This guide provides an overview of how SAP MaxDB works on Google Cloud, and provides details that you can use when planning the implementation of a new SAP MaxDB system.

For details about how to deploy SAP MaxDB on Google Cloud, see:

- SAP MaxDB Deployment Guide for Linux (/solutions/sap/docs/sap-maxdb-deployment-linux)
- SAP MaxDB Deployment Guide for Windows (/solutions/sap/docs/sap-maxdb-deployment-windows)

For information from SAP about SAP MaxDB, see:

- The SAP MaxDB Library (https://help.sap.com/viewer/9d62a6d2a95149718db6b65b7ffa2052/113/en-US)

GCP consists of many cloud-based services and products. When running SAP products on GCP, you mainly use the IaaS-based services offered through Compute Engine (/compute/docs/) and Cloud Storage (/storage/docs/), as well as some platform-wide features, such as tools (/docs/overview/developer-and-admin-tools).

See the GCP platform overview (/docs/overview/) for important concepts and terminology. This guide duplicates some information from the overview for convenience and context.

For an overview of considerations that enterprise-scale organizations should take into account when running on GCP, see best practices for enterprise organizations (/docs/enterprise/best-practices-for-enterprise-organizations).

GCP offers three main ways to interact with the platform, and your resources, in the cloud:

- The Google Cloud Console, which is a web-based user interface.
- The `gcloud` command-line tool, which provides a superset of the functionality that Cloud Console offers.
- Client libraries (/sdk/cloud-client-libraries), which provide APIs for accessing services and management of resources. Client libraries are useful when building your own tools.

tant: If you are using the **`gcloud`** command-line tool, always make sure that you are using the latest version of the G
o install the latest version of the GCP SDK, see the gcloud install instructions. (https://cloud.google.com/sdk/downl

SAP deployments typically utilize some or all of the following GCP services:

Service	Description
VPC Networking (/compute/docs/networking)	Connects your VM instances to each other and to the Internet. Each instance is a member of either a legacy network with a single global IP range, or a recommended subnet network, where the instance is a member of a single subnetwork that is a member of a larger network. Note that a network cannot span GCP projects, but a GCP project can have multiple networks.
Compute Engine (/compute/)	Creates and manages VMs with your choice of operating system and software stack.
Persistent disks (/compute/docs/disks/)	Persistent disks are available as either standard hard disk drives (HDD) or solid-state drives (SSD).
Google Cloud Console (https://console.cloud.google.com/)	Browser-based tool for managing Compute Engine resources. Use a template to describe all of the Compute Engine resources and instances you need. You don't have to individually create and configure the resources or figure out dependencies, because the Cloud Console does that for you.
Cloud Storage (/storage/)	You can back up your SAP database backups into Cloud Storage for added durability and reliability, with replication.
Stackdriver Monitoring (/monitoring/)	Provides visibility into the deployment, performance, uptime, and health of Compute Engine, network, and persistent disks. Stackdriver collects metrics, events, and metadata from GCP and uses these to generate insights through dashboards, charts, and alerts. You can monitor the compute metrics at no cost through Stackdriver Monitoring.
Cloud IAM (/iam/docs/)	Provides unified control over permissions for GCP resources. Control who can perform control-plane operations on your VMs, including creating, modifying, and deleting VMs and persistent disks, and creating and modifying networks.

You can use the pricing calculator (/products/calculator/) to estimate your usage costs. For more pricing information, see Compute Engine pricing (/compute/pricing), Cloud Storage pricing (/storage/pricing), and Stackdriver pricing (/stackdriver/pricing_v2).

GCP resources are subject to quotas. If you plan to use high-CPU or high-memory machines, you might need to request additional quota. For more information, see Compute Engine resource quotas. (/compute/quotas)

A basic single-node SAP MaxDB installation on Google Cloud comprises the following components:

- One Compute Engine VM running your SAP MaxDB database.
- Three or four attached persistent disk drives:

Drive contents	Linux	Windows
Root directory of the database instance	`/sapdb/[DBSID]`	`MaxDB (D:)`
Database data files	`/sapdb/[DBSID]/sapdata`	`MaxDB Data (E:)`
Database transaction logs	`/sapdb/[DBSID]/saplog`	`MaxDB Log (L:)`
Database backups (optional)	`/maxdbbackup`	`Backup (X:)`

Optionally, you can expand your installation to include the following as well:

- NetWeaver directories, including:
  - `/usr/sap` on Linux or `SAP (S:)` on Windows
  - `/sapmnt` on Linux or `Pagefile (P:)` on Windows
- A NAT gateway. A NAT gateway allows you to provide internet connectivity for your VMs while denying direct internet connectivity to those VMs. You could also configure this VM as a bastion host that allows you to establish SSH connections to the other VMs on your private subnet. See NAT gateways and bastion hosts (#nat_gateways_and_bastion_hosts) for more information.

Different use cases might require additional devices or databases. For more information, see the MaxDB documentation in the SAP Help Portal (https://help.sap.com/viewer/p/SAP_MAXDB).

You might be able to achieve a sustained use discount (/compute/docs/sustained-use-discounts) of up to 30% for yo
ute Engine instances. Use the pricing calculator (/pricing/calculator) to help you estimate your actual costs.

In many ways, running SAP MaxDB on Google Cloud is similar to running it in your own data center. You still need to think about computing resources, storage, and networking considerations. For more information, see 2456432 - SAP Applications on Google Cloud Platform: Supported Products and Google VM types (https://launchpad.support.sap.com/#/notes/2456432).

SAP MaxDB is certified to run on all Compute Engine machine types, including custom types. However, if you run MaxDB on the same VM as SAP NetWeaver or Application Server Central Services (ASCS), you must use a VM that is supported by SAP NetWeaver. For a list of the VMs that SAP NetWeaver supports, see the SAP NetWeaver Planning Guide (/solutions/sap/docs/netweaver-planning-guide#machine_types).

For information about all of the machine types available on Google Cloud and their use cases, see Machine Types (/compute/docs/machine-types) in the Compute Engine documentation.

The number of vCPUs you select for MaxDB depends on your application load and your performance objectives. You should allocate a minimum of two vCPUs to your SAP MaxDB installation. For the best performance, scale the number of vCPUs and the size of your persistent disks until your performance objectives are met. For more information from SAP about MaxDB, see the SAP Help Portal (https://help.sap.com/viewer/p/SAP_MAXDB).

The memory you allocate to your SAP MaxDB system is dependent on your use case. The optimal amount of memory for your use case depends on the complexity of the queries you're running, the size of your data, the amount of parallelism you're using, and the level of performance you're expecting.

For more information from SAP about MaxDB, see the SAP Help Portal (https://help.sap.com/viewer/p/SAP_MAXDB).

By default, each Compute Engine VM has a small root persistent disk (/compute/docs/disks/create-root-persistent-disks) that contains the operating system. You provision additional disks for your database data, logs, and, optionally, database backups.

For storage, Google Cloud provides standard HDD persistent disks and SSD persistent disks. The SSD disks provide higher performance. Use an SSD persistent disk for the MaxDB log volume. Depending on your performance objectives, consider using an SSD persistent disk for the MaxDB data volume as well.

The performance of your MaxDB database also depends on the size of the persistent disks and the number of vCPUs in the host machine. Scale the sizes of your log and data disks, as well as the number of your vCPUs, to meet the performance requirements of your application.

For a detailed overview of persistent disk performance benchmarks, see Optimizing Persistent Disk and Local SSD Performance (/compute/docs/disks/performance).

More information from SAP:

- SAP Note 869267 - FAQ: SAP MaxDB Log area (https://launchpad.support.sap.com/#/notes/869267).
- SAP Note 1173395 - FAQ: SAP MaxDB and liveCache configuration (https://launchpad.support.sap.com/#/notes/1173395).

For a high-level description of persistent disks, see Persistent disks (#persistent_disks) below.

SAP MaxDB version 7.9.09 and newer is certified by SAP for use on Google Cloud.

SAP also certifies the following versions of SAP liveCache and SAP Content Server on Google Cloud:

- SAP liveCache technology, at a minimum of SAP LC/LCAPPS 10.0 SP 39, including liveCache 7.9.09.09 and LCA-Build 39, released for EhP 4 for SAP SCM 7.0 and higher.
- SAP Content Server 6.50 on Windows using Internet Information Services 10 (IIS)
- SAP Content Server 6.50 on Linux using Apache Web Server 2.4.xx

For more information about supported versions of liveCache, see SAP Note 2074842 (https://launchpad.support.sap.com/#/notes/2074842).

For more information about the SAP products that are supported on Google Cloud, see 2456432 - SAP Applications on Google Cloud Platform: Supported Products and Google VM types (https://launchpad.support.sap.com/#/notes/2456432).

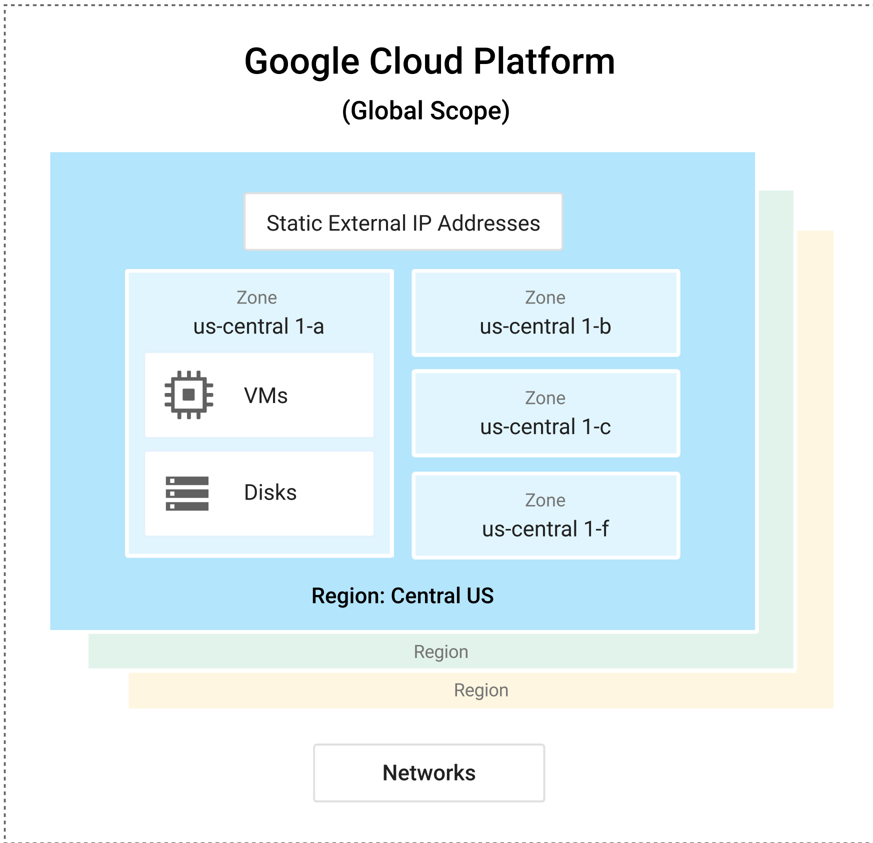
SAP has certified Google Cloud to run SAP MaxDB on the following SUSE Linux Enterprise Server (SLES), Red Hat Enterprise Linux (RHEL), and Windows Server operating system images:

- RHEL 7.4
- SLES 12 SP3
- Windows Server 2016

For more information about Compute Engine images, see Images (/compute/docs/images).

When you deploy a VM, you must choose a region and zone. A region is a specific geographical location where you can run your resources, and corresponds to a data center location. Each region has one or more zones.

Global resources, such as preconfigured disk images and disk snapshots, can be accessed across regions and zones. Regional resources, such as static external IP addresses, can be accessed only by resources that are in the same region. Zonal resources, such as VMs and disks, can be accessed only by resources that are located in the same zone.



When choosing regions and zones for your VMs, keep the following in mind:

- **The location of your users and your internal resources**, such as your data center or corporate network. To decrease latency, select a location that is in close proximity to your users and resources.
- **The location of your other SAP resources**. Your SAP application and your database must be in the same zone.

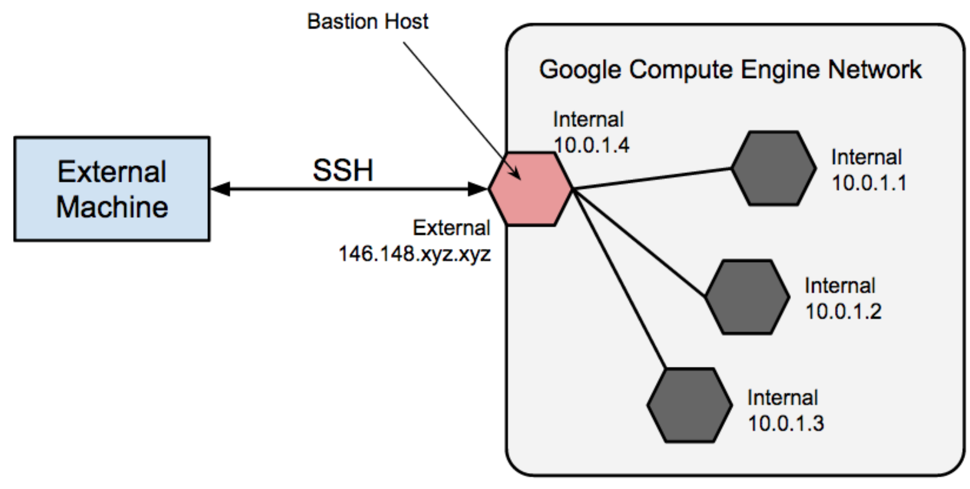
Persistent disks are durable storage devices that function similarly to the physical disks in a desktop or a server. Google manages the hardware behind these devices to ensure data redundancy and to optimize performance. Persistent disks are available as either standard hard disk drives (HDD) or solid-state drives (SSD). Standard HDD persistent disks are efficient and economical for handling sequential read-write operations, but are not optimized to handle high rates of random input-output operations per second (IOPS).

Persistent disks are located independently from your VMs, so you can detach or move persistent disks to keep your data, even after you delete your VMs. Persistent disk performance scales automatically with disk size, so you can resize your existing persistent disks or add more persistent disks to a VM to meet your performance and storage space requirements.

Google Cloud also offers local SSD (/compute/docs/disks/#localssds) disk drives. Although local SSDs can offer some advantages over persistent disks, don't use them as part of an SAP MaxDB system. VM instances with local SSDs attached cannot be stopped and then restarted.

If your security policy requires truly internal VMs, you need to set up a NAT proxy manually on your network and a corresponding route so that VMs can reach the internet. It is important to note that you cannot connect to a fully internal VM instance directly by using SSH. To connect to such internal machines, you must set up a bastion instance that has an external IP address and then tunnel through it. When VMs do not have external IP addresses, they can be reached only by other VMs on the network, or through a managed VPN gateway. You can provision VMs in your network to act as trusted relays for inbound connections, called bastion hosts, or network egress, called NAT gateways. For more transparent connectivity without setting up such connections, you can use a managed VPN gateway resource.

Bastion hosts (https://wikipedia.org/wiki/Bastion_host) provide an external facing point of entry into a network containing private-network VMs. This host can provide a single point of fortification or audit and can be started and stopped to enable or disable inbound SSH communication from the internet.



You can achieve SSH access to VMs that do not have an external IP address by first connecting to a bastion host. A complete hardening of a bastion host is outside the scope of this guide, but you can take some initial steps, including:

- Limit the CIDR range of source IPs that can communicate with the bastion.
- Configure firewall rules to allow SSH traffic to private VMs from only the bastion host.

By default, SSH on VMs is configured to use private keys for authentication. When using a bastion host, you log into the bastion host first, and then into your target private VM. Due to this two-step login, you should use SSH-agent forwarding to reach the target VM instead of storing the target VM's private key on the bastion host. You must do this even if you are using the same key-pair for both bastion and target VMs, as the bastion has direct access only to the public half of the key-pair.

When a VM does not have an assigned, external IP address, it cannot make direct connections to external services, including other Google Cloud services. To allow these VMs to reach services on the internet, you can set up and configure a NAT gateway (/compute/docs/vpc/special-configurations#natgateway). The NAT gateway is a VM that can route traffic on behalf of any other VM on the network. You should have one NAT gateway per network. Be aware that a single-VM NAT gateway should not be considered highly available, and cannot support high traffic throughput for multiple VMs. For instructions on how to set up a VM to act as a NAT gateway, see either the SAP MaxDB Deployment Guide for Linux (/solutions/sap/docs/sap-maxdb-deployment-linux#setting-up-a-nat-gateway) or the SAP MaxDB Deployment Guide for Windows (/solutions/sap/docs/sap-maxdb-deployment-windows#setting-up-a-nat-gateway).

After your system is up and running, you can create custom images (/compute/docs/images/create-delete-deprecate-private-images). You should create these images when you modify the state of your root persistent disk and want to be able to easily restore the new state. You should have a plan for how to manage the custom images you create. For more information, see Image Management Best Practices (/solutions/image-management-best-practices).

When planning security for an SAP deployment on Google Cloud, you must identify:

- The user accounts and applications that need access to the Google Cloud resources in your Google Cloud project
- The specific Google Cloud resources in your project that each user needs to access

You must add each user to your project by adding their Google account ID to the project as a member. For an application program that uses Google Cloud resources, you create a *service account*, which provides a user identity for the program within your project.

Compute Engine VMs have their own service account. Any programs that that run on a VM can use the VM service account, as long as the VM service account has the resource permissions that the program needs.

After you identify the Google Cloud resources that each user needs to use, you grant each user permission to use each resource by assigning resource-specific roles to the user. Review the predefined roles that Cloud IAM provides for each resource, and assign roles to each user that provide just enough permissions to complete the user's tasks or functions and no more.

If you need more granular or restrictive control over permissions than the predefined Cloud IAM roles provide, you can create custom roles.

For more information about the Cloud IAM roles that SAP programs need on Google Cloud, see Identity and access management for SAP programs on Google Cloud (/solutions/sap/docs/security-for-sap/iam-for-sap-programs).

For an overview of identity and access management for SAP on Google Cloud, see Identity and access management overview for SAP on Google Cloud (/solutions/sap/docs/security-for-sap/iam-for-sap).

Consider the information in the following sections when planning networking and security.

One of your first lines of defense is to restrict who can reach your network and your VMs by using firewalls (/compute/docs/vpc/firewalls). By default, all traffic to VMs, even from other VMs, is blocked by the firewall unless you create rules to allow access. The exception is the default network that is created automatically with each project and has default firewall rules (/compute/docs/networking#firewall_rules).

By creating firewall rules, you can restrict all traffic on a given set of ports to specific source IP addresses. You should follow the minimum privilege model to restrict access to the specific IP addresses, protocols, and ports that need access. For example, you should always set up a bastion host (/solutions/sap/docs/netweaver-planning-guide#bastion_hosts_nat) and allow SSH into your SAP NetWeaver system only from that host.

Understanding how access management works in Google Cloud is key to planning your implementation. You need to make decisions about:

- How to organize your resources in Google Cloud.
- Which team members can access and work with resources.
- Exactly which permissions each team member can have.
- Which services and applications need to use which service accounts, and what level of permissions to grant in each case.

tant: We strongly recommend that you follow the best practices for enterprise-grade access control provided in izational setup (/docs/enterprise/best-practices-for-enterprise-organizations#organizational_setup) and Identity ar s management (/docs/enterprise/best-practices-for-enterprise-organizations#identity-and-access-management) in ractices for Enterprise Organizations guide.

Start by understanding the Cloud Platform Resource Hierarchy (/resource-manager/docs/cloud-platform-resource-hierarchy#organizations). It's important that you understand what the various resource containers are, how they relate to each other, and where the access boundaries are created.

Cloud Identity and Access Management (Cloud IAM) provides unified control over permissions for Google Cloud resources. You can manage access control by defining who has what access to resources. For example, you can control who can perform control-plane operations on your SAP instances, such as creating and modifying VMs, persistent disks, and networking.

For more details about Cloud IAM, see the Overview of Cloud IAM (/iam/docs/overview).

For an overview of Cloud IAM in Compute Engine, see Access Control Options (/compute/docs/access/).

IAM roles are key to granting permissions to users. For a reference about roles and which permissions they provide, see Identity and Access Management Roles (/iam/docs/overview#roles).

Google Cloud's service accounts provide a way for you to give permissions to applications and services. It's important to understand how service accounts work in Compute Engine. For details, see Service Accounts (/compute/docs/access/service-accounts).

You can use a network to define a gateway IP and the network range for the VMs attached to that network. All Compute Engine networks use the IPv4 (http://tools.ietf.org/html/rfc791) protocol. Every Google Cloud project is provided with a default network with preset configurations and firewall rules, but you should add a custom subnetwork and firewall rules based on a minimum privilege model. By default, a newly created network has no firewall rules and hence no network access.

Depending on your requirements, you might want to add additional subnetworks to isolate parts of your network. For more information, see Subnetworks (/compute/docs/vpc/#vpc_networks_and_subnets).

The firewall rules apply to the entire network and all the VMs in the network. You can add a firewall rule that allows traffic between VMs in the same network and across subnetworks. You can also configure firewalls to apply to specific target VMs by using the tagging mechanism (/compute/docs/vpc/add-remove-network-tags).

Some SAP products, such as SAP NetWeaver, require access to certain ports. Be sure to add firewall rules to allow access to the ports outlined by SAP (https://help.sap.com/viewer/575a9f0e56f34c6e8138439eefc32b16/2.0/en-US/616a3c0b1cc748238de9c0341b15c63c.html)
.

Routes (/compute/docs/vpc/routes) are global resources attached to a single network. User-created routes apply to all VMs in a network. This means you can add a route that forwards traffic from VM to VM within the same network and across subnetworks without requiring external IP addresses.

For external access to internet resources, launch a VM with no external IP address and configure another virtual machine as a NAT gateway. This configuration requires you to add your NAT gateway as a route for your SAP instance. For more information, see NAT gateways and bastion hosts (#nat_gateways_and_bastion_hosts).

You can securely connect your existing network to Google Cloud through a VPN (https://wikipedia.org/wiki/Virtual_private_network) connection using IPsec (https://wikipedia.org/wiki/IPsec) by using Cloud VPN. Traffic traveling between the two networks is encrypted by one VPN gateway, then decrypted by the other VPN gateway. This protects your data as it travels over the internet. You can dynamically control which VMs can send traffic down the VPN using instance tags on routes (/compute/docs/vpc/using-routes#addingroute). Cloud VPN tunnels are billed at a static monthly rate plus standard egress charges. Note that connecting two networks in the same project still incurs standard egress charges. For more information, see Cloud VPN Overview (/vpn/docs/concepts/overview) and Creating a VPN (/vpn/docs/how-to/creating-vpns).

If you use Cloud Storage to host your backups for your data and log, make sure you use TLS (HTTPS) while sending data to Cloud Storage from your VMs to protect data in transit. Cloud Storage automatically encrypts data at rest. You can specify your own encryption keys if you have your own key-management system.

For security best practices, see Cloud Storage Security (/storage/docs/best-practices#security).

Refer to the following additional security resources for your SAP environment on Google Cloud:

- Securely Connecting to VM Instances (/solutions/connecting-securely)
- Security Center (/security/)
- Compliance in the Google Cloud (/security/compliance)
- Google Cloud security whitepaper (/security/whitepaper)
- Google Infrastructure security design (/security/security-design/resources/google_infrastructure_whitepaper_fa.pdf)

You must have a plan for how to restore your system to operating condition if the worst happens. For general guidance about how to plan for disaster recovery using Google Cloud, see:

- How to Design a Disaster Recovery Plan (/solutions/designing-a-disaster-recovery-plan)
- Disaster Recovery Cookbook (/solutions/disaster-recovery-cookbook)

This section provides information about licensing requirements.

Running SAP MaxDB on Google Cloud requires you to bring your own license (BYOL). For more information, see:

- SAP Note 2446441 - Linux on Google Cloud Platform (IaaS): Adaption of your SAP License (https://launchpad.support.sap.com/#/notes/2446441)
- SAP Note 2456953 - Windows on Google Cloud Platform (IaaS): Adaption of your SAP License (https://launchpad.support.sap.com/#/notes/2456953)

For more information about SAP licensing, contact SAP.

In Compute Engine, there are two ways to license SLES, RHEL, and Windows Server:

- With pay-as-you-go licensing, your Compute Engine VM hourly cost includes licensing. Google manages the licensing logistics. Your hourly costs are higher, but you have complete flexibility to increase and decrease your costs, as needed. This is the licensing model used for Google Cloud public images that include SLES, RHEL, and Windows Server.

  ★ **Important:** RHEL, SLES, and Windows Server are premium images. Premium images charge for OS licenses in addition to standard VM charges. For details about pricing, refer to the pricing for RHEL images (/compute/disks-image-pricing#rhel_images), pricing for SUSE images (/compute/disks-image-pricing#suse_images), and pricing for Windows Server images (/compute/disks-image-pricing#windows_server_pricing).

- With BYOL, your Compute Engine VM costs are lower because the licensing isn't included. You must migrate an existing license or purchase your own license, which means paying up front, and you have less flexibility.

Google Cloud customers either with a Production Support Role or with Enterprise Support can request assistance with the provisioning and configuration of the Google Cloud resources that are required for SAP systems. Google Cloud Production-level support or Enterprise support is required for support of SAP systems in production environments.

For more information about Google Cloud support options, see Google Cloud Support (/support/).

For SAP product-related issues, log your support request with SAP support (https://support.sap.com/support-programs-services/about/getting-started.html). SAP evaluates the support ticket and, if it appears to be a Google Cloud infrastructure issue, transfers the ticket to the Google Cloud queue.

You can also browse the information about SAP MaxDB in the SAP Help Portal (https://help.sap.com/viewer/p/SAP_MAXDB).

- To deploy SAP MaxDB on Linux, see the SAP MaxDB Deployment Guide for Linux (/solutions/sap/docs/sap-maxdb-deployment-linux).
- To deploy SAP MaxDB on Windows, see the SAP MaxDB Deployment Guide for Windows (/solutions/sap/docs/sap-maxdb-deployment-windows).