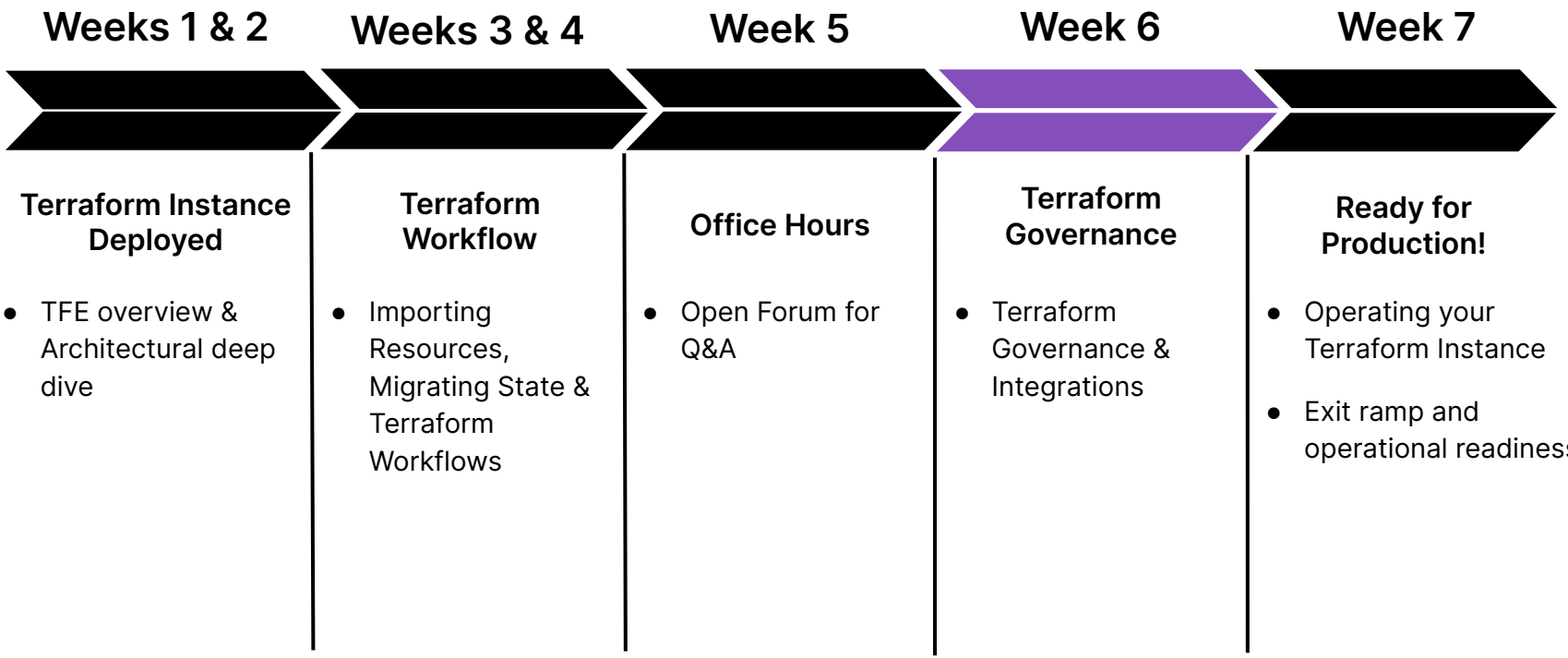
HashiCorp Terraform

Terraform Governance & Integrations

TFE Path to Production



Agenda

01

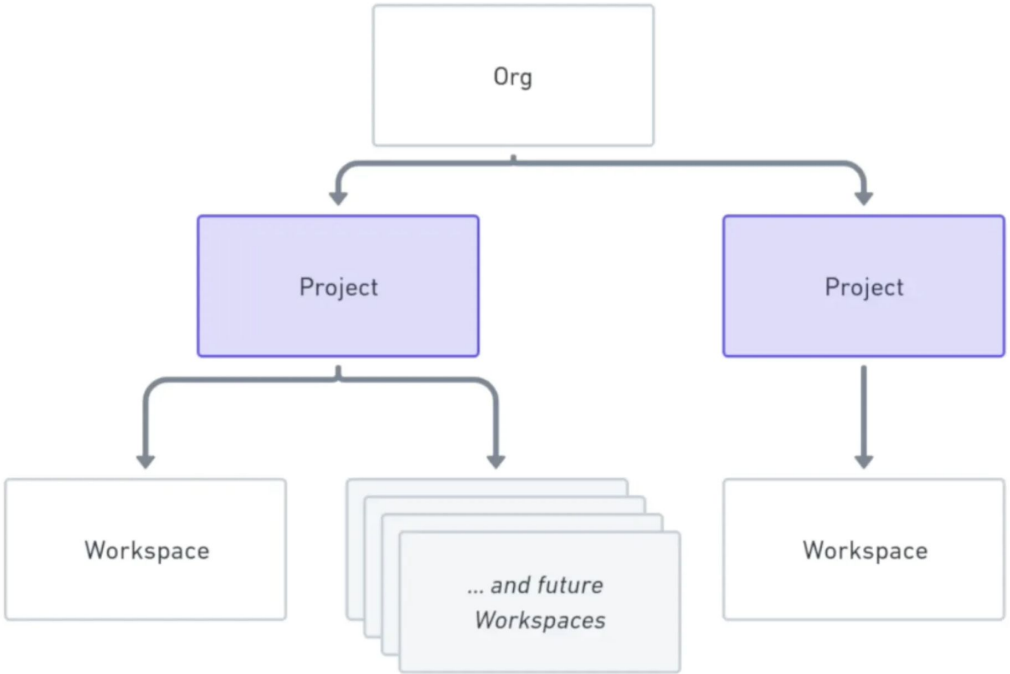
Role Based Access Controls (RBAC)

Terraform Enterprise RBAC Model

- Terraform Enterprise's (TFE) access model is team-based
  - Permissions are assigned at the team level
  - Users inherit permissions based upon team assignment
- TFE's permission model is split into organization-level & workspace-level permissions
- Every Org has an "owners" team which have every available permission in that org
- Workspace permissions allow administrators to delegate access to specific collections of infrastructure

Workspaces and Projects

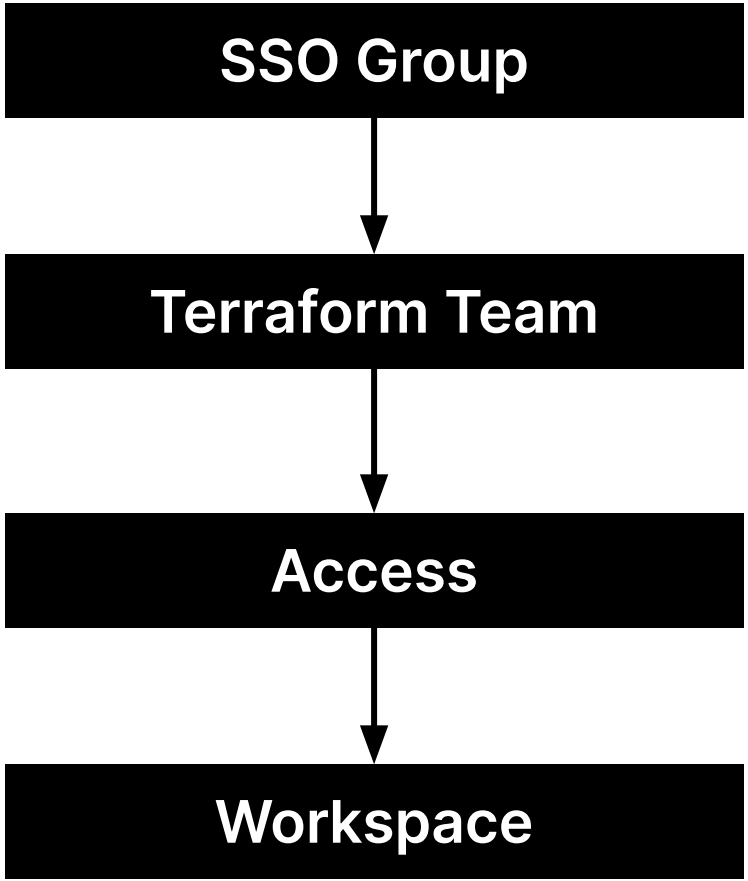
- Projects let you organize workspaces and scope access to workspace resources
- Each project has a separate permissions set which can be used to manage access to all workspaces in the project
- Project-level permissions
    - More granular than Org-level permissions
    - More specific than workspace-level grants
- Projects added in TFE 202302-1 (Feb 2023)



Common Scenarios

- TFE is often used by multiple Teams (i.e. *Developers*, *QA*, *Security*, *Operations*, *Networking*, *SQL Admins*, *Filestore Admins*, *Accounting*)
- The best approach to managing permissions is:
    a. Create Groups within your Single Sign-on (SSO) service for each team
    b. Assign each group as a TFC Team
    c. Determine how Workspaces will be divided, & assign permissions accordingly
- Data can be dynamically shared between Workspaces as read-only by using the **“tfe_outputs”** data source
- `Terraform_remote_state` Data Source

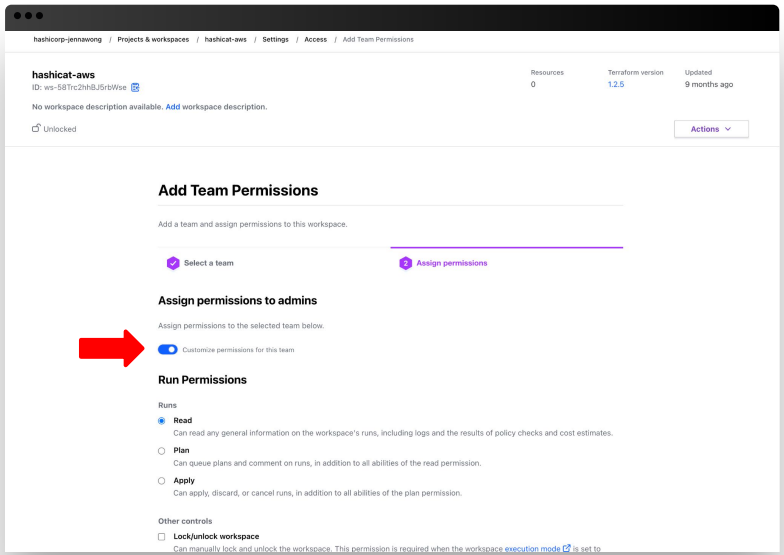
TFCB Permissions Flow



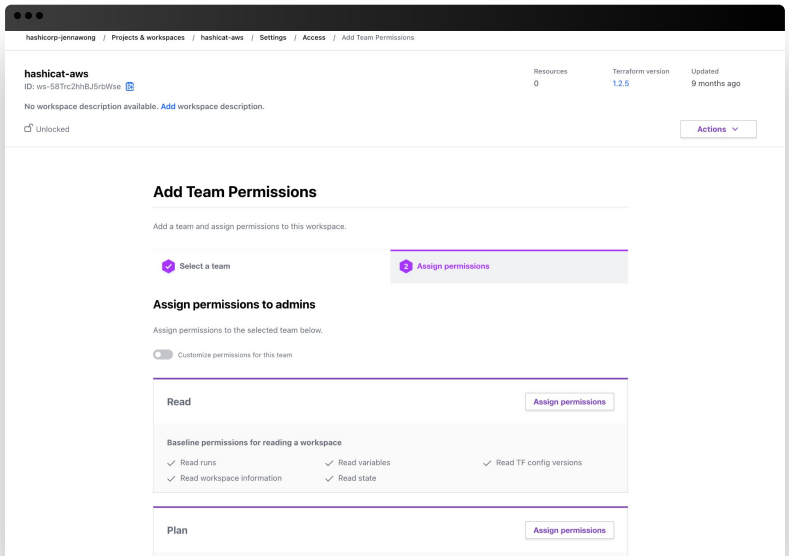
Workspace & Project Permissions

There are two ways to assign permissions to a TFE team:

1. Custom permissions



2. Fixed permission sets



Workspace & Project Permissions

- Each workspace has an “admin” permissions level with full control of the workspace
- Projects have specific permissions that can be assigned to teams
- Members of teams with "admin" permissions for a Project have permissions for every workspace in the project & additional permissions

Workspace Permission Sets

Read

- Read runs
- Read variables
- Read state versions

Plan

- Queue plans
- Read variables
- Read state versions

Admin

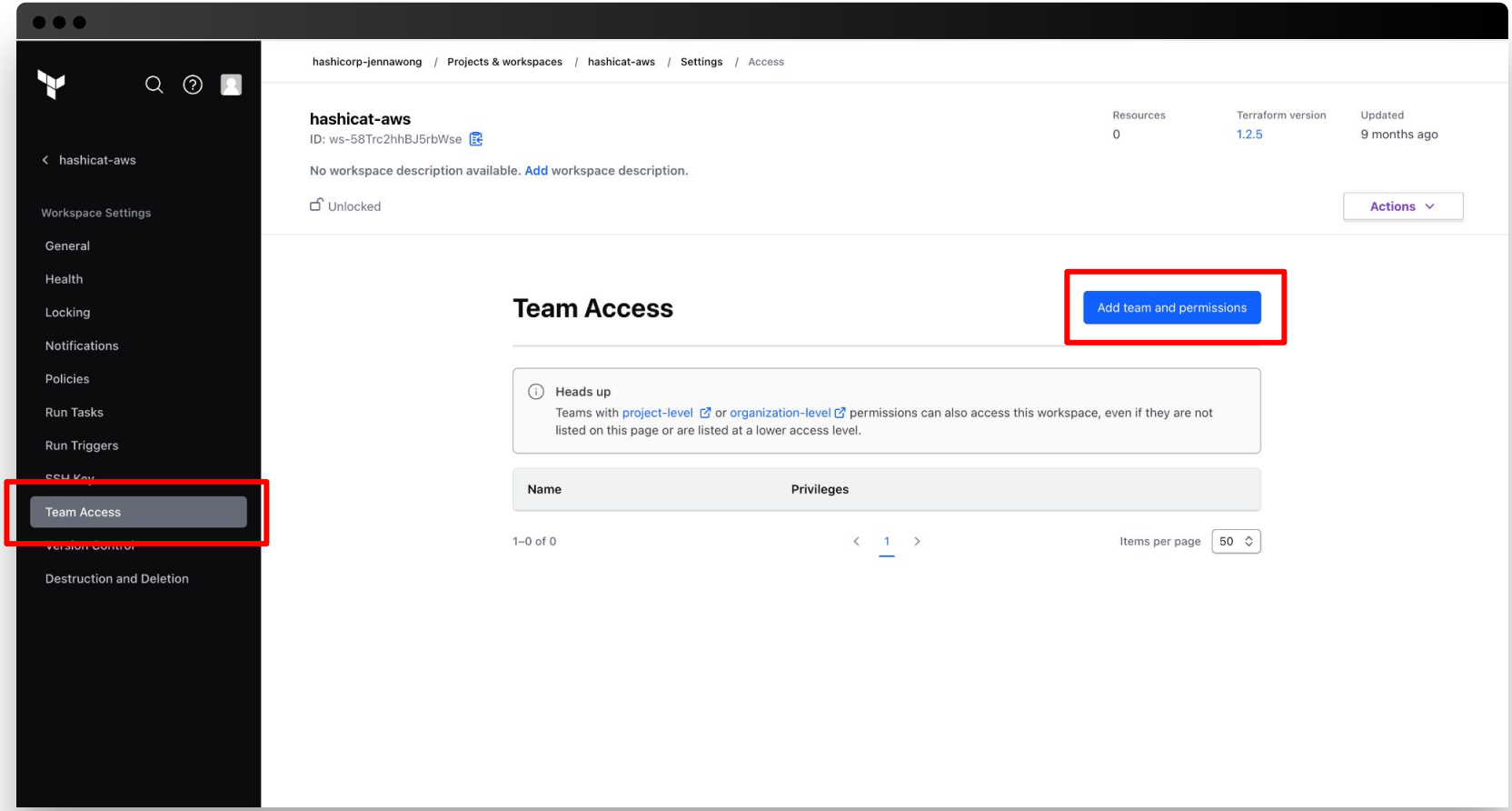
- VCS Configuration
- Manage Team Access
- Execution Mode
- Delete Workspace
- Read & write workspace settings, general settings, notification configurations, run triggers, & more

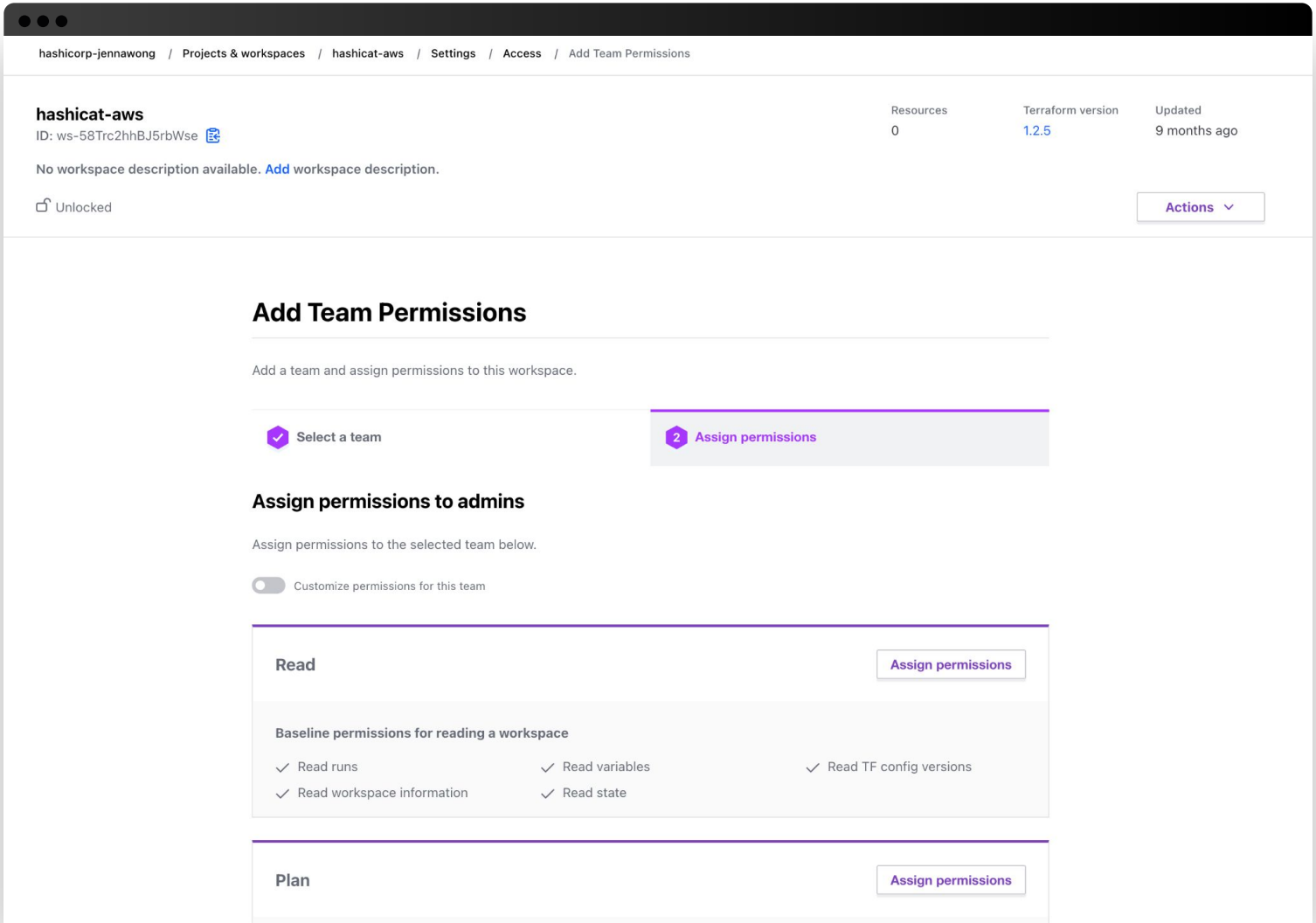
Write

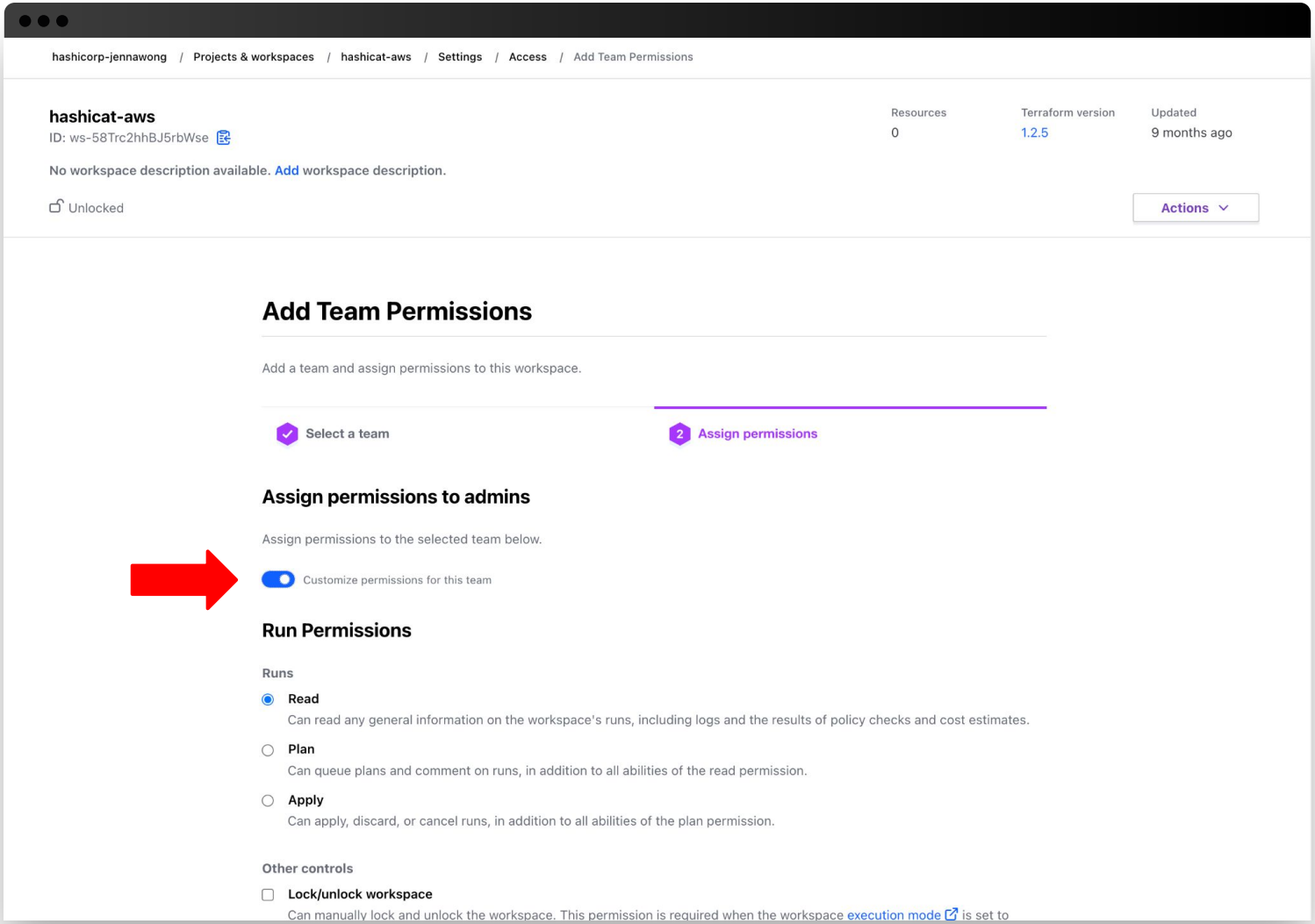
- Lock/unlock Workspace
- Download Sentinel mocks
- Read and write Variables
- Read and write State Versions
- Approve Runs

State Files

- May contain secrets, passwords, & API Tokens
- Should be handled as sensitive material when applying RBAC permissions
- Are encrypted at rest using HashiCorp Vault
- Data can still be read at runtime or directly from the TFE UI if a User has the necessary Workspace permissions


hashicorp-jennawong / Projects & workspaces / hashicat-aws / Settings / Access
hashicat-aws
ID: ws-58Trc2hhBJ5rbWse
No workspace description available. Add workspace description.
Unlocked
Resources
0
Terraform version
1.2.5
Updated
9 months ago
Actions
hashicat-aws
Workspace Settings
General
Health
Locking
Notifications
Policies
Run Tasks
Run Triggers
Team Access
Destruction and Deletion
Team Access
Add team and permissions
Heads up
Teams with project-level or organization-level permissions can also access this workspace, even if they are not listed on this page or are listed at a lower access level.
Name
Privileges
1–0 of 0
1
Items per page
50


hashicorp-jennawong / Projects & workspaces / hashicat-aws / Settings / Access / Add Team Permissions
hashicat-aws
ID: ws-58Trc2hhBJ5rbWse
Resources
0
Terraform version
1.2.5
Updated
9 months ago
No workspace description available. Add workspace description.
Unlocked
Actions
Add Team Permissions
Add a team and assign permissions to this workspace.
Select a team
2
Assign permissions
Assign permissions to admins
Assign permissions to the selected team below.
Customize permissions for this team
Read
Assign permissions
Baseline permissions for reading a workspace
Read runs
Read variables
Read TF config versions
Read workspace information
Read state
Plan
Assign permissions


hashicorp-jennawong / Projects & workspaces / hashicat-aws / Settings / Access / Add Team Permissions
hashicat-aws
ID: ws-58Trc2hhBJ5rbWse
Resources
0
Terraform version
1.2.5
Updated
9 months ago
No workspace description available. Add workspace description.
Unlocked
Actions
Add Team Permissions
Add a team and assign permissions to this workspace.
Select a team
2
Assign permissions
Assign permissions to admins
Assign permissions to the selected team below.
Customize permissions for this team
Run Permissions
Runs
Read
Can read any general information on the workspace's runs, including logs and the results of policy checks and cost estimates.
Plan
Can queue plans and comment on runs, in addition to all abilities of the read permission.
Apply
Can apply, discard, or cancel runs, in addition to all abilities of the plan permission.
Other controls
Lock/unlock workspace
Can manually lock and unlock the workspace. This permission is required when the workspace execution mode is set to

Team API Token

- A Team can only have a single API token
- The token can be regenerated
- The token capabilities is defined by the roles and permissions of the team
- The token can be used both by the CLI and API
- The token will bypass SSO and MFA
- Tokens can also be generated at Organisation and User level

Admin Roles

Super User Roles

Manage Policies

Create, edit and delete Sentinel Policy Sets

Manage Workspaces

Create and administrate all workspaces in the organisation

Manage VCS Settings

Create and manage VCS settings and SSH Keys

Manage Policy Overrides

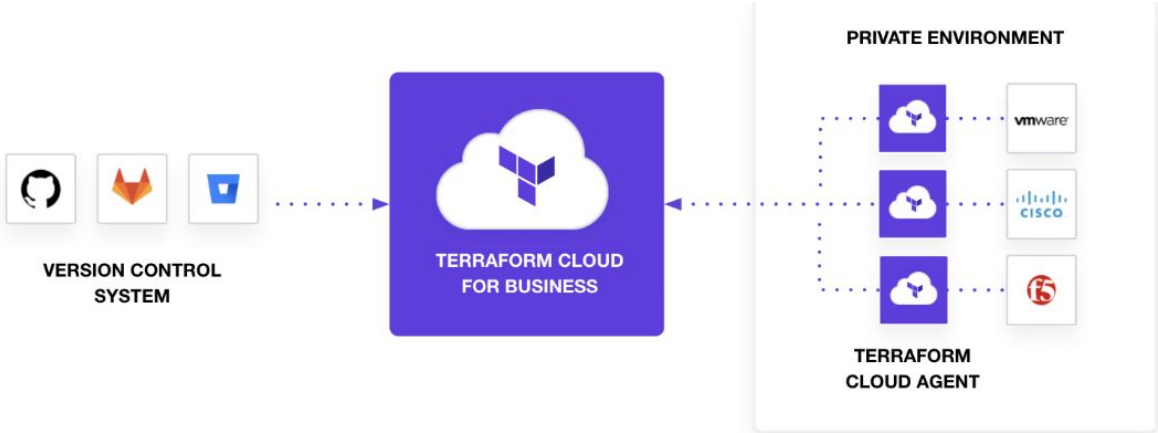
Override ‘soft-mandatory’ policy checks

02

Cloud Agents

Terraform Cloud Agents

- x86-based Golang binary
- Only outbound connectivity required
- Communicate with isolated, private infrastructure, such as vSphere, Nutanix, OpenStack, or across multiple cloud accounts
- Can be hosted close to target infrastructure
- Deployable on bare metal, a VM, as a Docker container, or in a Kubernetes cluster



Requirements

Supported Platforms

- Baremetal
- Docker
- Kubernetes (K8S)
- VMware VM
- AWS EC2 VM, EKS, ECS, Fargate EKS, Fargate ECS
- Azure VM, Container Service, AKS
- GCP Compute Engine VM, GKE

Hardware Requirements

- x86-based Linux host
- 2 GB of RAM
- 4 GB of disk space

Networking Requirements

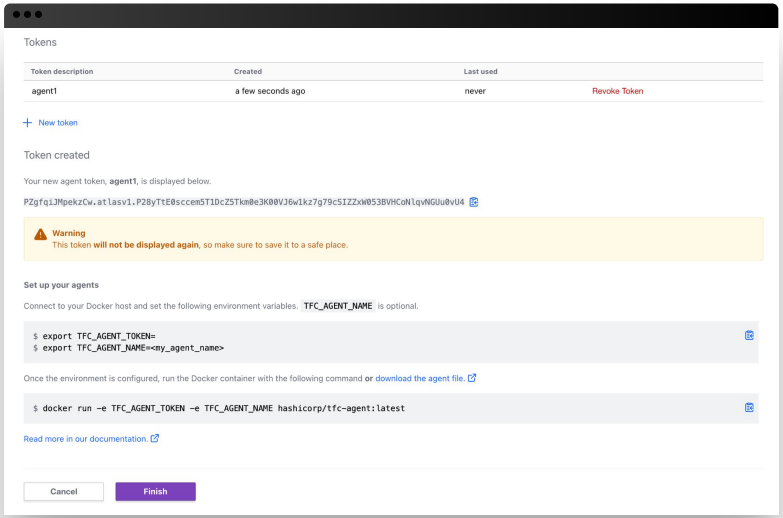
- TFE host via HTTPS (443)
- releases.hashicorp.com
- registry.terraform.io
- (Airgapped) if custom TF CLI binary is used external access is not needed.

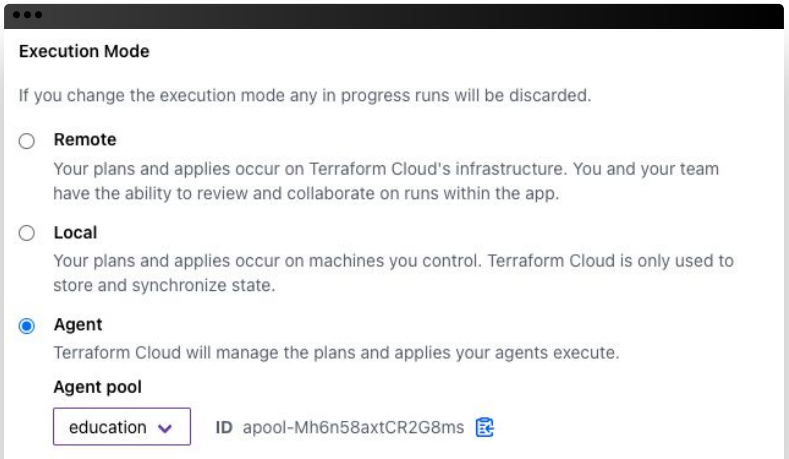
Terraform Cloud Agents

- No restriction on Agent or Agent Pool Count
- Agents must define the TFE hostname via either:
  - -address CLI flag
  - TFC_ADDRESS environment variable
- Agents support custom Terraform bundles
- Must be able to communicate with the TFE instance via **HTTPS**
- There are some restrictions on what versions of Agents can be registered

Terraform Cloud Agents

- Configured as an agent pool with many agents
- A token is generated and applied using a command line or ENV VAR and connects back to TFE
- Once an agent is in a pool, the pool can be assigned to a Workspace





03

Sentinel

Sentinel is: “Policy, Governance, & Security as Code”

Benefits

1. Enforcement
2. Speed
3. Reproducibility
4. Reliability
5. Automation
6. Version Control
7. Auditability

Sentinel

- Has its own language that includes variables, loops, imports, conditionals, and functions
- Modules are useful for creating reusable code and libraries
- Ensures governance is applied automatically rather than relying on manual auditing
- Supports fine-grained policies using conditional logic
- Allows you to write complex logic and even call cost estimation

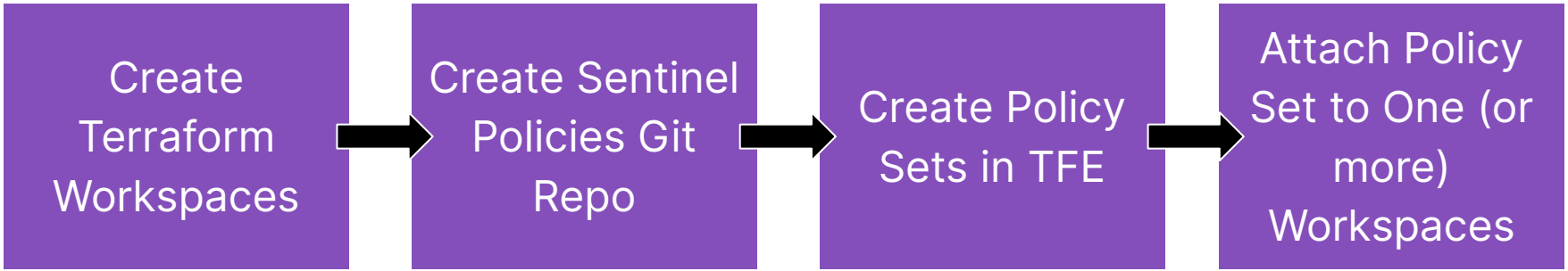
Sentinel

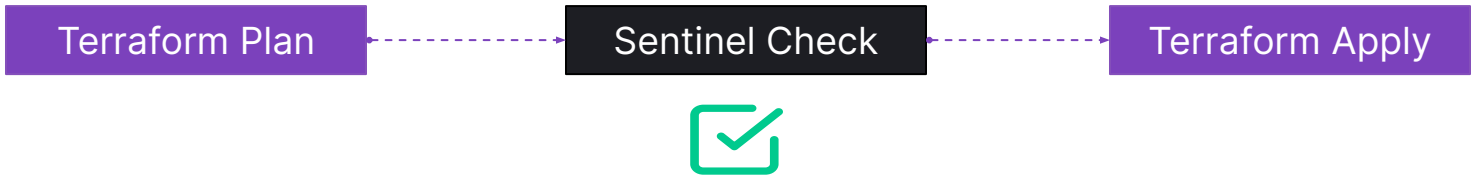
- Runs after a terraform plan and before a terraform apply
  terraform plan → sentinel check → terraform apply
- Enforcement levels:
  - Advisory: required, cannot bypass, fail the TF RUN (prod)
  - Soft mandatory: required, TF Owner can bypass with a comment in the TF UI, will halt the TF Run
  - Hard mandatory: guard-rails warning, info warnings in the TF Run
- Includes a CLI tool to allow fast policy tests and runs
- Validates Config and State (Create, Edit, Destroy) of Terraform resources
- Foundational Policies Library of premade policies is available

Use Cases

1. Cloud Provider
2. Account ID
3. Limit Availability Zones
4. Cost Estimates
5. Cost Limiting
6. Resource Tagging
7. Resource Types
8. Resource Sizes
9. Resource Configuration
10. Resource Destruction

Workflow





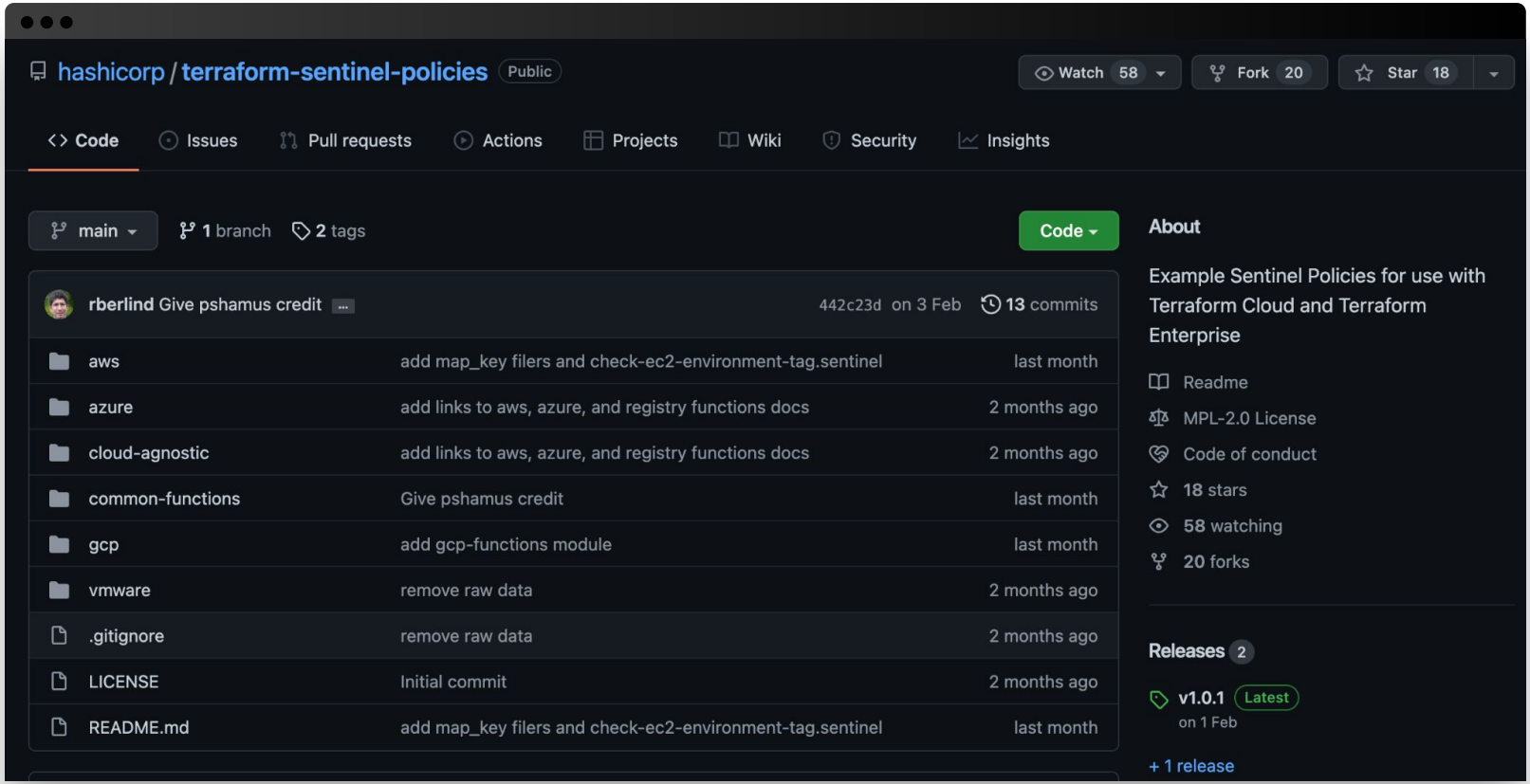
Architecture

- Variables, conditionals, loops, functions
  - Sentinel Language Reference
- Validates Config and State (Create, Edit, Destroy) of Terraform resources
- terraform plan → sentinel check → terraform apply
- Enforcement Levels – all are Logged
  - **Hard-mandatory**, required, cannot bypass, fail the TF RUN (prod)
  - **Soft-mandatory**, required, TF Owner can bypass with a comment in the TF UI, will halt the TF Run
  - **Advisory**, guard-rails warning, info warnings in the TF Run

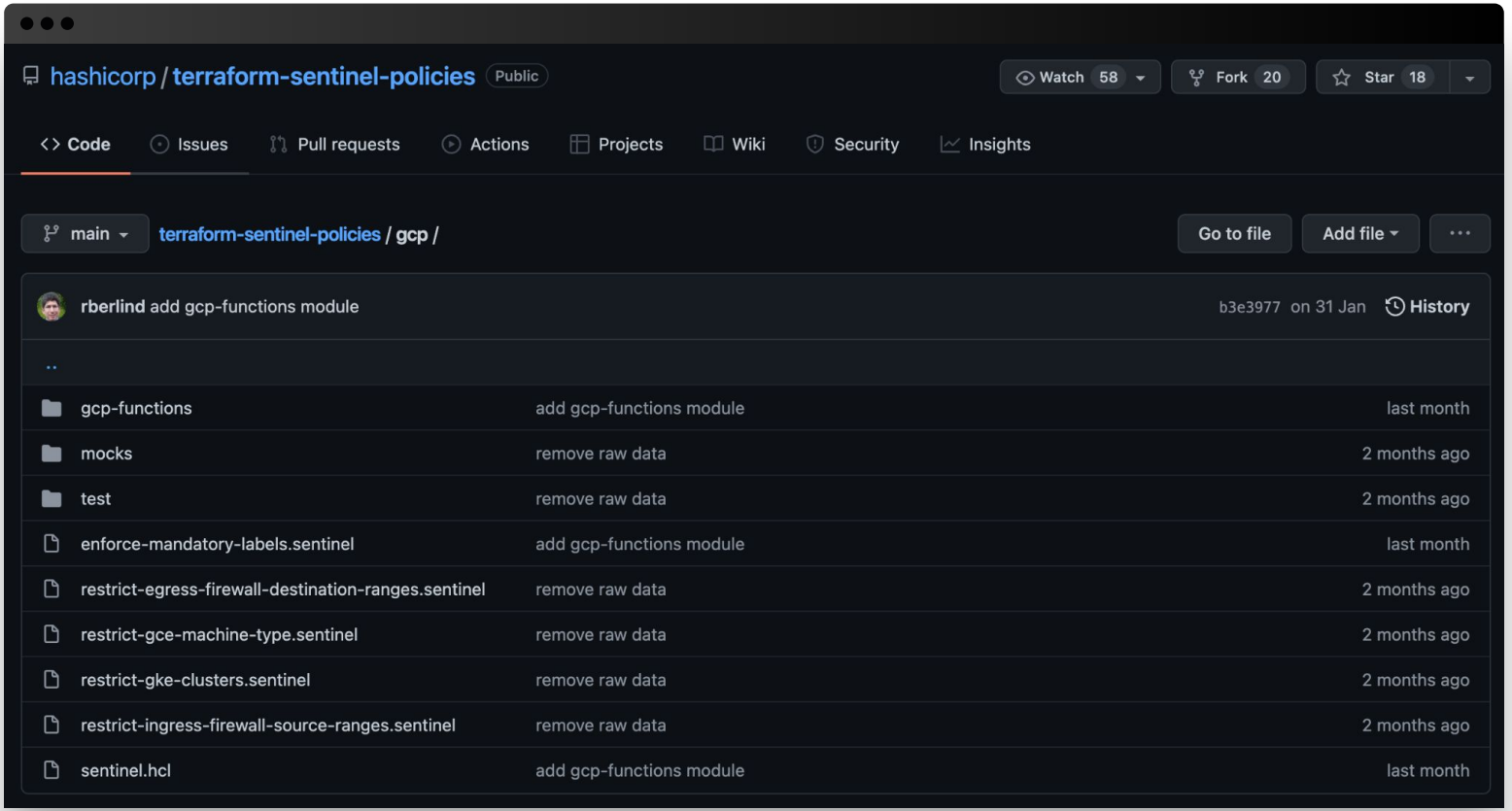
Syntax Example

```
import "units"

memory = func(job) {
    result = 0
    for job.groups as g {
        for g.tasks as t {
            result += t.resources.memory else 0
        }
    }
    return result
}

main = rule {
    memory(job) < 1 * units.gigabyte
}
```

Sentinel Rule Git Repo



Policy Set File Structure



Automate Sentinel to Workspaces

```
# Get a list of Workspace IDs, based on matching a Regex pattern
variable "workspace_name_pattern" {
  type = string
  default = ".*_dev_vdm"
}
data "tfe_workspace_ids" "all" {
  names = ["*"]
  organization = var.tf_org_name
}
output "all_workspace_ids" { value = data.tfe_workspace_ids.all.ids }
locals {
  # filter by the Workspace Name, then return the Workspace ID, or null, then remove null entries
  filtered_workspace_ids = compact(flatten([
    for name, id in data.tfe_workspace_ids.all.ids : [
      (length(regexall(var.workspace_name_pattern, name)) > 0) ? id : null
    ]
  ]))
}
output "filtered_workspace_ids" { value = local.filtered_workspace_ids }
```

Limitations

1. Can only enforce against resources deployed & managed by Terraform
2. Cannot enforce “self-managed” services (ex: mysql on AWS EC2, Azure VM, GCP VM, VMware VM)
3. Cannot enforce against resource logs / metrics (ex: AWS CloudTrail, Azure Monitor, GCP Cloud Audit Logs)
4. Cannot continuously monitor (ex: AWS Config, Azure Policy, GCP Forseti)
5. Sentinel uses the Cloud Provider’s Cost Estimation API, which doesn’t continuously run, & does not check costs for usage-based billing (ex: AWS Athena, Azure DataBricks, GCP BigQuery, GCP Pub/Sub)

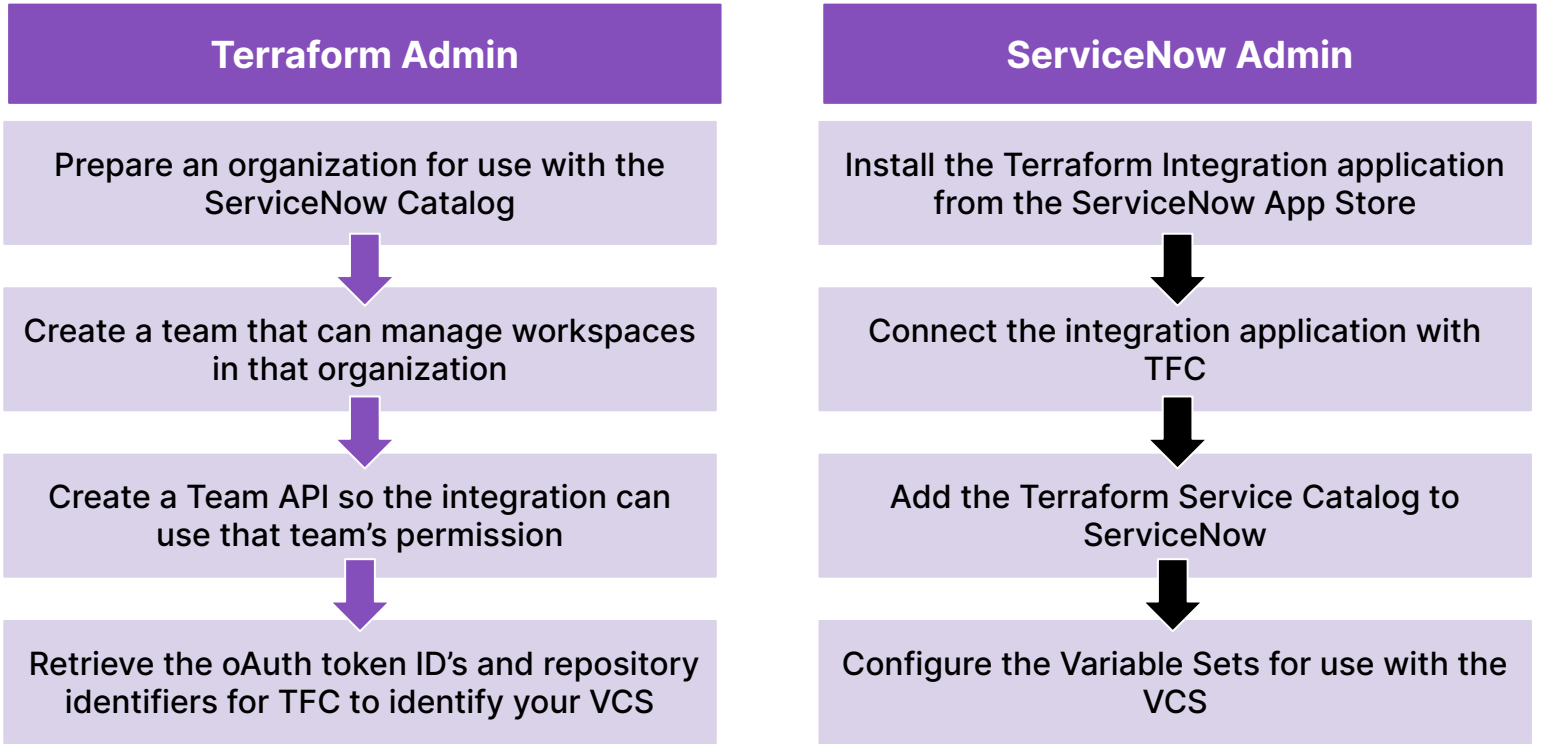
04

Terraform & ServiceNow Integration

Terraform Integration with ServiceNow

- The Terraform ServiceNow Service Catalog integration enables end-users to provision self-serve infrastructure via ServiceNow
- Connecting ServiceNow to Terraform Enterprise lets users:
  - Order Service Items
  - Create workspaces
  - Perform Terraform runs using prepared Terraform configurations hosted in VCS repositories
- Terraform ServiceNow Service Catalog Integration Setup
- Terraform ServiceNow Integration Administrator Guide

Workflow



05

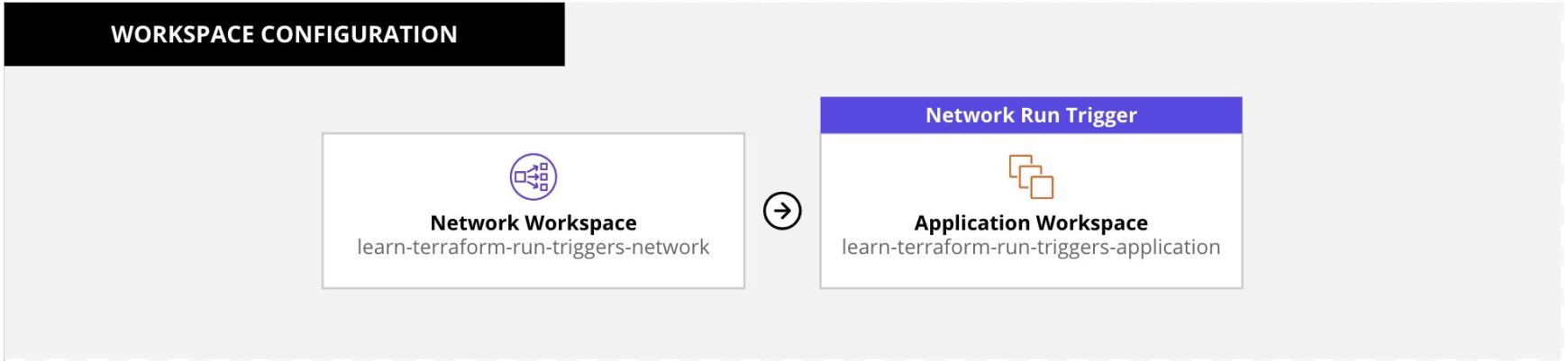
Run Triggers & Run Notifications

Run Triggers

- Create infrastructure pipelines in TFE
- Allow teams to manage complex infrastructure in TFE by creating infrastructure pipelines between multiple workspaces
- When a source workspace is selected, multiple dependent workspaces can be linked
- When a successful apply is executed in the source workspace, the dependent workspaces have runs triggered and can be configured to auto-apply their configurations

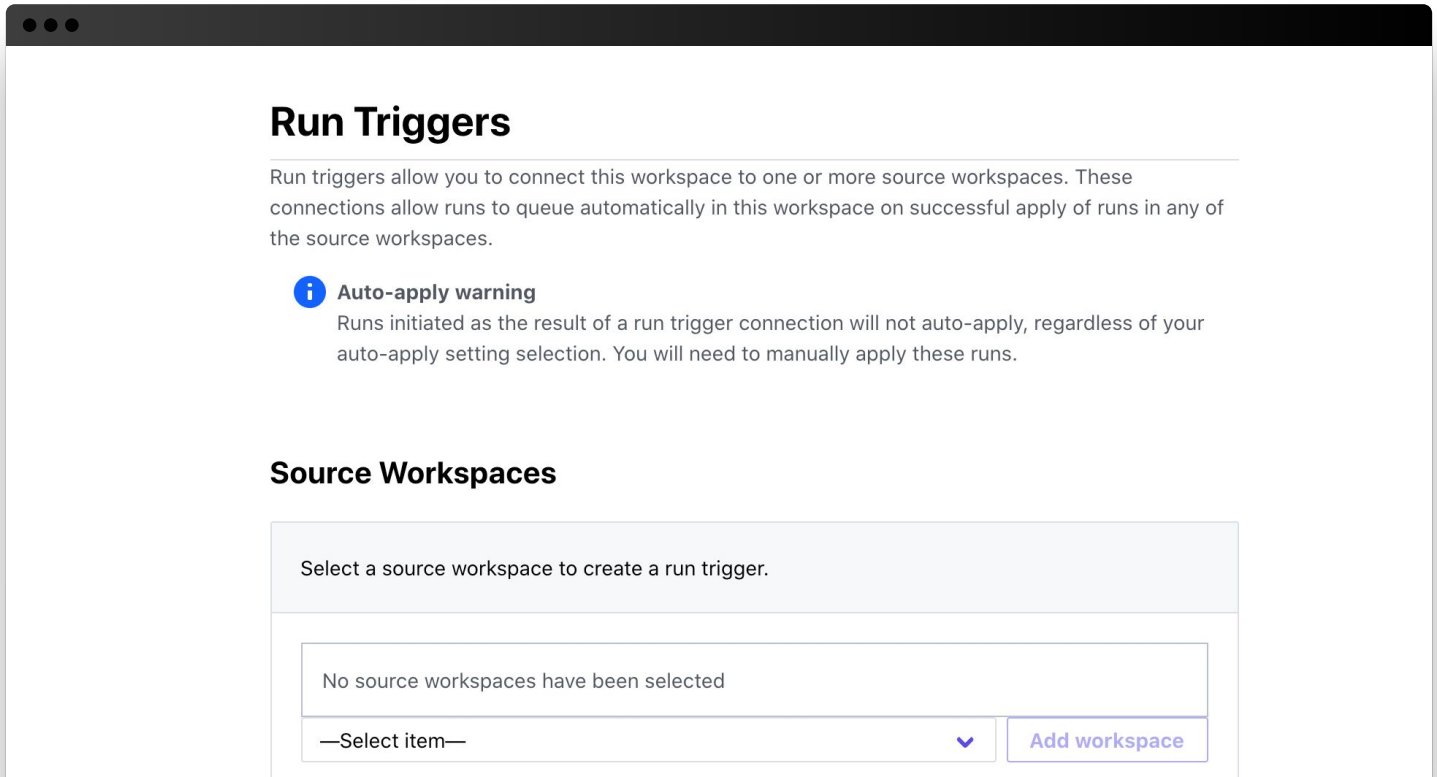
Use Case: Application Configuration Management

Run triggers automatically trigger updates to application configuration to rebalance servers across new subnets once they are successfully provisioned in the network workspace



Create Run Triggers

Workspace Settings → Run Triggers → Select Source Workspace



Run Notifications

- Run Notifications send updates/notifications to external services with details on run progress
- Notifications can be sent to up to 20 destinations
- Each workspace can be configured with it’s own notification settings
- Can send either POST message to any URL via webhook, email message, or sent to Slack & post updates in channels

Notification Triggers

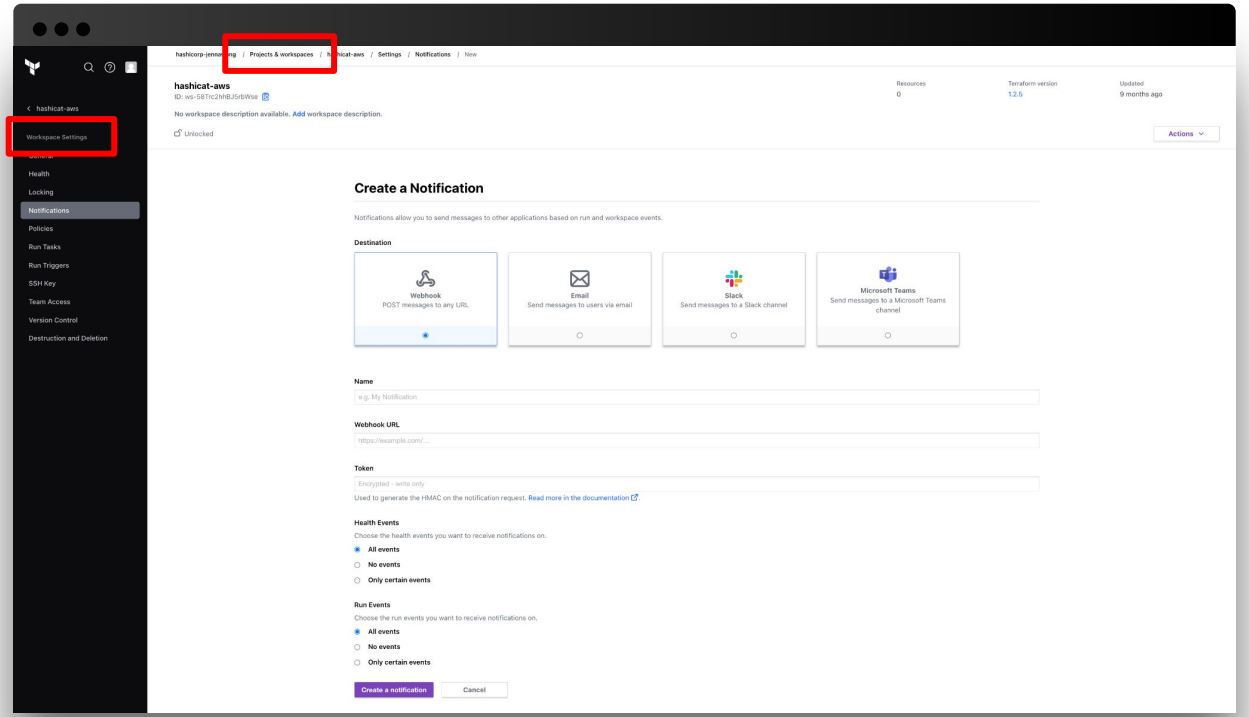
	Trigger	Description
Created	“run:created”	When a run is created and enters the "Pending" state.
Planning	“run:planning”	When a run acquires the lock and starts to execute.
Needs Attention	“run:needs_attention”	Human decision required. When a plan has changes and is not auto-applied, or requires a policy override.
Applying	“run:applying”	When a run begins the apply stage, after a plan is confirmed or auto-applied.
Completed	“run:completed”	When the run has completed on a happy path and can't go any further.
Errored	“run:errored”	When the run has terminated early due to error or cancellation.

Sample Notification Payload


```
{
  "payload_version": 1,
  "notification_configuration_id": "nc-AeUQ2zfKZzW9TiGZ",
  "run_url": "https://app.terraform.io/app/acme-org/my-workspace/runs/run-FwnENkvDnrpyFC7M",
  "run_id": "run-FwnENkvDnrpyFC7M",
  "run_message": "Add five new queue workers",
  "run_created_at": "2019-01-25T18:34:00.000Z",
  "run_created_by": "sample-user",
  "workspace_id": "ws-XdeUVMWShTesDMME",
  "workspace_name": "my-workspace",
  "organization_name": "acme-org",
  "notifications": [
    {
      "message": "Run Canceled",
      "trigger": "run:errored",
      "run_status": "canceled",
      "run_updated_at": "2019-01-25T18:37:04.000Z",
      "run_updated_by": "sample-user"
    }
  ]
}
```

Create Notification Triggers

Workspace → Settings → Notifications

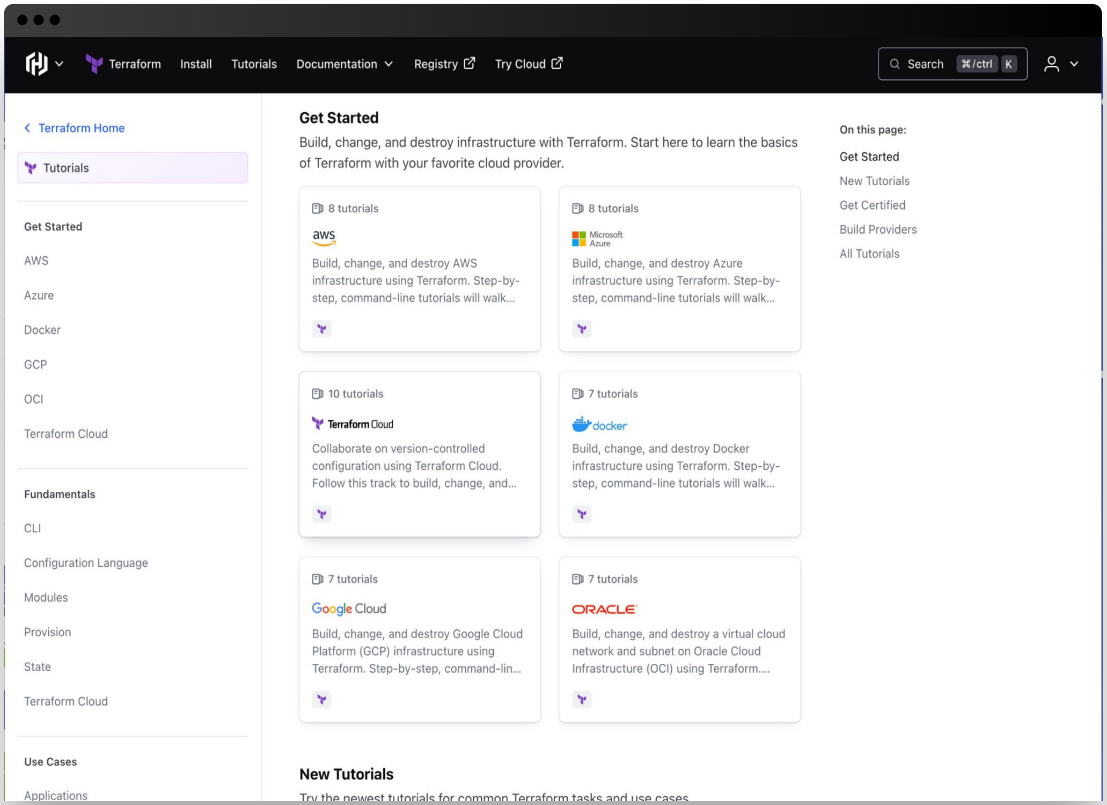


Next Steps

Tutorials

https://developer.hashicorp.com/terraform/tutorials

Step-by-step guides to accelerate deployment of Terraform Enterprise



Additional Resources

- TFE Permissions
- API Tokens
- Organizing Workspaces with Projects
- Terraform Cloud Agents on TFE
- Manage Private Environments with Agents
- Cloud Agent Releases & Kubernetes Module
- Sentinel Language Reference
- Sentinel Foundational Policies Library
- Run Triggers & Registry: tfe_run_trigger
- Notifications API & Registry: tfe_notifications

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

Upcoming Webinars

Terraform Enterprise Operations

We take a deep dive into best practices for operating Terraform Enterprise instances including backup & restore operations, upgrade process, and monitoring

Program Closing

We conclude the webinar series with a short recorded session

The session and accompanying materials include an Operational Readiness Checklist for Terraform Enterprise and links to all of the program materials and recordings

Action Items

- If you haven't, share to customer.success@hashicorp.com
  - Authorized technical contacts for support
  - Stakeholders contact information (name and email addresses)
- Validate TFE architecture and design with appropriate stakeholders for approval (Security Team, Network Team, Developer Leads, etc)
- Start planning RBAC structure for the deployment (Orgs, Teams, Projects, Workspaces, Roles)
- Review Sentinel resources and determine which policy sets will be utilized in your environment(s)

Q&A

Thank you

customer.success@hashicorp.com

www.hashicorp.com/customer-success