



Security

Learning objectives

- Design secure systems using best practices like separation of concerns, principle of least privilege, and regular audits.
- Leverage Google's Security Command Center to help identify vulnerabilities.
- Simplify cloud governance using organization policies and folders.
- Authenticate and authorize users with IAM roles, Identity-Aware Proxy, and Identity Platform.
- Manage the access and authorization of resources by machines and processes using service accounts.
- Secure networks with private IPs, firewalls, and Google Cloud private access.
- Mitigate DDoS attacks by leveraging Cloud DNS and Google Cloud Armor.

Agenda

Security Concepts

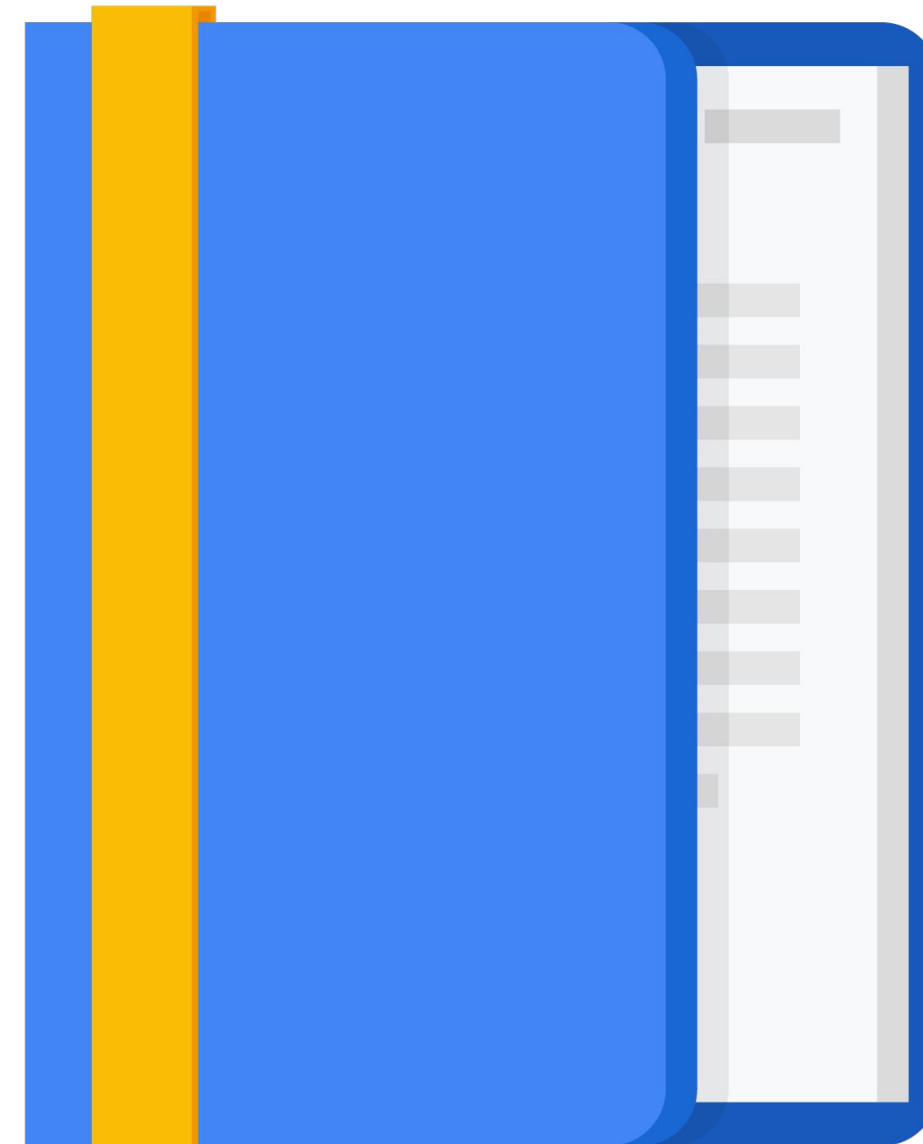
Securing People

Securing Machine Access

Network Security

Encryption

Design Activity #12



Google Cloud security is a shared responsibility between you and Google

Transparency

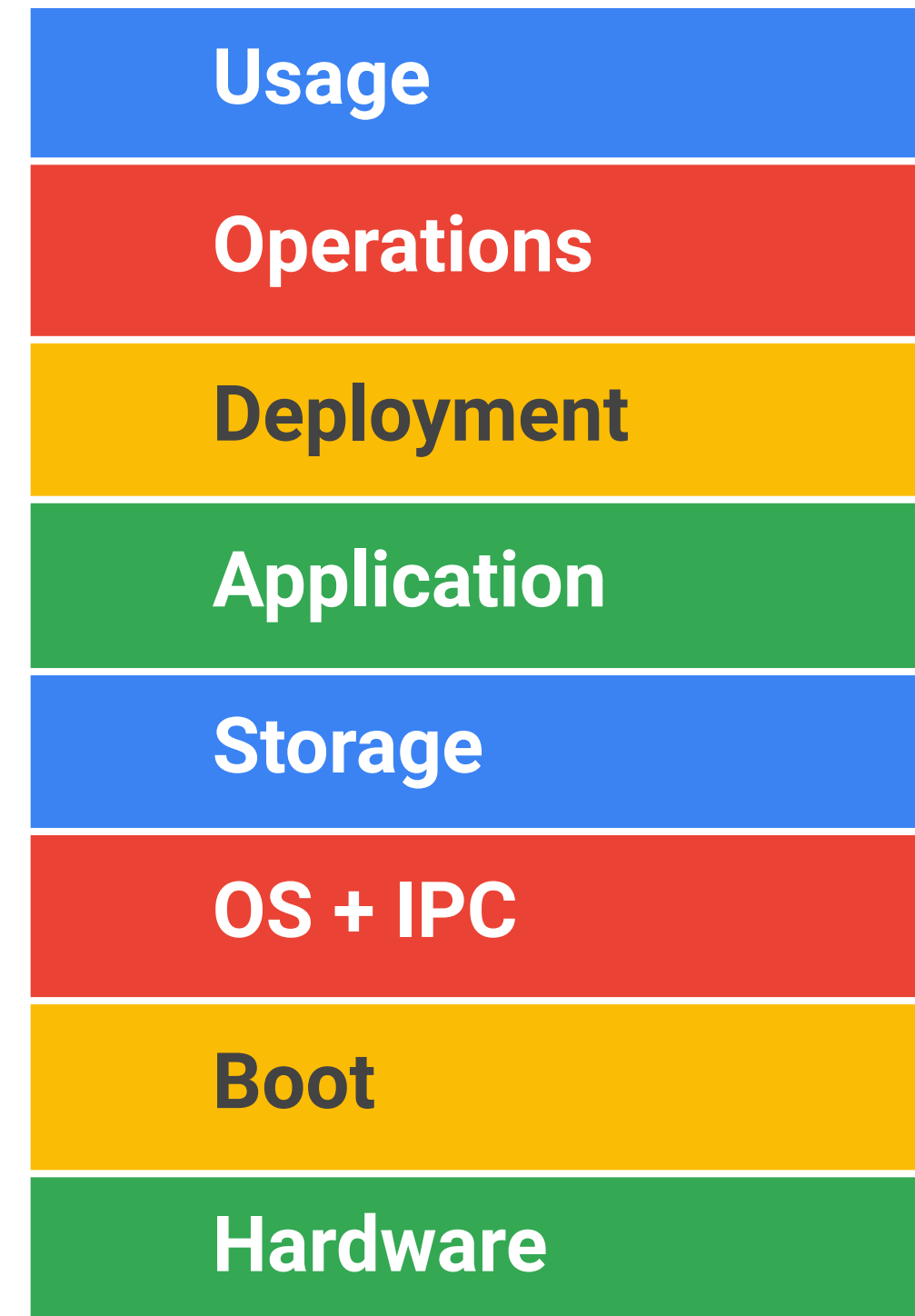
- The client is responsible for certain actions, and Google is responsible for others.
- Google Cloud provides the tools and access to monitor your service.
- Google Cloud provides the controls and features needed to leverage platform security.

Separation of duties

- What is provided by the platform?
- What are you responsible for?

Security is implemented in layers

- Google Cloud provides tools that, when properly configured, enable a secure environment.
- You can also integrate third-party tools for enhanced security.
- There are tools for monitoring and auditing your networks and resources.



Principle of least privilege

- Users should only be able to do the tasks that are required by their jobs.
- This should also apply to machine instances and run-time processes.

- Use IAM to enforce this principle.
- Identify users with their login.
- Identify machines and code using service accounts.
- Assign IAM roles to users and service accounts to restrict what they can do.

Separation of duties

Separation of duties means:

- No one person can change or delete data without being detected.
- No one person can steal sensitive data.
- No one person is in charge of designing, implementing, and reporting on sensitive systems.

For example, the people who write the code shouldn't deploy the code, and those who deploy the code shouldn't be able to change it.

- Use multiple projects to separate duties.
- Different people can be given different rights in different projects.
- Use folders to help organize projects.

Regularly audit the Google Cloud logs to discover attacks

All Google Cloud services write to audit logs:

- Admin logs
- Data access logs
- VPC Flow logs
- Firewall logs
- System logs



Google Cloud meets many third-party and government compliance standards worldwide

- Google Cloud has been certified as secure, but that does not mean that your application is certified.
- Don't worry about getting Google Cloud tools and services certified; only worry about what you build on top of Google Cloud.



ISO/IEC 27001



HIPAA



FedRAMP



SOC 1

Security Command Center provides access to organizational and project security configuration

Security

Security Command Center

Threat Detection

Context-Aware Access

Identity-Aware Proxy

Access Context Manager

VPC Service Controls

Binary Authorization

Data Loss Prevention

Cryptographic Keys

Access Approval

Web Security Scanner

Managed Microsoft AD

Security Command Center

+ ADD SECURITY SOURCES

SETTINGS

DASHBOARD

ASSETS

FINDINGS

VULNERABILITIES

Assets

1 day

Assets Summary

3690 total assets

Asset	New	Deleted	Total
Application	0	1	19
Service	0	1	15
Version	0	2	39
bigquery.Dataset	0	1	51
ManagedZone	0	0	4
CryptoKey	0	2	8
CryptoKeyVersion	0	1	27
KeyRing	0	2	9
Organization	0	0	1

Findings

Security Health Analytics

No current findings

Event Threat Detection

No current findings

No current findings

Findings Summary

No security findings for the organization

Anomaly Detection

No current findings

Agenda

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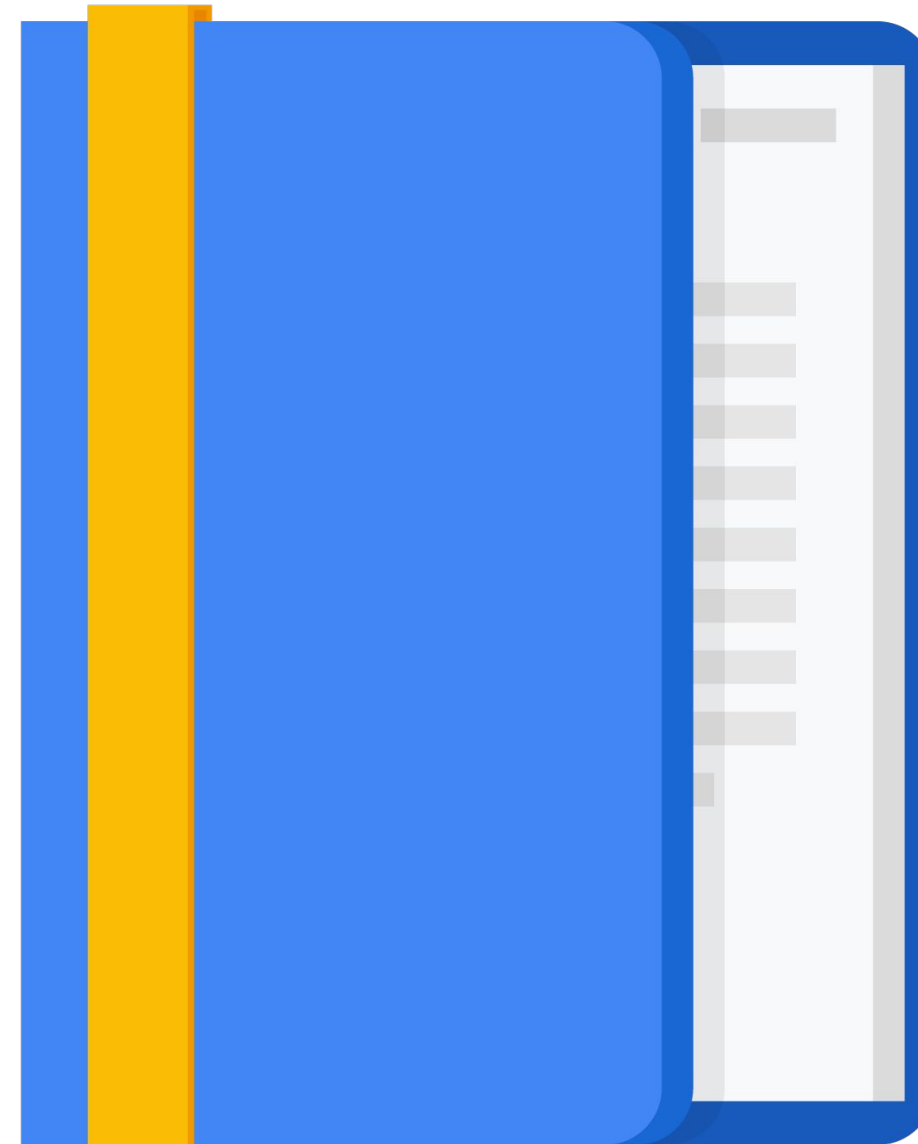
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Design Activity #12



To grant people access to your projects, add them as members and assign them one or more roles

- Members are identified by their login.
 - Add members to groups for easier management.
- Roles are simply a list of permissions.
 - Use the Console to easily see what permissions are granted to roles.

BigQuery

Filter table

Type	Title	Used in	Status
<input type="checkbox"/>	BigQuery Admin	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Connection Admin	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Connection User	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Data Editor	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Data Owner	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Data Viewer	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Job User	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Metadata Viewer	BigQuery	Enabled
<input type="checkbox"/>	BigQuery Read Session User	BigQuery	Enabled
<input type="checkbox"/>	BigQuery User	BigQuery	Enabled
<input type="checkbox"/>	Cloud Asset Owner	Cloud Asset	Enabled

BigQuery User

+ EDIT ROLE

CREATE FROM ROLE

ID

roles/bigquery.user

Role launch stage

General Availability

Description

Access to run queries and create datasets

15 assigned permissions

bigquery.config.get
bigquery.datasets.create
bigquery.datasets.get
bigquery.datasets.getIamPolicy
bigquery.jobs.create
bigquery.jobs.list
bigquery.models.list
bigquery.readsessions.create
bigquery.routines.list
bigquery.savedqueries.get
bigquery.savedqueries.list
bigquery.tables.list
bigquery.transfers.get
resourcemanager.projects.get
resourcemanager.projects.list

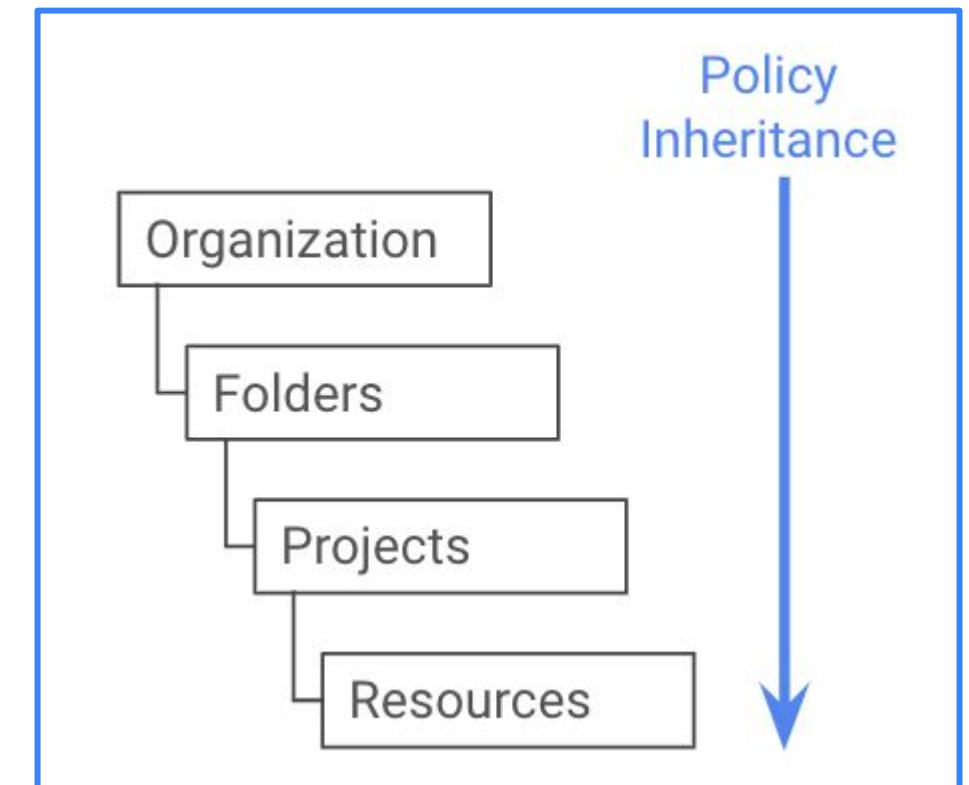
Use organizational policies and folders to simplify securing environments and managing resources

Grant roles to Google groups rather than individuals

- Groups can be more granular than job roles.
- Use multiple groups for better control (such as *view only*).

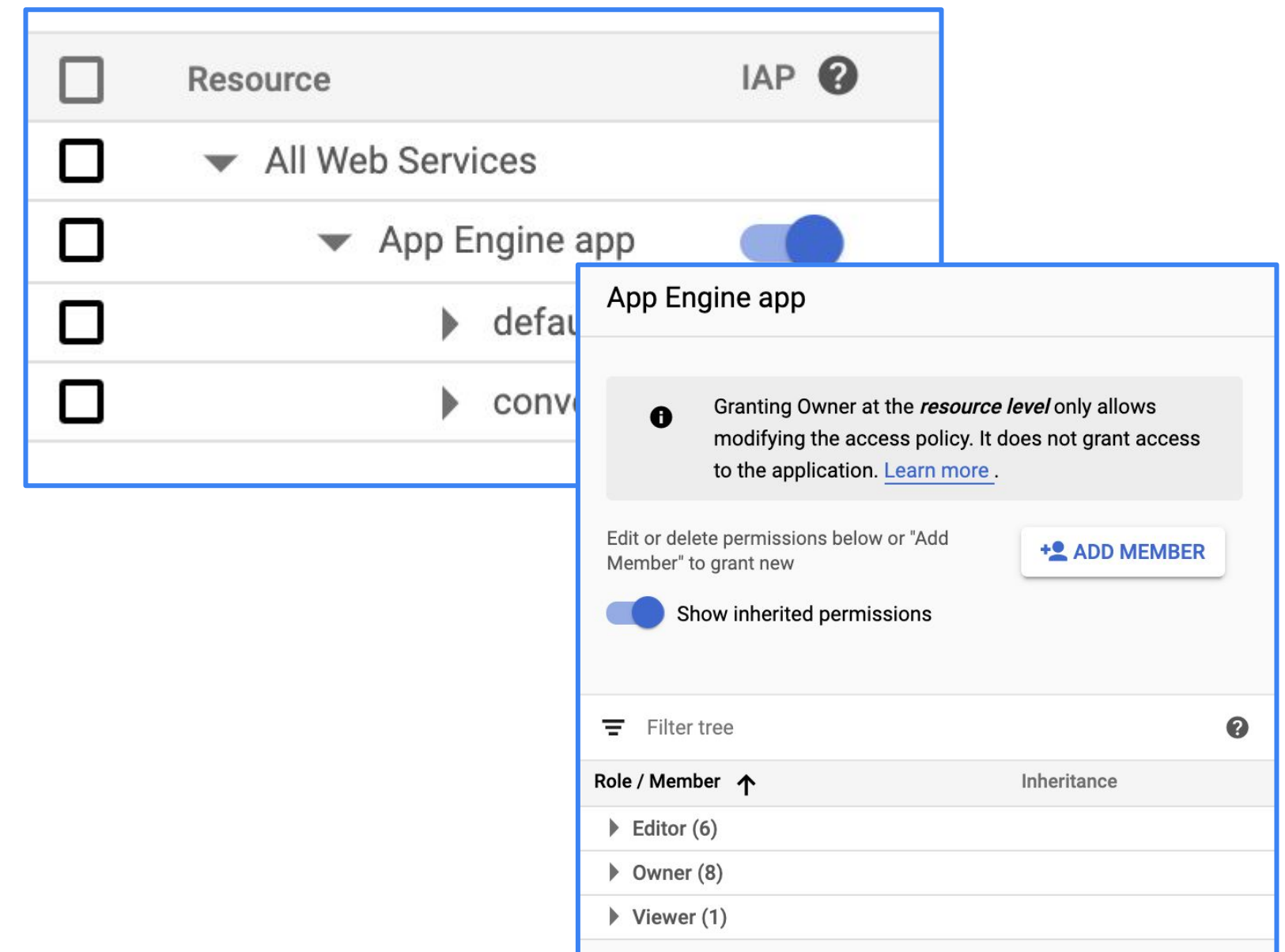
Roles

- Prefer pre-defined roles over custom roles.
- Grant roles at the smallest scope needed (least privilege).
- Limit use of “owner” and “editor” roles.
- Consider hierarchy inheritance when assigning roles.



Identity-Aware Proxy simplifies authorization to Google Cloud applications and VMs

- Works with applications deployed behind the HTTP(S) load balancer in Compute Engine, GKE, or App Engine.
- When configured, it forces users to log in.
- Admins control who can access to app.
- Allows employees to securely access web-based applications without the need for a VPN.










Identity Platform provides authentication as a service

- Provides federated login that integrates with many common providers.
- Use it to provide sign-up and sign-in for your end users' applications.

Sign-in method

Select and configure an identity provider.

Select a provider *

-  OpenID Connect
Identity built on top of OAuth 2.0
-  SAML
Open standard for exchanging auth
-  Google
-  Twitter
-  Facebook
-  Microsoft
-  LinkedIn

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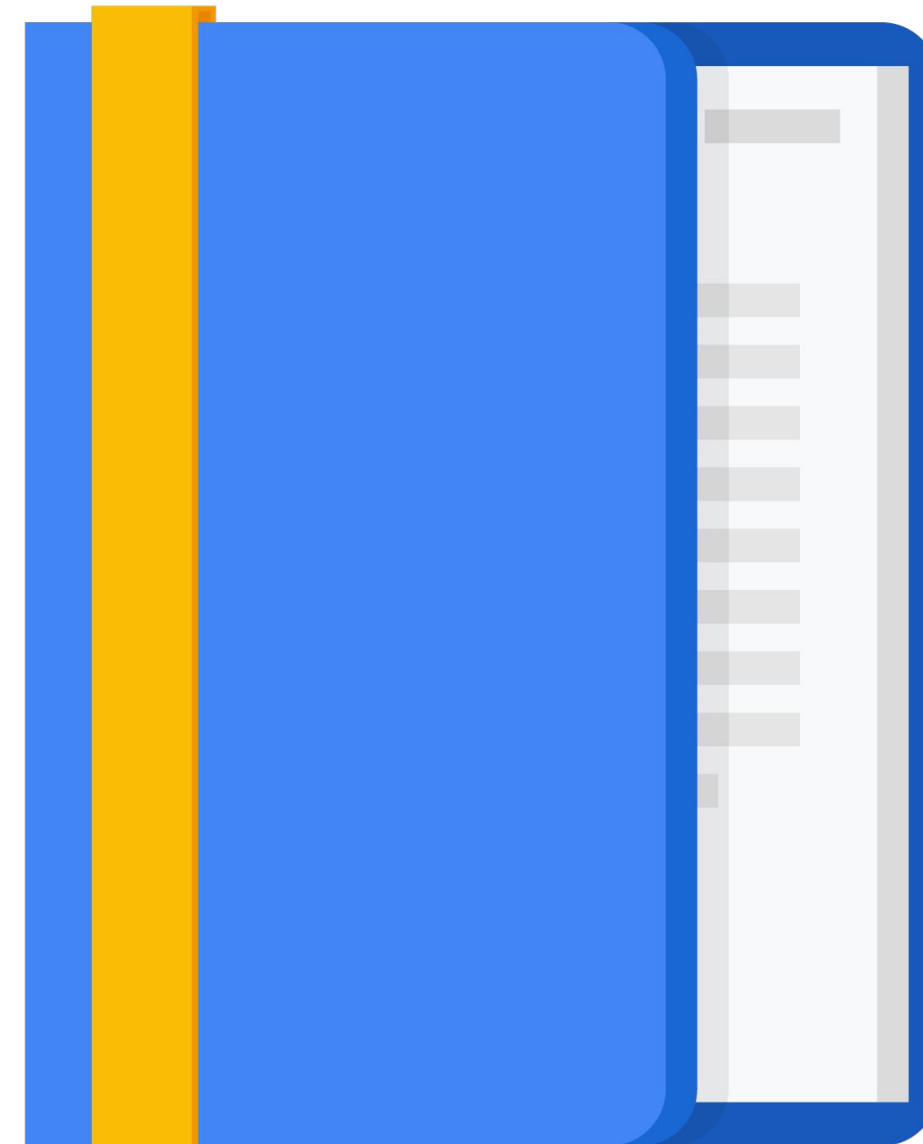
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Service accounts can be used for machine or application identities

- Create a service account and grant it one or more roles.
- Can assign that service account to VMs or GKE node pools.
- Those machines run with only the rights granted by the roles.

Identity and API access ?

Service account ?

jenkins-sa ▼

Access scopes ?

Use IAM roles with service accounts to control VM access [Learn more](#)

- Generate and download a key when creating a service account.
- This key can be used for authentication.
- Key is downloaded as JSON.
- Store the key safely.

Create key (optional)

Download a file that contains the private key. Store the file securely because this key can't be recovered if lost. However, if you are unsure why you need a key, skip this step for now.

[+ CREATE KEY](#)

```
{
  "type": "service_account",
  "project_id": "project-id",
  "private_key_id": "48e95bf20887235536f772dcf25d47b89f8cf49",
  "private_key": "-----BEGIN PRIVATE KEY-----\nMIIEvAIBADANBgkqhkiG9w0BAQsFAAOCAQEAg...",
  "client_email": "my-service-account@project-id.iam.gserviceaccount.com",
  "client_id": "113723034034071973858",
  "auth_uri": "https://accounts.google.com/o/oauth2/auth",
  "token_uri": "https://oauth2.googleapis.com/token",
  "auth_provider_x509_cert_url": "https://www.googleapis.com/auth/impersonation",
  "client_x509_cert_url": "https://www.googleapis.com/robot/v1/metadata/x509/my-service-account@project-id.iam.gserviceaccount.com"
}
```

Can use service account keys to configure the CLI

- Allows you to grant controlled Google Cloud access to developers without giving them access to the Cloud Console.
- Also useful for automation when configuring VMs to run CI/CD pipelines.
- Use: `gcloud auth activate-service-account --key-file=[PATH TO KEY FILE]`

Agenda

Security Concepts

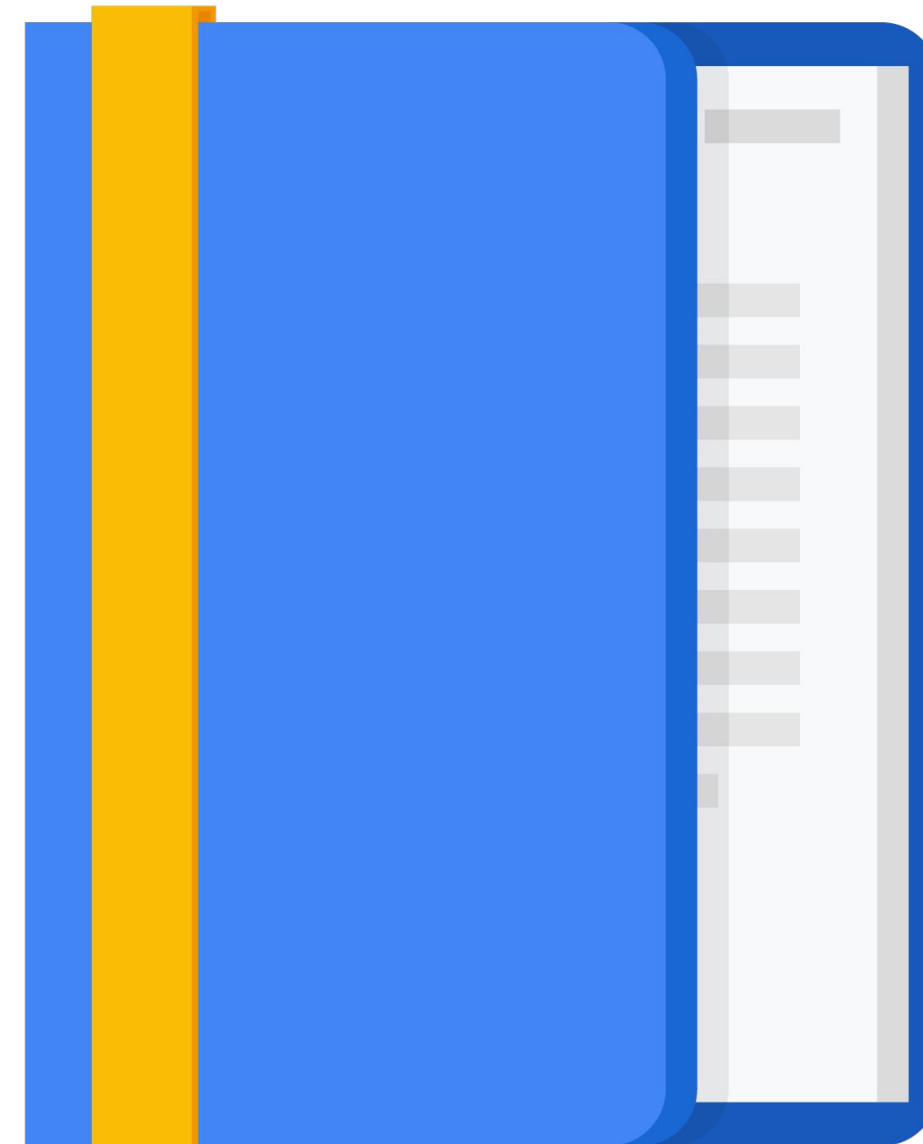
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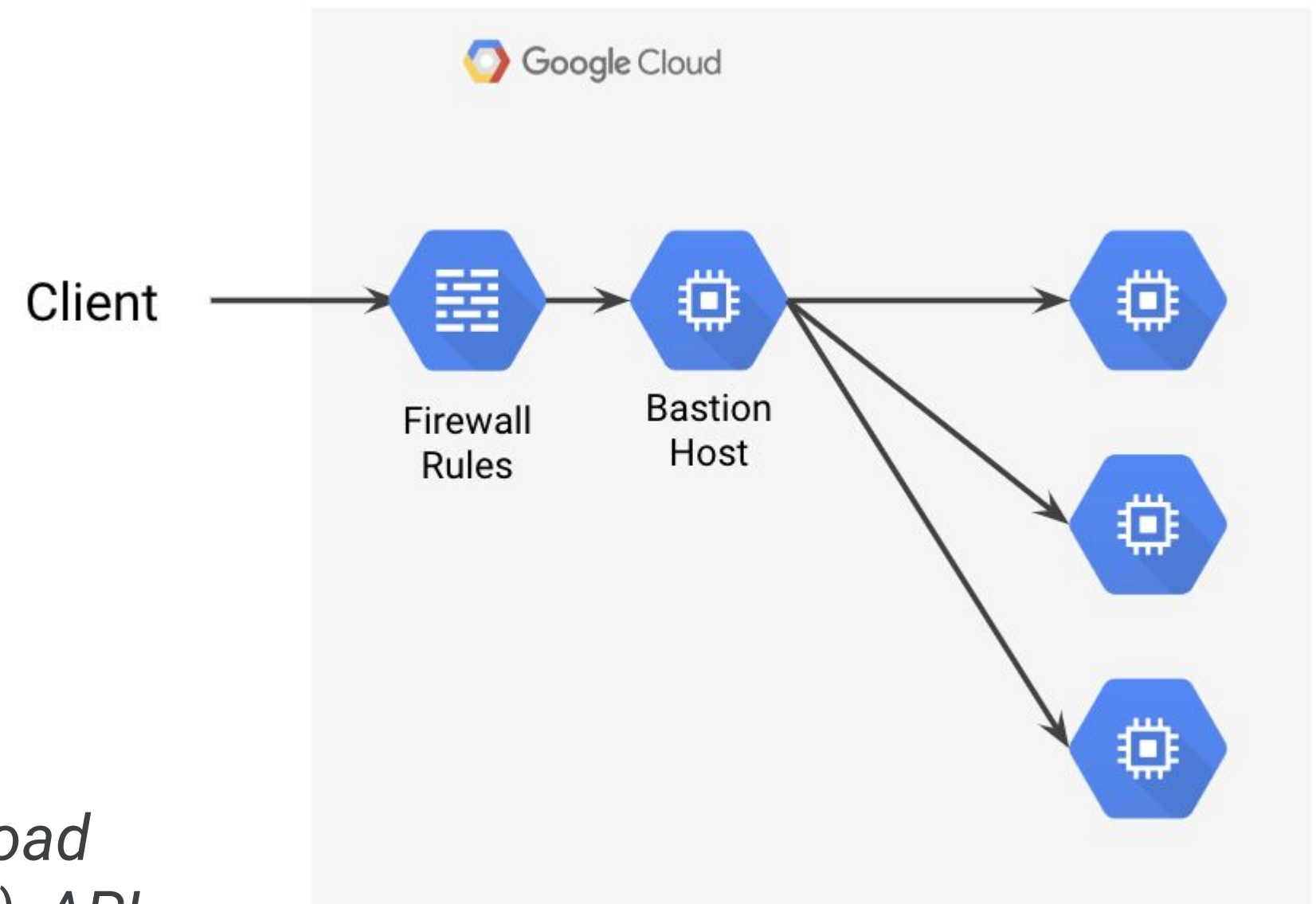
Design Activity #12



Remove external IPs to prevent access to machines outside their network

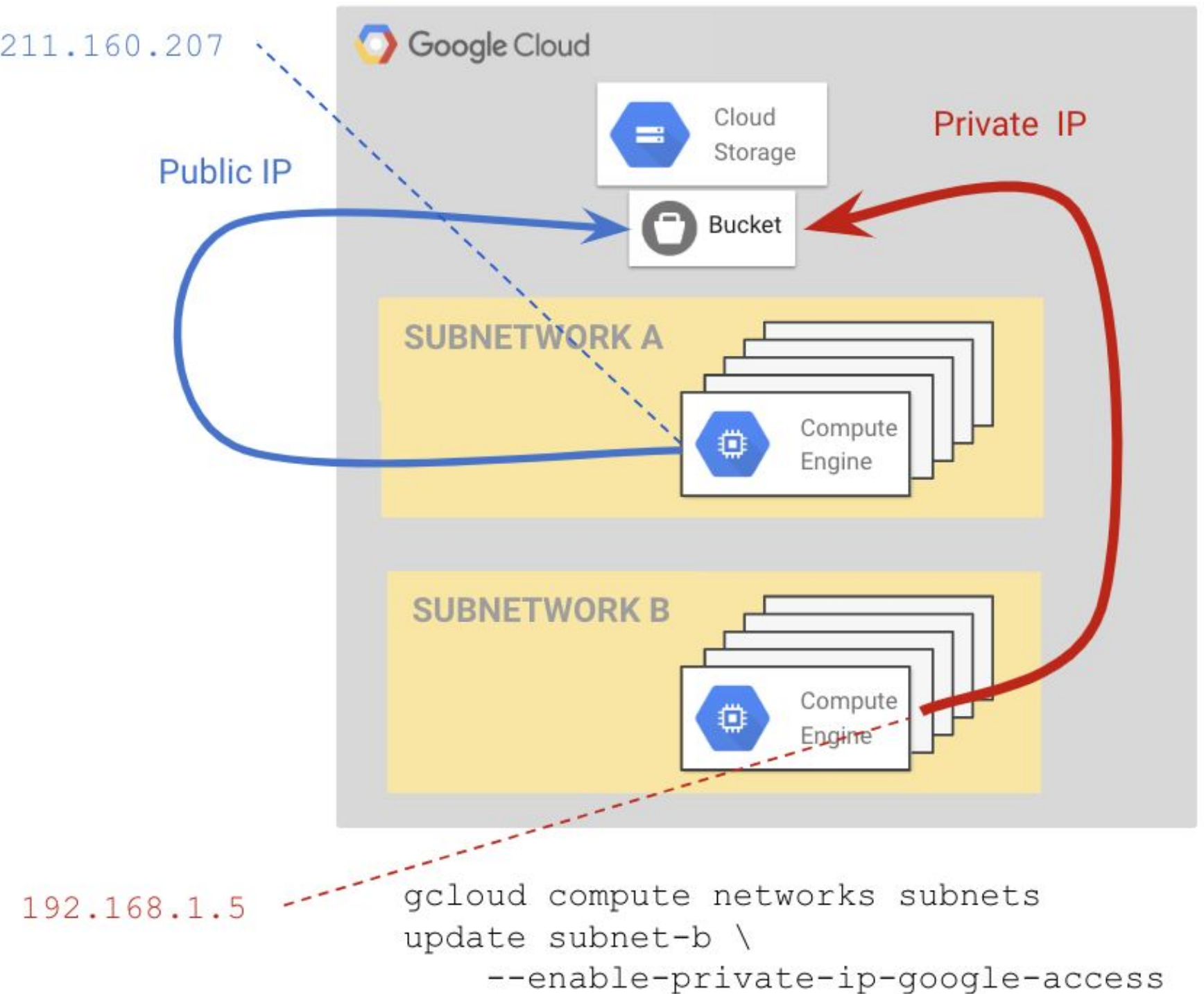
- Use a bastion host to provide access to private machines.
- Can also SSH into internal machines using Identity-Aware Proxy from the console and CLI.
- Use Cloud NAT to provide egress to the internet from internal machines.

All internet traffic should terminate at a load balancer, third-party firewall (proxy or WAF), API Gateway, or IAP. That way, internal services cannot be launched and get public IP addresses.



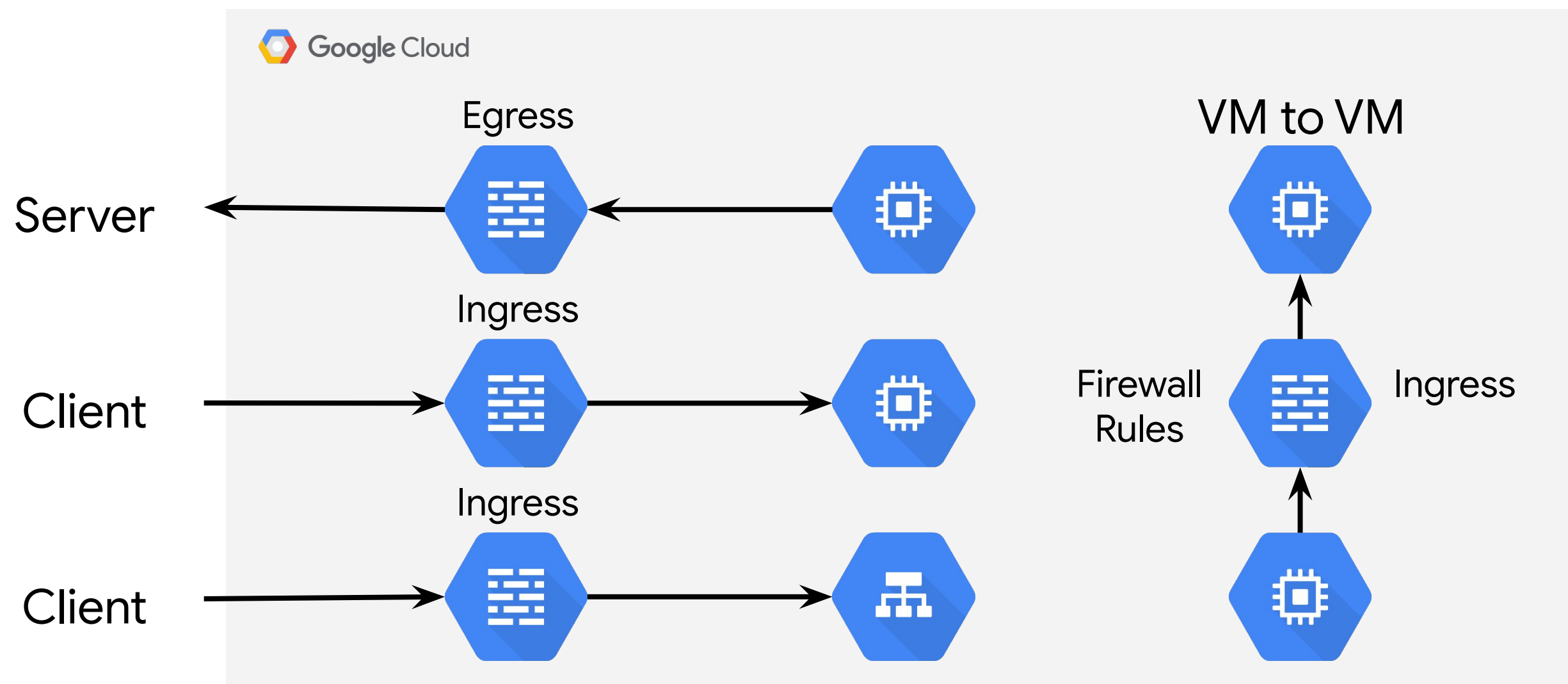
Private access allows access to Google Cloud services using an internal address

- Enabled when creating subnets.
- Allows access to Google Cloud services from VMs that only have internal IPs.
 - For example, a machine with only an internal IP would be able to reach a Cloud Storage bucket.



Configure firewall rules to allow access to VMs

- By default, ingress on all ports is denied.
- Add firewall rules to control which clients have access to which VMs on which ports.
- Application level security is the responsibility of the customer.



Control access to APIs using Cloud Endpoints

- Protect and monitor your public APIs.
- Control who has access to your API.
- Validate every call with JSON Web Tokens and Google API keys.
- Integrates with Identity Platform.



Restrict access to your services to TLS only

- All Google Cloud service endpoints use HTTPS.
- It's up to you to configure your service endpoints.
- In the load balancer setup, only create a secure frontend.

New Frontend IP and port

Name (Optional) ?
Name is permanent
lowercase, no spaces

Add a description

Protocol ?
HTTPS (includes HTTP/2)

Network Service Tier ?
☒ Premium (Current project-level tier, [change](#)) ?
☐ Standard ?

IP version
IPv4

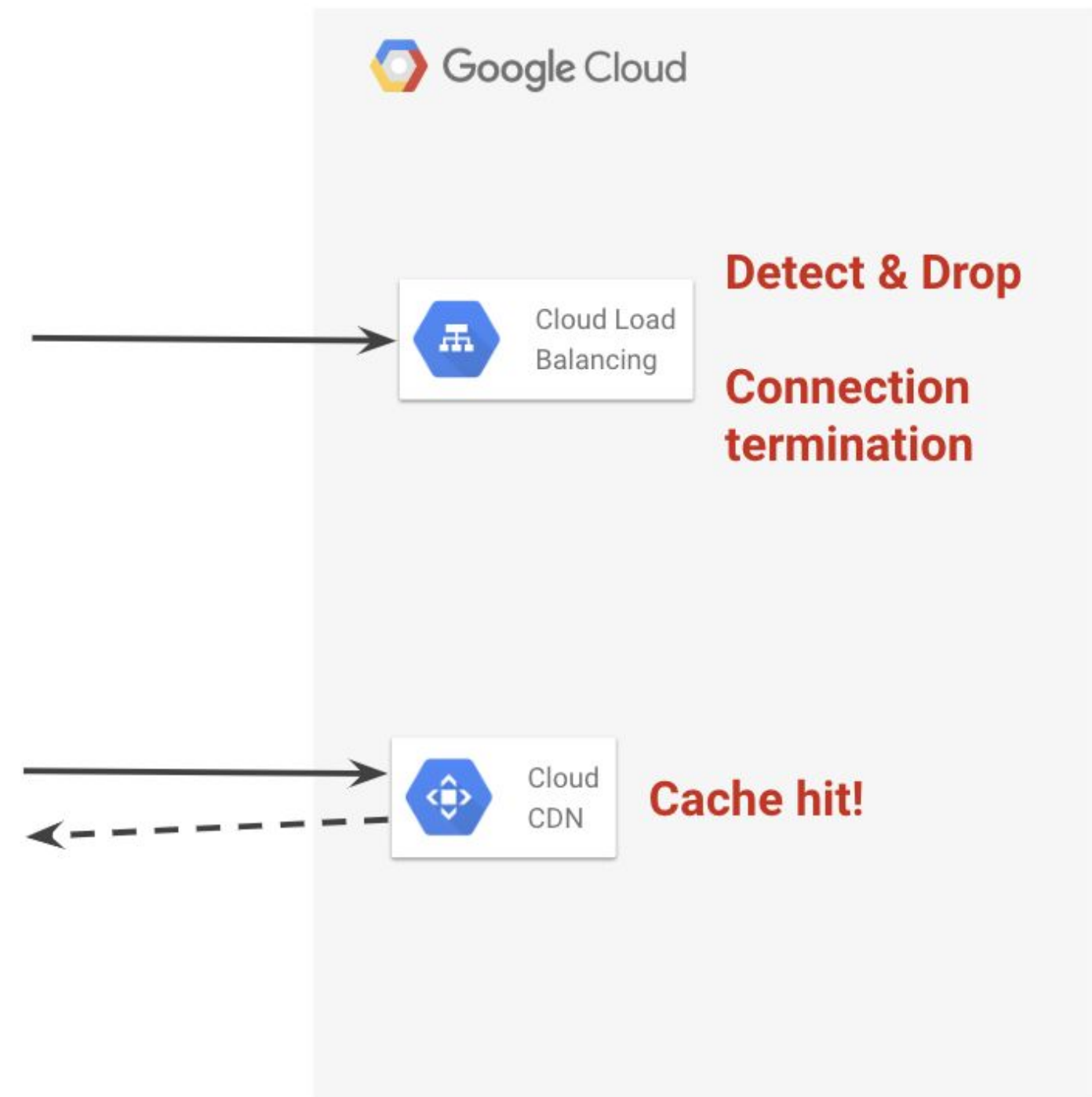
IP address
Ephemeral

Port
443

Certificate ?
my-cert (Managed)

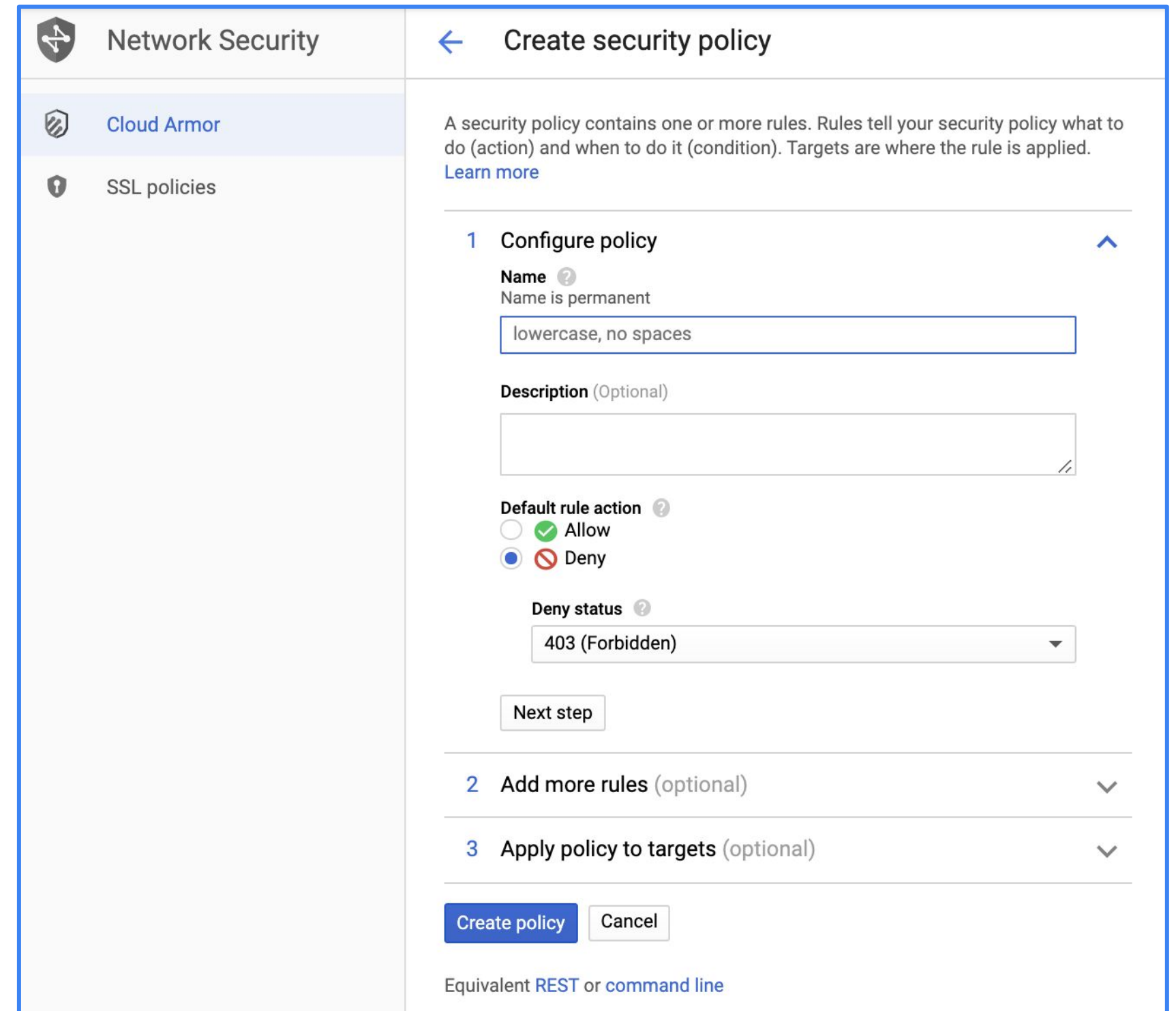
Leverage Google Cloud network services for DDoS protection

- Global load balancers detect attacks and drop them.
- Enabling the CDN will protect backend resources.



Use Cloud Armor to create network security policies

- Can allow or deny access to your Google Cloud resources using IP addresses or ranges.
- Create whitelists to allow known addresses.
- Create blacklists to block known attackers.



The screenshot shows the Google Cloud Network Security console. On the left, a sidebar menu includes 'Network Security' (selected), 'Cloud Armor', and 'SSL policies'. The main content area is titled 'Create security policy'. It contains a description of security policies, a 'Learn more' link, and a multi-step configuration process. Step 1, 'Configure policy', includes fields for 'Name' (with a hint 'Name is permanent' and a value 'lowercase, no spaces'), 'Description' (optional), 'Default rule action' (radio buttons for 'Allow' and 'Deny', with 'Deny' selected), and 'Deny status' (a dropdown menu set to '403 (Forbidden)'). A 'Next step' button is below these fields. Steps 2 and 3 are 'Add more rules (optional)' and 'Apply policy to targets (optional)', both with expandable arrows. At the bottom are 'Create policy' and 'Cancel' buttons, and a link for 'Equivalent REST or command line'.

Network Security

Cloud Armor

SSL policies

Create security policy

A security policy contains one or more rules. Rules tell your security policy what to do (action) and when to do it (condition). Targets are where the rule is applied.
[Learn more](#)

1 Configure policy

Name ?
Name is permanent
lowercase, no spaces

Description (Optional)

Default rule action ?
☐ Allow
☒ Deny

Deny status ?
403 (Forbidden)

Next step

2 Add more rules (optional)

3 Apply policy to targets (optional)

Create policy Cancel

Equivalent [REST](#) or [command line](#)

Cloud Armor supports layer 7 web application firewall (WAF) rules

- Predefined rules for preventing common attacks like SQL injection and cross-site scripting
- Flexible rules language allows you to allow or deny traffic using request headers, geographic location, ip addresses, cookies, etc.
- Examples:

```
inIpRange(origin.ip, '9.9.9.0/24')
request.headers['cookie'].contains('80=BLAH')
origin.region_code == 'AU'
inIpRange(origin.ip, '1.2.3.4/32') &&
request.headers['user-agent'].contains('WordPress')
evaluatePreconfiguredExpr('xss-canary')
```

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Security Concepts

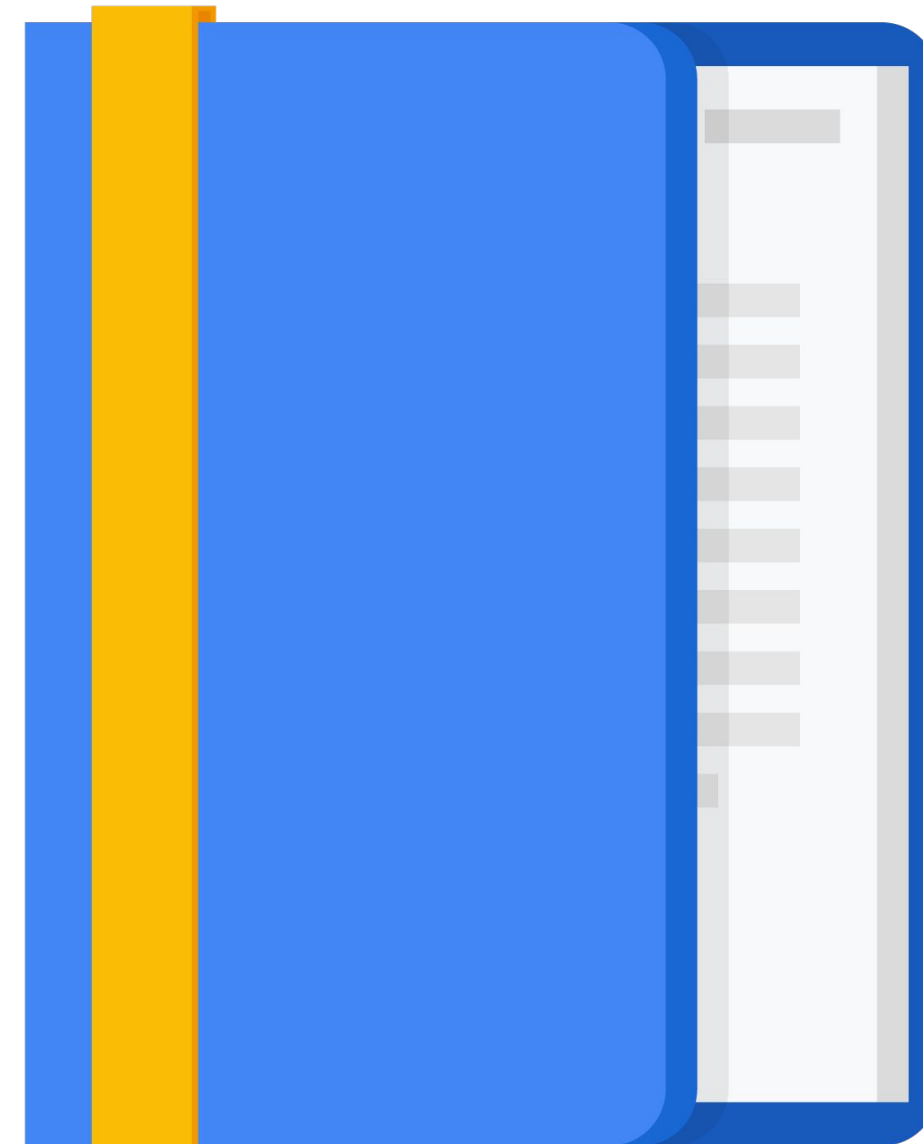
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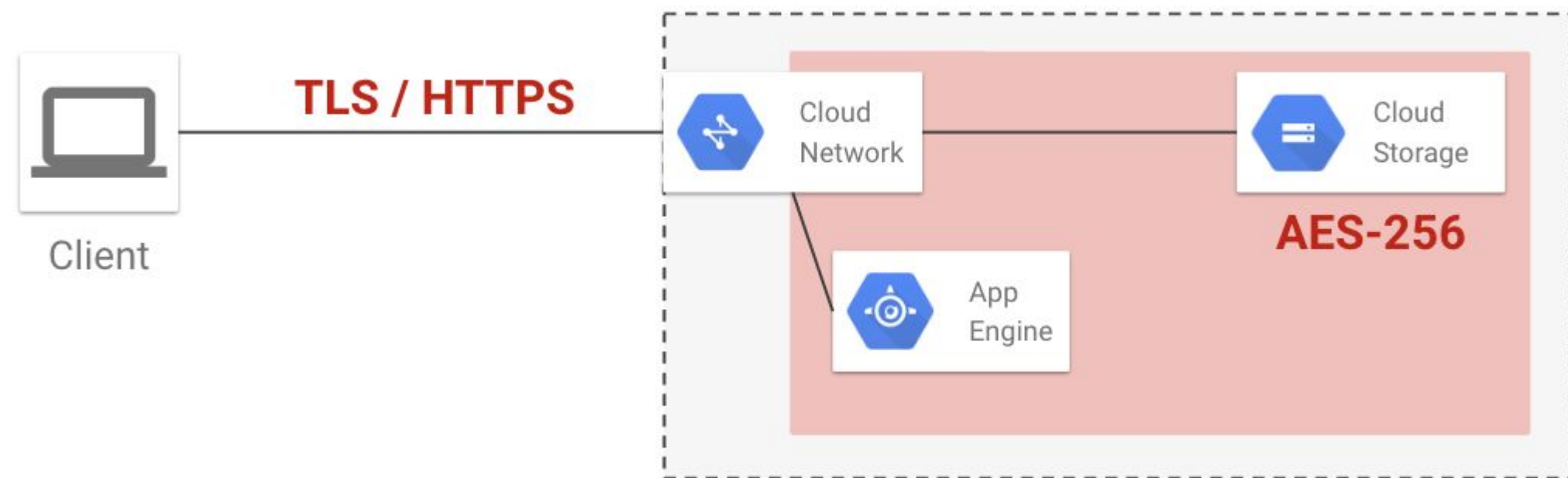
Encryption

Design Activity #12



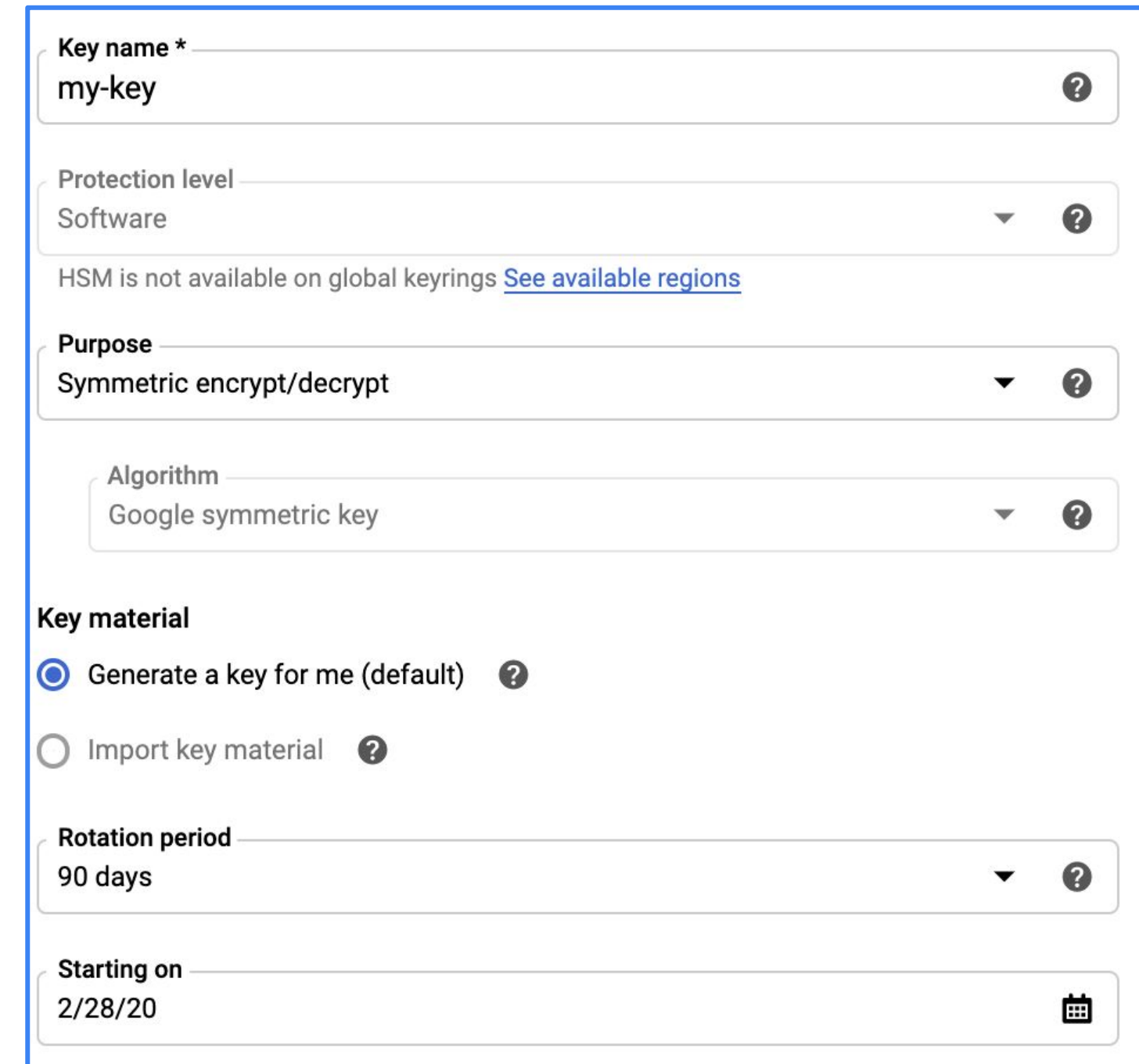
Google Cloud provides server-side encryption of data at rest by default

- Data Encryption Key (DEK) uses AES-256 symmetric key.
- Keys are encrypted by Key Encryption Keys (KEK).
- Google controls master keys in Cloud KMS.
- Keys are automatically periodically rotated.
- On-the-fly decryption by authorized user access with no visible performance impact



For compliance reasons, you may need to manage your own keys

- Customer-managed encryption keys are created in the cloud using Cloud Key Management Service (KMS).
- You create the keys and specify the rotation frequency.
- You can then select your keys when creating storage resources like bucket and disks.



The screenshot displays the Google Cloud Key Management Service (KMS) console interface for creating a new key. The form is enclosed in a blue border and contains the following fields and options:

- Key name ***: A text input field containing "my-key" with a help icon (?) on the right.
- Protection level**: A dropdown menu showing "Software" with a help icon (?). Below this, a note states: "HSM is not available on global keyrings [See available regions](#)".
- Purpose**: A dropdown menu showing "Symmetric encrypt/decrypt" with a help icon (?).
- Algorithm**: A dropdown menu showing "Google symmetric key" with a help icon (?).
- Key material**: Two radio button options:
 - ☒ Generate a key for me (default) with a help icon (?).
 - ☐ Import key material with a help icon (?).
- Rotation period**: A dropdown menu showing "90 days" with a help icon (?).
- Starting on**: A date input field showing "2/28/20" with a calendar icon on the right.

Customer-supplied encryption keys are created in your environment and provided to Google Cloud

- Use your own keys with Google Cloud services.
- CSEK are supplied by the calling application per-API call.
- Only cached in RAM by Google.
- They decrypt a single payload (or column) or block of returned data.
- Supported by Compute Engine (persistent disks) and Cloud Storage.

The Data Loss Prevention API can be used to protect sensitive data by finding it and redacting it

- Scans data in Cloud Storage, BigQuery, or Datastore.
- Can also scan images.
- Detects many different types of sensitive data, including:
 - Emails
 - Credit cards
 - Tax IDs
- You can add your own information types.
- Can delete, mask, tokenize, or just identify the location of the sensitive data.



Activity 12: Modeling Secure Google Cloud Services

Refer to your Design and Process Workbook.

- Draw a diagram that depicts your case study security requirements.



Quiz

What Google Cloud service can you use to enforce the principle of least privilege when using Google Cloud?

- A. IAM members and roles
- B. Firewall rules
- C. Encryption keys
- D. SSL certificates

Quiz

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A. IAM members and roles

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C. Encryption keys

D. SSL certificates

Quiz

You don't want programmers to have access to production resources. What's the easiest way to do this in Google Cloud?

- A. Create a firewall rule that blocks developer access to production servers and databases.
- B. Create development and production projects, and don't give developers access to production.
- C. Use different service accounts for production and development resources with your project.
- D. Set up private access and Identity-Aware Proxy.

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Quiz

Which Google Cloud features could help prevent DDoS attacks?

- A. HTTP global load balancer
- B. CDN
- C. Google Cloud Armor
- D. All of the above

Quiz

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C. Google Cloud Armor

D. All of the above

Quiz

What do you have to do to enable encryption when using Cloud Storage?

- A. Simply enable encryption when configuring a bucket.
- B. Enable encryption and upload a key.
- C. Create an encryption key using Cloud Key Management Service, and select it when creating a Cloud Storage bucket.
- D. Nothing: encryption is enabled by default.

Quiz

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Review

Security

More resources

Google Cloud security products

<https://cloud.google.com/security/products/>

Encryption at rest

<https://cloud.google.com/security/encryption-at-rest/default-encryption/>

Encryption in transit

<https://cloud.google.com/security/encryption-in-transit/>

