HashiCorp
Vault

Vault Dynamic Secrets

Agenda

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01

Dynamic Secrets

What is a Dynamic Secret?

- Credentials (username/password, certificate) that are created when they are accessed
- Secrets do not exist until they are read
- Time-bound via TTL
  - Can be renewed*
  - Cleans itself up at its TTL
- Built in revocation mechanism

Why Dynamic Secrets?

Static Secrets

- Manage Credentials

  (e.g. create username and password for application A)
- Manually created, typically have a long life due to management overhead
- Manual lifecycle management

Dynamic Secrets

- Manage Intentions

  (e.g. Spring application needs database access)
- Dynamically created when needed at read time (do not exist until read)
- Automatic lifecycle: create, revoke, & rotate

Why Dynamic Secrets?

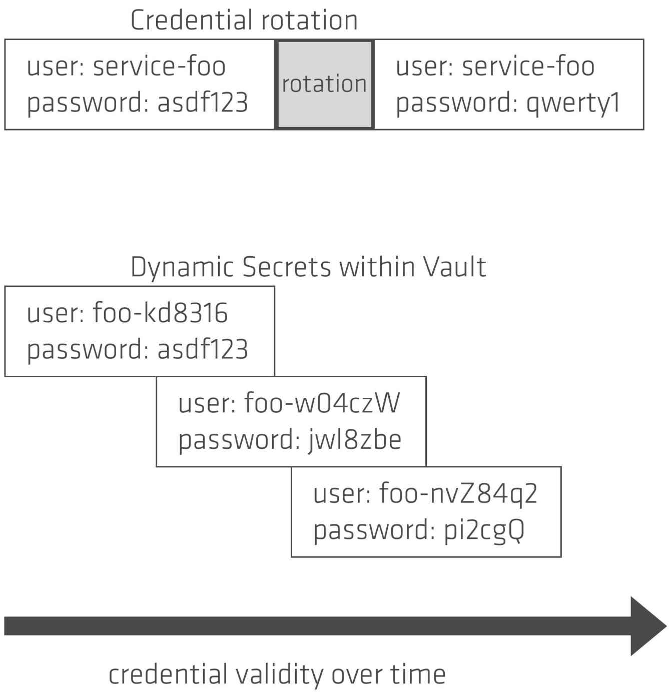
Static Secrets

- Often shared across applications and instances, hard to determine where secret is being used
- Exist at rest, can be leaked by operator, application, or logs
- Revocation requires operator intervention or action

Dynamic Secrets

- Vault knows which secrets each client has, simple to revoke and limit blast radius
- Do not exist until read, created on demand when needed
- Finite lifespan, automatically revoked / deleted / rotated via TTL.
- Unique credentials per client make forensics easy in the event of compromise or leak

Why Dynamic Secrets?



Credential rotation

user: service-foo
password: asdf123

rotation

user: service-foo
password: qwerty1

Dynamic Secrets within Vault

user: foo-kd8316
password: asdf123

user: foo-w04czW
password: jwl8zbe

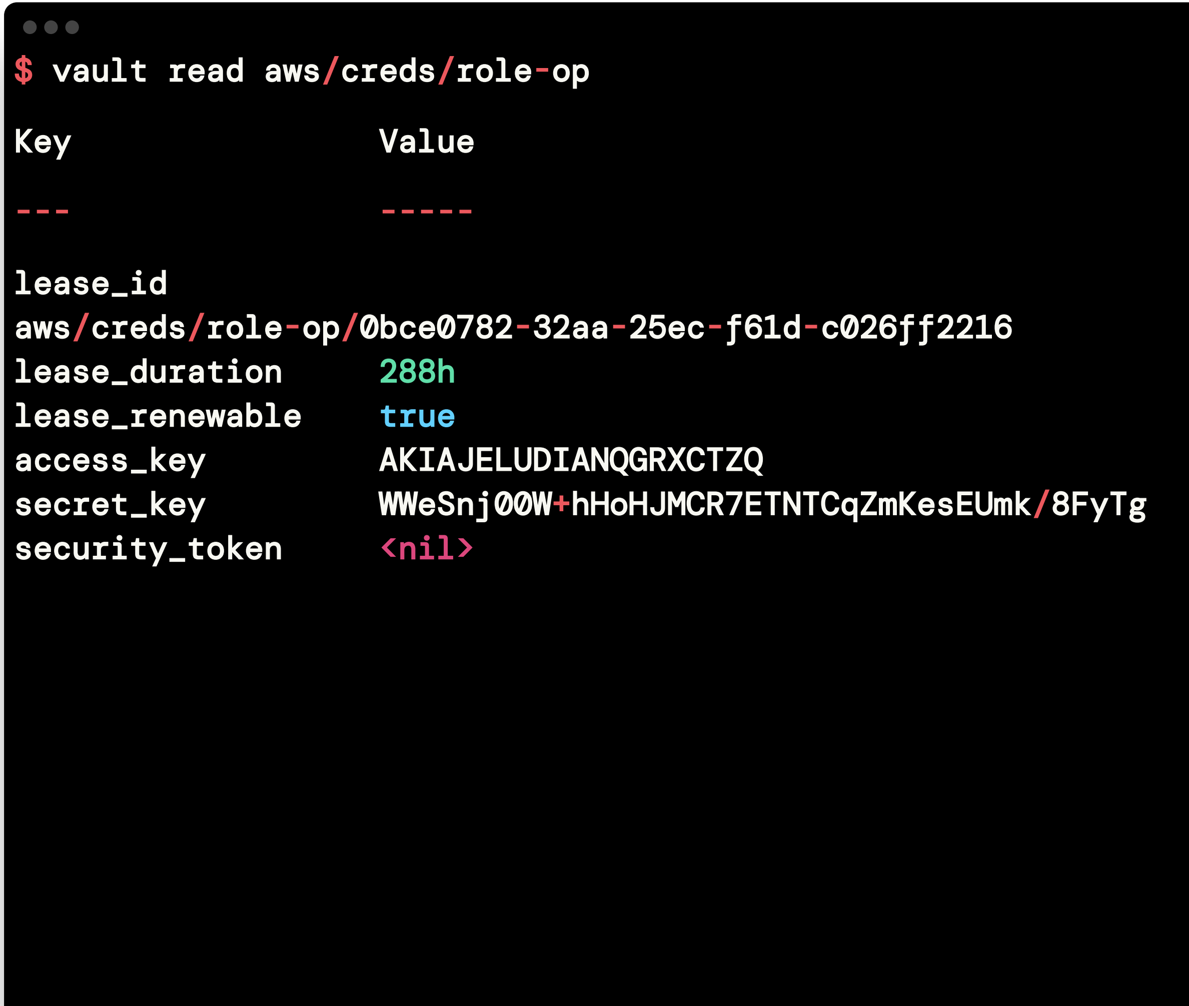
user: foo-nvZ84q2
password: pi2cgQ

credential validity over time

- No deadlock period during credential rotation
- Application logic for handling rotation scheduling not needed

Dynamic Credentials Example

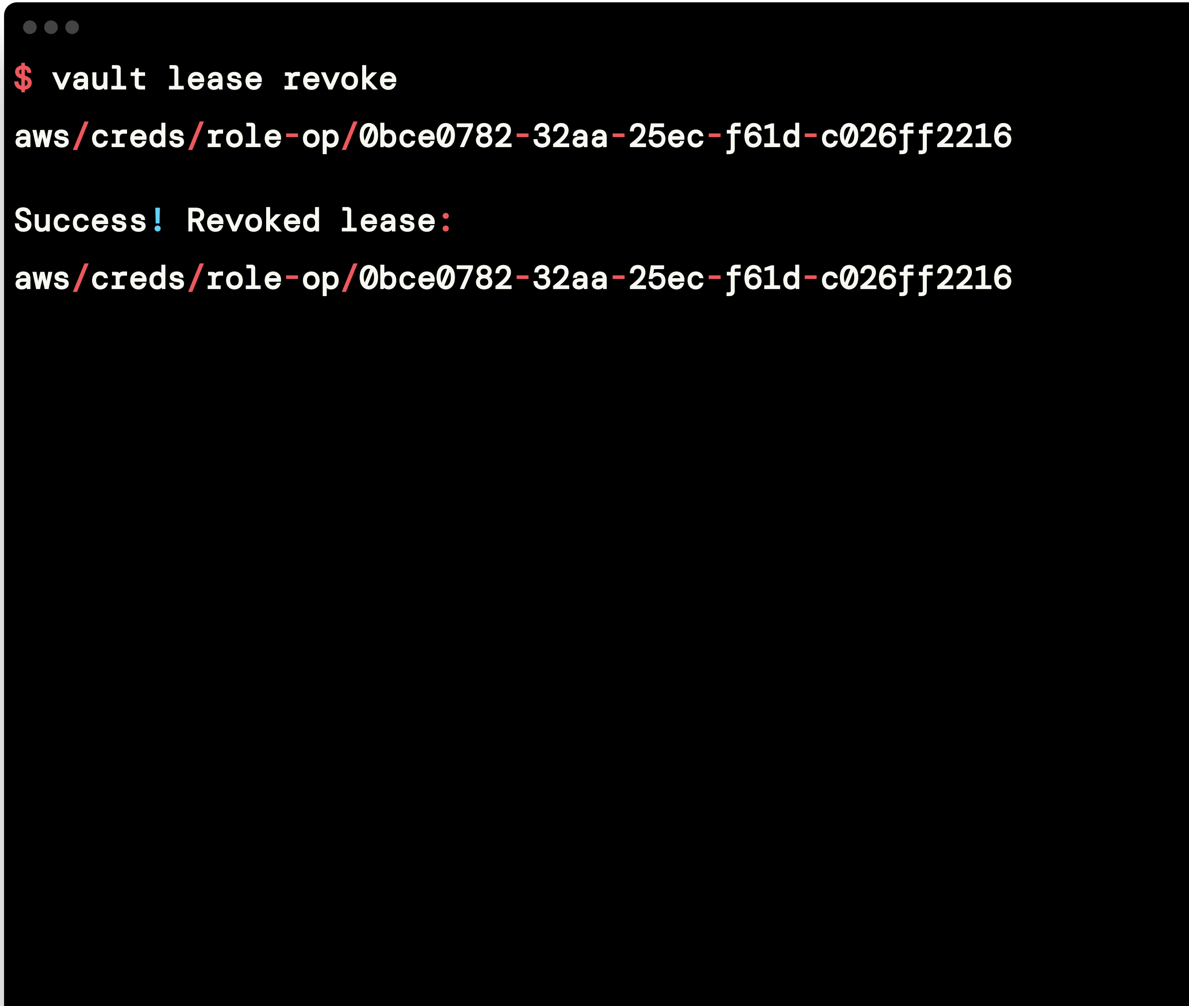
Generate AWS secret



```
$ vault read aws/creds/role-op

Key                  Value

---                  -----

lease_id
aws/creds/role-op/0bce0782-32aa-25ec-f61d-c026ff2216
lease_duration       288h
lease_renewable      true
access_key           AKIAJELUDIANQGRXCTZQ
secret_key           WWeSnj00W+hHoHJMCR7ETNTCqZmKesEUmk/8FyTg
security_token       <nil>
```

Dynamic Credentials Example

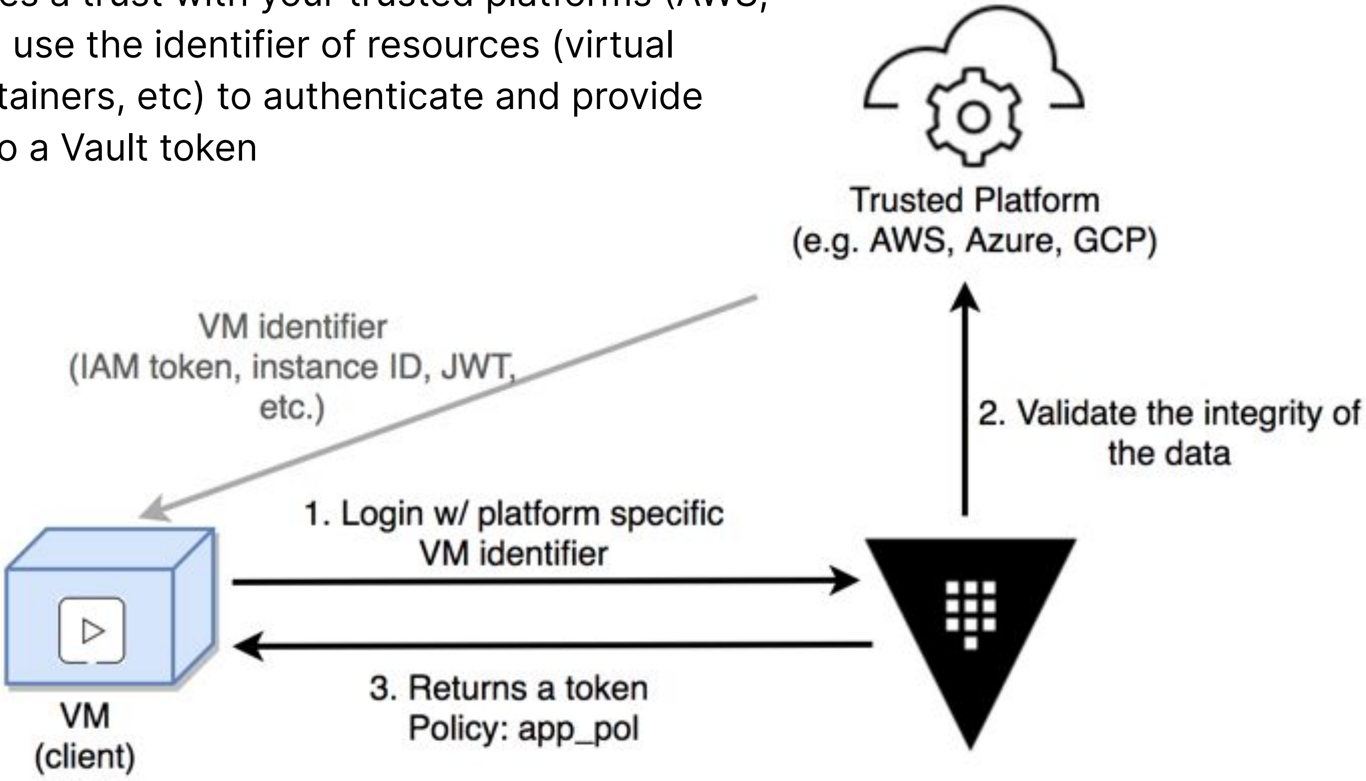
Revoke AWS secret



```
$ vault lease revoke
aws/creds/role-op/0bce0782-32aa-25ec-f61d-c026ff2216

Success! Revoked lease:
aws/creds/role-op/0bce0782-32aa-25ec-f61d-c026ff2216
```

Trust and Platform Integration

Vault establishes a trust with your trusted platforms (AWS, Azure, GCP) to use the identifier of resources (virtual instances, containers, etc) to authenticate and provide authorization to a Vault token



Trusted Platform
(e.g. AWS, Azure, GCP)

VM identifier
(IAM token, instance ID, JWT, etc.)

2. Validate the integrity of the data

1. Login w/ platform specific VM identifier

3. Returns a token
Policy: app_pol

VM
(client)

TLDR: Dynamic Secrets

- Reduce time spent managing secrets
- Help teams achieve compliance objectives
- Improve security posture
    - Create a moving target for attackers
    - Minimize the risk of exposing credentials
    - Make forensics easier
    - Credential rotation & revocation becomes SOP

Dynamic Secret Types

Cloud credentials

Database credentials

Other secrets

Dynamic Secret Engines

Cloud Credentials

- AWS
- AliCloud
- Azure
- GCP

Other Secrets

- Active Directory
- Terraform
- OpenLDAP
- RabbitMQ
- Consul
- Nomad
- PKI (Certificate)
- Venafi

Database Secrets

- DB2
- Couchbase
- Hana DB
- MongoDB
- MSSQL
- Oracle
- Redshift
- Cassandra
- Elasticsearch
- InfluxDB
- MongoDB Atlas
- MySQL/MariaDB
- PostgresQL
- Snowflake

02

Dynamic Cloud Credentials

Dynamic Cloud Credentials

- Generate short-lived cloud credentials
- Scoped to specific policies in each cloud's policy language
- Secure privileged access flows:
  - Operators need highly privileged cloud access for key administrative tasks
  - Generate short lived privileged credentials with an approval flow using **Vault Control Groups**
- Generate temporary cloud credentials with instance creation powers limited to the life of a single Terraform run

Azure Secrets Engine

Documentation

- Dynamically generates service principals along with role and group assignments
- Vault roles can be mapped to Azure roles
- Service principals are associated with a lease, when lease expires the service principal is deleted
- Calling an existing service principle will generate a dynamic password which is deleted when lease expires

GCP Secrets Engine

Documentation

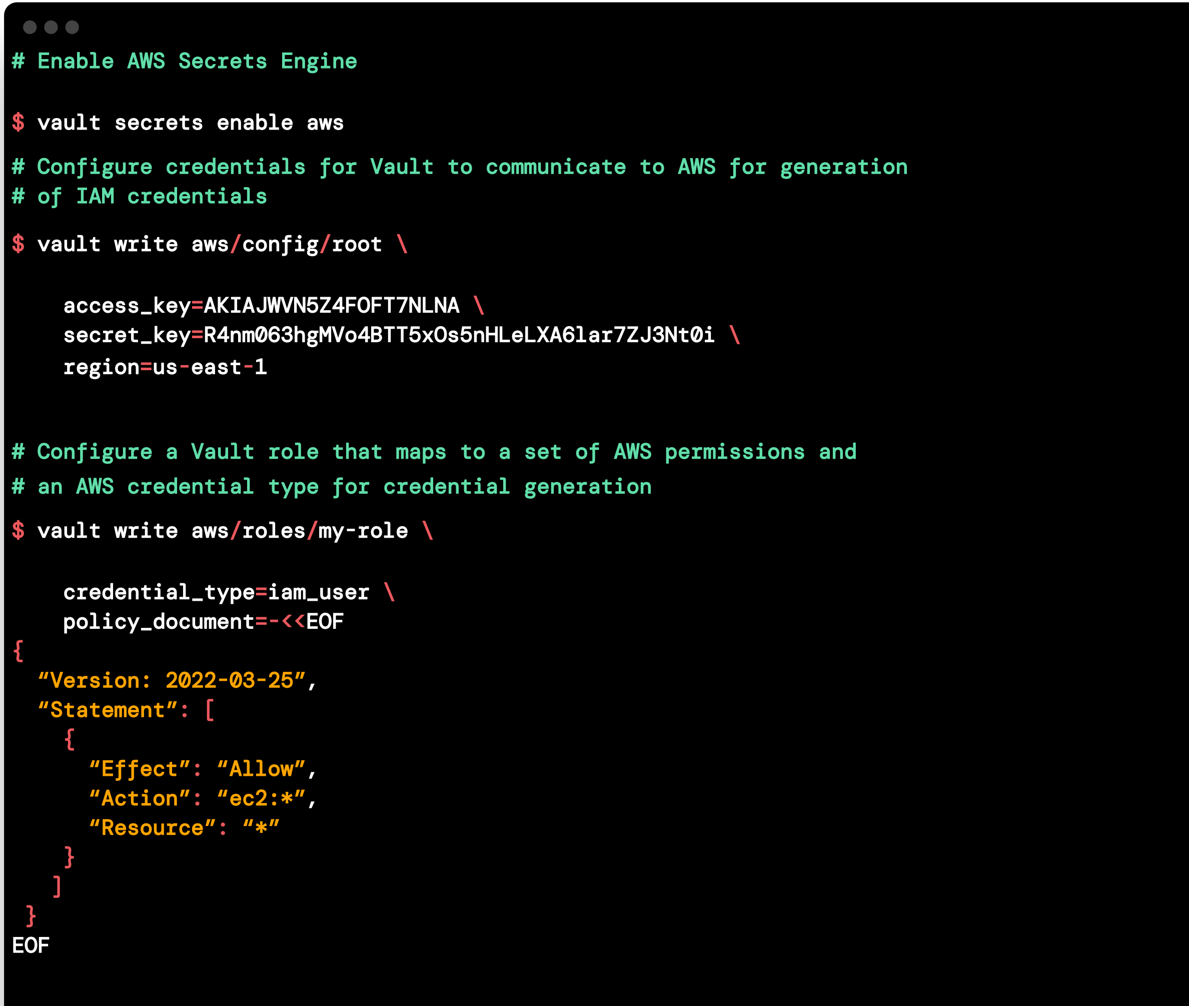
- Dynamically generates service account keys and OAuth tokens based on IAM policies
- Service account keys are associated with a lease, when lease expires the account key is revoked
- New Service Accounts do not need to be created for batch jobs or short-term access
- Supports rolesets, static accounts, access tokens, and service account keys

AWS Secrets Engine

Documentation

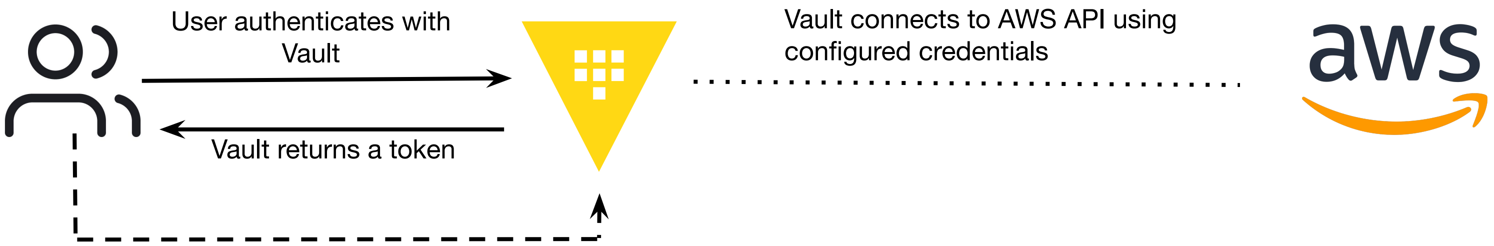
- Dynamically generates credentials based on IAM policies, can be mapped to internal auth methods like LDAP/OIDC
- No clicking in the UI is required, credentials are revoked when Vault lease expires
- Three supported credential types:
  - ***iam_user:*** Dynamically generates ephemeral IAM user, attaches IAM policies and generates an access key and secret key
  - ***assumed_role:*** Typically used for cross-account access, Vault calls sts:AssumeRole and returns the access key, secret key, and session token
  - ***federation_token:*** Vault calls sts:GetFederationToken passing AWS policy and returns access key, secret key and session token

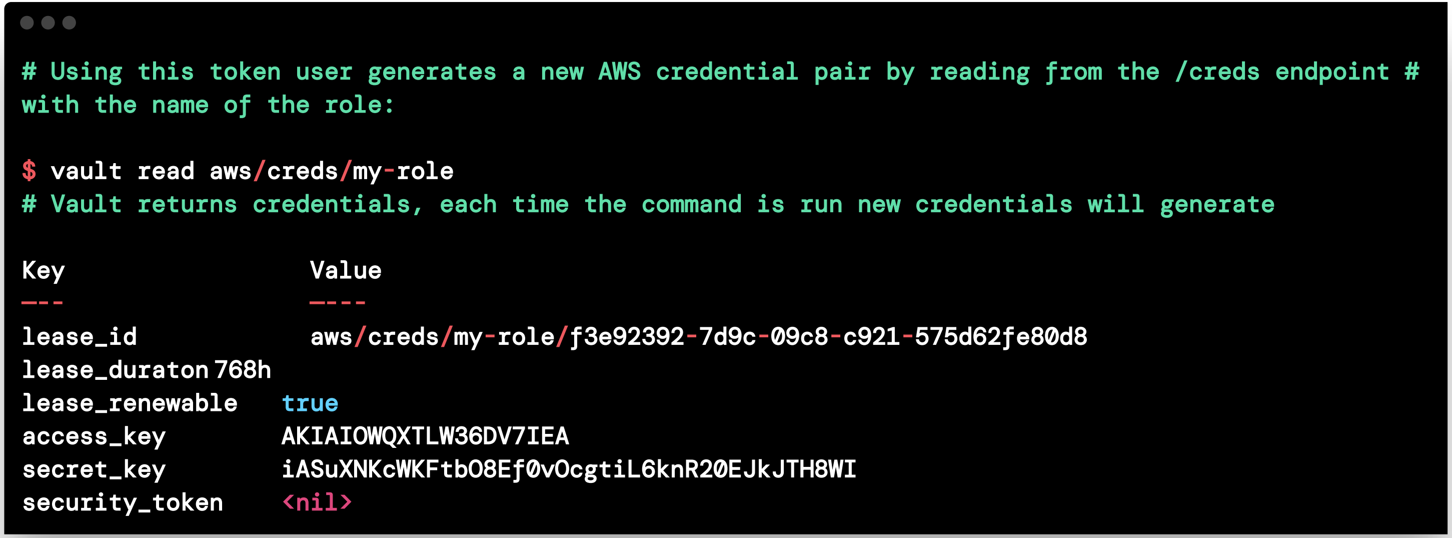
Configure AWS Dynamic Credentials



```
# Enable AWS Secrets Engine

$ vault secrets enable aws

# Configure credentials for Vault to communicate to AWS for generation
# of IAM credentials

$ vault write aws/config/root \

    access_key=AKIAJWVN5Z4FOFT7NLNA \
    secret_key=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 \
    region=us-east-1


# Configure a Vault role that maps to a set of AWS permissions and
# an AWS credential type for credential generation

$ vault write aws/roles/my-role \

    credential_type=iam_user \
    policy_document=-<<EOF
{
  “Version: 2022-03-25”,
  “Statement”: [
    {
      “Effect”: “Allow”,
      “Action”: “ec2:*”,
      “Resource”: “*”
    }
   ]
 }
EOF
```

Configure AWS Dynamic Credentials

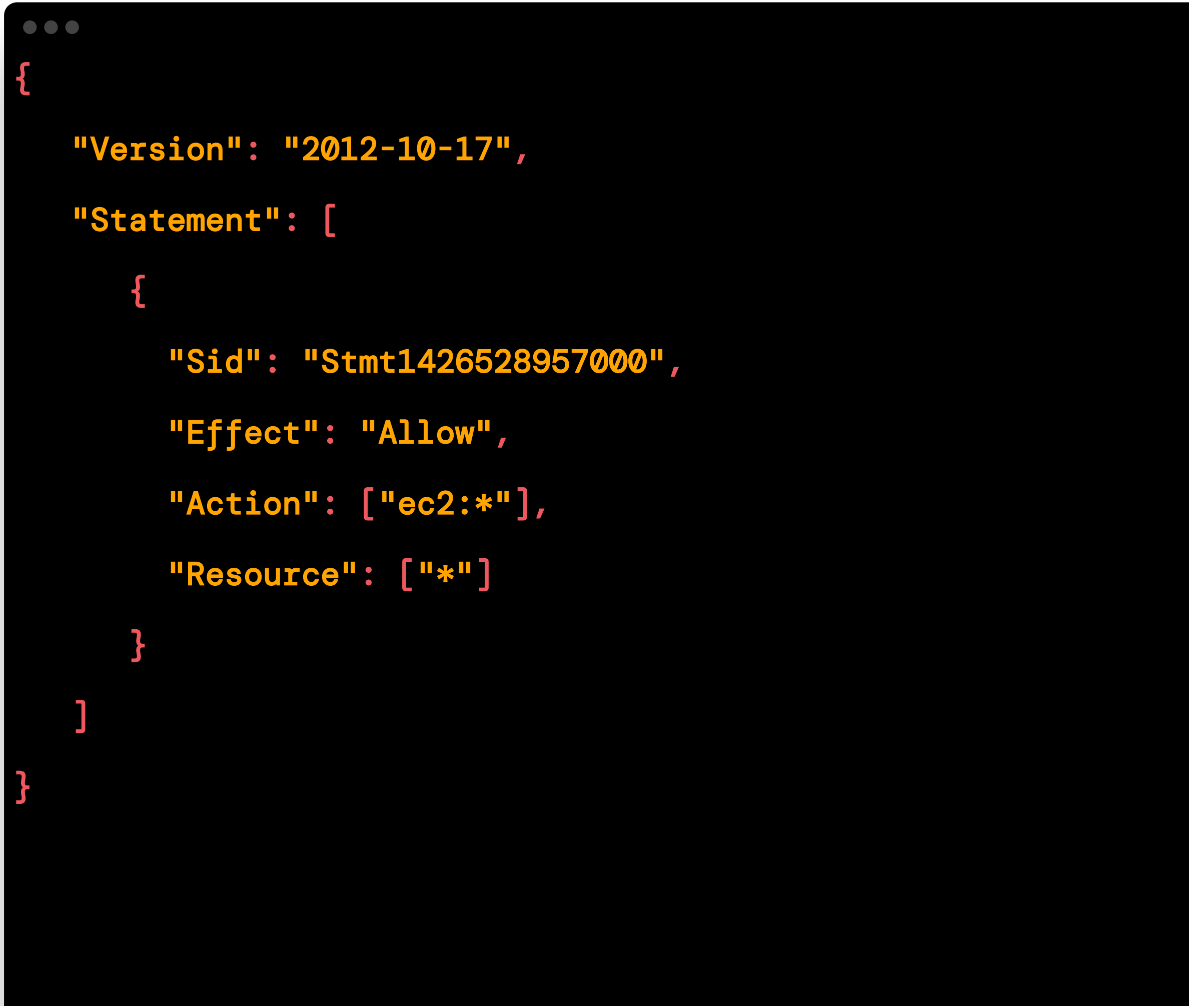

User authenticates with Vault
Vault returns a token
Vault connects to AWS API using configured credentials
aws



```
# Using this token user generates a new AWS credential pair by reading from the /creds endpoint #
with the name of the role:

$ vault read aws/creds/my-role
# Vault returns credentials, each time the command is run new credentials will generate

Key                 Value
---                 ----
lease_id            aws/creds/my-role/f3e92392-7d9c-09c8-c921-575d62fe80d8
lease_duraton 768h
lease_renewable   true
access_key        AKIAIOWQXTLW36DV7IEA
secret_key        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
security_token    <nil>
```

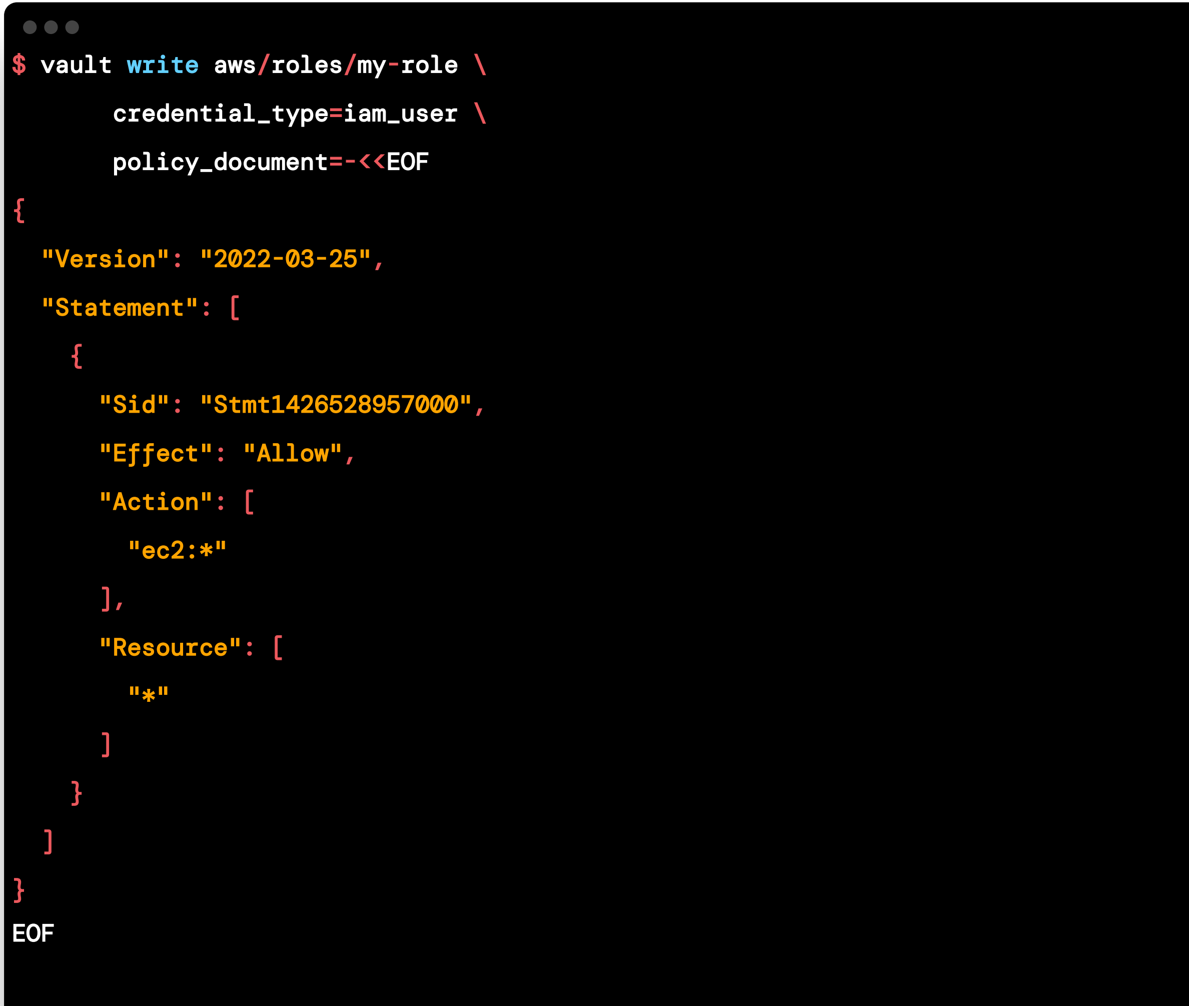
AWS Policy

IAM Policy that enables all actions on EC2, but not IAM or other AWS services



```
{
   "Version": "2012-10-17",
   "Statement": [
      {
        "Sid": "Stmt1426528957000",
        "Effect": "Allow",
        "Action": ["ec2:*"],
        "Resource": ["*"]
      }
   ]
}
```

Map IAM Policy to Vault Role



```
$ vault write aws/roles/my-role \
       credential_type=iam_user \
       policy_document=-<<EOF
{
  "Version": "2022-03-25",
  "Statement": [
    {
      "Sid": "Stmt1426528957000",
      "Effect": "Allow",
      "Action": [
        "ec2:*"
      ],
      "Resource": [
        "*"
      ]
    }
  ]
}
EOF
```

03

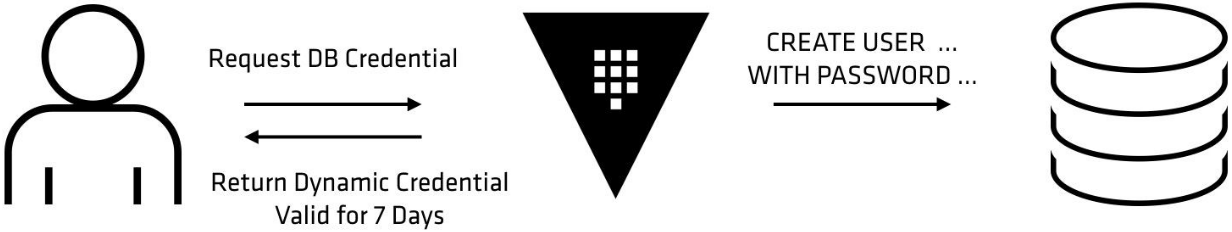
Dynamic Database Credentials

Database Credential Types

- Dynamic user/application credentials
- Root credential rotation
- Static Roles

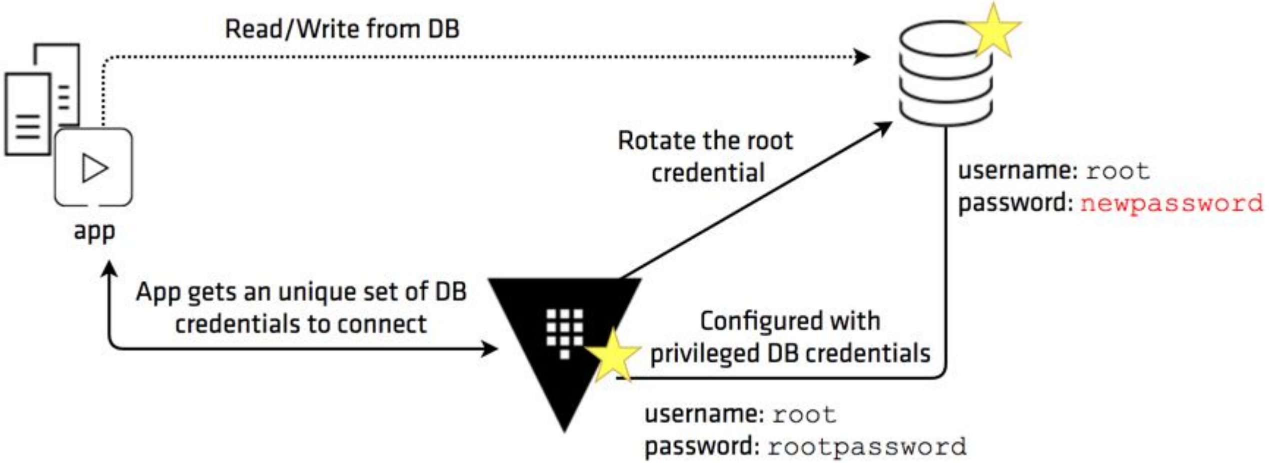
Dynamic Database Credentials

- On demand short-lived credentials for application and user requests
- Can be scoped to specific grant statements
- Revoked at TTL expiration
- Applications or users that need occasional access provision it as needed and credentials do not exist when not in use



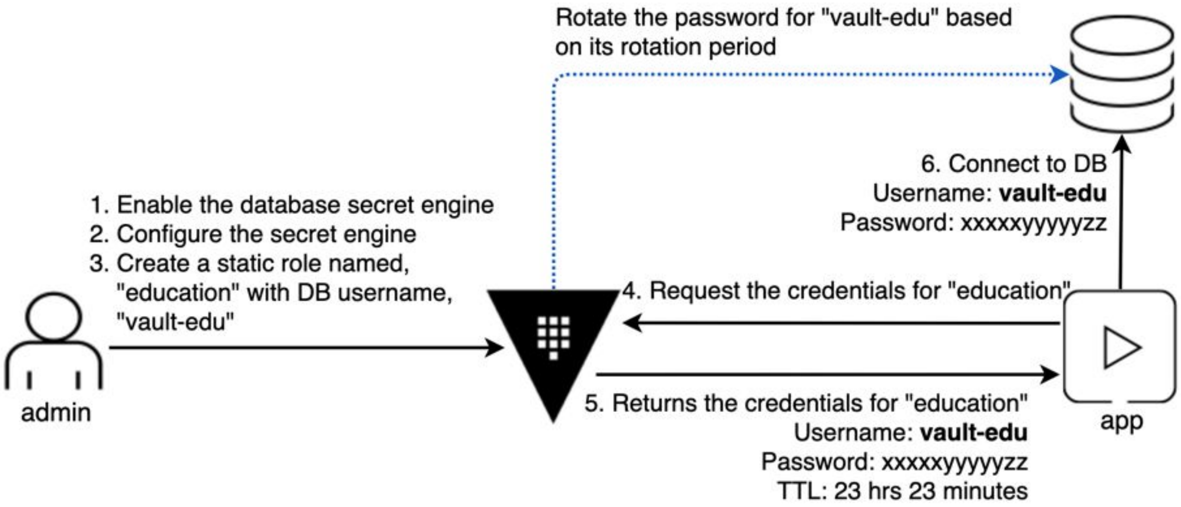
Root Credential Rotation

- Periodically rotate root database password
- Maintain GRC / Security policy compliance
- Rotate root credentials after initial database configuration - **only Vault will have the privileged credentials**


Read/Write from DB
app
Rotate the root credential
username: root
password: newpassword
App gets an unique set of DB credentials to connect
Configured with privileged DB credentials
username: root
password: rootpassword

Static Database Roles

- Automatic rotation of database user account passwords
- Ideal for longer-lived connections i.e. service accounts
- Align with security best practices and compliance policy



Rotate the password for "vault-edu" based on its rotation period

1. Enable the database secret engine
2. Configure the secret engine
3. Create a static role named, "education" with DB username, "vault-edu"

4. Request the credentials for "education"

5. Returns the credentials for "education"
Username: **vault-edu**
Password: xxxxxyyyyyzz
TTL: 23 hrs 23 minutes

6. Connect to DB
Username: **vault-edu**
Password: xxxxxyyyyyzz

03

Other Dynamic Credentials

Other Secret Engines

- Consul
- Nomad
- PKI (Certificates)
- Terraform Cloud
- LDAP
- RabbitMQ
- TOTP
- Venafi (Certificates)

LDAP Secrets Engine

- Manages LDAP credentials and performs dynamic credential creation
  - Integrates with LDAP v3 including OpenLDAP, Active Directory & IBM Resource Access Control Facility (RACF)
  - Does not require instances to be manually registered in advance to gain access
- Service Account Check-Out
  - Allows a library of service accounts to be checked out by an person or machine
  - Passwords rotate each time a service account is checked out
  - Accounts automatically check back in and rotate at TTL expiration

Terraform Cloud Secrets Engine

- Enables the generation, management, and revocation of credentials for Terraform Cloud (TFC) and Terraform Enterprise (TFE)
- Generates Terraform API tokens dynamically for Organizations, Teams, and Users
- Vault backed Dynamic Credentials create per-operation, short-lived, strictly-scoped credentials for each Terraform run

PKI Secrets Engine

- Generates dynamic X.509 certificates
- Provides a facility for services to get certificates without having to generate a private key and CSR, submitting to a CA, and waiting for signing
- Each instance of an application can have a unique certificate improving application security posture and blast radius
- Works with keys stored in an external KMS via the managed keys system (Vault 1.10+)

Resources

- Vault Secrets Engines
- Blog: Why We Need Dynamic Secrets
- Getting Started with Dynamic Secrets
- Database Credential Rotation Tutorial Collection
- LDAP Secrets Engine Tutorial
- Azure Secrets Engine Tutorial
- Terraform Cloud Secrets Engine
- Terraform Cloud Vault-Backed Dynamic Credentials
- Inject Secrets into Terraform Using the Vault Provider
- PKI Secrets Engine with Managed Keys

Q&A

Thank you

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