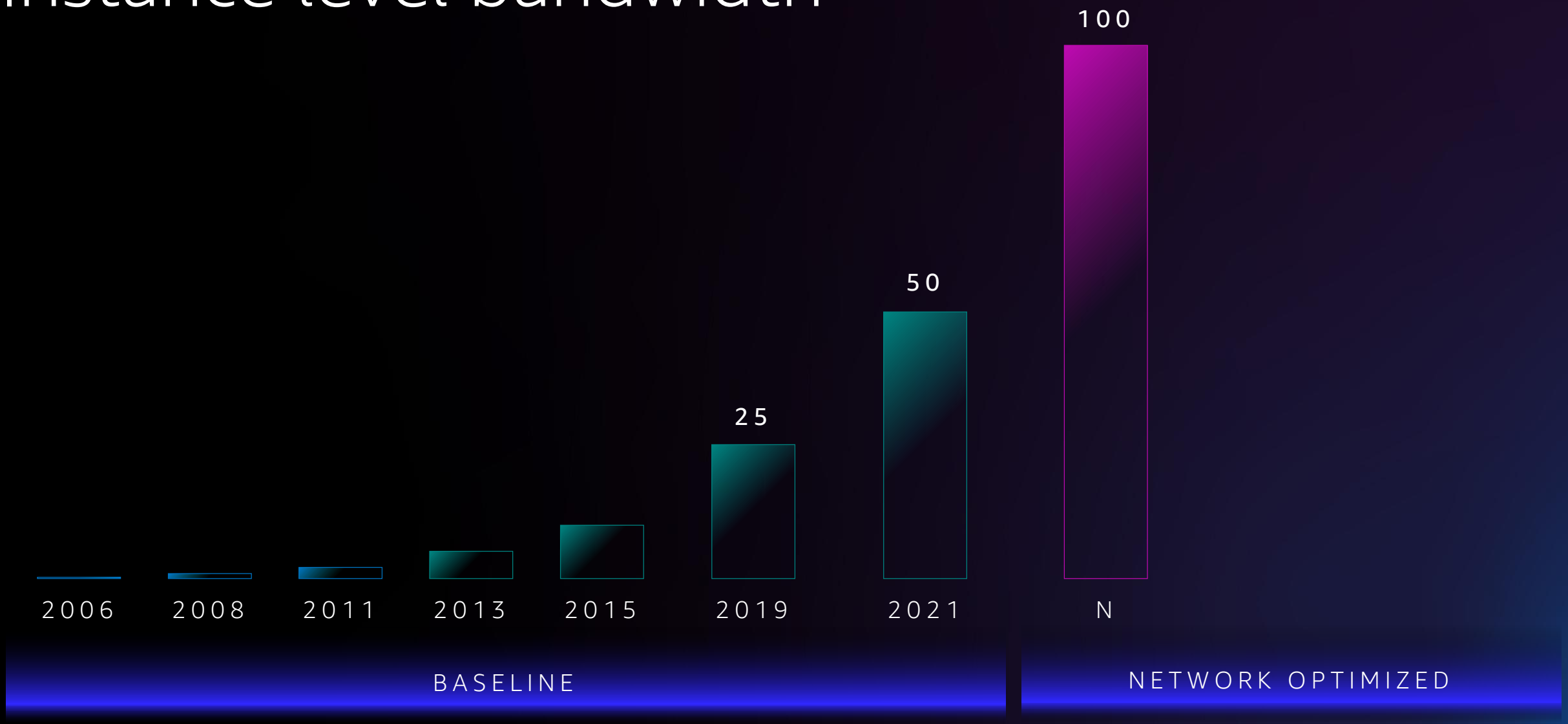
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Instance level bandwidth



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Instance level bandwidth



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Instance level bandwidth



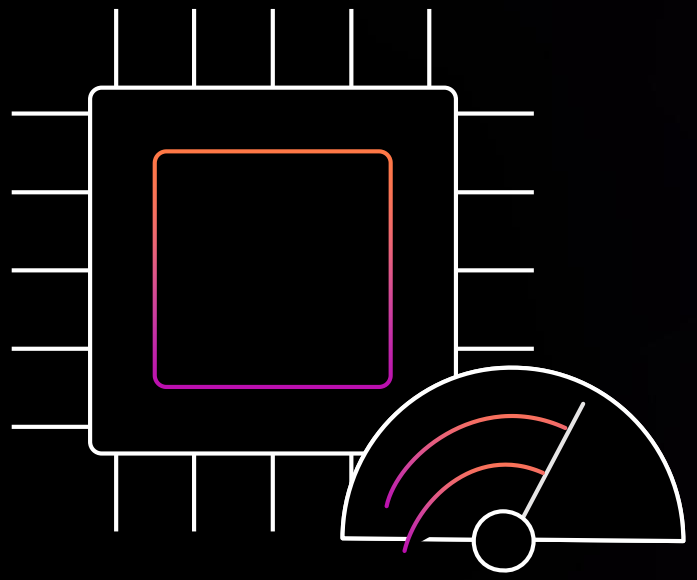
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NEW!

AVAILABLE NOW

Amazon EC2 instance bandwidth

UP TO 50 GBPS OF BANDWIDTH TO THE INTERNET, DIRECT CONNECT, AND OTHER AWS REGIONS



- Increased Bandwidth per instance to the Internet
- Higher bandwidth between applications running in multiple regions
- Faster data transfer over Direct Connect

aws

NEW!

AVAILABLE NOW

AWS Direct Connect 100 Gbps connections

100 GBPS DEDICATED CONNECTIONS TO SUPPORT YOUR PRIVATE CONNECTIVITY NEEDS



High bandwidth connectivity between AWS and your data center

Simplified operations without the overhead of managing multiple 10 Gbps connections

Secure and private with MACsec encryption enabled

aws

Exabyte Scale

NETWORKING AT 100 GBPS SCALE

ByteDance

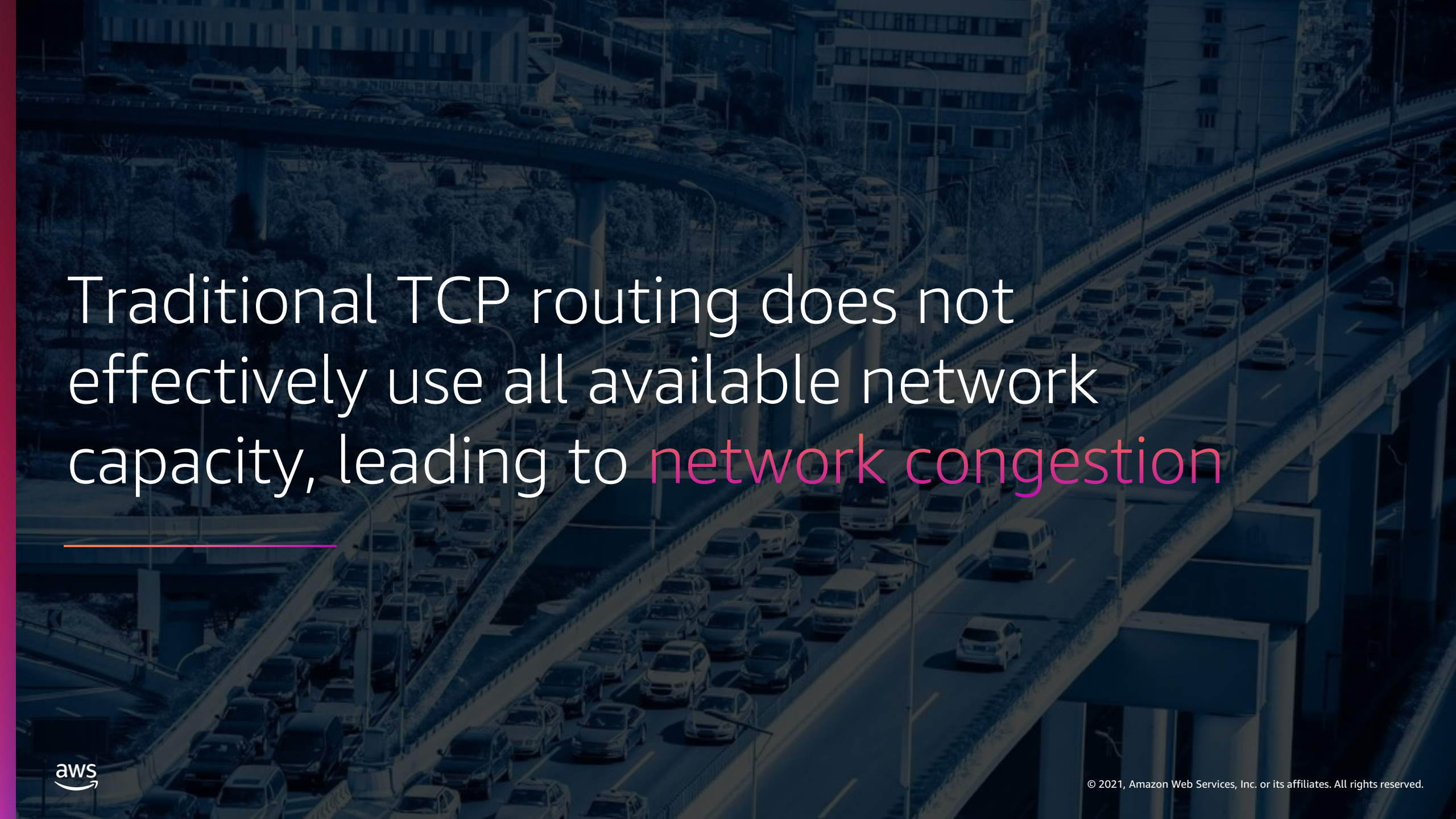
"To support ByteDance applications, we need high speed, low-latency connections capable of sending exabytes of data around the world.

We chose AWS Direct Connect for its performance, global footprint, and 100 Gbps connections. This makes our apps more responsive and ensures there are no limits on what our customers can bring to life."



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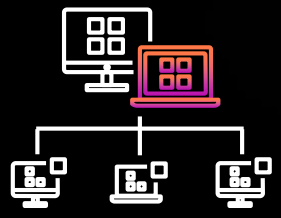
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Scalable Reliable Datagram (SRD)

LOW LATENCY FOR NETWORK-INTENSIVE APPLICATIONS



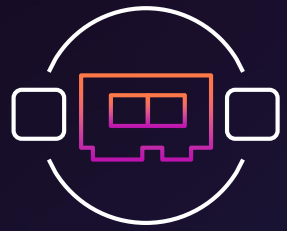
ETHERNET-BASED PROTOCOL

SRD leverages the massive investment that AWS has in Ethernet-based connectivity



NEGATES IN-ORDER PACKET DELIVERY

Packets are sent over all possible pathways in the fabric at once



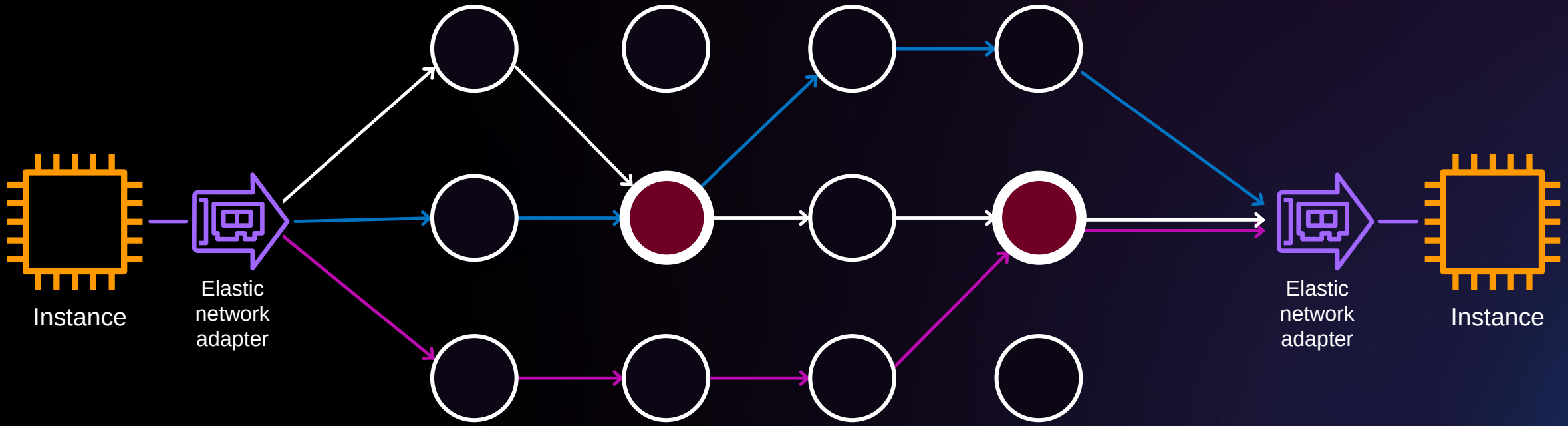
ELASTIC FABRIC ADAPTER

Underlying protocol supporting EFA for network-intensive applications

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Scalable Reliable Datagram (SRD)

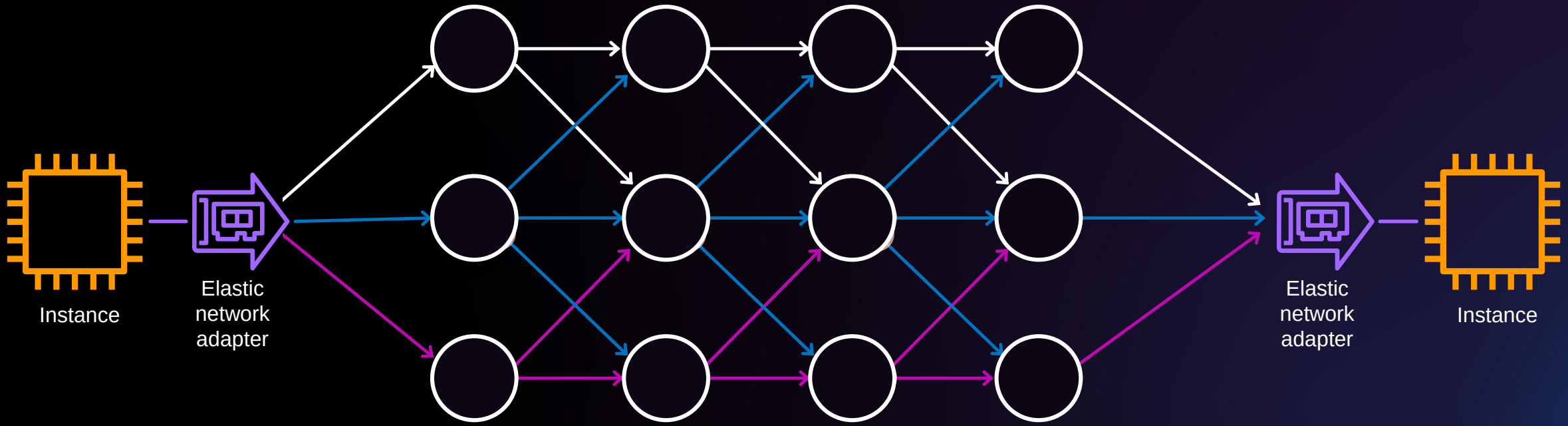
LOW LATENCY FOR NETWORK-INTENSIVE APPLICATIONS



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Scalable Reliable Datagram (SRD)

LOW LATENCY FOR NETWORK-INTENSIVE APPLICATIONS



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Supporting live broadcast

MICROSECOND NETWORK LATENCIES

FOX

"We recently accomplished uncompressed live video in the cloud.

Previously that wasn't possible with any cloud provider.

We've been able to accomplish that with AWS recently, and it's really going to enable our business to fully move into the cloud."

aws

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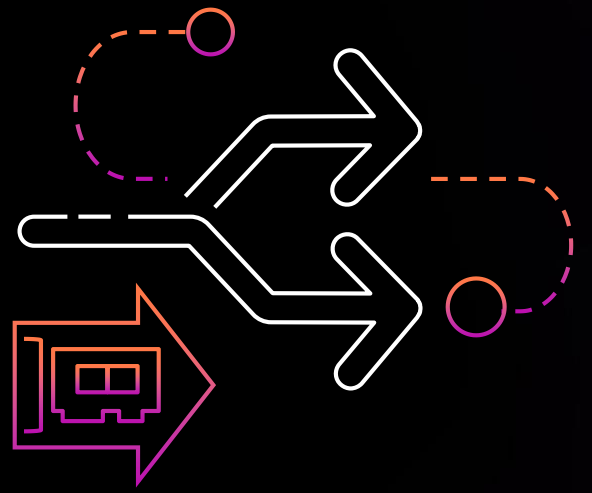


NEW!

COMING SOON

SRD for Elastic Networking Adapter (ENA)

INCREASED NETWORK PERFORMANCE WITH THE SCALABLE RELIABLE DATAGRAM (SRD) PROTOCOL



300% increase in single flow bandwidth

Up to 90% reduction in tail latency

Transparent to mainstream applications

aws

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Bringing AWS closer to you

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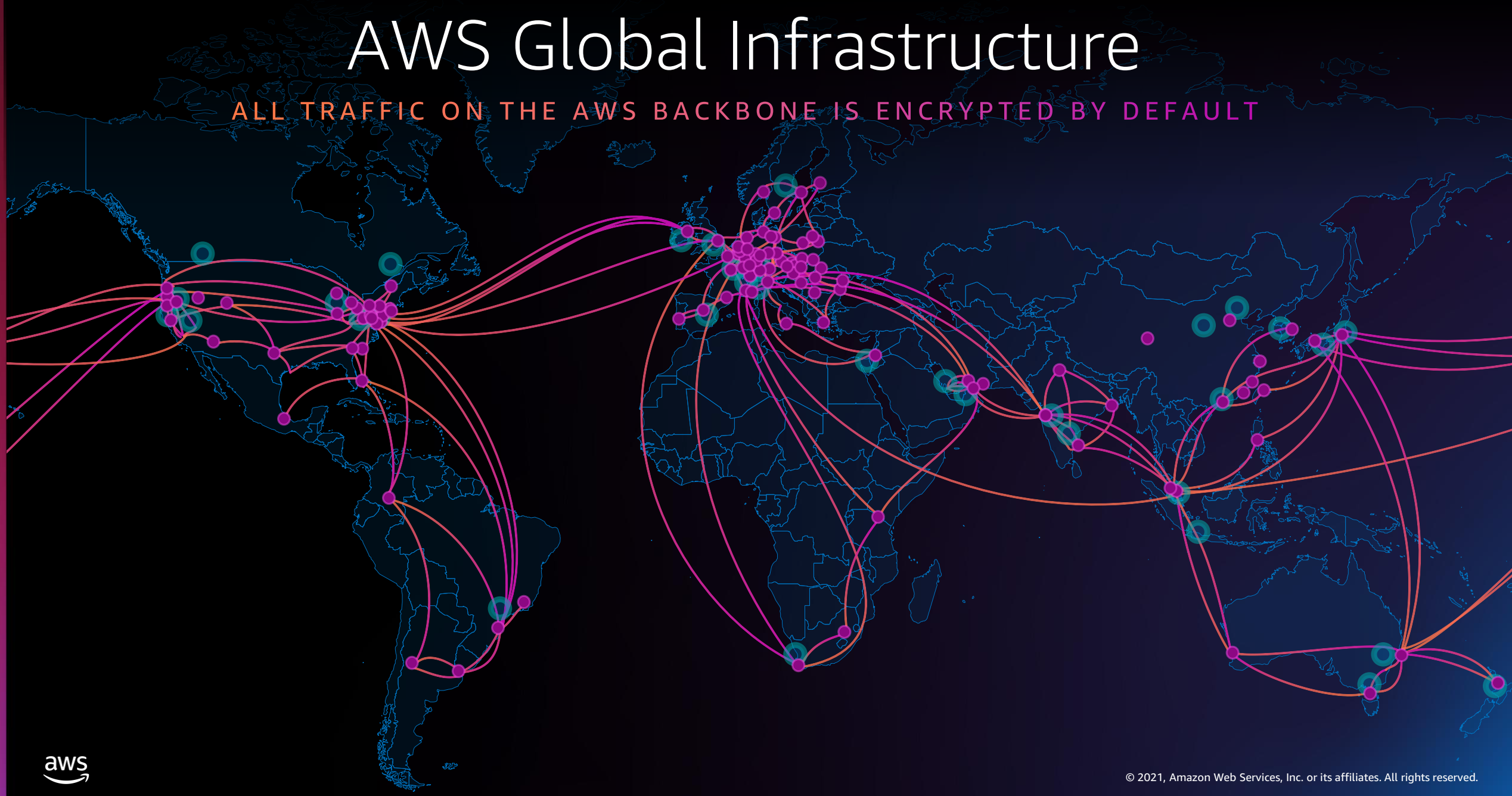


Most secure

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AWS Global Infrastructure

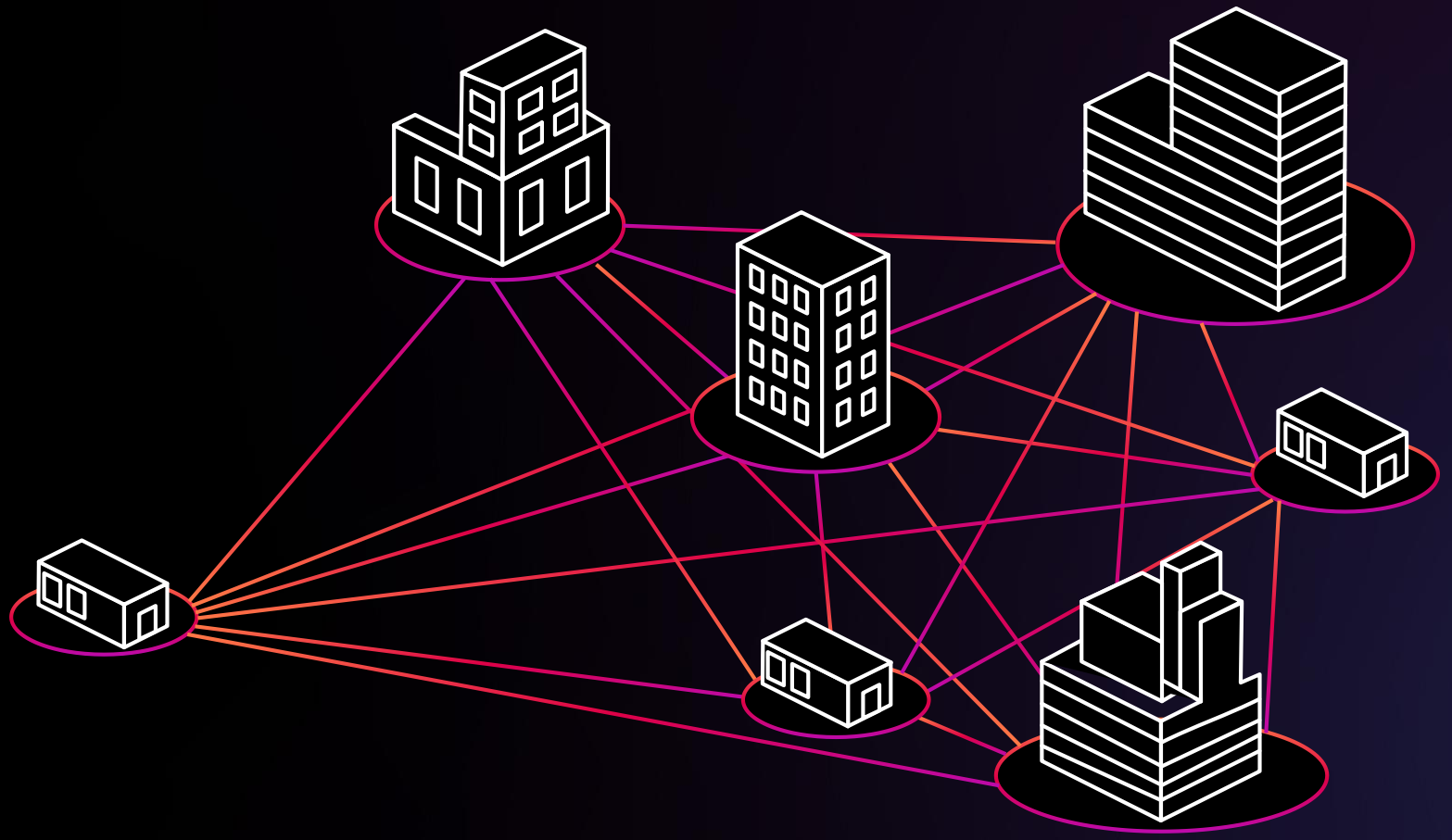
ALL TRAFFIC ON THE AWS BACKBONE IS ENCRYPTED BY DEFAULT



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AWS Region infrastructure

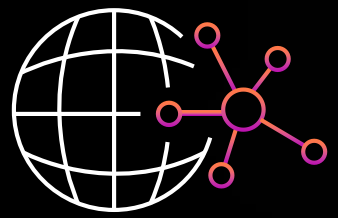
ALL TRAFFIC BETWEEN AVAILABILITY ZONES IS ENCRYPTED BY DEFAULT



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Protection at every level

WE PUT SECURITY AT THE CENTER OF EVERYTHING WE DO



CROSS-REGION

Traffic sent between regions with VPC Peering or TGW Peering is encrypted by default



BETWEEN INSTANCES

Some instance types use the offload capabilities of the Nitro Sysem hardware to automatically encrypt in-transit traffic between instances



TO YOUR DATACENTER

Use IPsec VPN tunnels or Direct Connect MACsec support to ensure that traffic between AWS and your locations remains protected



APPLICATION TRAFFIC

We make it easy for you to encrypt your application traffic with TLS

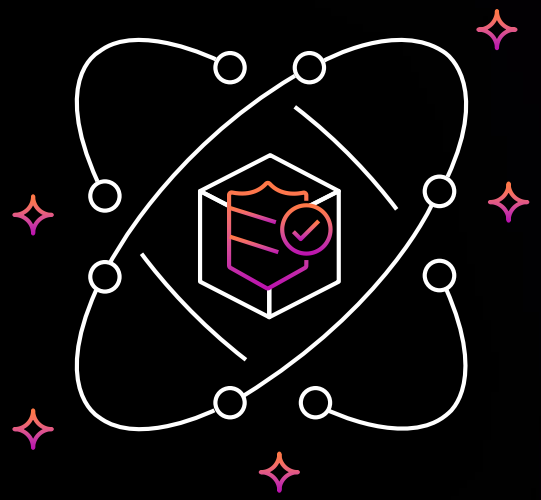
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NEW!

AVAILABLE NOW

Quantum Safe Encryption

PROTECT YOUR DATA IN TRANSIT WITH QUANTUM SAFE CRYPTOGRAPHY



All physical links leaving Amazon controlled facility encrypted with AES-256 encryption

AES-256 VPC encryption with quantum safe key exchange

Hybrid post-quantum key exchange with AWS KMS

aws

Many customers want to use third party security appliances that they may have used in their on-premises networks

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Third party security appliances

BROAD SET OF SECURITY APPLIANCES IN THE AWS MARKETPLACE

paloalto NETWORKS

FORTINET

Check Point SOFTWARE TECHNOLOGIES LTD

TREND MICRO

NETSCOUT

GLASNOSTIC

cpacket NETWORKS

aviatrix

CISCO

HashiCorp Terraform

radware

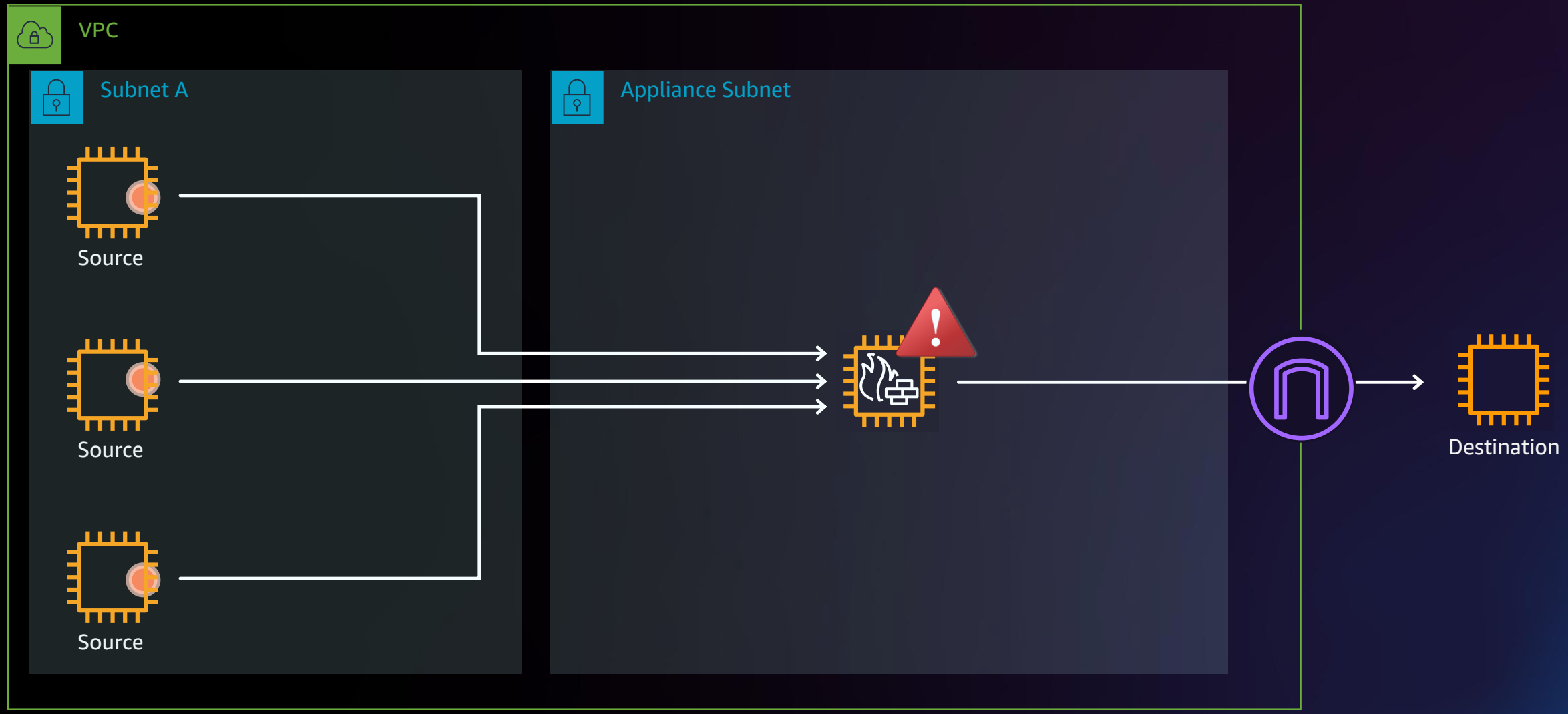
VALTIX

aws marketplace

aws

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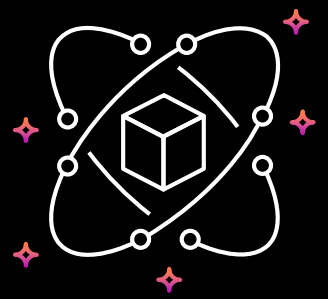
Third party security appliances



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Gateway Load Balancer

DEPLOY, SCALE, AND RUN THIRD-PARTY VIRTUAL APPLIANCES



FASTER DEPLOYMENTS

Continue using the appliances and tools you are familiar with, or look for something new. It's as simple as choosing a third-party virtual appliance in the AWS Marketplace.



AUTOMATIC SCALING

To prevent bottlenecks, Gateway Load Balancer automatically scales your virtual appliances up, or down, based on demand.



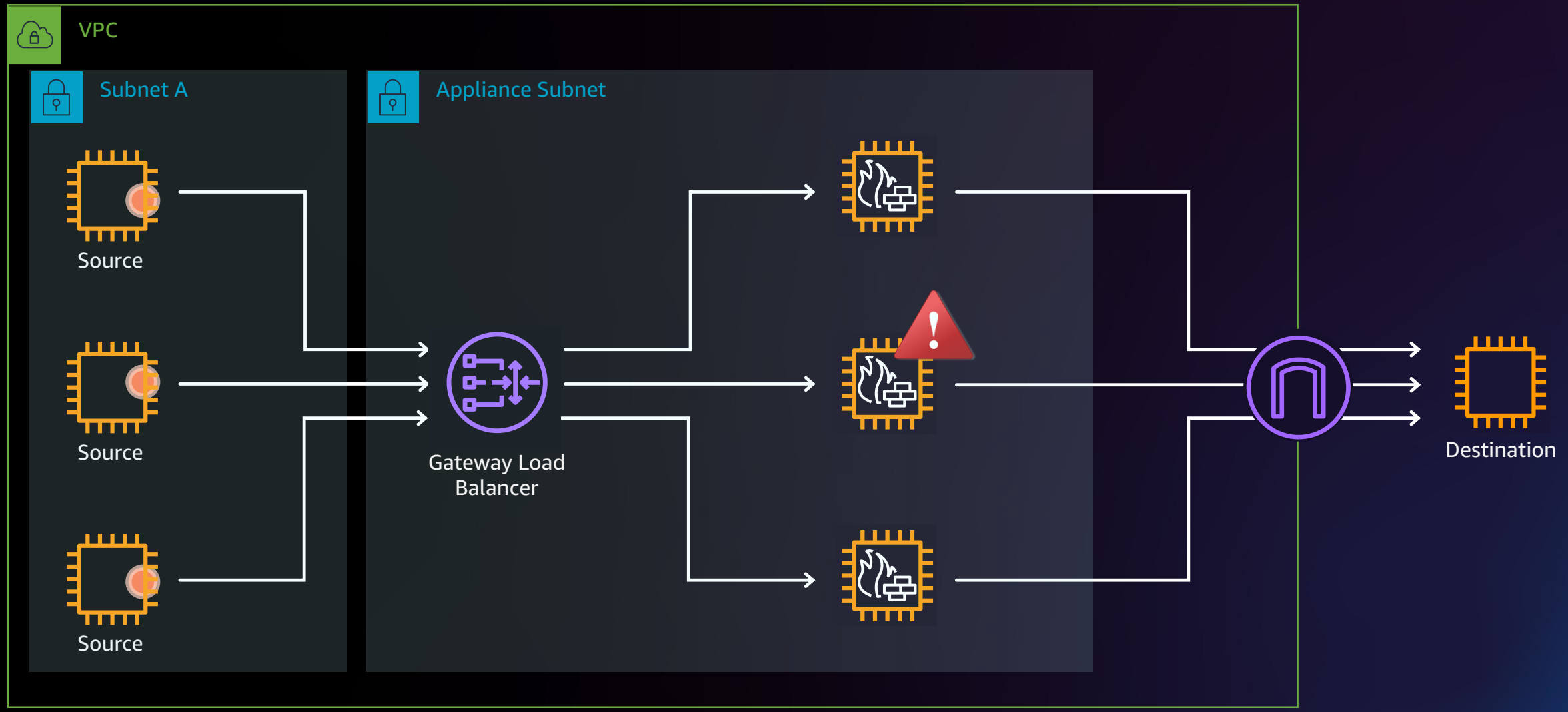
HIGH AVAILABILITY

To improve virtual appliance availability, Gateway Load Balancer routes traffic away from unhealthy instances so that you experience graceful failovers

aws

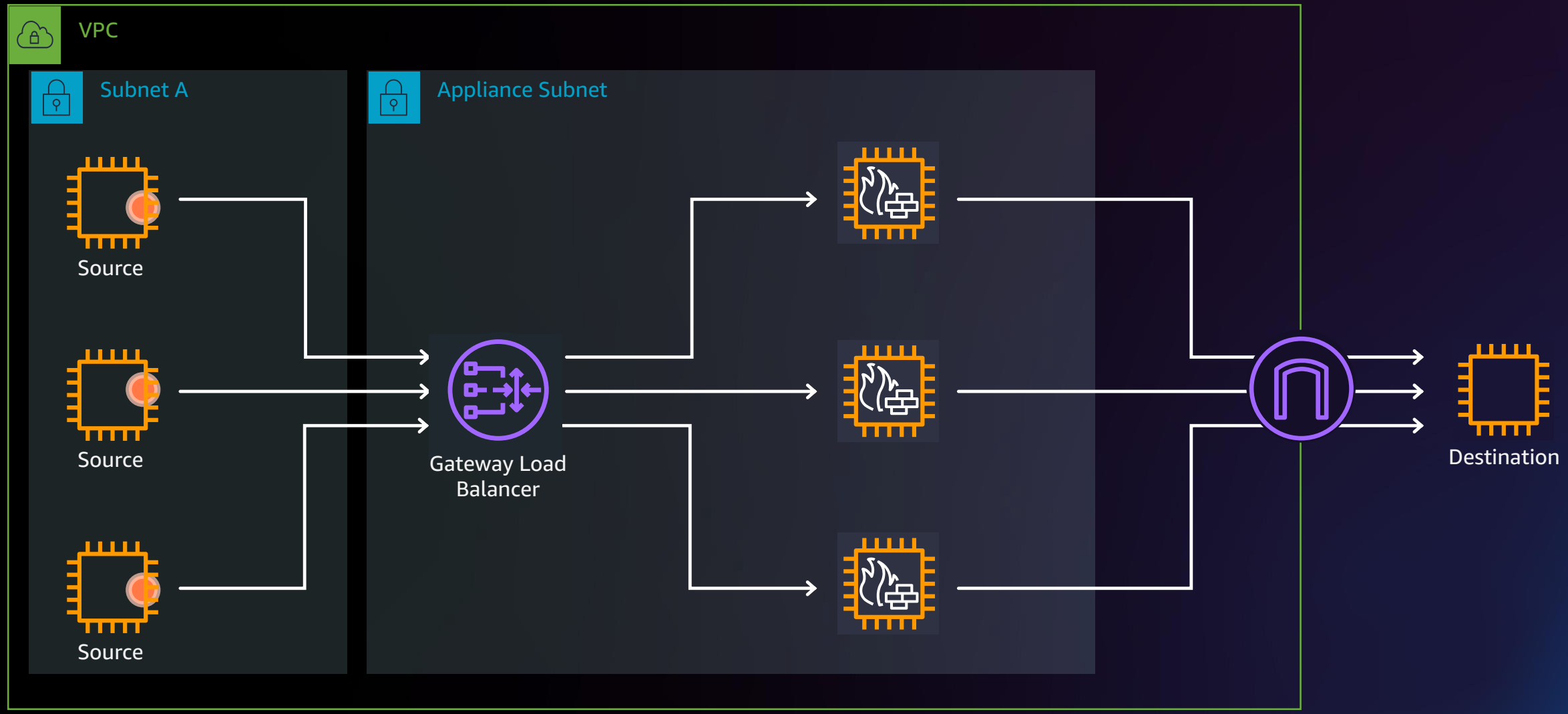
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Third party security appliances



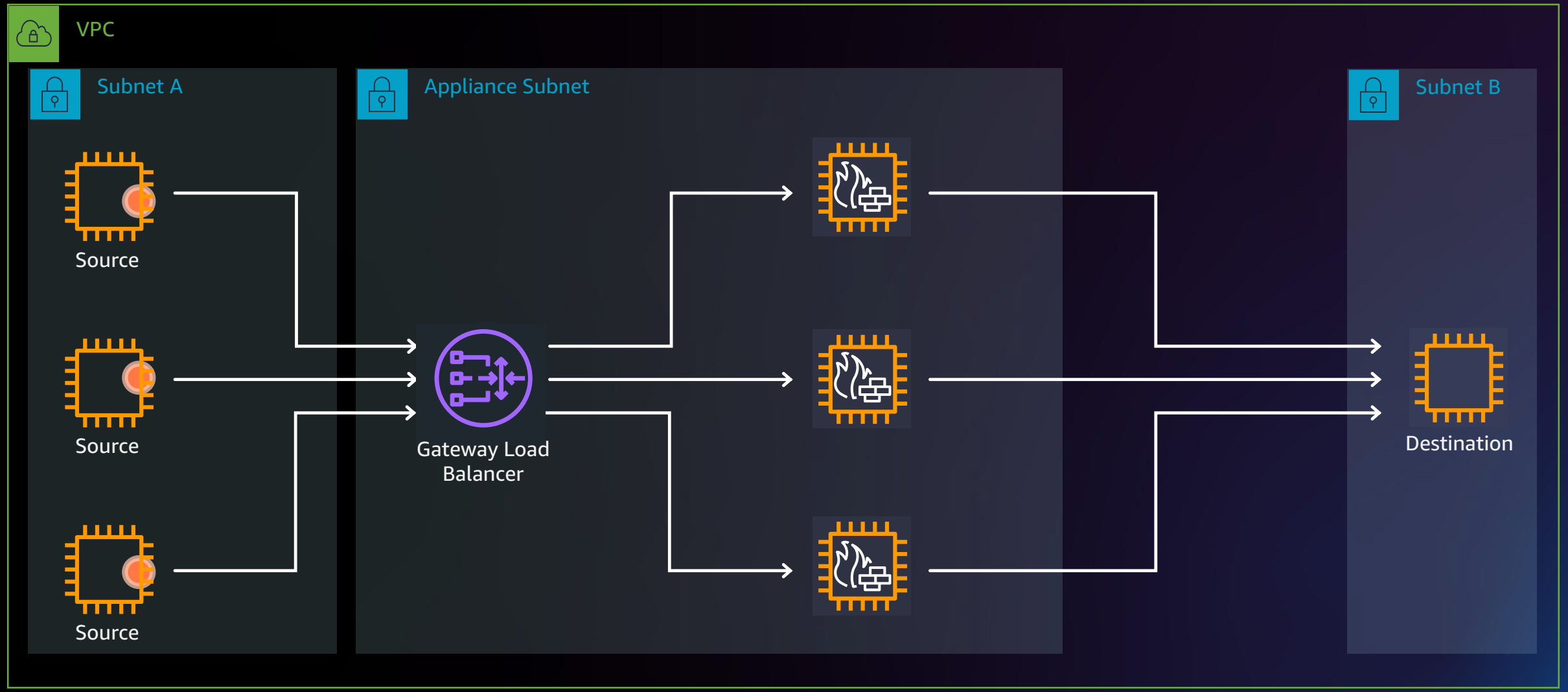
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North-south traffic



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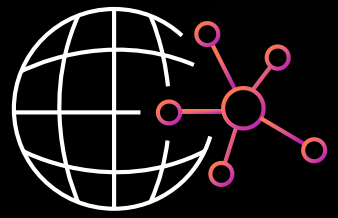
East-west traffic



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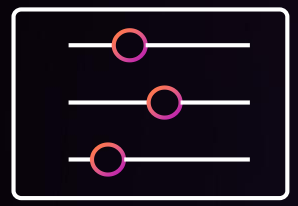
AWS Network Firewall

DEPLOY NETWORK SECURITY ACROSS YOUR AMAZON VPCS WITH JUST A FEW CLICKS



HIGH AVAILABILITY

Automatically scales with your network traffic and can support hundreds of thousands of connections



FLEXIBLE PROTECTION

Highly flexible rules engine that supports thousands of custom rules written in common open source rule formats.



REAL-TIME MONITORING

AWS Network Firewall provides real-time firewall activity monitoring through Amazon CloudWatch metrics.

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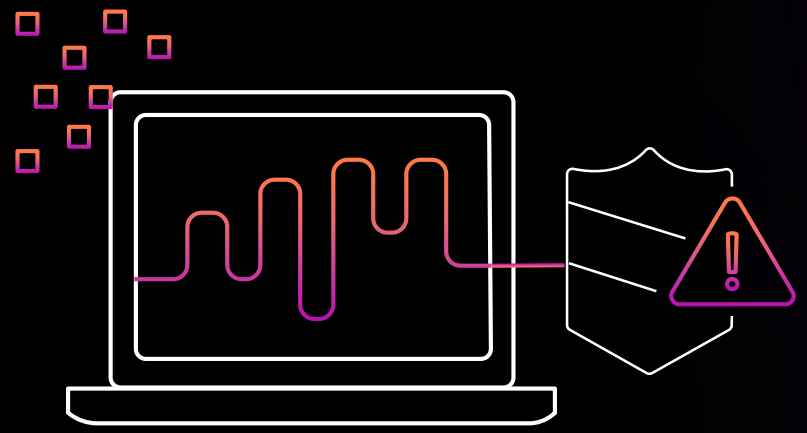
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NEW!

NEW LAUNCH

Amazon VPC Network Access Analyzer

IDENTIFY NETWORK CONFIGURATIONS THAT VIOLATE YOUR SECURITY OR COMPLIANCE REQUIREMENTS

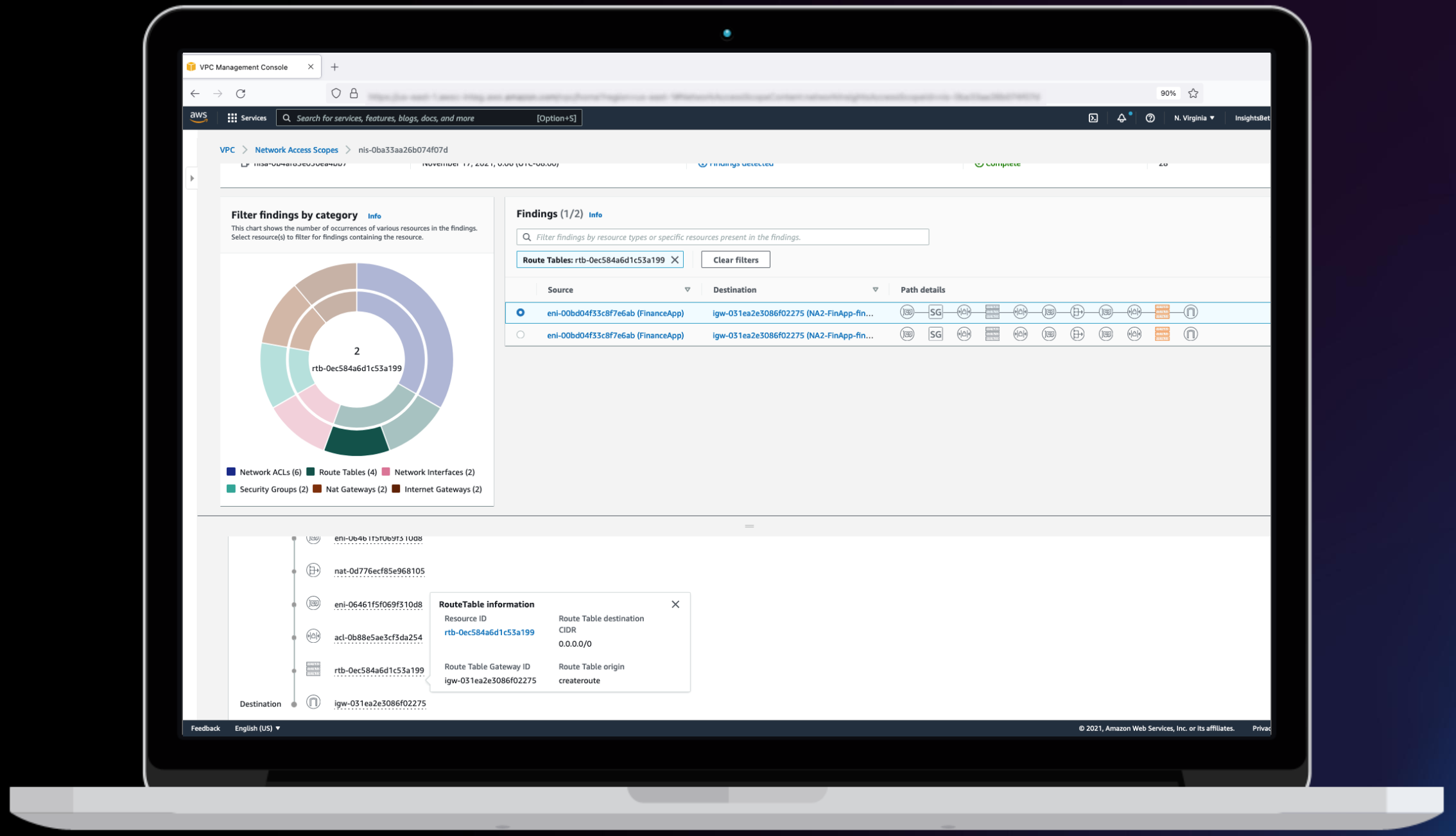


Understand network access to your critical resources

Identify network access that does not meet your security requirements

Automate compliance verification

aws



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1

Largest, most scalable global network

2

Highest performance

3

Most secure

4

A network for every workload

5

Bringing AWS closer to you

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4

A network for every workload

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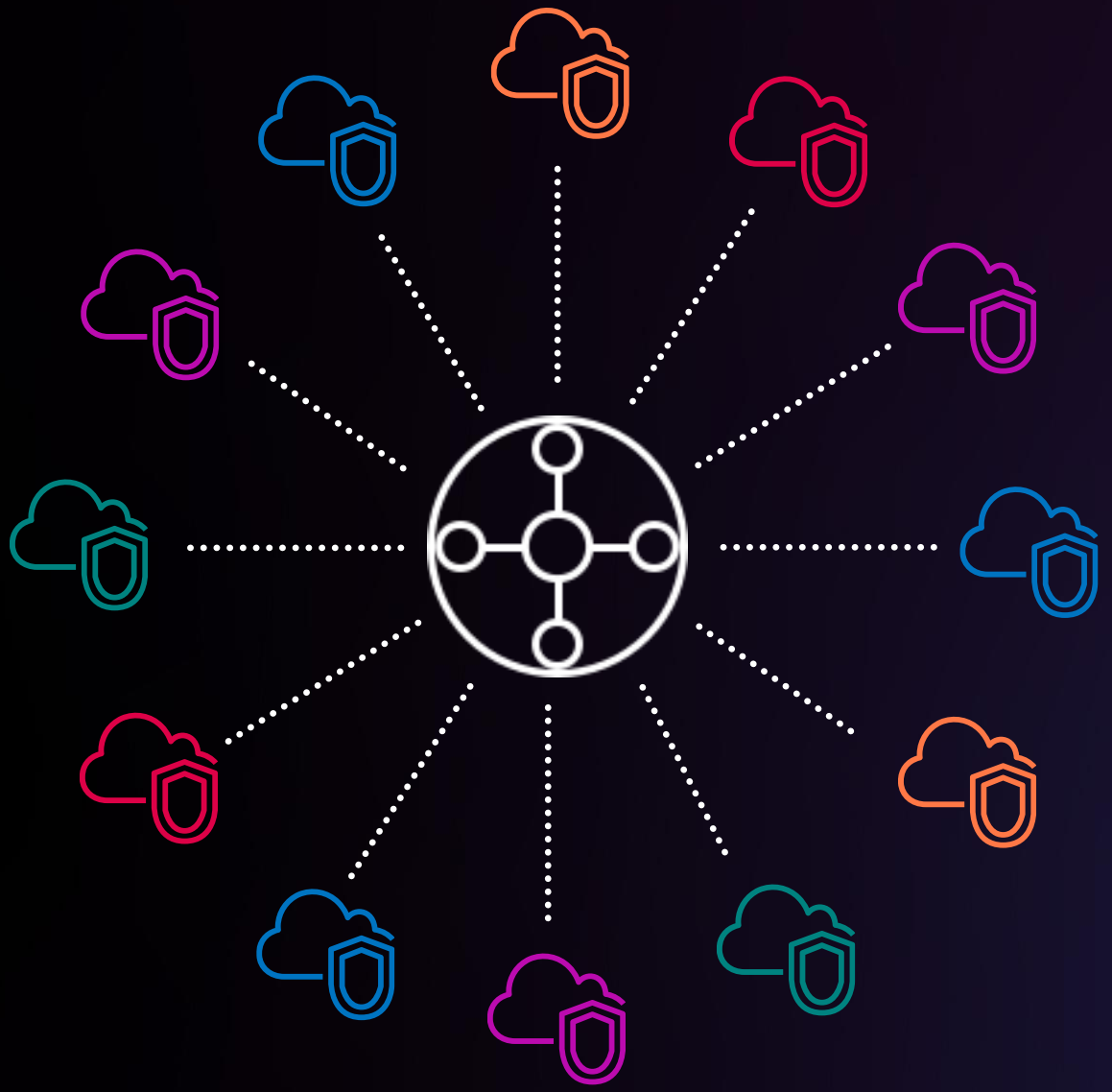
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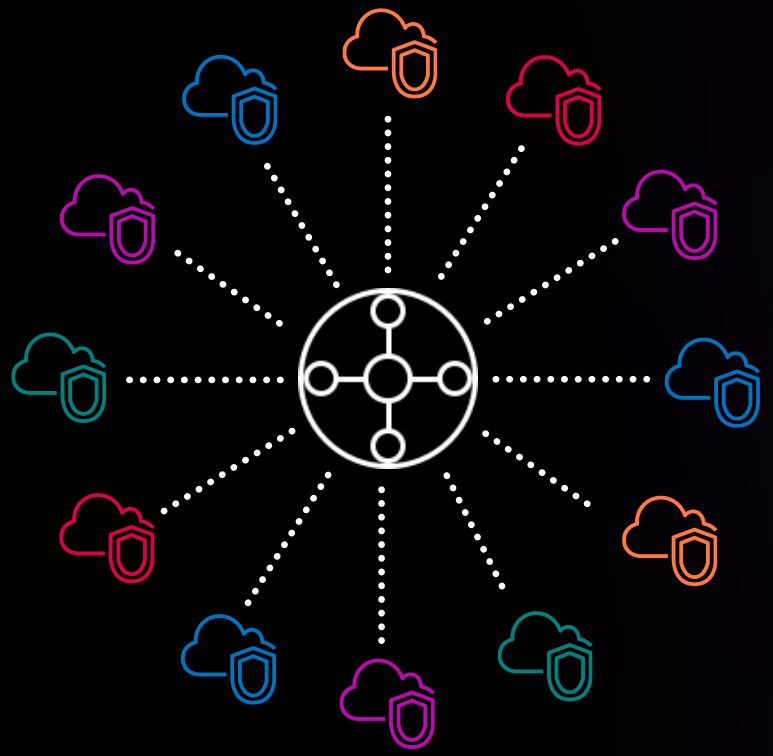
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Margaret Valtierra

Program Manager, Morningstar



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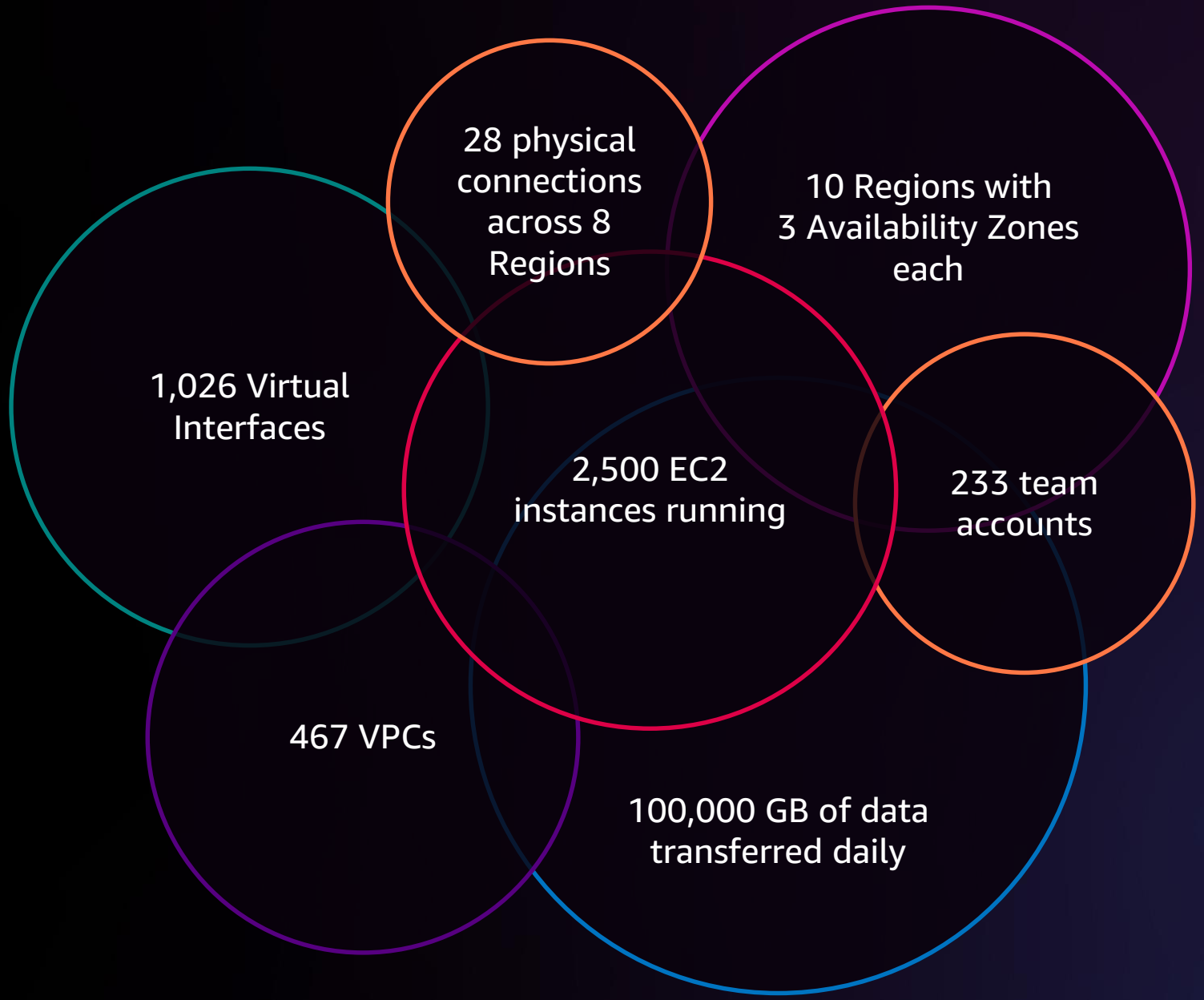
Team structure



@margaretvaltie

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Network challenges at scale

@margaretvaltie

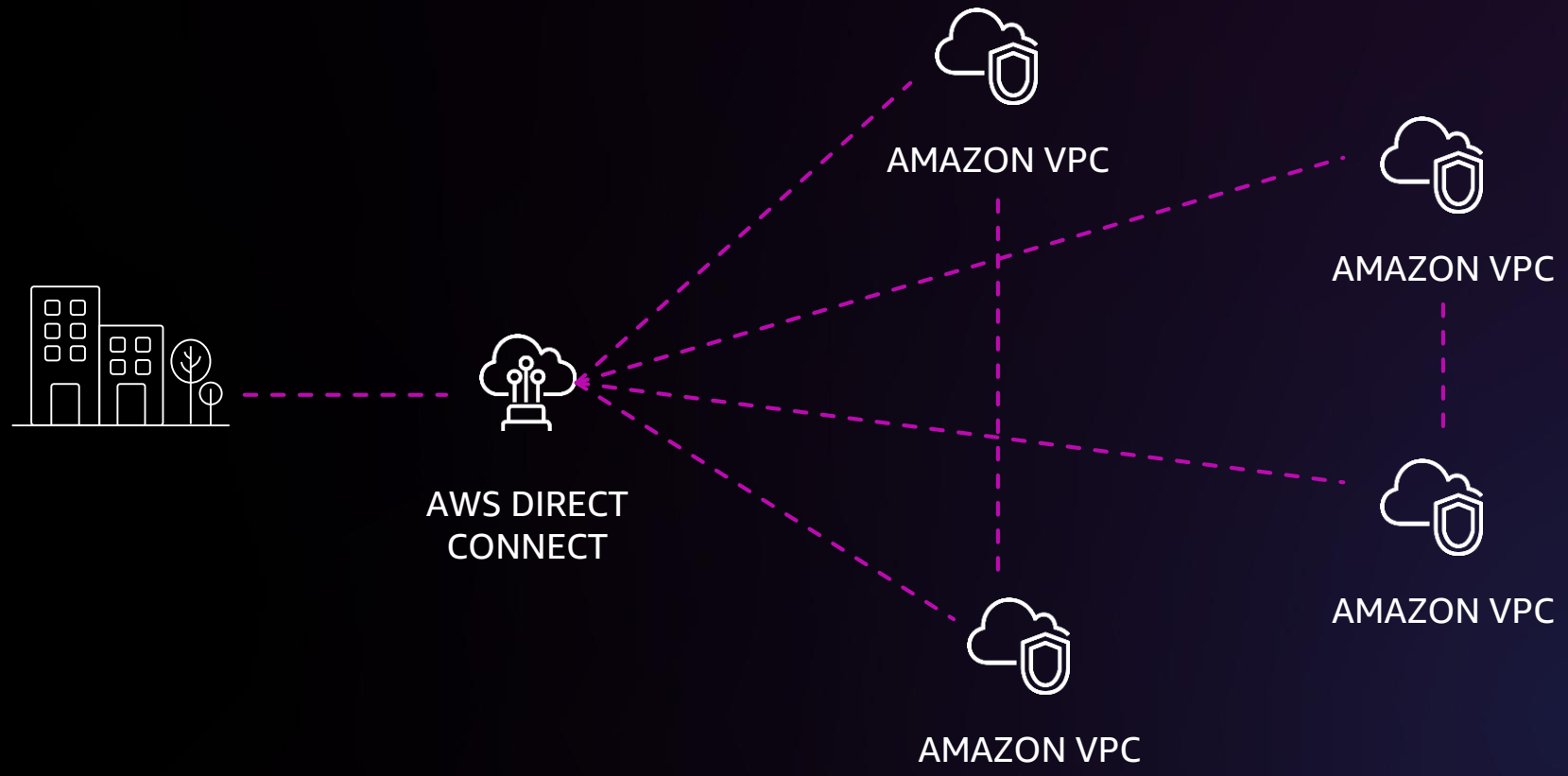
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Image Credit: Chicago Sun Times

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Network evolution

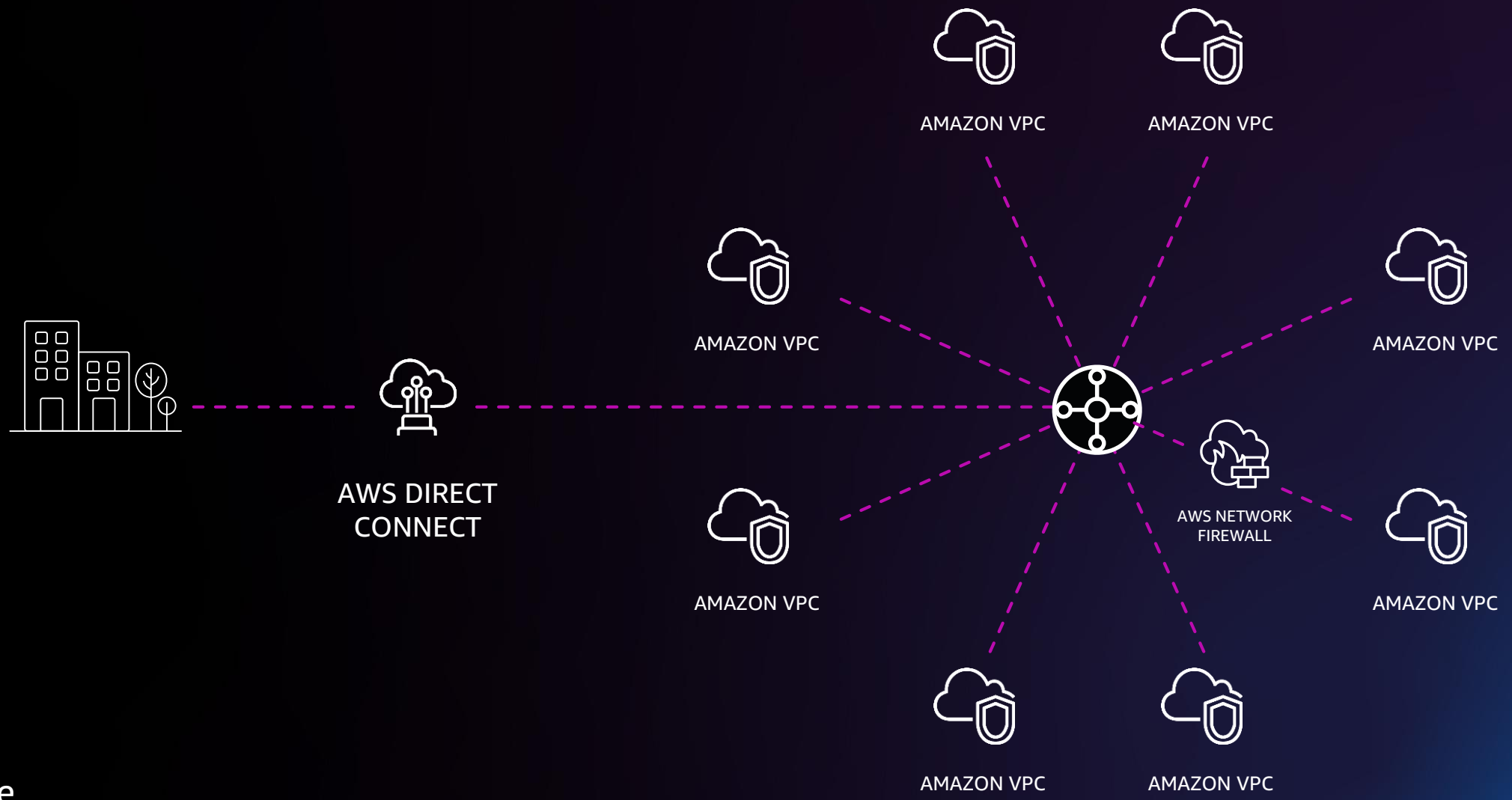


@margaretvaltie

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Modernizing our cloud network



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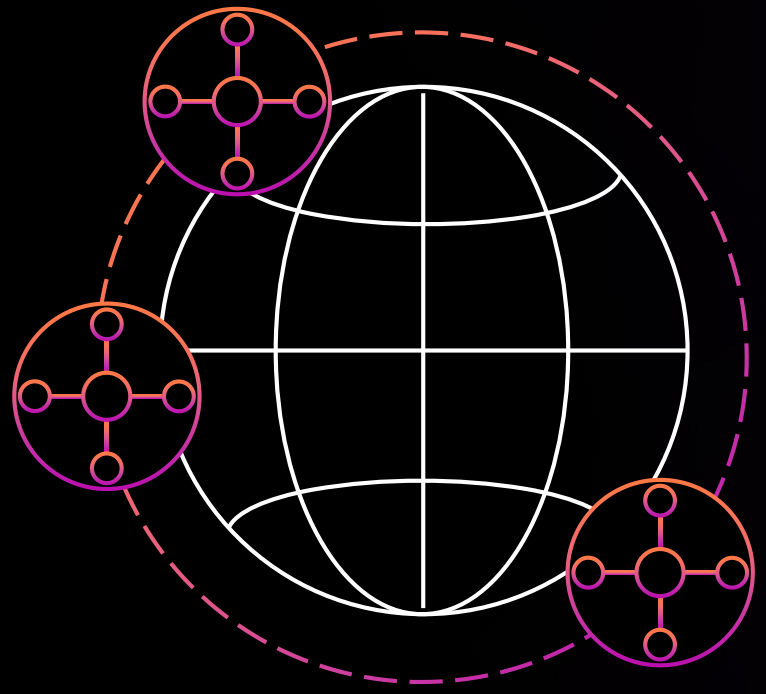
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NEW!

AVAILABLE NOW

AWS Transit Gateway Intra-Region Peering

BUILD ADVANCED NETWORK TOPOLOGIES WITHIN REGIONS

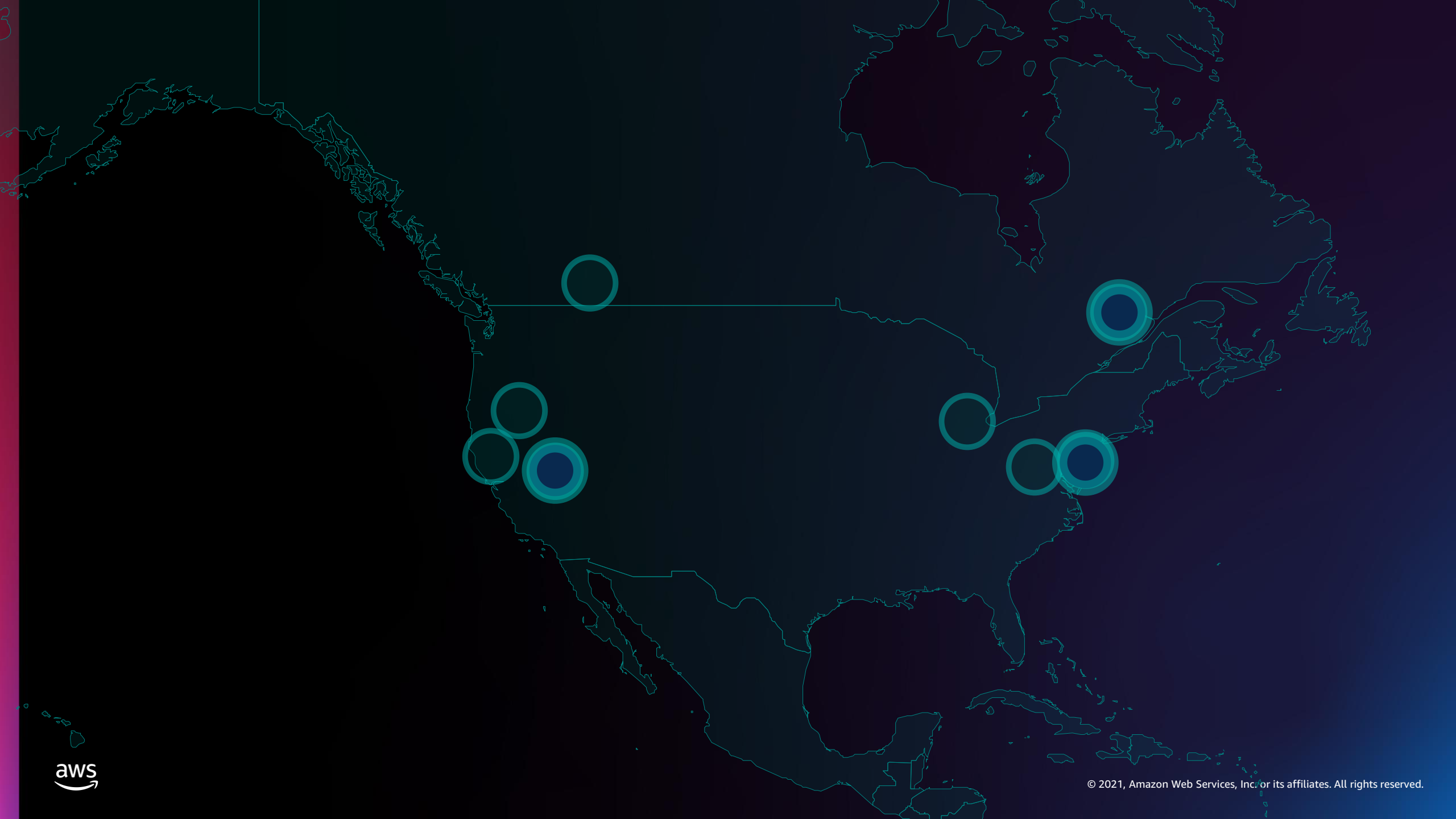


Connect your network with third-party or partner networks

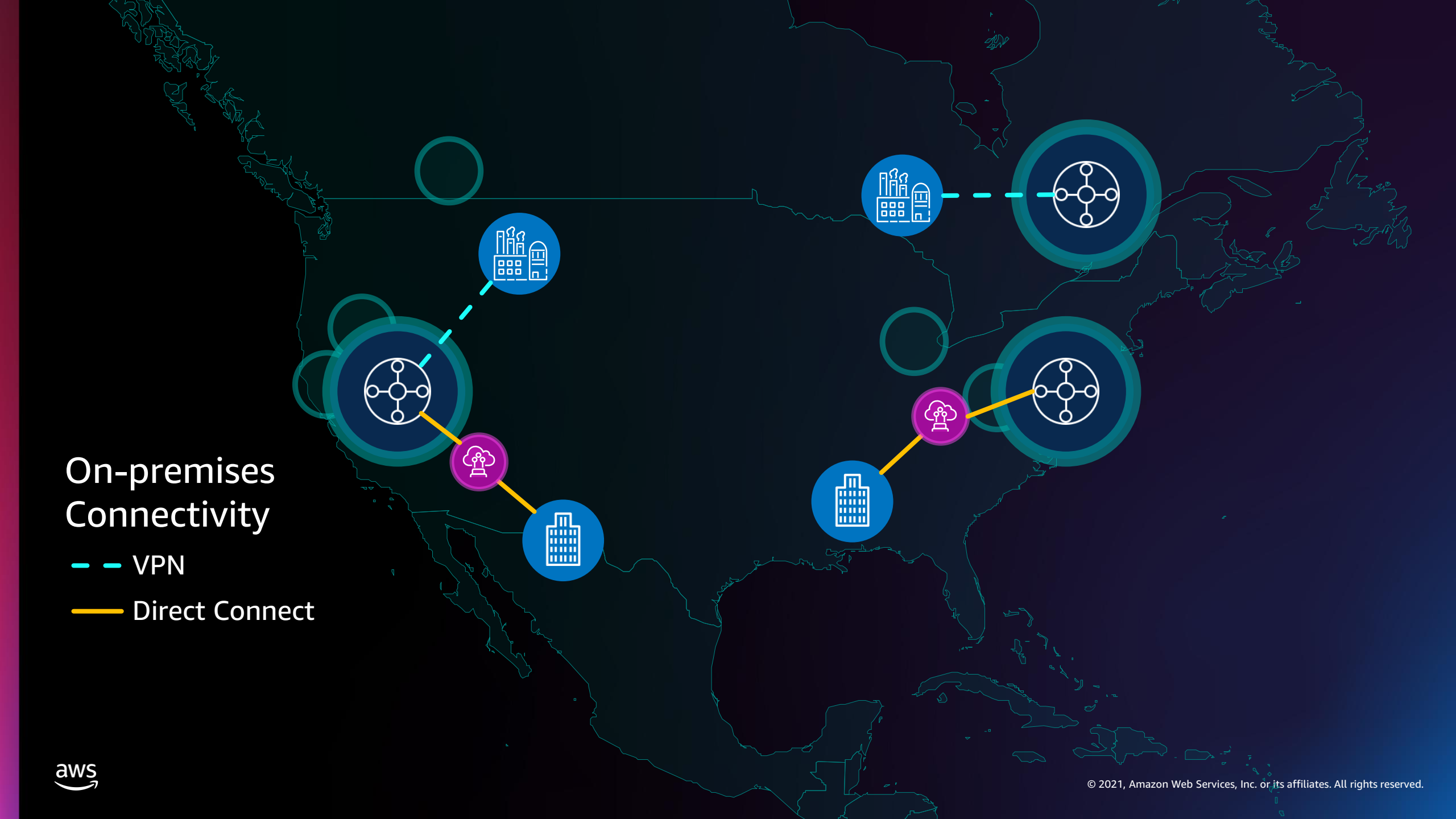
Provide autonomy for teams to deploy their own networks

Build more advanced network topologies on AWS

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More and more customers are using the AWS Global Backbone for inter-branch connectivity

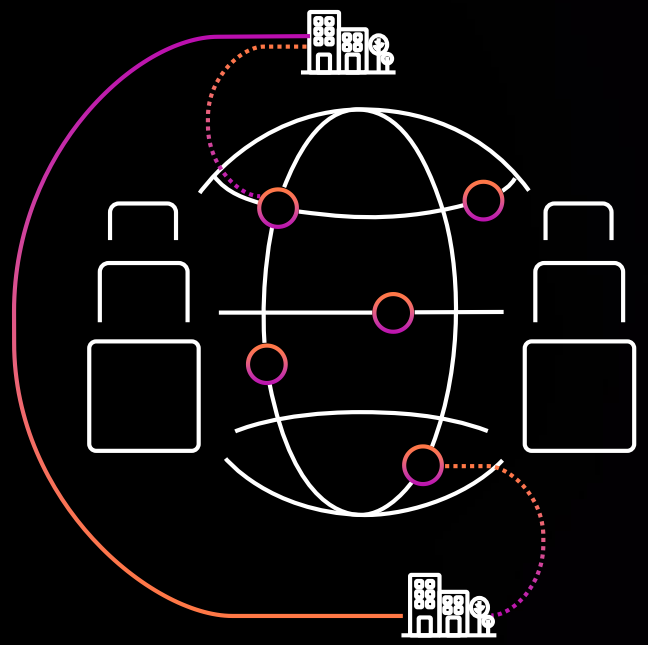
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NEW!

AVAILABLE NOW

AWS Direct Connect SiteLink

CONNECT BETWEEN DIRECT CONNECT POPS TO EXTEND YOUR PRIVATE NETWORK

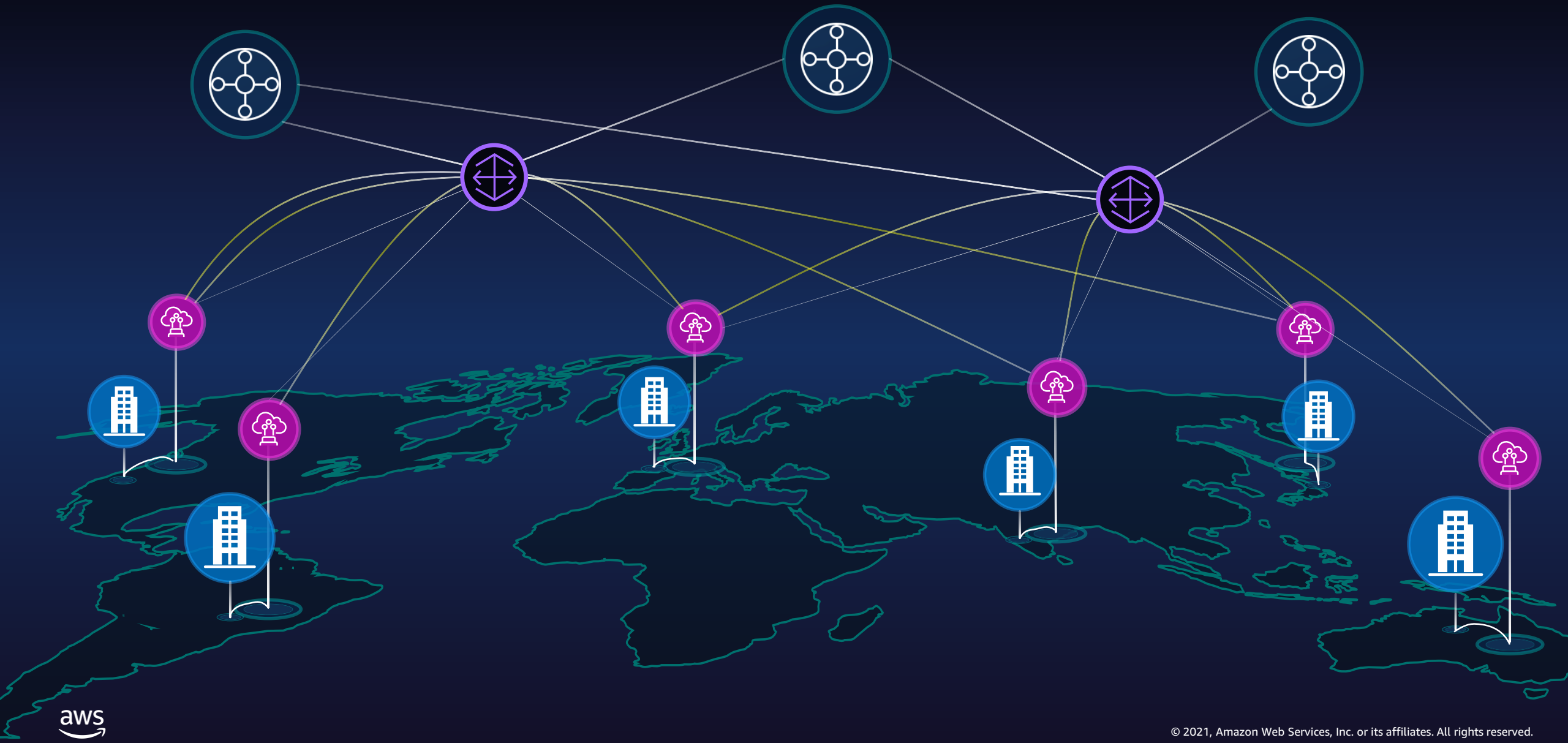


Use the AWS global network, without the need to route traffic through an AWS Region

Built on Direct Connect's proven reliability, pay-as-you-go pricing, and ease of use

Turn SiteLink on in seconds and connect locations around the world in minutes.

aws



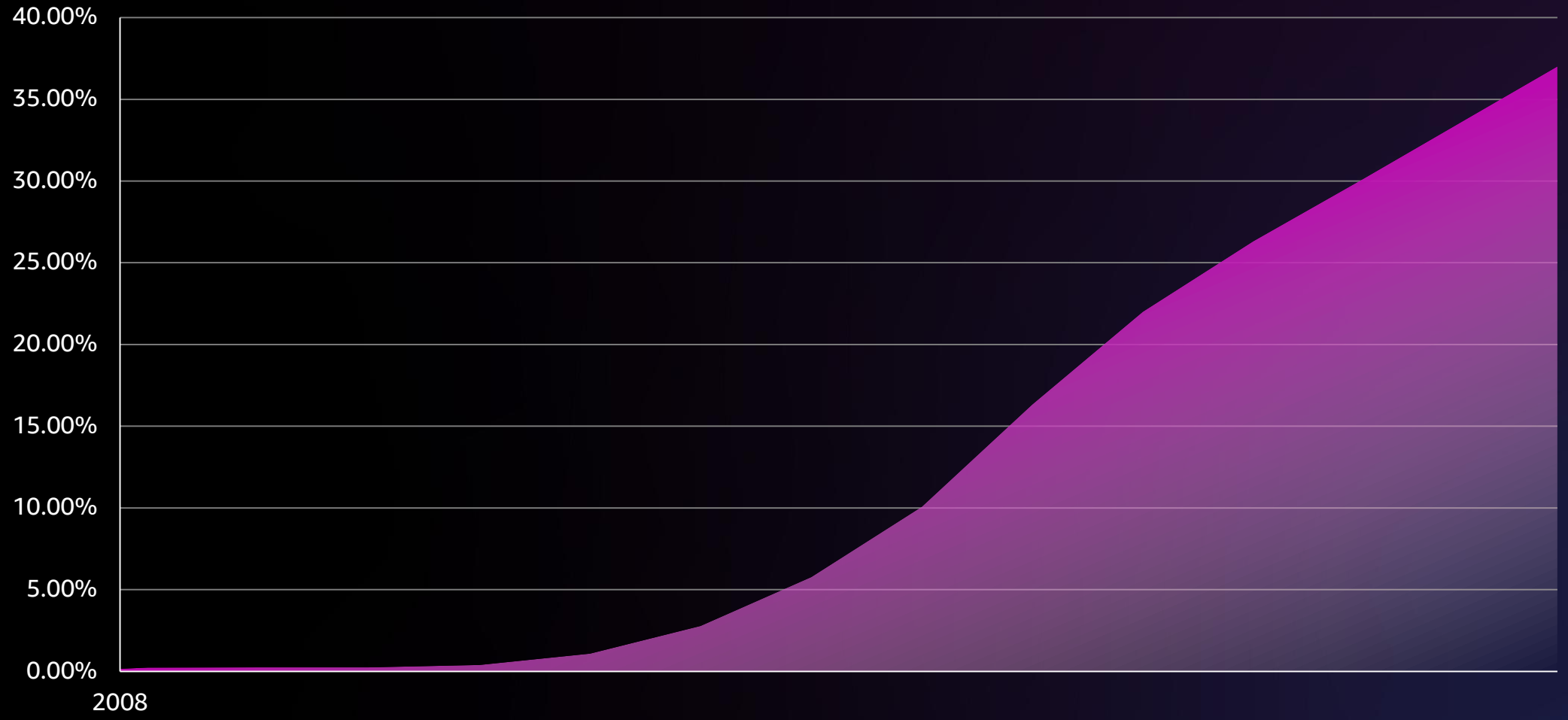
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Is there more that we could do to simply manage a network that spans multiple regions and on-premises locations?

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Where are we with IPv6?

RAPID INCREASE IN GLOBAL IPv6 ADOPTION



Source: Google IPv6 Statistics, November 2021. https://www.google.com/intl/en/ipv6/statistics.html

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NEW!

AVAILABLE NOW

IPv6-only Subnets

BUILD APPLICATIONS WITH ONLY IPV6 ADDRESSES



Take advantage of IPv6 to achieve virtually unlimited IP address scale

Deploy IPv6-only instances without RFC1918 IPv4 addresses

Connect to IPv4 applications with IPv6 to IPv4 translation

aws

NEW!

AVAILABLE NOW

IPv6-only Subnets

BUILD APPLICATIONS WITH ONLY IPV6 ADDRESSES

NAT64

DNS64

IPV6 Prefix Delegation

IPv6 support for IMDS

IPV6 only subnets

ALB IPv6 targets

NLB IPv6 targets

IPv6 support for Time Sync

EC2 Resource based Naming

IPv6 support for VPC DNS resolver

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NEW!

AVAILABLE NOW

Amazon VPC IP Address Manager

PLAN, TRACK AND MONITOR IP ADDRESSES ACROSS YOUR AWS ACCOUNTS AND REGIONS

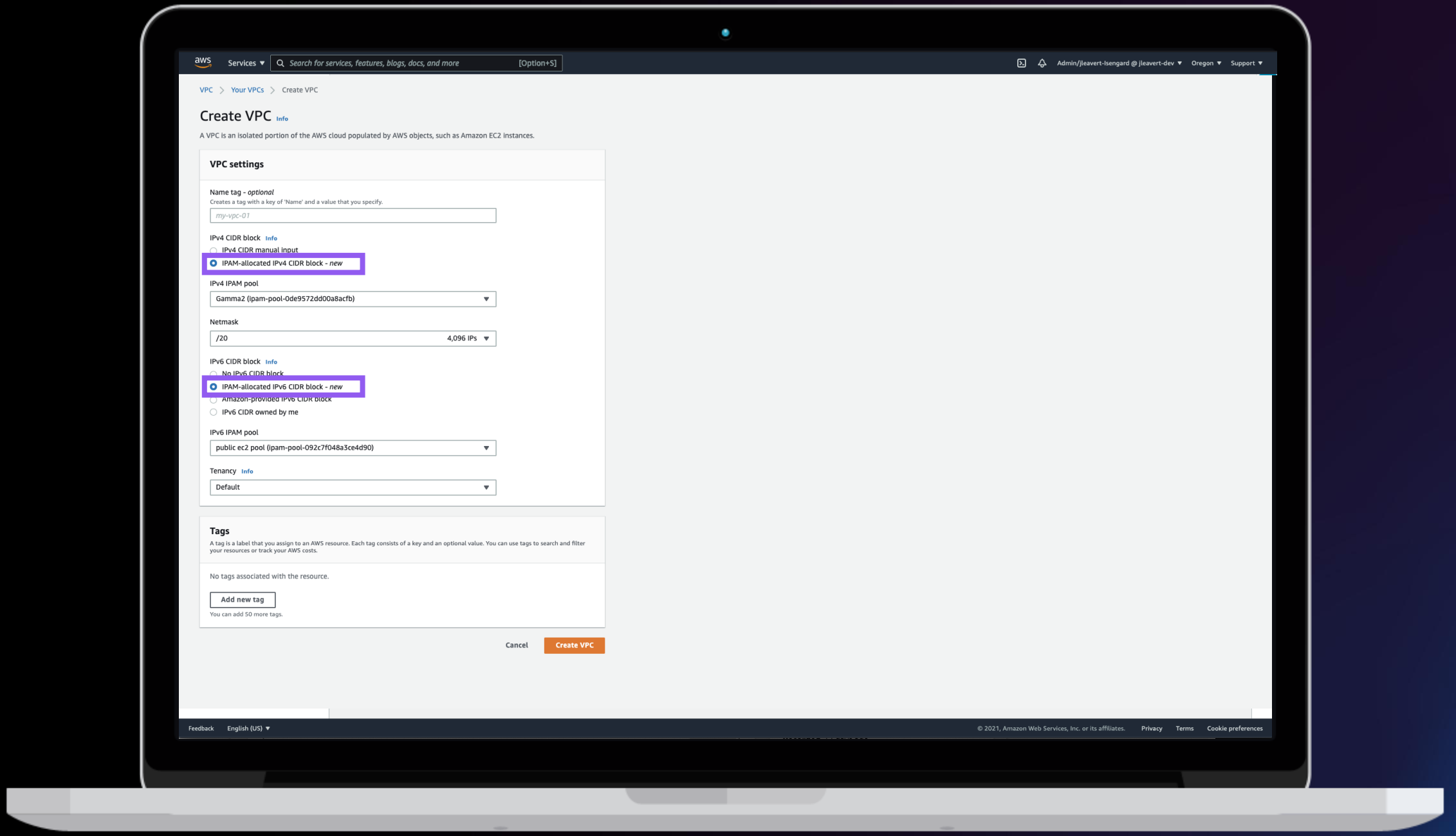


Automate IP assignments based on applications' unique networking and security needs

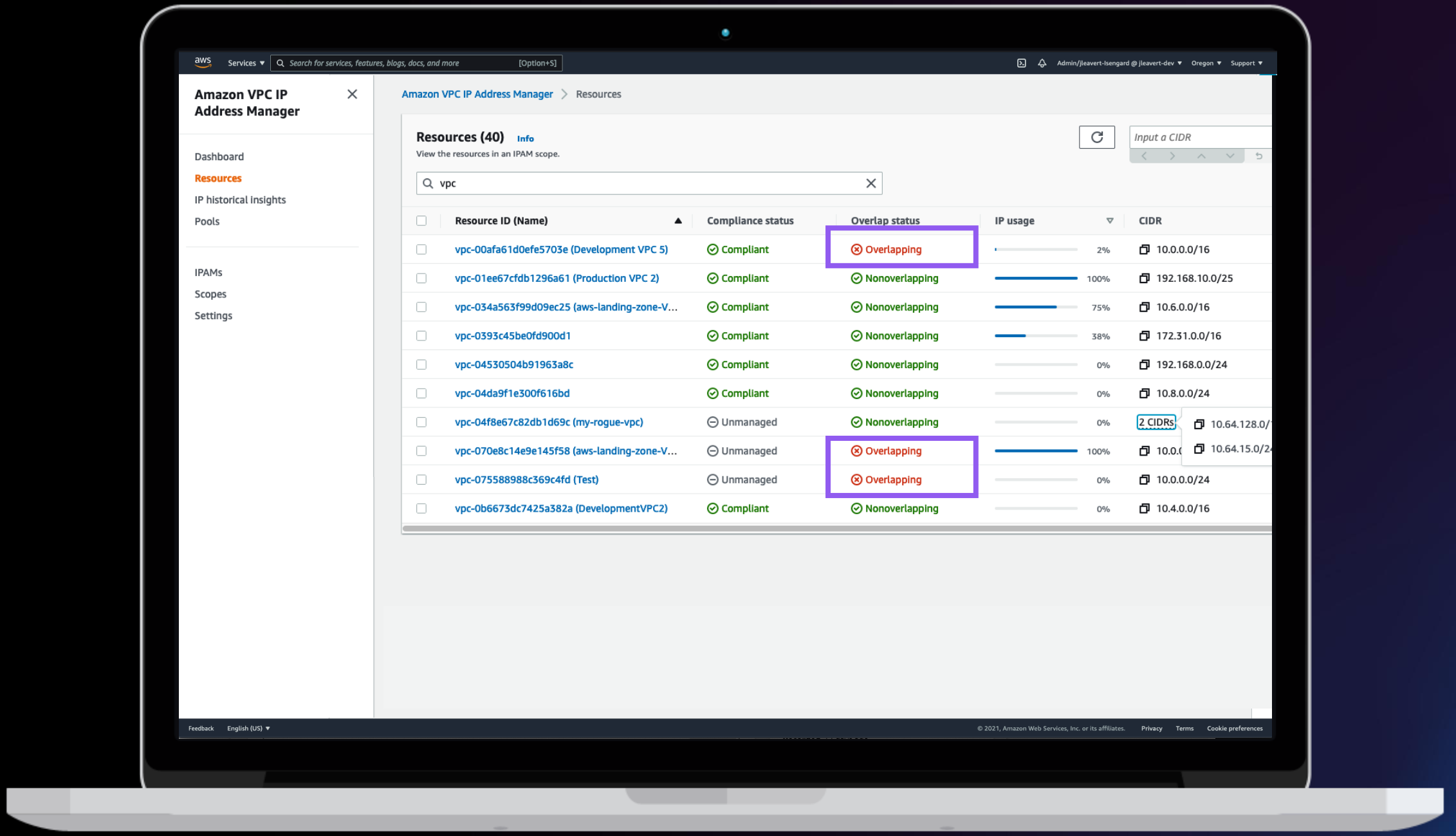
Monitor IP utilization across your network

Perform retrospective analysis for faster troubleshooting

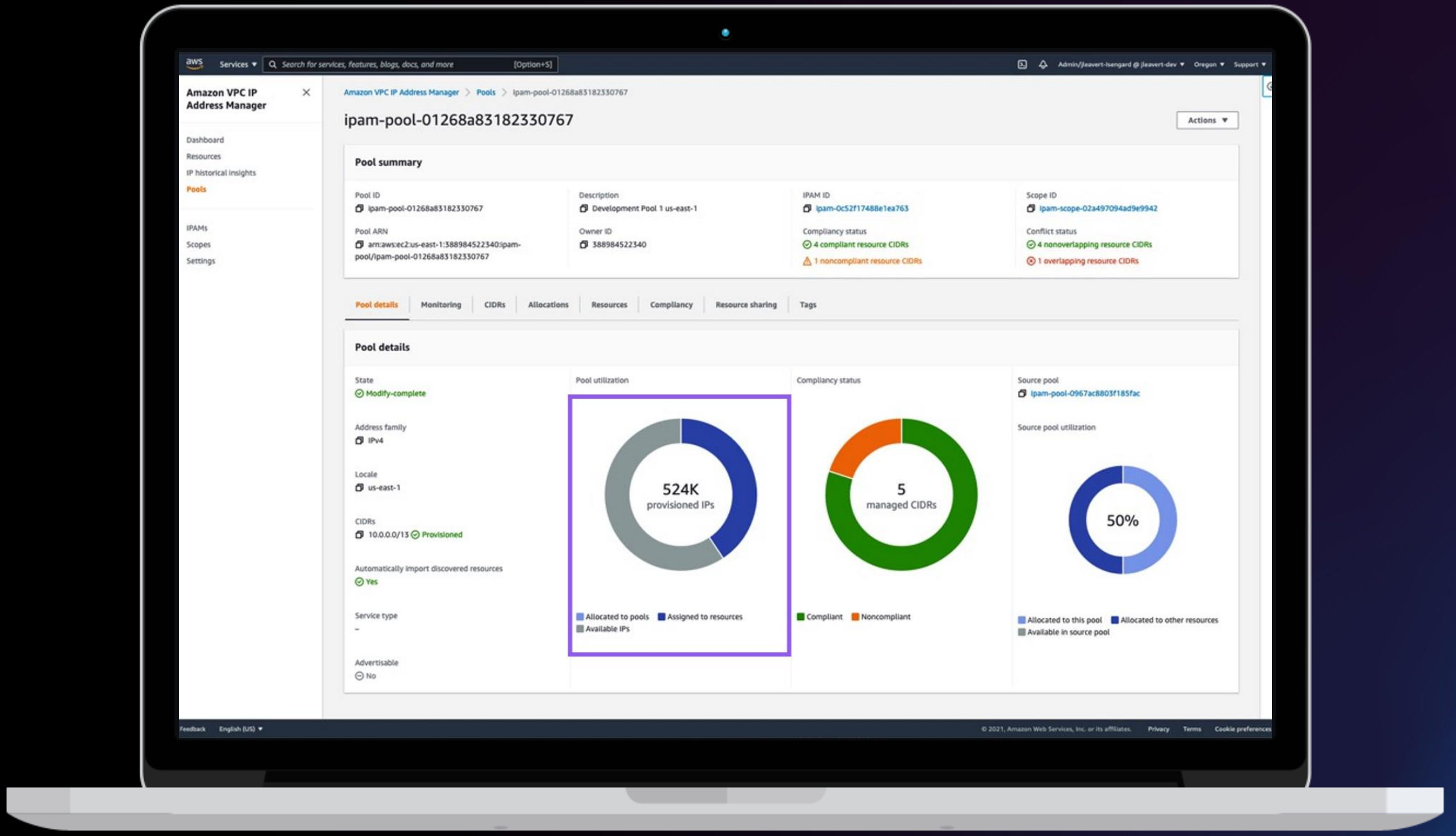
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Highest performance

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Most secure

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A network for every workload

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Bringing AWS closer to you

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5

Bringing AWS closer to you

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Extending the cloud

DELIVERING THE CLOUD ANYWHERE CUSTOMERS NEED IT

GLOBAL



AWS Regions

METRO CENTERS



AWS Local Zones

5G NETWORKS



AWS Wavelength

ON-PREMISES



AWS Outposts

SMART DEVICES



Internet of Things

RUGGED EDGE



AWS Snow Family

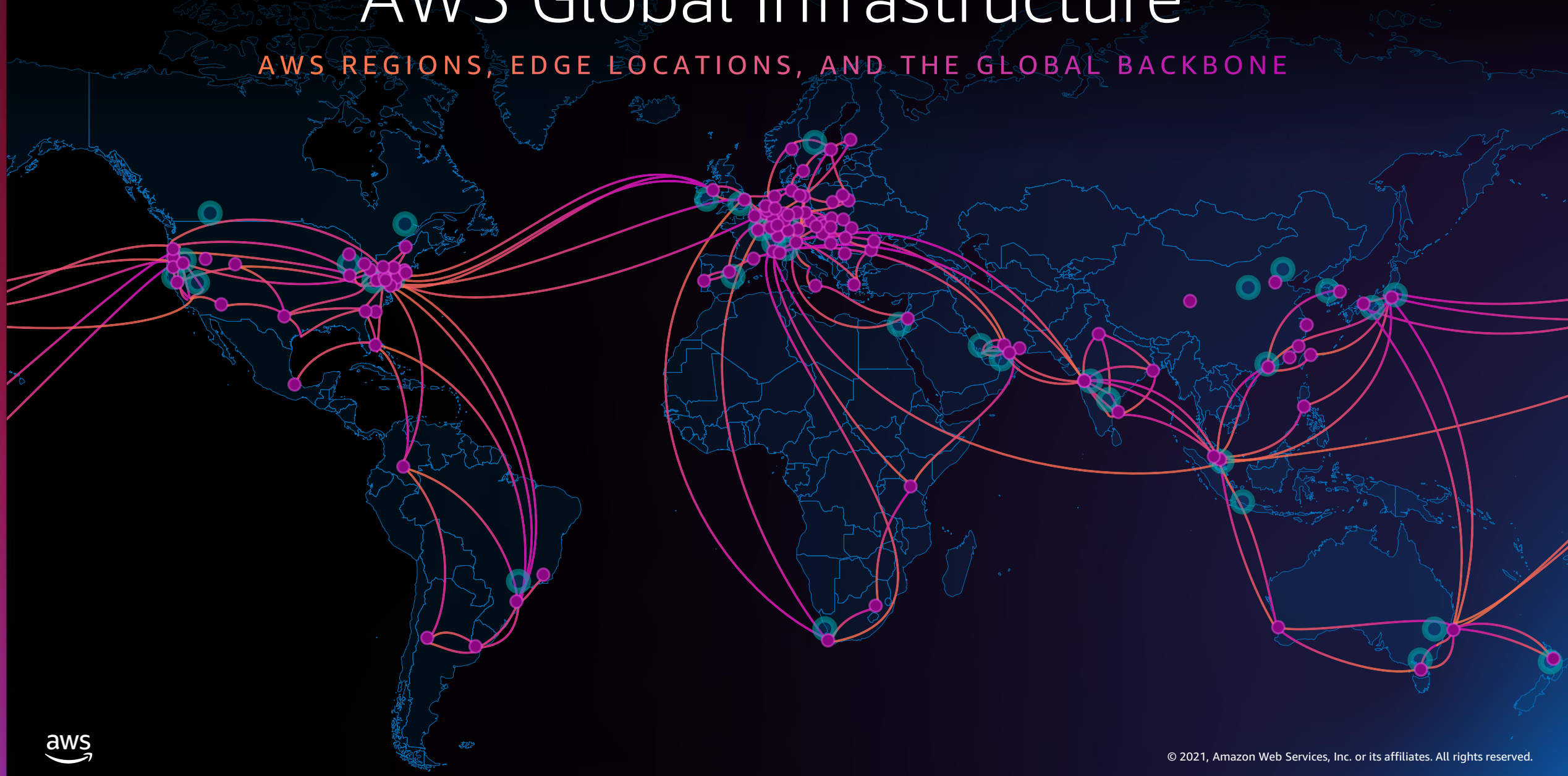
SAME INFRASTRUCTURE, SERVICES, APIS, AND TOOLS FOR A CONSISTENT EXPERIENCE

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AWS Global Infrastructure

AWS REGIONS, EDGE LOCATIONS, AND THE GLOBAL BACKBONE



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NEW!

AWS Local Zones

RUN LATENCY-SENSITIVE APPLICATIONS AT THE EDGE USING AWS INFRASTRUCTURE AND SERVICES



LOW LATENCY

Extends AWS infrastructure services, APIs, and tools to where customers need it to support low-latency applications



FULLY MANAGED

Fully owned, managed, and supported by AWS



NEW AWS INFRASTRUCTURE

New type of AWS infrastructure that places AWS compute, storage, networking, and select AWS services closer to where your end users are located

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AWS Local Zones

RUN LATENCY-SENSITIVE APPLICATIONS CLOSER TO END USERS



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AWS Local Zones

RUN LATENCY SENSITIVE APPLICATIONS CLOSER TO END USERS



NEW LOCAL ZONES LAUNCHING IN SEATTLE, ATLANTA, AND PHOENIX BEFORE THE END OF 2021

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NEW!

COMING SOON

Expanded Direct Connect support for AWS Local Zones

PRIVATE DEDICATED CONNECTIONS TO LOCAL ZONES IN MORE LOCATIONS



- Expanded Local Zones support for Direct Connect in Boston, New York, and Chicago
- Use existing Direct Connect connections to connect to AWS Regions and Local Zones
- Route traffic directly from your data center to the Local Zone

aws

Exchange in the Cloud

HYBRID COMPUTE FOR A GLOBAL MARKET

Nasdaq

Leveraging the on-premises capabilities of AWS Outposts – which extends AWS infrastructure, AWS services, APIs, and tools to virtually any datacenter, co-location space, or on-premises facility – Nasdaq plans to configure its network to deliver ultra-low-latency edge compute capabilities directly in its primary data center – Equinix NY11, in Carteret, NJ – to establish the first ever Private Local Zone in the capital markets industry at Carteret



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Make sure you watch Werner's keynote on Thursday at 8:00 a.m. for more Local Zones announcements

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Emergence of 5G

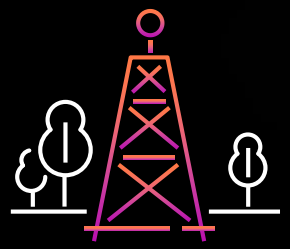


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NEW!

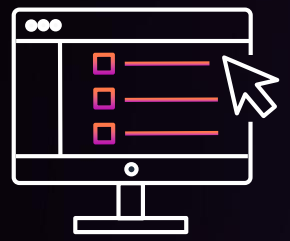
AWS Wavelength

RUN LATENCY-SENSITIVE APPLICATIONS AT THE 5G EDGE USING AWS INFRASTRUCTURE AND SERVICES



EMBEDDED IN 5G NETWORKS

Extends AWS infrastructure, services, APIs, and tools to 5G networks



AWS API & CONSOLE

Single pane of management in the cloud providing the same APIs and tools as in AWS Regions



BUILD ONCE, DEPLOY ANYWHERE

Simple to deploy application from AWS regions to 5G-enabled edge locations

aws

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AWS Wavelength

RUN LATENCY-SENSITIVE APPLICATIONS AT THE 5G EDGE



5G Partners

Bell

verizon

KDDI

SK telecom

vodafone business

aws

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What about 5G networks within a factory, smart building, or campus network?

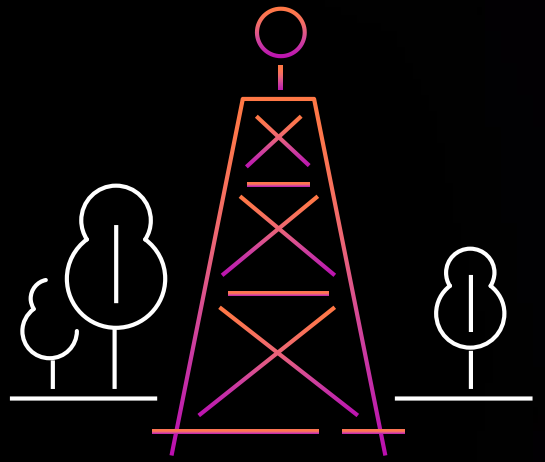
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NEW!

PREVIEW

AWS Private 5G

MANAGED SERVICE TO INSTALL, OPERATE, AND SCALE PRIVATE CELLULAR NETWORKS



- Order and deploy a private mobile network with just a few clicks in the AWS console
- Automatically configures, deploys, and manages the mobile network
- Scales easily to accommodate more connected devices or increases in network traffic

aws

AWS Private 5G

COMPONENTS AND FEATURES

Spectrum	Hardware	Software
Default operation in Unlicensed Spectrum (CBRS) Licensed Spectrum (in partnership with CSPs*)	Small-cell Radio Unit AWS-managed SIMs AWS Outposts server (if 5G Core on premises) – not needed if 5G Core runs in the AWS Region	Spectrum Access System (SAS) for CBRS operation 5G Core and RAN Software

Included in AWS Private 5G order

Customer provided

- Internet backhaul
- Customer on-premises equipment (such as gateways, router)
- IP Address Pool, DHPC Server
- Power

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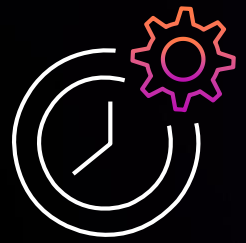
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AWS Private 5G

BRINGING THE CLOUD MODEL OF CONSUMPTION TO 5G NETWORKS



Hassle-free procurement using the AWS Console or APIs



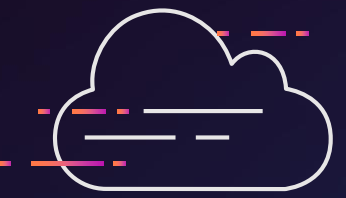
Ability to start as small as you want, validate your business requirement and then scale up as you need



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



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



Same pace of innovation as in the cloud

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Expansion and Disruption

ACCELERATING DELIVERY OF SOLUTIONS

KOCH

"In collaboration with industry software vendors like Mavenir and global communication service providers, AWS Private 5G can help solve real challenges that enterprises face in deploying private cellular networks around the world. We believe that this combination will also encourage expansion of the cellular Industrial IoT ecosystem and accelerate the delivery of disruptive private connectivity solutions for our customers."

Matt Hoag
CTO at Koch Global Services



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1

Largest, most scalable global network

2

Highest performance

3

Most secure

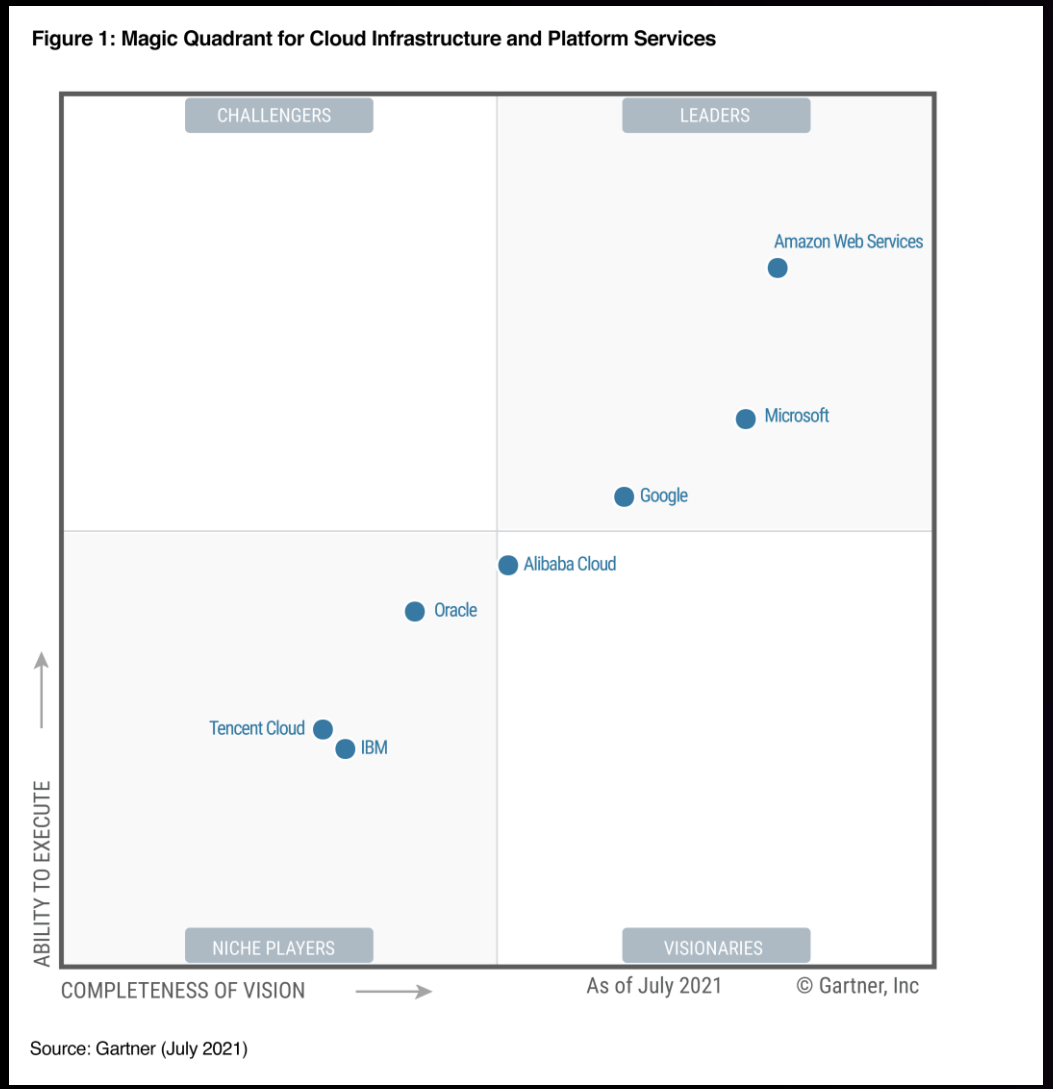
4

A network for every workload

5

Bringing AWS closer to you

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Gartner recognizes **AWS as a Leader** for the 11th straight year

Magic Quadrant for Cloud Infrastructure and Platform Services

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