AWS Outposts and AWS Wavelength
An in-depth look at hybrid cloud use cases

Matt Lehwess
Principal Developer Advocate
AWS
Extending the cloud for a truly consistent hybrid experience

On-premises, Metro centers and the 5G edge

**AWS Outposts**

Fully managed AWS infrastructure delivered to virtually any customer datacenter or on-premises location

**AWS Local Zones**

Places compute, storage, database, and select AWS services closer to where your end users are located

**AWS Wavelength**

Embedded in 5G networks to extend AWS infrastructure, services, APIs, and tools

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AWS Outposts: Bringing AWS on-premises

- **Same AWS-designed infrastructure** as in AWS data centers (built on AWS Nitro System)
- **Fully managed, monitored, and operated** by AWS as if in AWS Regions
- **Single pane of management** in the cloud providing the **same APIs and tools** as in AWS Regions
AWS Outposts:
The hardware

42U Rack

Patch Panels
1/10/40/100G Network Fiber Uplink Options

Hosts

Network Switches

Power Shelf
Redundant Centralized Power Conversion Unit

5kVA-15kVA Power Supply
Redundant feeds supported

Bus Bar
AWS Outposts: Use Cases

Low Latency

Rendering, inference, data processing

Application Modernization

Modernize enterprise applications running at the edge

Data Residency

Regulatory, security, process requirements

Local Data Processing

Local control systems, 5G/IOT
Build on the same Amazon EC2 instances and Amazon EBS volumes

For general-purpose applications

For compute-intensive applications (media transcoding, gaming servers, machine learning inference)

For memory-intensive applications (databases, in-memory caches, real-time data analytics)

For machine learning inference and graphics workstations

For I/O-intensive applications (NoSQL databases, in-memory or transactional databases, distributed file systems)

Local instance storage and EBS gp2 volumes for temporary and persistent storage
Run AWS services locally

- **Compute and storage**
  Amazon EC2 instances and Amazon EBS volumes

- **Networking**
  Amazon Virtual Private Cloud (Amazon VPC)
  Amazon Application Load Balancer (Amazon ALB)

- **Database and Cache**
  Amazon Relational Database Service (Amazon RDS)
  Amazon ElastiCache

- **Containers**
  Amazon Elastic Container Service (Amazon ECS) and
  Amazon Elastic Kubernetes Service (Amazon EKS)

- **Data processing**
  Amazon Elastic Map Reduce (Amazon EMR)

- **Local storage**
  Amazon S3
With the same AWS APIs and tools as in the AWS Region

- Amazon EC2 Auto Scaling groups
- AWS CloudFormation
- Amazon CloudWatch
- AWS CloudTrail
- AWS Elastic Beanstalk
- AWS Cloud9

and more . . .
Amazon VPC Networking

To understand AWS Outposts, we need to first understand Amazon VPC networking
Amazon VPC networking

AWS Region

Amazon S3  Amazon DynamoDB  AWS Lambda  Amazon SQS  Amazon SNS  AWS IoT Core

Amazon VPC

Availability Zone 1

Public subnet
Instance A
10.1.0.11/24

Private subnet
Instance C
10.1.2.33/24

Availability Zone 2

Public subnet
Instance B
10.1.1.22/24

Private subnet
Instance D
10.1.3.44/24

VPC CIDR 10.1.0.0/16  + Expand  + IPv6

The internet
Amazon VPC Networking

Now, let’s dive into Amazon VPC networking for AWS Outposts
Access to the same networking constructs as the AWS Region

VPC CIDR 10.1.0.0/16

AWS Region

Availability Zone
- Public subnet
  - Instance A 10.1.0.11/24
- Private subnet
  - Instance C 10.1.2.53/24

Availability Zone
- Public subnet
  - Instance B 10.1.1.22/24
- Private subnet
  - Instance D 10.1.3.44/24

Outpost-abc123
- Outpost Subnet
  - Instance Y 10.1.4.55/24
- Outpost Subnet
  - Instance Z 10.1.5.66/24

AWS Outposts On-premises

Route tables
Security groups
Network ACLs

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VPC CIDR 10.1.0.0/16

AWS Outposts
On-premises

Customer-owned IP

EIP - 10.1.4.11 : 10.10.0.21

Other on-premises workloads

Outpost Subnet
abc123

Local Gateway (LGW)

Transit GW

VPC Peering

VGW

Availability Zone

Public subnet

Instance A
10.1.0.11/24

Private subnet

Instance C
10.1.2.33/24

Availability Zone

Public subnet

Instance B
10.1.1.22/24

Private subnet

Instance D
10.1.3.44/24

Outpost Subnet

Instance Y
10.1.4.55/24

Instance Z
10.1.5.66/24

Destinations:

<table>
<thead>
<tr>
<th>Destination</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.0.0/16</td>
<td>Local</td>
</tr>
<tr>
<td>0.0.0.0/0</td>
<td>IGW</td>
</tr>
<tr>
<td>S3.prefix.list</td>
<td>VPCE-123</td>
</tr>
<tr>
<td>Other routes</td>
<td>TGW</td>
</tr>
<tr>
<td>Another VPC</td>
<td>PCX-123</td>
</tr>
<tr>
<td>VPN routes</td>
<td>VGW</td>
</tr>
<tr>
<td>On-premises</td>
<td>LGW</td>
</tr>
</tbody>
</table>

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On-premises connectivity: Local Gateway (LGW)

- Multiple Outpost network devices per rack, providing physical redundancy

- Separation of service link and LGW traffic paths using Virtual LANs (VLANs)

- Multiple BGP sessions for service link and LGW

- Local Gateway (LGW) is a logical entity attached to your VPC

- Customer-owned IP addresses (CoIP) are advertised on LGW BGP sessions

- VPC configuration is distinctly separate from the physical configuration
On-premises connectivity: Local Gateway

- **Coming soon!** – Direct advertisement of the Outpost subnet range over the LGW BGP sessions, no CoIP required.
Don't forget to check out the Outposts reference architectures from our partners

Cisco:  

Juniper:  
https://juni.pr/2MTkol7
AWS Region connectivity: Service link

AWS Outposts Service

Amazon VPC

Service link connection to Outpost

AWS Direct Connect (DX) location

DX POP

Customer POP

AWS cage

Customer cage

WAN

The internet

Cross connect

Service link CIDR: 10.5.0.0/26

NAT: Service link CIDR to public range 10.5.0.0/26 to – something public

Alternative path to AWS via public Internet

Outpost device

Outpost device

Instances

Instances

Outpost Subnet

AWS Region

AWS control plane traffic

Public virtual interface

VPC data plane traffic

To local network

To AWS

Customer on-premises

Or anywhere – including back to AWS

VPC: 10.1.0.0/16

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AWS Region connectivity: Service link

- AWS Outposts Service
- Private VPC IPs
- VPC data plane traffic
- AWS Direct Connect (DX) location
- Private virtual interface
- AWS control plane traffic

Private service link connectivity

Service link CIDR: 10.5.0.0/26

AWS Region

Amazon VPC

VPC: 10.1.0.0/16

Amazon VPC

Instances

VPC data plane traffic

AWS Outposts

Service link

Customer on-premises

Outpost device

Outpost device

Instances

AWS Outposts

Or anywhere – including back to AWS

To local network

To AWS
VPCs and a single Outpost deployment

Intra-VPC traffic traverses the AWS Outposts Service / Availability Zone and the service link.

AWS Outposts is an extension of an Availability Zone.

AWS Outpost

VPCs extended to the Outpost
VPCs and a multi Outpost deployment

- **VPC A**: AWS Outposts Service
  - Amazon public IPs
  - Service link to VPC A

- **VPC B**: AWS Outposts Service
  - Amazon public IPs
  - Intra VPC traffic from Outpost to the region is OK
  - Intra VPC traffic across Outposts is not a supported traffic path via the service link connections

- **VPC C**: AWS Outposts Service
  - Amazon public IPs
  - Service link to VPC A

- **AWS Outpost 1**: A, B, C
- **AWS Outpost 2**: A, B, C

Customer on-premises

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AWS Outposts Architectures

Rendering, inference, data processing? How about online games

Low Latency

Rendering, inference, data processing
Using the AWS Region for low-latency online games

Due to the proximity of users to their closest region, an amount of variance in latency occurs.
Example:
4 moderately distributed players

Max single RTT: 30ms
RTT latency range: 15ms
Avg RTT latency: ~19ms
Using AWS Outposts for low-latency online games

With Outposts deployed closer to the users, variance for local users is decreased.
Using AWS Outposts for low-latency online games

- AWS Region
  - Amazon DynamoDB
  - Game runtimes
- VPC
  - Availability Zone
    - Subnet
      - AWS Lambda
    - Subnet
      - Session state server
- Availability Zone
  - Subnet
    - DX Public VIF
- Game streaming servers
- Outpost-abc123
- LGW
- On-premises
  - Outpost subnet
  - Game runtimes

Connection to game servers over the internet:
- RTT = 15ms
- RTT = 30ms
- RTT = 15ms

Customer datacenter networking:

This works for game streaming too!
AWS Outposts:
Use Cases

Low Latency

Application Modernization

Rendering, inference, data processing

Modernize enterprise applications running at the edge
Application modernization tools

AWS CloudFormation

Application Load Balancer

Amazon Simple Storage Service (S3)

Amazon VPC

Amazon EC2 Auto Scaling

And many more!
Using AWS Outposts for application modernization

- AWS Region
- Amazon DynamoDB
- AWS CloudFormation
- VPC
  - Availability Zone
    - Subnet
      - AWS Lambda
  - Availability Zone
    - Subnet
      - Instance N
- The internet
  - DX Public VIF
- On-premises
  - Outpost abc123
    - Outpost Subnet
    - ALB
      - Service link to region
      - Outpost Subnet
        - Autoscaling Group
          - Instance A
          - Instance B
      - Application Users
- New - Amazon S3 on AWS Outposts

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AWS Outposts: Use Cases

**Low Latency**
- Rendering, inference, data processing

**Application Modernization**
- Modernize enterprise applications running at the edge

**Data Residency**
- Regulatory, security, process requirements
Example:
User data, e.g. local Outposts S3 or Amazon Elastic Block Store does not leave the Outpost unless configured by the user.
AWS Outposts:
Use Cases

Low Latency
- Rendering, inference, data processing

Application Modernization
- Modernize enterprise applications running at the edge

Data Residency
- Regulatory, security, process requirements

Local Data Processing
- Local control systems, 5G/IOT
Using AWS Outposts for application modernization

AWS Region

VPC

Public subnet
- Availability Zone B
  - PI Vision
  - PI Integrator for Business Analytics

Private subnet
- Availability Zone C
  - PI System
    - PI AF
    - PI Data Archive
  - Domain Controller
  - SQL Server

On-premises

Outpost-abc123

Outpost Subnet
- PI Vision
- PI Integrator for Business Analytics

Outpost Subnet
- PI System
  - PI AF
  - PI Data Archive
  - Domain Controller
  - SQL Server

The internet

Service link to region to Availability Zone A

The internet

DX Public VIF

Manufacturing shop floor

LGW

PI Interfaces

PLC

PI AF

PI Data Archive

Domain Controller

SQL Server
AWS Outposts Architectures

**Low Latency**
- Rendering, inference, data processing

**Application Modernization**
- Modernize enterprise applications running at the edge

**Data Residency**
- Regulatory, security, process requirements

**Local Data Processing**
- Local control systems, 5G/IOT
AWS Wavelength
The end-to-end network

Route trip time (RTT) latency = 100ms

AWS Region

The internet

Transit / peering point

Communications service provider (CSP) network

Mobile Network

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Compute at the 5G network edge

Route trip time (RTT) latency = ~10ms

Wavelength Zone

Note: p90 latency across user population across the US
Compute at the 5G network edge

- AWS Region
- The internet
- Transit / peering point
- Wavelength Zone
- Communications service provider (CSP) network
- Mobile Network
- Reduced latency and jitter
Compute at the 5G network edge

Compressed video information (BW savings)

A

Multiple 24/7 video streams

B

 AWS Region

The internet

Transit / peering point

Communications service provider (CSP) network

Wavelength Zone

Mobile Network

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Wavelength zones
Wavelength zones

AWS Region

The internet

Transit / peering point

Communications service provider (CSP) network

Wavelength Zone

Mobile Network
What is a Wavelength Zone

- Same AWS-designed infrastructure as AWS data centers
- Hosted in a site within a CSP partner network
- Managed and monitored from an AWS region
- Integrated into the CSP 5G Network
What is unique about a Wavelength Zone

- Single pane of management, across zones and AWS regions
- Same operational consistency (upgrades, patches, versions)
- Same pace of innovation as in the AWS regions
- Failover from Wavelength Zone to AWS region
Using Wavelength Zones
Deploying applications

1. Control, management, and monitoring
2. VPC extension across Region and WL Zone
3. Connecting end users to WL Zone
4. WL Zone and server outside of AWS region
5. WL Zone and region service end points
Deploying applications

AWS Region

VPC

Player state service

Game runtimes

Amazon S3

Service discovery

AWS Wavelength Zone (WL Zone)

Carrier Gateway

Wavelength Carrier Gateway

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Wrap up
Coming soon for AWS Outposts:
AWS Outposts in 2 new sizes

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

Choose between a 1U Outpost server with an AWS Graviton2 processor or a 2U Outposts server with an Intel processor.

Run AWS services locally, including EC2, ECS, and EKS 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 a preferred 3rd party vendor.
Additional resources & next steps

Reference Architecture
AWS Outposts Networking

Resources Page
Solution Briefs, E-Books, and more!

Reinvent Session
Cloud Where you Want it

reinvent Session
Bringing the AWS experience on premises
Thank you!

Matt Lehwess
Principal Developer Advocate
AWS
@mlehwess