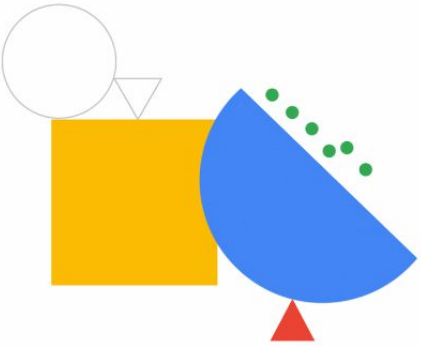
Google Cloud

Security



This is the security module in the course on managing and securing the Apigee hybrid API platform.

In this module, you will learn about the security features and role-based access control used in Apigee hybrid and about using Workload Identity with Apigee Hybrid.

You will also learn how traffic is secured within the hybrid runtime plane and with the management plane in Google Cloud.

Agenda

01	Infrastructure Security
02	Data Storage and Encryption
03	RBAC
04	Quiz

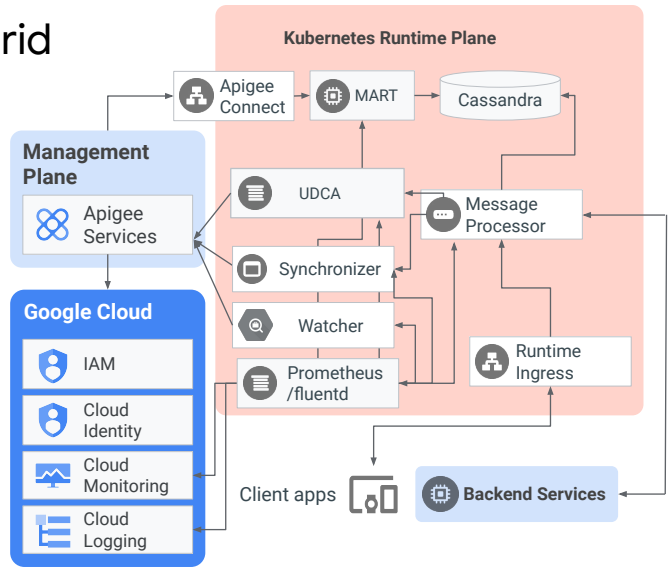
In this lecture, we will discuss the security features used in Apigee hybrid and how traffic within the runtime plane and with the management plane is secured.

In later lectures, you will learn how data is collected and stored and how role-based access control is implemented in Apigee hybrid.

Securing traffic in hybrid

Traffic between various hybrid components is secured as described below:

- Management plane ⇨ Apigee Connect uses OAuth over TLS.
- Client Apps ⇨ Runtime Ingress can be configured to use TLS 1.2/OAuth.
- MP ⇨ Backend services can be configured to use TLS 1.2/OAuth.
- All runtime components to the Apigee management plane use OAuth over TLS 1.2.
- Prometheus/fluentd ⇨ Google Cloud services use TLS.



Traffic between the Apigee hybrid runtime components and the management plane is over TLS and uses OAuth access tokens.

Ingress traffic from client applications into the cluster and egress traffic from the runtime message processors to backend target servers can be secured using TLS and OAuth.

All logging and metrics data sent from the hybrid runtime plane to Google Cloud services goes over TLS.

Securing traffic between runtime components

Traffic between various hybrid components is secured as described below:

- MART and MPs connect to Cassandra using mTLS.
- Intra-node communication between Cassandra nodes uses mTLS.
- The Runtime Ingress gateway connects to MPs over TLS.
- MPs send Analytics data to fluentd using mTLS.
- Prometheus scrapes metrics data from various components over TLS.

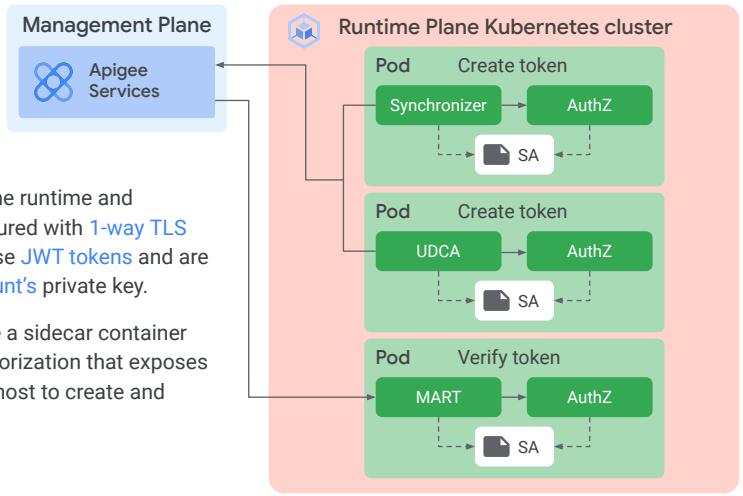
All internal communication between the hybrid runtime plane components uses TLS.

In addition, components that connect to the runtime Cassandra data store use client authentication or mutual TLS.

Intra-node Cassandra communication also uses mutual TLS.

Apigee hybrid stores keys and certificates used by the runtime components in Kubernetes secrets.

Generation and verification of runtime plane tokens



- Communication between the runtime and management planes is secured with 1-way TLS and OAuth 2.0. Requests use JWT tokens and are signed by the service account's private key.
- Runtime plane services use a sidecar container for authentication and authorization that exposes an HTTP interface on localhost to create and verify tokens.

When communicating with management plane services, the synchronizer and UDCA components use OAuth access tokens.

Each component employs a sidecar authorization container that generates an OAuth 2.0 JWT token, which is signed using the component's service account private key.

The service accounts are stored as Kubernetes secrets and made available to the runtime pods.

The MART runtime component uses the authorization container to verify OAuth 2.0 tokens sent with API requests from the hybrid management plane to the runtime plane.

To verify the token, the container uses the public key of a configured service account available from a Google Cloud endpoint.

Service accounts

- A service account is a special type of account that enables components and applications of a system to interact with each other and with other APIs.
- In hybrid, they act as trusted issuers for the runtime and management planes and are used by hybrid components to perform various operational tasks.
- During the installation of Apigee hybrid, you create multiple service accounts. Each account is assigned to a specific hybrid component with its own set of roles and permissions.
- Service accounts have to be registered with the Apigee hybrid management plane before they can be used.
- Apigee publishes service accounts that it uses to connect to runtime planes, which can be accessed via the hybrid.issuers.list management API.

Apigee hybrid uses service accounts to perform various tasks that include sending logs and metrics data to Google Cloud and downloading proxy bundles from the management plane.

A service account is a type of Google account that represents a system or application user that needs to be authenticated and be authorized to access Google APIs and services.

Apigee hybrid requires you to create several service accounts during installation. Each service account requires a specific role or set of roles that enable it to perform certain functions.

Service accounts in hybrid

Service Account	Role	Description
apigee-cassandra	Storage Object Admin	Allows Cassandra backups to Cloud Storage
apigee-logger	Logs Writer	Allows logging data collection
apigee-mart	Apigee Connect Agent	Allows MART service authentication
apigee-metrics	Monitoring Metric Writer	Allows metrics data collection
apigee-runtime	No role required	Allows the Apigee hybrid runtime to connect to Google services and custom services on Google Cloud
apigee-synchronizer	Apigee Synchronizer Manager	Allows the synchronizer to download proxy bundles and configuration data and enables operation of trace
apigee-udca	Apigee Analytics Agent	Allows the transfer of trace and deployment status data to management plane
apigee-watcher	Apigee Runtime Agent	Allows retrieval of virtual host changes for an org, and configures Runtime ingress.

This is a list of service accounts used in Apigee hybrid. You create these service accounts when you install Apigee hybrid.

The service accounts have a specific assigned role and are used by the runtime plane components to perform the function described.

For example, the apigee-synchronizer service account is used by the synchronizer component to download API proxy bundles and configuration data from the management plane.

The Apigee hybrid distribution includes the create-service-account tool that you can use to create service accounts. You can also use the Google Cloud Console or the gcloud SDK.

It is a good practice to use only one role for each service account in order to limit access for each runtime component.

When installing the hybrid runtime plane, you configure the paths to the service account key files on your machine in the overrides.yaml configuration file.

[About service accounts | Apigee]

Service accounts in hybrid

Service Account	Role	Description
apigee-non-prod	Apigee Analytics Agent, Apigee Connect Agent, Apigee Organization Admin, Apigee Runtime Agent, Apigee Synchronizer Manager, Cloud Trace Agent, Logs Writer, Monitoring Metric Writer, Storage Object Admin	Single service account for demo or test environments.

As an alternative, for non-production, test, and demo environments, you can use a single service account with all the roles assigned to it. This is not recommended for production environments.

[About service accounts | Apigee]

Securing environments

- When you create an environment, you must assign it to an environment group.
- The environment group is mapped to a virtual host configuration in the overrides.yaml file.
- As part of the virtual host configuration, you provide a TLS key and certificate to secure traffic between client apps and the ingress gateway.
- Self-signed certificates are supported for test environments but not recommended for production clusters.

overrides.yaml

```
...
namespace: my-namespace
org: my-organization
...
envs:
  - name: test
...

virtualhosts:
  - name: testenvgrp
    sslCertPath: ./certs/fullchain.pem
    sslKeyPath: ./certs/privkey.pem
...
```


A hybrid environment must be assigned to an environment group.

The environment group is configured with one or more host aliases or DNS names, and is mapped to a virtual host configuration in the overrides.yaml file.

You configure the virtual host with the path to a TLS certificate and key that is used to secure that host.

Client apps that send API requests to the host domain must be able to trust the certificate in order to establish the TLS connection.

You can use a self-signed certificate for a development or test installation of Apigee hybrid.

Certificates and DNS entries can be generated using the Let's Encrypt CA, the Certbot client, and Google Cloud Cloud DNS.

Securing Synchronizer

- Synchronizer's primary job is to periodically poll the management plane, download config data about proxies, shared flows, target servers, etc., and make those available to the local runtime.
- In order to download Apigee configuration data, Synchronizer must first be authorized via the setSyncAuthorization Apigee API. This is accomplished by:
  1. Generating an OAuth token using a gcloud authenticated user with the Apigee Org Admin role.
  2. Calling the API passing in the bearer token and the synchronizer service account that has the Apigee Synchronizer Manager role.

```
1.
$export TOKEN=$(gcloud auth
print-access-token)


2.
curl -X POST -H "Authorization: Bearer
$TOKEN" -H
"Content-Type:application/json" \
https://apigee.googleapis.com/v1/organiz
ations/{org}:setSyncAuthorization" -d \
'{"identities":["serviceAccount:synchron
izer-manager-service-account-name"]}'
```


The synchronizer runtime component securely accesses the management plane using OAuth over TLS to download API proxy and configuration data to the runtime plane.

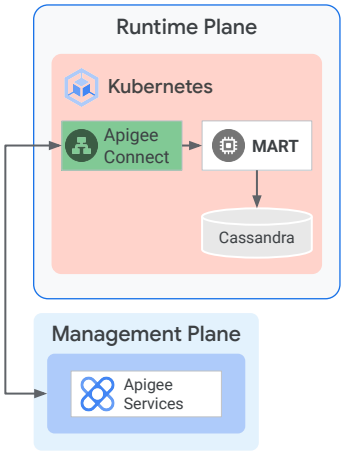
It uses a service account whose key file path is configured in the runtime plane configuration file.

In order to authorize the synchronizer account, you must call the setSyncAuthorization Apigee API as part of the hybrid installation process.

To invoke the API, you must first generate an OAuth access token using your Apigee organization admin or gcloud authenticated user credentials.

Securing MART with Apigee Connect

- Apigee Connect is a runtime component that allows the management plane to securely connect to MART.
- With Apigee Connect, you do not expose the MART endpoint, and you do not need to configure the MART ingress gateway and certificate.
- All MART traffic between the management and runtime plane passes through the secure Apigee Connect connection.
- The management plane uses OAuth tokens on all API requests to the MART service.



Apigee Connect allows the hybrid management plane to connect securely to the MART service in the runtime plane, without requiring you to expose the MART endpoint outside the cluster.

To use Apigee Connect, you must enable the Apigee Connect API in the Google Cloud API library for your project.

A service account with the Apigee Connect Agent role must be created and used to configure the Apigee Connect runtime component in the overrides.yaml configuration file.

On startup, Apigee Connect uses the service account credentials to establish a secure bi-directional gRPC stream with the management plane.

All communication between the management plane and Apigee Connect is encrypted using TLS. In addition, all MART API requests from the management plane use OAuth JWT tokens for authentication.

Using Apigee Connect

To use Apigee Connect, follow these steps:

To configure Apigee Connect for your hybrid installation, follow these steps:

Using Apigee Connect

To use Apigee Connect, follow these steps:

1. Enable the Apigee Connect API in the Google Cloud API library.

Enable the Apigee Connect API in the Google Cloud API library.

Using Apigee Connect

To use Apigee Connect, follow these steps:

1. Enable the Apigee Connect API in the Google Cloud API library.
2. Add the Apigee Connect Agent role to the MART service account created earlier:

```
$ gcloud projects add-iam-policy-binding {project_id}
--member serviceAccount:{mart_svc_acct_email}   --role
roles/apigeeconnect.Agent
```


Add the Apigee Connect Agent role to the MART service account.

This is a pre-defined role with the apigeeconnect.endpoints.connect permission that is needed to set up the Apigee Connect agent.

Using Apigee Connect

To use Apigee Connect, follow these steps:

1. Enable the Apigee Connect API in the Google Cloud API library.
2. Add the Apigee Connect Agent role to the MART service account created earlier:

   ```
   $ gcloud projects add-iam-policy-binding {project_id}
   --member serviceAccount:{mart_svc_acct_email}   --role
   roles/apigeeconnect.Agent
   ```

3. Update the overrides.yaml file to enable Apigee Connect.

overrides.yaml

```
...
# Apigee Connect Agent
connectAgent:
  enabled: true
  serviceAccountPath:
./svc-accts/mart_sa_key.json
...
```


To enable Apigee Connect, update your overrides.yaml configuration file, specifying the path to the MART service account key file.

Using Apigee Connect

To use Apigee Connect, follow these steps:

1. Enable the Apigee Connect API in the Google Cloud API library.
2. Add the Apigee Connect Agent role to the MART service account created earlier:

   ```
   $ gcloud projects add-iam-policy-binding {project_id}
   --member serviceAccount:{mart_svc_acct_email}   --role
   roles/apigeeconnect.Agent
   ```
3. Update the overrides.yaml file to enable Apigee Connect.
4. Update the Apigee hybrid org to enable the Apigee Connect feature using an organizations.update API call.

overrides.yaml

```
...
# Apigee Connect Agent
connectAgent:
  enabled: true
  serviceAccountPath:
./svc-accts/mart_sa_key.json
...
```


To enable the Apigee Connect feature, update the Apigee hybrid organization by using an organizations.update Apigee API call.

Using Apigee Connect

To use Apigee Connect, follow these steps:

1. Enable the Apigee Connect API in the Google Cloud API library.
2. Add the Apigee Connect Agent role to the MART service account created earlier:

   ```
   $ gcloud projects add-iam-policy-binding {project_id}
   --member serviceAccount:{mart_svc_acct_email}   --role
   roles/apigeeconnect.Agent
   ```

3. Update the overrides.yaml file to enable Apigee Connect.
4. Update the Apigee hybrid org to enable the Apigee Connect feature using an organizations.update API call.
5. Start the agent by applying the config changes:

   ```
   $ apigeectl apply -f your_overrides_file.yaml --org
   ```

overrides.yaml

```
...
# Apigee Connect Agent
connectAgent:
  enabled: true
  serviceAccountPath:
./svc-accts/mart_sa_key.json
...
```


To apply the configuration changes to the cluster, use the *apigeectl* command, passing in the path to the overrides config file and supplying the organization flag.

Apigee Connect is enabled by default for new installations of Apigee hybrid version 1.3.0 and newer. You are most likely to need these steps if you are upgrading from an older version of Apigee hybrid.

Securing Cassandra

- In hybrid, TLS is enabled by default for any communication between Cassandra nodes and between clients and Cassandra nodes.
  - All client communication to Cassandra requires authentication over mTLS.
- These user accounts can be used by clients that communicate with Cassandra:
  - DML User: Used by the client to read and write data to Cassandra (KMS, KVM, Cache and Quota).
  - DDL User: Used by MART for any of the data definition tasks.
  - Admin User: Used for any admin activities on Cassandra.
  - Default Cassandra User: Default user when authentication is enabled.
  - JMX User: Used to authenticate and communicate with the Cassandra JMX interface.
  - Jolokia User: Used to authenticate and communicate with the Cassandra JMX API.

overrides.yaml

```
...
cassandra:
   auth:
     default:  ## un:cassandra
       password: "iloveapis123"
     admin: ## un:admin_user
       password: "iloveapis123"
     ddl: ## username: ddl_user
       password: "iloveapis123"
     dml: ## username: dml_user
       password: "iloveapis123"
...
```


In Apigee hybrid, TLS is enabled by default for any communication between Cassandra nodes and between clients and Cassandra nodes in the cluster.

Any hybrid runtime component that communicates with Cassandra requires authentication.

Apigee hybrid provides user accounts that are used by clients to communicate with Cassandra.

The DML user account is used by the runtime components to read and write API runtime data to the Cassandra data store.

The DDL user account is used by the MART runtime component for data definition tasks like keyspace creation, update, and deletion.

The admin user account is used for any administrative activities performed on the cassandra cluster.

Apigee hybrid provides default passwords for the Cassandra user accounts. You can change the default passwords in the overrides.yaml configuration file, and apply the change to your cluster using the *apigeectl* command.

Apigee hybrid also supports JMX and Jolokia users to authenticate and communicate with the Cassandra JMX interface and JMX API.

Securing Cassandra

- The Cassandra username and passwords can be stored in a Kubernetes secret and configured in the overrides file.
  - Create the Kubernetes secret.
  - Apply the secret to the cluster.
  - Add the secret to your overrides file.
  - Apply the overrides file:

    ```
    apigeectl apply -f overrides.yaml --datastore
    ```

overrides.yaml

```
...
cassandra:
   auth:
     secret: SECRET_NAME
...
```


The Cassandra username and passwords can be stored in a Kubernetes secret and configured in the overrides file.

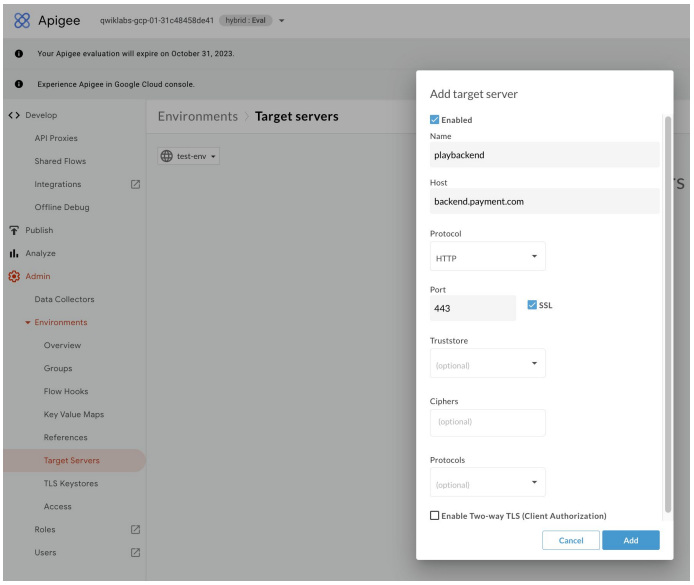
You must first create the Kubernetes secret and apply it to your cluster.

Then add the secret configuration to your overrides file for the Cassandra component, and apply the overrides file to the hybrid datastore component.

For more information, see Using Kubernetes secrets to configure Cassandra authentication.

Securing traffic to the backend

- Message Processor to backend services can be configured to use TLS/mTLS based on requirements.
- Create a TargetServer configuration using the hybrid UI or Apigee API.
- You can set up 1-way or 2-way TLS between the MP and backend service in the TargetServer configuration.
- Keys and Certificates are managed by creating Keystores & Truststores in the hybrid UI or via the Apigee API.



You can use TLS to secure traffic to backend servers. You can also use OAuth access tokens in your API proxies to implement authentication and authorization.

Use the Apigee hybrid UI or API to create a TargetServer definition. Configure it to use 1-way or 2-way TLS, depending on your requirements.

To store TLS keys and certificates, create keystores and truststores in the hybrid UI or API.

Securing the runtime plane

- A typical Apigee hybrid installation is made of multiple pods. Each of these pods requires specific access to ports, but not every pod needs to communicate with every other pod.
  - In Kubernetes, you can lock down the ingress and egress connections created to and from the pods by using network policies.
- Follow these guidelines to harden the security for your GKE cluster running Apigee hybrid.
- Review the Security overview document that provides an overview of each layer of your Kubernetes infrastructure and explains how you can configure its security features to best meet your needs.

You can secure the Apigee hybrid runtime plane by also implementing Kubernetes network policies in your cluster.

A network policy is a specification of how groups of pods are allowed to communicate with each other and other network endpoints.

A typical Apigee hybrid installation is made of multiple pods that require access to specific ports, and not every pod needs to communicate with every other pod.

Use network policies to restrict communication between pods and to pods that have access outside the Kubernetes network.

You can further harden the security of your runtime cluster by following the recommended guidelines of your Kubernetes infrastructure provider.

Draft network policy: This repo provides network policies for an Apigee hybrid installation.

Agenda

01	Infrastructure Security
02	Data Storage and Encryption
03	RBAC
04	Quiz

In this lecture, we will discuss the types of data entities used in Apigee hybrid and the mechanisms used to collect, store, and make that data available for use.

Apigee hybrid data

Apigee hybrid uses various types of data:

- Data managed by you and stored in Cassandra in the runtime plane:
  - Key management system (KMS) data, including developers, apps, API products, OAuth tokens, authorization codes, and API keys
  - Key value map (KVM) data
  - Environment-scoped cache data
  - Quota data, including buckets and counters
- Data managed by Apigee and stored in the management plane:
  - API proxies
  - Target servers
  - Truststores and keystores
  - Audit logs

Apigee hybrid stores API runtime data in the Cassandra data store in the Kubernetes cluster that you manage.

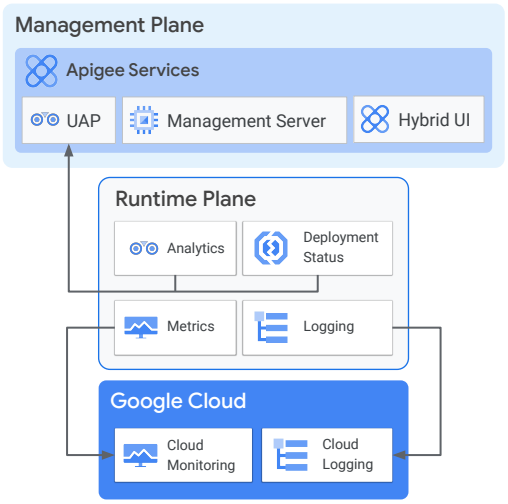
This data includes KMS entities like developers, apps, API products, and API keys. It also includes key value map entries, cache objects, and quota counters.

Apigee manages and stores API proxies, Target server configuration, TLS keys, and certificates in truststores and keystores in the management plane on Google Cloud. This data is downloaded by the synchronizer and made available in the runtime plane.

Apigee hybrid also stores audit logs in the management plane.

Metrics and analytics data

- Apigee hybrid collects three categories of informational data:
  - Logging data
  - Metrics data
  - Analytics and Deployment Status data
- Logging and Metrics data is used for debugging and troubleshooting.
  - Data is streamed and accessed via Cloud Logging, Cloud Monitoring, or other tools.
- Analytics and deployment status data is batched and accessed by the hybrid UI and Apigee APIs.



Apigee hybrid collects logging, metrics, analytics, and proxy deployment status data during its normal operation.

Logging and metrics data is stored on Google Cloud under your project and accessed via the Cloud Logging and Cloud Monitoring user interfaces in Google Cloud Console.

Analytics, proxy deployment status, and trace data are stored in the Apigee management plane on Google Cloud.

Data encryption

- By default, the following data is stored encrypted in the hybrid runtime plane:
  - Key Management Service (KMS) data
  - Key-value map (KVM) data
  - Cache data
- Encryption keys for KMS, KVM, and cache have scope that determines the set of resources that can be encrypted.
- Hybrid uses default data encryption keys (DEKs) and does not require any additional configuration.

Encryption Key	Scope
KMS data	Organization only
KVM data	Organization or Environment
Cache	Environment only

KVM, KMS, and cache data in the runtime plane are stored encrypted by default.

Apigee hybrid provides a set of default Base64-encoded keys that are used to encrypt KVM, KMS, and cache data.

The Apigee hybrid installer stores the keys in the runtime plane as Kubernetes Secrets and uses them to encrypt your data with AES-128 standard encryption.

The keys are under your control and never used by the hybrid management plane at any time.

Data encryption keys (DEKs)

- The default DEKs can be replaced with your own keys by specifying them as base64-encoded strings in the overrides.yaml file and applying them to your cluster.
- The hybrid installer stores the DEKs in the runtime plane as Kubernetes Secrets and uses them to encrypt data with AES-128 encryption.
- It is recommended to use your own DEKs for production clusters.

overrides.yaml

```
defaults:
  org:
    ...
    kmsEncryptionKey: base64-encoded-key
    kvmEncryptionKey: base64-encoded-key
    ...
  env:
    ...
    kvmEncryptionKey: base64-encoded-key
    cacheEncryptionKey: base64-encoded-key
    ...
```


The default data encryption keys can be replaced with your own keys by configuring them in your overrides.yaml configuration file when you initially install Apigee hybrid in a new cluster.

If you change the encryption keys after the runtime is created in your cluster, previously encrypted data can no longer work (it cannot be decrypted); only new data added after the change will be encrypted and function as expected.

We recommend that you use your own data encryption keys for production installations.

How to create an encoded key

Kubernetes secrets

- A Secret is an object that contains a small amount of sensitive data, such as a password, a token, or a key.
- It is used with a *pod* as files in a volume mounted on one or more of its containers using the *secret* volume type.
- It can also be exposed as environment variables to the container.
- The *secret* volume type is backed by a RAM-backed filesystem, so they are never written to non-volatile storage.
- To list all the secrets in the hybrid *apigee* namespace, run:

```
$kubectl get secrets -n apigee
```

- To view data for a specific secret run:

```
$kubectl get secret {secret-name} -o yaml
```

- You can also create secrets and access them in an API proxy as flow variables.

Kubernetes Secrets let you store and manage sensitive information, such as passwords, OAuth tokens, and keys.

A Secret is used with a pod as files in a volume mounted on its containers, or it can be exposed as an environment variable to the container.

You can create Kubernetes secrets and access them in an API proxy as flow variables in Apigee hybrid.

Storing data in a Kubernetes secret

Agenda

01	Infrastructure Security
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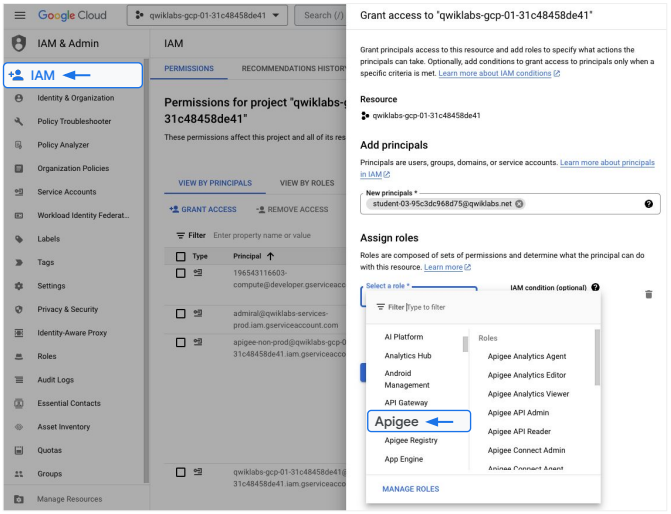
In this lecture, we will discuss how role-based access control, or RBAC, is implemented in Apigee hybrid. We will also discuss Workload Identity with Apigee hybrid.

Users and roles

- In Apigee hybrid, a user represents an authenticated Google Cloud account.
- The account must have access to a Google Cloud project and Apigee hybrid organization and the resources within them.
- Access control for the user account is implemented by granting roles at the project level and at the environment level within the hybrid organization.
- The resources that a user can access depend on roles assigned in the project and hybrid environment.
- User accounts can be federated between Google Cloud and Active Directory.



An Apigee hybrid user is represented by an authenticated Google Cloud account.

The user is granted access by using roles at the project level, which are inherited in all hybrid environments by default.

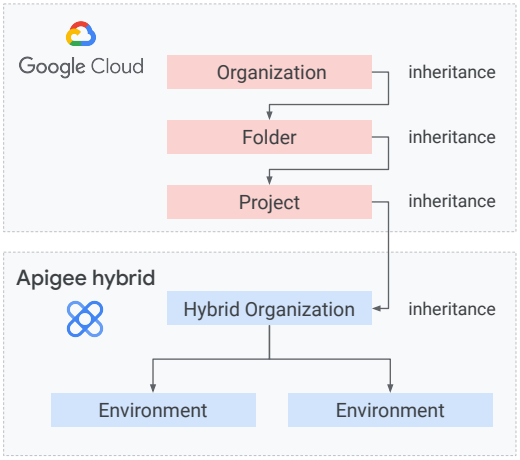
You can refine a user's access by using the hybrid UI to specify one or more roles per environment in your hybrid organization.

The user acts in that role only for the selected environment.

You can federate user accounts between Active Directory and Google Cloud Identity or Google Workspace.

Role inheritance

- Roles assigned to users at the project level are inherited by the hybrid organization resource.
- Permissions set on the project apply to all environments, unless you specify more fine-grained permissions for each environment.
- If you assign a role to a user for a given environment, the user has that role only for the selected environment.
- It is recommended to set a minimum level of permissions for a user at the project level; then refine those roles for each environment in the hybrid organization as needed.

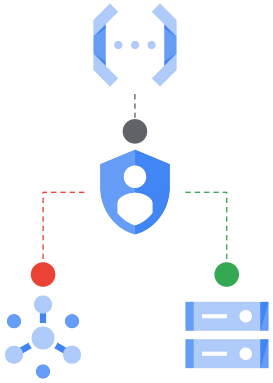


A user inherits roles from the Google Cloud project in the hybrid organization and environments.

You typically assign roles with the least permissions to the user in the project, and then refine those roles in the hybrid organization and individual environments based on the functionality that the user can perform.

Principle of least privilege

- The principle of least privilege states that a resource should only have access to the exact set of resources it needs in order to function.
  - For example: A database backup service should be restricted to read-only permissions on the one database being backed up.
- To implement this principle, consider the following best practices:
  - Avoid excessive use of broad basic roles like *Owner, Editor*.
  - Use predefined or custom roles for granular access to resources.
  - Assign roles to groups, instead of to individuals, to easily manage user attrition.
  - Reduce default service account permissions and instead use custom dedicated service accounts.
  - Use networking features (firewalls, VPCs) to control access to project resources.



It is a best practice to follow the principle of least privilege when assigning roles that allow users to access resources.

The principle states that a user or resource should only have access to the exact set of resources needed in order to perform a given function.

Avoid granting users broad basic roles like Owner or Editor.

To manage user attrition, assign roles to groups instead of to individual users. This makes it efficient to change user access by simply managing the user's group membership.

Consider using predefined or custom roles to provide more granular access to resources.

Practicing the principle of least privilege

Apigee-specific hybrid roles

Role	Description
`Analytics Editor`	Creates and analyzes reports on API proxy traffic for an Apigee organization. Can edit queries and reports.
`API Admin (V2)`	A developer that creates and tests API proxies. This role can read API products and apps, as well as edit API proxies, shared flows, and KVMs. This role replaces the deprecated `API Creator` role.
`API Reader (V2)`	Provides read-only access to most Apigee features, including API products, environment groups, environments, KVMs, proxies, shared flows, and more.
`Analytics Viewer`	Views analytics data for an organization. This role can get environment stats.
`Environment Admin`	Gives full read/write access to Apigee environment resources, including flow hooks, keystores, KVMs, shared flows, and target servers. For a full listing of permissions for this role, see Apigee roles in IAM documentation.
`Developer Admin`	Manages developer access to apps. This role can read API products and can edit app keys, developer apps, and developers
`Org Admin`	A super user that has full access to all Apigee resources in the Apigee organization. This role can access all available actions for all APIs. This is the only role that can create, delete, or update organizations.
`Read Only Admin`	An administrator who can run reports and view everything in the Apigee organization without the ability to create or change anything. This role has read access to all Apigee resources within the Apigee organization. Your Google Cloud project's service account is assigned this role during setup and installation.

Apigee hybrid provides a set of predefined roles that you can assign to users based on their job function.

The org admin role has full access privileges to all resources in the Apigee hybrid organization.

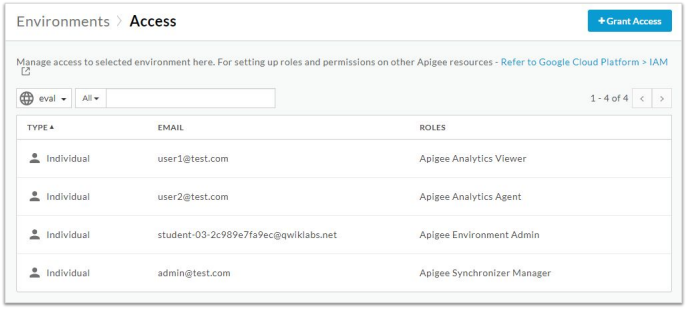
API developers can be assigned the API Admin and Environment Admin roles, and a business user can be assigned the Analytics Viewer or Analytics Editor role.

A user with the Developer Admin role has edit access to Apps, API keys, and App developers in hybrid.

Apigee pre-defined roles and permissions

Assigning roles

- A new user is first added to the project and granted one or more roles. This gives the user the same role in all environments in the hybrid organization.
- In the hybrid UI, you can refine a user's access by specifying one or more roles per environment in your hybrid organization.
  - Select Admin > Environments > Access in the left navigation menu, and click +Grant Access to add user roles for the environment.



A new user who is added to your project is granted one or more roles based on job function.

By default, the new user inherits the same role for all the project resources, including the hybrid organization and environments.

You can use the Apigee hybrid UI to refine the user roles for each hybrid environment.

When defined for a hybrid environment, the user only functions in the specified role in that environment.

Managing roles using the API

- You can use Apigee APIs, Google Cloud APIs, Google Cloud Console and the gcloud tool to manage user roles in hybrid.
- Use the /organizations API to list the Apigee organizations and associated projects that you have permission to access.
- Use the /organizations/ * /environments/ * :getIamPolicy and /organizations/ * /environments/ * :setIamPolicy operations to get and update the IAM policy bindings for user roles and resources.
- The above operations use a Policy object that is a collection of bindings. A binding binds one or more members (user account) to a single role.

```
{
  "bindings": [
    {
      "role":
"roles/resourcemanager.organization
Admin",
      "members": [
        "user:mike@example.com",
        "group:admins@example.com",
        "domain:google.com",

"serviceAccount:my-project-id@appsp
ot.gserviceaccount.com"
      ]
       },
   ...
}
```


You can use the Google Cloud Console, the Apigee API, or the gcloud tool to set a user's roles in Apigee hybrid.

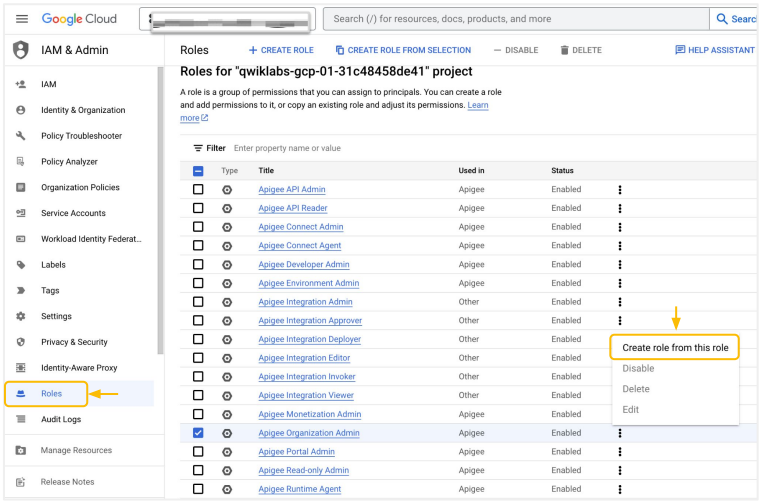
Use the getIamPolicy and setIamPolicy operations of the /organizations/environments Apigee API to get and set a user's role in a hybrid environment.

The API uses a Policy object that contains a collection of role bindings assigned to a set of user accounts.

Manage users, roles, and permissions using the API | Apigee

Creating custom roles

- Using Google's IAM, you can also create custom roles for use in Apigee hybrid.
- From the Roles page in the Cloud Console, you can create a new custom role from an existing role, or create one by setting permissions individually.

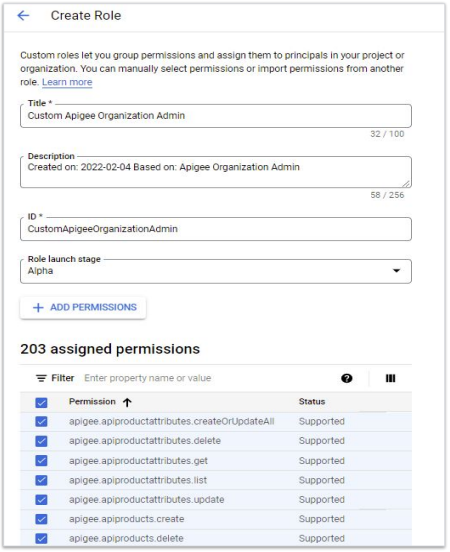


Apigee hybrid supports the creation of custom roles using Google's Identity and Access Management.

You can use the Cloud Console to create a custom role from an existing Apigee hybrid role.

Assigning custom role permissions

- Add or remove permissions for the custom role when creating it.
- After the custom role is created, you can assign users in your hybrid project to that role using the UI or API.



In the IAM user interface of the Cloud Console, add or remove permissions for the custom role.

After that, use the Cloud Console UI or gcloud API to assign the custom role to users in your project.

Overview of Workload Identity with Apigee Hybrid

- **Workload Identity** allows applications running within GKE to access Google Cloud services.
- A Google **IAM service account** is an identity applications may use to make requests to Google APIs.
- Kubernetes has **service accounts**. A service account provides an identity for processes that run in a Pod.
  - Kubernetes service accounts are Kubernetes resources.
  - Google service accounts are specific to Google Cloud.
- Apigee creates and uses a Kubernetes service account for each type of component. Enabling Workload Identity allows the hybrid components to interact with the Kubernetes service accounts.

Workload Identity is a way for applications running within GKE (Google Kubernetes Engine) to access Google Cloud services in a secure and manageable way. Workload Identity allows workloads in your GKE clusters to impersonate Identity and Access Management (IAM) service accounts to access Google Cloud services.

A Google IAM service account is an identity that an application can use to make requests to Google APIs.

Separately, Kubernetes also has the concept of service accounts. A service account provides an identity for processes that run in a Pod. Kubernetes service accounts are Kubernetes resources, while Google service accounts are specific to Google Cloud.

From Apigee hybrid 1.4 and later, Apigee creates and uses a Kubernetes service account for each type of component. Enabling Workload Identity allows the hybrid components to interact with the Kubernetes service accounts.

Workload Identity with Apigee Hybrid - Prerequisites

- Workload Identity must be enabled for the GKE cluster running Apigee.
- Confirm if Workload Identity is enabled by running the following command:

```
gcloud container clusters describe $CLUSTER_NAME
```

The output should include something like this:

```
...
...
status: RUNNING
subnetwork: default
workloadIdentityConfig:
  workloadPool: PROJECT_ID.svc.id.goog
```


Before enabling Workload Identity for Apigee hybrid, Workload Identity must be enabled for the GKE cluster running Apigee.

When running Apigee hybrid on GKE, the standard practice is to create and download private keys (.json files) for each of the service accounts. When using Workload Identity, you do not need to download service account private keys and add them to GKE clusters.

Enable Workload Identity with Apigee Hybrid

You can enable Workload Identity on clusters and node pools by performing the following:

- Enable Workload Identity for a fresh install:
  - Add `workloadIdentityEnabled: true` to `overrides.yaml` under the `gcp` stanza.
  - Create Google Service Accounts.
  - Create the Kubernetes Service Accounts.
- Upgrade an install to use Workload Identity.

Prior to enabling Workload Identity, you ensure Workload Identity is enabled per node pool and then initialize variables. You can enable Workload Identity for a fresh install or upgrade and existing install.

For more information on configuring and using Workload Identity with Apigee hybrid, see Enabling Workload Identity with Apigee hybrid.

Agenda

01	Infrastructure Security
02	Data Storage and Encryption
03	RBAC
04	Quiz

Question #1

Question

Which one of the following statements about authentication between the hybrid management plane and runtime plane components is true:

A. The MART runtime component uses a sidecar container to generate OAuth tokens used for securely communicating with the hybrid management plane.

B. The UDCA runtime component uses a sidecar container to verify OAuth tokens received when securely communicating with the hybrid management plane.

C. The Synchronizer runtime component uses a sidecar container to generate OAuth tokens used for securely communicating with the hybrid management plane.

D. OAuth tokens are not used for communication between the hybrid management plane and the runtime plane components.

Question #1

Answer

Which one of the following statements about authentication between the hybrid management plane and runtime plane components is true:

A. The MART runtime component uses a sidecar container to generate OAuth tokens used for securely communicating with the hybrid management plane.

B. The UDCA runtime component uses a sidecar container to verify OAuth tokens received when securely communicating with the hybrid management plane.

C. The Synchronizer runtime component uses a sidecar container to generate OAuth tokens used for securely communicating with the hybrid management plane.

D. OAuth tokens are not used for communication between the hybrid management plane and the runtime plane components.

Explanation:

A. Incorrect. MART uses the authz sidecar container to verify OAuth tokens on requests from the management plane.

B. Incorrect. UDCA uses the authz sidecar container to generate OAuth tokens when sending analytics and trace session data to the management plane.

C. Correct! Synchronizer uses the authz sidecar container to generate OAuth tokens when fetching API proxy and other data from the management plane.

D. Incorrect. OAuth alongwith TLS is used for secure communication between the Apigee hybrid management and runtime planes.

Question #2

Question

To securely communicate between the API proxy running in Apigee hybrid and the target backend, as a best practice:

A. Use a keystore that contains the private key and certificate of the runtime component.

B. For 2-way TLS, only use a keystore that contains the private key and certificate chain of the runtime message processor.

C. Configure the virtualhost property with a TLS key and certificate in the overrides configuration file.

D. Create a TargetServer configuration with TLS and client authentication enabled. Use references to a truststore and keystore in the configuration of the target server.

Question #2

Answer

To securely communicate between the API proxy running in Apigee hybrid and the target backend, as a best practice:

A. Use a keystore that contains the private key and certificate of the runtime component.

B. For 2-way TLS, only use a keystore that contains the private key and certificate chain of the runtime message processor.

C. Configure the virtualhost property with a TLS key and certificate in the overrides configuration file.

D. Create a TargetServer configuration with TLS and client authentication enabled. Use references to a truststore and keystore in the configuration of the target server.

Explanation:

A. Incorrect. To establish trust, use a truststore that contains the SSL certificate and CA chain of the target backend server.

B. Incorrect. For 2-way TLS, use a keystore that contains the private key and certificate chain of the runtime message processor and a truststore that contains the SSL certificate and CA chain of the target backend server.

C. Incorrect. The virtualhost property is used to configure the ingress gateway and secure API traffic from application clients to the runtime components in the cluster.

D. Correct! To properly secure API traffic between the API proxy and the target backend, it is a best practice to use mutual TLS by creating a TargetServer configuration with references to a truststore and keystore that contains the required keys and certificates.

Question #3

Question

In Apigee hybrid, the KMS, key-value map, and cache data are encrypted using organization- or environment-scoped encryption keys. Which one of the following is correct:

A. KMS data is encrypted using an organization-scoped encryption key.

B. KVM data is encrypted using only an environment-scoped encryption key.

C. Cache data is encrypted using an organization-scoped encryption key.

D. The default Apigee-provided encryption keys cannot be changed.

Question #3

Answer

In Apigee hybrid, the KMS, key-value map, and cache data are encrypted using organization- or environment-scoped encryption keys. Which one of the following is correct:

A. KMS data is encrypted using an organization-scoped encryption key.

B. KVM data is encrypted using only an environment-scoped encryption key.

C. Cache data is encrypted using an organization-scoped encryption key.

D. The default Apigee-provided encryption keys cannot be changed.

Explanation:

A. Correct! The KMS encryption key is used to encrypt KMS data (developers, apps, API products, OAuth tokens, authorization codes, and API keys) for the entire Apigee hybrid organization.

B. Incorrect. Key-value map (KVM) data can be encrypted using an organization-scoped or environment-scoped encryption key.

C. Incorrect. Cache data is encrypted using an environment-scoped encryption key, because caches are scoped to environments only.

D. Incorrect. You can change the default encryption keys by configuring them in the overrides configuration file for your cluster.

Question #4

Question

In Apigee hybrid, roles that are granted to a user at the Google Cloud project level are inherited at:

A. The Google Cloud organization level.

B. The Apigee hybrid environment level for all environments in the Apigee hybrid organization by default.

C. The Apigee hybrid environment level for a specific environment in the Apigee hybrid organization.

D. The Google Cloud project level only.

Question #4

Answer

In Apigee hybrid, roles that are granted to a user at the Google Cloud project level are inherited at:

A. The Google Cloud organization level.

B. The Apigee hybrid environment level for all environments in the Apigee hybrid organization by default.

C. The Apigee hybrid environment level for a specific environment in the Apigee hybrid organization.

D. The Google Cloud project level only.

Explanation:

A. Incorrect. The Google Cloud organization is a parent of the Google Cloud project resource.

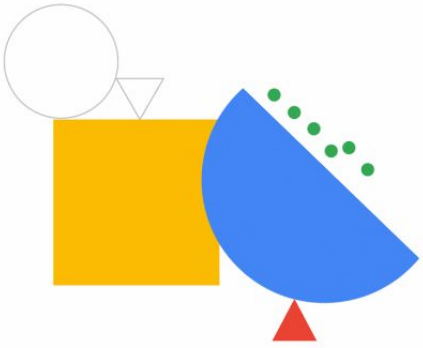
B. Correct! All Apigee hybrid environment resources inherit any roles granted to a user at the Google Cloud project level.

C. Incorrect. All Apigee hybrid environments are child resources of the Google Cloud project, so roles that are granted to a user at the project level are inherited by all environments. You can further refine the user roles for specific environments in the Apigee hybrid UI.

D. Incorrect. All child resources of the Google Cloud project inherit the user roles.

Google Cloud

Review: Security



In this module, you learned how communications between the Apigee hybrid runtime and management plane components are secured. You also learned how components within the runtime plane are secured.

You learned about the different types of data used in hybrid and their secure storage mechanisms. You also learned about role-based access control used for users of Apigee hybrid and about using Workload Identity with Apigee hybrid.

In the next module, you will learn about capacity planning for Apigee hybrid and how the platform can be scaled to handle your API traffic.