AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

NET211-L

Leaping ahead: The power of cloud network innovation

Dave Brown (he/him)

Vice President, Amazon EC2 Networking
AWS

Milena Talavera

SVP of Engineering, Core Infrastructure
Slack

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Provide customers with tools and services to build scalable networks, for any workload, and promote an increased pace of innovation

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“Through this collaboration with AWS, we will operate not just as a communications services provider, but as a digital services provider harnessing the combined power of 5G connectivity and the cloud.”

Charlie Ergen
Co-founder and Chairman, DISH Wireless

dish wireless

aws

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THE POWER OF CLOUD NETWORK INNOVATION

- Global scale and highest availability
- World-class performance
- Building large-scale network topologies
- Networking for applications
- Industry-leading security
- Building networks at global scale

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AWS Global Infrastructure

AWS REGIONS, LOCAL ZONES, EDGE LOCATIONS, AND GLOBAL BACKBONE

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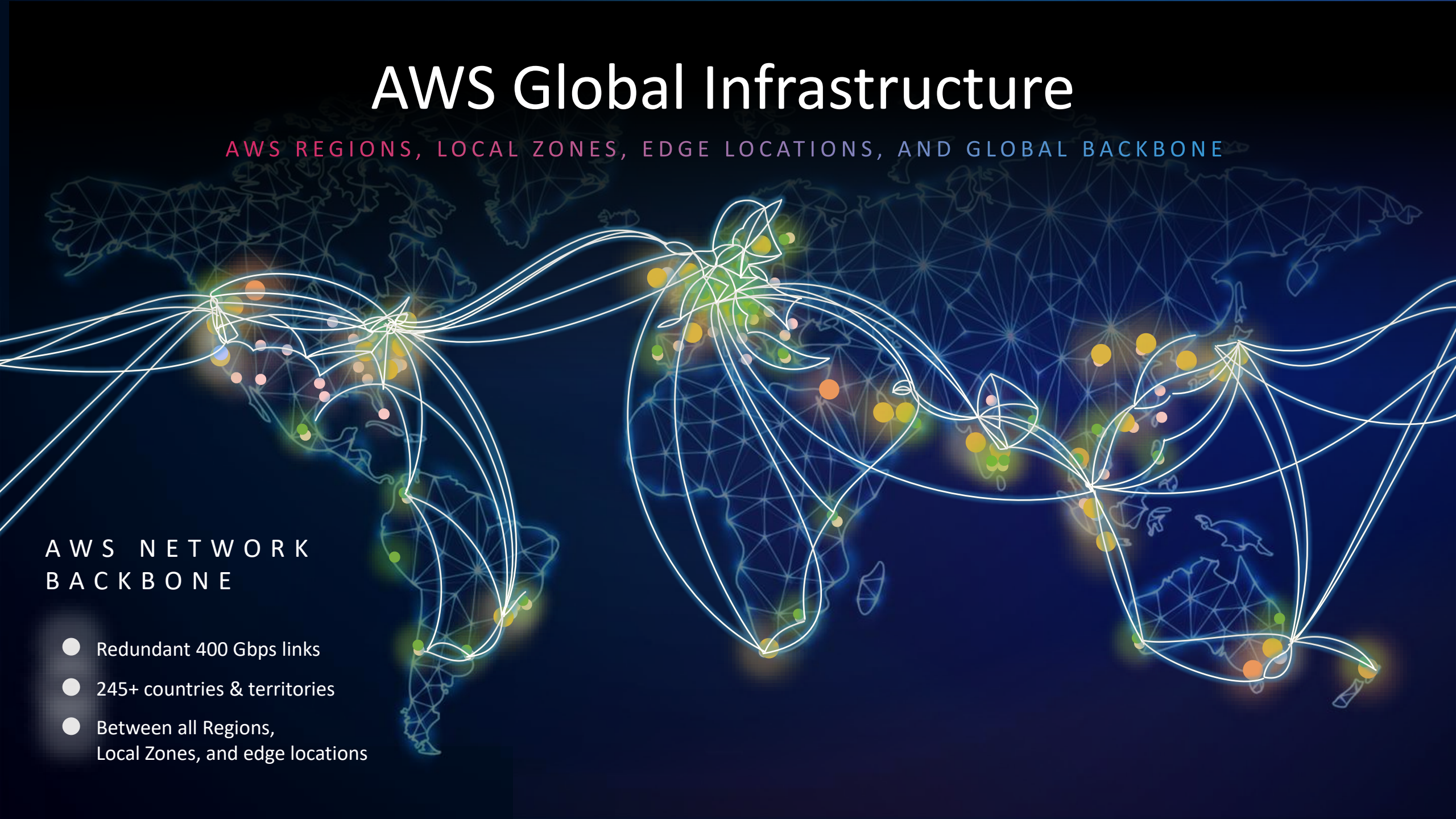

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Why build a global backbone?

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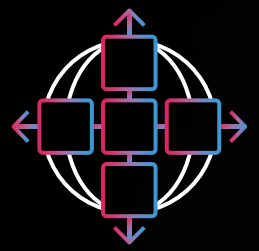
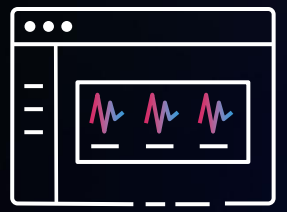
Why have a global backbone network?



SCALABILITY

Improved scalability by controlling network expansion



AVAILABILITY

Improved availability by controlling network redundancy

PERFORMANCE

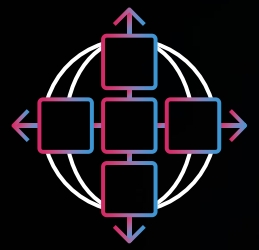
Improved performance by controlling paths customer traffic traverses

SECURITY

Improved security by ensuring traffic traverses our infrastructure rather than the internet

ALL REGION-TO-REGION TRAFFIC TRAVERSES THE AWS BACKBONE

Why have a global backbone network?



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Most customers don’t think about the AWS network backbone, except if it does not operate flawlessly

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CHALLENGES IN BUILDING A GLOBAL BACKBONE

PLANNING

Forecasting and deployment systems have to be 5–10 years ahead of growth

COST

Constant innovation ensures that we can build at the needed scale while keeping the cost per GB down

SUPPLY CHAIN

Intense management of the supply chain at the component level to ensure we are never short

PHYSICAL

Doing the work to put the needed fiber in place, whether it crosses the ocean or continent

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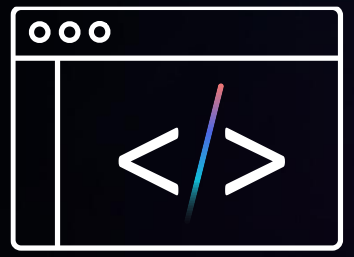
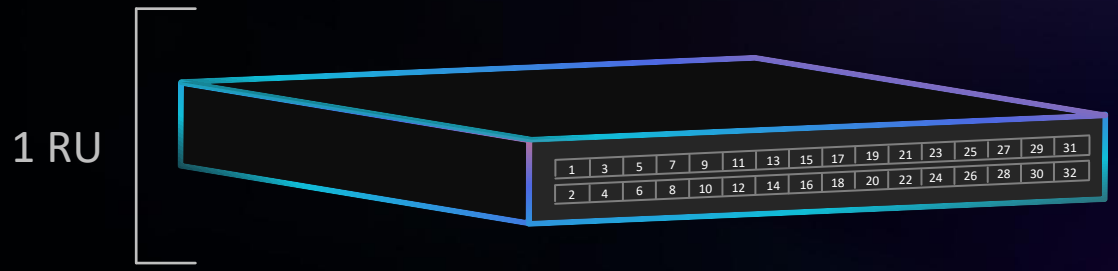


CUSTOM SOFTWARE

Having complete control over the software in our network lowered costs, improved security, reliability, and performance

CUSTOM HARDWARE

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



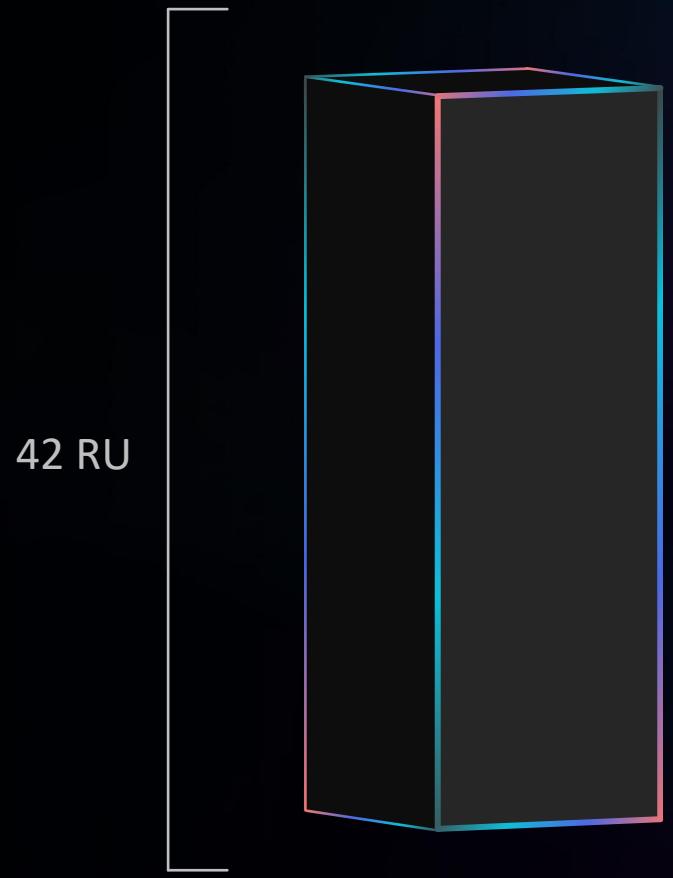
12.8

TERABITS PER SECOND

DEVICE: 1 x Switch

HEIGHT: 1 x Rack Unit (RU)

PORTS: 32 x 400G



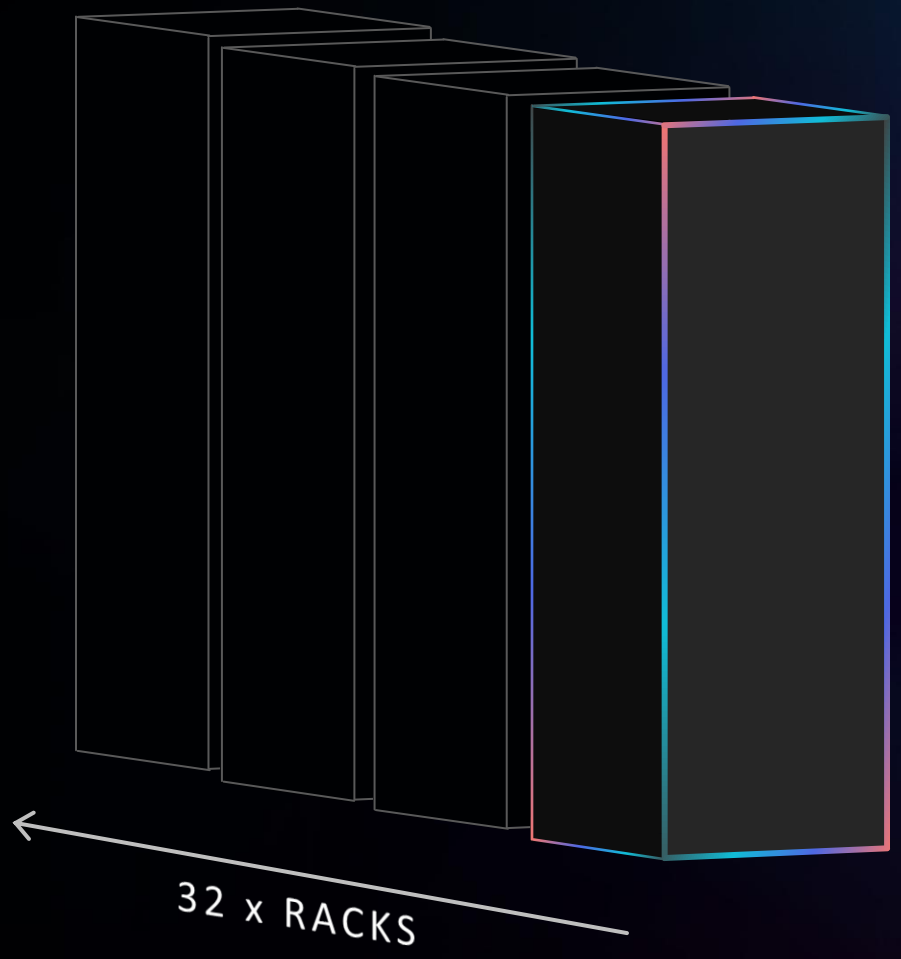
100

TERABITS PER SECOND

DEVICE: 1 rack (32 x switches)

HEIGHT: 42 x Rack Unit (RU)

PORTS: 32 x 400G (12.8 Tbps)



3,200

TERABITS PER SECOND

DEVICE: 32 racks (32 x switches)

HEIGHT: 42 x Rack Unit (RU)

THROUGHPUT/RACK: 100 Tbps

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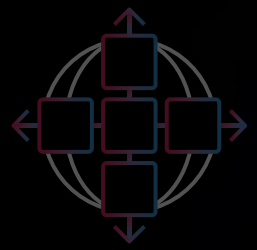
Why have a global backbone network?



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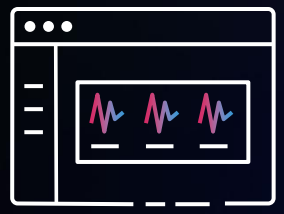

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ALL REGION-TO-REGION TRAFFIC TRAVERSES THE AWS BACKBONE

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“ Everything fails all the time ”

Dr. Werner Vogels, VP and CTO, Amazon.com

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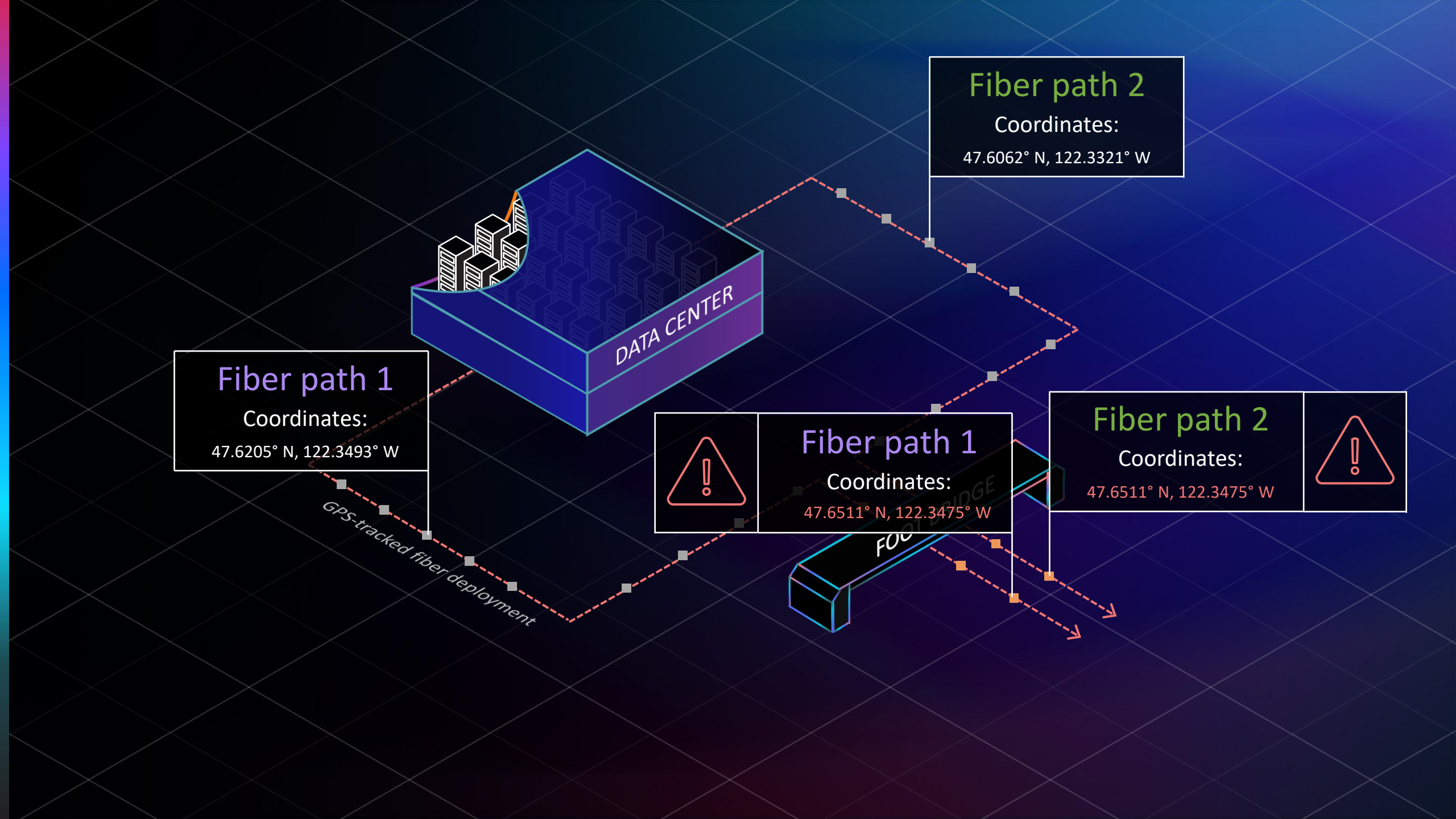
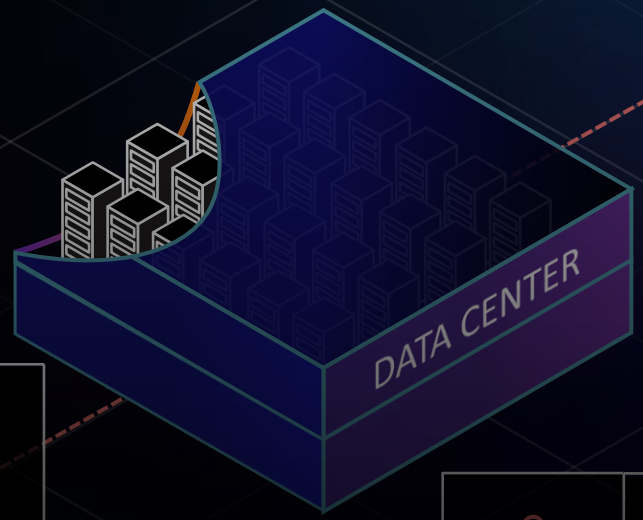

Fiber path 2
Coordinates:
47.6062° N, 122.3321° W
DATA CENTER
Fiber path 1
Coordinates:
47.6205° N, 122.3493° W
GPS-tracked fiber deployment
Fiber path 1
Coordinates:
47.6511° N, 122.3475° W
Fiber path 2
Coordinates:
47.6511° N, 122.3475° W



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Fiber path 1

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Fiber path 2

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47.6511° N, 122.3475° W

MONITORING & INTELLIGENT ROUTING

MONITORING

Consume billions of metrics every second from every fiber within the network

DETECTION

Fully automated software detects and mitigates normal faults, as well as partial failures

INTERNET

Consume billions of probes across thousands of service providers to route around any internet weather

SELF-HEALING

Traffic routing decision are automated, routing customer traffic around any potential congestion

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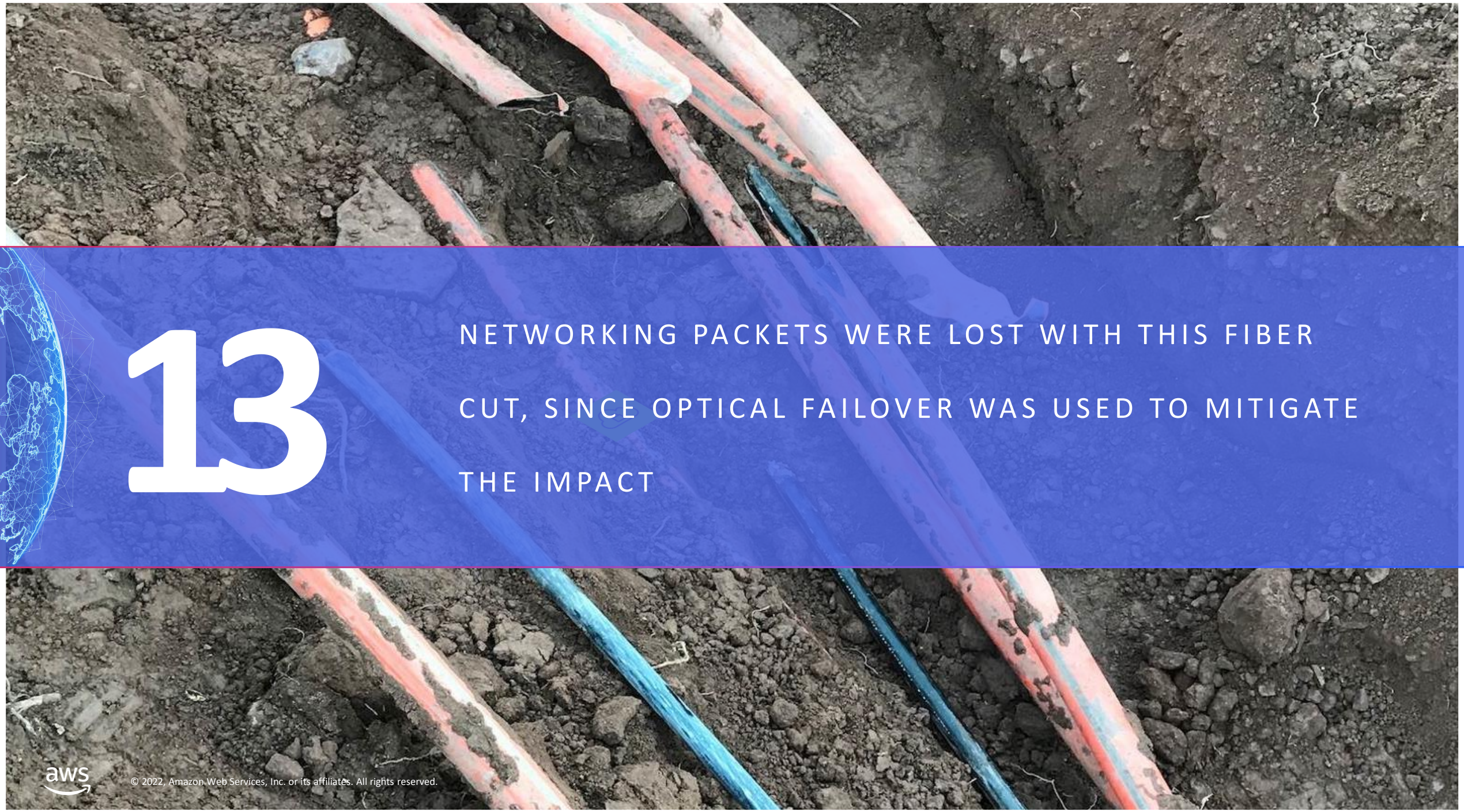

13

NETWORKING PACKETS WERE LOST WITH THIS FIBER CUT, SINCE OPTICAL FAILOVER WAS USED TO MITIGATE THE IMPACT

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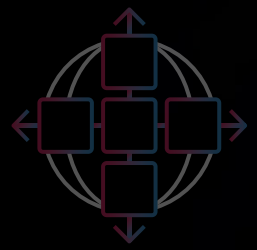
Why have a global backbone network?



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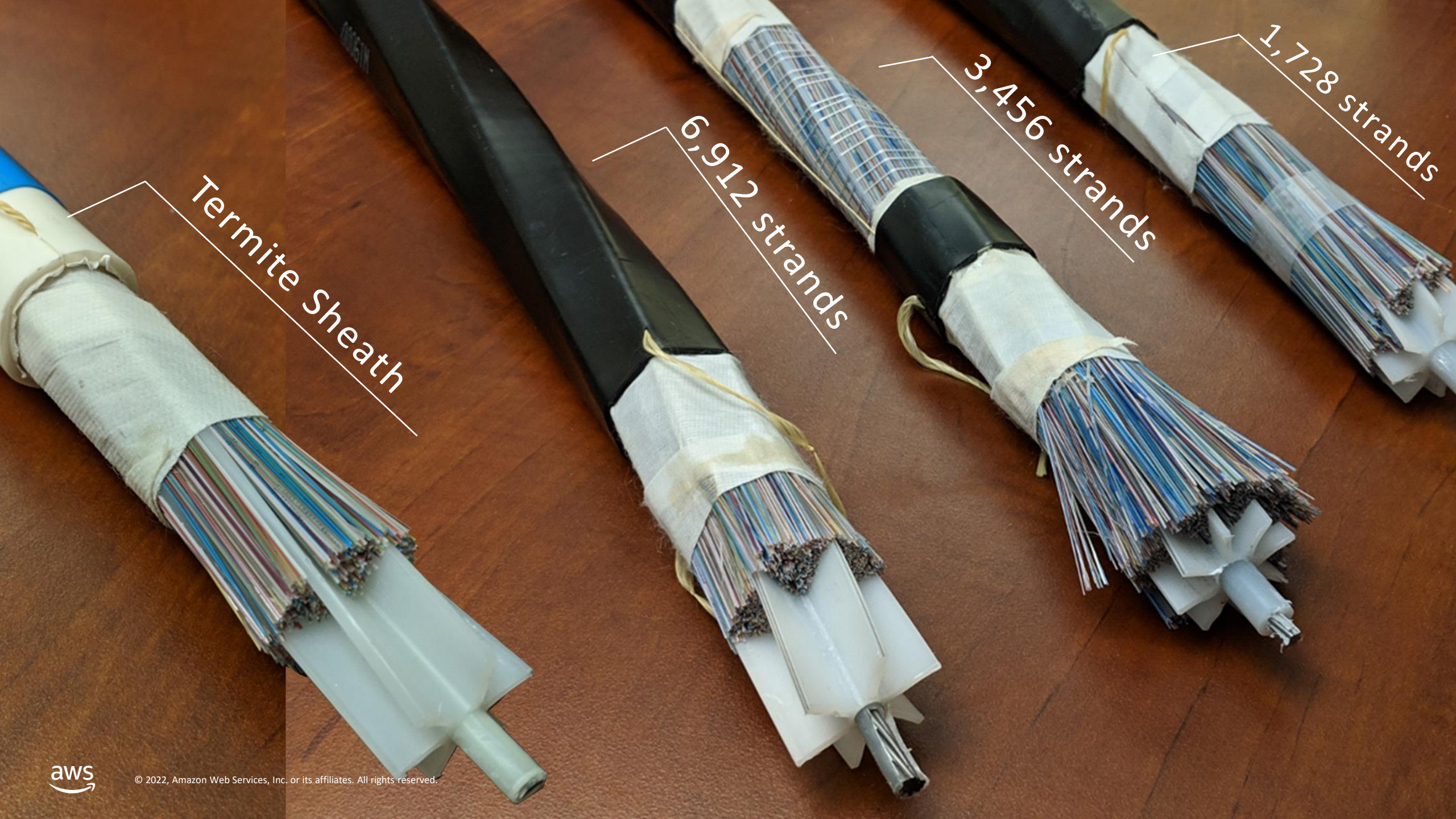
AWS Global Infrastructure

AWS REGIONS, LOCAL ZONES, EDGE LOCATIONS, AND GLOBAL BACKBONE

AWS NETWORK BACKBONE

- Redundant 400 Gbps links
- 245+ countries & territories
- Between all Regions, Local Zones, and edge locations



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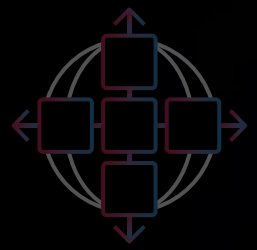

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Protecting data using encryption

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

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

TO YOUR DATA CENTER

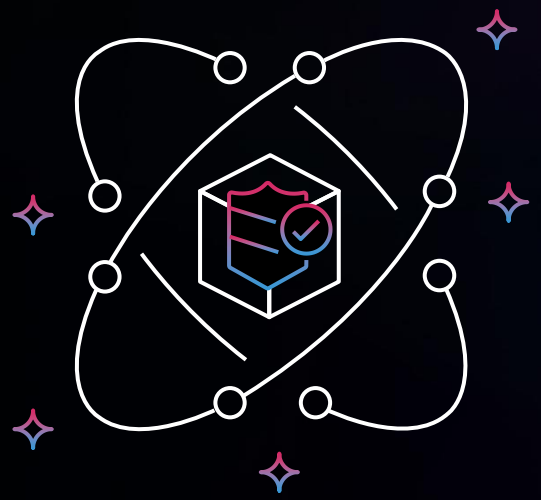
Use IPsec VPN tunnels or Direct Connect MACsec support to ensure that traffic between AWS and your locations remains protected

APPLICATION TRAFFIC

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

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

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In the early days of cloud computing, customers experienced high latencies and periods of network jitter

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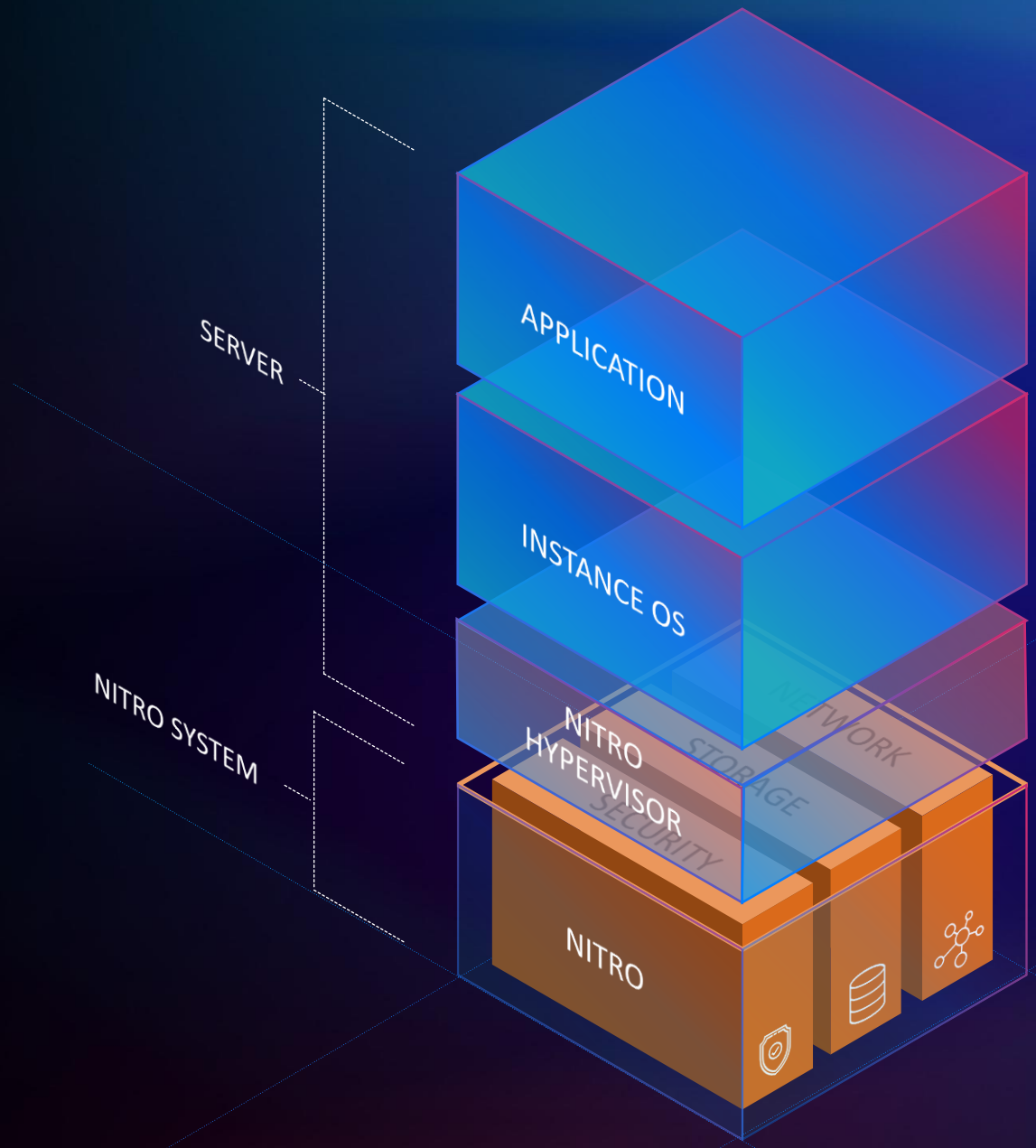
The AWS Nitro System architecture

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



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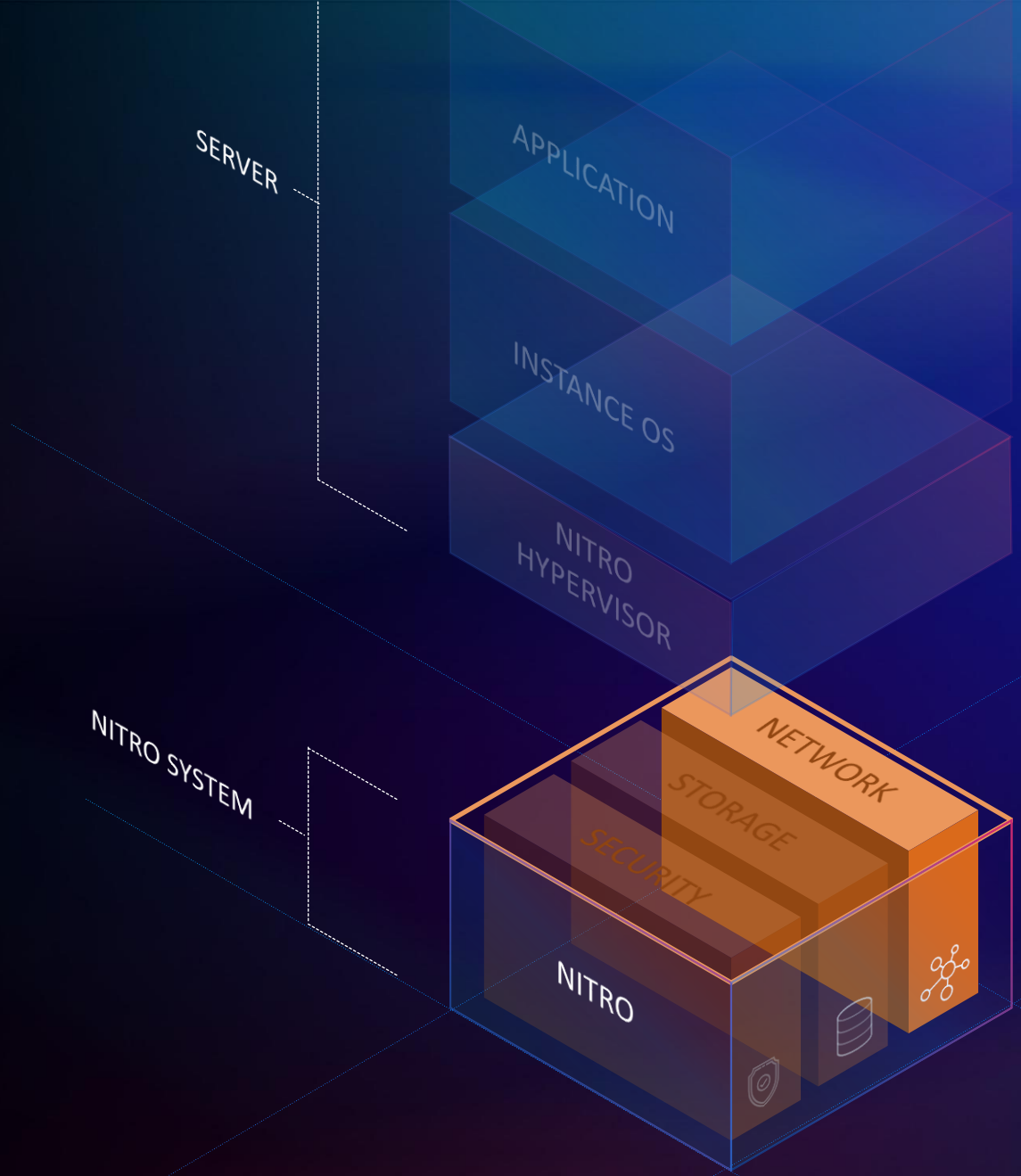
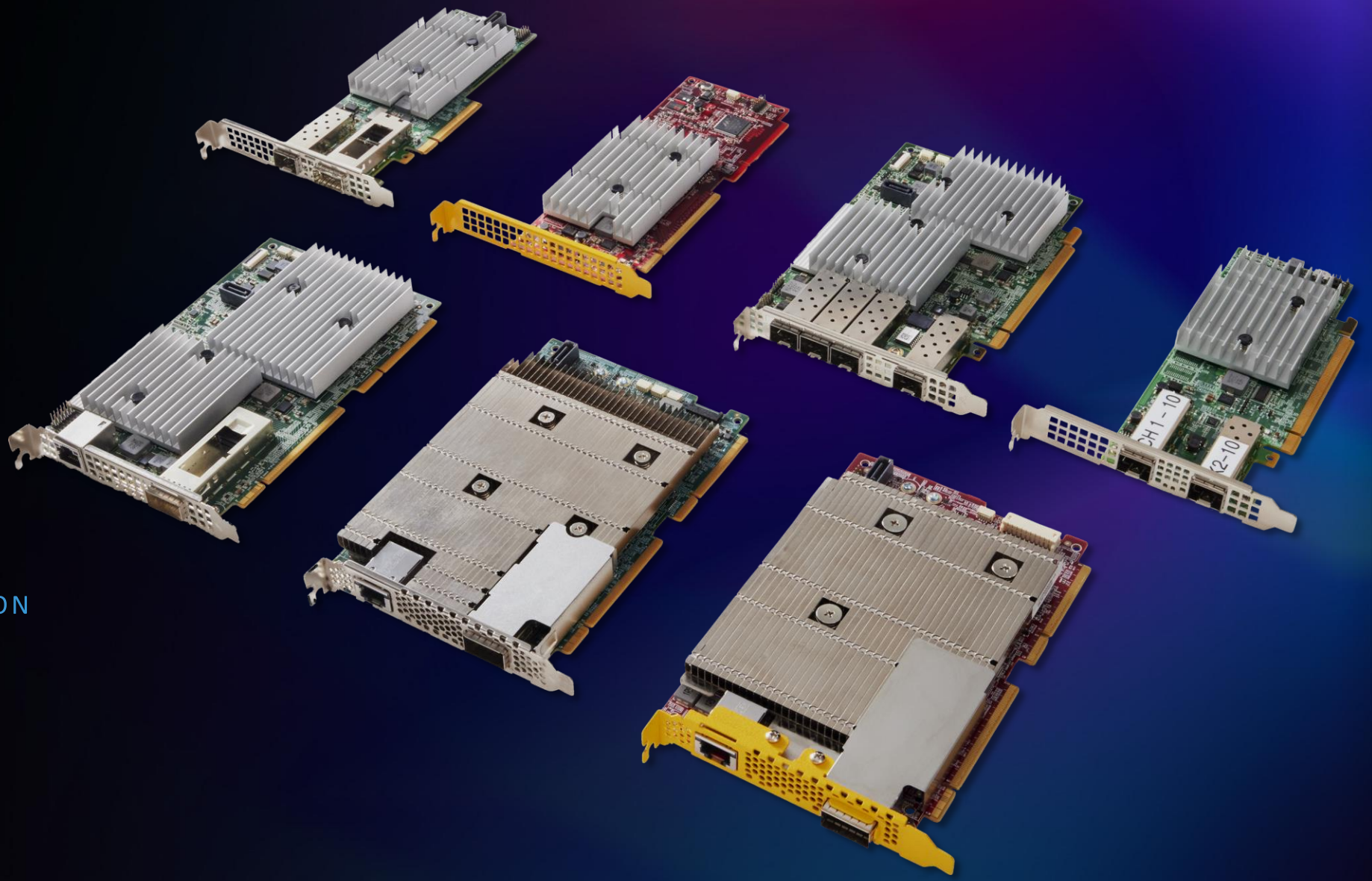
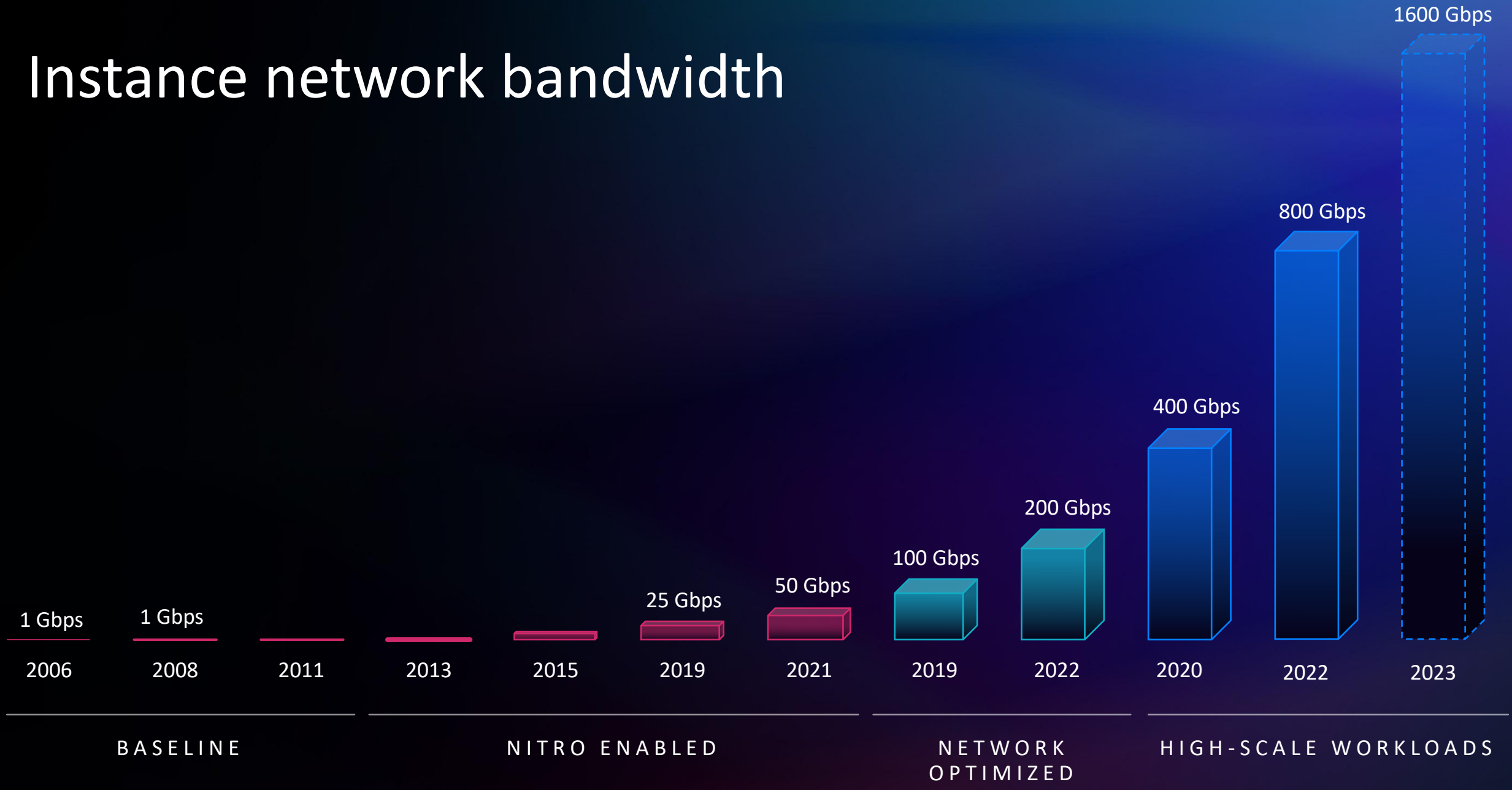


The AWS Nitro System hardware

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



Instance network bandwidth



NEW!

AVAILABLE NOW

6th Gen EC2 Network-optimized instances

BEST PERFORMANCE IN THE CLOUD FOR HIGH-NETWORKING AND EBS WORKLOADS

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NEW!

AVAILABLE NOW

6th Gen EC2 Network-optimized instances

BEST PERFORMANCE IN THE CLOUD FOR HIGH-NETWORKING AND EBS WORKLOADS

UP TO 200 GBPS

First network-optimized instance in the cloud to support 200 Gbps to accelerate data-intensive analytics workloads

UP TO 2X PPS

Scale performance of network virtual appliances, Telco, and in-memory database workloads

EBS OPTIMIZED

Supports up to 80 Gbps of EBS bandwidth to enable high performance file systems, databases, and big data analytics

NEW!

IN PREVIEW

Amazon EC2 C7gn Instances

HIGHEST NETWORK BANDWIDTH FOR EC2 NETWORK-OPTIMIZED INSTANCES

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NEW!

IN PREVIEW

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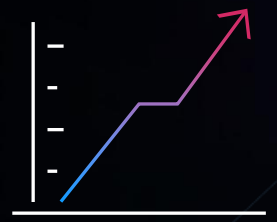

HIGHEST NETWORK PERFORMANCE

Scale data-intensive workloads with 200 Gbps of bandwidth and 2x higher throughput per vCPU compared to current C6gn instances

HIGHEST PPS PERFORMANCE

The new Nitro v5 card enables the highest packet processing performance across network-optimized instances to scale network virtual appliances

LATEST GRAVITON3 PROCESSORS

Up to 25% better compute performance and up to 2x faster performance for cryptographic workloads compared to Graviton2 instances

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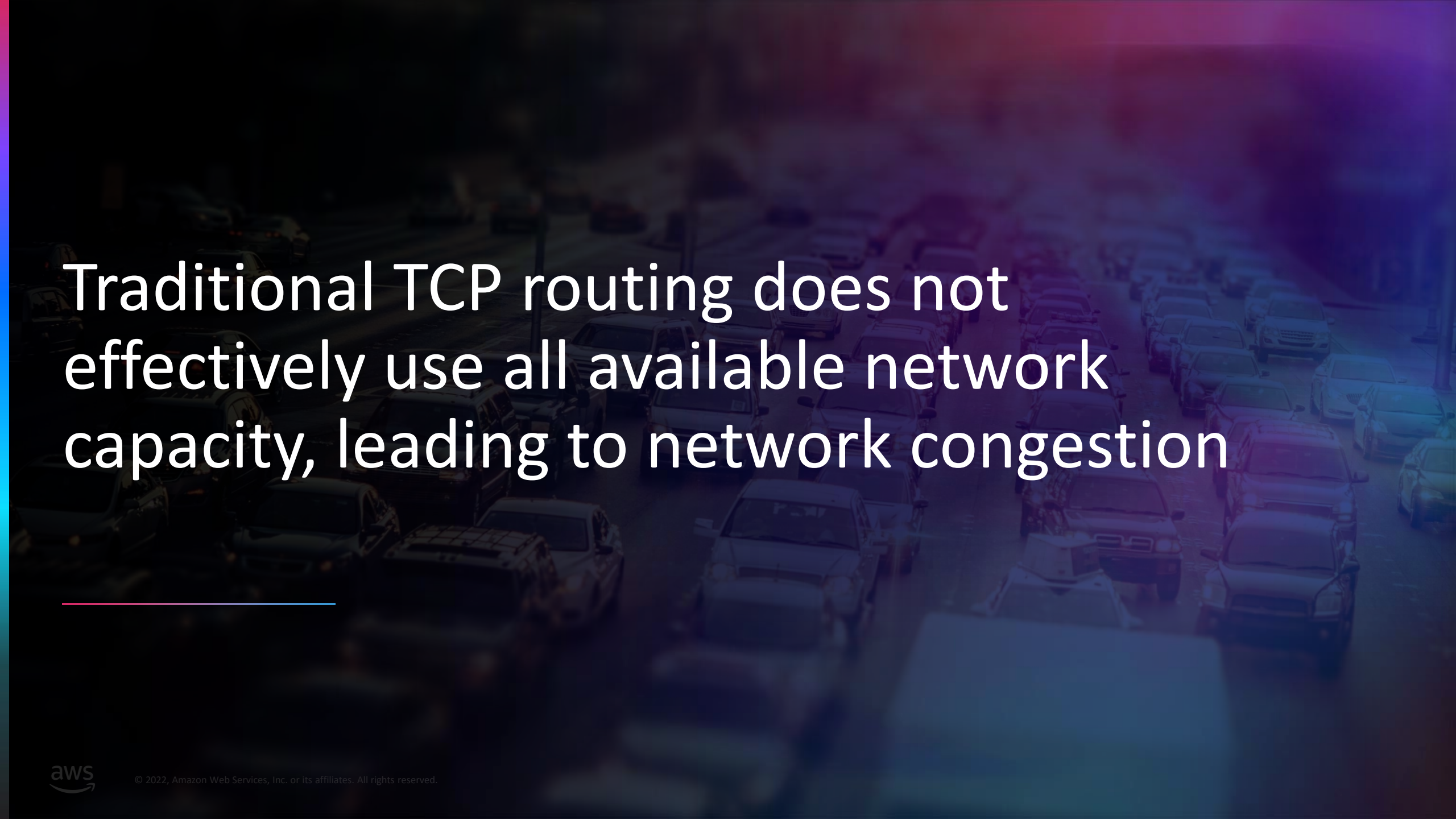

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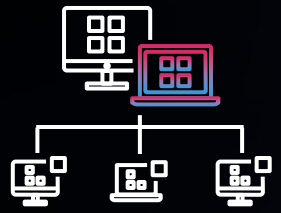
Scalable Reliable Datagram (SRD)

LOW LATENCY FOR NETWORK-INTENSIVE APPLICATIONS

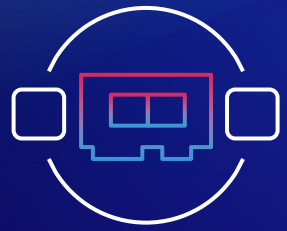


ETHERNET-BASED PROTOCOL

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

USED BY

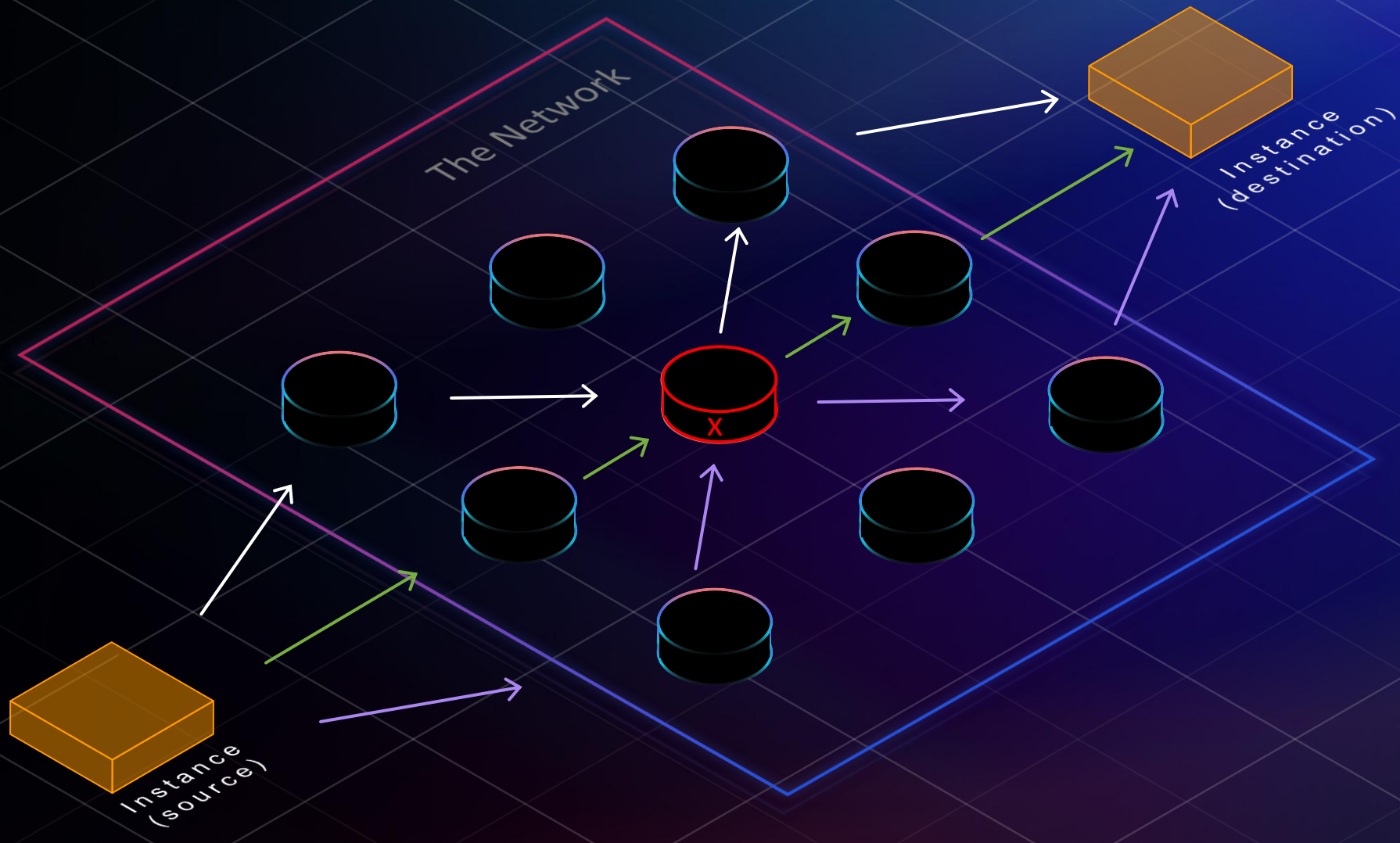
ELASTIC FABRIC ADAPTER

Low latency and high throughput for High Performance Computing workloads

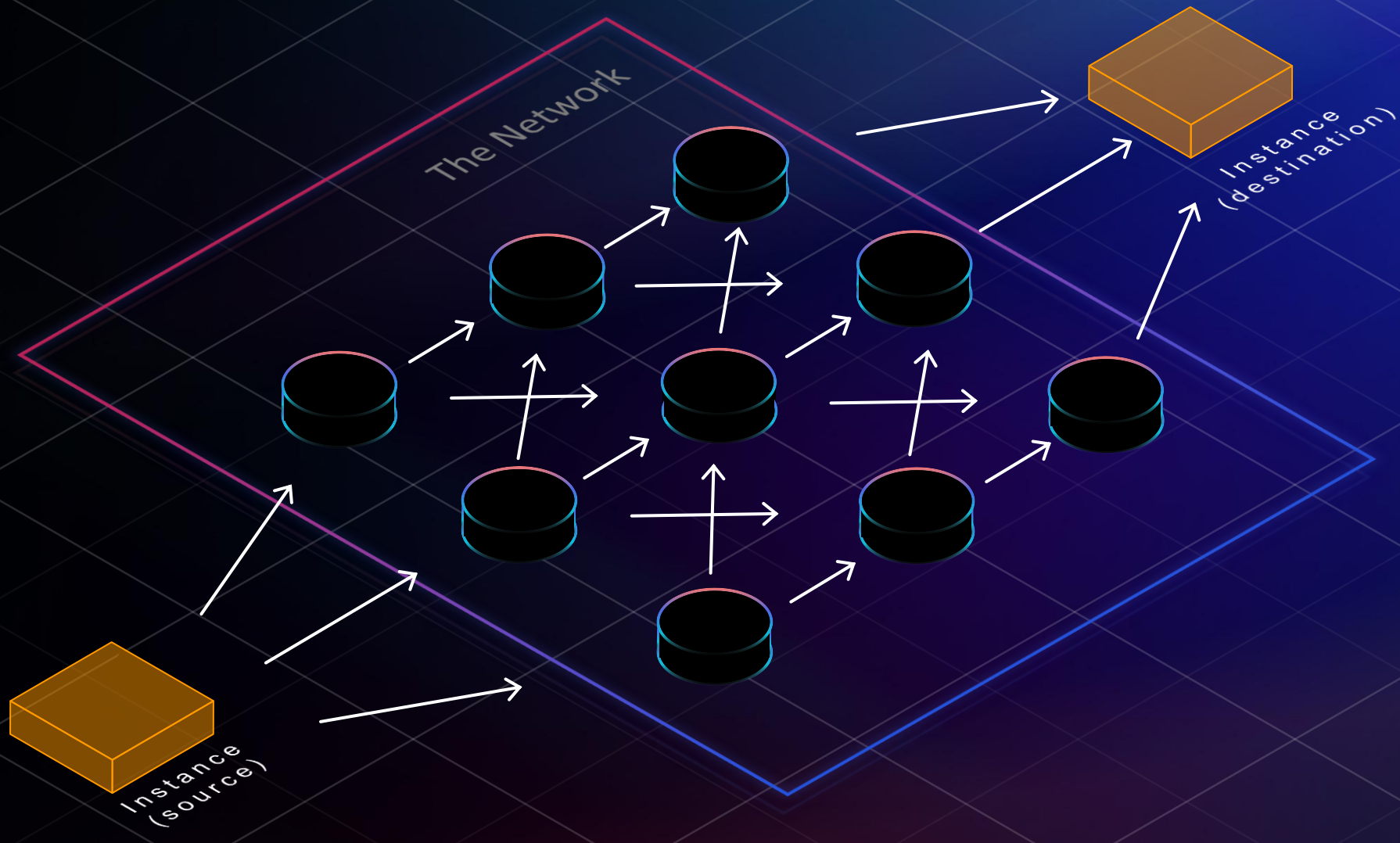
AMAZON EBS

IO2 Block Express volumes, delivering up to 4x higher throughput, IOPs, and capacity

Traditional TCP Routing



Scalable Reliable Datagram (SRD) Routing



NEW!

AVAILABLE NOW

Announcing ENA Express

INCREASED THROUGHPUT WITH LOWER TAIL LATENCY

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NEW!

AVAILABLE NOW

Announcing ENA Express

INCREASED THROUGHPUT WITH LOWER TAIL LATENCY

SIMPLE

Enable for network traffic between EC2 instances with a single API call

TRANSPARENT

Use TCP/UDP for your application and the SRD encapsulation will be done by the network

PERFORMANCE

Reduces p99 network latency by up to 50%, and p99.9 latency by up to 85%. Single flow throughput up to 25 Gbps.

AVAILABLE AT NO ADDITIONAL COST

NEW!

AVAILABLE NOW

Announcing ENA Express

INCREASED THROUGHPUT WITH LOWER TAIL LATENCY

25Gbps

5X INCREASE IN BANDWIDTH

Up to 25 Gbps of single flow bandwidth – up from 5 Gbps

50%

LOWER P99 LATENCY

ENA Express reduces p99 network latency by up to 50%

85%

LOWER P99.9 LATENCY

ENA Express reduces p99.9 network latency by up to 85%

AVAILABLE AT NO ADDITIONAL COST

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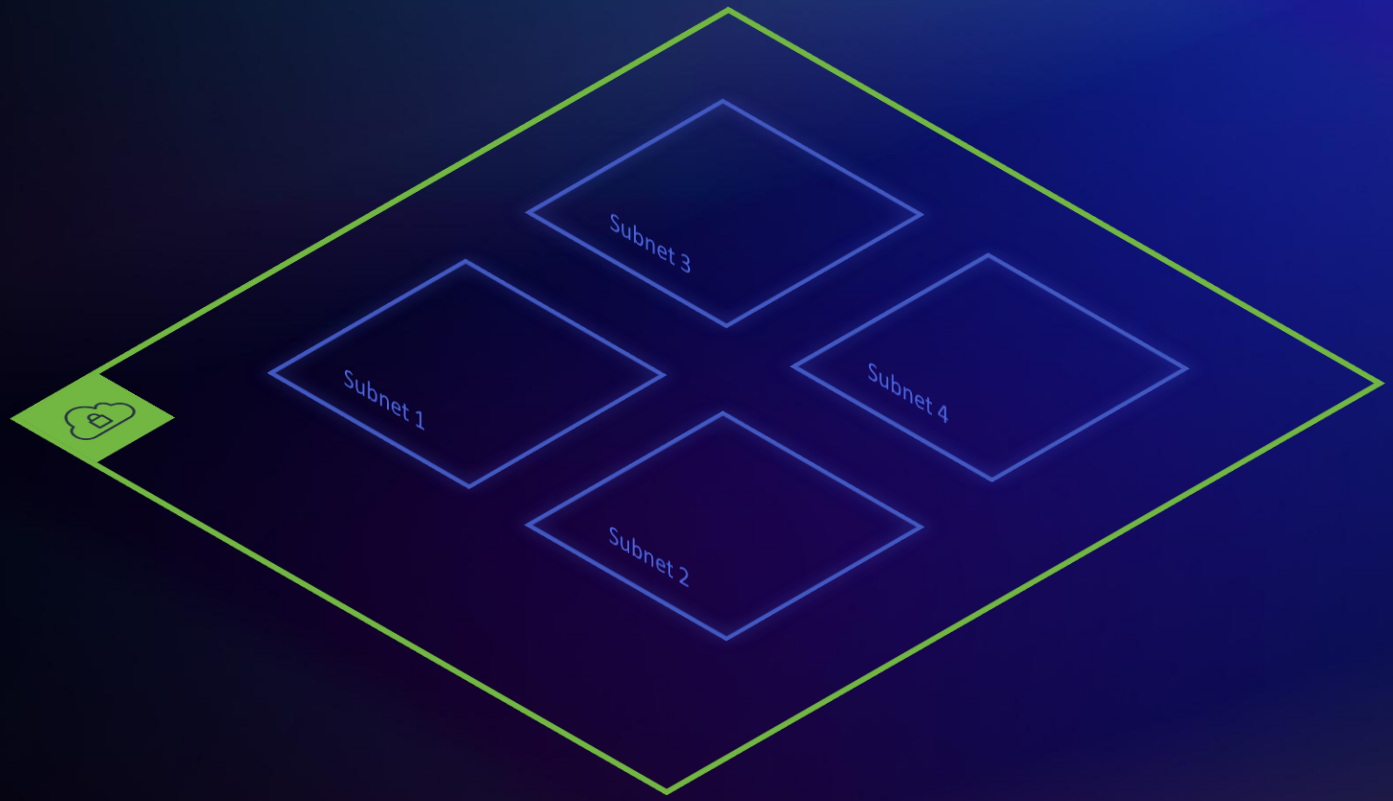
Amazon Virtual Private Cloud

AMAZON VPC PROVIDES A LOGICALLY ISOLATED VIRTUAL NETWORK FOR YOUR CLOUD RESOURCES



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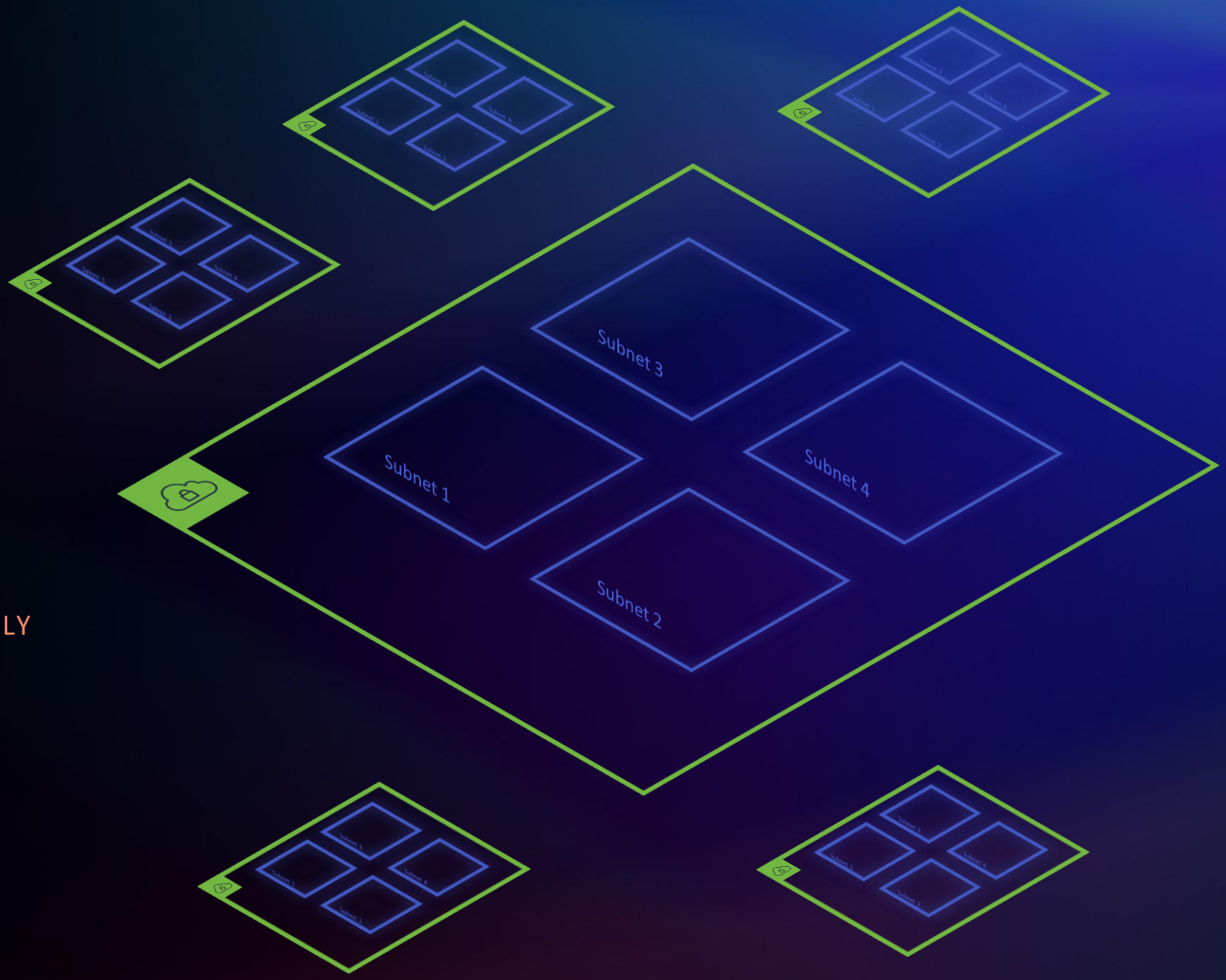
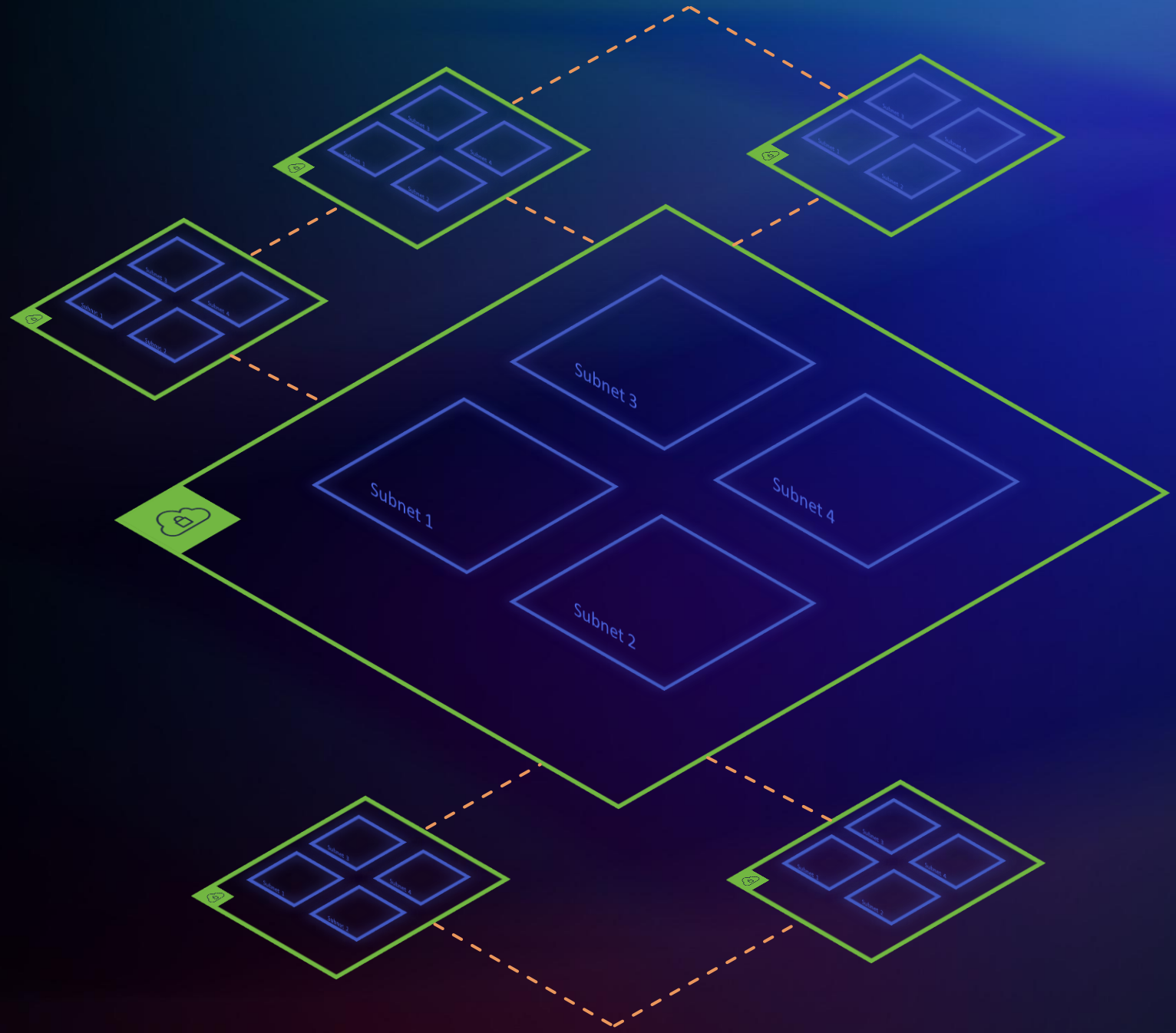
AMAZON VPC PROVIDES A LOGICALLY ISOLATED VIRTUAL NETWORK FOR YOUR CLOUD RESOURCES



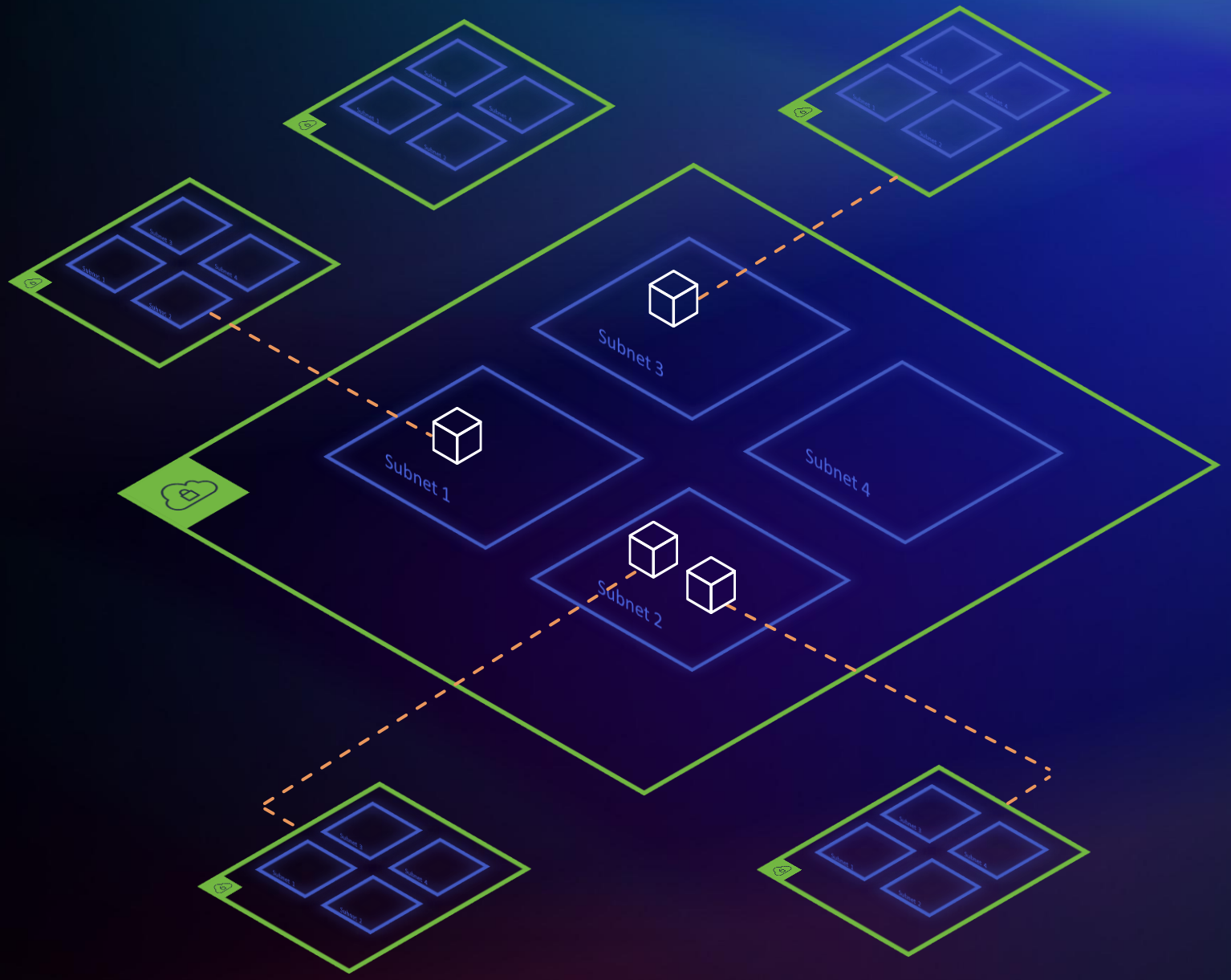
Virtual Private Cloud Peering

ALLOWS TRAFFIC TO BE ROUTED BETWEEN PEERED VPCS



AWS PrivateLink

ALLOWS TRAFFIC TO BE ROUTED
BETWEEN SERVICES WITHIN VPCS



“AWS PrivateLink will give our developers an easy, secure, and scalable way to enable private connectivity for shared services and microservices across different accounts and VPCs.”

Reeny Sondhi
Chief of Product Security, Autodesk

AUTODESK

aws
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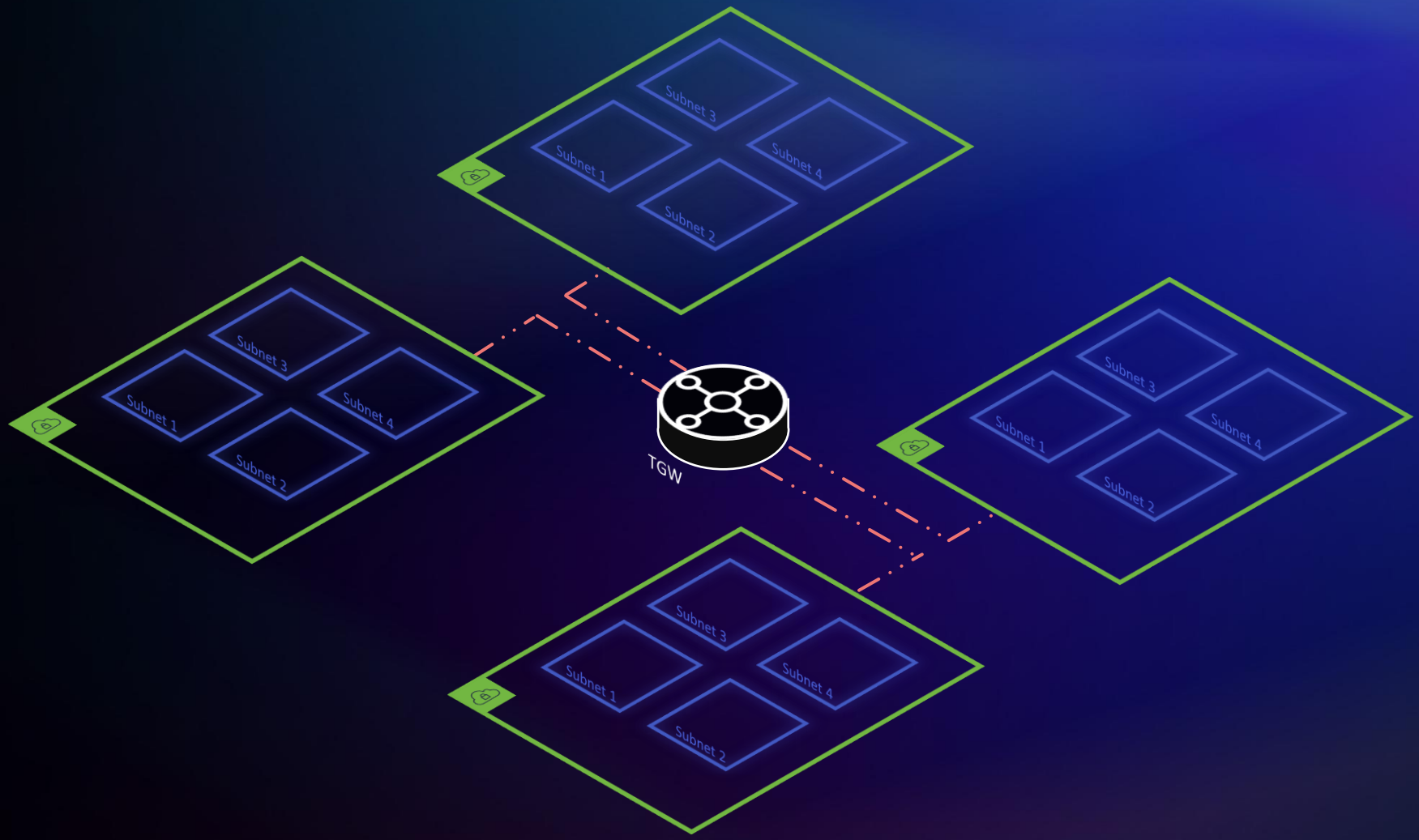
AWS Transit Gateway

CONNECTS YOUR VPCS AND ON-PREMISES NETWORKS THROUGH A CENTRAL HUB



"AWS Transit Gateway radically evolved and simplified cloud networking. Using Transit Gateway, we reduced the time to interconnect new VPCs and on-premise networks from weeks to minutes while attaining consistent and more reliable network performance!"

Khoder Shamy
Director, Cloud Platform and Infrastructure, Fuze

fuze

aws

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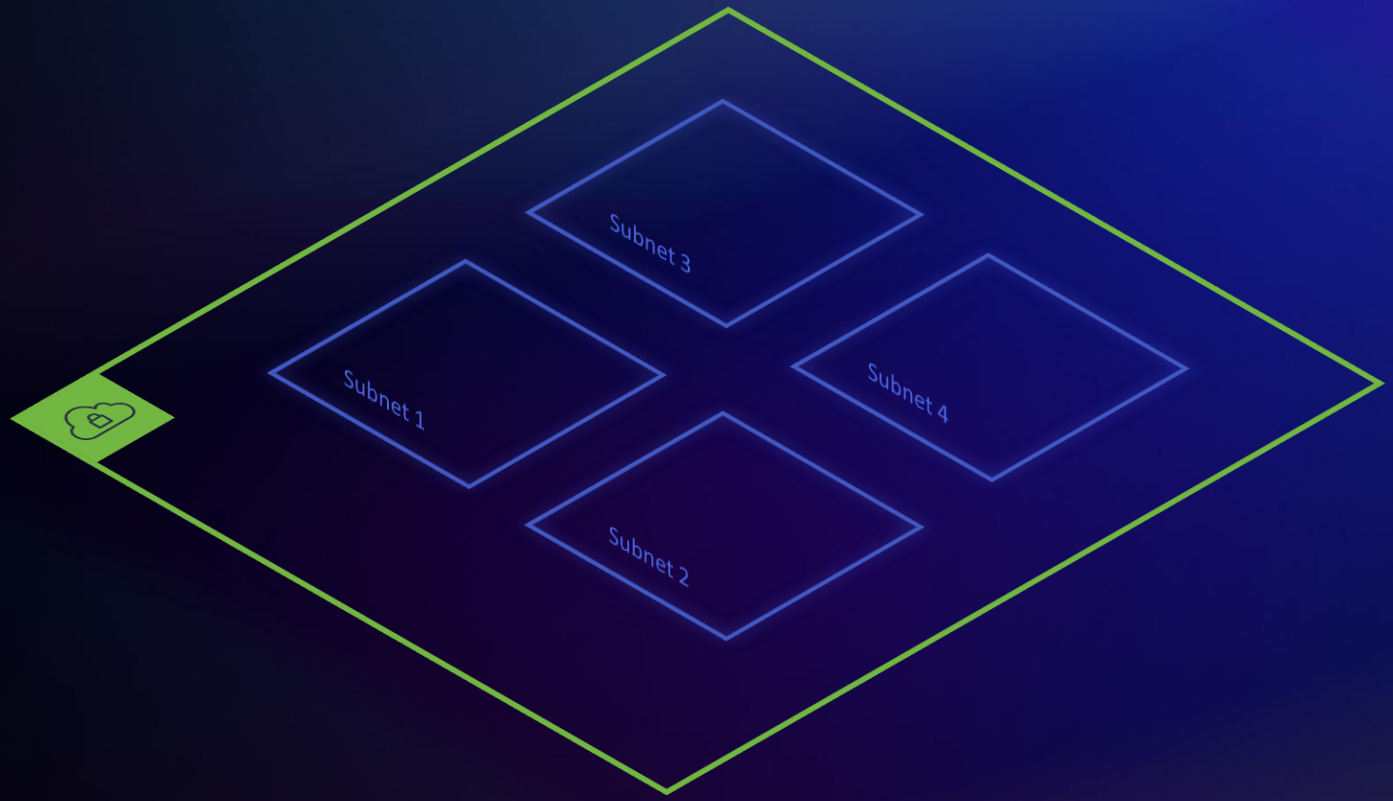
It’s important that past decisions do not affect your ability to scale your network topology in the future

Amazon Virtual Private Cloud

AMAZON VPC PROVIDES A LOGICALLY ISOLATED VIRTUAL NETWORK FOR YOUR CLOUD RESOURCES



Amazon Virtual Private Cloud (VPC)

50,000

MAXIMUM NUMBER OF IN-USE IP ADDRESSES WITH A VPC

AMAZON VPC PROVIDES A LOGICALLY ISOLATED VIRTUAL NETWORK FOR YOUR CLOUD RESOURCES

NEW!

AVAILABLE NOW

Announcing Increased VPC Size

SUPPORTING UP TO 256,000 IN-USE IP ADDRESSES WITHIN A VPC

NEW!

AVAILABLE NOW

Announcing Increased VPC Size

SUPPORTING UP TO 256,000 IN-USE IP ADDRESSES WITHIN A VPC

256K

IN-USE IP ADDRESSES

Support up to 256K in-use IP addresses within a single VPC

512K

WHEN USING VPC PEERING

Support up to 512K in-use IP addresses between VPCs when using VPC peering

3.5x

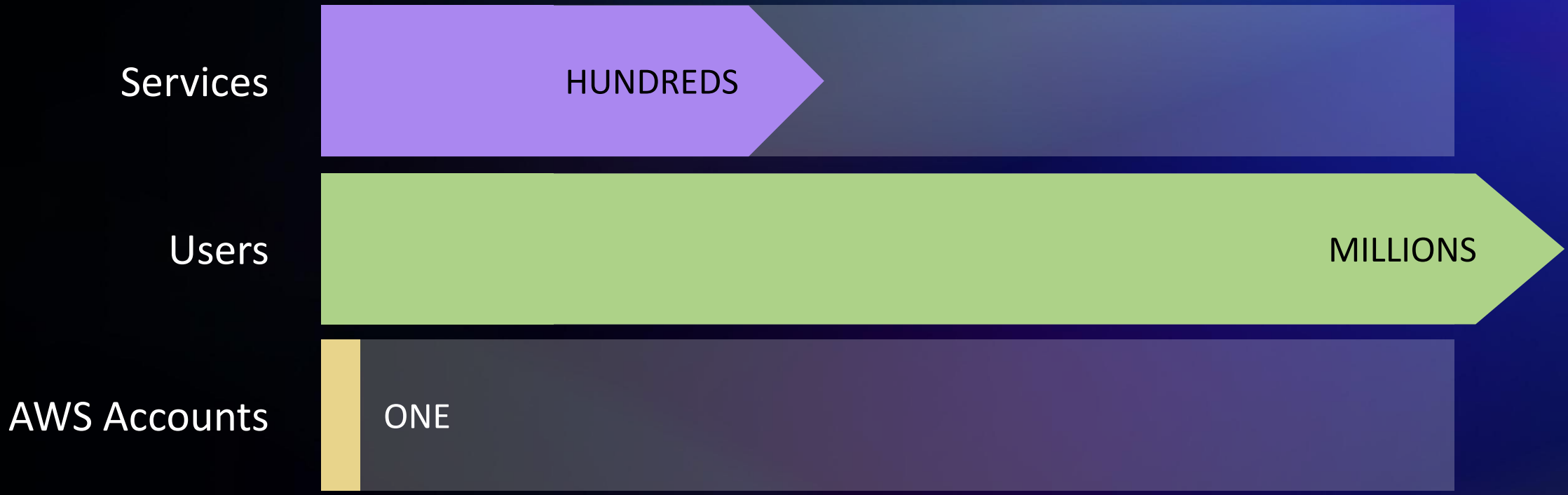
HIGHER THAN OTHER CLOUDS

Don’t worry about unexpected consequences of network scaling

slack

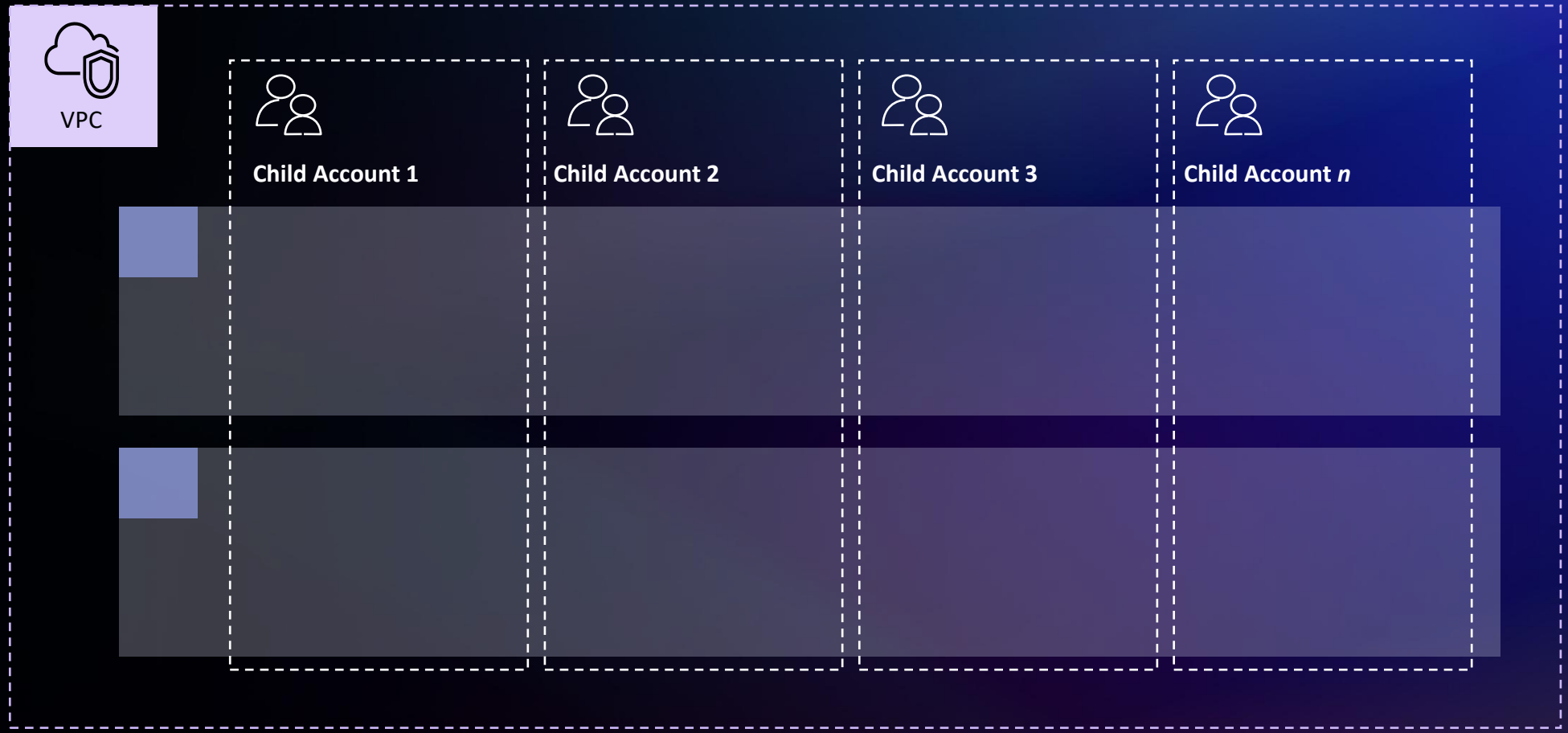
Milena Talavera (she/her)

SVP of Engineering, Core Infrastructure, Slack



slack

slack


VPC
Child Account 1
Child Account 2
Child Account 3
Child Account *n*

Expanding Globally

Migration & Scale

“Whitecastle”

Shared VPC

AWS Transit Gateway

AWS Transit Gateway Inter-Region Peering

slack

Amazon VPC IP Address Manager

IP Address Manager

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

Monitor IP utilization across our network

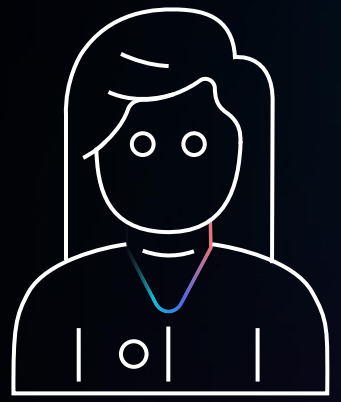
Perform retrospective analysis for faster troubleshooting

Looking back,
Looking ahead

slack

THE POWER OF CLOUD NETWORK INNOVATION

- Global scale and highest availability
- World-class performance
- Building large-scale network topologies
- Networking for applications
- Industry leading security
- Building networks at global scale



ADMINISTRATOR

Wants stricter control to ensure that only approved entities are communicating on the network

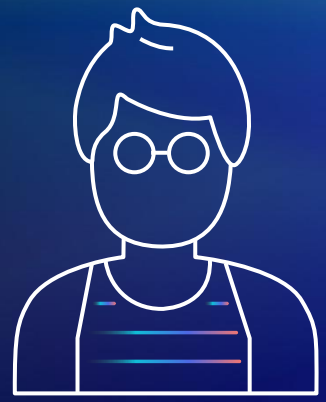
Wants to enforce proper identity and authentication – often limits compute platforms to achieve this

Wants control of network and ability to monitor and audit all traffic flows within the network

CONNECTIVITY

SECURITY

VISIBILITY



DEVELOPER

Wants to connect applications without worrying about the VPC or account boundaries

Wants to use the right compute platform with integrated support for identity and authentication

Wants application logs, but not overly concerned with controlling, monitoring, or auditing network flows

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A service mesh is a platform layer that enables managed, observable, and secure communication between individual services

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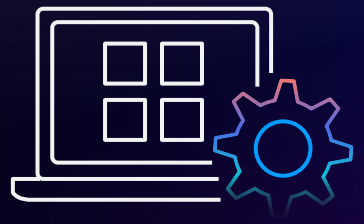
Service Mesh Challenges

CHALLENGES USING SERVICE MESH ARCHITECTURES

SIDECAR PROXIES REQUIRED

Deploying and maintaining proxies at scale can be difficult



ONLY FOR CONTAINER WORKLOADS

Does not work for other workloads such as serverless and Amazon EC2

REQUIRES NETWORKING EXPERTISE

Complex inter-VPC networking slows down developers

NEW!

IN PREVIEW

Announcing Amazon VPC Lattice

SIMPLIFYING APPLICATION LAYER NETWORKING

NEW!

IN PREVIEW

Announcing Amazon VPC Lattice

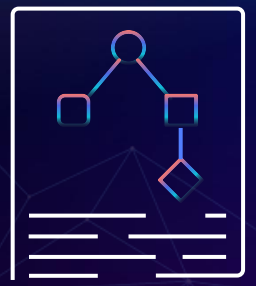
SIMPLIFYING APPLICATION LAYER NETWORKING

NO SIDECAR PROXIES REQUIRED

Fully managed service with no proxies to deploy and maintain

WORKS ACROSS ALL WORKLOADS

Works across Amazon EC2, Amazon EKS, Amazon ECS, and AWS Lambda



NO NETWORKING EXPERTISE REQUIRED

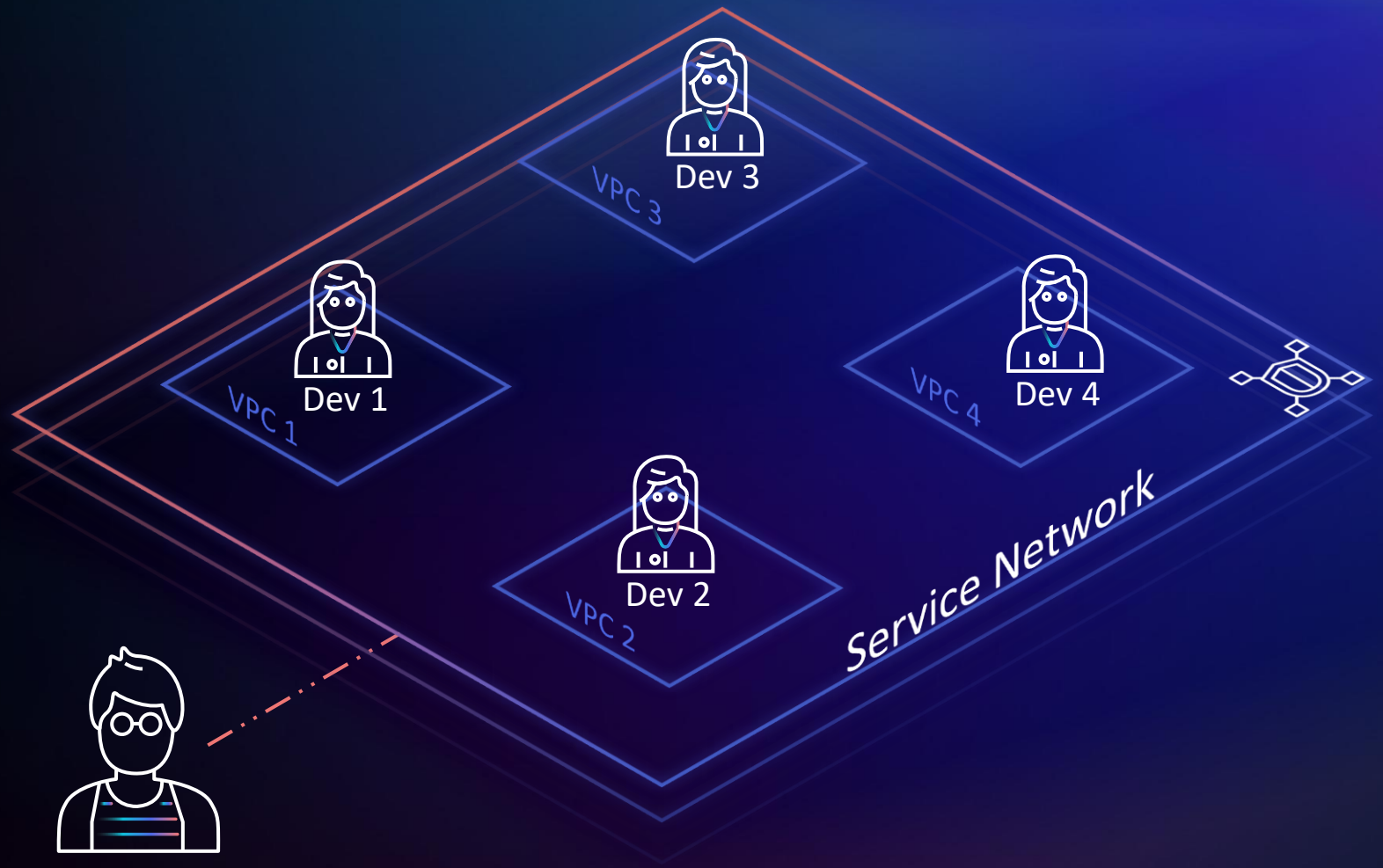
Simplified connectivity and security across VPCs and accounts

TRAFFIC AND ACCESS CONTROLS

Improved security posture and rich traffic controls

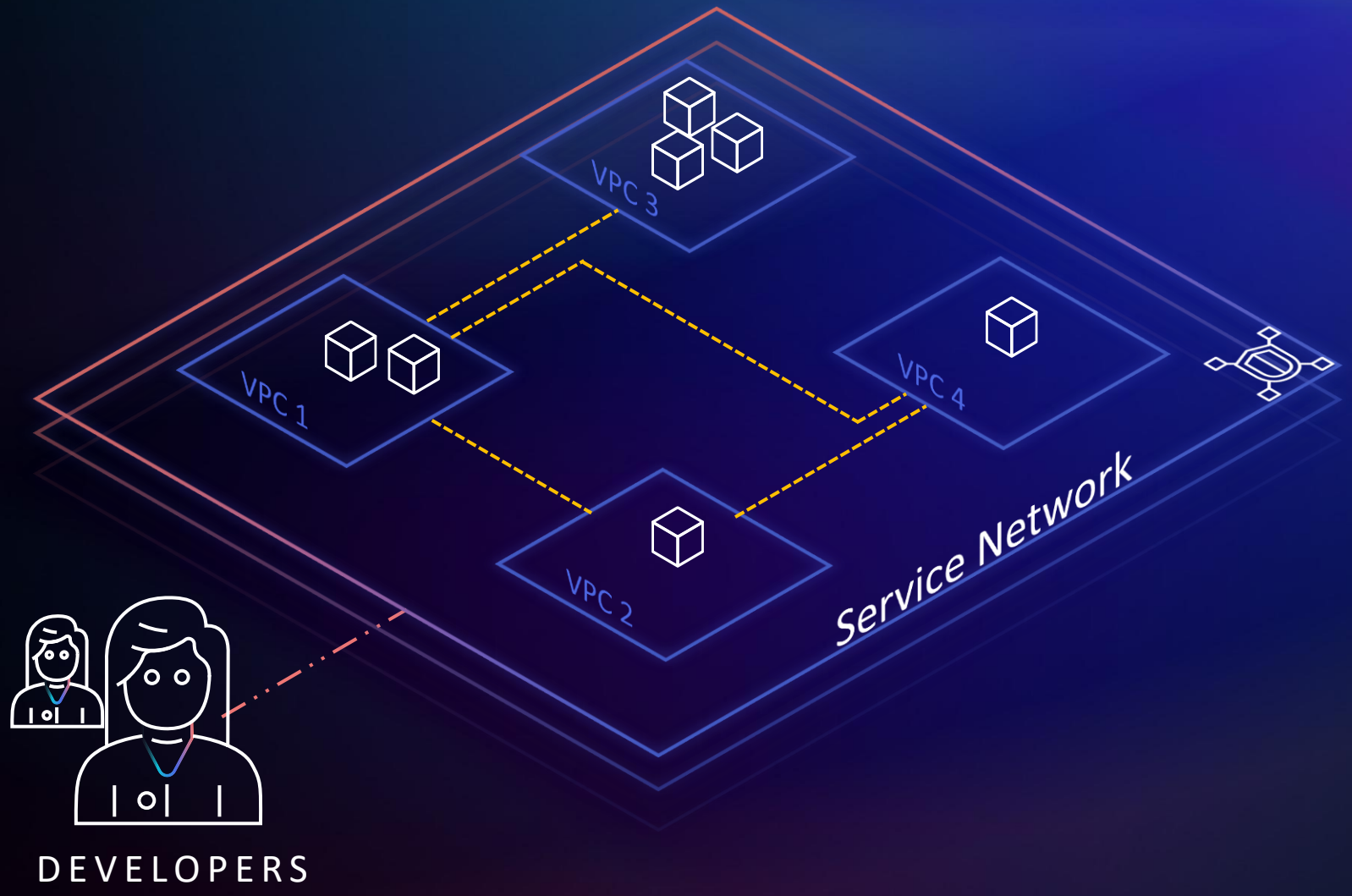
Amazon VPC Lattice

SIMPLIFYING APPLICATION LAYER NETWORKING



Amazon VPC Lattice

SIMPLIFYING APPLICATION LAYER NETWORKING



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Provide you with improved observability so that you spend less time on operational tasks and more time building applications

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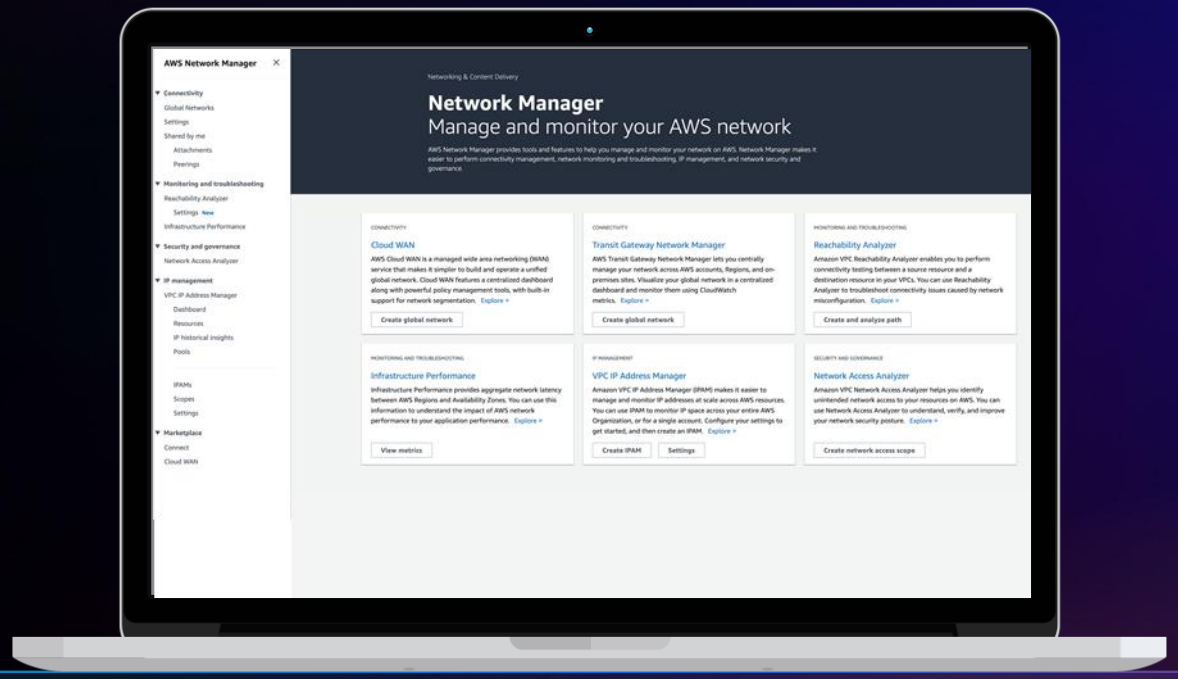
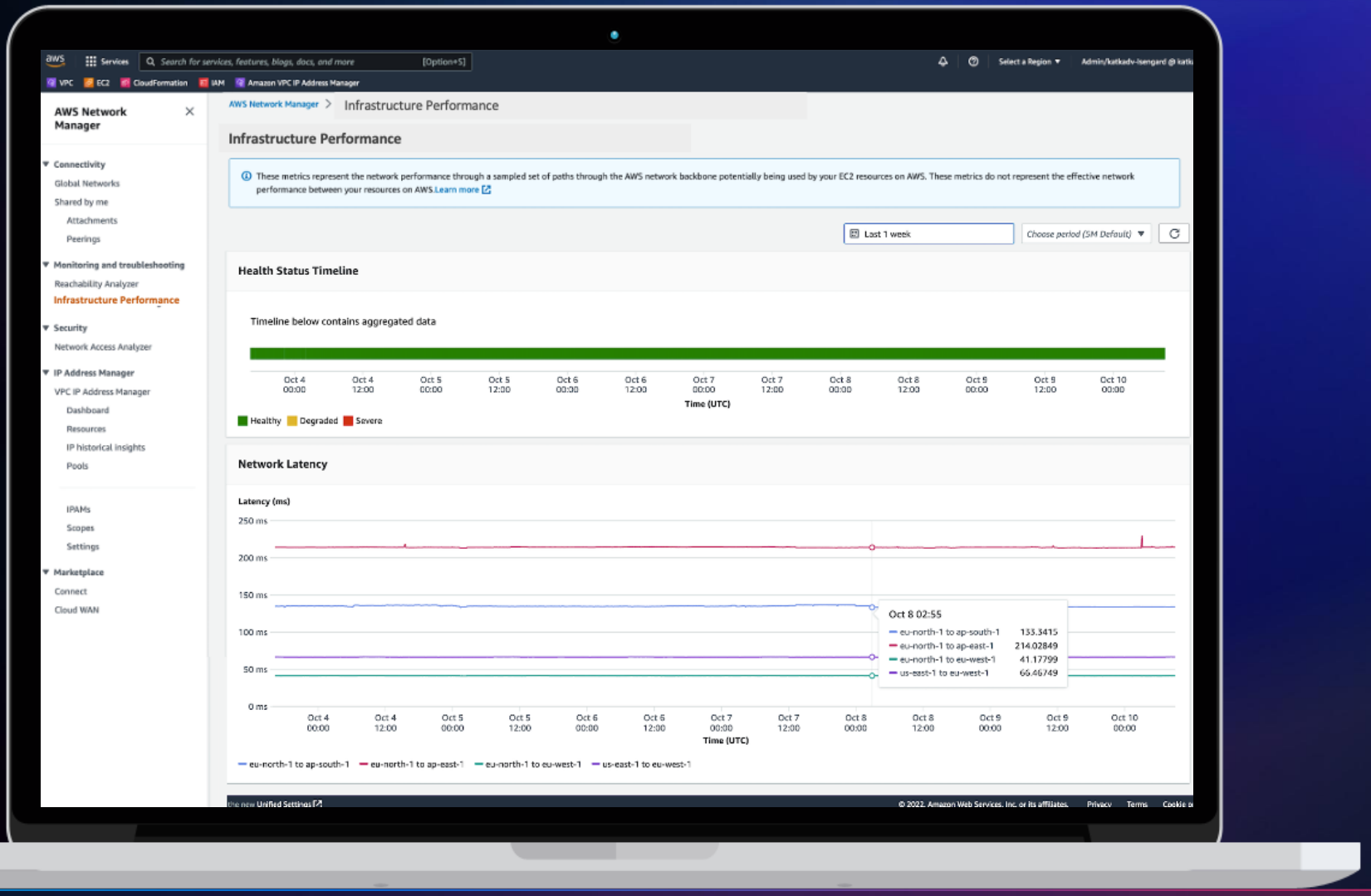
AVAILABLE NOW

AWS Network Manager

A CENTRAL LOCATION FOR MANAGING AND MONITORING YOUR AWS NETWORK



Infrastructure Performance



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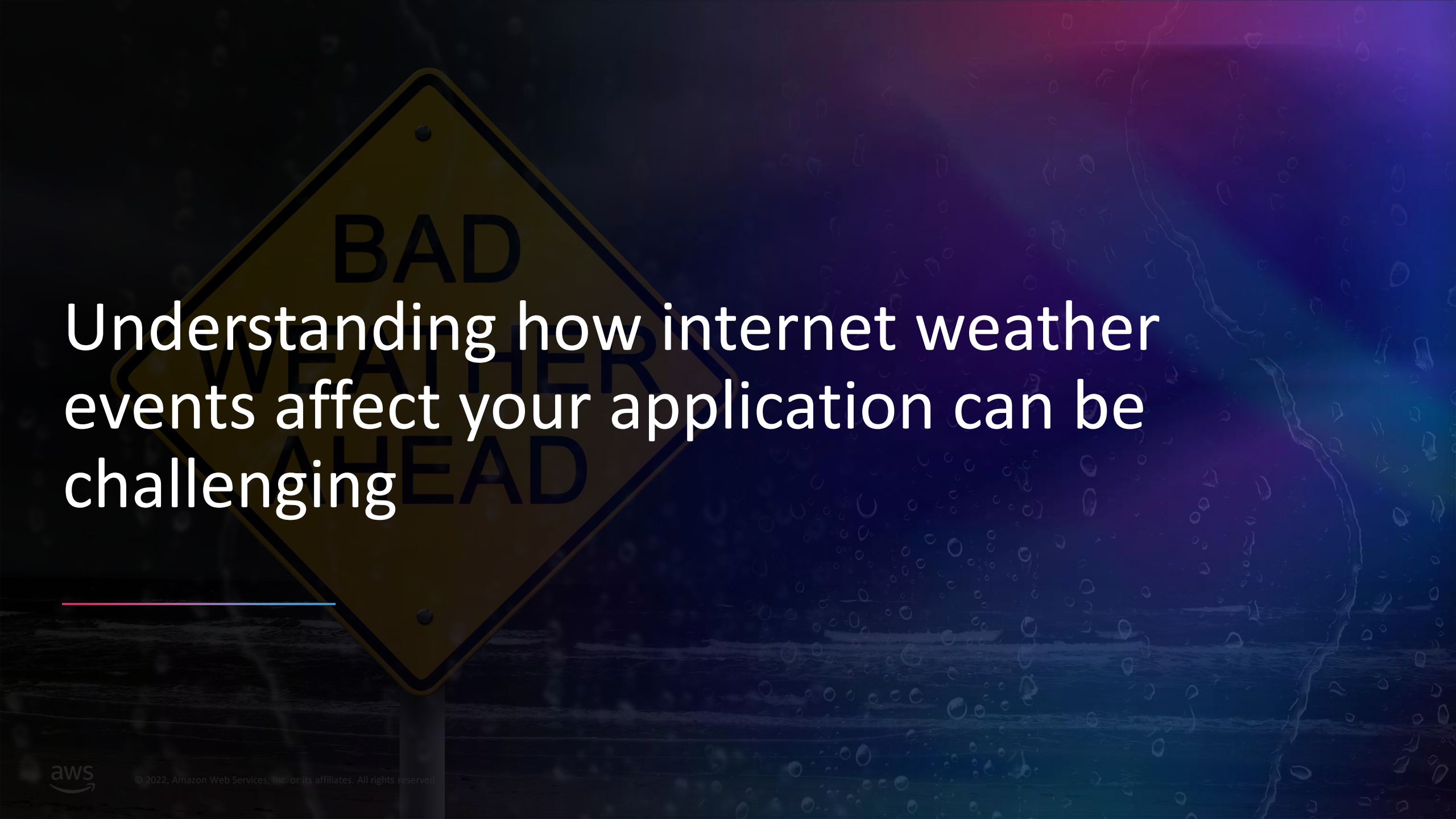

Understanding how internet weather events affect your application can be challenging

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NEW!

IN PREVIEW

Amazon CloudWatch Internet Monitor

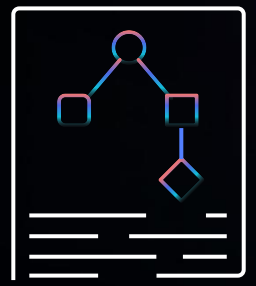
SEE HOW THE INTERNET IS AFFECTING YOUR USERS

NEW!

IN PREVIEW

Amazon CloudWatch Internet Monitor

SEE HOW THE INTERNET IS AFFECTING YOUR USERS



DETECT

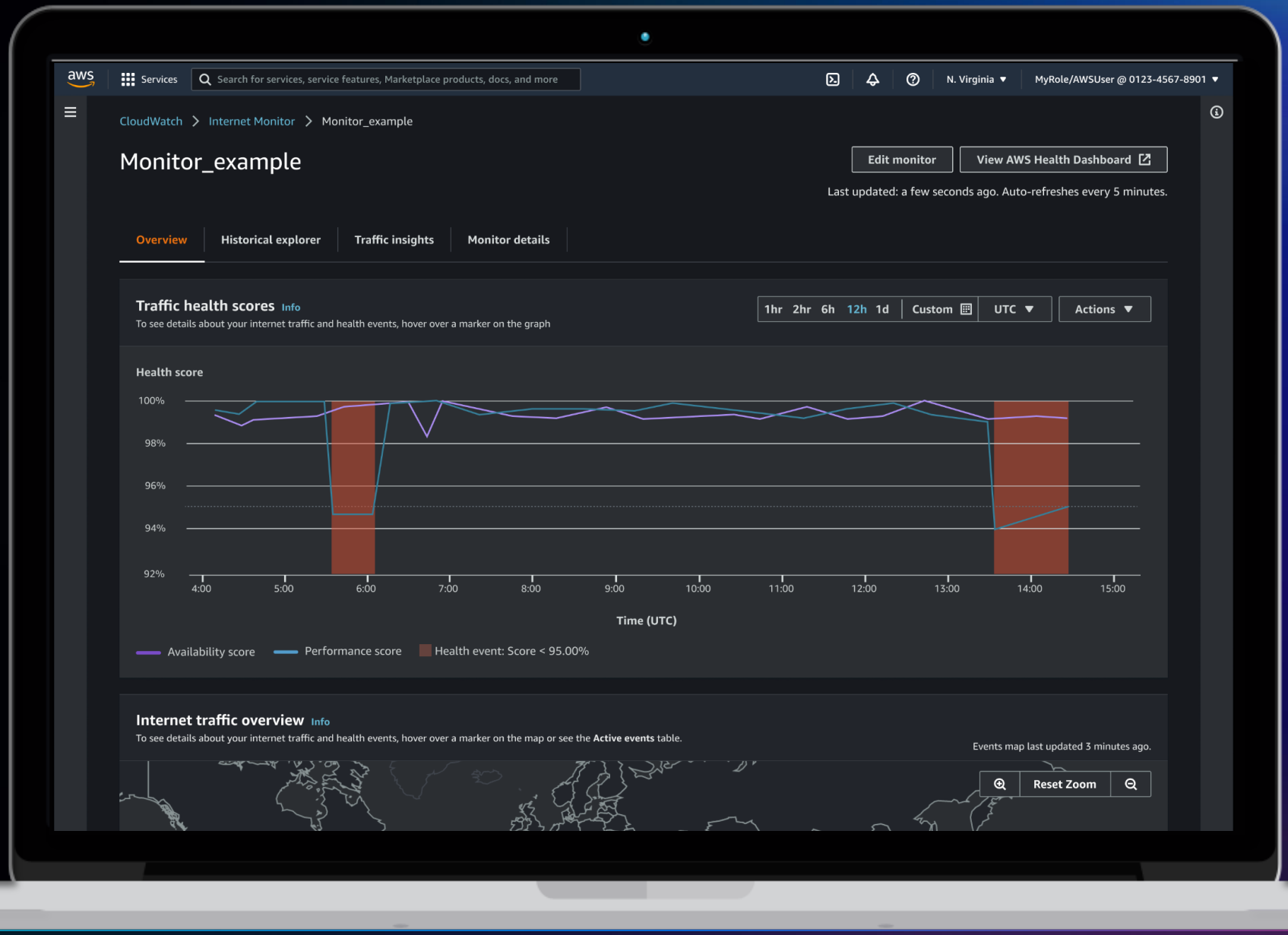
Identify network and application performance issues in minutes

DIAGNOSE

Anomaly detection and visibility into metrics by geography and ASN

ALARMING

Dashboarding and alarming on network metrics


aws
Services
Search for services, service features, Marketplace products, docs, and more
N. Virginia
MyRole/AWSUser @ 0123-4567-8901
CloudWatch
Internet Monitor
Monitor_example
Monitor_example
Edit monitor
View AWS Health Dashboard
Last updated: a few seconds ago. Auto-refreshes every 5 minutes.
Overview
Historical explorer
Traffic insights
Monitor details
Traffic health scores Info
To see details about your internet traffic and health events, hover over a marker on the graph
1hr 2hr 6h 12h 1d
Custom
UTC
Actions
Health score
100%
98%
96%
94%
92%
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
Time (UTC)
Availability score
Performance score
Health event: Score < 95.00%
Internet traffic overview Info
To see details about your internet traffic and health events, hover over a marker on the map or see the Active events table.
Events map last updated 3 minutes ago.
Reset Zoom

THE POWER OF CLOUD NETWORK INNOVATION

- Global scale and highest availability
- World-class performance
- Building large-scale network topologies
- Networking for applications
- Industry leading security
- Building networks at global scale

Strengthen your security posture

Over 50 global compliance certifications & accreditations

Benefit from AWS industry leading security teams 24/7, 365 days a year

Security infrastructure built to satisfy military, global banks, and other high-sensitivity organizations

World-class network performance and capabilities

vodafone

"Amazon Web Services (AWS) was the clear choice in terms of security and PCI DSS Level 1 compliance compared to an on-premises or co-location data center solution."

Stefano Harak, Senior Product Manager for Vodafone Italy

Amazon Virtual Private Cloud

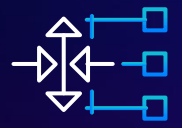
WORLD-CLASS SECURITY FOR ADVANCED NETWORK TOPOLOGIES

Security Groups and ACLs

NAT Gateway

Network Firewall

Partner Appliances



Gateway Load Balancer

Encryption

DNS Firewall

AWS WAF

AWS Shield

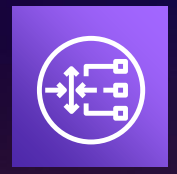
AWS Marketplace network security Partners

EASILY INTEGRATE WITH YOUR VPC

TRANSIT GATEWAY

INTERNET GATEWAY

VPC ROUTING



GATEWAY LOAD BALANCER

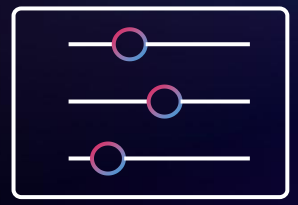
This is not a complete list. To view all AWS Partners for this category, visit AWS Partner Solutions Finder. This list of partners is current as of November 29, 2022.

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

aws

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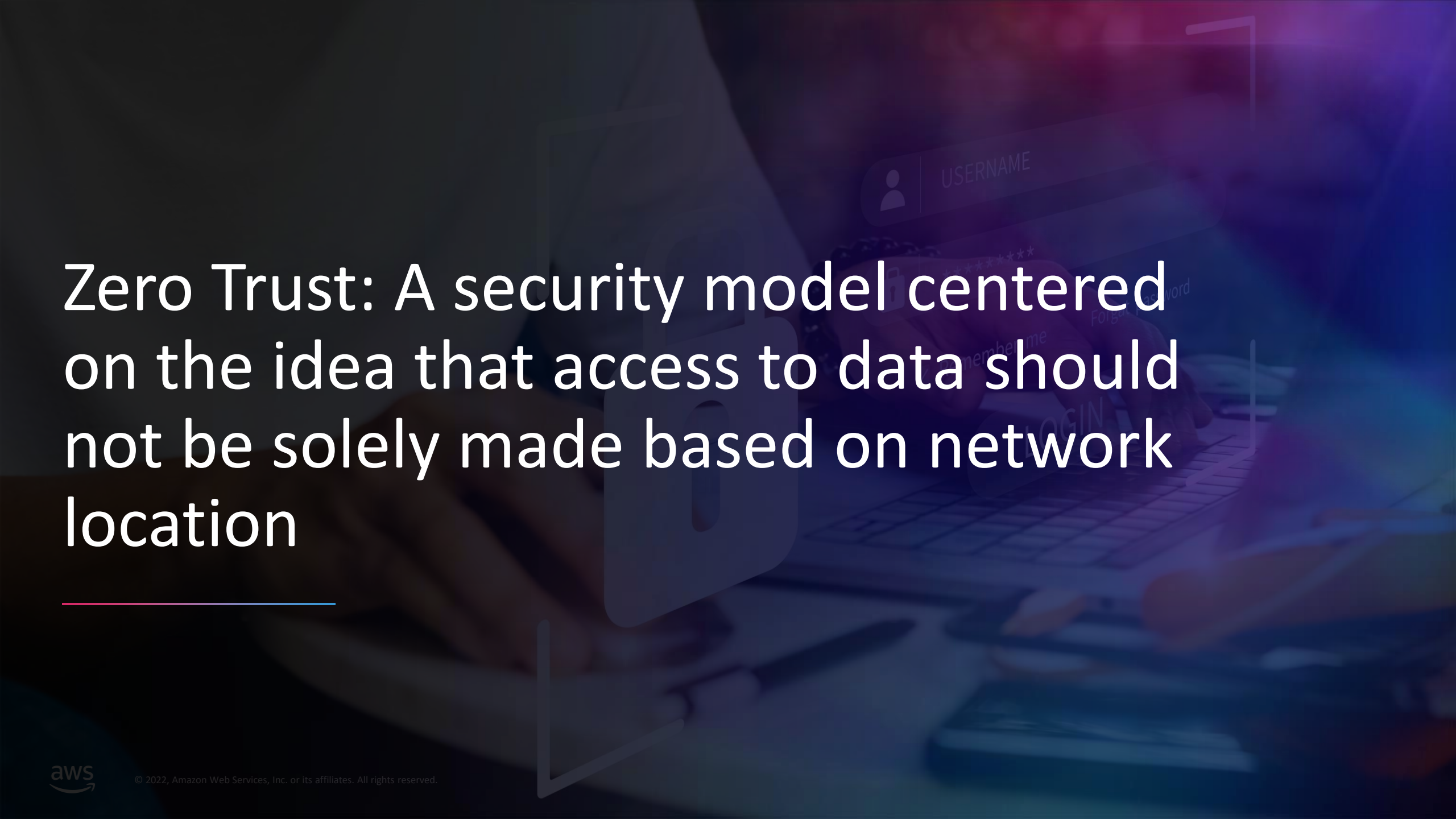

Zero Trust: A security model centered on the idea that access to data should not be solely made based on network location

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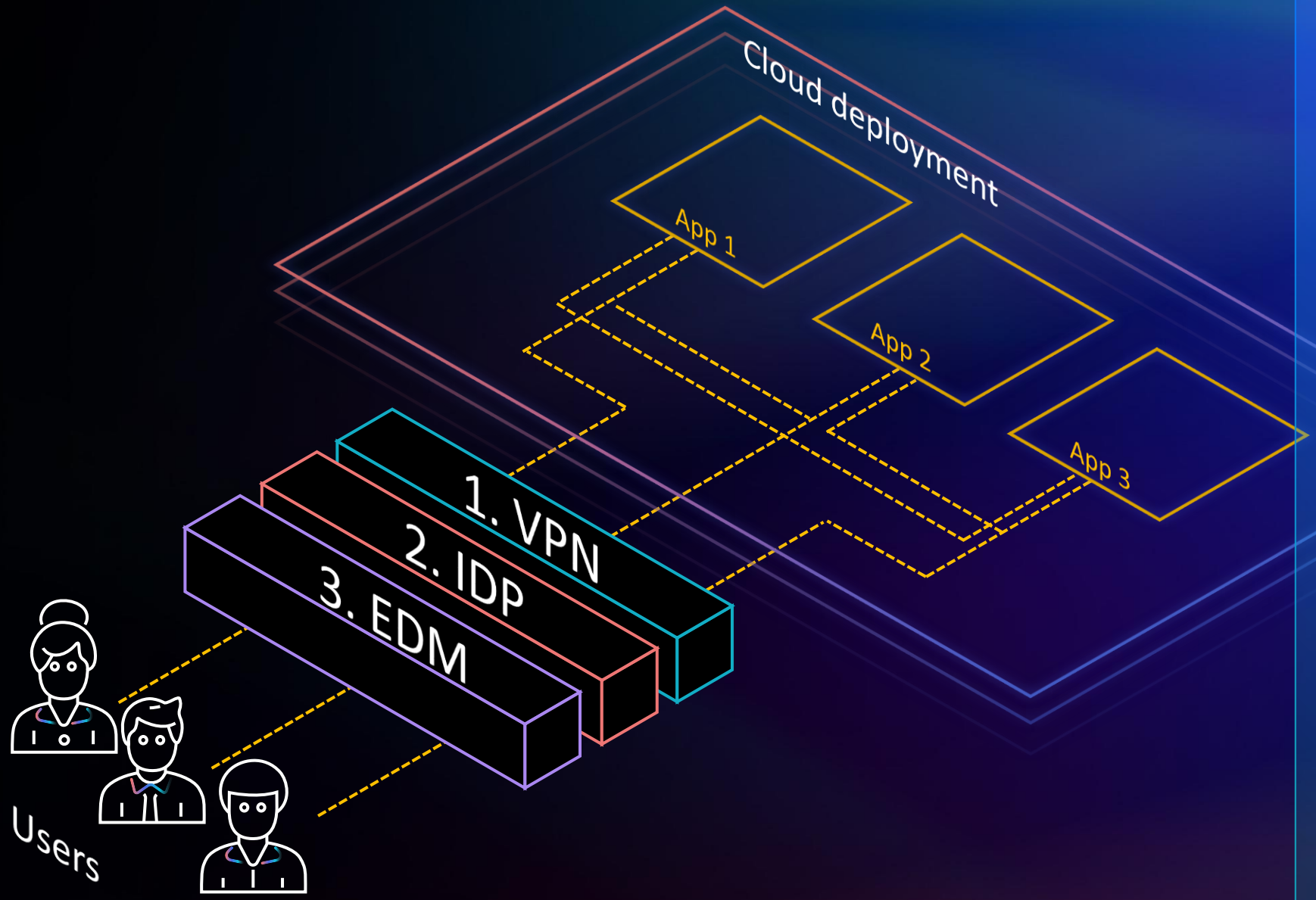

1

VPN POLICY

2

IDENTITY POLICY

3

DEVICE POLICY

NEW!

IN PREVIEW

Announcing AWS Verified Access

SECURE ACCESS TO CORPORATE APPLICATIONS WITHOUT A VPN

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NEW!

IN PREVIEW

Announcing AWS Verified Access

SECURE ACCESS TO CORPORATE APPLICATIONS WITHOUT A VPN

IMPROVE SECURITY POSTURE

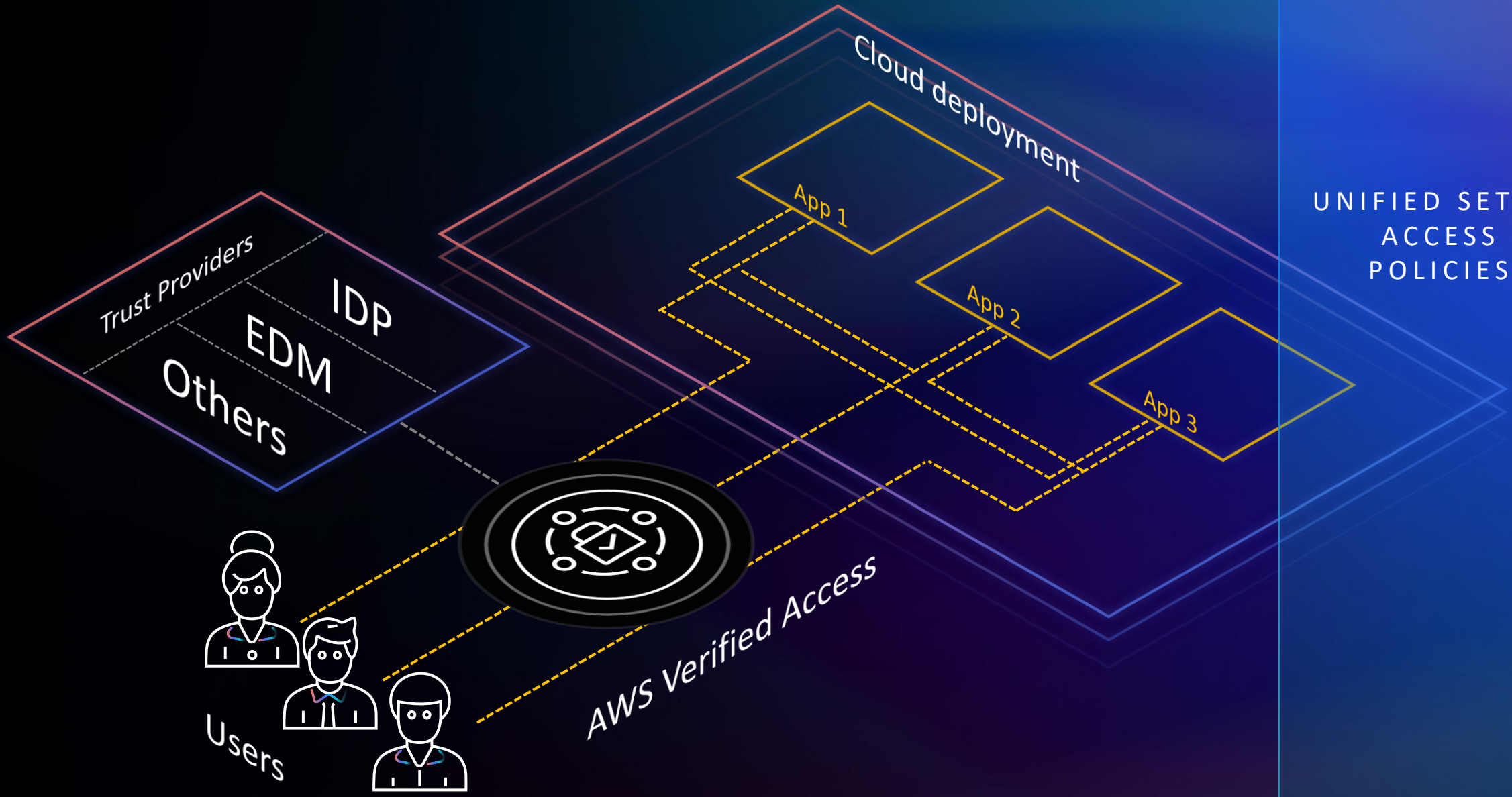
Evaluates each user request in real time using identity and device posture

SIMPLIFY OPERATIONS

Onboard applications using a few clicks; manage all policies centrally

INCREASED MOBILITY

Users access applications with a web browser, without any additional agents



UNIFIED SET OF ACCESS POLICIES

AWS Verified Access Partners

TRUST/NETWORK PROVIDERS

CROWDSTRIKE

CYBERARK®

DUO

jamf

jumpcloud™

okta

prosimo

Ping Identity.

SIEM/OBSERVABILTY PROVIDERS

DATADOG

IBM

netskope

new relic.

RAPID7

sumo logic

Trellix

aws

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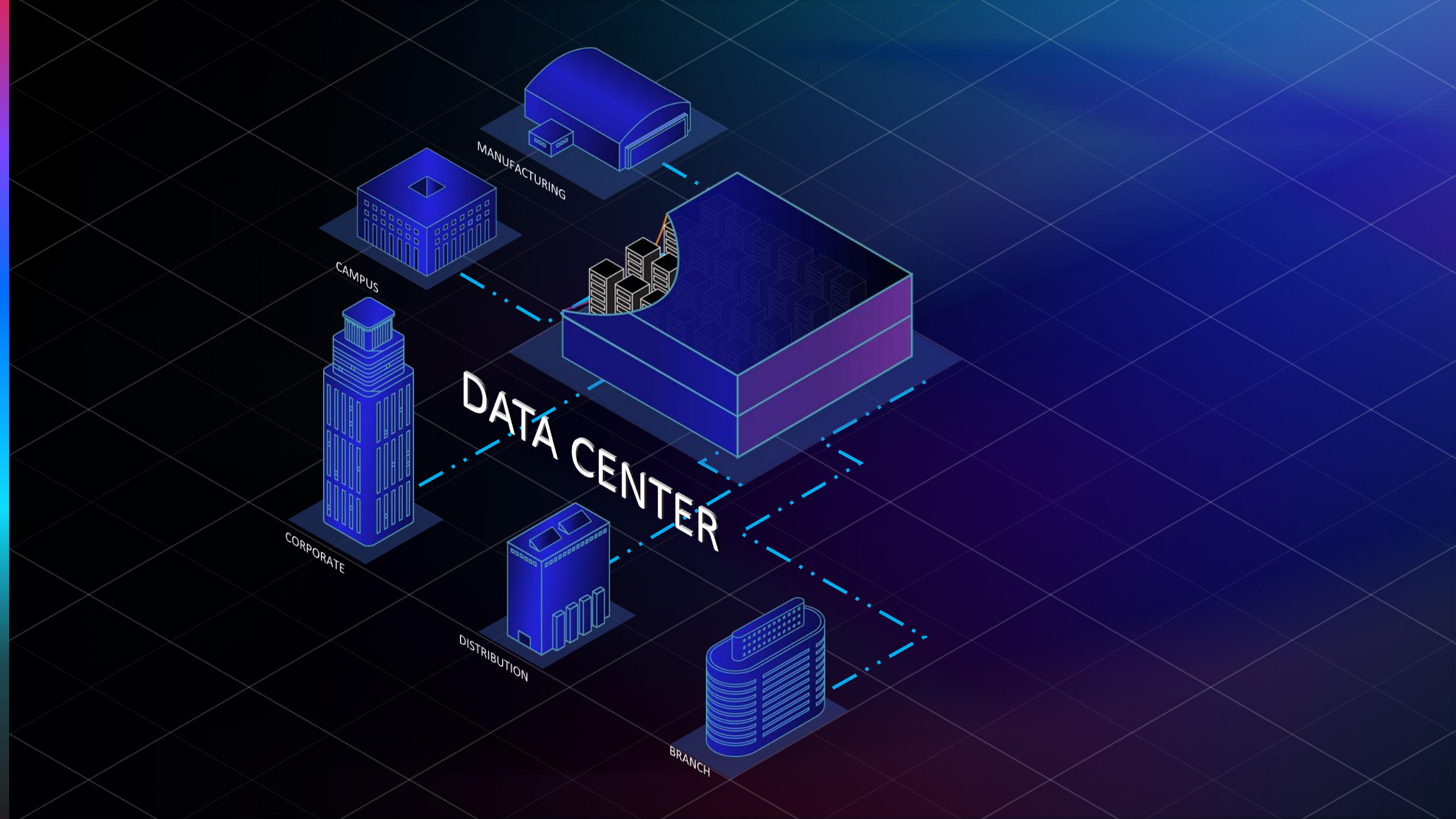
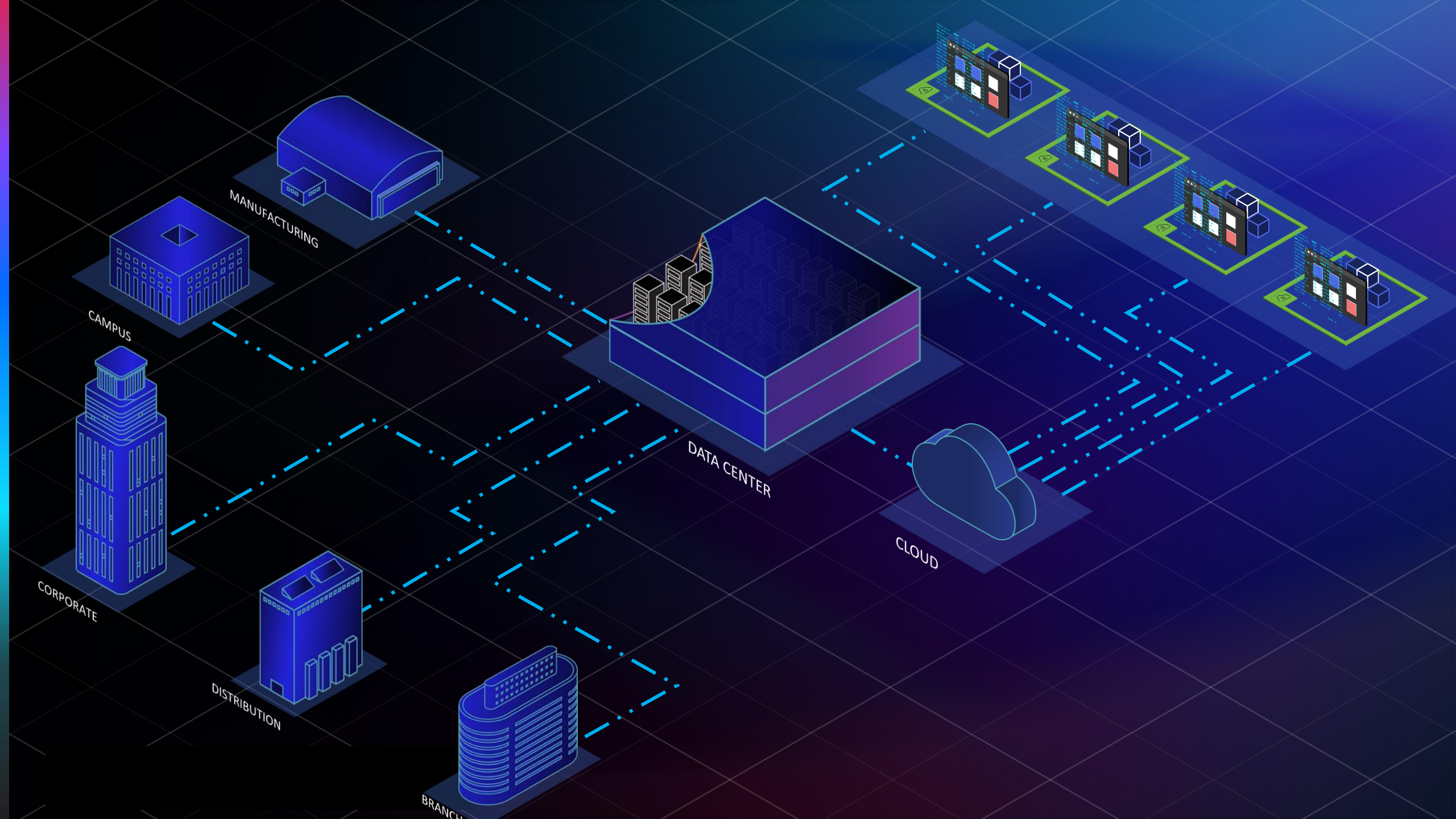

MANUFACTURING
CAMPUS
DATA CENTER
CORPORATE
DISTRIBUTION
BRANCH


MANUFACTURING
CAMPUS
DATA CENTER
CORPORATE
DISTRIBUTION
CLOUD

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While manageable, it does increase complexity and push the network topology in multiple directions

NEW!

AVAILABLE NOW

AWS Cloud WAN

BUILD, MANAGE, AND MONITOR GLOBAL WIDE-AREA NETWORKS

SIMPLE

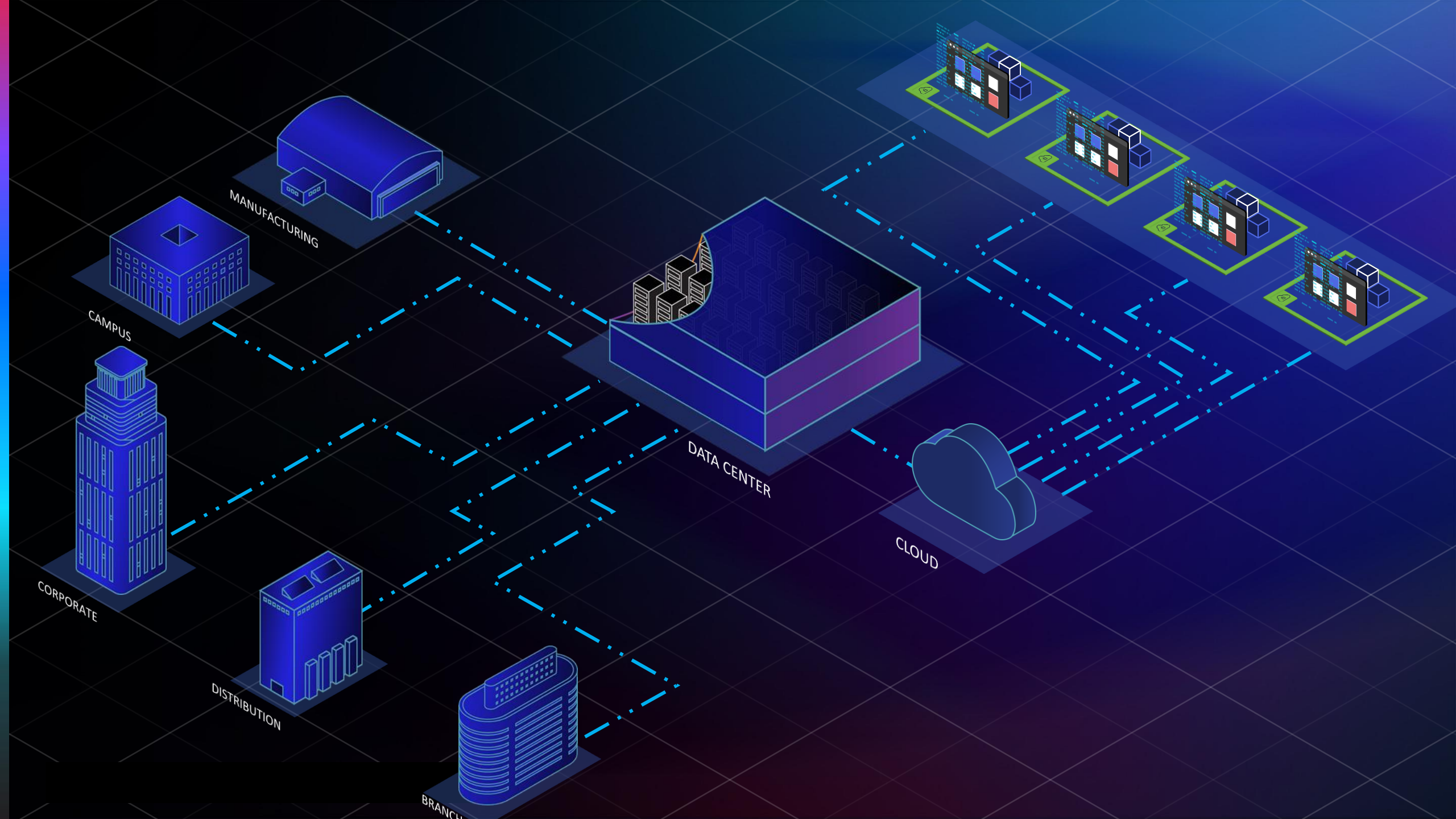
Unify your cloud and on-premises network to reduce complexity

SECURE

Increase security with built-in network segmentation

VISUALIZE

Visualize and monitor your global network in a single dashboard


MANUFACTURING
CAMPUS
DATA CENTER
CORPORATE
DISTRIBUTION
CLOUD

SEGMENT 1
AWS CLOUD WAN

SEGMENT 3
SEGMENT 2
SEGMENT 1
AWS CLOUD WAN

“We use Cloud WAN to simplify connections between our globally distributed labs and cloud resources.
This improves the secure collaboration between departments and sites at a global scale without incurring manual overhead.”

Jeffrey Lee
Associate Director, Cloud Architecture,
Foundation Medicine, Inc.

FOUNDATION MEDICINE

aws
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Additional networking and security sessions

- NET302 - Advanced VPC design and new Amazon VPC capabilities
- NET204 - Application networking foundations
- NET303 - Build your global wide area network using AWS
- NET306 - Building resilient networks
- NET311 - Layered VPC security and inspection
- NET205 - Observing and diagnosing your network with AWS
- SEC405 - Zero Trust: Enough talk, let's build better security
- NET304-R - AWS network architectures for very large environments
- NET212-R - Application networking best practices

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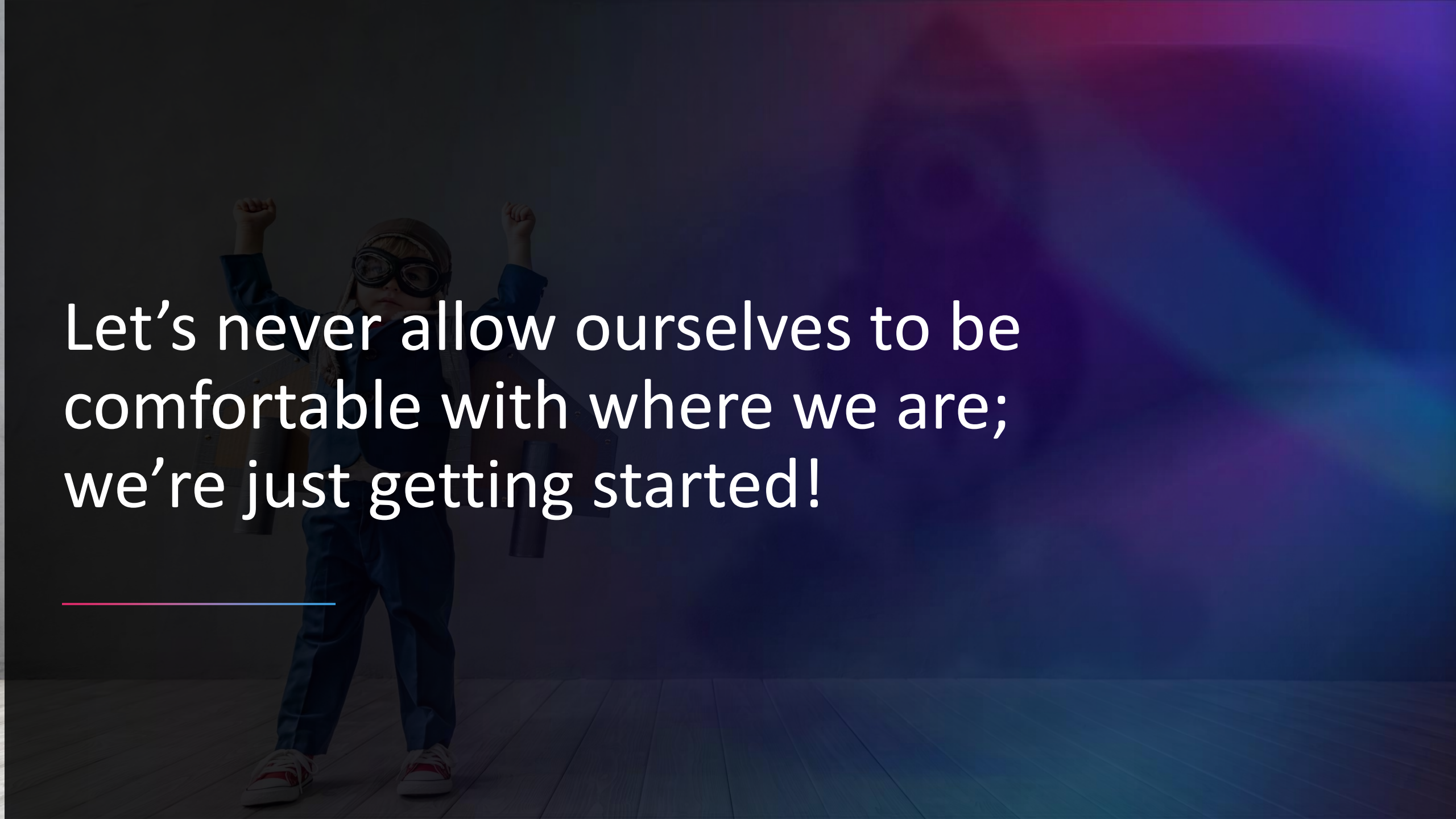
Let’s never allow ourselves to be comfortable with where we are; we’re just getting started!

Thank you!

Please complete the session survey in the **mobile app**

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