SAP HANA based workloads on Azure

A Starter Guide

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Abstract

Welcome to the Starter Guide for SAP HANA based workloads on Azure: Your Essential Handbook for Streamlining Deployment, Ensuring Security, and Maximizing Resilience.

Embarking on the journey of migrating your SAP HANA workload to Azure can be both exhilarating and daunting. With a plethora of documentation available, navigating through best practices, security protocols, and resilience strategies can traverse a labyrinth.

Fear not, for this Starter Guide serves as your trusted compass, simplifying the complexities and providing a clear roadmap for success. Whether you are a seasoned IT professional or new to the world of cloud deployment, this guide is designed to be your starting point, offering concise yet comprehensive insights tailored to your needs.

Within these pages, you will discover:

Best Practices Unveiled: Benefit from our years of expertise and industry insights distilled into actionable best practices, ensuring optimized performance and cost-efficiency for your SAP workload on Azure.

Security Fortified: Safeguard your data and operations with robust security measures meticulously crafted to meet the highest standards, mitigating risks and bolstering confidence in your cloud environment.

Resilience Reinforced: Prepare for the unexpected with resilience strategies that prioritize continuity and reliability, empowering your business to weather any storm and thrive in an ever-changing landscape.

While this Starter Guide does not aim to replace the comprehensive Microsoft Documentation, it serves as a Starter Guide to them, offering streamlined access to essential information and complementing your journey with Azure. Consider it your gateway to the wealth of knowledge provided by Microsoft, distilled into digestible, actionable insights.

Whether you are considering the migration process, fine-tuning your deployment, or seeking to enhance your existing setup, this Starter Guide equips you with the knowledge and tools necessary to succeed. Let us embark on this transformative journey together, where innovation meets reliability, and possibilities abound.

Let us build the future, one step at a time.

Sincerely,

SAP on Azure Fasttrack WW team.

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Azure Landing Zone

And Azure landing zone is the foundation for deploying workloads in Azure. It should provide a structure that lets you implement the security, governance, and management controls you require. We suggest you get familiar with and use the SAP on Azure landing zone accelerator to set up and operate SAP workload landing zones inside your Cloud Adoption Framework enterprise-scale landing zone. The landing zone accelerator provides a specific architectural approach and reference implementation for your SAP systems on Azure. Please explore the documentation below before starting to build your landing zone.

MSFT Doc:
Review your environment or Azure landing zone for an SAP enterprise-scale migration - Cloud Adoption Framework
SAP on Azure landing zone accelerator - Cloud Adoption Framework

Identity and Access management for SAP

Review the required Azure administration and management activities for your team. Consider your SAP on Azure landscape. Determine the best possible distribution of responsibilities within your organization.
Provide access to Azure resources through role-based access control (RBAC) for management of infrastructure and applications.

For Central IT and SAP Basis teams, consider using Privileged Identity Management (PIM) and multifactor authentication to access SAP Virtual Machine resources from the Azure portal and the underlying infrastructure.
Tagging strategy
Naming Convention for infrastructure components, including Azure VMs (Virtual Machines).

MSFT Doc:

What is Azure role-based access control (Azure RBAC)?
What is Privileged Identity Management? - Microsoft Entra ID Governance
Describe Microsoft Defender for Cloud - Training
Explore identity services for SAP on AZURE
Tutorial: Microsoft Entra integration with SAP HANA - Microsoft Entra ID

Integrate SAP HANA with Azure Active Directory / Microsoft Entra for authentication and authorization. Explore AAD (Azure Active Directory) / Microsoft Entra features for user management and access control. Integrate SAP HANA with Azure Active Directory for authentication and authorization. Explore AAD features for user management and access control.

Subscriptions

Use subscriptions to manage costs and resources created by users, teams, or projects. For **SAP at least two subscriptions are recommended** (Prod and Non-Prod).

MSFT Doc:
[Subscriptions, licenses, accounts, and tenants for Microsoft's cloud offerings - Microsoft 365 Enterprise](#)

Quotas

Azure subscription quotas are limits set on various Azure resources and services to control usage and prevent abuse. These quotas define the maximum number of resources you can create or consume within a specific period and will be necessary step after you have your sizing done, note that you can request or change your quotas at any time. They vary depending on the type of subscription you have, such as Free, Pay-As-You-Go, or Enterprise Agreement. Quotas can affect resources like virtual machines, storage accounts, databases, and more. It is essential to monitor and manage quotas to ensure your Azure services operate smoothly without hitting any limits. You **can request quota increases** if you need more resources than the default limits allow (for some resources like M-Series VMs there is no pre-set standard quota limit so you should request quota for those SKUs if you are planning to deploy it. Additionally, please verify if the VM SKU is available in the Region and Zone you want to deploy it and request quota appropriately beforehand.

MSFT Doc:
[Quotas overview - Azure Quotas](#)

Decide on Azure Region

Choosing the right Azure region is important because it affects factors like latency, compliance, data residency, service availability, disaster recovery, and cost. Optimal region selection improves performance, ensures regulatory compliance, meets data residency requirements, maximizes service availability, enhances disaster recovery capabilities, and can result in cost savings.

Before deploying your workload decide that get familiar with:
- Azure Regions & their pairs
- Azure Availability zones
- Supported services/features in the region
- Data Sovereignty
- Network Distance: If you plan the deploy servers across zones as per example in a HA setup where A(SCS) is in one zone and ERS in a different one, to guarantee the SAP latency requirements we recommend you running [a latency test on Azure availability zones](#) (for each subscription in case you have a PRD subscription and a Non PRD subscription for example) before proceed with the

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zonal deployment as the latency can vary from zone to zone, so you can choose low-latency zones for deployment of SAP on Azure.

MSFT Doc & Useful links:
SAP-on-Azure-Scripts-and-Utilities/AvZone-Latency-Test at main · Azure/SAP-on-Azure-Scripts-and-Utilities · GitHub
Choose the Right Azure Region for You | Microsoft Azure
Azure Products by Region | Microsoft Azure
SAP workload configurations with Azure Availability Zones

Networking

In the context of cloud architecture, a **hub-and-spoke topology** refers to a networking model where a central "hub" network serves as a point of connectivity for multiple "spoke" networks. Each spoke network typically connects to the hub but not directly to other spokes. This architecture is important for SAP workload protection due to several reasons:

Security Isolation: The hub-and-spoke model provides a centralized point for security enforcement and monitoring. By directing traffic through the hub, you can implement security measures such as firewalls, intrusion detection systems, and data loss prevention solutions to protect SAP workloads from unauthorized access and cyber threats.

Network Segmentation: Spoke networks can be logically separated from each other, enabling better network segmentation. This segregation helps contain potential security breaches, limiting their impact on SAP systems and data.

Traffic Control: Routing SAP workload traffic through the hub allows for centralized traffic control and optimization. This facilitates efficient network management, load balancing, and prioritization of traffic to ensure consistent performance and availability for SAP applications.

Compliance Requirements: Many industries have strict compliance requirements regarding data protection and privacy. The hub-and-spoke architecture provides a framework for enforcing compliance policies and ensuring that SAP workloads adhere to relevant regulatory standards.

Scalability and Flexibility: The hub-and-spoke model is inherently scalable and adaptable to changing business requirements. As your SAP workload needs evolve, you can easily add or remove spokes, adjust network configurations, and integrate new security measures without disrupting existing operations.

Overall, the hub-and-spoke architecture plays a vital role in SAP workload protection by centralizing security enforcement, enabling network segmentation, facilitating traffic control, ensuring compliance, and providing scalability and flexibility to meet evolving business needs.

HUB and SPOKE Topology.
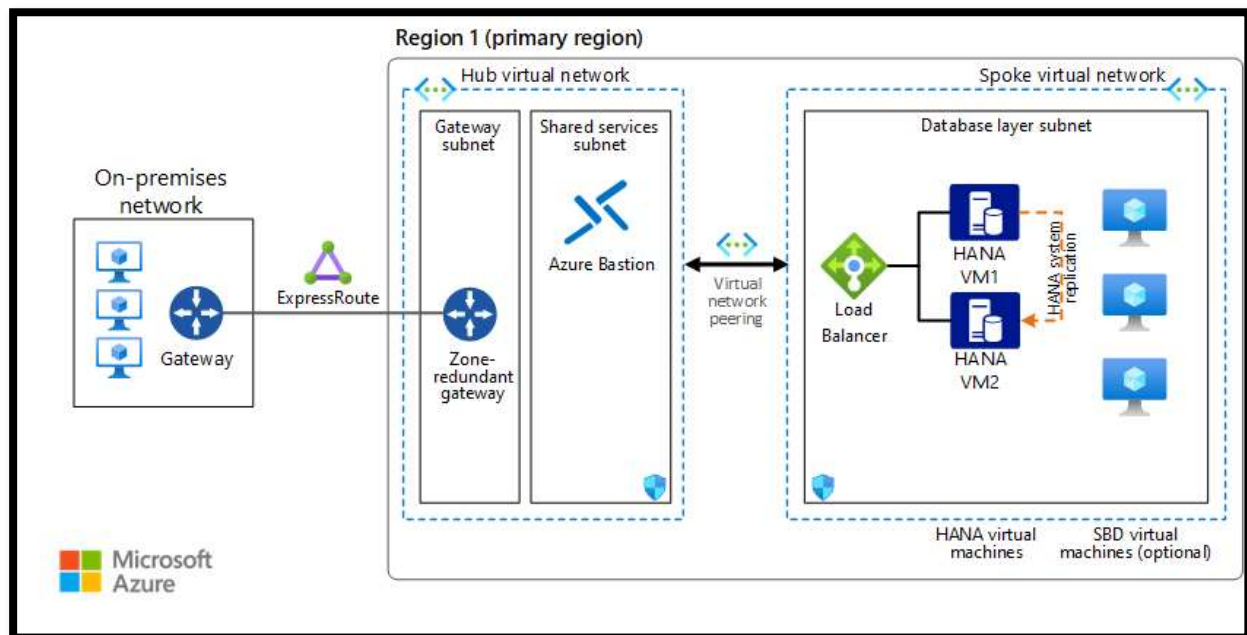
MSFT Doc:
Network topology and connectivity for an SAP migration - Cloud Adoption Framework
SAP on Azure landing zone accelerator - Cloud Adoption Framework

Connectivity

Connecting on-premises systems to SAP workloads running on Azure involves setting up network connectivity between your on-premises environment and Azure. Here are some options for establishing this connection:

Azure Virtual Network (VPN): You can create a site-to-site VPN connection between your on-premises network and an Azure Virtual Network (VNet). This establishes a secure and encrypted connection over the internet, allowing communication between on-premises resources and SAP workloads in Azure.

Azure ExpressRoute: Azure ExpressRoute provides a dedicated private connection between your on-premises network and Azure data centers. It offers higher reliability, faster speeds, and lower latency compared to VPN connections. ExpressRoute circuits can be used to connect directly to Azure VNets where your SAP workloads reside.

Azure Bastion: Azure Bastion is a fully managed PaaS (platform as a service) service that provides secure and seamless RDP (Remote Desktop Protocol) and SSH connectivity to your virtual machines in Azure directly from the Azure portal. While it does not directly connect your on-premises network to Azure, it can facilitate remote access to SAP systems hosted in Azure VMs.

Hybrid Network Solutions: Depending on your requirements, you can also explore hybrid network solutions offered by third-party vendors. These solutions provide additional features such as enhanced security, monitoring, and management capabilities for connecting on-premises and Azure environments.

When connecting on-premises systems to SAP workloads on Azure, it is essential to consider factors like security, performance, scalability, and compliance requirements. Choose the connectivity option that best aligns with your organization's needs and ensures seamless and reliable communication between on-premises and cloud environments. Additionally, consult with your network and Azure specialists to design and implement the most suitable connectivity solution for your SAP workloads on Azure.

MSFT Doc:
Azure VPN Gateway: https://docs.microsoft.com/en-us/azure/vpn-gateway/
Azure ExpressRoute: https://docs.microsoft.com/en-us/azure/expressroute/
Azure Bastion: https://docs.microsoft.com/en-us/azure/bastion/
Azure Virtual Network: https://docs.microsoft.com/en-us/azure/virtual-network/
SAP on Azure: https://docs.microsoft.com/en-us/azure/architecture/solution-ideas/articles/sap-on-azure-overview
Network topology and connectivity for an SAP migration - Cloud Adoption Framework
SAP on Azure landing zone accelerator - Cloud Adoption Framework
Azure Hybrid Network Solutions: https://azure.microsoft.com/en-us/solutions/hybrid-networking/

Network for SAP specifics

General Rule: SAP Application VMs and SAP HANA or Any DB VMs must be in the same VNET (Virtual Network). Although you can segregate APP and DB into different subnets without performance prejudice, also it is highly recommended to use NSG (network security groups) between subnets to have more security between SAP tiers.
NSG (Network Security Group) is a software firewall to monitor and perform action on inbound and outbound traffic. Configure NSG on Subnet Level for better control and management.

Latency

Latency optimization can be achieved by using the Azure Accelerated Networking, which is a mandatory setting for all SAP workloads in Azure. When using Accelerated Networking, the VM communicates directly with the network and bypasses the virtual switch in the hypervisor, which results in a much lower latency between hosts.

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Most general-purpose and computer optimized VM instance sizes with two or more vCPUs support Accelerated Networking. On instances that support hyperthreading, VM instances with four or more vCPUs support Accelerated Networking.

Important:

- To check whether a VM size supports Accelerated Networking, see Sizes for virtual machines in Azure.
- Perform Zone latency test based on GitHub content to ensure values are within the acceptable limit and within SAP recommended threshold.
- Use ABAPMETER tool (only for distributed systems) for ABAP based systems to test latency between Application and database.

Firewall

For Inbound/Outbound Internet traffic we recommend that your VM is protected by a firewall. To accomplish it you can use the Azure Firewall or a 3rd party appliance.
Implement an Azure Firewall or a Network Appliance to restrict access only to SAP Resources.

For secure delivery of HTTP/S apps, use Application Gateway v2 and ensure that WAF protection and policies are enabled.

Important:

- SAP and Microsoft do not recommend putting network firewalls (Appliances) between the network communication of application servers and database. Considering also not inspecting the traffic between the same landscape (Example between production systems like S/4 and CAR).

MSFT Doc:
Inbound and outbound internet connections for SAP on Azure - Azure Architecture Center

SAP Note:
2438832 - Network problems if firewall used between database and application servers - SAP for Me

DNS

If the virtual machine's DNS or virtual name is not changed during migration to Azure, Background DNS and virtual names connect many system interfaces in the SAP landscape, and customers are only sometimes aware of the interfaces that developers define over time. Connection challenges arise between various systems when virtual or DNS names change after migrations, and it is recommended to retain DNS aliases to prevent these types of difficulties.

Use different DNS zones to distinguish each environment (sandbox, development, preproduction, and production) from each other. The exception is for SAP deployments with their own VNET; here, private DNS zones might not be necessary.

IP Planning

Public IP assignment to VM running SAP Workload is not recommended.
You do not have to have a public IP address directly on the virtual machine, but you will need a public endpoint to access over the Internet. Deploy an Azure Load Balancer and port forward via a NAT rule.

You can use Azure Bastion as a secure jump box/bastion host to access your virtual machines.

Consider reserving IP address on DR (Disaster Recovery) side when configuring ASR (Azure Site Recovery).   Avoid using overlapping IP address ranges for production and DR sites.

MSFT Doc:
Network Appliances
Azure Firewall and Application Gateway for Vnets.
Azure Bastion overview

SAP Notes & Useful links:

2731110 - Support of Network Virtual Appliances (NVA) for SAP on Azure
2879613 - ABAPMETER in NetWeaver AS ABAP
500235 - Network Diagnosis with NIPING
2986631 - How to do NIPING and checking network performance
1100926 - FAQ: Network performance
2382421 - Optimizing the Network Configuration on HANA- and OS-Level

Storage

General Rules:

1. Only premium SSD are supported for Productive SAP HANA VMs. DEV/QAS when using disk storage (not ANF). Nonproductive environments you can explore different storage types as documented on SAP notes below.

   SAP Note:

   2367194 - Use of Azure Premium SSD Storage for SAP DBMS Instance

   1928533 - SAP Applications on Microsoft Azure: Supported Products and Azure VM types

   2015553 - SAP on Microsoft Azure: Support prerequisites

2. Azure provides several types of storage suitable for Azure VMs running SAP HANA. The SAP HANA certified Azure storage types that can be considered for SAP HANA deployments list like:

   Azure Premium SSD: A solution based on high performance SSD, and the recommended storage for M Series and Mv2 series VMs when used for SAP HANA and combined with the write accelerator (make sure you follow the strip recommendations and specific configurations described in the following document.

   MSFT Doc:

   SAP HANA Azure virtual machine storage configurations

   Azure Premium SSD v2: The Azure Premium SSD v2 Disk Storage is the most advanced general purpose block storage solution available, designed for performance-critical workloads like online transaction processing systems that consistently need sub-millisecond latency combined with high IOPS and throughput.

   MSFT Doc:

   SAP HANA Azure virtual machine Premium SSD v2 configurations

   Important consideration: Not all Azure Services are supported by Azure Ultra Disks at the moment we are writing it. As per example, Azure Backup or Azure Site Recovery (please consult the supportability here).

MSFT Doc about Limitations:

Deploy a Premium SSD v2 managed disk - Azure Virtual Machines

Azure Ultra-SSD : A Solution based on ultra-performance SSD, which is only supported storage for Ev3 series VMs and gradually being supported on M Series and Mv2 series.

Important consideration: Not all Azure Services are supported by Azure Ultra Disks at the moment we are writing it. As per example, Azure Backup or Azure Site Recovery (please consult the supportability here)

MSFT Doc about Limitations:

Ultra disks for VMs - Azure managed disks - Azure Virtual Machines

	Ultra disk	Premium SSD v2	Premium SSD	Standard SSD	Standard HDD
Disk type	SSD	SSD	SSD	SSD	HDD
Scenario	IO-intensive workloads such as SAP HANA, top tier databases (for example, SQL, Oracle), and other transaction-heavy workloads.	Production and performance-sensitive workloads that consistently require low latency and high IOPS and throughput	Production and performance sensitive workloads	Web servers, lightly used enterprise applications and dev/test	Backup, non-critical, infrequent access
Max disk size	65,536 GiB	65,536 GiB	32,767 GiB	32,767 GiB	32,767 GiB
Max throughput	10,000 MB/s	1,200 MB/s	900 MB/s	750 MB/s	500 MB/s
Max IOPS	400,000	80,000	20,000	6,000	2,000, 3,000*
Usable as OS Disk?	No	No	Yes	Yes	Yes

* Only applies to disks with performance plus (preview) enabled.

Azure NetApp Files (ANF): Azure NetApp Files provides native NFS shares that can be used for /hana/shared, /hana/data, and /hana/log volumes. Using ANF-based NFS shares for the /hana/data and /hana/log volumes requires the usage of the v4.1 NFS protocol. The NFS protocol v3 is not supported for the usage of /hana/data and /hana/log volumes when basing the shares on ANF.

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MSFT Doc:

Solution architectures using Azure NetApp Files

SAP HANA Azure virtual machine ANF configuration

Useful links:

SAP on Azure NetApp Files Sizing Best Practices (microsoft.com)

Important consideration: Not all Azure Services are supported by Azure NetApp files at the moment we write it, as per example Azure Backup or Azure Site Recovery.

Disk Striping

Please consider using LVM (logical volume management) for all HANA systems built on top of Premium SSD disks (HA (High Availability) and no HA): As a linear volume is created when you use **lvcreate** without the -i switch. We suggest that you create a striped volume for better I/O performance. Align the stripe sizes to the values documented in SAP HANA VM storage configurations. The **-i** argument should be the number of the underlying physical volumes, and the -I argument is the stripe size. By using striped LVM (-i) you will multiply the individual disk IOPs and throughput by the number of disks in the stripe.

Example:

VM SKU	RAM	Max. VM I/O Throughput	/hana/data	Provisioned Throughput	Maximum burst throughput	IOPS	Burst IOPS
M32ts	192 GiB	500 MBps	4 x P6	200 MBps	680 MBps	960	14,000
M32ls	256 GiB	500 MBps	4 x P6	200 MBps	680 MBps	960	14,000

In the above list you can see that for the M32ts data volume we recommend a LVM strip consisting of 4 disks P6. Consulting our public documentation, you can see that each P6 supports 240 IOPS and 50 MB/s in throughput. Alone one single disk would not meet SAP requirement for HANA data volume (below). To meet the throughput requirement, you would have to use a P60 (around 100 more expensive than a P6) but by using 4 **stripped** P6 **you would meet the requirement saving money and providing better performance experience.**

- Read/write on **/hana/log** of 250 MB/sec with 1 MB I/O sizes
- Read activity of at least 400 MB/sec for **/hana/data** for 16 MB and 64 MB I/O sizes
- Write activity of at least 250 MB/sec for **/hana/data** with 16 MB and 64 MB I/O sizes

MSFT Doc:

SAP HANA Azure virtual machine storage configurations
SAP HANA Azure virtual machine premium storage configurations
High availability of SAP HANA on Azure VMs on RHEL
High availability for SAP HANA on Azure VMs on SLES
Stripe sizes when using logical volume managers
Stripe sets versus SAP HANA data volume partitioning

Other Considerations:

- Choose between Premium SSD (v1 or v2), Ultra Disk, or Azure NetApp Files for SAP HANA data and log volumes. When using Premium SSD v1 for your log volume please have the write accelerator enabled.
- Consider always using Premium Storage for higher performance I/O.
- Validate the disk performance using **SAP HCMT** tool.

- Follow SAP HANA and Azure Guidelines for storage configuration.
  Run all production systems on Premium managed SSDs when not using Azure NetApp Files or Ultra Disk Storage.

- The OS disk should be on the Premium tier so you can achieve better performance and the best SLA for your database and application server VMs.
- Also keep in mind that different Azure storage types influence the single VM availability SLAs as released in SLA for Virtual Machines.

You should run SAP HANA on Azure only on the types of storage that are certified by SAP. Note that certain volumes must be run on certain disk configurations, where applicable. These configurations include enabling Write Accelerator and using Premium storage.
You also need to ensure that the file system that runs storage is compatible with the DBMS that runs on the machine.

Consider configuring high availability depending on the type of storage you use for your SAP workloads. Some storage services available in Azure are not supported by Azure Site Recovery, so your high availability configuration may differ.
Different native Azure storage services (like Azure Files, Azure NetApp Files, Azure Shared Disk) may not be available in all regions. So, to have similar SAP setup in the DR region after failover, ensure the respective storage service is offered in DR site.

Important:
- SAP HANA certification for Azure M-Series virtual machines is exclusively with Azure Write Accelerator for the /hana/log volume. As a result, production scenario SAP HANA deployments on Azure M-Series virtual machines are mandatory to be configured with Azure Write Accelerator for the /hana/log volume (When using Premium SSD v1 for HANA Log Volumes).

MSFT Doc:

What´s new for Azure Disk Storage
DISKs FAQS
Premium storage SSD V1 configuration.

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Premium SSD v2 storage configurations.
Ultra Disk storage configurations.
Sizing HANA DB on Azure NetApp Files
Storage hierarchy of Azure NetApp Files

SAP Notes and Useful links:

2972496 - SAP HANA Filesystem Types
3024346 - Linux Kernel Settings for NetApp NFS
2367194 - Use of Azure Premium SSD Storage for SAP DBMS Instance
2493172 - SAP HANA Hardware and Cloud Measurement Tools
1999930 - FAQ: SAP HANA I/O Analysis

SAP on Azure: Migration Strategy
Migrating SAP to Azure requires careful planning and execution to ensure a smooth transition with minimal disruption to your business operations. Here is a strategy outline to help you migrate SAP to Azure effectively:

Assessment and Planning: Evaluate current SAP setup and Azure options, set migration objectives, and identify prerequisites.

Design and Architecture: Plan Azure architecture, including networking, storage, and HANA deployment.

Pilot and Proof of Concept: Test migration approaches, validate performance, and gather feedback.

Data Migration: Migrate SAP databases with tools like Backup Restore, SUM, or SAP DMO with System Move Option. An important observation is that the DMO with System Move cannot be used for migration when the source system is already running on SAP HANA in this case you can use Backup Restore or HANA System Replication.

Application Migration: Move SAP application servers to Azure VMs or PaaS services, ensuring compatibility.

Post-Migration Optimization: Optimize Azure environment for performance, cost, and security.

Training and Knowledge Transfer: Provide training and documentation for IT staff and end-users.

Continuous Improvement: Monitor performance, stay updated on Azure and SAP enhancements, and make necessary adjustments.

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MSFT Doc:
Plan and implement an SAP deployment on Azure
Azure Database Migration Guides

SAP Notes & Useful links:

2015553 - SAP on Microsoft Azure: Support prerequisites **(This note is your source of true and best friend)**
3234349 - Azure data transfer slow during migration

SIZING for SAP HANA

AZURE MIGRATE

Why we do not recommend using Azure Migrate for SAP on Azure Sizing:

Azure migration tools focus on facilitating the migration process but may not adequately address the complexities of sizing SAP on Azure. Sizing SAP workloads requires a deep understanding of SAP's architecture, performance requirements, and custom configurations, which generic migration tools may not fully consider as example this tool still don't understand the real utilization of the system resources since SAP works with pre-allocated memory, it can bring you a super dimensioned VM or also this tool still don't check the VM support per role based on the SAP note 201553 recommendations.

SAP EARLYWATCH ALERT

EarlyWatch Alert (EWA) is a proactive monitoring tool provided by SAP that analyzes system data and provides insights and recommendations for optimizing SAP systems' performance, stability, and security. By using the SAP EarlyWatch Alert report and monitoring tools, you can observe your true resource consumption based on historical system usage. Based on historical data you can have an idea of the average utilization of your resources (CPU, Memory) and translate it to SAPs required and then utilize the SAP Note 2015553 to pick the right VMs based on your necessity.

SAP Notes & Useful links:

2015553 - SAP on Microsoft Azure: Support prerequisites **(This note is your source of true and best friend)**

How to Size SAP Systems Running on Azure VMs - Microsoft Community Hub

SAP HANA SIZING REPORT

To facilitate the upgrade of an existing ECC system to S/4HANA, SAP has introduced a valuable tool for memory sizing assistance. To get started, apply OSS note 1872170 – Business Suite on HANA and S/4HANA Sizing Report in your current ECC system. This note will enable access to the ABAP report /SDF/HDB_SIZING. It is advisable to initially test this report in a development system and then transport it to the production environment for actual sizing calculations.

SAP Notes & Useful links:

[1872170 - ABAP on HANA sizing report (S/4HANA, Suite on HANA...) - SAP for Me](#)

[How to install & run the ABAP on HANA Sizing Repor... - SAP Community](#)

SAP QUICK SIZER

To ascertain the correct sizing for S/4HANA, you can utilize the specialized SAP tool known as the S4HANA Quick Sizer. This tool is suitable for both new installations (greenfield) and existing ECC systems. You can access the S4HANA Quick Sizer using the provided [link](#) and launch the tool. Despite its name suggesting a swift process, it is crucial to understand that the tool is sophisticated and demands a significant amount of input to produce precise sizing recommendations. More details on CPU sizing can be found in OSS note 1793345

SAP Notes & Useful links:

[1793345 - Sizing for SAP Suite on HANA - SAP for Me](#)

Last thoughts:

- For Existing Workload Migration: When migrating an existing workload from on-premises to Azure, it is recommended to use reference sizing, using the capacity and utilization of the existing installed hardware to calculate the required resources in Azure.
- Rather than moving with a like-to-like basis approach, it is better to use performance-based approach, because Azure provides the way to scale-up and scale-down the VMs at any time based on requirement. Based on the above results, we can determine the appropriate Azure VM size from Azure /SAP certified VM SKUs.
- Create a high-level of SAP solution architecture (as-is <-> to-be) and share it with all teams involved, it will avoid noise in the communication and bring more awareness about the migration/implementation goals.

Scenario	SAP Business Suite (OLTP)	SAP BW/4HANA (OLAP)	Non SAP NetWeaver
New implementation	Quick Sizer for SAP Business Suite	Quick Sizer for SAP BW/4HANA	Sizing guides are available
Database migration	SAP Note 1793345: Sizing for SAP Suite on SAP HANA	SAP Note 2296290: New Sizing Report for BW/4HANA	SAP Note 1514966: SAP HANA: Sizing SAP In-Memory Database
	SAP Note 1872170: ABAP on HANA sizing report (/SDF/HDB_SIZING)	SAP Note 2121330: FAQ BW Sizing Report (/SDF/HANA_BW_SIZING)	
	SAP Note 2810633: Suite on HANA memory Sizing	SAP Note 2610534: FAQ HANA BW Sizing Report (/SDF/HANA_BW_SIZING)	
	SAP Note 2758146 - SAP Readiness Check 2.0 for SAP S/4HANA	SAP Note 2363248: SAP BW/4HANA Hardware Sizing	

SAP Notes & Useful links:

Performing SAP HANA Sizing

SAP HANA Sizing Essentials - A Starter Guide to HANA... - SAP Community

1793345 - Sizing for SAP Suite on HANA

1872170 - ABAP on HANA sizing report (S/4HANA, Suite on HANA...)

2296290 - New Sizing Report for SAP BW/4HANA

1958910 - EarlyWatch Alert For HANA Database

Azure Virtual Machines (VM)

Always use VMs certified for SAP HANA and Application Servers as not all Azures VMs are suitable to run SAP workloads. Check the SAP HANA Hardware Directory for compatibility and/or SAP Note 2015553.

Before you deploy your high-availability infrastructure, and depending on the region you choose, determine whether to deploy with an Azure availability set or an availability zone. Following are the platform-level SLAs for different high-availability deployment options.

Always check Availability/capacity of VMs and Azure resources based on Regions and Zones for all VMs types you are planning to deploy.

From an availability perspective the options you have for deploying SAP on Azure are as follows:

99.9% for single instance VMs with Azure premium storage.
99.95% for VMs within the same Azure availability set.
99.99% for VMs within Azure availability zones.

Other Considerations:

Run a VM Extension for SAP check. VM Extension for SAP uses the assigned managed identity of a virtual machine (VM) to access VM monitoring and configuration data. The check ensures that all performance metrics in your SAP application come from the underlying Azure Extension for SAP.

When deploying a VM for SAP system always verify if the image you are using is supported for SAP workloads and their lifecycle expectations. Also check if items like Azure Backup and Azure Site Recovery are already certified for the version you are planning to use.

MSFT Doc:
What SAP Software is supported on Azure
Azure Virtual Machine types
VMs Sizes

SAP Notes & Useful links:
1928533 - SAP Applications on Azure: Supported Products and Azure VM types.
2235581 – SAP HANA: Supported Operating Systems
2178632 - Key Monitoring Metrics for SAP on Microsoft Azure
Certified and Supported SAP HANA Hardware

Resilience

Check the operating system versions supported for the SAP HANA database.

Azure Center for SAP Solutions

The Azure Center for SAP Solutions is a dedicated initiative by Microsoft to provide comprehensive support and services for running SAP applications on the Azure cloud platform.

The Azure Center for SAP Solutions aims to facilitate the migration, deployment, and management of SAP applications on Azure, offering tailored solutions to meet the specific needs of SAP customers. This includes providing automated deployment capabilities to certain SAP products, providing intergradation with Azure Monitor for SAP and Azure Backup, also have your infrastructure regularly analyzed against our always evolving best practices by using the Quality Insights and potentially reduce costs by using the ACSS Cost Optimization tool. We recommend the usage of ACSS for all new and existing SAP systems on Azure.

MSFT Doc:
Azure Center for SAP solutions | Microsoft Learn

SAP Azure Quality Check (Standalone)

QualityCheck is a freely available tool designed to verify SAP installations on the Azure platform. By interfacing with Azure Resource Manager and the operating system, it scrutinizes system configurations against Microsoft's recommended practices. Regularly running QualityCheck ensures your system remains current and aligned with best practices.
This tool extends its support to various operating systems, including SUSE, RedHat, and Oracle Linux, as well as configurations for databases like HANA, Db2, ASE, and Oracle. It offers the flexibility to execute QualityCheck for database, ASCS, and application servers.
Continuous enhancements are underway, with upcoming features such as support for Windows and MSSQL being added soon.

Important:
We recommend when not using ACSS always downloading the last version of the Quality Check script and running it against your SAP VMs before turning those VMs available to the functional team or companywide it will show you possible important items that need fixing before you release those environments for general usage.

MSFT Doc:
SAP on Azure Quality Check

Azure Monitor for SAP Solutions

If your business depends on vital SAP applications and workflows hosted on Azure, monitoring their availability, performance, and functionality becomes paramount. Azure Monitor for SAP solutions is purpose-built for this task, leveraging Azure's native monitoring capabilities tailored for SAP landscapes on Azure infrastructure.

This monitoring solution seamlessly integrates with both SAP running on Azure virtual machines (VMs) and SAP on Azure Large Instances, ensuring comprehensive oversight across various deployment scenarios.

We encourage you to implement Azure Monitor for SAP Solutions or at lease Azure Monitor standard features to better management of your SAP workload on Azure.

MSFT Doc:
What is Azure Monitor for SAP solutions? | Microsoft Learn
What are providers in Azure Monitor for SAP solutions? | Microsoft Learn
Azure Monitor overview - Azure Monitor | Microsoft Learn

High Availability

General Rule: Recommended solution from SAP is to use HANA System Replication (HSR) in synchronous mode for HA scenarios. This effectively keeps two HANA instances in sync, with updates applied to the primary and the secondary at the same time. This allows rapid failover of the service if the primary node fails. This is the solution we recommend in addition to the Pacemaker cluster.

Some options are possible when implementing High Availability for SAP on Azure, the most common is the usage of the Linux Pacemaker Cluster and its possible by using SLES (SUSE Linux Enterprise Server) and REDHAT HA (high availability) distributions.

The SAP HANA system replication setup uses a dedicated virtual host name and virtual IP addresses. In Azure, you need a load balancer to deploy a virtual IP address.

You can integrate the pacemaker with Hana System Replication.

Pacemaker HA feature is only available in the following distributions:

- RHEL-HA
- RHEL-SAP
- SLES for SAP Applications

Other considerations:

Before you deploy your high-availability infrastructure, and depending on the region you choose, determine whether to deploy with an Azure availability set or an availability zone.

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When using Azure Availability Zones to achieve high availability, you must consider latency between SAP application servers and database servers. For zones with high latencies, operational procedures must be in place to ensure that SAP application servers and database servers are running in the same zone.

Availability sets

Availability sets are logical groupings of VMs that reduce the chance of correlated failures bringing down related VMs at the same time. Availability sets place VMs in different fault domains for better reliability, especially beneficial if a region doesn't support availability zones. When using availability sets, create two or more VMs within an availability set. Using two or more VMs in an availability set helps highly available applications and meets the 99.95% Azure SLA. There's no extra cost for using availability sets, you only pay for each VM instance you create.

Important:

- You cannot deploy Azure availability sets within an Azure availability zone unless you use proximity placement groups.
- Do not mix servers of different roles in the same availability set. Keep central services VMs, database VMs, application VMs in their own availability sets.
- When creating availability sets, use the maximum number of fault domains and update domains available. For example, if you deploy more than two VMs in one availability set, use the maximum number of fault domains (three) and enough update domains to limit the effect of potential physical hardware failures, network outages, or power interruptions, in addition to Azure planned.

MSFT Doc:
Availability sets overview - Azure Virtual Machines | Microsoft Learn

Proximity placement groups (PPG)

Proximity placement groups enable the grouping of different VM types under a single network spine, ensuring optimal low network latency between them. When the first VM is deployed in proximity placement group, that VM gets bound to a specific network spine. Like all the other VMs that are going to be deployed into the same proximity placement group, those VMs get grouped under the same network spine.

Important observations about PPG usage:

- Only use PPG, when it's strictly necessary (should not be generally used due to its constrictive nature)
- When the network latency between application layer and DBMS layer is too high and impacts the workload

- Only on granularity of a single SAP system and not for a whole system landscape or a complete SAP landscape
- In a way to keep the different VM types and the number of VMs within a proximity placement group to a minimum
- When you use Azure proximity placement groups in an availability set deployment, all three SAP components (central services, application server, and database) should be in the same proximity placement group.

Back to High Availability recommendations:
- Deploy VMs in the high-availability pair in an availability set or in availability zones. These VMs should be the same size and have the same storage configuration.
- Consider the availability of SAP software against single points of failure. This includes other single points of failure within Application Layer (ASCS/SCS). Also, consider protecting other important tools such as SAP Web Dispatcher (please review the MSFT Doc section below for more deep information).
- Most failover clusters for SAP application layer components (ASCS) and the DBMS layer require a virtual IP address for a failover cluster. On Azure this role is done by the Azure Load Balancer (so it's a mandatory item on your HA design)

MSFT Doc:
Configuration options for optimal network latency with SAP applications | Microsoft Learn

Best Practices:
- Install ASCS/ERS and DB HA in individual Linux Pacemaker cluster.
  would still be to install separate as greater flexibility, performance, management, and control.
- One design principle is to use one load balancer per cluster configuration. We recommend that you use the standard version of the load balancer (Standard Load Balancer SKU).
- Make sure the Floating IP is enabled on the Load balancer.
- See more information about setup and virtual hostname/IP configuration with Azure Load balancer in our documentation.

Cost Optimization Scenario:
We also support a scenario where you can install the A(SCS) and ERS instances in the same Pacemaker cluster nodes as your HANA DB when using RHEL as OS. Unfortunately **Cost Optimized** scenario is only supported on RHEL, that is means that isn´t supported for SLES yet.

MSFT Doc:
SAP Web Dispatcher Highly Availability
HA for SAP ASCS/SCS on Linux.
Azure VMs HA architecture and scenarios for SAP NetWeaver | Microsoft Learn
Availability sets overview - Azure Virtual Machines | Microsoft Learn

[SAP workload configurations with Azure Availability Zones | Microsoft Learn](#)
[Deploy SAP dialog instances with SAP ASCS/SCS high-availability VMs on RHEL](#)
[Deploy SAP ASCS/SCS and SAP ERS with SAP HANA high-availability VMs on RHEL](#)

SAP Notes:
1999880 - FAQ: SAP HANA System Replication.

Backup

General Rule: Azure backup provides simple, secure, and cost-effective solutions to back up your data and recover it from Microsoft.
Azure Backup allows to backup entire virtual machine and provide capability to restore the virtual machine back-in-place in case of crash incident.

SAP HANA databases are critical workloads that require a low recovery-point objective (RPO) and long-term retention. You can back up SAP HANA databases running on Azure virtual machines (VMs) by using Azure Backup. Azure Backup is the native backup solution for Azure and is BackInt certified by SAP.

For more details, see support Matrix for backup of SAP HANA databases on Azure VMs.

Azure Backup now supports backing up databases that have HSR enabled. This means that backups are managed automatically when a failover occurs, which eliminates the necessity for manual intervention. Backup also offers immediate protection with no remedial full backups, so you can protect HANA instances or HSR setup nodes as a single HSR container
For HANA, Azure Backup is now providing a HANA-consistent, snapshot-based approach that's integrated with Backint, so that you can use Azure Backup as a single product for your entire HANA landscape, irrespective of database size.

During the implementation/migration make sure to **schedule regular backups and test the restore process**.

Other considerations:

You can use Azure Snapshot capabilities for VM disks to have snapshoots of your VM disks however, as this feature do not guarantee application consistency make sure to but your database in backup mode or shut it down before snapshoot data or log disks in your HANA VMs

To back up SAP HANA databases running on Azure VM, you need to allow the installation of the plugin (SAP HANA Backup agent) on the Azure VM. This plugin connects with HANA Backint and helps the Azure Backup service to move data to the vault. It also enables Azure Backup to perform restores.

ANF Backup for SAP Solutions **(public preview) Azure** NetApp Files backup expands the data protection capabilities of Azure NetApp Files by providing fully managed backup solution for long-term recovery, archive, and compliance. Backups created by the service are stored in Azure storage, independent of volume snapshots that are available for near-term recovery or cloning. Backups taken by the service can be restored to new Azure NetApp Files volumes within the same Azure region. Azure NetApp Files supports both policy-based (scheduled) backups and

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manual (on-demand) backups.

MSFT Doc:
Tutorial-backup-HANA-DB
Tutorial: Configure SAP HANA database instance snapshot backup
Manage and monitor backed up SAP HANA databases
Azure Backup Support Matrix

Disaster Recovery

General Rule: For HANA disaster recovery, the data must be replicated to another **Azure region** to ensure no data is lost in case of a region-level failure. For SAP HANA, the recommended solution is to have a server provisioned in the secondary region that will be a target for HANA system replication (ASYNC), to ensure the shortest recovery time. Due to the nature of disaster recovery, the failover should be manual, as it is normal to want to determine whether the primary site will be recovered quickly or an actual failover to DR is required. Customers who want to mimic their on-premises **metro DR** strategy on Azure can use availability zones for disaster recovery. But zone-to-zone DR strategy may fall short of resilience requirement if there's geographically widespread natural disaster.

Other considerations:

DR Failover in Azure from primary to secondary region using Azure Site recovery is a simple activity compared to on-premises failover to azure.
For SAP systems running on virtual machines, you can use Azure Site Recovery to create a disaster recovery plan. Following is the recommended disaster recovery approach for each component of an SAP system. Standalone non-NetWeaver SAP engines such as TREX and non-SAP applications are not covered in this document.

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Components	Recommendation
SAP Web Dispatcher	Replicate VM using Azure Site Recovery
SAP Central Services	Replicate VM using Azure Site Recovery
SAP Application server	Replicate VM using Azure Site Recovery
SAP Database	Use replication method offered by the database
Shared Storage	Replicate content, using appropriate method per storage type

Azure Site Recovery replicates VMs and local managed disk attached, but it does not replicate NFS mounts.
Use a combination of Site Recovery, rsync or robocopy, and other third-party software for the SAP application layer.

Storage type	DR strategy recommendation
Managed disk	Azure Site Recovery
NFS on Azure files (LRS or ZRS)	Custom script to replicate data between two sites (for example, rsync)
NFS on Azure NetApp Files	Use Cross-region replication of Azure NetApp Files volumes
Azure shared disk (LRS or ZRS)	Custom solution to replicate data between two sites
SMB on Azure files (LRS or ZRS)	Use RoboCopy to copy files between two sites
SMB on Azure NetApp Files	Use Cross-region replication of Azure NetApp Files volumes

You can replicate standard storage between paired regions, but you cannot use standard storage to store your databases or virtual hard disks. You can replicate backups only between

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paired regions that you use.

Setup ExpressRoute connections from on-premises to the primary and secondary Azure disaster recovery regions. Also, as an alternative to using ExpressRoute, consider setting up VPN connections from on-premises to the primary and secondary Azure disaster recovery regions. Replicate key vault contents like certificates, secrets, or keys across regions so you can decrypt data in the DR region.

Peer the primary and disaster recovery virtual networks. For example, for HANA System Replication, an SAP HANA DB virtual network needs to be peered to the disaster recovery site's SAP HANA DB virtual network.

If you use Azure NetApp Files storage for your SAP deployments, at a minimum, create two Azure NetApp Files accounts in the Premium tier, in two regions.

Avoid using overlapping IP address ranges for production and DR sites.
The CIDR for the primary virtual network (VNet) should not conflict or overlap with the CIDR of the DR site's Vnet. Consider reserving IP address on DR side when configuring ASR

MSFT Doc:
Disaster recovery overview and infrastructure guidelines for SAP workload
Add an HSR third site to a HANA Pacemaker cluster
Set up disaster recovery for a multi-tier SAP NetWeaver app deployment

SAP SSO
Active Directory can be integrated with SAP single sign-on (Kerberos-SPNego) by configuring your SAP system with SNC (Secure Network Communication). The primary purpose of SNC is to secure connections between the NetWeaver ABAP application server and external applications, including SAP GUI. SNC provides an interface for external security products that can be used to enable single sign-on.

Implement SSO to SAP NetWeaver-based web applications like SAP Fiori and SAP Web GUI by using SAML.

More about SAP HANA on Azure

- Regularly perform a technical SAP HANA health check.
- Fine-tune SAP HANA parameters for best performance.
- Adjust memory settings, parallelization, and other configuration options.

HANA Large Instance

This service is in sunset mode and does not accept new customers anymore. Providing units for existing HANA Large Instance customers is still possible. For alternatives, check the offers of HANA certified Azure VMs in the HANA Hardware Directory.

Integrating Azure with SAP RISE managed workloads

For customers with SAP solutions such as RISE with SAP Enterprise Cloud Services (ECS) and SAP S/4HANA Cloud, private edition (PCE) deployed in Azure, integrating the SAP managed environment with their own Azure ecosystem and third-party applications are of particular importance.

SAP Cloud Appliance Library

Offers a quick and easy way to create SAP workloads in Azure. You can set up a fully configured demo environment from an Appliance Template or deploy a standardized system for an SAP product based on default or custom SAP software installation stacks. This page lists the latest Appliance Templates and below the latest SAP S/4HANA stacks for production-ready deployments.

Azure Review Checklist for SAP

During the design phase and before implementing the SAP application on Azure, it is highly recommended to use the Azure review checklist for SAP. This is a checklist that helps to design & deploy the SAP application following the best practices guidance for Azure Well-Architected Framework (WAF).

SAP workloads on Azure: planning and deployment checklist

Review the checklist of key milestones during your project. Doing so will enable you to detect small problems before they become large problems. You will also have enough time to re-engineer and test any necessary changes. Do not consider this checklist complete. Depending on your situation, you might need to perform additional checks.

MSFT Doc:
Optimizing Microsoft's SAP environment with Microsoft Azure
SAP on Azure Change Log
Use Azure to host and run SAP workload scenarios
Azure Fundamentals concepts
Azure Landing Zone Review Assessment

SAP Notes and Useful Links:

1999993 - How-To: Interpreting SAP HANA Mini Check Results.
2600030 - Parameter Recommendations in SAP HANA Environments.
2186744 - FAQ: SAP HANA Parameters.
2999990 - How-To: SAP HANA Performance Analysis.
1380654 - SAP support in IaaS environments
2243692 - Linux on Microsoft Azure (IaaS) VM: SAP license issues

IMPORTANT:
Remember to follow the best practices outlined in the Azure and SAP documentation for security, performance, and well-managed deployments. Regularly review and update your monitoring and management strategies as your SAP landscape evolves.

Document the entire SAP HANA on Azure deployment.
Include architecture diagrams, VM configurations, SAP HANA settings, and any custom configurations.

Conclusion

In this SAP HANA on Azure Starter Guide, we have embarked on a journey to harness the power of SAP HANA's in-memory computing capabilities within the robust infrastructure of Microsoft Azure. Through a series of comprehensive guides, best practices, and hands-on tutorials, we have equipped you with the knowledge and tools necessary to embark on your SAP HANA deployment journey confidently.

We began by understanding the constructive collaboration between SAP HANA and Azure, leveraging Azure's scalability, security, and global presence to optimize SAP HANA's performance and reliability. With a focus on deployment considerations, we explored various deployment models, from virtual machines to fully managed services like Azure Virtual Machines and Azure SQL Managed Instances.

Delving deeper, we examined key architectural considerations, including networking, storage, and high availability strategies, ensuring a resilient and efficient SAP HANA deployment on Azure. Through step-by-step tutorials, we guided you through the deployment process, from provisioning resources to configuring networking and optimizing storage for SAP HANA workloads.

Moreover, we addressed critical aspects of security and compliance, outlining Azure's robust security features and best practices for securing SAP HANA environments, safeguarding your data and infrastructure against emerging threats.

It is important to note that while this starter guide provides comprehensive guidance, it is not a replacement for Microsoft's official documentation. Instead, it complements existing resources and takes into consideration recommendations published up to the date of its release.

Lastly, we highlighted the importance of monitoring and optimization, introducing Azure Monitor and other monitoring tools to proactively monitor performance metrics, diagnose issues, and optimize resource utilization for peak SAP HANA performance.

As you embark on your SAP HANA journey on Azure, remember that this starter guide is just the beginning. Continuously explore Azure's evolving ecosystem, leverage new features and services, and stay abreast of best practices to maximize the value of your SAP HANA investment on Azure.

With SAP HANA and Azure, the possibilities are limitless. Empower your organization with real-time insights, agility, and scalability to drive innovation and stay ahead in today's dynamic business landscape.

Thank you for joining us on this journey. Now, it is time to unleash the full potential of SAP HANA on Azure and transform your business.

Appendix

Document Owner & Contributors

This document was prepared and revised by our talented WW SAP on Azure Fasttrack team members. If you have any questions or suggestions for this guide, please reach out to the document owner listed below:

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Document Revisions

Provide details on updates to this document in the table below, this will let readers know that it is maintained and how the guidance on this solution has changed over time.

Date	Description of Change	Revision made by	Rational
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4/17/2024	Revised and implemented AI Morrison's suggestions	Carlos Motta	
74/30/2024	Layout and Fonts Fix	Carlos Motta	