

Wifi / Password

Wifi name:
TDPK-WIFI

Username:
AWS-Workshop-1
AWS-Workshop-2
AWS-Workshop-3

Password
Welcome@2022



<https://github.com/TIDC-PS-Inter/AWS-Workshop>

Part 1

AWS Workshop Series Day 7: SAP on AWS

Taking Enterprise Beyond the Cloud by TruelDC

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Cloud & Solution Consultant



Presented by



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- Cloud & Solution Consultant, TrueIDC
- AWS Specialist
- SAP Basis Specialist
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Agenda

- SAP on AWS Overview
- High Availability & Disaster Recovery
- AWS Backint Agent



Source: AWS Immersion day



SAP on AWS

Introduction to AWS

Why customers choose AWS

Most experience

15

years helping millions of customers

Global reach & high availability

84

availability zones spanning 26
geographic regions

Security & compliance

230+

security features

Customer obsession
& innovation

200+

service offerings

Capable of delivering up to

256,000

IOPS/
instance

Improve TCO

111

price reductions since 2006

Machine learning

81%

of all deep learning is running on AWS¹

Ecosystem

11,000

AWS Marketplace transactable listings
across 50 different categories

Architected for availability

AWS offers 26 geographical regions, 84 availability zones, 310+ POPs

Canada West
AWS GovCloud West
Oregon
N. California
Ohio
Montreal
AWS GovCloud East
N. Virginia

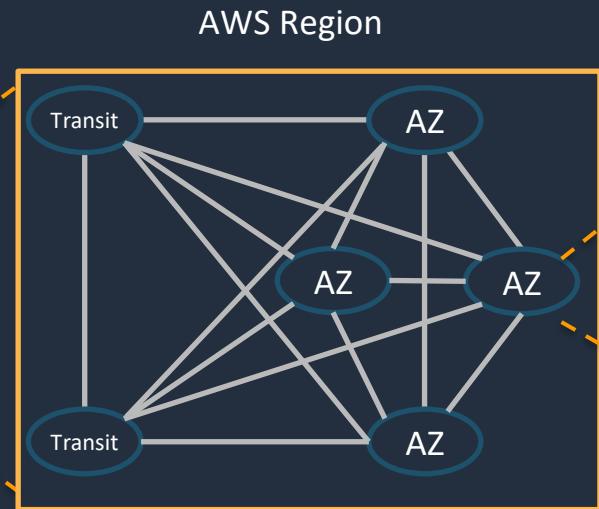
Regional expansion

- 📍 First 5 years: 4 regions
- 📍 Next 5 years: 7 regions
- 📍 2016–2021: 15 regions
- 📍 Coming soon: 8 regions

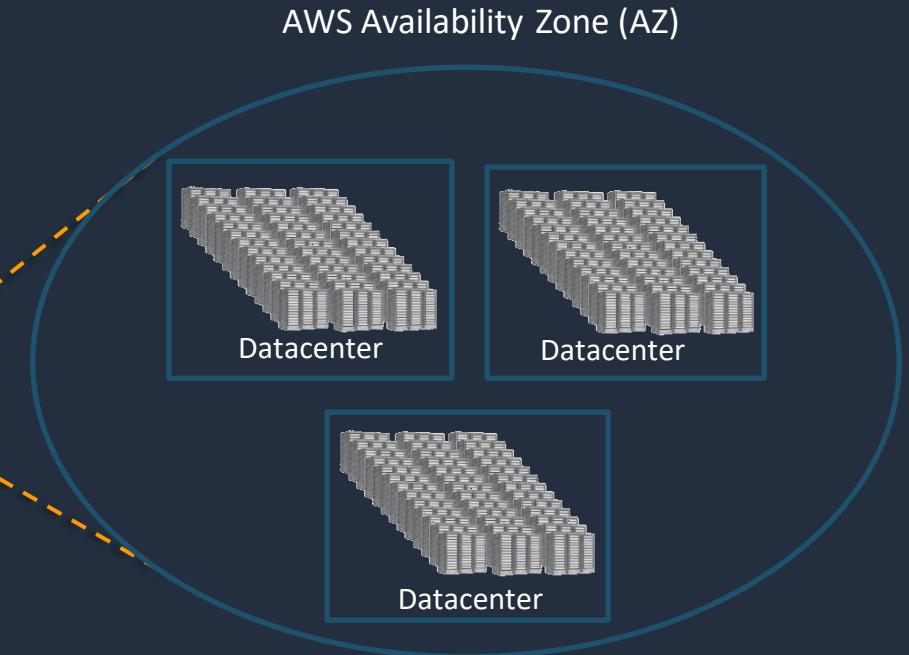


AWS region design

AWS Regions are comprised of multiple AZs for **high availability, high scalability, and high fault tolerance**. Applications and data are replicated in real time and consistent in the different AZs.



A Region is a physical location in the world where we have multiple **Availability Zones**.



Availability Zones consist of one or more discrete data centers, each with redundant power, networking, and connectivity, housed in separate facilities.

Why is AWS better than On-Premises solutions?



On-premises solutions

Large initial up-front investment, which makes it tougher to justify experimentation.

Cost

Consume large amounts of resources in both personnel and capital. Prioritization of resources creates tough decisions that can risk hindering your business growth.

Resources

Over-provision infrastructure to ensure enough capacity is available to handle business operations at the peak level of activity.

Planning

Deploying your application in multiple physical locations around the world takes both time and resources to build that infrastructure. This limits your ability to adapt to market conditions that can impact your business.

Deployment



AWS

Trade capital expense for variable expense, and only pay for IT as they consume it.

Innovate faster by focusing IT resources on developing applications that differentiate the business, instead of on undifferentiated heavy lifting.

Provision the amount of resources that they actually need, knowing they can instantly scale up or down along with the needs of their business.

Deploy your application in multiple physical locations around the world, with just a few clicks. Provide lower latency and better experience for your end users simply, and at minimal cost.

SAP on AWS

AWS and SAP Alliance

SAP and AWS Alliance



13+ year relationship of
collaboration and
innovation

**SAP has been an AWS
customer since 2008**

**AWS has been SAP
certified and supported
since early 2011**

Why SAP on AWS?



Build once,
deploy globally



Scale to
meet demand



Strengthen
operational
reliability



Deploy
infrastructure
in minutes



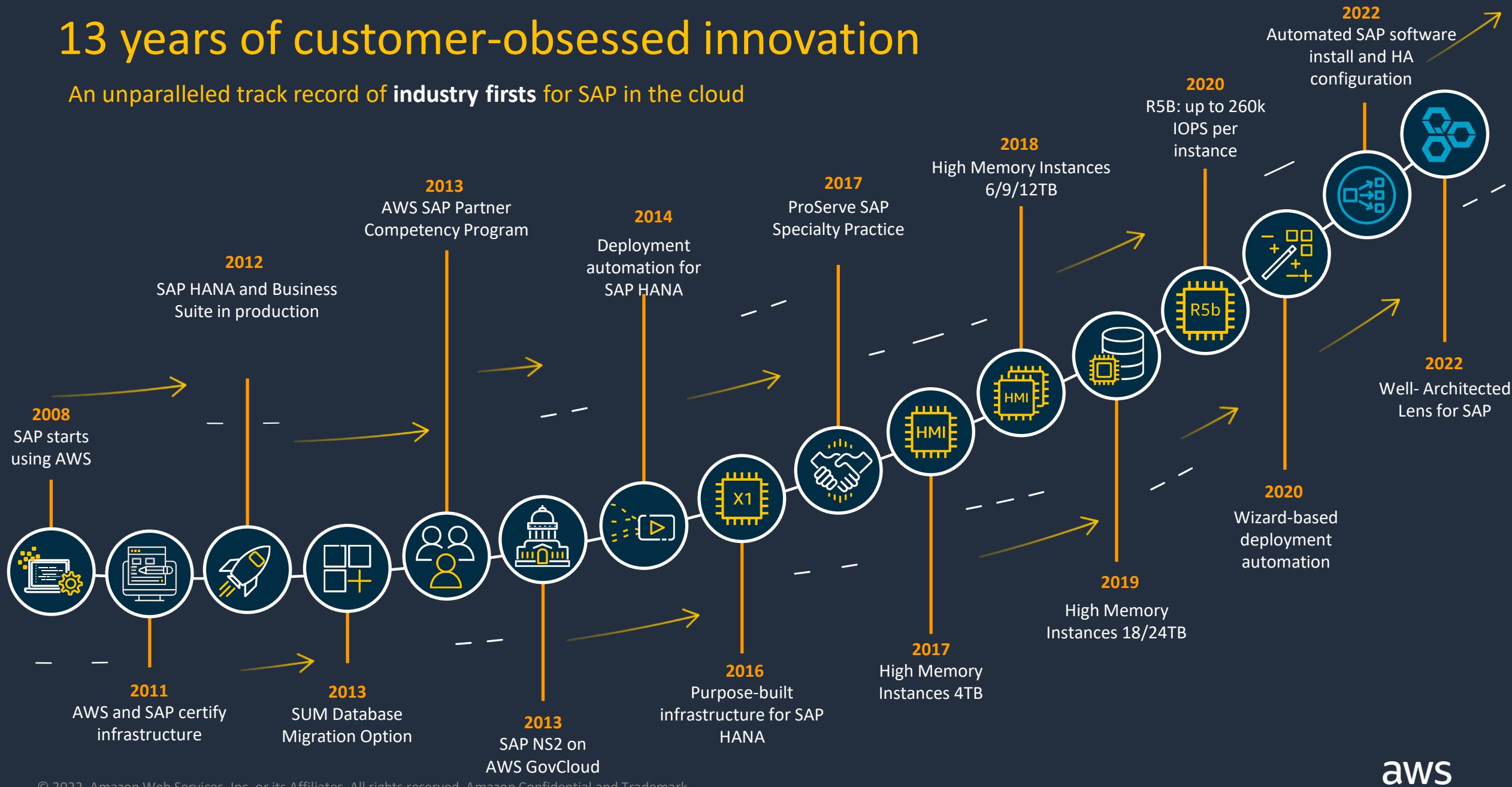
Improve your
security position



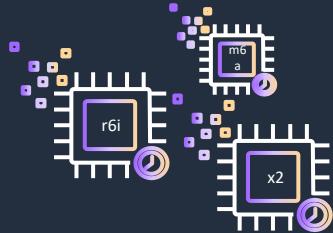
Combine with
other AWS
Services

13 years of customer-obsessed innovation

An unparalleled track record of **industry firsts** for SAP in the cloud



Major AWS innovations for SAP



EC2 Compute

New instances for SAP including R5b (storage optimized), Virtual High Mem, Intel Ice Lake (m6i, r6i,) AMD Milan (m6a), x2 for SAP HANA



EBS Storage

New storage options for SAP (e.g. gp3, io2 Block Express, FSx for NetApp ONTAP)



Amazon AppFlow

Native integration through the SAP OData Connector



Amazon CloudWatch Application Insights for SAP HANA

Easily set up observability for SAP HANA to identify and resolve issues faster



AWS Launch Wizard for SAP

7 major additional features
Including DevOps capabilities, HA config, RHEL/SUSE version support, AMS support



AWS Backint Agent for SAP HANA

3 major enhancements including support for S3 Intelligent Tiering



AWS Well-Architected Lens for SAP

Proven SAP on AWS best practice guidance across operational excellence, security, reliability, performance, and cost optimization



AWS Training and Certification

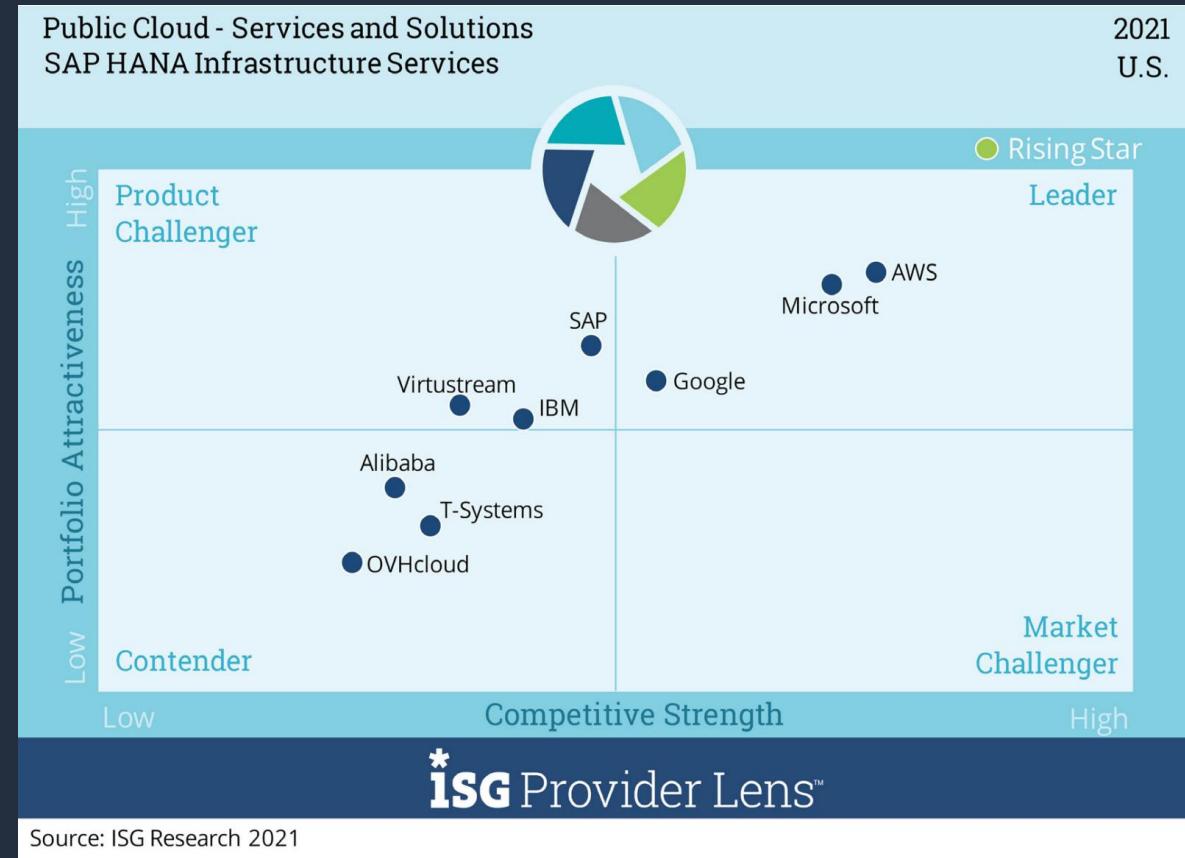
SAP on AWS specialty certification to validate skills in architecting, migrating and managing SAP workloads on AWS

AWS leads HANA Infrastructure Services

ISG recognizes AWS as a leader for the fourth consecutive year

“AWS continues to lead by providing robust, secure, resilient and diverse infrastructure for hosting SAP workloads of all sizes and complexities to its large client base, along with saving costs through various optimization programs.”

“AWS has the most options for SAP in the cloud, offering a plethora of innovations that share data with SAP to enhance business performance.”



SAP Business Solutions Supported on AWS



Operating Systems Available for SAP on AWS

Amazon Machine Images



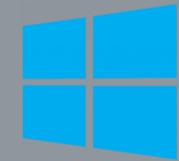
SUSE Linux
Enterprise Server
(SLES)



Red Hat Enterprise
Linux (RHEL)



Oracle
Linux



Microsoft Windows
Server



HANA Support and Extended Support

Database Platforms Available for SAP on AWS



IBM Db2

Microsoft
SQL Server

Database Platforms

ORACLE
D A T A B A S E



SAP HANA
SAP MaxDB
SAP ASE

SAP HANA
SAP MaxDB
SAP ASE

For the most up-to-date list of supported database applications, see [SAP note #1656099](#) or [SAP Wiki](#)

* Requires Oracle Linux, see [SAP note #2358420](#)

** For SAP Hybris Commerce

SAP on AWS

AWS Core Services for SAP

SAP Systems Essential Components



Networking Resources
(VLAN, DNS, ...)



Amazon
VPC



AWS
Direct
Connect



AWS
VPN



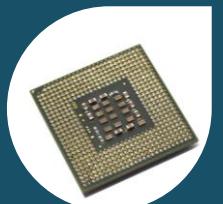
AWS
Transit
Gateway



Amazon
Route 53



Amazon VPC
PrivateLink



Compute Resources
(Physical or Virtual Machines)



Amazon
EC2



Amazon
Machine Images



Amazon
Elastic
Load Balancing



Storage Resources
(SAN, NAS, Tapes, HDDs, ...)



Amazon
EBS



Amazon
EFS



Amazon
FSx



Amazon
S3



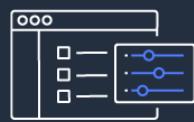
Networking Services

Amazon Virtual Private Cloud (VPC)

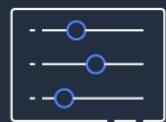


Provision a logically isolated section of the AWS Cloud where you can launch AWS resources in a virtual network that you define.

Bring your own network



IP Addresses



Subnets



Network Topology



Routing Tables



Security Groups
Network ACLs

Connect an On-Prem SAP Environment to an Amazon VPC



AWS VPN

VPN is a secure connection that runs over the internet. You can **securely extend your data center or branch office network to the cloud** with an AWS Site-to-Site VPN (Site-to-Site VPN) connection. It uses internet protocol security (**IPSec**) communications to create encrypted VPN tunnels between two locations.



AWS Direct Connect

AWS Direct Connect is a dedicated line that you build with telcos, and it can provide **high bandwidth** and **low latency**. This private connection can reduce network costs, increase bandwidth throughput, and provide a **more consistent network experience** than internet-based connections.

VPC Patterns for SAP on AWS

Single VPC

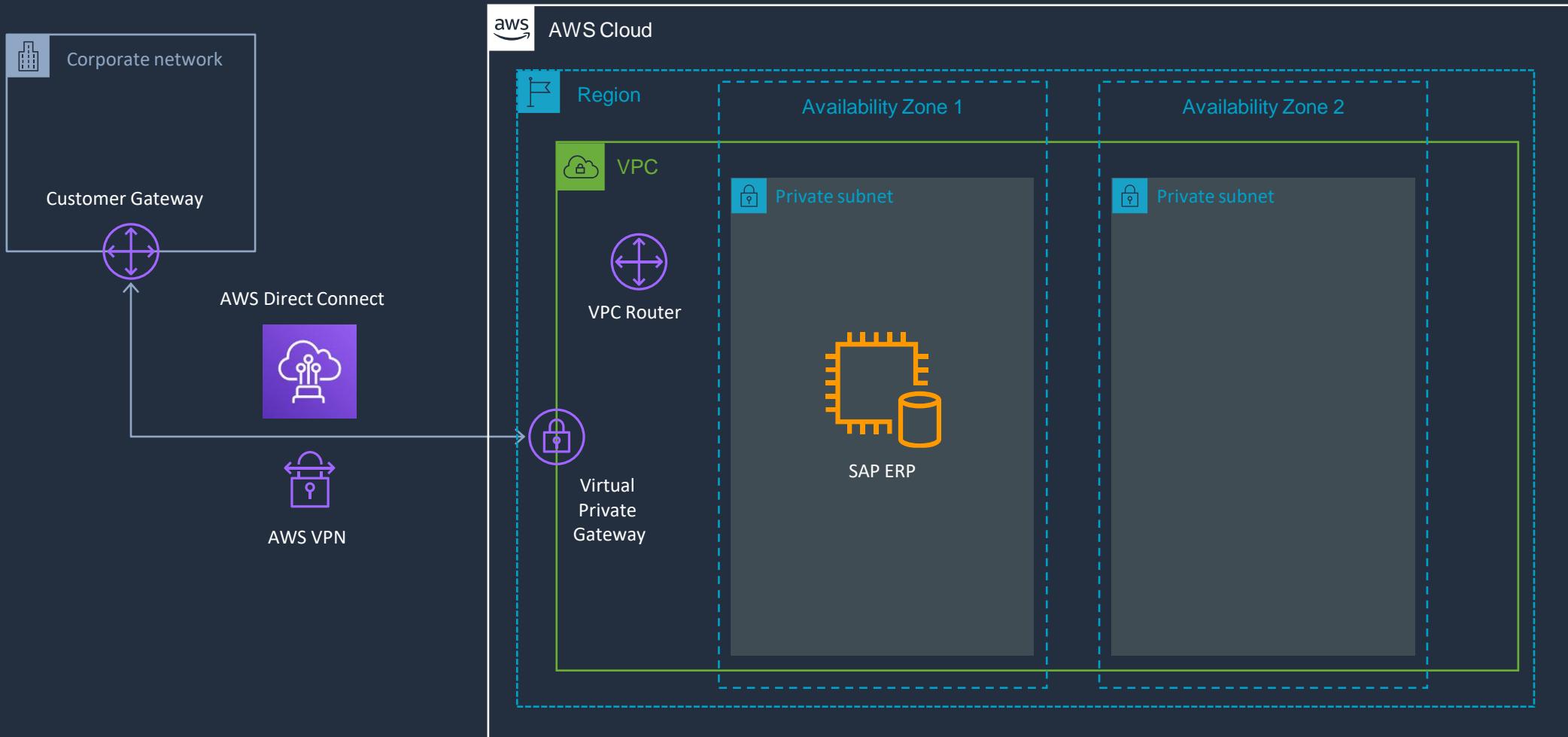
Only Private Subnets

Public and Private Subnets

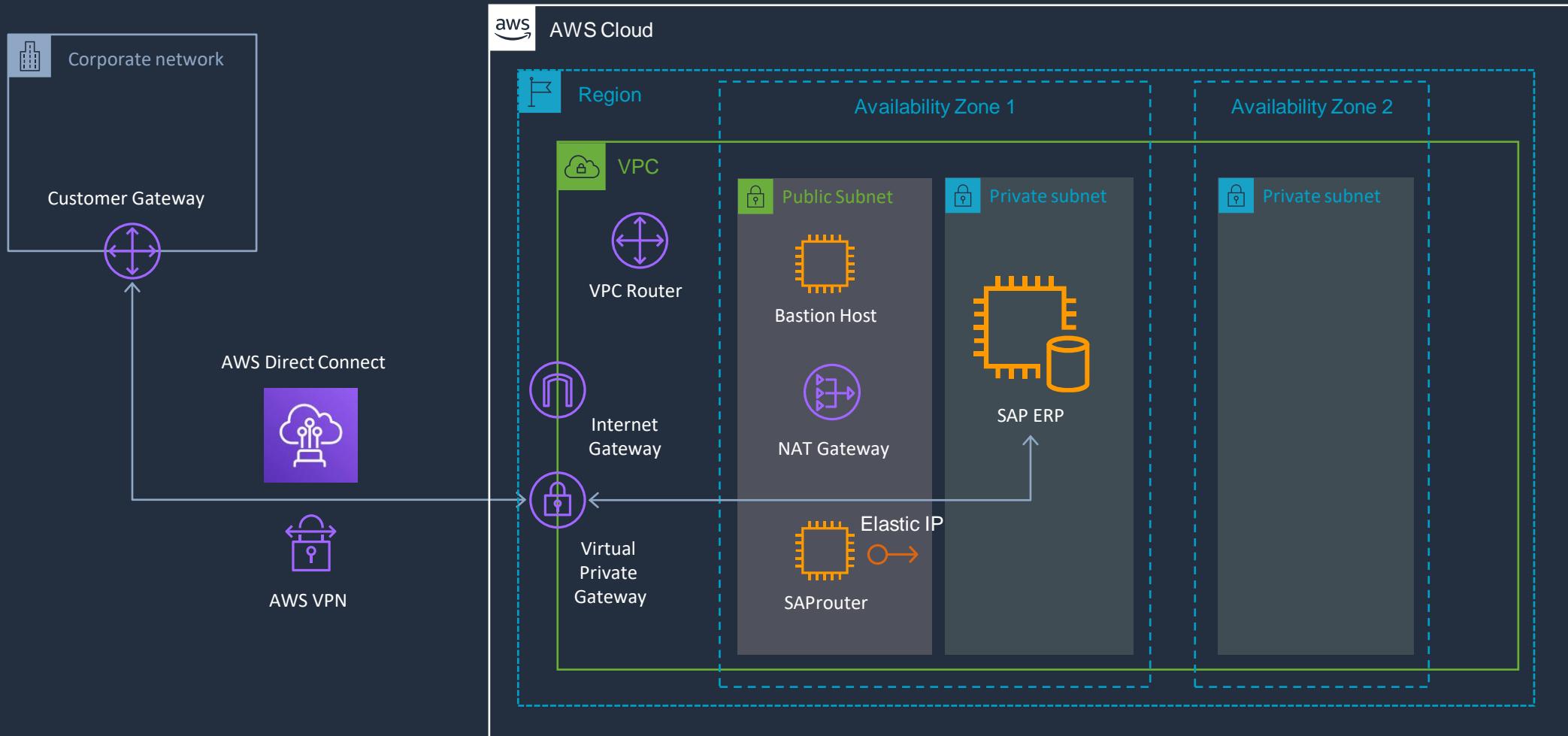
Multiple VPCs

Multiple Accounts

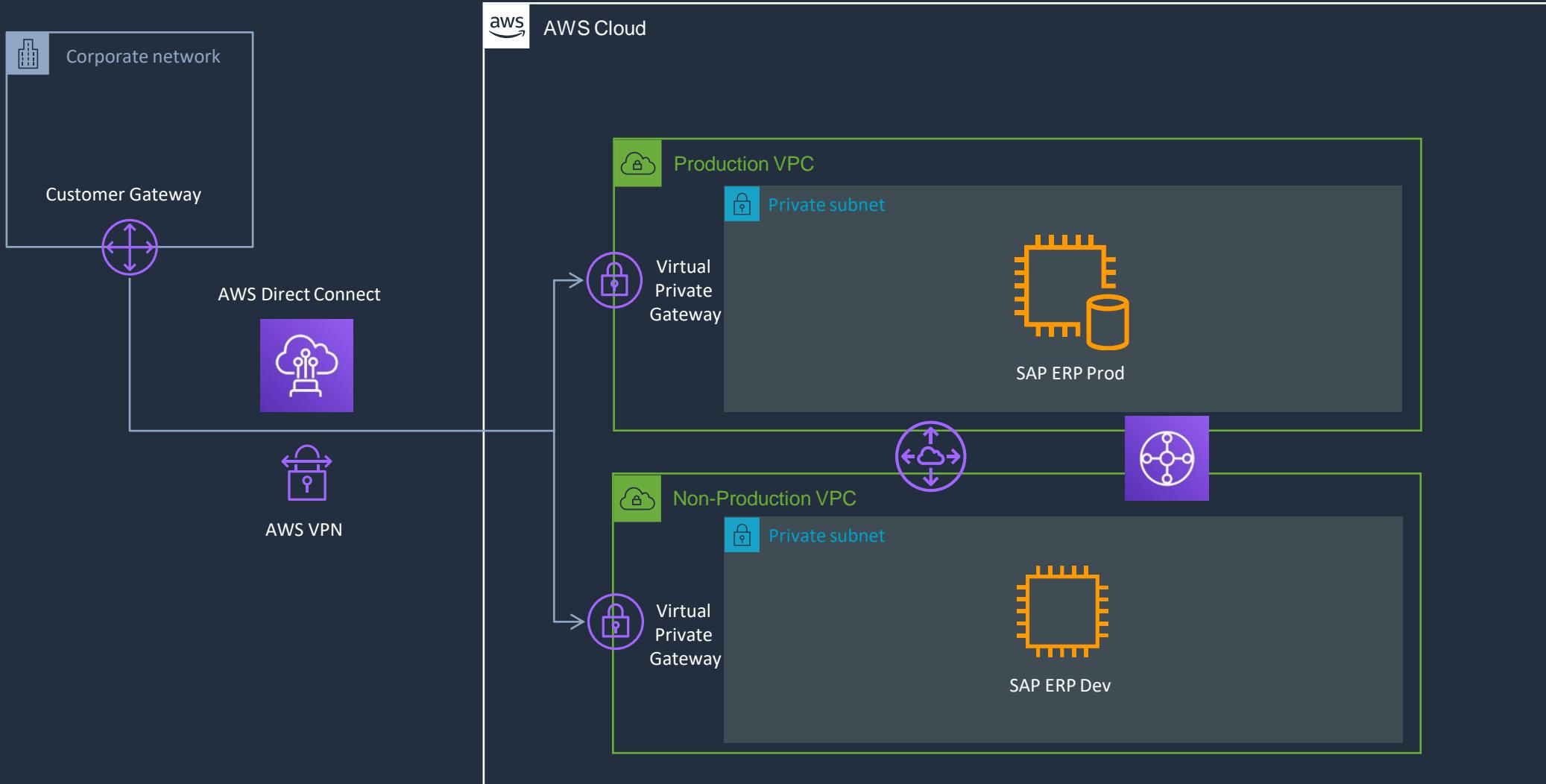
Single VPC with Only Private Subnets



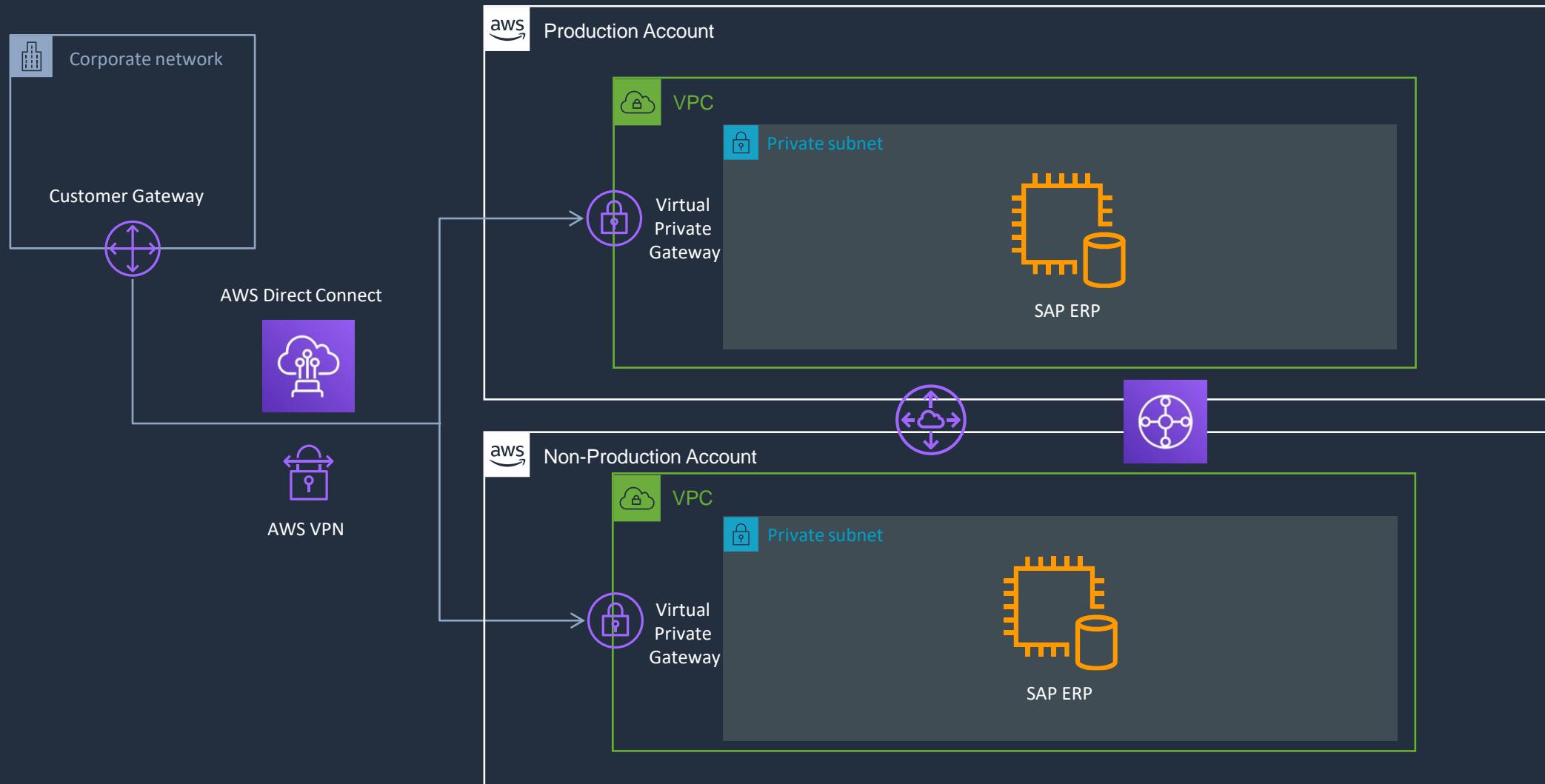
Single VPC with Public and Private Subnets

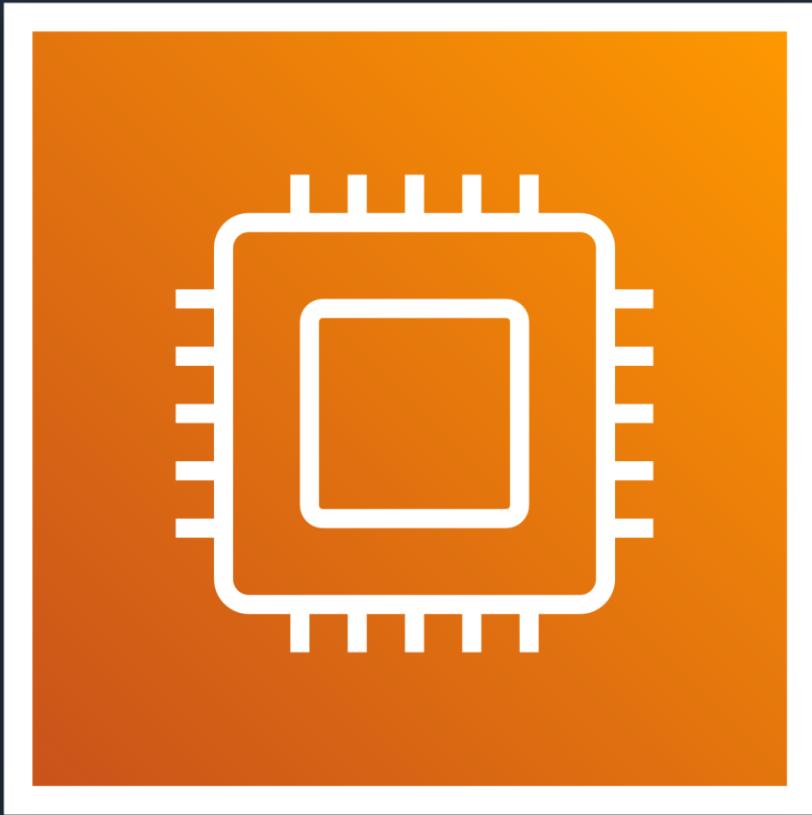


Multiple VPCs



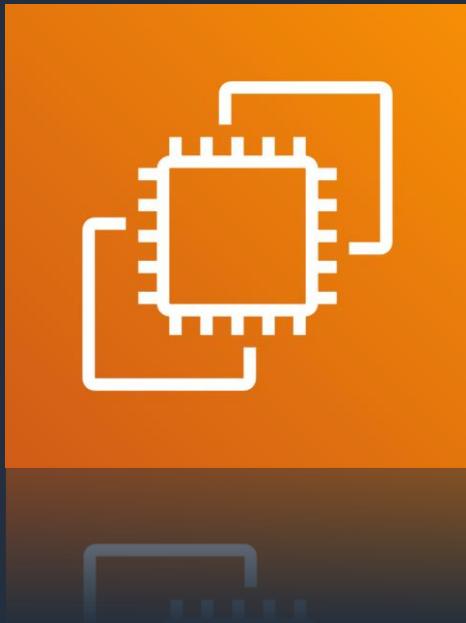
Multiple AWS Accounts





Computing Services

Amazon Elastic Compute Cloud (EC2)



Amazon EC2 provides **secure, resizable compute capacity in the cloud**. It is designed to make web-scale cloud computing easier for developers. Simple web service interface allows. It provides you with complete **control of your computing resources** and lets you run on Amazon's proven computing environment.

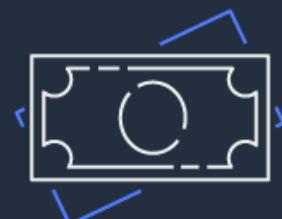
Control



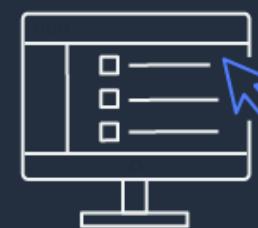
Scaling



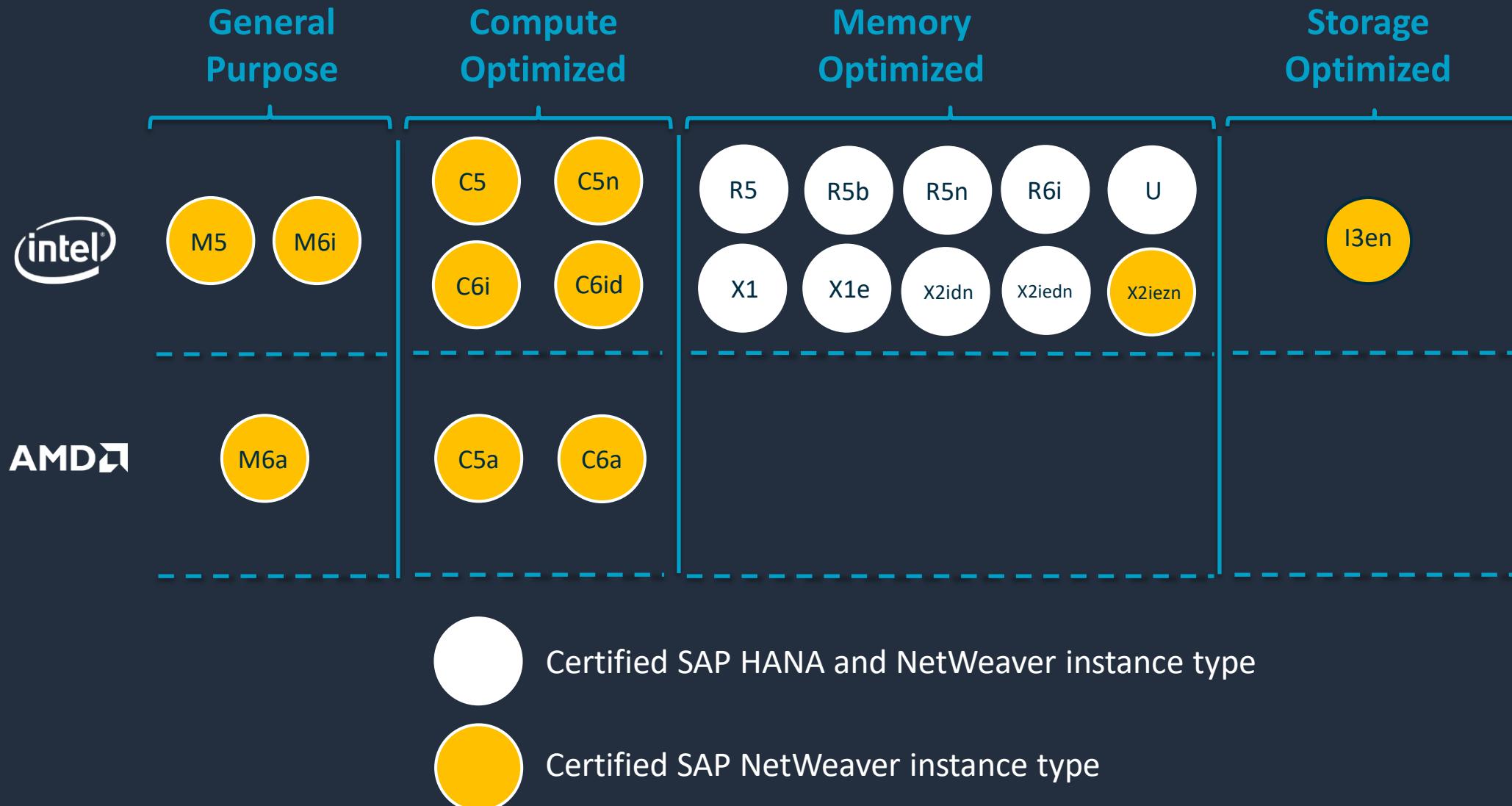
Pay-As-You-Go



OS Compatibility



Amazon EC2 Instance Types for SAP



SAP HANA certified instances

Current generation Amazon EC2 instances for SAP HANA

SAP HANA OLTP and OLAP Scale-up		SAP HANA OLTP and OLAP Scale-out									
Instance Family	Instance Type	vCPU	Memory (GiB)	SAPS	Network (Gbps)	Storage (Mbps)	SAP HANA OLTP Prod *	SAP HANA OLTP Sizing	SAP HANA OLAP Prod *	SAP HANA OLAP Sizing	FSx for ONTAP
r5	r5.metal	96	768	143,230	25	19,000	✓	Standard	✓	Standard	X
r5	r5.24xlarge	96	768	138,770	25	19,000	✓	Standard	✓	Standard	X
r5	r5.16xlarge	64	512	92,513	20	13,600	✓	Standard	✓	Standard	X
r5	r5.12xlarge	48	384	69,385	10	9,500	✓	Standard	✓	Standard	X
r5	r5.8xlarge	32	256	46,257	10	6,800	✓	Standard	✓	Standard	X
r5	r5.4xlarge	16	128	23,128	Up to 10	4,750	X	N/A	X	N/A	X
r5	r5.2xlarge	8	64	11,564	Up to 10	Up to 4,750	X	N/A	X	N/A	X
r5b	r5b.metal	96	768	143,230	100	60,000	✓	Standard	✓	Standard	X
r5b	r5b.24xlarge	96	768	138,770	100	60,000	✓	Standard	✓	Standard	X
r5b	r5b.16xlarge	64	512	92,513	75	40,000	✓	Standard	✓	Standard	X
r5b	r5b.12xlarge	48	384	69,385	50	30,000	✓	Standard	✓	Standard	X
r5b	r5b.8xlarge	32	256	46,257	25	20,000	✓	Standard	✓	Standard	X
r5b	r5b.4xlarge	16	128	23,128	Up to 10	10,000	X	N/A	X	N/A	X
r5b	r5b.2xlarge	8	64	11,564	Up to 10	Up to 10,000	X	N/A	X	N/A	X
r6i	r6i.32xlarge	128	1,024	196,050	50	40,000	✓	Standard	✓	Standard	✓

Right Sizing Example: Memory Optimized Instances R5

Current Situation

You plan to deploy an SAP HANA system to support enterprise business applications that require fast performance and processing of large data sets in memory.

Ideally, you would like to first deploy a small-sized system in order to test and monitor performance.

The SAPS requirement for this initial system is around 10,000.

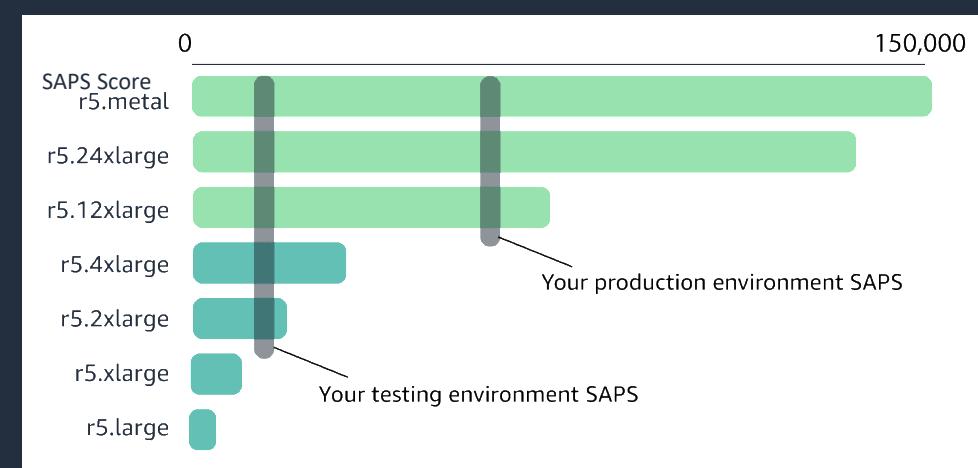
Once you are satisfied with the performance of the testing system, you would like to deploy a large-scale production system, requiring memory-intensive resources with a SAPS requirement closer to 100,000.

Using the R5 instance class as our example, how would you go about selecting your instance type?

Solution

Your current solution requires a SAPS rating of 10,000. In the chart above, you can see several memory-intensive, SAP-certified options to choose from.

You have the flexibility to choose a solution that meets your goals now, or one that allows capacity as you grow. Memory-intensive sizes approved by AWS and SAP optimize both cost and performance for your workload needs.



Set up an Amazon EC2 Instance for SAP

There are 4 main steps to set up an Amazon EC2 instance for SAP:

Prerequisites: Identity and Access Management (IAM) role and AWS Data Provider for SAP

Creating an Amazon EC2 instance for SAP

Resizing and modifying your instance

Enabling Auto-Recovery and other important configurations



Storage Services

SAP Systems Essential Components



Block Storage

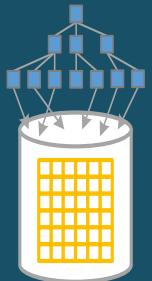
- Raw Storage
- Data organized as an array of unrelated blocks
- Host File System places data on disk
- Ex: Hard Disks, Storage Area Network (SAN) Storage Arrays



Amazon Elastic Block Store (EBS)



Amazon FSx for NetApp ONTAP



File Storage

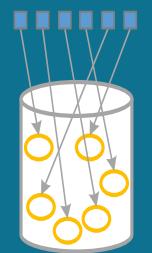
- Unrelated data blocks managed by a file (serving) system
- Native file system places data on disk
- Ex: Network Attached Storage (NAS) Appliances, Windows File Servers



Amazon Elastic File System



Amazon FSx for Windows File Server



Object Storage

- Stores Virtual containers that encapsulate the data, data attributes, metadata and Object IDs
- API Access to data
- Metadata Driven, Policy-based, etc.
- Ex: Ceph, OpenStack Swift



Amazon Simple Storage Service (S3)



Amazon S3 Glacier

AWS Storage Services for SAP Workloads



Amazon Elastic Block Store
(EBS)



Amazon FSx
for NetApp ONTAP

- SAP applications
- SAP database data, logs and backup volumes



Amazon Elastic File System



Amazon FSx
for Windows File Server

- /sapmnt
- /usr/sap/trans



Amazon Simple Storage
Service (S3/S3IA)



Amazon S3 Glacier

- SAP applications backups
- Long-term backups and data archiving for compliance and regulatory reasons (Glacier)



EBS Volume Types for SAP Workloads

gp3		io2		st1	
<ul style="list-style-type: none">Boot volumes, low latency applications, “bursty” databases, development, and testing applications**High baseline performance for smaller volumes, more performance scalabilityRecommended for all types of SAP systems, including most SAP production systems.		<ul style="list-style-type: none">io2 Block Express provides even higher performance and scaling*Meets the needs of I/O intensive workloads that are storage performance sensitive, and need high durability, particularly databases.Recommended for SAP production systems that require a greater level of I/O performance or more durability than gp2/gp3 volumes		<ul style="list-style-type: none">Commonly used for streaming workloads, big data, data warehouse, log processing, or any workload that requires large-block, sequential throughput at a low price.Recommended only for SAP workloads that involve large block transfers – backup staging and some archival scenarios.Do not use for root, apps, data, or log volumes.	
Volume Size	1 GB – 16 TB	4 GB – 16 TB / 64 TB		125 GB – 16 TB	
Max IOPS per volume	16,000	64,000		500	
Max throughput per volume	1,000 MB/s	1,000 / 4,000 MB/s		500 MB/s	
Max IOPS per instance	260,000	160,000 / 260,000		260,000	
Max throughput per instance	7,500 MB/s	4,750 / 7,500 MB/s		7,500 MB/s	
Durability	99.8% - 99.9%	99.999%		99.8% - 99.9%	
Latency	single digit millisecond	single digit ms / sub-ms		--	
Main performance attribute	\$/IOPS	IOPS and volume durability		MB/s	

Solid State Disk (SSD)

Magnetic (HDD)

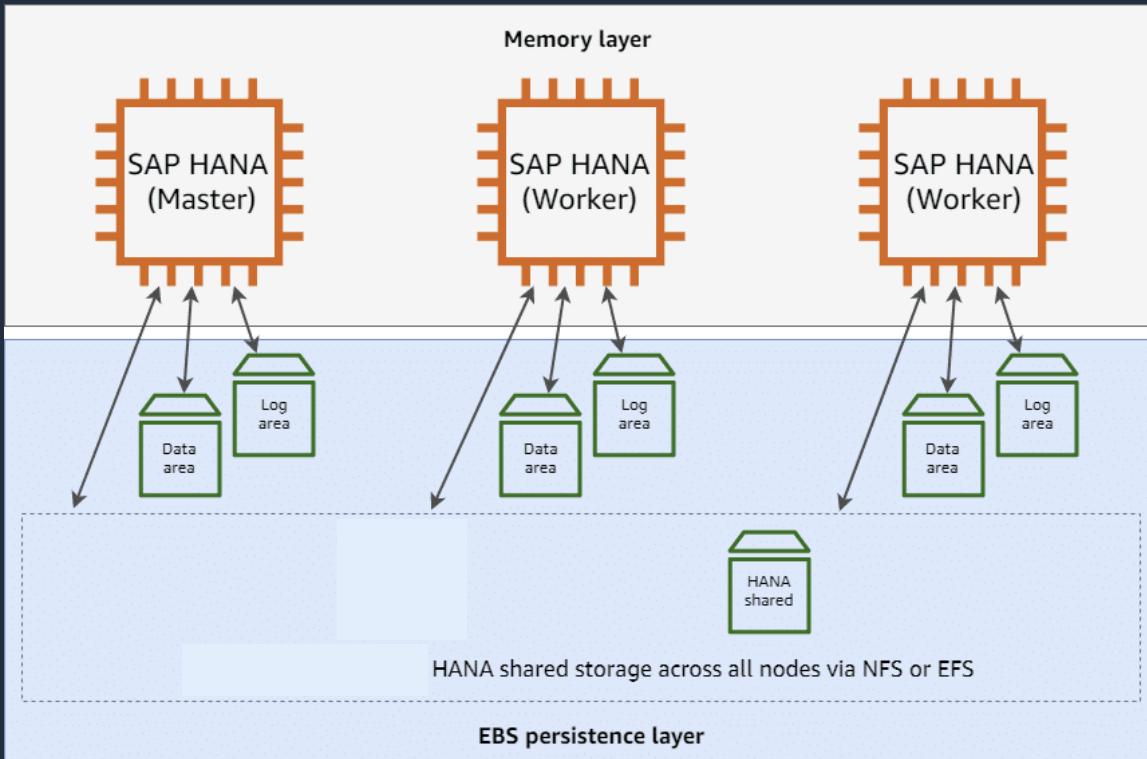
Choosing between gp3 and io2

- Number of IOPS that gp3 volume provides may be defined, and caps out at a maximum IOPS per volume
- If a particular SAP file system needs more IOPS than what the gp3 volume provides, options are:
 - Change the volume type to io2 with more IOPS
 - Increase the gp3 volume allocated IOPS
- For high uptime requirements, propose the added durability of io2

In most cases it will be cheaper to use gp3, instead of changing volume type to io2 to get more IOPS

This may be done dynamically, to address changing workload requirements.

EBS Storage Architecture for HANA



- Production configuration leverages SAP certified EBS for SAP HANA Data, and Log areas
 - Backed by solid-state drives (SSD)
 - Single-digit millisecond latency
- EBS volumes for data and log are configured as RAID 0 for maximum throughput, depending on storage type selected.
- Each Amazon EBS volume data is replicated across multiple servers in an Availability Zone
- Each SAP HANA node carries the same Amazon EBS configuration regardless of whether it is configured as master or worker node
- Shared nothing storage concept for the SAP HANA data and log areas

SAP Supported EBS Storage Configurations for HANA

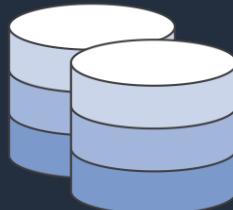
SAP HANA File systems (striped with LVM)

x2iedn.32xlarge (4 TB)

Config	File System	EBS Volume Type	Size (GiB)	Combined Throughput (MiB/s)	Total IOPS	Recommendation
#1	Data	gp3 *	2 x 2,400	1,500	9,000	Non-Production & Production
#2	Data	io2 Block Express **	2 x 2,400	2,250	9,000	Production
#3	Log	gp3 *	1 x 512	300	3,000	Non-Production & Production
#4	Log	io2 Block Express **	1 x 525	500	2,000	Production

* general purpose SSD gp3 volumes balance price and performance for a wide variety of workloads, IOPS and Throughput can be increased from a high baseline value

** io2 Block Express volumes provide the highest performance consistently and resiliency for mission-critical applications, with the lowest (sub-millisecond) latency



Storage Configuration for SAP HANA

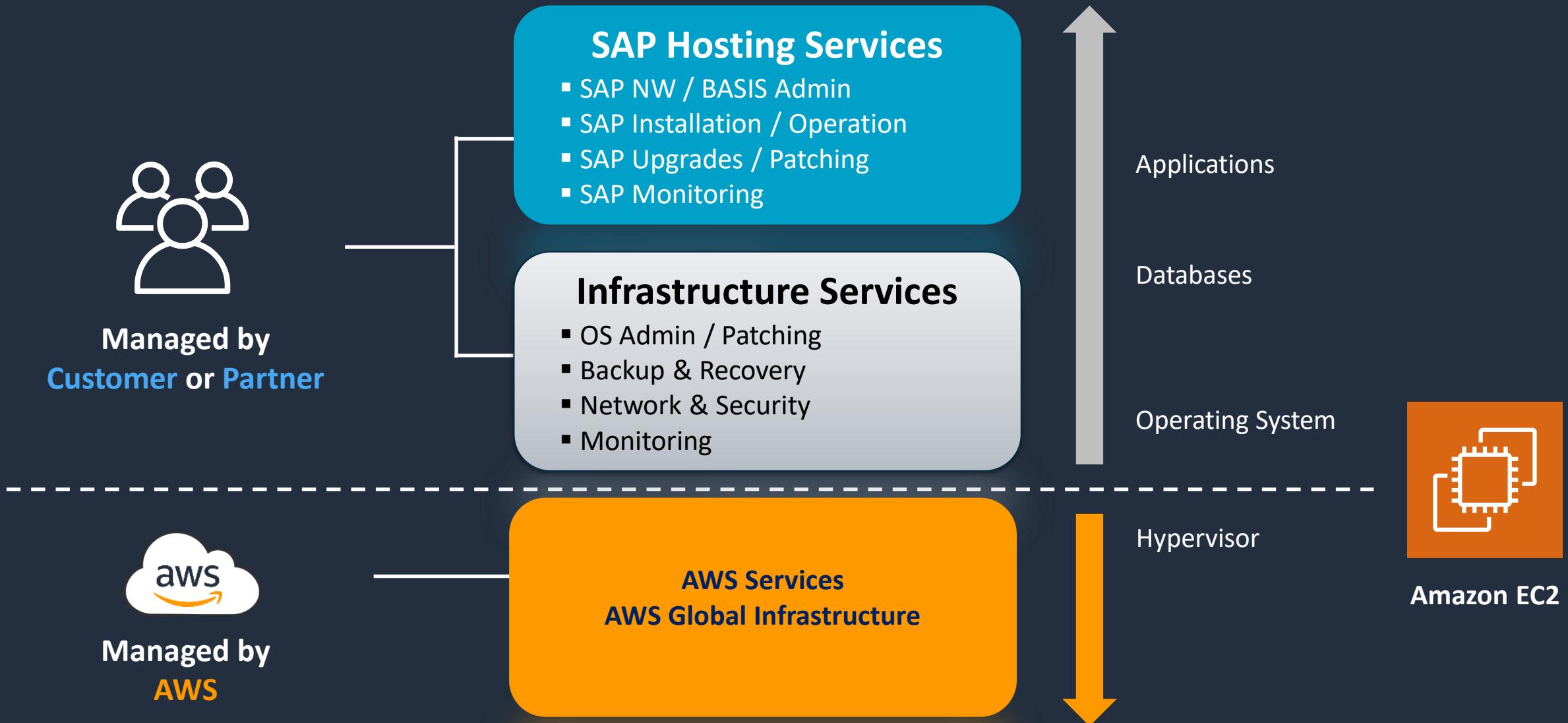


Non-database areas

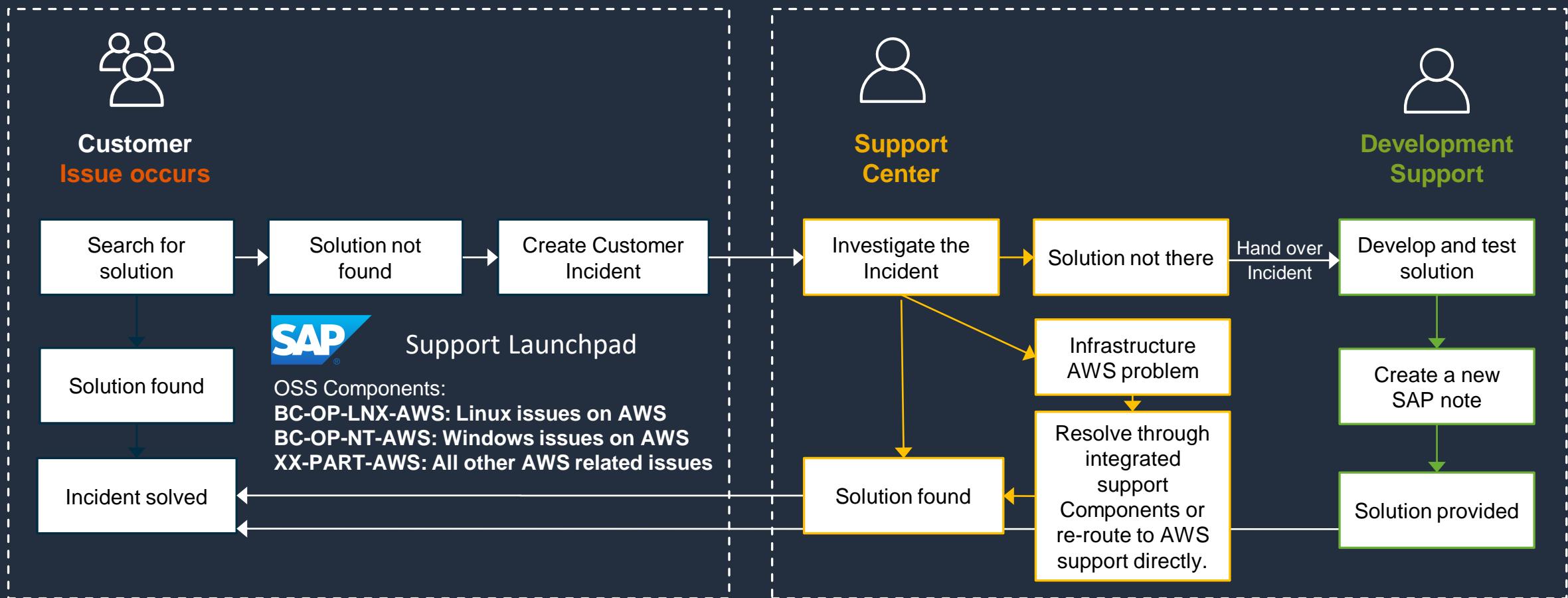
Filesystem	EBS Volume Type	Size (GiB)
/	General Purpose SSD (gp3)	1 x 50
/usr/sap	General Purpose SSD (gp3)	1 x 50
/hana/shared	General Purpose SSD (gp3)	1 x 1,024

SAP on AWS Support Model

Managed services for SAP on AWS



Incident Solving Process at a Glance



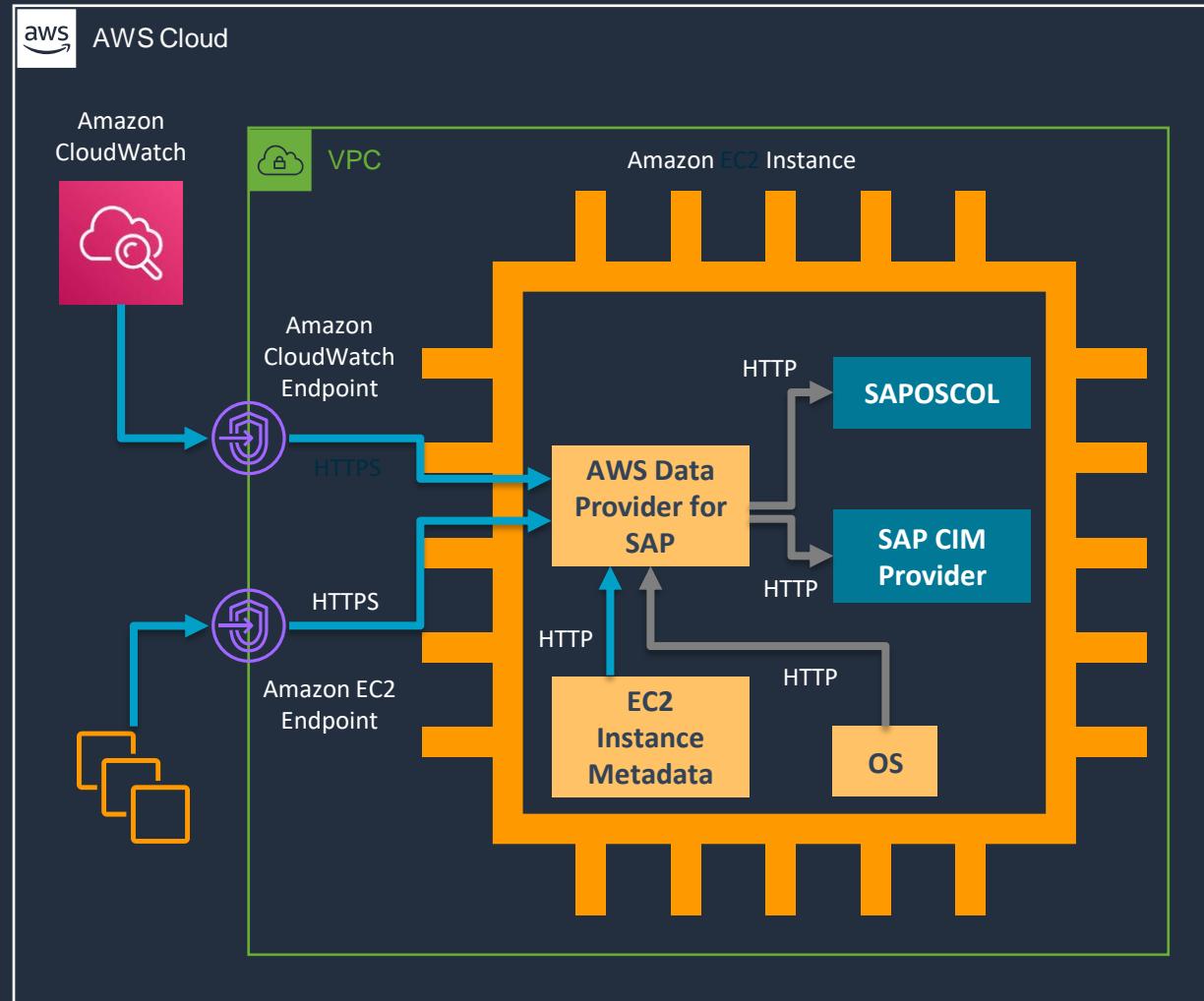
Contact SAP Customer Interaction Center: <https://support.sap.com/contactus> or via SAP Note [560499](#)

AWS Data Provider for SAP

In order to run your SAP workloads, you can set up the AWS Data Provider for SAP. This is a daemon or service that automatically starts with your operating system and collects, aggregates, and exposes metrics to the SAP platform. The AWS Data Provider is a mandatory component for receiving integrated support from SAP and AWS.

It gathers the following data:

- AWS-specific information about **instance type**, **instance ID**, etc.
- Key system configuration (**number of processors**, **main memory**, **disks**, etc.)
- Key parameter of **CPU**, **memory**, **disks**, **network** resource consumption data
- **SAP DB/OS Cockpit** and **SAP Support** use the information gathered by the AWS Data Provider to analyze performance issues.

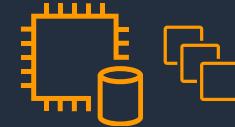


[AWS Documentation](#)

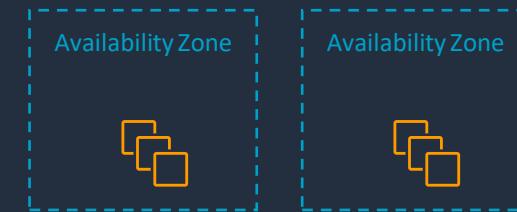
SAP on AWS Architecture Patterns

Architecture Patterns

Basic Architecture (Single AZ)

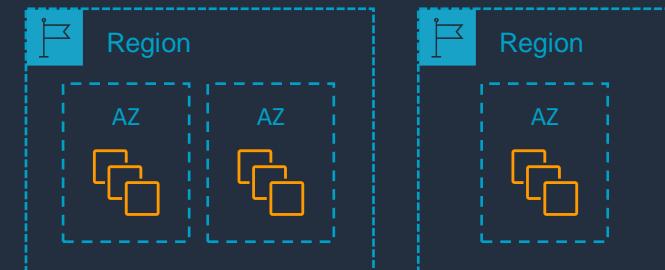


High Availability (HA) - Multi-AZ

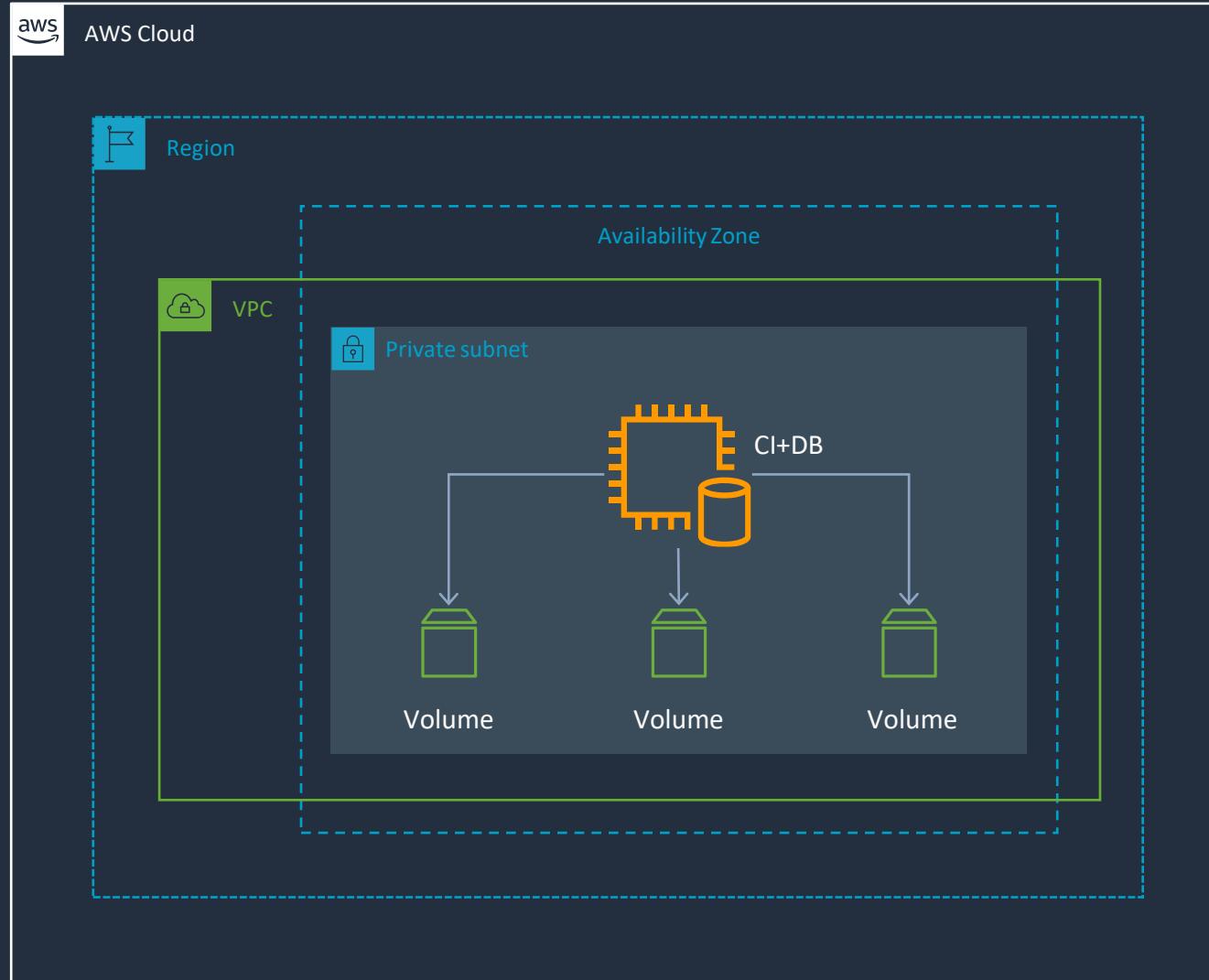


Disaster Recovery (DR) – Multi Region

- Backup & Restore
- Pilot Light
- Warm Standby



Single Instance Architecture

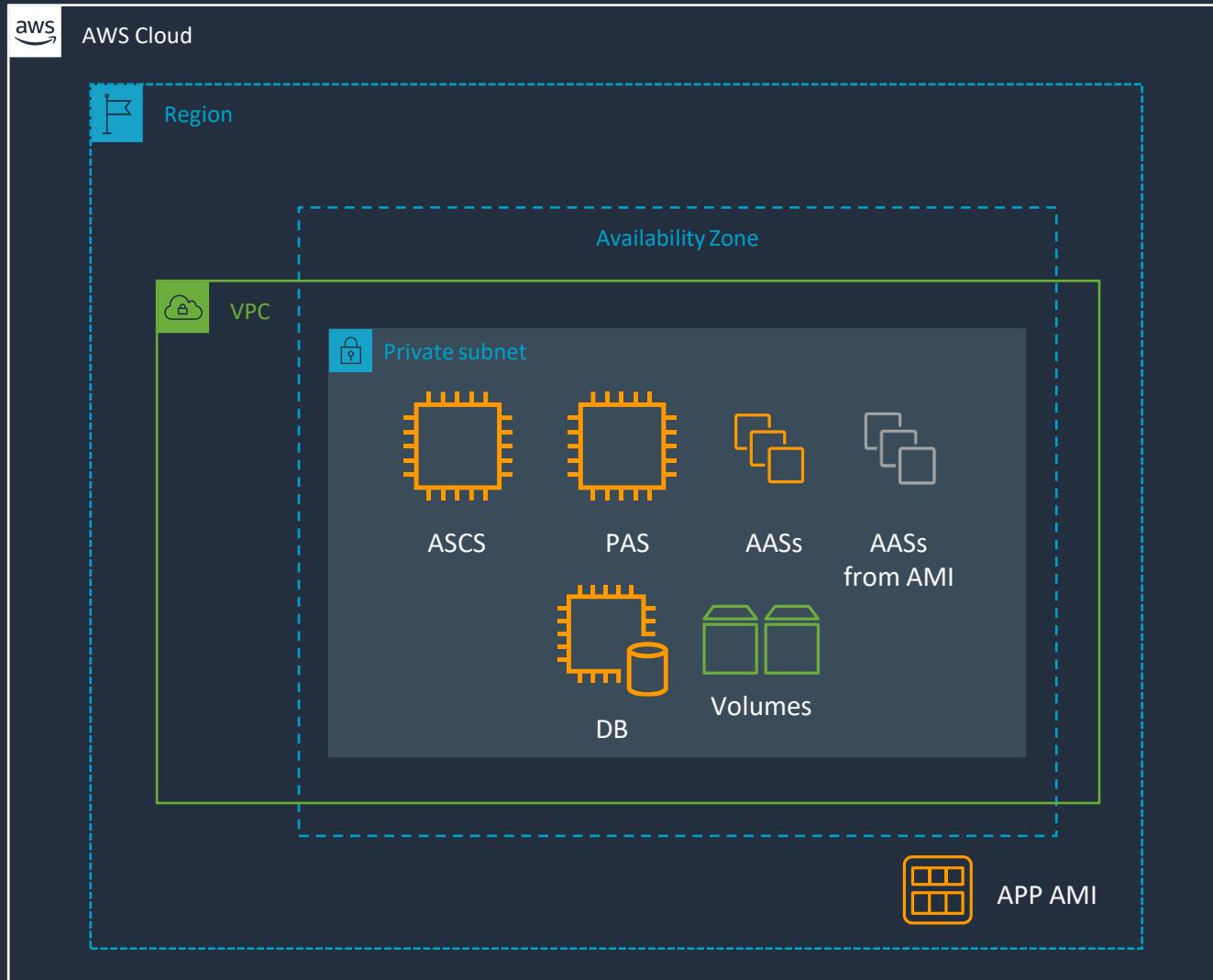


Single Certified SAP EC2 Instance
for all SAP components

Use-cases

- Dev, Sandbox, POC, QA systems
- Maintenance activities
- Non-Critical Systems:
RTO/RPO of Hours/Days

Distributed Instances Architecture



Multiple Certified SAP EC2 Instances for SAP components:

- ASCS
- PAS
- AAs
- DB

Use-cases

- QA & Training Systems
- Variable Load Patterns
- Production Systems with RTO/RPO of Hours/Days

Backup

All backup mechanisms seen for single-instance pattern need to be applied to multiple instances patterns

High Availability Options

Mean Time to Respond (MTTR) is the time it takes to respond to a failure scenario and get the production operations back in place

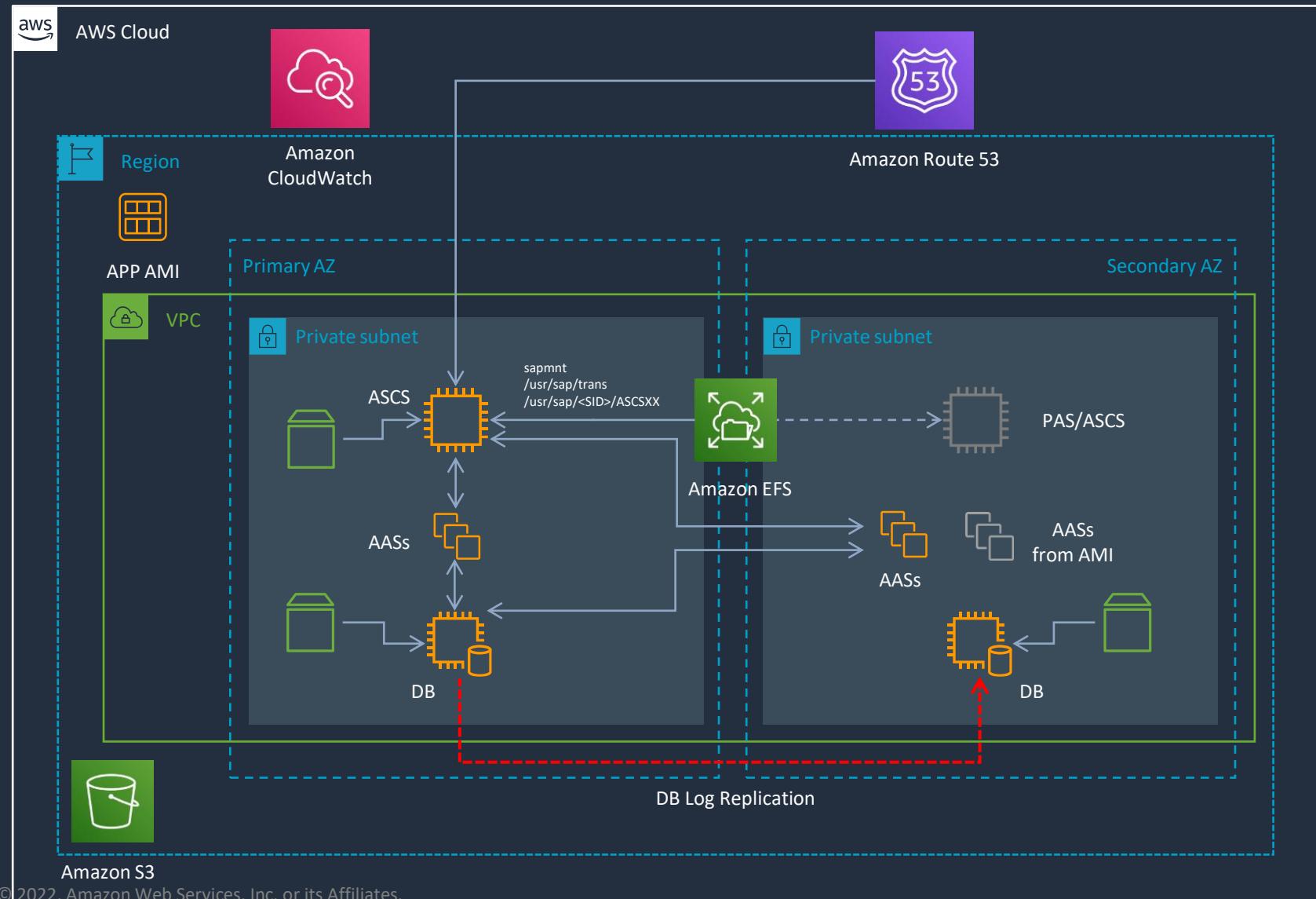
Component Failover

- Automated Alert with Manual Failover
 - Near HA
hour > MTTR > minutes
- Clustering Solutions
 - HA
MTTR < minutes



Availability and Reliability SAP on AWS Architecture Guidance documentation:
<https://docs.aws.amazon.com/sap/latest/general/architecture-guidance-of-sap-on-aws.html>

High Availability (Multi-AZ) Architecture Pattern



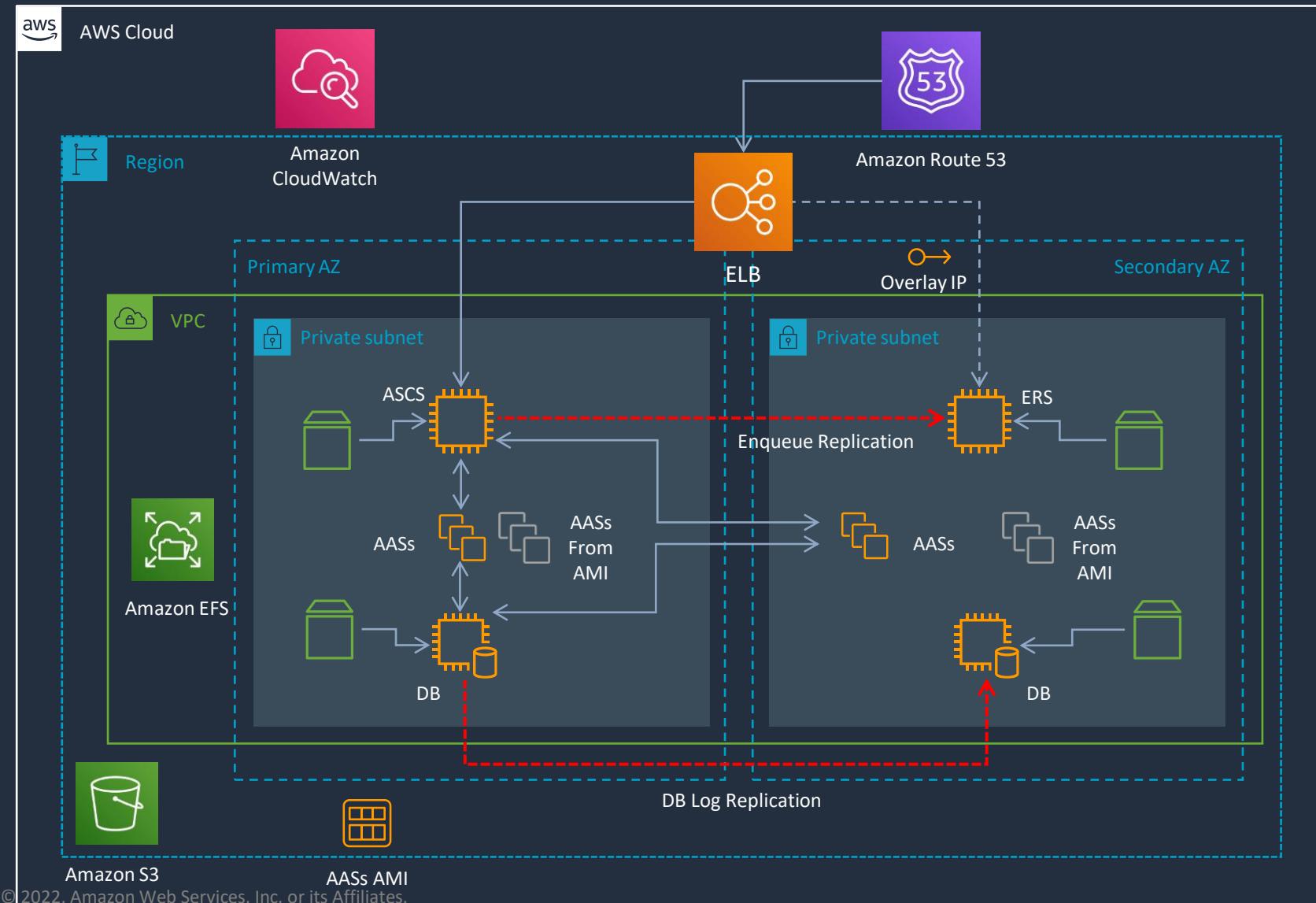
Simplified multi-AZ architecture

Failover Mechanisms

- Restart of PAS/ASCS and mount SAP file system from EFS
- DB updates shipped from Primary to Secondary AZ through DB Log Replication
- Manual or Automated Tools



High Availability (Multi-AZ) Architecture Pattern



Multi-AZ for Distributed Instances Architecture

Failover Mechanisms

- Enqueue Logs Replication from ASCS to ERS
- DB updates shipped from Primary to Secondary AZ through DB Log Replication
- Manual or Automated Tools
- Automated failover would focus on 2 clusters, DB and ASCS

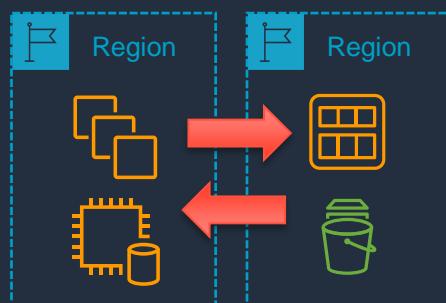


Multi-Region Disaster Recovery Strategies

For when recovery in a geographically distant area (or different country) is required.

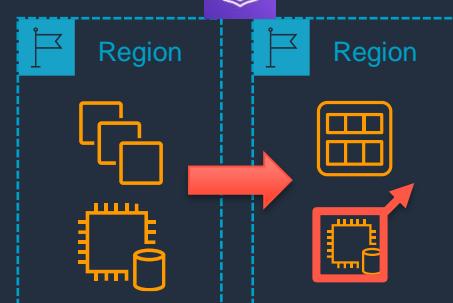
Passive DR

- Data backed-up on S3
- Application Servers AMIs used in secondary AZ, or replicated to Secondary Region
- RPO/RTO hours
- Cost: \$



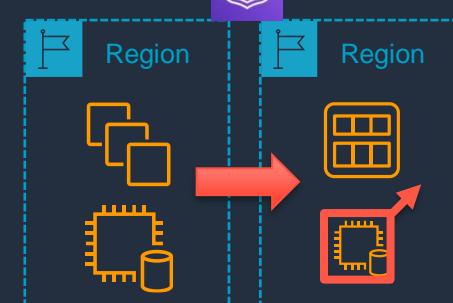
Pilot Light DR

- Only critical core systems of SAP (e.g. database) is replicated (usually small-scaled) in Secondary AZ or Region
- Application Servers AMIs used in secondary AZ or replicated to Secondary Region
- RPO/RTO minutes
- Cost: \$\$



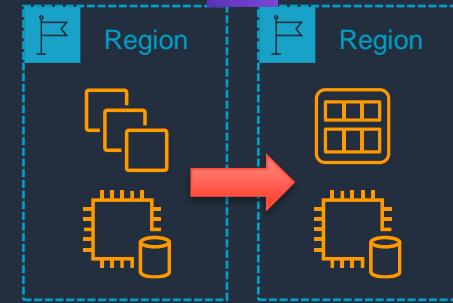
AWS Elastic Disaster Recovery (DRS)

- All of PROD is replicated to a secondary AZ or Region
- DRS Agent implements storage block level replication to staging VPC
- Trigger automated failover to DR
- RPO/RTO minutes
- Cost: \$\$

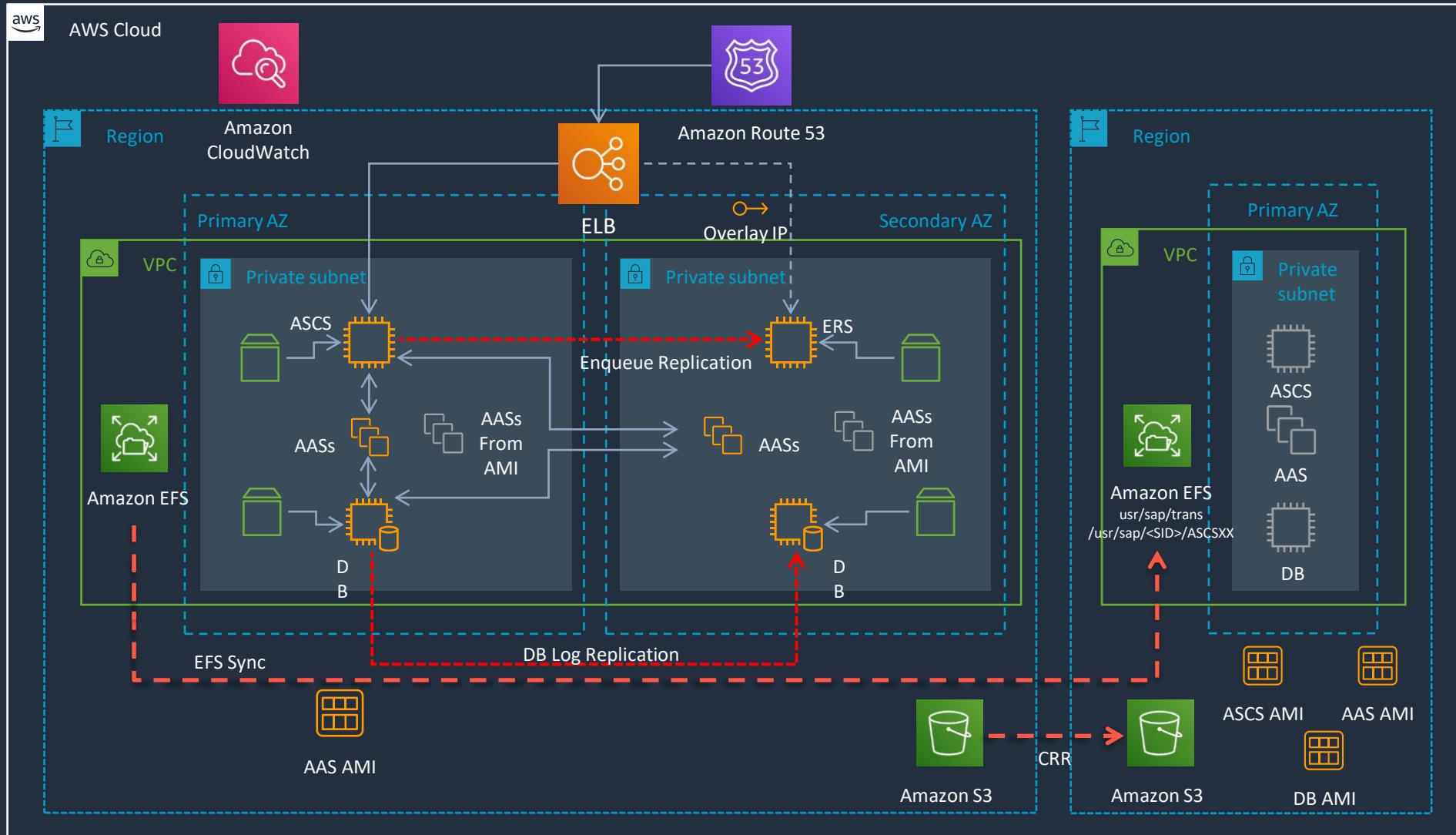


Warm Standby DR

- Only critical core systems of SAP (e.g. database) is replicated to same sized instance in Secondary AZ or Region
- Application Servers AMIs used in secondary AZ or replicated to Secondary Region
- RPO/RTO seconds
- Cost: \$\$\$



Passive Disaster Recovery for HA Architecture



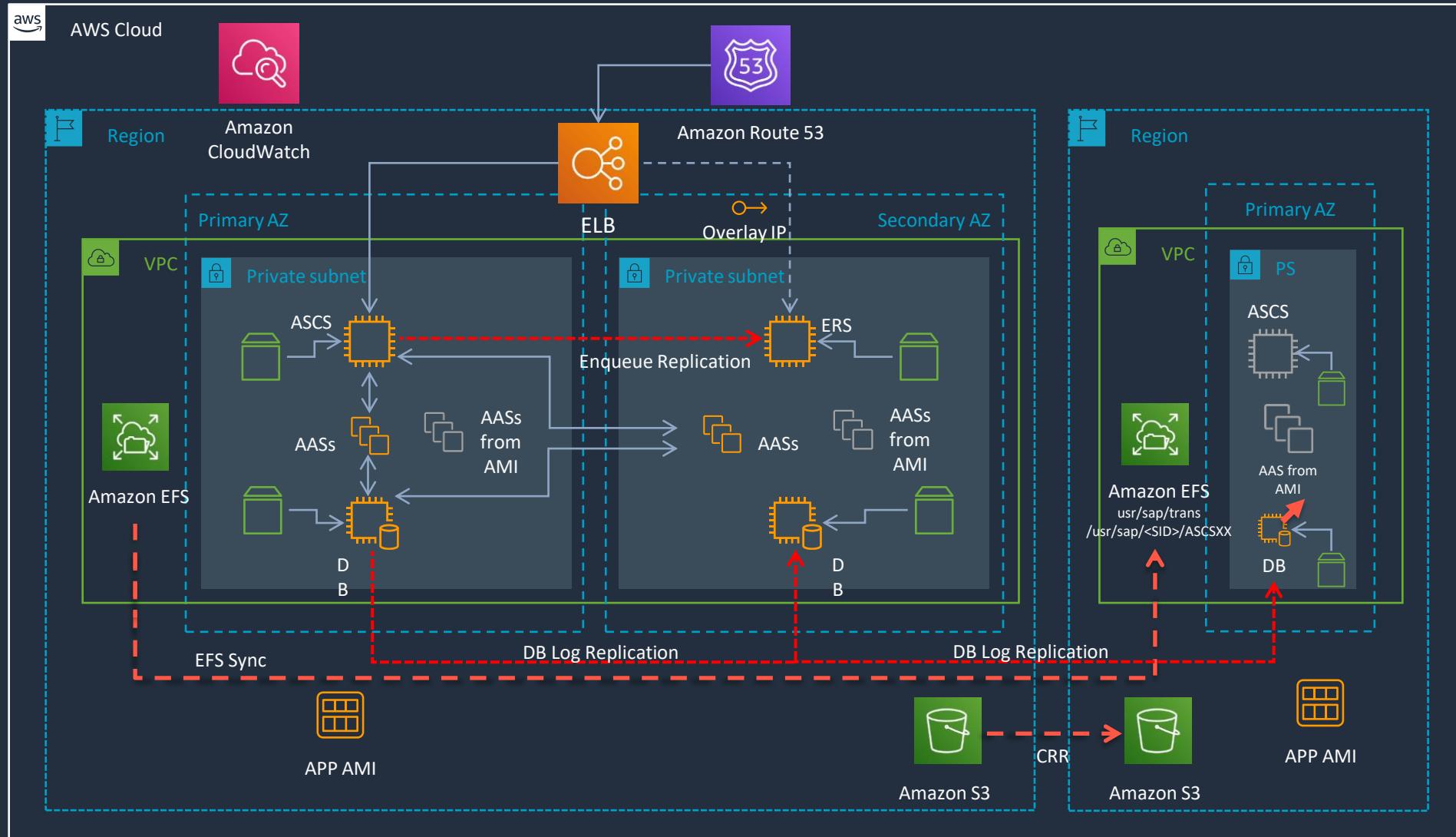
Replication

- AMIs
- Cross-Region
- Replication for S3
- EFS Sync

Failover

- Spin-up instances from AMIs
- Download DB logs and backups from S3
- Update DNS

Pilot Light Disaster Recovery for HA Architecture



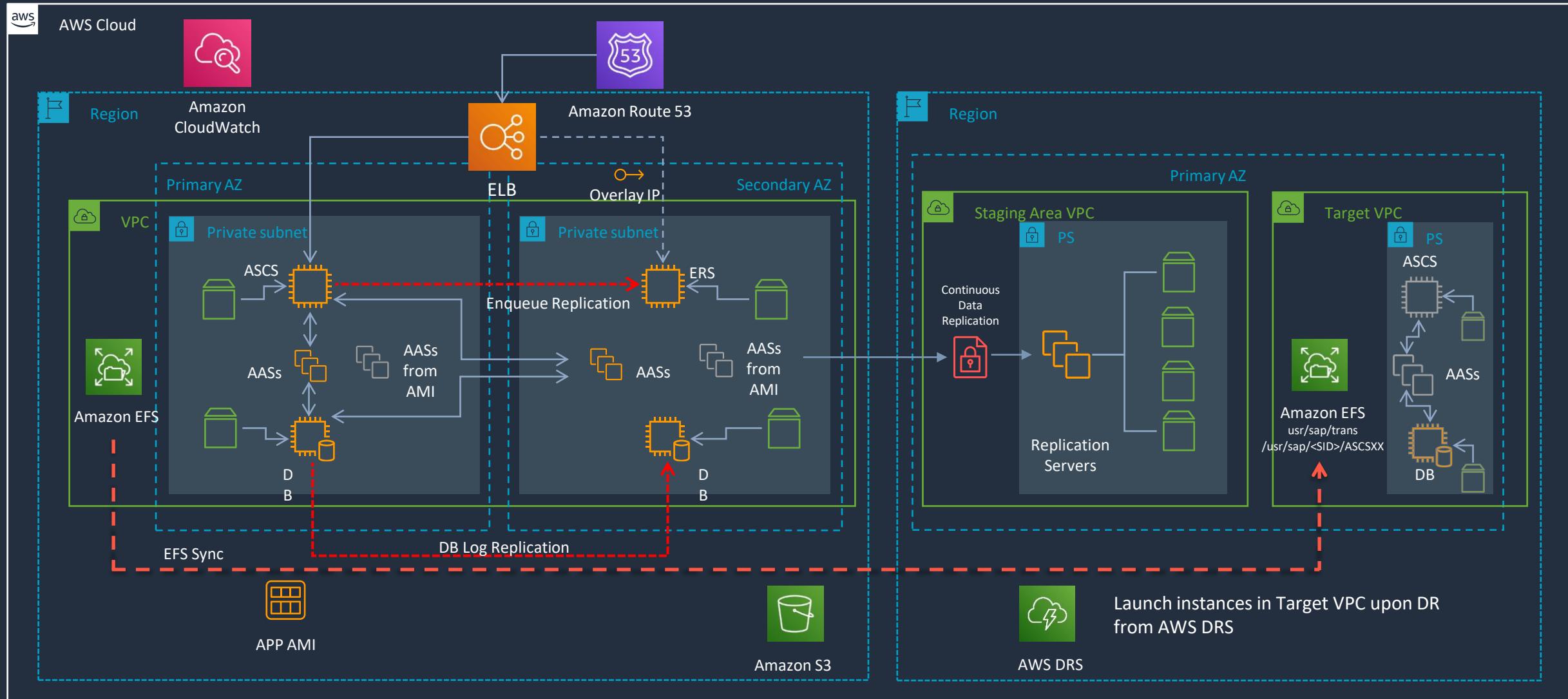
Replication

- DB log replication
- AASs AMIs
- EFS sync
- S3 CRR

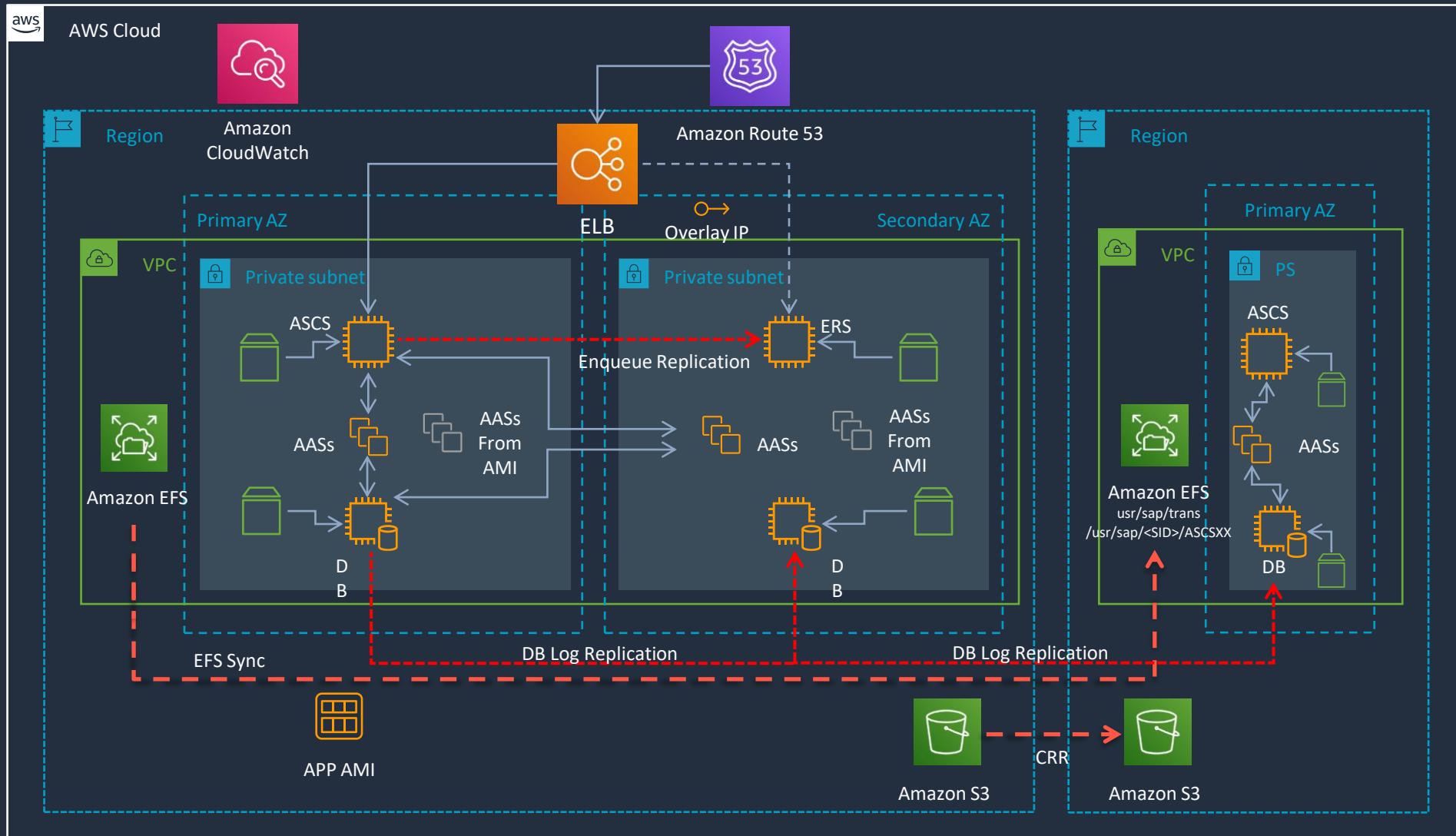
Failover

- Scale-up DB node if needed
- Spin-up instances from AMIs
- Update DNS

AWS DRS Disaster Recovery Architecture



Warm Standby Disaster Recovery for HA Architecture



Replication

- DB log replication
- EFS sync
- S3 CRR

Failover

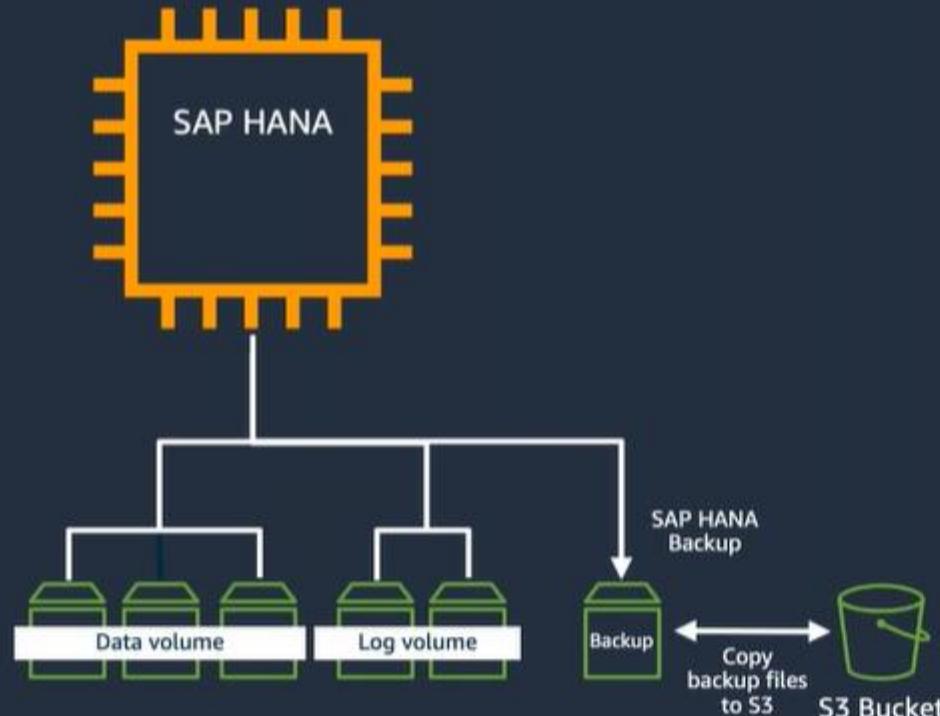
- Spin-up instances from AMIs or start the App servers that were shutdown
- Update DNS

SAP on AWS

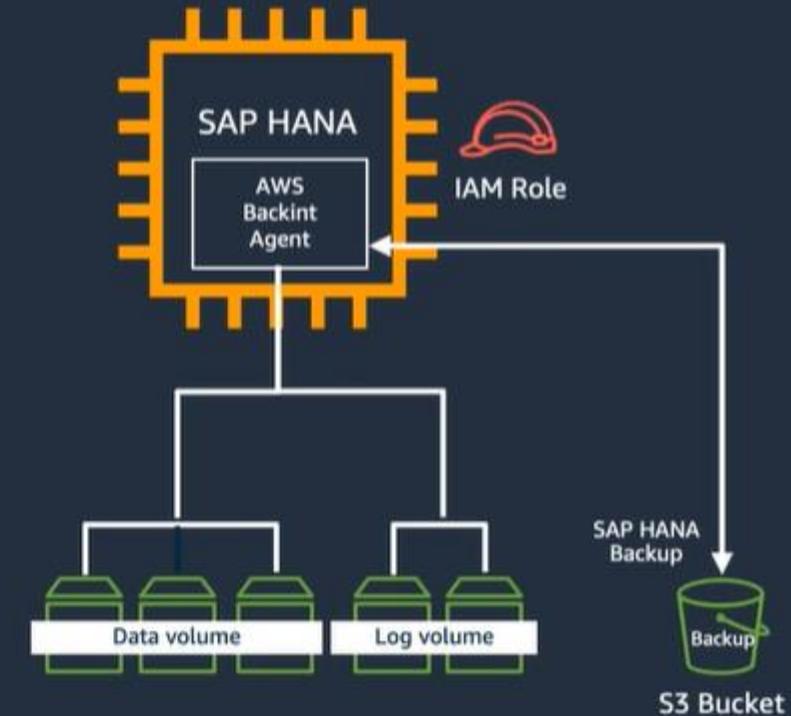
Backup and Recovery

AWS Backint Agent Overview

File based backup



Backup with AWS Backint

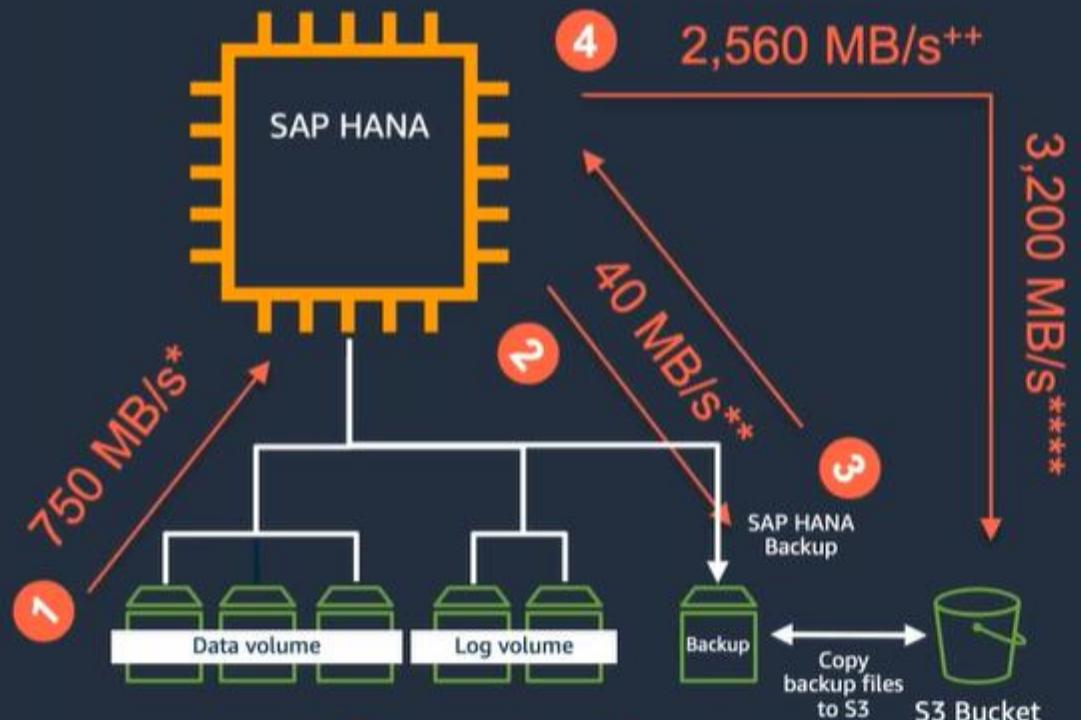


Performance improvements

Let's assume a 512 GiB HANA appliance (r5.16xlarge), with EBS gp2 volumes...

What might "slow you down" ?

File based backup

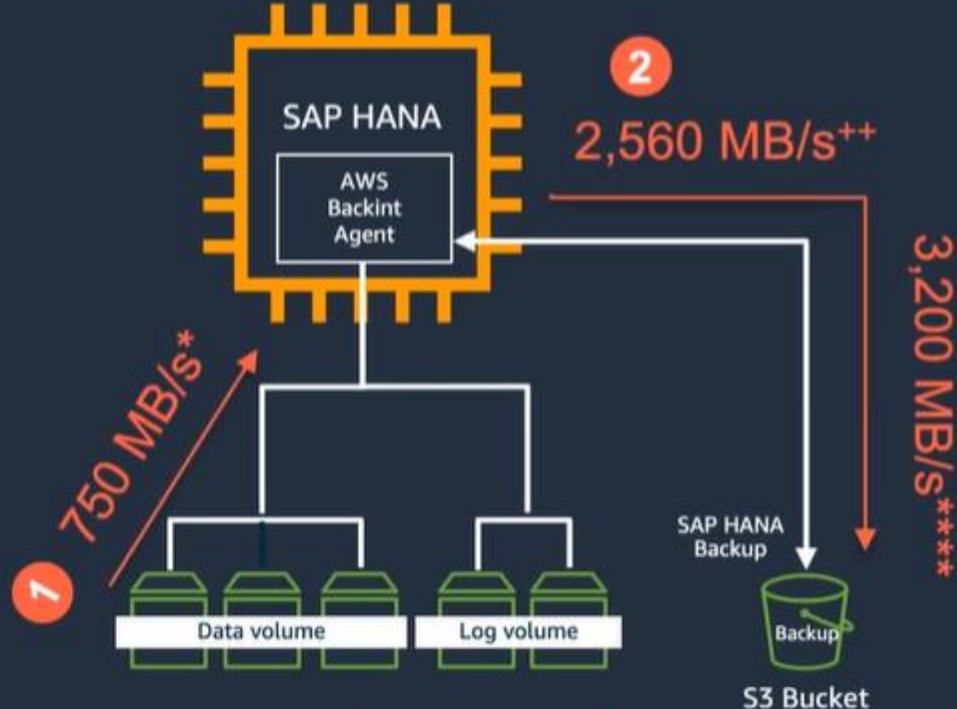


2 copy actions
40 MB/s throughput sustained

* 3 x 225 GiB gp2 = 750 MB/s baseline throughput

** 1 x 1,024 GiB st1 = 40 MB/s baseline / 250 MB/s burst throughput

Backup with AWS Backint



1 copy action
750 MB/s throughput sustained

*** r5.16xlarge = 1,700 MB/s max storage throughput

**** EC2 to S3 peak throughput 25 Gbps

++ r5.16xlarge = 20 Gbps max network throughput

Expected Backup Durations

Expected backup duration based on AWS recommended storage configuration for SAP HANA

Instance Type	Memory Size (GiB)	Database Size on EBS (GiB)	EBS Throughput gp2 (MiB/s)	Duration (mins)	EBS Throughput io1 (MiB/s)	Duration (mins)
x1e.32large	3,904	1,952	750	~ 54	1,500	~ 27
x1.32xlarge	1,952	976	750	~ 24	1,500	~ 13
x1.16xlarge	976	488	750	~ 13	500	~ 18
r5.16xlarge	488	244	750	~ 6.5	500	~ 9

Note: use S3 Endpoint instead of NAT Gateway where possible to provide best throughput

Configuration File

/<installation directory>/aws-backing-agent/aws-backing-agent-config.yaml

Name of the parameter	Description	Default value
S3BucketAwsRegion	AWS Region of your Amazon S3 bucket	N/A
S3BucketName	Name of the Amazon S3 bucket where you want to store your SAP HANA backup files	N/A
S3BucketFolder	Name of the folder in the Amazon S3 bucket where you want to store your SAP HANA backup files	Empty
S3BucketOwnerAccountId	12-digit account ID of the Amazon S3 bucket owner	N/A
LogFile	Location of the AWS Backint Agent log file	/hana/shared/aws-backint-agent/aws-backint-agent.log
S3SseEnabled	Specifies whether KMS encryption is enabled.	Set to false if the S3SseKmsArn parameter is empty. Otherwise, set to true.
S3SseKmsArn	ARN of the KMS key that AWS Backint Agent can use to encrypt the backup files stored in Amazon S3	Empty

Optional Parameters

Cost-optimize: use S3 Std-IA

Name of the parameter	Description	Default value
S3StorageClass	Specifies the S3 Storage Class type that AWS Backint Agent can use while storing your backup files	STANDARD
EnableTagging	Enables or disables default Object tagging for backups files stored in S3	TRUE
UploadChannelSize	Specifies the number of files that can be uploaded in parallel to the S3 bucket during the backups	10
MaximumConcurrentFilesForRestore	Specifies the number of files that can be downloaded in parallel from S3 during the restore	5



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