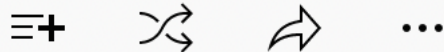




## Cloud Bytes

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# Analytics Hub

Analytics Hub is a data exchange that allows you to efficiently and securely exchange data assets across organizations to address challenges of data reliability and cost. Curate a library of internal and external assets, including unique datasets like Google Trends, backed by the power of BigQuery.

- Drive innovation with unique datasets from Google, commercial data providers, or your partners
- Exchange data, ML models, or other analytics assets to increase the ROI of data initiatives
- Easily publish or subscribe to shared datasets in an open, secure, and privacy-safe environment

## BENEFITS

### Manage analytics assets in a centralized hub

Analytics Hub streamlines the accessibility of data and analytics assets from internal teams, from [public or industry providers](#), and from Google, like pre-built [Looker Blocks](#) code or [Google Trends](#) data.

### A powerful platform for efficient exchanges

Analytics Hub builds on the scalability and flexibility of [BigQuery](#) to streamline how you publish, discover, and subscribe to data or analytics exchanges, and incorporate them into your existing workflows.

### Robust security controls, always privacy-safe

Data shared within Analytics Hub automatically includes in-depth governance, encryption, and security from [BigQuery](#), [Cloud KMS](#), [Cloud IAM](#), [VPC Security Controls](#), and more.

## KEY FEATURES

## The Analytics Hub difference

### Built on a decade of data sharing in BigQuery

Since 2010, BigQuery has supported always-live, in-place data sharing within an organization's security perimeter (intra-organizational sharing) as well as data sharing across boundaries to external organizations, e.g., in your vendor or partner ecosystem. Looking at usage over a one week period in November of 2021, more than 4,500 organizations shared over 250 petabytes of data in BigQuery, not

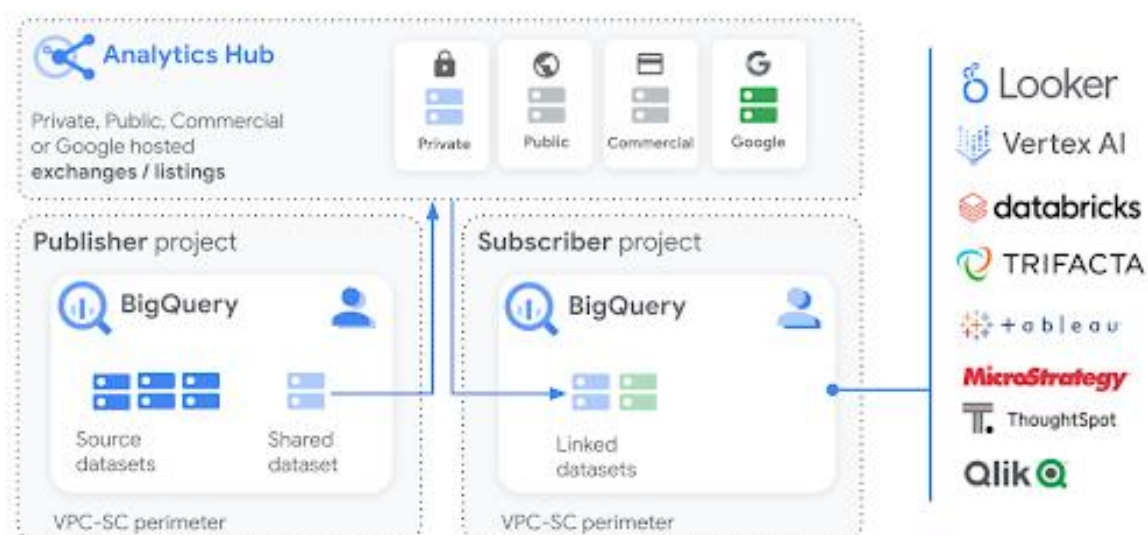
accounting for intra-organizational sharing. Analytics Hub makes the administration of sharing assets across any boundary even easier and more scalable, while retaining access to key capabilities of BigQuery like its built-in ML, real-time, and geospatial analytics.

### **Curation and self-service through exchanges**

Exchanges are collections of data and analytics assets designed for sharing. Administrators can easily curate an exchange by managing the dataset listings within the exchange. Rich metadata can help subscribers find the data they're looking for, and even leverage analytics assets associated with that data. Exchanges within Analytics Hub are private by default, but granular roles and permissions can be set easily for you to deliver data at scale to exactly the right audiences.

### **A sharing model for scalability, security, and flexibility**

Shared datasets are collections of tables and views in BigQuery defined by a data publisher and make up the unit of cross-project / cross-organizational sharing. Data subscribers get an opaque, read-only, linked dataset inside their project and VPC perimeter that they can combine with their own datasets and connect to solutions from Google Cloud or our partners. For example, a retailer might create a single exchange to share demand forecasts to the 1,000's of vendors in their supply chain—having joined historical sales data with weather, web clickstream, and Google Trends data in their own BigQuery project, then sharing real-time outputs via Analytics Hub. The publisher can add metadata, track subscribers, and see aggregated usage metrics.



# Anthos

Migrate directly from VMs, Build, deploy, and optimize apps on GKE, Anthos serverless landing zones and VMs anywhere—simply, flexibly, and securely

- Build, deploy, and optimize apps on GKE and VMs anywhere—simply, flexibly, and securely
- Consistent development and operations experience for hybrid and multicloud environments
- Achieve up to 4.8x ROI within 3 years according to the [Forrester Total Economic Impact study](#)
- Accelerate your VM-based app [migration journey](#) to containers

## BENEFITS

### **Manage applications anywhere**

Anthos is a managed platform for all your application deployments, both traditional as well as cloud native. It enables you to build and manage global fleets and establish operational consistency across them.

### **Deliver software faster**

Bring the benefits of cloud services, containers, and serverless across your deployments and improve developer productivity with easy cloud-native tooling, container migration services, and guidance from Google

### **Protect applications and software supply chain**

Anthos integrates security into each stage of the application life cycle, from develop to build to run, and automates security and policy management for all your deployments.

## **Key features**

### **Enterprise-grade container orchestration and management service**

Anthos enables you to manage GKE clusters and workloads running on virtual machines across environments. You get consistent managed Kubernetes experience with simple installs as well as upgrades validated by Google. Anthos can run on your existing virtualized infrastructure and [bare metal](#) servers without a hypervisor layer. Anthos simplifies your application stack, reduces the costs associated with licensing a hypervisor, and decreases time spent learning new skills.

### **Automate policy and security at scale**

Define, automate, and enforce policies across environments in order to meet your organization's unique security and compliance requirements. [Anthos Config Management](#) evaluates changes and rolls them out to all Kubernetes clusters so that your desired state is always reflected.

### **Fully managed service mesh with built-in visibility**

[Anthos Service Mesh](#) unburdens operations and development teams by empowering them to manage and secure traffic between services while monitoring, troubleshooting, and improving application performance.

### **Modernizing your security for hybrid and multi-cloud deployments**

Anthos integrates [security](#) into each stage of the application life cycle—from develop to build to run—while enabling a defense-in-depth security strategy with a comprehensive portfolio of security controls across all of these deployment models.

### **CI/CD Anywhere: Google Cloud, on-premises, or other clouds**

Using the Anthos platform, [Cloud Build hybrid pools](#) and [Cloud Deploy](#), both in preview, provide the advantages of cloud-native CI/CD across anywhere you can run Kubernetes, including Google Cloud, on-premises, or other public clouds.

## **All features**

Modernizing your security for hybrid and multicloud deployments	Anthos integrates <a href="#">security</a> into each stage of the application life cycle—from develop, to build, to run. Anthos enables a defense-in-depth security strategy with a comprehensive portfolio of security controls, across all of these deployment models.
Bringing the power of containers to your existing workloads	Migrate to Containers minimizes the manual effort required to move and convert existing applications into containers. Analyze your entire application portfolio with the <a href="#">Fit Assessment tool</a> . Migrate your current workloads to containers on secure and managed landing zones, including <a href="#">Google Compute Engine</a> , <a href="#">Google Cloud VMware Engine</a> , <a href="#">Google Kubernetes</a>

	<a href="#">Engine</a> (including Autopilot mode), and <a href="#">Cloud Run</a> .
Accelerate adoption of day 2 operations	For day 2 operations, save on labor and costs associated with maintaining, patching, and updating VMs and physical servers by switching to modern CI/CD pipelines, image-based management, and desired-state configuration with Anthos.
Bringing serverless everywhere	<a href="#">Cloud Run for Anthos</a> provides a flexible serverless development platform and allows you to deploy your workloads to Anthos clusters, all with the same consistent experience. Cloud Run for Anthos is Google's managed and fully supported Knative offering, an open source project that supports serverless workloads on Kubernetes.
Deploy containerized apps from Google Cloud Marketplace	<a href="#">Kubernetes applications from Google Cloud Marketplace</a> are enterprise-ready containerized solutions with prebuilt deployment templates, featuring portability, simplified licensing, and consolidated billing.
Toil-free traffic management for your service mesh	<a href="#">Traffic Director</a> is a fully managed traffic control plane for service mesh. With Traffic Director, you can easily deploy global load balancing across clusters and VM instances in multiple regions, offload health checking from service proxies, and configure sophisticated traffic control policies.
Monitor, troubleshoot, and improve application performance	Google Cloud's <a href="#">operations suite</a> (formerly Stackdriver) provides visibility into the

	<p>performance, uptime, and overall health of cloud-powered applications. Collect metrics, logs, and traces across Google Cloud and your applications. Use built-in out-of-the-box dashboards and views to monitor the platform and applications.</p>
<p>Eliminate the dependency on hypervisors when modernizing apps</p>	<p><a href="#">Anthos on bare metal</a> is a deployment option to run Anthos on physical servers, deployed on an operating system provided by you, without a hypervisor layer for better performance. Anthos on bare metal lets you extend Anthos to new scenarios such as edge locations and support for your mission critical applications.</p>
<p>Anthos multicloud</p>	<p>Anthos Multicloud API enables you to provision and manage GKE clusters running on AWS and Azure infrastructure through a centralized Google Cloud backed control plane. This means that your team can have a consistent experience to create, manage, and update GKE clusters, regardless of which public cloud you're using.</p>
<p>Anthos for VMs</p>	<p>Anthos for VM in preview, supports development teams that want to standardize on Kubernetes but have existing workloads running on virtual machines that cannot be easily containerized. Anthos for VMs lets you modernize virtual machine workloads with the power of Kubernetes. We also provide a fit assessment tool to identify which of your VMs are the best candidates to Shift or Attach.</p>



# App Engine

Build monolithic server-side rendered websites. App Engine supports popular development languages with a range of developer tools.

New customers get \$300 in free credits to spend on App Engine. All customers get 28 instances in standard environment free per day, not charged against your credits.

- Deploy a website using App Engine with this [quickstart](#)
- Free up your developers with zero server management and zero configuration deployments
- Stay agile with support for popular development languages and a range of developer tools

## Key features

### Popular programming languages

Build your application in Node.js, Java, Ruby, C#, Go, Python, or PHP.

### Fully managed

A fully managed environment lets you focus on code while App Engine manages infrastructure concerns.

## All features

Popular languages	Build your application in Node.js, Java, Ruby, C#, Go, Python, or PHP.
Fully managed	A fully managed environment lets you focus on code while App Engine manages infrastructure concerns.
Powerful application diagnostics	Use Cloud Monitoring and Cloud Logging to monitor the health and performance of your app and Cloud Debugger and Error Reporting to diagnose and fix bugs quickly.

Application versioning	Easily host different versions of your app, and easily create development, test, staging, and production environments.
Application security	Help safeguard your application by defining access rules with App Engine firewall and leverage managed SSL/TLS certificates by default on your custom domain at no additional cost.
Services ecosystem	Tap a growing ecosystem of Google Cloud services from your app including an excellent suite of cloud developer tools.

# BeyondCorp Enterprise

A zero trust solution that enables secure access to applications and resources, and offers integrated threat and data protection.

- Provide secure access to critical apps and services
- Safeguard your information with integrated threat and data protection
- Simplify the experience for admins and end-users with an agentless approach
- Increase visibility into unsafe user activity
- Improve your security posture with a modern zero trust platform

## BENEFITS

### **Scalable, reliable foundation**

Built on the backbone of Google's planet-scale network and infrastructure to provide a seamless and secure experience with integrated DDoS protection, low-latency connections, and elastic scaling.

### **Continuous end-to-end protection**

A layered approach to security across users, access, data, and applications that helps protect every click from malware, data loss, and fraud.

### **Open and extensible ecosystem**

Integrates posture information and signals from leading security vendors, for extra protection.

## KEY FEATURES

# **A proven approach to zero trust security**

### **Identity and context-aware access control**

Easily configure policies based on user identity, device health, and other contextual factors to enforce granular access controls to modern and legacy apps, VMs, and Google APIs. Implement strong authentication and authorization policies to ensure users have access to the resources they need.

### **Integrated threat and data protection**

Prevent data loss and thwart threats such as malware and phishing. Utilize real-time alerts and detailed reports, all built into the [Chrome Browser](#).

**Support across your environment: cloud, on-premises, or hybrid**

Securely access SaaS apps, web apps, client-server apps, and cloud resources whether they are hosted on Google Cloud, on other clouds, or on-premises.

**Easy adoption with our agentless approach**

Delivered as a non-disruptive overlay to your existing architecture, with no need to install additional agents, for a seamless, familiar, easy-to-use experience.

**Rely on Google Cloud's global infrastructure**

Benefit from the scale, reliability, and security of Google's [network](#), with 144 edge locations in over 200 countries and territories.

# BigLake

Built on years of investment in BigQuery, BigLake is a storage engine that allows organizations to unify data warehouses and lakes, and enable them to perform uniform fine-grained access control, and accelerate query performance across multi-cloud storage and open formats.

- Store a single copy of data with uniform features across data warehouses & lakes.
- Fine-grained access control and multi-cloud governance over distributed data.
- Seamless integration with open source analytics tools and open data formats.

## BENEFITS

### **Freedom of choice**

Unlock analytics on distributed data regardless where and how it's stored, while choosing the best analytics tools, open source or cloud native over a single copy of data.

### **Secure and performant data lakes**

Fine-grained access control across open source engines like Apache Spark, Presto and Trino, and open formats such as Parquet. Performant queries over data lakes powered by BigQuery.

### **Unified governance & management at scale**

Integrates with [Dataplex](#) to provide management at scale, including logical data organization, centralized policy & metadata management, quality and lifecycle management for consistency across distributed data.

## KEY FEATURES

### **Key features**

#### **Fine grained security controls**

BigLake eliminates the need to grant file level access to end users. Apply table, row, column level security policies on object store tables similar to existing BigQuery tables.

**Multi-compute analytics**

Maintain a single copy of data and make it uniformly accessible across Google Cloud and open-source engines, including [BigQuery](#), [Vertex AI](#), [Dataflow](#), Spark, Presto, Trino, and Hive using BigLake connectors. Centrally manage security policies in one place, and have it consistently enforced across the query engines by the API interface built into the connectors.

**Multi-cloud governance**

Discover all BigLake tables, including those defined over Amazon S3, Azure data lake Gen 2 in [Data Catalog](#). Configure fine grained access control and have it enforced across clouds when querying with [BigQuery Omni](#).

**Performance acceleration**

Achieve industry leading performance over data lake tables on Google Cloud, AWS and Azure, powered by proven BigQuery infrastructure.

**Built on open formats**

Gain access to the most popular open data formats including Parquet, Avro, ORC, CSV, JSON. The API serves multiple compute engines through Apache Arrow.

# BigQuery

Cost-effective, serverless, multicloud data warehouse to power your data-driven innovation.

New customers get \$300 in free credits to spend on BigQuery. All customers get 10 GB storage and up to 1 TB queries free per month, not charged against their credits.

- Run analytics at scale with 27% lower three-year TCO than [cloud data warehouse alternatives](#)
- Democratize insights with built-in business intelligence and machine learning
- Power business decisions from data across clouds with a flexible, multicloud analytics solution
- BigQuery is at the core of Google's unified data cloud. [Watch the demo](#) to see how it works

## BENEFITS

### **Gain insights with real-time and predictive analytics**

Query streaming data in real time and get up-to-date information on all your business processes. Predict business outcomes easily with built-in machine learning—without the need to move data.

### **Access data and share insights with ease**

Securely access and share analytical insights in your organization with a few clicks. Easily create stunning reports and dashboards using popular business intelligence tools, out of the box.

### **Protect your data and operate with trust**

Rely on BigQuery's robust security, governance, and reliability controls that offer high availability and a 99.99% uptime SLA. Protect your data with encryption by default and customer-managed encryption keys.

## KEY FEATURES

# Key features

## ML and predictive modeling with BigQuery ML

[BigQuery ML](#) enables data scientists and data analysts to build and operationalize ML models on planet-scale structured or semi-structured data, directly inside BigQuery, using simple SQL—in a fraction of the time. Export BigQuery ML models for online prediction into Vertex AI or your own serving layer. Learn more about the [models we currently support](#).

## Multicloud data analysis with BigQuery Omni

[BigQuery Omni](#) is a flexible, fully managed, multicloud analytics solution that allows you to cost-effectively and securely analyze data across clouds such as AWS and Azure. Use standard SQL and BigQuery’s familiar interface to quickly answer questions and share results from a single pane of glass across your datasets. Try BigQuery Omni at no cost for a limited period or purchase flat rate slots for capacity reservations. [Learn more](#).

## Interactive data analysis with BigQuery BI Engine

[BigQuery BI Engine](#) is an in-memory analysis service built into BigQuery that enables users to analyze large and complex datasets interactively with sub-second query response time and high concurrency. BI Engine natively integrates with Google’s [Data Studio](#) using BI Engine single node and natively accelerates any other business intelligence tools using BI Engine SQL interface.

## Geospatial analysis with BigQuery GIS

[BigQuery GIS](#) uniquely combines the serverless architecture of BigQuery with native support for geospatial analysis, so you can augment your analytics workflows with location intelligence. Simplify your analyses, see spatial data in fresh ways, and unlock entirely new lines of business with support for arbitrary points, lines, polygons, and multi-polygons in common geospatial data formats.

ALL FEATURES

# All features

Serverless	With serverless data warehousing, Google does all resource provisioning behind the scenes, so you can focus on data and analysis rather than worrying about upgrading, securing, or managing the infrastructure.
Multicloud capabilities	<a href="#">BigQuery Omni</a> allows you to analyze data across clouds using standard SQL and without leaving



	BigQuery's familiar interface. Its flexible, fully managed infrastructure allows your data analysts or data scientists to have a completely seamless data analysis experience. From a single pane-of-glass, you can also combine data or train models cross-clouds using cross-cloud transfer.
Built-in ML and AI integrations	Besides bringing ML to your data with <a href="#">BigQuery ML</a> , integrations with <a href="#">Vertex AI</a> and <a href="#">TensorFlow</a> enable you to train and execute powerful models on structured data in minutes, with just SQL.
Foundation for BI	BigQuery forms the backbone for modern cloud BI solutions and enables seamless data integration, transformation, analysis, visualization, and reporting with tools from Google and our technology partners. To accelerate BI workloads you can turn on <a href="#">BI Engine</a> , an in-memory analysis service, to achieve sub-second query response time and high concurrency for popular BI tools via standard ODBC/JDBC.
Spreadsheet interface	<a href="#">Connected Sheets</a> allows users to analyze billions of rows of live BigQuery data in Google Sheets without requiring SQL knowledge. Users can apply familiar tools—like pivot tables, charts, and formulas—to easily derive insights from big data. Learn more about Connected Sheets in the <a href="#">getting started guide</a> .
Real-time analytics	BigQuery's high-speed streaming insertion API provides a powerful foundation for real-time analytics, making your latest business data immediately available for analysis. You can also leverage Datastream, Pub/Sub and Dataflow to stream data into BigQuery.

Real-time change data capture and replication	Synchronize data across heterogeneous databases, storage systems, and applications reliably and with minimal latency with <a href="#">Datastream</a> . Datastream integrates with purpose-built and extensible <a href="#">Dataflow templates</a> to pull change streams written to Cloud Storage, and create up-to-date replicated tables in BigQuery for real-time analytics.
Automatic high availability	BigQuery transparently and automatically provides highly durable, replicated storage in multiple locations and high availability with no extra charge and no additional setup.
Standard SQL	BigQuery supports a standard SQL dialect that is ANSI:2011 compliant, which reduces the need for code rewrites. BigQuery also provides ODBC and JDBC drivers at no cost to ensure your current applications can interact with its powerful engine.
Federated query and logical data warehousing	Through powerful federated queries, BigQuery can process external data sources in object storage (Cloud Storage) for Parquet and ORC open source file formats, transactional databases (Bigtable, Cloud SQL), or spreadsheets in Drive. All this can be done without moving the data.
Convergence of data warehouse and data lake	Run open source data science workloads (Spark, TensorFlow, Dataflow and Apache Beam, MapReduce, Pandas, and scikit-learn) directly on BigQuery using the Storage API. The Storage API provides a much simpler architecture and less data movement and doesn't need to have multiple copies of the same data.

Materialized Views	Accelerate query performance and reduce costs within your environment with <a href="#">BigQuery materialized views</a> . It is easy to set up, effortless to use, and best of all it's real time, allowing you to quickly get answers to your questions.
Storage and compute separation	With BigQuery's separated storage and compute, you have the option to choose the storage and processing solutions that make sense for your business and control access and costs for each.
Automatic backup and easy restore	BigQuery automatically replicates data and keeps a seven-day history of changes, allowing you to easily restore and compare data from different times.
Geospatial data types and functions	<a href="#">BigQuery GIS</a> combines the serverless architecture of BigQuery with native support for geospatial analysis, so you can augment your analytics workflows with location intelligence. Simplify your analyses, see spatial data in fresh ways, and unlock entirely new lines of business with support for arbitrary points, lines, polygons, and multi-polygons in common geospatial data formats.
BigQuery data transfer service	The <a href="#">BigQuery Data Transfer Service</a> automatically transfers data from external data sources, like Google Marketing Platform, Google Ads, YouTube, and partner SaaS applications to BigQuery on a scheduled and fully managed basis. Users can also easily transfer data from Teradata and Amazon S3 to BigQuery.
Big data ecosystem integration	With Dataproc and Dataflow, BigQuery provides integration with the Apache big data ecosystem, allowing existing Hadoop/Spark and Beam workloads

	to read or write data directly from BigQuery using the Storage API.
Petabyte scale	Get great performance on your data, while knowing you can scale seamlessly to store and analyze petabytes to exabytes of data with ease.
Flexible pricing models	On-demand pricing lets you pay only for the storage and compute that you use. Flat-rate pricing with Reservations enables high-volume users or enterprises to choose price predictability and workload management seamlessly. For more information, see <a href="#">BigQuery pricing</a> or <a href="#">cost controls</a> .
Data governance and security	BigQuery's <a href="#">integration with security and privacy services</a> from Google Cloud provides strong security and fine-grained governance controls, down to the <a href="#">column-level</a> and <a href="#">row-level</a> . Rest assured knowing your data is <a href="#">encrypted</a> at rest and in transit by default.
Geo-expansion	BigQuery gives you the option of geographic data control (in US, Asia, and European locations), without the headaches of setting up and managing clusters and other computing resources in-region.
Flexible data ingestion	Automatically move data from hundreds of popular business SaaS applications into BigQuery for free with Data Transfer Service (DTS) or leverage data integration tools like <a href="#">Cloud Data Fusion</a> , <a href="#">Datastream</a> , Informatica, Talend, and more. Load and transform data at any scale from hybrid and multicloud applications.
Programmatic interaction	BigQuery provides a REST API for easy programmatic access and application integration. Client libraries are available in Java, Python, Node.js, C#, Go, Ruby, and

	PHP. Business users can use Google Apps Script to access BigQuery from Sheets.
Rich monitoring and logging	BigQuery provides rich monitoring, logging, and alerting through <a href="#">Cloud Audit Logs</a> and it can serve as a repository for logs from any application or service using Cloud Logging.
Public datasets	Google Cloud <a href="#">Public Datasets</a> offer a powerful data repository of more than 200 high-demand public datasets from different industries. Google provides free storage for all public datasets, and customers can query up to 1 TB of data per month at no cost.
Always-free access	The <a href="#">BigQuery sandbox</a> gives you always-free access to the full power of BigQuery subject to certain limits. You can get started without a credit card, or without creating or enabling a billing account for your project.

# BigQuery ML

## What is BigQuery ML?

BigQuery ML lets you create and execute machine learning models in [BigQuery](#) using standard SQL queries. BigQuery ML democratizes machine learning by letting SQL practitioners build models using existing SQL tools and skills. BigQuery ML increases development speed by eliminating the need to move data.

BigQuery ML functionality is available by using:

- The Google Cloud console
- The bq command-line tool
- The BigQuery REST API
- An external tool such as a Jupyter notebook or business intelligence platform

Machine learning on large datasets requires extensive programming and knowledge of ML frameworks. These requirements restrict solution development to a very small set of people within each company, and they exclude data analysts who understand the data but have limited machine learning knowledge and programming expertise.

BigQuery ML empowers data analysts to use machine learning through existing SQL tools and skills. Analysts can use BigQuery ML to build and evaluate ML models in BigQuery. Analysts don't need to export small amounts of data to spreadsheets or other applications or wait for limited resources from a data science team.

## Supported models in BigQuery ML

A [model](#) in BigQuery ML represents what an ML system has learned from the training data.

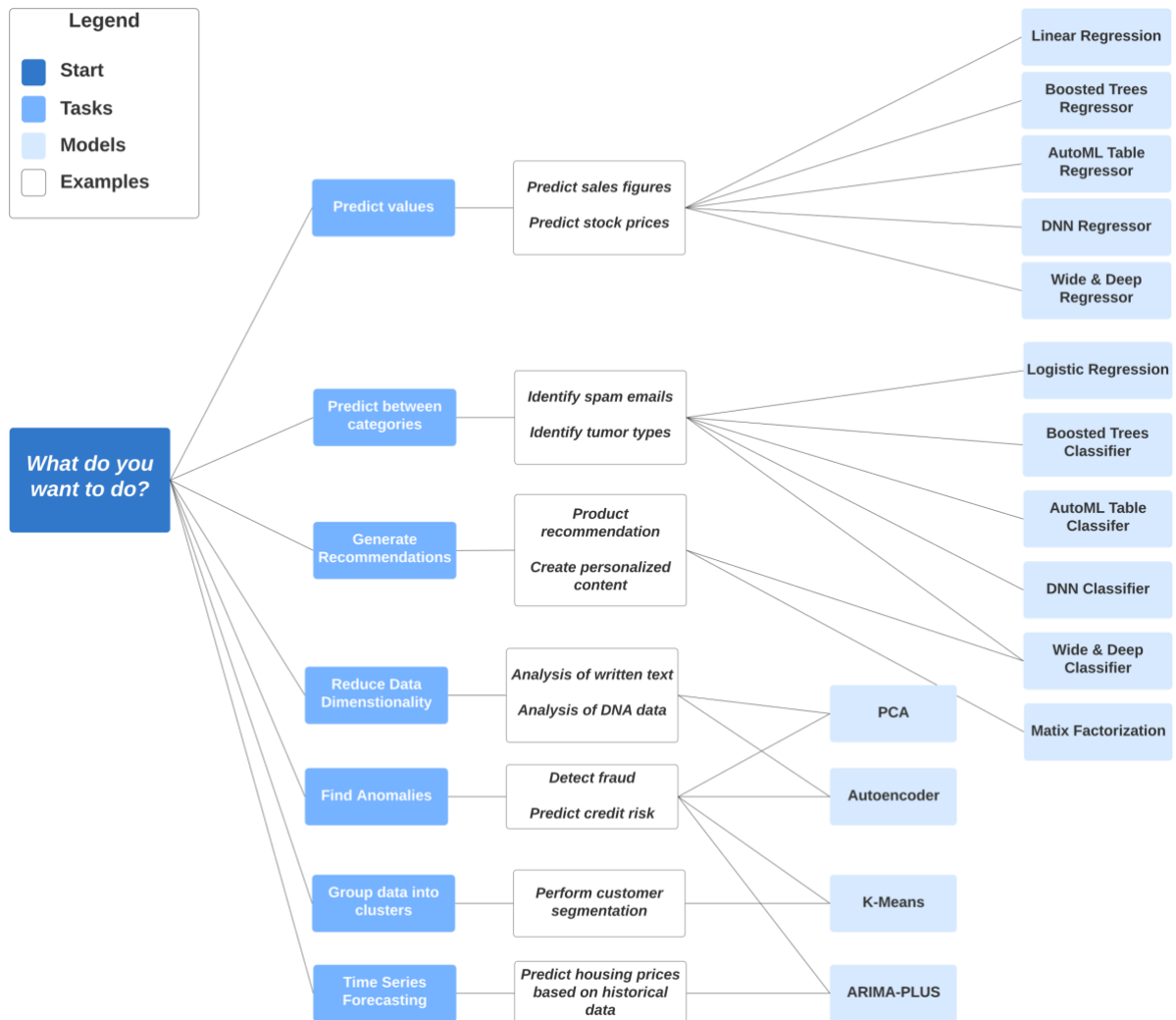
BigQuery ML supports the following types of models:

- [Linear regression](#) for forecasting; for example, the sales of an item on a given day. Labels are real-valued (they cannot be +/- infinity or NaN).
- [Binary logistic regression](#) for classification; for example, determining whether a customer will make a purchase. Labels must only have two possible values.
- [Multiclass logistic regression](#) for classification. These models can be used to predict multiple possible values such as whether an input is "low-value," "medium-value," or "high-value." Labels can have up to 50 unique values. In BigQuery ML, multiclass logistic regression training uses a [multinomial classifier](#) with a [cross-entropy loss function](#).

- [K-means clustering](#) for data segmentation; for example, identifying customer segments. K-means is an unsupervised learning technique, so model training does not require labels nor split data for training or evaluation.
- [Matrix Factorization](#) for creating product recommendation systems. You can create product recommendations using historical customer behavior, transactions, and product ratings and then use those recommendations for personalized customer experiences.
- [Time series](#) for performing time-series forecasts. You can use this feature to create millions of time series models and use them for forecasting. The model automatically handles anomalies, seasonality, and holidays.
- [Boosted Tree](#) for creating [XGBoost](#) based classification and regression models.
- [Deep Neural Network \(DNN\)](#) for creating TensorFlow-based Deep Neural Networks for [classification](#) and [regression](#) models.
- [AutoML Tables](#) to create best-in-class models without feature engineering or model selection. [AutoML Tables](#) searches through a variety of model architectures to decide the best model.
- [TensorFlow model importing](#). This feature lets you create BigQuery ML models from previously trained TensorFlow models, then perform prediction in BigQuery ML.
- [Autoencoder](#) for creating Tensorflow-based BigQuery ML models with the support of sparse data representations. The models can be used in BigQuery ML for tasks such as unsupervised anomaly detection and non-linear dimensionality reduction.

In BigQuery ML, you can use a model with data from multiple BigQuery datasets for training and for prediction.

# Model selection guide



## Advantages of BigQuery ML

BigQuery ML has the following advantages over other approaches to using ML with a cloud-based data warehouse:

- BigQuery ML democratizes the use of ML by empowering data analysts, the primary data warehouse users, to build and run models using existing business intelligence tools and spreadsheets. Predictive analytics can guide business decision-making across the organization.
- There is no need to program an ML solution using Python or Java. Models are trained and accessed in BigQuery using SQL—a language data analysts know.
- BigQuery ML increases the speed of model development and innovation by removing the need to export data from the data warehouse. Instead, BigQuery



ML brings ML to the data. The need to export and reformat data has the following disadvantages:

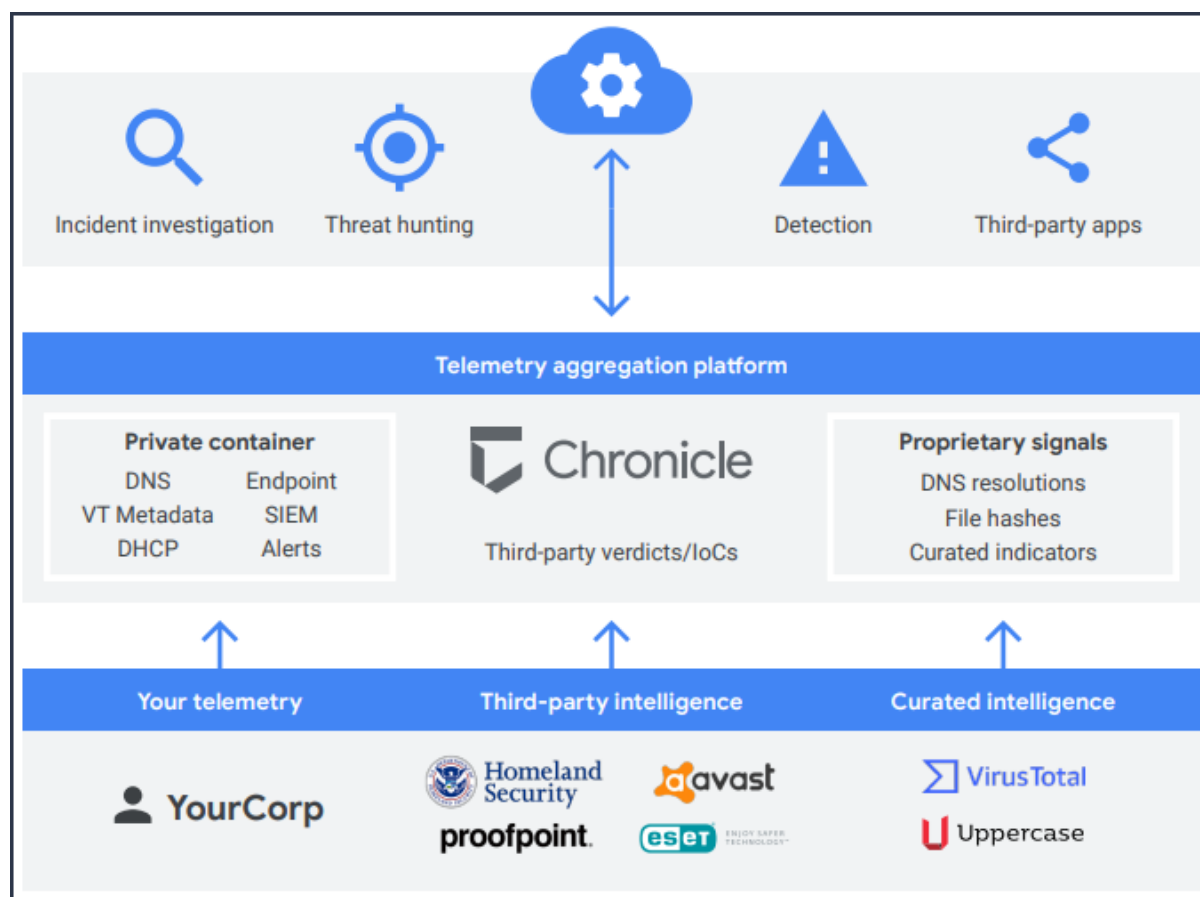
- Increases complexity because multiple tools are required.
- Reduces speed because moving and formatting large amounts data for Python-based ML frameworks takes longer than model training in BigQuery.
- Requires multiple steps to export data from the warehouse, restricting the ability to experiment on your data.
- Can be prevented by legal restrictions such as HIPAA guidelines.

# Chronicle

## Chronicle overview

Chronicle is a cloud service, built as a specialized layer on top of core Google infrastructure, designed for enterprises to privately retain, analyze, and search the massive amounts of security and network telemetry they generate. Chronicle normalizes, indexes, correlates, and analyzes the data to provide instant analysis and context on risky activity.

Chronicle enables you to examine the aggregated security information for your enterprise going back for months or longer. Use Chronicle to search across all of the domains accessed within your enterprise. You can narrow your search to any specific asset, domain, or IP address to determine if any compromise has taken place.



## Chronicle platform overview

## Data collection

Chronicle can ingest numerous security telemetry types through a variety of methods, including:

- Forwarder: A lightweight software component, deployed in the customer's network, that supports syslog, packet capture, and existing log management or security information and event management (SIEM) data repositories.
- Ingestion APIs: APIs that enable logs to be sent directly to the Chronicle platform, eliminating the need for additional hardware or software in customer environments.
- Third-party integrations: Integration with third-party cloud APIs to facilitate ingestion of logs, including sources like Office 365 and Azure AD.

## **Data analysis**

The analytical capabilities of Chronicle are delivered to security professionals as a simple, browser-based application. Many of these capabilities are also accessible programmatically through Read APIs. Chronicle gives analysts a way, when they see a potential threat, to determine what it is, what it's doing, whether it matters, and how best to respond.

## **Security and compliance**

As a specialized, private layer built over core Google infrastructure, Chronicle inherits compute and storage capabilities as well as the security design and capabilities of that infrastructure.

## **Chronicle features**

### **Search**

- Raw Log Scan: Search your raw unparsed logs.
- Regular Expressions: Search your raw unparsed logs using regular expressions.

### **Investigative views**

- Enterprise Insights: Displays the domains and assets most in need of investigation.
- Asset view: Investigate assets within your enterprise and whether or not they have interacted with suspicious domains.
- IP Address view: Investigate specific IP addresses within your enterprise and what impact they have on your assets.
- Hash view: Search for and investigate files based on their hash value.
- Domain view: Investigate specific domains within your enterprise and what impact they have on your assets.
- User view: Investigate users within your enterprise who may have been impacted by security events.

- Procedural filtering: Fine tune information about an asset, including by event type, log source, network connection status, and Top Level Domain (TLD).

### **Curated information**

- Asset insight blocks: Highlights the domains and alerts that you might want to investigate further.
- Prevalence graph: Shows the number of domains an asset has connected to over a specified time period.
- Alerts from popular security products.

### **Detection Engine**

You can use the Chronicle Detection Engine to automate the process of searching across your data for security issues. You can specify rules to search all of your incoming data and notify you when potential and known threats appear in your enterprise.

### **Additional tools**

- VirusTotal: Launch VirusTotal from Chronicle to further investigate an asset, domain, or IP address by clicking [VT Context](#).
- Chronicle extension for Chrome: Launch Chronicle from anywhere within the Chrome browser.

# Cloud Bigtable

A fully managed, scalable NoSQL database service for large analytical and operational workloads with up to 99.999% availability.

New customers get \$300 in free credits to spend on Cloud Bigtable.

- Consistent sub-10ms latency—handle millions of requests per second
- Ideal for use cases such as personalization, ad tech, fintech, digital media, and IoT
- Seamlessly scale to match your storage needs; no downtime during reconfiguration
- Designed with a storage engine for machine learning applications leading to better predictions
- Easily connect to Google Cloud services such as [BigQuery](#) or the Apache ecosystem

## BENEFITS

### Fast and performant

Use Cloud Bigtable as the storage engine that grows with you from your first gigabyte to petabyte-scale for low-latency applications as well as high-throughput data processing and analytics.

### Seamless scaling and replication

Start with a single node per cluster, and seamlessly scale to hundreds of nodes dynamically supporting peak demand. Replication also adds high availability and workload isolation for live serving apps.

### Simple and integrated

Fully managed service that integrates easily with big data tools like [Hadoop](#), [Dataflow](#), and [Dataproc](#). Plus, support for the open source [HBase API](#) standard makes it easy for development teams to get started.

# Key features

## **High throughput at low latency**

Bigtable is ideal for storing very large amounts of data in a key-value store and supports high read and write throughput at low latency for fast access to large amounts of data. Throughput scales linearly—you can increase QPS (queries per second) by adding Bigtable nodes. Bigtable is built with proven infrastructure that powers Google products used by billions such as Search and Maps.

## **Cluster resizing without downtime**

Scale seamlessly from thousands to millions of reads/writes per second. Bigtable throughput can be dynamically adjusted by adding or removing cluster nodes without restarting, meaning you can increase the size of a Bigtable cluster for a few hours to handle a large load, then reduce the cluster's size again—all without any downtime.

## **Flexible, automated replication to optimize any workload**

Write data once and automatically replicate where needed with eventual consistency—giving you control for high availability and isolation of read and write workloads. No manual steps needed to ensure consistency, repair data, or synchronize writes and deletes. Benefit from a high availability SLA of 99.999% for instances with multi-cluster routing across 3 or more regions (99.9% for single-cluster instances).

# Cloud Composer

A fully managed workflow orchestration service built on Apache Airflow.

New customers get \$300 in free credits to spend on Composer or other Google Cloud products during the first 90 days.

- Author, schedule, and monitor pipelines that span across hybrid and multi-cloud environments
- Built on the [Apache Airflow](#) open source project and operated using Python
- Frees you from lock-in and is easy to use

## BENEFITS

### Fully managed workflow orchestration

Cloud Composer's managed nature and Apache Airflow compatibility allows you to focus on authoring, scheduling, and monitoring your workflows as opposed to provisioning resources.

### Integrates with other Google Cloud products

End-to-end integration with Google Cloud products including BigQuery, Dataflow, Dataproc, Datastore, Cloud Storage, Pub/Sub, and AI Platform gives users the freedom to fully orchestrate their pipeline.

### Supports hybrid and multi-cloud

Author, schedule, and monitor your workflows through a single orchestration tool—whether your pipeline lives on-premises, in multiple clouds, or fully within Google Cloud.

## Key features

### Hybrid and multi-cloud

Ease your transition to the cloud or maintain a hybrid data environment by orchestrating workflows that cross between on-premises and the public cloud. Create workflows that connect data, processing, and services across clouds to give you a unified data environment.

### Open source

Cloud Composer is built upon [Apache Airflow](#), giving users freedom from lock-in and portability. This open source project, which Google is contributing back into,

provides freedom from lock-in for customers as well as integration with a broad number of platforms, which will only expand as the Airflow community grows.

### Easy orchestration

Cloud Composer pipelines are configured as directed acyclic graphs (DAGs) using Python, making it easy for any user. One-click deployment yields instant access to a rich library of connectors and multiple graphical representations of your workflow in action, making troubleshooting easy. Automatic synchronization of your directed acyclic graphs ensures your jobs stay on schedule.

## All features

Multi-cloud	Create workflows that connect data, processing, and services across clouds, giving you a unified data environment.
Open source	Cloud Composer is built upon <a href="#">Apache Airflow</a> , giving users freedom from lock-in and portability.
Hybrid	Ease your transition to the cloud or maintain a hybrid data environment by orchestrating workflows that cross between on-premises and the public cloud.
Integrated	Built-in integration with <a href="#">BigQuery</a> , <a href="#">Dataflow</a> , <a href="#">Dataproc</a> , <a href="#">Datastore</a> , <a href="#">Cloud Storage</a> , <a href="#">Pub/Sub</a> , <a href="#">AI Platform</a> , and more, giving you the ability to orchestrate end-to-end Google Cloud workloads.
Python programming language	Leverage existing Python skills to dynamically author and schedule workflows within Cloud Composer.
Reliability	Increase reliability of your workflows through easy-to-use charts for monitoring and troubleshooting the root cause of an issue.



Fully managed	Cloud Composer's managed nature allows you to focus on authoring, scheduling, and monitoring your workflows as opposed to provisioning resources.
Networking and security	During environment creation, Cloud Composer provides the following configuration options: <a href="#">Cloud Composer environment with a route-based GKE cluster</a> (default), <a href="#">Private IP Cloud Composer environment</a> , Cloud <a href="#">Composer environment with a VPC Native GKE cluster using alias IP addresses</a> , <a href="#">Shared VPC</a> .

# Cloud Data Fusion

Fully managed, cloud-native data integration at any scale.

New customers get \$300 in free credits to spend on Data Fusion. All customers get the first 120 hours of pipeline development free per month, per account, not charged against your credits.

- Visual point-and-click interface enabling code-free deployment of ETL/ELT data pipelines
- Broad library of 150+ preconfigured [connectors and transformations](#), at no additional cost
- Natively integrated best-in-class Google Cloud services
- End-to-end data lineage for root cause and impact analysis
- Built with an open source core ([CDAP](#)) for pipeline portability

## BENEFITS

### **Avoid technical bottlenecks and lift productivity**

Data Fusion's intuitive drag-and-drop interface, pre-built connectors, and self-service model of code-free data integration remove technical expertise-based bottlenecks and accelerate time to insight.

### **Lower total cost of pipeline ownership**

A serverless approach leveraging the scalability and reliability of Google services like Dataproc means Data Fusion offers the best of data integration capabilities with a lower total cost of ownership.

### **Build with a data governance foundation**

With built-in features like end-to-end data lineage, integration metadata, and cloud-native security and data protection services, Data Fusion assists teams with root cause or impact analysis and compliance.

## **Key features**

### **Open core, delivering hybrid and multi-cloud integration**

Data Fusion is built using open source project CDAP, and this open core ensures data pipeline portability for users. CDAP's broad integration with on-premises and public cloud platforms gives Cloud Data Fusion users the ability to break down silos and deliver insights that were previously inaccessible.

## Integrated with Google's industry-leading big data tools

Data Fusion's integration with Google Cloud simplifies data security and ensures data is immediately available for analysis. Whether you're curating a data lake with [Cloud Storage](#) and [Dataproc](#), moving data into [BigQuery](#) for data warehousing, or transforming data to land it in a relational store like [Cloud Spanner](#), Cloud Data Fusion's integration makes development and iteration fast and easy.

## Data integration through collaboration and standardization

Cloud Data Fusion offers [pre-built transformations](#) for both batch and real-time processing. It provides the ability to create an internal library of custom connections and transformations that can be validated, shared, and reused across teams. It lays the foundation of collaborative data engineering and improves productivity. That means less waiting for ETL developers and data engineers and, importantly, less sweating about code quality.

## All features

Code-free self-service	Remove bottlenecks by enabling nontechnical users through a code-free graphical interface that delivers point-and-click data integration.
Collaborative data engineering	Cloud Data Fusion offers the ability to create an internal library of custom connections and transformations that can be validated, shared, and reused across an organization.
Google Cloud-native	Fully managed Google Cloud-native architecture unlocks the scalability, reliability, security, and privacy features of Google Cloud.
Real-time data integration	<a href="#">Replicate</a> transactional and operational databases such as SQL Server, Oracle and MySQL directly into BigQuery with just a few clicks using Data Fusion's replication feature. Integration with <a href="#">Datastream</a> allows you to deliver change streams into BigQuery for continuous analytics. Use feasibility assessment for faster development

	iterations and performance/health monitoring for observability.
Batch integration	Design, run and operate high-volumes of data pipelines periodically with support for popular data sources including file systems and object stores, relational and NoSQL databases, SaaS systems, and mainframes.
Enterprise-grade security	Integration with <a href="#">Cloud Identity and Access Management (IAM)</a> , <a href="#">Private IP</a> , <a href="#">VPC-SC</a> and <a href="#">CMEK</a> provides enterprise security and alleviates risks by ensuring compliance and data protection.
Integration metadata and lineage	Search integrated datasets by technical and business metadata. Track lineage for all integrated datasets at the dataset and field level.
Seamless operations	REST APIs, time-based schedules, pipeline state-based triggers, logs, metrics, and monitoring dashboards make it easy to operate in mission-critical environments.
Comprehensive integration toolkit	<a href="#">Built-in connectors</a> to a variety of modern and legacy systems, code-free transformations, conditionals and pre/post processing, alerting and notifications, and error processing provide a comprehensive data integration experience.
Hybrid enablement	Open source provides the flexibility and portability required to build standardized data integration solutions across hybrid and multi-cloud environments.

What is Cloud Data Fusion?

Cloud Data Fusion is a fully managed, cloud-native, enterprise data integration service for quickly building and managing data pipelines.

The Cloud Data Fusion web UI lets you to build scalable data integration solutions to clean, prepare, blend, transfer, and transform data, without having to manage the infrastructure.

Cloud Data Fusion is powered by the open source project [CDAP](#).

# Cloud Data Loss Prevention

Fully managed service designed to help you discover, classify, and protect your most sensitive data.

- Take charge of your data on or off cloud
- Gain visibility into sensitive data risk across your entire organization
- Reduce data risk with obfuscation and de-identification methods like masking and tokenization
- Seamlessly inspect and transform structured and unstructured data

Cloud DLP provides access to a powerful sensitive data inspection, classification, and de-identification platform.

Cloud DLP includes:

- Over 150 built-in [information type \(or "infoType"\) detectors](#).
- The ability to [define custom infoType detectors](#) using dictionaries, regular expressions, and contextual elements.
- [De-identification techniques](#) including redaction, masking, format-preserving encryption, date-shifting, and more.
- The ability to detect sensitive data within [streams of data, structured text, files in storage repositories such as Cloud Storage and BigQuery](#), and even within [images](#).
- [Analysis of structured data](#) to help understand its risk of being re-identified, including computation of metrics like *k*-anonymity, *l*-diversity, and more.
- The ability to automatically [profile BigQuery data](#) across an organization, folder, and project to identify tables where high-risk and sensitive data reside.

## Key features

### **Automated sensitive data discovery for your data warehouse**

Discover sensitive data by profiling every BigQuery table and column across your entire organization, select organization folders, or individual projects. Configure directly in the Cloud Console UI and let DLP handle the rest. Use table and column profiles to inform your security and privacy posture.

### **Use Cloud DLP from virtually anywhere, on or off Cloud**

With over [150 built-in infoTypes](#), Cloud DLP gives you the power to scan, discover, classify, and report on data from virtually anywhere. Cloud DLP has built-in support for scanning and classifying sensitive data in Cloud Storage, BigQuery, and

Datastore, and a streaming content API to enable support for additional data sources, custom workloads, and applications.

### **Automatically mask your data to safely unlock more of the cloud**

Cloud DLP provides tools to classify, mask, tokenize, and transform sensitive elements to help you better manage the data that you collect, store, or use for business or analytics. With support for [structured](#) and [unstructured](#) data, Cloud DLP can help you preserve the utility of your data for joining, analytics, and AI while protecting the raw sensitive identifiers.

### **Measure re-identification risk in structured data**

Enhance your understanding of data privacy risk. Quasi-identifiers are partially identifying elements or combinations of data that may link to a single person or a very small group. Cloud DLP allows you to measure statistical properties such as k-anonymity and l-diversity, expanding your ability to understand and protect data privacy.

## **All features**

Automatic discovery, inspection, and classification	Automatic DLP can be configured directly in the Cloud Console and runs continuously for you.
Flexible classification	<a href="#">150+ pre-defined detectors</a> with a focus on quality, speed, and scale. Detectors are improving and expanding all the time.
Simple and powerful redaction	De-identify your data: redact, mask, tokenize, and transform text and images to help ensure data privacy.
Serverless	Cloud DLP is ready to go, no need to manage hardware, VMs, or scale. Just send a little or a lot of data and Cloud DLP scales for you.
Detailed findings with on-demand inspection	Classification results can be sent directly into BigQuery for detailed analysis or export into other systems.

	Custom reports can easily be generated in Data Studio.
Secure data handling	Cloud DLP handles your <a href="#">data securely</a> and undergoes several independent third-party audits to test for data safety, privacy, and security.
Pay-as-you-go pricing	Cloud DLP is charged based on the amount of data processed, not based on a subscription service or device. This customer-friendly pricing allows you to pay as you go and not in advance of demand.
Easy workload integration	Efficiently deploy Cloud DLP with reusable templates, monitor your data with periodic scans, and integrate into serverless architecture with Pub/Sub notifications.
Custom rules	Add your own custom types, adjust detection thresholds, and create detection rules to fit your needs and reduce noise.



# Cloud Functions

Run your code in the cloud with no servers or containers to manage with our scalable, pay-as-you-go functions as a service (FaaS) product.

New customers get \$300 in free credits to spend on Functions. All customers get 2 million monthly invocations free, not charged against your credits.

- Build and deploy your first Cloud Function using only your web browser with this [Quickstart](#)
- Serve users from zero to planet-scale without even thinking about any infrastructure.
- See how [customers](#) design applications using event-driven architectures with Cloud Functions

## Key features

### **Simplified developer experience and increased developer velocity**

Cloud Functions has a simple and intuitive developer experience. Just write your code and let Google Cloud handle the operational infrastructure. Develop faster by writing and running small code snippets that respond to events. Streamline challenging orchestration problems by connecting Google Cloud products to one another or third party services using events.

### **Pay only for what you use**

You are only billed for your function's execution time, metered to the nearest 100 milliseconds. You pay nothing when your function is idle. Cloud Functions automatically spins up and backs down in response to events.

### **Avoid lock-in with open technology**

Use open source FaaS (function as a service) framework to run functions across multiple environments and prevent lock-in. Supported environments include Cloud Functions, local development environment, on-premises, [Cloud Run](#), and other Knative-based serverless environments.

# All features

Connects and extends services to build complex applications	Cloud Functions lets you treat all Google and third-party cloud services as building blocks. Connect and extend them with code, and rapidly move from concept to production with end-to-end solutions and complex workflows. Further, integrate with third-party services that offer webhook integrations to quickly extend your application with powerful capabilities.
End-to-end development and diagnosability	Go from code to deploy, with integrated monitoring. Get full observability and diagnosability for your application with <a href="#">Cloud Trace</a> and <a href="#">Cloud Debugger</a> . Additionally, get support for local and disconnected development/debugging using open sourced functions framework.
Develop locally, scale globally	Serve users from zero to planet-scale without even thinking about any infrastructure. Cloud Functions automatically manages and scales underlying infrastructure with the size of workload.
No server management	Deploy your code and let Google run and scale it for you. Cloud Functions abstracts away all the underlying infrastructure, so that you can focus on your code and build applications faster than ever before.
Runs code in response to events	Cloud Functions allows you to trigger your code from Google Cloud, Firebase, and <a href="#">Google Assistant</a> , or call it directly from any web, mobile, or backend application via HTTP.

Pay only for what you use	<p>You are only billed for your function's execution time, metered to the nearest 100 milliseconds.</p> <p>You pay nothing when your function is idle.</p> <p>Cloud Functions automatically spins up and backs down in response to events.</p>
Avoid lock-in with open technology	<p>Use open source FaaS (function as a service) framework to run functions across multiple environments and prevent lock-in. Supported environments include Cloud Functions, local development environment, on-premises, <a href="#">Cloud Run</a>, <a href="#">Cloud Run for Anthos</a>, and other Knative-based serverless environments.</p>

# Cloud Key Management

Manage encryption keys on Google Cloud.

- Deliver scalable, centralized, fast cloud key management
- Help satisfy compliance, privacy, and security needs
- Apply hardware security modules (HSMs) effortlessly to your most sensitive data
- Use an external KMS to protect your data in Google Cloud and separate the data from the key
- Approve or deny any request for your encryption keys based on clear and precise justifications

## Cloud Key Management Service

Cloud Key Management Service allows you to create, import, and manage cryptographic keys and perform cryptographic operations in a single centralized cloud service. You can use these keys and perform these operations by using Cloud KMS directly, by using Cloud HSM or Cloud External Key Manager, or by using Customer-Managed Encryption Keys (CMEK) integrations within other Google Cloud services.

With Cloud KMS you are the ultimate custodian of your data, you can manage cryptographic keys in the cloud in the same ways you do on-premises, and you have a provable and monitorable root of trust over your data.

## BENEFITS

### **Scale your security globally**

Scale your application to Google's global footprint while letting Google worry about the challenges of key management, including managing redundancy and latency.

### **Help achieve your compliance requirements**

Easily encrypt your data in the cloud using software-backed encryption keys, FIPS 140-2 Level 3 validated HSMs, customer-provided keys or an External Key Manager.

### **Leverage from integration with Google Cloud products**

Use customer-managed encryption keys (CMEK) to control the encryption of data across Google Cloud products while benefiting from additional security features such as Google Cloud IAM and audit logs.

# Key features

## Centrally manage encryption keys

A cloud-hosted key management service that lets you manage symmetric and asymmetric cryptographic keys for your cloud services the same way you do on-premises. You can generate, use, rotate, and destroy AES256, RSA 2048, RSA 3072, RSA 4096, EC P256, and EC P384 cryptographic keys.

## Deliver hardware key security with HSM

Toggle between software- and hardware-protected encryption keys with the press of a button. Host encryption keys and perform cryptographic operations in FIPS 140-2 Level 3 validated HSMs. With this fully managed service, you can protect your most sensitive workloads without the need to worry about the operational overhead of managing an HSM cluster.

## Provide support for external keys with EKM

Encrypt data in [BigQuery](#) and [Compute Engine](#) with encryption keys that are stored and managed in a third-party key management system that's deployed outside Google's infrastructure. External Key Manager allows you to maintain separation between your data at rest and your encryption keys while still leveraging the power of cloud for compute and analytics.

## Be the ultimate arbiter of access to your data

Key Access Justifications works with [Cloud EKM](#) to greatly advance the control you have over your data. It's the only product that gives you visibility into every request for an encryption key, a justification for that request, and a mechanism to approve or deny decryption in the context of that request. These controls are covered by [Google's integrity commitments](#) and are currently in [beta](#).

# All features

Symmetric and asymmetric key support	Cloud KMS allows you to create, use, rotate, automatically rotate, and destroy AES256 symmetric and RSA 2048, RSA 3072, RSA 4096, EC P256, and EC P384 asymmetric cryptographic keys. With HSM, encrypt, decrypt, and sign with AES-256 symmetric and RSA 2048, RSA 3072, RSA 4096, EC P256, and EC P384 asymmetric cryptographic keys.
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Create external keys with EKM	Generate your external key using one of the following external key managers: Equinix, Fortanix, Ionic, Thales, and Unbound. Once you have linked your external key with Cloud KMS, you can use it to protect data at rest in BigQuery and Compute Engine.
Delay for key destruction	Cloud KMS has a built-in 24-hour delay for key material destruction, to prevent accidental or malicious data loss.
Encrypt and decrypt via API	Cloud KMS is a REST API that can use a key to encrypt, decrypt, or sign data such as secrets for storage.
High global availability	Cloud KMS is available in several global locations and across multi-regions, allowing you to place your service where you want for low latency and high availability.
Automated and at-will key rotation	Cloud KMS allows you to set a rotation schedule for symmetric keys to automatically generate a new key version at a fixed time interval. Multiple versions of a symmetric key can be active at any time for decryption, with only one primary key version used for encrypting new data. With EKM, create an externally managed key directly from the Cloud KSM console.
Statement attestation with HSM	With Cloud HSM, verify that a key was created in the HSM with attestation tokens generated for key creation operations.
Integration with GKE	Encrypt Kubernetes secrets at the application-layer in GKE with keys you manage in Cloud

	KMS. In addition, you can store API keys, passwords, certificates, and other sensitive data with the <a href="#">Secret Manager</a> storage system.
Maintain key-data separation	With EKM, maintain separation between your data at rest and your encryption keys while still leveraging the power of cloud for compute and analytics.
Key data residency	If using Cloud KMS, your cryptographic keys will be stored in the region where you deploy the resource. You also have the option of storing those keys inside a physical Hardware Security Module located in the region you choose with Cloud HSM.
Key import	You may be using existing cryptographic keys that were created on your premises or in an external key management system. You can import them into Cloud HSM keys or import software keys into Cloud KMS.
Justified access	Get a clear reason for every decryption request that will cause your data to change state from at-rest to in-use with Key Access Justifications (beta).
Automated policy	Key Access Justifications (beta) lets you set automated policies that approve or deny access to keys based on specific justifications. Let your external key manager, provided by Google Cloud technology partners, take care of the rest.
Integrity commitment	Controls provided by Key Access Justifications are covered by <a href="#">Google's</a>

	<a href="#">integrity commitments</a> , so that you know they can be trusted.
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# Cloud Logging

Fully managed, real-time log management with storage, search, analysis and alerting at exabyte scale.

New customers get \$300 in free credits to spend on Cloud Logging.

- Use [Logs Explorer](#) quickstart to view your logs in the Google Cloud Console
- Learn how Cloud Logging helps [customers](#) improve their troubleshooting and reliability practices
- Stay up-to-date with the [latest blogs, videos and other logging resources](#)
- Get deep operational and business insights with [Log Analytics](#) (in Preview), powered by BigQuery

Cloud Logging is a fully managed service that allows you to store, search, analyze, monitor, and alert on logging data and events from Google Cloud and Amazon Web Services. You can collect logging data from over 150 common application components, on-premises systems, and hybrid cloud systems.

Logging includes storage for logs through [log buckets](#), a user interface called the [Logs Explorer](#), and [an API](#) to manage logs programmatically. Logging lets you read and write log entries, query your logs, and control how you route and use your logs.

## BENEFITS

### Get started immediately

Platform logs are ingested from Google Cloud services and securely stored with no setup required. GKE workload logs are captured automatically and the Ops Agent captures workload logs from VMs.

### Quickly resolve issues

Cloud Logging is integrated with Cloud Monitoring, Error Reporting, and Cloud Trace so you can troubleshoot issues across your services. Configure alerts for logs so you stay up to date on important events.

### Real-time insights

Quickly spot anomalies with real-time ingestion, and use log-based metrics to build Cloud Monitoring dashboards. Log Analytics brings the power of BigQuery to Cloud Logging for deeper insights.

# Key features

## Logs Explorer

[Logs Explorer](#) enables you to search, sort, and analyze logs through flexible query statements, along with rich histogram visualizations, a simple field explorer, and ability to save the queries. Set [alerts](#) to notify you whenever a specific message appears in your included logs, or use Cloud Monitoring to [alert on](#) logs-based metrics you define.

## Regional log buckets

Use [log buckets](#) as part of your local or industry-specific compliance strategy. Log buckets store and process your workload's logs data only in the region you specify. These buckets feature customizable access control and retention.

## Error Reporting

[Error Reporting](#) automatically analyzes your logs for exceptions and intelligently aggregates them into meaningful error groups. See your top or new errors at a glance and set up notifications to automatically alert you when a new error group is identified.

## Cloud Audit Logs

[Cloud Audit Logs](#) helps security teams maintain audit trails in Google Cloud. Achieve the same level of transparency over administrative activities and [access](#) to data in Google Cloud as in on-premises environments. Every administrative activity is recorded on a hardened, always-on audit trail, which cannot be disabled by any rogue actor.

## Logs Router

Cloud Logging receives log entries through the [Cloud Logging API](#) where they pass through the Logs Router. The Logs Router checks each log entry against existing [inclusion filters](#) and [exclusion filters](#) to determine which log entries to discard, which to ingest, and which to include in exports.

# All features

Logs Explorer	<a href="#">Search, sort, and query logs</a> through flexible query statements, along with rich histogram visualizations, simple field explorers, and ability to save the queries.
Custom logs / Ingestion API	Write any custom log, from on-premises or another cloud, using our <a href="#">public write APIs</a> .
Logs alerting	Alert on specific messages in your logs or alert on logs-based metrics with <a href="#">Cloud Monitoring</a> .

Log Analytics (in Preview)	Platform and workload logging data ingested into Cloud Logging is made available in <a href="#">Log Analytics</a> , which is powered by BigQuery. Perform advanced analytics using SQL to query your logs. The log data is also made available directly in BigQuery so you can correlate your logs with other business data.
Logs retention	<a href="#">Configure</a> different retention periods for logs in different log buckets, and criteria for different logs using the Logs Router.
Logs-based metrics	Create <a href="#">metrics from log data</a> which appears seamlessly in Cloud Monitoring, where you can visualize these metrics and create dashboards.
Audit logging	Access <a href="#">audit logs</a> that capture all the admin and data access events within Google Cloud, with 400 days of data retention at no additional cost.
Third-party integrations	Integrate with external systems using Pub/Sub and configuring Logs Router to export the logs.
Logs archival	Store logs for a longer duration at lower cost by easily exporting into <a href="#">Cloud Storage</a> .
Error Reporting	<a href="#">Error Reporting</a> lets you see problems through the noise by automatically analyzing your logs for exceptions and intelligently aggregating them into meaningful error groups.
Log buckets and views	<a href="#">Log buckets</a> provide a first-class logs storage solution that lets you centralize or subdivide your logs based on your needs. From there, use log views to specify which logs a user should have access to, all through standard IAM controls.

# Cloud Monitoring

Gain visibility into the performance, availability, and health of your applications and infrastructure.

- Get started now with: [dashboards](#), the [Ops Agent for VMs](#), and [Managed Service for Prometheus](#)
- Built on the same backend used by Google that holds over [65 quadrillion points on disk](#)
- Learn how Cloud Monitoring helps [customers](#) implement SRE principles to improve their businesses
- Stay up-to-date with the [latest blogs and resources](#)
- Learn about [Managed Service for Prometheus](#), our fully managed storage and query service

**Cloud Monitoring** collects metrics, events, and metadata from Google Cloud, Amazon Web Services (AWS), hosted uptime probes, and application instrumentation. Using the [BindPlane service](#), you can also collect this data from over 150 common application components, on-premise systems, and hybrid cloud systems. Google Cloud's operations suite ingests that data and generates insights via dashboards, charts, and alerts. BindPlane is included with your Google Cloud project at no additional cost.

To collect metrics data from your Compute Engine instances, [create an Agent Policy](#) that automatically installs and maintains the Google Cloud's operations suite agents across your fleet of VMs.

## BENEFITS

### For Google Cloud and other environments

Cloud Monitoring offers automatic out-of-the-box metric collection dashboards for Google Cloud services. It also supports monitoring of hybrid and multicloud environments.

### Identify trends, prevent issues

Metrics, events, and metadata are displayed with rich query language that helps identify issues and uncover patterns. Service-level objectives measure user experience and improve collaboration with developers.

## Reduce monitoring overhead

One integrated service for metrics, uptime monitoring, dashboards, and alerts reduces time spent navigating between systems. Observability in context makes metrics available within Google Cloud resource pages.

## Key features

### SLO monitoring

Automatically infer or custom define [service-level objectives \(SLOs\)](#) for applications and get alerted when SLO violations occur. Check out our [step-by-step guide](#) to learn how to set SLOs, following SRE best practices.

### Managed metrics collection for Kubernetes and virtual machines

Google Cloud's operations suite offers [Managed Service for Prometheus](#) for use with Kubernetes, which features self-deployed and managed collection options to simplify metrics collection, storage, and querying. For VMs, you can use the [Ops Agent](#), which combines logging and metrics collection into a single agent that can be deployed at scale using popular configuration and management tools.

### Google Cloud integration

Discover and monitor all Google Cloud resources and services, with no additional instrumentation, integrated right into the Google Cloud console.

## All features

SLO monitoring	Automatically infer or custom define <a href="#">service-level objectives (SLOs)</a> for applications and get alerted when SLO violations occur.
Custom metrics	Instrument your application to monitor <a href="#">application and business-level metrics</a> via Cloud Monitoring.
Google Cloud Console integration	<a href="#">Discover and monitor</a> all Google Cloud resources and services, with no additional configuration, integrated right into the Google Cloud console.

Managed Service for Prometheus	<a href="#">Monitor and alert</a> on your workloads, using Prometheus, without having to manually manage and operate Prometheus at scale.
Ops Agent	Deploy the <a href="#">Ops Agent</a> on your Google Cloud VMs to collect detailed metrics and logs from your applications and system. Try the in-console, <a href="#">step-by-step tutorial</a> to experience installing the agent on a live VM.
Logging integration	Drill down from dashboards and charts to logs. Create, visualize, and alert on <a href="#">metrics based on log data</a> .
Dashboards	Get visibility into your cloud resources and services with no configuration. Define <a href="#">custom dashboards</a> and take advantage of Google's powerful data visualization tools.
Multiple project and group/cluster support	Create <a href="#">metrics scopes</a> to monitor single or multiple projects together, and create <a href="#">resource groups</a> to define relationships based on resource names, tags, security groups, projects, regions, accounts, and other criteria. Use those relationships to create targeted dashboards and topology-aware alerting policies.
Alerting	Configure <a href="#">alerting policies</a> to notify you when events occur or particular system or custom metrics violate rules that you define. Use multiple conditions to define

	complex alerting rules. Receive notifications via email, SMS, Slack, PagerDuty, and more.
Uptime monitoring	<a href="#">Monitor the availability</a> of your internet-accessible URLs, VMs, APIs, and load balancers from probes around the globe with uptime checks. Create alerts to be notified proactively if there is an outage.

# Cloud Run

Build and deploy scalable containerized apps written in any language (including Go, Python, Java, Node.js, .NET, and Ruby) on a fully managed platform.

New customers get \$300 in free credits to spend on Cloud Run. All customers get 2 million requests free per month, not charged against your credits.

- Deploy a sample container that responds to incoming web requests with this [Quickstart](#).
- Building from source? Deploy a sample application to Cloud Run from source with this [guide](#).
- Run database migrations, nightly reports, or batch data transformation with [Cloud Run jobs](#)

Cloud Run is a managed compute platform that enables you to run containers that are invocable via requests or events. Cloud Run is serverless: it abstracts away all infrastructure management, so you can focus on what matters most — building great applications.

## Key features

### **Any language, any library, any binary**

Use the programming language of your choice, any language or operating system libraries, or even bring your own binaries.

### **Leverage container workflows and standards**

Containers have become a standard to package and deploy code and its dependencies. Cloud Run pairs great with the container ecosystem: [Cloud Build](#), [Cloud Code](#), [Artifact Registry](#), and [Docker](#).

### **Pay-per-use**

Only pay when your code is running, billed to the nearest 100 milliseconds.



# All features

Any language, any library, any binary	Built-in support for Node.js, Go, Java, Kotlin, Scala, Python, .Net and Docker. Use the programming language of your choice, any language or operating system libraries, or even bring your own binaries.
Leverage container workflows and standards	Cloud Run takes any container images and pairs great with the container ecosystem: <a href="#">Cloud Build</a> , <a href="#">Artifact Registry</a> , <a href="#">Docker</a> .
Enhanced developer experience	A simple command-line and user interface to quickly deploy and manage your services. Integration with <a href="#">Cloud Code</a> and <a href="#">Cloud Build</a> for continuous deployments.
Fully managed	No infrastructure to manage: once deployed, Cloud Run manages your services so you can sleep well.
Per-instance concurrency	Cloud Run automatically scales container instances and allows for up to <a href="#">1,000 concurrent requests</a> on each container instance, providing a high level of efficiency.
Fast autoscaling	Cloud Run automatically scales up or down from zero to N depending on traffic, leveraging container image streaming for a fast startup time.
Redundancy	Cloud Run services are regional, automatically replicated across multiple zones.
Security	Mount secrets from <a href="#">Secret Manager</a> . Only deploy trusted container images with <a href="#">Binary Authorization</a> . Bring your own encryption keys. Container instances run in a secure sandbox

	isolated from other resources, with dedicated identities and permissions.
Ephemeral and persistent storage	Leverage up to 32GiB of ephemeral storage with an <a href="#">in-memory filesystem</a> . Connect to <a href="#">network file systems</a> like Filestore or Cloud Storage FUSE for persistent storage.
Integrated logging and monitoring	Out-of-the-box integration with <a href="#">Cloud Monitoring</a> , <a href="#">Cloud Logging</a> , <a href="#">Cloud Trace</a> , and <a href="#">Error Reporting</a> to ensure the health of an application.
Process web traffic	Expose Cloud Run services publicly to receive web requests
Process asynchronous events	<a href="#">Set up triggers</a> to receive events from Google services, SaaS, and your own apps using loosely coupled services that react to state changes.
Portability	Cloud Run accepts standard container images and is built on the Knative open-source project, enabling portability of your workloads across platforms.
HTTPS URLs	Each Cloud Run service gets an out-of-the-box stable HTTPS endpoint, with TLS termination handled for you.
Custom domains	Map your services to your own domains.
HTTP/2, WebSockets, and gRPC	Invoke and connect Cloud Run services with HTTP/1.*, HTTP/2, WebSockets, or gRPC (unary and streaming).

# Cloud Spanner

Fully managed relational database with unlimited scale, strong consistency, and up to 99.999% availability.

New customers get \$300 in free credits to spend on Spanner. All customers can create a 90-day Spanner free trial instance with 10 GB of storage, not charged against their credits.

- Get all the benefits of relational semantics and SQL with unlimited scale
- Start at any size and scale with no limits as your needs grow. Get started with a [free trial](#).
- Enjoy high availability with zero scheduled downtime and online schema changes
- Deliver high-performance transactions with strong consistency across regions and continents
- Focus on innovation, eliminating manual tasks with capabilities like automatic sharding

Cloud Spanner is a fully managed, mission-critical, relational database service that offers transactional consistency at global scale, automatic, synchronous replication for high availability, and support for two SQL dialects: Google Standard SQL (ANSI 2011 with extensions) and PostgreSQL.

## BENEFITS

### **Scale as needed with no limits**

Globally distributed, ACID-compliant database that automatically handles replicas, sharding, and transaction processing, so you can quickly scale to meet any usage pattern and ensure success of your products.

### **Make your database highly available anywhere**

Cloud Spanner is built on Google's dedicated network and battle tested by Google services used by billions. It offers up to 99.999% availability with zero downtime for planned maintenance and schema changes.

## Do fewer thankless tasks with a simpler experience

IT admins and DBAs are inundated with operating databases. With Cloud Spanner, creating or scaling a globally replicated database now takes a handful of clicks and reduces your cost of maintaining databases.

## Key features

### Relational database, built for scale

Everything you would expect from a relational database—schemas, [SQL queries](#), and ACID transactions—battle tested and ready to scale globally.

### 99.999% availability

Cloud Spanner delivers industry-leading 99.999% availability for multi-regional instances—10x less downtime than four nines—and provides transparent, synchronous replication across region and multi-region configurations.

### Automatic sharding

Cloud Spanner optimizes performance by automatically sharding the data based on request load and size of the data. As a result, you can spend less time worrying about how to scale your database and instead focus on scaling your business.

## All features

Relational database, built for scale	Everything you would expect from a relational database—schemas, SQL queries, and ACID transactions—battle-tested and ready to scale for both reads and writes globally.
99.999% availability	Industry-leading 99.999% availability for multi-regional instances with TrueTime atomic clocks and transparent, synchronous replication. 100% online schema changes and maintenance while serving traffic with zero downtime.
Automatic sharding	Optimize performance by automatically sharding the data based on request load and data size. As a result, you can scale your database without disruptive re-architecture, and focus on growing your business.

Fully managed	Easy deployment at every stage and for any size database. Synchronous replication and maintenance are automatic and built in.
Strong transactional consistency	Purpose-built for industry-leading <a href="#">external</a> consistency without compromising on scalability or availability.
Granular instance sizing	Start with Spanner with a granular instance for only \$65/month and scale it based on your needs without downtime and with no need for re-architecting. <a href="#">Learn more.</a>
PostgreSQL interface	Combine the scalability and reliability of Spanner with the familiarity and portability of PostgreSQL. Use the skills and tools that your teams already know, future-proofing your investment for peace of mind. <a href="#">Learn more.</a>
Regional and multi-regional configurations	No matter where your users may be, apps backed by Spanner can read and write up-to-date strongly consistent data globally. Additionally, when running a multi-region instance, your database is protected against a regional failure and offers industry-leading 99.999% availability.
Federated queries with BigQuery	Query data in Spanner from BigQuery in real time without moving or copying the data, bridging the gap between operational data and analytics and creating a unified data life cycle.
Built on Google Cloud network	Cloud Spanner is built on Google's dedicated <a href="#">network</a> that provides low-latency, security, and reliability for serving users across the globe.

Enterprise-grade security and controls	<a href="#">Customer-managed encryption keys (CMEK)</a> , data-layer encryption, <a href="#">IAM integration</a> for access and controls, and comprehensive <a href="#">audit logging</a> . Support for VPC-SC, Access Transparency and Access Approval.
Backup and Restore, point-in-time recovery (PITR)	<a href="#">Backup</a> your database to store a consistent copy of data and restore on demand. <a href="#">PITR</a> provides continuous data protection with the ability to recover your past data to a microsecond granularity.
Rich application and tool support	Meet development teams where they are with native <a href="#">client libraries</a> for Java/ <a href="#">JDBC</a> , Go, Python, C#, Node.js, PHP, Ruby and C++ as well as the most popular ORMs, including Hibernate and Entity Framework.
Real-time change data capture and replication	Use <a href="#">Datastream</a> to deliver change data from Oracle and MySQL databases into Spanner for up-to-date information. Use <a href="#">Spanner change streams</a> to capture change data from Spanner databases and integrate it with other systems for analytics, event triggering, and compliance.
Observability	Monitor performance of Spanner databases with <a href="#">metrics</a> and <a href="#">stats</a> . Analyze usage patterns in Spanner databases with <a href="#">Key Visualizer</a> , an interactive monitoring tool.

# Cloud SQL

Fully managed relational database service for MySQL, PostgreSQL, and SQL Server with rich extension collections, configuration flags, and developer ecosystems.

New customers get \$300 in free credits to spend on Cloud SQL. You won't be charged until you upgrade.

- Reduce maintenance costs with fully managed [MySQL](#), [PostgreSQL](#) and [SQL Server](#) databases
- Ensure business continuity with reliable and secure services backed by 24/7 SRE team
- Automate database provisioning, storage capacity management, and other time-consuming tasks
- Database observability made easy for developers with Cloud SQL Insights
- Easy integration with existing apps and Google Cloud services like GKE and BigQuery

Cloud SQL is a fully-managed database service that helps you set up, maintain, manage, and administer your relational databases on Google Cloud Platform.

You can use Cloud SQL with [MySQL](#), [PostgreSQL](#), or [SQL Server](#).

## BENEFITS

### Secure and compliant

Data encryption at rest and in transit. Private connectivity with Virtual Private Cloud and user-controlled network access with firewall protection. Compliant with SSAE 16, ISO 27001, PCI DSS, and HIPAA.

### Scale as you go

Scale your instances effortlessly with a single API call whether you start with simple testing or you need a highly available database in production.

### Set up in minutes

Standard connection drivers and built-in migration tools allow you to create and connect to your first database in just a few minutes.

# Key features

## Fully managed

Cloud SQL automatically ensures your databases are reliable, secure, and scalable so that your business continues to run without disruption. Cloud SQL automates all your backups, replication, encryption patches, and capacity increases—while ensuring greater than 99.95% availability, anywhere in the world. Learn more about Cloud SQL availability features in this [guide](#).

## Integrated

Access Cloud SQL instances from just about any application. Easily connect from [App Engine](#), [Compute Engine](#), [Google Kubernetes Engine](#), and your workstation. Open up analytics possibilities by using BigQuery to [directly query](#) your Cloud SQL databases.

## Reliable

Easily configure replication and backups to protect your data. Go further by enabling automatic failover to make your database highly available. Your data is automatically encrypted, and Cloud SQL is SSAE 16, ISO 27001, and PCI DSS compliant and supports HIPAA compliance.

## Easy migrations to Cloud SQL

Database Migration Service (DMS) makes it easy to migrate your production databases to Cloud SQL with minimal downtime. This serverless offering eliminates the hassle of manually provisioning, managing, and monitoring migration-specific resources. DMS leverages the native replication capabilities of [MySQL](#), [PostgreSQL](#), [SQL Server](#) and [Oracle](#) to maximize the fidelity and reliability of your migration. And it's available at no additional charge for migrations to Cloud SQL. [Learn more](#).

# All features

Fast, easy migrations	<a href="#">Database Migration Service</a> makes it easy to migrate databases from on-premises, Compute Engine, and other clouds to Cloud SQL with minimal downtime.
Secure access and connectivity	Cloud SQL data is encrypted when on Google's internal networks and when stored in database tables, temporary files, and backups. Cloud SQL supports private connectivity with <a href="#">Virtual Private</a>



	<a href="#">Cloud (VPC)</a> , and every Cloud SQL instance includes a network firewall, allowing you to control public network access to your database instance.
Built-in high availability	<p>Replicate your instance to another zone or region with just a click of a button. Leverage built-in HA to provide isolation from many types of infrastructure hardware, and software failures.</p> <p> <a href="#">Cloud SQL for MySQL HA</a>  <a href="#">Cloud SQL for PostgreSQL HA</a>  <a href="#">Cloud SQL for SQL Server HA</a> </p> <p>Learn more about Cloud SQL availability features in this <a href="#">guide</a>.</p>
Scalability	<p>Easily scale up as your data grows—add processor cores, RAM and storage, and scale out by adding read replicas to handle increasing read traffic. Read replicas support high availability, can have their own read replicas, and can be located across regions and platforms.</p>
Automatic storage increases	<p>Cloud SQL can automatically scale up storage capacity when you are near your limit. This way you don't have to spend time estimating future storage needs or spend money on capacity until you need it.</p>
Cloud SQL Insights	<p>Quickly understand and resolve database performance issues on Cloud SQL. Pre-built dashboards and visual query plans help developers identify the root cause of problems. Access database metrics and traces in existing tools using <a href="#">OpenTelemetry</a>. Monitor databases through the lens of the application using query tags.</p> <p>Available now for PostgreSQL and MySQL.</p>

High performance	Cloud SQL supports performance-intensive workloads with very high IOPS and no extra cost for IO.
Easy integration	Access Cloud SQL instances from just about any application. Easily connect from App Engine, Compute Engine, Google Kubernetes Engine, and your workstation. Open up analytics possibilities by using BigQuery to directly query your Cloud SQL databases.
Real-time change data capture and replication	Synchronize data across heterogeneous databases, storage systems, and applications reliably and with minimal latency with <a href="#">Datastream</a> . Seamlessly deliver change streams from Oracle and MySQL databases into Google Cloud services such as BigQuery, Cloud SQL, Google Cloud Storage, and Cloud Spanner for up-to-date information.
Automatic backups	Automate daily backups and binary logging (for replication or point-in-time recovery).
Point-in-time recovery	Restore your instance to its state at an earlier point in time.
Compatibility	Build and deploy for the cloud faster because Cloud SQL offers standard <a href="#">MySQL</a> , <a href="#">PostgreSQL</a> , and <a href="#">Microsoft SQL Server</a> databases, ensuring application compatibility.
Standard APIs	Build and deploy for the cloud faster because Cloud SQL offers standard <a href="#">MySQL</a> , <a href="#">PostgreSQL</a> , and <a href="#">SQL Server</a> databases, ensuring application compatibility. Use standard connection drivers and built-in migration tools to get started quickly.

# Cloud Storage

Object storage for companies of all sizes. Store any amount of data. Retrieve it as often as you'd like.

New customers get \$300 in free credits to spend on Storage. All customers get 5 GB of US regional storage free per month, not charged against your credits.

- Deploy new storage capacity 99% faster than with on-premises environments. [Read the IDC report.](#)
- Replicate 100% of your data between regions in 15 mins or less. [Learn about Turbo Replication.](#)
- Understand what it means to have 99.999999999% annual storage durability [in this article](#)
- Learn how [customers](#) are building global businesses on Cloud Storage
- Start using Cloud Storage now with this [Quickstart guide](#)

## KEY FEATURES

### Reliable and secure object storage

#### Transition to lower-cost classes easily

Configure your data with [Object Lifecycle Management](#) (OLM) to automatically transition to lower-cost storage classes when it meets the criteria you specify, such as when it reaches a certain age or when you've stored a newer version of the data.

#### Multiple redundancy options

Cloud Storage has an ever-growing list of [storage bucket locations](#) where you can store your data with multiple automatic redundancy options. Whether you are optimizing for split-second response time, or creating a robust disaster recovery plan, customize where and how you store your data.

#### Easily transfer data to Cloud Storage

[Storage Transfer Service](#) offers a highly performant, online pathway to Cloud Storage—both with the scalability and speed you need to simplify the data transfer process. For offline data transfer our [Transfer Appliance](#) is a shippable storage

server that sits in your datacenter and then ships to an ingest location where the data is uploaded to Cloud Storage.

### **Archival storage you can actually use**

With low latency and a consistent API across Cloud Storage, the Archive and Coldline tiers deliver cold storage you can actually use. Tap your data archived in Archive or Coldline directly from applications with low latency, comparable to the other storage classes. When it comes to archival and business continuity, Archive and Coldline change what the industry can expect from cold storage in the cloud.

### **Storage classes for any workload**

Save costs without sacrificing performance by storing data across different storage classes. You can start with a class that matches your current use, then reconfigure for cost savings.

[Standard Storage](#): Good for “hot” data that’s accessed frequently, including websites, streaming videos, and mobile apps.

[Nearline Storage](#): Low cost. Good for data that can be stored for at least 30 days, including data backup and long-tail multimedia content.

[Coldline Storage](#): Very low cost. Good for data that can be stored for at least 90 days, including disaster recovery.

[Archive Storage](#): Lowest cost. Good for data that can be stored for at least 365 days, including regulatory archives.

## **All features**

Turbo Replication	An industry-leading premium feature that delivers a 15-min Replication Point Objective (RPO) for customers using dual-region storage. When enabled, 100% of writes are replicated to another region within 15 minutes. <a href="#">Learn more.</a>
Object Lifecycle Management	<a href="#">Define conditions</a> that trigger data deletion or transition to a cheaper storage class.
Object Versioning	Continue to <a href="#">store</a> old copies of objects when they are deleted or overwritten.

Retention policies	Define minimum <a href="#">retention periods</a> that objects must be stored for before they're deletable.
Object holds	<a href="#">Place a hold</a> on an object to prevent its deletion.
Customer-managed encryption keys	Encrypt object data with <a href="#">encryption keys</a> stored by the Cloud Key Management Service and managed by you.
Customer-supplied encryption keys	Encrypt object data with <a href="#">encryption keys</a> created and managed by you.
Uniform bucket-level access	Uniformly <a href="#">control access</a> to your Cloud Storage resources by disabling object ACLs.
Requester Pays	Require <a href="#">accessors of your data</a> to include a project ID to bill for network charges, operation charges, and retrieval fees.
Bucket Lock	<a href="#">Bucket Lock</a> allows you to configure a data retention policy for a Cloud Storage bucket that governs how long objects in the bucket must be retained.
Pub/Sub notifications for Cloud Storage	Send <a href="#">notifications</a> to Pub/Sub when objects are created, updated, or deleted.
Cloud Audit Logs with Cloud Storage	<a href="#">Maintain</a> admin activity logs and data access logs for your Cloud Storage resources.
Object- and bucket-level permissions	<a href="#">Cloud Identity and Access Management (IAM)</a> allows you to control who has access to your buckets and objects.

# Compute Engine

Secure and customizable compute service that lets you create and run virtual machines on Google's infrastructure.

New customers get \$300 in free credits to spend on Google Cloud. All customers get a general purpose machine (e2-micro instance) per month for free, not charged against your credits.

- [Predefined machine types](#): Start running quickly with pre-built and ready-to-go configurations
- [Custom machine types](#): Create VMs with optimal amounts of vCPU and memory, while balancing cost
- [Spot machines](#): Reduce computing costs by up to 91%.
- [Confidential computing](#): Encrypt your most sensitive data while it's being processed
- [Rightsizing recommendations](#): Optimize resource utilization with automatic recommendations

## KEY FEATURES

## Choosing the right virtual machine type

### Scale-out workloads (T2D)

T2D offers [the best price-performance](#) compared to general-purpose VMs from any of the leading public cloud vendors. It is the first instance type in the [Tau VM family](#) and comes in predefined shapes, with up to 60vCPUs per VM and 4GB of memory per vCPU. T2D is ideal for scale-out workloads like web servers, containerized microservices, media transcoding, and large scale java applications.

### General purpose workloads (E2, N2, N2D, N1)

[E2](#), [N2](#), [N2D](#), and [N1](#) are general-purpose machines offering a good balance of price and performance, and are suitable for a wide variety of common workloads including databases, development and testing environments, web applications, and mobile gaming. They support up to 224 vCPUs and 896 GB of memory.

### Ultra-high memory (M2, M1)

[Memory-optimized machines](#) offer the highest memory configurations with up to 12 TB for a single instance. They are well suited to memory-intensive workloads

such as large in-memory databases like SAP HANA, and in-memory data analytics workloads.

### **Compute-intensive workloads (C2, C2D)**

[Compute-optimized machines](#) provide the highest performance per core on Compute Engine and are optimized for workloads such as [high performance computing](#) (HPC), game servers, and latency-sensitive API serving.

### **Most demanding applications and workloads (A2)**

[Accelerator-optimized machines](#) are based on the [NVIDIA Ampere A100 Tensor Core GPU](#). Each A100 GPU offers up to 20x the compute performance compared to the previous generation GPU. These VMs are designed for your most demanding workloads such as machine learning and [high performance computing](#).

## **All features**

VM Manager	<a href="#">VM Manager</a> is a suite of tools that can be used to manage operating systems for large virtual machine (VM) fleets running Windows and Linux on Compute Engine.
Confidential VMs	<a href="#">Confidential VMs</a> are a breakthrough technology that allows you to encrypt data in use—while it's being processed. It is a simple, easy-to-use deployment that doesn't compromise on performance. You can collaborate with anyone, all while preserving the confidentiality of your data.
Live migration for VMs	Compute Engine virtual machines can <a href="#">live-migrate</a> between host systems without rebooting, which keeps your applications running even when host systems require maintenance.
Sole-tenant nodes	<a href="#">Sole-tenant nodes</a> are physical Compute Engine servers dedicated exclusively for your use. Sole-tenant nodes simplify deployment for bring-your-own-license (BYOL) applications. Sole-tenant nodes give you access to the same machine types and VM configuration options as regular compute instances.

Custom machine types	Create a virtual machine with a <a href="#">custom machine type</a> that best fits your workloads. By tailoring a custom machine type to your specific needs, you can realize significant savings.
Predefined machine types	Compute Engine offers predefined virtual machine configurations for every need from small general purpose instances to large memory-optimized instances with up to 11.5 TB of RAM or fast compute-optimized instances with up to 60 vCPUs.
Spot VMs	Affordable compute instances suitable for batch jobs and fault-tolerant workloads. <a href="#">Spot VMs</a> provide significant savings of up to 91%, while still getting the same performance and capabilities as regular VMs.
Instance groups	<a href="#">An instance group</a> is a collection of virtual machines running a single application. It automatically creates and deletes virtual machines to meet the demand, repairs workload from failures, and runs updates.
Persistent disks	Durable, high-performance block storage for your VM instances. You can create persistent disks in HDD or SSD formats. You can also take snapshots and create new persistent disks from that snapshot. If a VM instance is terminated, its persistent disk retains data and can be attached to another instance.
Local SSD	Compute Engine offers always-encrypted local solid-state drive (SSD) block storage. Local SSDs are physically attached to the server that hosts the virtual machine instance for very high input/output operations per second (IOPS) and very low latency compared to persistent disks.
GPU accelerators	GPUs can be added to accelerate computationally intensive workloads like machine learning, simulation, and



	virtual workstation applications. Add or remove GPUs to a VM when your workload changes and pay for GPU resources only while you are using them. Our new A2 VM family is based on the NVIDIA Ampere A100 GPU. You can learn more about the A2 VM family by requesting access to our alpha program.
Global load balancing	Global load-balancing technology helps you distribute incoming requests across pools of instances across multiple regions, so you can achieve maximum performance, throughput, and availability at low cost.
Linux and Windows support	Run your choice of OS, including Debian, CentOS, CoreOS, SUSE, Ubuntu, Red Hat Enterprise Linux, FreeBSD, or Windows Server 2008 R2, 2012 R2, and 2016. You can also use a shared image from the Google Cloud community or bring your own.
Per-second billing	Google bills in second-level increments. You pay only for the compute time that you use.
Commitment savings	With committed-use discounts, you can save up to 57% with no up-front costs or instance-type lock-in.
Container support	Run, manage, and orchestrate Docker containers on Compute Engine VMs with Google Kubernetes Engine.
Reservations	Create reservations for VM instances in a specific zone. Use reservations to ensure that your project has resources for future increases in demand. When you no longer need a reservation, delete the reservation to stop incurring charges for it.
Right-sizing recommendations	Compute Engine provides machine type recommendations to help you optimize the resource utilization of your virtual machine (VM) instances. Use these recommendations to

	resize your instance's machine type to more efficiently use the instance's resources.
OS patch management	With OS patch management, you can apply OS patches across a set of VMs, receive patch compliance data across your environments, and automate installation of OS patches across VMs—all from a centralized location.
Placement Policy	Use Placement Policy to specify the location of your underlying hardware instances. Spread Placement Policy provides higher reliability by placing instances on distinct hardware, reducing the impact of underlying hardware failures. Compact Placement Policy provides lower latency between nodes by placing instances close together within the same network infrastructure.

# Confidential Computing

Encrypt data in-use with Confidential VMs and Confidential GKE Nodes

- Breakthrough technology that allows you to encrypt data in use—while it's being processed
- Simple, easy-to-use deployment that doesn't compromise on performance
- Collaborate with anyone, all while preserving the confidentiality of your data

## BENEFITS

### **Breakthrough in confidentiality**

Confidential VMs are a breakthrough technology that allow customers to encrypt their most sensitive data in the cloud while it's being processed.

### **Simple for everyone**

Google Cloud's approach allows customers to encrypt data in use without making any code changes to their applications or having to compromise on performance.

### **Enabling new possibilities**

Confidential Computing can unlock scenarios which previously have not been possible. Organizations will be able to collaborate, all while preserving the confidentiality of their data.

## **Key features**

### **Real-time encryption in use**

Google Cloud customers can encrypt data in use, taking advantage of security technology offered by modern CPUs (e.g., Secure Encrypted Virtualization extension supported by 2nd Gen AMD EPYC™ CPUs) together with confidential computing cloud services. Customers can be confident that their data will stay private and encrypted even while being processed.

### **Lift and shift confidentiality**

Our goal is to make Confidential Computing easy. The transition to Confidential VMs is seamless—all workloads you run today, new and existing, can run as a Confidential VM. You do not need to make any code changes to your applications to use Confidential VMs. One checkbox—it's that simple.

## Enhanced innovation

Confidential Computing can unlock computing scenarios that have previously not been possible. Organizations will now be able collaborate on research in the cloud across geographies, across competitors, all while preserving confidentiality.

## All features

Real-time encryption in use	Google Cloud customers can encrypt data in use, taking advantage of security technology offered by modern CPUs (e.g., secure encrypted virtualization supported by 2nd Gen AMD EPYC™ CPUs) together with confidential computing cloud services. Customers can be confident that their data will stay private and encrypted even while being processed.
Lift and shift confidentiality	Our goal is to make Confidential Computing easy. The transition to Confidential VMs is seamless—all workloads you run today, new and existing, can run as a Confidential VM. You do not need to make any code changes to your applications to use Confidential VMs. One checkbox—it's that simple.
Detection of advanced persistent attacks	Confidential Computing builds on the protections Shielded VMs offer against rootkit and bootkits. This helps ensure the integrity of the operating system you choose to run in your Confidential VM.
Enable innovation	Confidential Computing can unlock computing scenarios that have previously not been possible. Organizations will now be able collaborate on research in the cloud, all while preserving confidentiality.

High performance	Confidential VMs offer similar performance to standard N2D VMs. Explore <a href="#">tech docs and whitepapers</a> .
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# Encrypt workload data in-use with Confidential Google Kubernetes Engine Nodes

## Overview

Confidential GKE Nodes is built on top of Compute Engine [Confidential VM](#), which encrypts the memory contents of VMs in-use. Encryption-in-use is one of the three states of end-to-end encryption.

When you enable Confidential GKE Nodes on a cluster or on a node pool, data in workloads running on the confidential nodes is encrypted-in-use. For visibility over your control plane, use [Access Transparency](#).

You can enable Confidential GKE Nodes when doing one of the following:

- Create a new cluster
- Create a new node pool
- Update an existing node pool

You cannot update an existing cluster to change the cluster-level Confidential GKE Nodes setting.

The following table shows you the GKE behavior that applies when you enable Confidential GKE Nodes at the cluster level or at the node pool level:

Confidential GKE Nodes setting	How to configure	Behavior
Cluster-level	Create a new cluster	<p>All nodes in the cluster in any node pool use Confidential GKE Nodes. You <b>cannot</b> do the following:</p> <ul style="list-style-type: none"> <li>• Disable Confidential GKE Nodes for a new or existing node pool in the cluster</li> <li>• Disable Confidential GKE Nodes on the cluster</li> </ul>

		<ul style="list-style-type: none"> <li>• Enable Confidential GKE Nodes on existing clusters</li> </ul>
Node pool level	<ul style="list-style-type: none"> <li>• Create a new node pool</li> <li>• Update an existing node pool</li> </ul>	You can only configure Confidential GKE Nodes for node pools when this feature disabled at the cluster-level.

Data Catalog is now a part of Dataplex.

# Dataplex

Break free from data silos with Dataplex's intelligent data fabric that enables organizations to centrally discover, manage, monitor, and govern their data across data lakes, data warehouses, and data marts with consistent controls, providing access to trusted data and powering analytics at scale.

- Single pane of glass for data management across data silos
- Centralized security and governance enabling distributed ownership of data with global control
- Unified search and data discovery, based on business context, across distributed data
- Built-in data intelligence to enable trust in data and accelerate time to insights
- An open platform with support for open source tools and a robust partner ecosystem

## BENEFITS

### **Freedom of choice**

Get the freedom to store data where you want for the best price and performance while choosing the best analytics tools, open source or cloud native, to accelerate the entire analytics lifecycle.

### **Intelligent automation**

Built-in data intelligence using Google's best-in-class AI/ML capabilities that automate data discovery, metadata harvesting, data lifecycle management, data quality and lineage to reduce management costs.

### **Unified governance**

Enable standardization and unification of metadata, security policies, governance, and data classification for consistency across distributed data.

# Key features

## Centralized security and governance

Enable central policy management, monitoring, and auditing for data authorization and classification, across data silos. Facilitate distributed data ownership based on business domains with global monitoring and governance.

## Unified metadata management with Data Catalog

Automate data discovery, classification, and metadata enrichment of structured, semi-structured, and unstructured data, stored in Google Cloud and beyond, with built-in data intelligence. Manage technical, operational, and business metadata, for all your data, in a unified, flexible, and powerful Data Catalog.

## Simplified data discovery and exploration

Easily search, find, and understand your data with built-in faceted-search interface using the same search technology as Gmail. Explore and analyze this data using a variety of analytics and data science tools.

## Data quality and lineage

Automate data quality across distributed data and enable access to data you can trust. Use automatically captured data lineage to better understand your data, trace dependencies, and effectively troubleshoot data issues.

## Data organization and lifecycle management

Logically organize your data that spans multiple storage services into business-specific domains using Dataplex lakes and data zones. Manage, curate, tier, and archive your data easily with one-click.

## What is Data Catalog?

Data Catalog is a fully managed, scalable metadata management service within [Dataplex](#).

Why do you need Data Catalog?

Most organizations today are dealing with a large and growing number of data assets.

Data stakeholders (consumers, producers, and administrators) within an organization face multiple challenges:

- **Searching for insightful data:**
  - Data consumers don't know the location and origin of data. They have to navigate data "swamps".
  - Data consumers don't know what data to use to get insights because most data is not well documented and, even if documented, is not well maintained.



- Data can't be found and is often lost when it resides only in people's minds.
- **Understanding data:**
  - Is the data fresh, clean, validated, approved for use in production?
  - Which dataset out of several duplicate sets is relevant and up-to-date?
  - How does one dataset relate to another?
  - Who is using the data and who is the owner?
  - Who and what processes are transforming the data?
- **Making data useful:**
  - Data producers don't have an efficient way to put forward their data for consumers. If there's no self-service, consumers may overwhelm producers. Several data engineers can't manually provide data to thousands of data analysts.
  - Valuable time is lost if data consumers have to find out how to request data access, request it, wait without a defined response time, escalate, and wait again.

Without the right tools, the challenges become a major obstacle to the efficient use of data. Data Catalog provides a centralized place that lets organizations achieve the following:

- Gain a **unified view** to reduce the pain of searching for the right data.
- Support data-driven decision making and accelerate the insight time by enriching data with **technical and business metadata**.
- Improve **data management** to increase operational efficiency and productivity.
- Take **ownership** over the data to improve trust and confidence in it.

Data Catalog functions

Data Catalog provides three main functions:

- Searching for data entries for which you have access
- Tagging data entries with metadata
- Providing column-level security for BigQuery tables

In addition, Data Catalog can leverage the results of a [Cloud Data Loss Prevention](#) (DLP) scan to identify sensitive data directly within Data Catalog in the form of tag templates.

## What is Dataplex?

Dataplex is an intelligent data fabric that helps you unify distributed data and automate data management and governance across that data to power analytics at scale.

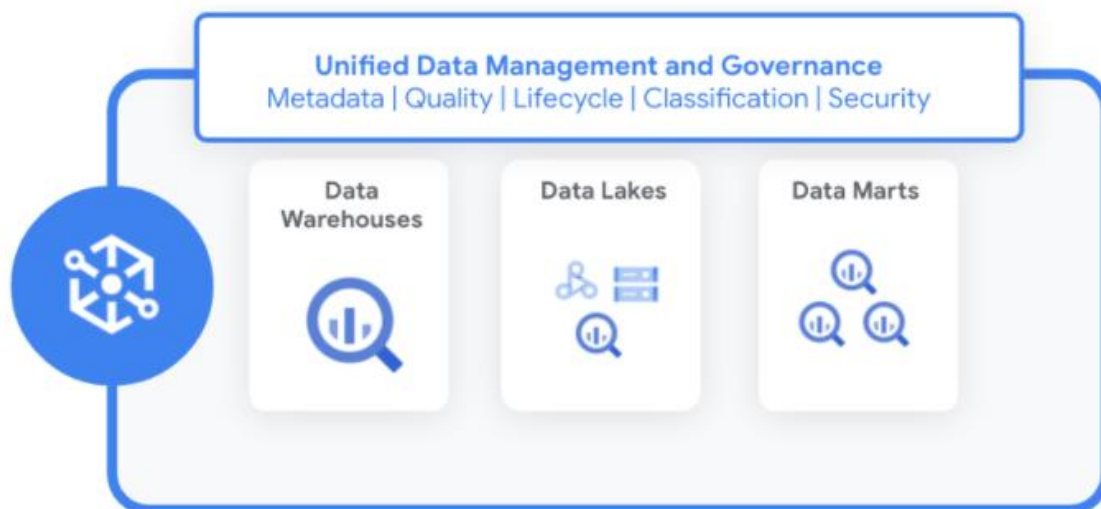
Additionally, you can discover and curate metadata across various silos using catalog capabilities in Dataplex. See [Data Catalog Overview](#).

For data stored in Cloud Storage and BigQuery, Dataplex enables you to:

- Build a domain-specific data mesh across data stored in multiple Google Cloud projects, without any data movement.
- Consistently govern and monitor data with a single set of permissions.
- Automate metadata discovery and make the data securely accessible and available for querying via BigQuery as external tables, and open source applications such as SparkSQL, Presto, and HiveQL.
- Run data quality and data lifecycle management tasks, including serverless Spark tasks.
- Explore data using fully-managed, serverless Spark environments with simple access to notebooks and SparkSQL queries.

## Why use Dataplex?

Enterprises have data distributed across data lakes, data warehouses, and data marts. Dataplex enables you to discover, curate, and unify this data without any data movement, organize it based on your business needs, and centrally manage, monitor, and govern this data. Dataplex enables standardization and unification of metadata, security policies, governance, classification, and data lifecycle management across this distributed data.



# Data Studio

Self-service business intelligence with unmatched flexibility for smarter business decisions.

- Tell impactful stories by creating and sharing engaging reports and data visualizations
- Unite your data by easily connecting to more than 800 data sources
- Transform your data to impactful business metrics and dimensions with intuitive smart reports
- Empower your teams with key business metrics by sharing automated dashboards
- Create meaningful, shareable, customizable, charts and graphs with just a few clicks

Data Studio is a free, self-service business intelligence platform that lets users build and consume data visualizations, dashboards, and reports. With Data Studio, you can connect to your data, create visualizations, and share your insights with others.

## BENEFITS

### **Your data is beautiful—use it**

Data Studio unlocks the power of your data by making it easy to create interactive dashboards and compelling reports from a wide variety of sources, driving smarter business decisions.

### **Connect to data without limits**

You can access a wide variety of data sources through the more than 600 partner connectors that instantly enable you to connect virtually any kind of data, without any coding or software.

### **Share your data story**

You can share your compelling reports with your team or with the world, collaborate in real time, or embed your reports on the web.

# Key features

## **An easy-to-use web interface**

Data Studio is designed to be intuitive and easy to use. The report editor features simple drag-and-drop objects with fully custom property panels and a snap-to-grid canvas.

## **Report templates**

With a robust library of report templates to choose from, you can visualize your data in minutes. Connect your data sources and customize the design to meet your needs.

## **Data connectors**

Data sources act as pipes to connect a Data Studio report to underlying data. Each source has a unique, prebuilt connector to ensure your data is easy to access and use.

## **Data Studio API**

The Data Studio API allows Google Workspace or Cloud Identity organizations to automate management and migration of Data Studio assets. You can configure an application to use the Data Studio API quickly and easily.

## **Report embedding**

Embedding allows you to include your Data Studio report in any web page or intranet, making it easier for you to tell your data story to your team or the world.

# Dataflow

Unified stream and batch data processing that's serverless, fast, and cost-effective.

New customers get \$300 in free credits to spend on Dataflow.

- Fully managed data processing service
- Automated provisioning and management of processing resources
- Horizontal autoscaling of worker resources to maximize resource utilization
- OSS community-driven innovation with Apache Beam SDK
- Reliable and consistent exactly-once processing

Dataflow is a managed service for executing a wide variety of data processing patterns. The documentation on this site shows you how to deploy your batch and streaming data processing pipelines using Dataflow, including directions for using service features.

The Apache Beam SDK is an open source programming model that enables you to develop both batch and streaming pipelines. You create your pipelines with an Apache Beam program and then run them on the Dataflow service. The [Apache Beam documentation](#) provides in-depth conceptual information and reference material for the Apache Beam programming model, SDKs, and other runners.

## BENEFITS

### **Streaming data analytics with speed**

Dataflow enables fast, simplified streaming data pipeline development with lower data latency.

### **Simplify operations and management**

Allow teams to focus on programming instead of managing server clusters as Dataflow's serverless approach removes operational overhead from data engineering workloads.

### **Reduce total cost of ownership**

Resource autoscaling paired with cost-optimized batch processing capabilities means Dataflow offers virtually limitless capacity to manage your seasonal and spiky workloads without overspending.

## Key features

### Autoscaling of resources and dynamic work rebalancing

Minimize pipeline latency, maximize resource utilization, and reduce processing cost per data record with data-aware resource autoscaling. Data inputs are partitioned automatically and constantly rebalanced to even out worker resource utilization and reduce the effect of “hot keys” on pipeline performance.

### Flexible scheduling and pricing for batch processing

For processing with flexibility in job scheduling time, such as overnight jobs, flexible resource scheduling (FlexRS) offers a lower price for batch processing. These flexible jobs are placed into a queue with a guarantee that they will be retrieved for execution within a six-hour window.

### Ready-to-use real-time AI patterns

Enabled through ready-to-use patterns, Dataflow’s real-time AI capabilities allow for real-time reactions with near-human intelligence to large torrents of events. Customers can build intelligent solutions ranging from predictive analytics and anomaly detection to real-time personalization and other advanced analytics use cases.

## All features

Vertical autoscaling - new in Dataflow Prime	Dynamically adjusts the compute capacity allocated to each worker based on utilization. Vertical autoscaling works hand in hand with horizontal autoscaling to seamlessly scale workers to best fit the needs of the pipeline.
Right fitting - new in Dataflow Prime	Right fitting creates stage-specific pools of resources that are optimized for each stage to reduce resource wastage.
Smart diagnostics - new in Dataflow Prime	A suite of features including 1) SLO-based data pipeline management, 2) Job visualization capabilities that provide users a visual way to inspect their job graph and identify bottlenecks, 3) Automatic recommendations to identify and tune performance and availability problems.

Streaming Engine	Streaming Engine separates compute from state storage and moves parts of pipeline execution out of the worker VMs and into the Dataflow service back end, significantly improving autoscaling and data latency.
Horizontal autoscaling	Horizontal autoscaling lets the Dataflow service automatically choose the appropriate number of worker instances required to run your job. The Dataflow service may also dynamically reallocate more workers or fewer workers during runtime to account for the characteristics of your job.
Dataflow Shuffle	Service-based Dataflow Shuffle moves the shuffle operation, used for grouping and joining data, out of the worker VMs and into the Dataflow service back end for batch pipelines. Batch pipelines scale seamlessly, without any tuning required, into hundreds of terabytes.
Dataflow SQL	Dataflow SQL lets you use your SQL skills to develop streaming Dataflow pipelines right from the BigQuery web UI. You can join streaming data from Pub/Sub with files in Cloud Storage or tables in BigQuery, write results into BigQuery, and build real-time dashboards using Google Sheets or other BI tools.
Flexible Resource Scheduling (FlexRS)	Dataflow FlexRS reduces batch processing costs by using advanced scheduling techniques, the Dataflow Shuffle service, and a combination of preemptible virtual machine (VM) instances and regular VMs.

Dataflow templates	<p><a href="#">Dataflow templates</a> allow you to easily share your pipelines with team members and across your organization or take advantage of many Google-provided templates to implement simple but useful data processing tasks. This includes Change Data Capture templates for streaming analytics use cases. With Flex Templates, you can create a template out of any Dataflow pipeline.</p>
Notebooks integration	<p>Iteratively build pipelines from the ground up with Vertex AI Notebooks and deploy with the Dataflow runner. Author Apache Beam pipelines step by step by inspecting pipeline graphs in a read-eval-print-loop (REPL) workflow. Available through Google's Vertex AI, Notebooks allows you to write pipelines in an intuitive environment with the latest data science and machine learning frameworks.</p>
Real-time change data capture	<p>Synchronize or replicate data reliably and with minimal latency across heterogeneous data sources to power streaming analytics. Extensible <a href="#">Dataflow templates</a> integrate with <a href="#">Datastream</a> to replicate data from Cloud Storage into BigQuery, PostgreSQL, or Cloud Spanner. Apache Beam's <a href="#">Debezium connector</a> gives an open source option to ingest data changes from MySQL, PostgreSQL, SQL Server, and Db2.</p>
Inline monitoring	<p>Dataflow inline monitoring lets you directly access job metrics to help with troubleshooting</p>



	batch and streaming pipelines. You can access monitoring charts at both the step and worker level visibility and set alerts for conditions such as stale data and high system latency.
Customer-managed encryption keys	You can create a batch or streaming pipeline that is protected with a customer-managed encryption key (CMEK) or access CMEK-protected data in sources and sinks.
Dataflow VPC Service Controls	Dataflow's integration with VPC Service Controls provides additional security for your data processing environment by improving your ability to mitigate the risk of data exfiltration.
Private IPs	Turning off public IPs allows you to better secure your data processing infrastructure. By not using public IP addresses for your Dataflow workers, you also lower the number of public IP addresses you consume against your Google Cloud project quota.

# Dataproc

Dataproc is a fully managed and highly scalable service for running Apache Spark, Apache Flink, Presto, and 30+ open source tools and frameworks. Use Dataproc for data lake modernization, ETL, and secure data science, at planet scale, fully integrated with Google Cloud, at a fraction of the cost.

- Open: Run open source data analytics at scale, with enterprise grade security
- Flexible: Use [serverless](#), or manage clusters on Google Compute and Kubernetes
- Intelligent: Enable data users through integrations with [Vertex AI](#), [BigQuery](#), and [Dataplex](#)
- Secure: Configure advanced security such as Kerberos, Apache Ranger and [Personal Authentication](#)
- Cost-effective: Realize [54% lower TCO](#) compared to on-prem data lakes with per-second pricing

## BENEFITS

### Modernize your open source data processing

Whether you need VMs or Kubernetes, extra memory for Presto, or even GPUs, Dataproc can help accelerate your data and analytics processing through on-demand purpose-built or serverless environments.

### Intelligent and seamless OSS for data science

Enable data scientists and data analysts to seamlessly perform data science jobs through native integrations with [Vertex AI](#).

### Advanced security, compliance, and governance

Manage and enforce user authorization and authentication using existing [Kerberos](#) and [Apache Ranger](#) policies or [Personal Cluster Authentication](#). Define permissions without having to set up a network node.

# Key features

## Fully managed and automated big data open source software

[Serverless deployment](#), logging, and monitoring let you focus on your data and analytics, not on your infrastructure. Reduce TCO of Apache Spark management by [up to 54%](#). Enable data scientists and engineers to build and train models 5X faster, compared to traditional notebooks, through integration with [Vertex AI Workbench](#). The Dataproc Jobs API makes it easy to incorporate big data processing into custom applications, while [Dataproc Metastore](#) eliminates the need to run your own Hive metastore or catalog service.

## Containerize Apache Spark jobs with Kubernetes

Build your Apache Spark jobs using [Dataproc on Kubernetes](#) so you can use Dataproc with Google Kubernetes Engine (GKE) to provide job portability and isolation.

## Enterprise security integrated with Google Cloud

When you create a Dataproc cluster, you can enable Hadoop Secure Mode via Kerberos by adding a [Security Configuration](#). Additionally, some of the most commonly used Google Cloud-specific security features used with Dataproc include default at-rest encryption, OS Login, VPC Service Controls, and customer-managed encryption keys (CMEK).

## The best of open source with the best of Google Cloud

Dataproc lets you take the open source tools, algorithms, and programming languages that you use today, but makes it easy to apply them on cloud-scale datasets. At the same time, Dataproc has out-of-the-box integration with the rest of the Google Cloud analytics, database, and AI ecosystem. Data scientists and engineers can quickly access data and build data applications connecting Dataproc to [BigQuery](#), [Vertex AI](#), [Cloud Spanner](#), [Pub/Sub](#), or [Data Fusion](#).

# All features

Serverless Spark	Deploy Spark <a href="#">applications and pipelines</a> that autoscale without any manual infrastructure provisioning or tuning.
Resizable clusters	Create and <a href="#">scale</a> clusters quickly with various virtual machine types, disk sizes, number of nodes, and networking options.
Autoscaling clusters	Dataproc <a href="#">autoscaling</a> provides a mechanism for automating cluster resource management and enables

	automatic addition and subtraction of cluster workers (nodes).
Cloud integrated	Built-in integration with Cloud Storage, BigQuery, Cloud Bigtable, Cloud Logging, Cloud Monitoring, and AI Hub, giving you a more complete and robust data platform.
Versioning	<a href="#">Image versioning</a> allows you to switch between different versions of Apache Spark, Apache Hadoop, and other tools.
Highly available	Run clusters in <a href="#">high availability mode</a> with multiple main nodes and set jobs to restart on failure to help ensure your clusters and jobs are highly available.
Cluster scheduled deletion	To help avoid incurring charges for an inactive cluster, you can use Dataproc's <a href="#">scheduled deletion</a> , which provides options to delete a cluster after a specified cluster idle period, at a specified future time, or after a specified time period.
Automatic or manual configuration	Dataproc automatically configures hardware and software but also gives you <a href="#">manual control</a> .
Developer tools	Multiple ways to manage a cluster, including an easy-to-use web UI, the <a href="#">Cloud SDK</a> , RESTful APIs, and SSH access.
Initialization actions	Run <a href="#">initialization actions</a> to install or customize the settings and libraries you need when your cluster is created.
Optional components	Use <a href="#">optional components</a> to install and configure additional components on the cluster. Optional components are integrated with Dataproc components and offer fully configured environments for Zeppelin, Druid, Presto, and other open source software

	components related to the Apache Hadoop and Apache Spark ecosystem.
Custom images	Dataproц clusters can be provisioned with a <a href="#">custom image</a> that includes your pre-installed Linux operating system packages.
Flexible virtual machines	Clusters can use <a href="#">custom machine types</a> and <a href="#">preemptible virtual machines</a> to make them the perfect size for your needs.
Component Gateway and notebook access	Dataproц <a href="#">Component Gateway</a> enables secure, one-click access to Dataproц default and optional component web interfaces running on the cluster.
Workflow templates	Dataproц <a href="#">workflow templates</a> provide a flexible and easy-to-use mechanism for managing and executing workflows. A workflow template is a reusable workflow configuration that defines a graph of jobs with information on where to run those jobs.

## What is Dataproц?

Dataproц is a managed Spark and Hadoop service that lets you take advantage of open source data tools for batch processing, querying, streaming, and machine learning. Dataproц automation helps you create clusters quickly, manage them easily, and save money by turning clusters off when you don't need them. With less time and money spent on administration, you can focus on your jobs and your data.

# Datasets

Enhance your analytics and AI initiatives with pre-built data solutions and valuable datasets powered by [BigQuery](#), [Cloud Storage](#), [Earth Engine](#), and other Google Cloud services.

## Expand your data ecosystem

Increase the value of your data assets when you augment your analytics or AI initiatives with external data. Discover and access unique and valuable datasets and pre-built solutions from Google, public, or commercial providers. With fully managed data pipelines, you can stay focused on what matters most: delivering insights and business value.



## BigQuery public datasets



A public dataset is any dataset that is stored in BigQuery and made available to the general public through the [Google Cloud Public Dataset Program](#). The public datasets are datasets that BigQuery hosts for you to access and integrate into your applications. Google pays for the storage of these datasets and provides public access to the data via a [project](#). You pay only for the queries that you perform on the data. The first 1 TB per month is free, subject to [query pricing details](#).

Public datasets are available for you to analyze using either legacy SQL or [standard SQL](#) queries. Use a fully qualified table name when querying public datasets, for example `bigquery-public-data.bbc_news.fulltext`.



You can access BigQuery public datasets by using the [Google Cloud console](#), by using the [bq command-line tool](#), or by making calls to the [BigQuery REST API](#) using a variety of [client libraries](#) such as [Java](#), [.NET](#), or [Python](#). You can also [view and query public datasets through Analytics Hub](#), a data exchange platform in [preview](#) that helps you discover and access data libraries.



## Featured datasets


CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
<b>Google datasets</b>	 <p><a href="#">Google Trends</a></p> <p>View the Top 25 and Top 25 rising queries from Google Trends from the past 30-days with this dataset. Each term includes 5 years of historical data across the 210 Designated Market Areas (DMAs) in the US and now over 50 countries across the globe.</p>	<ul style="list-style-type: none"> <li>What are the most popular retail items people have searched for across the area?</li> </ul>
	 <p><a href="#">Community Mobility Reports</a></p> <p>This dataset reports movement trends over time by geography, across different categories of places such as retail and recreation, groceries and pharmacies, parks, transit stations, workplaces, and residential.</p>	<ul style="list-style-type: none"> <li>Use case: Identifying the difference in retail traffic on weekends</li> </ul>



CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	 <p><a href="#">Google Analytics (Sample)</a></p> <p>The dataset provides 12 months (August 2016 to August 2017) of obfuscated Google Analytics 360 data from the <a href="#">Google Merchandise Store</a> to show what an ecommerce website would see, including traffic source, content, and transactional data.</p>	<ul style="list-style-type: none"> <li>What is the total number of transactions generated per device browser?</li> </ul>
	 <p><a href="#">Google Patents Research</a></p> <p>Google Patents Research Data contains the output of much of the data analysis work used in Google Patents (<a href="https://patents.google.com">patents.google.com</a>), including machine translations of titles and abstracts from Google Translate, embedding vectors, extracted top terms, similar</p>	<ul style="list-style-type: none"> <li>What are the 20 most recent patents filed?</li> </ul>






CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	documents, and forward references.	
<b>Commercial datasets</b>	 <b>Crux Informatics</b>  Crux Deliver is a managed service for data engineering and operations. Crux wires up all of the traditional and alternative data providers on behalf of its clients and manages all aspects of onboarding, data engineering, and operations. Every dataset is validated so that we only deliver clean and actionable data.	<ul style="list-style-type: none"> <li>What are the datasets Crux can help me onboard into my data ecosystem?</li> </ul>
	 <b>Exchange Data International</b>  Exchange Data International (EDI) helps the global financial and investment community make informed decisions. EDI's extensive content database includes worldwide equity and	<ul style="list-style-type: none"> <li>Understand historical events that affect Equity Shares and ETFs.</li> </ul>



CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	fixed income corporate actions, dividends, static reference data, closing prices, and shares outstanding.	
	 <a href="#">Factset</a> <p>FactSet is a global provider of integrated financial information, analytical applications, and industry-leading service that delivers superior content, analytics, and flexible technology.</p>	<ul style="list-style-type: none"> <li>Track multiple versions of merger deals to enhance your investment process.</li> </ul>
	 <a href="#">HouseCanary</a> <p>Instant access to reliable property, loan and valuation information for 100M homes. ML algorithms process hundreds of data sources to provide Home Price Indices for 381 Metros, 18,300 ZIP codes</p>	<ul style="list-style-type: none"> <li>Make investment decisions from 40-year historical volatility or 3-year forecast.</li> </ul>



CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	and 4M blocks covering >95% of the US residential market.	
	 <a href="#">LinkUp</a>  LinkUp, the global leader in accurate, real-time, and predictive job market data and analytics offers proprietary data solutions that give customers the ability to derive valuable insights into the global labor market and help investors generate alpha at the macro, sector, geographic, and individual company level.	<ul style="list-style-type: none"> <li>• Create models and signals to assess and predict job growth at the sector level.</li> </ul>
	<a href="#">London Energy Brokers Association</a>  LEBA's solution gives customers the ability to access a unique, consolidated view of the Energy markets from across	<ul style="list-style-type: none"> <li>• Understand the energy prices across countries in Europe</li> </ul>

CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	<p>the main energy brokers. Energy, Oil and Gas producers, wholesale users, utilities, and financial traders benefit from independent market information based on traded activity rather than price assessments.</p>	
	 <p><a href="#"><b>Neustar</b></a></p> <p>Neustar, Inc., a TransUnion company, is a leader in identity resolution providing the data and technology that enable trusted connections between companies and people at the moments that matter most. Neustar offers industry-leading solutions in marketing, risk and communications.</p>	<ul style="list-style-type: none"> <li>• Improve customer data assets and build privacy-focused consumer databases</li> </ul>
	 <p><a href="#"><b>RS Metrics</b></a></p>	<ul style="list-style-type: none"> <li>• Create independent, verifiable, and objective benchmarks of</li> </ul>



CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	<p>RS Metrics, the leading company for asset-level, real-time, objective and verifiable ESG data, gives customers the ability to access accurate insights into EV manufacturers' factory inventory levels.</p>	<p>EV car production.</p>
	 <p><a href="#">Ursa Space Systems</a></p> <p>Ursa Space Systems, a global satellite intelligence infrastructure provider, gives customers the ability to monitor global economic trends with data derived from satellite imagery, updated on a weekly basis.</p>	<ul style="list-style-type: none"> <li>What is the likely direction of oil price benchmarks and regional spreads?</li> </ul>

CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
<b>Public datasets</b>	 <p><a href="#"><u>Severe Storm Event Details</u></a></p> <p>The Storm Events Database is an integrated database of severe weather events across the United States from 1950 to this year, with information about a storm event's location, azimuth, distance, impact, and severity, including the cost of damages to property and crops.</p>	<ul style="list-style-type: none"> <li>• Use case: home improvement retailer understanding impact of storms on inventory</li> <li>• Technical Reference Pattern: <a href="#"><u>Dynamic insurance pricing model using this dataset</u></a></li> </ul>
	 <p><a href="#"><u>Census Bureau US Boundaries</u></a></p> <p>These are full-resolution boundary files, derived from TIGER/Line Shapefiles, the fully supported, core geographic products from the US Census Bureau. These include information for the 50 states, the District of Columbia, Puerto Rico, and the outlying island areas.</p>	<ul style="list-style-type: none"> <li>• Use case: Developing an urbanization index for retailers</li> </ul>

CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
	 <p><a href="#"><u>American Community Survey</u></a></p> <p>The American Community Survey (ACS) is an ongoing survey that provides vital information on a yearly basis about our nation and its people by contacting over 3.5 million households across the country. The resulting data provides incredibly detailed demographic information across the US aggregated at various geographic levels.</p>	<ul style="list-style-type: none"> <li>• Use case: Population growth trends as inputs to facility/site selection analysis</li> </ul>
	 <p><a href="#"><u>All public datasets</u></a></p> <p>Search for and access over 200 datasets listed in Google Cloud Marketplace.</p>	<ul style="list-style-type: none"> <li>• What datasets can help provide deeper context for our analytics or ai workflows?</li> </ul>

CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
<b>Earth Engine datasets</b>	 <a href="#">Earth Engine</a>  Earth Engine's public data archive includes more than forty years of historical imagery and scientific datasets, updated daily and available for online analysis.	<ul style="list-style-type: none"> <li>• How has surface temperature changed over the past 30 years?</li> <li>• What did this area look like before year 2000?</li> </ul>
<b>Kaggle datasets</b>	 <a href="#">Kaggle Datasets</a>  Inside Kaggle you'll find all the code and data you need to do your data science work. Use over 80,000 public datasets and 400,000 public notebooks to conquer any analysis in no time.	<ul style="list-style-type: none"> <li>• Can you tackle some of the most vexing and provocative problems in data science?</li> </ul>



CATEGORY	FEATURED DATASETS	SAMPLE USE CASES AND INSIGHTS
<b>Synthetic datasets</b>	 <a href="#">Cymbal Investments</a> <p>The synthetic data represents transactions from automated trading bots operated by the fictional Cymbal Investments group, each using a single algorithm to guide its trading decisions. The records are derived from FIX protocol (version 4.4) <a href="#">Trade Capture Reports</a> loaded into BigQuery.</p>	<ul style="list-style-type: none"> <li>How much did traders make from each individual trade?</li> </ul>
<b>Research datasets</b>	 <a href="#">Dataset Search</a> <p>Google's Dataset Search program has indexed almost 25 million datasets from across the web, giving you a single place to search for datasets and find links to where the data is. Filter by recency, format, topic, and more.</p>	<ul style="list-style-type: none"> <li>What datasets exist for &lt; keyword you're interested in &gt;?</li> <li>Which sustainability datasets exist from last year are free for commercial use?</li> </ul>

# Filestore

High-performance, fully managed file storage.

- Learn to perform Filestore operations with the [quickstart guide](#)
- Hear how [Sabre](#) intends to use Filestore for SAP and their business-critical apps
- Explore the latest [news, articles, and videos](#) for Filestore
- 99.99% regional availability SLA

Filestore instances are fully managed NFS file servers on Google Cloud for use with applications running on Compute Engine virtual machines (VMs) instances or Google Kubernetes Engine clusters. Not sure which storage product is right for you? Learn more about our [storage services](#).

## BENEFITS

### **Expedite your migration to cloud**

Filestore enables application migration to cloud without requiring you to rewrite or rearchitect, accelerating and simplifying your migration.

### **Simple to manage**

Deploy Filestore instances easily, from the [console](#), gCloud CLI, or using APIs. Spend less time configuring and monitoring your file storage, and more time focused on driving value for your business.

### **Scale capacity up or down as you need**

Pay for what you use, not what you don't. Automatically scale capacity up and down based on the demand of your applications.

## KEY FEATURES

# Filestore meets the needs of the most demanding applications

### **Scales to meet needs of high performance workloads**

Filestore offers low latency storage operations for applications. For workloads that are latency sensitive, like high performance computing, data analytics, or other metadata intensive applications, Filestore supports capacity up to 100 TB and throughput of 25 GB/s and 920K IOPS.

**99.99% regional availability SLA supports enterprise apps**

Filestore Enterprise is built for critical applications (e.g., SAP) requiring regional availability to ensure the applications are unphased in a zonal outage. Avoid the need to rewrite your applications, and jump start your migration to the cloud.

**Protect your data with backups and snapshots**

Filestore offers instantaneous [backups](#) and snapshots to help you protect your data easily. Back up data and metadata of the file share, set up a regular backup schedule, or take snapshots of your instances anytime you need. When it comes to recovering your data, recover some or all of your data from a prior snapshot recovery point in 10 minutes or less.

**Support GKE workloads with Filestore**

For apps running in GKE that require file storage, the fully managed NFS solution supports stateful and stateless applications. With an integrated and managed [GKE Container Storage Interface \(CSI\) driver](#), multiple pods can have shared file system access to the same data.

# Firestore

Easily develop rich applications using a fully managed, scalable, and serverless document database.

New customers get \$300 in free credits to spend on Firestore. All customers get 1 GB storage free per project, not charged against your credits.

- Serverless document database that effortlessly scales to meet any demand, with no maintenance
- Accelerate development of mobile, web, and IoT apps with direct connectivity to the database
- Built-in live synchronization and offline mode makes it easy to develop real-time applications
- Fully customizable security and data validation rules to ensure the data is always protected
- Seamless integration with Firebase and Google Cloud services like Cloud Functions and BigQuery

Firestore is a NoSQL document database built for automatic scaling, high performance, and ease of application development. While the Firestore interface has many of the same features as traditional databases, as a NoSQL database it differs from them in the way it describes relationships between data objects.

## BENEFITS

### **Launch applications and features faster**

Firestore offers a great developer experience with built-in live synchronization, offline support, and ACID transactions. These features are available across a robust set of client and server-side libraries.

### **Effortlessly scale to meet unpredictable demand**

Firestore automatically scales up and down based on demand. It requires no maintenance, and provides high availability of 99.99–99.999% achieved through strongly consistent data replication.

## Simple and flexible with pay as you go

No-ops database lets you pay only for what you use—no up-front expenditure or underutilized resources. Simplified architecture lets your apps talk directly to Firestore from your mobile or web clients.

### KEY FEATURES

## Key features

### Serverless

Focus on your application development using a fully managed, serverless database that effortlessly scales up or down to meet any demand, with no maintenance windows or downtime.

### Live synchronization and offline mode

Built-in live synchronization and offline mode makes it easy to build multi-user, collaborative applications on mobile web, and IoT devices, including workloads consisting of live asset tracking, activity tracking, real-time analytics, media and product catalogs, communications, social user profiles, and gaming leaderboards.

### Powerful query engine

Firestore allows you to run sophisticated ACID transactions against your document data. This gives you more flexibility in the way you structure your data.

## All features

Serverless	Fully managed, serverless database that effortlessly scales up or down to meet any demand, with no maintenance windows or downtime.
Live synchronization and offline mode	Built-in live synchronization and offline mode make it easy to build multi-user, collaborative applications on mobile web, and IoT devices, including workloads consisting of live asset tracking, activity tracking, real-time analytics, media and product catalogs, communications, social user profiles, and gaming leaderboards.
Powerful query engine	Firestore allows you to run sophisticated ACID transactions against your document data. This

	gives you more flexibility in the way you structure your data.
Libraries for popular languages	Focus on your application development using Firestore client-side development libraries for Web, iOS, Android, Flutter, C++, and Unity. Firestore also supports traditional server-side development libraries using Node.js, Java, Go, Ruby, and PHP.
Security	Firestore seamlessly integrates with Firebase Authentication and Identity Platform, to enable customizable identity-based security access controls and enables data validation via a configuration language.
Multi-region replication	With automatic multi-region replication and strong consistency, your data is safe and has a 99.999% availability guarantee, even when disasters strike.
Datastore mode	Firestore supports the Datastore API. You won't need to make any changes to your existing Datastore apps, and you can expect the same performance characteristics and pricing with the added benefit of strong consistency. Existing Cloud Datastore databases will be automatically upgraded to Firestore starting in 2021.

## Cloud Firestore

Cloud Firestore is a flexible, scalable database for mobile, web, and server development from Firebase and Google Cloud. Like Firebase Realtime Database, it keeps your data in sync across client apps through realtime listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity. Cloud Firestore also offers seamless integration with other Firebase and Google Cloud products, including Cloud Functions.

# Google Cloud Armor

Help protect your applications and websites against denial of service and web attacks.

- Benefit from DDoS protection and WAF at Google scale
- Detect and mitigate attacks against your [Cloud Load Balancing](#) workloads
- [Adaptive Protection](#) ML-based mechanism to help detect and block Layer 7 DDoS attacks
- Mitigate OWASP Top 10 risks and help protect workloads on-premises or in the cloud
- [Bot management](#) to stop fraud at the edge through native integration with [reCAPTCHA Enterprise](#)

## BENEFITS

### Enterprise-grade DDoS defense

Cloud Armor benefits from our experience of protecting key internet properties such as Google Search, Gmail, and YouTube. It provides built-in defenses against L3 and L4 DDoS attacks.

### Mitigate OWASP Top 10 risks

Cloud Armor provides [predefined rules](#) to help defend against attacks such as cross-site scripting (XSS) and SQL injection (SQLi) attacks.

### Managed protection

With [Cloud Armor Managed Protection Plus](#) tier, you will get access to DDoS and WAF services, curated rule sets, and other services for a predictable monthly price. [Learn more](#).

## Key features

### Adaptive protection

Automatically detect and help mitigate high volume Layer 7 DDoS attacks with an ML system trained locally on your applications. [Learn more](#).

### Support for hybrid and multicloud deployments

Help defend applications from DDoS or web attacks and enforce Layer 7 security policies whether your application is deployed on Google Cloud or in a hybrid or multicloud architecture.

### Pre-configured WAF rules

Out-of-the-box rules based on industry standards to mitigate against common web-application vulnerabilities and help provide protection from the OWASP Top 10.

Learn more in our [WAF rules guide](#).

### Bot management

Provides automated protection for your apps from bots and helps stop fraud in line and at the edge through native integration with reCAPTCHA Enterprise. [Learn more](#).

### Rate limiting

Rate-based rules help you protect your applications from a large volume of requests that flood your instances and block access for legitimate users. [Learn more](#).

## All features

Pre-defined WAF rules to mitigate OWASP Top 10 risks	Out-of-the-box rules based on industry standards to mitigate against common web-application vulnerabilities and help provide protection from the OWASP Top 10.
Rich rules language for web application firewall	Create custom rules using any combination of L3–L7 parameters and geolocation to help protect your deployment with a flexible rules language.
Visibility and monitoring	Easily monitor all of the metrics associated with your security policies in the Cloud Monitoring dashboard. You can also view suspicious application traffic patterns from Cloud Armor directly in the <a href="#">Security Command Center</a> dashboard.
Logging	Get visibility into Cloud Armor decisions as well as the implicated policies and rules on a per-request basis via <a href="#">Cloud Logging</a> .
Preview mode	Deploy Cloud Armor rules in preview mode to understand rule efficacy and impact on



	production traffic before enabling active enforcement.
Policy framework with rules	Configure one or more security policies with a hierarchy of rules. Apply a policy at varying levels of granularity to one or many workloads.
IP-based and geo-based access control	Filter your incoming traffic based on IPv4 and IPv6 addresses or CIDRs. Identify and enforce access control based on geographic location of incoming traffic.
Support for hybrid and multicloud deployments	Help defend applications from DDoS or web attacks and enforce Layer 7 security policies whether your application is deployed on Google Cloud or in a hybrid or multicloud architecture.
Named IP Lists	Allow or deny traffic through a Cloud Armor security policy based on a curated Named IP List.

# Google Cloud's operations suite (formerly Stackdriver)

Integrated monitoring, logging, and trace managed services for applications and systems running on Google Cloud and beyond.

New customers get \$300 in free credits to spend on operations suite. All customers get monthly allotments for logging and monitoring free, not charged against your credits.

- Start using the operations suite with [Monitoring](#) and [Logging](#) quickstart guides
- [Research shows](#) successful reliability is 4.1 times more likely to incorporate observability
- Learn how Google Cloud's operations suite helps [customers](#) improve cloud observability
- Stay up-to-date with the [latest blogs](#) and our [o11y in-depth](#) video series
- Download the overview one-pager: [Observability in Google Cloud](#)

## Key features

### Real-time log management and analysis

[Cloud Logging](#) is a fully managed service that performs at scale and can ingest application and platform log data, as well as custom log data from GKE environments, VMs, and other services inside and outside of Google Cloud. Get advanced performance, troubleshooting, security, and business insights with [Log Analytics](#), integrating the power of BigQuery into Cloud Logging.

### Built-in metrics observability at scale

[Cloud Monitoring](#) provides visibility into the performance, uptime, and overall health of cloud-powered applications. Collect metrics, events, and metadata from Google Cloud services, hosted uptime probes, application instrumentation, and a variety of common application components. Visualize this data on charts and dashboards and create alerts so you are notified when metrics are outside of expected ranges.

## Stand-alone managed service for running and scaling Prometheus

[Managed Service for Prometheus](#) is a fully managed Prometheus-compatible monitoring solution, built on top of the same globally scalable data store as Cloud Monitoring. Keep your existing visualization, analysis, and alerting services, as this data can be queried with PromQL or Cloud Monitoring.

## Monitor and improve your application's performance

Application Performance Management (APM) combines the monitoring and troubleshooting capabilities of Cloud Logging and Cloud Monitoring with [Cloud Trace](#) and [Cloud Profiler](#) to help you reduce latency and cost so you can run more efficient applications.

## All features

Log management	<a href="#">Log Router</a> allows customers to control where logs are sent. All logs, including audit logs, platform logs, and user logs, are sent to the Cloud Logging API where they pass through the log router. The log router checks each log entry against existing rules to determine which log entries to discard, which to ingest, and which to include in exports.
Proactive monitoring	<a href="#">Cloud Monitoring</a> allows you to create alerting policies to notify you when metrics, health check results, and uptime check results meet specified criteria. Integrated with a wide variety of notification channels, including Slack and PagerDuty.
Prometheus as a managed service	Offload the scaling and management of Prometheus infrastructure, updates, storage, and more with <a href="#">Managed Service for Prometheus</a> . Avoid vendor lock-in and keep all of the open source tools you use today for visualization, alerting, and analysis of Prometheus metrics.
Custom visualization	Cloud Monitoring provides default out-of-the-box <a href="#">dashboards</a> and allows you to define custom dashboards with powerful visualization tools to suit your needs.

Health check monitoring	Cloud Monitoring provides <a href="#">uptime checks</a> to web applications and other internet-accessible services running on your cloud environment. You can configure uptime checks associated with URLs, groups, or resources, such as instances and load balancers.
Service monitoring	<a href="#">Service Monitoring</a> provides out-of-the-box telemetry and dashboards that allow troubleshooting in context through topology and context graphs, plus automation of health monitoring through SLOs and error budget management.
Latency management	<a href="#">Cloud Trace</a> provides latency sampling and reporting for App Engine, including per-URL statistics and latency distributions.
Performance and cost management	<a href="#">Cloud Profiler</a> provides continuous profiling of resource consumption in your production applications, helping you identify and eliminate potential performance issues.
Security management	<a href="#">Cloud Audit Logs</a> provides near real-time user activity visibility across Google Cloud.

# Google Kubernetes Engine

The most automated and scalable managed Kubernetes platform.

New customers get \$300 in free credits to spend on GKE. All customers get one Autopilot or zonal cluster free per month, not charged against your credits.

- [Run your apps](#) on a fully managed Kubernetes cluster with GKE Autopilot
- Start quickly with single-click clusters and [scale up to 15000 nodes](#)
- Leverage a high-availability control plane including multi-zonal and regional clusters
- Eliminate operational overhead with industry-first four-way auto scaling
- Secure by default, including vulnerability scanning of container images and data encryption

## BENEFITS

### **Speed up app development without sacrificing security**

Develop a wide variety of apps with support for stateful, serverless, and application accelerators. Use Kubernetes based CI/CD tooling to secure and speed up each stage of the build-and-deploy life cycle.

### **Streamline operations with release channels**

Choose the channel that fits your business needs. Rapid, regular, and stable release channels have different cadences of node upgrades and offer support levels aligned with the channel nature.

### **Reduce Day 2 ops with help from Google SREs**

Get back time to focus on your applications with help from Google Site Reliability Engineers (SREs). Our SREs constantly monitor your cluster and its computing, networking, and storage resources.

# Key features

## Two modes of operation, one GKE

GKE now offers two modes of operations: Autopilot and Standard. [Autopilot mode](#) is a hands-off, fully managed solution that manages your entire cluster's infrastructure without worrying about configuring and monitoring, while still delivering a complete Kubernetes experience. And with per-pod billing, Autopilot ensures you pay only for your running pods, not system components, operating system overhead, or unallocated capacity. Standard mode is the experience we've been building since the launch of GKE, enabling additional customization options over the nodes with the ability to fine tune and run custom administrative workloads for when you need low level controls.

## Pod and cluster autoscaling

GKE is the industry's first fully managed Kubernetes service that implements full Kubernetes API, 4-way autoscaling, release channels and multi-cluster support. Horizontal pod autoscaling can be based on CPU utilization or custom metrics. Autopilot automatically scales your cluster capacity based on the resource requirements in your Pod specs. In the Standard mode of operation, cluster autoscaling works on a per-node-pool basis to scale up your nodes on demand. Vertical pod autoscaling continuously analyzes the CPU and memory usage of pods, automatically adjusting CPU and memory requests.

## Prebuilt Kubernetes applications and templates

Get access to enterprise-ready containerized solutions with prebuilt deployment templates, featuring portability, simplified licensing, and consolidated billing. These are not just container images, but open source, Google-built, and commercial applications that increase developer productivity. Click to deploy on-premises or in third-party clouds from [Google Cloud Marketplace](#).

## Container focused networking and security

Privately networked clusters in GKE can be restricted to a private endpoint or a public endpoint that only certain address ranges can access. [GKE Sandbox](#) for the Standard mode of operation provides a second layer of defense between containerized workloads on GKE for enhanced workload [security](#). GKE clusters inherently support Kubernetes Network Policy to restrict traffic with pod-level firewall rules.

## Migrate traditional workloads to GKE containers with ease

[Migrate to Containers](#) makes it fast and easy to modernize traditional applications away from virtual machines and into containers. Our unique automated approach extracts the critical application elements from the VM so you can easily insert those elements into containers in Google Kubernetes Engine or Anthos clusters

without the VM layers (like Guest OS) that become unnecessary with containers. This product also works with GKE Autopilot.

## All features

Backup for GKE	<a href="#">Backup for GKE</a> is an easy way for customers running stateful workloads on GKE to protect, manage, and restore their containerized applications and data.
Identity and access management	Control access in the cluster with your Google accounts and role permissions.
Hybrid networking	Reserve an IP address range for your cluster, allowing your cluster IPs to coexist with private network IPs via Google Cloud VPN.
Security and compliance	GKE is backed by a Google security team of over 750 experts and is both HIPAA and PCI DSS compliant.
Integrated logging and monitoring	Enable Cloud Logging and Cloud Monitoring with simple checkbox configurations, making it easy to gain insight into how your application is running.
Cluster options	Choose clusters tailored to the availability, version stability, isolation, and pod traffic requirements of your workloads.
Auto scale	Automatically scale your application deployment up and down based on resource utilization (CPU, memory).
Auto upgrade	Automatically keep your cluster up to date with the latest release version of Kubernetes. Kubernetes release updates are quickly made available within GKE.

Auto repair	When auto repair is enabled, if a node fails a health check, GKE initiates a repair process for that node.
Resource limits	Kubernetes allows you to specify how much CPU and memory (RAM) each container needs, which is used to better organize workloads within your cluster.
Container isolation	Use <a href="#">GKE Sandbox</a> for a second layer of defense between containerized workloads on GKE for enhanced workload security.
Stateful application support	GKE isn't just for 12-factor apps. You can attach persistent storage to containers, and even host complete databases.
Docker image support	GKE supports the common Docker container format.
Fully managed	GKE clusters are fully managed by Google Site Reliability Engineers (SREs), ensuring your cluster is available and up-to-date.
OS built for containers	GKE runs on Container-Optimized OS, a hardened OS built and managed by Google.
Private container registry	Integrating with Google Container Registry makes it easy to store and access your private Docker images.
Fast consistent builds	Use Cloud Build to reliably deploy your containers on GKE without needing to setup authentication.
Workload portability, on-premises and cloud	GKE runs Certified Kubernetes, enabling workload portability to other Kubernetes platforms across clouds and on-premises.
GPU and TPU support	GKE supports GPUs and TPUs and makes it easy to run ML, GPGPU, HPC, and other workloads that benefit from specialized hardware accelerators.



Built-in dashboard	Google Cloud console offers useful dashboards for your project's clusters and their resources. You can use these dashboards to view, inspect, manage, and delete resources in your clusters.
Spot VMs	Affordable compute instances suitable for batch jobs and fault-tolerant workloads. <a href="#">Spot VMs</a> provide significant savings of up to 91% while still getting the same performance and capabilities as regular VMs.
Persistent disks support	Durable, high-performance block storage for container instances. Data is stored redundantly for integrity, flexibility to resize storage without interruption, and automatic encryption. You can create <a href="#">persistent disks</a> in HDD or SSD formats. You can also take snapshots of your persistent disk and create new persistent disks from that snapshot.
Local SSD support	GKE offers always-encrypted local solid-state drive (SSD) block storage. Local SSDs are physically attached to the server that hosts the virtual machine instance for very high input/output operations per second (IOPS) and very low latency compared to persistent disks.
Global load balancing	Global load-balancing technology helps you distribute incoming requests across pools of instances across multiple regions, so you can achieve maximum performance, throughput, and availability at low cost.
Linux and Windows support	Fully supported for both Linux and Windows workloads, GKE can run both Windows Server and Linux nodes.

Hybrid and multi-cloud support	Take advantage of Kubernetes and cloud technology in your own data center. Get the GKE experience with quick, managed, and simple installs as well as upgrades validated by Google through <a href="#">Anthos</a> .
Serverless containers	Run stateless serverless containers abstracting away all infrastructure management and automatically scale them with <a href="#">Cloud Run</a> .
Usage metering	Fine-grained visibility to your Kubernetes clusters. See your GKE clusters' resource usage broken down by namespaces and labels, and attribute it to meaningful entities.
Release channels	Release channels provide more control over which automatic updates a given cluster receives, based on the stability requirements of the cluster and its workloads. You can choose rapid, regular, or stable. Each has a different release cadence and targets different types of workloads.
Software supply chain security	Verify, enforce, and improve security of infrastructure components and packages used for container images with Container Analysis.
Per-second billing	Google bills in second-level increments. You pay only for the compute time that you use.

# Identity and Access Management (IAM)

Fine-grained access control and visibility for centrally managing cloud resources.

## Enterprise-grade access control

Identity and Access Management (IAM) lets administrators authorize who can take action on specific resources, giving you full control and visibility to manage Google Cloud resources centrally. For enterprises with complex organizational structures, hundreds of workgroups, and many projects, IAM provides a unified view into security policy across your entire organization, with built-in auditing to ease compliance processes.

### Simplicity first

We recognize that an organization's internal structure and policies can get complex fast. Projects, workgroups, and managing who has authorization to do what all change dynamically. IAM is designed with simplicity in mind: a clean, universal interface lets you manage access control across all Google Cloud resources consistently. So you learn it once, then apply everywhere.

### The right roles

IAM provides tools to manage resource permissions with minimum fuss and high automation. Map job functions within your company to groups and roles. Users get access only to what they need to get the job done, and admins can easily grant default permissions to entire groups of users.

### Smart access control

Permissions management can be a time-consuming task. [Recommender](#) helps admins remove unwanted access to Google Cloud resources by using machine learning to make smart access control recommendations. With Recommender, security teams can automatically detect overly permissive access and rightsize them based on similar users in the organization and their access patterns.

### Get granular with context-aware access

IAM enables you to grant access to cloud resources at fine-grained levels, well beyond project-level access. Create more granular access control policies to resources based on attributes like device security status, IP address, resource type,

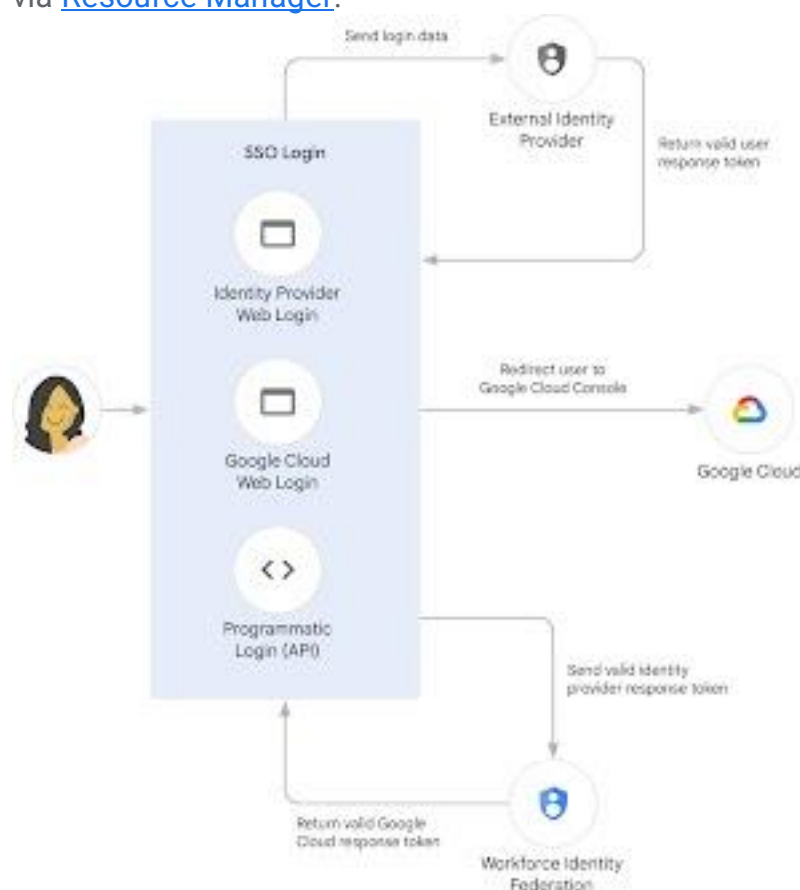
and date/time. These policies help ensure that the appropriate security controls are in place when granting access to cloud resources.

## Streamline compliance with a built-in audit trail

A full audit trail history of permissions authorization, removal, and delegation gets surfaced automatically for your admins. IAM lets you focus on business policies around your resources and makes compliance easy.

## Enterprise identity made easy

Leverage [Cloud Identity](#), Google Cloud's built-in managed identity to easily create or sync user accounts across applications and projects. It's easy to provision and manage users and groups, set up single sign-on, and configure two-factor authentication (2FA) directly from the Google Admin Console. You also get access to the Google Cloud Organization, which enables you to centrally manage projects via [Resource Manager](#).



## Workforce Identity Federation

[Workforce Identity Federation](#) lets you use an external identity provider (IdP) to authenticate and authorize a workforce—a group of users, such as employees, partners, and contractors—using IAM, so that the users can access Google Cloud services. Workforce Identity Federation uses an identity federation approach

instead of directory synchronization, eliminating the need to maintain separate identities across multiple platforms.

## Features

### **Single access control interface**

IAM provides a simple and consistent access control interface for all Google Cloud services. Learn one access control interface and apply that knowledge to all Google Cloud resources.

### **Fine-grained control**

Grant access to users at a resource level of granularity, rather than just project level. For example, you can create an IAM access control policy that grants the Subscriber role to a user for a particular Pub/Sub topic.

### **Automated access control recommendations**

Remove unwanted access to Google Cloud resources with smart access control recommendations. Using Recommender, you can automatically detect overly permissive access and rightsize them based on similar users in the organization and their access patterns.

### **Context-aware access**

Control access to resources based on [contextual](#) attributes like device security status, IP address, resource type, and date/time.

### **Flexible roles**

Prior to IAM, you could only grant Owner, Editor, or Viewer roles to users. A wide range of services and resources now surface additional IAM roles out of the box. For example, the Pub/Sub service exposes Publisher and Subscriber roles in addition to the Owner, Editor, and Viewer roles.

### **Web, programmatic, and command-line access**

Create and manage IAM policies using the Google Cloud Console, the IAM methods, and the gcloud command line tool.

### **Built-in audit trail**

To ease compliance processes for your organization, a full audit trail is made available to admins without any additional effort.

### **Support for Cloud Identity**

IAM supports standard Google Accounts. Create IAM policies granting permission to a [Google group](#), a [Google-hosted domain](#), a [service account](#), or specific [Google Account](#) holders using Cloud Identity. Centrally manage users and groups through the [Google Admin Console](#).

## **Free of charge**

IAM is offered at no additional charge for all Google Cloud customers. You will be charged only for use of other Google Cloud services. For information on the pricing of other Google Cloud services, see the [Google Cloud Pricing Calculator](#).

# Local SSD

Local solid-state drive storage for virtual machine instances.

## High-performance, ephemeral storage

Local SSDs are physically attached to the server that hosts your VM instance. This tight coupling offers superior performance, very high input/output operations per second (IOPS), and very low latency compared to other block storage options. Local SSDs are designed for temporary storage use cases such as caches or scratch processing space. Which makes them suitable for workloads like media rendering, data analytics, or high-performance computing.

### ***Access our highest performance block storage***

Directly attaching a Local SSD on the server that hosts your VM instance enables the lowest latency and highest performance storage for temporary use cases like scratch data, caches, or for data replicated at higher layers.

### ***Support a range of workloads***

Different workloads require different VM shapes to achieve the best performance at the right price. Customize the VM shape to your workload or attach to predefined shapes that we offer for typical use cases like data analytics, media rendering, or gaming.

### ***Always encrypted***

Data stored on our infrastructure is automatically encrypted at rest. With Local SSDs, your data is always encrypted with an ephemeral encryption key. The SSDs manage and protect these device-level encryption keys.

## Features

### **Fast IOPS and high-speed throughput**

Choose Local SSDs when you need Google's highest speed ephemeral storage. Reach IOPS of 2,400,000 / 1,200,000 (read/write) and throughput up to 9,360 MB per second / 4,680 MB per second for 9 TB instances.

### **Scale as you need it**

Attach up to 24 Local SSD partitions for 9 TB of total Local SSD storage space per instance. Or you can format and mount multiple Local SSD partitions into a single logical volume.

## Customizable VM shapes

Depending on your workload, you may require specific memory-to-storage configuration to achieve the best performance at the right price. With Local SSDs, attach custom-sized disks to your VMs, allowing you to tailor your storage to your use case, needs, and budget.

## About local SSDs

Compute Engine offers [always-encrypted](#) local solid-state drive (SSD) block storage for virtual machine (VM) instances. Each local SSD is 375 GB in size, but you can attach a maximum of 24 local SSD partitions for [9 TB per instance](#). Optionally, you can [format and mount multiple local SSD partitions](#) into a single logical volume.

Unlike [Persistent Disks](#), Local SSDs are physically attached to the server that hosts your VM instance. This tight coupling offers superior performance, very high input/output operations per second (IOPS), and very low latency compared to persistent disks. See [Configure disks to meet performance requirements](#) for details.

**Warning:** The performance gains from local SSDs require certain trade-offs in availability, durability, and flexibility. Because of these trade-offs, Local SSD storage is **not** automatically replicated and **all data on the local SSD may be lost** if the instance stops for any reason. See [Local SSD data persistence](#) for details.

Local SSDs are suitable only for temporary storage such as caches, processing space, or low value data. To store data that is not temporary or ephemeral in nature, use one of our [durable storage options](#).

You cannot stop a VM with a local SSD via the gcloud CLI or the console. However, Compute Engine does not prevent you from shutting down a VM from inside the guest operating system (OS). If you do shut down a VM with a local SSD through the guest operating system, the data on the local SSD is lost. Make sure that you migrate your critical data from the local SSD to a persistent disk or to another VM before [deleting the VM](#).

If local SSDs do not meet your redundancy or flexibility requirements, you can use local SSDs in combination with other [storage options](#).



# Memorystore

Reduce latency with scalable, secure, and highly available in-memory service for Redis and Memcached.

- Build application caches that provide sub-millisecond data access
- 100% compatible with open source Redis and Memcached
- Migrate your caching layer to cloud with zero code change

## BENEFITS

### Focus on building great apps

Memorystore automates complex tasks for open source [Redis](#) and [Memcached](#) like enabling high availability, failover, patching, and monitoring so you can spend more time coding.

### Scale as needed

Scale as your application grows. You can scale reads to over a million QPS with Redis 6 and Read Replicas. Memorystore for Memcached provides clusters as large as 5 TB to meet your caching needs.

### Highly available

Memorystore for Redis standard tier instances supports up to five read replicas which are replicated across zones and provide a 99.9% availability SLA, resulting in minimal disruption of applications.

## Key features

### Choice of engines

Choose from the two most popular open source caching engines to build your applications. Memorystore supports both Redis and Memcached and is fully protocol compatible. Choose the right engine that fits your cost and availability requirements.

### Security

Memorystore is protected from the internet using VPC networks and private IP and comes with IAM integration—all designed to protect your data. Systems are monitored 24/7/365, ensuring your applications and data are protected.

### Fully managed

Provisioning, replication, failover, and patching are all automated, which drastically reduces the time you spend doing DevOps.

# All features

Choice of engines	<p>Choose from the two most popular open source caching engines to build your applications.</p> <p>Memorystore supports both <a href="#">Redis</a> and <a href="#">Memcached</a> and is fully protocol compatible. Choose the right engine that fits your cost and availability requirements.</p>
Fully managed	<p>Provisioning, replication, failover, and patching are all automated, which drastically reduces the time you spend doing DevOps.</p>
Highly scalable	<p>Memorystore for Redis Read Replicas along with Redis 6 allow applications to scale read requests to more than a million QPS. Memorystore for Redis and Memcached enable scaling on-demand with minimal downtime making it easy to rightsize your instances based on application demand.</p>
Security	<p>Memorystore is protected from the internet using VPC networks and private IP and comes with <a href="#">IAM</a> integration—all designed to protect your data. Systems are monitored 24/7/365, ensuring your applications and data are protected. Memorystore for Redis provides in-transit encryption and Redis AUTH to further secure your sensitive data.</p>
Monitoring	<p><a href="#">Monitor</a> your instance and set up custom alerts with Cloud Monitoring. You can also integrate with <a href="#">OpenCensus</a> to get more insights to client-side metrics.</p>
Highly available	<p>Standard Tier Memorystore for Redis instances provide a 99.9% <a href="#">availability SLA</a> with automatic failover to ensure that your instance is highly available.</p>

	You also get the same availability SLA for Memcached instances.
Migration	Memorystore is compatible with open source protocol which makes it easy to switch your applications with no code changes. You can leverage the import/export feature to migrate your Redis and Memcached instance to Google Cloud.

## Memorystore for Redis

Memorystore for Redis is a fully managed Redis service for Google Cloud. Applications running on Google Cloud can achieve extreme performance by leveraging the highly scalable, available, secure Redis service without the burden of managing complex Redis deployments.

# Persistent Disk

Reliable, high-performance block storage for virtual machine instances. Enterprise scale, limitless flexibility, and competitive price for performance.

New customers get \$300 in free credits to spend on Persistent Disk.

- Get started today by [creating or attaching a disk](#)
- Understand how to [pick the best disk for your workload](#)
- A recent [study](#) shows our monthly machine costs are up to 80% less than other leading clouds
- See the latest [news, blogs, and articles](#) about Persistent Disk

## BENEFITS

### **Block storage that is easy to deploy and scale**

No volumes, no striping, no sizing—just disks. Stop the headache of dealing with partitioning, redundant disk arrays, or subvolume management. Scale up or down as needed, and only pay for what you use.

### **Industry-leading price and performance**

HDD offers low-cost storage when bulk throughput is of primary importance. SSD offers consistently high performance for both random-access workloads and bulk throughput. Both types can be sized up to 64 TB.

### **Flexibility that comes with no downtime**

Attach multiple persistent disks to Compute Engine or GKE instances simultaneously. Configure quick, automatic, incremental backups or resize storage on the fly without disrupting your application.

## **Key features**

### **High-performance block storage for any workload**

Persistent Disk performance scales with the size of the disk and with the number of vCPUs on your VM instance. Choose from the range of disk performance options that fit your business goals, and only pay for the storage you use.

### **Durability and availability that keep your business running**

Persistent Disks are designed for durability. We automatically store your data redundantly to ensure the highest level of data integrity. Whether you're worried

about planned maintenance or unexpected failures, we ensure your data is available, and your business stays uninterrupted.

### **Automatic security and encryption**

Automatically encrypt your data before it travels outside of your instance to Persistent Disk storage. Each Persistent Disk remains encrypted with system-defined keys or with [customer-supplied keys](#). Google distributes Persistent Disk data across multiple physical disks, ensuring the ultimate level of security. When a disk is deleted, we discard the keys, rendering the data irretrievable.

## **All features**

Find the right price and performance for your workload	Persistent Disks come in four types at different price points and performance profiles. We've designed these disk types based on years of working with customers to understand the range of uses of our Persistent Disks. Understand the <a href="#">price and performance of each disk type</a> .
Scale anytime: resize your block storage while it's in use	Persistent Disk allows you to flexibly resize your block storage while it's in use by one or more virtual machines. Performance scales automatically with size, so you can <a href="#">resize your existing persistent disks</a> or add more persistent disks to an instance to meet your performance and storage requirements—all with no application downtime.
Use disk clones to create new disks from a data source	Use <a href="#">Disk Clones</a> to quickly bring up staging environments from production, create new disks for backup verification or data export jobs, and create disks in a different project.
Use Local SSD option for temporary storage	<a href="#">Local SSDs</a> are physically attached to the server that hosts your VM instance. This tight coupling offers superior performance, very high input/output operations per second (IOPS), and very low latency compared to other block storage options. Local SSDs

	are often used for temporary storage such as caches or scratch processing space.
Automatic security and encryption	Automatically encrypt your data before it travels outside of your instance to Persistent Disk storage. Each Persistent Disk remains encrypted with system-defined keys or with <a href="#">customer-supplied keys</a> . Google distributes Persistent Disk data across multiple physical disks, ensuring the ultimate level of security. When a disk is deleted, we discard the keys, rendering the data irretrievable.
Decoupled compute and storage	Your storage is located independently from your virtual machine instances, so you can detach or move your disks to keep your data even after you delete your instances.
Use snapshots to back up your data on a schedule	Create <a href="#">snapshots</a> to periodically back up data from your zonal or regional Persistent Disks. To reduce the risk of unexpected data loss, consider the best practice of setting up a snapshot schedule to ensure your data is backed up on a regular <a href="#">schedule</a> .
Use Machine Images to store your disk metadata and permissions	Use a <a href="#">Machine Images</a> to store all the configuration, metadata, permissions, and data from one or more disks for a VM instance running on Compute Engine. The VM instance that you use to create a machine image is referred to as a source instance.

# Pub/Sub

Ingest events for streaming into BigQuery, data lakes or operational databases.

New customers get \$300 in free credits to spend on Pub/Sub. All customers get up to 10 GB for ingestion or delivery of messages free per month, not charged against your credits.

- Ingest analytic events and stream them to [BigQuery](#) with [Dataflow](#)
- No-ops, secure, scalable messaging or queue system
- In-order and any-order at-least-once message delivery with pull and push modes
- Secure data with fine-grained access [controls](#) and always-on encryption

## BENEFITS

### High availability made simple

Synchronous, cross-zone message replication and per-message receipt tracking ensures reliable delivery at any scale.

### No-planning, auto-everything

Auto-scaling and auto-provisioning with no partitions eliminates planning and ensures workloads are production ready from day one.

### Easy, open foundation for real-time data systems

A fast, reliable way to land small records at any volume, an entry point for real-time and batch pipelines feeding BigQuery, data lakes and operational databases. Use it with ETL/ELT pipelines in Dataflow.

## Key features

### Stream analytics and connectors

Native [Dataflow](#) integration enables reliable, expressive, exactly-once processing and integration of event streams in Java, Python, and SQL.

### In-order delivery at scale

Optional per-key ordering simplifies stateful application logic without sacrificing horizontal scale—no partitions required.

## Cost-optimized ingestion with Pub/Sub Lite

Complementing Pub/Sub, [Pub/Sub Lite](#) aims to be the lowest cost option for high-volume event ingestion. Pub/Sub Lite offers zonal storage and puts you in control of capacity management.

## All features

At-least-once delivery	Synchronous, cross-zone message replication and per-message receipt tracking ensures at-least-once delivery at any scale.
Open	Open APIs and client libraries in seven languages support cross-cloud and hybrid deployments.
Exactly-once processing	Dataflow supports reliable, expressive, exactly-once processing of Pub/Sub streams.
No provisioning, auto-everything	Pub/Sub does not have shards or partitions. Just set your quota, publish, and consume.
Compliance and security	Pub/Sub is a HIPAA-compliant service, offering fine-grained access controls and end-to-end encryption.
Google Cloud–native integrations	Take advantage of integrations with multiple services, such as Cloud Storage and Gmail update events and Cloud Functions for serverless event-driven computing.
Third-party and OSS integrations	Pub/Sub provides third-party integrations with Splunk and Datadog for logs along with Striim and Informatica for data integration. Additionally, OSS integrations are available through Confluent Cloud for Apache Kafka and Knative Eventing for Kubernetes-based serverless workloads.
Seek and replay	Rewind your backlog to any point in time or a snapshot, giving the ability to reprocess the messages. Fast forward to discard outdated data.



Dead letter topics	Dead letter topics allow for messages unable to be processed by subscriber applications to be put aside for offline examination and debugging so that other messages can be processed without delay.
Filtering	Pub/Sub can filter messages based upon attributes in order to reduce delivery volumes to subscribers.

# reCAPTCHA Enterprise

Help protect your website from fraudulent activity, spam, and abuse without creating friction.

reCAPTCHA Enterprise is a service that protects your site from spam and abuse.

## Defend your website with frictionless security

Fraudulent web activities cost enterprises billions of dollars each year. Security teams need to keep attackers out of their websites and ensure that their customers can always get in. reCAPTCHA has over a decade of experience defending the internet and data for its network of more than 5 million sites. reCAPTCHA Enterprise builds on this technology with capabilities, such as two-factor authentication and mobile application support, designed specifically for enterprise security concerns. With reCAPTCHA Enterprise, you can defend your website against common web-based attacks like credential stuffing, account takeovers, and scraping and help prevent costly exploits from malicious human and automated actors. And, just like reCAPTCHA v3, reCAPTCHA Enterprise will never interrupt your users with a challenge, so you can run it on all webpages where your customers interact with your services.

### ***Protect your site with trusted security technology***

reCAPTCHA Enterprise uses an adaptive risk analysis engine to keep automated software from engaging in abusive activities on your site. With technology that has helped defend millions of websites for over a decade, reCAPTCHA Enterprise is built to help mitigate fraudulent online activity for your enterprise.

### ***Let your valid users in seamlessly***

The reCAPTCHA Enterprise service helps you detect abusive traffic on your website without any user friction. Using a score-based detection system, you can rest assured that your countermeasures rely on detailed data about online activity in order to stop bots and other automated attacks while letting valid users in.

### ***Built for the enterprise***

This service offers unique capabilities built specifically for the enterprise. Security teams benefit from enhanced detection such as extra granular scores, reason codes for high-risk scores, and the ability to tune the risk analysis engine to your site's specific needs.

# Features

## View scores

reCAPTCHA Enterprise returns a score based on interactions with your websites, with 1.0 being a likely good interaction and 0.0 being a likely abusive action.

## Take action

Based on the reCAPTCHA Enterprise score, you can take action in the context of your site. For example, with a low score, you can require two-factor authentication or email verification in order to allow a user to continue.

## Tune the service to your website's needs

Using reCAPTCHA Enterprise, you can tune your site specific model by sending reCAPTCHA IDs back to Google labeled as false positives or false negatives. And reCAPTCHA's adaptive risk analysis engine will adapt future scores to fit your site.

## Flexible API

You can easily integrate reCAPTCHA Enterprise on your site or mobile application using an API-based service.

## Overview of reCAPTCHA Enterprise

Google has been defending millions of sites with reCAPTCHA for over a decade. reCAPTCHA Enterprise is built on the existing reCAPTCHA API and it uses advanced risk analysis techniques to distinguish between humans and bots. With reCAPTCHA Enterprise, you can protect your site from spam and abuse, and detect other types of fraudulent activities on the sites, such as credential stuffing, account takeover (ATO), and automated account creation. reCAPTCHA Enterprise offers enhanced detection with more granular scores, reason codes for risky events, mobile app SDKs, password breach/leak detection, Multi-factor authentication (MFA), and the ability to tune your site-specific model to protect enterprise businesses.

## When to use reCAPTCHA Enterprise

reCAPTCHA Enterprise is useful when you want to detect automated attacks or threats against your website. These threats typically originate from scripts, mobile emulators, bot software, or humans.

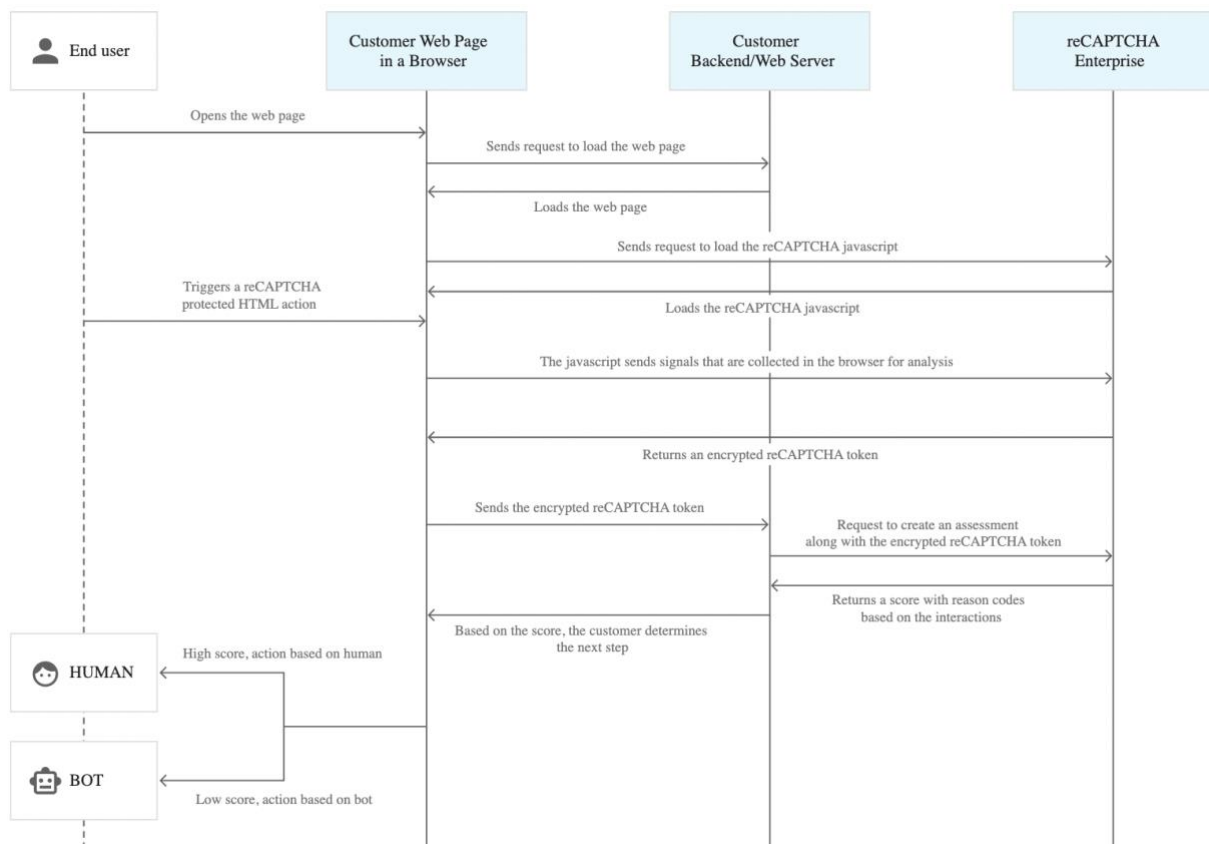
How reCAPTCHA Enterprise works

When reCAPTCHA Enterprise is deployed in your environment, it interacts with the customer backend/server and customer web pages.

When an end user visits the web page, the following events are triggered in a sequence:

1. The browser loads the customer web page stored on the backend/web server, and then loads the reCAPTCHA JavaScript from reCAPTCHA Enterprise.
2. When the end user triggers an HTML action protected by reCAPTCHA such as login, the web page sends signals that are collected in the browser to reCAPTCHA Enterprise for analysis.
3. reCAPTCHA Enterprise sends an encrypted reCAPTCHA token to the web page for later use.
4. The web page sends the encrypted reCAPTCHA token to the backend/web server for assessment.
5. The backend/web server sends the create assessment (assessments.create) request and the encrypted reCAPTCHA token to reCAPTCHA Enterprise.
6. After assessing, reCAPTCHA Enterprise returns a score (from 0.0 through 1.0) and reason code (based on the interactions) to the backend/web server.
7. Depending on the score, you (developer) can determine the next steps to take action on the user.

The following sequence diagram shows the graphical representation of the reCAPTCHA Enterprise workflow:



# Virtual Private Cloud (VPC)

Global virtual network that spans all regions. Single VPC for an entire organization, isolated within projects. Increase IP space with no downtime.

New customers get \$300 in free credits to spend on VPC.

- Start using VPC networks with these [how-to-guides](#)
- [Network](#) of 34 regions, 103 zones in 200+ countries and territories with uptime of 99.99%
- Use a single VPC to span multiple regions without communicating across the public internet
- Learn more about what [customers](#) are saying about Google VPCs

## Key features

### VPC network

VPC can automatically set up your virtual topology, configuring prefix ranges for your subnets and network policies, or you can configure your own. You can also expand CIDR ranges without downtime.

### VPC flow logs

Flow logs capture information about the IP traffic going to and from network interfaces on Compute Engine. VPC flow logs help with network monitoring, forensics, real-time security analysis, and expense optimization. Google Cloud flow logs are updated every five seconds, providing immediate visibility.

### VPC Peering

[Configure private communication](#) across the same or different organizations without bandwidth bottlenecks or single points of failure.

### Shared VPC

[Configure a VPC network to be shared](#) across several projects in your organization. Connectivity routes and firewalls associated are managed centrally. Your developers have their own projects with separate billing and quotas, while they simply connect to a shared private network where they can communicate.

### Bring your own IPs

[Bring your own IP addresses](#) to Google's network across all regions to minimize downtime during migration and reduce your networking infrastructure cost. After you bring your own IPs, Google Cloud will advertise them globally to all peers. Your

prefixes can be broken into blocks as small as 16 addresses (/28), creating more flexibility with your resources.

## All features

VPC network	<a href="#">VPC</a> can automatically set up your virtual topology, configuring prefix ranges for your subnets and network policies, or you can configure your own. You can also expand CIDR ranges without downtime.
VPC flow logs	Flow logs capture information about the IP traffic going to and from network interfaces on Compute Engine. <a href="#">VPC flow logs</a> help with network monitoring, forensics, real-time security analysis, and expense optimization. Google Cloud flow logs are updated every five seconds, providing immediate visibility.
Bring your own IPs	<a href="#">Bring your own IP addresses</a> to Google's network across all regions to minimize downtime during migration and reduce your networking infrastructure cost. After you bring your own IPs, Google Cloud will advertise them globally to all peers. Your prefixes can be broken into blocks as small as 16 addresses (/28), creating more flexibility with your resources.
VPC peering	<a href="#">Configure private communication</a> across the same or different organizations without bandwidth bottlenecks or single points of failure.
Firewall	Segment your networks with a globally distributed <a href="#">firewall</a> to restrict access to instances. <a href="#">VPC Firewall Rules Logging</a> lets you audit, verify, and analyze the effects of your firewall rules. It logs firewall access and denies events with the same responsiveness of VPC flow logs.
Routes	<a href="#">Forward traffic</a> from one instance to another instance within the same network, even across subnets, without requiring external IP addresses.

Shared VPC	<a href="#">Configure a VPC network to be shared</a> across several projects in your organization. Connectivity routes and firewalls associated are managed centrally. Your developers have their own projects with separate billing and quota, while they simply connect to a shared private network, where they can communicate.
Packet mirroring	Troubleshoot your existing VPCs by collecting and inspecting network traffic at scale, providing intrusion detection, application performance monitoring, and compliance controls with <a href="#">Packet Mirroring</a> .
VPN	<a href="#">Securely connect</a> your existing network to a VPC network over IPsec.
Private access	Get <a href="#">private access</a> to Google services, such as storage, big data, analytics, or machine learning, without having to give your service a public IP address. Configure your application's front end to receive internet requests and shield your backend services from public endpoints, all while being able to access Google Cloud services.
VPC Service Controls	Mitigate data exfiltration risks by enforcing a <a href="#">security perimeter</a> to isolate resources of multi-tenant Google Cloud services. Configure private communications between cloud resources from VPC networks spanning cloud and on-premise deployments. Keep sensitive data private and take advantage of the fully managed storage and data processing capabilities.

# VPC Service Controls

Managed networking functionality for your Google Cloud resources.

New customers get \$300 in free credits to spend on Google Cloud during the first 90 days. All customers get free usage (up to monthly limits) of select products, including BigQuery and Compute Engine.

## Key features

### **Centrally manage multi-tenant service access at scale**

With VPC Service Controls, enterprise security teams can define fine-grained perimeter controls and enforce that security posture across numerous Google Cloud services and projects. Users have the flexibility to create, update, and delete resources within service perimeters so they can easily scale their security controls.

### **Securely access multi-tenant services**

VPC Service Controls enables a context-aware access approach of control for your cloud resources. Enterprises can create granular access control policies in Google Cloud based on attributes like user identity and IP address. These policies help ensure the appropriate security controls are in place when granting access to cloud resources from the internet.

### **Establish virtual security perimeters for API-based services**

Users can define a security perimeter around Google Cloud resources such as Cloud Storage buckets, Bigtable instances, and BigQuery datasets to constrain data within a VPC and control the flow of data. With VPC Service Controls, enterprises can keep their sensitive data private as they take advantage of the fully managed storage and data processing capabilities of Google Cloud.



## All features

Coverage of services	VPC SC offers broad coverage of internet to service, service to service, VPC to service access controls.
Rich security logging	Maintain an ongoing log of access denials to spot potential malicious activity on Google Cloud resources. Flow logs capture information about the IP traffic going to and from network interfaces on Compute Engine. The logs provide near real-time visibility.
Support for hybrid environments	Configure private communication to cloud resources from VPC networks that span cloud and on-premises hybrid deployments using Private Google Access.
Secure communication	Securely share data across service perimeters with full control over what resource can connect to others or to the outside.
Context-aware access	Control access to Google Cloud services from the internet based on context-aware access attributes like IP address and a user's identity.
Perimeter security for managed Google Cloud services	Configure service perimeters to control communications between virtual machines and managed Google Cloud resources. Service perimeters allow free communication within the zone and block all service communication outside the perimeter.

## Overview of VPC Service Controls

VPC Service Controls improves your ability to mitigate the risk of data exfiltration from Google Cloud services such as Cloud Storage and BigQuery. You can use VPC Service Controls to create perimeters that protect the resources and data of services that you explicitly specify.

**Note:** For more information about products and services that VPC Service Controls supports, refer to the [Supported products](#) page.

VPC Service Controls secures your Google Cloud services by defining the following controls:

- Clients within a perimeter that have private access to resources do not have access to unauthorized (potentially public) resources outside the perimeter.
- Data cannot be copied to unauthorized resources outside the perimeter using service operations such as [gsutil cp](#) or [bq mk](#).
- Data exchange between clients and resources separated by perimeters is secured by using ingress and egress rules.
- Context-aware access to resources is based on client attributes, such as identity type (service account or user), identity, device data, and network origin (IP address or VPC network). The following are examples of context-aware access:
  - Clients outside the perimeter that are on Google Cloud or on-premises are within authorized VPC networks and use Private Google Access to access resources within a perimeter.
  - Internet access to resources within a perimeter is restricted to a range of IPv4 and IPv6 addresses.

VPC Service Controls provides an extra layer of security defense for Google Cloud services that is independent of Identity and Access Management (IAM). While IAM enables granular *identity-based access control*, VPC Service Controls enables broader *context-based perimeter security*, including controlling data egress across the perimeter. We recommend using both VPC Service Controls and IAM for defense in depth.

Security benefits of VPC Service Controls

VPC Service Controls helps mitigate the following security risks without sacrificing the performance advantages of direct private access to Google Cloud resources:

- **Access from unauthorized networks using stolen credentials:** By allowing private access only from authorized VPC networks, VPC Service Controls protects against theft of OAuth credentials or service account credentials.
- **Data exfiltration by malicious insiders or compromised code:** VPC Service Controls complements network egress controls by preventing clients within those networks from accessing the resources of Google-managed services outside the perimeter.

VPC Service Controls also prevents reading data from or copying data to a resource outside the perimeter. VPC Service Controls prevents service operations such as a `gsutil cp` command copying to a public Cloud Storage bucket or a `bq mk` command copying to a permanent external BigQuery table.

Google Cloud also provides a restricted virtual IP that is used integrated with VPC Service Controls. The restricted VIP also allows requests to be made to services supported by VPC Service Controls without exposing those requests to the internet.

- **Public exposure of private data caused by misconfigured IAM policies:** VPC Service Controls provides an extra layer of security by denying access from unauthorized networks, even if the data is exposed by misconfigured IAM policies.
- **Monitoring access to services:** Use VPC Service Controls in [dry run mode](#) to monitor requests to protected services without preventing access and to understand traffic requests to your projects. You can also create honeypot perimeters to identify unexpected or malicious attempts to probe accessible services.

You can use an organization access policy and configure VPC Service Controls for your entire Google Cloud organization, or use [scoped policies](#) and configure VPC Service Controls for a folder or project in the organization. You retain the flexibility to process, transform, and copy data within the perimeter. The security controls automatically apply to all new resources created within a perimeter.

VPC Service Controls and metadata

VPC Service Controls is not designed to enforce comprehensive controls on metadata movement.

In this context, "data" is defined as content stored in a Google Cloud resource. For example, the contents of a Cloud Storage object. "Metadata" is defined as the attributes of the resource or its parent. For example, Cloud Storage bucket names.

The primary goal of VPC Service Controls is to control the movement of data, rather than metadata, across a service perimeter through supported services. VPC Service Controls also manages access to metadata, but there might be scenarios in which metadata can be copied and accessed without VPC Service Controls policy checks.

We recommend that you rely on [IAM](#), including the use of [custom roles](#), to ensure appropriate control over access to metadata.

Capabilities

VPC Service Controls lets you to define security policies that prevent access to Google-managed services outside of a trusted perimeter, block access to data from untrusted locations, and mitigate data exfiltration risks. You can use VPC Service Controls for the following use cases:

- [Isolate Google Cloud resources and VPC networks](#) into service perimeters

- [Extend perimeters to on-premises networks](#) to authorized VPN or Cloud Interconnect
- [Control access to Google Cloud resources](#) from the internet
- [Protect data exchange across perimeters and organizations](#) by using ingress and egress rules
- [Allow context-aware access to resources](#) based on client attributes by using ingress rules

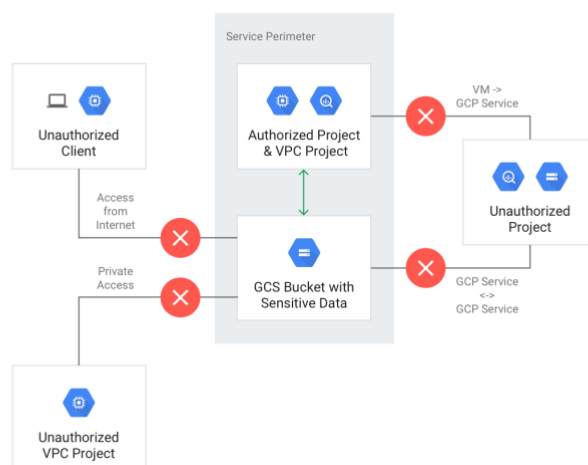
Isolate Google Cloud resources into service perimeters

A **service perimeter** creates a security boundary around Google Cloud resources. You can configure a perimeter to control communications from virtual machines (VMs) to a Google Cloud service (API), and between Google Cloud services. A perimeter allows free communication within the perimeter but, by default, blocks communication to Google Cloud services across the perimeter. The perimeter does not block access to any third-party API or services in the internet.

Here are some examples of VPC Service Controls creating a security boundary:

- A VM within a [Virtual Private Cloud \(VPC\) network](#) that is part of a service perimeter can read from or write to a Cloud Storage bucket in the same perimeter. However, VPC Service Controls doesn't allow VMs within VPC networks that are outside the perimeter to access Cloud Storage buckets that are inside the perimeter.
- A copy operation between two Cloud Storage buckets succeeds if both buckets are in the same service perimeter, but if one of the buckets is outside the perimeter, the copy operation fails.
- VPC Service Controls doesn't allow a VM within a VPC network that is inside a service perimeter to access Cloud Storage buckets that are outside the perimeter.

The following diagram shows a service perimeter that allows communication between a VPC project and Cloud Storage bucket inside the perimeter but blocks all communication across the perimeter:

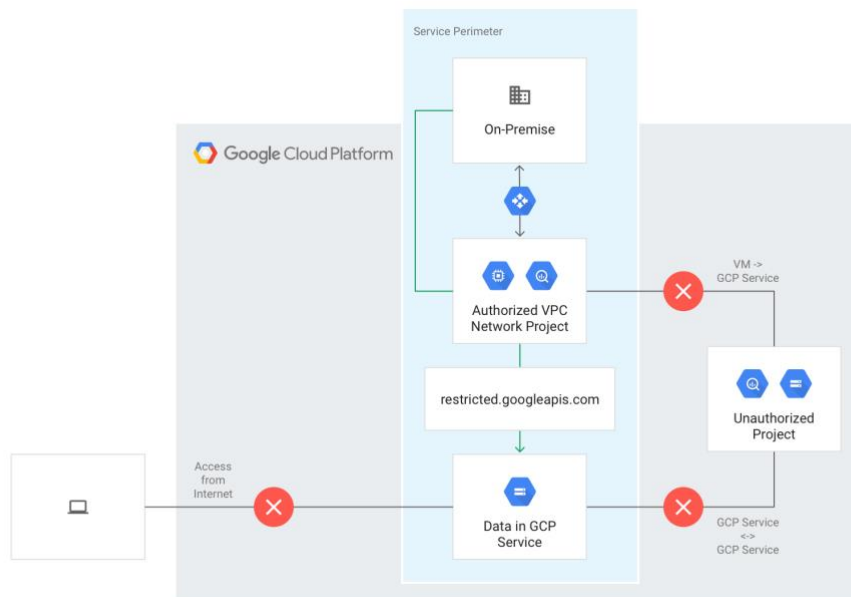


Extend perimeters to authorized VPN or Cloud Interconnect

You can configure private communication to Google Cloud resources from VPC networks that span hybrid environments with Private Google Access [on-premises extensions](#). A VPC network must be part of a service perimeter for VMs on that network to privately access managed Google Cloud resources within that service perimeter.

VMs with private IPs on a VPC Network that is part of a service perimeter cannot access managed resources outside the service perimeter. If necessary, you can continue to enable inspected and audited access to all Google APIs (for example, Gmail) over the internet.

The following diagram shows a service perimeter that extends to hybrid environments with Private Google Access:

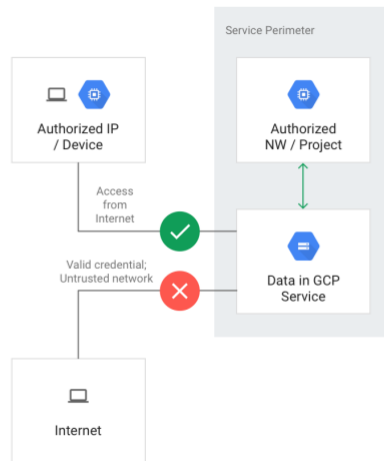


Control access to Google Cloud resources from the internet

Access from the internet to managed resources within a service perimeter is denied by default. Optionally, you can enable access based on the context of the request. To do so, you can create **access levels** that control access based on various attributes, such as the source IP address. If requests made from the internet do not meet the criteria defined in the access level, the requests are denied.

To use the Google Cloud console to access resources within a perimeter, you must configure an access level that allows access from one or more IPv4 and IPv6 ranges, or to specific user accounts.

The following diagram shows a service perimeter that allows access from the internet to protected resources based on the configured access levels, such as IP address or device policy:



## Unsupported Services

For more information on products and services that are supported by VPC Service Controls, refer to the [Supported products](#) page.

**Warning:** While it may be possible to enable unsupported services to access the data of supported products and services, we recommend that you do not. Unexpected issues might occur when attempting to access a supported service using an unsupported service, especially within the same project.

Unsupported services may not function at all when enabled in a project protected by VPC Service Controls, especially when low-level storage services like Cloud Storage or Pub/Sub are restricted. We recommend deploying unsupported services in projects outside perimeters. To allow these services to access data in resources within a perimeter, [create an access level](#) that includes the service account for that service and [apply it to perimeters as needed](#).

Attempting to restrict an unsupported service using the `gcloud` command-line tool or the Access Context Manager API will result in an error.

Cross-project access to data of supported services will be blocked by VPC Service Controls. Additionally, the restricted VIP can be used to block the ability of workloads to call unsupported services.

## Terminology

In this topic, you have learned about several new concepts introduced by VPC Service Controls:

### VPC Service Controls

Technology that enables you to define a service perimeter around resources of Google-managed services to control communication to and between those services

### service perimeter

A service perimeter around Google-managed resources. Allows free communication within the perimeter but, by default, blocks all communication across the perimeter.

### **ingress rule**

A rule that allows an API client that is outside the perimeter to access resources within a perimeter.

### **egress rule**

A rule that allows an API client or resource that is inside the perimeter to access Google Cloud resources outside the perimeter. The perimeter does not block access to any third-party API or services in the internet.

### **service perimeter bridge**

A perimeter bridge allows projects in different service perimeters to communicate. Perimeter bridges are bidirectional, allowing projects from each service perimeter equal access within the scope of the bridge.

**Note:** Instead of using a perimeter bridge, we recommend using ingress and egress rules that provide more granular controls.

### **Access Context Manager**

A context-aware request classification service that can map a request to an access level based on specified attributes of the client, such as the source IP address.

### **access level**

A classification of requests over the internet based on several attributes, such as source IP range, client device, geolocation, and others. A service perimeter can be configured to grant access from the internet based on the access level associated with a request. Access levels are determined by the Access Context Manager service.

### **access policy**

A Google Cloud resource object that defines service perimeters. You can create access policies that are scoped to specific folders or projects alongside an access policy that can apply to the entire organization.

### **restricted VIP**

The restricted VIP provides a private network route for products and APIs supported by VPC Service Controls in order to make data and resources used by those products inaccessible from the internet. `restricted.googleapis.com` resolves to 199.36.153.4/30. This IP address range is not announced to the internet.

# Workflows

Combine Google Cloud services and APIs to build reliable applications, process automation, and data and machine learning pipelines.

New customers get \$300 in free credits to spend on Workflows. All customers get 5,000 steps and 2,000 external API calls per month, not charged against your credits.

- Deploy and execute a Workflow that connects a series of services together with this [tutorial](#)
- Reliably automate processes that include waiting and retries for up to one year
- Implement real-time processing with low-latency, event-driven executions

## BENEFITS

### **Simplify your architecture**

Stateful Workflows allow you to visualize and monitor complex service integrations without additional dependencies.

### **Incorporate reliability and fault tolerance**

Control failures with default or custom retry logic and error handling even when other systems fail—checkpointing every step to Cloud Spanner to help you keep track of progress.

### **Zero maintenance**

Scale as needed: There's nothing to patch or maintain. Pay only when your workflows run, with no cost while waiting or inactive.

## **Key features**

### **Reliable workflow execution**

Call any service, from Cloud Functions to private and third-party APIs. Connectors make Google Cloud services particularly easy to use by taking care of request formatting, retries, and waiting to complete long-running operations.



### Powerful execution control

Use expressions and functions to transform response data and prepare request inputs. Automate conditions based on input and service responses. Specify retry policies and error handling. Wait for asynchronous operations and events with polling and callbacks.

### Pay per use

Only pay when workflows take steps.

## All features

Redundancy and fault-tolerance	Workflows are automatically replicated across multiple zones and checkpoint state after each step, ensuring executions continue even after outages. Failures in other services are handled through default and customizable retry policies, timeouts, and custom error handling.
Self-documenting	Specify workflows in YAML or JSON with named steps, making them easy to visualize, understand, and observe. These machine-readable formats support programmatic generation and parsing of workflows.
Wait up to one year	Wait for a given period to implement polling. Connectors provide blocking steps for many Google Cloud services with long-running operations. Simply write your steps and know each is complete before the next runs.
Event-driven, scheduled, and programmatic triggers	Workflow executions are low-latency, supporting both real-time and batch processing. Through Eventarc, workflows can be executed when events occur, such as when a file is uploaded to Cloud Storage or when a Pub/Sub message is published.
HTTP callbacks	Create unique callback URLs inside your workflow. Then wait (with a configurable timeout of up to one

	year) for the URL to be called, receiving the HTTP request data in your workflow. Useful for waiting for external systems and implementing human-in-the-loop processes.
Security	Workflows run in a sandboxed environment and have no code dependencies that will require security patches. Store and retrieve secrets with <a href="#">Secret Manager</a> .
Seamless authentication within Google Cloud	Orchestrate work of any Google Cloud product without worrying about authentication. Use a proper service account and let Workflows do the rest.
Low-latency execution	Fast scheduling of workflow executions and transitions between steps. Predictable performance with no cold starts.
Fast deploys	Deploy in seconds to support a fast developer experience and quick production changes.
Integrated logging and monitoring	Out-of-the-box integration with <a href="#">Cloud Logging</a> with automatic and custom entries provides insight into each workflow execution. <a href="#">Cloud Monitoring tracks execution volume, error rates, and execution time.</a>