EIN VAULT FÜR ALLE FÄLLE

heise devSec() 2018

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```yaml
spring:
  datasource:
    name: myDatabase
    username: myDatabaseUser
    password: mySuperSecretDatabasePassword
management:
  endpoints:
    web:
      base-path: /admin
logging:
    level:
        root: warn
```

hard coded

widely accessible

rarely rotated


Store
secrets securely
(cloud & on-premises)

1 **Vault** features to **securely store secrets**

Vault for **developers** to use in any application 2

3 **Spring Cloud Vault**, **Spring Vault** and **Vault** in a Spring Boot application

VAULT

A tool for managing secrets.

Vault manages static and dynamic secrets

1. Various **authentication** and **authorization** possibilities

2. Extensible **storage** and **secret backend architecture**

3. **Auditing** of **who** accessed **what** secret **when**

Authentication

Static tokens and dynamic token generation (core method for authentication)

Additional methods: AppRole, AliCloud, AWS, Azure, Google Cloud, GitHub, JWT, Kubernetes, LDAP, Okta, RADIUS, TLS Certificates, Username & Password

```
$ vault auth list
Path          Type        Accessor                    Description
----          ----        --------                    -----------
token/        token       auth_token_41858cb8         token based credentials
userpass/     userpass    auth_userpass_86174ece      n/a
```

```
$ vault auth enable userpass
Success! Enabled userpass auth method at: userpass/
```

```
$ vault write auth/userpass/users/dummy password=dummy
Success! Data written to: auth/userpass/users/dummy
```

```
$ vault login -method=userpass username=dummy
Password (will be hidden):
Success! You are now authenticated. The token information displayed below
is already stored in the token helper. You do NOT need to run "vault login"
again. Future Vault requests will automatically use this token.
```

Authorization with policies

Access control policies for protecting secrets - **deny by default**

Policies determine what **specific actions are (not) allowed on specific paths or endpoints**

Configured in HCL - HashiCorp Configuration Language (a JSON variant)

```
path "secret/*" {
  capabilities = ["create", "read",
"update", "delete", "list"]
}

# explicitly denies secret/production
# (takes precedence)
path "secret/production" {
  capabilities = ["deny"]
}
```

```
$ vault write sys/policy/dev-policy policy=@dev-policy.hcl
Success! Data written to: sys/policy/dev-policy
```

```
$ vault list sys/policy
Keys
----
default
dev-policy
root
```

```
$ vault write auth/userpass/users/dummy password=dummy policies=dev-policy
Success! Data written to: auth/userpass/users/dummy
```

Storage backend never sees plaintext

Responsible for **generating and storing secrets** as key/value, Consul, databases, AWS, Google …

Static and dynamic secrets, e.g. for AWS and databases including **renewal**

Time To Live (TTL) for generated secrets

```
$ vault secrets enable kv
Success! Enabled the kv secrets engine at: kv/
```

```
$ vault secrets disable kv
Success! Disabled the secrets engine (if it existed) at: kv/
```

Auditing is disabled by default

Detailed audit log of all client **interaction**

Sensitive data hashed using HMAC-SHA256

Audit backend can **block Vault operations** once enabled

```
$ vault audit enable file file_path=~/vault_audit.log
Success! Enabled the file audit device at: file/
```

Setting up Vault for dev or prod

```
# start Vault in dev mode
vault server -dev
  -dev-root-token-id=
   "00000000-0000-0000-0000-000000000000"
  -dev-listen-address=
   "127.0.0.1:8200"

# Vault is initialized and unsealed
   # single unseal key
   # in-memory storage
   # authenticated with CLI
```

```
# start Vault in prod mode
vault server -config=vault-file.conf

# init Vault
vault operator init -key-shares=5
  -key-threshold=2

# Shamir's Secret Sharing Algorithm
Unseal Key 1: mjrFtVQ9hIr/XmlQYFIJABI56udiHQ1H3zcu9khDqn36
Unseal Key 2: oTnepVQSGiJOWgLSy8tcmdddbmPoxDQRilduaCKu62rN
Unseal Key 3: X6mi5FR28zPDgaIMSmmpO10bi4abeSp0f8pxgfILhGBF
Unseal Key 4: ADCf1VTf7Vd0Rghxtynse7p639Jz/ZuoOmy1ny8bNw9I
Unseal Key 5: at5AAlQR+eauNcQn6KBj8gDNTkPDBUXJtajEi7nyHEW3

Initial Root Token: 2UNQMkhq4eZnuuoQkSCMH7zv
```

encrypt keys with PGP

```
vault operator init -key-shares=3 -key-threshold=2
  -pgp-keys="public-key1.asc,public-key2.asc,public-key3.asc"
```

Shamir’s Secret Sharing Algorithm


```
Unseal Key 1: wcBMAw8suEO6TlNRAQgAniakIS2bmnPqc/Rc6eIJAbISSKq1
d3oBT2Ba8FFt678kdZ6ZFVNq64nLcOlpuCV6gxLYz8lEwlRmeAKPm7F+z4fM3h
GBO36z2CUnFPURUAY0NEQdQ+6UzkeWjTUVqbRFbfrBXydO1oH923laKWLCVSRD
pSBLmbbgOHIhwx0E4gP0CObTnmblPP0gJU0FrqMjqvBzT0lTfWR1C+qCDPkVs5
Es8QGyVxLOXBkWSRD/Yx6TnR3Z3gUsT8YDyufCnXN02DLKR0teQ2hFo2zQfY+u
ljOuKxYw82TgfmDEOOEQ7P4MgMN6H7IJf1lVXG0fEISCqZZzn+pZPlNah+OLq2
re9LgAeTwEi/QinaEn6iMEbAuMiwG4RIV4DfgsOGRreBi4nITJdng2Oa1RIFS3
AFoUacwje5z+/BdZmBeM0m7lS0RO9/gP+e0tT0+imeUfAYC4EaO0lgSOGzsS9e
mygIjAMoSfOVqRvVW4JrknPKKOdwb+b+uMHonRtzEEOK9cSC14YVCAA==
```

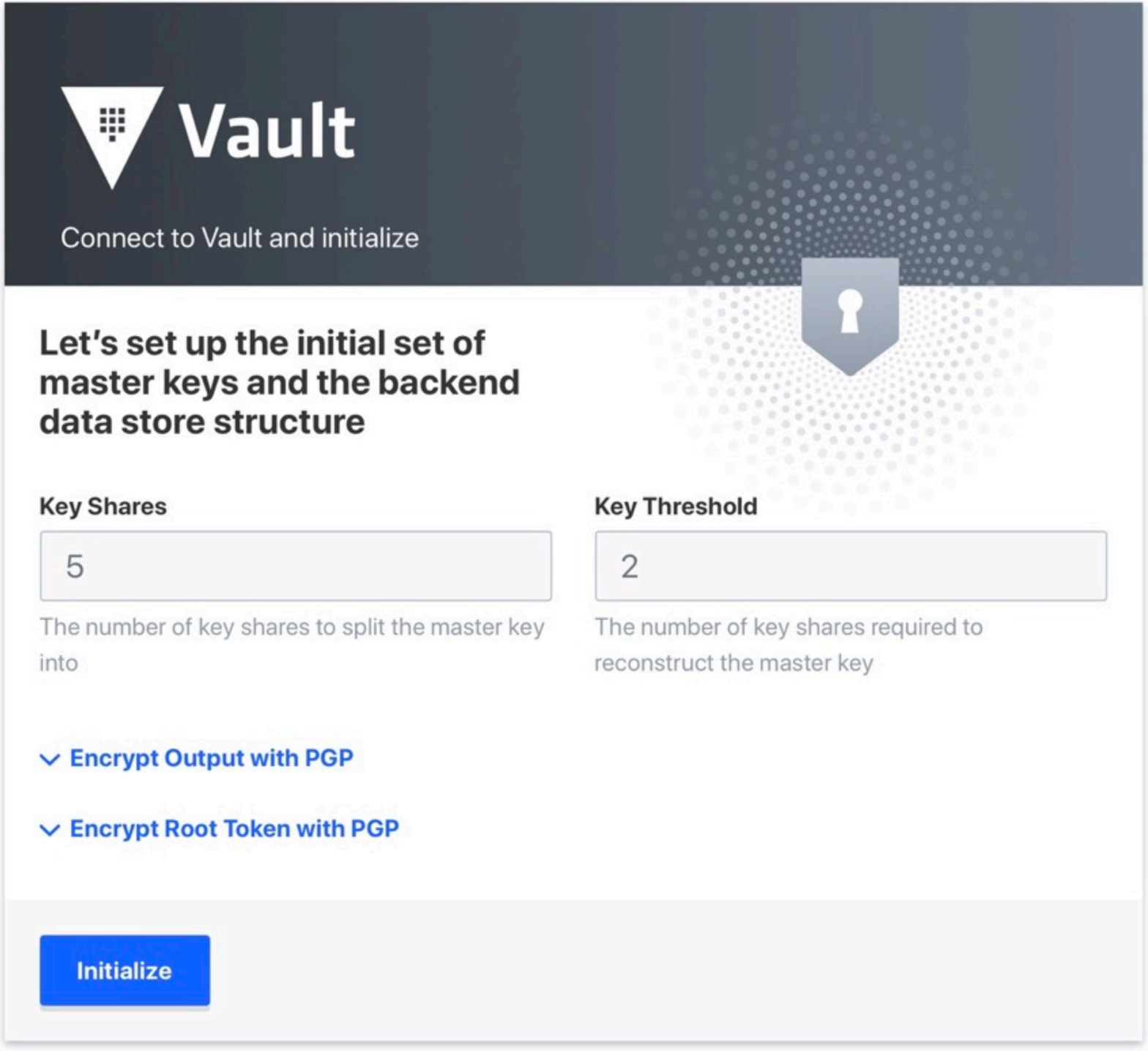
Unseal Key 2:

...

Initial Root Token: 6kuSlnq41raWSE5EzRNkZRCc

```
# unseal Vault with key 1
vault operator unseal ↵
 mjrFtVQ9hIr/XmlQYFIJABI56udiHQ1H3zcu9khDqn36
Key                    Value
---                    -----
Seal Type              shamir
Initialized            true
Sealed                 true
Total Shares           5
Threshold              2
Unseal Progress        1/2
Unseal Nonce           ec9e88cd-cbe5-becf-19ea-...
Version                0.11.3
HA Enabled             false
```

```
# unseal Vault with key 2
vault operator unseal ↵
 oTnepVQSGiJOWgLSy8tcmdddbmPoxDQRilduaCKu62rN
Key                    Value
---                    -----
Seal Type              shamir
Initialized            true
Sealed                 false
Total Shares           5
Threshold              2
Version                0.11.3
Cluster Name           vault-cluster-8b633aa6
Cluster ID             03b03551-3818-c1c8-6f3a-...
HA Enabled             false
```



Init and manage Vault and all secrets in the browser

Vault UI is enabled by default in dev mode only

http://localhost:8200/ui

```
# vault-inmem.conf
storage "inmem" {
}

listener "tcp" {
  address     = "127.0.0.1:8200"
  tls_disable = 1
}

# enable Vault UI
ui = true
```

```
# vault-file.conf
storage "file" {
  path = "vault_data"
}

listener "tcp" {
  address     = "127.0.0.1:8200"
  tls_disable = 1
}

# enable Vault UI
ui = true
```

All data stored securely

Multiple unseal keys

Vault server security

Vault for developers

Access **resources** via path

- Authentication backends
- Storage backends
- Secrets
- Policies
- Configurations

mount point

```
vault write secret/conferences/2018
title="Ein Vault für alle Fälle"
```

key/value format
(generic backend)

```
$ vault read secret/conferences/2018
Key                 Value
---                 -----
refresh_interval    768h
title               Ein Vault für alle Fälle
```

Securing data in transit

Cryptographic functions - **cryptography as a service**

Transit Secrets Engine - only **data in transit** - no storage

Encrypt, decrypt, sign, verify, hash, random number generator for base64 encoded input

Key rotation and **versioning**

no key/value input

key name

```
$ vault write -f transit/keys/demo-key
Success! Data written to: transit/keys/demo-key
```

aes256-gcm96 as default algorithm

```
$ vault write transit/encrypt/demo-key plaintext=$(base64 <<< "Vault für alle")
Key            Value
---            -----
ciphertext     vault:v1:D58irmWBh1jQstfNTcaDdKoATleUfA5NYjy/uVSQgUDp2+puMYKjwIXCtLc=
```

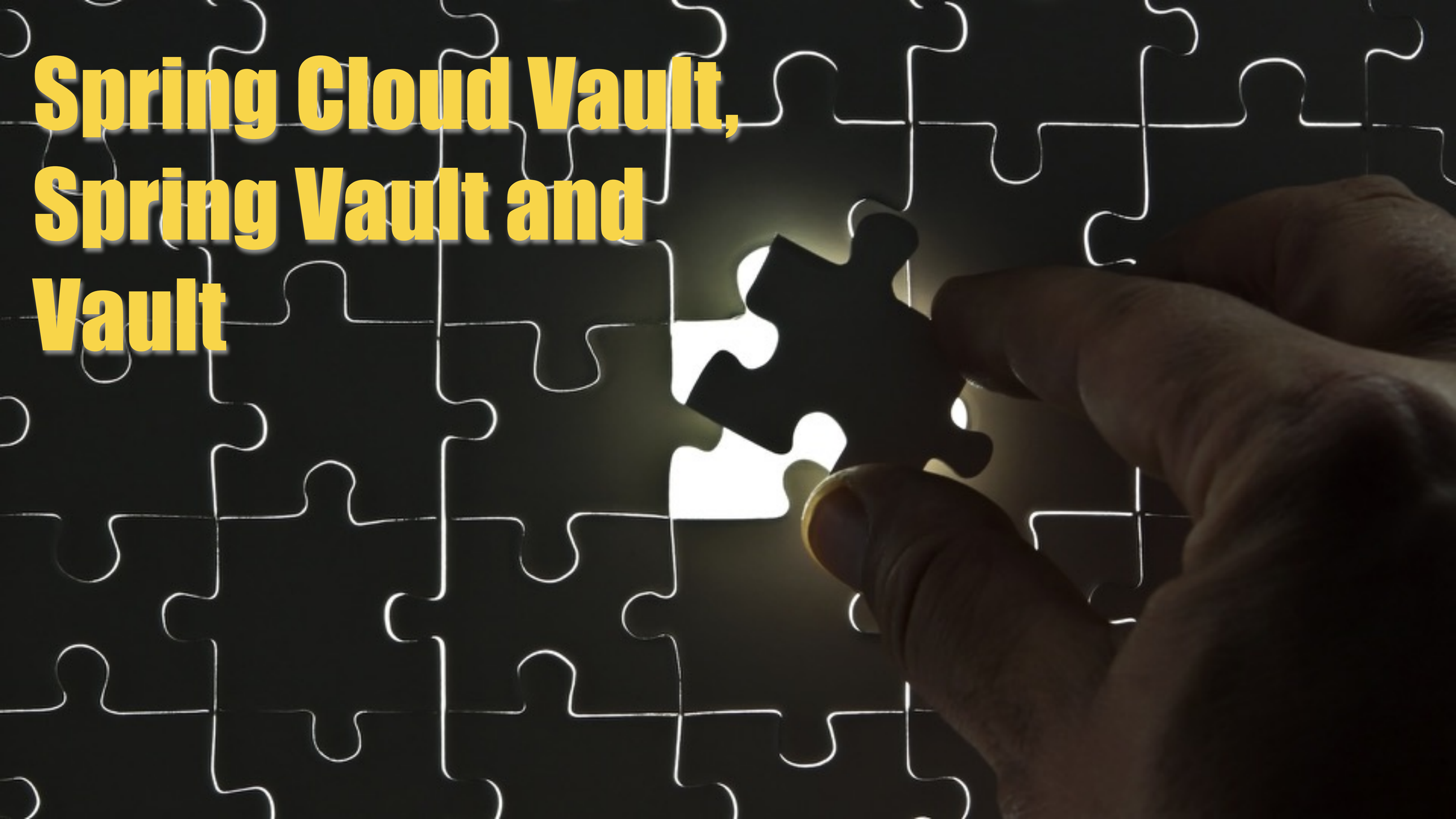
key version

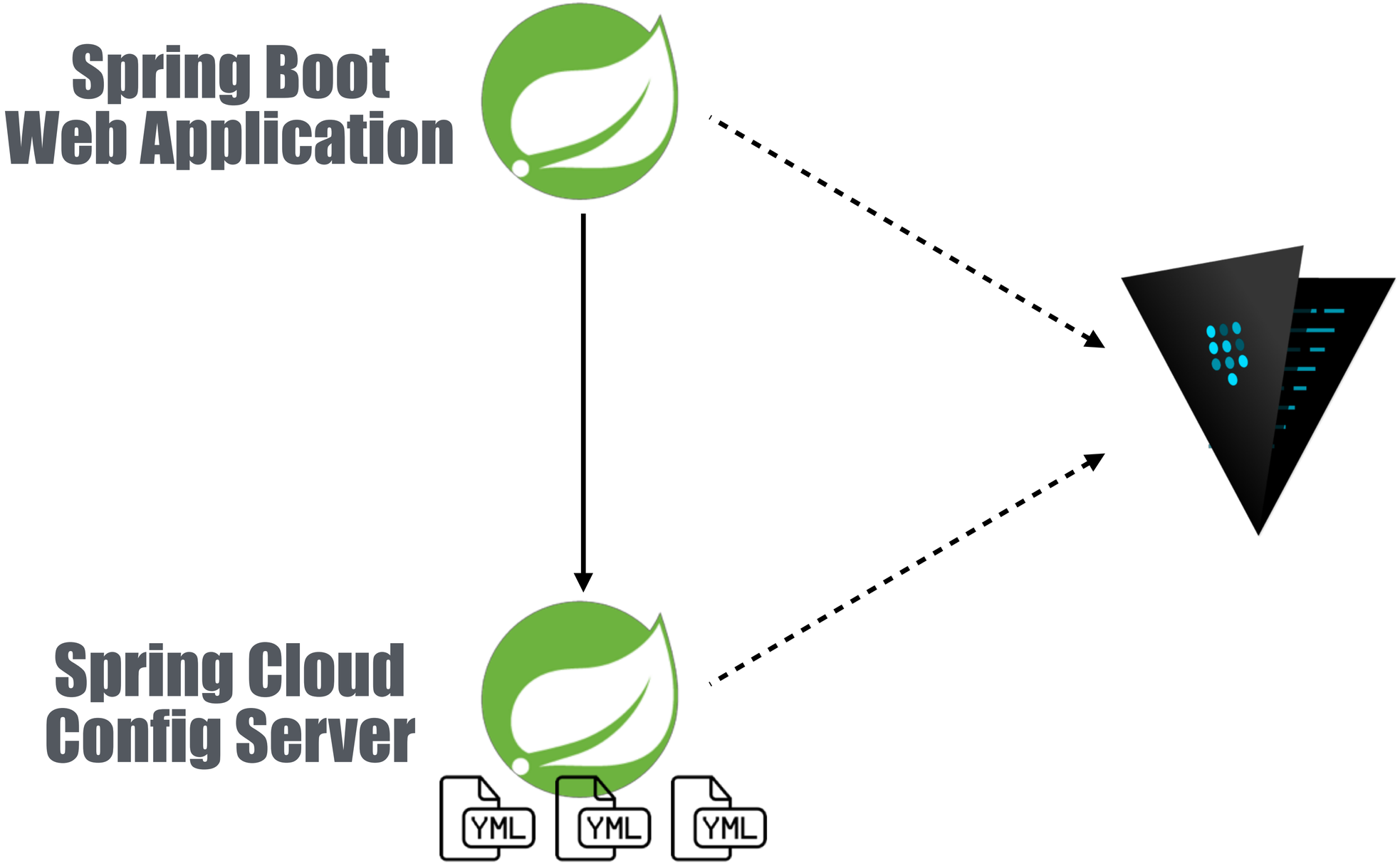
```
$ vault write transit/decrypt/demo-key ciphertext=vault:v1:D58irmWBh1jQstfNTcaDdKoAT
leUfA5NYjy/uVSQgUDp2+puMYKjwIXCtLc=
Key           Value
---           -----
plaintext     VmF1bHQgZsO8ciBhbGxlCg==


$ base64 --decode <<< "VmF1bHQgZsO8ciBhbGxlCg=="
Vault für alle
```

```
$ vault write -f transit/keys/demo-key/rotate
Success! Data written to: transit/keys/demo-key/rotate
```

Spring Cloud Vault, Spring Vault and Vault




Spring Boot
Web Application
Spring Cloud
Config Server
YML
YML
YML

Spring Cloud Vault

1. **Externalized configuration in Vault** for Spring Cloud Config Server
2. Initialize **Spring Environment** with **secrets from Vault**
3. **Naming conventions** as with property files

```yaml
spring:
 application:
  name: config-client-vault
 cloud:
  config:
   uri: http://localhost:8888
```

Spring Cloud Vault

```
/secret/{application}/{profile}
/secret/{application}
/secret/{defaultContext}/{profile}
/secret/{defaultContext}
```

```
$ vault read secret/config-client-vault
Key                     Value
---                     -----
refresh_interval        768h
application.name        Config Client Vault
application.profile     Demo
```

localhost:8888/config-client-vault/default

X-Config-Token 6kuSlnq41raWSE5EzRNkZRCc


```
name:                          "config-client-vault"
profiles:
  0:                           "default"
label:                         null
version:                       null
state:                         null
propertySources:
  0:
    name:                      "vault:config-client-vault"
    source:
      application.name:        "Config Client Vault"
      application.profile:     "Demo"
```

Spring Vault

1. **Client side** support for Vault

2. **Manage** (list, read, write, delete) **secrets**

```yaml
spring:
 vault:
  host: localhost
  port: 8200
  scheme: http
  authentication: token
  token: 6kuSlnq41raWSE5EzRNkZRCc
```

```
# VaultOperations (VaultTemplate) for
# list, read, write, and delete operations
# Similar to RestTemplate
vault.list("secret");

vault.read("secret/12345", Secret.class);

vault.write("secret/12345", secret);

vault.delete("secret/12345");
```

Demo

Summary

Vault **stores secrets securely** and provides **secret management functionality**

Vault **integrates** nicely with **Spring Boot** and **Spring Cloud Config**

Vault **requires strict access control** and must be **maintained** like any other application

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Demo Project
https://github.com/dschadow/CloudSecurity
Spring Cloud
https://projects.spring.io/spring-cloud
Spring Cloud Vault
https://cloud.spring.io/spring-cloud-vault
Spring Vault
https://projects.spring.io/spring-vault
Vault
https://www.vaultproject.io
Pictures
https://www.dreamstime.com