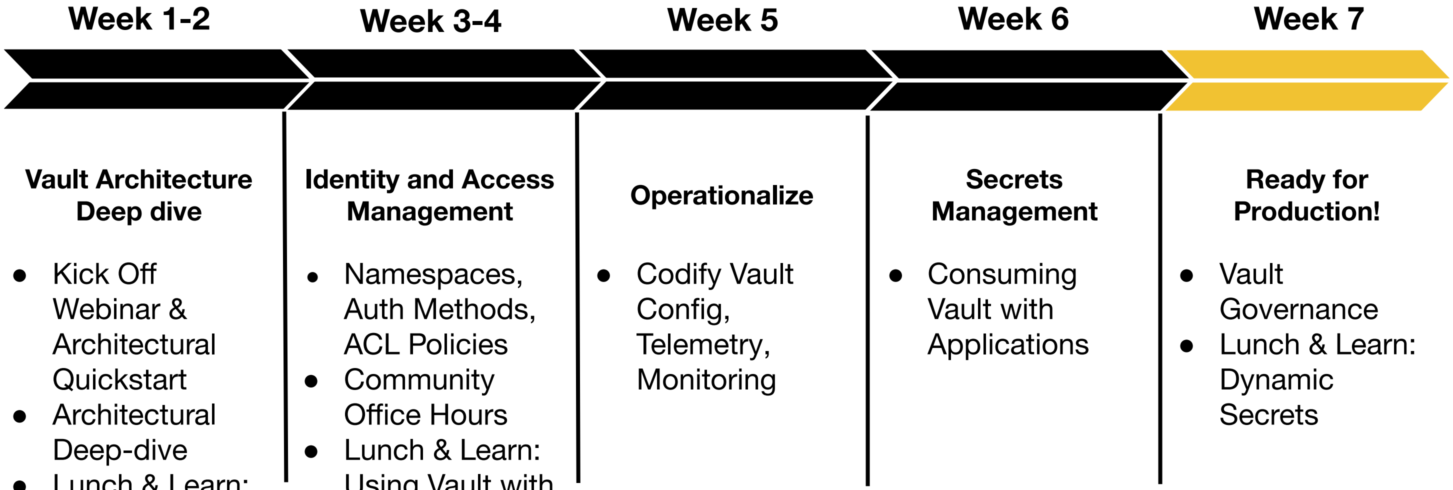
HashiCorp Vault

Vault Governance

September 2022

Vault Enterprise Path to Production



Week 1-2

Vault Architecture Deep dive

- Kick Off Webinar & Architectural Quickstart
- Architectural Deep-dive
- Lunch & Learn: Migrating from Vault OSS

Week 3-4

Identity and Access Management

- Namespaces, Auth Methods, ACL Policies
- Community Office Hours
- Lunch & Learn: Using Vault with K8s

Week 5

Operationalize

- Codify Vault Config, Telemetry, Monitoring

Week 6

Secrets Management

- Consuming Vault with Applications

Week 7

Ready for Production!

- Vault Governance
- Lunch & Learn: Dynamic Secrets

Agenda

- Sentinel
- Control Groups
- Quotas
- Next Steps
- Q & A

01

Sentinel

Overview

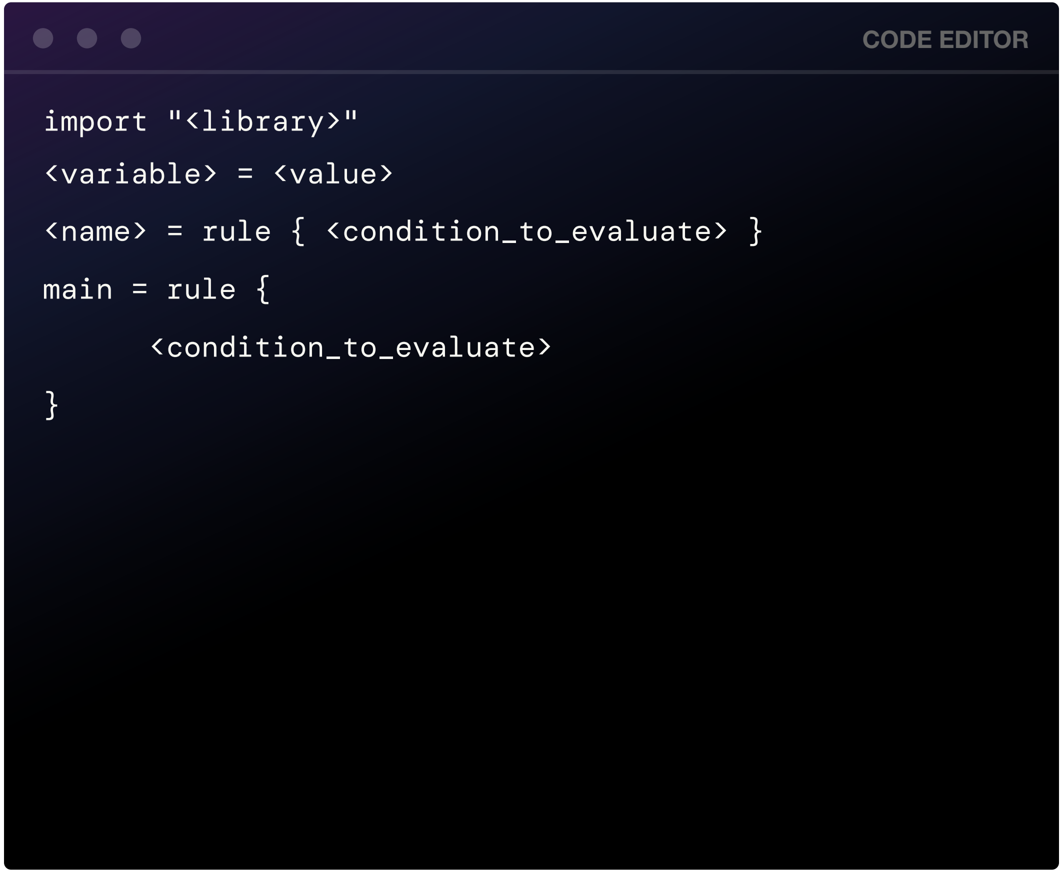
- Sentinel is an embeddable ‘policy as code’ framework to enable fine-grained, logic-based policy decisions that can be extended to source external information to make decisions

- Sentinel policies are used in combination with ACL policies and policy templates

Working with Sentinel policies

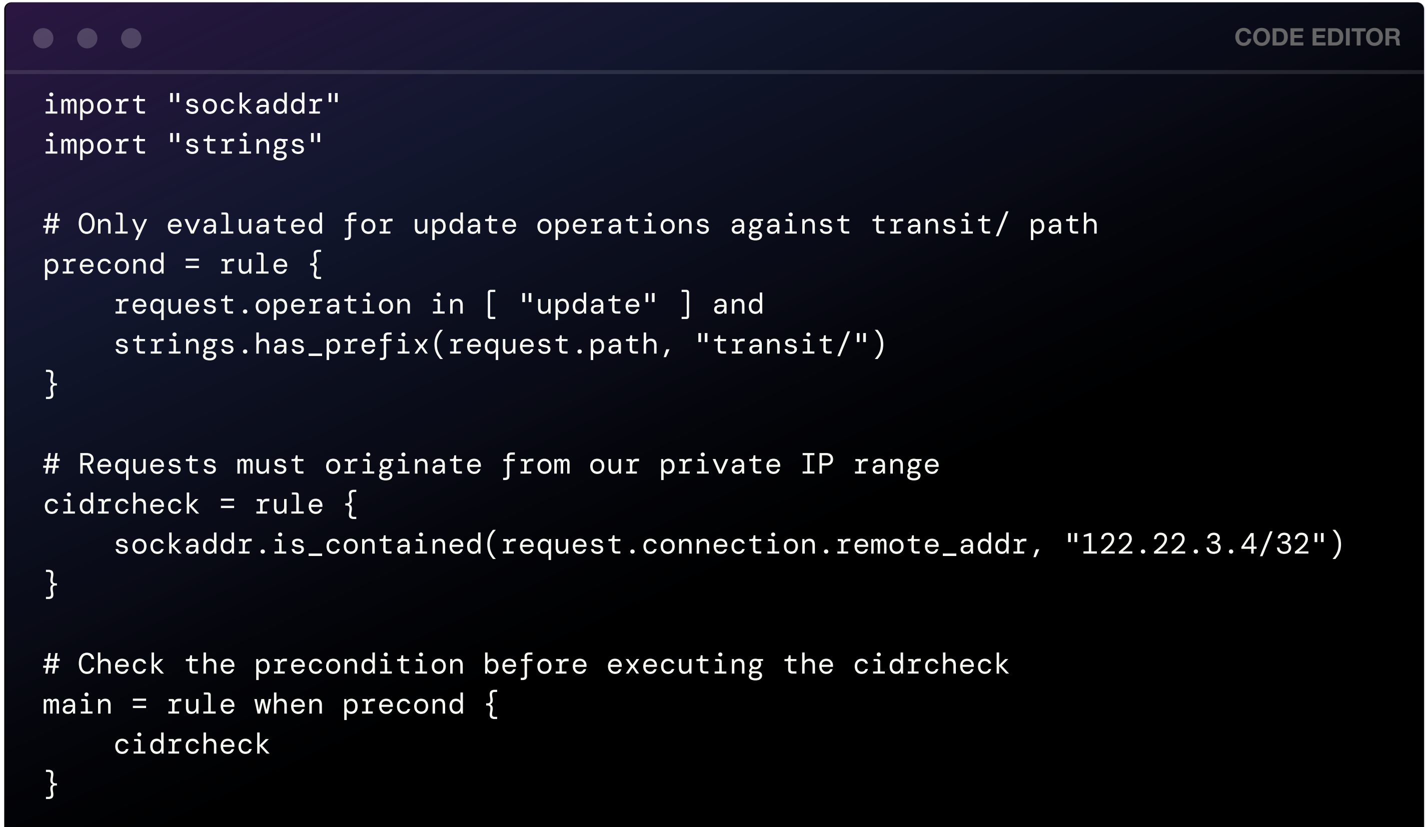
- Vault injects data into the Sentinel runtime environment, including properties for: requests, replication, tokens, Identity secrets engine, MFA, and Control Groups
- Sentinel Properties List
- Sentinel policies are written in a domain specific language
- Manage policies via HTTP API, CLI, or web UI
- The root token or tokens with the **root** policy attached are **exempt** from Sentinel policies!

Sentinel policy structure



```
import "<library>"
<variable> = <value>
<name> = rule { <condition_to_evaluate> }
main = rule {
      <condition_to_evaluate>
}
```

Example Sentinel policy



```
import "sockaddr"
import "strings"

# Only evaluated for update operations against transit/ path
precond = rule {
    request.operation in [ "update" ] and
    strings.has_prefix(request.path, "transit/")
}

# Requests must originate from our private IP range
cidrcheck = rule {
    sockaddr.is_contained(request.connection.remote_addr, "122.22.3.4/32")
}

# Check the precondition before executing the cidrcheck
main = rule when precond {
    cidrcheck
}
```

Policy types

- Sentinel allows you to write complex logic and use external information like client CIDR
- Two types **Endpoint Governing Policy** (EGP) & **Role Governing Policy** (RGP)
  - EGPs are applied to particular paths
  - RGPs are applied to tokens, Identity entities, or Identity groups
- Enforcement levels: **advisory**, **soft-mandatory**, or **hard-mandatory**

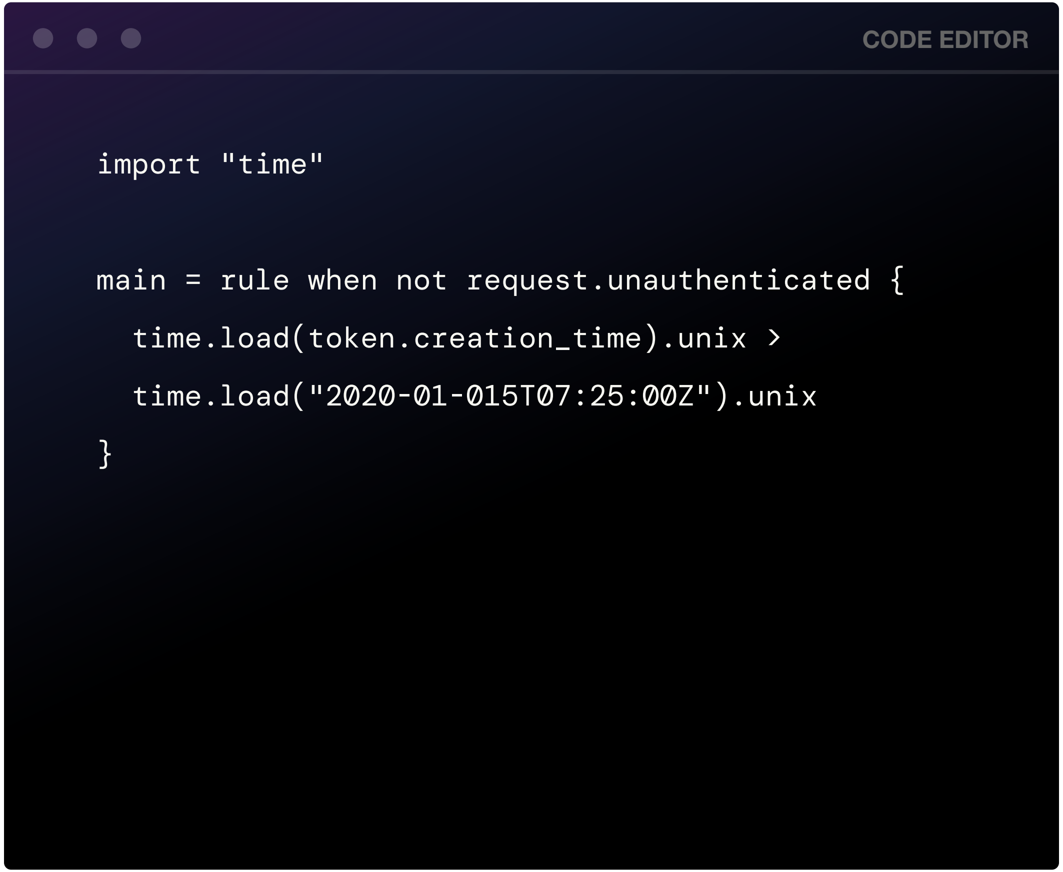
Endpoint Governing Policies (EGPs)

https://www.vaultproject.io/docs/enterprise/sentinel#policy-types

- API: `/sys/policies/egp/`
- EGPs are tied to particular paths
- Access to as much information in the request as possible
- Can be tied to all authenticated and most unauthenticated paths
- Denote suffix with glob character (`*`) for example: **`my-secret-path/*`**
- Path of just `*` affects all authenticated and login requests

EGP example

‘Break Glass’ policy denies access when token created prior to specified time.



```
import "time"

main = rule when not request.unauthenticated {
  time.load(token.creation_time).unix >
  time.load("2020-01-015T07:25:00Z").unix
}
```

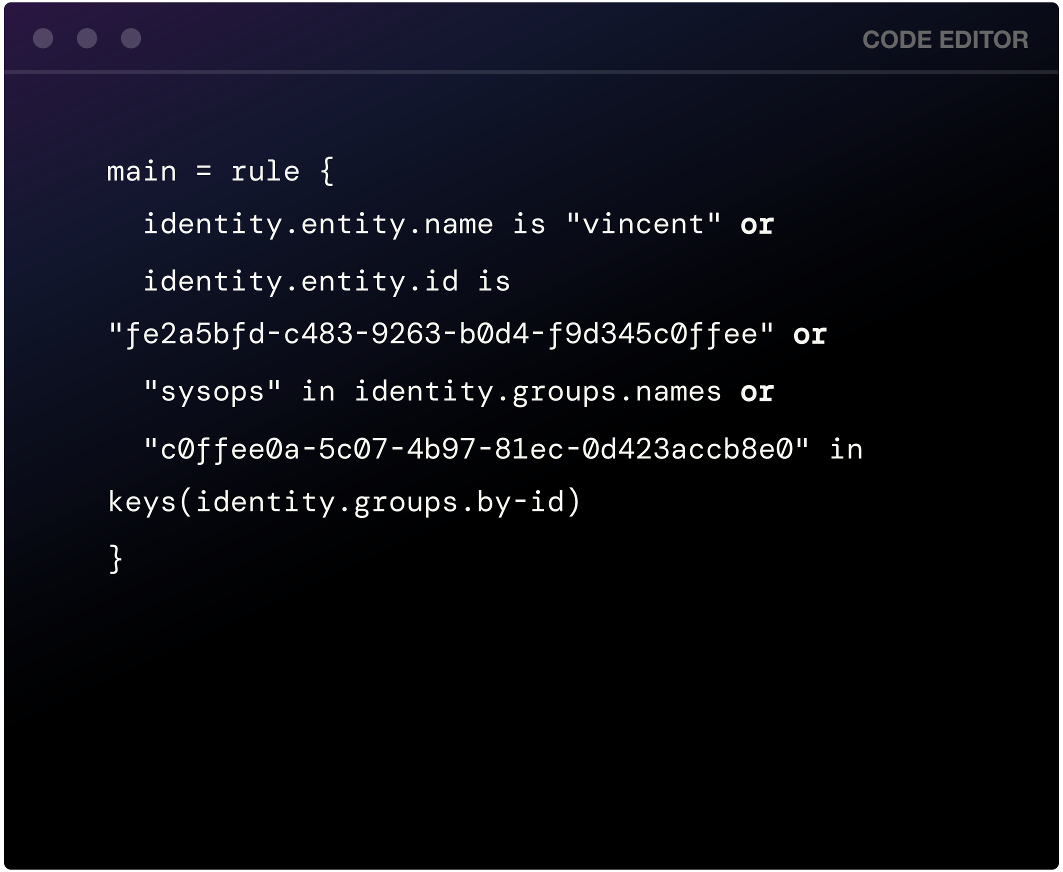
Role Governing Policies (RGPs)

https://www.vaultproject.io/docs/enterprise/sentinel#policy-types

- API: `/sys/policies/rgp/`
- RGPs are tied to tokens, Identity entities, or Identity groups
- Access to a rich set of controls across many aspects of Vault

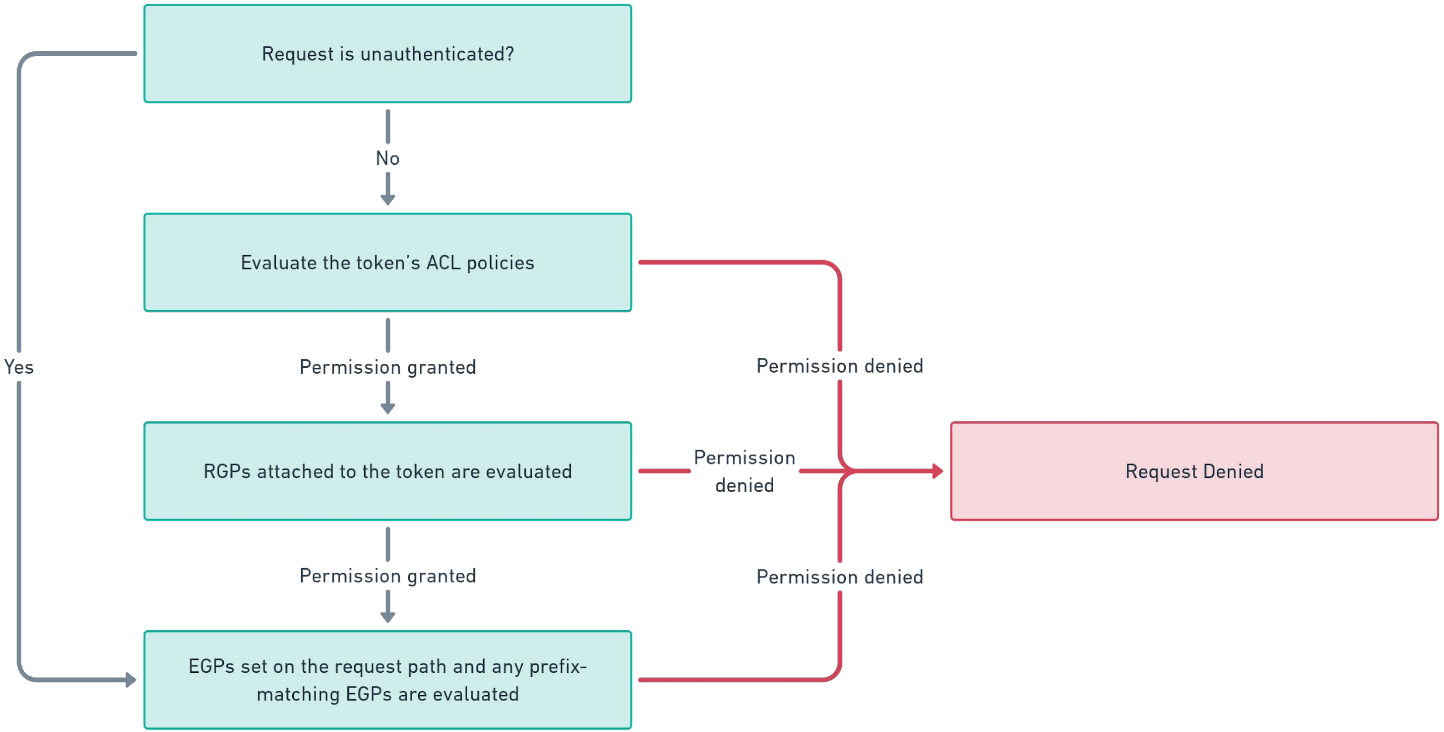
RGP example

Use available Identity secrets engine properties to make decisions



```
main = rule {
  identity.entity.name is "vincent" or
  identity.entity.id is
"fe2a5bfd-c483-9263-b0d4-f9d345c0ffee" or
  "sysops" in identity.groups.names or
  "c0ffee0a-5c07-4b97-81ec-0d423accb8e0" in
keys(identity.groups.by-id)
}
```

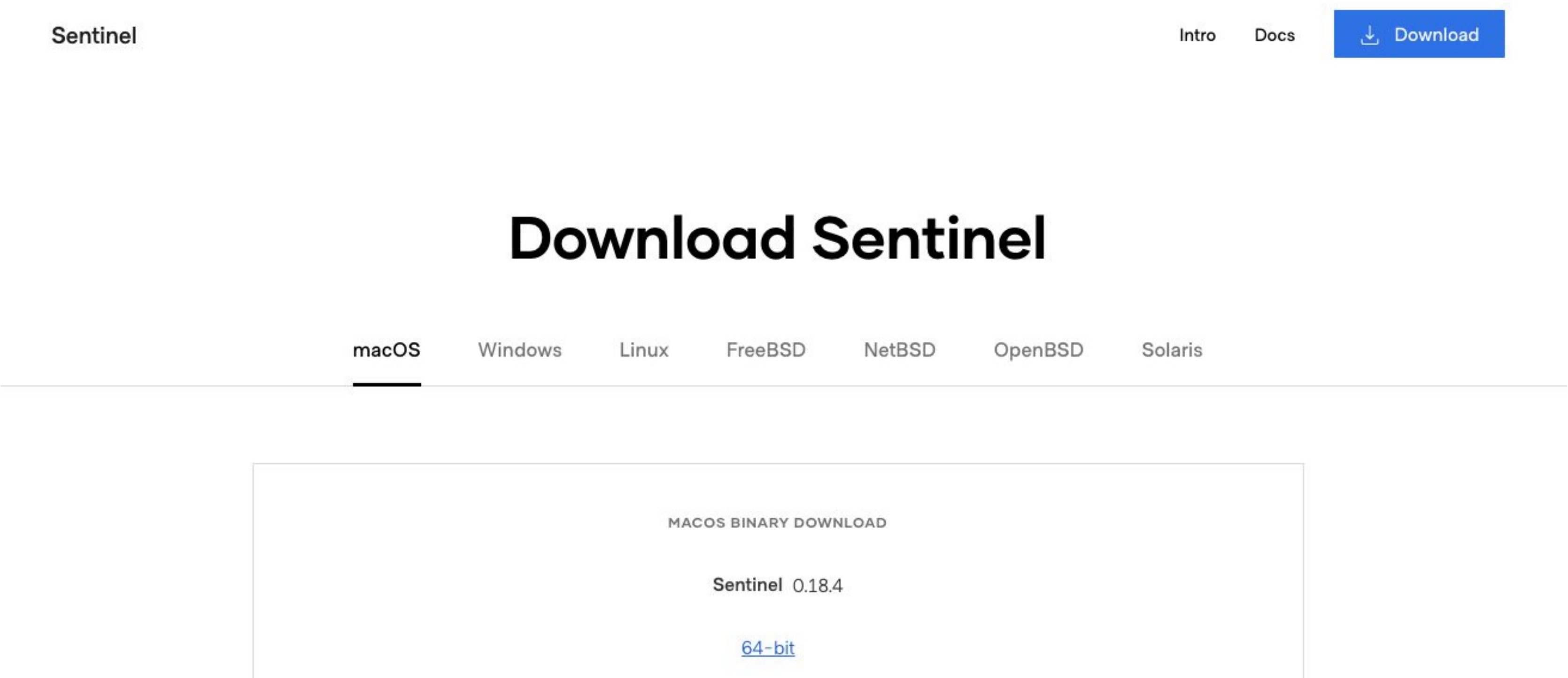
Policy evaluation workflow



Request is unauthenticated?
No
Yes
Evaluate the token's ACL policies
Permission granted
Permission denied
RGPs attached to the token are evaluated
Permission denied
Request Denied
Permission granted
Permission denied
EGPs set on the request path and any prefix-matching EGPs are evaluated

Test policies with Sentinel CLI

https://docs.hashicorp.com/sentinel/downloads



Download Sentinel

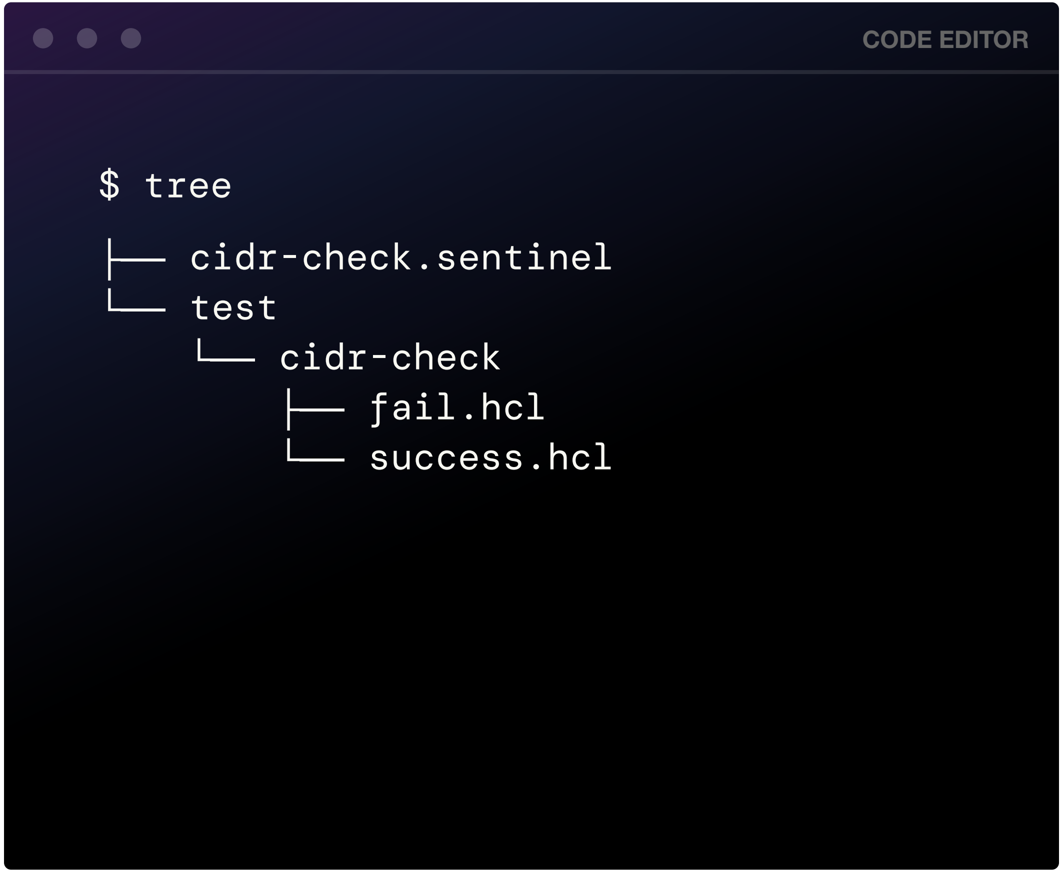
MACOS BINARY DOWNLOAD

Sentinel 0.18.4

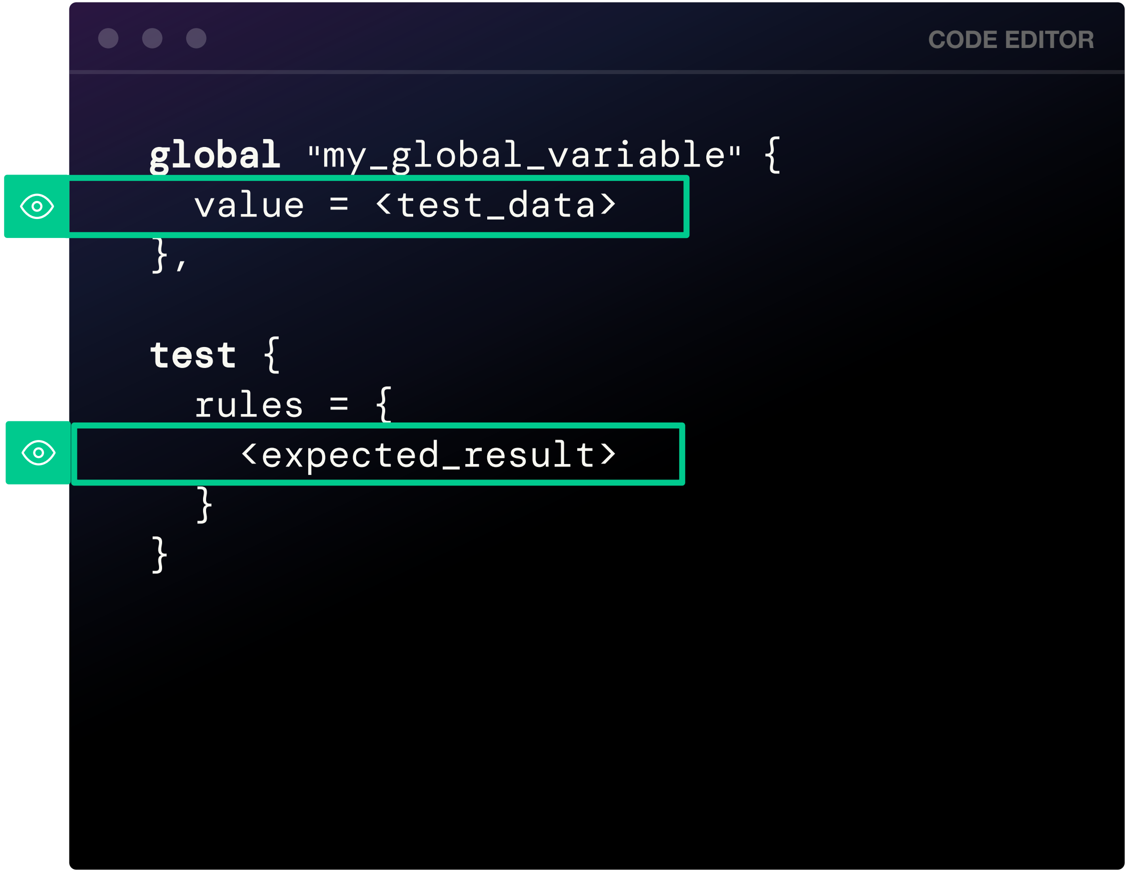
64-bit

Test cases 1/3

- Sentinel expects a **`test/<policy_name>`** folder with test case files in either HCL or JSON format.
- Test case files contain data to test the policy.



```
$ tree
├── cidr-check.sentinel
└── test
    └── cidr-check
        ├── fail.hcl
        └── success.hcl
```



```
global "my_global_variable" {
  value = <test_data>
},

test {
  rules = {
    <expected_result>
  }
}
```

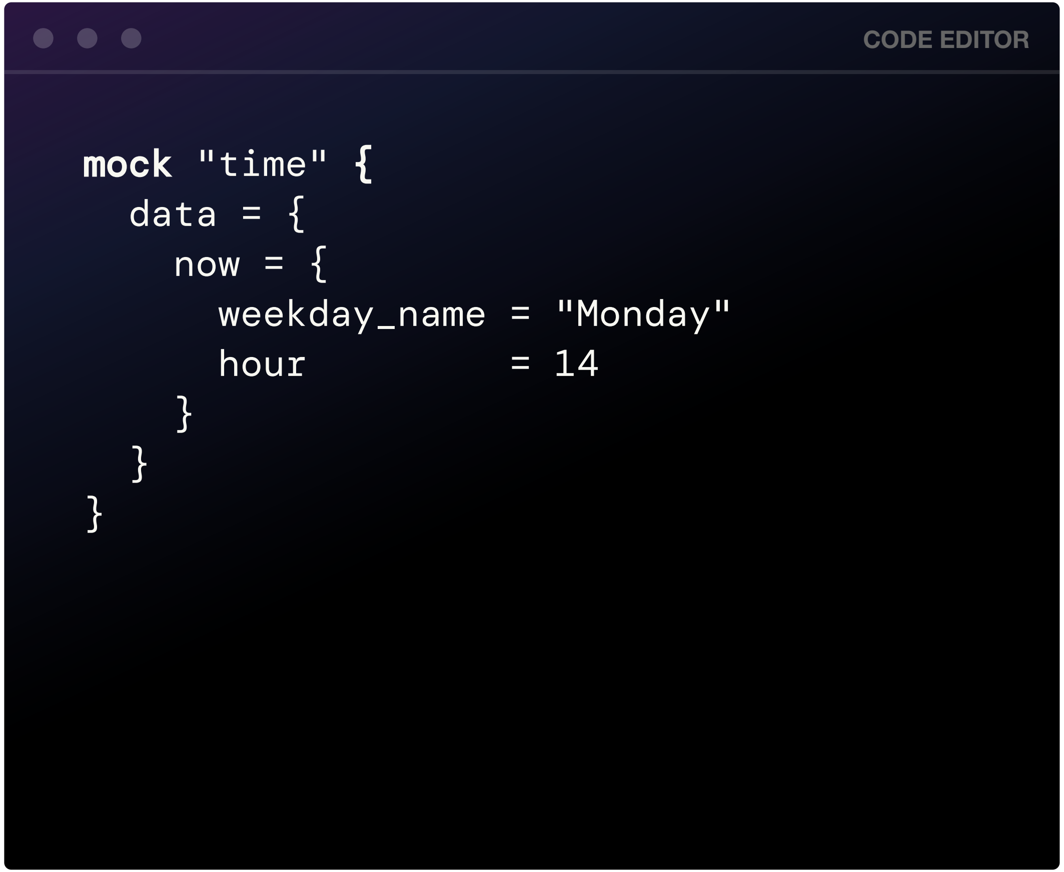
Test cases 2/3

Example test case

Specify the data to test the policy against.

Optional: Expected boolean value of the rules.

In absence of the ‘test’ block, all rules are expected to return true.

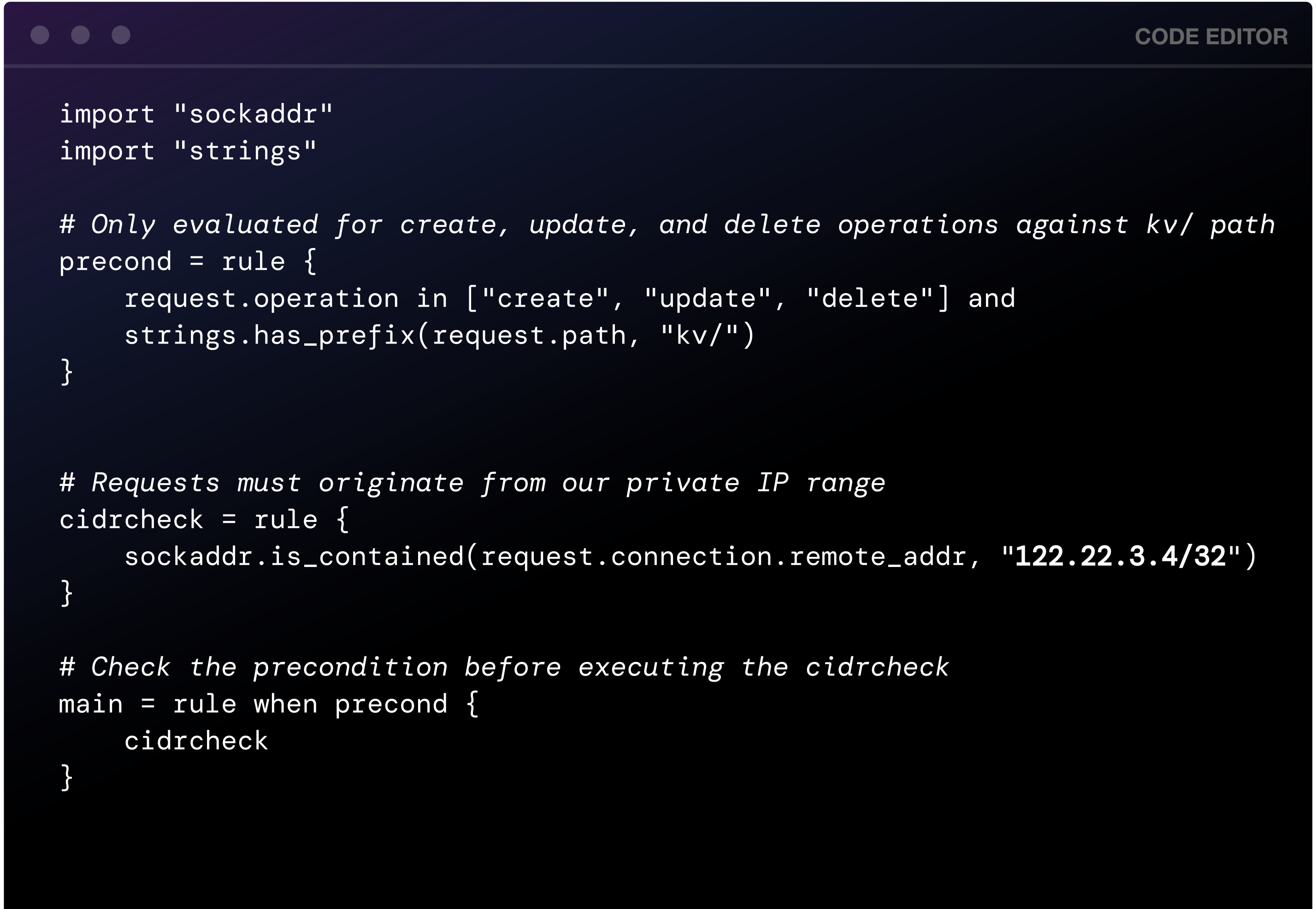


```
mock "time" {
  data = {
    now = {
      weekday_name = "Monday"
      hour         = 14
    }
  }
}
```

Test cases 3/3

Use **mock** instead of global to inject static value directly into the policy's scope.

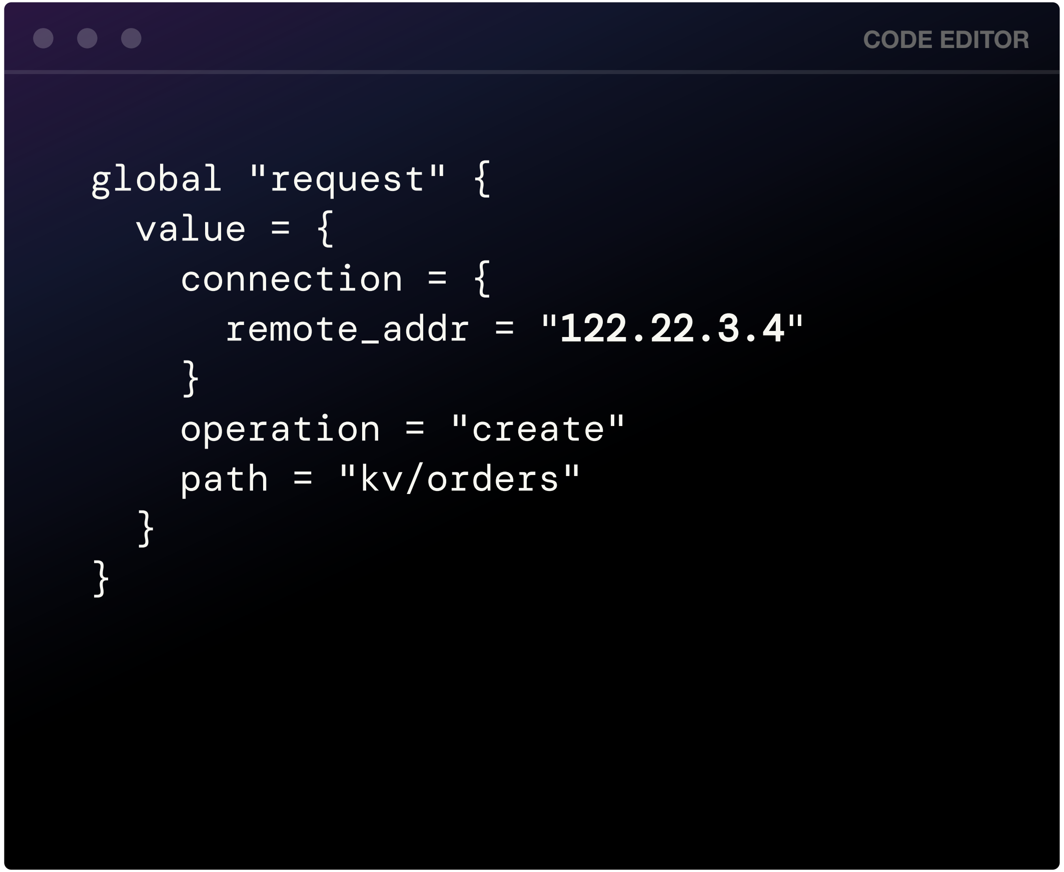
For example, if the `time` library is used in the policy, use `mock` to mock `time.now`.



```
import "sockaddr"
import "strings"

# Only evaluated for create, update, and delete operations against kv/ path
precond = rule {
    request.operation in ["create", "update", "delete"] and
    strings.has_prefix(request.path, "kv/")
}


# Requests must originate from our private IP range
cidrcheck = rule {
    sockaddr.is_contained(request.connection.remote_addr, "122.22.3.4/32")
}

# Check the precondition before executing the cidrcheck
main = rule when precond {
    cidrcheck
}
```

Passing test

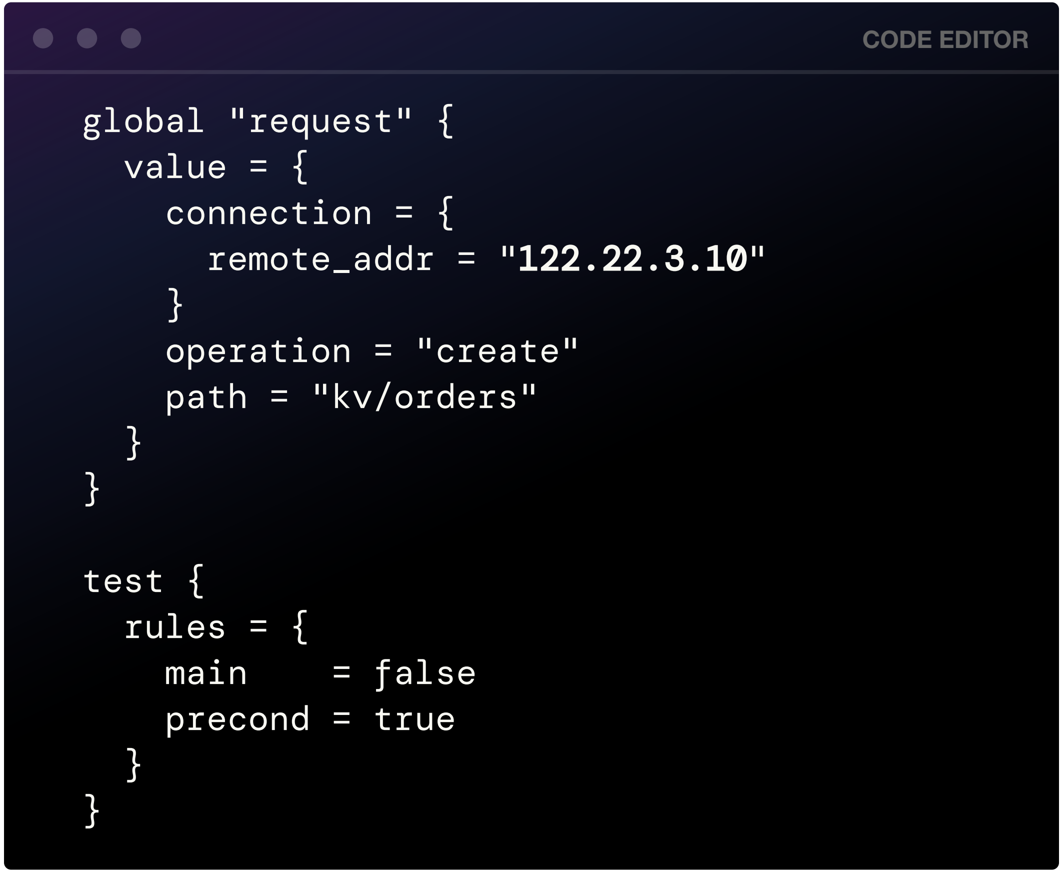
The file **`test/cidr-check/success.hcl`** contains data for a passing test.



```
global "request" {
  value = {
    connection = {
      remote_addr = "122.22.3.4"
    }
    operation = "create"
    path = "kv/orders"
  }
}
```

Failing test

The file `test/cidr-check/fail.hcl` contains data for a failing test.

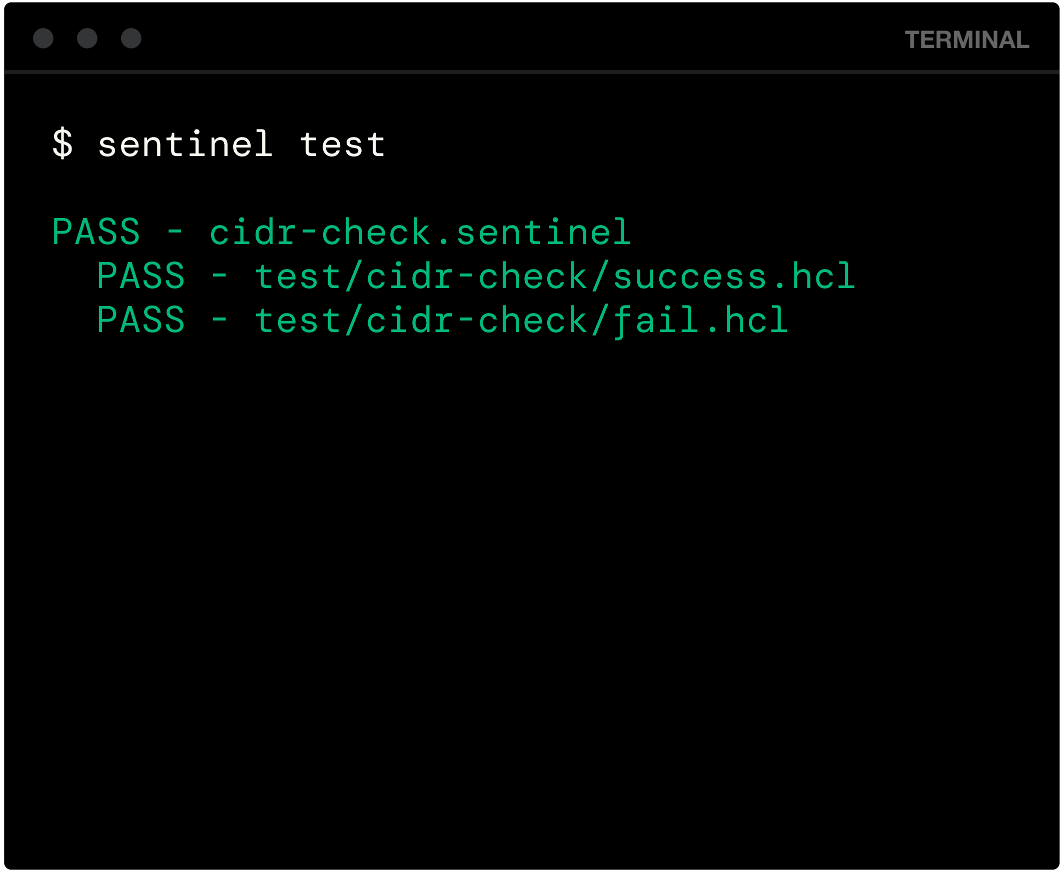


```
global "request" {
  value = {
    connection = {
      remote_addr = "122.22.3.10"
    }
    operation = "create"
    path = "kv/orders"
  }
}

test {
  rules = {
    main    = false
    precond = true
  }
}
```

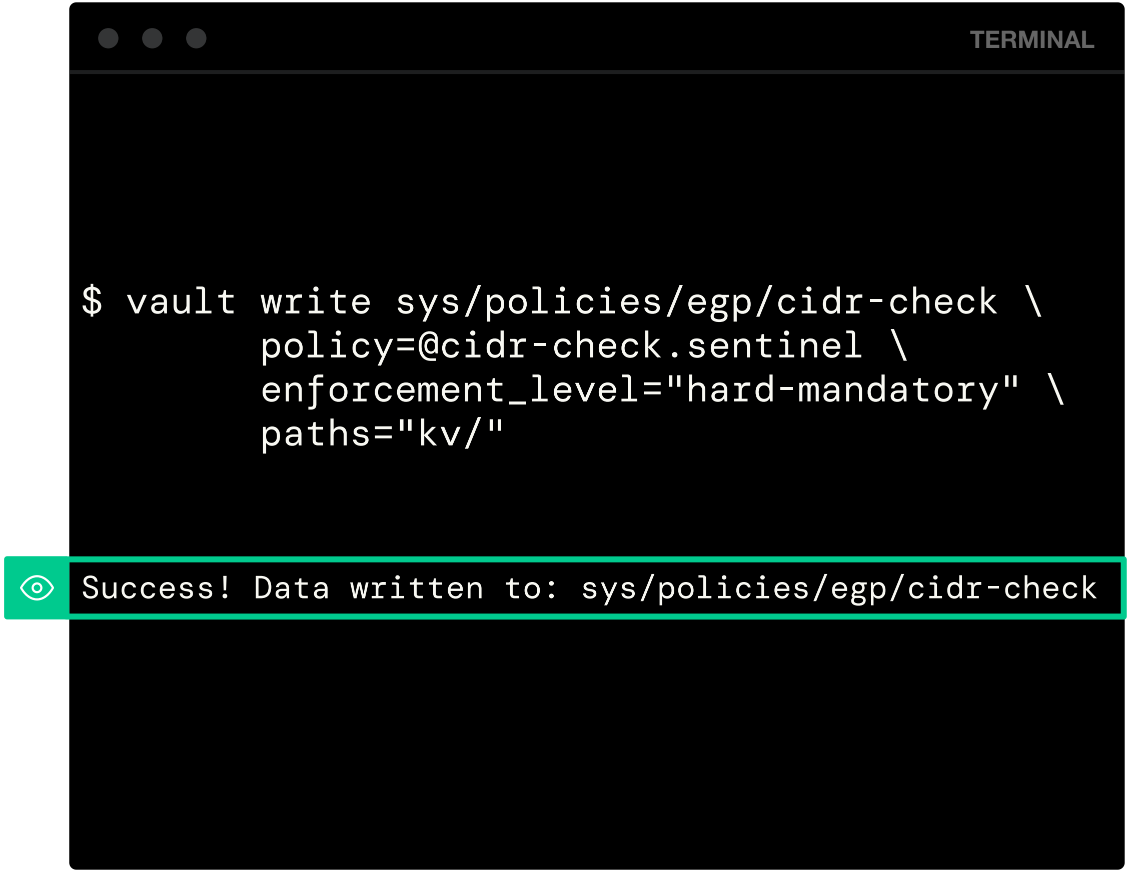
Run tests

Use the **`sentinel test`** command to invoke the simulator and test policy.

TIP: Use **`-verbose`** flag to output additional traces and logs for failed tests.



```
$ sentinel test

PASS - cidr-check.sentinel
  PASS - test/cidr-check/success.hcl
  PASS - test/cidr-check/fail.hcl
```



```
$ vault write sys/policies/egp/cidr-check \
        policy=@cidr-check.sentinel \
        enforcement_level="hard-mandatory" \
        paths="kv/"
```

```
Success! Data written to: sys/policies/egp/cidr-check
```

Use CLI to deploy policy

Use `vault` CLI to write the policy.

When successfully written, Vault begins immediately enforcing the policy at the hard mandatory level.

02

Control Groups

Overview

Control groups allow for additional authorizations to be required for access to a path in Vault.

When a control group is defined, the following occurs:

1. The requestor receives a wrapping token in return
2. The authorizers required by the control group policy must approve the request
3. Once all authorizations are satisfied, the requester can unwrap the secrets

Factors

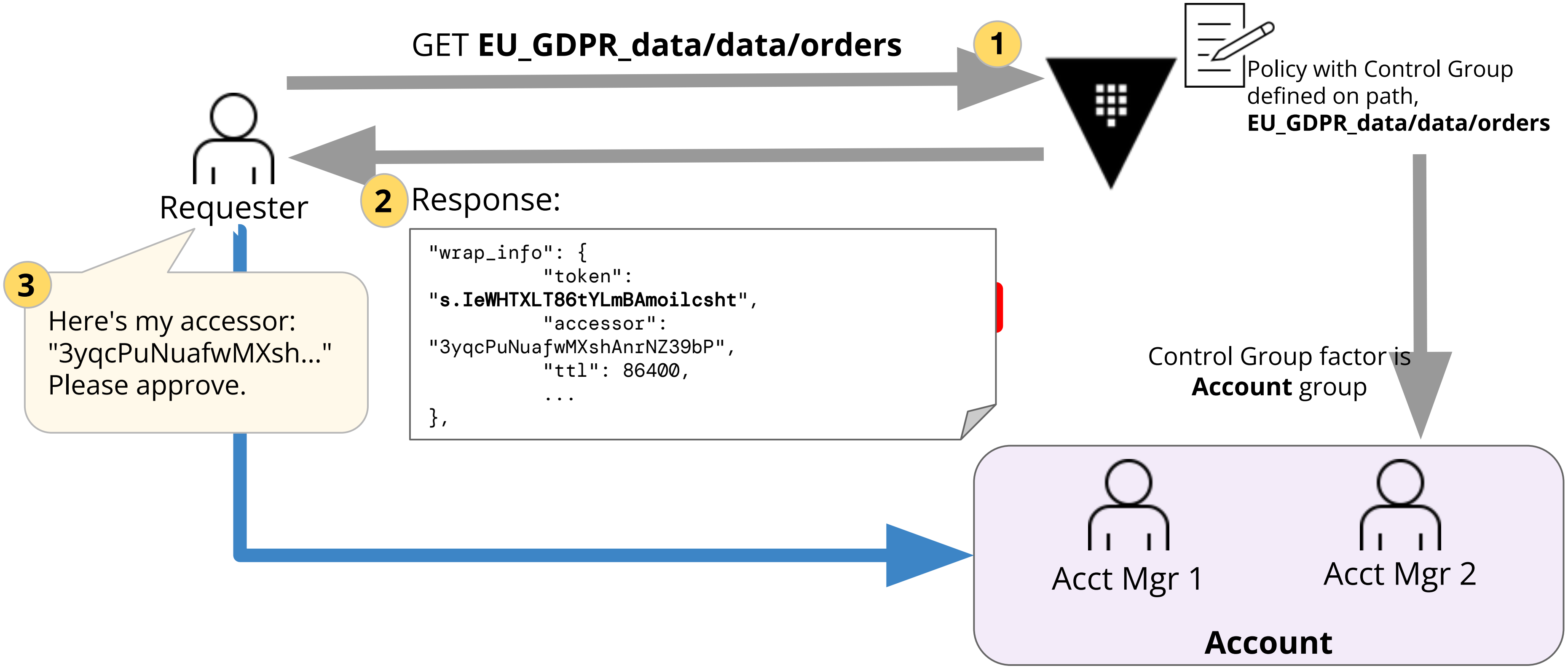
Control Group requirements on paths can be specified in:

- ACL policies
- Sentinel policies

The single currently supported Control Groups factor is Identity Groups

- An authorizer must belong to a specific Identity group (factor)

Control Groups Workflow (1/2)



1 GET **EU_GDPR_data/data/orders**

Policy with Control Group defined on path, **EU_GDPR_data/data/orders**

2 Response:

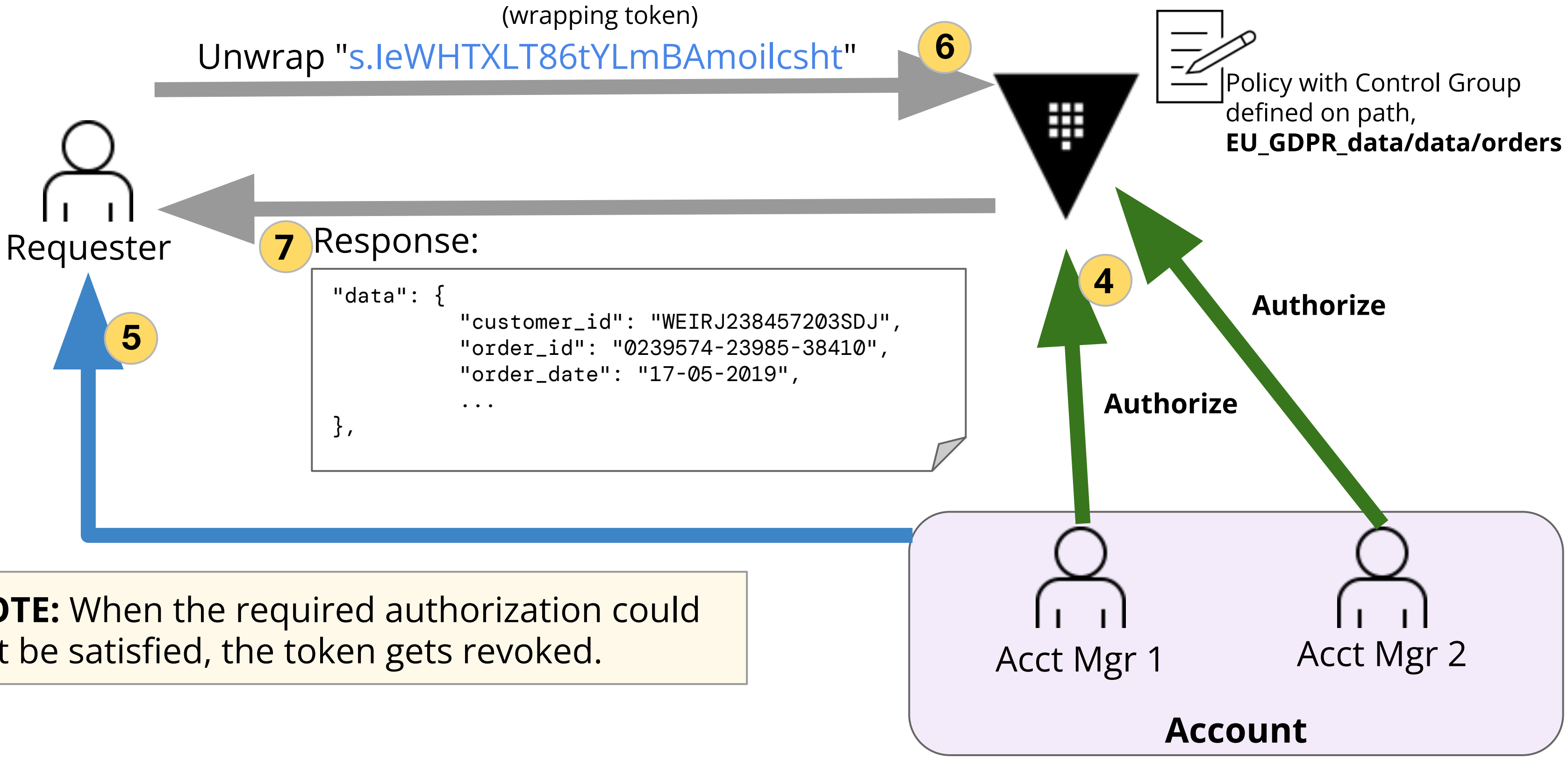
```
"wrap_info": {
          "token":
"s.IeWHTXLT86tYLmBAmoilcsht",
          "accessor":
"3yqcPuNuafwMXshAnrNZ39bP",
          "ttl": 86400,
          ...
},
```

Requester

3 Here's my accessor: "3yqcPuNuafwMXsh..." Please approve.

Control Group factor is **Account** group

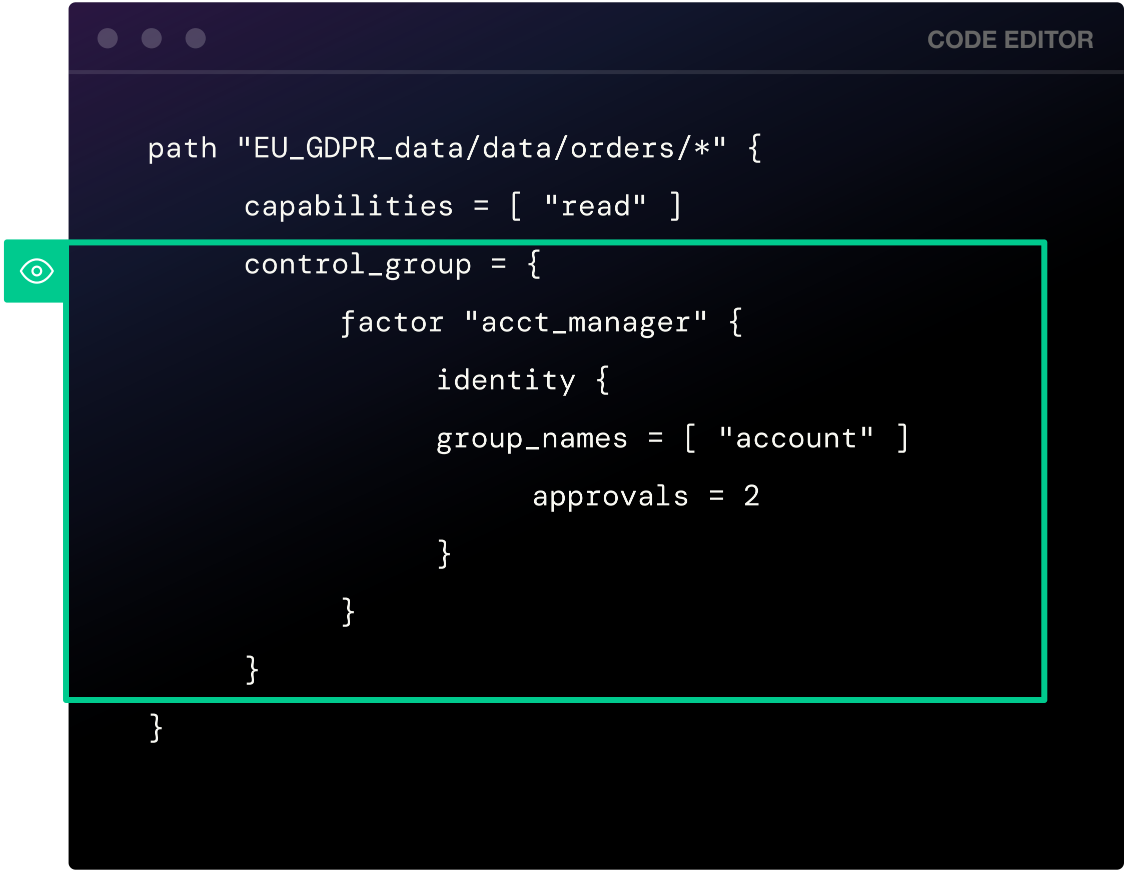
Control Groups Workflow (2/2)



```
"data": {
          "customer_id": "WEIRJ238457203SDJ",
          "order_id": "0239574-23985-38410",
          "order_date": "17-05-2019",
          ...
},
```

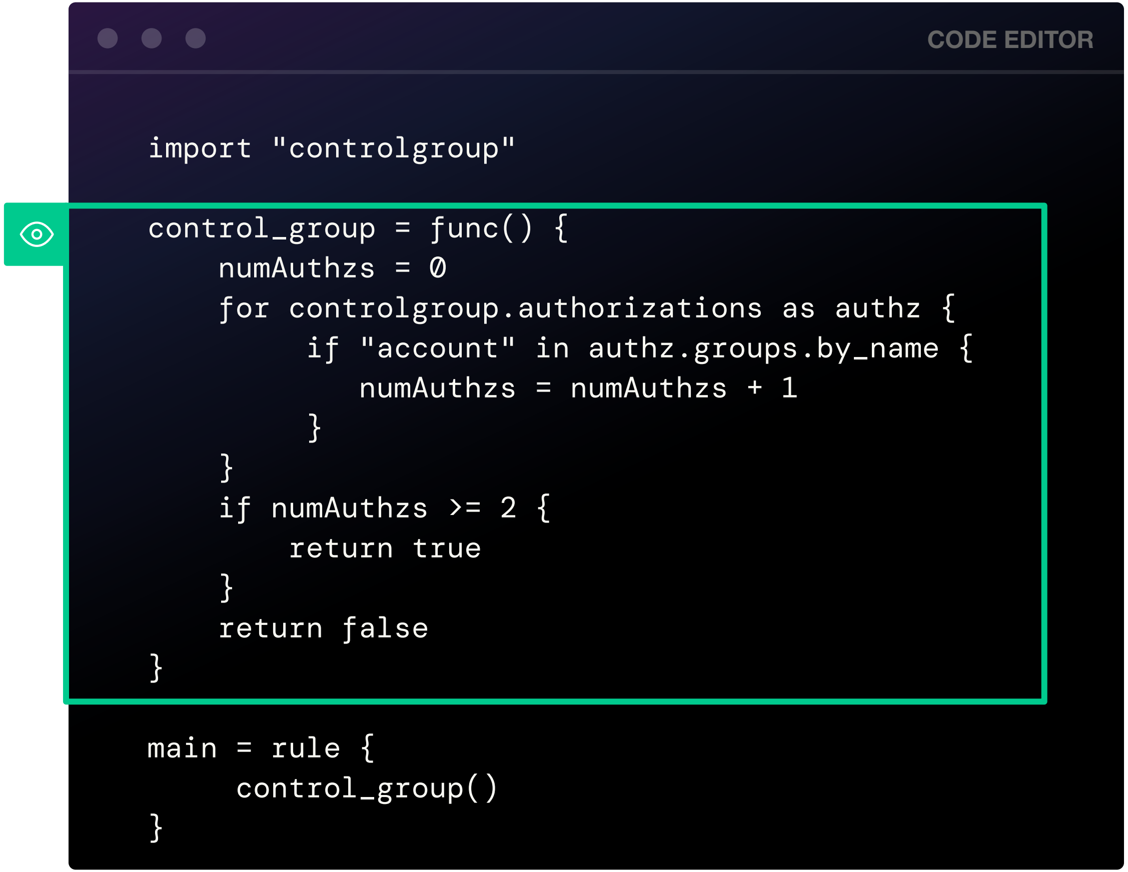
NOTE: When the required authorization could not be satisfied, the token gets revoked.

Control Groups in ACL policies



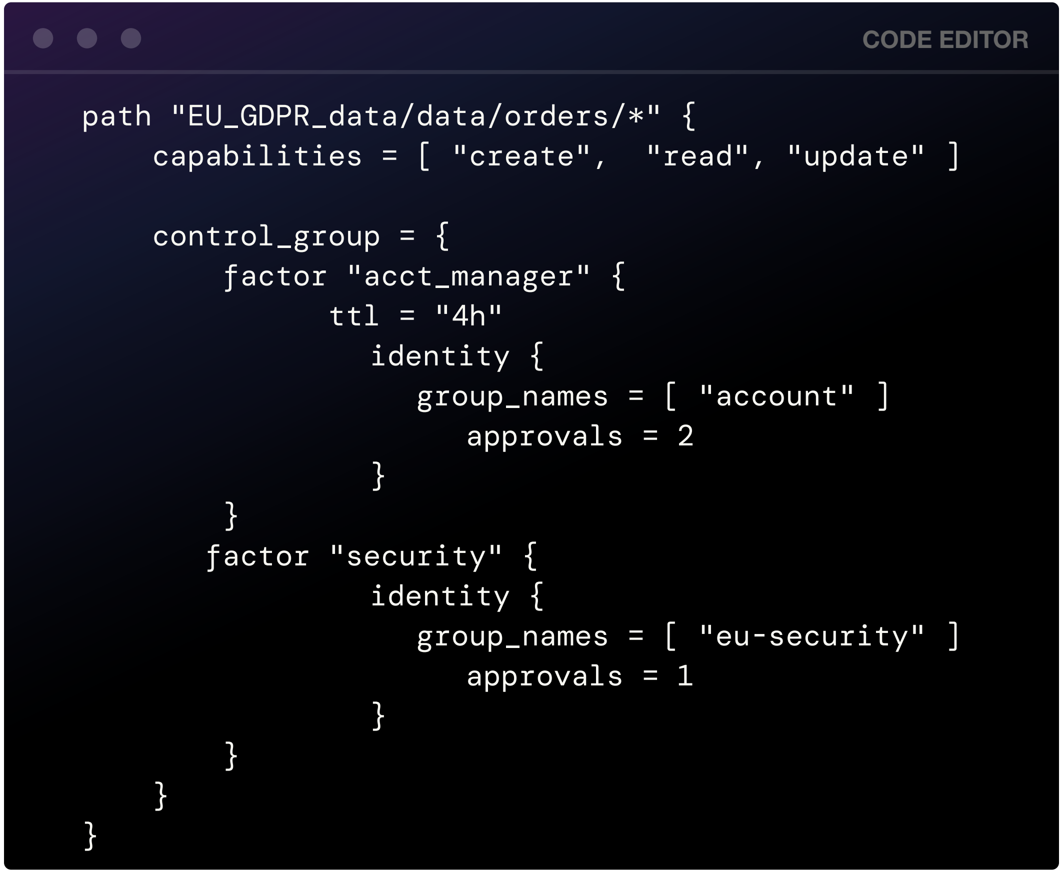
```
path "EU_GDPR_data/data/orders/*" {
    capabilities = [ "read" ]
    control_group = {
        factor "acct_manager" {
            identity {
            group_names = [ "account" ]
                approvals = 2
            }
        }
    }
}
```

Control Groups in Sentinel policies



```
import "controlgroup"

control_group = func() {
    numAuthzs = 0
    for controlgroup.authorizations as authz {
         if "account" in authz.groups.by_name {
            numAuthzs = numAuthzs + 1
         }
    }
    if numAuthzs >= 2 {
        return true
    }
    return false
}

main = rule {
     control_group()
}
```

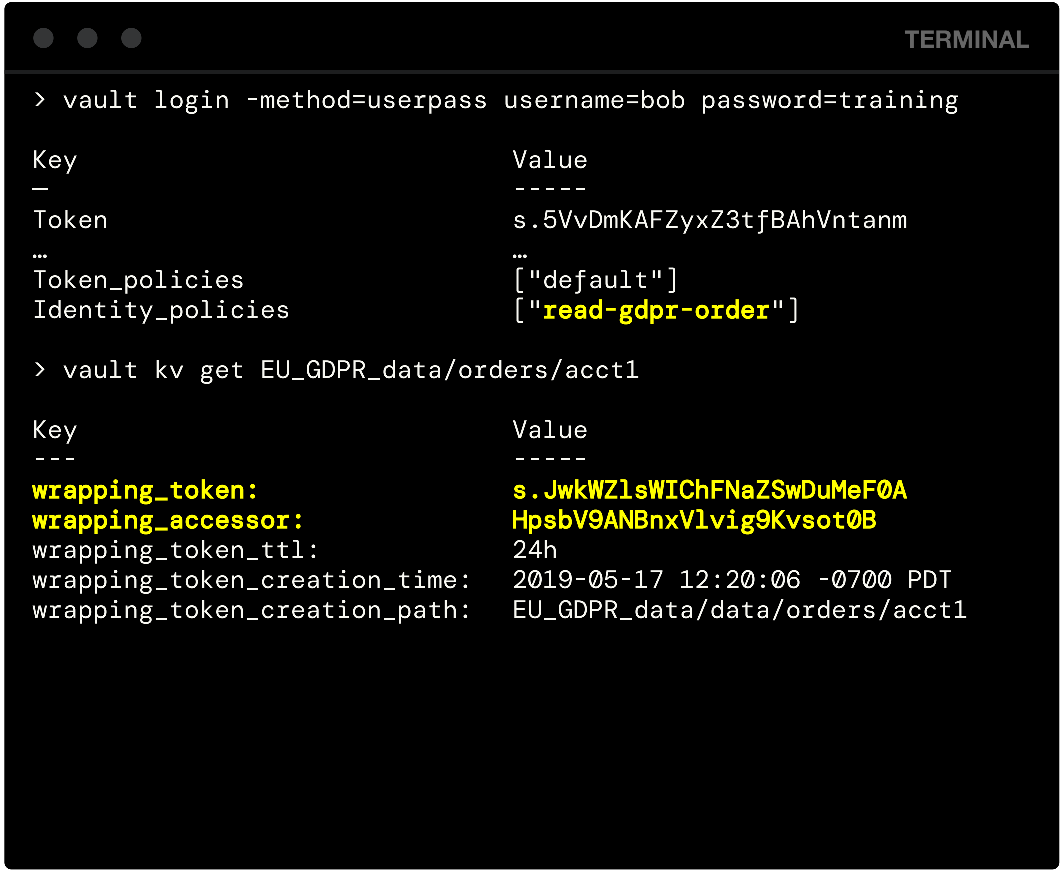
Multiple factor Control Groups



```
path "EU_GDPR_data/data/orders/*" {
    capabilities = [ "create",  "read", "update" ]

    control_group = {
        factor "acct_manager" {
              ttl = "4h"
                identity {
                   group_names = [ "account" ]
                      approvals = 2
                }
        }
       factor "security" {
                identity {
                   group_names = [ "eu-security" ]
                      approvals = 1
                }
        }
    }
}
```

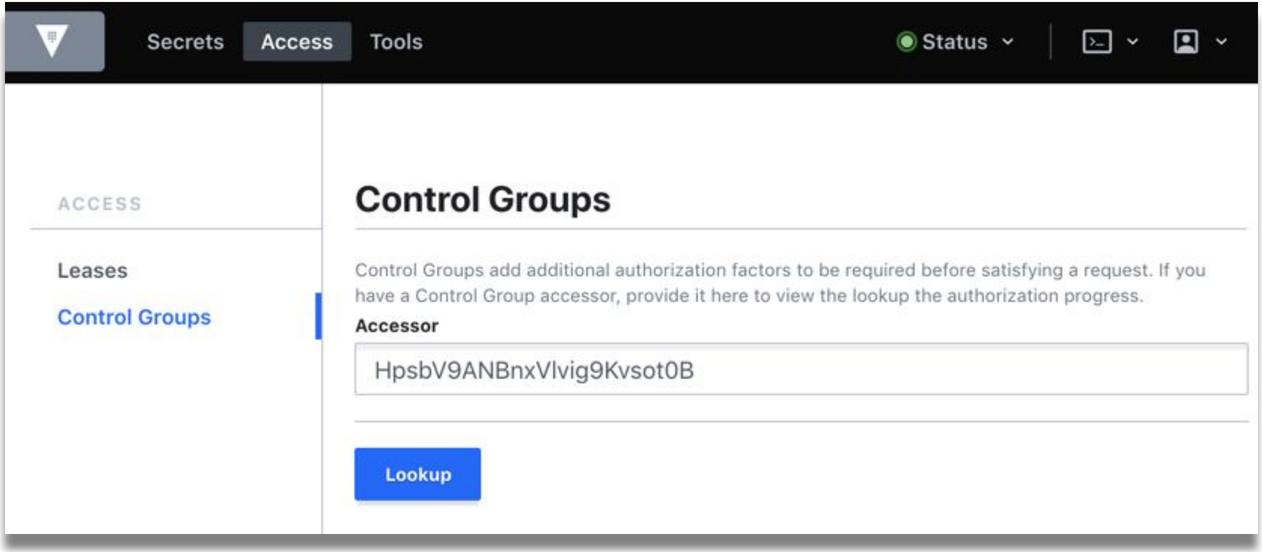
Control Groups Workflow

Requester actions



```
> vault login -method=userpass username=bob password=training

Key                             Value
—                               -----
Token                           s.5VvDmKAFZyxZ3tfBAhVntanm
…                               …
Token_policies                  ["default"]
Identity_policies               ["read-gdpr-order"]

> vault kv get EU_GDPR_data/orders/acct1

Key                             Value
---                             -----
wrapping_token:                 s.JwkWZlsWIChFNaZSwDuMeF0A
wrapping_accessor:              HpsbV9ANBnxVlvig9Kvsot0B
wrapping_token_ttl:             24h
wrapping_token_creation_time:   2019-05-17 12:20:06 -0700 PDT
wrapping_token_creation_path:   EU_GDPR_data/data/orders/acct1
```

Authorizer actions

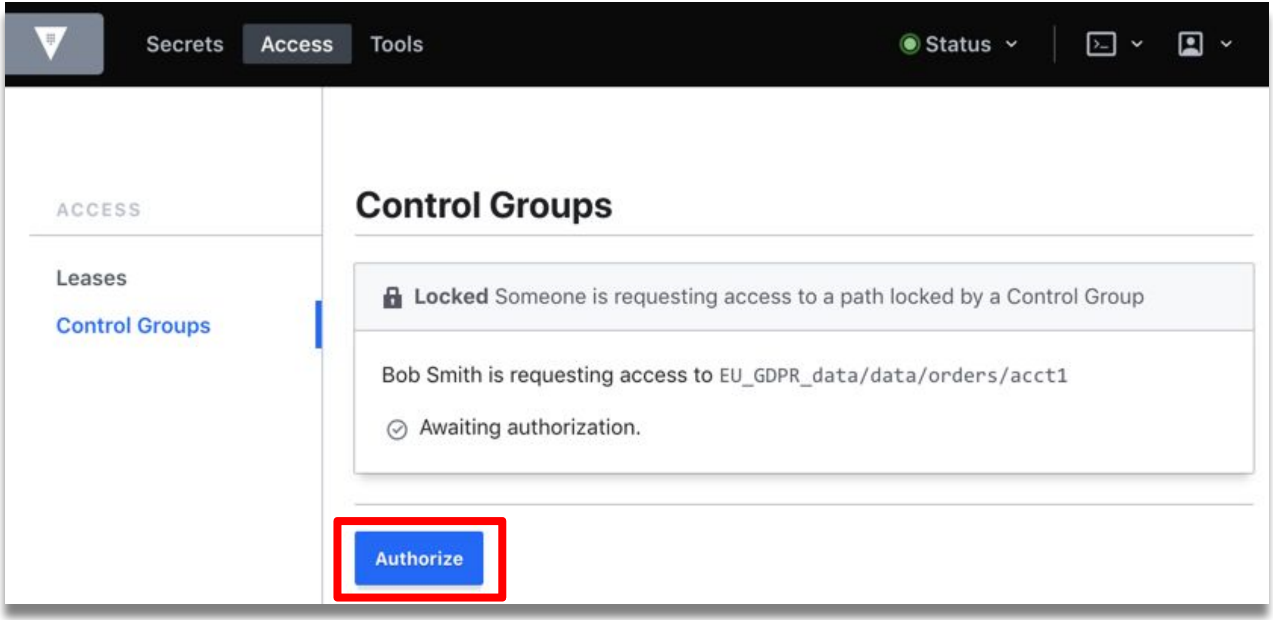


Control Groups

Control Groups add additional authorization factors to be required before satisfying a request. If you have a Control Group accessor, provide it here to view the lookup the authorization progress.

Accessor: HpsbV9ANBnxVlvig9Kvsot0B

Authorizer actions



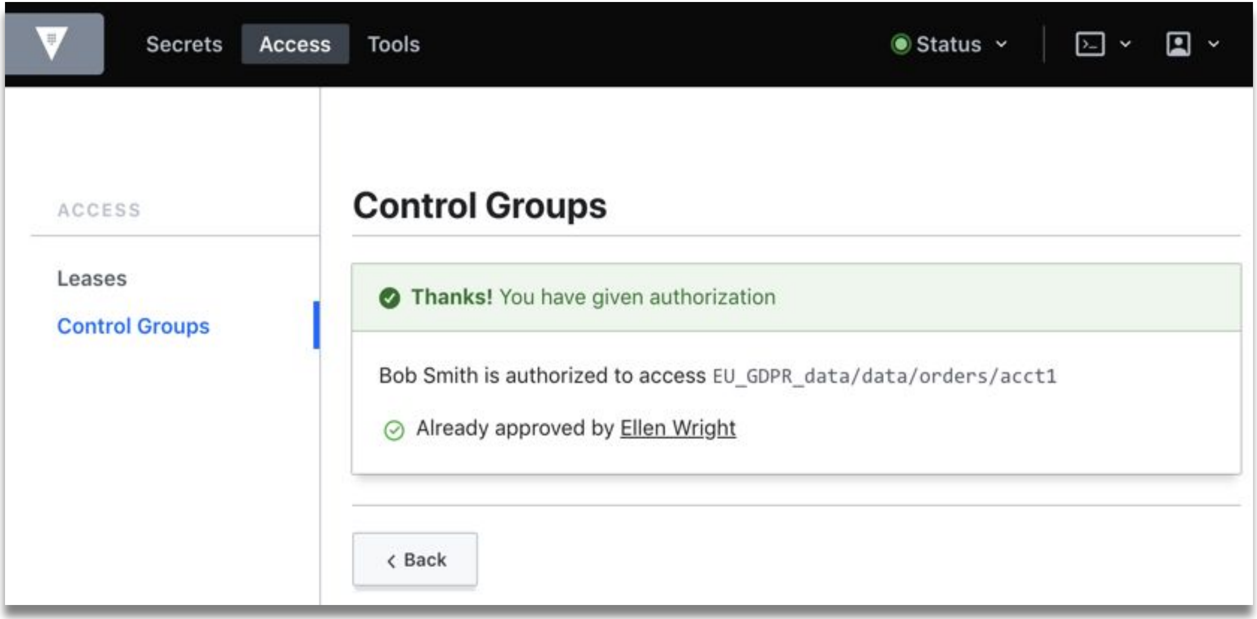
Control Groups

Locked Someone is requesting access to a path locked by a Control Group

Bob Smith is requesting access to `EU_GDPR_data/data/orders/acct1`

Awaiting authorization.

Authorizer actions



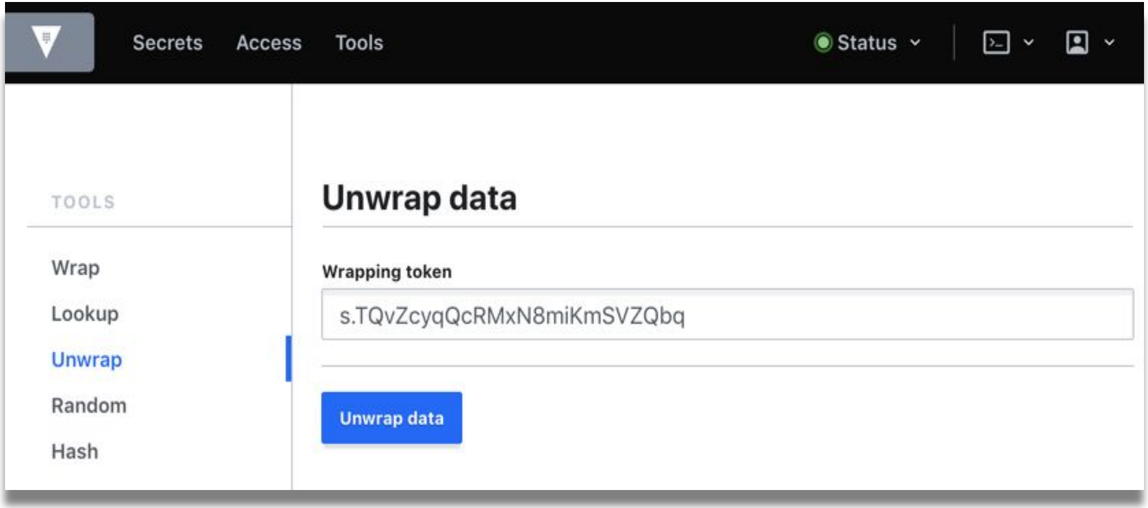
Control Groups

✓ **Thanks!** You have given authorization

Bob Smith is authorized to access `EU_GDPR_data/data/orders/acct1`

✓ Already approved by Ellen Wright

Unwrap the secret

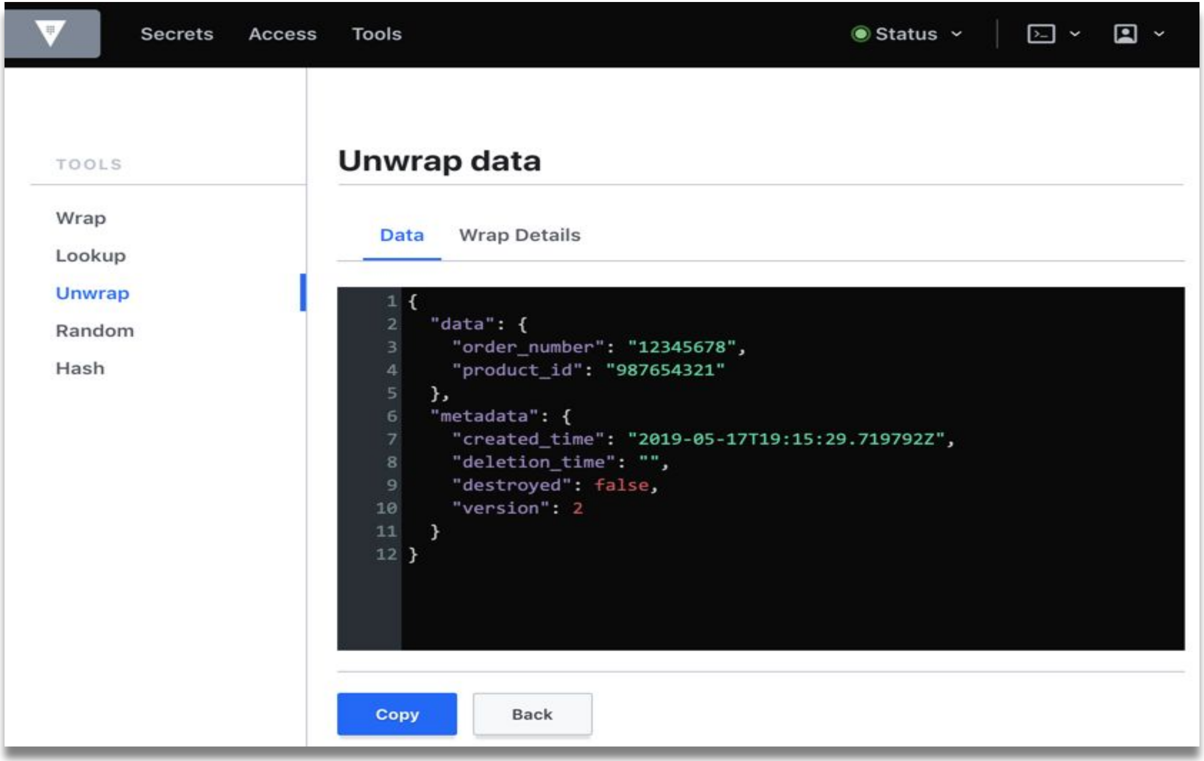


Unwrap data

Wrapping token

s.TQvZcyqQcRMxN8miKmSVZQbq

Unwrap the secret



Unwrap data

```
{
  "data": {
    "order_number": "12345678",
    "product_id": "987654321"
  },
  "metadata": {
    "created_time": "2019-05-17T19:15:29.719792Z",
    "deletion_time": "",
    "destroyed": false,
    "version": 2
  }
}
```

03

Quotas

Overview

Protect system stability and network, storage resource consumption from runaway application behavior and Distributed Denial of Service (DDoS)

- **Rate Limit Quotas**
  Limit maximum amount of requests per second (RPS) to a system or mount to protect network bandwidth.

- **Lease Count Quotas**
  Cap number of leases generated in a system or mount to protect system stability and storage performance at scale.

Configuring Resource Quotas

Creating Resource Quotas:

To set rate limit or lease quotas, set `/sys/quotas/`**`<type>`** with possible types being:

- rate-limit: Rate limit quota.
- lease-count: Maximum lease count (Enterprise only).

Configuring Resource Quotas

- Set/list specific types of quotas from **`/sys/quotas/<type>/<name>`**
- Path parameter can be set to a mount, mount in the namespace, or omitted for a systemwide quota.
- Different quotas have different parameters; see the documentation for more details.

Logging

If a request is rejected due to a ‘Lease Count Quota’ violation, Vault will record this in the audit log.

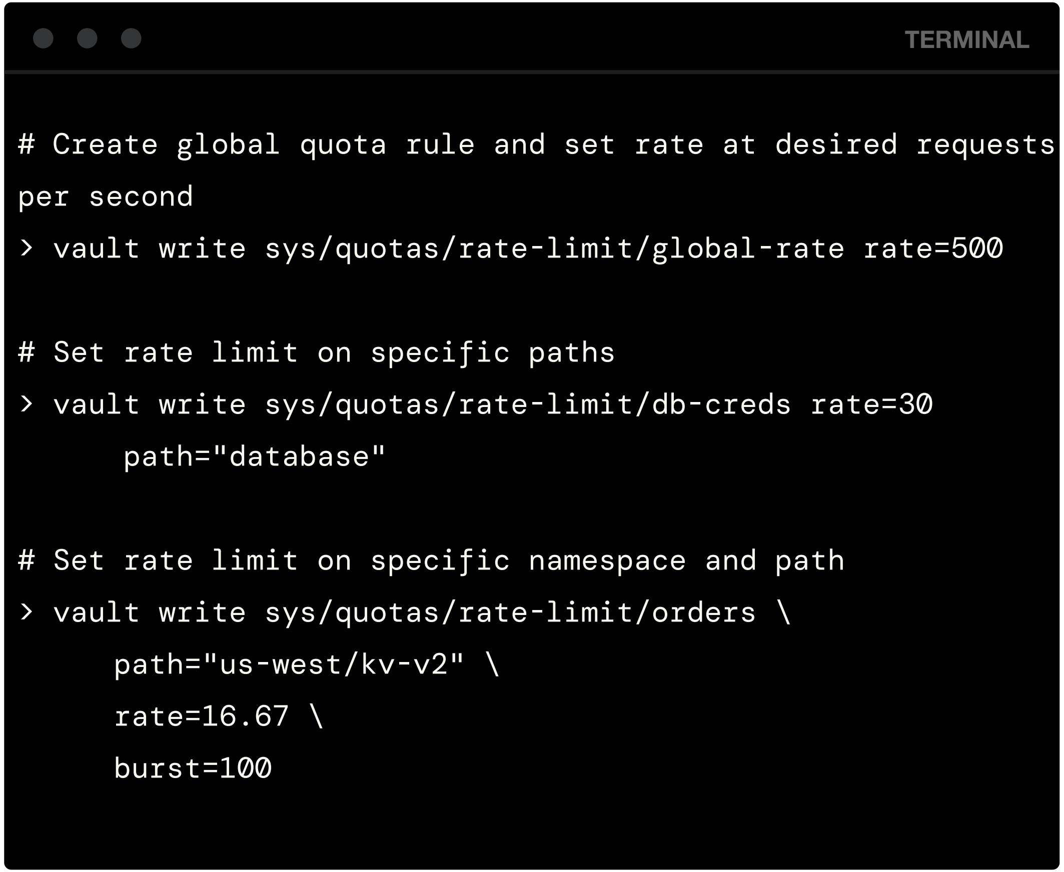
Violations of ‘Rate Limit Quotas’ are not logged to the audit log.

It is possible to enable traceability of ‘Rate Limit Quotas’ via the HTTP API endpoint: `sys/quotas/config`, changing the parameter: ‘`enable_rate_limit_audit_logging`’ to **`true`** (by default it will be false).

Enabling this can potentially impact performance if the request volume is large.

Rate Limit Quotas Example

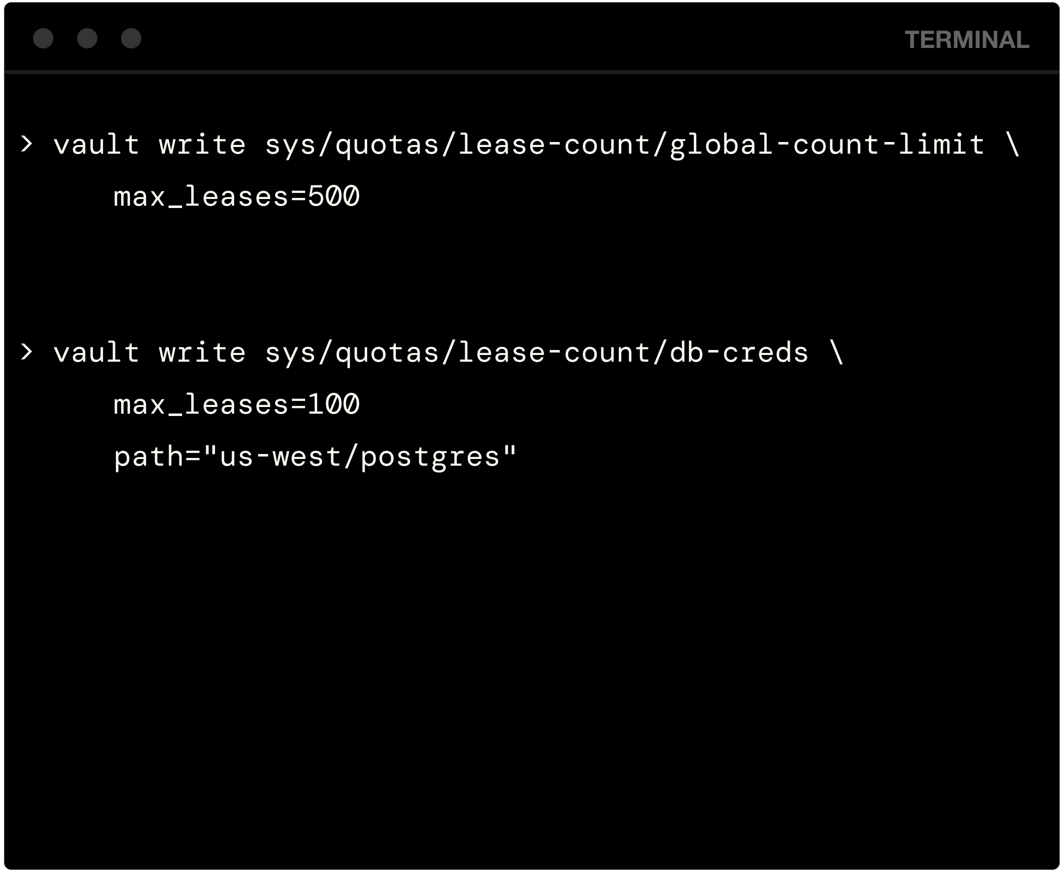
Protect Vault from potential DDoS attack



```
# Create global quota rule and set rate at desired requests
per second
> vault write sys/quotas/rate-limit/global-rate rate=500

# Set rate limit on specific paths
> vault write sys/quotas/rate-limit/db-creds rate=30
      path="database"

# Set rate limit on specific namespace and path
> vault write sys/quotas/rate-limit/orders \
     path="us-west/kv-v2" \
     rate=16.67 \
     burst=100
```

Lease Count Quotas Example

Prevent the storage backend from becoming the point of failure



```
> vault write sys/quotas/lease-count/global-count-limit \
    max_leases=500


> vault write sys/quotas/lease-count/db-creds \
    max_leases=100
    path="us-west/postgres"
```

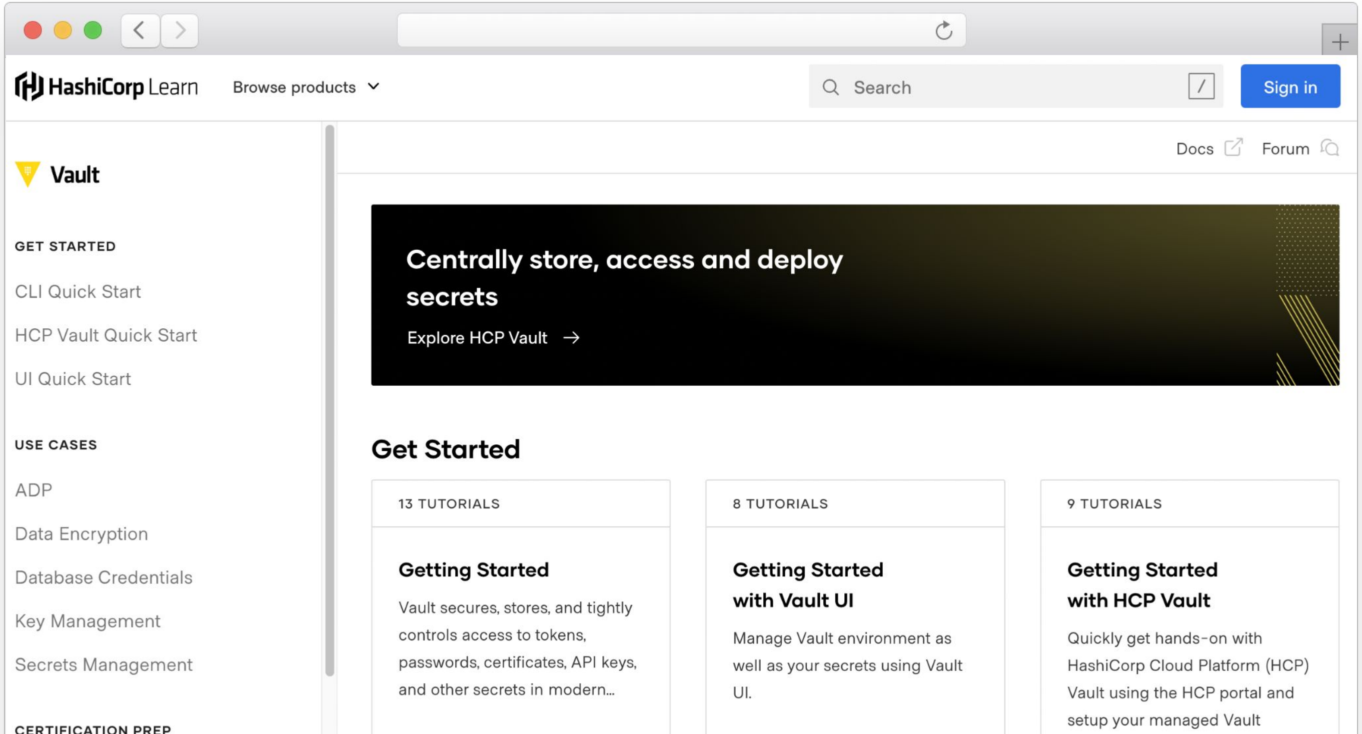
04

Next Steps

Learn

https://learn.hashicorp.com/vault

Step-by-step guides to accelerate deployment of Vault



Vault

GET STARTED

CLI Quick Start

HCP Vault Quick Start

UI Quick Start

USE CASES

ADP

Data Encryption

Database Credentials

Key Management

Secrets Management

CERTIFICATION PREP

Centrally store, access and deploy secrets

Explore HCP Vault →

Get Started

13 TUTORIALS

Getting Started

Vault secures, stores, and tightly controls access to tokens, passwords, certificates, API keys, and other secrets in modern...

8 TUTORIALS

Getting Started with Vault UI

Manage Vault environment as well as your secrets using Vault UI.

9 TUTORIALS

Getting Started with HCP Vault

Quickly get hands-on with HashiCorp Cloud Platform (HCP) Vault using the HCP portal and setup your managed Vault

Resources

- Sentinel Policy Examples
- Standard Sentinel Imports
- List of Vault data available for Sentinel policies
- Sentinel Policy HashiCorp Learn Example
- Control Groups Learn Guide
- Protecting Vault with Resource Quotas

Need Additional Help?

Customer Success

Contact our Customer Success Management team with any questions. We will help coordinate the right resources for you to get your questions answered.

customer.success@hashicorp.com

Technical Support

Something not working quite right? Engage with HashiCorp Technical Support by opening a ticket for your issue at support.hashicorp.com.

Discuss

Engage with the HashiCorp Cloud community including HashiCorp Architects and Engineers

discuss.hashicorp.com

COBRA Vault Onboarding Journey

Up Next…

- Program Closing Email and Survey!

05

Q & A

Thank You

customer.success@hashicorp.com
www.hashicorp.com