



How Google Cloud and The Home Depot Got an SAP Cloud Migration Done

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Nearly every retail consumer expects a connected experience—one where they can shop whenever and from wherever they want—online, in store, or both. Brands have been adopting digital solutions to make this possible, but offering connected retail experiences that scale quickly and flexibly calls for extreme agility that can only be supported by cloud infrastructure.

When The Home Depot, the world's largest home improvement retailer, adopted ambitious plans for building connected retail experiences across its entire operation, the company's IT team decided to migrate its core SAP systems to the cloud. Running everything on-premises, from central finance to POS systems, meant that The Home Depot's IT teams experienced redundancy and repetitive, manual processes. Their data warehouse needed an upgrade to process and analyze growing and increasingly diverse data sets. [The Home Depot chose to migrate its SAP environment to Google Cloud](#) to support the speed, scale and flexibility needed for the business as well as critical analytics capabilities needed for its bold digital initiatives.

"We chose Google Cloud to support our SAP implementation," explains Sam Moses, Vice President of Corporate Systems. "Our decision had a lot to do with the relationship between Google Cloud and SAP and also for the applications and services that are offered by Google Cloud, like BigQuery, which are helping to enable data and analytics within our organization."

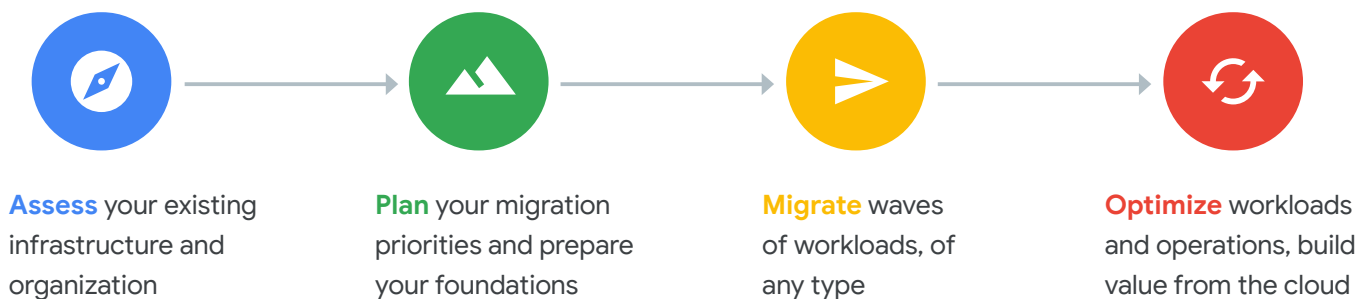
In this white paper, we'll dive deep into the four-stage migration process. We'll explain in detail the steps that the Google Cloud Professional Services Organization (PSO) team and The Home Depot project team took to execute the migration with minimal disruption, and how your organization can take similar steps. We'll also address lessons learned that can help your company consider and prepare for its own cloud migration.

ASSESS: Perform a cloud discovery and application assessment

A cloud migration involves significant changes within the organization, spanning people, process and technology. To begin the migration journey, cloud discovery was done in collaboration with Google Cloud PSO and The Home Depot Project team to identify hardware and SAP applications running in The Home Depot's data center that are qualified to migrate their workloads to Google Cloud quickly and with minimal effort. We defined requirements, dependencies, and other integration components for systems running in The Home Depot's data center, considering the following factors:

- Whether an application has dependencies and integrates with other applications
- How critical the application is for the business
- How difficult the applications are to migrate, does it require any upgrade or whether we can quickly perform a lift and shift of the workload

4 stages of cloud migration



PLAN: Lay a foundation and establish priorities

Next, we created a full migration plan to move systems from the on-premises data center to Google Cloud. Developing a migration plan prevents issues during the migration and ensures that production go-live proceeds smoothly. Items we addressed in the migration plan included SAP workload priorities, timelines, functional and application testing, volume testing milestones, and resources and project costs.

This step assesses your on-premises environments and generates detailed insights into your applications, using [GCP automation methods](#) to deploy SAP HANA and the appropriate Google Cloud application resources.

Setting a Google Cloud foundation

Establishing the [Google Cloud foundation](#) is the most important set of steps required to plan for a migration. Doing so helps enterprises create the basic cloud infrastructure to support SAP workloads and plan how that infrastructure supports SAP applications. This planning allows companies to create cloud projects, which form the basis for enabling and using all Google Cloud services—for instance, configuring a Virtual Private Cloud (VPC) within Google Cloud and consuming Google Cloud resources like Compute Engine, Storage, Network, Storage Bucket, and Kubernetes, among others.

The Google Cloud team worked with The Home Depot to establish a Google Cloud Foundation that addressed the following areas:

- ➔ **Identity management.** Before deploying any resources on Google Cloud, The Home Depot needed Google Cloud identity and [IAM roles and permissions](#) to activate Compute Engine and Storage resources. Learn more [here](#).
- ➔ **Compute Engine.** We ensured that [Compute Engine](#) capacity (6 TB or 12 TB) was available in the region of our Google Cloud project to meet The Home Depot's business requirements, which in turn were based on the sizing requirement for the company's SAP workloads. (SAP S/4HANA is currently deployed on Google Cloud using a Compute Engine of 12 TB (m2-ultramem-416) capacity. Learn more [here](#).) High memory optimized machines are available in specific zones as a predefined machine type. [Learn more](#) about regions and zones.
- ➔ **Resource management.** Through [Resource Manager](#), Google Cloud platform provides companies with resources such as [organizations](#), [folders](#) and the ability to manage [projects in folders](#), which allow you to group and organize other Google Cloud resources hierarchically. Some of the features of Resource Manager include asset inventory, [organization policies](#), [the ability to create Google Cloud projects](#), [cloud IAM policies](#), cloud folders, and access to Resource Manager through the Google Cloud Console or API access, Cloud Folders.



Establishing the Google Cloud foundation is the most important set of steps required to plan for a migration.

- ➔ **Identity and access management (IAM).** The [IAM policies](#) define access controls for Google resources running on Google Cloud. Within any organization, including The Home Depot, groups and roles require different levels of access to diverse resources. Google Cloud best practice is to provision the minimum required access to individual groups based on their roles and responsibilities. [Learn more](#) about IAM.
- ➔ **Networking.** To provide connectivity from an on-premises data center to a Google Cloud project, Google Cloud provides a number of [networking services and technologies](#). For SAP deployments, these include [Hybrid Connectivity](#), [Network Connectivity Center](#), [Virtual Private Cloud \(VPC\)](#), [Cloud DNS](#), [Service Directory](#), and [Cloud Load Balancing](#).
- ➔ **Firewall ports.** We assisted The Home Depot in creating and opening firewall rules to allow communication between VM on Google Cloud, the on-premises data center, and their SAP applications that will run on Google Cloud. To learn more, explore [SAP TCP/IP ports for all applications](#).
- ➔ **Stackdriver.** We set up [Stackdriver](#), a monitoring tool that collects operating data from Google Cloud resources. Stackdriver monitors [metrics](#), events, and metadata to perform [system monitoring](#), [system health checks](#), [uptime checks](#), and [system alerts](#) on Compute Engine, network usage, storage, and other Google Cloud components.
- ➔ **Cloud monitoring.** We deployed the [stackdriver agent](#) as part of the installation for HANA systems and the SAP Netweaver application. The agent collects required metrics from the VMs, which can be viewed in a dashboard.

- ➔ **Infrastructure as a Code.** To deploy SAP HANA or the SAP Netweaver application, we followed Google Cloud best practice and took advantage of our automation templates. Learn more about using [Google Cloud Deployment Manager](#) or [SAP Terraform on Google Cloud](#).

Note: Before kicking off the migration project, make sure you have defined the full-scale deployment architecture, including all the integration points and the firewall ports needed for communication between other SAP systems, on-prem systems, third-party systems/services, load balancers, backup and restore methods, and your HA/DR plan and procedures.

Creating a Cloud Center of Excellence

For any migration to be successful, it's critical to involve business stakeholders in developing the migration plan to facilitate a fast move with minimal disruption. Google Cloud best practice recommends that companies create a Cloud Center of Excellence to bring together stakeholders from across the organization who stand to benefit from operating in the cloud. With broad involvement in and support for the migration, you can ensure that the project meets your company's organization goals.



Engaging a cloud migration partner

For organizations that have put off moving to the cloud, one of the barriers is often the perceived risk—particularly the risk of disruption in planning and executing a migration. To minimize risk, Google Cloud recommends engaging a Google Cloud service partner that will augment your team’s cloud skill set and work with you to plan and execute the entire project. [Explore](#) Google Cloud service partners.

MIGRATE: Determine the migration strategy for SAP applications to Google Cloud

During this phase, we prepared to deploy and migrate resources to Google Cloud. This includes sizing and defining the [VM size](#) (SAP HANA Workload), [zone](#), [region](#), and [storage](#) for the SAP workloads that will be running on Google Cloud.

The migration was an opportunity for members of The Home Depot IT team to develop new cloud skills and redefine their roles for operating in the cloud. Working with their team, we aligned their staff resources to build necessary skills—including [Google Cloud fundamentals](#), [infrastructure modernization](#), [hybrid and multi-cloud](#) (Anthos and GKE), [smart analytics and data management](#), and [network and security](#)—and provide organization standards, expertise, and Google Cloud best practice methods.

Performing proper sizing of VM instances

For a lift-and-shift migration, it’s necessary to identify the closest size Compute Engine on Google Cloud and compare the size to your on-premises machine. We performed an [SAP quick-sizing](#) exercise to identify [SAP-certified HANA](#) VMs and [SAP application](#) servers that are required for each environment. [Learn more](#) about different types of VMs which are certified to run SAP Workload on Google Cloud.

Note: *If your source server is running on a different database, you can also carry out sizing exercises and size the VMs based on SAP’s number of application servers, and by running a HANA sizing report on the source for HANA DB. [Learn more](#) about sizing.*

Being a Warehouse solution, SAP Business Warehouse (BW) has a lot of integration connectivity between on-prem and BW applications on Google Cloud and relies extensively on data between on-prem source systems. Consider deploying VMs in the Google Cloud region closest to your on-premises data center to get the lowest possible network latency. [Learn more](#) about best performance recommendations from Google Cloud.



For organizations that have put off moving to the cloud, one of the barriers is often the perceived risk.



Selecting a migration strategy

Organizations can take three different approaches to migrating their SAP systems: lift and shift, a greenfield implementation, or a brownfield implementation. To decide the most appropriate migration approach for The Home Depot, we defined a strategy based on the company’s migration triggers, business goals, and SAP workload priorities, focusing first on modernizing SAP systems that were critical to business workloads and that will see continued investment. Below is a breakdown of which migration approaches we chose for which SAP systems, and the specific considerations for each.

Lift and shift

We performed a lift-and-shift migration of The Home Depot’s SAP BW system. Previously, the on-premises SAP BW application was running SAP HANA DB on Bare Metal servers for more than six years before reaching the end of life for support. In addition, we migrated an archiving server running on IQ NLS 16.1 to Google Cloud along with BW.

SAP Application	SAP version	DB Version	OS version	Dependencies
SAP BW (ABAP)	NW 7.50	HANA 20-SP05	SLES15 SP1	NA
SAP BI Java	NW 7.50	HANA 20-SP05	SLES15 SP1	SAP BW
SAP IQ	NA	IQ Database - 16.1	RHEL 7.9	SAP BW
SAP BPC	10.1	HANA 20-SP05	SLES15 SP1	SAP BW

Greenfield

We performed a greenfield implementation of SAP S/4HANA to run The Home Depot’s SAP-based [SAP Financials](#) (including Finance Accounting, Sales Audit, and Central Finance), systems on Google Cloud. S/4HANA running on Google Cloud offers the power to support these large-scale core enterprise systems; map all proprietary business scenarios, business processes, and business functions; handle 2,000+ active users; and integrate with non-SAP systems.

SAP Application	SAP version	DB Version	OS version	Dependencies
SAP S/4HANA	SAP S/41809	HANA 20-SP05	SLES 15.0 SP01	NA
SAP S/4 Application	SAP S/41809	NA	RHEL 7.9	NA
SAP CAR	NW 7.52	HANA 20-SP05	SLES 15.0 SP01	NA
SAP SLT	NW 7.50	HANA 20-SP05	SLES 15.0 SP01	NA
SAP PI	NW 7.50	HANA 20-SP05	SLES 15.0 SP01	NA



Brownfield

We performed a brownfield implementation for The Home Depot’s SAP Supply Chain Management (SCM) system, which the company relies on for sales forecasting and inventory replenishment to meet customer demand. Using the SAP SWPM tool, we migrated the SCM system from a Mainframe system running at The Home Depot’s data center to Google Cloud.

SAP Application	SAP version	DB Version	OS version	Dependencies
SAP SCM	NW 7.50	HANA 20-SP03	SLES 15.0 SP01	NA

Creating a high-level migration strategy for SAP workloads

Any organization developing a migration strategy faces many decisions, as the Google Cloud and Home Depot teams did—the most significant being which migration approach to take for each application and system. The following tables will help you consider your choices in light of your organization’s priorities and risk profile, and the dependencies of other applications that integrate with your SAP systems.

Replace	Refactor	Replatform	Rehost
Deploy the SAP application on Google Cloud and migrate data from the on-premises data center.	Split, merge, and harmonize source system data into a new target VM deployed on Google Cloud.	Migrate the application running on different software and hardware, complete technical migration of applications of OS/DB.	Move as-is from the current environment to Google Cloud—also known as lift and shift.
<ul style="list-style-type: none"> • Highest level of time and effort required • Risk of business disruption • High cost • High degree of testing required • Highest innovation 	<ul style="list-style-type: none"> • Highest level of time and effort required • Risk of business disruption • High cost • High degree of testing required 	<ul style="list-style-type: none"> • Highest level of time and effort required • Risk of business disruption • High cost • High degree of testing required 	<ul style="list-style-type: none"> • Lowest time and effort required • Easy to migrate • Lowest cost to migrate • Low risk • Some innovation



The most significant decision is which migration approach to take for each application and system.

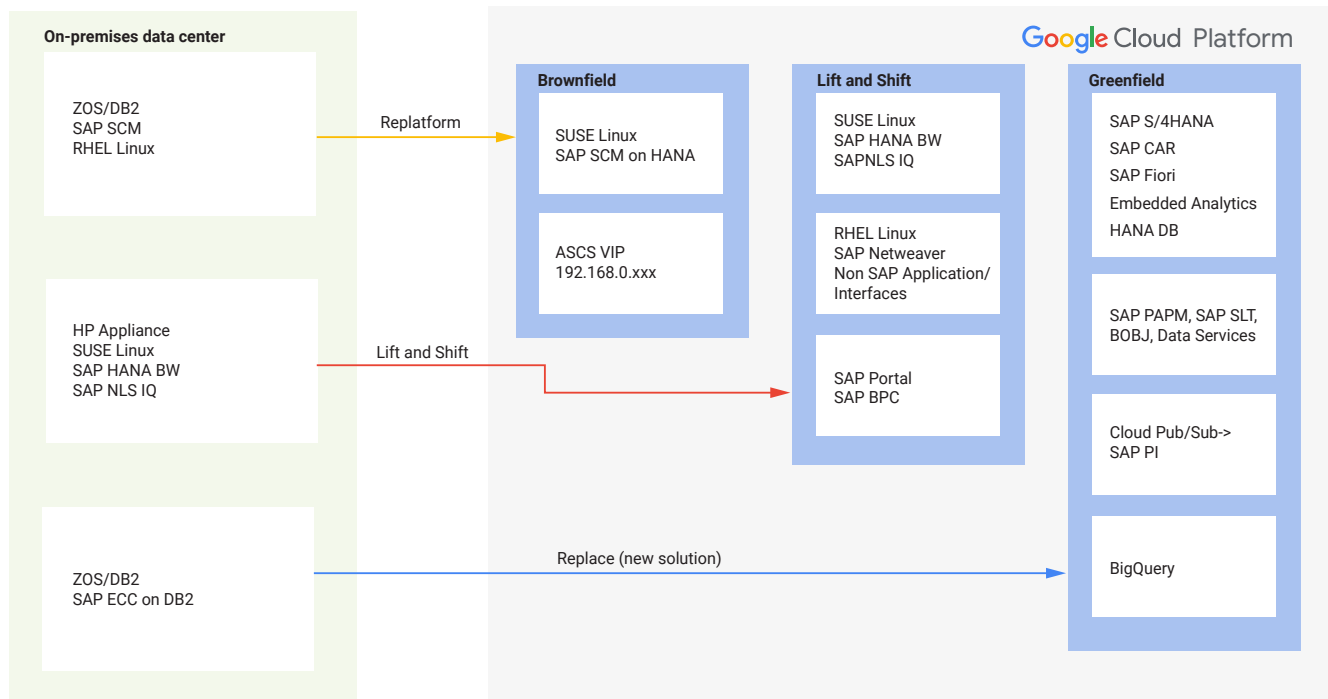


Timelines by migration approach

Migration Tasks	Rehost	Replatform	Refactor	Replace
HANA Database and OS upgrades	NA	NA		
Migration time	<5 months	<6 months	9–12+ months	9–12+ months
Infrastructure testing	Required	Required	Required	Required
Regression testing	Required	Must	Required	Required
Volume testing	Must	Must	Must	Must
Functional testing	Must	Must	Required	Required
Integration test	Must	Must	Required	Required
Business downtime	<16 hours	<24 hours	<40 hours	<12–20 hours

Paths chosen to migrate critical SAP landscapes to Google Cloud

SAP Cloud journey and path





Resource requirements by migration approach

Migration Type / Approach	Downtime	Effort	Comments / Overview
Lift and Shift via SAP DMO (Source and Target VM is identical)	~40+ hours	\$\$\$	<ul style="list-style-type: none"> SAP DMO team, requires functional team and application team
SAP Backup and Restore (Source and Target VM may not be identical, Database and Operating System are same, but on different hardware)	~12-18 hours	\$\$	<ul style="list-style-type: none"> HANA Studio / command line backup from source system, restore on target system AnyDB using third-party tooling / supported DB tooling
Homogeneous Migration (Source and Target Database and Operating System are same, but on different hardware)	~15 hours	\$	<ul style="list-style-type: none"> AnyDB to AnyDB (same version), using SWPM HANA DB to HANA DB (same version), using database replication System Copy for ABAP and JAVA, using SWPM
Heterogeneous Migration (Source and Target Database and Operating System are different, and on different hardware)	~10 hours	\$\$\$	<ul style="list-style-type: none"> AnyDB to HANA DB on GC using DMO (plus other tasks, like ABAP remediation, etc.) Any DB to another AnyDB (e.g. Oracle to SQL Server) OS Migration (IBM AIX, HP-UX to SLES or RHEL)

OPTIMIZE: Manage and secure SAP workloads on Google Cloud

After workloads have been migrated to Google Cloud, it is important to ensure you manage them. We worked with The Home Depot to prepare different teams that need to be actively involved in monitoring and securing SAP workloads on Google Cloud. Google Cloud tools used include [Stackdriver monitoring](#) for [Infrastructure, third-party applications](#), and solution manager for monitoring business processes and setting up alerting policies for security and governance.

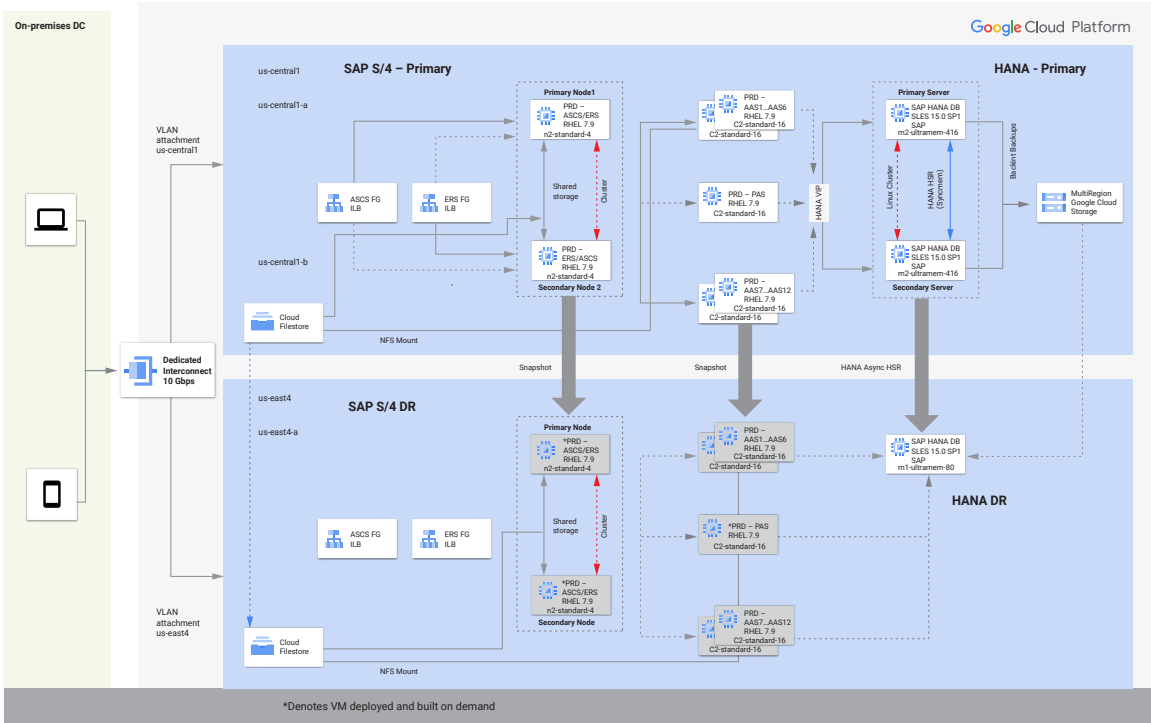
Planning for high availability and disaster recovery

High availability (HA) and disaster recovery (DR) are a set of techniques, engineering practices, and design principles to enable business continuity. The SAP S/4 architecture is designed to eliminate single points of failure and provide the ability to rapidly resume operations after a system outage or any hardware or application failure. Here, we demonstrate the S/4HANA and BW HANA scale out reference architectures we employed and explain how we planned for both HA and DR for The Home Depot’s SAP systems on Google Cloud.



SAP S/4HANA - Reference architecture

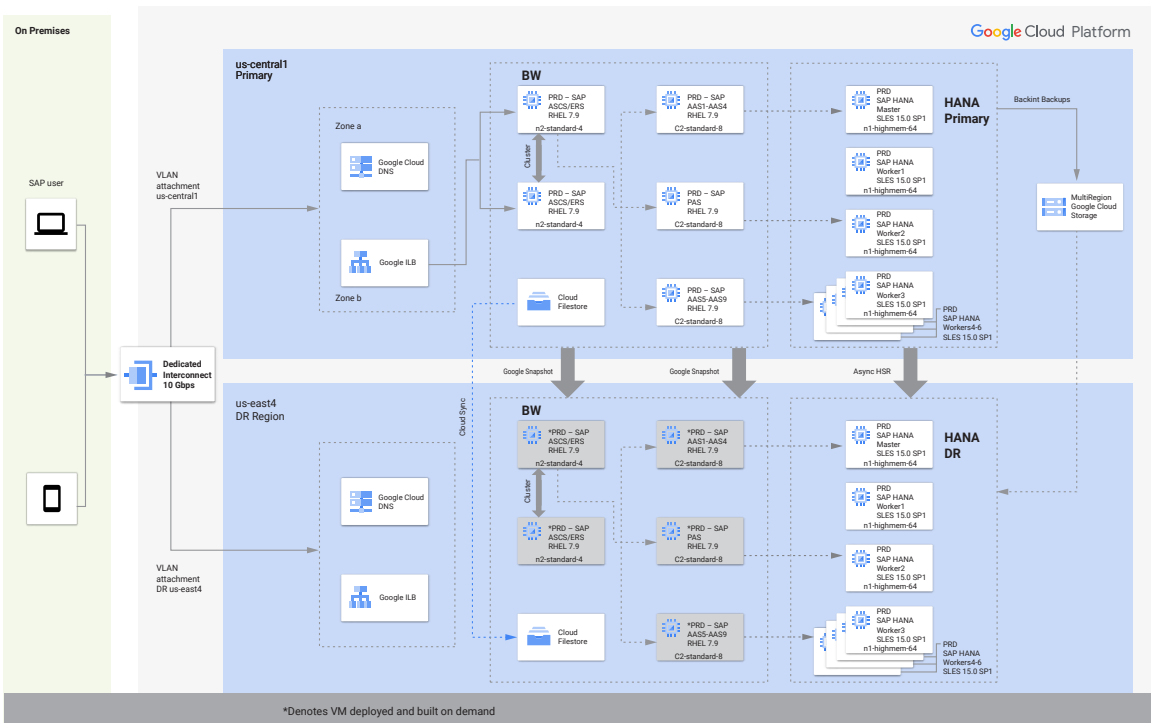
SAP S/4 Solution Architecture



BW HANA scale out - Reference architecture


We deployed the SAP BW HANA scale out deployment with one master and six worker nodes in primary region us-central1 and DR Region us-east4.

SAP BW HANA scale out - Architecture

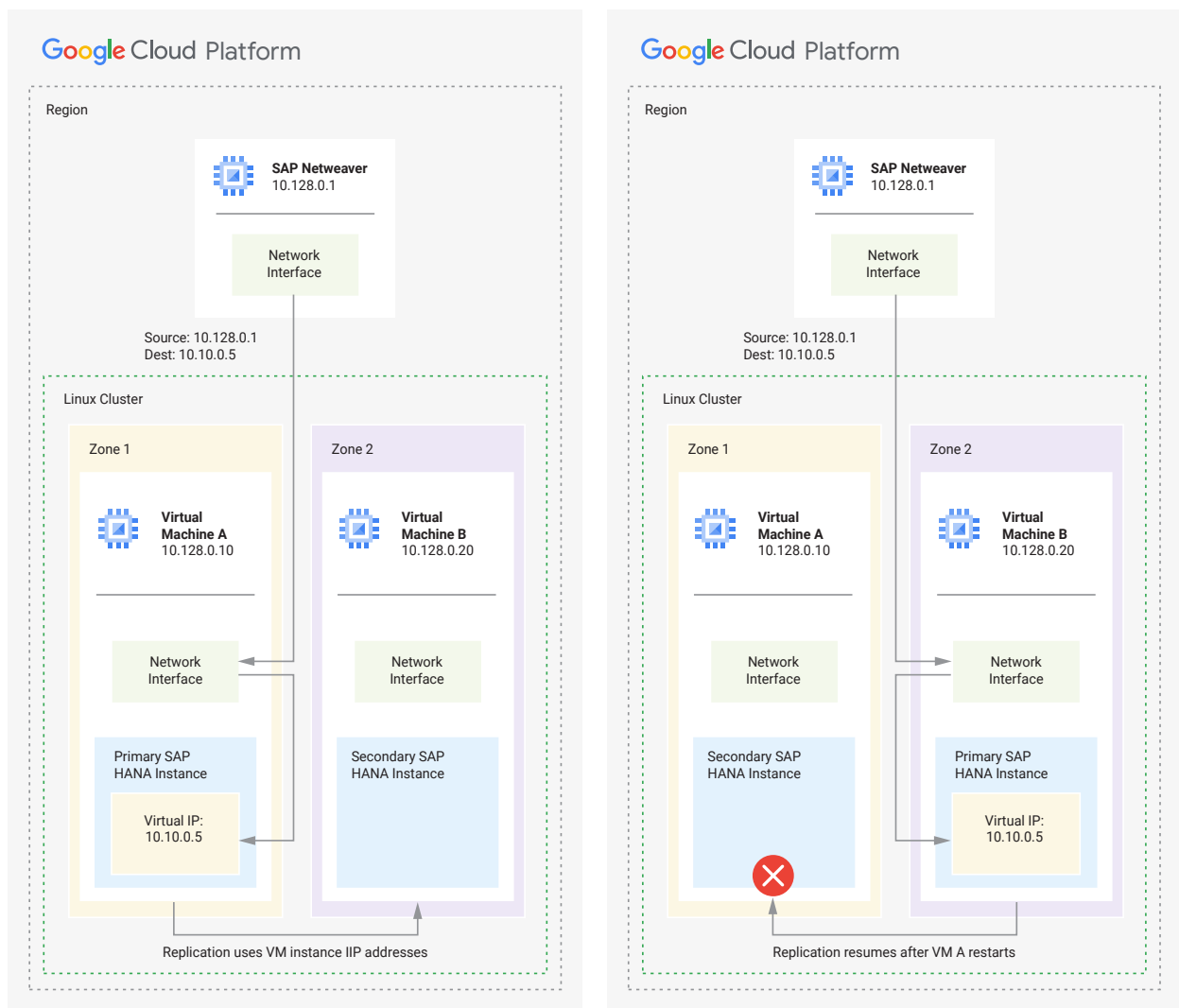


Designing high availability on Google Cloud

High availability is critical for a global, high-volume, cross-channel retailer like The Home Depot—and was therefore a critical design for the company’s SAP deployment on Google Cloud. Designing HA helps to protect against possible downtime due to zonal outages in the region, hardware failures, and maintenance operations.

 **Database high availability**

Database high availability can be achieved through database native tools. This is the most highly recommended approach to configure high availability for all databases. The following sections cover HA setup for SAP HANA. Find information in the [SAP HANA HA Scale Up Deployment Guide](#).





➔ **SAP application high availability**

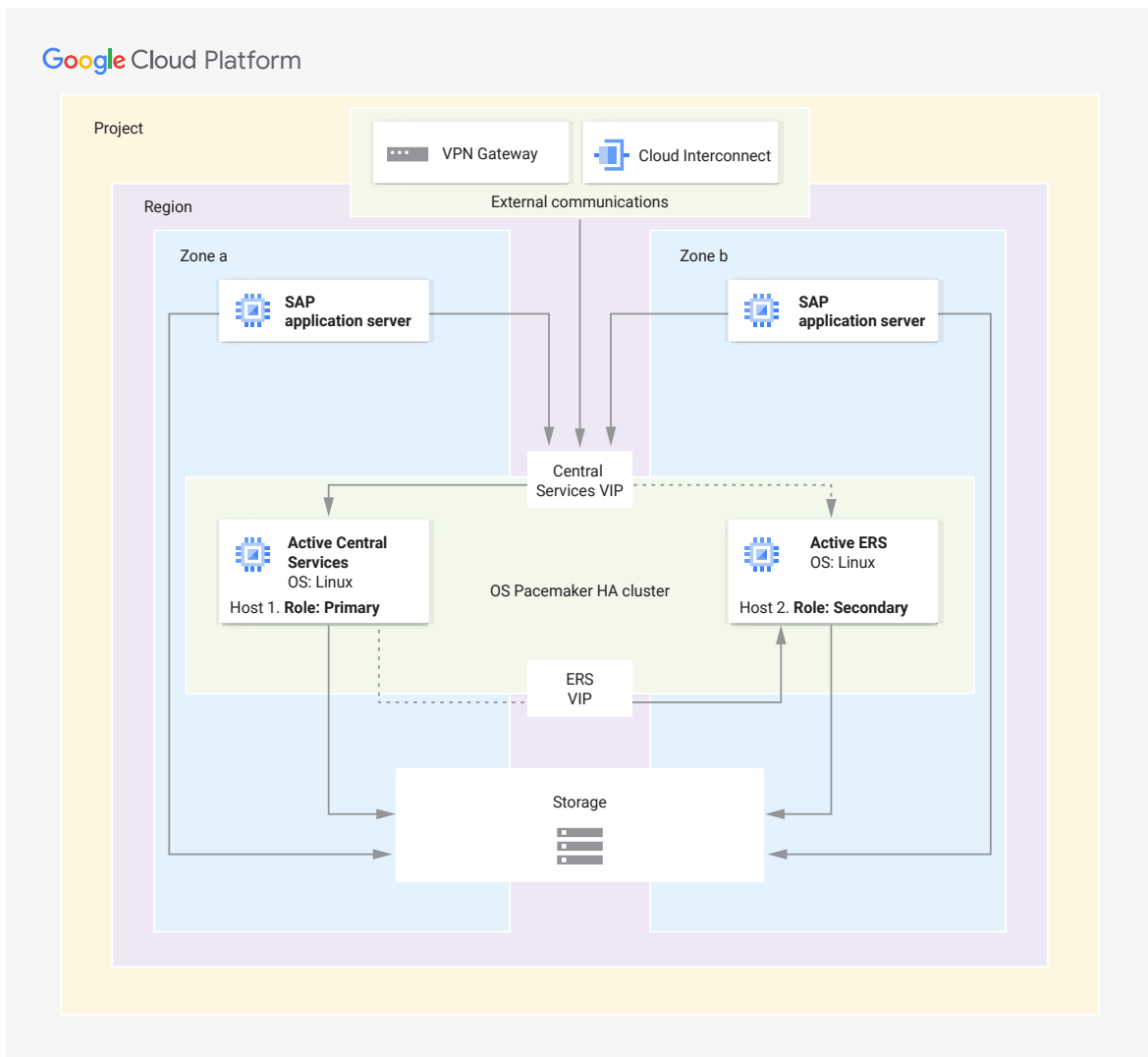
Google Compute Engine (GCE) provides public images for Linux and Windows operating systems, which can be used to provision Compute Engine instances that need to be configured for high availability of SAP systems.

Single points of failure (SPOF) in the context of SAP applications can be defined as a component or service whose failure or unavailability can cause the whole SAP system to come to a halt. To ensure a stable SAP application, it is necessary to protect any potential single points of failure.

The diagram below demonstrates the SPOF components of a SAP NetWeaver application:

- ABAP SAP Central Services (ASCS)
- [Enqueue Replication Server \(ERS\)](#)
- Shared File Storage: [NetApp](#), or [GCFS](#)

[Learn more](#) about SAP Application HA.





Designing disaster recovery on Google Cloud

In case of power outages, floods, or other disaster scenarios, a disaster recovery setup provides protection against organizational data loss. Disaster recovery for an SAP deployment can be set up using one of the following methods.

DR method	Recovery Point Objective	Recovery Time Objective	Cost of GC infrastructure
Backup and Restore	Low	High	Low
HANA SR using Async replication with data preload (Standby Server)	Low	Medium	Medium
HANA SR using Async replication without preload (Standby Server +Dev/QA)	Low	High	High

[Learn more](#) about DR for SAP on Google Cloud.

Designing backup and restore

Backups are vital for protecting your database. Because SAP HANA is an in-memory database, you should create regular backups so you can recover from instances of data corruption. SAP HANA provides native backup and recovery features to help you do this. You can use Google Cloud services such as Cloud Storage to serve as the backup destination for SAP HANA backup.

Backup and recovery can be performed using the following methods on Google Cloud:

- a. Backup and recovery using GC Native tools ([Google PD Snapshot](#), Image)
- b. Backup and recovery using Database Native tools
- c. Backup and recovery using [Cloud storage BACKINT](#) (i.e., directly to Google Cloud Storage).
Learn more [here](#).

Storage and server backup

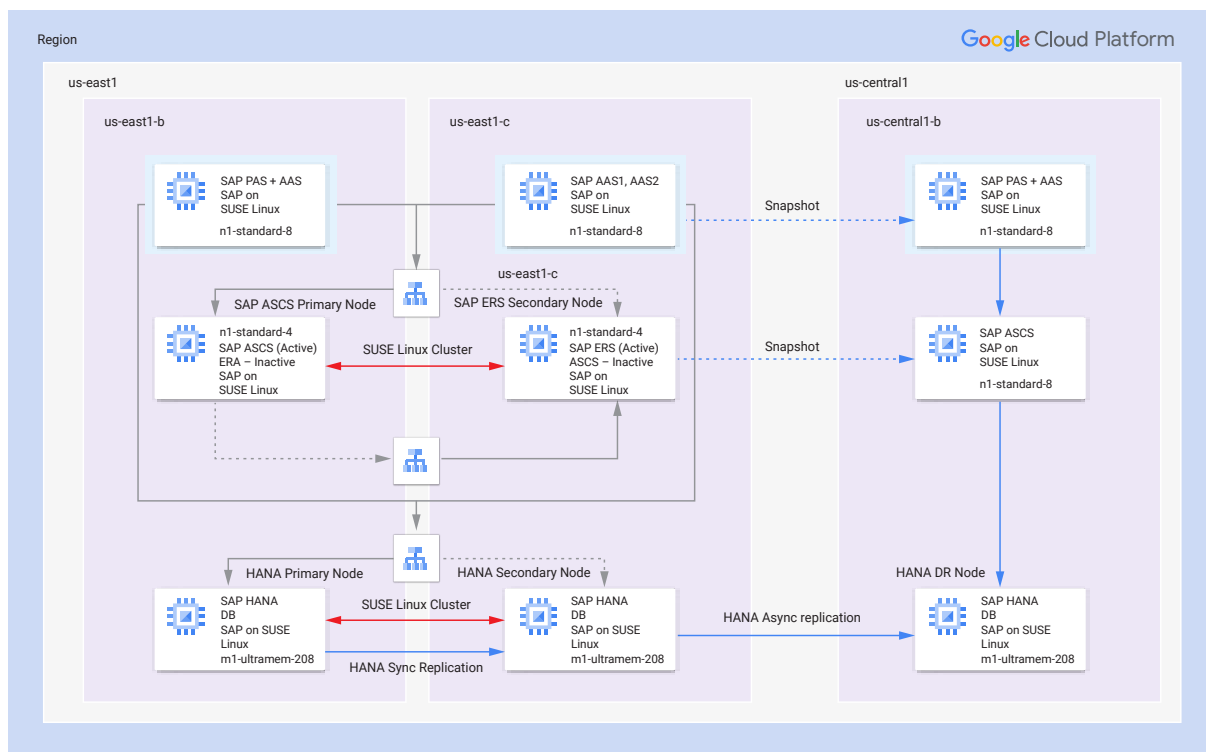
SAP component/layer	Primary storage options	Secondary storage options (backup locations)
Boot Disk and Application Libraries	Persistent Disk	Persistent Disk Snapshots
SAP Database (HANA, ASE, MaxDB, ASE, MS SQL)	Persistent Disk	Persistent Disk snapshots
SAP Netweaver Application (ASCS, ERS and Apps Server)	Persistent Disk , NetApp(Cloud Volumes) , Elastifile	Filestore , Cloud Storage Buckets, Persistent Disk snapshots

SAP solution architecture for HA and DR

You can use a combination of Google Cloud and SAP features in the design to provide high availability for SAP HANA and SAP applications that can handle failures at both the infrastructure or software levels.

Google Cloud features that are used to provide high availability include [Compute Engine Live Migration](#), [Compute Engine Auto-Restart](#), [SAP HANA Service Auto-Restart](#), [SAP HANA Backups](#), [SAP HANA System Replication](#), and [SAP HANA Host Auto-Failover](#).

SAP solution architecture provides automatic failover for SAP HANA and SAP applications



Assessing the migration: Insights and lessons learned

Throughout the migration process, the Google Cloud PSO and Home Depot project teams continually assessed our progress to revisit key strategies, identify wins, and glean learnings—for both of our teams, and for any company embarking on a cloud migration for their SAP systems.

Lift and shift

- [Database backup/restore](#) - SAP ABAP and Netweaver Application
- For JAVA SAP Application - Standard SWPM tool used [Export/Import](#).
- SAP IQ application - [Database Backup/restore](#) method.
- When deploying SAP workloads, Google Cloud recommends using automation templates. To learn more, refer to the [SAP HANA deployment guide](#).

Performance improvements

After the migration, the Google Cloud and Home Depot teams performed a full SAP volume performance test to compare the on-premises environment with the new Google Cloud environment. The results showed a 90% performance improvement in critical SAP transactions on Google Cloud Network latency for BW extraction jobs (ECC to BW) at < 0.700 msec.

Technical issues

During the migration process, we exported a 4.5 TB database from The Home Depot's on-premises data center to Google Cloud. When undertaking a database export/import, consider using [gsutil](#) to optimize performance when uploading large files. This could have shortened the time required to less than <5 hours using a dedicated interconnect.

Migration duration

It took less than five months to migrate six SAP landscapes to Google Cloud—SAP production and non-production systems. This can be attributed to proper planning, testing, and optimization.

High availability and DR

A high availability solution initially was implemented using [alias based solution](#). However, due to a few issues reported on failover, Google recommended migrating using a [Google ILB-based solution](#) for HANA database and SAP applications. Since the ILB implementation, the system has been stable.

Network security and governance

A proper DNS table should be maintained in a centralized repository. Google Cloud recommends using [Google Cloud DNS](#).

It's essential to ensure that [network firewalls](#) are defined correctly to allow communication between servers within the Google Cloud project, and that the [firewall rules and policies](#) in place allow communication between on-premises systems and Google Cloud. Consider applying firewall rules for the application to communicate with third-party vendors and SAP systems over the internet.

To fortify system security, [Google Cloud Armor](#) was used to protect against DDoS and WAF at Google Cloud.

Forge ahead with a seamless cloud migration

It's no longer a question of if it makes sense to migrate your SAP systems to the cloud, but rather when. But concerns about the risks of business disruption have kept many organizations from achieving the cloud's many performance benefits. The Home Depot has demonstrated how it's possible to get cloud migration done quickly and with minimal business disruption when you team up with the right partner.

[Watch](#) Sam Moses, VP of Corporate Systems at The Home Depot, discuss the company's migration experience. And learn how your company can unlock all the value of SAP on Google Cloud—[start your exploration now](#).

References and documents:

Configure ASCS/ERS HA on RHEL 7.6 - [SAP Netweaver HA on RHEL](#)

Configuration of Cluster pacemaker and Corosync - [Cluster Configuration on RHEL](#)

Configuration HANA HA on RHEL 7.6 - [SAP HANAHA Auto failover on RHEL](#)

RHEL Certification on GCP - [SAP Certification on GCP](#)

